SPRAWOZDANIA ARCHEOLOGICZNE 74/2, 2022
PL ISSN 0081-3834
DOI: 10.23858/SA/74.2022.2.3091

Andrzej Bronicki[1]

ENEOLITHIC FLAT AXE FROM RACIBOROWICE, SITE NO. 7, BIAŁOPOLE COMMUNE, CHEŁM DISTRICT

ABSTRACT

Bronicki A. 2022. Eneolithic flat axe from Raciborowice, Site No. 7, Białopole commune, Chełm district. *Sprawozdania Archeologiczne* 74/2, 111-138.

This study is a contribution to research on copper metallurgy in the early Eneolithic (= Chalcolithic). The axe was discovered as a "single" artefact. It represents the category of flat axes with a convex cutting edge. The metallurgical mass consist of "pure" copper, or it may contain a small admixture of silver. The Raciborowice specimen corresponds well to the Szakálhát type, the Sárazsadány variant, and specifically to the two Budapest-Békásmegyer tools. According to Albert Schmitz's classification, the tool from Raciborowice belongs to category 5 or to its variant marked as 6 (Beilform 5, 6). Categories 5 and 6 are dated to the early Eneolithic: from the transition of phase Ib to IIa, the entire phase II, up to phase IIIa. Their concentration occurs in Hungary and Slovakia, where are recorded in the Bodrogkeresztúr culture graves. The analysed artefact, should probably be related to the Lublin-Volhynian culture.

Keywords: early Eneolithic, coper flat axe, import, Lublin-Volhynian culture, eastern Lublin region
Received: 27.04.2022; Revised: 26.05.2022; Accepted: 17.12.2022

1 Wiktor Ambroziewicz Museum of the Chełm Region in Chełm (Muzeum Ziemi Chełmskiej im. Wiktora Ambroziewicza w Chełmie); Lubelska st. 55, 22-100 Chełm, Poland; muzeum.chelmskie56@mzch.pl; asbronicki@wp.pl; ORCID 0000-0002-6461-3952

At the beginning of 2010, the collection of the Chełm Land Museum increased by the addition of seven archaeological artefacts, donated as the result of an administrative decision of the Lublin Voievodship Conservator of Monuments. Among them was a massive flat axe with a convex cutting edge. In the appendix to the conservation decision, it was aptly called a „copper axe (?), possibly Eneolithic". The place of its discovery, as well as other artefacts, has not been determined. It was suspected that they originate from ar-

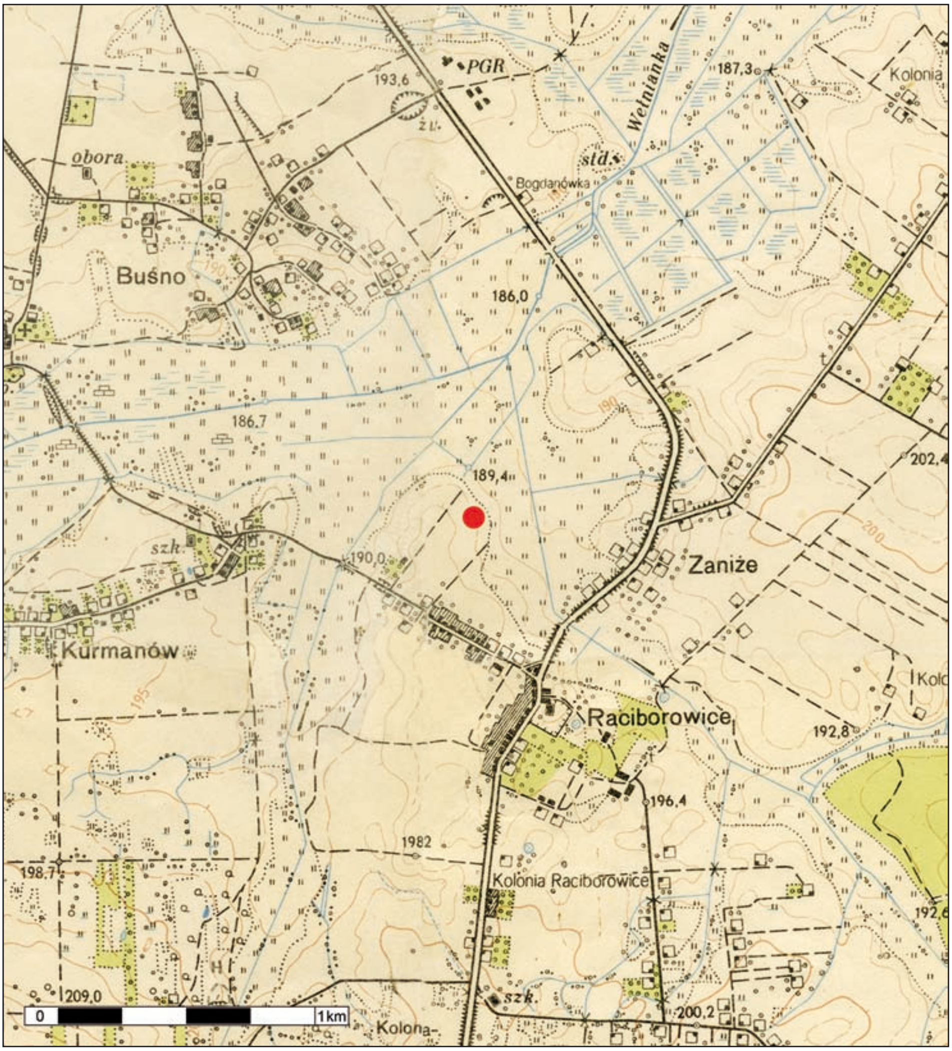


Fig. 1. Raciborowice, Site 7. Place of the copper axe discovery – red dot
(map fragment 1: 25,000; Hrubieszów district. Lublin Voivodeship. Publisher: Topographic Board of the Polish General Staff, Warsaw 1963)

chaeological sites in the area of the police station in Żmudź, *loco* comm., *i.e.* from the area of the southern municipalities of the Chełm district. The interview with the discoverer – Roman Pawełczuk from Hrubieszów, who gladly indicated on maps the places of discovery of several artefacts donated to our Museum, including this Eneolithic axe, turned out to be very useful.

LOCATION OF DISCOVERY

Pawełczuk discovered the metal axe in the arable layer of a field, accompanied by a bifacial, slightly asymmetrical flint axe. The place of discovery is located on fairly extensive, slightly undulating headland, indenting into the southern part of the Wełnianka river valley – a tributary of the Bug (Fig. 1). The slope descends to the east and northeast. In autumn 1983 a trace of settlement had been recorded approx. 80 m west of the place of discovery during surface-surveys carried out by Sławomir Jastrzębski and Andrzej Kokowski in the Archaeological Map of Poland program (AZP). It consisted of an uncharacteristic flint flake and a fragment of prehistoric ceramics of undefined cultural affiliation (inventory number in the archaeological collection of the Chełm Land Museum: MCH/A/877). Observation conditions were difficult at that time, which influenced the number of finds. It seems, however, that both: the archaeological material discovered in 1983, as well as both axes, occurred on the same site, the area of which probably exceeds two hectares. Following the presented considerations, it was decided that the trace site No. 7 in Raciborowice (known from AZP) should be enlarged to include the places where both axes were found and to avoid the need to assign a new number. The site is at least of bi-cultural nature (the flint bifacial axe is dated back to the early Bronze Age). It is located in the AZP area No. 83-93 (number 22), which is part of the Dubienka Depression – part of the Volhynian Polesia. The headland is covered by a light, dusty, sandy soil formed on the loess layer (Mięczyński ante 1939). It is a quite fertile soil, easy to cultivate, well-drained, so it is not threatened with excessive dampness. According to Doc. Stanisław Gołub, a few years ago, a "hoard of copper or bronze objects" was found less than a kilometre to the southwest, on the western side of the valley of the nameless tributary of the Wełnianka, within the land of Kurmanów, Białopole commune. The hoard was scattered by the finders. Unfortunately, nothing more is known on this subject.

DESCRIPTION OF THE AXE

The massive, symmetrical axe from Raciborowice was assigned to the group of flat specimens (with non-raised edges). Its slender body in the shape of tall trapezoid change into separate, symmetrical, convex cutting edge. The faces (side walls) are wide, slightly concave, in the form of an elongated leaf. The symmetrically arched cutting edge is in shape of

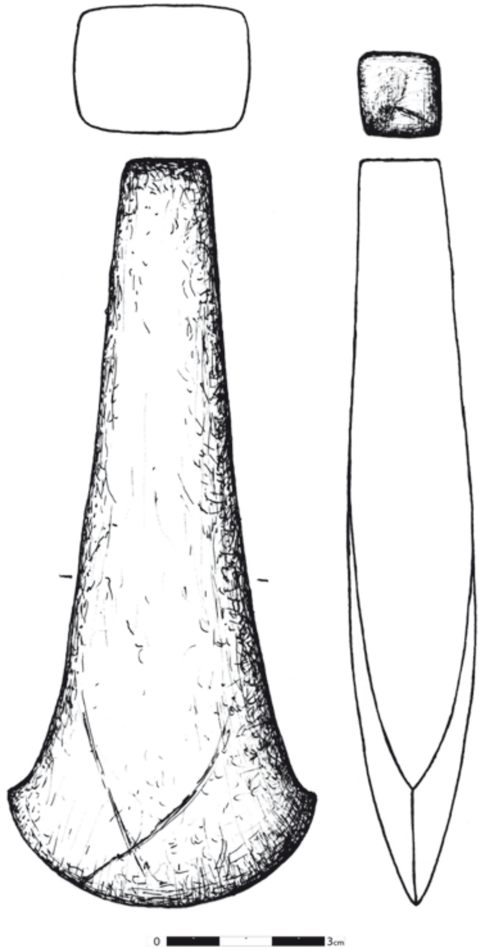


Fig. 2. Raciborowice, Site 7. Copper axe.
Drawing by E. Hander

a half of an ellipse. The butt is flat, almost square. The cross-section of the tool is in shape a fairly tall, horizontal rectangle with slightly convex sides and rounded corners. The longitudinal cross-section is wedge-shaped. The largest thickness occur slightly lower than half of the axe length (closer to the butt then to the cutting edge). All surfaces are covered by the green patina with grey and brown spots. Both faces, one edge and butt are covered by modern scars caused by farming machinery (Figs 2, 3). The tool hasn't been subjected to conservation treatment. Its weight – 698 g. Dimensions: height: 14.5 cm, cutting edge: major axis length (=cutting edge width): 5.9 cm, minor axis length: 4.3 cm, cutting edge high: 2.25 cm, butt: 1.6 × 1.5 cm, maximal body thickness: 2.5 cm.

Fig. 3. Raciborowice, Site 7. Copper axe. Photo by G. Zabłocki

LABORATORY RESEARCH

The studies on elemental composition was conducted with the use of two independent research methods. In the first case – in the laboratory of the Department of Geology, Soil Science and Geoinformation in the Institute of Earth and Environmental Sciences of the Maria Curie-Skłodowska University in Lublin. In the second case – in the Laboratory of Construction Engineering in Civil Engineering Centre of the State Academy of Applied Sciences in Chełm. In both cases they have a non-invasive nature due to aspiration to keep the artefact in intact condition. Therefore, the surface layer covered with patina and dirt, caused by long-term exposure to the soil, was examined. These circumstances, as well as chemicals used in agriculture (natural and artificial fertilizers, plant protection products,

Table 1. Results of the studies on elemental composition obtained with use of the electron microscope and electron gun in percentage by weight

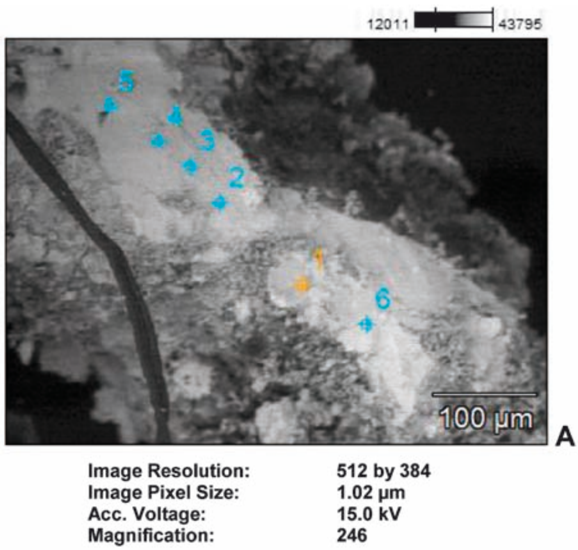
Element	Value	
	minimal	maximal
C	3,38	35,54
Fe	-	32,01
O	1,75	30,06
Ca	-	20,45
N	-	14,14
P	-	7,12
Cl	0,28	5,93
K	-	5,70
Si	-	4,19
S	-	3,25
Al	-	2,48
Br	-	2,33
Ar	**-**	**1,31**
Cu	**17,21**	**91,09**

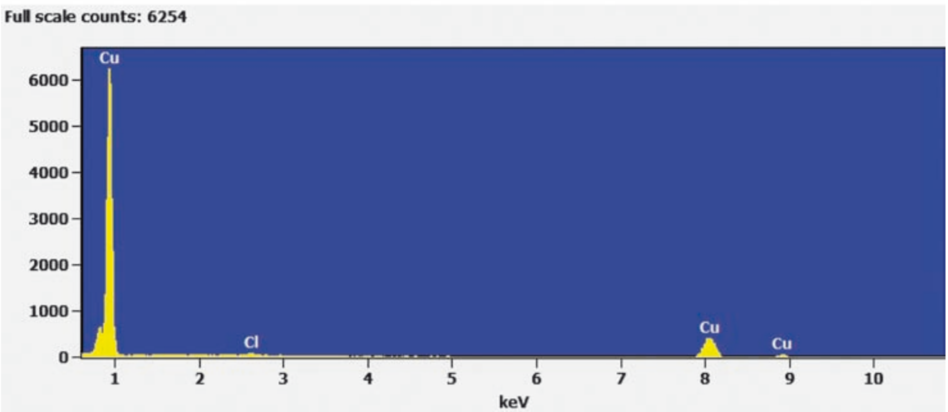
lime) have probably left their mark on the chemical (elemental) composition of the axe coating.

During the Lublin research, Doc. Miłosz Huber used the Hitachi SU6600 scanning electron microscope with an EDS attachment. The samples were placed in the microscope without sputtering, in the conditions of so-called low vacuum. Subsequently they were tested with a 15 keV electron gun. The standard research procedure time at one sample was 90 seconds. The presence of elements was established as a result of 37 readings of 25 samples. It was possible to record: carbon, nitrogen, oxygen, aluminium, silicon, phosphorus, chlorine, potassium, calcium, iron, bromine, sulphur and – above all – copper, and a trace of silver (Table 1; Figs 4-7).

Most likely the elements that create silicates and phosphates cannot be considered as an addition to the metallurgical mass (except for silver). They should rather be interpreted as a surface contamination resulted from the artefact being depsited in the soil that since then was periodically or continuously cultivated.

The lack of arsenic and antimony (and, of course, tin) is noteworthy, as well as significant quantitative fluctuations of particular elements in various samples, which indicates the heterogeneous nature of the surface layer. Copper is the absolutely dominant element by weight (and percentage). Most probably the casting was made of almost "pure" copper, perhaps with a small, natural admixture of silver.



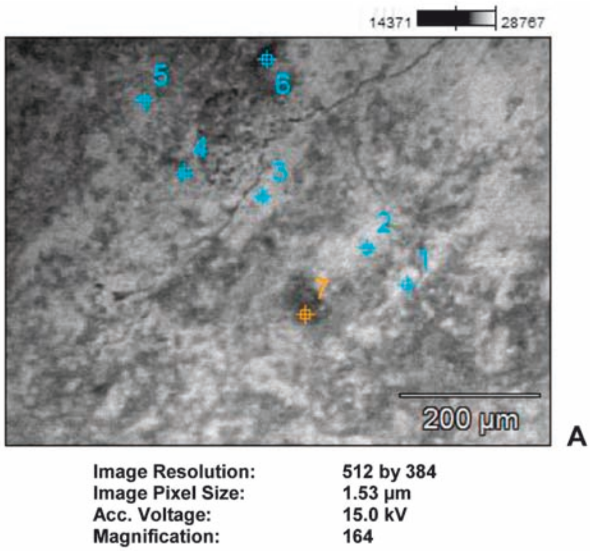


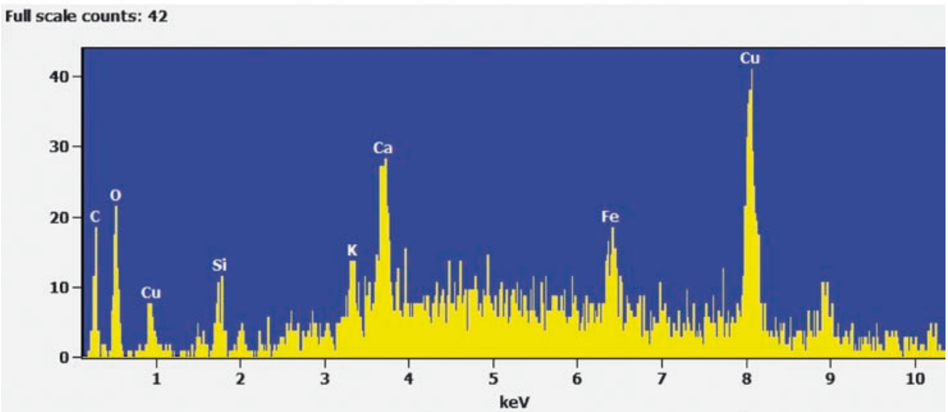
Weight %

	C	O	Cl	Cu
Point 1	11.31	13.51	0.53	74.65

B

Fig. 4. Measurement 1. A – microphotograph of backscattered electrons and measurement points; B – elemental composition at the measuring point 1. Prepared by G. Zabłocki and the author on the basis of illustration by M. Huber



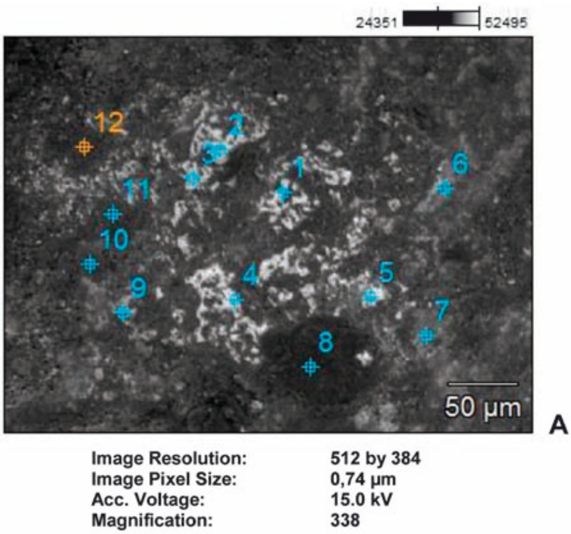


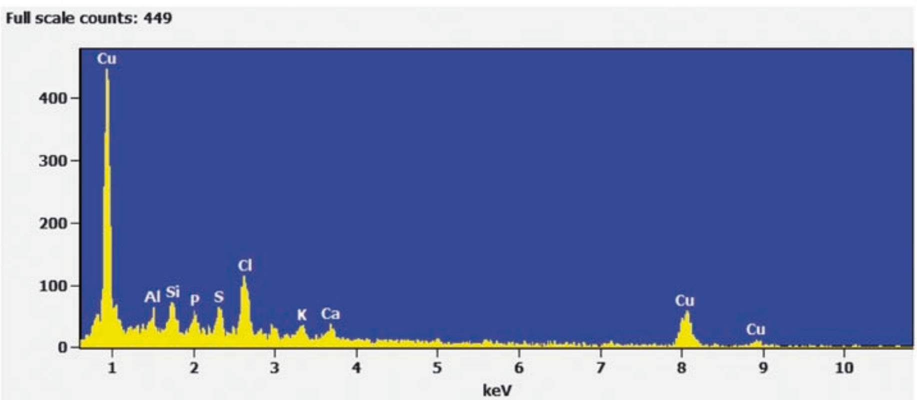
Weight %

	C	O	Si	K	Ca	Fe	Cu
Point 7	4.68	6.43	1.90	1.71	6.95	11.71	66.62

B

Fig. 5. Measurement 2. A – microphotograph of backscattered electrons and measurement points; B – elemental composition at the measuring point 7. Prepared by G. Zabłocki and the author on the basis of illustration by M. Huber



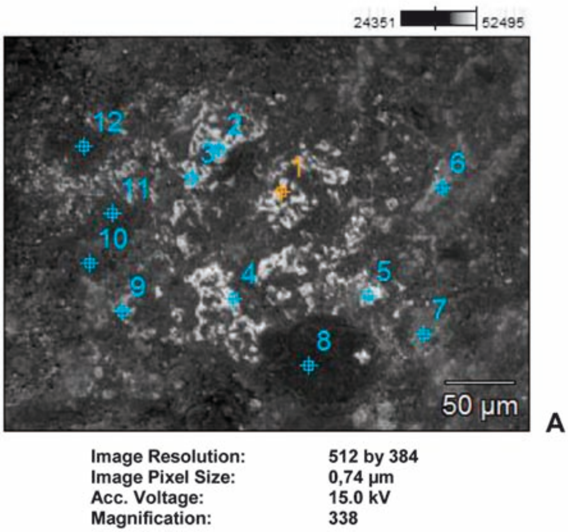


Weight %

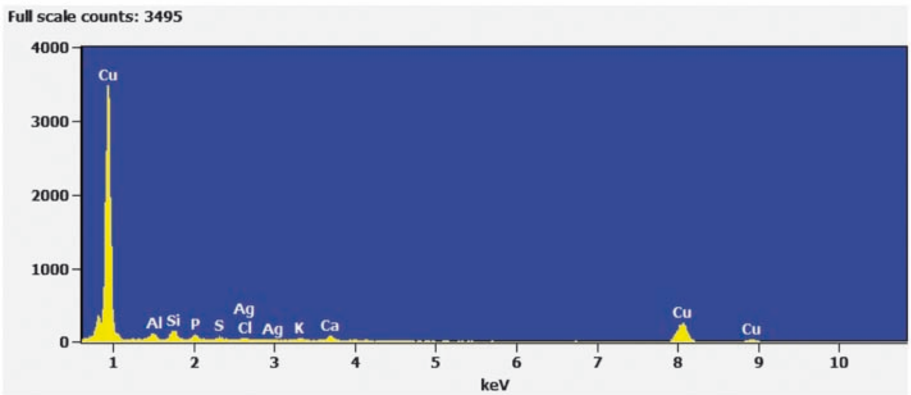
	C	N	O	Al	Si	P	S	Cl	K	Ca	Cu
Point 12	33.48	11.48	29.83	0.39	0.95	0.65	0.77	2.64	0.67	0.57	18.55

B

Fig. 6. Measurement 5a. A – microphotograph of backscattered electrons and measurement points; B – elemental composition at the measuring point 12. Prepared by G. Zabłocki and the author on the basis of illustration by M. Huber



A



Weight %

	C	O	Al	Si	P	S	Cl	K	Ca	Cu	Ag
Point 1	28.57	21.73	0.88	1.30	0.65	0.39	0.49	0.50	1.33	43.85	0.31

B

Fig. 7. Measurement 5b. A – microphotograph of backscattered electrons and measurement points; B – elemental composition at the measuring point 1. Prepared by G. Zabłocki and the author on the basis of illustration by M. Huber

Table 2. Results of the studies on elemental composition obtained with use of the X-ray fluorescence spectrometer in percentage by weight

Element	**Value**
Si	25,626
P	5,362
Al	4,388
Ca	3,275
Fe	3,095
K	2,946
Ti	0,823
S	0,308
Mn	0,111
Sr	0,050
Zr	0,031
V	0,031
Cu	**53,955**

The research in the Chełm laboratory was carried out by Natalia Iwanicka, MSc, using the Shimadzu EDX-7000 X-ray fluorescence spectrometer. Reading was conducted in the air atmosphere. The collimator was 10 mm in diameter. The test time was 30 seconds. One reading was recorded (Table 2).

The presence of silicon, phosphorus, aluminium, calcium, iron, potassium, sulphur – known from previous studies – was recorded with use of this method as well. The contents of titanium, manganese, strontium, zirconium and vanadium were also detected – they were not recorded by the electron microscope due to their low concentrations. The presence of silicon, phosphorus, aluminium, calcium and potassium draws attention. They probably form silicates and phosphates. In the examined part of the artefact, silicon was present in a much higher concentrations than in the case of analyses carried out in the Lublin laboratory.

Also in this case studies of the tool's surface layer did not provide an unambiguous answer about the elemental composition of the metallurgical mass. It is impossible to clearly decide whether titanium, manganese, strontium, zirconium and vanadium are a natural component of the ore, or they got there like other inclusions present in the patina, while the axe was corroding in the ground for several thousand years. Of course, copper dominates by percentage and weight also in the case of Chełm tests. At the same time, the lack of arsenic, antimony and silver (and tin) was found.

Thus, there are many indications that the Raciborowice axe was made of "pure" copper.

ARCHAEOLOGICAL ANALYSIS

The Raciborowice axe is classified into the group of flat axes (with non-raised edges), trapezoidal in cross-section, with slightly concave faces, widened, convex cutting edge, flat butt and both sections symmetrical. Jiři Říhovský described these types of artefacts as group V, type 3c, Bb variant (1992, No. 101) of copper axes discovered in Moravia. Miroslav Dobeš found that identical and similar specimens in the Czech Republic, Moravia, Poland and Eastern Germany (former GDR) form group I, Boljun type, Szakálhát variant (1989, 44), in his more recent work (2013) he placed the most similar specimens among the axes of the first group, the Osik type (38, Pl. 6: 7) and the Jordanów type (39-40, Pl. 7: 10, 8: 1). Moreover, in the study on Central Germany and the Czech Republic the authors: Dobeš, Lutz Klassen and Pierre Pétrequin included the most similar axe – a specimen of the Steinbach type (2011, 10, pl. 6: 2) into the group of 3 triangular flat axes (2011, 12, 13). Henrieta Todorova placed similarly shaped Bulgarian specimens among the flat axes of the Sălcuţa (1981, Nos 49-64), Kamenar (1981, Nos 67-76) and Dolčevo (1981, Nos 65, 66) variants, while Alexandru Vulpe included Romanian specimens among flat axes of the 1st group (narrow) of the Cucuteni (1975, No. 268) and Sălcuţa (1975, No. 271) variants. Viktor Klochko and Anatoliy Kozymenko, in the catalogue of metal artefacts from Ukraine (2017), present three similar specimens from Turiysk (8, Fig. 12), – a field between the villages of Nosivtsi, Kunka (16, Fig. 25) and Novovolynsk (18, Fig. 32). In the western part of the Balkan Peninsula (in Dalmatia, Croatia, Montenegro, Bosnia and Herzegovina) Zdenko Žeravica classified axes similar to Raciborowice specimen as the Stollhof-Pločnik type (1993, No. 131), possibly Stollhof-Pločnik, Hartberg variant (1993, Nos 132-134), while others as Spitz type (1993, No. 135), Gurnitz type (1993, Nos 136-152A), Szakálhát type, Sălace variant (1993, Nos 153-157). For the territory of the former Yugoslavia Martin Kuna identified also the types of Dugo Selo and Buljun (1981, 17-19) – also quite similar to our specimen. Among the Slovak copper artefacts that Mária Novotna classified into the very broad ("multi-threaded") category of "narrow axes" (1970), there are specimens that fully resemble the Raciborowice one. These are the discoveries from Bešeňová (No. 35) and Handlová (No. 36). Pál Patay gathered (1984) similar Hungarian specimens in a collection called the Szakálhát type, divided into seven variants and two additional single special forms (Nos. 16-75). The closest analogy to the Raciborowice specimen is the Sárazsadány variant, namely two tools from Budapest-Békásmegyer (Nos. 44, 45). Among the Austrian artefacts collected by Eugen Fridrich Mayer (1977), quite similar axes also occur. They represent the Stollhof type: the Hartberg variant (No. 97), the Gurnitz variant (No. 103) and the Szakálhát type (Nos. 109, 112). In Western Germany, Kurt Kibber placed similar axes among flat triangular tools (Grundform 2; 1980, Nos 18, 19, 25, 26) as well as small, massive axes: Nieder-Ramstadt (Grundform 7a; Nos 27-30), Rűnthe (Grundform 7b; Nos. 31-34). J. Jacobs classified copper flat axes from Eastern Germany into four basic types: I, II, IIIa and IIIb (1989). Type II is identical with Nieder-Ramstadt, type IIIa with basic form 2 (Grundform 2) of Kibber, and IIIb with type Boljun, variant Hartberg and also type Szakálhát, variant Sălacea. The Raciborowice specimen also should be included into that group.

The above considerations indicate, that in the literature, local typologies have been developed covering national (*e.g*. Hungary, Slovakia) or regional (*e.g*. Moravia) territories, which in various extent correspond to closer or slightly further areas. The nomenclature of each type (and variant) varies, depending on the geographic location of the discoveries (Table 3).

Albert Schmitz (2004) tried to overcome this methodological difficulty by studying Early Eneolithic copper flat axes all over Europe. His analysis covered 1137 specimens (Tabelle/Diagramm Nr 74), *i.e*. almost all of the published ones. Using complicated methods of statistics, as well as special computer software to compare particular discoveries, it was possible to classify eight basic forms (Beilform), with form 8 – that covers chisels, and form 7 – gouges (chisel-shaped axes). The Raciborowice specimen has no features of either form. Moreover, it is also different from forms 1-4. It represents category 5 (Pl. No. 135) or possibly 6 (the latter is described by the author as "variant of the form 5"; Pl. 136; collective definition of form 5: Schmitz 2004, 371, 372; and form 6: 372-374). In Plate 94 Schmitz included transitional forms with features of both categories. It is interesting that the same types identified by different researchers can be placed by Schmitz in different typological categories, *e.g*. the Gurnitz-Boljun axes from Bosnia can be classified in categories 5, 5/6 or 6 (Table 3). Whereas the "Polish" axes described by Andrzej Szpunar (1987) as type Dąbrówka Dolna – also correspond to three Schmitz categories: 5, 5/6 and 6; Strzelin, variant A – 5 and 5/6; Strzelin, variant B – 5; Bytyń, variant A – also 5, and the same find from Jarosław, considered to be a "single and indefinite specimen" (Table 4).

At this point, it is worth taking a closer look at the axes from Poland, classified into one of the above-mentioned categories (Table 4; Fig. 8), in the context of the similarity with the Raciborowice specimen. Schmitz qualified seven axes into category 5, three into the transitional 5/6 and one into the 6. None of them seem to be identical to our specimen. The overall outline proportions resemble the Trzebuska axe (Szpunar 1987, Pl. 1: 11), but it is not as massive (thick) and does not have such a distinct convex blade. A specimen from Dobkowice (Szpunar 1987, Pl. 1: 11B) has a distinctively shaped cutting edge (maybe a little less convex) and a matching thickness (proportionally). It is, however, much less slender. It can be assumed that two more specimens should be included in this list: from Wożuczyn (Gurba 1992) – not included by Schmitz, and from Książnice, site. 2 (Zakościelna 2010, 149) – discovered after the completion of work on early Neolithic axes and chisels in Europe. However, including them in one of the distinct categories is not possible without applying the methodology used by the German researcher. In Table 4, they were recorded without specifying the typological position of Schmitz. It appears that the specimen from Wożuczyn is quite similar in shape to the Raciborowice one. It has a similar slenderness and a widened blade (Gurba 1992, 72, Fig. 1) but slightly different shape, its cross-section

Table 3. Types and variants of flat axes corresponding to categories 5, transitional 5/6 and 6 (according to Schmitz 2004; Tabelle 94)

<table>
<tr><th rowspan="2">Type of Schmitz 2004</th><th>Switzerland</th><th colspan="2">Germany</th><th>Denmark</th><th colspan="2">Romania</th><th>Dalmatia</th></tr>
<tr><th>Type</th><th>Type</th><th>Variant</th><th>Type</th><th>Type</th><th>Variant</th><th>Type</th></tr>
<tr><td rowspan="7">5</td><td rowspan="6">Thayngen,</td><td rowspan="2">Small massive</td><td>Rűnthe</td><td rowspan="2">Vantore ?</td><td rowspan="2">narrow</td><td>Cucuteni</td><td rowspan="7">Gurnitz / Boljum</td></tr>
<tr><td>Nider-Ramstadt</td><td>Sălcuța</td></tr>
<tr><td>Nider-Ramstadt / Jacobs-II</td><td>-</td><td rowspan="2">Valdkilde 1 / Bygholm</td><td rowspan="4">wide</td><td rowspan="4">Ostrovul-Corbului</td></tr>
<tr><td>Bygholm / Jacobs-IIIa</td><td>-</td></tr>
<tr><td>triangular, flat / Jacobs-IIIa</td><td>Grundform 2</td><td rowspan="2">Valdkilde A1</td></tr>
<tr><td>triangular, flat / Jacobs-II</td><td>Grundform 2</td></tr>
<tr><td>Bevaix / Altheim</td><td>Boljun / Jacobs- IIIb</td><td>Hartberg</td><td>Valdkilde 4</td><td>-</td><td>-</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td rowspan="3">5/6</td><td rowspan="3">-</td><td>triangular, flat</td><td>Grundform 2</td><td rowspan="3">-</td><td rowspan="3">-</td><td rowspan="3">-</td><td rowspan="3">Miniature flat axe</td></tr>
<tr><td>triangular, flat / Jacobs-II</td><td>Grundform 2</td></tr>
<tr><td>Szakálhát / Jacobs-IIIa</td><td>-</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>6</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

Type of Schmitz 2004	Hungary		Croatia		Bosnia		Est France
	Type	Variant	Type	Variant	Type	Variant	Type
5	Szakálhát	Vasmegyer	Buljun	-	Spitz / Boljun	-	Nider-Ramstadt
		Sárazsadány					
		Sălacea					
		Sălacea, with central ridge					
	stocky	Ravazd	Stollhof / Pločnik / Dugo selo	-	Gurnitz / Boljun	-	Rűnthe
	Boljun	-	Stollhof / Pločnik / Dugo selo	Hartberg			
	Felsögalla	-			Stollhof / Pločnik / Dugo selo	Hartberg	
		Szendrö					
	flat	krępy					
5/6	Hungarian form	-	Buljun / jak Szakálhát	-	Gurnitz / Boljun	-	-
	Szakálhát	Sárazsadány					
		Sălacea, with central ridge			Szakálhát / Boljun	-	
6	Szakálhát	Keszthely	-	-	Gurnitz / Boljun	-	-

Type of Schmitz 2004	Bulgaria		Slovakia		Moravia		
	Type	Variant	Type	Variant	Group	Type	Variant
5	flat	Kamenar	Sălacea	-	V	2a	Ab
			Salcuța	-			
	flat	Sălcuța	płaski	Gumelnița	VI	2a	Bb
			Coteana	-			
5/6	flat	Kamenar	Cucuteni / Handlová	-	-	-	-
			Cucuteni	-			
			Boljun / Szakálhát / Cucuteni / Gurnitz	-			
6	flat	Delčevo	-	-	V	3c	Bb
	flat	Salcuța / Pločnik					

Type of Schmitz 2004	Austria		Former Yugoslavia		Ukraine		Serbia
	Type	Variant	Type	Variant	Type	Variant	Type
5	Salzburg-Rainberg	-	Szakálhát	Sălacea	Boljun / Stollhof	Hartberg	-
	Szakálhát	-					
	Stollhof	Hartberg					
	Stollhof / Boljun	Hartberg					
5/6	Split	-	-	-	-	-	as Alba Julia
6	-	-	-	-	-	-	-

Table 4. Flat axes of Shmitz (2004) categories 5, transitional 5/6 and 6 (*Beilform* 5, 5/6, 6) from the area of Poland

No.	Place	Schmitz ax category (2004, Tabelle 76)	According to Szpunar 1987			According to Dobeš 1989			According to Patay 1984
			Type	Variant	Catalogue number, figure	Group	Type	Variant	Type
1	Dąbrówka Dolna	6	Dąbrówka Dolna	-	7	-	-	-	-
2	Dobkowice	5	Strzelin	A	11B	-	-	-	-
3	Gołostowice	5/6	Strzelin	A	12	-	-	-	-
4	Jarosław	5	znaleziska pojedyncze i formy nieokreślone	-	66	-	-	-	-
5	Książki	5	Strzelin	B	15	-	-	-	-
6	Książnice**, stan. 2	?	-	-	-	-	-	-	between Hajdúszoboszló and Fesögalla
7	Lubycza Królewska	5	Dąbrówka Dolna	-	11A	-	-	-	-
8	Strzelin	5	Strzelin	A	14	-	-		-
9	Trzebuska	5/6	Dąbrówka Dolna	-	11	-	-	-	-
10	Tyniec Mały	5/6	-	-	-	I	Boljun	Szakálhát	-
11	Wożuczyn*	?	-	-	-	I	Boljun	Jordanów	-
12	Nieznana	5	Strzelin	B	17	-	-	-	-
13	Nieznana	5	Bytyń	A	57	-	-	-	-

* According to typological classification of Jan Gurba (1992, s. 72).

** According to typological classification of Anna Zakościelna (2010, s. 149).

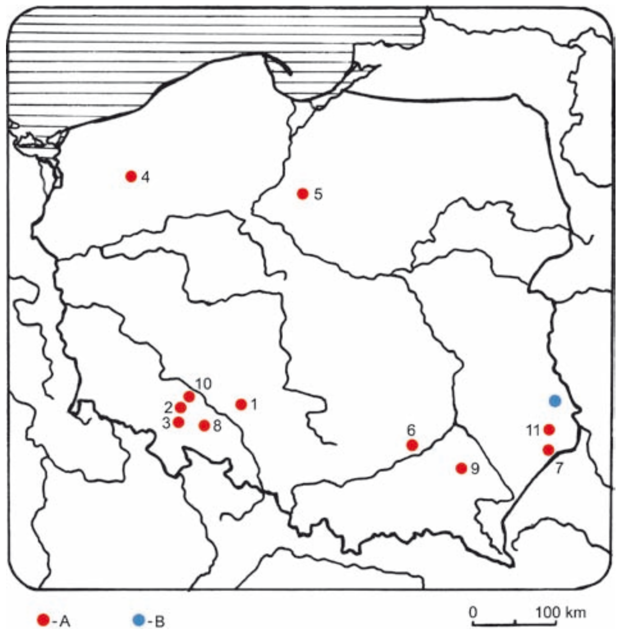


Fig. 8. Spread of the Schmitz category 5, 6 and transitional 5/6 (Beilform 5, 6, 5/6) flat axes in Poland. According to A. Schmitz 2004, 1075-1081, Tab. 76; 1321, 1322, Karte 158; with supplements by J. Gurba (1992), A. Zakościelna (2010) and the author. Finds known from literature (A), Raciborowice, site No. 7 (B) 1 – Dąbrówka Dolna, 2 – Dobkowice, 3 – Gołostowice, 4 – Jarosław, 5 – Książki, 6 – Książnice, site 2, 7 – Lubycza Królewska, 8 – Strzelin, 9 – Trzebuska, 10 – Tyniec Mały, 11 – Wożuczyn. By G. Zabłocki on the basis of drawing by the author and E. Hander

is rather flat than rectangular. The axe from grave No. 5 in Książnice has a similar separate blade (Zakościelna 2010, Pl. 37: 4). Nevertheless, it is a specimen of much smaller size, more stocky, with a flat-convex cross-section, which differs significantly from the Raciborowice one. The remaining "Polish" tools of Schmitz categories 5, 5/6 and 6 cannot be treated as exact analogies. It seems that the features are quite similar: a specimen from Jordanów Śląski is characterized by appropriate slenderness and thickness, and the discrete cutting edge (Szpunar 1987, Pl. 1: 5). Schmitz, however, included him in category 7 (2004, 1166, Pl. 94).

A CHRONOLOGY OF AXES CORRESPONDING TO SCHMITZ 5, 5/6 AND 6 CATEGORIES

Todorova ascribes Bulgarian discoveries of Sălcuţa variant flat axes to the younger phase of the Varna culture, Krivodol-Sălcuţa culture and the Kadžadermen-Gumelniţa-Koranowo VI complex, functioning in the late phase of the local Eneolithic and during the

Bulgarian Transitional Period (Schmitz 2004, 48; Todorowa 1981, 2, 3, Abb. 1). She connects the Dolčevo variant with the second phase of the Kadžadermen-Gumelniţa-Koranowo VI complex (*ibid.*), while Kamenar with the final section of the Varna culture and the beginning of the Bulgarian Transitional Period (*ibid.*).

Vulpe dates Romanian narrow axes of the Cucuteni and Sălcuţa variant, to phase A1 of the Gumelniţa culture, with the possibility of their production and use in the Bodrogkeresztúr culture, *i.e.* it would be the older (early) Eneolithic period, phase I/II and II in Schmitz's periodization (Schmitz 2004, 53). The wide axes of the Ostrovul-Corbului variant, on the other hand, are placed by the same author at the turn of the Copper Age and Bronze Age, *i.e.* the third phase of the older (early) Eneolithic and the first phase of the middle Eneolithic (*ibid.*).

Ukrainian tools were ascribed by Kłoczko and Kozymienko to the Trypillia culture. Specimens most similar to the Raciborowice one were dated to the A-BI1 phase (2017, 8), while the other two – BII-CI (2017, 10). In the light of other well-dated axes of this type, such an early chronology of the Turiysk single find is unjustified. The oldest specimens from Ukraine could originate at the earliest from the turn of phase Ib to IIa of the Schmitz early Eneolithic, as this is the date of the Tiszavalk-Tetes cemetery (documenting the transition from Tiszapolgár to the Bodrogkeresztúr culture; Patay 1984, 32).

In the countries of former Yugoslavia, Kuna related the Pločnik type axes with the Kadžadermen-Gumelniţa-Koranowo VI-B complex, Vinča-Pločnik II and the Tiszapolgár culture, with the possibility of their existence also in the Baden culture (Schmitz 2004, 57). The Dugo Selo type is related to the late stage of the Bodrogkeresztúr culture, which indicates the IIb phase of the older Eneolithic according to Schmitz (*ibid.*). The Boljun type is synchronized with the B phase of the Bodrogkeresztúr culture, B2 of the Trypillia culture and the Sălcuţa III-IV culture, thus placing it in phase II of the older Eneolithic (*ibid.*).

In the Adriatic countries of the western Balkans, Žeravica classified axes of the Stollhof/Pločnik type, some of them identifying with the Hartburg variant. He attributes them to the Vinča-Pločnik culture, phase B of the Cucuteni culture, as well as the Baden and Michelsberg cultures (Schmitz 2004, 61). The Spitz type is a product also used by the Vinča-Pločnik culture, just like Gurnitz, however the last one – in its younger phase (*ibid.*). The Szakálhát type was connected with the Bodrogkeresztúr culture (*ibid.*).

Novotna ascribes narrow Slovak axes, to the Bodrogkeresztúr culture, synchronizing them with the B phase of the Cucuteni culture, however in specimens No. 35 and 36 (1970) she sees relatively late forms parallel to the Remadello culture from northern Italy (Schmitz 2004, 70).

Patay assigned Hungarian axes of the Szakálhát type, Vasmegyer, Sălacea, Sárazsadány variants to the younger phase of the Bodrogkeresztúr culture (Schmitz 2004, 73), the Keszthely variant – the Baden culture, while the Gurnitz type from Austria, which – according to him – is a variant of Szakálhát, to the Balaton culture (*ibid.*). According to Patay, the Felsögall type, including the Szendrö variant, was used in the Bodrogkeresztúr culture (*ibid.*), as well as stocky axes of the Ravazd variant, and additionally in the Baden culture (*ibid.*).

Říhovskýis ascribes Moravian axes classified to group V, type 3c, variant Bb to the Bodrogkeresztúr, Sălcuţa III-IV, Cucuteni B, possibly Baden culture (Schmitz 2004, 83).

Czech axes of the Dobeš 1st group, Pločnik type, Stollhof, Split and Dugo Selo variants (1989) may be dated to the second phase of the early Eneolithic (Schmitz 2004, 90). Split, by resemblance to Szakálhát, is related to the late Bodrogkeresztúr culture (phase IIb of the early Eneolithic in Schmitz's periodization; *ibid.*). The same author in a later study synchronizes the Stollhof type with Cucuteni A-Gumelniţa A2, which equates to the late phase of the Lendziel culture in the Czech Republic (Dobeš 2013, 38). The Hartberg type is simultaneous with the Jordanów culture (group) and the chronologically corresponding Lower Austrian group of Bisemberg-Oberpullendorf (*ibid.*). The Osik type originate from the Jordanów horizon (*ibid.*), as well as the Jordanów type (Dobeš 2013, 39, 40).

Szpunar classified Polish axes of the Dąbrówka Dolna type as the products of the Funnel Beaker culture (Schmitz 2004, 96), the Strzelce type (both variants) - of the Jordanów culture (group; *ibid.*), and Bytyń to the late phase of the Funnel Beaker Culture (Schmitz 2004, 97). The axe from Wożuczyn, probably an import from the Tisza River area, could have been used by the population of the Lublin-Volhynian culture (Gurba 1992, 73, 74). Undoubtedly, the specimen from Grave 5 in Książnice, Site 2 should be related to this cultural unit (Zakościelna 2010, Pl. 37: 4).

Flat axes of the Stollhof (including the Hartberg variant) and Spitz types from Austria were ascribed by Mayer to the horizon Baden culture: / "Commercial" / Trypillia culture A / Vinča-Pločnik / Cucuteni B / Michelsberg (Schmitz 2004, 99). Szakálhát ascribes Type Gurnitz – generally dated to the younger stage of the Eneolithic (*ibid.*), to the culture of Michelsberg (Schmitz 2004, 99) of the Early Eneolithic stage II (*ibid.*), Split – also to the Bodrogkeresztúr and Michelsberg cultures (Schmitz 2004, 100).

Swiss Thayngen type axes occurred in the older and middle phases of the Pfyn culture, in phase IIb of the Early Eneolithic in Schmitz periodization (2004, 107). It is the horizon of Cortaillod – Pfyn – Althaim – Mondsee – Ludanice-Lažňany-Balaton II – Bodrogkeresztúr – Trypillia culture C (Schmitz 2004, 109).

Western Germany tools – triangular, flat (Grundform 2) were classified by Kibbert as products used in the Michelsberg culture (Schmitz 2004, 115), similar to the small triangular axes (Form 7a and 7b): Nieder-Ramstadt and Rűnte (the latter in its the younger phase; *ibid.*).

According to Schmitz, on the basis of the uniform collections analysis (Table 5 and 6), category 5 axes appear at the time of transition from Early the Eneolithic phase Ib to phase IIa, they last through the entire phase II (a and b) up to phase IIIa, when they disappear (*e.g.* Schmitz 2004, Diagramm No. 130). Specimens of category 6 appear in Early Eneolithic phase IIa and occur in phase IIb to phase IIIa (*ibid.*). Axes with transitional features – probably have the same chronology.

Table 5. Cultural situation in the central part of Europe, in countries where flat axes of categories 5, transitional 5/6 and 6 occurred (according to Schmitz (2004; Tabelle 94)

Dating: Early Eneolithic		Place	Country
Phase	Culture / Time horizon		
Treasures			
Ib	-	Luica	Romania
II	-	Boljun	Croatia
	-	Bosanska Krupa	Bosnia
IIa	-	Kolubara river mouth	Serbia
IIab	-	Novest	Croatia
	-	Orašje	Bosnia
	-	Surčin	Croatia
IIb	-	Horodnica	Ukraine
	-	Kladari-Karavid	Bosnia
II / III	-	Conţešti	Romania
	-	Handlová	Slovakia
IIb / transition to IIIa	-	Stollfof	Austria
	-	Veliki Gaj	Serbia
Graves			
Ib / IIa	Transition from Tiszapolgár to Bodrogkeresztúr	Tiszavalk-Tetes	Hungary
IIa	Bodrogkeresztúr	Ciumesti	Romania
IIab	Bodrogkeresztúr	Hódmezövásárhely-Szakálhát	Hungary
	Gumelniţa B	Sava	Romania
IIb	Jordanów	Dobkowice	Poland
	Bodrogkeresztúr – earlier phase	Fényslitke	Hungary
	Jordanów	Tyniec Mały	Poland
Settlements			
IIb	Trypillia BII	Brynzeny III	Ukraine
		Michurin Sovchoz	
IIb or transition to IIIa	Pfyn	Thayngen	Switzerland

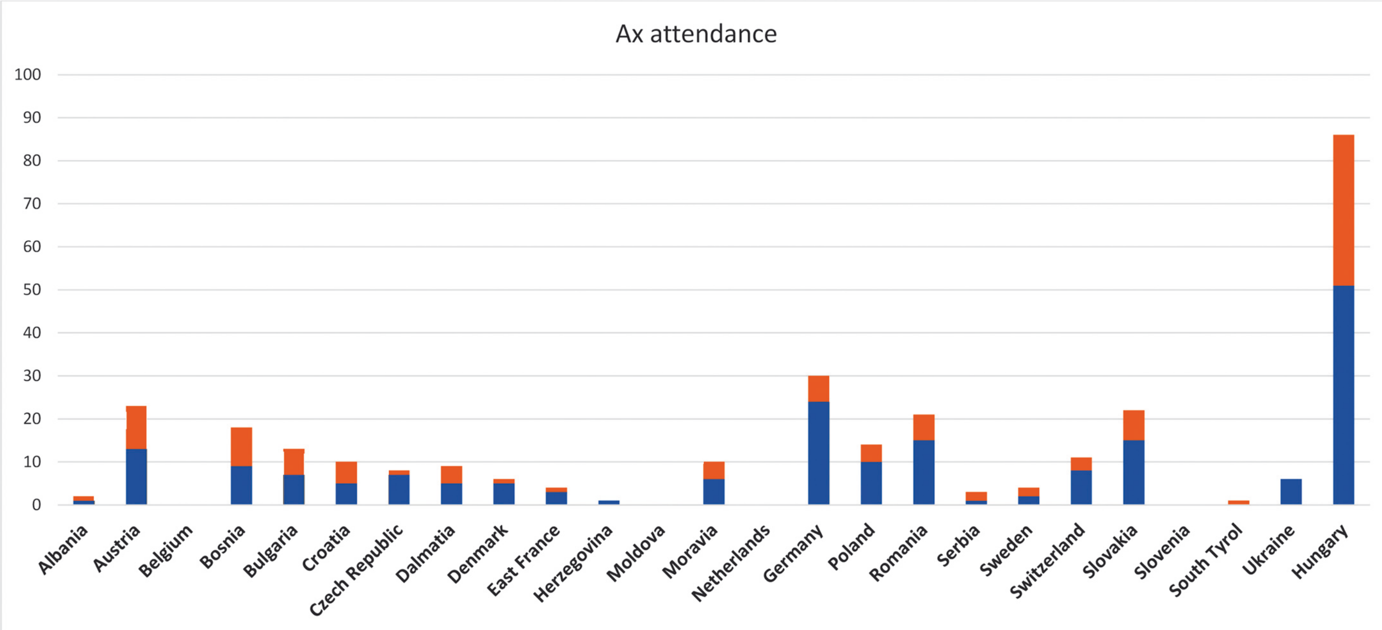
The cultural situation in the countries where the axes of Schmitz categories 5, 5/6 and 6 were discovered is presented in Table 7. The quantitative summary is presented in Fig. 9. The range of category 5 axes (Beilform 5) covers the area from Alsace and Lorraine in eastern France in the West to western Ukraine in the East and from the southern Balkans (Albania, Bulgaria) in the South to southern Scandinavia in the North. Category 6 axes (Beilform 6), roughly repeats this range (except western Ukraine, where they have not been recorded; Schmitz 2004, Karte 144, 145). At first glance it can be recorded that the greatest density

Table 6. Chronology of Schmitz category 5 axes (Beilforme 5) – uniform groups (Schmitz 2004, 573, 574)

Dating: Early Eneolithic		Place	Country
Phase	Culture / Time horizon		
Treasures			
IIa	-	Kolubary river mouth	Serbia
	-	Surčin	Croatia
IIab	-	Boljun	Croatia
	-	Bosanska Krupa	Bosnia
	-	Dorog	Hungary
	-	Kladari-Karavid	Croatia
IIb	Ludanice	Hradec	Slovakia
	-	Orašje	Bosnia
	Treasure corresponds to Bodrogkeresztúr B	Split-Gripe	Croatia
	Bodrogkeresztúr – earlier phase	Szeged-Szillér	Hungary
IIb / IIIa	Transition to Bajč-Retz	Handlová	Slovakia
Graves			
Ib / IIa	Kadžadermen-Gumelnița-Koranowo VI	Reka Devnja	Bulgaria
	-	Tiszavalk	Hungary
IIa	Bodrogkeresztúr A	Magyarhomorog	Hungary
IIab	Bodrogkeresztúr	Hódmezövásárhely-Szakálhát	Hungary
		Srárazsadány	
Settlements			
IIa	Karanovo VI, phase IIb	Goljamo Dolcevo	Bulgaria
IIab	Karanovo VI, phase III	Russe	Bulgaria
II	Sălcuța-III	Cerat	Romania
		Sălcuța	

occur in today's Hungary and in neighbouring Slovakia, definitely exceeding all other areas in terms of quantity. The area of these two countries appears to be the centre of production and spreading of these products to the entire central part of Europe, but – of course – the existence of secondary centres of regional production, following the Hungarian-Slovak models, must be taken into account. Such kind of assumption of the potential exploitation of copper ore deposits and metallurgical production in the Jordanów culture (group) was recently formulated by Beata Miazga and Marta Mozgała-Swacha (2018, 41). Klochko and Kozymenko expressed their opinions in a similar way in relation to the Trypillia culture in Ukraine (2017, 287, 288).

The Raciborowice axe was probably made of "pure" copper, but it is also possible that the small amount of silver was a natural admixture of the ore (Table 1). The presence of arsenic was not recorded in the analysed samples, which may have some chronological



Schmitz ax category (*Beilform*)	Albania	Austria	Belgium	Bosnia	Bulgaria	Croatia	Czech Republic	Dalmatia	Denmark	East France	Hertzegovina	Moldova	Morawia	Netherlands	Germany	Poland	Romania	Serbia	Sweden	Switzerland	Slovakia	Slovenia	South Tyrol	Ukraine	Hungary	Total
5	1	13	-	9	7	5	7	5	5	3	1	-	6	-	24	10	15	1	2	8	15	-	-	6	51	**194**
6	1	10	-	9	6	5	1	4	1	1	-	-	4	-	6	4	6	2	2	3	7	-	1	-	35	**108**
Total	**2**	**23**	**-**	**18**	**13**	**10**	**8**	**9**	**6**	**4**	**1**	**-**	**10**	**-**	**30**	**14**	**21**	**3**	**4**	**11**	**22**	**-**	**1**	**6**	**86**	**302**

Fig. 9. Spread of the Schmitz category 5 and 6 (Beilform 5, 6) flat axes in Europe. According to Schmitz 2004, 1015, Tab. 74

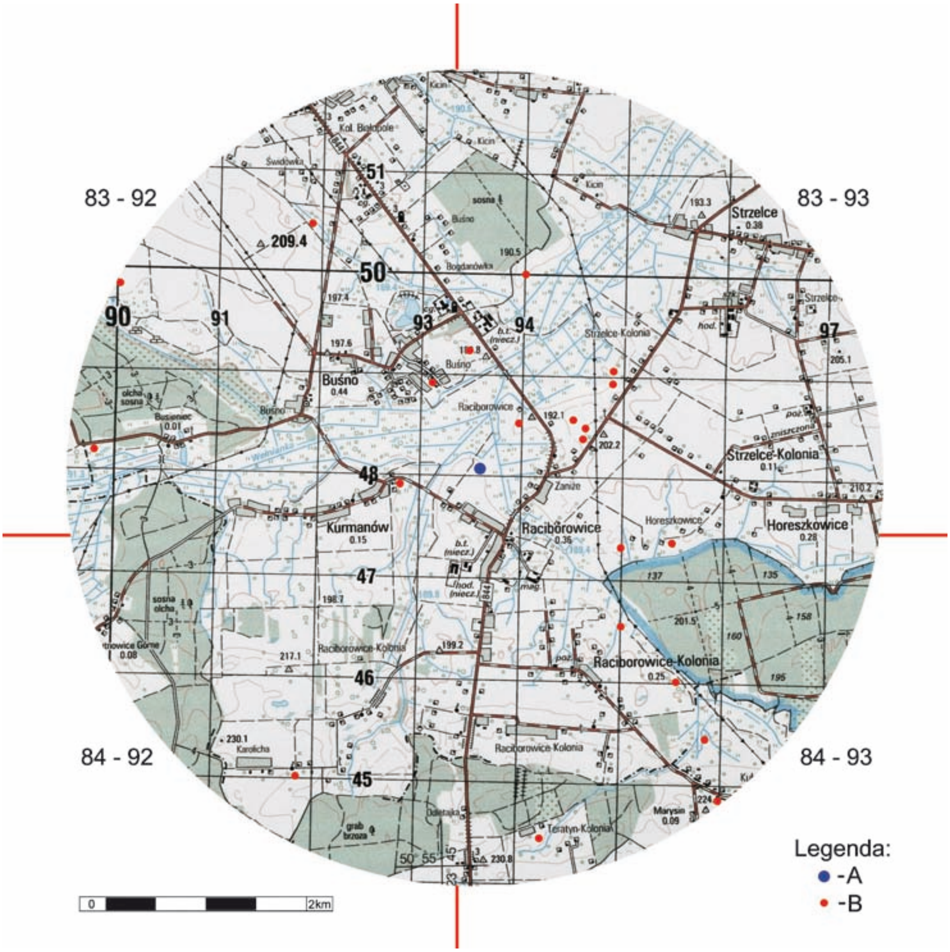


Fig. 10. Raciborowice, Site 7. The place of the copper axe discovery (A) in the context of the Lublin-Volhynian culture sites known from the AZP and excavations (B). According to: Kokowski and Jastrzębski 1983; Bronicki and Hander 2008 (map fragment 1: 50,000; M-34-048-A, B Wojsławice. Publisher: Chief of Military Geography, Warsaw 2013). Illustration by G. Zabłocki and the author

importance. The elemental composition analysis of the Schmitz category 5 and 6 axes indicates, that throughout the second phase of the early Eneolithic, both: completely "pure" copper, as well as copper with the addition of antimony, silver and a small amount of bismuth were used for their production. The latter one is called Nógrádmarcal type copper. Its ore was found in the area of the North Hungarian Mountains (Schmitz 2004, 580). Traces of copper ore exploitation and processing have also been recorded in Slovakia – in the Low Tatras, near Banska Bystrica. They are related to the Ludanice taxonomic unit (Łęczycki 2010, 276, 277). Arsenic copper was widely used only in Early Eneolithic phase

Table 7. Chronology of Schmitz category 6 axes (Beilforme 6) – uniform groups (Schmitz 2004, 574, 575)

Country	Early Eneolithic	
	Phase II	Phase III
Austria	Epi-Lengyel	Retz
Upper Austria	Műnchshöfen / Michelsberg III/IV ?	Montsee I
Bavaria	Wallerfing	Altheim I
Bulgaria	Karanovo VI	
Tisza river basin	Bodrogkeresztúr A i B	Hunyadihalom
Czech Republic	Jordanov	Baalberge
Moravia / Lower Austria	Lengyel V	Lengyel VI
Central Germany	Baalberge A	Baalberge B
West Germany	Michelsberg II/III	Michelsberg IV/V
Poland	FBC – Pikutkowo	FBC – early Wiórek
Northeast Romania	Cucuteni A/B	Cucuteni B
South Romania	Gumelniţa A2-B1	Gumelniţa B2
Serbia	Bubanj-hum	
South Scandinavia	FBC A/B	FBC C
Slovakia	Lengyel V: Ludanice A i B	Lengyel VI: Bajč-Retz
Switzerland	Pfyn	
Silesia	Jordanów A-B	FBC C
Ukraine	Trypillia BI	Trypillia BII

III, especially in IIIb (Schmitz 2004, 581). Arsenic next to antimony, silver and bismuth characterizes the so-called Handlová type copper from the upper Nitra in Slovakia. Due to the strong evidence that the Raciborowice specimen was made of arsenic-free metallurgical mass, it should be dated to the second phase of early Eneolithic, eventually stage IIIa, *i.e.* before the widespread use of arsenic copper.

The Bodrogkeresztúr A culture corresponds to Schmitz's early Eneolithic phase IIa, period B – phase IIb. According to the recent radiocarbon dates analyses Tomasz Chmielewski suggests that this culture period A should be dated to 4290/4270-4250/4220 BC, and period B to 4250/4220-3950/3850 BC. On the other hand, the Hunyadi-Halom culture could have developed at the end of the 40th and the beginning of the 39th centuries BC (partly in parallel with the latest stage of the Bodrogkeresztúr culture) and would last until *ca*. 3800 BC (2019, 29) – in stage III of the Schmitz Early Eneolithic. The cut-off dates of taxonomic units quoted by Sławomir Kadrow are slightly different: The Tiszapolgar culture: 4420-4240 BC (Schmitz's Eneolithic phase I); Bodrogkeresztúr: 4250-4070 BC (2nd phase) and Hunyadi-Halom: 4020-3780 BC (3rd phase; 2016, 70; 77; see also Brummack and Diaconescu 2014; Raczky and Siklósi 2013). The BII phase of the Trypillia culture was quite similarly dated by Soviet scholars, corresponding to Cucuteni AB: 4250-4000 BC (Masson and Merpert eds 1982, 175, Pl. 10).

Klassen, Dobeš and Pétrequin dated the Steinbach type axe (very similar to the specimen from Raciborowice) from 3900-3700 BC (2011, 19), which corresponds to the transition from Schmitz's IIb to IIIa stage.

As a result of these considerations, it follows that the Raciborowice discovery probably dates back to the end of the 5th or rather the beginning of the 4th millennium BC.

One issue still remains to be resolved – an attempt to answer the question with what cultural environment in the Lublin region should be the imported axe related. It seems it was the Lublin-Volhynian community – the last Eneolithic taxonomic unit with strong relations with the Carpathian Basin, which clearly marked its presence in south-eastern Poland (and, of course, in Volhynia). The discovery of a copper axe in the deposit of the Lublin-Volhynian Grave 5 in Książnice (Zakościelna 2010, 393, Pl. 37: 4), dated back to the third phase of this culture (Zakościelna 2010, 28, Pl. 5), also is important. The classic phase (II: 4000-3800 BC) of the Lublin-Volhynian culture is synchronized with the Trypillia BII culture, and the older part of the late phase (IIIa: 3800-3600 BC) with the Trypillia CI (Zakościelna 2006, 90). At that time, the communities of the Funnel Beaker Culture only incidentally visited the loess highlands of south-eastern Poland, and mainly in peripheral zones, beyond the compact range of settlements of the "southern" competitors (Włodarczak 2006, 57).

Around the site where the "single" copper axe was discovered, within a 4 km radius, traces of 21 relics of the Lublin-Volhynian culture were discovered (Fig. 10). They were recorded primarily during surface surveys (Kokowski and Jastrzębski 1983). Further ones (Raciborowice-Kolonia, Site 3) were discovered after their completion. The latter is located almost 3 km southeast from the place of discovery of the copper artefact. They were archaeologically excavated (Bronicki and Hander 2008). The ceramic material dates a small (?) settlement to the classical phase, with the possibility of its continuation also in the late phase (*ibid.*, 23).

The period of the "Funnel Beaker" domination in the loesses areas of western Lesser Poland, the Lublin region and western Volhynia falls a bit later, when the Lublin-Volhynian culture communities have already lost their identity. This happened around 3650-3400/3300 BC (phases II-IIIA – classic – Funnel Beaker culture; Włodarczak 2006, 58). This fact rather excludes the possibility of linking our axe with this taxonomic unit.

Acknowledgements

I would like to express my gratitude to Doc. Eng. Miłosz Huber for the selfless conducting of the analysis of this object and comprehensive assistance in interpreting the results, as well as for reviewing the chapter on the material composition of the artefact and his priceless comments, which were fully included in the text.

I would also like to thank MSc Natalia Iwanicka – a scientific and technical specialist and MSc. Eng. Piotr Różański – head of the Laboratory of Construction Engineering in Civil Engineering Centre of the State School of Higher Education in Chełm for undertaking the second set of analyses.

The author would like to thank Tomasz Myśliwiec for translating the text.

References

Bronicki A. and Hander E. 2008. Wielokulturowe stanowisko 3 w Raciborowicach-Kolonii, pow. chełmski. In J. Libera (ed.), *Pradziejowe i wczesnośredniowieczne materiały z Obniżenia Dubienki. Lubelskie Materiały Archeologiczne* 16, 11-169 +2. Lublin: Wydawnictwo UMCS.

Brummack S. and Diaconescu D. 2014. A Bayesian approach to the AMS dates for the Copper Age in the Great Hungarian Plain. *Prähistorische Zeitschrift* 89/2, 242-260.

Chmielewski T. J. 2019. Chronologia absolutna rozwoju kręgu Polgár na etapie środkowego eneolitu (epoki miedzi). *Gdańskie Studia Archeologiczne* 7, 21-37.

Dobeš M. 1989. Zu den äneolithischen Kupferflachbeilen i Mähren, Böhmen, Polen und in der DDR – K eneolitickým plochym měděným sekerám na Moravě, v Čechách, Polsku a NDR. *Praehistorica* 15, 39-48.

Dobeš M. 2013. *Měď v eneolitických Čechách Kupfer im Äneolithikum Böhmens* (= *Dissertationes Brunenses/Pragensesque* 16). Praha: Filozofická Fakulta Univerzity Karlovy v Praze.

Gurba J. 1992. Siekierka miedziana z Wożuczyna w woj. zamojskim. *Acta Universitatis Lodziensis. Folia Archaeologica* 16, 71-74.

Jacobs J. 1989. Jungsteinzeitliche Metallfunde aus Gebiet der DDR. *Zeitschrift fűr Archaeologie* 23, 1-17.

Kadrow S. 2016. About the Chronology of the Beginning of the Metal Ages. *Analecta Archaeologica Ressoviensia* 11, 66-78.

Kibbert K. 1980. *Die Axte und Beile in mittleren Westdeutschland I* (= *Prähistorische Bronzefunde* 9/10). München: C.H. Beck.

Klassen L., Dobeš M. and Pétrequin P. 2011. Dreieckige Kupferflachbeile aus Mitteldeutschland und Böhmen. *Alt-Thüringen* 41(2008/2009), 7-35.

Klochko V. I. and Kozymenko A.V. 2017. Drevniy metal Ukrainy. Kiev.

Kokowski A. and Jastrzębski S. 1983. *Dokumentacja badań powierzchniowych obszaru 83-93*. Lublin (typescript in Chełm Land Museum in Chełm).

Kuna M. 1981. Zur neolithischen und äneolithischen Kupferverarbeitung im Gebiet Jugoslawiens. *Godišnjak* 19, 13-81, I-XXVII.

Łęczycki S. 2010. Początki metalurgii oraz górnictwa od Anatolii po Europę Centralną. In P. P. Zagożdżon and M. Madziarz (eds), *Dzieje górnictwa – element europejskiego dziedzictwa kultury* 3. Wrocław: Oficyna Wydawnicza Politechniki Wrocławskiej, 205-240.

Masson V. M. and Merpert N. Ya. eds 1982. Eneolit SSSR. Moskva: Nauka.

Mayer: E. F. 1977. *Die Äxte und Beile in Österreich* (= *Prähistorische Bronzefunde* 9/9). München: C.H. Beck.

Miazga B. and Mozgała-Swacha M. 2018. Wyroby miedziane kultury jordanowskiej ze stan. 10/11/12 w Domasławiu, gm. Kobierzyce, w świetle badań metaloznawczych. *Przegląd Archeologiczny* 66, 31-43.

Mieczyński T. (ed.) ante 1939. *Mapa gleb województwa lubelskiego/Soil map of the departament of Lublin 1: 300 000*. Lublin: Wydział Gleboznawczy Instytutu w Puławach.

Novotna M. 1970. Die Äxte und *Beile in der Slowakei* (= *Prähistorische Bronzefunde* 9/3). München: C.H. Beck.

Patay P. 1984. *Kupferzeitliche Maissel, Beile und Axte in Ungarn* (= *Prähistorische Bronzefunde* 9/15). München: C.H. Beck.

Raczky P. and Siklósi Zs. 2013. Rekonsideration of the Copper Age chronology of the eastern Carpatian Basin: a Bayesian approach. *Antiquity* 87, 555-573.

Říhovský J. 1992. *Die Äxte, Beile, Meissel und Hämmer in Mähren* (= *Prähistorische Bronzefunde* 9/17). Stuttgart: Franz Steiner.

Schmitz A. 2004. *Typologische, chronologische und paläomatallurgische Untersuchungen zu den frühkupferzetlichen Kupferflachbeilen und Kupfermeißeln in Alteuropa. Dissertation zur Erlangung des akademischen Grades eines Doktors der Philosopfie der Philosophischen Fakultäten der Universität des Saarlandes* 1/2 – Text, 2/2 – Anhang. Saarbrücken.

Szpunar A. 1987. *Die Beile in Polen I (Flachbeile, Randleistenbeile, Randleistenmeißel)* (= *Prähistorische Bronzefunde* 9/16). München: C.H. Beck.

Todorova H. 1981. *Die kupferzeitlichen Äxte, und Beile in Bulgarien* (= *Prähistorische Bronzefunde* 9/14). München: C. H. Beck.

Vandkilde H. 1996. *From Stone to Bronze. The Metalwork of the Late Neolithic and earliest Bronze Age in Denmark* (= *Jutland Archaeological Society Publications* 32). Højbjerg: Aarhus Universitetsforlag.

Vulpe A. 1975. Die Äxte und *Beile in Rumänien II* (= *Prähistorische Bronzefunde* 9/5). München: C. H. Beck.

Włodarczak P. 2006. Chronologia grupy południowo-wschodniej kultury pucharów lejkowatych w świetle dat radiowęglowych In J. Libera and K. Tunia (eds), *Idea megalityczna w obrządku pogrzebowym kultury pucharów lejkowatych*. Lublin, Kraków: Instytut Archeologii UMCS, Instytut Archeologii i Etnologii PAN, 27-66.

Zakościelna A. 2006. Kultura lubelsko-wołyńska. Zagadnienia jej genezy, periodyzacji i chronologii. In M. Kaczanowska (ed.), *Dziedzictwo cywilizacji naddunajskich: Małopolska na przełomie epoki kamienia i miedzi* (= *Biblioteka Muzeum Archeologicznego w Krakowie* 1). Kraków: Muzeum Archeologiczne w Krakowie, 77-94.

Zakościelna A. 2010. *Studium obrządku pogrzebowego kultury lubelsko-wołyńskiej*. Lublin: Wydawnictwo UMCS.

Žeravica Z. 1993. *Die Äxte und Baile aus Dalmation und anderen Teilen Kroatien, Montenegro, Bosnien und Herzegowina* (= *Prähistorische Bronzefunde* 9/18). München: Franz Steiner.