

# Wind from the South? Mace head from Surowica in the light of formal and metallurgical analysis

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## WIND FROM THE SOUTH? MACE HEAD FROM SUROWICA IN THE LIGHT OF FORMAL AND METALLURGICAL ANALYSIS

### ABSTRACT

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A mace head with a socket was incidentally discovered in 2020 in the locality of Surowica in the Podkarpackie Voivodeship. On the basis of analogies, it can be dated to the 14<sup>th</sup> century. These analogies also indicated that the artefact was in all probability manufactured in the territory of the Kingdom of Hungary. Metallurgical analyses demonstrated that the mace head was cast of copper with natural admixtures by using the lost wax method. Regrettably, the present state of knowledge does not allow an exact identification of the places of the manufacture of such artefacts.

Keywords: Halych-Volodymyr Rus', Red Rus', Hungary, Middle Ages, mace head, archaeometallurgy

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In 2020, a mace head was handed over to the collection of the Subcarpathian Museum in Krosno; the artefact had been discovered on the site of the non-existent village of Surowica (Jaśliska Commune, Krosno District, Podkarpackie Voivodeship) during the course of a legal prospection with a metal detector that was conducted by Mr Klaudiusz Kotulak. The artefact was recorded in the museum inventory under the number MPK-A-4956, and the find site of the mace head was recorded in the register of archaeological monuments as Surowica, Site 1 (Archaeological Record of Poland AZP 115-75/3). The discovery was made in a forest complex that was located to the north of the former buildings of the village (Plot 63) on the south-western slope (shelving toward the River Wisłok) of a nameless hill that is part of the Low Beskid mountains at a height of about 447 m a.s.l. (Fig. 1). The artefact was found near a stream and a forest road that was used for the hauling of wood. It was deposited in a mixed layer at a depth of about 10-15 cm and was not accompanied by any other finds. No verification research has been carried out thus far at the spot of the discovery.

The mace head from Surowica (Fig. 2) is multifaceted in the projection from above and is composed of five large centrally placed quadrilateral spikes that are slightly flattened as well as ten smaller spikes (the latter are trilateral and less-pronounced). The spaces between the spikes are filled with slats that are semi-oval in the transverse cross-section. The

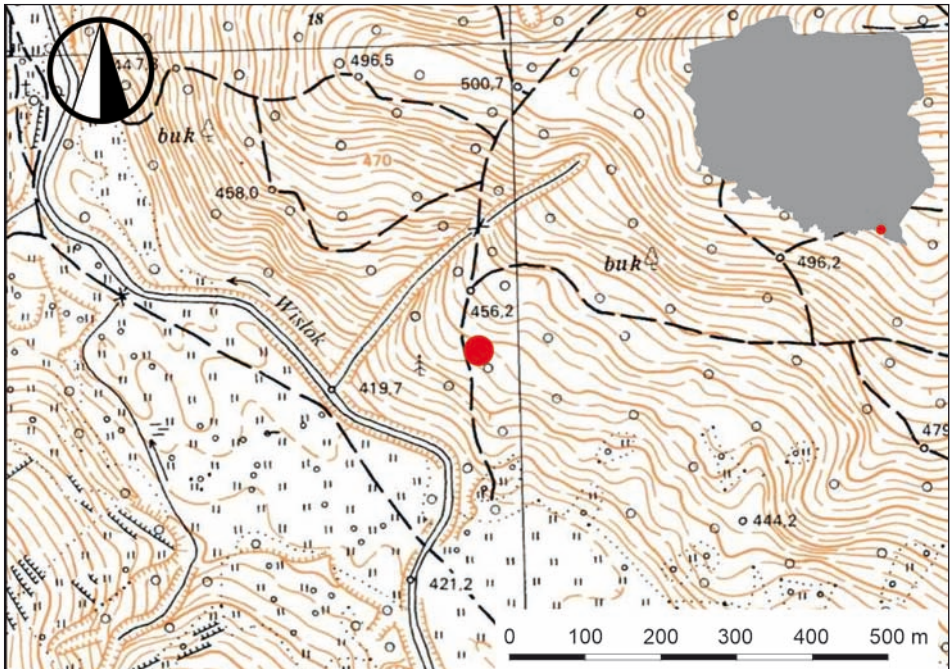


Fig. 1. Surowica, Jaśliska Commune, Krosno District, Podkarpackie Voivodeship – location of find site of mace head (P. Kotowicz)

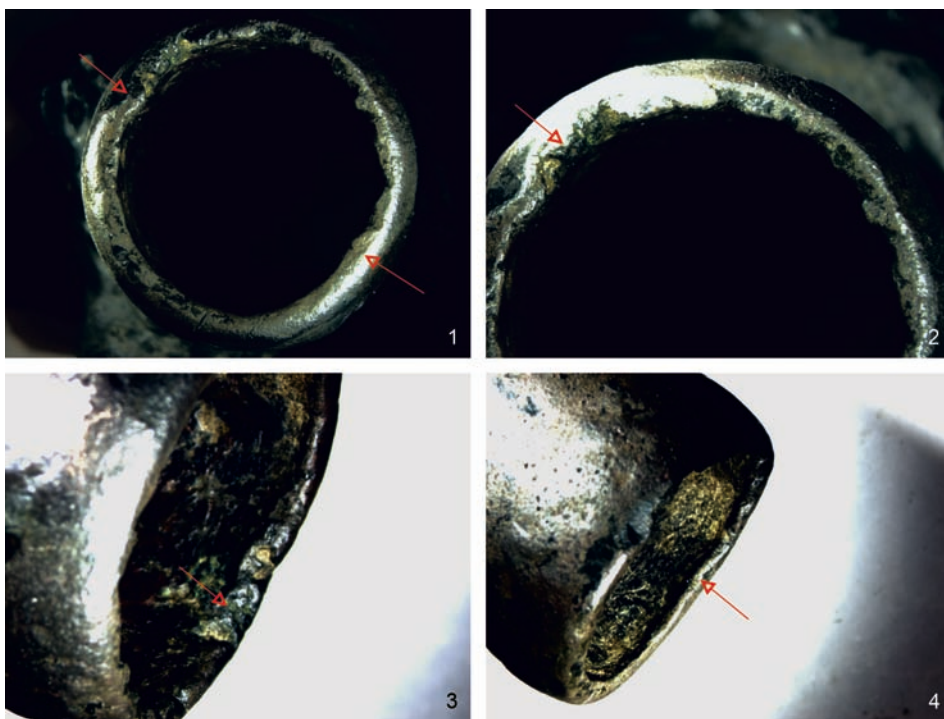


Fig. 2. Mace head from Surowica, Krosno District, with marked sampling spot for metallurgical analyses (photos by P. Szuwalski – processed by P. Kotowicz)

slats are arranged in a crosswise manner and are isolated from the spikes by notable grooves. The upper plane of the mace head is flat, while it transforms into a round socket at the bottom and ends with a thickened ring. This ring is semi-oval in cross-section and is ornamented with diagonal and not-very-pronounced grooves. A conical round opening for fastening the shaft goes through the entire mace head. The upper rim of the opening ends in an irregular manner. On the other hand, the lower edge of the socket is bent slightly upward. The find underwent conservation in the Conservation Department of the Subcarpathian Museum in Krosno.

The height of the artefact is 5.9 cm, the socket length is 3.1 cm, and the maximum width of the mace head is 5.2 cm. The diameter of the socket at the inlet is 2.3 cm, and the diameters of the shaft opening are 1.9 cm at the inlet and about 1.1 cm at the outlet. The weight of the mace head is 222 g.

Metal science analyses were conducted to examine the manufacturing technology of the mace head from Surowica as well as to assess its utilitarian values. The analysis of the manufacturing technology was carried out on the basis of macro- and microscopic observations using a NIKON SMZ 745T stereoscopic microscope with a digital camera and an



**Fig. 3.** Mace head from Surowica:

- 1 – lower flange with remains of gating system; 2-3 – broken-off part of ring (remains of gating system);  
4 – rounded part of ring with processed trace of gating system (photos by P. Jurecki)

NIS-ELEMENTS image-analysis system. The examinations of the chemical composition were conducted with a SPECTRO Midex spectrometer using the ED-XRF method.

The mace head was made by casting. Macroscopic observations of the surface and the analysis of the artefact allowed us to conclude that an investment casting method called the “lost-wax casting technique” (*cire perdue*) was used, with a core imitating the internal part of the cast artefact (Kotowicz *et al.* 2024). In the mould, the mace head was turned upward with the socket. The gating system, formed by two channels and a pouring cup, was symmetrically connected to the flange of the socket (Fig. 3: 1-4). Regarding the manufacturing technique, the following technological stages were isolated: (I) preparing a wax model on the core; (II) preparing a one-time-use clay mould; and (III) performing the casting operation itself. All of the elements (including the spikes and the ornaments) were prepared on the wax model (Fig. 4: 1-8). Before pouring the liquid alloy into the mould, the wax model had to be melted away from it, and the clay mould itself had to be fired to provide it with the proper fire resistance. After breaking the clay mould and removing the core and the gating system, the surface processing was carried out; this was done by grinding.



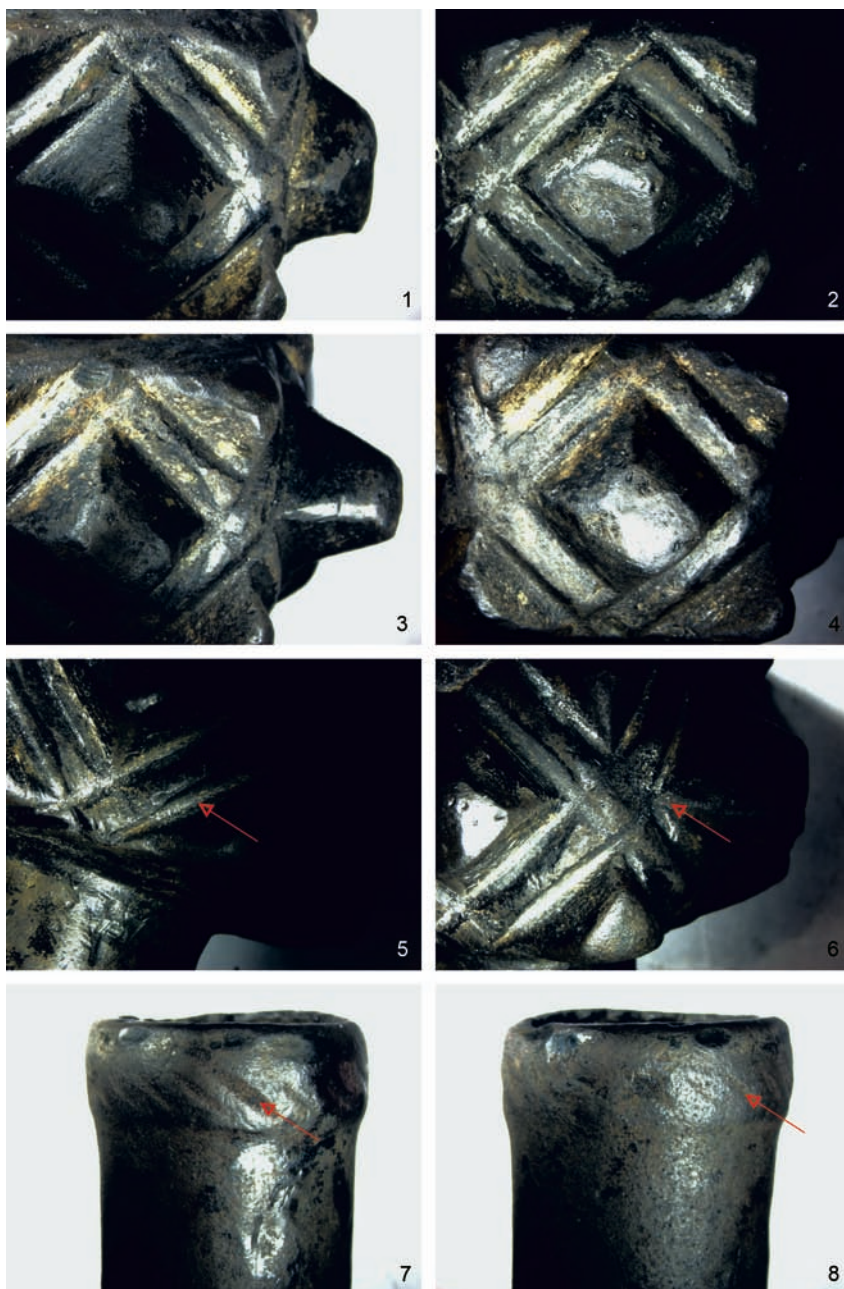


Fig. 4. Mace head from Surowica:

1-4 – quadrilateral spikes modelled in wax; 5-6 – ornaments made on wax model and deepened by grinding;  
7, 8 – ornaments made on wax model (photos by P. Jurecki)

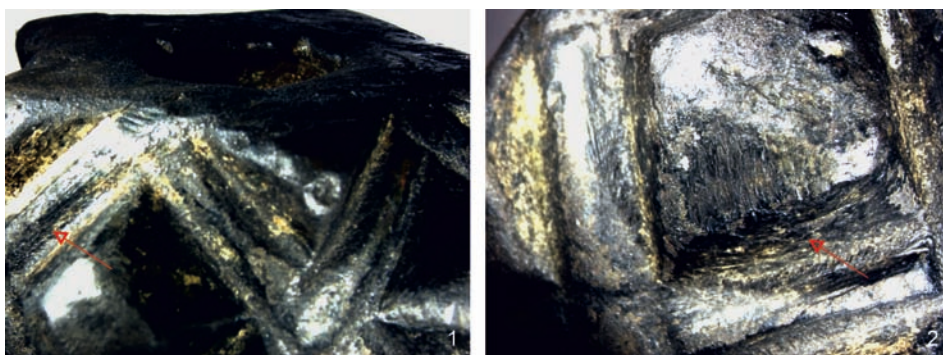
**Table 1.** Chemical composition of mace head from Surowica on basis of ED-XRF analysis (wt.%)  
(A. Garbacz-Klempka)

Fe	Co	Ni	Cu	Zn	As	Ag	Sn	Sb	Pb	Bi
1.52	0.27	2.26	88.52	0.11	4.25	0.30	0.10	1.99	0.44	0.24

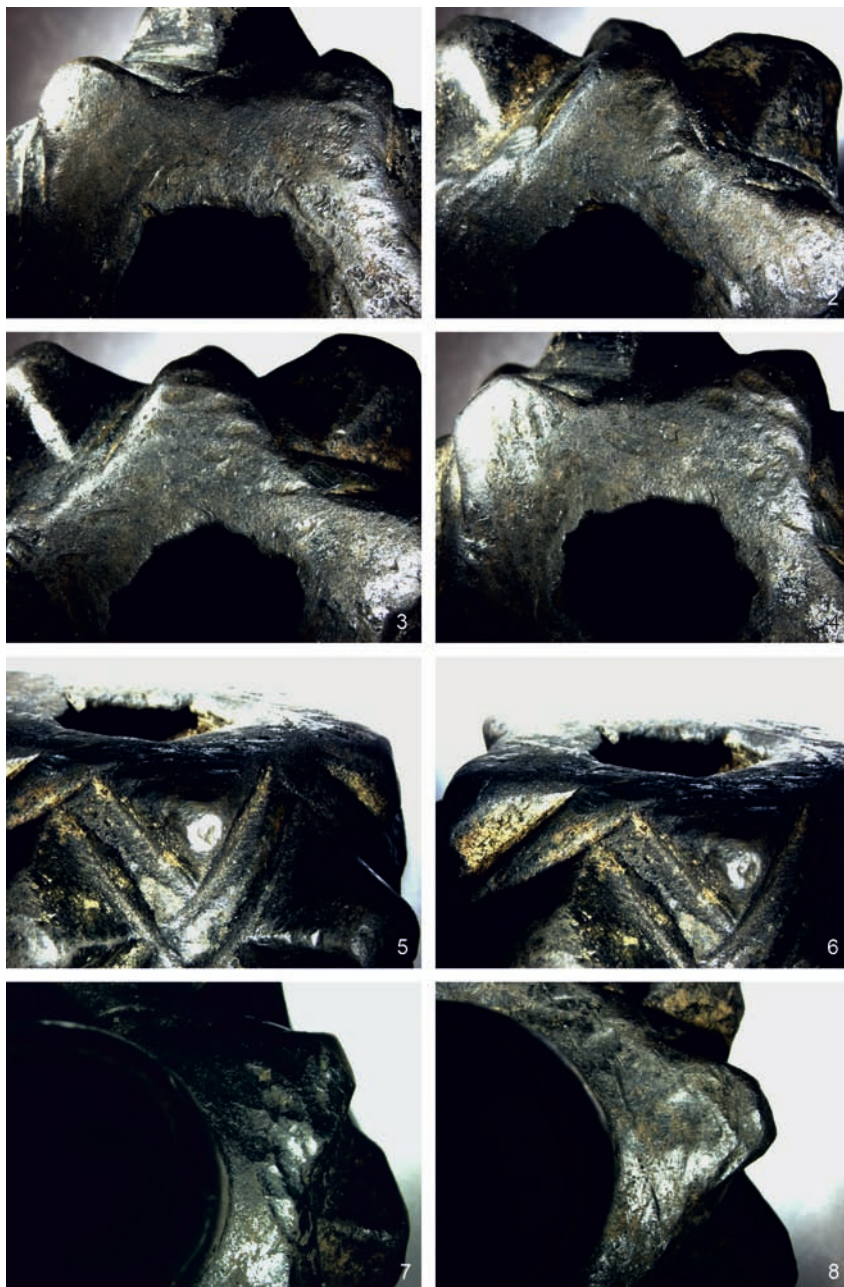
Traces of this grinding were visible on the surface of the mace head (Figs 4: 7, 8; 5: 1, 2) – especially near the bases of the spikes. The lower edge of the socket was bent upward, which was likely related to fastening the mace head on the shaft. Attention was also drawn to the upper surface of the artefact, which bore traces of numerous examples of mechanical damage (Fig. 6: 1-6), perhaps also related to secondary mounting of the mace head's shaft. Similar traces of damage could be seen on the lower surface of the find (Fig. 6: 7, 8).

The results of the analysis of the chemical composition (Table 1) indicated that the mace head was cast of copper with increased contents of As (4.3%), Ni (2.3%), Sb (2.0%), and Fe (1.5%). The content of Cu in the alloy was 88.5%. The group of cupriferous minerals from which the copper (Cu) was extracted included, among other compounds, sulphides and sulfosalts; these were remarkable due to their high concentrations of As, Ni, and Sb. Bearing the named concentration of natural admixtures in mind, the alloy could be termed arsenic bronze. It must be remembered, however, that it was obtained by means of the smelting of copper ores that contained increased levels of As, Sb, Ni, and Fe (and not by an intentional admixture of these elements). The contents of Sn (0.1%) and Pb (0.4%) in the alloy were too low to be considered intentional admixtures.

Due to the atypical chemical profile of the discussed artefact, it was not possible to assess the alloy's properties on the bases of analogies and databases. However, it can be said that the elements that were present in the alloy (As, Ni, Sb, and Fe) increased the hardness of the copper alloys. This was due to the phenomenon of solid-solution strengthening or the creation of strengthening phases (Garbacz-Klempka 2018).



**Fig. 5.** Mace head from Surowica: 1, 2 – traces of grinding (photos by P. Jurecki)



**Fig. 6.** Mace head from Surowica:  
1-6 – upper plane of mace head with traces of mechanical damage; 7, 8 – lower part of mace head with traces of mechanical damage (photos by P. Jurecki)



In spite of the fact that, in the mace heads that have been analysed thus far, shares of copper that have exceeded 80% have already been recorded in a few cases (*cf.*, Kotowicz *et al.* 2024, tab. I); however, no find with such a high content of As has ever been encountered. Perhaps this may be a characteristic trait that will allow us to identify the outcrop from which the mace head's raw material came. However, this issue calls for further research – perhaps also including isotopic analyses. On the other hand, it must be borne in mind that such analyses have mainly been conducted on prehistoric bronzes (*cf.* Stos-Gale 2019). Due to the use of recycling by medieval manufacturers, these examinations may yield disappointing or misleading results; therefore, it is indispensable to conduct a larger series of analyses of medieval bronze artefacts (including mace heads).

Analogously to a majority of the finds of mace heads of this kind in Europe, the discussed artefact is deprived of its context that would allow for defining the find's chronology. It is therefore necessary to refer to available analogies. The artefact possesses a few characteristic distinctive traits, such as the presence of five spikes in each row, the ornamentation of the circumferences of the central spikes with double incised lines, or along the socket whose end is provided with a ring-shaped finial and ornamented with diagonal grooves. Let us inspect these individual traits in a more detailed manner.

The double lines around the central spikes seem to be a simple adaptation of the relief ornaments that are known from mace heads in the cultural milieu of the Rus'. Such ornaments occurred not only on artefacts that were discovered in the territory of Rus' (as in the case of a find from the locality of Zelenche, Ternopil Oblast [UA]) (Liwoch 2006, fig. 5: 1, 2) but also in the lands of the former Kingdom of Hungary (Kovács 1971, fig. 7: 2).

On the other hand, the presence of a long socket rather unambiguously excludes any relationship of the artefact with the Rus' cultural milieu. Mace heads with such parts are known there, but they are relatively uncommon. We must mention the Type I artefacts according to Anatoliy N. Kirpichnikov; their sockets are well-pronounced, both from below and above (Bektineev 1993, fig. 31: 1; Plavinskiy 2009, fig. 2: 1-4; Plavinski 2012), and their chronology is relatively early, falling sometime between the 9<sup>th</sup> and the first half of the 12<sup>th</sup> centuries (Kirpichnikov 1966, 130-131, pl. 26: 5; Zayats 1995, 70; Izmaylov 1997, 97, fig. 66: 1; Volkov 1999, 107-110, fig. 1: 2). Yet another find of this type (provided with a long socket that extends from the bottom of the mace head) is known from the settlement of Kozarki in the locality of Petrushy, Chernihiv oblast (UA). The settlement itself is dated sometime between the 10<sup>th</sup> and 13<sup>th</sup> centuries (Kovalenko and Sytyi 2004, 135, fig. 7: 8). In Eastern Europe, there are also artefacts with short sockets (for example, a 13<sup>th</sup>-14<sup>th</sup> century find from the locality of Mishkovichy, Magilëuskaya vobl. [BY]) (Plavinskiy 2015).

Mace heads with long sockets that are similar to the artefact from Surowica are known in the territory of Rus'- solely from Grodno (BY), the locality of Humnyshche, Volyn oblast (UA), Czermno, Tomaszów Lubelski district (PL), and the stronghold of Tustan' in the locality of Urych, Lviv oblast (UA). The first of these was explored on the grounds of the former stronghold from cultural layers that were dated from the 12<sup>th</sup> through the first half

of the 13<sup>th</sup> century (Voronin 1954, 54, fig. 22: 13). The second one was a stray find from the early 20<sup>th</sup> century, on the basis of analogies, it could be dated to the last half of the 13<sup>th</sup> through the first half of the 14<sup>th</sup> century (Osypenko 2021). The artefact from Czermno was also a stray find that was dated to the 14<sup>th</sup> century (Michalak and Wyszyński 2021). Regarding the find from Tustan', it can be only generally dated to the 13<sup>th</sup>-14<sup>th</sup> centuries (Rozhko 1996, 205, 210, fig. 112; Liwoch 2006, 74, kat. 19, fig. 4: 5). Even though Radosław Liwoch proposed a 12<sup>th</sup> century context for this artefact, recent chronological findings have suggested that the fortress may have first originated 100 years later (*cf.*, Hupalo 2020). It seems that the presence of such artefacts in the territory of Rus' can be linked to Hungarian influences in these lands. It must be added here that mace heads with long sockets were not common in the territories that were seized by Byzantium in the Middle Ages, nor were they widespread in the Byzantine sphere of influence. In the enormous assemblage of mace heads that have been found in the territory of Bulgaria (more than 500 finds), there was only one artefact of this kind (Popov 2015, 57-58). This is indicated by the common occurrence of mace heads with such sockets in those territories that were occupied by the Kingdom of Hungary in the Middle Ages (Kovács 1971, tabs. 4: 2, 3; 5: 2, 3; Takács 1997; Simina and Anghel 1998, fig. 2). It must be added, however, that such artefacts have also often occurred among finds from the territory of the Kingdom of Bohemia (Durdík 1990; Goš 1993; Sigl 2003; Kalferst 2009; Fröhlich and Chvojka 2012). Such mace heads also arrived in the territory of medieval Poland, although they were not very common there (Horbach 1976; Liwoch 2016). Among such artefacts, there have regrettably been no finds that are datable on the basis of their archaeological contexts, their 13<sup>th</sup>-14<sup>th</sup> century chronology can be proposed solely on typological grounds.

Yet another important formal trait that implies a relationship between the discussed mace head and finds from Bohemia and Hungary is the presence of five spikes that were arranged in a ring-like manner. This trait is more than common for those artefacts that were found in both of the territories of the Kingdoms of Hungary and Bohemia (Simina and Anghel 1998, fig. 3: 5, 6; Kouřil 2003; Kovács 2016, 47). Among the known artefacts, a mace head from the National Museum in Budapest (Kalmár 1971, fig. 5) can be considered to be fully analogous to the find from Surowica. Janos Kalmár dated this mace head to the 14<sup>th</sup> century, and this chronology can be considered to be probable. We also assume such a date for the find that is discussed in this paper.

It would be also recommended to briefly discuss the circumstances in which the mace head found its way to the grounds of the village of Surowica. The general 14<sup>th</sup> century chronology does not render this discussion easier, as this was a time of dynamic political changes in the area of the artefact's discovery. Until 1340, this area was part of the southwestern part of Halych-Volodymyr Rus' – very close to the borders with Poland and Hungary. In close proximity to the find site of the mace head is the Beskid Pass above Czeremcha, which was certainly used in communication and trade between the lands that were situated to the south and north of the Carpathians after the mid-14<sup>th</sup> century. A route from

the territory of present-day Slovakia via Jaśliska to Rymanów went through this pass (Fastnacht 2007, 59). It cannot be excluded, however, that this route was also in use during the earlier period. Due to the scarcity of sources, we do not know much about any contact between the Duchy of Halych and Volodymyr and the Kingdom of Hungary during the first half of the 14<sup>th</sup> century. It is certain, however, that it was vivid, as this was during the preceding century; this contact would have included trade, military actions, and settlement. Without discussing this issue in too much detail, we can merely mention (as speculated by historians) the military aid from the Hungarian King Charles Robert (Károly Róbert) to the Polish ruler Władysław the Short in order to place Jerzy II Trojdenowicz on the throne of Halych in 1324 (Font 2011, 96, 97). This duke also granted nearby town of Sanok with a Magdeburg law foundation privilege, permitting the town's mayor and his heirs to judge each person (including Hungarians) in the territory of the town (Kiryk 1995, 97; Fastnacht 2007, 205).

After the death of Trojdenowicz (1340), the Halych part of the duchy was seized by force by Polish King Kazimierz the Great. A new territorial unit (that is, the land of Sanok) came into being during the reign of this ruler. Within this unit, the already-existing village of Surowica ('Surowicze') was first mentioned in 1361 as a royal property in a grant charter (Fastnacht 2002, 161). Regarding the provenance of the discussed mace head, it seems interesting that Surowica is situated next to a place that was referred to in this charter as 'loca deserta Wysloczkie' (now, the village of Wisłok Wielki, Sanok District). King Kazimierz granted this place to Peter and Paul – brothers from Hungary (Fastnacht 2002, 226; 2007, 148, 149). John, the first mayor of neighbouring Jaśliska who was mentioned in 1366 ('Johanni de Henselino regni Hungariae'), was also of Hungarian descent (Fastnacht 2007, 205, 206).

After the death of the last Piast king of Poland (1370), the territory of Red Rus' (this name later became used for the Halych part of the former Duchy of Halych and Volodymyr) came under the formal suzerainty of the Hungarian King Louis. Duke Władysław Opolczyk, the former Palatine of Hungary, was its governor during the years of 1372-1378 as well as in 1386. Apart from Silesians, the important offices in Red Rus' were held by Hungarians during Opolczyk's rule; for example, Andrzej (Andraszko) Schony of Barlabas, who was the General Starost of the land (Sperka 2016, 278). After the eventual incorporation of the land of Sanok into the Kingdom of Poland in 1387, there were no mentions in the written sources of the presence of Hungarians in this territory during the last decade of the 14<sup>th</sup> century.

To conclude, it must be said that the mace head from Surowica is yet another find from the area of present-day Poland that demonstrates the close genetic relationships with the territory of medieval Hungary (*cf.*, Michalak 2006). The numerous artefacts of this kind that were discovered in medieval Hungary imply large-scale manufacturing, whose products could be exported to neighbouring lands (Kovács 1971; Kovács 2016). There is no doubt that this was rendered possible by the huge resources of copper from mines that

were located in the territory of Upper Hungary (Baitizi 2018, 166-181). Some reservations have been provoked by the low number of sites with confirmed mace head manufacture in the territory of medieval Hungary (although their numbers are scant in general terms).

There are many possible reasons why the discussed artefact found its way to the northern side of the Carpathians; it is difficult to narrow down the chronology of the mace head from Surowica on this basis. Its discovery, however, is yet another important premise for studies on the influence of Hungarian armaments on the weaponry of Hungary's northern neighbours. The number of military artefacts that can be unequivocally related to the Angevin period is still very low in these territories. It is interesting that, apart from swords (*cf. e.g.*, Głosek 1973, 326, 327; 1984, 45, kat. 273, 276, 372), these finds are exclusively mace heads (*cf.*, Michalak 2011). These artefacts include 14<sup>th</sup> century finds from the castle on Birów Mountain, Zawiercie district (Michalak 2011), and from Librantowa, Nowy Sącz district (Liwoch 2016), as well as the aforementioned mace heads from the stronghold of Tustan' (Rozhko 1996, fig. 112; Liwoch 2006, fig: 4: 5), from Grodno (Voronin 1954, fig. 22: 13), from Czeremno-Czerwień (Michalak and Wyszyński 2021), and from Humnyshche (Osypenko 2021).

Regrettably, the metallurgical examinations that demonstrated that the mace head was made of copper with an increased arsenic content did not allow for confirmations of the aforementioned suppositions. We still do not know enough about the copper outcrops that were exploited in the Middle Ages. Lead isotopic data may possibly enable us to eventually verify these assumptions.

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