BRONZE SPEAR/JAVELIN HEADS FROM THE HOMELAND MUSEUM IN HLOHOVEC[1]

Use-Wear Analysis, XRF Measurements and Radiocarbon Dating

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This paper presents a detailed analysis of a set of bronze spear/javelin heads from the Urnfield cultures, stored in the Homeland Museum in Hlohovec (Vlastivedné múzeum v Hlohovci). Altogether, six artefacts originating from various archaeological sites in the Váh river basin are studied, most of them characterized by strongly curved blades. The authors provide a typo-chronological, use-wear, and XRF analyses of these artefacts. In one particular case, a radiocarbon date from remnants of a wooden shaft preserved in the spearhead socket is published, highlighting a remarkable fact – the secondary reuse of this weapon in the Early Modern period. The paper also acknowledges that the distribution of the analysed types of spear/javelin heads extends beyond not only the museum's collecting area but also Slovakia's borders. Detailed studies of similar weapon assemblages from museum collections, including isolated Bronze Age finds, provide valuable insights into their usage and subsequent histories.

INTRODUCTION

A wide array of prehistoric weapons is stored in the archaeological collections of Slovak museums. Some of these have not yet been analysed in detail or published. One reason for this is that many are single finds with unclear discovery circumstances. Nevertheless, we believe that if typologically similar archaeological finds are part of a museum collection, publishing them in a comprehensive manner is worthwhile. Collections of this kind may (and generally do) originate from the museum's own collecting region and thus at least reflect the regional specifics of the artifacts under study and the issues in question. This also applies to the set of bronze spear/javelin heads from the Urnfield cultures deposited in the Homeland Museum in Hlohovec (Vlastivedné múzeum v Hlohovci).

In total, these are six artefacts from various archaeological sites in the Váh River basin, mostly spearheads with strongly curved blades. The aim of this contribution is to present a typological-chronological analysis, XRF analyses, and use-wear analyses of the items in question, and, in one case, to publish ^{14}C data from the wooden shaft fragment preserved in one of the sockets. At the same time, we must not overlook the fact that the distribution of these bronze spear/javelin heads extends beyond not only the collecting region of the Homeland Museum in Hlohovec, but also beyond the borders of Slovakia. The purpose of the analyses presented here is to deepen our knowledge of these types of specialized Urnfield culture weapons housed at the above-mentioned museum (*Mitáš et al. 2018*, 229–233) and to shed light on their broader archaeological context within Central Europe.

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Tab. 1. Metric measurements of the analysed spear/javelin heads.

Site	Max. lenght [mm]	Max. width [mm]	Lenght of the socket [mm]	Outer diameter of the socket [mm]	Inner diameter of the socket [mm]	Max. diameter of the rivet holes [mm]	Distance between rivet holes and base of the leaf [mm]	Weight [g]
Banka	243	37	85	27	24	5	36	171.6
Hlohovec I	270	39	88	26	24	5	38	218.3
Hlohovec II	139	26	66	27	21	3	–	78.7
Madunice	170	34	35	19	13	–	–	94.6
Piešťany	235	41	76	25	23	5	33	193.4
Šintava	154	29	54	26	22	5	46	98.8

SPEAR/JAVELIN HEADS FROM THE HOMELAND MUSEUM IN HLOHOVEC

Six spearheads from the collection of the Homeland Museum in Hlohovec were made available for study. Below is a description of these objects along with the context of their discovery. Drawings, or in some instances photographs of these spearheads, together with catalogue of spearheads from the area of the Váh river valley were published in *V. Mitáš et al.* (*2018*). Metric measurements of each are presented in Tab. 1. As the differentiation between spear and javelin heads is quite troublesome (*Mitáš et al. 2018*, 238), we will refer to significantly larger examples (longer than 20 cm; Banka, Hlohovec I, Madunice, Piešťany) as spearheads, to the smallest from Hlohovec II as javelin head, and to specimen from Šintava as spear/javelin head (as it is intermediate in weight and length).

1. Spearhead from Banka

(Inv. no. A-78; reg. no. 119/65; Pl. I: 1)

Found in either 1903 or 1914, most likely at Osvaldova tehelňa in Banka. According to the publication História Banky (*Klčo/Krupa 2004*, 13), the spearhead was discovered at Osvaldova tehelňa in 1914 by Š. Osvald. His son, J. Osvald, donated it to the museum in 1965. However, the inscription *Talalt 1903* (Hungarian for found in 1903) is engraved on the piece, contradicting this information (*Mitáš et al. 2018*, 232, 233). The spearhead has a strongly curved blade with a stepped profile. The tip is broken, the blade is slightly bent, and there are numerous damage marks along the edges, some of them covered with patina. The casting seams have been removed. A preserved fragment of an oak (*Quercus sp.*) shaft remains inside the socket (*Mihályiová 2016*; *Mitáš et al. 2018*, 238). Most of the surface is covered with a well-preserved dark green patina, though it is missing in certain sections, particularly along parts of the edges and the exposed fracture surface where the break occurred near the tip.

2. Spearhead from Hlohovec

(Hereinafter referred to as Hlohovec I; inv. no. A-8, reg. no. 56/64; Pl. II: 1)

No information is available regarding the circumstances and context of its discovery. It was found before 1964, as indicated by the date of its entry into the museum inventory. The spearhead has the same flame-shaped blade and stepped profile as the previously described specimen. It is significantly bent, and numerous damage marks are present along the edges. The midrib is cracked at the midpoint of the spearhead's total length. The casting seams have been removed. The surface retains a dark grey to black patina, particularly on the socket and the lower part of the blade. However, in many areas, the underlying colour of bronze is exposed. Minor traces of corrosion are visible along the edges, especially in small section of the lower, widened part of the blade.

3. Javelin head from Hlohovec

(Hereinafter referred to as Hlohovec II; inv. no. A-198, reg. no. 126B/76; Pl. II: 2)

According to the museum catalogue, this is a single find from 1976. The spearhead has a triangular blade shape with no profilations on either the socket or the blade. Casting seams have been removed. It is covered by a very thick layer of dark grey patina. The socket is broken, with the fracture surface also covered in patina. Minor damage is visible along the edge, particularly on one side of the blade.

4. Spearhead from Madunice
(Inv. no. A-9, reg. no. 57/64; Pl. I: 2)

According to the museum catalogue, the spearhead was found in 1960 by D. Tomeček. No further information regarding the finding circumstances or context is available.

The spearhead has a strongly curved blade with a stepped profile. The casting seams have been removed. Its surface is covered with a dark grey to black patina, but in many areas – especially near the edges of the blade – the colour of bronze is exposed. The edges are heavily corroded and also show marks of mechanical damage. The socket is broken, with the fracture surface at its end covered in patina. It was broken above the rivet holes, which are therefore not preserved. Three modern drilled holes are present in the lower part of the blade. The tip is asymmetrical.

5. Spearhead from Piešťany
(Inv. no. A-318, reg. no. 570/85; Pl. III: 1)

Discovered in 1985 during the extraction of gravel from the Váh riverbed in the locality of Lido, where a ford was once located. A bronze sword was also found at this site (*Pastorek 1986*, 180). Additionally, a total of four swords (including previously mentioned) and two spearheads have been reported from this locality. Two swords have been assigned chronologically – one can be dated to the end of the Middle Bronze Age, while the other belongs to the Older Urnfield Period (*Bartík 1997*, 421–423). The spearhead has the same strongly curved blade with a stepped profile as the previously described specimens. It is well-preserved, with a relatively thin patina in a light brown colour, partially also covered with a grey to nearly black patina. There are relatively few signs of mechanical damage, though the tip is bent and cracked. Modern damage is visible on the midrib, likely caused by the use of heavy machinery during excavation work in the Váh riverbed. The patina is worn off on one side of the socket and near the edges. The bevels are not visible.

6. Spear/javelin head from Šintava
(Inv. no. A-460, reg. no. 26/18; Pl. III: 2)

A single find discovered in 2014 in the "Nad Mostom" locality, found in a plough furrow or wheel rut in a field. The object was delivered to the museum by the finder (*Mitáš et al. 2018*, 229–232). Spearhead features a laurel-shaped blade, has a midrib with three ribs that merge approximately 2 cm under the tip. The central rib terminates 1 cm above the blade base, while the lateral ribs extend onto the socket, curving approximately 0.5 cm below the blade base and creating a thickening along the sides. Two rivet holes are present below the leaf. A preserved fragment of the wooden shaft remains inside the socket, archaeobotanical analysis indicates the presence of silver fir (*Abies alba*) wood (*Mihályiová 2015*; *Mitáš et al. 2018*, 238). Significant damage is visible on one side, where the midrib is cracked, part of the blade is crushed, and a portion is missing. The socket is noticeably bent. These distinct damages can be linked to agricultural activity, most likely resulting from the spearhead being crushed by farming machinery. Few use-wear marks are visible on the preserved edge. Partial cleaning after discovery resulted in a surface unevenly covered with a blue-green patina, with most of the original patina preserved on the socket. Slight corrosion marks can be observed on the blade's surface (*Mitáš et al. 2018*, 231, 232, 235; *2020*, 112, 113). The radiocarbon dating of the wood from the socket indicates the secondary use of the object in the Early Modern period, in the 16th–17th c. AD.

TYPOLOGICAL AND CHRONOLOGICAL CONSIDERATIONS

Bronze spear/javelin heads have so far been classified according to typologies proposed by various authors, which often differ considerably from each other (a detailed overview is provided in *Bader 2006*). In this chapter, we have primarily decided to utilize the typology proposed by *T. Bader* (*2015*), as it covers the Central European area of interest and represents one of the most recent approaches.

Within the mentioned spearheads, three types can be distinguished. The spearheads from Banka, Hlohovec I, Madunice, and Piešťany share a number of common features and will therefore be discussed together. The spear/javelin head from Šintava and javelin head from Hlohovec II have been classified separately. The typological classification within selected typologies is presented in Tab. 2.

Tab. 2. Classification of the spear/javelin heads within selected typologies.

Site	*Furmánek 1977*	*Říhovský 1996*	*Gedl 2009*	*Ölvecky 2010*	*Vasić 2015*	*Bader 2015*
Banka	type IIIb; flame-shaped spearhead with flame-like profilation	socketed spearhead, belonging to group with profiled leaf and smooth socket, main form (Grundform) C (flame-shaped), medium-wide form with maximum width in the lower part of the blade; variant with free socket shorter than half the total length	spearhead with stepped leaf, flame-shaped variant	spearhead with a smooth socket and a profiled leaf, flame-shaped, large variant	spearhead with curved leaf, variant 2 (leaf with stepped profile)	group B (with profiled leaf), spearhead with strongly curved leaf, variant b1 or b2 (with stepped profilation of the leaf and semi-circular or pointed cross-section of the midrib)
Hlohovec I	type IIIb; flame-shaped spearhead with flame-like profilation	socketed spearhead, belonging to group with profiled leaf and smooth socket, main form (Grundform) C (flame-shaped), medium-wide form with maximum width in the lower part of the blade; variant with free socket shorter than half the total length	spearhead with stepped leaf, flame-shaped variant	spearhead with a smooth socket and a profiled leaf, flame-shaped, large variant	spearhead with curved leaf, variant 2 (leaf with stepped profile)	group B (with profiled leaf), spearhead with strongly curved leaf, variant b1 or b2 (with stepped profilation of the leaf and semi-circular or pointed cross-section of the midrib)
Hlohovec II	–	closest to socketed spearhead, belonging to group with smooth leaf and smooth socket, main form (Grundform) B (rounded leaf), narrow form with maximum width in the lower part of the blade; variant with a free socket constituting half the total length	most similar to some examples assigned as medium-sized and small spearheads with laurel-shaped blades	most similar to spearhead with a smooth leaf and smooth socket, with a laurel-shaped leaf, small variant, subvariant with a slender leaf and an extremely long socket	closest to spearhead with willow-leaf shaped leaf	group A (simple, plain spearheads, with smooth leaf and smooth socket), with triangular or rhombic leaf
Madunice	type IIIb; flame-shaped spearhead with flame-like profilation	socketed spearhead, belonging to group with profiled leaf and smooth socket, main form (Grundform) C (flame-shaped), medium-wide form with maximum width in the lower part of the blade; variant with free socket shorter than half the total length	spearhead with stepped leaf, flame-shaped variant	spearhead with a smooth socket and a profiled leaf, flame-shaped, large variant	spearhead with curved leaf, variant 2 (leaf with stepped profile)	group B (with profiled leaf), spearhead with strongly curved leaf, variant b1 or b2 (with stepped profilation of the leaf and semi-circular or pointed cross-section of the midrib)
Piešťany	type IIIb; flame-shaped spearhead with flame-like profilation	socketed spearhead, belonging to group with profiled leaf and smooth socket, main form (Grundform) C (flame-shaped), medium-wide form with maximum width in the lower part of the blade; variant with free socket shorter than half the total length	spearhead with stepped leaf, flame-shaped variant	spearhead with a smooth socket and a profiled leaf, flame-shaped, large variant	spearhead with curved leaf, variant 2 (leaf with stepped profile)	group B (with profiled leaf), spearhead with strongly curved leaf, variant b1 or b2 (with stepped profilation of the leaf and semi-circular or pointed cross-section of the midrib)
Šintava	similar to type Ib; broad spearhead with rounded leaf and profiled socket	socketed spearhead, belonging to group with smooth leaf and profiled socket, main form (Grundform) B (rounded leaf), medium-wide form with maximum width in the lower part of the blade, variant with free socket shorter than half the total length	spearhead with ribbed socket (or socket extension, Tüllenverlängerung)	spearhead with profiled socket and a smooth leaf, almond/laurel shaped leaf, large variant	spearhead with profiled socket (mit profilierter Blatttülle)	group C (with profiled midrib, with two lateral ribs extending below the blade base), variant e (trapezoidal cross-section of the midrib, with three ribs and gaps between them)

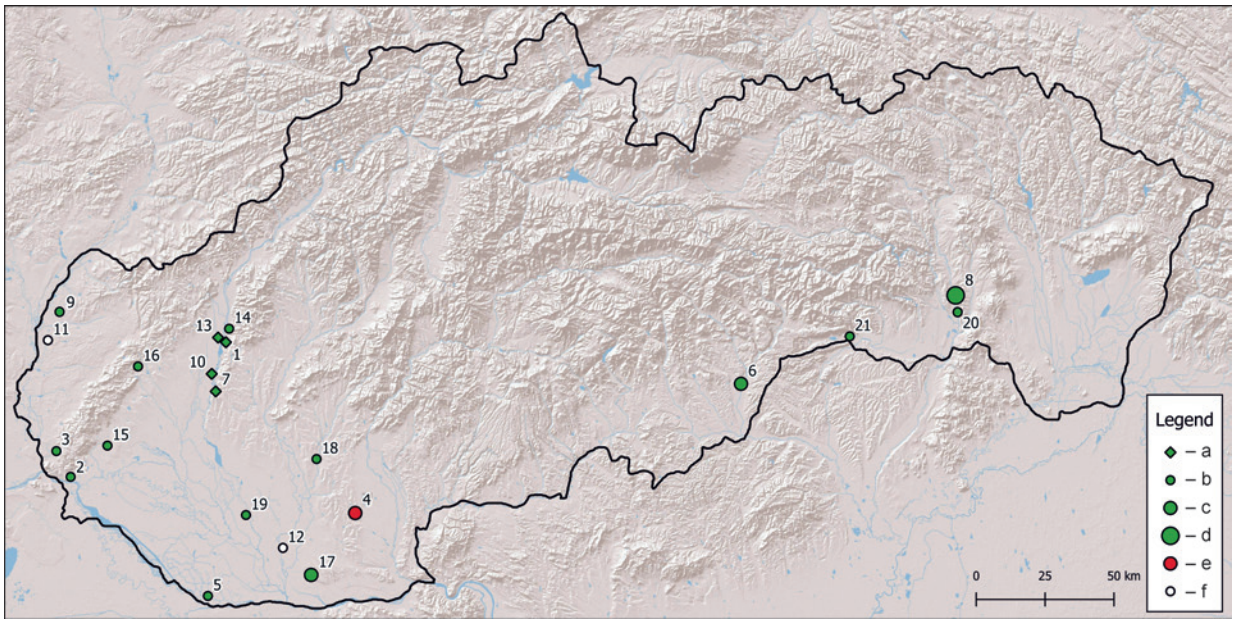


Fig. 1. Map of analogies for spearheads with strongly curved blade and step-like profilation on the leaf. 1 – Banka; 2 – Bratislava; 3 – Bratislava-Záhorská Bystrica; 4 – Čaka; 5 – Čičov; 6 – Gemer; 7 – Hlohovec I; 8 – Košické Olšany; 9 – Kúty; 10 – Madunice; 11 – Moravský Svätý Ján; 12 – Nesvady; 13 – Piešťany; 14 – Piešťany (Ducové); 15 – Slovenský Grob; 16 – Smolenice; 17 – Svätý Peter; 18 – Vajka (Lúčnica nad Žitavou); 19 – Vlčany; 20 – Vyšná Hutka; 21 – Zádiel. Legend: a – the spearheads discussed in this article; b – finds of spearheads from Bader's Group B, variant 6 (one specimen); c – finds of spearheads from Bader's Group B, variant 6 (two specimens); d – finds of spearheads from Bader's Group B, variant 6 (three specimens); e – finds of spearheads from Bader's Group B, variant 7 (two specimens); f – possible finds of spearheads with strongly curved blade and step-like profilation on the leaf. Author J. Wójcik.

Spearheads with profiled leaf and strongly curved blades (Banka, Hlohovec I, Madunice, Piešťany)

A characteristic feature of these four spearheads (respectively Pl. I: 1, 2; II: 1; III: 1) is their strongly curved blade shape (sometimes also referred to as flame-like or pear-shaped) and the presence of profiling on the blade in the form of a step, resembling leaf contour. All are of large dimensions – three well-preserved examples exceed 20 cm in length, while the fourth (from Madunice), if complete, would also be longer. In *T. Bader's* typology (*2015*), these spearheads can be classified as belonging to Group B (with a profiled leaf), variant 6 (spearheads with a strongly curved blade). The examples from Banka, Piešťany, Hlohovec, and Madunice fall into subvariant b (featuring step-like profiling on the blade). Within this subvariant, the author distinguishes three possible cross-sections of the midrib: semi-circular (b_1), pointed (originally dachförmig; b_2), and trapezoidal (b_3). The described spearheads correspond most closely to the first two subvariants. Distribution of analogical spearheads in Slovakia is presented in Fig. 1.

Among Slovak finds, T. Bader classifies as in this type the single finds from Vajka (now part of Lúčnica nad Žitavou; *Veliačik 1975*, 112, fig. 98) and Bratislava, as well as two spearheads from a collection of Late Bronze Age artefacts from Dolný Peter (now Svätý Peter), which *J. Paulík* (*1963*, 314, fig. 44) interpreted as part of a grave inventory. However, it is worth noting that one of the spearheads from this site, judging from the drawing, does not have a stepped profiling on the blade (*Novotná 2007*, fig. 2).

This group also includes a specimen from the Zádiel hoard, which exhibits identical typological features – strongly curved blade outline, step-like profiling on the leaf, and large dimensions – but differs in its trumpet-shaped socket ending. This hoard is dated to the Late Bronze Age (BrD–HaA; *Gašaj 1994*, 29). Three of the five spearheads from the Košické Olšany hoard belong to this type. The fourth spearhead, although also featuring a strongly curved blade, appears to lack step-like profiling; additionally, unlike the others, it has a profiled socket, as inferred from the published photographs. *E. Miroššayová* (*1998/1999*, 127, 128, fig. 2; 11; *1999*, 142, 143) dated the hoard to the older Urnfield Period, corresponding to phases BrD–HaA1 in P. Reinecke's chronology. A somewhat similar spearhead appears in the Vyšná Hutka hoard, though it has a much slimmer, narrower, and thinner blade with a more angular lower section.

This hoard was classified by M. Novotná within the Oždany horizon, dating to the transition between phases BrC2 and BrD (*Novotná 1959*, 1, fig. 3: 5; *1970*, 30, 31, 34).

A spearhead in this style was likely discovered in Vlčany (Farkasd), described by J. Hampel as being found at a settlement alongside other Bronze Age artefacts during river regulation work on the Váh (*Hampel 1892*, pl. CXXXI). Other, single finds include specimens from Kúty (*Pichlerová 1957*, 65, 66, pl. I: 3), Smolenice (Molpír site; *Ölvecky 2010*, 43), and Bratislava-Záhorská Bystrica (*Novotná 1987*, 79, 136, fig. 35), as well as a fragment from Slovenský Grob (*Bartík 2011*, 45, 46). Two additional spearheads, possibly found in Gemer, display all the aforementioned typological characteristics (*Hampel 1886*, pl. CXV: 4, 5; *Márton 1904*, 444, 445). Additional examples include a spearhead from Číčov (*Barta/Willvonseder 1934*, 11, fig. 1: 5) and from surroundings of Piešťany (possibly from the Ducové settlement? *Bača/Krupa 1998*, 85, pl. LXXXVIII: 1488). The group may also include a single find from Moravský Svätý Ján, though it is only schematically illustrated (*Paulík 1972*, 13, pl. IX: 9), as well as a spearhead from Nesvady, now lost, which was possibly part of a richly furnished grave (containing gold artefacts) and is very schematically represented in a find report (*Szőke 1953*).

Two specimens come from unknown locations: one, damaged, is housed in the Balneological Museum in Piešťany (*Bača/Krupa 1998*, 57, pl. XXXVII: 328), while the other, well-preserved but unpublished, is in the Slovak National Museum in Martin.

A related variant in Bader's typology, described as spearheads with a slightly flame-shaped blade, includes the specimen from grave II at Čaka, which also exhibits step-like profiling on the leaf. The second, smaller spearhead from the same grave likely belongs to this type as well, although it is heavily damaged. Grave II from Čaka is dated to phases BrD and HaA. (*Točík/Paulík 1960*, 74, 75, 93).

For some Slovak spearheads, an exact typological or chronological classification was not possible. This applies particularly to the spearhead found in the barrow in Očkov. It exhibits step-like profiling on the blade, but the fragment is too small to determine the overall shape of the leaf (*Paulík 1962*, fig. 27: 2). Additionally, *G. Jacob-Friesen* (*1967*, 371, tab. 112: 1) locates a flame-shaped spearhead with a profiled blade in Sása (originally recorded in the R. G. Z. M. catalogue as "Szaska, Northern Hungary").

To summarize, well-dated Slovak specimens mainly appear in the early and older phases of the Urnfield Period, in BrD and HaA (*Novotná 2007*, 162). If we consider the somewhat different specimen from Vyšná Hutka, then the transition between phases BrC (C2) and D should also be taken into account as the earliest occurrence of the type. Taking into account the dating of analogies from other regions, the overall chronological range can be estimated to cover phases BrB1–HaB1, with the highest number of finds in BrD and HaA1, as discussed below.

This spearhead type extends across a broad area, with the most numerous examples found in Hungary, Slovakia, Romania, Croatia, and Serbia. To a lesser extent, they also appear in Austria, Bohemia, Switzerland, and northern Germany (*Říhovský 1996*, 80). Their northernmost occurrence is a find from the grave in southern Sweden (Köpinge, Skåne), dated to Bronze Age Period II or III (*Gedl 2009*, 67; *Jacob-Friesen 1967*, 223; *Tarot 2000*, 12). In Poland, they are rare and mark the north-eastern boundary of their distribution, with find from Pomerania (Suchostrzygi, now part of Tczew), and are dated to the Periods III and IV of the Bronze Age (*Gedl 2009*, 66, 67). Only a few examples have been found in Switzerland, reaching its western part (Cheseaux-sur-Lausanne, canton Vaud) and they are dated to BrD and HaA phases. A typologically similar spearhead, particularly in blade form and profiling, was found in St. Jean de Maurienne, south-eastern France, though it is very small, only 8 cm long (*Tarot 2000*, 11, 55). This spearhead variant is also found in north-eastern Italy, specifically in Alto Adige/Südtirol and Friuli-Venezia Giulia, where is dated to the Recent Bronze Age in Italian chronological system (*Bruno 2012*, 117, 118, 122). To the south, they appear in the northern Balkans, in Croatia, Serbia, Romania, and Bosnia and Herzegovina, mainly in the regions of Banat, Syrmia, Bačka, Mačva, eastern Serbia, and Transylvania. The North Balkan specimens are dated from the BrD to HaB1 periods. (*Bader 2015*, 382–384; *König 2004*, 31; *Vasić 2015*, 59, 60). To the east, they are distributed in Transcarpathia, examples of variants b_1 and b_2 appear within the hoards assigned to Lazy I, Kriva, and Suskovo series (BrD–HaA2; *Bader 2015*, 383, 384; *Kobaľ 2000*, 33–35).

The earliest known example of this spearhead type comes from the Úzd hoard (modern Sárszentlőrinc), which belongs to the Koszider hoard horizon (variously dated; BrB1–B2/C1 or BrB2). Notably, no examples of this type have been recorded in Hungary during the subsequent Forró phase, and they reappear, in a relatively small number, in the Ópályi hoard horizon (BrC2/D). They continue to be relatively scarce in the Aranyos horizon (BrD–BrD/HaA1), however, the Kurd phase (HaA1) brings the largest number of finds (*Bader 2015*, 383; *Mozsolics 1967*, 174).

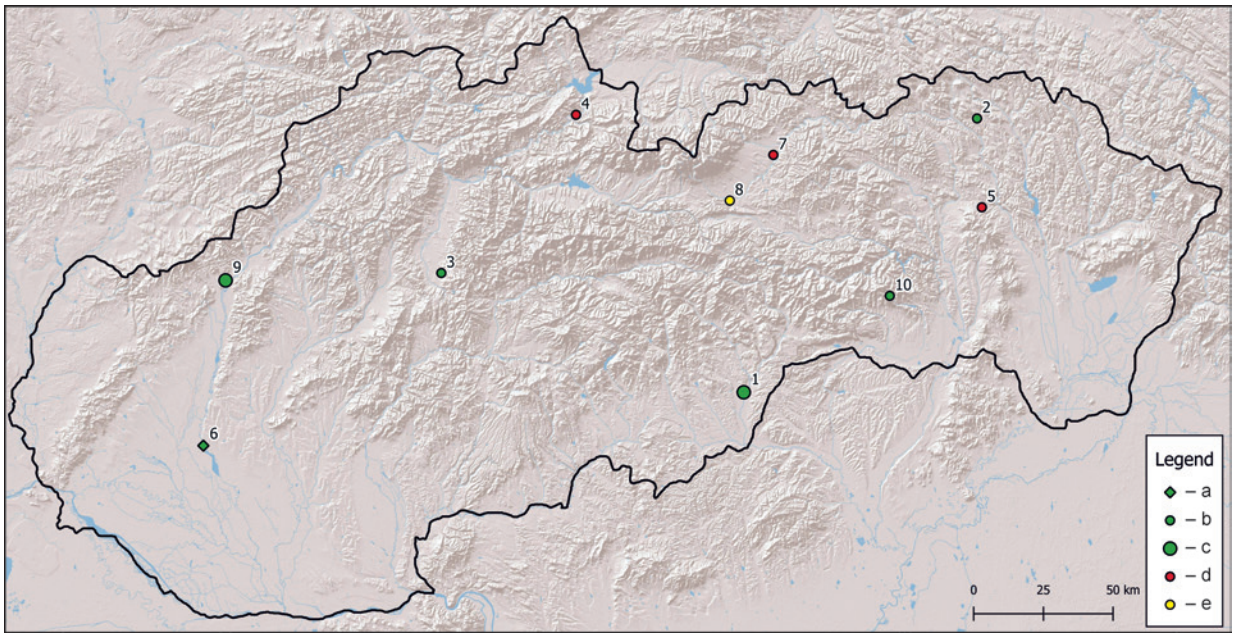


Fig. 2. Map of analogies for spearhead from Šintava. 1 – Gemer; 2 – Hažlín; 3 – Horná Štubňa; 4 – Nižná; 5 – Pavlovce; 6 – Šintava; 7 – Spišská Belá; 8 – Spišská Teplica; 9 – Trenčianske Bohuslavice; 10 – Zlatá Idka. Legend: a – spearhead from Šintava; b – finds of spearheads from Bader's Group C, variant e (one specimen); c – finds of spearheads from Bader's Group C, variant e (two specimens); d – finds of spearheads from Bader's Group C, variant d (one specimen); e – finds of spearheads from Bader's Group C, variant f (one specimen). Author J. Wójcik.

In the case of Bohemia, the oldest find of this type comes from the Varvažov hoard, which *O. Kytlicová* (*2007*, 108, 109) assigns to the Plzeň-Jíkalka horizon (BrC2–BrD). These spearheads appear primarily in the Lažany (end of BrD) and the Suchdol (HaA1) phases, with the latest example occurring in the Jenišovice phase (HaA2–HaB1). In Moravia, the earliest finds are slightly later than the oldest ones from Bohemia and they are dated to Blučina phase (BrD). They also appear in two subsequent horizons, Drslavice and Přestavlky. The majority of them occur in the early and continue into the older Urnfield Period (BrD–HaA; *Říhovský 1996*, 79, 80). Spearheads with a strongly curved blade and step-like profilation are the most numerous spearheads type in Moravian hoards during the Late Bronze Age (*Salaš 2005*, 71).

Austrian specimens from Waldviertel are dated by *M. Lochner* (*1991*, 208, 211, 215) to the older Urnfield Period.

Spear/javelin head with profiled socket/midrib, with three ribs and gaps between them (Šintava)

The specimen from Šintava (Pl. III: 2) can be generally classified as a spear/javelin head with a smooth blade and a profiled socket. In Bader's typology, it falls under Group C (with a profiled midrib, with two lateral ribs extending below the blade base), specifically variant e (trapezoidal cross-section of the midrib, with three ribs and gaps between them). Distribution of analogical spearheads in Slovakia is presented in Fig. 2.

Among Slovak finds, T. Bader classifies two smaller spearheads from the Trenčianske Bohuslavice hoard within this variant, one of which has a more heart-shaped blade. This hoard is dated to HaA2 (*Novotná 1970*, 120, 121, pl. XII; *Veliačik 1983*, 247, pl. XL: 2, 5). He also includes two spearheads from the probable Gemer V hoard, actually a collection of bronze objects acquired by the Gemersko-malohontské múzeum in Rimavská Sobota in 1927, dated to the Ópályi horizon, BrC (C2)/D (*Mozsolics 1973*, 174) or to HaA (*Furmánek 1977*, 270, 272, pl. XX: 7, 8; *Paulík 1965*, 57, pl. V). At least one such spearhead was found in the hoard from Hažlín, an assemblage of bronze artefacts, part of which was purchased by the Regional Museum in Prešov in 1953 and the other part by the Bardejov Museum in 1956. This hoard is dated to

phase HaB, as noted by V. Budinský-Krička, specifically to its older phase, which allows it to be classified in HaB1 (*Budinský-Krička 1967*, 82, pl. II: 10; *Novotná 1970*, 95, 96).

The Horná Štubňa hoard also contained a spearhead classified by T. Bader in this group, though it differs significantly from the others, featuring an exceptionally broad blade and distinct contouring of the lateral ribs near the blade base. The second spearhead from the same hoard exhibits a different, rhomboidal blade shape and unique, wide ribs flanking the midrib. L. Veliačik dates the hoard from Horná Štubňa to BrD, or possibly to the beginning of HaA1 (*Eisner 1937*, 101, 102; *Novotná 1970*, 96; *Veliačik 1983*, 44, tab. 35: 6).

A spearhead of this type was found in the hoard from Zlatá Idka (*Novotná 1970*, 124; *Spöttl 1886*, 59).[2]

Similar examples, with three ribs on the socket, though less distinctly separated (variant d in T. Bader's typology; *Bader 2015*, 385, 386), also occur in Slovakia, including one in the Nižná hoard, assigned to phase HaA1 (*Novotná 1970*, 108; *Veliačik 1983*, 44, tab. 37: 8), another one in the Spišská Belá hoard, dated to HaA2 (*Novotná 1970*, 117) and a single find from Pavlovce (*Jenčová 1993*, 67, 157, fig. 28; *Tarbay 2015*, 334). The single find from Spišská Teplica represents T. Bader's variant f, also characterized by three ribs, with the lateral ones doubled under the base of the blade (*Soják 1998*, 155, 282, fig. 110: 6).

In summary, the appearance of this type in Slovakia is most likely dated from phase BrD, with the chronology of the oldest examples depending on the varying datings of the Gemer V hoard, while its presence is attested until phase HaB1. Considering finds from other regions, this variant exhibits a broad chronological range, spanning from phase BrD to HaB3, as will be discussed in the following paragraphs (*Bader 2015*, 386).

J. G. Tarbay (*2015*, 313, 314) devotes significant attention to this type of spearhead in his study on the reanalysis of the hoard from Gyermely, where he proposes a revised dating of the mentioned hoard to HaB1 while also noting the difficulties in distinguishing phase HaA2 in the Carpathian Basin. This hoard contained two similar spearheads, which can be classified in T. Bader's typology as variants d and e. A nearly identical specimen to the one from Šintava is the spearhead catalogued as No. 5, though it should be noted that its socket is broken. The author delineates the distribution range of analogous spearheads, extending west to Saxony (Zerbst), north to Greater Poland (a single find), east to western Moldavia (Ilişeni) in Romania, and south to Varna region in Bulgaria (Bozveliysko; *Tarbay 2015*, 314, 333, liste 1).

The largest number of finds of this variant comes from the area of present-day Hungary, with most discovered in hoards. The earliest Hungarian finds of variant e are dated to the Aranyos horizon (BrD/HaA1). They subsequently appear in the Kurd, Gyermely, and Hajdúböszörmény horizons (HaA1–B1), with the highest concentration in the Kurd phase. In the case of the few Croatian contexts containing this variant, they are classified within phases HaA1 and HaB1. Hoard finds from Serbia are chronologically classified into Stage II of the Urnfield period. In the case of Transylvanian finds, the majority originate from hoards associated with the Cincu-Suseni horizon (HaA1), with fewer occurrences in the subsequent Jupalnic-Turia stage (HaA2). The latest examples still appear in the hoard from Ghirişu Român, belonging to the Şomartin-Vetiş phase, dated to HaB3. Among Polish finds, the most typologically similar examples include single finds from Nowy Sącz-Biegonice and Greater Poland, as well as a grave find from Sobótka, and are dated to Bronze Age Period IV. In the Carpathian Ukraine, J. Kobaľ assigned the hoard find from Boržavskoe to the Lazy I phase, corresponding to HaA1 (*Bader 2015*, 386; *Gedl 2009*, 70; *Kobaľ 2000*, 76). In the case of Moravian finds, the spear/javelin head from Šintava strongly resembles one of the spearheads from the Drslavice I hoard, dated to the "older phase of the Older Urnfield Period" (approximately BrD). However, as *J. Říhovský* (*1996*, 65) points out, the profilation on the socket of this spearhead is only reconstructed based on inventory documentation.

Unprofiled javelin head with triangular/rhombic blade (Hlohovec II)

In the case of the javelin head Hlohovec II (Pl. II: 2), a distinctive triangular blade shape is evident. The object does not feature any profiling, either on the socket or the blade. The classification of this specimen presents certain challenges, as such blade shape is extremely rare among Slovak examples from the Bronze Age. Entire javelin head is covered by a thick layer of patina, which prevents detailed documentation of any potential traces that might indicate whether the blade's shape was remodelled. Additionally,

[2] The authors would like to thank Mag. Dr. G. Tiefengraber for providing photographs of this spearhead, stored at the NHM Wien, which facilitated its typological classification.

the socket is damaged, making it impossible to assess its original length. Several factors suggest that the current shape of the javelin head's leaf is unlikely to be a result of corrosion. The preserved symmetry of the blade and the relatively straight edge outline, with only minor corrosion pits on one side, indicate that the blade's shape is intentional rather than a by-product of material degradation.

The total length of this javelin head is nearly 14 cm, despite being incomplete. This makes it longer than the javelin heads classified by J. Říhovský, who defines them as not exceeding 10 cm in length. However, it still fits within the older definition proposed by J. Szombathy, according to which such objects are identified as javelin heads when the blade (excluding the socket) is shorter than 8 cm (*Říhovský 1996*, 88).

In T. Bader's typology, the closest parallels to this object are possibly those classified under Group A (plain, simple spearheads without profilation on the leaf or on the socket), variants with rhombic or triangular blades. However, within the latter, he assigns Slovak finds with significantly broader blades than the example from Hlohovec. Among them, he lists spearheads from the hoards of Lesné and Spišská Belá – the first broadly dated, to the periods HaA and HaB1, while the second belongs to the Trenčianske Bohuslavice hoard horizon, corresponding to P. Reinecke's HaA2 (*Bader 2015*, 377; *Novotná 1970*, 46, 47, 103, 117, pl. XXXVI; *1991*, 23). The closest Slovak analogy in terms of blade shape is a find from Gemer, which *R. Ölvecky* (*2010*, 27) classifies together with the spearhead from Horná Streda – the latter featuring a flame-shaped blade outline – into the subvariant of spearheads with a short, slender blade and an extremely long socket. Both of these artifacts are single finds, specimen from Horná Streda is only broadly dated to the Late Bronze Age (*Novotná 1968*, 40, pl. XII: 1; *Ožďáni 1988*, 104, 165, fig. 30).

Considering finds from neighbouring areas, classification of similar spear or javelin heads varies significantly. The closest parallel in Moravia, in terms of the narrow blade shape, midrib cross-section and lack of profiling, albeit slightly different in the rounded lower part of the blade, is the specimen from Žeranovice. In J. Říhovský's typology, it is classified as a rounded form, medium-wide with maximum width in the lower part of the blade; variant with socket shorter than half of the total length. It is a single find, examples of this variant are dated from BrA2 up to the younger Urnfield period (*Říhovský 1996*, 39–41). In terms of blade shape, the javelin head from Hlohovec II is also close to some javelin heads from Moravia, which are classified in a group with a rounded blade. They are dated to the older Urnfield period (BrD–HaA1); however, the Northern European analogies are assigned to Period V of the Bronze Age, corresponding to phases HaB2–B3 (*Říhovský 1996*, 92–94, cat. no. 227–231). In the case of Polish finds, the closest in terms of the triangular blade shape is the single find from Mielno Pyrzyckie, classified in M. Gedl's typology within the group of medium-sized and small spearheads with laurel leaf-shaped blades. The dating of the entire variant spans from the Middle Bronze Age to the beginning of the Iron Age (*Gedl 2009*, 38–40, cat. no. 70). The blade shape also resembles some specimens of the type classified by G. Jacob-Friesen as Lüneburg Type I, particularly the find from Katzien in in Lower Saxony (*Jacob-Friesen 1967*, cat. no. 1183). However, it should be noted that one of the defining features of this type is a long socket, a characteristic that cannot be determined for the spearhead from Hlohovec. Additionally, the spearhead from Katzien has a damaged blade on one side. This type is dated to Periods III and IV of the Bronze Age, which can be corelated with BrD–HaB1. In R. Vasić's typology (*Vasić 2015*, 39, 41), specimens with an extremely narrow, triangular blade without profiling (*Vasić 2015*, cat. no. 67–71) are classified in the group of willow leaf-shaped spearheads. However, as the author notes, the majority of these analogies have damaged blades. The rather diverse group of willow leaf-shaped spearheads is largely dated to Stage II, corresponding to the period from the end of BrD to the beginning of HaA2 (*Vasić 2015*, 7).

Overall, numerous spearheads described as having a severely damaged blade bear some resemblance to the examined piece (e.g., *Tarot 2000*, 28, cat. no. 283). It is possible that the leaf shape of the spearheads we regard as analogous did not originate from intentional design but rather resulted from damage, repairs made during their use-life, or post-depositional processes. As a result, we do not attempt to define its distribution area or precise dating. It can only be suggested that this spearhead may have been in use from phase BrA2 up to the early Iron Age.

OBSERVATIONS ON USE-WEAR AND MANUFACTURING TRACES

In order to determine the damage and production traces on the spear/javelin heads, photographs were taken using a Levenhuk DTX 90 digital microscope. The terminology applied to describe individual damages is based on articles written by *Gentile/van Gijn 2019* and *Gentile/van Dijk/Ter Mors 2024*, and to a lesser extent by *Hermann et al. 2020*.

All the spearheads described in this article are finished objects with their casting seams removed. The presence of bevels and grinding striations was found only on the spearhead from Banka.

Mechanical damage was observed on all spearheads, varying in intensity. Combination of locations of observed wear marks along the edges and sockets from spearheads from Banka, Hlohovec I and Piešťany, is presented on Fig. 3. In the literature, the distinction between damage from the Bronze Age and damage of post-recovery character is generally made based on whether or not it is covered by a patina layer corresponding to the patina on the rest of the artifact (*Knight 2021*, 50, 59). However, when examining the patina in detail, it can be seen that only spearhead from Banka and javelin head from Hlohovec II displays a well-developed patina, forming a thick layer covering most of the artifact. On this second spearhead, the patina layer is so thick that it may obscure any potential manufacturing and use-wear traces, a phenomenon also noted on other bronze artifacts (*Sych et al. 2020*, 10–12). In the case of the spearhead from Piešťany, it is only partially covered with a dark grey to black patina, which may be associated with its deposition in a watery environment. The absence of patina on part of this spearhead may be due to the abrasive action of debris carried by the river current, which aligns with similar observations on a sword discovered in Horné Zelenice, also recovered from the Váh River (*Bartík 1997*, 419). The spearhead from Hlohovec I is only partially covered by a nearly black, thin patina layer. Regarding the spear/javelin head from Šintava, it is confirmed that its finder removed the patina. The original, dark green layer remains to some extent on the socket, and on its entire surface there are signs of "bronze disease" in the form of light green spots. Additionally, as radiocarbon dating shows, it was reused in the 16th–17th c., and in the authors' view, it is impossible to distinguish damage that might have occurred in that period from marks dating to the Bronze Age. The spearhead from Madunice is heavily corroded; in many places, an orange-light brown colour of the bronze is visible. A slightly thicker patina layer, dark grey to black in colour, occurs only on the socket.

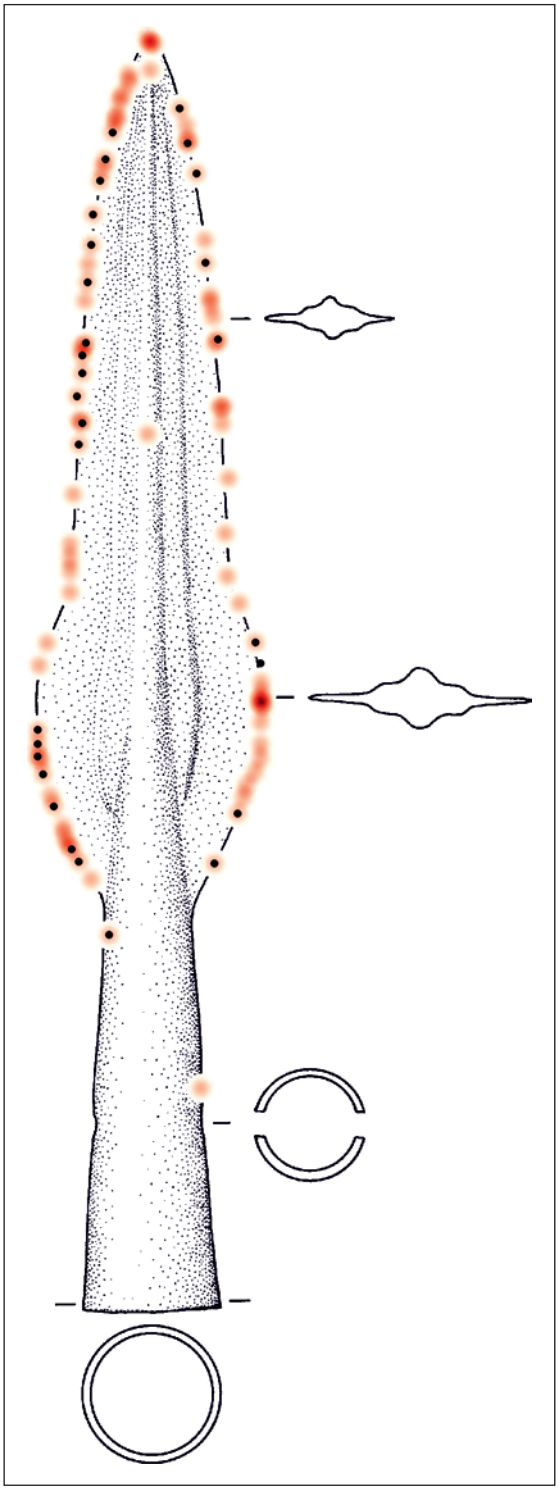


Fig. 3. Location of damage on three spearheads with strongly curved blade (Banka, Hlohovec I, and Piešťany) – more intense red colour indicates a higher frequency of damage in a given section of the spearhead; black dots indicate damage beneath the patina observed on the spearhead from Banka.

Moving on to the observed damage, it is undoubtedly the spearhead from Banka that exhibits by far the most instances. The entire spearhead is slightly bent along its axis (Pl. IV: 3). The tip is broken, and although the fracture surface is devoid of patina, its rounded edges make it appear not to be a recent break (Pl. IV: 6). Practically the entire cutting edge is covered with damage in the form of symmetrical and asymmetrical dents; in some places, flattening also occurs (Pl. IV: 4). None of these dents show a burr (displaced metal around the damage marks). It should be noted, however, that the patina is absent in

certain edge sections; yet in some of these areas, patina remains inside the dents, these are interpreted as Bronze Age damage (Pl. IV: 1, 2).

Slightly before the blade begins to flare at the lower portion, V-shaped notches can be seen (two on each side of the spearhead). The patina layer around them is disrupted, suggesting a modern origin. On one side of the spearhead near these notches, there are irregular damage marks resembling asymmetrical dents, but with heavily "chipped" interiors and sharply outlined edges. They do not match experimental analogies and are unpatinated. Numerous symmetrical and asymmetrical dents, in one case with a trail, appear on the lower, widened part of the blade. Some are covered by patina; others show breaks in the patina layer (Pl. IV: 5, 7).

It appears that a part of the blade was modified in modern times. A small section shows partial grinding of the edge, free of patina and forming a secondary, narrow bevel. The original Bronze Age bevel is mainly visible near the blade base and on one side of the blade's middle portion; elsewhere, it was destroyed by damage and probable edge repairs. Much of the blade edge is uneven, exhibiting a "wavy edge" characteristic, interpreted as evidence of repairs (*Horn/von Holstein 2017,* 93).

A rather distinctive damage is found on the socket, about 0.5 cm below the blade base: a deep, oval depression with straight scratches oriented perpendicular to its outline, entirely covered in patina. This suggests contact with a metal object having a relatively oval central cross-section and thin edges – possibly the tip of another spearhead (Pl. IV: 8). The entire flat surface of the spearhead shows multiple scratches beneath the patina, parallel or oblique to the axis of symmetry.

A set of scratches appears on the socket, likely a decorative feature, consisting of oblique lines, chevrons and multiple arcs. They run along a narrow band of about 0.5 cm in width, starting just below the blade, following the socket. These scratches are intersected by a blow mark that is entirely covered by patina. Additionally, modern traces were identified on the socket, including blow marks perpendicular to the axis of symmetry of the spearhead that clearly cut through the patina, as well as the inscription Talalt 1903 incised in the patina.

In the case of the spearhead from Hlohovec I, it is visibly bent, forming an S-shaped profile (Pl. V: 3). The midrib is cracked in the central part of the blade, revealing a dark grey patina inside the fracture (Pl. V: 7). Although the edge damage is not as extensive as on the spearhead from Banka, it similarly occurs not only around the tip but also on the lower sections of the blade.

Near the tip, there is a notable concentration of damage in the form of U-shaped vertical notch and two symmetrical dents on one side, covered by patina (Pl. V: 1, 2). On the other side, slightly lower than these notches, a single bowing dent was observed. In the middle part of the blade, on the same side as the bowing dent, there is a cluster of various damage types – bowing, bowing dent, and symmetrical notch – all unpatinated (Pl. V: 5, 6). Below them is a very large, nearly 2 cm wide bowing, with displaced material curled outward and showing cracks along its edges. The dark patina does not cover this damage; a clear boundary separates the patinated area below it from the unpatinated surface around it. Both this feature and the sharply defined edges of the damage suggest a modern origin (Pl. V: 10, 11). On the opposite side of the blade's midpoint, a U-shaped vertical notch was recorded, accompanied by a micronotch nearby (Pl. V: 4). Pronounced damage also appears at the blade's lower widening, in the form of U-shaped vertical notches, micronotches, and symmetrical and asymmetrical dents on both sides (Pl. V: 8, 9). Some of these are covered by patina, and show signs of corrosion. Small symmetrical dents were additionally noted on the socket rim, not covered by patina.

The third spearhead with a strongly curved blade – the specimen from Piešťany – displays significantly fewer documented marks. There is visible slight blunting of the tip, which is also bent and cracked about 2 mm from its end (Pl. VI: 2). Nearly all other damages on the spearhead cluster within the first quarter of its length, measured from the tip. On one side, there is a rather distinctive damage that appears to be a combination of an experimentally observed asymmetrical dent and a U-shaped vertical notch, along with an oblique trail. Grey patina is visible inside this trail (Pl. VI: 5, 6). On the same side, a single symmetrical dent was noted (Pl. VI: 3). On the opposite side, several symmetrical dents and a micronotch were recorded (Pl. VI: 4). In the widened section at the lower part of the blade, a linear, straight crack begins at the edge and extends toward the midrib, perpendicular to the axis of symmetry (Pl. VI: 7). A round depression was also found on the socket, close to one of the peg holes, and it is free of patina (Pl. VI: 1). The midrib exhibits pronounced flattening and grinding on one side, which we consider modern (Pl. VI: 8).

In the case of the last spearhead with a strongly curved blade, found in Madunice, its surface has been severely damaged by corrosion, making a precise assessment of the damage problematic. The tip

is asymmetric (Pl. VII: 1). Slightly below the tip, a group of three symmetrical dents was observed on one side (Pl. VII: 3). Further along, before the blade begins to flare, two very conspicuous damage marks lie close together, each nearly 0.5 cm wide. These resemble experimentally produced dents, but they are considerably wider and deeper (Pl. VII: 4) Additionally, there are two marks resembling bowing dents close together, at this spot the edge is clearly displaced to the side (Pl. VII: 5, 6). Two marks close to each other at the widened, lower part of the blade – a symmetrical dent and a U-shaped notch (Pl. VII: 8). Other recorded damages appear likely to result from corrosion, judging by their irregular form.

The spearhead's socket was broken above the rivet holes, and the entire fracture is coated with a relatively thick layer of dark grey/black patina, suggesting this break dates back to the Bronze Age (Pl. VII: 2). In the lower part of the blade, three through-holes approximately 1.5 mm in diameter were noted, displaying a visible drilling burr along its edges (Pl. VII: 7). Although experiments confirm that copper and bronze objects (with 4% tin content) can be drilled using a bow-drill and flint bits (*Bell 2016*, 21–25), indications that the drill bit was fluted suggest the use of a modern drill.

The spear/javelin head from Šintava shows very pronounced damage on one side – almost half of the blade is broken off, and the socket is crushed and markedly bent near the base of the blade. No hammering marks were noted in the damaged area, so we assume it resulted from a single application of significant force to the side of the spearhead, most likely when it was run over by agricultural machinery (Pl. VIII: 5, 6).

Older damage associated with the spearhead's use is minimal. Slightly below the tip, there is a small flattening, and the tip itself is slightly blunted (Pl. VIII: 1). On the side opposite the major break, just below the tip, there is an asymmetrical dent with a burr (Pl. VIII: 2). Symmetrical dents and micronotches occur on the same side in three places: at about one quarter of the blade's length from the tip, around its widest point, and near the blade base (Pl. VIII: 3). A round depression was found on the socket, slightly above the rim, covered with patina.

A piece of wood was discovered inside the socket, and a sample was taken for radiocarbon analysis (Pl VIII: 4). The results showed that the spearhead was reused in the Early Modern period. Since the observed crushing of the socket would have made it impossible to mount the spearhead on a shaft, this damage must be more recent than the 16th–17th c., fitting our initial interpretation that it does not date to the Bronze Age. Regarding the remaining damage, it is impossible to determine whether it occurred during the Bronze Age or during its secondary use in the Early Modern period. The patina was partially removed, and even if we had identified damage beneath the patina, the 400–500 years it spent in the ground would have been sufficient for it to become re-patinated.

The javelin head from Hlohovec II is covered by a very thick layer of patina, which significantly affects how its damage is identified. The tip appears to be blunted, and just below it there are fairly shallow symmetrical and asymmetrical dents (Pl. VIII: 8). A cluster of what are likely asymmetrical dents occurs about halfway along the blade on one side (Pl. VIII: 7).

This javelin head's socket was broken; the fracture line is concave, and the socket is slightly flattened. In one spot, a triangular piece of metal is missing, with an additional crack running toward the blade (Pl. VIII: 9). The entire fracture surface is covered by a thick patina layer, indicating that this break dates to the Bronze Age.

All of the examined spear and javelin heads show signs of use. In the case of those from Banka, Madunice, and Hlohovec II, some of the damage can be interpreted as dating to the Bronze Age, given that it is covered by a substantial patina layer. When analysing the types of damage in detail, symmetrical and asymmetrical dents are the most frequently observed features on every examined piece. Together with notches, they also were noted in some studies as most frequent. For instance, a study of Early Bronze Age spearheads from Sweden (a sample of 63 specimens) revealed that such damage appeared on 61% of the investigated items (*Horn 2015*, 204). Dents together with flattening traces predominated also in one of the experimental studies (*Gentile/van Dijk/Ter Mors 2024*, 10, 11), in the other blow marks were the most common (*Hermann et al. 2020*, 93, 94).

All the analysed spearheads exhibited damage in the tip area. In one case, the tip is completely broken (the spearhead from Banka, though the fracture is not covered by patina), and in another, it is significantly cracked (Piešťany). Studies on Bronze Age spearheads show considerable variation in this respect. In the previously mentioned research on Swedish spearheads, a broken tip was identified in as many as 41% of cases (*Horn 2015*, 204). By contrast, in a study of northern British spearheads, mechanical tip damage connected to use was noted in only 3% of cases (the sample included 89 spearheads; *Anderson 2011*, 599, 600).

In experimental studies (*Hermann et al. 2020*, 89–92), breaking of the tip was not achieved despite subjecting spearheads to challenging tests – strikes against wooden and bronze shields. However, from the Bronze Age, there are examples of human bones with a broken spear tip embedded in them, such as at Tormarton (*Knight et al. 1972*, 15), indicating that a broken tip need not necessarily result from the intentional destruction of a weapon but could also occur in combat. The tip pressure noted by Horn in 30% of cases (and, importantly, impossible to identify on many of the broken-tip spearheads in that study) was observed in our sample on the spear/javelin head from Šintava and spearhead from Piešťany. In experimental trials, tip bending and tip pressure occurred after thrusts against bronze and wooden shields and strikes against another spear's shaft (*Gentile/van Dijk/Ter Mors 2024*, 8; *Hermann et al. 2020*, 90, 91, 94).

On three spearheads with strongly curved blades – those from Banka, Hlohovec I, and Madunice – the edge is clearly damaged in the lower, widened section of the blade. Moreover, on the spearhead from Banka, some of these damages are covered by patina, and they occur near the blade base, below the blade's widest point. This suggests that the mentioned spearhead was likely used for more than thrusting attacks, indicating a more complex mode of use, employing also the lower section of the spearhead's blade. According to *K. Anderson* (*2011*, 599) and *C. Horn* (*2014*, 104; *2015*, 210), Bronze Age spearheads were mounted on a short shaft and used in combat for both cutting and thrusting attacks, in a manner similar to swords. However, experiments conducted by *K. Anderson* (*2011*, 603) showed that to strike effectively with the blade's lateral edges, a slashing motion is needed. Cutting did not inflict particularly pronounced injuries on the test animal carcasses, and it frequently caused the short shaft to break. Additionally, as *P. Schauer* (*1979*, 74) and *M. Salaš* (*2016*, 218) suggest, some of the spearheads – particularly those with a distinct ricasso – may have been used in a manner similar to later polearms, mounted on a long shaft, held with both hands, and used for both thrusting and cutting/slashing.

On the other hand, the spearhead from Piešťany presents an entirely different case. First, it has no bevels, indicating that its edge was not sufficiently sharpened for slashing attacks. Second, most of its damage is concentrated near the tip, suggesting that thrusting attacks – if these damages date to the Bronze Age – were more prevalent.

Marks similar to round depressions, visible on the sockets of the spear/javelin head from Šintava, and spearheads from Banka, and Piešťany were produced in experiments simulating violent collisions against an opponent's socket or shaft (*Gentile/van Dijk/Ter Mors 2024*, 8). However, interpreting these marks is quite problematic. In the first specimen, the damage is located beneath the patina, but in the case of this spearhead, patina may not be a reliable indicator for dating the damage, as was mentioned before. In the second specimen, the damage exhibits a rather unique form: it appears deeper than that shown in Gentile et al.'s work (*Gentile/van Dijk/Ter Mors 2024*, fig. 8: D) and features additional scratches along its edges. The damage on the third specimen, on the other hand, is not covered by patina, so we cannot attribute it with certainty to the Bronze Age usage.

X-RAY FLUORESCENCE ANALYSIS OF BRONZE SPEAR/JAVELIN HEADS

The chemical composition of the discussed spear/javelin heads' alloys was examined using X-ray fluorescence analysis (XRF). It is a non-destructive method based on measuring the characteristic X-ray radiation induced by irradiating the object under examination.

Its main advantages are that it is fast, accurate, repeatable, does not require sample preparation and does not damage the analysed object. Entire item can be examined, making it suitable for analysing the composition of historical artefacts, which can aid in their dating, determining their origin, and verifying their authenticity. XRF is primarily suitable for analysing major elements and, in some cases, certain trace elements. It is a relative analytical method, as the measured quantity must be related to the sample composition through calculations or comparisons with standards. The actual measurement is performed on the surface of the examined object, where the spectrometer determines the concentration values (Wt % – weight percentages) of specific elements.

The analyses of the spear/javelin heads were performed using a handheld XRF spectrometer, DELTA CLASSIC+ by Olympus, USA. This device is designed for non-destructive quantitative analyses of archaeological artefacts, precious metals, and their alloys. The analyser determines the percentage content of up to 29 elements (Au, Pd, Ag, Pt, Ir, Rh, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Zr, Nb, Mo, Hf, W, Re, Pb, Sn, Bi, and Sb) without leaving any traces on the examined objects.

Tab. 3. Results of XRF analysis.

Object	Cu	Sn	Ni	Ag	As	Sb	Pb	Fe	Zn	Bi
Banka – 1a	90.04	8.45	0.44	ND	0.5	0	ND	ND	0.58	ND
Banka – 1b	88.07	10.24	0.42	ND	0.66	0	ND	ND	0.61	ND
Banka – 1c	62.68	33.99	0.69	ND	1.97	0	ND	ND	0.67	ND
Banka – 2a	87.2	10.25	0.39	ND	0.82	0.81	ND	ND	0.53	ND
Banka – 2b	87.1	11.07	0.43	ND	0.91	0	ND	ND	0.5	ND
Banka – 2c	69.08	27.73	0.48	ND	2.15	0	ND	ND	0.55	ND
Hlohovec I – 1a	88.56	9.43	0.54	ND	0.47	ND	0.25	0.23	0.52	ND
Hlohovec I – 1b	88.45	9.6	0.51	ND	0.49	ND	0.23	0.23	0.49	ND
Hlohovec I – 1c	80.89	13.61	0.36	ND	0.62	ND	0.41	3.58	0.53	ND
Hlohovec I – 2a	88.1	9.68	0.52	ND	0.51	ND	0.25	0.46	0.49	ND
Hlohovec I – 2b	88.2	9.6	0.53	ND	0.52	ND	0.28	0.36	0.51	ND
Hlohovec I – 2c	85.92	11.06	0.44	ND	0.61	ND	0.36	1.05	0.56	ND
Hlohovec II – 1a	70.81	12.32	ND	5.09	6.39	2.1	ND	1.58	0.7	1
Hlohovec II – 1b	71.59	12.34	ND	5.05	6.73	2.12	ND	0.3	0.55	1.32
Hlohovec II – 1c	70.33	10.93	ND	5.46	1.35	2.31	ND	9.62	0	0
Hlohovec II – 2a	76.57	9.51	ND	4.41	6.19	1.59	ND	0	0.61	1.11
Hlohovec II – 2b	75.23	10.25	ND	4.59	6.59	1.68	ND	0	0.61	1.05
Hlohovec II – 2c	71.29	12.28	ND	5.46	6.04	2.08	ND	1.29	0.6	0.96
Madunice – 1a	90.46	7.95	0.4	ND	0.35	ND	0.28	ND	0.57	ND
Madunice – 1b	89.62	8.73	0.43	ND	0.31	ND	0.4	ND	0.52	ND
Madunice – 1c	88.85	9.33	0.43	ND	0.39	ND	0.28	ND	0.72	ND
Madunice – 2a	88.73	9.6	0.34	ND	0.42	ND	0.43	ND	0.48	ND
Madunice – 2b	89.41	8.9	0.33	ND	0.41	ND	0.51	ND	0.43	ND
Madunice – 2c	90.6	7.54	0.41	ND	0.41	ND	0.47	ND	0.57	ND
Piešťany – 1a	90	8.44	0.52	ND	0.25	ND	0.27	0	0.51	ND
Piešťany – 1b	88.5	9.72	0.48	ND	0.28	ND	0.21	0.19	0.61	ND
Piešťany – 1c	88.6	9.85	0.47	ND	0.29	ND	0.23	0	0.56	ND
Piešťany – 2a	89.68	8.94	0.43	ND	0.23	ND	0.21	0	0.5	ND
Piešťany – 2b	89.21	9.12	0.46	ND	0.25	ND	0.23	0.22	0.51	ND
Piešťany – 2c	89.45	8.97	0.49	ND	0.26	ND	0.25	0	0.59	ND
Šintava – 1a	89.41	8.39	0.2	0	0.43	0.96	0.12	0	0.49	ND
Šintava – 1b	85.61	11.14	0.22	0.35	0.72	1.28	0.19	0	0.49	ND
Šintava – 1c	78.73	16.71	0.15	0.34	1.15	1.95	0.24	0	0.74	ND
Šintava – 2a	89.95	7.8	0.2	0	0.47	0.94	0.13	0	0.52	ND
Šintava – 2b	89.62	8.12	0.21	0	0.53	0.94	0.16	0	0.42	ND
Šintava – 2c	77.22	17.81	0.2	0	0.84	1.87	0.37	0.8	0.89	ND

Technical specifications of the device are as follows: DELTA CLASSIC+ is an energy-dispersive XRF spectrometer; it features a 4-watt X-ray tube with a current of up to 200 μA, a Si-PIN detector, and an integrated full VGA camera. It allows narrowing the X-ray beam from 9 mm to 3 mm, enabling the analysis of small objects or heterogeneous materials.

The DELTA CLASSIC+ measures only the surface of the examined material, and therefore it does not guarantee the homogeneity of the chemical composition throughout the entire volume of the material. It provides information solely about the composition of the surface layer of the object at the specific examined location, with the penetration depth of the X-ray beam determined by the chemical composition of the material.

This makes the selection of the analysis location on the examined object critically important. If the material is gold-plated, clad, or otherwise surface-treated, or if it is affected by corrosion, the chemical composition will not correspond to the weight percentages of the entire volume but rather to the weight percentages of the surface layer at the specific measurement location. For objects with a spherical or rounded shape, the positioning of the object can influence the results. Therefore, it is essential to select an appropriate geometry for such samples.

Results of Spectral Analysis Measurements

The results of the XRF analysis are presented in Tab. 3. Each artefact was measured six times: three times each on the leaf and on the socket. The measurements are marked in the table as follows: 1a, 2a – measurements on a cleaned surface; 1b, 2b – repeated measurements on a cleaned surface; 1c, 2c – measurements without surface cleaning. The table display the average weight percentages (Wt %) of ten elements (Cu, Sn, As, Sb, Ag, Ni, Pb, Fe, Zn, and Bi). Following the table is a description of the composition of the examined alloy as determined by the XRF analysis.

Spearheads with a strongly curved blade (Banka, Hlohovec I, Madunice, Piešťany) are characterized by a similar chemical composition, and therefore, the results obtained for them are discussed together. The copper content in these artefacts ranges between 90% and 87%, while the level of tin varies between 8% and 11%. They also exhibit a relatively high levels of arsenic (0.23% to 0.91%) and nickel (0.33% to 0.54%). The silver content was below the detection level in all measurements. The same applies to antimony, except for a single measurement of a spearhead from Banka (2a). However, the zinc level in these artefacts is relatively high, ranging from 0.43% to 0.61%. Differences in the chemical composition of this type of spearheads are observed only in the case of two elements: lead and iron. The lead content was below the detection level in the specimen from Banka, ranged from 0.21% to 0.28% in the spearheads from Hlohovec I and Piešťany, and reached the highest values in the artefact from Madunice, ranging from 0.28% to 0.51%. Regarding iron, its content was below the detection level in the objects from Banka and Madunice, as well as in two measurements from Piešťany (1a and 2a). In the remaining measurements from the last object, it was approximately 0.2%, while in the specimen from Hlohovec I, lead had the highest values, ranging from 0.23% to 0.46%.

The spear/javelin head from Šintava differs from the spearheads with a strongly curved blade described above in terms of trace element content. It should also be noted that one of the measurements (1b) clearly deviates from the others. The levels of copper and tin are similar to that of the spearheads with a strongly curved blade (85–89% and approx. 8%, respectively). The arsenic content is also at a similar level (0.43–0.72%). Silver is below the detection level, except for measurement 1b, where it has value of 0.35%. However, the antimony content is significantly higher than in the previously described spearheads (above 0.9%), while the nickel level is lower (approx. 0.2%). The content of lead is also relatively low (0.12–0.19%). On the other hand, the zinc content is similar to that recorded in the spearheads with a strongly curved blade (0.42–0.52%).

The javelin head from Hlohovec II noticeably differs from the other analysed artefacts in terms of the results obtained. In this case, the copper content is considerably lower (70.81–76.57%), while the tin is only slightly higher (9.51%–12.34%). However, the levels of arsenic (approximately 6%), silver (approximately 4.5–5%), antimony (approximately 1.5–2%), and bismuth (above 1%) are remarkably high. In contrast, the levels of nickel and lead were below the detection limit. The zinc content was the only element similar to the values obtained for other spearheads (0.55–0.7%). There are significant variations in iron content between individual measurements – in two cases (2a and 2b), it was below the detection limit, while in measurement 1b, it was recorded at 0.3%, and in measurement 1a, it reached as high as 1.58%.

The exceptionally high levels of trace elements, particularly arsenic and silver, in this spearhead may indicate either intentional addition or insufficient cleaning of the surface from corrosion. Comparative studies using XRF and OES methods have shown that arsenic and silver exhibit significant surface enrichment when measured by pXRF (*Pollard et al. 2018*, 75). This theory is further supported by the minor differences in tin content between measurements taken on the cleaned (a and b) and uncleaned surfaces (c). The only other artefact with well-preserved patina – the spearhead from Banka – showed approximately three times higher concentrations of that element when measuring from the patina compared to the cleaned surface.

Comparison with other XRF results from Slovakia

Other artefacts dated to the Late and Final Bronze Age and discovered in present-day Slovakia have also been subjected to chemical composition analysis using the XRF method. The results obtained in this study were therefore compared with those from artefacts found at Buková (*Bartík/Farkaš 2021*, 96), Horné Srnie (*Ondrkál/Peška 2024*, 387), Nitrianska Blatnica (*Bartík/Jelínek/Gábriková 2022*, 80), Málinec (*Makarová/Rusko/Čambal 2023*, 66), Stakčín (*Makarová/Harčar 2022*, 62), Svätý Jur (*Zachar/Bartík/Farkaš 2019*), and from sites at Nižná-Lazy, Dolný Kubín II, and Krásna Hôrka (*Danielová 2018*, 81). The comparative group encompassed a total of 55 measurements from 45 artefacts (two-arm pickaxes, sickles, spearheads, dagger, ornaments and parts of costume). Fragments of ingots were excluded from comparison. In all these cases, measurements were taken on surfaces cleaned of patina. Results of the comparison are presented on Diagram 1.

The copper content in the objects from this group ranges between 43.74% and 97.068%, with the non-outlier range falling between 76.852% and 97.068%. Thus, the results obtained for the artefacts analysed in this study fall within this range, except for the javelin head from Hlohovec II, which has slightly lower values. The tin content in the comparative group exhibited a wide variation, ranging from 2.129% to as high as 54.077%, while the non-outlier range was between 6.512% and 12.879%. The analysed spearheads, containing between 8% and 12% tin, therefore fall within the characteristic range for other bronze artefacts from Slovakia, dated to the Late and Final Bronze Age. The results also indicate that ornaments and elements of costume generally have lower copper and higher tin content (average Cu 81.667%, Sn 15.926%) compared to tools and weapons (average Cu 88.29%, Sn 7.946%).

The antimony content in the comparative group ranged from 0% to 4.247%, with the non-outlier range falling between 0% and 1.392%, indicating significant variability in the presence of this element. This variation is also evident in the artefacts analysed in this study. In the spearheads with a strongly curved blade, antimony levels are generally below the detection limit, whereas in the two other objects, they are significantly higher. In the Šintava spear/javelin head, antimony falls within the upper part of the given non-outlier range (0.94–1.28%), while in the specimen from Hlohovec II, it exceeds this range, with values between 1.59% and 2.12%.

In most artefacts from the comparative group, the levels of arsenic, silver, and zinc are below the detection limit. Regarding silver, this result aligns with the findings for the spear/javelin heads analysed in this study, except for one measurement from Šintava and the results for the javelin head from Hlohovec II. However, there is a notable difference in arsenic and zinc levels. In all measurements of the analysed spearheads, these elements were detected at concentrations of 0.23–0.91% for arsenic (and above 6% in the case of the Hlohovec II specimen) and 0.42–0.7% for zinc. The presence of arsenic and zinc in the alloy therefore clearly distinguishes the spearheads analysed in this study from other artefacts found in Slovakia. However, it must be considered that this difference may be attributed to the equipment used for analysis or its calibration (*Pollard et al. 2018*, 75). Additionally, in many measurements where arsenic was not detected, relatively high lead content was recorded. This could be related to the known difficulty in measuring arsenic in the presence of lead due to spectral overlap (*Pollard et al. 2018*, 77). As for zinc, comparative studies of measurements obtained using XRF and ICP-OES methods have shown that the former often fails to detect this element, in cases where ICP-OES identified zinc at levels ranging from 0.002% to 0.183% (*Zachar/Bartík/Farkaš 2019*, 106).

In the comparative group, nickel content ranged from 0% to 1.142%, with the same range for non-outlier values. These figures indicate significant variability in level of nickel in objects from the Late and Final Bronze Age in Slovakia. For the spearheads with a strongly curved blade, nickel content falls around the median obtained for the comparative group (0.33–0.54%). In the Šintava specimen, the level is

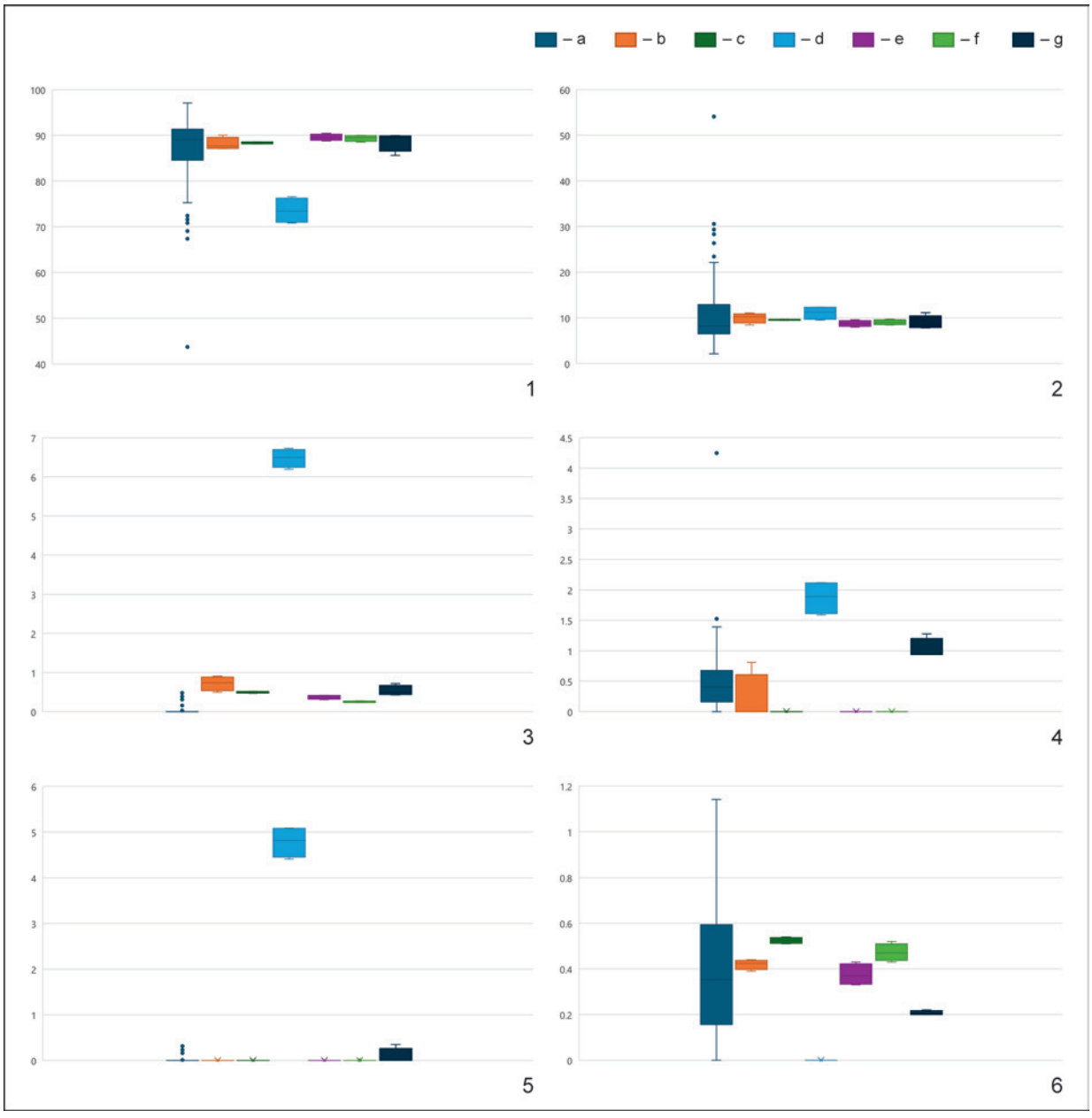


Diagram 1. Comparison of chemical composition of discussed spear/javelin heads with comparative group (XRF analyses of 45 Late and Final Bronze Age artefacts from Slovakia). 1 – copper (Cu); 2 – tin (Sn); 3 – arsenic (As); 4 – antimony (Sb); 5 – silver (Ag); 6 – nickel (Ni). Legend: a – comparative group; b – Banka; c – Hlohovec I; d – Hlohovec II; e – Madunice; f – Piešťany; g – Šintava.

below this median (~0.2%), while in the Hlohovec II javelin head, no nickel was detected at all. Nevertheless, all these values fall within the non-outlier range of the comparative group.

The lead content in the comparative group ranges from 0% to 4.205%, with the non-outlier range falling between 0% and 1.841%. Higher lead values (above 1%) may indicate intentional addition, although some studies suggest that copper ores can naturally contain up to 2% lead (*Ondrkál/Peška 2024*, 385). Among the artefacts considered here, this threshold is exceeded in only two cases – an axe and a bracelet from the Stakčín site (2.71% and 4.205%, respectively). Therefore, only these instances clearly indicate the intentional addition of lead. In all the spear/javelin heads analysed in this study, lead levels remain below the median for other artefacts from Slovakia. The maximum recorded value is 0.51% in the spearhead from Madunice, while in the remaining cases, it is either between ~0.1% and ~0.3% (Hlohovec I, Piešťany, Šintava) or below the detection limit (Banka, Hlohovec II).

The iron content in the group of artefacts used for comparison ranges from 0% to 1.619%, with the non-outlier range falling between 0% and 0.863%. Most of the measurements from spearheads analysed in this study fall within this range. Only in the case of the Hlohovec II specimen does one measurement show a higher iron level – 1.58%. Such high concentrations of this element are very rare in the material form Slovakia. In fact, only five other objects showed iron levels exceeding 1% – four from the hoard in Nitrianska Blatnica and one from Buková I.

In approximately half of the artefacts from the Late and Final Bronze Age in Slovakia, bismuth content is below the detection limit. In the remaining artefacts, it is present at low levels, with a maximum of 0.12%. A similar pattern is observed in the objects analysed in this study – except for the javelin head from Hlohovec II, where bismuth levels exceed 1%.

In conclusion, the chemical composition of the analysed spearheads generally aligns with Late and Final Bronze Age artefacts from Slovakia, except for certain anomalies in Hlohovec II (notably high arsenic, silver, antimony and bismuth levels). Only differences in arsenic and zinc levels clearly distinguish analysed spearheads from other artefacts, though these variations may be influenced by analytical methods.

When comparing XRF analysis results obtained by different researchers, caution should be exercised, as studies by *Heginbotham et al.* (*2015*) and *Heginbotham/Sole 2017* have shown that the reproducibility of results between laboratories is relatively low (*Pollard et al. 2018*, 69). The results are largely dependent on the instrument used, the calibration methodology, and the degree to which the surface has been cleaned (*Pollard et al. 2018*, 75).

Additionally, studies comparing XRF results with those obtained through other methods (ICP-MS/ICP-OES) have revealed discrepancies between measurements. Researchers point to the lower reliability of the XRF method due to the fact that it only analyses the composition of the object's surface (or metal near the surface), and because of the detection limits, it cannot reliably measure certain important chemical elements (*Zachar/Bartík/Farkaš 2019*, 104).

Worthy of mention in this context is the chemical composition analysis carried out with the EDX method on the spearhead from Pavlovce, previously mentioned in the chapter addressing analogies to the spear/javelin head from Šintava (*Bogušová/Pribulová 2006*, 3). With a copper content of 92.9%, this artifact falls within the standard range documented for archaeological finds from Slovakia. The recorded tin content (5.7%) is lower compared to the analyzed spearheads from the Homeland Museum in Hlohovec and falls within the outlier range established for the comparative group. The only additional element detected in the chemical composition of this spearhead is sulfur (0.5%), an element not identified in any spearheads from the Homeland Museum in Hlohovec. However, as ICP-MS/ICP-OES analyses have shown, sulfur concentrations measured by ICP methods at levels up to almost 1% were sometimes undetectable using the XRF method, applied to the same artefacts (*Zachar/Bartík/Farkaš 2019*, 106).

Regarding the possible origin of the ore (or ores) used in the production of the analysed artefacts, based on the ratio of Ni to Ag, it can be concluded that the spearheads with a strongly curved blade (Banka, Hlohovec I, Madunice, Piešťany) are closer to the characteristics of the chalcopyrite deposits from the Eastern Alps (regions of Mitterberg, Kitzbühel, and Viehofen). These deposits are characterized by high arsenic and nickel content, while antimony and silver levels remain low (*Pernicka/Lutz/Stöllner 2016*, tab. 4). Other studies also suggest that metal from these sources was present in Slovakia during the Late and Final Bronze Age (*Ondrkál/Peška 2024*, 388; *Zachar/Bartík/Farkaš 2019*, 111–114). The Šintava spear/javelin head exhibits a different elemental composition, with the proportions of key elements following the pattern: Sb > As > Ni/Ag. The high levels of antimony would tend to indicate characteristics similar to the deposits from the Slovak Ore Mountains, however, they are also known to have higher levels of silver, which in the case of this specimen was only confirmed in one of the measurements (*Ondrkál/Peška 2024*, 390, fig. 5).

Going somewhat beyond the scope of this chapter, it is worth drawing attention to XRF analysis projects conducted in the 1990s on objects primarily from Bohemia, and to a lesser extent Moravia and Austria (*Frána et al. 1995*; *1997*). Among the studied items were 41 spearheads, dated from the Middle to the Final Bronze Age. The tin content in these spearheads ranges from 1.58% (specimen from Hradec Králové-Slezské Předměstí; HaB3) up to 52.15% (spearhead from Dýšina-Nová Huť; Middle Bronze Age), with the non-outlier range of 1.58% to just below 20%. All of the spear and javelin heads from the Homeland Museum in Hlohovec also fall within this range. One possible explanation for

the particularly low tin content in the Hradec Králové–Slezské Předměstí spearhead, as suggested by *J. Frána et al.* (*1997*, 72), is a regional tin shortage in eastern Bohemia toward the end of the Bronze Age, also reflected in the tin levels of other bronze objects from nearby sites. The unusually high tin content from the Dýšina – Nová Huť spearhead is interpreted by *M. Salaš* (*2016*, 213) as possibly skewed due to corrosion products.

Arsenic, as noted earlier in this chapter, is rarely detected in Slovak bronze objects (though it was found in all the spearheads from the Homeland Museum in Hlohovec), but was present in the majority of the spearheads in the aforementioned studies. Only in one from Rýdeč and one from Sipbachzell arsenic was not detected. The highest arsenic content, around 1.5%, was found in two spearheads from Rataje nad Sázavou (HaB3), although this is still far below the level recorded in the Hlohovec II javelin head (approx. 6.5%).

The silver content in most cases did not exceed 0.3% in the spearheads from these studies, with a maximum of 0.54% in one spearhead from Rataje nad Sázavou. These results correspond closely with the values observed in the spear and javelin heads from the Homeland Museum in Hlohovec – again with the notable exception of Hlohovec II (approx. 4.5–5%).

Antimony levels in the spearheads from *J. Frána et al.* (*1995*; *1997*) range from 0 to 1.27% (the highest in a spearhead from Světec; HaB3), with non-outlier values between 0 and 0.83%. The spear/javelin head from Šintava slightly exceeds this range (0.94–1.26%), while the Hlohovec II javelin head clearly surpasses it (1.59–2.12%).

Nickel content in the cited studies ranges from 0 to 1.27%, with non-outlier values between 0 and 0.5%. Only the measurements for Hlohovec I spearhead slightly exceeds this threshold (0.51–0.54%).

In the case of lead, the range of non-outlying values in the aforementioned study falls between 0 and 1.09%. Only for six spearheads can the intentional addition of lead, above 2%, be suggested: five from the site of Rataje nad Sázavou and one from the site of Světec. Additionally, all items from the former site are dated to HaB3, while most objects from the latter are also dated to HaB3, but some date as early as HaA1 (*Frána et al. 1995*; 139, 141, 142). The objects from the Homeland Museum in Hlohovec fall within the non-outlier range, with the highest lead content found in the spearhead from Madunice, ranging between 0.28% and 0.51%.

RADIOCARBON DATING – FRAGMENT OF A SHAFT FROM THE SOCKET OF THE SPEAR/JAVELIN HEAD FROM ŠINTAVA

As mentioned earlier, two of the examined spear/javelin heads – those from Banka and Šintava – had preserved fragments of their shafts inside the socket (*Mitáš et al. 2018*, 238, 239). In the case of the latter, a sample was taken from the end of the preserved section and sent to the Poznań Radiocarbon Laboratory for dating. Rather unexpectedly, the dates obtained via the AMS method are as follows: 285 ±30 BP, which at the 1 sigma level (68.3% probability) corresponds to 1524–1655 AD, and at the 2 sigma level (95.4% probability) corresponds to 1500–1794 AD.

As noted in previous sections, the Šintava spear/javelin head has close analogies to other Bronze Age spearheads discovered in datable contexts. Its chemical composition also aligns with that of other Bronze Age artifacts from Slovakia. We therefore assume it was produced in the Bronze Age. Hence, we interpret the discrepancy between the radiocarbon dating of the shaft and the typological dating of the spearhead as a result of the spearhead's discovery, removal from its original depositional context, and subsequent remounting on a shaft in the Early Modern period. Such practices are known in the context of Slovak finds, as many marks observed on swords and spearheads are modern, although this may represent one of the earliest examples of reusing an archaeological artifact. A similar case concerns for example a bronze sword from unknown locality, which, after discovery in modern times, was significantly shortened (*Novotná 2014*, cat. no. 105).

Radiocarbon dating has thus shed light on one of the chapters in the "life story" of this spearhead. At the same time, these results highlight that, when the exact find context is unknown, it must be considered that traces of use – or even certain typological features – could have been altered at a later time. Thus, the way an artifact appears today may not always reflect the intentions of its original maker or its usage in the Bronze Age. This also raises the question of whether, in other cases where a piece of shaft has been preserved, it truly dates to the Bronze Age or is a more recent addition.

CONCLUSIONS

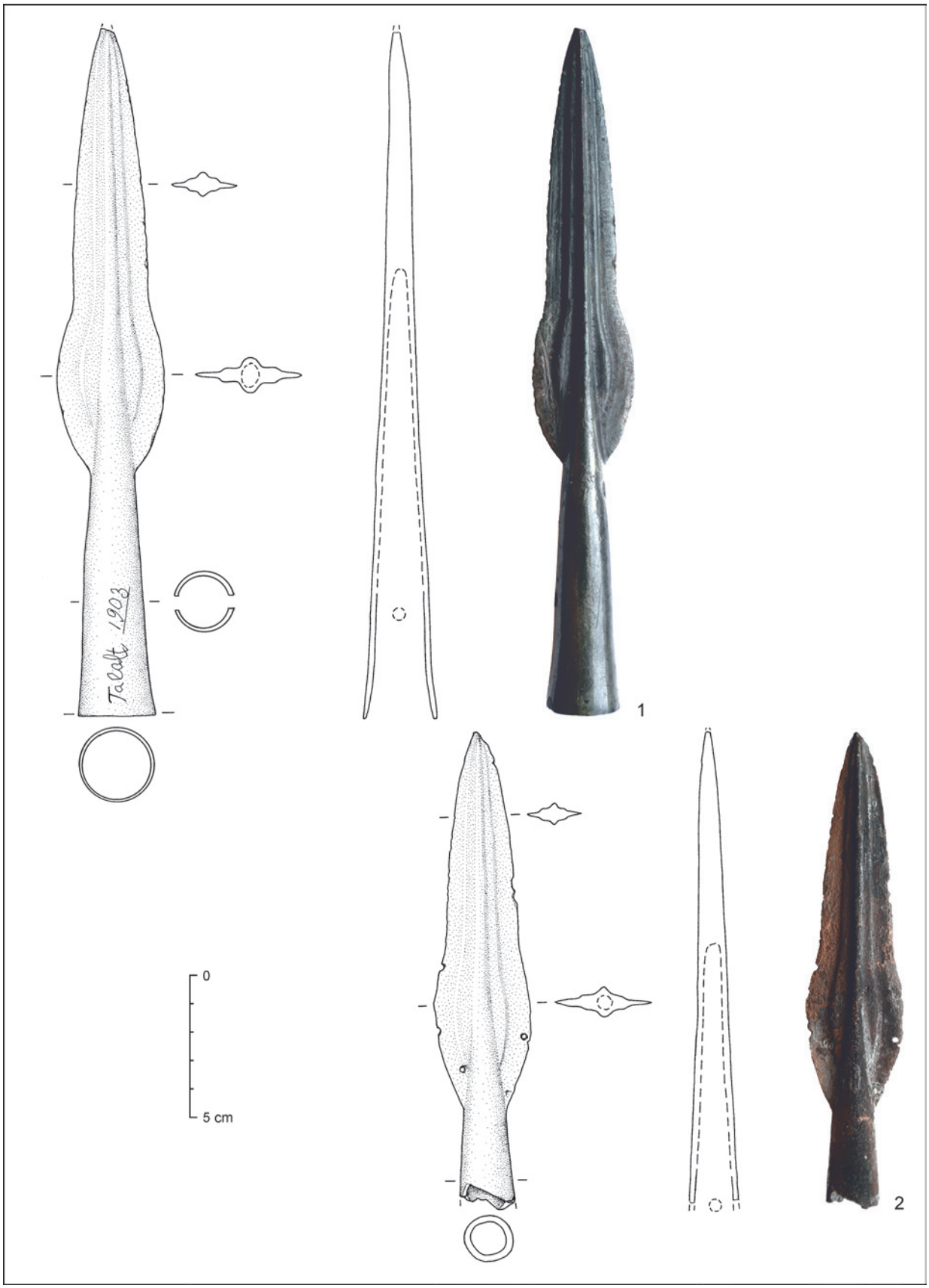
A detailed analysis of six artifacts, typically overlooked as single finds, was undertaken. Bronze spear/javelin heads from the Homeland museum in Hlohovec were classified typologically and chronologically, not only according to Slovak systems but also within the broader context of Central Europe. Use-wear analyses documented damages, likely originating from the Bronze Age (particularly evident on the spearhead from Banka), as well as later modifications and damage – grinding of the edge at Banka specimen, drill-holes on the spearhead from Madunice, grinding and flattening of the midrib in the example from Piešťany, possible modern damage marks on the spearhead Hlohovec I, modern crushing possibly by agricultural machinery in case of Šintava specimen.

Chemical composition analyses revealed significant differences. In one instance, these differences appear to be related at least to some extent, to thick layer of patina on the javelin head from Hlohovec II. In the remaining cases, the analyses allowed for the distinction of a group comprising the spearheads from Banka, Hlohovec I, Madunice, and Piešťany with the trace elements composition close to the Alpine ores. Spear/javelin head from Šintava exhibits a different trace element composition, especially in the amount of antimony. This dichotomy corresponds with the differences in typological classification.

Comparison with the chemical composition of other objects from Slovakia dating to the Late and Final Bronze Age indicates that, in most measurements, analysed spear/javelin heads (with the exception of the one from Hlohovec II) fall within the normative range for Bronze Age objects, although certain discrepancies – most notably in arsenic content, one of key elements in interpretation of Bronze Age metallurgy – are evident. In these spearheads, arsenic was consistently detected, whereas in other studies it was more often undetected, possibly due to differences in analytical equipment and calibration.

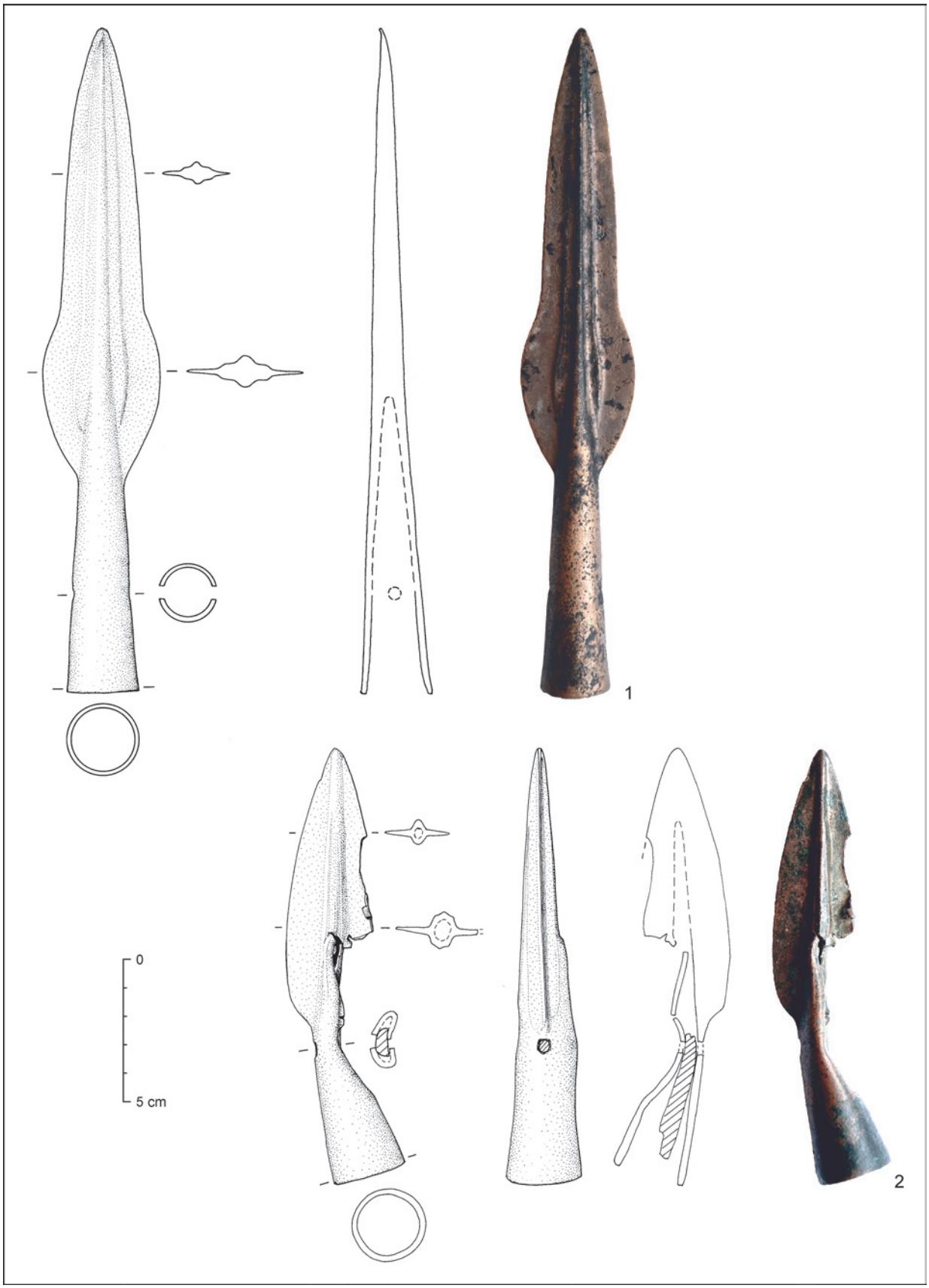
Furthermore, radiocarbon dating of a fragment of the wooden shaft from the socket of the spear/javelin head from Šintava revealed its secondary use in the Early Modern period – a finding that would have remained unnoticed without application of this method. This prompts the question of how often spear/javelin heads – and other bronze artefacts – have been removed from their original contexts and re-deposited, thereby affecting our understanding of artefacts distribution, chronology, and depositional practices.

This study demonstrates that detailed analyses, even of single finds discovered out of context, can yield valuable insights into the use of weaponry in the Bronze Age and their subsequent fate.

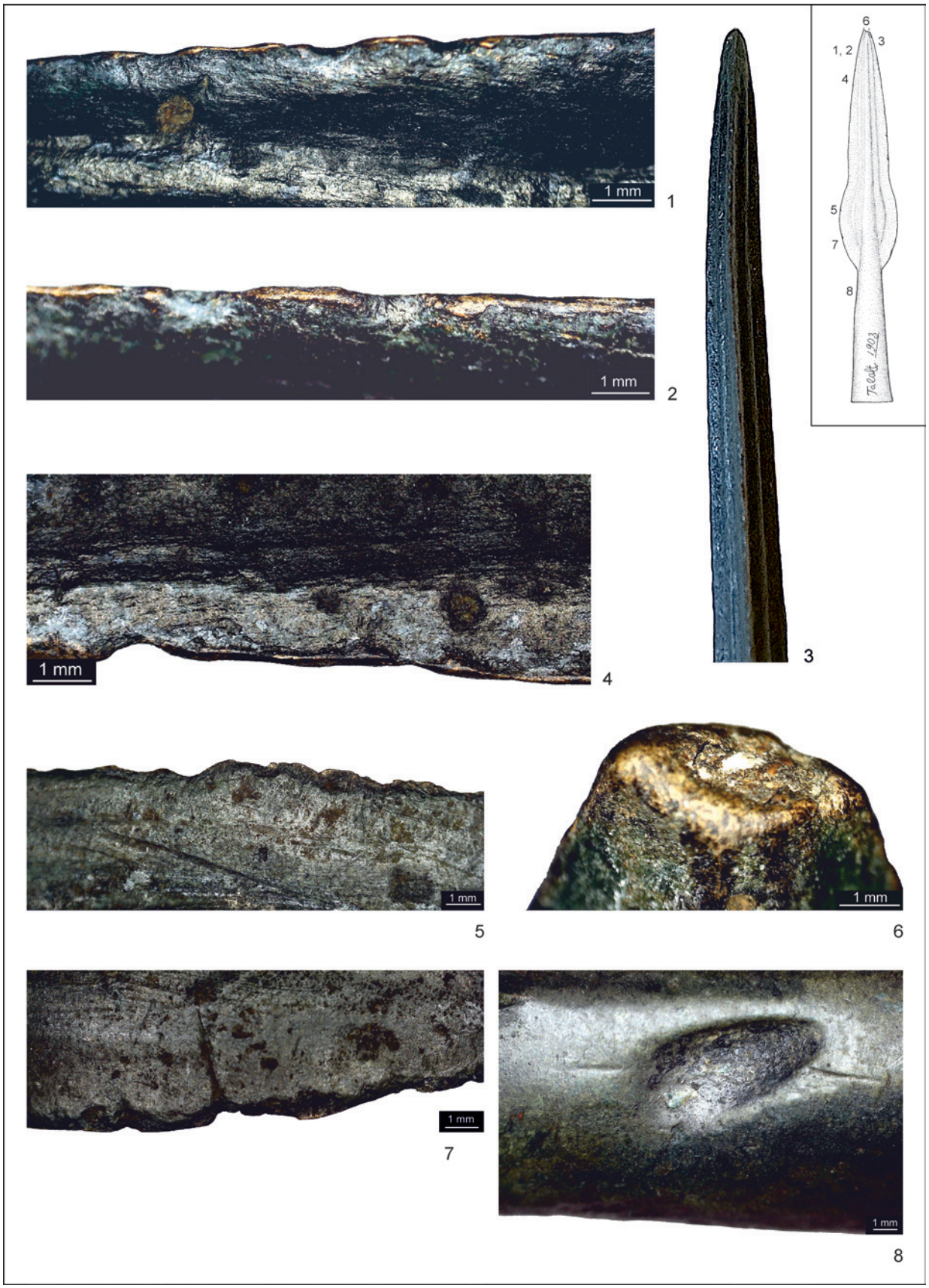


Pl. I. 1 – spearhead from Banka; 2 – spearhead from Madunice. Photos V. Mitáš, drawings Z. Nagyová.

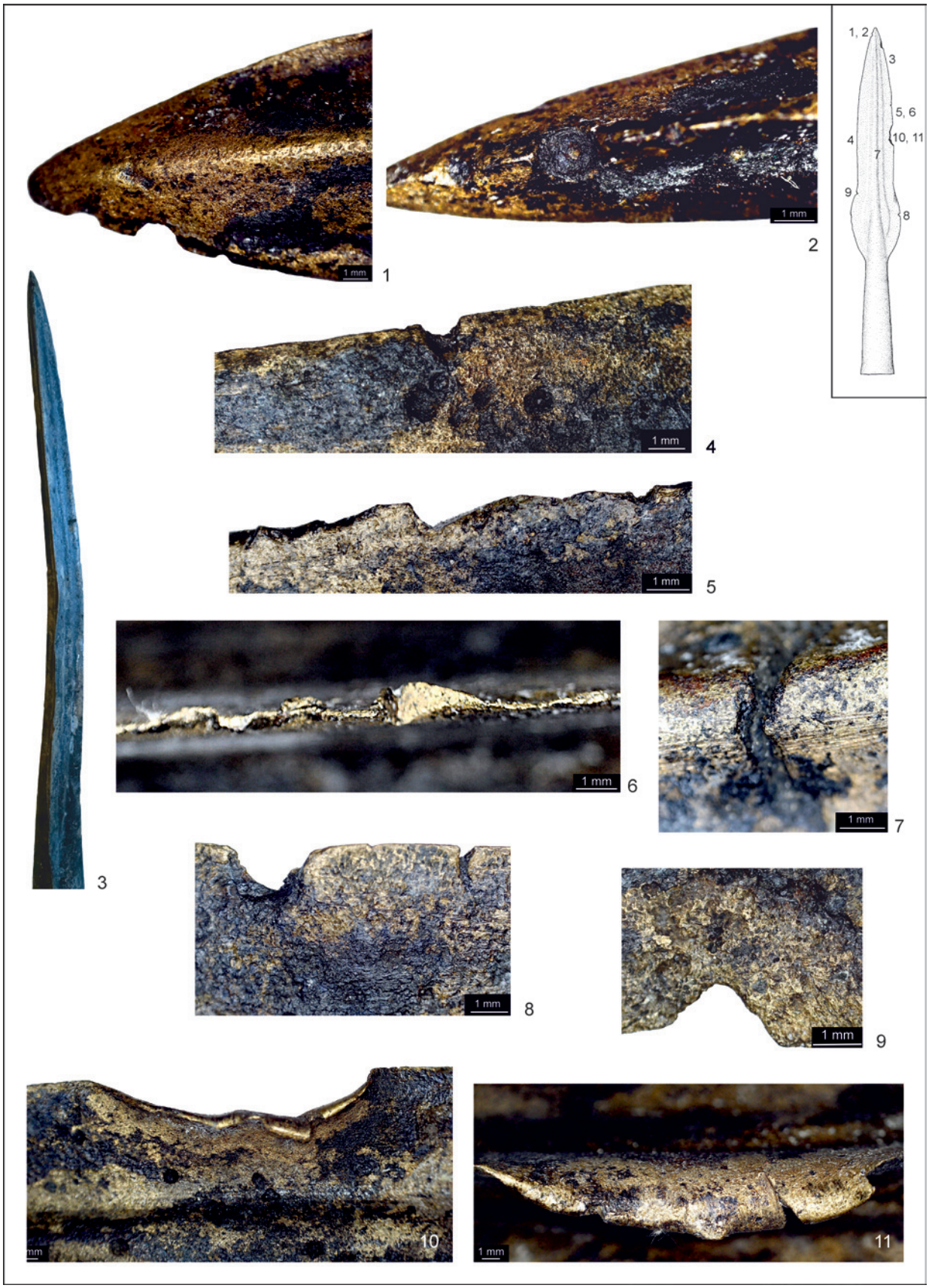
Pl. II. 1 – spearhead from Hlohovec I; 2 – javelinhead from Hlohovec II. Photos V. Mitáš, drawings Z. Nagyová.



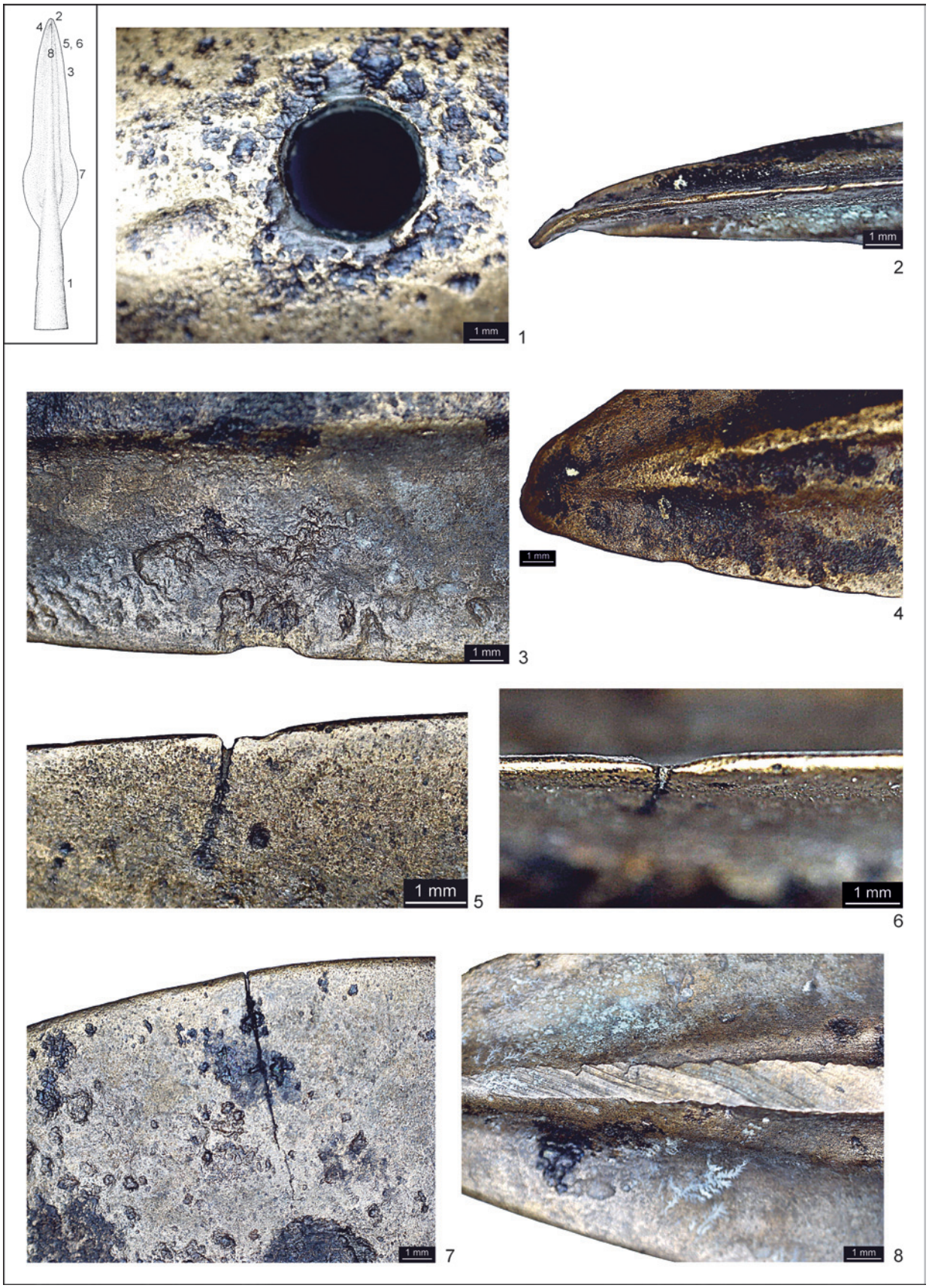
Pl. III. 1 – spearhead from Piešťany; 2 – spearhead from Šintava. Photos V. Mitáš, drawings Z. Nagyová.



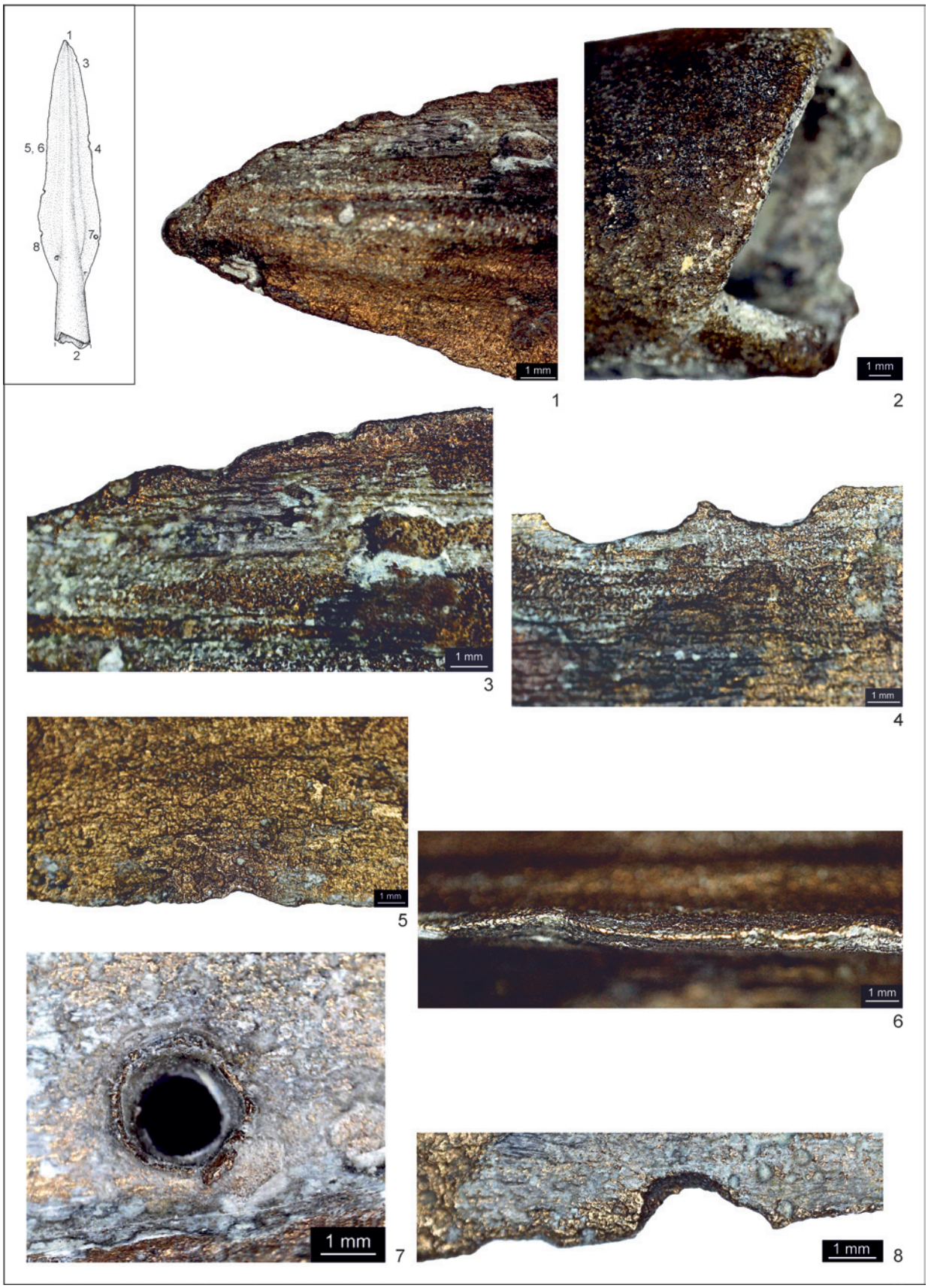
Pl. IV. Selected marks on the spearhead from Banka. Author J. Wójcik.



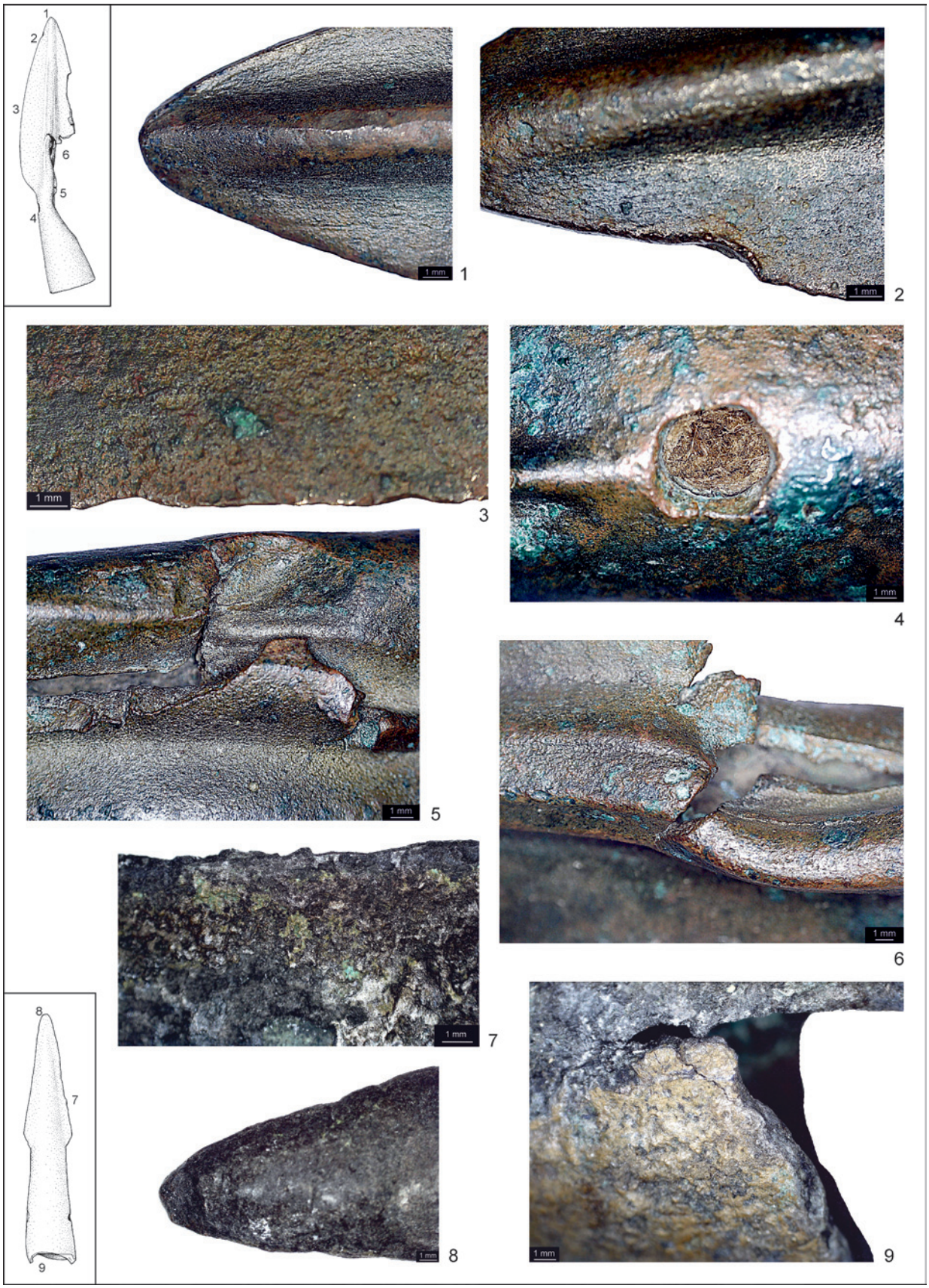
Pl. V. Selected marks on the spearhead from Hlohovec I. Author J. Wójcik.



Pl. VI. Selected marks on the spearhead from Piešťany. Author J. Wójcik.



Pl. VII. Selected marks on the spearhead from Madunice. Author J. Wójcik.



Pl. VIII. Selected marks on the spearheads from Šintava (1–6) and Hlohovec II (7–9). Author J. Wójcik.

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Bronzové hroty kopijí/oštepov z Vlastivedného múzea v Hlohovci

Analýza stôp používania, XRF analýza a rádiokarbónové datovanie

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Súhrn

V príspevku je predložená detailná analýza súboru bronzových hrotov kopijí/oštepov, ktoré sú deponované vo Vlastivednom múzeu v Hlohovci. Celkovo bolo analyzovaných šesť artefaktov z rôznych archeologických lokalít v povodí rieky Váh na západnom Slovensku, prevažne ide o hroty s výrazne zahnutými listami. Hroty boli klasifikované typologicky a chronologicky nielen podľa slovenských systémov, ale aj v širšom stredoeurópskom kontexte. Na celý súbor sa aplikovala analýza stôp používania a XRF analýza.

Skúmanie opotrebovania artefaktov odhalilo poškodenia, ktoré sú pravdepodobne už z doby bronzovej (obzvlášť evidentné na hrote z Banky), ale zistili sa aj neskoršie úpravy a poškodenia (zabrúsenie ostria exemplára z Banky, vyvŕtané otvory na hrote z Maduníc, obrúsenie a sploštenie strednej časti ostria exemplára z Piešťan, možné novodobé poškodenia na hrote Hlohovec I či moderné zdeformovanie exemplára zo Šintavy, pravdepodobne spôsobené poľnohospodárskou činnosťou).

Chemické zloženie artefaktov umožnilo identifikovať výrazné odlišnosti medzi hrotmi. Zatiaľ čo hrot evidovaný ako Hlohovec II vykazuje odlišnosti pravdepodobne spôsobené silnou koróziou, skupina hrotov z lokalít Banka, Hlohovec I, Madunice a Piešťany vykazuje zloženie stopových prvkov blízke alpským rudám. Porovnanie chemického zloženia s ďalšími objektmi zo Slovenska datovanými do mladšej a neskorej doby bronzovej ukázalo, že analyzované hroty (s výnimkou exemplára Hlohovec II) vo väčšine prípadov zodpovedajú chemickému zloženiu, typickému pre predmety z doby bronzovej, hoci isté odchýlky – predovšetkým stabilná prítomnosť arzénu – sú pozorovateľné. Arzén, ktorý je dôležitým indikátorom metalurgie doby bronzovej, bol stabilne detegovaný na všetkých analyzovaných artefaktoch, zatiaľ čo v iných štúdiách často zaznamenaný nebol, pravdepodobne v dôsledku diferencií v analytických prístrojoch či v ich kalibrácii.

V jednom prípade sa realizovala aj rádiokarbónová analýza zvyšku drevenej násady z tuľajky hrotu (Šintava), ktorá preukázala jeho sekundárne využitie vo včasnom novoveku. Bez aplikácie uvedenej metódy by táto skutočnosť zostala nepovšimnutá. To otvára otázku, ako často boli hroty kopijí/oštepov, ale aj iné bronzové predmety premiestňované zo svojho pôvodného kontextu a opätovne využité, čo môže výrazne ovplyvniť naše vnímanie distribúcie artefaktov, ich chronológie či depozičných praktík.

Táto štúdia ukazuje, že detailné analýzy aj ojedinelých nálezov (a všeobecne artefaktov bez ich pôvodného kontextu) môžu významne prispieť tak k lepšiemu chápaniu využitia bronzových zbraní v dobe bronzovej, ako aj k osvetleniu ich ďalších osudov.

Obr. 1. Mapa analógií hrotov kopijí plameňovitého tvaru so stupňovitou profiláciou listu. 1 – Banka; 2 – Bratislava; 3 – Bratislava-Záhorská Bystrica; 4 – Čaka; 5 – Číčov; 6 – Gemer; 7 – Hlohovec I; 8 – Košické Oľšany; 9 – Kúty; 10 – Madunice; 11 – Moravský Svätý Ján; 12 – Nesvady; 13 – Piešťany; 14 – Piešťany (Ducové); 15 – Slovenský Grob; 16 – Smolenice; 17 – Svätý Peter; 18 – Vajka (Lúčnica nad Žitavou); 19 – Vlčany; 20 – Vyšná Hutka, 21 – Zádiel. Legenda: a – hroty kopijí diskutované v tomto článku; b – nálezy hrotov kopijí zo skupiny B podľa Badera, variant 6 (jeden kus); c – nálezy hrotov kopijí zo skupiny B podľa Badera, variant 6 (dva kusy); d – nálezy hrotov kopijí zo skupiny B podľa Badera, variant 6 (tri kusy); e – nálezy hrotov kopijí zo skupiny B podľa Badera, variant 7 (dva kusy); f – možné nálezy hrotov kopijí plameňovitého tvaru so stupňovitou profiláciou listu. Autor J. Wójcik.

Obr. 2. Mapa analógií hrotu kopije zo Šintavy. 1 – Gemer; 2 – Hažlín; 3 – Horná Štubňa; 4 – Nižná; 5 – Pavlovce; 6 – Šintava; 7 – Spišská Belá; 8 – Spišská Teplica; 9 – Trenčianske Bohuslavice; 10 – Zlatá Idka. Legenda: a – hrot kopije zo Šintavy; b – nálezy hrotov kopijí zo skupiny C podľa Badera, variant e (jeden kus); c – nálezy hrotov kopijí zo skupiny C podľa Badera, variant e (dva kusy); d – nálezy hrotov kopijí zo skupiny C podľa Badera, variant d (jeden kus); e – nálezy hrotov kopijí zo skupiny C podľa Badera, variant f (jeden kus). Autor J. Wójcik.

Obr. 3. Lokalizácia poškodení na troch hrotoch kopijí s výrazne zahnutými listami, so stupňovitou profiláciou listu (Banka, Hlohovec I a Piešťany). Intenzívnejšia červená farba označuje vyššiu frekvenciu poškodení v danej časti hrotu; čierne bodky označujú poškodenia pod patinou pozorované na hrote z Banky.

Diagram 1. Porovnanie chemického zloženia diskutovaných hrotov kopijí/oštepov s porovnávacou skupinou (XRF analýzy 45 artefaktov z mladšej a neskorej doby bronzovej zo Slovenska). 1 – meď (Cu); 2 – cín (Sn); 3 – arzén (As); 4 – antimón (Sb); 5 – striebro (Ag); 6 – nikel (Ni). Legenda: a – porovnávacia skupina; b – Banka; c – Hlohovec I; d – Hlohovec II; e – Madunice; f – Piešťany; g – Šintava.

Tabela 1. Metrické údaje k analyzovaným hrotom kopijí/oštepov.
Tabela 2. Klasifikácia hrotov kopijí/oštepov v rámci vybraných typológií.
Tabela 3. Výsledky XRF analýzy.

Tab. I. 1 – hrot kopije z Banky; 2 – hrot kopije z Maduníc. Foto V. Mitáš, kresby Z. Nagyová.
Tab. II. 1 – hrot kopije z Hlohovca I; 2 – hrot oštepu z Hlohovca II. Foto V. Mitáš, kresby Z. Nagyová.
Tab. III. 1 – hrot kopije z Piešťan; 2 – hrot kopije zo Šintavy. Foto V. Mitáš, kresby Z. Nagyová.
Tab. IV. Vybrané stopy na hrote kopije z Banky. Autor J. Wójcik.
Tab. V. Vybrané stopy na hrote kopije z Hlohovca I. Autor J. Wójcik.
Tab. VI. Vybrané stopy na hrote kopije z Piešťan. Autor J. Wójcik.
Tab. VII. Vybrané stopy na hrote kopije z Maduníc. Autor J. Wójcik.
Tab. VIII. Vybrané stopy na hrotoch kopijí zo Šintavy (1–6) a z Hlohovca II (7–9). Autor J. Wójcik.

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