



AKADÉMIAI KIADÓ

Acta Archaeologica  
Academiae Scientiarum  
Hungaricae


75 (2024) 1, 1-18

DOI:

[10.1556/072.2024.00012](https://doi.org/10.1556/072.2024.00012)

© 2024 The Author(s)

# Archaeometric analysis of the metal ornamentation of Late Bronze Age vessels and funnel-shaped pendants from the south-western Transdanubia

Katalin Jankovits<sup>1\*</sup> , Zoltán Szőkefalvi-Nagy<sup>2</sup> and Imre Kovács<sup>2</sup>

<sup>1</sup> Faculty of Humanities, Pázmány Péter Catholic University, Mikszáth Kálmán tér 1, H-1088 Budapest, Hungary

<sup>2</sup> HUN-REN Wigner Research Centre for Physics, Konkoly-Thuenge M. út 29–33, H-1121 Budapest, Hungary

Received: January 22, 2024 • Revised manuscript received: March 7, 2024 • Accepted: March 7, 2024

## ORIGINAL RESEARCH PAPER



### ABSTRACT

Vessels decorated with domed metal discs were extraordinarily rare and valuable commodities of the Late Bronze Age. Pottery adorned with bronze discs and tin first appeared in Hungary during the earlier Urnfield period (14th/13th century BC). A vessel adorned with three ring motifs inlaid with a high-tin alloy on its belly is known from Nagykanizsa-Bilkei-dűlő and a cup decorated with bronze domed discs was recovered from Grave 222 of the Vörs-Battyáni-Disznólegelő cemetery, both in southern Transdanubia. The decorative bronze discs similarly had a high tin content. The metal composition was analysed with particle induced X-ray emission (PIXE) spectroscopy. Pendant ornaments of “white bronze”, an alloy with a high tin content, are principally known from southern Transdanubia: the elemental composition of two pendants with bird protomes from Grave 51 of the Vörs-Battyáni-Disznólegelő cemetery and of a funnel-shaped pendant from the Pamuk hoard were examined by PIXE for compositional make-up, which indicated a high tin content for all three. These pendants had been worn as adornments. Tin was an important raw material in the production of bronze. Most of the vessels decorated with bronze discs were brought to light in the late Urnfield cemetery uncovered at Budapest-Békásmegyér (boot- and amphora-shaped vessels, a feeding vessel, resin balls). It seems likely that these vessels had once served ritual purposes. Regrettably, they have not yet been submitted to PIXE analyses.

### KEYWORDS

Late Bronze Age, Urnfield culture, south-western Transdanubia, mug decorated with high-tin copper alloy, vessels decorated with bronze domed discs, PIXE

## INTRODUCTION

Clay vessels accentuated with metal adornments represent an unusual, rare group in the material record of the Late Bronze Age. The different varieties of metal embellishments adorning clay pottery and the distribution of these vessels in Europe have most recently been discussed by Bianka Nessel.<sup>1</sup> Vessels enhanced with applied metal ornamentation first appeared during the earlier Urnfield period in Hungary (Bz D/Ha A1, 14th/13th century BC). None of the Late Bronze Age vessels with metal adornments found in Hungary had been previously submitted to archaeometric analyses, as neither had the pendants of white bronze known from southern Transdanubia. This study seeks to fill this gap.

\*Corresponding author.

E-mail: [jankov@btk.ppke.hu](mailto:jankov@btk.ppke.hu)



<sup>1</sup>Nessel (2020) 429–439.

## MATERIALS AND METHODS

The chemical composition of the samples was determined by external-beam milli-PIXE spectroscopy. This is one of the most commonly used non-destructive methods for determining the elemental composition of valuable artworks and archaeological artefacts.<sup>2</sup> It allows the examination of the elemental composition of surface structures on objects of practically any size and shape. Selected surface structures are irradiated with a high-energy focused proton beam and the resulting characteristic X-ray emissions are utilised for the qualitative and quantitative analysis of the irradiated volume. Taking into consideration the deceleration of penetrating protons within the material and the attenuation of the generated characteristic X-ray radiation, surface-proximate areas can be examined to a depth of several tens of micrometers. With the standard PIXE setup, elements from Al to U can be detected simultaneously, and with appropriate measurement configurations, sensitivity down to ppm ( $\mu\text{g g}^{-1}$ ) detection limit can be achieved.<sup>3</sup>

The milli-PIXE measurements were conducted on the 5 MV Van de Graaff accelerator of the Institute of Particle and Nuclear Physics of the HUN-REN Wigner Research Centre for Physics. The properly collimated proton beam with an energy of 2.5 MeV was extracted from the accelerator's evacuated beam pipe to air through a 7.5  $\mu\text{m}$  thick Kapton foil and directed toward the target object to be analysed. The surface area of the target object was positioned 10 mm away from the exit window, where the diameter of the proton beam was 1.5 mm. The final precise positioning was carried out using a computer-controlled 3D positioning device. The extracted proton beam current was set within the range of 2–5 nA. The characteristic X-ray radiation was detected using an Amptek-123 spectrometer, which had an SDD-type detector with an active area of 25 mm<sup>2</sup>, a thickness of 500 and 8  $\mu\text{m}$  thick Be window. The detector was positioned at 135° with respect to the beam direction. Its resolution, referenced to the Mg K $\alpha$  line, was 130 eV. The net X-ray peak intensities and elemental concentrations were calculated using the GUPIX off-line code.<sup>4</sup>

The PIXE method was employed to analyze the following items:

1. Nagykanizsa-Bilkei-dűlő (County Zala): the metal-inlaid ornamentation of a vessel (Figs 3–4)
2. Vörs-Battyáni-Disznólegelő (County Somogy): funnel-shaped pendant with bird protomes of white bronze from Grave 51 (Fig. 7a and b)
3. Vörs-Battyáni-Disznólegelő (County Somogy): funnel-shaped pendant with bird protomes of white bronze from Grave 51 (Fig. 8a and b)
4. Pamuk (County Somogy): funnel-shaped pendant from the hoard (Fig. 9a and b)

5. Vörs-Battyáni-Disznólegelő (County Somogy): cup ornamented with bronze discs from Grave 222 (Fig. 11a and b)

## THE ORNAMENTATION OF THE VESSEL FROM THE EARLY URNFIELD SETTLEMENT AT NAGYKANIZSA-BILKEI-DŰLŐ

A remarkable, unique vessel came to light during László Horváth's excavation of the Urnfield settlement at Nagykanizsa-Bilkei-dűlő (County Zala) that was most intensely occupied during the Bz D, Bz D/Ha A1 period.<sup>5</sup>

### Description of the mug

Reddish-brown mug with brownish-grey mottling: straight rim, curved neck, rounded belly, lower part tapering towards the base, decorated with an applied horseshoe-shaped motif on the belly and three round stamped motifs inlaid with some white substance, of which only traces remained, spaced at equal intervals. Restored H.: 10.9 cm, dR.: 9.2 cm, diam. of belly: 12.8 cm, dB.: 8.0 cm, Th.: 0.3 cm, Nagykanizsa, Thury György Museum, Archaeological Collection, uninventoried (Fig. 1).

The mug itself is a typical form of the early Urnfield period in Transdanubia,<sup>6</sup> with good analogies from the Hahót-Vadaskert settlement in southern Transdanubia,<sup>7</sup>



Fig. 1. Vessel from Nagykanizsa-Bilkei-dűlő (H, County Zala)

<sup>2</sup>Gyódi et al. (1999).

<sup>3</sup>Johansson et al. (1995).

<sup>4</sup>Campbell et al. (2000).

<sup>5</sup>Horváth (2001) 42.

<sup>6</sup>Patek (1968) Taf. IV.4

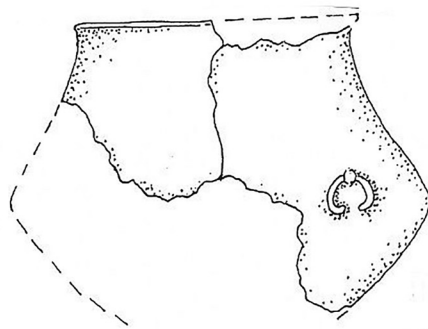
<sup>7</sup>Szárász (2020) 210, Fig. IV. A.



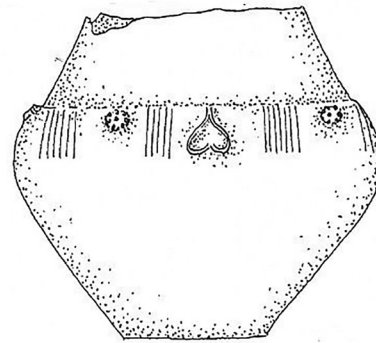
although it is also attested in the Budapest-Békásmegyer cemetery, where it was found in a later context.<sup>8</sup>

The remarkable modelled horseshoe motif on the mug recalls the popular horseshoe-shaped pendants of the Tumulus (Bz B2/C2) and of the late Tumulus-early Urnfield period (Bz D/Ha A1), which survived into the earlier Urnfield period.<sup>9</sup> This ornament was principally popular in eastern Hungary.<sup>10</sup> A similar applied horseshoe motif adorns a vessel from Vajdácška (County Szabolcs-Szatmár-Bereg) (Fig. 2.1).<sup>11</sup> Clay vessels with modelled pendant motifs imitating the period's fashionable jewellery items are

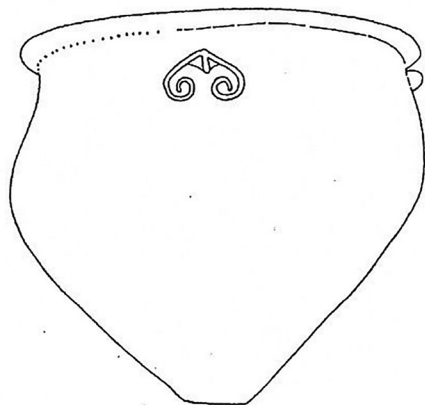
attested in other regions, too: these include a heart-shaped pendant (Vajdácška, Fig. 2.2),<sup>12</sup> a lunular pendant (*Mondförmiger Anhänger mit Mittelzier*, Felsőszőcs/Suciu de Sus, Romania, Fig. 2.3),<sup>13</sup> and a Kisterenye-type pendant (Cârna, com. Goicea, jud. Dolj, Romania, Fig. 2.4).<sup>14</sup> The horseshoe motif on the vessel from Nagykanizsa-Bilkei-dűlő was in all likelihood vested with some symbolic meaning, while the three impressed ring motifs inlaid with high-tin bronze similarly accentuated the vessel's special role. In addition to its aesthetically pleasing appearance, the mug's remarkable decoration suggests that it was a luxury item used by a



1



2



3



4

**Fig. 2.** 1: Vajdácška (H, County Szabolcs-Szatmár-Bereg); 2: Vajdácška (H, County Szabolcs-Szatmár-Bereg), after Kemenczei (1984); 3: Felsőszőcs/Suciu de Sus (R, County Maramureș), after Bader (1980); 4: Cârna (R, County Goicea, jud. Dolj), after David (2020)

<sup>8</sup>Kalicz – Schreiber et al. (2010) 422, Taf. 73.2: Gr. 165

<sup>9</sup>Jankovits (2017) 199–208, Nr. 2517: Debrecen-Fancsika, Nr. 2520: Esztergom-Szentgyörgymező; Pavlin and Stipančić (2023) 144, T.6.14: Gorenji Suhadol in Gorjanci.

<sup>10</sup>Jankovits (2017) 199–211.

<sup>11</sup>Kemenczei (1984) Taf. LVI.11.

<sup>12</sup>Kemenczei (1984) Taf. LVI. 2.

<sup>13</sup>Bader 1980) 45, Abb. 15; Ruttkay (1983) 8, Abb. 3.

<sup>14</sup>Jankovits (2017) Nr. 1291–1298; David (2020) 226, Fig. 8.1.

member of the period's social elite. Its creation reflects a blend of two crafts, having been produced through the work of two craftsmen, a potter and a bronzesmith.

László Horváth contended that the stamped ring motifs on the vessel body had been inlaid with glass paste.<sup>15</sup> Zoltán Szőkefalvi-Nagy and Imre Kovács undertook the PIXE analysis in the HUN-REN Wigner Research Centre for Physics and found that the rings had been accentuated with high-tin bronze (Figs 3 and 4).

## Discussion

According to our current knowledge, tin-decorated vessels made their appearance in Europe during the Bz D period (14th/13th century BC) and have mostly been recovered from lavishly furnished burials.<sup>16</sup> Tin foil or tin sheets were used for adorning the vessels; it seems unlikely that molten tin had been used for this purpose.<sup>17</sup> The remnants of a tin inlay can only be found in the three simple ring motifs on the vessel from Nagykanizsa-Bilkei-dűlő (Fig. 2). A comparable pottery fragment was recovered from Grave 12 at Neftenbach, dated to the Bz D period (14th/13th century BC; Fig. 5.1).<sup>18</sup>

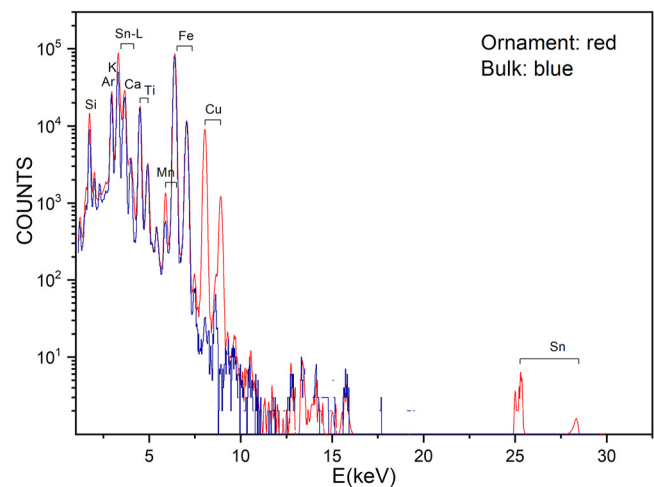
The fragment of a jug-shaped vessel decorated with bronze foil of the Velatice-Baierdorf culture is known from the richly provisioned tumulus burial uncovered at Očkov in Slovakia (Fig. 5.2), which has been dated to the Bz D/Ha A1 period.<sup>19</sup> An amphora-shaped vessel adorned with bronze

foil dating to the Podoli period (Ha B1–B3) has been reported from Brhlovice (okr. Levice, Slovakia; Fig. 5.3);<sup>20</sup> the best analogy to its ornamentation can be found on the vessel from Grave 83 of the Canegrate cemetery (Lombardy) assigned to the Bz D period (Fig. 5.4).<sup>21</sup>

Aside from copper, tin was the other raw material indispensable for the production of bronze. However, in contrast to copper that could be procured more easily, bronze workshops could only acquire tin from more distant sources through their long-distance trade connections.<sup>22</sup> Tin has a lower melting point and its white colour and gleam resembles silver. One important trait of tin is that it is relatively resistant to corrosion. High-tin bronzes, so-called white bronzes, most often in the form of jewellery and pendants, appeared during the earlier Urnfield period in various regions of Europe, such as southern Transdanubia, north-eastern Hungary, Switzerland, Austria and Germany.<sup>23</sup> In her discussion of pendants made of white bronze, Margareta Primas assumed that these articles had a dual function: they could be worn as pretty, sparkling adornments and they could equally well serve as raw material for bronze casting.<sup>24</sup> The examination of the funnel-shaped pendants from Bor and Lazise in northern Italy revealed that their tin content was over 90% and could therefore be categorised as white bronzes.<sup>25</sup>



**Fig. 3.** The PIXE measurement setup for the mug from Nagykanizsa-Bilkei-dűlő. The pointer shows the examined surface



**Fig. 4.** The PIXE spectrum of the mug's ornamentation (red) with the Cu and Sn peaks, the apparent concentrations are  $\text{Cu}_2\text{O}$  1.1%,  $\text{SnO}_2$  2.1%, and the background spectrum of the bulk (blue)

<sup>15</sup>Horváth (2001) 42.

<sup>16</sup>Rittatore (1953–54) 4, Fig. 6, Tab. XII: Canegrate, Grave 83; Paulík (1963) 25, Abb. 16: Očkov; Eibner (1967) 38–48; Ožďani (1977) 465–467, Obr. 4: Brhlovice; Benkovsky-Pivovarová (1991) 72, Taf. 40: Pitten; Fischer (1993) 17–24, Abb. 2.1–3: Neftenbach, Grave 12, 15, 22; Gebhard (1997) 237–244; Nessel (2020) 429–439.

<sup>17</sup>Holmberg (1983) 383–384; Fischer (1993) 21–22; Nessel (2020) 431–434.

<sup>18</sup>Fischer (1993) 19, Abb. 2.1.

<sup>19</sup>Paulík (1962) 25, Abb. 16.

<sup>20</sup>Ožďani (1977) 465, Obr. 1, Obr. 2.

<sup>21</sup>Rittatore (1953–54) 4, Obr.6, Tav. XII; Ožďani (1977) 463–472.

<sup>22</sup>Penhallurick (1986) 67; Fischer (1996) 23, Abb. 9; Nielsen (2014) 177–193, Fig. 3; Radivojević et al. (2019). 131–185.

<sup>23</sup>Primas (1984) 33–42; Primas (1985) 555–562; Windholz-Konrad (2008) 50–52, Abb. 54–55; Salzani (2011) 56, tav.14.5–6; Pernicka and Salzani (2011) 89–98; Nielsen (2014) 177–193, Fig. 6.

<sup>24</sup>Primas (1984) 33–42; Primas (1985) 555–562.

<sup>25</sup>Salzani (2011) 56; Pernicka and Salzani (2011) 89–98.

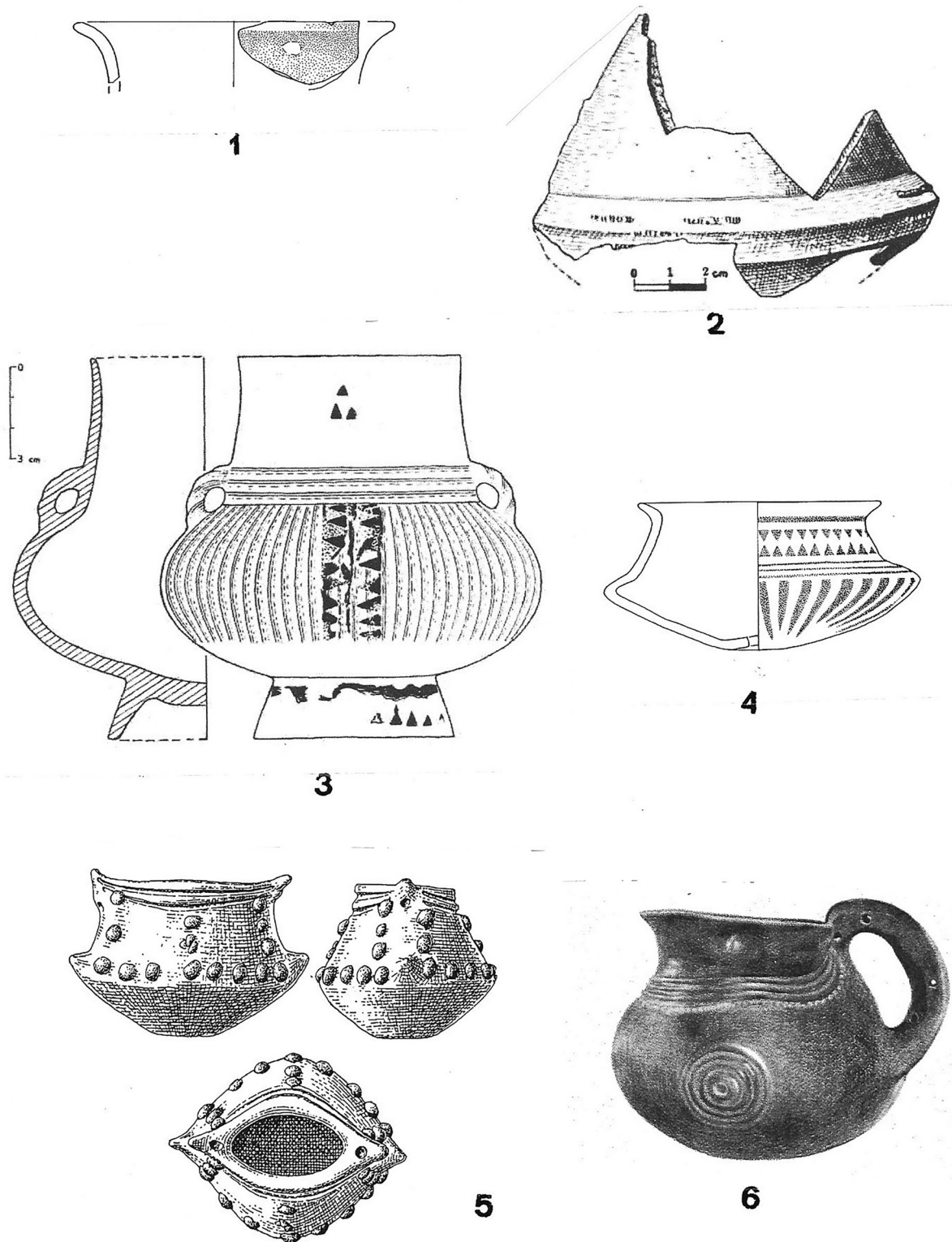


Fig. 5. 1: Neftenbach (Switzerland), Grave 12, after Fischer (1993); 2: Očkov (SK), tumulus grave, after Paulík (1962); 3: Brhlovce (SK, okr. Levice), after Ožd'ani (1977); 4: Canegrate (I, Lombardia), after Rittatore (1954); 5: Beluša (SK, County Povazská Bystrica), after Furmánek et al. (2015); 6: Laganiš (CR, Istria), after Mihovilič (2008)

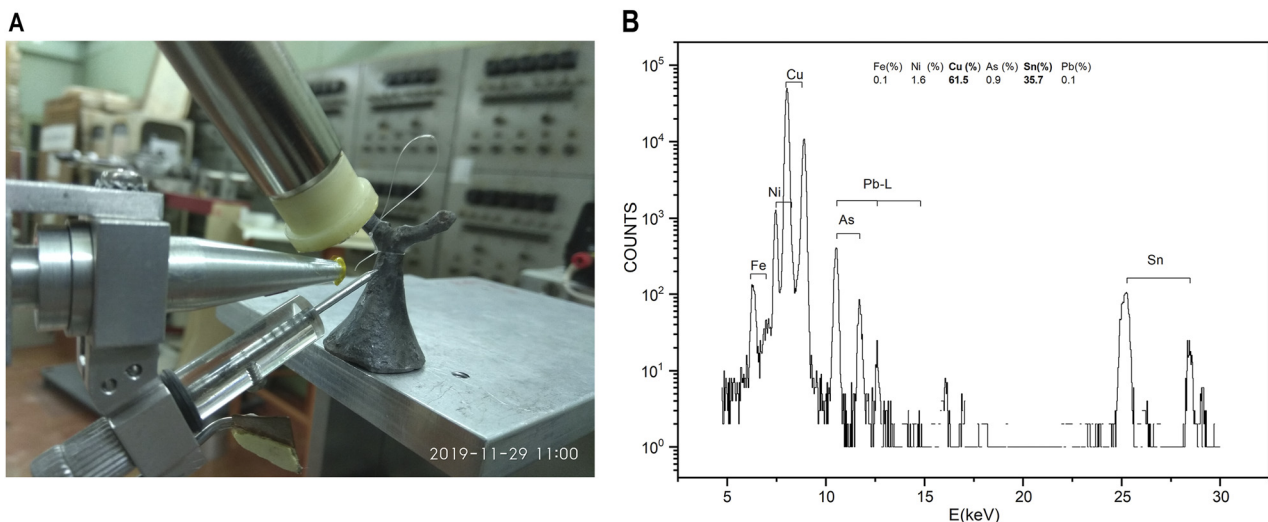
## FUNNEL-SHAPED PENDANTS WITH BIRD PROTOMES OF WHITE BRONZE

Two funnel-shaped pendants with bird protomes of white bronze that had not been thrown onto the funerary pyre

were recovered from Grave 51, a cremation burial in the cemetery investigated by Szilvia Honti at Vörs-Battyáni-Disznólegelő (County Somogy) (Fig. 6).<sup>26</sup> The grave goods – pottery, a dagger fragment, brooch fragments, arming fragments, rings and spiral tubes – date the burial to the Ha A1 period. The PIXE spectrum of both pendants

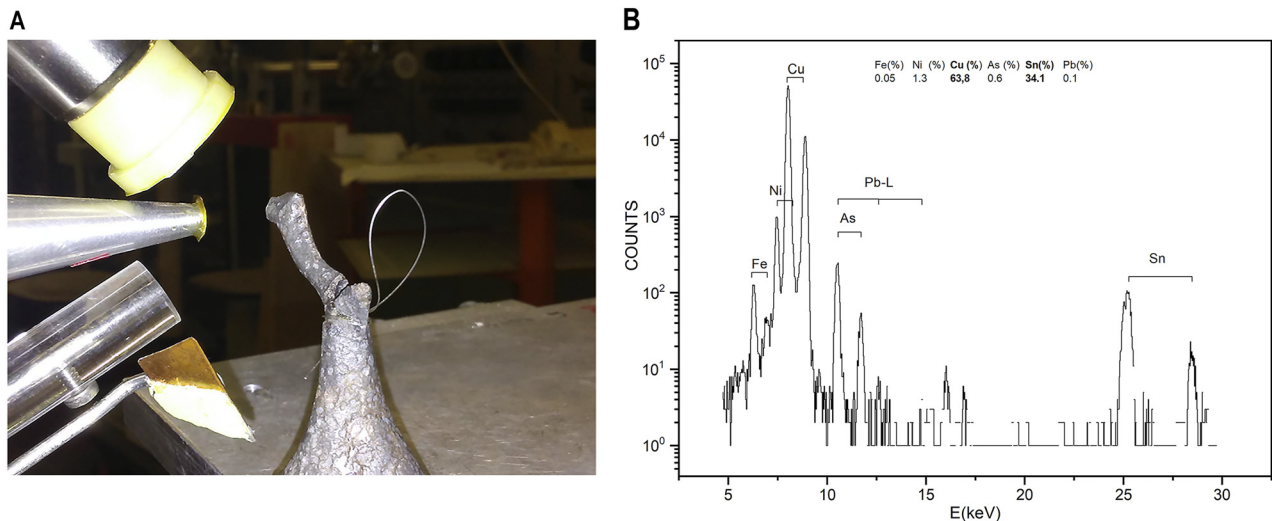


**Fig. 6.** Vörs-Battyáni-Disznólegelő (H, County Somogy), Grave 51, two funnel-shaped pendants with bird protomes from Szilvia Honti's excavation

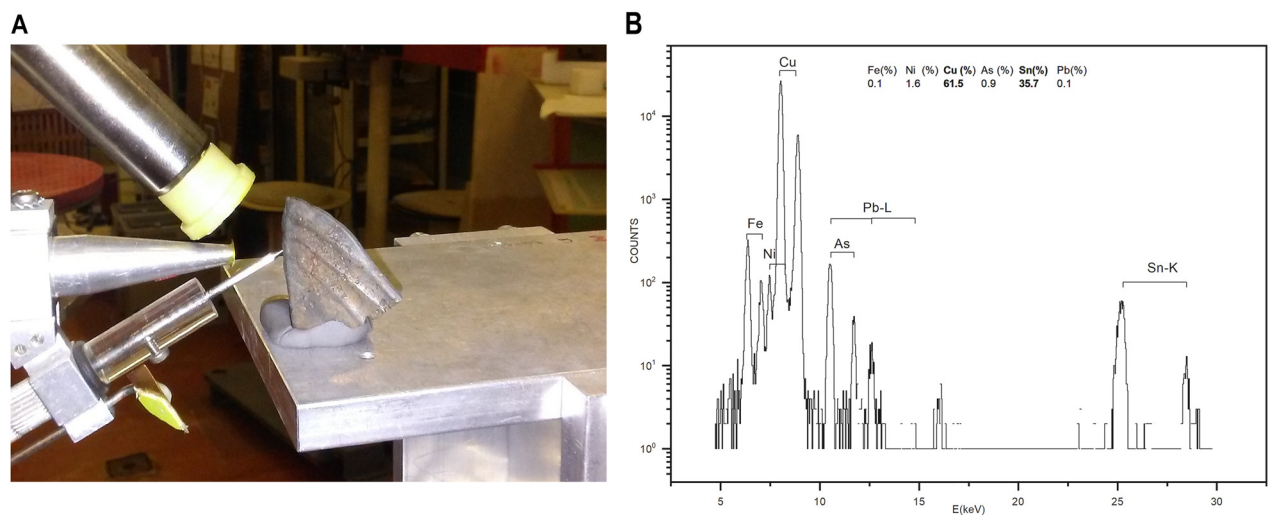


**Fig. 7.** a: The PIXE measurement setup for the intact funnel-shaped pendant with bird protome from Vörs-Battyáni-Disznólegelő, Grave 51; b: The PIXE spectrum with the inserted table showing the composition of the intact pendant from Vörs-Battyáni-Disznólegelő, Grave 51

<sup>26</sup>Honti and Németh (2001) 46–47; Kaposvár, Rippl-Rónai Museum, inv. no. Ö.86.101.8–9.



**Fig. 8.** a: The PIXE measurement setup for the measurement of the fragmentary funnel-shaped pendant with bird protome from Vörs-Battyáni-Disznólegelő, Grave 51; b: The PIXE spectrum with the inserted table showing the composition of the fragmentary pendant from Vörs-Battyáni-Disznólegelő, Grave 51



**Fig. 9.** a: The PIXE measurement setup for the funnel-shaped pendant fragment from the Pamuk hoard; b: The PIXE spectrum and the measured concentration of the pendant from the Pamuk hoard: its material is a high-tin bronze alloy with 35.7% tin

indicated a high tin content (intact funnel-shaped pendant: 61.5% Cu and 35.7% Sn, Fig. 7a and b; fragmentary funnel-shaped pendant: 63.8% Cu and 34.1% Sn, Fig. 8a and b). This pendant type is relatively rare. Bird protomes were prominent religious symbols in the Urnfield period.<sup>27</sup>

<sup>27</sup>Kossack (1954); Müller-Karpe (1979) 29–28; Müller-Karpe (2001) 127–141; Müller-Karpe (2003) 145–154; Müller-Karpe (2006), 680–683; Furmánek (1980, 1997) 313–324; Kilian-Dirlmeier (1979); Mozsolics (1973) 52–53; Mozsolics (1985) 61–63; Paulik (1999) 29–54, Paulik (2000) 29–60; Paulik (2001) 9–72; Kristiansen and Larsson (2005); Reich (2005) 231–239; Guba and Szeverényi (2007) 75–110; Jankovits (2008) 61–71; Pankau (2013) 1–104.

Interestingly, this pendant represents the first piece to have been brought to light from a burial since the other currently known exemplars were all parts of hoards, most of which, such as the Keszőhidegkút, Kurd and Lengyeltóti III hoards, came to light in southern Transdanubia.<sup>28</sup> Given that the pendant was recovered from a cremation burial, virtually nothing is known about how it was worn. Comparable pendants occur in the hoards from

<sup>28</sup>Jankovits (2017) 275–276, Nr. 3299–3304.

Brodski Varoš (Croatia)<sup>29</sup> and Gorenji Suhadol in Gorjanci (Slovenia),<sup>30</sup> in the hoards from Gyöngyössolymos IV (north-eastern Hungary)<sup>31</sup> and from Cincu/Nagysink (Romania).<sup>32</sup> The pendant with bird protome of white bronze was a distinctive product of the bronze industry of southern Transdanubia and the occurrence of similar pieces in other regions is a reflection of the intense connections and interactions between Transdanubia and more distant lands during the earlier Urnfield period.<sup>33</sup>

The large funnel-shaped pendants, representing another widely used type in southern Transdanubia, were similarly made of white bronze, a high-tin alloy (51.3% Cu, 44.3% Sn) as confirmed by the archaeometallurgical examination of the pendant from the Pamuk hoard (Fig. 9a and b).<sup>34</sup>

### CUP ORNAMENTED WITH BRONZE DISCS FROM GRAVE 222 OF THE VÖRS-BATTYÁNI-DISZNÓLEGELŐ CEMETERY (COUNTY SOMOGY)

In Hungary, the adornment of pottery vessels with small domed discs of sheet bronze is first attested in the earlier Urnfield period. Grave 222 of the cemetery excavated by Szilvia Honti at Vörs-Battyáni-Disznólegelő (County Somogy)<sup>35</sup> yielded a handled cup decorated with bronze discs, an extremely rare decorative mode (Fig. 10). The other grave goods deposited in the burial (fragments of bowls, mugs, cups and pots, some with faceted ornamentation, a bronze pin, a conical pendant of sheet bronze, armrings of bronze wire, a bronze bead and spiral tubes) date the burial to the earlier Urnfield period, to the Bz D/Ha A1.

Description of the cup: reddish-brown one-handled cup with curved neck, rounded belly, constricted base and strap handle rising high above the rim, decorated with bronze discs pressed into the vessel body before firing; three discs survive above the fluting on the belly. The cup was fragmented, secondarily burnt on the pyre and is here reconstructed in drawing. H.: ca. 4.9 cm; dR.: ca. 11.3 cm, dB.: ca. 3.7 cm, Kaposvár, Rippl-Rónai Museum, inv. no. Ó.86.101.8–9 (Fig. 10).

The archaeometallurgical examination (PIXE) of the bronze discs adorning the cup revealed that they were made

from a high-tin alloy (72.4% Cu and 22.9 % Sn) (Fig. 11a and b).

Similar cups with high-drawn handle were principally distributed in the Danube region during the earlier Urnfield period: they are attested in the Čaka/Cseke culture,<sup>36</sup> the Velatice-Baiersdorf culture<sup>37</sup> and the Late Bronze Age cultures of north-eastern Hungary,<sup>38</sup> and they are also common in southern Transdanubia.<sup>39</sup> A variant with diagonal fluting on the belly is known from the Nagyrécs-Boróka-dűlő settlement<sup>40</sup> and the Balatonmagyaród-Híd-végpuszta cemetery.<sup>41</sup>

The best analogy to the cup decorated with bronze discs from Grave 222 of the Vörs-Battyáni-Disznólegelő cemetery is a similar vessel of the Terramare culture from Grave 1880/484, a cremation burial, of the cemetery uncovered at Casinalbo (Modena, Italy). The cup was placed on top of the urn. Regrettably, nothing is known about the other grave goods of this burial.<sup>42</sup>

Description of the cup: brownish-greyish-brown cup with lustrous surface, strongly carinated belly and handle drawn high above the rim, decorated with vertical fluting on the body and the handle, six concentric fluted rings on the base, three horizontal rows of three bronze discs separated by fluted lines on the handle and bronze discs between the fluting on the belly (Fig. 12).

It seems likely that these elegant cups with their unique ornamentation served for the consumption of beverages; being luxury items betokening social rank, they had been used by members of the social elite. Similarly as on the cup from Grave 222 of the Vörs-Battyáni-Disznólegelő cemetery, the combination of fluted decoration with bronze discs enhanced the vessel's elegant appearance and value. The vessel itself was the creation of a potter working in conjunction with a bronzesmith. While similar handled cups have been found in other the burials of the Casinalbo cemetery,<sup>43</sup> the cup ornamented with bronze discs is a unique piece among the finds not only in the Casinalbo cemetery, but also in Italy since no similar piece has yet been found in that region. Regrettably, nothing is known about the burial's other grave goods that would enable an accurate dating of the cup. The burial has been dated to the

<sup>29</sup>Vinski-Gasparini (1973) Taf. 56.46.

<sup>30</sup>Pavlin and Stipančić (2023) 154, Pl. 6.13.

<sup>31</sup>Kemenczei (1979) 138, Taf. 5.6; Kemenczei (1984) 148; Jankovits (2017) 275, Nr. 3299.

<sup>32</sup>Petrescu-Dîmbovița (1978) Taf. 90A.47.

<sup>33</sup>Jankovits (2015) 248; Jankovits (2017) 276.

<sup>34</sup>Mozsolics (1985) 168, Taf. 106.18; Jankovits (2017) 276–277, Nr. 3316.

<sup>35</sup>Honti and Németh (2001) 46–47.

<sup>36</sup>Paulík (1963) Obr. 6.8, 12; Obr. 7.12, 13; Čaka Gr. IV; Obr. 29.3: Dolný Peter.

<sup>37</sup>Lochner (1991) 276, Typ A.

<sup>38</sup>Kemenczei (1984) Taf. XVII.2: Gelej, Kanális-dűlő; Taf. LXXX.2: Szajla; Taf. CXXV. Debrecen-Nyulas; Taf. CXXXIV.13: Tiszakeszi-Szódadomb.

<sup>39</sup>Patek (1968) Taf. LXXV.3; Kőszegi (1988) Taf. 7A. 7: Lengyel; Szilvia Honti's 1997 excavation, Vörs-Battyáni-Disznólegelő, Grave 677: two cups; Száraz (2020) Taf. 120.3: Nagykanizsa-Bilkei-dűlő.

<sup>40</sup>Száraz (2020) Taf. 125.2, 126.9.

<sup>41</sup>Száraz (2020) Taf. 137.1–3.

<sup>42</sup>Crespellani (1882) 19–20, tav. II.11; Säflund (1939) 199, tav. 78.3; Limido (1978) 203–204, tav. 8.42; Cardarelli and Tirabassi (1997) 678, fig. 382; Cardarelli (2014) 407, 532, Fig. 249.1.

<sup>43</sup>Cardarelli (2014) 191, Fig. 127: Grave 3/1; 287, Fig. 172: Grave 207/2.





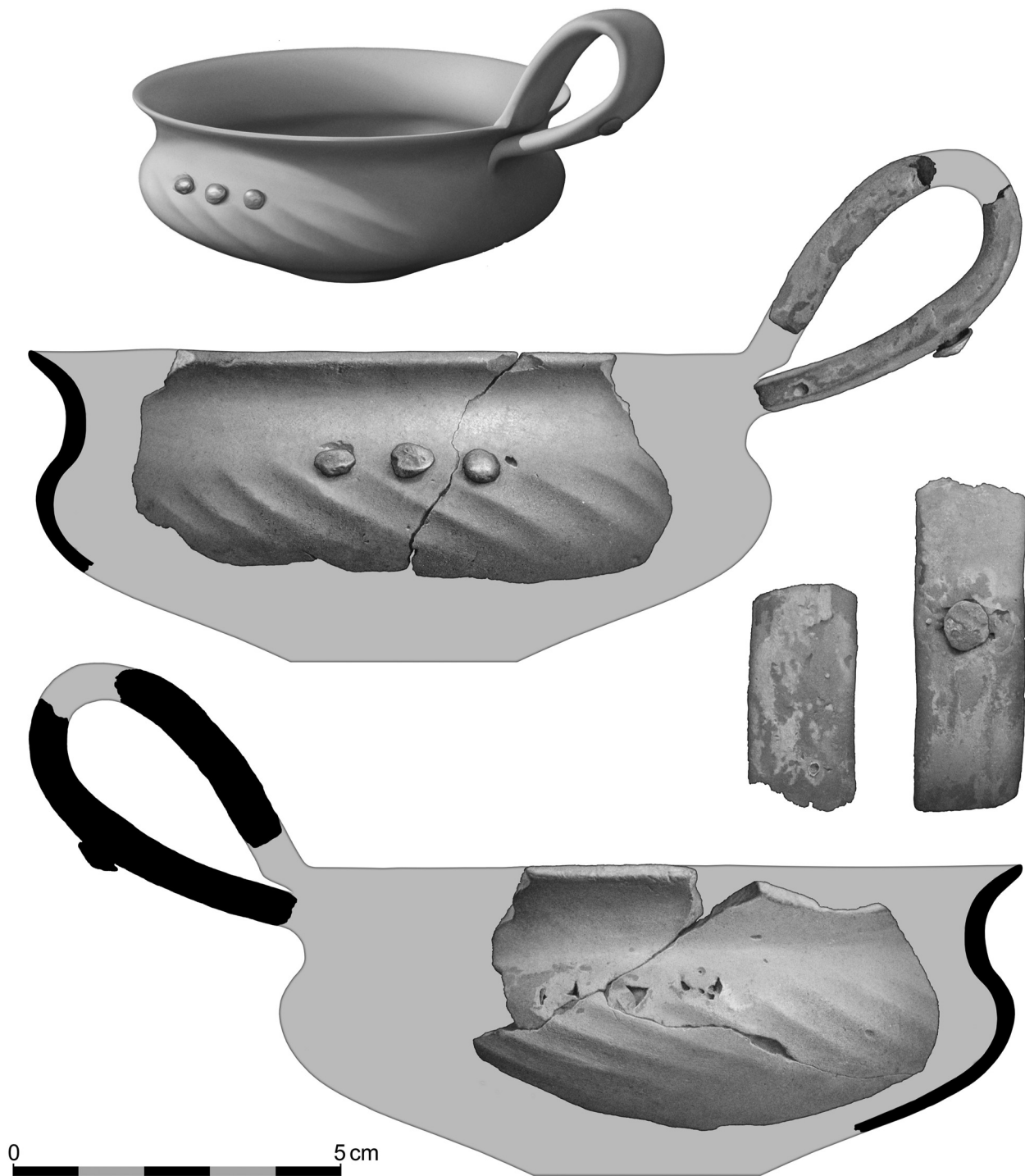


Fig. 10. Vörs-Battyáni-Disznólegelő (H, County Somogy), Grave 222, cup decorated with bronze discs

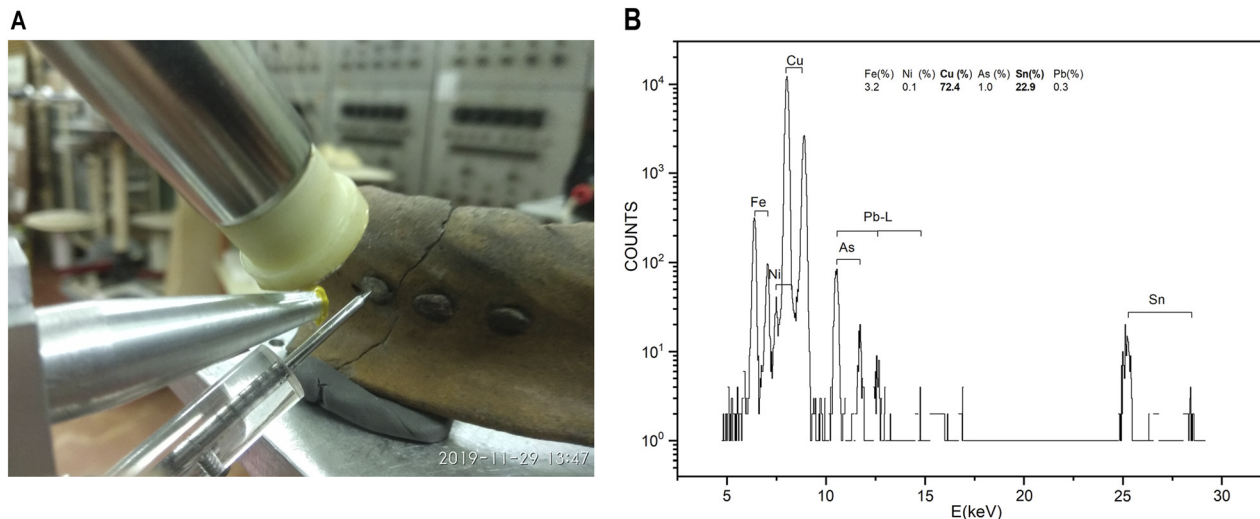
“bronzo recente 2” period (14th/13th century BC).<sup>44</sup> The cremation cemetery of the Terramare culture at Casinalbo contained more than 2000 graves that have been dated between 1500 and 1200 BC.<sup>45</sup> The cremation rite

represented a novel way of the disposal of the dead on the Apennine Peninsula during this period and has been regarded as a reflection of cultural impulses from Central Europe and the Balkans.<sup>46</sup>

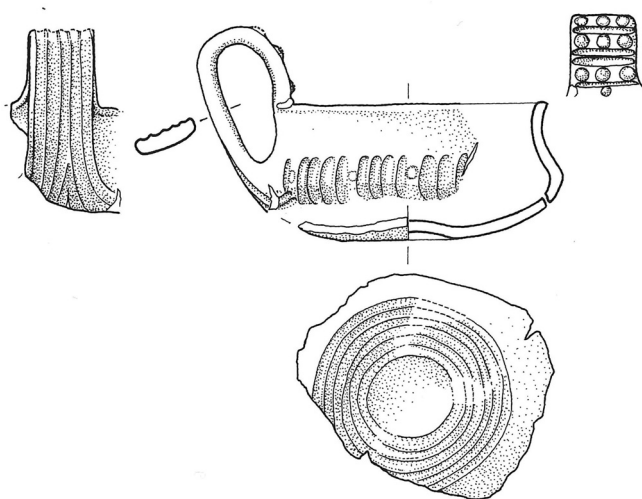
<sup>44</sup>Cardarelli (2014) 645, Fig. 399.

<sup>45</sup>Cardarelli (2014).

<sup>46</sup>Cardarelli et al. (2020) 231–243; Cavazzuti et al. (2022) 45–86.



**Fig. 11.** a: The PIXE measurement setup for the measurement of the cup decorated with bronze discs from Vörs-Battyáni-Disznólegelő, Grave 222; b: The PIXE spectrum measured on the middle disc and its composition of the cup from Vörs-Battyáni-Disznólegelő, Grave 222. The material of the decorative disc is bronze with a tin content of ca. 10–20%



**Fig. 12.** Casinalbo (I, Modena) cemetery, cup decorated with bronze discs from Grave 1880/484 (after Cardarelli, 2014)

## VESSELS DECORATED WITH BRONZE DISCS FROM THE LATE URNFIELD CEMETERY OF BUDAPEST-BÉKÁSMEGYER

The cemetery's use spanned the Ha A2/B2–B3 period; most of the burials containing vessels decorated with bronze discs and the greater part of the cemetery can be assigned to the Ha B1–B2 period.<sup>47</sup> A total of 22 boot-shaped vessels were recovered from 19 burials of the Békásmegyer cemetery (of these, 19 were intact, one was fragmentary and only sherds survived of the remaining two). Two of these vessels, the

<sup>47</sup>Kalicz-Schreiber (1991) 161–162; Kalicz-Schreiber et al. (2010) 319–320.

exemplars recovered from Graves 47<sup>48</sup> and 51,<sup>49</sup> were decorated with bronze discs. The modelling of these two boot-shaped vessels differs. The toe of the boot vessel from Grave 47 is perforated and the laces are depicted by vertical and horizontal lines. The vamp is decorated with three, the quarters with one decorative disc (Fig. 13.1).<sup>50</sup> The vamp of the boot vessel from Grave 51 was originally adorned with five discs from the toe upward, of which only traces survive (Fig. 13.2).<sup>51</sup> This burial was extraordinarily richly provisioned: the grave goods included a disc-shaped amber bead, a bowl, an amphora-shaped vessel decorated with bronze discs and six balls probably made from resin studded with bronze discs.

Boot vessels in all likelihood had a special function: their use can be linked to the presentation of liquid offerings (*libatio*), with the perforation through the toe for pouring the liquid. Their role resembled that of the rhytons used during various ceremonies.<sup>52</sup> Boot vessels became widespread during the Late Bronze Age in Central and Eastern Europe, and were popular in the Urnfield, Lausitz, Kyjatice and Gáva cultures in the Carpathian Basin, Bohemia, Moravia, northern Austria, Germany, and central and eastern Poland,<sup>53</sup> and they are attested also in the Mediterranean.<sup>54</sup> The best analogy to the boot vessel from Grave 51 of the Békásmegyer cemetery comes from Grave 34 of the Le Franchine (I, Oppeano)

<sup>48</sup>Kalicz-Schreiber et al. (2010) 45, Taf. 26.1.

<sup>49</sup>Kalicz-Schreiber et al. (2010) Taf. 28.3.

<sup>50</sup>Kalicz-Schreiber et al. (2010) 45, Taf. 26.1.

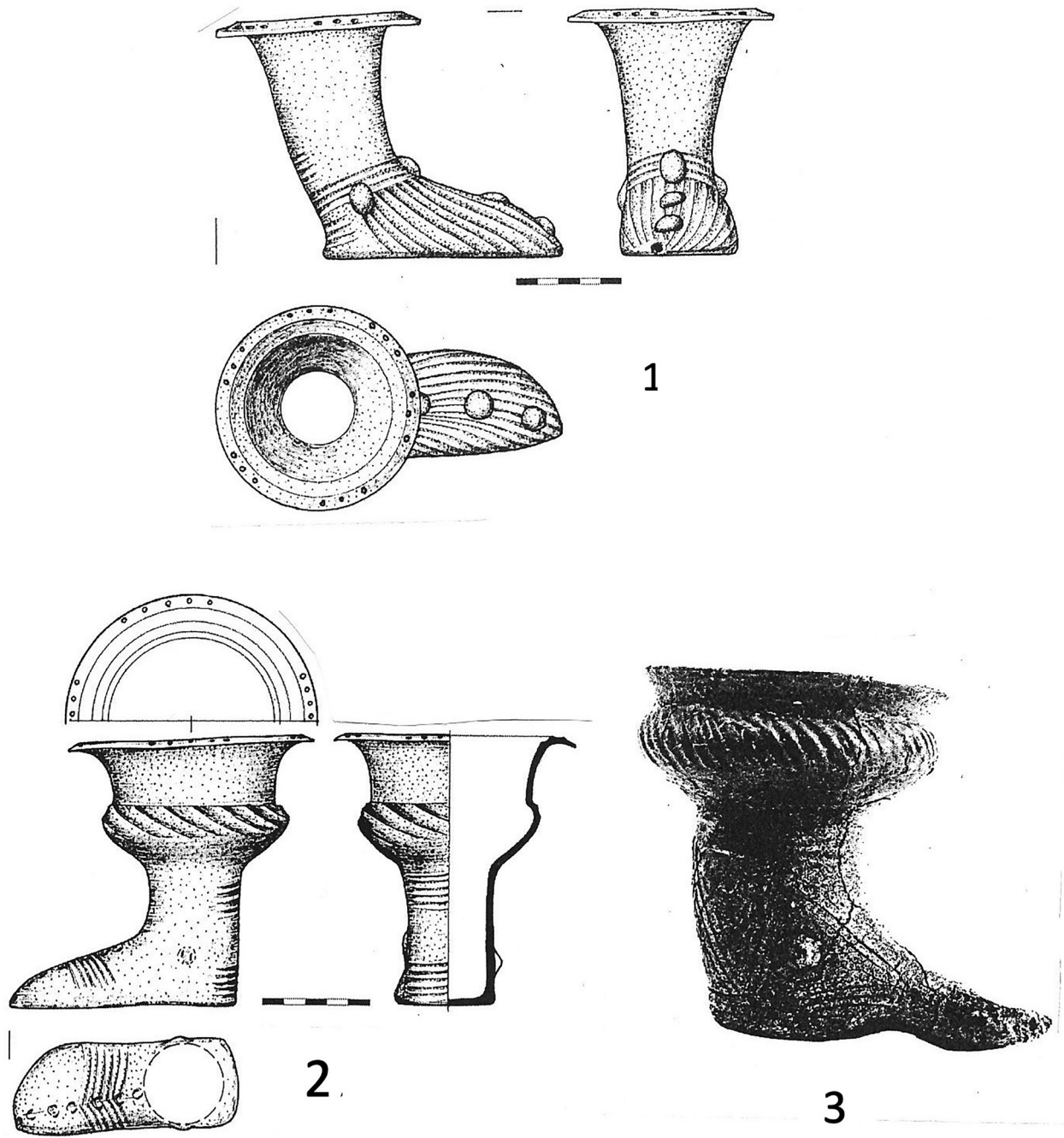
<sup>51</sup>Kalicz-Schreiber et al. (2010) Taf. 28.3

<sup>52</sup>Kossack (1954); Kalicz-Schreiber and Kalicz (1997) 365–367; Kalicz-Schreiber et al. (2010); Nebelsick (2016).

<sup>53</sup>Kovács (1981) 65–78; Kalicz-Schreiber (1997) 365–367; Jankovits (2006) 313–316, Fig.1; Baitinger (2007) 54, Abb. 61; Kalicz-Schreiber et al. (2010) 290–292.

<sup>54</sup>Kohle (2013) 49–70; D'Onofrio (2017) 27–52.





**Fig. 13.** Budapest-Békásmegyer (H) cemetery, boot-shaped vessels decorated with bronze discs: 1. Grave 47; 2. Grave 51 (after [Kalicz-Schreiber et al., 2010](#)); 3. Le Franchine (I, Oppeano), Grave 34 (after [Salzani, 1987](#))

cemetery dating to the 9th century BC ([Fig. 13.3](#)),<sup>55</sup> an indication of the connections between the Carpathian Basin and northern Italy during the Urnfield period.

Amphora-shaped vessels represent the ceramic type most frequently enhanced with bronze discs. Amphora-shaped vessels lacking handles were recovered from six

burials. Two vessels from Grave VIII were decorated with bronze discs: on one vessel, the discs were arranged in an inverted T formation on the shoulder, part of a garland motif ([Fig. 14.1](#)),<sup>56</sup> while on the other vessel, the biconical middle part was adorned with a garland motif combined with bronze discs pressed into the vessel in a similar inverted

<sup>55</sup>Salzani (1985) 73, Fig. 90; Salzani (1987) 146–147, Fig. 4; Jankovits (2006) 313, Fig. 1.7; Fig. 1.10.

<sup>56</sup>Kalicz-Schreiber et al. (2010) 22, Taf. 4.1.

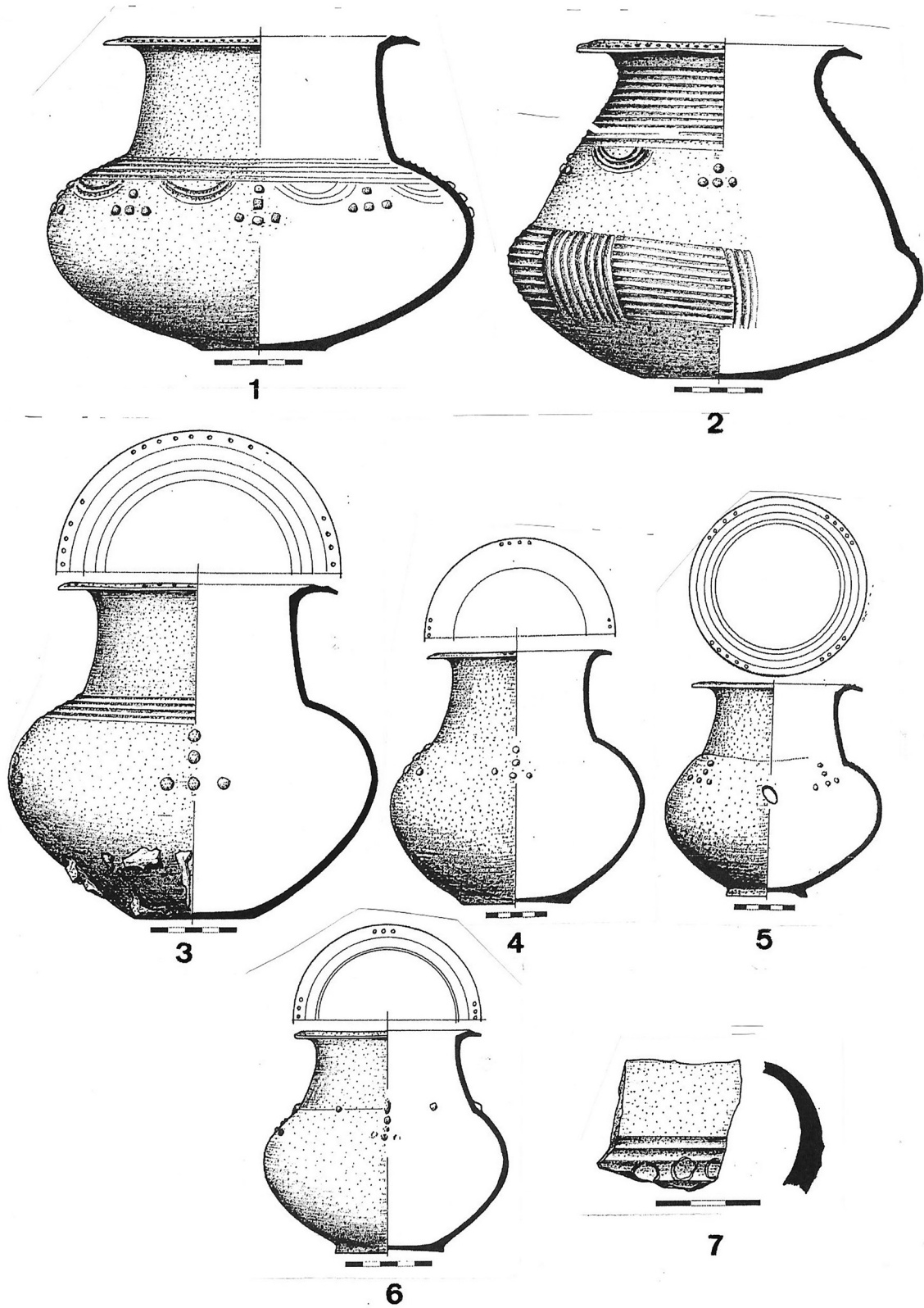


Fig. 14. Budapest-Békásmegyer (H), amphora-shaped vessels decorated with bronze discs: 1-2. Grave VIII; 3. Grave 51; 4-5. Grave 56; 6. Grave 118; 7. Grave 52 (after Kalicz-Schreiber et al., 2010)

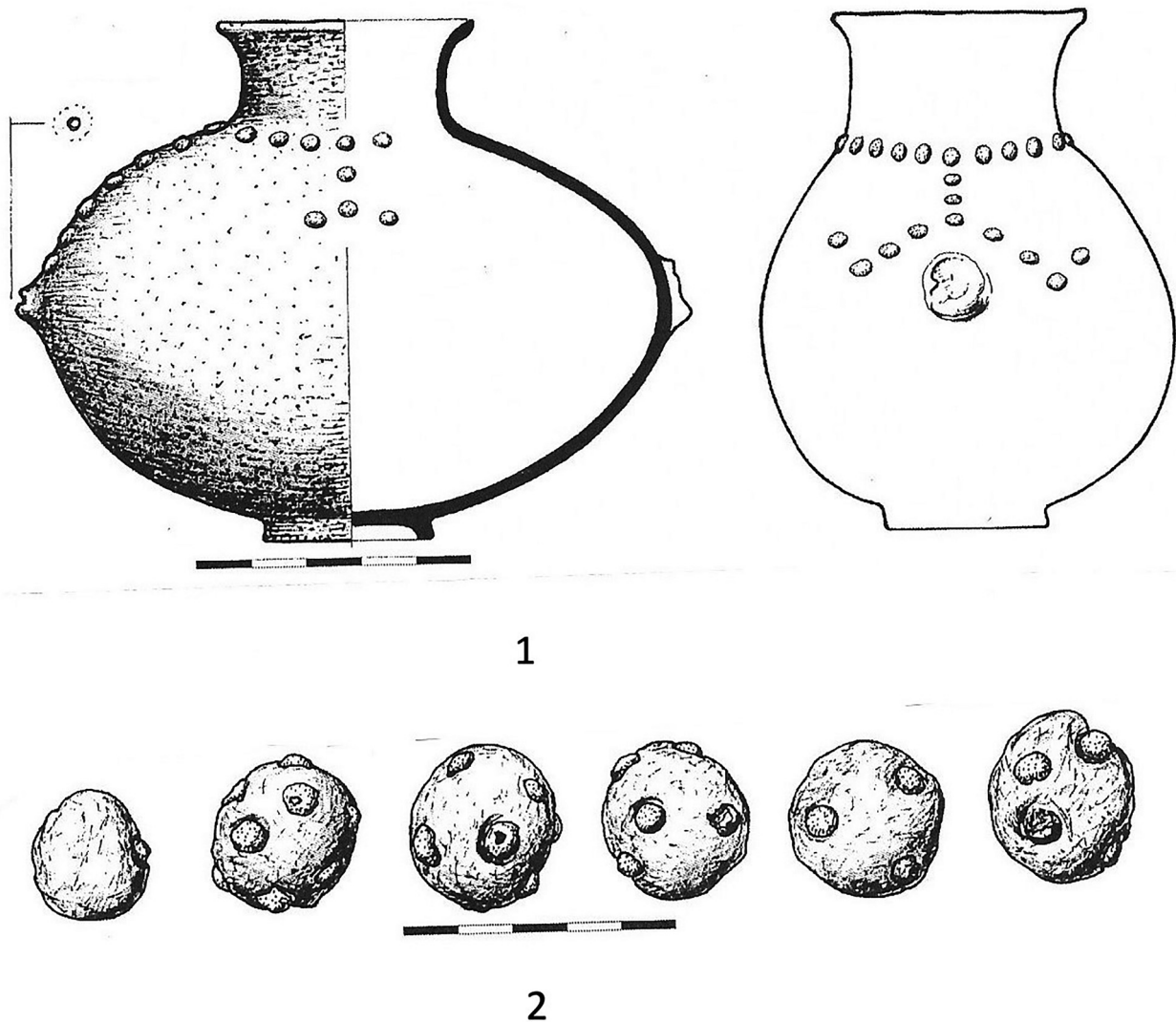
T-shaped arrangement (Fig. 14.2).<sup>57</sup> On the vessel from Grave 51, the bronze discs forming an inverted T motif accentuate the vessel's rounded body (Fig. 14.3).<sup>58</sup> The one-time position of the bronze discs can still be made out on the body fragment of the vessel from Grave 52 (Fig. 14.7).<sup>59</sup> Two amphora-shaped vessels from Grave 56 were adorned with four groups of bronze discs arranged in an inverted T formation (Fig. 14.5 and 6).<sup>60</sup> The shoulder of the amphora from Grave 118 was similarly decorated with four groups of bronze discs forming an inverted T motif (Fig. 14.4).<sup>61</sup>

A feeding vessel (*Sauggefäß*) decorated with bronze discs was recovered from Grave 58: the bronze discs accentuating

the shoulder were combined with similar bronze discs arranged in an inverted Y motif underneath (Fig. 15.1).<sup>62</sup> The burial also contained a boot vessel, although without a decoration of bronze discs.

The grave goods of Grave 51 included balls studded with bronze discs (Fig. 15.2) that were presumably child toys.<sup>63</sup> The richly furnished burial yielded a boot vessel and an amphora-shaped vessel, both adorned with bronze discs,<sup>64</sup> already mentioned in the above.

In the Budapest-Békásmegyér cemetery, ornamentation with bronze discs appears to have been employed on vessels that presumably served some ritual purpose. The discs were



**Fig. 15.** Budapest-Békásmegyér (H). 1. Feeding bottle decorated with bronze discs from Grave 58; 2. balls decorated with bronze discs from Grave 51 (after Kalicz-Schreiber et al., 2010)

<sup>57</sup>Kalicz-Schreiber et al. (2010) 22, Taf. 4.2.

<sup>58</sup>Kalicz-Schreiber et al. (2010) 46, Taf. 28.2.

<sup>59</sup>Kalicz-Schreiber et al. (2010) 47, Taf. 29.5

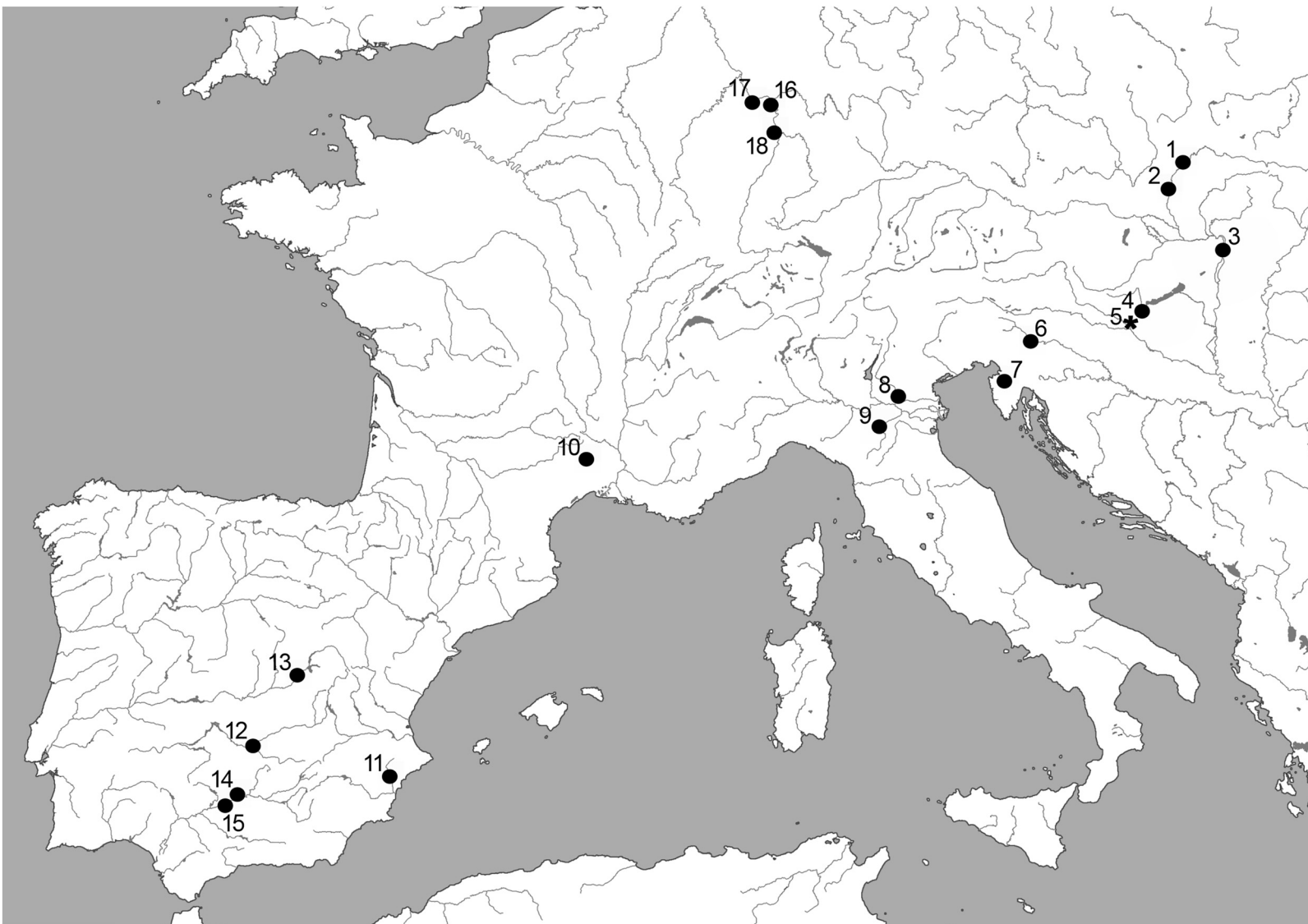
<sup>60</sup>Kalicz-Schreiber et al. (2010) 49, Taf. 31.1,5.

<sup>61</sup>Kalicz-Schreiber et al. (2010) Taf. 56.3.

<sup>62</sup>Kalicz-Schreiber et al. (2010) 51, Taf. 32.4.

<sup>63</sup>Kalicz-Schreiber et al. (2010) 47, Taf. 28.7.

<sup>64</sup>Kalicz-Schreiber et al. (2010) 46, Taf. 28.3, Taf. 28.2.



**Fig. 16.** Distribution of metal-decorated pottery in the European Bronze Age, circle: decorated with bronze discs, star \*: decorated with tin. 1. Beluša (SK), 2. Očkov (SK), 3. Budapest-Békásmegyer (H), 4. Vörs-Batthyány-Disznólegelő (H), 5. Nagykanizsa-Bilkei-dűlő (H), 6. Ljubljana (SL), 7. Laganiš Cave (CR), 8. Frattesina (I), 9. Casinalbo (I), 10. Navacelles-Gard (FR), 11. Caramoro (SP), 12. Cerro de Alarcos (SP), 13. Cerro de La Muela/La Alcazaba (SP), 14. Llanete de los Moros (SP), 15. Colina de los Quenados (SP), 16. Nierstein (D), 17. Bad Kreuznach (D), 18. Rheingönheim (D) (after [Nessel, 2020](#), complemented with the new sites)



added before the vessels were fired. The discs were applied to prominent parts of the vessels, accentuating their form and achieving an elegant aesthetic appearance. The creation of these vessels called for the joint work of potters and bronzesmiths.

## THE DISTRIBUTION OF POTTERY ADORNED WITH BRONZE DISCS

In Europe, the ornamentation of vessels with domed discs of sheet bronze appeared during the formative Urnfield period and is attested in central Germany, in Slovakia and Hungary in the Carpathian Basin, and in Slovenia, Italy and Spain farther to the south (Fig. 16).<sup>65</sup> Grave 12 of the Beluša cemetery (County Povazská Bystrica, Slovakia) yielded a vessel of the Lausitz culture with a unique ornamentation of large bronze discs (Fig. 5.5) that was assigned to the Bz D/Ha A1 period by Václav Furmánek.<sup>66</sup> A handled cup studded with bronze discs has been published from Laganiš Cave (Istria, Croatia), a site lying south of Transdanubia: the discs adorned the neck, the handle and the concentric fluting on the belly (Fig. 5.6).<sup>67</sup> The site yielded several other fluted cups with high-drawn handle dating from the 12th/11th century BC whose analogies can be found in the cemeteries of the local Urnfield culture.<sup>68</sup> Farther to the south, a similar ornamentation occurs on a vessel from Grave 1880/484 of the Casinalbo cemetery (Modena area, Italy) assigned to the “bronzó recente 2” period (Fig. 12).<sup>69</sup> A pottery fragment found on the Frattesina settlement (Veneto, Italy) dated to the Ha A2 period is similarly adorned with a bronze disc.<sup>70</sup> Chronologically, the next piece is the vessel from Grave 35 of the Ljubljana cemetery, dated to the Ha B period.<sup>71</sup> The accentuation of vessels with bronze discs can be noted from the Ha B period onward in the eastern Alpine region (Ruše, Maribor, Ljubljana),<sup>72</sup> a decorative mode which in Michaela Lochner’s view reached this region from Italy.<sup>73</sup> The adornment of vessels with tiny bronze discs appears on elegant tableware from the Late Bronze Age onward (10th/8th century), mainly in the distribution of the Tartésos culture in the Guadalquivir valley in southern Spain.<sup>74</sup> This decorative mode became more widespread in Veneto, Etruria, and Slovenia during the Early Iron Age.<sup>75</sup>

<sup>65</sup>Nessel (2020) Fig. 1 – complemented with the new sites.

<sup>66</sup>Furmánek (1997) 435, Abb. 3; Furmánek et al. (2015) 209, Obr. 185.

<sup>67</sup>Mihovilič (2008) 16–17.

<sup>68</sup>Mihovilič (2008) 17.

<sup>69</sup>Cardarelli (2014) Tomo I, 407, Fig. 249/1.

<sup>70</sup>Bellintani (1992) 248, Fig. 3.19.

<sup>71</sup>Mihovilič (2008) 17.

<sup>72</sup>Staré (1964) 395, Pl. IX.7, Pl. X.65; Mihovilič (2008) 16–17.

<sup>73</sup>Lochner (1986) 302.

<sup>74</sup>Torres Ortiz (2001) 275–281, Fig. 1; Fig. 2.

<sup>75</sup>Mihovilič (2008) 16–17; Nessel (2020) 429–439.

## CONCLUSION

The ornamentation of different pottery types with domed discs of sheet bronze can be principally noted on the luxury vessels used by the social elite, which have been recovered from both burials and settlements. These vessels were produced through the joint work of two specialised artisans, potters and bronzesmiths, calling for well-organised work processes. The metal adornments applied to pottery had a tin content of 10–22.9% (Figs 4 and 11b). This decorative mode was most widespread in the Carpathian Basin, where most of these vessels were brought to light in the Urnfield cemetery uncovered at Budapest-Békásmegyér. Regrettably, the bronze discs adorning the vessels from this burial ground have not yet been submitted to archaeometallurgical examination. Various articles of white bronze, mainly pendants with a high tin content of 35–44.3%, are principally known from southern Transdanubia (Figs 7b, 8b and 9b). These pendants could have been worn as jewellery pieces or could have served as the valuable, less easily procurable tin raw material needed for bronze casting.

## ACKNOWLEDGEMENTS

We are grateful to Szilvia Honti and Csilla Száraz for their permission to conduct a PIXE analysis of the finds, to Krisztián Balla for preparing the drawings and the map, and to Magdaléna Seleanu for the English translation. We also thank the unknown reviewers for their useful advice.

## REFERENCES

- Bader, T. (1980). *Marturii archeologice din judetul Satu Mare* [Archaeological finds from Szatmár County]. Satu Mare.
- Baitinger, H. (2007). Ein Schuhgefäß der Urnenfelderzeit von Glauberg, Wetteraukreis (Hessen). *Germania*, 85(1): 47–59.
- Bellintani, P. (1992). Frattesina di Fratta Polesone: Il materiale ceramico conservato presso il Museo Civico di Rovigo. *Padusa*, 26–27: 245–297.
- Benkovsky-Pivovarová, Z. (1991). *Das mittelbronzezeitliche Gräberfeld von Pitten in Niederösterreich*, 3. Mitteilungen der Prähistorischen Kommission der Österreichische Akademie der Wissenschaften, 3. Wien.
- Campbell, J.L., Hopman, T.L., Maxwell, J.A., and Nejedly, Z. (2000). The Guelph PIXE software package, III: alternative proton database. *Nuclear Instruments and Methods in Physics Research*, B 170: 193–204.
- Cardarelli, A. (2014). *La necropoli della terramara di Casinalbo*, 1–2. Grandi contesti e problemi della protostoria italiana, 15. All’Insegna del Giglio, Sesto Fiorentino.
- Cardarelli, A. and Tirabassi, J. (1997). Le necropoli delle terramare emiliane. In: Bernabò Brea, M., Cardarelli, A., and Cremaschi, M. (Eds.), *Le terramare. La prima civiltà padana*. Electa, Milano, pp. 677–682.



- Cardarelli, A., Cavazzuti, C., Fritze, M., Gavranović, M., Hajdu, T., Kiss, V., Köhler, K., Kulcsár, G., Melis, E., Ribay-Salisbury, K., Szabó, G., and Szeverényi, V. (2020). The connections between the plains of the Po and the Danube during the Bronze Age seen through the spread of the “Urnfield model”. In: Bernabò Brea, M. (Ed.), *Italia tra Mediterraneo ed Europa: mobilità, interazioni e scambi*. Rivista di Scienze Preistoriche, 70, S1. Firenze, pp. 231–243.
- Cavazzuti, C., Arena, A., Cardarelli, A., Fritze, M., Gavranović, M., Hajdu, T., Kiss, V., Köhler, K., Kulcsár, G., Melis, E., Rebay-Salisbury, K., Szabó, G., and Szeverényi, V. (2022). The first “Urnfields” in the plains of the Danube and the Po. *Journal of World Prehistory, published online: 18 March 2022*, 35: 45–86. <https://doi.org/10.1007/s10963-022-09164-0> (Accessed 10.12.2023).
- Crespellani, A. (1882). Scavi del Modenese. Relazione (1880). *AMDSP (Atti e memorie Deputazioni di storia patria province Emilia, n.s., 7(2): 10–21*.
- David, W. (2020). L'Italia settentrionale tra il sud del centro Europa ed il Bacino Carpatico. Contatti transalpini nelle prima metà del secondo millennio BC tra Pianura Padana e alto e medio Danubio. In: Bernabò Brea, M. (Ed.), *Italia tra Mediterraneo ed Europa: mobilità, interazioni e scambi*. Rivista di Scienze Preistoriche, 70, S1. Firenze, pp. 219–230.
- D'Onofrio, A.M. (2017). Working tools, toilet implements and personal adornments in weapon burials at early Iron Age Athens and Lefkandi. *Studi Micenei ed Egeo Anatolici*, 3: 27–52.
- Eibner, Cl. (1967). Zu einem metallfolienverzierten Beigefäß der jüngeren Urnenfelderbestattung aus Niederösterreich. *Archäologie Austriaca*, 42: 38–48.
- Fischer, C. (1993). Zinnnachweis auf Keramik der Spätbronzezeit. *Archäologie der Schweiz*, 16: 17–24.
- Furmánek, V. (1980). *Bronzezeitliche Anhänger in der Slowakei*. Prähistorische Bronzefunde, XI/3. München.
- Furmánek, V. (1997). Bronzeanhänger als Belege für Kontakte des Karpatenbeckens mit dem östlichem Mittelmeerraum. In: Dobiat, C. and Leidorf, K. (Hrsg.) *Chronos. Festschrift für Bernhard Hänsel*. Studia honoraria, 1. Espelkamp, pp. 313–324.
- Furmánek, V., Bátor, J., Oždáni, O., Mitáš, V., Kujovský, R., and Vladár, J. (2015). *Staré Slovensko 4: Doba bronzová* [Prehistory of Slovakia, 4: Bronze Age]. *Archaeologica Slovaca, Monographiae*, 4. Archeologický Ústav Slovenskej Akadémie Vied, Nitra.
- Gebhard, K. (1997). Eine zinnfolienverzierte urnenfelderzeitliche Scherbe aus dem hessischen Ried. *Archäologisches Korrespondenzblatt*, 27: 237–244.
- Guba, Sz. and Szeverényi, V. (2007). Bronze Age bird representations in the Carpathian Basin. *Communicationes Archaeologicae Hungaricae*, 2007: 75–110.
- Gyódi, I., Demeter, I., Hollós-Nagy, K., Kovács, I., and Szókefalvi-Nagy, Z. (1999). External-beam PIXE analysis of small sculptures. *Nuclear Instruments and Methods in Physics Research*, B 150: 605–610.
- Holmberg, K. (1983). Application of tin to ancient pottery. *Journal of Archaeological Science*, 10(4): 383–384.
- Honti, Sz. and Németh, P.G. (2001). Vörs, Battyáni-disznólegelő (Somogy megye). Excavation of a Late Bronze Age cemetery at Vörs-Battyáni-disznólegelő (County Somogy). In: Mesterházy, K. (Ed.), *Archaeological reports 1997*. Régészeti füzetek, I.51(1998). Magyar Nemzeti Múzeum, Budapest, pp. 46–47.
- Horváth, L. (2001). Késő bronzkori település feltárása Nagykanizsán. Excavation of a Late Bronze Age settlement at Nagykanizsa. In: Mesterházy, K. (Ed.), *Archaeological reports 1997*. Régészeti füzetek, I.51(1998). Magyar Nemzeti Múzeum, Budapest, pp. 37–43.
- Jankovits, K. (2006). Nuovi dati sui rapporti tra i vasi a forma di stivale dell'area danubiana e quelli veneti tra la tarda età del bronzo e l'inizio dell'età del ferro. In: *Studi di Protostoria in onore di Renato Peroni*. All'Insegna del Giglio, Sesto Fiorentino, pp. 313–316.
- Jankovits, K. (2008). The symbolism and the wearing fashion of jewelry-pendants during the Bronze Age in Hungary – Die Symbolik und die Trachtweise der bronzezeitlicher Anhänger in Ungarn. In: Anati, E. (Ed.), *Prehistoric art and ideology. Colloquium, UISPP Session C27*. British archaeological reports, International series (Supplementary), 1872. Oxford, pp. 61–71.
- Jankovits, K. (2015). Neue Angaben zu den Kontakten zwischen den Karpatenbecken und Norditalien auf grund einiger spätbronzezeitlicher Schmucktypen. In: Szathmári, I. (Hrsg.), *An der Grenze der Bronze- und Eisenzeit. Festschrift für Tibor Kemenczei zum 75. Geburtstag*. Magyar Nemzeti Múzeum, Budapest, pp. 235–252.
- Jankovits, K. (2017). *Die bronzezeitlichen Anhänger in Ungarn*. Studia ad archaeologiam Pazmaniensia, 9. Budapest.
- Johansson, S.A.E., Campbell, J.L., and Malmqvist, K.G. (1995). *Particle-induced X-ray emission spectrometry (PIXE)*. Wiley, New York.
- Kalicz-Schreiber, R. (1991). Das spätbronzezeitliche Gräberfeld von Budapest (Ungarn). *Prähistorische Zeitschrift*, 88: 161–196.
- Kalicz-Schreiber, R. and Kalicz, N. (1997). Die Stiefelgefäße des spätbronzezeitliches Gräberfeldes von Budapest-Békásmegyer. In: Dobiat, C. and Leidorf, K. (Hrsg.), *Chronos. Festschrift für Bernhard Hänsel*. Studia honoraria, 1. Espelkamp, pp. 353–371.
- Kalicz-Schreiber, R. (2010). *Ein Gräberfeld der Spätbronzezeit von Budapest-Békásmegyer*. Bearbeitet und fertiggestellt von N. Kalicz und G. Váczi. Mit Beiträgen von B. Hänsel und B. Heußner. Budapest.
- Kemenczei, T. (1979). A Gyöngyössolymos-kishegyi negyedik bronzlelet (Der vierte Bronzefund von Gyöngyössolymos-Kishegy). *Agria. Az Egri Múzeum Évkönyve*, 16–17(1978–79): 137–155.
- Kemenczei, T. (1984). *Die Spätbronzezeit Nordostungarns*. *Archaeologia Hungarica, Series nova*, 51. Budapest.
- Kilian-Dirlmeier, I. (1979). *Anhänger in Griechenland von der mykenischen bis zur spätgeometrischen Zeit (Griechisches Festland, Ionische Inseln, dazu Albanien und Jugoslawisch Mazedonien)*. Prähistorische Bronzefunde, XI/2. München.
- Kohle, M. (2013). Schuhgefäße der Bronze- und Eisenzeit. Überlegungen zur Funktion und Bedeutung. *Ethnographische Archäologische Zeitschrift*, 54(1–2): 49–70.
- Kossack, G. (1954). *Studien zum Symbolgut der Urnenfelder- und Hallstattzeit Mitteleuropas*. Römisch-Germanische Forschungen, 20. Berlin.
- Kovács, T. (1981). Bronzezeitliche Tradition in der hallstattzeitlichen Kunst Transdanubiens. In: Eibner, Cl. (Red.), *Die Hallstattkultur. Bericht über das Symposium in Steyer 1980 aus*





- Anlass der Internationalen Ausstellung des Landes Oberösterreich*. Linz, pp. 65–78.
- Köszegi, F. (1988). *A Dunántúl története a későbronzkorban – The history of Transdanubia during the Late Bronze Age*. BTM műhely, 1. Budapest.
- Kristiansen, K. and Larsson, T.B. (2005). *The rise of Bronze Age society. Travel, transmissions and transformations*, Cambridge.
- Limido, C. (1978). La necropoli terramaricola di Casinalbo. *Annali Benacensi*, 4: 197–208.
- Lochner, M. (1986). Ein urnenfelderzeitliches Keramikdepot aus Oberravelsbach, Niederösterreich. *Archaeologia Austriaca*, 70: 295–315.
- Lochner, M. (1991). *Studien zur Urnenfelderkultur im Waldviertel – Niederösterreich*. Hrsg. von H. Friesinger. Mitteilungen der Prähistorischen Kommission, 25. Wien.
- Mihovilić, K. (2008). Vessel decorated with bronze appliques. In: Komšo, D. (Ed.), *Peina Laganiši. Mjesto životai smrti – Laganiši cave. A place of life and death*. Pula, pp. 16–17.
- Mozsolics, A. (1973). *Bronze- und Goldfunde des Karpatenbeckens. Depotfundhorizonte von Forró und Ópályi*. Budapest.
- Mozsolics, A. (1985). *Bronzefunde aus Ungarn. Depotfundhorizonte von Aranyos, Kurd und Gyermely*. Budapest.
- Müller-Karpe, H. (1979). Bronzezeitliche Heilszeichen. *Jahresbericht des Instituts für Vorgeschichte der Universität Frankfurt am Main*, 1978–79, pp. 9–28.
- Müller-Karpe, H. (2001). Religionsgeschichtliche Komponente der mediterran-mitteuropäischen Kontakte von der Bronzezeit bis zur Spätantike. *Anodos. Studies of the Ancient World*, 1: 127–141.
- Müller-Karpe, H. (2003). Zur religiösen Symbolik von bronzezeitlichem Trachtschmuck aus Mitteleuropa. *Anodos. Studies of the Ancient World*, 3: 145–154.
- Müller-Karpe, H. (2006). Cielo e sole come simboli divini nell'età del bronzo. In: *Studi di protostoria in onore di Renato Peroni*. All'Insegna del Giglio, Sesto Fiorentino, pp. 680–683.
- Nebelsick, L.D. (2016). *Drinking against death. Studies on the materiality and iconography of ritual, sacrifice and transcendence in later prehistoric Europe*. Warszawa.
- Nessel, B. (2020). Metal appliques in Bronze Age Europe. Searching for the meaning behind tacks, buckles and lamellas. In: Kozubová, A., Makarová, E., and Neumann, M. (Eds.), *Ultra verum temporis. Venované Jozefovi Bátorovik 70. narodeninám*. Slovenska Archeológia, Supplementum, 1. Nitra, pp. 429–439.
- Nielsen, E. H. (2014). A Late Bronze Age tin ingot from Sursee-Gammainseli (Kt. Luzern). *Archäologisches Korrespondenzblatt*, 44: 177–193.
- Ožďani, O. (1977). Amfora podolskej kultúry s kovovou výzdobou z Brhloviec [Amphora of the Podol culture with metal decoration from Brhlovice]. *Slovenska Archeológia*, 25: 463–472.
- Pankau, C. (2013) (2015). Das spätbronzezeitliche Wagengrab von Königsbronn (Lkr. Heidenheim). *Jahrbuch des Römisch-Germanischen Zentralmuseums*, 60(1): 1–103.
- Patek, E. (1968). *Die Urnenfelderkultur in Transdanubien*. Archaeologia Hungarica, 44. Budapest.
- Paulík, J. (1962). Das veletice-baierdoerfer Hügelgrab in Očkov. *Slovenska Archeológia*, 10: 5–96.
- Paulík, J. (1963). K problematike čakanskej kultúry v Karpatskjej kotline – Zur Problematik der Čaka-Kultur im Karpatenbecken. *Slovenska Archeológia*, 11: 269–338.
- Paulík, J. (1999). Nález hlinenej vtácej lodky v Dvorníkoč Posádke – Der Fund einer tönernen Vogelbarke in Dvorníky-Posádka, I. *Zborník Slovenského Národného Múzea, História*, 9: 29–54.
- Paulík, J. (2000). Nález hlinenej vtácej lodky v Dvorníkoč Posádke – Der Fund einer tönernen Vogelbarke in Dvorníky-Posádka, II. *Zborník Slovenského Národného Múzea, História*, 10: 29–60.
- Paulík, J. (2001). Nález hlinenej vtácej lodky v Dvorníkoč Posádke – Der Fund einer tönernen Vogelbarke in Dvorníky. Posádka, III. *Zborník Slovenského Národného Múzea, História*, 11: 9–72.
- Pavlin, P. and Stipančić, P. (2023). Bronastodobni depo iz Gorenjega Suhadola na Gorjancih – Bronze Age hoard from Gorenji Suhadol in Gorjanci. *Arheološki Vestnik*, 74: 125–160.
- Penhallurick, R.D. (1986). *Tin in Antiquity. Its mining and trade throughout the ancient world with particular reference to Cornwall*. London.
- Pernicka, E. and Salzani, P. (2011). Remarks on the analyses and future prospects. In: Aspes, A. (Ed.), *Bronzi del Garda. Valorizzazione delle collezioni di bronzi preistorici di uno dei più importanti centri metallurgici dell'Europa del II millennio a.C.* Memorie del Museo Civico di Storia Naturale di Verona, 2. serie: Sezione scienze dell'uomo, 11. Verona, pp. 89–98.
- Petrescu-Dîmbovița, M. (1978). *Die Sichel in Rumänien*. Prähistorische Bronzefunde, XVIII/1. München.
- Primas, M. (1984). Bronzezeitliche Schmuck aus Zinn. *Helvetica Archaeologica*, 15: 33–42.
- Primas, M. (1985). Tin objects in Bronze Age Europe. In: Liverani, M., Palmieri, A., and Peroni, R. (Eds.), *Studi di Paleontologia in onore di Salvatore M. Puglisi*. Università di Roma “La Sapienza”, Roma, pp. 555–562.
- Radivojević, M., Roberts, B.W., Pernicka, E., Stos-Gale, Z., Martínón-Torres, M., Rehren, T., Bray, P., Brandherm, D., Ling, J., Mei, J., Vandkilde, H., Kristiansen, K., Shennan, S.J., and Broodbank, C. (2019). The provenance, use, and circulation of metals in the European Bronze Age. The state of debate. *Journal of Archaeological Research*, 27: 131–185.
- Reich, C. (2005). Vogelmenschen und Menschenvögel. Bronzezeitliche Mensch-Darstellungen im mittleren und unteren Donaauraum. In: Horejs, B., Jung, R., Kaiser, E., and Teržan, B. (Eds.), *Interpretationsraum Bronzezeit. Bernhard Hänsel von seinen Schülern gewidmet*. Universitätsforschungen zur prähistorischen Archäologie, 121. Bonn, pp. 231–239.
- Rittatore, F. (1954). La necropoli di Canegrate. Centro di Studi Preistorici e archeologici, Musei Civici di Villa Mirabello, Varese. *Sibrium*, 1(1953–54): 7–43.
- Ruttkay, E. (1983). *Zur Deutung der Depotfunde vom Typus Tolnanémedi im Zusammenhang mit dem Idol von Babska*. Annales Naturhistorisches Museum, Wien, 85/A, pp. 1–17.
- Säflund, G. (1939). *Le terramare delle province di Modena, Reggio Emilia, Parma, Piacenza*. Acta Instituti Romani Regni Sueciae, 8. Uppsala.
- Salzani, L. (1985). Le Franchine (Comune di Oppeano). In: Salzani, L. (Ed.), *Preistoria e protostoria nella media pianura veronese*. Vago di Lavagno, pp. 73–80.
- Salzani, L. (1987). Le Franchine di Oppeano. In: *Prima della storia. Inediti di 10 anni di ricerche a Verona. Catalogo della mostra tenuta a Verona nel 1987*. Verona.
- Salzani, P. (2011). I materiali del progetto, „I bronzi del Garda”: primi risultati e prospettive future. In: Aspes, A. (Ed.), *Bronzi del*



- Garda. *Valorizzazione delle collezioni di bronzi preistorici di uno dei più importanti centri metallurgici dell'Europa del II millennio a.C.* Memorie del Museo Civico di Storia Naturale di Verona, 2. serie: Sezione scienze dell'uomo, 11. Verona, pp. 47–87.
- Staré, F. (1964). Kipeč ilirskoga bojevnika z Vač – Statuette eines illyrischen Kriegers aus Vače. Brodarjev zbornik. *Arheološki Vestnik*, 13–14(1962–63): 383–434.
- Szárász, Cs. (2020). *A Zala és Mura folyók térsége (Zala megye) a késő bronzkorban. Késő halomsíros és urnasíros időszak* (Das Gebiet der Flüsse von Zala und Mura (Bezirk Zala) in der Spätbronzezeit (Späthügelgräber- und Urnenfelderzeit). PhD Thesis. Eötvös Loránd University, Budapest.
- Torres Ortiz, M. (2001). La cerámica a manos con decoración de botones de bronce: una aportación al estudio de la alfarería tartésica del Bronce Final. *SPAL. Revista de prehistoria y arqueología de la Universidad de Sevilla*, 10: 275–281.
- Vinski-Gasparini, K. (1973). *Kultura polja sa žarama u sjevernoj Hrvatskoj (Die Urnenfelderkultur in Nordkroatien)*. Sveučilište u Zagrebu, Filozofski fakultet u Zadru, monografije, 1. Zadar.
- Windholz-Konrad, M. (2008). *Der prähistorische Depotfund vom Brandgraben, Steiermark. Schätze, Gräber, Opferplätze. Archäologie im Salzkammergut. Ausstellungskatalog, Traunkirchen*. Fundberichte aus Österreich, Materialhefte, Reihe A, Sonderheft, 6. Wien.

