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Ingunn M. Røstad, Elna Siv Kristoffersen, Håkon Reiersen, Unn Pedersen, Marie Dave Amundsen and Sigmund Oehrl (eds)

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The front page: Amber nuggets and semi-finished amber beads and pendants from pit-house 7/91 in Biskupice, Poland. Photo: Marcin Woźniak.
The back page: Suspension loop for gold bracteate S12625, from Hå on Jæren, Rogaland. Photo: Annette G. Øvrelid.

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Technology – art – identity. Zoomorphic spurs in the light of metallographic analysis

PAWEŁ SZCZEPANIK AND SŁAWOMIR WADYL

Paweł Szczepanik and Sławomir Wadyl 2025. **Technology – art – identity. Zoomorphic spurs in the light of metallographic analysis.** *AmS-Skrifter 29,* 81–89, Stavanger, ISSN 0800-0816, ISBN 978-82-7760-205-9.

In the 11th century AD, spurs with zoomorphic decoration, cast from copper alloy, were attributes of elite horsemen. The pair of spurs from grave 42/2009 at an Early-medieval cemetery at Ciepłe, Pomeranian Voivodeship, Poland, are the best-preserved example in Central Europe. Further specimens are known from Lutomiersk, Cerkiewnik, Wrocław, Lubniewice, Kumachevo, and Skegrie. The spur fragments share formal similarities, which suggest that they were made in one place for a narrow circle of individuals belonging to the Early-medieval elite and served as a form of identifier for them. Judging from the finds' geographical distribution, they were probably made on West Slavic territory. The discoveries in neighbouring areas are extremely interesting; perhaps they are evidence of the presence of members of a Slavic elite in these areas? The spurs' rich zoomorphic decoration in the form of serpent/dragon and horse/cattle imagery is in line with reconstructed Slavic cosmological and perhaps eschatological beliefs. However, the imagery can also be interpreted within the context of Scandinavian and Baltic mythology. The similarity of the spurs, indicating replicable technology and alloys, suggested that it might be fruitful to examine selected finds using Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDS), through which significant differences in the amount of zinc (Zn) were observed. The proportions of the alloys are similar, but were not strictly maintained from object to object.

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Key words: Early Medieval, elite, riding equipment, SEM EDS, alloys, Poland, spurs, metallography

Introduction

Spurs have been known since about 500 BC (Żak and Maćkowiak-Kotkowska 1988, 247–48). They have always served both a practical function – goading the horse – and a symbolic one – broadcasting the status of the wearer. For the culture of the Early-medieval Slavs, they are the oldest material signifiers of membership in the emerging elite (Gossler 2013; Hilczerówna 1956; Kavánová 1976; Kleingärtner 2009; Pedersen 2014; Żak 1959; Żak and Maćkowiak-Kotkowska 1988, 247–48; Wadyl 2018). In a later period, spurs, together with belt and sword, are signs of belonging to the knightly estate (Ackerman 1944; Nadolski 1954, 80). Some of the oldest Slavic spurs are richly decorated (Żak and Maćkowiak-Kotkowska1988). Some Great Moravian (e.g. Mikulčice: Kouřil 2014, 368–72), Scandinavian (e.g. Rød: Vedeler et al. 2019, 54–55), and Pomeranian finds (e.g. Ciepłe: Gardeła et al. 2019a, 139–45) are luxury pieces that have not lost their utility. The use of copper alloys, similar in colour to gold, additionally marked out these spurs as objects reserved for the elite (Gossler 1998, 594–96; Marek 2018, 574–75; Pankiewicz 2023, 260–61).

This paper underlines problems in linking technology, art, and identity in Early-medieval craft objects. We examine 11th-century copper alloy spurs with zoomorphic decoration from several archaeological sites. In literature, spurs of this type are known as "Lutomiersk type spurs", pointing to the site of the first finds, where they first were interpreted as saddle-bow fittings (Gardeła et al. 2019b, 66–76; Jażdżewski 1949, 118–20; Nadolskiet et al. 1959, 57–58).

State of research

The first finds came from graves in Lutomiersk in central Poland. Research at this cemetery began with the discovery of a richly decorated Early-medieval sword and was conducted by German archaeologists during World War II, who, in 1940–41, excavated 15 graves. Their propaganda aim was to find "Viking" objects that would provide "scientific proof" of the idea of Germanic superiority over

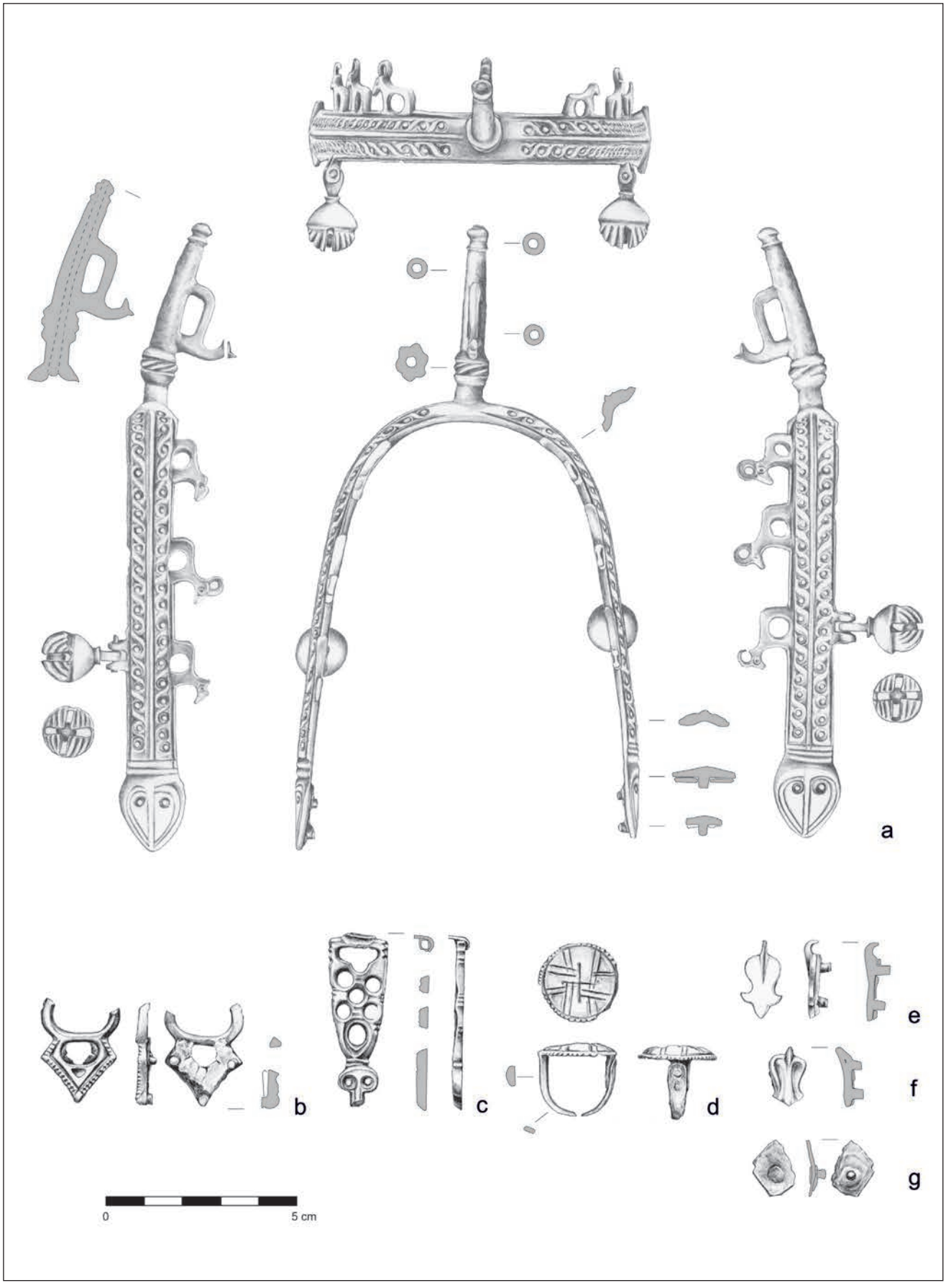

Figure 1. Zoomorphic (right) spur from Ciepłe, grave 42. Drawing K. Odya.

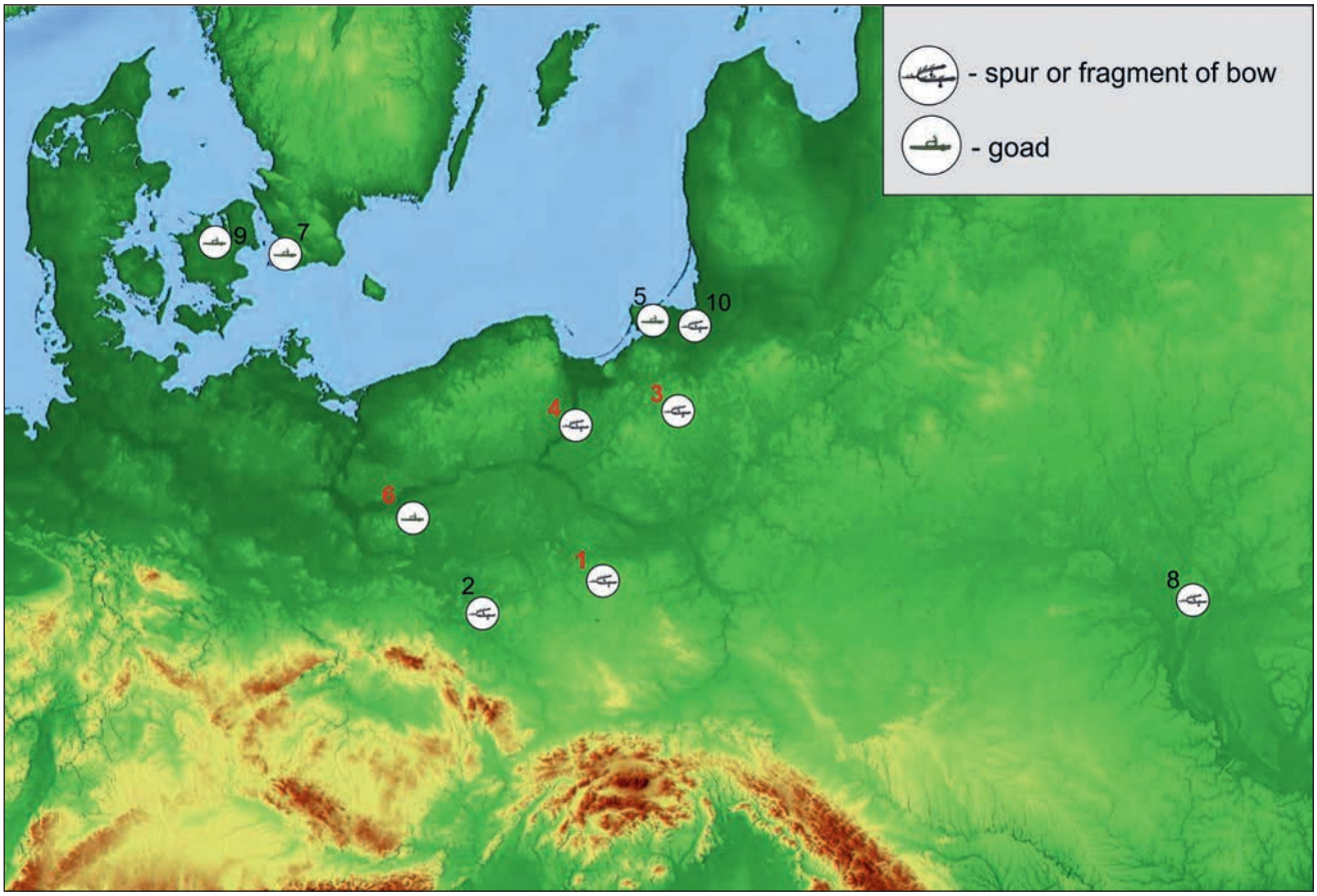

Figure 2. Geographic distribution of zoomorphic spurs and their fragments. Red numbers indicate analysed specimens.

the Early-medieval Slavic population of Poland (Gardeła 2018, 42). The next excavation at Lutomiersk took place in 1949–50 under the direction of Konrad Jażdżewski. The spurs of interest here were discovered during this campaign, when the archaeologists investigated 113 graves, mostly of adult men and women and only a few children. The burials were richly furnished with weapons, riding equipment, jewellery, pottery, and wooden vessels. Despite the prevalent practice of inhumation, the presence of a significant number of cremations within the cemetery suggests that it had been utilised by individuals adhering to traditional pre-Christian eschatology (Rębkowski 2023; Szczepanik 2018; Zoll-Adamikowa 1988). Two graves from the cemetery's first phase (Grygiel 2014; Nadolski et al. 1959) contained copper alloy objects with atypical zoomorphic decoration. Unfortunately, radiocarbon analysis of bones from both graves did not produce results (Grygiel 2014, 733–42).

Grave no. 5 was a large male cremation grave measuring 3.6 by 1.3m and covered by a stone pavement. The cremated remains were located in the eastern part (where in an inhumation grave the head would be expected) with a spearhead with a decorated socket close by; in the centre part lay a set of riding gear consisting of saddle (?), spurs, stirrups, bits, and a bridle, and at the western end was a wooden bucket. The grave also contained an arrowhead (Grygiel 2014, 682–96; Nadolski et al. 1959, 164–65, tab. I).

Grave no. 10 was a male inhumation grave in the central part of the cemetery and measured 4.3 by 2.5m. The pit was lined with stones and covered with three layers of paving stones. The grave goods consisted of riding gear – saddle (?), spurs, stirrups, bits, and a bridle – as well as a fragment of a spearhead, a few iron buckles, a wooden bucket, and an iron fire striker (Grygiel 2014, 682–96, fig. 8; Kempke 2000; Nadolski et al. 1959, 164–65, tab. III).

A breakthrough in the interpretation of Lutomiersk-type fittings was the discovery in 2009 of grave 42 (3.6 x 2.1m) at Ciepłe, a large chamber grave of a mature male. Here, for the first time, the spurs were observed directly on the foot bones of the dead horseman, which led to their old interpretation as parts of saddles being abandoned. In addition to the spurs, the burial contained other types of riding gear (such as stirrups, bits, and bridles), a richly decorated sword (Petersen Type Z), a spearhead, an iron buckle, a wooden bucket, and a touchstone (Ratajczyk 2013), as well as burnt animal bones (Ratajczyk and Wadyl 2019, 596).

The spurs from Ciepłe are the best-preserved ones known to date (Figure 1). Their arms are almost symmetrical and decorated along their entire length with a wave pattern. Three zoomorphic figures with horn-like, circular terminals on their heads are seen standing or walking on each arm, the ends of which, where the rivets are located, are also shaped like animal heads. The straps that originally were riveted to these spurs were richly decorated with a buckle (no tongues survive), two zoomorphic attachments, a circular strap slider with a swastika, and a zoomorphic strap end each; in addition, spherical bells were placed below the animal figures on the bows (spur's arms) that served both functional and aesthetic/symbolic purposes (Gardeła et al. 2019a, 141–44).

The finds from Lutomiersk and Ciepłe are distinctive, but there are others that have been discovered across the territory of today's Poland and beyond (Gardeła and Kajkowski 2020), such as at Cerkiewnik (Ziemlińska-Odoj 1992), Wrocław (Kaźmierczyk and Lasota 1979; Wachowski 2006), Lubniewice (Michalak and Gardeła 2020), Kumachevo in Kaliningrad Oblast (Wadyl and Skvorcov 2018), Shatrovo in Kaliningrad Oblast (pers. comm. Konstantin Skvorcov), as well as at Skegrie in Sweden (Gardeła et al. 2019c; Söderberg 2014), an unknown site in Ukraine (Gardeła and Kajkowski 2023), and recently Herslev on Zealand, Denmark (Gardeła 2023) (Figure 2).

A single workshop? Morphological and SEM EDS analyses

These objects are not identical, but slight differences are noticeable in the size of the arms, the distances between the open work animals, and their shapes. The animals on the spur arms from Ciepłe have solid silhouettes with straight backs, for example, while the corresponding figures at Lutomiersk and Cerkiewnik are more slender. There, the holes under the animals' abdomens cut into the outline of the spur's arm; at Ciepłe, they are placed slightly higher. Also, the spurs from Ciepłe have no additional holes, unlike two spurs from Lutomiersk (one from each of the graves) and the specimen from Ukraine. On the Lutomiersk spurs, these holes, located between the rivets at the ends of the arms, are secondary, cutting into the cast relief decoration of the serpent head. The purpose of the additional holes located on the heads is not entirely clear. The spur from Ukraine has three holes (two on the serpent head, one on the bow), but the lack of data and photographs makes a detailed description of this object difficult. Perhaps the hole on the bow was meant to replace a bell fastening, which would have been located there. Morphological and metric analyses we conducted suggest that the spurs were not cast in reusable half moulds.

Most of the spurs are stray finds (Lubniewice, Kumachevo, Skegrie, Herslev) or simply lost to research (Wrocław, Ukraine). Six more or less complete spur sets have been found in three graves at Lutomiersk and Ciepłe, a partial spur in a grave at Cerkiewnik. The spur parts from Kaliningrad Oblast probably also come from graves. The fragments from Wrocław probably belong to two spurs. Unfortunately, these artefacts are lost (Pankiewicz 2023, 260–61). All the rest, with the exception of the find from Ukraine, are broken-off goads. It is difficult to say whether they were lost during riding or whether they represent horseman's graves in destroyed cemeteries.

Being aware of similarities of the analysed spurs, but noticing certain design differences, we have investigated the metal of some of them. The main part of our examination, and a new step in the study of Lutomiersk-type zoomorphic spurs, is an archaeo-metallurgical analysis. Our basic methods are Scanning Electron Microscopy (SEM) and Energy Dispersive X-Ray Spectroscopy (EDS), a non-destructive combined technique that allows us to determine alloy compositions.

This work was carried out at the Centre of Nanotechnology at Gdańsk University of Technology, using a FEI Quanta FEG scanning microscope at a beam voltage of 30kV, a secondary electron (SE) detector for mapping purposes, and an EDAX Genesis APEX 2i ApolloX SDD detector for the analysis of elemental composition.

We analysed the metal of spurs from Ciepłe, Lutomiersk, Cerkiewnik, and Lubniewice. For Ciepłe, we sampled the end of the arm, the goad and the bell, plus the buckle, the strap slider, and the fitting. We chose the spur from grave 10 at Lutomiersk and sampled the broken animals on the bow and the goad rivet, as well as repair material at the goad. For Cerkiewnik, we analysed the spur and the strap slider, taking samples from the bow, the rivet, and the plate. For Lubniewice, we took samples from the iron core and the brass covering (Figure 3).

In total, we analysed thirteen samples (Table 1). The result was that while all were made of brass (Cu-Zn) with small amounts of tin (Sn) and lead (Pb), there are significant differences in the proportions of zinc to copper (Figure 4). The high percentage of zinc (over 22%) seen at Ciepłe suggests a particular sophistication in the production of the alloy and the spurs themselves. The specimens from Ciepłe are formally similar to the one from Cerkiewnik, but in the latter, the zinc percentage is considerably lower (ca. 17%). The ones from Lutomiersk and Lubniewice are almost identical in their alloys, with zinc at 10–11%. Copper-zinc alloys were popular in the

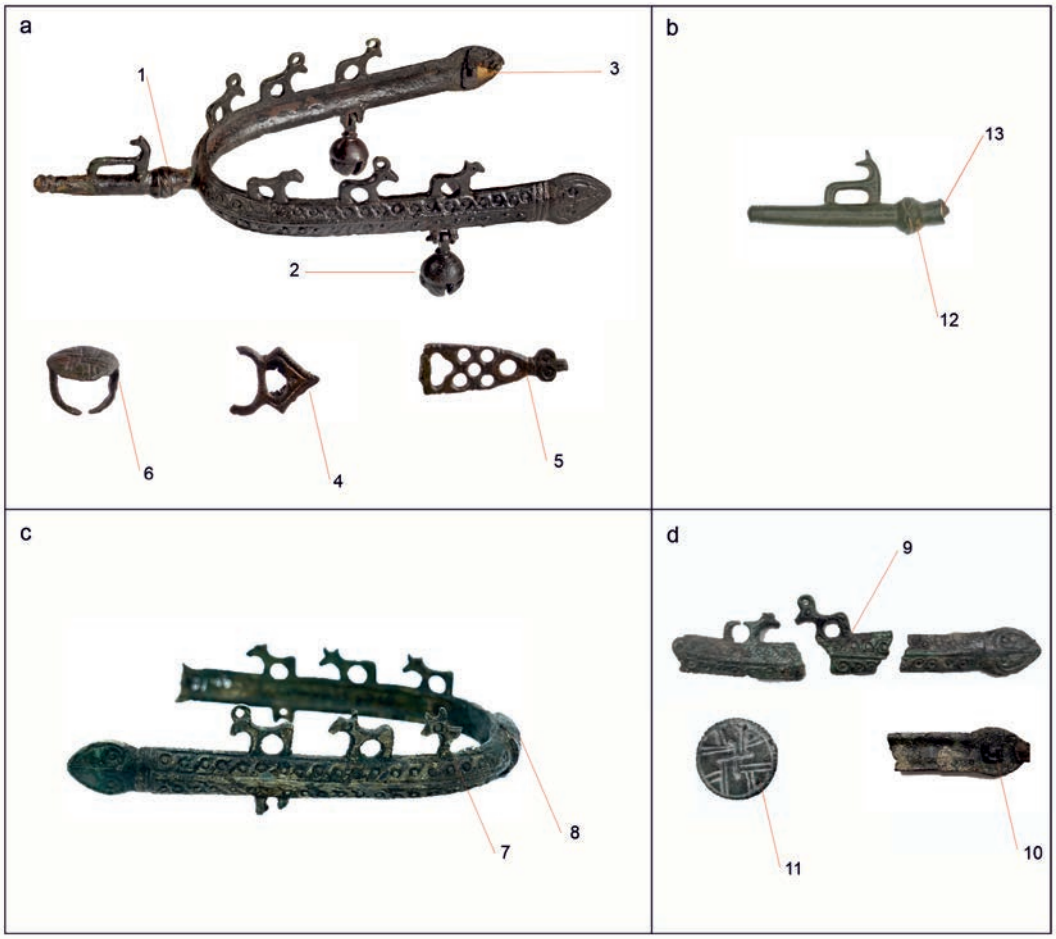

Figure 3. Analysed artefacts and locations of SEM-EDS spot analysis. a: Ciepłe, grave 42; b: Lubniewice, loose find; c: Lutomiersk, grave 10; d: Cerkiewnik, grave 7. Photo: Sławomir Wadyl (b-d) and Joanna Szmit, The Archaeological Museum in Gdańsk (a).

Table 1. Chemical composition of analysed artefacts.

	Site	Artefact	Cu	Al	Mn	Fe	Ni	Zn	As	Ag	Sn	Sb	Pb	Au
1	Ciepłe, grave 42	goad, right spur	73,14	0	0,06	0,15	0,08	22,81	0,59	0,02	2,07	0,04	1,02	0
2	Ciepłe, grave 42	bell, right spur	73,56	0	0,05	0,25	0,08	22,28	0,57	0,03	1,99	0,05	1,09	0
3	Ciepłe, grave 42	bow, right spur	71,78	0	0,06	0,12	0,08	23,25	0,48	0,03	2,95	0,00	0,99	0
4	Ciepłe, grave 42	buckle, right spur	69,85	0,01	0	0,19	0,07	23,31	0	0	1,51	0,03	4,89	0,09
5	Ciepłe, grave 42	strap end	71,44	0,09	0,11	0,29	0	21,64	0,1	0,03	1,67	0	4,53	0
6	Ciepłe, grave 42	strap slide, right spur	74,39	0	0,03	0,12	0,08	21,66	0,60	0,03	2,08	0,02	0,98	0
7	Lutomiersk, grave 10	bow	85,24	0	0	0	0	11,35	0	0	2,36	0	1,05	0
8	Lutomiersk, grave 10	bow, repair	3,88	0	0	0	0	0	0	0	0	0	96,12	0
9	Cerkiewnik, grave 7	bow	79,88	0	0	0	0	17,43	0	0	0,75	0	1,94	0
10	Cerkiewnik, grave 7	rivet	88,34	0	0	3,54	0	2,38	0	0	0	0	5,74	0
11	Cerkiewnik, grave 7	strap slide	86,63	0	0	0	0	11,49	0	0	0,69	0	1,2	0
12	Lubniewice, loose find	goad	85,51	0	0	1,26	0	11,67	0	0	0,83	0	0,73	0
13	Lubniewice, loose find	goad, edge	86,05	0	0	1,21	0	9,96	0	0	1,42	0	1,36	0

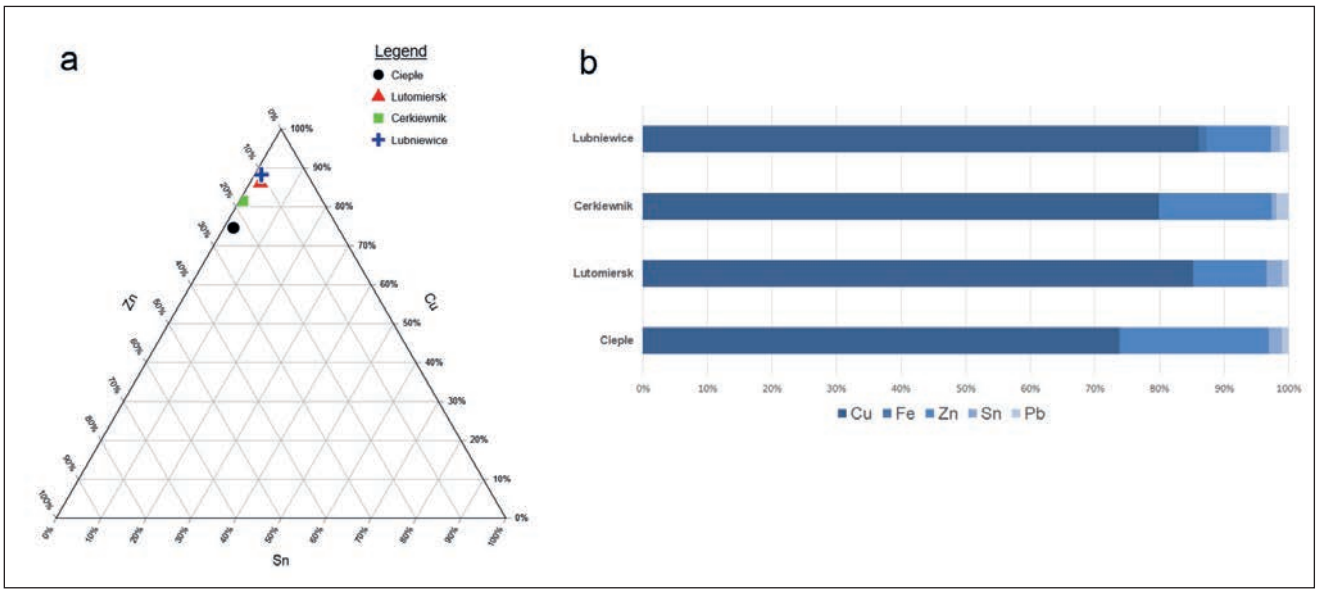

Figure 4. Gibbs phase diagram showing the compositional variation among analysed artefacts (a), and a diagram comparing main components (b).

Early Middle Ages, but there was no known source of pure zinc, making it difficult to produce brass. Minor differences in the percentages of zinc are often attributed to the complex nature of the production of brass, where zinc tends to evaporate. Influential factors are the initial ratio of the metals, temperature control, and the timing of the metallurgical process (Morton 2019).

It seems that the differences in the spurs' alloys are too large to allow for a single recipe: a common, standardised technology and the use of high-quality materials should produce alloys with more consistent Zn/Cu ratios.

Interestingly, the strap buckles and other fittings have a higher ratio of lead of ca. 5%; this had the effect to make the alloy more malleable. The sheet metal on the bow of the spur from Lutomiersk is made of lead instead of brass. This obviously is indicative of a repair and probably one that only was intended to make the spur hold together for the duration of the burial, as a grave good connected with *ars moriendi*: crafts people at the time understood perfectly well that lead was too soft to repair a spur for practical use.

The spur from Lubniewice shows how technologically advanced production was. The goad was made in two stages: in the first step, an iron core was forged and placed in a casting mould; in the second step, molten brass was poured into the mould. The iron core of the goads is also evident in copies from Ciepłe, Skegrie, and Herslev. The product is highly decorative yet strong enough for practical use. These items thus display two separate areas of usage: the first is symbolic and related to funerary rituals; the second is evidence of the technological sophistication and utility of the spurs.

Iconography

There is considerable scholarly literature on both the geographic origin of the zoomorphic spurs (e.g. Gardeła et al. 2019a; Gardeła and Kajkowski 2020; Grygiel 2014; Jażdżewski 1949; Kara 1991; Nadolski et al. 1959; Wachowski 2006; Wołoszyn 2010) and on their iconography and symbolism (Gardeła and Kajkowski 2020; Gardeła et al. 2019a; Szczepanik 2019, 219–48). To our knowledge, Ingo Gabriel (1988) was the first scholar to discuss the spurs in the context of Slavic mythology. He argued that the imagery of the Lutomiersk finds is analogous to that seen on a knife scabbard mount from Oldenburg, Schleswig-Holstein, Germany. The details may be different, but the stylistic similarity is obvious, and the idea of showing a complex zoomorphic and anthropomorphic system relevant to cosmology seems to be evident in both examples (cf. Szczepanik 2017).

The spurs can be interpreted along two main lines. The first interprets them as a schematic representation of Slavic cosmology (Gardeła et al. 2019a, 123–30); the second sees a connection with Slavic eschatology and ideas about the road to the underworld (Szczepanik 2019, 245–48). Unfortunately, we have no Early-medieval written sources describing Slavic cosmology. Instead, we must use later ethnographic sources (e.g. Mianecki 2010; Tomiccy 1975; Tomicki 1976) to infer a *longue durée* mythical structure (Braudel 2009; Lee 2018; cf. Szczepanik 2018, 121–27). Applying these sources and Indo-European comparative mythology to reconstruct a tripartite Slavic vision of the cosmos, we see a) the heavenly sphere belonging to sky gods and sun gods, b) the middle sphere of everyday human life, and c) the underworld with a three-

headed deity, who can also take on the form of a serpent dragon (Gieysztor 2006, 98–130; Szyjewski 2003, 58–65). From reconstructed cosmological myth we know of a battle between the Thunder God and the God of the Underworld (Iwanow and Toporow 1974, 75–103): in West Slavic religion, these deities were most likely named Perun/Svantevit and Veles/Triglav, respectively.

Looking closely at the spurs, we can – with all due caution – recognise some elements from these myths, such as the six small zoomorphic figurines that might represent horses with haloes (Gabriel 1988, 194; Kempke 2000, 391; Szczepanik 2019, 245–46) or horned cattle (Gardeła et al. 2019a, 114–16). In a reconstructed vision of the underworld, according to ethnographic sources, the souls of the dead could take the form of horses (Mianecki 2019) or of cattle (Szyjewski 2003, 54). However, rather than representing souls, the horses with haloes or wreaths depicted on the spurs are more likely intended as *psychopomps* – intermediaries guiding souls between the three realms of the cosmos.

There is a similar problem with the zoomorphic figures on the goads. Here, we are fairly convinced that it is a horse that is depicted, but why is it looking backwards? Some interpretations have seen this as the horse turning around to look at a god seated on its back (Gardeła et al. 2019a, 112–14), but in our opinion, a comparison with other archaeological materials may produce a more convincing idea. One of the most promising would be a horse burial from Pień in Kuyavian-Pomeranian Voivodeship, because here, the neck of the buried horse had quite the same position. Archaeozoologists have suggested that the aim in this had been to obtain easier access to the animal's main blood vessels (Makowiecki and Janeczek 2020), for the process of bleeding the horse to death in a sacrifice. Such a practice would suggest great respect for the horse. Blood sacrifices enabled contact between the worlds of humans and gods (Makowiecki et al. 2022, 13–14, fig. 7). The reading of the ideographic programme is not entirely clear and should not be considered conclusively settled and proven, but rather requires significant further research.

Discussion

The zoomorphic spurs of the 11th century are fine examples of high-level metalworking skill. They combine technology, art, and mythological symbolism in elite horse-riding equipment. They probably were produced on West Slavic territory and chronologically connected with the time of the rise of the First Polish State, but where exactly they were made remains unknown. Some researchers interpret spurs as material markers of membership to the Piast elite, i.e. the first ruling dynasty of Poland (Gardeła and Kajkowski 2020, 8–11). But these finds are distributed over a very large area, and it is difficult to decide with certainty where they came from. Their absence in Greater Poland – the heart of the Piast State – makes us wonder whether it is correct to associate them with the formal state elite. The iconography of the spurs is associated with pre-Christian Slavic beliefs but may also have been understood within the myths and beliefs of elite members of Germanic and Baltic communities. In all three mythological systems, serpents and horses played important roles. It can be assumed that the spurs were made in a single place or workshop, but they were not cast in reusable half moulds. Our metallographic analyses indicate that although all are made of brass, the alloy was not standardised. The spurs from Ciepłe have a composition different from the rest, and the diversity of materials is considerable. While usable, the spurs were quite fragile, as is evidenced by the incompleteness of most specimens and repairs to some of them. The repair seen at Lutomiersk – where a spur was reassembled, but not into any useable state before being placed in a grave – testifies to the high symbolic value of the spurs and to a sophisticated scenario of funeral rituals and eschatological beliefs. A further, more detailed study of all known spurs and their fragments will help confirm the hypothesis as to where they were made.

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