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Dedicated to Anna Dzieduszycka-Machnikowa
for Her 100th Birthday

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PREFACE

ANNA DZIEDUSZYCKA-MACHNIKOWA

On August 31, 2025, Anna Dzieduszycka-Machnikowa celebrated her 100th birthday. Anna Róża Maria, Countess Dzieduszycka of Dzieduszyce, of the Sas coat of arms, was born in Lviv. In 1954, she became one of the first employees of the newly established Department of Polish Archaeology at the Institute of the History of Material Culture of the Polish Academy of Sciences, headed by Professor Stefan Nosek. Throughout her professional career, she remained associated with the Kraków Centre of this institute.

Fig. 1. Anna Dzieduszycka-Machnikowa (first from the left) in a photograph of the excavation team in front of the palace in Igołomia in the summer of 1954. Photo probably by Aleksander Wasilewicz, Archives of the IAE PAN in Igołomia

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Fig. 2. Anna Dzieduszycka-Machnikowa with Jan Machnik at a conference on the turn of the Neolithic and Bronze Age in Starý Smokovec in 1970. Photo from the archives of Prof. Jan Machnik

Fig. 3. Anna Dzieduszycka-Machnikowa with Jan Machnik during an archaeological trip to the Igołomia area (palace in Igołomia, September 4, 2014). Photo by K. Tunia

From the outset, she took part in numerous fieldwork projects (Fig. 1). In the 1960s, she conducted research on the settlement at Złotniki, in the Igołomia-Wawrzeńczyce commune – an important Eneolithic site linked to the late phase of the Lengyel-Polgár cultural circle. Her work on the Neolithic Jurassic flint mine at Sąspów, in the Jerzmanowice-Przeginia commune, was also of major significance. She was among the first Polish prehistorians to take a closer interest in the Neolithic flint industry. From 1967 to 1974, she participated in the field investigation of a complex of Early Bronze Age sites in Iwanowice, in the same commune. She later co-authored studies discussing the materials uncovered during these excavations.

In 1958, Anna Dzieduszycka married Jan Machnik, who would go on to become a distinguished professor and head of the Kraków Centre of the Institute of the History of Material Culture of the Polish Academy of Sciences. Until his death in 2023, they remained a devoted couple for more than 65 years, successfully balancing family life with both field and office-based archaeological work (Figs 2 and 3).

We wish Anna continued good health and every success!

Piotr Włodarczak

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ARTICLES

Rebecca Bristow[1]

BETWEEN TWO WORLDS: ON FIGURATIVE REPRESENTATIONS OF THE MIDDLE NEOLITHIC STROKED POTTERY CULTURE

ABSTRACT

Bristow R. 2025. Between Two Worlds: on figurative representations of the Middle Neolithic Stroked Pottery culture. *Sprawozdania Archeologiczne* 77/2, 13-37.

Once characteristic of the Southeastern and, to a lesser extent, Central European Neolithic lifestyle, the use of clay figurines, figurative vessels and applications took a turn at the start of the Middle Neolithic (5000 BCE). While thousands were still found in Southeastern Europe, their number dropped significantly in large parts of Central Europe. This article focuses on the Stroked Pottery culture, the Samborzec-Malice culture, and the Southeastern Bavarian Middle Neolithic group as an area of transition between a figurative Southeastern Europe and a non-figurative Northwestern Europe. Observing notable changes in both the shapes and contexts of the finds as early as when farmers settled in Central Europe, I argue that the disappearance of the Southeastern clay tradition was tied to changes within communal practices, as well as a transformation of figuration through a common, stylised motif.

Keywords: Neolithic, figurines, figurative representations, fifth millennium BC, Stroked Pottery Culture, Middle Neolithic, toad engravings

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INTRODUCTION

As farming communities expanded into Central Europe, they retained many of their southeastern traditions, including the creation of clay anthropomorphic and zoomorphic figurines, vessels, and figurative applications. However, when the Central European Linear Pottery culture (LBK) split into distinct regional cultures at the turn of the 5th millennium BCE, its figurative landscape underwent a decisive change. Placed at the margins of a non-figurative area along the Rhine, and a figurative burst in Transdanubia, the Stroked Pottery culture (Stichbandkeramik, SBK), Samborzec-Malice culture and Southeastern Bavarian Middle Neolithic group (Südostbayerisches Mittelneolithikum, SOB) seem like a transitional area. Eventually, figuration disappeared from most of Central Europe (Becker in print). A simple explanation for this development could be that the traditional use of clay shifted to wood. However, although submerged settlements were present during the Early and Middle Neolithic periods, as well as pile dwellings that yielded textiles and wooden artefacts, not a single wooden figurative object has been uncovered. It is hard to imagine that wooden representations were still being made during the Middle Neolithic, but none have been found, whereas Mesolithic and Bronze Age ones have been uncovered (Iversen *et al.* 2024; Verhart 2015; Capelle 1995). An alternative explanation that I will explore in this article is that figuration became increasingly diversified and stylised throughout the Early and Middle Neolithic, eventually turning into abstract pottery motifs. The context of this shift is particularly interesting, as it lies at the turn of the Middle Neolithic (5000 BCE) and involves many cultural changes (Fig. 1).

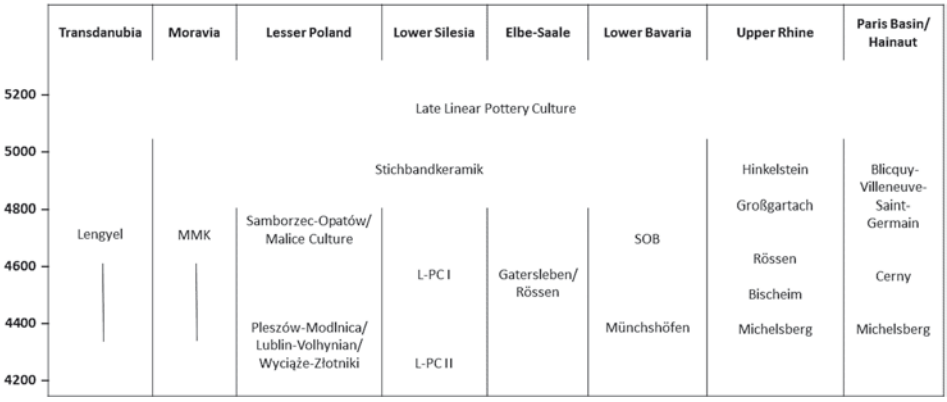

Fig. 1. Simplified chronological table of the mentioned areas. MMK: Moravian Painted Pottery Culture; L-PC: Lengyel-Polgár Culture

FIGURATIVE REPRESENTATIONS

The LBK

Types of representations

Through the project 'A World without Images' at the University of Copenhagen, Starčevo-Körös-Criş, LBK and post-LBK figurative finds were recorded in a relational database, which amounted to *c.* 2500 entries. The main publications used for this data collection were Becker 2011, Hansen 2007, and Quitta 1957. Data for Lengyel figurines was kindly provided by Corina Fiutak (2021). This indicates that, compared to the southeastern Starčevo-Körös-Criş cultures, LBK figurative representations decreased in density but increased in variability (Figs 2 and 3).

The two main anthropomorphic figurine types from the southeastern Starčevo-Körös-Criş cultures remained. These are Valeska Becker's Type 1, defined as column-like, without arms or legs, and Type 2, including more articulated figurines with legs (Becker 2007, 121). However, they became less naturalistic and more heavily decorated, with regional variants (Becker 2007, 121-124). While two-thirds of the Starčevo-Körös-Criş figurines could be sexually identified as female, only one-third of the LBK finds were identifiable as female. This ambiguity may have been deliberate, as even the distinction between human and animal was sometimes blurred (Hofmann 2014, 51). The proportion of anthropomorphic figurines also decreased compared to the proportion of anthropomorphic vessels and applications (Fig. 3), which were characterised by their variability: anthropomorphic vessels consisted of three main categories: *face vessels*, *feet vessels* and *figurine vessels* (Becker 2011, 109), with signs of regionalisation regarding face vessels – in the Lower Danube region and Carpathian basin, many face vessels bore a distinctive 'M' shaped incision (Pavlů and Zápotocká 2013, 109). However, despite this variability in vessel shape and decoration, sexual identification, when it was possible, always pointed to female features.

The increase in vessel and application proportions during the LBK was also visible in zoomorphic representations. In Bohemia, zoomorphic applications often appeared as horns on vessels, as seen in the example of Bylany's early LBK vessel (Pavlů and Zápotocká 2013, 87).

When identifiable, zoomorphic representations mainly depicted cattle, *caprinae* and pigs in both the Starčevo-Körös-Criş and LBK cultures (Fig. 4: a). Post-LBK finds suggest an increase in the proportion of cattle depictions, but the number of finds is too low to make solid observations.

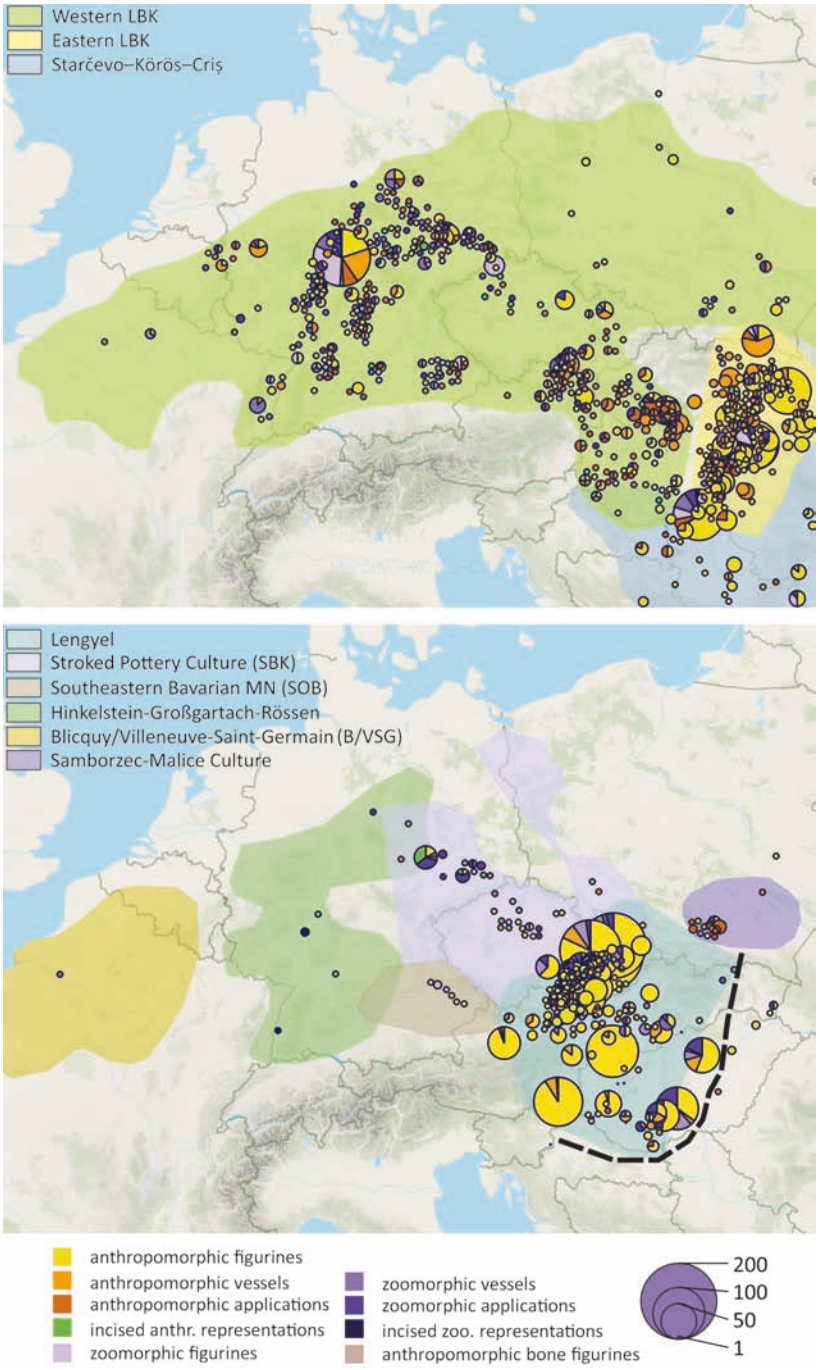

Fig. 2. Distribution of Early and early-Middle Neolithic figurative finds in Central Europe

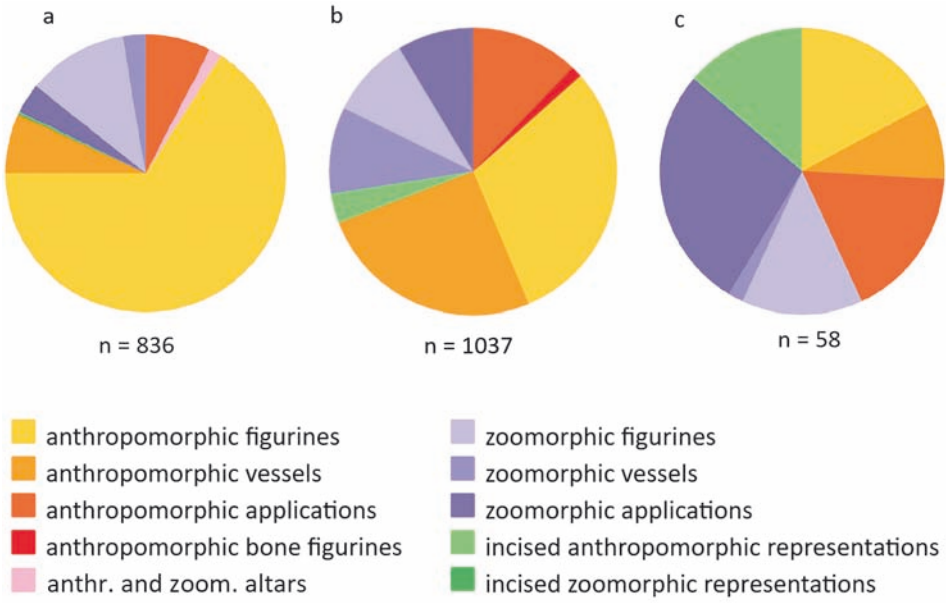

Fig. 3. Figurative representation types:
a. Starčevo-Körös-Criş, b. LBK, c. eastern post-LBK (see list of representations below)

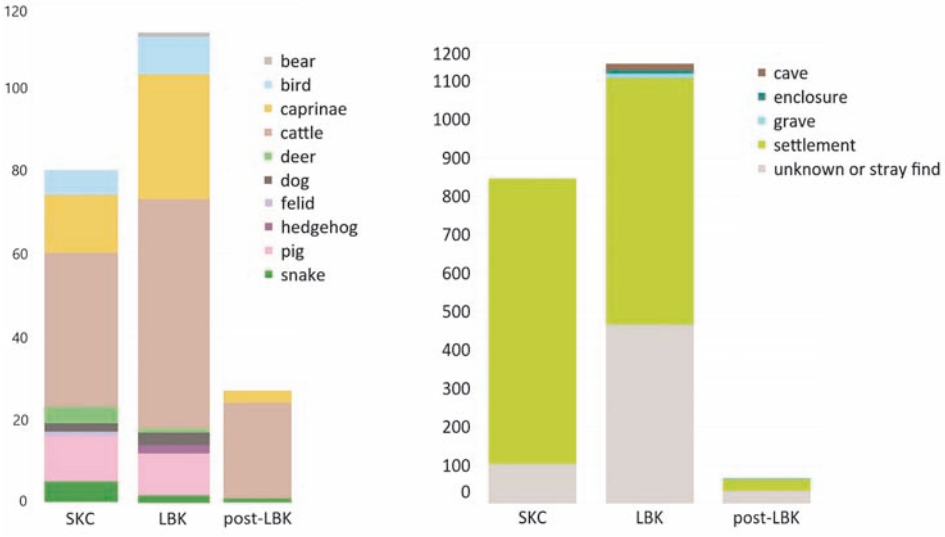

Fig. 4. Identified species and find contexts of the Starčevo-Körös-Criş, LBK, and eastern post-LBK datasets

Contexts

In terms of context, figurative finds of all kinds were tightly linked to the settlement throughout the Early Neolithic. However, the term 'settlement' often groups together very distinct types of contexts. Many Starčevo-Körös-Criş representations were found directly in houses (often near the hearth), whereas in LBK the longhouse context emerged, with representations found in long pits alongside houses (Bánffy 2017, 718). Of the 41 LBK figurative finds in our database that were tied to a house, 35 came from long pits, three from pit houses and one from a posthole. Whether these different contexts led to distinct uses of the figurative representations remains to be investigated further.

Another novelty during the LBK was the use of enclosures as deposition areas of figurative finds, which may once again indicate a shift of usage – especially if certain enclosures were used for social gatherings and ceremonies (Fig. 4: 2). Finally, the very few LBK finds found in graves were very distinctive figurative representations made of long bones with what appears to be eyes (Allard *et al.* 1997, 40). Due to their features and the fact that they were found in children's graves, they are considered here to be separate from the clay corpus and are interpreted as children's toys.

Post-LBK

Types of representations

At the beginning of the Middle Neolithic, the number of figurative objects in northern Central Europe dropped significantly (Bristow 2025, fig. 3). The use of the term 'object' is important here, as figuration may have shifted from individual clay objects to abstract motifs on pottery vessels, thus becoming almost invisible to our modern eye. This might be the case with the so-called 'toad engravings', which overtook the first phases of the SBK and western Hinkelstein pottery decoration at the start of the Middle Neolithic (Quitta 1957; Spatz 2003). These stick figures with bent arms and legs, incised or applied on pottery, were well known from the LBK and even in Starčevo-Körös-Criş contexts, but seem to have developed into a highly schematised motif at the start of the Middle Neolithic. The rise in anthropomorphic applications shown in Fig. 3: c consists, in fact, mainly of the stick figures from Targowisko (Lesser Poland), which might be a variation of the toad motif (Fig. 5: c). The SBK vessel from Stary Zamek (Lower Silesia) depicts its inside another possible variation of the stick figure with no head, but bent arms and legs (Fig. 5: e).

From the start of the fifth millennium BCE, this motif found itself at the core of northern Central European pottery, and is hard to interpret as anthropomorphic confidently. Therefore, only the most distinctive toad figures were recorded in the database, *e.g.*, the figures that detached themselves from a band-like pattern and clearly showed pairs of bent arms and legs. If we were to add to the database every single vessel bearing a variation of

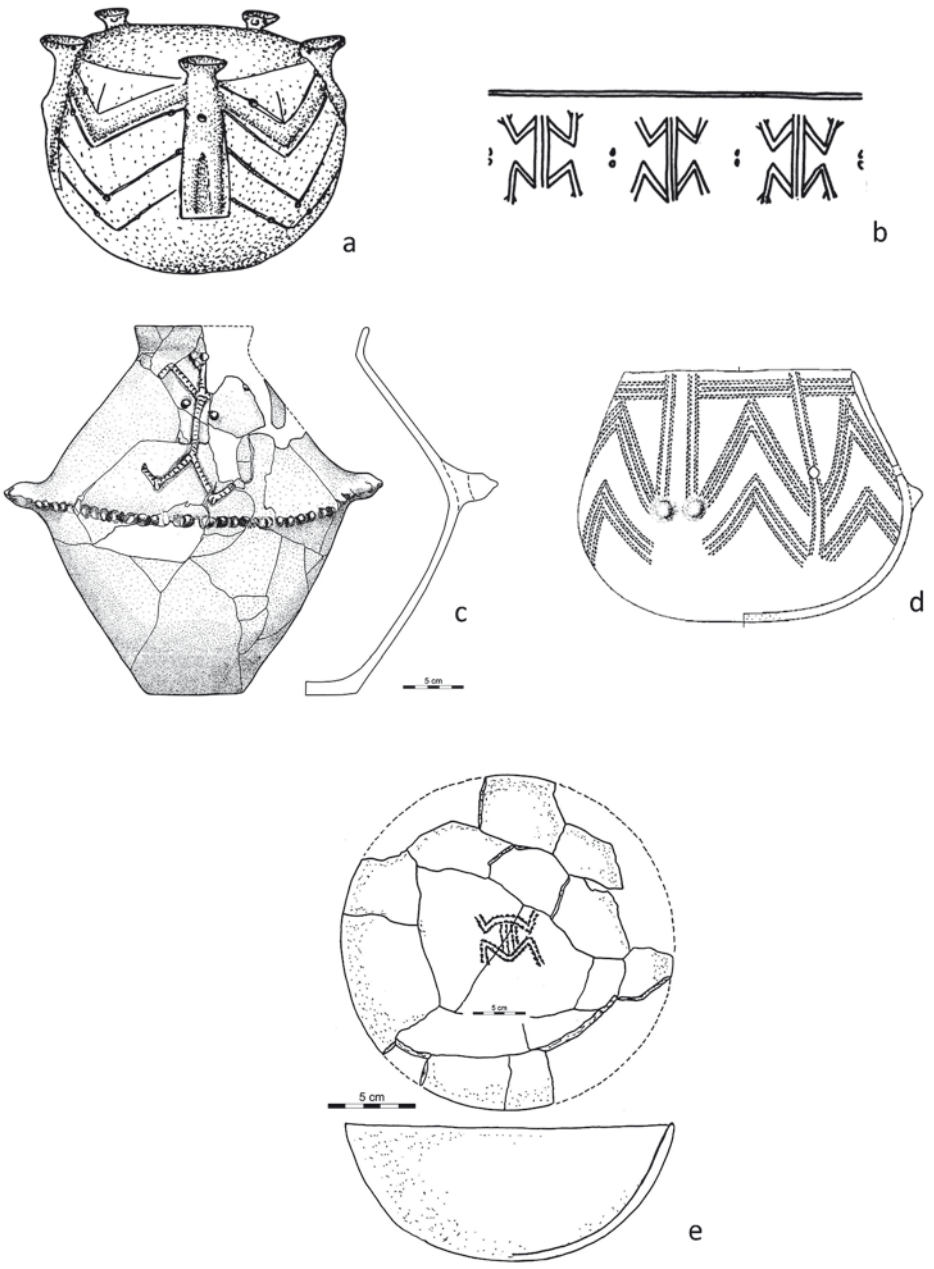

Fig. 5. 'Toad representations': a – LBK find from Vedrovice (after Becker 2011, 774); b – LBK find from Prag-Bubeneč (after Becker 2011, 788); c – Malice Culture find from Targowisko (after Grabowska and Zastawny 2008, 72; Pyzel 2017, fig. 3); d – SBK find from Hořovičky (after Pavlů and Zápotocká 2013, 43); e – SBK find from Stary Zamek (after Romanow 1977, 51; Pyzel 2017, fig. 20)

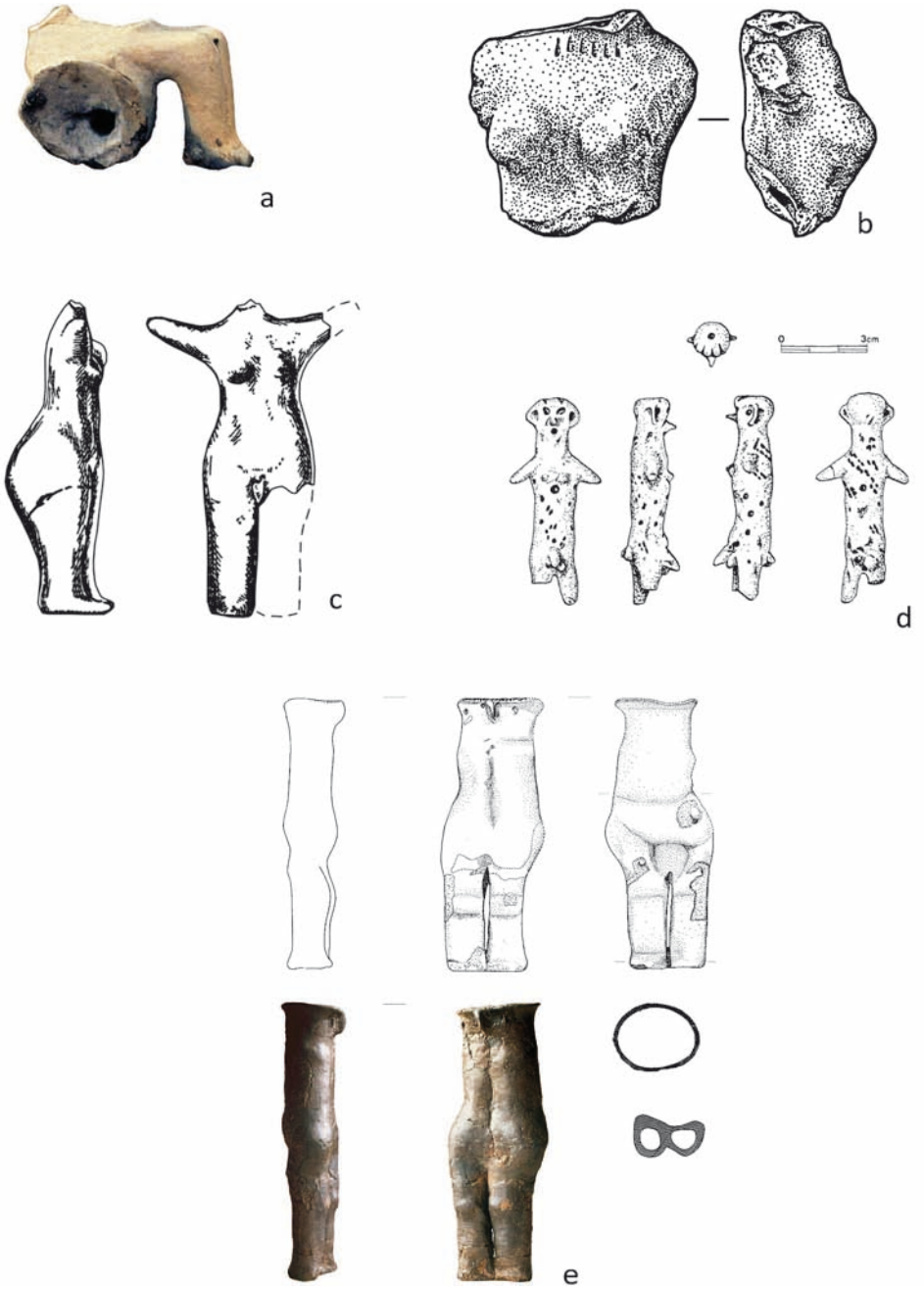

Fig. 6. Some SBK anthropomorphic representations: a – Aldersbach-Kriestorf (after Engelhardt 2010, 51); b – Oberpöring (after Becker 2011, 289); c – Zauschwitz (after Becker 2011, 287); d – Plotiště nad Labem (after Vokolek 2000, 478); e – Aufhausen (after Engelhardt 2010, 51)

the toad motif, the map of Middle Neolithic figurative finds would look very different. Firstly, it would seem that figurative representations were numerous at the turn of the fifth millennium BCE. Secondly, it would give the burial context a decisive place in the fifth millennium BCE figurative world, as many vessels bearing toads were found in the funerary context.

Interestingly, the toad motif is also known from Late Palaeolithic and Mesolithic Europe, with many examples listed by Judith Grünberg and Heribert Graetsch (Grünberg and Graetsch 2023, 614). It is also known from the Southwestern Asian Neolithic, which makes pinpointing its potential origin difficult but indicates that this motif was shared across a wide geographic and temporal area.

Contrary to Western Central Europe, where almost no figuration is visible outside the area covered by the toad engravings, the SBK and SOB areas retain more traditional figurine shapes. A few anthropomorphic figurines have been found, such as the 'Venus of Zauschwitz' (Saxony) and the female torso from Oberpöring (Bavaria), both very similar to neighbouring Lengyel figurines (Fig. 6: b and c). Similar to the LBK, post-LBK anthropomorphic figurines were female and standing upright, with the notable exceptions of the seated figurine from Aldersbach-Kriestorf and the male/hybrid figurine from Plotiště nad Labem (Fig. 6: d). Although the sex of the seated figure from Aldersbach-Kriestorf is not identifiable, some researchers noted that figurines seating on the ground were always female in the Aegean (Mina 2008, 227) and the Pre-Pottery Neolithic site of Jarmo (Lesure 2017, fig. 3: 6), while figurines seating on a stool were often male (Mina 2008, 227). The figurine from Plotiště nad Labem, on the other hand, is a notable rarity among both LBK and post-LBK figurines. It bears a male attribute, but the presence of small breasts could indicate a hybrid.

A few anthropomorphic vessels were also found in post-LBK contexts: the anthropomorphic vessel from Aufhausen was not added to our statistics as it was dated as being from the Münchshöfen culture (4500-3900 BCE), but is an example of an anthropomorphic vessel from the second part of the fifth millennium BCE (Fig. 6: e). Similar finds have been uncovered in Poland (Pyzel 2017, fig. 8: 2). A gynaikomorphic vessel found in Bavaria proved difficult to date (Engelhardt 2010, 67; Pyzel 2017). Its immediate resemblance to other gynaikomorphic vessels from the Alpine region and western Carpathian basin might place it in the fourth or even third millennium BCE. It will therefore not be addressed further here but is an example of one path that figuration took during the fourth millennium BCE, with the abandonment of traditional figurines and a shift towards breast representations on vessels and walls (Höckmann 1965; Becker in print).

In terms of zoomorphic representations, the depiction of cattle was not new, but it was argued that its proportion increased during the fifth millennium BCE (Höckmann 1965, fig. 4: a). This is visible on the site of Zauschwitz, where LBK representations mainly included anthropomorphic vessels, while post-LBK representations consisted of zoomorphic applications and anthropomorphic incisions. In Bohemia, cattle heads and horn-shaped

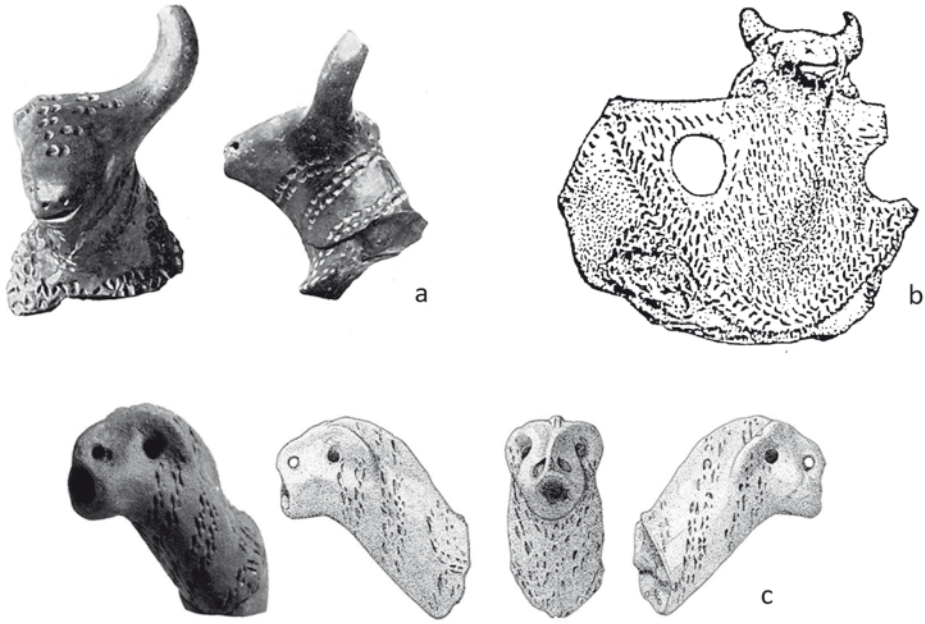

Fig. 7. SBK and SOB zoomorphic representations:
a – Černý Vůl (after Engelhardt 2010, 70); b – Straubing-Lerchenhaid (after Engelhardt 2010, 57)

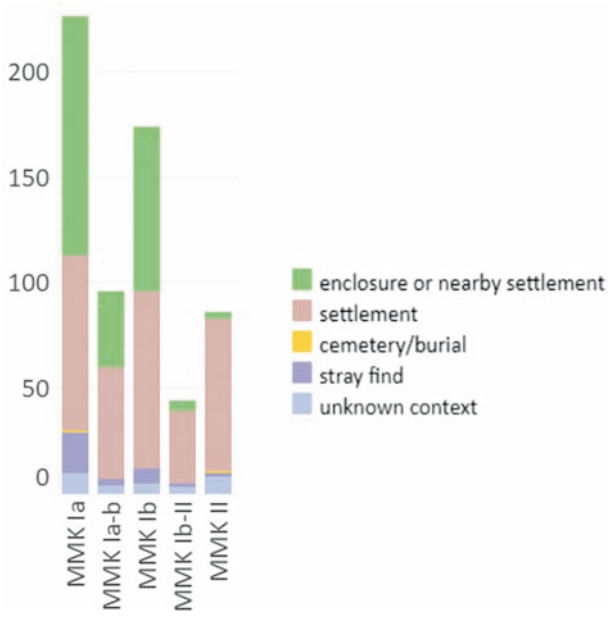

Fig. 8. Contexts of the dated Lengyel finds from Corina Fiutak's dataset (Fiutak 2021). MMK = Moravian Painted Pottery group. The majority of the Lengyel representations were uncovered in Moravia

lugs were applied to vessels, especially during the late phase of the SBK (4800-4500 BCE), as evidenced by the vessel from Kolín, which bears two horn-shaped lugs (Pavlů and Zápotocká 2013, 47). Other creatures were also depicted, such as the snake from Piskowitz (Saxony) and the unidentifiable creature from Straubing-Lerchenhaid (Bavaria) (Fig. 7: c).

Contexts

Post-LBK figurative objects were still linked to the settlements, although two other contexts – depending on whether the 'toad engraving' pottery motif is considered anthropomorphic or not – took on a greater role during the Middle Neolithic. The first one, tied to the toad figures, is a funerary one. As mentioned previously, it does not appear in the statistics of this article as the entire SBK pottery decoration was covered in toad-like bands, and only the most distinctive were added to the database. The second context is the enclosure context (see *rondels* in the next section). In the SBK/SOB area, this context is hard to assess, as the sample size of figurative representations is particularly small. Data from the neighbouring Lengyel culture does, however, suggest an important increase in finds in the enclosure context compared to the LBK (Fig. 8). It is furthermore notable that material depositions in enclosures appear different regionally, indicating regional differences in the use of enclosures during the Middle Neolithic.

Changes at the turn of the fifth millennium BCE

A smooth transition

One of the distinctive characteristics of Central Europe at the start of the fifth millennium BCE is its pottery. From the Rhine to the Oder, pottery was decorated with rectilinear bands – often in a toad-like shape – made of alternating pairs of strokes (Fig. 5: d). The bands were sometimes filled with white paint while the inside of the vessel was painted red (Pavlů and Zápotocká 2013, 72). This pottery style appeared relatively smoothly from the LBK, with double lines of strokes already present on late LBK pottery, becoming bands of alternating double strokes during the SBK (Link 2015, 355). The similarity between LBK and SBK pottery sparked debate concerning the origin and spread of SBK pottery and, by extension, SBK people (Riedhammer 2019). Ultimately, while direct evidence cannot yet back any conclusion on an SBK migration across Central Europe, the homogeneity of Central European pottery at the start of the Middle Neolithic does point to contacts between different groups, and possibly greater mobility. According to Karin Riedhammer, the rather uniform distribution of pottery styles across Central Europe could be interpreted as a 'constant marriage network reaching across regions'. This aligns with the fact that some areas of Central Europe saw episodes of depopulation and violence at the end of the LBK and may have needed to create contacts over long distances (Riedhammer 2019, 154).

These episodes of depopulation and violence, however, are primarily visible in the western part of Central Europe. Eastern Central Europe did show signs of depopulation, with the examples of Schönebeck in Saxony and many hiatuses at the end of the LBK in the Polish lowlands (Wollenweber 2019, 174, 175; Pyzel 2020, 42), but overall, the LBK seems to have transitioned relatively smoothly towards the SBK (Jeunesse 2019, 109). The main LBK elements remained present at all sites that continued to exist: longhouses and settlement locations only saw slight changes, with longhouses becoming more trapezoidal and segmented (Pavlů and Zápotocká 2013, 59; Link 2015, 353; Lenneis 2017, 270; Pyzel 2017, 140). On the Dresden-Prohlis site, this continuity may have even extended to the household level (Link 2015, 358). There does, however, seem to have been a greater distance between houses and farms in Bohemia, which may have reflected a difference in field systems (Pavlů and Zápotocká 2013, 59).

While there does not seem to have been any clear break in settlement and economic levels from the LBK to the post-LBK, some changes are visible in the funerary context. In Bohemia, while inhumations remained prevalent, cremations also existed, eventually accounting for one-third of all single finds (Pavlů and Zápotocká 2013, 102). Another innovation at the start of the SBK in Bohemia was the presence of cemeteries outside settlement areas. Finally, changes also affected funerary ornamentation, with the appearance of white marble armlets and deer canine teeth (Pavlů and Zápotocká 2013, 78-85). The opposite is visible in Bavaria, where cemeteries started disappearing (Hofmann 2012, 234).

4800 BCE: innovations and influences

After an initially rather smooth transition between the LBK and post-LBK, a few significant transformations appeared in the late phase of the SBK (phase IV) around 4800 BCE. This is evident in the emergence of new pottery styles in Saxony and the appearance of horn-like knobs on vessels (Becker 2011, 286). From 4800 BCE, settlements became smaller, more dispersed, and were occupied for a shorter amount of time (Pavlů and Zápotocká 2013, 59; Frirdich *et al.* 2015, 454; Czerniak *et al.* 2019, 61). This is noticeably similar to the situation in the West (Breitwieser 2009; Bostyn *et al.* 2018). In Bohemia, the overall weaker house structure was explained by the influence of forager mobility, through seasonal or generational abandonment of houses (Pavlů and Zápotocká 2013, 59). But the most striking early fifth millennium BCE innovation was the sudden emergence of rondels, or 'Kreisgrabenanlagen' – circular enclosures with V-shaped ditches up to 6 m deep, several narrow entrances, and often palisades. Their diameter ranged from 45 to 180 metres (Lenneis 2017, 276). Found throughout Central Europe from 4850 BCE, they lasted no more than 150 years (Řídký *et al.* 2019, 181). Their size, location, and the absence of houses within them led to their interpretation as spaces for gathering and potential ceremonies. The ceremonial interpretation of the enclosures was further supported by the fact that some rondels were oriented towards the sun's setting points during the solstices or equi-

noxes (Schier 2023, 12). Excavations surrounding the rondels in Horoměřice-Chotol, Kolín and Svodín confirmed the hypothesis that rondels were one of the basic components of what Ivan Pavlů and Marie Zápotocká called a 'rural unit' (open settlement, cemetery, socio-ritual feature). They argued that these socio-ritual features served as waypoints of long-distance routes (Pavlů and Zápotocká 2013, 66). Rondels may therefore have even been part of a network of contacts between SBK communities from the Czech Republic, Lower Silesia, and the Elbe (Czerniak *et al.* 2020, 265).

While rondels were characteristic of the early fifth millennium BCE, they were deeply rooted in the past, with some of them reusing former LBK sites and trapezoidal longhouses. This was the case at Quedlinburg (Saxony-Anhalt) and many Bohemian sites (Wollenweber 2019, 175; Pavlů and Zápotocká 2013, 60). Pavlů and Zápotocká argued that building a rondel may have served the same purpose as building an LBK longhouse, namely to involve people from vast surrounding regions through communal activities (Pavlů and Zápotocká 2013, 106). Furthermore, the rondels' short time span led Wolfram Schier *et al.* to argue that the communal activity required to build them was more important than the result (Schier 2023, 288). They referred to this as 'performative architecture', which involves not only the construction process but also the associated rituals performed by the community.

Whether it was an enclosure or a longhouse, building such large features with a predesigned plan required a great level of social organisation. Already, LBK enclosures – which appeared during the middle LBK and increased during the late LBK – were associated with possible 'tribalisation' of Neolithic communities, that is to say their transition from small, loosely organised bands to larger, more structured tribal societies (Kerig 2003, 237). The construction of rondels during the Middle Neolithic might have served to enhance or demonstrate the status of an individual initiating it, possibly a chief (Řídký *et al.* 2019, 39).

The rondel phenomenon was present in the SOB/SBK areas, as well as in the Lengyel culture further to the south-east. The late phase of the SBK, as well as the second phase of the SOB, dating to 4800 BCE, did in fact seem to tie stronger bonds with the Lengyel culture, which led Link to talk about a 'Lengyelisation' of eastern Central Germany (Link 2015, 358; Engelhardt 2010, 73). According to Juraj Pavúk, it was tied to a movement of Lengyel communities to Lower Austria around 4900 BCE and subsequently the Moravian basin, occupied by SBK communities (Pavuk 2007, 24; Lenneis 2017, 294). Overall, long-distance contacts across the post-LBK area were evident through raw material exchanges, such as Bavarian chert distributed in Bohemia, Saxony, and Lower Austria (Řídký *et al.* 2019, 150). Großgartach pottery from the Main valley has been found in Bohemia, as has evidence of salt trade and Rössen pottery from the Elbe/Saale region. Marble armlets from Bohemia were also exported to the Saale valley, Bavaria and northern Germany, possibly in exchange for salt (Pavlů and Zápotocká 2013, 109). These intense exchange routes led Ivan Pavlů and Marie Zápotocká to suggest that the late stage of the SBK and contempora-

neous earlier stages of Lengyel were periods of 'social and economic advancement'. The situation was similar in central Poland, where exchanges with Großgartach-Rössen were evident through pottery sherds from the Konary Site 20 in Kujavia. An increase in wild meat consumption post-LBK and the presence of 'Danubian' stone tools on the southern Baltic coast suggested contacts with hunter-gatherers (Czerniak 2012, 158, 159). According to Lech Czerniak, these contacts led to significant changes for both foragers and farmers. He argued that cultural changes in post-LBK groups should be linked to internal social dynamism, contacts with local foragers, and the influence of more complex communities from the Balkans and the Mediterranean (Czerniak 2012, 155). This placed the SBK and SOB between many spheres of influence in the North, West and Southeast.

Discussion: new shapes for new practices?

Different shapes

The rise and fall of figuration in Central Europe can be observed through two distinct developments. Initially, the LBK clay tradition appears as a continuation of the Southeastern one. However, the diversification of shapes and increasing stylisation show an early detachment from the southeastern clay tradition as the LBK reached Transdanubia. This was noted by Eszter Bánffy when observing the monumental cattle figurine from Szakmár-Kisülés, Hungary (Bánffy 2019, 131). Bánffy suggested that as Neolithic settlers reached the forested hills of the northern Balkans, changes in subsistence patterns affected the figurative paraphernalia. According to her, the shift from *caprinae* to cattle was from then on visible in figurative depictions, although this is not so clear for the LBK data (Fig. 4). Bánffy moreover argued that this migration led to the decline of the clay-centered orbit, in favour of a timber and stone orbit. This may be the reason why the figurative tradition ultimately never reached the Paris Basin. By moving away from clay, figuration in that area may have shifted towards new materials and shapes, involving new practices.

Through a second development, events at the start of the Middle Neolithic might have accelerated the progressive abandonment of the southeastern figurative tradition in Central Europe. In the Rhine area, population density dropped significantly on many sites, where a full reoccupation only happened after 4800 BCE (Denaire *et al.* 2017). This could explain the almost complete disappearance of figurative objects in the area. In the Elbe and Oder area, on the other hand, the transition between the LBK and post-LBK groups appeared smoother, which would explain the slower abandonment of southeastern clay figuration.

Parallel to the drop of clay figurative objects at the turn of the fifth millennium BCE was the rise of a common pottery style across Central Europe. Its rectilinear bands may have represented a stylisation of the long-known anthropomorphic 'toad' motif applied and incised on LBK pottery. If that is the case, then the apparent non-figurative landscape

of post-LBK Central Europe was, in fact, filled with figures on vessels highlighted with white paint.

Zoomorphic representations may have increased during this period, often representing cattle as figurines and vessel applications. This led Olaf Höckmann to argue for a shift from toad engravings to a bull cult during the fifth millennium BCE (Höckmann 1965, 25). The idea of a bull cult during the Neolithic is not particularly unlikely, as the use of cattle for traction and meat probably required planning and adaptation to diseases, which gave cattle a special status. Interestingly, horned bovid representations are generally associated with bulls and, by extension, the idea of 'strength' and 'manliness', when in fact, cows are also born with horns and could be the subjects depicted through horned representations (Bánffy 2019, 3). Proving that the representation of bulls or cows was associated with a cult during the Middle Neolithic, however, is difficult, given the low number of representations.

Nevertheless, comparing LBK and post-LBK figurative representations reveals many changes that may have influenced their purpose and use. In this respect, changes in their archaeological contexts are also notable.

Different contexts

One context that remained persistent throughout the Early and Middle Neolithic is the settlement. However, the term 'settlement' often lacks precision – it can refer to the inside of a house, or a separate pit. The presence of clusters of figurines and clay altars in Southeastern European houses led to the interpretation of certain rooms as 'sanctuaries' (Bánffy 2001, 59). LBK representations, on the other hand, were often found in long pits or 'unstructured pits' that did not necessarily display special handling (Hofmann 2020). Starčevo and LBK buildings were additionally quite different from each other. The building of LBK longhouses may have required a significantly higher amount of planning and cooperation among the community. Therefore, the use of figurative objects inside and outside Starčevo and LBK buildings may have differed depending on the number of participants and whether the making, handling, and breaking of figurative objects occurred during a ceremony. It would furthermore be insightful to gather more information on the exact location of figurative finds in the pit, in order to examine in which phase of the longhouse they were deposited. Figurative objects could have been part of ceremonies celebrating the building or destruction of a house. This might have also been the case with objects found in the context of enclosures. On the site of Herxheim (Rhineland-Palatinate), the late LBK enclosure that was linked to mass cannibalism also featured figurine fragments (Zeeb-Lanz 2019). In this context interpreted as 'ritualised' (Boulestin *et al.* 2009: 979), figurines may have held an important spiritual value.

At the start of the Middle Neolithic, rondels became a new find-context for figurative representations, especially in the Lengyel culture. In this case, too, the collective building

of the enclosure could have led to ceremonies involving the deposition of figurative objects in the enclosure ditches. However, the majority of dated finds from the Lengyel Moravian Painted culture belonged to its first phase (MMK I, *c.* 4700-4500 BCE). After this initial peak, figurative finds decreased. By the end of the Lengyel culture around 4100 BCE, figurative objects had almost completely disappeared from Transdanubia (Bánffy 1997, 47; Becker 2025) and Central Europe in general. Given the appearance and progressive stylisation of 'toad engravings' at the start of the fifth millennium BCE, it is possible that abstraction gradually replaced traditional clay figurines, and led figuration towards the funerary context. What is clear is that the shifts in find contexts and figurative shapes reflected broader socio-cultural changes at the turn of the Middle Neolithic, with signs of long-distance contacts and influences, as well as the emergence of large-scale social gatherings.

CONCLUSION

Neolithic figurative representations are often studied as a homogeneous corpus that served a single purpose, despite their heterogeneous shapes and contexts. The decrease and diversification of representations since the start of the Linear Pottery Culture are, however, a clear indication that practices surrounding figuration began to change as soon as the Neolithic reached Central Europe. In fact, it suggests that the Southeastern European clay figurative tradition was progressively discarded as farmers moved northwest. But while traditional clay depictions were abandoned, figuration may not have actually vanished from Central Europe. Instead, it may have turned highly stylised, to the point of abstraction. The so-called toad engravings, already present during the Early Neolithic, flourished in Central Europe at the start of the Middle Neolithic. This common anthropomorphic motif, shared from the Rhine to the Oder, could be the sign of a turn towards ambiguous, stylised ways of representing living or spiritual beings. It also seems to reflect, furthermore, the emergence of new networks across Central Europe, possibly due to a crisis at the end of the LBK and the subsequent movement of people.

Overall, the diversification of figurative shapes and the emergence of new contexts (longhouses, enclosures, and cemeteries, if toad engravings are considered anthropomorphic) during the Early Neolithic, especially at the start of the Middle Neolithic, may reflect changes in the use of figurative objects. These new contexts shared a common feature: they were connected to communal activities. LBK longhouses and enclosures required the movement, planning and coordination of groups of people, which means that their construction may have led to foundation ceremonies and social gatherings. Therefore, the use of figurative vessels and figurines during the LBK may have been significantly different from earlier Starčevo-Körös-Criş use, with ties to outdoor, collective activities rather than domestic ones. Within these large-scale developments were furthermore regional variations, which my research team and I have started investigating in a recent article (Bristow *et al.* 2025).

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List of figurative representations

Aldersbach-Kriestorf (Bavaria), pit house: figure seated on a wheel; only the legs and wheel remain. 5.6 cm high. At approximately the same level, bones from a child, an adult, and an animal – possibly a pig – were found. SOB III (Reinecke 1979; Engelhardt 2010).

Altenburg (Saxony), unknown context: horn-shaped vessel application. Decorated with incisions. SBK (Niţu 1972).

Aufhausen (Bavaria), settlement pit: Anthropomorphic cylindrical vessel with no arms. Eyes, ears and a nose are modelled right underneath the rim. 31.8 cm high. Münchshöfen culture (Kreiner and Pleyer 1999; Engelhardt 2010).

Bernwitz (Saxony), unknown context: two horn-shaped vessel applications. SBK (Höckmann 1965).

Birmenitz (Saxony):

– settlement pit: clay torso. SBK (Deichmüller 1910),

– unknown context: four horn-shaped vessel applications. Decorated with incisions. SBK (Niţu 1972; Hoffmann 1963),

– unknown context: vessel sherd with possible anthropomorphic representation; body made up of curved rows of parallel impressions; rows of impressions branching off could be an arm or leg. SBK.

Bodzia Site 1 (Kuyavian-Pomeranian), settlement features B501, E301, F208: fragments of three bowls with human decoration: two stroked and one incised-punctuated. SBK/Late Band Pottery Culture (Czerniak 2012a; Pyzel 2017).

Bolechowice Site 4 (Lesser Poland), unknown context: vessel fragment with anthropomorphic decoration. Malice Culture; unpublished (mentioned in Grabowska and Zastawny 2014, 284 and Pyzel 2017, 151).

Černožice (Hradec Králové), stray find: torso of an anthropomorphic figurine. SBK (Vávra 1993).

Černý Vůl (Bohemia), unknown context: cattle head from a vessel. Decorated with bands of pairs of incisions. SBK (Stocký 1929, pl. 46; Engelhardt 2010).

Dresden-Nickern (Saxony), settlement: head fragment of an anthropomorphic figurine. SBK (von Lehmann 2023).

Dresden-Prohlis (Saxony), unknown context: one incised anthropomorphic representation. SBK (Hoffmann 1963, pl. 56: 3).

Eutritzsch (Saxony), unknown context: two horn-like fragments. SBK (Niţu 1972).

Geiselhöring-Stockbahnen (Bavaria), settlement pit: cattle vessel. 16 cm long. Münchshöfen culture (Engelhardt 2010).

Haidlfing (Bavaria), stray find: leg fragment of a figurine decorated with lines of incisions. 6.5 cm. Münchshöfen culture (Engelhardt 2010).

Heldrungen (Thuringia), unknown context: fragment of a face pot. SBK (Kaufmann 1984, tab. 1: e; Pavlů and Šumberová 2017).

Kolín (Bohemia)

burial: a vessel with two lugs that could be horns. Decorated with incisions. SBK phase IVa (late stage) (Pavlů and Zápotocká 2013: 47),

pit 80 metres away from Rondel 3, area VII: fragment of a face pot made of brown-grey sandy clay. The face is shown in profile. SBK, possibly 4925-4763 BCE according to the rondel's C14 dates (Pavlů and Šumberová 2017).

Komořany (Moravia), unknown context: fragment of a seated figure. SBK (Höckmann 1965, Abb. 2: 7).

Kraków Nowa Huta-Mogiła Site 62a (Lesser Poland), settlement feature 219 – probably a grave: anthropomorphic vessel with schematic depiction of arms and a head. Samborzec-Opatów Group (Kamieńska and Kozłowski 1990, pl. 4: 8; Pyzel 2017).

Kraków Nowa Huta-Pleszów Site 17 (Lesser Poland), settlement feature 426: two vessel fragments with breast-shaped knobs. Pleszów-Modlnica Group (Kaczanowska 2006, 46, fig. 5: 4, 129 cited in Pyzel 2017).

Kraków-Wyciąże Site. 5 (Lesser Poland), stray find: anthropomorphic vessel with schematic depiction of arms. Probably Malice Culture; unpublished (Pyzel 2017).

Kuczkowo Site 5 (Greater Poland), settlement: anthropomorphic vessel fragment with breasts modelled on the neck. Decorated with incised lines and strokes. SBK (Czerniak 1998, 33, fig. 18; Pyzel 2017).

Las Stocki Site 7 (Lublin), settlement: female figurine fragment/rim application. Lublin-Volhynian Culture (Zakościelna 1986: 36, fig. 5; Pyzel 2017).

Leippen (Saxony), settlement: head fragment of a zoomorphic figurine. SBK (von Lehmann 2023).

Leipzig-Eutritzsch (Saxony), unknown context: clay stick that could be a horn. SBK (Neustupný 1931).

Litoměřice (Bohemia), unknown context: cattle head from a vessel. Decorated with bands of pairs of incisions. SBK (Engelhardt 2010).

Miskovice (Bohemia), burial: vessel with two lugs that could be horns. SBK phase IVa (late stage) (Pavlů and Zápotocká 2013, 47).

Modlnica Site 5 (Lesser Poland), settlement feature 788 and secondary deposit: two pottery sherds with breast-shaped knobs. Pleszów-Modlnica Group (Grabowska and Zastawny 2011, 103, fig. 9: b, c; Pyzel 2017).

Murr (Bavaria), settlement pit: vessel with incised anthropomorphic representations. Two clothed figures on the outside body of the vessel, one figure on the bottom. Münchshöfen culture (Engelhardt 2010).

Münschöfen (Bavaria), stray find: leg fragment of a figurine decorated with lines and pairs of incisions. SOB II (Engelhardt 2010).

Oberpöring-Gneiding (Bavaria), unknown context: female torso. 3.2 cm high. Decorated on the back and neck with incised lines. SOB (Engelhardt 2010).

Piskowitz (Saxony), settlement pit: Bottom part of a vessel, sculpted in the shape of a spiral

(probably a snake), and decorated with several rows of incised lines following the spiral. Grey-black, fine-grained clay. SBK (von Baumann 1976).

Podłęże Site 17 (Lesser Poland), ditch enclosure: fragment of vessel on four pairs of human legs. Wyciąże-Złotniki Group (Nowak *et al.* 2007, 461, fig. 9; Nowak *et al.* 2008; Pyzel 2017).

Regensburg-Pürkelgut (Bavaria), unknown context: leg fragment of a figurine decorated with lines and pairs of incisions. SOB (Engelhardt 2010).

Scheuer (Bavaria):

stray find: cattle head that was part of a vessel. Two holes seem to represent eyes. The head is decorated with bands of pairs of incisions. SBK (Engelhardt 2010).

stray find: this vessel fragment looking like a broken version of the cattle head found on the same site. SBK (Engelhardt 2010).

Slavětín (Bohemia), unknown context: fragment of seated figure with stroked decoration. SBK (Höckmann 1965).

Sovětice (Bohemia), Building 24: zoomorphic clay figurine decorated with incised lines and strokes. SBK (Kalferst 2006, 126, cited in Marková 2018).

Stary Zamek Site 2a (Lower Silesia), settlement feature connected with House 1: bowl with incised anthropomorphic depiction/toad engraving inside. SBK III (Romanow 1977, 51, fig. 20; Pyzel 2017)

Straubing-Lerchenhaid (Bavaria), settlement: head with long neck, open mouth and holes for eyes and nostrils. Decorated with bands of pairs of incisions. 6.7 cm. SOB II (Engelhardt 2010).

Straubing-Lerchenhaid (Bavaria), settlement pit: pelvic fragment of a clay figurine. SOB (Engelhardt 2010).

Targowisko Site 11 (Lesser Poland), settlement feature 2823: vessel with anthropomorphic decoration. Malice Culture (Grabowska and Zastawny 2007; Grabowska and Zastawny 2008; Grabowska and Zastawny 2014, 280-285; Pyzel 2017).

Targowisko Site 12-13 (Lesser Poland), settlement features 294, 299, 783, 1978, 2680, 3461: six fragments of vessels with anthropomorphic applications. Malice Culture (Czerniak *et al.* 2007, fig. 5; Pyzel 2017).

Targowisko, Site 14-15 (Lesser Poland), settlement feature 67: two vessel fragments with anthropomorphic application. Malice Culture (Czerniak *et al.* 2007, fig. 5; Pyzel 2017).

Untermixnitz (Austria), stray find, plot 271: foot fragment of an anthropomorphic figurine. SBK.

Vilsbiburg (Bavaria), settlement pit: gynaikomorphic vessel found with animal bones. No date (Engelhardt 2010).

Vochov (Bohemia): pillar-shaped figurine with schematically modelled brow ridges, nose, arms and breasts. SBK or Lengyel import (Böhm 1950; Pleiner 1978, 230; Becker 2011, 287).

Watenstedt (Saxony), FStNr. 12/2, Kreisgraben, Befund 2: what could be a horn application on a pottery sherd. SBK (Heske and Posselt 2017).

Zarzyca Site 6 (Lower Silesia), settlement: fragment of vessel on four human legs. LPC IIb1 (Czarniak 2012, 135, fig. 40: h; Pyzel 2017).

Zauschwitz (Saxony):

15 objects:

Six SBK zoomorphic applications (mainly horns) (Nițu 1972; von Baumann 1976).

Two SBK zoomorphic vessels found in settlement pits (Nițu 1972; von Baumann and Fritszche 1973).

Six SBK incised/impressed anthropomorphic representations (Hoffmann 1963, Taf. 56; von Lehmann 2023, 94-96).

An SBK female figurine in a settlement pit (Höckmann 1965).

Złota Grodzisko I (Świętokrzyskie), settlement feature 46a: anthropomorphic vessel/female figurine hollow inside. Lublin-Volhynian Culture (Podkowińska 1953, 17, pl. 18: 1 and 19: 2 cited in Pyzel 2017).

Złota Grodzisko II (Świętokrzyskie) settlement feature 75: fragment of anthropomorphic vessel/male figurine hollow inside. Lublin-Volhynian Culture (Podkowińska 1953, pl. 19: 1 cited in Pyzel 2017).

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POTS: THE KEY TO THE TYPE-CHRONOLOGY OF THE LUBLIN-VOLHYNIAN CULTURE CERAMICS

ABSTRACT

Wilk S. 2025. Pots: the key to the type-chronology of the Lublin-Volhynian culture ceramics. *Sprawozdania Archeologiczne* 77/2, 39-63.

The Lublin-Volhynian Culture is the oldest community representing the Early Eneolithic socio-economic model in Lesser Poland. Together with the Wyciąże-Złotniki group, it has been the subject of a multifaceted analysis as part of the National Science Centre's project, 'Adaptation of Transcarpathian cultural patterns of the Copper Age in Younger Danubian cultures in the Lesser Poland Upland,' which was carried out between 2018 and 2023. A significant element of this research was a typological and chronological analysis of the ceramics of the Lublin-Volhynian culture. It showed that pots show apparent variability in form and ornamentation over time. The clarification of the absolute chronology of the Lublin-Volhynian culture enabled the separation of a group of graves containing pots, whose chronology was defined by AMS dates. These became the base for a pattern of variation in the forms and decoration of the pots. The resulting pattern corresponds to the general dynamics of development of the discussed unit between c. 4050-3700 BC.

Keywords: Eneolithic, pottery, typology, chronology, Lesser Poland, Carpathian Basin
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1. INTRODUCTION

The Lublin-Volhynian culture (LVC) is the largest Early Eneolithic taxonomic unit in south-eastern Poland (Fig. 1). Although almost a century has passed since the first materials were discovered (Żurowski 1930), many of its characteristics remain controversial. Over the years, numerous attempts have been made to solve the mystery of its origin and chronology (*e.g.*, Podkowińska 1953; Nosek 1955b; Gurba 1973; Kulczycka-Leciejewiczowa 1979; Kruk and Milisauskas 1985; Kamieńska and Kozłowski 1990, 56-64; Kadrow and Zakościelna 2000; Zakościelna 2006). Most of the views expressed in the literature share an emphasis on the role of the Malice culture as a substrate on which, under the influence of the Tiszapolgár culture, the earliest Lesser Poland Eneolithic communities formed. Sławomir Kadrow and Anna Zakościelna (Kadrow and Zakościelna 2000) proposed dating the LVC between approximately 4400/4200 and 3400 BC and dividing its development into three phases, which would reflect the dynamics of cultural change in the Carpathian Basin during the Early and Middle Copper Age.

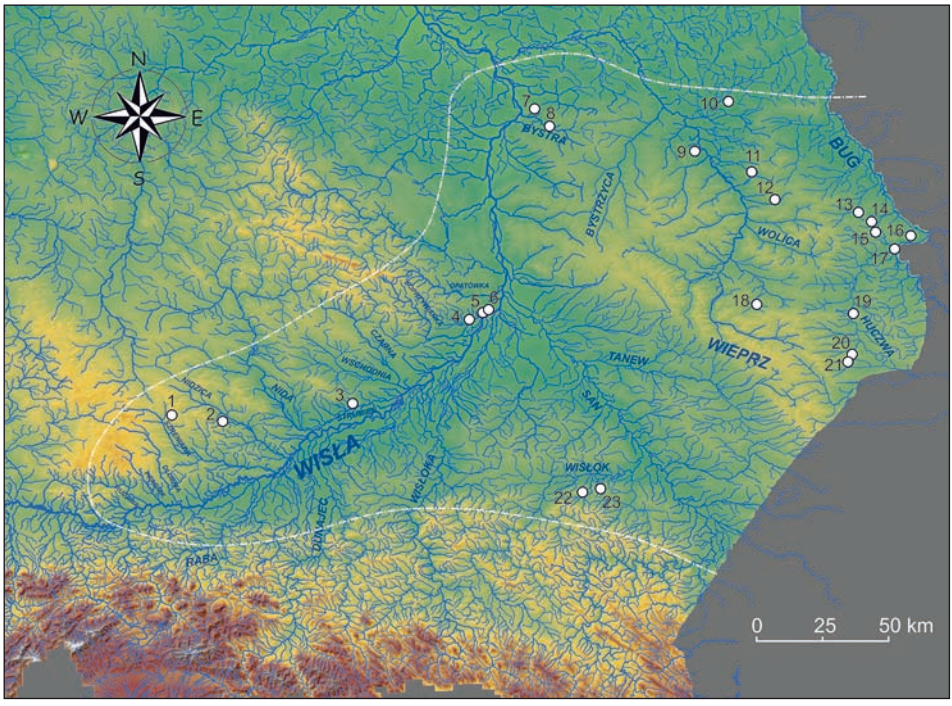

Fig. 1. LVC area with the locations of the sites mentioned in the text: 1 – Miechów, 2 – Bronocice, 3 – Książnice, 4 – Złota, 5 – Sandomierz – Wzgórze Zawichojskie, 6 – Sandomierz – Kamień Plebański, 7 – Wąwolnica, 8 – Las Stocki, 9 – Jaszczów, 10 – Garbatówka Kolonia, 11 – Krasne Kolonia, 12 – Siennica Różana, 13 – Raciborowice, 14 – Stefankowice Kolonia, 15 – Moniatycze Kolonia, 16 – Strzyżów, 17 – Gródek, 18 – Topornica, 19 – Tyszowce, 20 – Podlodów, 21 – Łubcze, 22 – Łańcut, 23 – Kosina. By S. Wilk

Less than a decade after the publication of the cited work, the validity of the proposition that the origins of the LVC were shaped by the influence of the Tiszapolgár culture came under scrutiny (Chmielewski 2008). One of the many contentious issues was the proper assessment of the genetic and typological relationships of the LVC pottery. Some of its features, especially the presence of white-painted geometric motifs on vessel walls and decoration with stamped or pierced hollows arranged in triangular motifs, were considered to be of high chronological significance in older publications (Kadrow and Zakościelna 2000, 213, 214; Zakościelna 2006, 82-84). Similarly, some vessel forms were also regarded as precise indicators of chronology and intercultural links due to their similarity to pottery used in the Carpathian Basin (Kadrow and Zakościelna 2000, 223; Zakościelna 2006, 85). These included high-necked amphorae presumed to refer to the milk pots of the Bodrogkeresztúr culture.

However, new data on the absolute chronology of Early Eneolithic/Copper Age populations on both sides of the Carpathians (Oross *et al.* 2010; Raczky and Siklosi 2013; Brummack and Diaconescu 2014; Chmielewski 2019; Siklósi and Szilagyi 2021), including the LVC and the Wyciąże-Złotniki group (Nowak 2014; 2017; Wilk 2016; Włodarczak 2017; Kadrow 2017; Kadrow and Zakościelna 2022a; 2022b; Mattila *et al.* 2023; Wilk *et al.* 2024), have brought into question the importance of the aforementioned pottery characteristics as sensitive chronological determinants.

'Adaptation of Transcarpathian cultural patterns of the Copper Age within the Younger Danubian cultures in the Lesser Poland Upland' is a Preludium 13 project of the National Science Centre of Poland, which was carried out from 2018 to 2023 at the Faculty of History of the Jagiellonian University in Kraków. As part of this project, the author of this article attempted to verify older hypotheses concerning the role of ceramic markers in intercultural relations. Among other things, the analyses conducted at that time enabled the establishment of a typology of LVC pottery, primarily based on funerary materials (Wilk 2021, 243-278). In the course of the research, it became clear that pots were the only type of vessel whose formal variation could be reliably correlated with broader changes of a sociocultural chronological nature. Hence, the proposal is to base the relative chronology of the pottery of LVC on this type of vessel.

2. TYPOLOGY OF LVC POTS

LVC pots are bipartite vessels with an S-shaped profile, provided with handles on the rim or on the widest part of the body, meeting the following criteria: $r1:h1 \leq 1.2$, when $r2 < r1$ (Dreczko 2016, 13 – modified, with 1.2 instead of 1.1). LVC pots typically have rough surfaces, occasionally with traces of smoothing, but they are never as carefully smoothed as cups, amphorae or flowerpot-shaped vessels. Most of the vessels were made of clay tempered with grog, with an admixture of fine sand. The rims can be smooth, notched (incised)

or covered with fingertip impressions. The decoration is dominated by various types of knobs and cordons applied to the neck or the upper body.

With their wide variety of shapes, LVC pots proved very difficult to subdivide. Eventually, they were divided into two subtypes using the ratio of the diameter of the rim to the height of the vessel (r1:h1): slender pots (subtype A), where r1:h1<1.0, and squat pots (subtype B), where 1.0<r1:h1>1.3 (Fig. 2). In the typology developed by Ewa Dreczko for Funnel Beaker culture pots from Lower Silesia, on which the system presented here was partly modelled, slender pots are defined by the ratio r1:h1<0.7 (Dreczko 2016, 13, fig. 2). This criterion could not be applied to the LVC pots as none of the vessels analysed would have met it. It was therefore decided to use the ratio r1:h1<1.0.

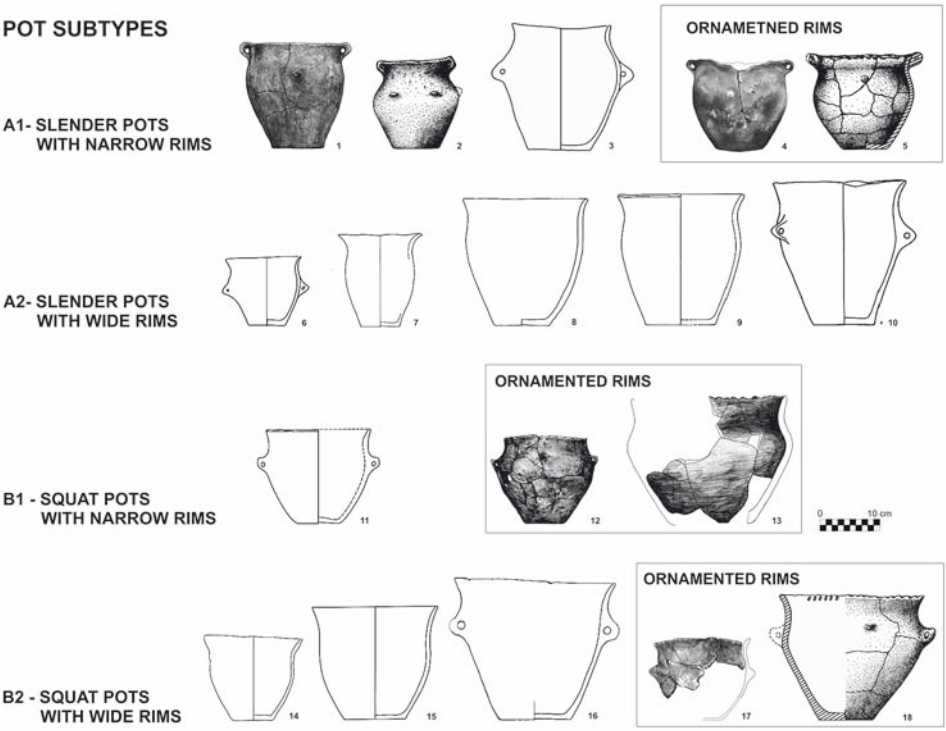

Fig. 2. Typology of pots of LVC: 1 – Grave 5 at Książnice 2; 2 – Grave 390 at Złota-Grodzisko I; 3 – Grave 6 at Garbatówka Kolonia 7; 4 – Grave 10 at Książnice 3; 5 – Grave 101 at Złota-Grodzisko II; 6 – grave at Garbatówka Kolonia 7; 7 – Grave 1/1961 at Strzyżów 1A; 8 – Grave 18 at Podlodów 2; 9 – Grave 2 at Żuków; 10 – Grave 1 at Strzyżów 10; 11- Grave 1/1947 at Sandomierz-Kamień Plebański, 12 – Grave 9 at Książnice 2; 13 – Pit 458 at Miechów 3; 14 – Grave 1/1987 at Tyszowce 25B; 15 – Grave III at Gródek 1C; 16 – damaged graves at Topornica 36; 17 – Grave 11 at Książnice 2; 18 – Grave 122 at Złota-Grodzisko II. Illustrations: 2-3, 5-11, 14-16, 18 – after Zakościelna 2010; 1, 4, 12, 18 – drawing by K. Kielijańska, 13 – by courtesy of the authors of the study of Site 3 in Miechów: M. Nowak and M. M. Przybyła, drawing by M. Podsiadło

The two subtypes were further split according to the ratio of rim diameter to maximum body diameter (r1:r3). Pots with wide mouths, where r1>r3, were described as Variant 1, while those with narrower mouths, where r1<r3, were described as Variant 2. Both subtypes include vessels with handles on the rim, with handles or other grips at the broadest part of the body, and those without handles or grips.

2.1. Slender pots (subtype A)

Among the sepulchral sites of the LVC, the most significant number of pots of subtype A (8 pieces) were found in the cemetery of Książnice: Ks/c/2/9/03 from Grave 4, Ks/c/1/1/04 from Grave 5, Ks/w/22/08 from Grave 7, Ks/w/7/11 from Grave 10, Ks/22/12 from Grave 12, Ks/37/12 from Grave 14, Ks/72/12 from Grave 16, and Ks/w/8/23 from Grave 21 (Fig. 3: b-c, e, g, i-k, n). Apart from the penultimate pot, in which the rim part has not survived, all the others have two opposed handles on the rim. Two pots, Ks/c/4/3/04 from Grave 6 and Ks/37/12 from Grave 14, have two vertical holes in the rim or just below it (Fig. 3: d, j). Subtype A pots were also discovered in Grave I at Gródek IC (Kokowski and Zakościelna 1988, fig. 6: a), in Grave 1 at Jaszczów (Nosek 1949; Zakościelna 2010, pl. 20A: 1), in Grave 1/1961 at Strzyżów 1A (Głosik and Gurba 1963; Zakościelna 2010, pl. 52: 6), and in Graves 3 and 4 at Strzyżów 26 (Zakościelna 2010, pl. 63a: 8, 64a: 7). Interestingly, they all lacked handles. The only pots outside of Książnice with slender proportions and handles on the rim come from Złota: from Grave 390 at the Grodzisko I site (Sałacińska and Zakościelna 2007, fig. 12: 1) and from Grave 101 at the Grodzisko II site (Sałacińska and Zakościelna 2007, fig. 20: 7). In addition, a miniature pot of this type was discovered in Pit 316 (grave) at Site 3 in Miechów (Fig. 4: d). Pots with handles on the belly were discovered in a grave at Garbatówka Kolonia 7 (Polańska 1999, fig. 2: 2); in Grave 2 from Jaszczów (Kowalczyk 1954, fig. 3); in a Grave 18 from Podlodów 2 (Bagińska and Banasiewicz-Szykuła 2002; Zakościelna 2010, pl. 47: 2, 47a: 6); in Grave 1 at Strzyżów 10 (Zakościelna 1996, fig. 5: a, b); and in Graves 2, 5 and 7 at Strzyżów 26 (Zakościelna 2010, pl. 62: 3, 65: 3, 66: 3) (Fig. 2: 1-10).

In the LVC, slender pots are much more common in settlement contexts. They were found at, among other locations, the Grodzisko I site in Złota, in Pit s 3 and 36 (Podkowińska 1953, fig. 8, pl. 10: 2); at Łańcut 3 in Pits 30 and 30A (Gruszczyńska and Mitura 2002, pl. 5: 10-11); and at Łańcut 10 in the only LVC pit examined at this site (Kadrow and Kłosińska 1988, fig. 7: a, b). Another example of this subtype is known from Site 7 at Las Stocki, from Pit 46 (Zakościelna 1986, fig. 10: 5). An interesting variant of this pot, with an egg-shaped body and a notched rim shaped into four protrusions with vertical holes, was found in Pit 1601 at Miechów 3 (Fig. 4: f).

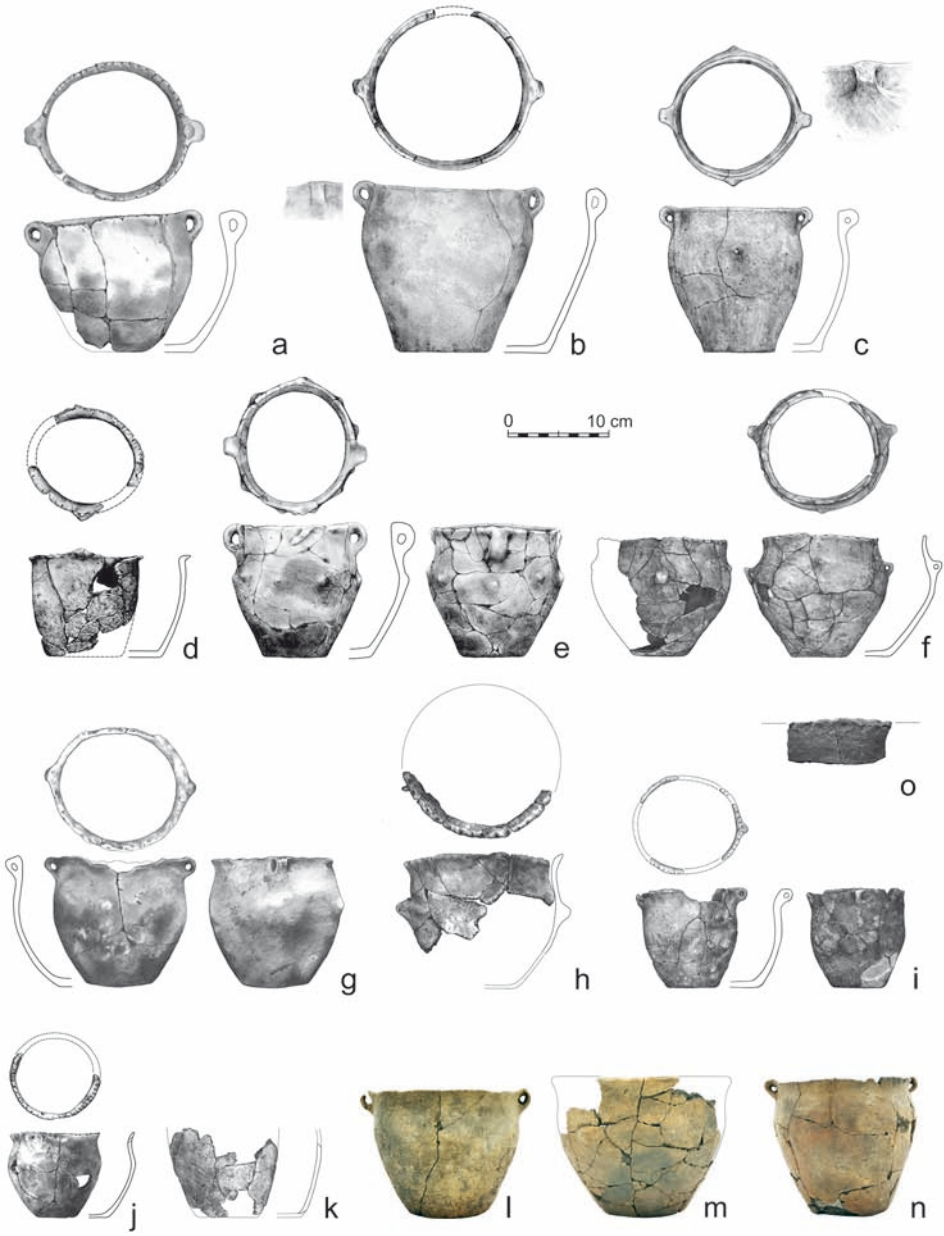

Fig. 3. Pots from the cemetery of LVC at Site 2 in Książnice: a – Ks-c/3/9a/02 from Grave 2, b – Ks-c/2/9/03 from Grave 4, c – Ks-c/1/1/04 from Grave 5, d – Ks-c/4/3/04 from Grave 6, e – Ks/w/22/08 from Grave 7, f – Ks/w/10/10 from Grave 9, g – Ks/w/7/11 from Grave 10, h – Ks/w/18/12 from Grave 11, i – Ks/w/22/12 from Grave 12, j – Ks/w/37/12 from Grave 14, k – Ks/w/72/12 from Grave 16, l – Ks/w/16/22 from Grave 19, m – Ks/w/3/22 from Grave 20, n – Ks/w/8/22 from Grave 21, o – fragment of pot Ks/220/06 from Pit 16/06, drawings by K. Kielijańska and N. Kędzierska

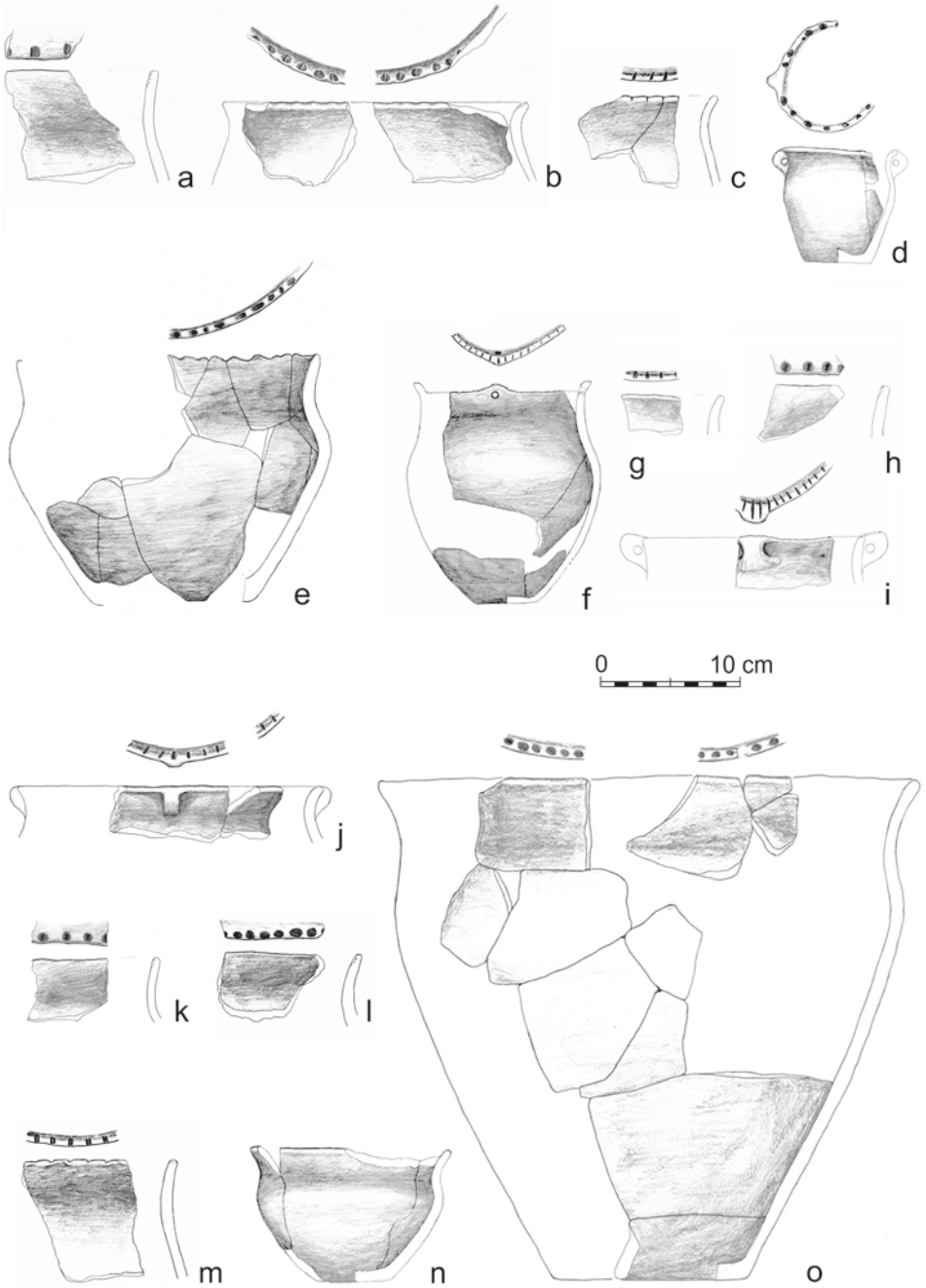

Fig. 4. Examples of LVC pots from Site 3 in Miechów: a, b – Pit 425, c – Pit 355, d – Pit 316, e – Pit 458, f-i – Pit 1601, j-k – Pit 2031, l-m – Pit 2681, n – Pit 1603, o – Pit 431, drawings by M. Podsiadło

2.2. Squat pots (subtype B)

Like the slender pots, vessels with squat proportions were made with or without handles (Fig. 2: 11-18). Examples of pots with squat proportions come from locations that include Grave III at Site 1C in Gródek (Zakościelna 2010, pl. 12: 1), Grave 1/1987 at Site 25B in Tyszowce (Buszewicz 1987; Zakościelna 2010, tabl. 71: 4), and Grave 1 at Moniatycze Kolonia (Gurba 1967, fig. 9). Five of the vessels from the Książnice cemetery belong to the discussed subtype: Ks/c/3/9a/02 from Grave 2, Ks/w/10/10 from Grave 9, Ks/18/12 from Grave 11, Ks/w/16/22 from Grave 19, and Ks/w/3/22 from Grave 20 (Fig. 3: b, f, h, l-m). The pots from Graves 2 and 19 have handles located on the rim, while those from Graves 9 and 11 have handles or grips located at the widest part of the belly. In the case of the pot from Grave 20, it is difficult to say whether it had handles due to its fragmentary state of preservation. Squat pots with handles or other grips at the broadest part of the body, similar to examples Ks/w/10/10 and Ks/18/12, form a relatively compact group. They can be found in Grave 122 at the Grodzisko II site in Złota (Sałacińska and Zakościelna 2007, fig. 29: 1), at Site 36 in Topornica (Buszewicz 1993; Zakościelna 2010, pl. 67: 1, 67a: 6), in a grave at Site 4 in Gródek (Gąssowski 1954; Zakościelna 2010, pl. 16B: 1), in a grave 1/1947 at the Kamień Plebański site in Sandomierz (Nosek 1950; Zakościelna 2010, pl. 49: 5), in grave at Site 7 in Garbatówka Kolonia (Polańska 1999, fig. 3: 5), and other locations. It is worth noting that the artefacts from Grave 9 from Książnice (Ks/w/10/10) and Grave 122 at Grodzisko II in Złota differ from the others in that they have additional small knobs placed slightly higher than the handles. It is also significant that both these pots were found in cenotaphs. A similar vessel was found in Pit 458 at Miechów 3 (Fig. 4: e), and a slightly slenderer example comes from Pit 431 at the same site (Fig. 4: o). In addition, similar vessels have been found in Pit 46 at Las Stocki 7 (Zakościelna 1986, fig. 9: 1) and in Pit 49 at the Wzgórze Zawichojskie site in Sandomierz (Kowalewska-Marszałek *et al.* 2017, pl. II.59: 1). The latter site yielded fragments of pots of proportions that are difficult to determine, which were found in material from the eroded loess slope below Wzgórze Zawichojskie (Ścibior 1993, pl. 10: 1-11, 11: 1-10). Similar fragments of pots decorated with notches or fingertip impressions on the rim were also found in large numbers at Site 3 in Miechów (Fig. 4: a-c, g-m).

The category of squat pots includes a specific group of vessels with rims wider than the greatest width of the base (r1>r3). Their proportions are similar to the tulip-shaped pots known from Younger Danubian Neolithic cultures. Examples of this type of vessel are known from locations that include Grave III at Site 1C in Gródek (Zakościelna 2010, pl. 12: 1), Grave II at Site 27 in Łubcze (Koman 1997, fig. 6: 2) and Grave 1/1987 at Site 25B in Tyszowce (Zakościelna 2010, pl. 71: 4). An analogous vessel also occurred in Pit 1603 at Miechów 3 (Fig. 4: n).

3. POTS OF LVC – THEIR ORIGINS AND CHRONOLOGY

Due to the great variety of forms and ornamentation, the pots used by the people of the Lublin-Volhynian culture can be considered chronologically sensitive artefacts. Referring to artefacts discovered in settlement contexts at Las Stocki 7 and Wąwolnica 6, Anna Zakościelna and Sławomir Kadrow have proposed linking the appearance of this type of vessel with the second phase of the discussed culture (Kadrow and Zakościelna 2000, 214, figs 22-24; Zakościelna 2006, 82, fig. 3).

This hypothesis was already questioned by the author of this paper in 2017, on the occasion of the publication of Grave 14 from the Książnice cemetery (Wilk and Szczepanek 2017, 363). Indeed, suppose we accept the genetic links between the Rzeszów phase of the Malice culture and the classic stage of the LVC, as emphasised by Sławomir Kadrow and Anna Zakościelna. In that case, we should assume that the custom of decorating pot rims with fingertip impressions and notches originated from Malice culture. This, however, would not explain the flourishing of this type of decoration at sites dated to the third phase, where S-profiled pots with fingertipped or notched rims make up a significant proportion of the ceramic assemblage. Examples of such ornamentation can be found, among other places, at Sites 3 and 10 in Łańcut (Gruszczyńska and Mitura 2002, 50, 51; Kadrow and Kłosińska 1988, 12, fig. 7), at the defensive settlement of Bronocice (Kruk and Milisauskas 1985, 55-57), at the cemetery and settlement in Złota Grodzisko I and II (Podkowińska 1953, fig. 8, pl. 4: 3; 10: 1, 2; Sałacińska and Zakościelna 2007, fig. 12: 1; 20:7; 29: 1), and at the cemetery at Site 2 in Książnice (Wilk 2004, figs 4B: 3 and 7C: 2; 2006, fig. 8B).

The arguments put forward a few years ago take on a deeper meaning since both the early chronology (corresponding to the classic phase of the LVC) of the hanging triangle motif on pottery from Las Stocki 7 and its relationship to the Rzeszow phase of the Malice culture and the Tiszapolgár culture have been questioned (Chmielewski 2008; Wilk 2021, 486-503). This has two important implications. First, there is no longer any reason to argue for the presence of relics of the classic phase of LVC (in the understanding of Sławomir Kadrow and Anna Zakościelna) at this settlement. Second, we should assume that most of the artefacts discovered there should be associated with the later phase of this site, dated to c. 4000/3950-3700/3650 BC based on four 'younger' radiocarbon dates (Wilk 2021, 500). This is supported by several stylistic features, including references to the Scheibenhenkel style, notched plastic rings of hollow-pedestal bowls, notched pot rims and fingertip impressions on the inside of pot rims (Fig. 5), that are generally characteristic of younger LVC assemblages, as first pointed out by Tomasz Jacek Chmielewski (Chmielewski 2008, 60-69).

In conclusion, in light of the arguments presented above, there is no sufficient basis for considering any of the elements discovered at Las Stocki 7, including the group of pots with a S-shaped profile, as exemplary of the classic phase of LVC (Fig. 5). In addition, the analysis of pots from the grave assemblages dated by Anna Zakościelna to the classic phase

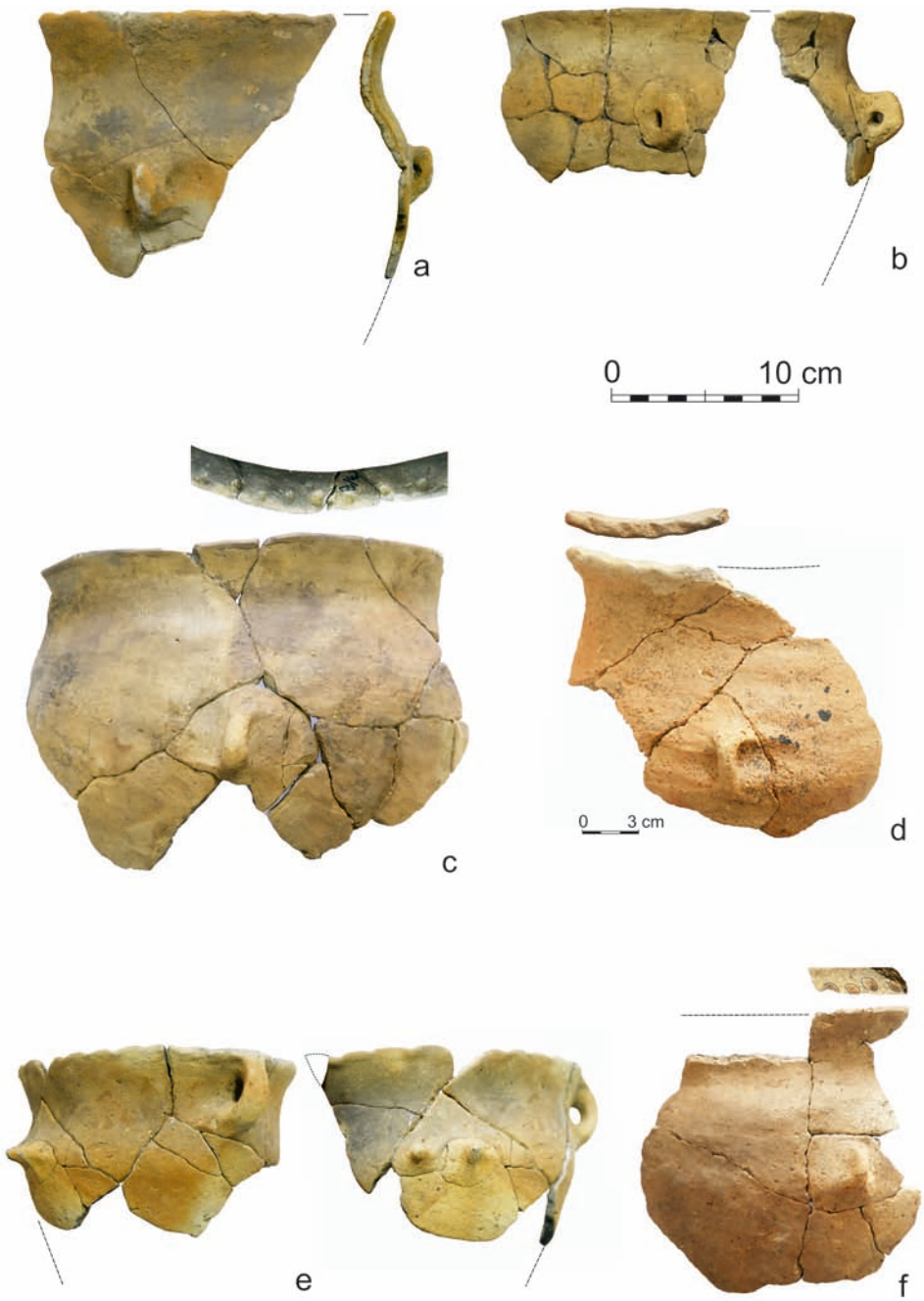

Fig. 5. Examples of LVC pots from Site 7 at Las Stocki, photo. S. Wilk.
Illustration courtesy of Anna Zakościelna, author of the research on Site 7 in Las Stocki

(Grave 1/1987 at Gródek 1C; Graves 1 and 2 at Jaszczów 5; Grave II at Łubcze 27; Grave 1 at Moniatycze Kolonia; Podlodów 2; the Karolicha site in Raciborowice; Sandomierz-Kamień Plebański; Siennica Różana; Grave 1/1982 at Stefankowice Kolonia 3; Grave 1 at Strzyżów 1A; Grave 4 at Strzyżów 2A; Grave 390 at the Grodzisko I site in Złota; Zubków; Zakościelna 2010, pl. 5) revealed no features that would consistently distinguish them from other LVC pots. On the contrary, most of these graves were assigned to the second phase based on other criteria, such as the decoration with oval or circular stamp impressions, the white-painted decoration on the cups, the presence of knobs or handles on the lower body, and so on. This observation was behind the decision that, when establishing a typology of LVC pottery based on funerary material, the diachronic variability of some types of ceramic vessels, including pots, should also be investigated (Wilk 2021, 243-278).

3.1. Chronology of LVC pots

Due to the number and variety of pots at Site 2 in Książnice, unprecedented at other sites, as well as the well-recognised and precisely dated context of the discovery, the vessels from this cemetery turned out to be the key to understanding the chronology and typology of LVC pots. The artefacts of interest were found in fourteen out of the twenty-one graves reliably associated with the LVC (Nos 2, 4-7, 9-12, 14, 16 and 19-21). Absolute age determinations are available for seven of these burials (Table 1). If we add the pots from other radiocarbon-dated cemeteries (Graves 101 and 122 at the Grodzisko II site in Złota;

Table 1. List of radiocarbon dated LVC graves with pots from the cemetery in Książnice 2

No.	Grave no.	Laboratory no.	Radiocarbon Age (BP)	References
1	2	Poz-91025	5050±35	Mattila *et al.* 2023; Wilk *et al.* 2024
2	4	Poz-91024	5160±40	Mattila *et al.* 2023; Wilk *et al.* 2024
3	5	Poz-117118	5235±35	Wilk *et al.* 2024
4	6	Poz-117119	4940±35	Wilk 2021
5	7	Poz-117064	5180±35	Wilk 2016; Wilk *et al.* 2024
6	9	Poz-117120	4970±40	Wilk 2021
7	10	Poz-91026	5040±40	Mattila *et al.* 2023

Table 2. List of radiocarbon dated LVC graves with pots from other cemeteries

No.	Site	Grave no.	Laboratory no.	Radiocarbon Age (BP)	References
1	Podlodów 2	feature 18	Ki-8730	5180±100	Zakościelna 2010
2	Złota, Grodzisko I	390	Poz-17501	5170±40	Sałacińska, Zakościelna 2007
3	Złota, Grodzisko II	101	Poz-19407	5060±30	Sałacińska, Zakościelna 2007
4	Złota, Grodzisko II	122	Poz-19408	5020±40	Sałacińska, Zakościelna 2007
5	Krasne Kolonia 16	9	Ki-7835	4970±90	Zakościelna 2010

Grave 390 at the Grodzisko I site in Złota; Feature 18 at Podlodów2; Grave 9 at Krasne Kolonia 16; Table 2), we arrive at a collection of thirteen vessels from twelve graves. Pots from three other radiocarbon-dated graves: Graves 2 and 4 at Strzyżów 26 and Grave III at Gródek 1C, are not included in the analysis due to their controversial, very 'young' dates, which after calibration fall into the middle or even the second half of the 4th millennium BC (Zakościelna 2010, 35, table 6).

Following calibration and Bayesian analysis of the above set of twelve radiocarbon dates from graves containing pots, the resulting calendar age ranges are: 4072-3616 BC (start of the boundary start parameter and end of the boundary end parameter for 95,4% range) and 4046-3688 BC (start of the boundary start parameter and end of the boundary end parameter for 68% range) (Fig. 6).

The result of applying Bayesian analysis to the data set in question was a division into three groups. A second Bayesian modelling (Fig. 7) was carried out to test whether this division corresponded to the typological variability of the pots. The result was a division into three chronological phases, which partly coincide with the typological variability of the LVC pots. The division in question is most clearly legible in the 68% calibration and

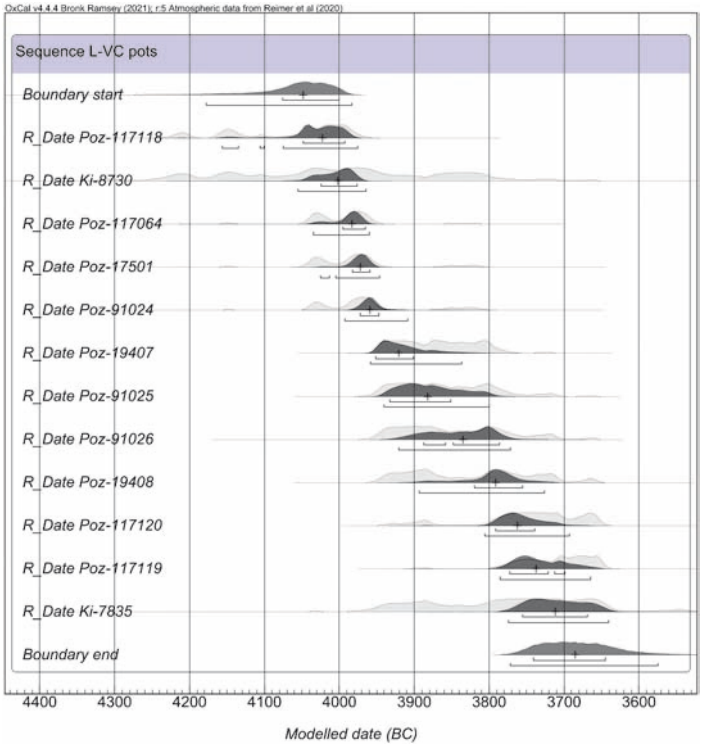

Fig. 6. Calibration (pale grey) and Bayesian modelling (dark grey) of radiocarbon dates from LVC burials with pots; Amodel=174.4 Aoverall=169.7

modelling range. Based on the dates from Graves 5, 7, 4 at Książnice 2, Feature 18 at Podlodów 2, and Grave 390 at the Grodzisko I site in Złota, Phase I can be dated to *ca*. 4046-3945 BC (beginning of the boundary start parameter and end of the boundary end parameter for 68% range). Phase II, based on the dates from Graves 2 and 10 at Książnice 2 and Graves 101 and 122 at the Grodzisko II site in Złota, falls to c. 3959-3793 BC (beginning of the boundary start parameter and end of the boundary end parameter for 68% range). Phase III, based on the results of radiocarbon dating of Graves 9 and 6 at Książnice 2 and Grave 9 at Krasne Kolonia 16, is dated to *ca*. 3806-3688 BC (beginning of the boundary

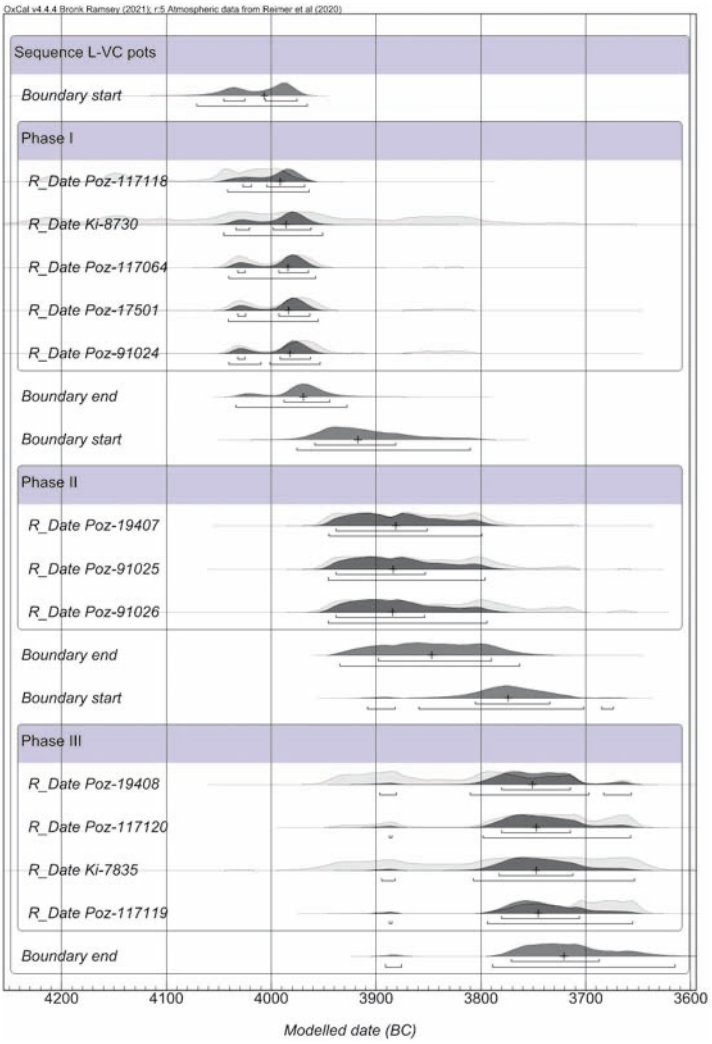

Fig. 7. Calibration (light grey) and Bayesian modelling (dark grey) with phases of radiocarbon dates from LVC burials with pots; Amodel=152.5 Aoverall=155.3

start parameter and end of the boundary end parameter for 68% range). At this point it should be noted that due to the specificity of the calibration curve for the second half of the 5th millennium BC and for the 1st half of the 4th millennium BC, the age determinations included in Phase I (apart from the date from Podlodów, which has a high standard error and has been used conditionally in this compilation) are characterised by exceptional dating precision. The exception is the date from the grave in Podlodów, which is characterised by a very large standard error and has been used conditionally in this compilation only because it is the oldest uncalibrated age designation among all LVC radiocarbon dates from the Lublin region. This is in contrast to the dates from Phase II, which fall entirely on the plateau of the beginning of the 4th millennium BC (c. 3950-3800 BC) and those from Phase III, which fall into the next flattening of the calibration curve (*ca*. 3770 to 3720 BC) (Fig. 7).

The oldest well-dated pot of LVC is a specimen from Grave 5 at Site 2 in Książnice, a burial belonging to the first chronological period. However, when we look at the calibration curve with the superimposed results of the calibration and Bayesian modelling of dates from LVC graves with pots, it is clear that the calendar age range of the sample from Grave 5 deviates slightly from the other determinations (Fig. 8). The calendar age range of this grave obtained by Bayesian modelling is 4028-3969 BC with 68% probability and 4042-3965 BC with 95,4% probability. In our opinion, this grave was most likely created shortly before the beginning of the 4th millennium BC.

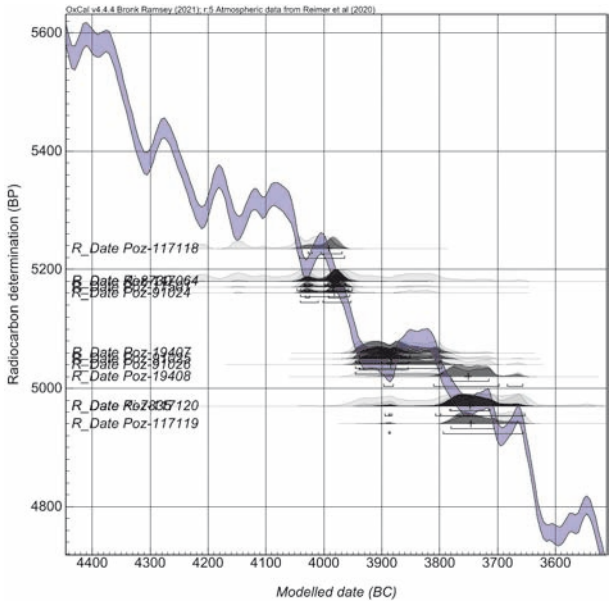

Fig. 8. Calendar age ranges of LVC burials with pots against calibration (light grey) and Bayesian modelling (dark grey) for the second half of the 5th millennium BC and the first half of the 4th millennium BC

So, what does the oldest reliably dated LVC pot look like, and what are its distinguishing features? The vessel has an S-shaped profile with a gently rounded body, rough walls, and two small handles protruding slightly above the plain, undecorated rim. There are two small conical knobs at the broadest part of the belly, symmetrically placed in the spaces between the handles, and traces of a white substance are preserved in the central part of the vessel (Fig. 3: c). Of particular note is the fact that the rim of the pot from Grave 5 was neither notched nor otherwise decorated, which suggests that it was most likely made before the influence of the Hunyadihalom-Lažňany horizon became noticeable in Lesser Poland. Such an assumption aligns with the aforementioned new findings on the absolute chronology of the Early and Middle Copper Age cultures in the Carpathian Basin. Another important feature of the described vessel is the presence of two opposed conical knobs placed on the handle line. The decoration with two single knobs or two pairs of knobs is typical of LVC pots and was most probably borrowed from the Malice culture. One of the oldest examples of such decoration is a pot from Feature 49 at Wzgórze Zawichojskie in Sandomierz, which is described as a vase in the source publication and broadly dated to the Lengyel-Polgar cycle (Kowalewska-Marszałek *et al.* 2017, 112; 107, 108, pl. 2.59: 1). The radiocarbon date obtained for a charcoal sample taken from this feature (Gd-4459) is 5680±140 BP (Kowalewska-Marszałek *et al*. 2017, 108).

Graves 7 and 4 from Książnice produced comparable radiocarbon dates, namely 5180±35 BP and 5160±40 BP. For Grave 7, the calendar age ranges obtained by Bayesian modelling are 4033-3965 BC, with a 68% probability, and 4041-3958 BC, with a 95.4% probability. Grave 4 can be dated to 4033-3963 BC with a 68% probability and to 4041-3954 BC with a 95.4% probability.

The vessels from these two graves represent different styles. The pot from Grave 7 is one of the best indicators of the Hunyadihalom-Lažňany horizon in the Książnice cemetery and in the LVC in general (Wilk 2016, 15). Its distinctive features are two notched cordons placed diagonally from the rim towards the neck, eight conical knobs placed at the widest part of the belly, and the distinctly oval mouth (Fig. 3: e). The closest analogues to this artefact come from the north-eastern part of the Carpathian Basin. An identical decoration was found, among other cases, on a vessel from Grave 21 in the cemetery of Šebastovce (Šiška 1972, Abb. 30: 6), and with slightly larger knobs, on a vessel from the Panyola settlement (Patay 2011, Taf. 3: 5). Six knobs decorate a similar vessel from Grave 10 at Barca (Šiška 1972, Abb. 32: 2). Eight knobs, but in a double arrangement (four pairs, each consisting of two knobs one above the other) were observed on, among other examples, vessels from Grave 39 in Šebastovce and Grave 8 in Barca (Šiška 1972, Taf. 9: 3, 10: 13). Diagonal cordons, plain or notched, are known from, among other sites, the settlement of Tiszalúc (Patay 2005, Taf. 35: 11, 15).

In the Lublin-Volhynian culture, characteristic diagonal cordons also appeared on two vessels from the cemetery at Hołyszów Wołyński (Голишів, Hołysziw): on the neck of a small vase from Grave 4 (Zakościelna 2010, pl. 85: 5) and on a fragment of a vase from

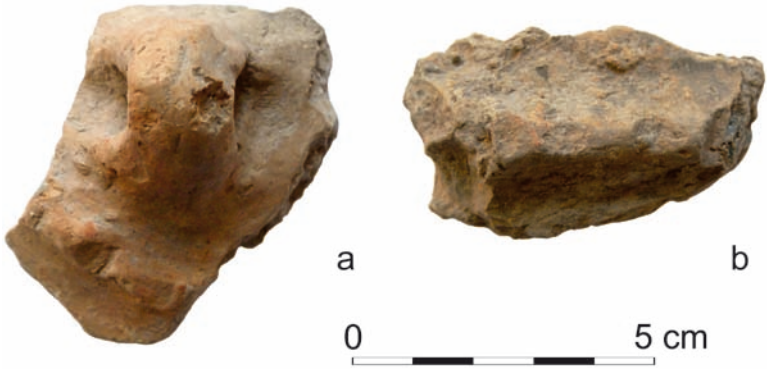

Fig. 9. Fragments of LVC pots with cordons at Łańcut 10: a – fragment from Pit 1, b – fragment from the surface of Trench II, photo. S. Wilk. By courtesy of the District Museum in Rzeszów

Fig. 10. Fragments of LVC pots with cordons: a – from Pit s 20, 30A at Łańcut 3, b – from the cultural layer at Kosina 35, photo. S. Wilk. By courtesy of the District Museum in Rzeszów

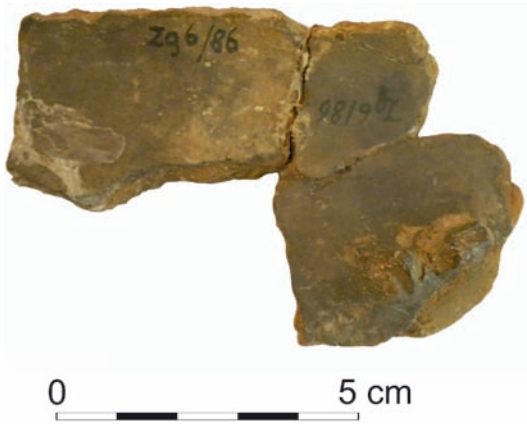

Fig. 11. Fragment of LVC vessel with a diagonal cordon from Pit 10 at Wąwolnica 6, photo. S. Wilk. By courtesy of Anna Zakościelna, author of the research on Site 6 in Wąwolnica

destroyed graves (Zakościelna 2010, pl. 86: 3). Similar cordons, but applied horizontally or vertically, were discovered at Site 10 in Łańcut. One fragment, with a cordon placed diagonally under a small handle, comes from Pit 1 (Fig. 9: a), while the other was found on the surface of Trench 2 (Fig. 9: b) (Kadrow and Kłosińska 1988, Fig. 5: d). Similar cordons decorate vessel fragments from Features 30 and 30A at Łańcut 3 (Fig. 10: a) (Gruszczyńska and Mitura 2002, pl. 4: 6) and from the cultural layer at Kosina 35 (Fig. 10: b) (Kadrow 1992, fig. 7: t). A slightly different, deeply notched cordon appears on a fragment of a wide-mouthed S-shaped vessel from Pit 10 at Wąwolnica 6 (Fig. 11). In addition, horizontal notched cordons attached below the rim occur on several sherds from the Bronocice settlement (Kruk and Milisauskas 1985, pl. 5: 2, 3; fig. 23: 4-4). The pot from Grave 4 at Książnice, although slightly larger, is similar to the artefact from Grave 5. It has an S-shaped profile with the widest part at three-quarters of the height, two small handles protruding slightly above the rim, and rough walls, with a white substance preserved in places in the central part of the vessel (Fig. 3: b).

From the same period (first half of the 39th century BC), we know of three more pots from radiocarbon-dated grave assemblages. Two of them (a slender pot with two horizontally pierced handles in the broadest part of the body, which is slightly above the mid-height of the vessel, and a slender pot with a gentle S-shaped profile, without handles) were found in a grave (Feature 18) at Site 2 in Podlodów (Zakościelna 2010, 281, 282, pls 47: 2 and 47a: 6). The radiocarbon date obtained for this grave (Ki-8730) is 5180±100 BP (Zakościelna 2010, tab. 6). Bayesian modelling resulted in the following calendar age ranges: 4034-3963 BC, with 68% probability, and 4046-3952 BC, with 95,4% probability. The third pot comes from Grave 390 at the Grodzisko I site in Złota. In the source publication, the vessel of interest is described as a biconical amphora (Sałacińska and Zakościelna 2007, 89, 90). Its widest part, decorated with two conical knobs, is situated slightly above the middle of the vessel's height, while two small handles protrude above the rim (Sałacińska and Zakościelna 2007, fig. 12: 1). It was the presence of the conical knobs that determined the classification of the vessel in question to the group of pots. The radiocarbon date obtained for Grave 390 (Poz-17501) is 5170±40 BP (Sałacińska and Zakościelna 2007, table 2). Bayesian modelling yielded calendar age ranges of 4033-3964 BC, with a 68% probability, and 4042-3956 BC, with a 95.4% probability.

The middle group of dates, falling between c. 3959 and 3790 BC (the beginning of the boundary start parameter and the end of the boundary end parameter for a 68% range), comprises the age determinations for samples from Graves 2 and 10 at Książnice and Grave 101 at the Grodzisko II site in Złota. Despite relatively small standard errors (±35), the calendar age ranges obtained after calibration are very wide. This is due to the shape of the calibration curve, which flattens out noticeably between c. 3940 and 3800 BC. In the case of Grave 2, the calendar age range obtained by Bayesian modelling is 3939-3854 BC, with 68% probability, and 3946-3797 BC, with 95.4% probability. The pot discovered in Grave 2 at Książnice belongs to a group of squat vessels. It is characterised by a fairly wide

mouth, a gentle body line with a faintly marked shoulder, a short, poorly defined neck, and two small handles protruding over the notched rim. The handles have single, shallow hollows at the upper bases (Fig. 3: a). After Bayesian modelling, the sample from Grave 10 at Książnice yielded calendar age ranges of 3939-3855 BC, with a 68% probability, and 3946-3795 BC, with a 95.4% probability. The pot found in Grave 10 has slender proportions and an S-shaped profile. It is also provided with two small handles protruding slightly above the rim, which are decorated on the inside with a series of oval fingertip impressions. At the broadest part of the belly, on either side, were originally two small conical knobs, one of which has survived intact, while only a trace of the other remains (Fig. 3: g). The date obtained for Grave 101 at the Grodzisko II site in Złota (Poz-19407) is 5060±30 BP (Sałacińska and Zakościelna 2007, table 2), which, after Bayesian modelling, gives calendar age ranges of 3939-3852 BC, with 68% probability, and 3946-3800 BC, with 95,4% probability. The pot from this grave has slender proportions, an S-shape profile with a gently rounded belly, and two handles protruding clearly over the rim, which is notched on the inside. The pot is decorated with two conical knobs, located slightly above the widest part of the body, in the spaces between the handles (Sałacińska and Zakościelna 2007, fig. 20: 7).

As can be easily seen, the described pot model is present in both the features assigned to Phase I and those of Phase II. How should this be interpreted? It seems that the appearance of this type of vessel in Lesser Poland at the beginning of the 4th millennium BC confirms the spread of ceramic patterns from the Hunyadihalom-Lažňany milieu (notched rims, circumferential knobs, fingertip impressions, cordons, *etc.*). However, the motif of single or doubled conical knobs situated between the handles, as shown above, should be seen as a continuation of an older local tradition.

The link between Phases II and III is Grave 122 (a cenotaph) at Grodzisko II in Złota. A sample taken from an animal bone from this grave produced a radiocarbon date (Poz-19408) of 5020±40 BP (Sałacińska and Zakościelna 2007, table 2). After calibration, the following chronological ranges were obtained: 3781-3716 BC, with 68% probability, and 3897-3657 BC, with a 95.4% probability. This is important because this grave marks the first appearance of a new type of pot, characterised by an S-shape profile and squat proportions (r1:h1 >1.0), a wide, almost funnel-shaped neck topped by a rim decorated on the inside with a row of fingertip and fingernail impressions, and two horn-shaped handles placed at the widest part of the belly (Sałacińska and Zakościelna 2007, 98-101, fig. 29: 1). Admittedly, the earliest example of such a pot was found in Feature 18 at Podlodów 2, but this type of vessel did not appear in its fully developed form until the beginning of the 38th century BC. It should also be taken into account that the grave from Podlodów, due to the already emphasised very high standard error of the radiocarbon date, may be younger than suggested by the Bayesian analysis (Fig. 7). In which case, the presence of a pot of the type in question in its inventory would not be such a big surprise.

The feature in which the described type of pot reappeared is another cenotaph – Grave 9 from the Książnice cemetery, which represents the latest chronological stage of burials

with pots. The radiocarbon date for this burial, obtained from an animal shoulder blade (horse or cattle), is 4970±40 BP (Poz-117120). Bayesian modelling resulted in a calendar age range of 3781-3715 BC, with a 68% probability, and 3888-3658 BC, with a 95.4% probability. Compared to the vessel from Grave 122 at Złota, the pot from Grave 9 is slightly lower and has a shorter neck. However, the other features are almost identical, including the fingertip and fingernail impressions on the rim, the two horn-shaped handles at the widest point, and the conical knobs between the handles (Fig. 3: f). Grave 9 at Krasne Kolonia 16 has a radiocarbon date of 4970±90 BP (Ki-7835) (Zakościelna 2010, 35). In this case, the sample came from charcoal at the bottom of the burial pit. Bayesian modelling resulted in the following calendar age ranges: 3783-3713 BC, with a 68% probability, and 3895-3654 BC, with a 95.4% probability. The pot's widest part is at two-thirds of its height, and it has a short, straight neck with two small, horizontally pierced handles (Zakościelna 2010, 266, pl. 31: 1). Unfortunately, no analogy could be found for this vessel.

The assemblage that closes the development of the Książnice cemetery is Grave 6, which is also the latest radiocarbon-dated LVC burial with a pot (Wilk 2006, 249, figs 10-13). The radiocarbon date of 4940±35 BP (Poz-117119) was obtained from a goat/sheep bone found in this grave. Bayesian modelling resulted in calendar age ranges of 3781-3707 BC, with a 68% probability, and 3888-3656 BC, with a 95.4% probability. The pot found in this grave has a very gentle profile and lacks a defined neck. Its distinguishing feature is the rim, which is strongly everted and forms a kind of narrow overhang covered with fingertip and fingernail impressions. In addition, the pot has no handles, only two tongue-like projections that extend beyond the rim and are pierced vertically (Fig. 3: d). The described pot is somewhat reminiscent of flowerpot-shaped vessels, but due to the shape and decoration of the rim and the rough outer surface, it has been classified as a pot. A fragment of a similar vessel was found in Grave 16 at Książnice 2 (Fig. 3: k). Grave 14 on the same site contained a miniature S-profiled pot with no lugs, a notched rim, and two holes (Fig. 3: j). Similar vessels with vertical holes are known from Site 7 at Las Stocki (Zakościelna 1986, 43, fig. 12: 4), from the second grave at Jaszczów (Kowalczyk 1954, 4, fig. 3), and from the Hunyadihalom culture settlement in Tiszalúc (Patay 2005, 182, Taf. 30: 16).

4. SUMMARY

The analysis presented above demonstrates that pots do indeed vary in shape and decoration over time (Fig. 12). Specimens with slender proportions and an S-shaped profile, provided with two small handles protruding above the undecorated rim, were found in the earliest confidently dated grave assemblages (Graves 5 and 4 at Książnice 2, Grave 390 at the Grodzisko I site in Złota). The chronology of these features can be closed within the range of c. 4046-3945 BC. Some of the vessels are decorated with conical knobs (single or double) applied to the widest part of the body.

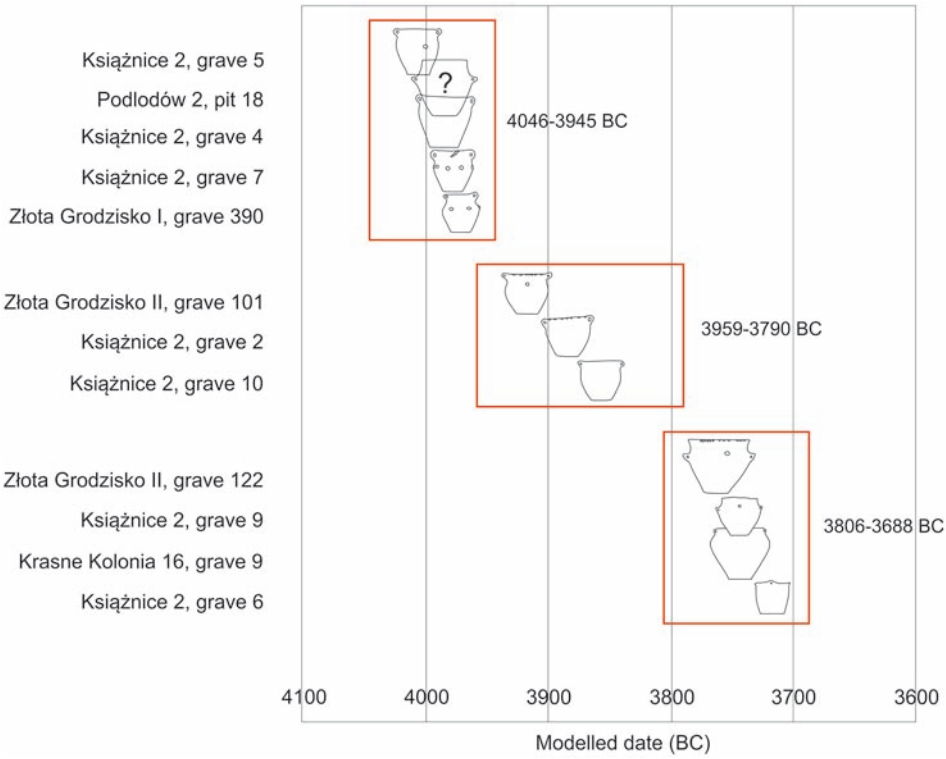

Fig. 12. Formal variation of pots during the development of LVC. 68% calendar age ranges obtained by calibration and Bayesian modelling of radiocarbon dates for burials with pots, by S. Wilk

In the first half of the 4th millennium BC, the first influences of the Early Hunyadihalom-Lažňany environment appeared in LVC, bringing with them the ornamental motifs originating in the eastern part of the Carpathian Basin, such as knobs and fingertipped cordons. The best example of this style is the vessel from Grave 7 at Książnice 2. From about the middle of the 40th century, throughout the 39th century, and into the early 38th century, pots essentially retained their original form. However, a new stylistic element appeared in the form of notches and fingertip and fingernail impressions on the inside of the rim. The practice of decorating the body with single or double knobs continued. This type of pot is represented by vessels from Graves 2 and 10 at Książnice 2 and Grave 101 at the Grodzisko II site in Złota.

Pots decorated in the manner described are found mainly in the western part of the LVC ecumene. However, they also appear east of the Vistula River, the best examples being the vessels from Las Stocki 7, or Sites 3 and 10 in Łańcut, already mentioned above.

The earliest pot with an S-shaped profile and slender proportions, with handles placed at the widest part of the belly, was found in a Grave 18 in Podlodów 2, classified as phase I

on the basis of Bayesian analysis. However, the chronological position of this grave is problematic, and it may well be younger. In their fully developed form – as vessels characterised by squat proportions, funnel-shaped, short necks and wide rims decorated with fingertip and fingernail impressions, and with single or double knobs at the widest part of the belly – such pots did not become popular until the beginning of the 38th century BC. This is evidenced by the chronology of Grave 122 at the Grodzisko II site in Złota and Grave 9 at Książnice 2 (Fig. 6). Further examples come from Graves 11 and 20 from Książnice, which have not been radiocarbon dated (Fig. 3: h, m). In addition, similar vessels were found at, among other locations, Topornica 36; in a grave from Garbatówka Kolonia Site 7 (Polańska 1999, fig. 3: 5); in a Grave 1/1947 at Sandomierz-Kamień Plebański; in Grave at Gródek 4 (Zakościelna 2010, pls 49: 5 and 16B: 1); in Pit 10 at the Grodzisko II site in Złota (Podkowińska *et al.* 1959, fig. 10: b); and in Pit 31 at the Grodzisko I site in Złota (Podkowińska 1953, tabl. 10: 1). They have also been found in settlement pits in Bronocice (Kruk and Milisauskas 1983, fig. 2: 9), as well as in Pit 458 at Miechów 3 (Fig. 4: e). Similar specimens, but of much more slender proportions, were found in a Grave 1 at Strzyżów 10 (Zakościelna 1996, fig. 5: a), in Graves 2 and 5 at Strzyżów 26 (Zakościelna 2010, pls 62: 3 and 55: 3), and in a grave at Garbatówka Kolonia 7 (Polańska 1999, fig. 2: 2), among other locations. Based on other characteristic elements of the inventory, such as the Michelsberg-Baalber beakers from Grave 5 at Strzyżów 26, or the flowerpot-shaped vessels with slightly concave bodies from a grave in Garbatówka Kolonia, one can venture the hypothesis that pots with handles at the widest part of the belly but with slender proportions became particularly popular towards the end of the LVC development.

Other vessels that should be associated with the end of the discussed cultural unit are miniature pots with fingertip and fingernail impressions on the rim and with holes instead of handles, known from Graves 6, 16 and 14 at Książnice 2 (Fig. 3: d, k, j). They demonstrate that the practice of decorating pot rims with various types of incisions and finger impressions, which began in the mid-39th century with the beginning of the influence of the Hunyadihalom-Lažňany horizon, survived in Lesser Poland until the end of the Early Eneolithic period.

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THE PROBLEM OF DATING THE BEGINNING OF THE CENTRAL SETTLEMENTS OF THE BRZEŚĆ KUJAWSKI CULTURE. THE CASE OF RADIOCARBON DATING OF SITE 3 AT ŻEGOTKI, STRZELNO COMMUNE

ABSTRACT

Więcaszek K. and Czerniak L. 2025. The problem of dating the beginning of the central settlements of the Brześć Kujawski culture. The case of radiocarbon dating of Site 3 at Żegotki, Strzelno commune. *Sprawozdania Archeologiczne* 77/2, 65-84.

One of the most characteristic elements of the Brześć Kujawski culture (4350-4000 cal. BC) were central settlements distinguished by dense development in the form of longhouses and associated graves, a large area (on average 3-6 ha), and a long period of use. A controversial issue is the dating of the beginning of this type of settlement (4600/4500 cal. BC versus 4350 cal. BC) and, consequently, of a given culture.

The article aims to analyse six radiocarbon dates from a previously unpublished central settlement in Żegotki, Strzelno commune (Site 3), excavated in 1995. Each date refers to a separate house, giving a general picture of the settlement chronology within the range of 4300-3980 cal. BC. This finding is consistent with the general BKC dating model (Czerniak *et al.* 2016) and the dating of the settlement in Osłonki (Budd *et al.* 2020).

Keywords: Neolithic, Central Europe, Brześć Kujawski culture, longhouses, chronology
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INTRODUCTION

The Brześć Kujawski culture (further: BKC) marks the Danubian Neolithic era in the Lowlands. On the one hand, continuing the tradition of pioneer settlement of the Linear-bandkeramik culture (further LBK: 5500-5050 cal. BC) and Late Band Pottery culture (further LBPC: 4800-4350 cal. BC) and on the other hand, starting a new era called the Eneolithic or, more traditionally, Chalcolithic (Czerniak and Pyzel 2019). One of the most characteristic elements of the BKC were central settlements distinguished by dense development in the form of longhouses and graves associated with them, a large area (on average 3-6 ha), and a long period of use (Czerniak 2002; Grygiel 2008). A controversial issue is the dating of this type of settlements, which is crucial for the interpretation of the process of origin of the BKC. Lech Czerniak and his co-authors date them within the range of 4350-4000 cal. BC (Czerniak *et al.* 2016; Czerniak 2018). Ryszard Grygiel and Peter Bogucki date them to 4700/4600-4000 cal. BC (Grygiel 2008; Bogucki 2023).

A significant role in this discussion is played by the settlement at Osłonki, Site 1, which has been recently dated to the period 4385-3990 cal. BC based on Bayesian chronological modelling of radiocarbon dating for 17 burials (Budd *et al.* 2020). On this basis, it can be

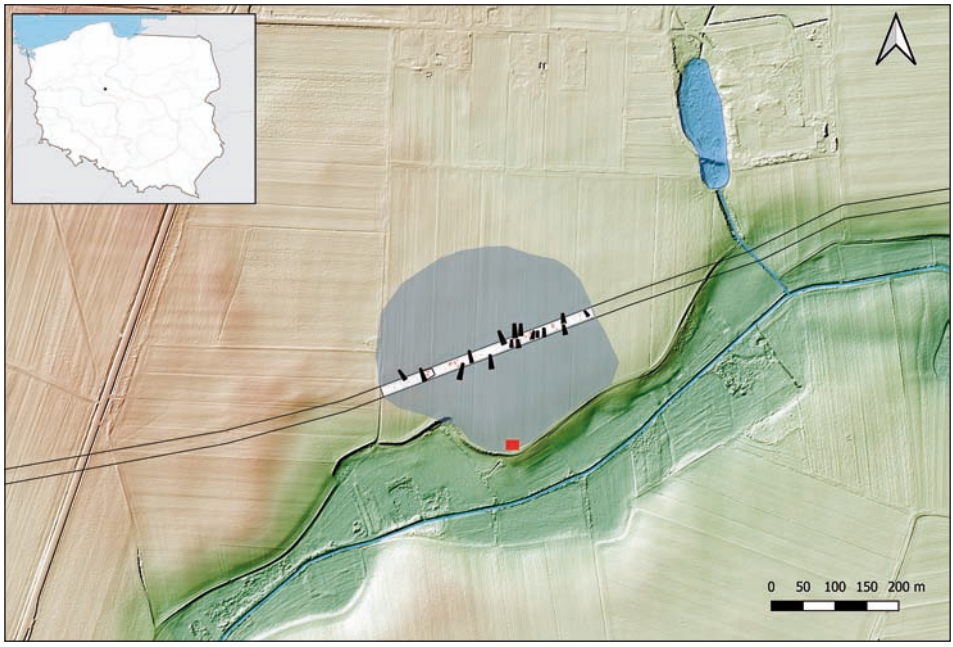

Fig. 1. Żegotki, Strzelno commune, Site 3. Location of the site. The plan shows the site range (grey colour), the course of the gas pipeline route, the boundaries of the excavation examined within Site 3 (357 × 13 m) and the outlines of the BKC longhouses are schematically marked. The red square indicates the place where two longhouses were recorded using aerial photography

assumed that the chronology of Brześć Kujawski type settlements has been established. Especially since the radiocarbon dating for Site 4 at Brześć Kujawski currently represents little value due to the large error range and the lack of dating made using the AMS method. However, it seems that the authors of the study of this site and the participants of this latest publication (Budd *et al.* 2020) have not changed their view on the earlier BKC dating (Grygiel and Bogucki 2022; Bogucki 2023).

In this article, we present a previously unpublished central settlement at Żegotki, Strzelno commune (Site 3), excavated during rescue excavations conducted on the route of the former Yamal-Germany transit gas pipeline in 1995. This is an area of western Kuyavia much less explored than the eastern part (for which Site 3 at Krusza Zamkowa has been representative so far). Our goal is to analyse six radiocarbon dates, each referring to a separate house, giving a general picture of the settlement chronology within the range of 4300-3980 cal. BC. It is consistent with the general BKC dating model (Czerniak *et al.* 2016) and the dating of the settlement at Osłonki (Budd *et al.* 2020). This provides a reasonable basis for revisiting the discussion on the BKC chronology. The presented research is of a pilot nature. In the next two years, we plan to conduct a larger series of dating studies relating to all Kuyavia BKC sites located along the gas pipeline route.

1. Methods and materials

1.1. Research

The sites examined along the gas pipeline route were investigated several times as part of field walking research: in the 1970s by the Kuyavia Research Team of Adam Mickiewicz University in Poznań, and in the 1980s as part of the Polish Archaeological Record. The next phase of surface observations was carried out in 1994 by Lech Czerniak and Jacek Kabaciński in connection with the planned rescue research on the gas pipeline route. All subsequent site investigations provided repeatable and abundant material, mainly ceramic.

Rescue excavation was carried out by the expedition of the Institute of Archaeology and Ethnology of the Polish Academy of Sciences in Poznan from 10 August to 15 November 1995. The work, led by Lech Czerniak, was conducted by Teresa Krysztofiak, Ryszard Kirkowski and Ewa Czerniak. The collision area (and thus the research area) determined based on the surface reconnaissance covered a 350 m long and 13 m wide strip, which was extended during the excavation research to a length of 357 m (62 trenches measuring 10 x 6.5 m, divided between 100-metre-long sections: A, B, C and D) due to the continuation of the occurrence of features towards the east. A total area of 45.5 ares was examined. The method used involved the removal of ploughsoil using a bulldozer and the cleaning of the entire site surface. Archaeological features appeared most often directly under the topsoil against the background of the sloping natural subsoil, which in the majority of the sites was heavy till.

1.2. Location and extent of the BKC settlement

Site 3 at Żegotki is located on a small moraine headland with an S and S-E exposure, distinguished on the northern slope of the extensive valley of an unnamed stream connecting the Pakoskie and Gopło lakes (Fig. 1). On the west, the site is directly adjacent to Site 5, and on the east to Site 2. Excavations indicate that the extent of the site determined during field walking was arbitrary and distorted, as it considered field boundaries and terrain configuration rather than the occurrence of archaeological features. Especially since this area was settled multiple times, starting from the early Neolithic (LBK) period and continuing through the Roman influence and the Middle Ages. The surface of the site is covered with black soils on a substrate of heavy moraine clays (locally – in a small section in the western part – sands).

Traces of settlement of the Brześć Kujawski culture were among the most numerous at the site, continuing eastwards-already within the Żegotki 2 site-for another 170m. The total length of the zone of occurrence of the BKC objects, counted from west to east, was approximately 520 m. This, depending on the assumed width (*e.g.*, 100 to 200 m), allows us to estimate the area of development within the range of 5 to 10 ha. Over the last 25 years, three attempts have been made to determine the range of longhouses at the discussed site using aerial photography (*cf.*, Czerniak *et al.* 2003). However, due to the strongly clayey substrate and the dominance of root crops, it was only in 2023 that it was possible to photograph two houses located about 100 m south of the excavation line (the research was carried out by Michał Jakubczak, whom we thank for providing the results). This suggests that the BKC development area reached the lower edge of the valley slope (approximately 100 m south of the excavation) and, considering the slope's shape, it could also have extended about 100 m in the opposite direction, resulting in a total width of up to 200 m. In this article, we present only the features from Site 3 (Fig. 2). The outlines of the foundation ditches of 16 longhouses, 77 accompanying utility pits, and five graves were uncovered.

1.3. Development of site layout

The layout of the houses and their accompanying structures presents a typical picture of the development of settlements of the Brześć Kujawski type, characterized by the relatively compact occurrence of longhouses in the form of clusters, most often in pairs distinguished by the parallel arrangement of side walls and often also by the location of the rear gable walls in one line (*e.g.*, Houses C1 – C24; C153 – C155; perhaps also Houses C35 – C51). Despite the considerable density, no overlapping of houses is observed, a characteristic of settlements at Krusza Zamkowa, Brześć Kujawski and Osłonki. This may indicate that the examined excavation did not cut through the central part of the village, or that we are dealing with a very uniform system of building a later (successive) house next to an older one. Both hypotheses are equally probable, although the relatively small size of the

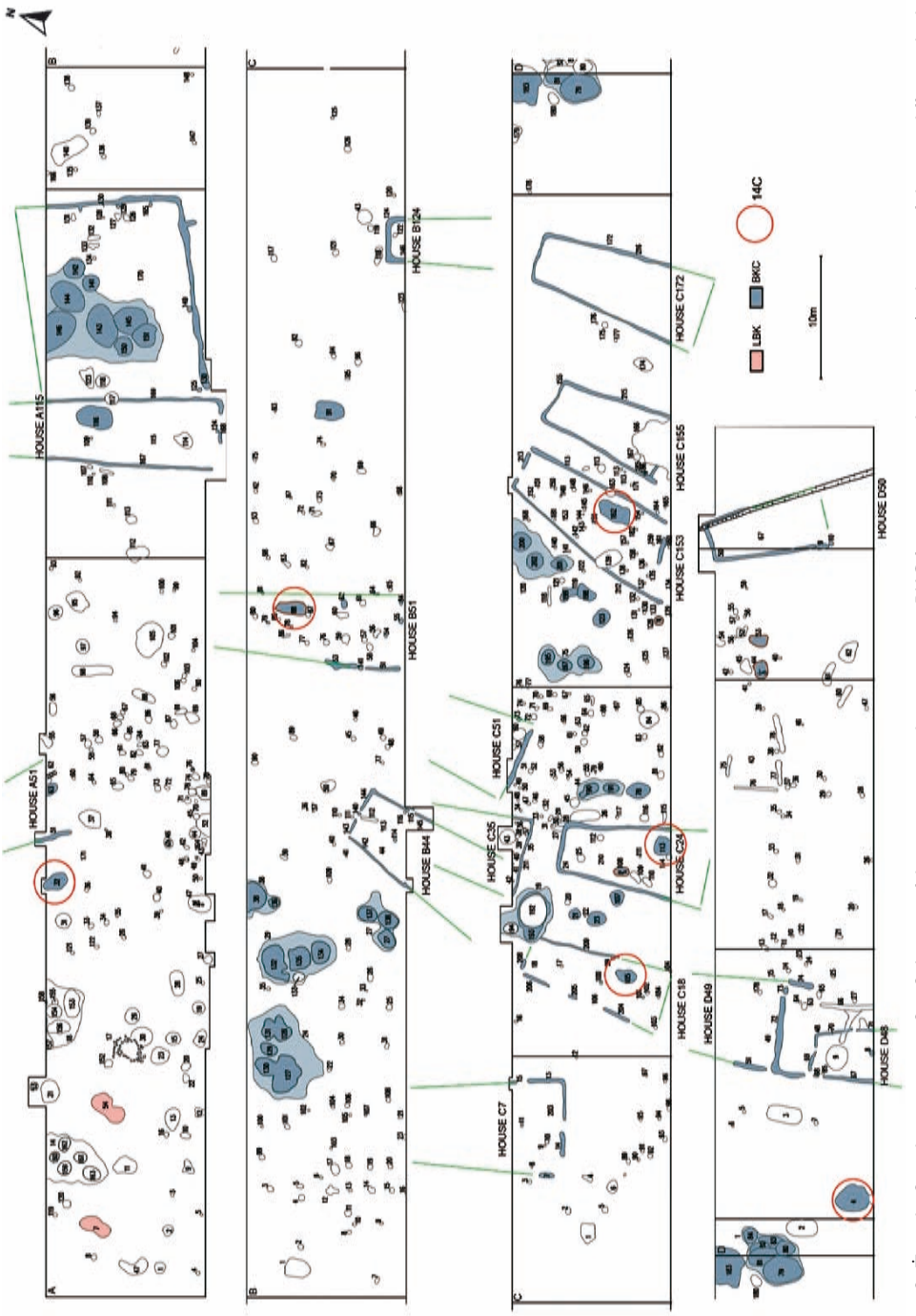

Fig. 2. Żegotki, Strzelno commune, Site 3. Layout of the structures in the excavation. BKC features are marked in grey (in the case of clay pits, different shades of grey); the red border inside the feature indicates a BKC grave. Green lines suggest the further course of the foundation trenches

houses, more often found on the outskirts of the development, speaks in favour of the first one. Out of 16 houses, full dimensions could be determined for six (*ca.* 37% of the total), which are within the range of 10-15 m in length and their area does not exceed 80 m^2. This means that they belong to the category of the smallest houses in the BKC, the percentage of which in central settlements oscillates around 20% (Czerniak and Pyzel 2016). There were also larger houses, as indicated by the size of the front wall (Houses A115, C35, C51, C7 and D49 or the back wall (House B44). House A115 deserves a separate mention, distinguished by the adjacent fence closing off a large space of unspecified function. A similar house with a fence occurs on the eastern edge of the settlement at Brześć Kujawski Site 4 (House 12: *cf.*, Grygiel 2008), which can be interpreted as a central house in relation to which the remaining houses were located, creating a radial layout. In this case, it is not so; however, the large size of the house and the enclosure indicate a unique function.

Out of eight houses uncovered in suitably large sizes, five had internal cellars. The second characteristic element of the house surroundings are clay pits (sometimes used as garbage dumps) located most often in the vicinity of the rear (NW) gables of the houses, and exceptionally on the eastern or western side. A well was uncovered in the vicinity of Houses D48-49, which could have served a communal function.

At Site, five graves and one ceremonial pit (A32) were recorded. The latter had a significant accumulation of animal bones and was located near the SW corner of House A51, similarly to Grave C128 at House C153. Grave B88 was placed in the cellar of House B51, and Grave C108 was located inside House C24, parallel to the western wall. The latter grave was likely associated with House C18: the younger of the pair of Houses C18-C24, and was placed inside the older house (C24) as the ancestral home. In one grave (Feature D44), traces of green discolouration of some parts of the skull were observed, which proves the presence of copper ornaments dissolved by humic acids.

1.4. Features selected for radiocarbon dating

The optimal dating program for Żegotki Site 3 should include sampling from: (1) at least all cellars located inside longhouses, as features clearly associated with the houses, (2) all graves, and (3) other objects important due to their function and high artefact content – unfortunately, not all features meeting the above criteria contained 'safe' bone samples. Considering the limited financial resources, we ultimately selected only six samples from the features described below.

Feature A32. Located at the SW corner of House A51, on the western edge of the settlement. The connection with House A51 is evidenced by its location in the area of the entrance to the house, similarly to, for example, Grave C128 at House C153. It could probably have served a ritual function as a sacrificial object or a pit in which the remains of a feast were deposited. In the fill of the feature, in addition to two layers of bones, there was also a clear layer of burnt material. It yielded 276 pottery fragments, 127 flints, 44 fragments of

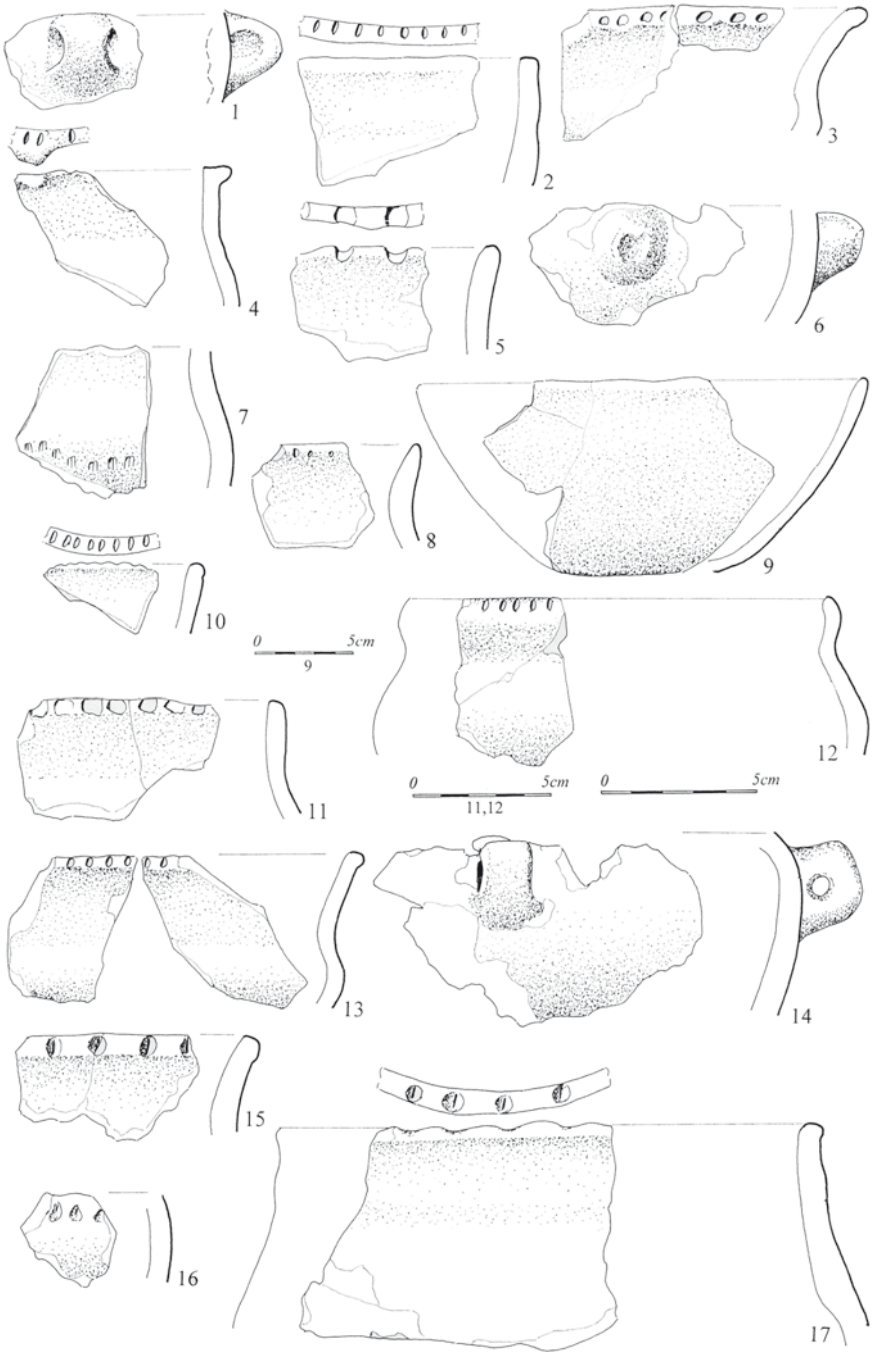

Fig. 3. Żegotki, Strzelno commune, Site 3. Selection of the BKC pottery. Feature A32 (House A51)

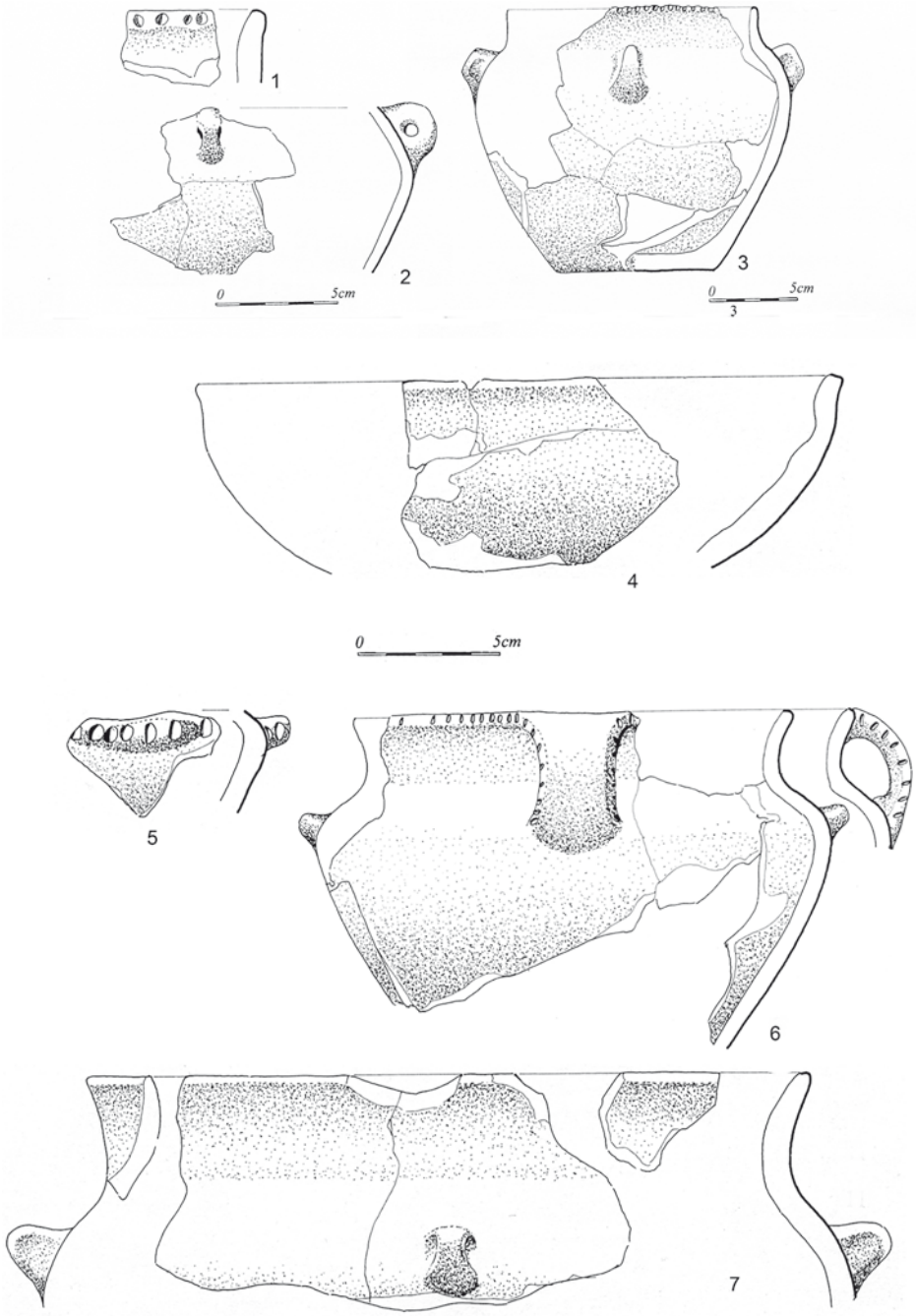

Fig. 4. Żegotki, Strzelno commune, Site 3. Selection of the BKC pottery. Feature B88 (House B51): 1-2 pottery from the cellar filling; 3 – vessel deposited as a grave good. Feature B91: 4-8

clay and as many as 586 animal bones. In addition, five beads, a grinding plate and two awls were discovered. This feature has the oldest radiocarbon date among those from this site (95.4% probability: 4331 BC (52.7%) 4219 BC), and the ceramic style can be quite clearly assigned to phase IIb (the oldest) of the BKC (*cf.*, Czerniak 1994). This is evidenced by bowls with a sharp profile (Fig. 3: 3, 13), conical bowls (Fig. 3: 9), a knob/lug with a depression instead of an opening (Fig. 3: 1), and horizontal edge corrugation in the form of incisions.

Feature B88. This was probably an inhumation grave, as evidenced by small fragments of long bones and a fragment of a human spine found in the fill. Perhaps an almost entirely preserved clay vessel (Fig. 4) was a grave offering. However, the nature of the fill itself suggests a utility pit, or perhaps even a cellar of a longhouse, which has not yet been designated on the site plan. Animal bones were selected for dating this feature because the condition of the human bones was poor. The total inventory of this feature consists of 97 fragments of pottery, six flints, 17 fragments of clay, 110 animal bones, a pestle and a stone grinder.

Features C105 and C113 are internal cellars of Houses C18 and C24, respectively. We discuss them together because the houses form a pair of successive buildings, and dating both cellars gives a chance to verify the hypothesis of the sequential functioning of both houses. Indirectly, an analysis of the time separating the two houses may be an indication of the length of use of a single house. House C24 was older, as indicated by radiocarbon dating, but also by the presence of a C108 Grave inside, in which one can assume a burial was made after (or during) its abandonment by the inhabitants of the successor House C18. Both houses have rear gable walls (NW) in a line and parallel side walls. House C24 had a more solid foundation trench and was slightly wider. This may suggest that it was longer than House C18 and that their front walls did not form a line, similarly to the neighbouring pair of Houses C153-C155 to the east.

The radiocarbon dating of both houses is difficult to verify because the cellar C105 (House C18) contained only eight pottery fragments and 11 animal bone fragments. This is a significant inconvenience, because the radiocarbon date suggests that it may have been one of the latest houses on the site. The older cellar (C113) contained 88 fragments of ceramic vessels, a grinding plate, a pulper and 71 animal bones. The pottery assemblage represents an average collection of ceramics, in addition consisting mostly of rather banal forms, among which a sharply profiled bowl (Fig. 5: 4) with an undecorated rim and a bent belly stands out. Generally, on this basis, this house can be dated to phase IIIa BKC.

Feature C162. This is the cellar of House C153, which forms a pair with House C155. This is evidenced by the alignment of the rear gable walls, the parallel arrangement of the side walls and the similar (but quite unique in its form) construction of the front wall. In the discussed feature, 38 fragments of pottery, nine flints, a tubular bone bead and 273 animal bones were discovered. Unfortunately, House C155 had no cellar, and its surroundings lacked other pits that would have allowed for radiocarbon dating and stylistic dating of the

pottery. In this situation, there is also no point in considering which of the two houses was older. Generally, it should be stated that the pottery from feature/cellar C162 and the accompanying clay pits (C120, C200-201-202 plus C123, C198-199) can be dated within the relatively broad framework of phases IIIa-IIIb (Fig. 6).

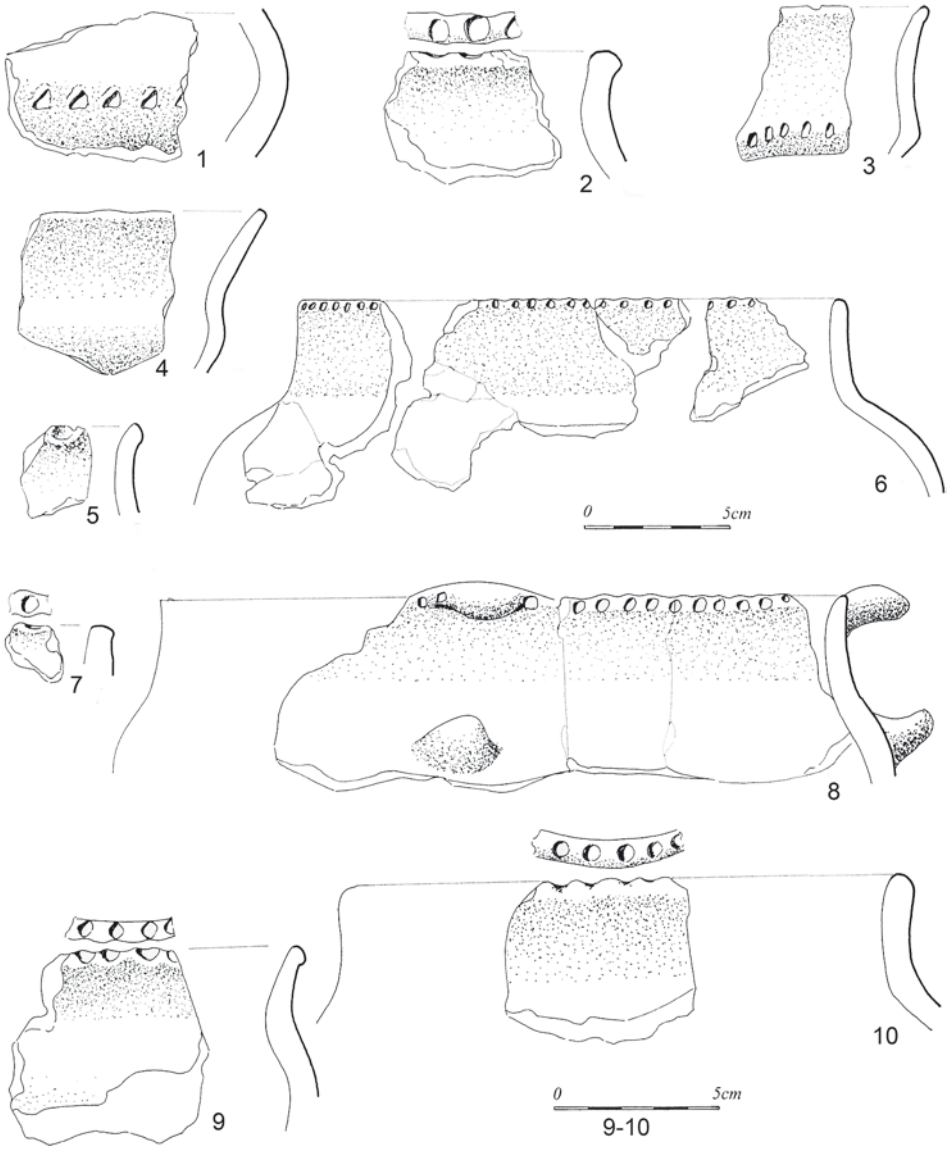

Fig. 5. Żegotki, Strzelno commune, Site 3. Selection of the BKC pottery. Feature C113 (House C24): 1-7. Feature C107: 9, 10

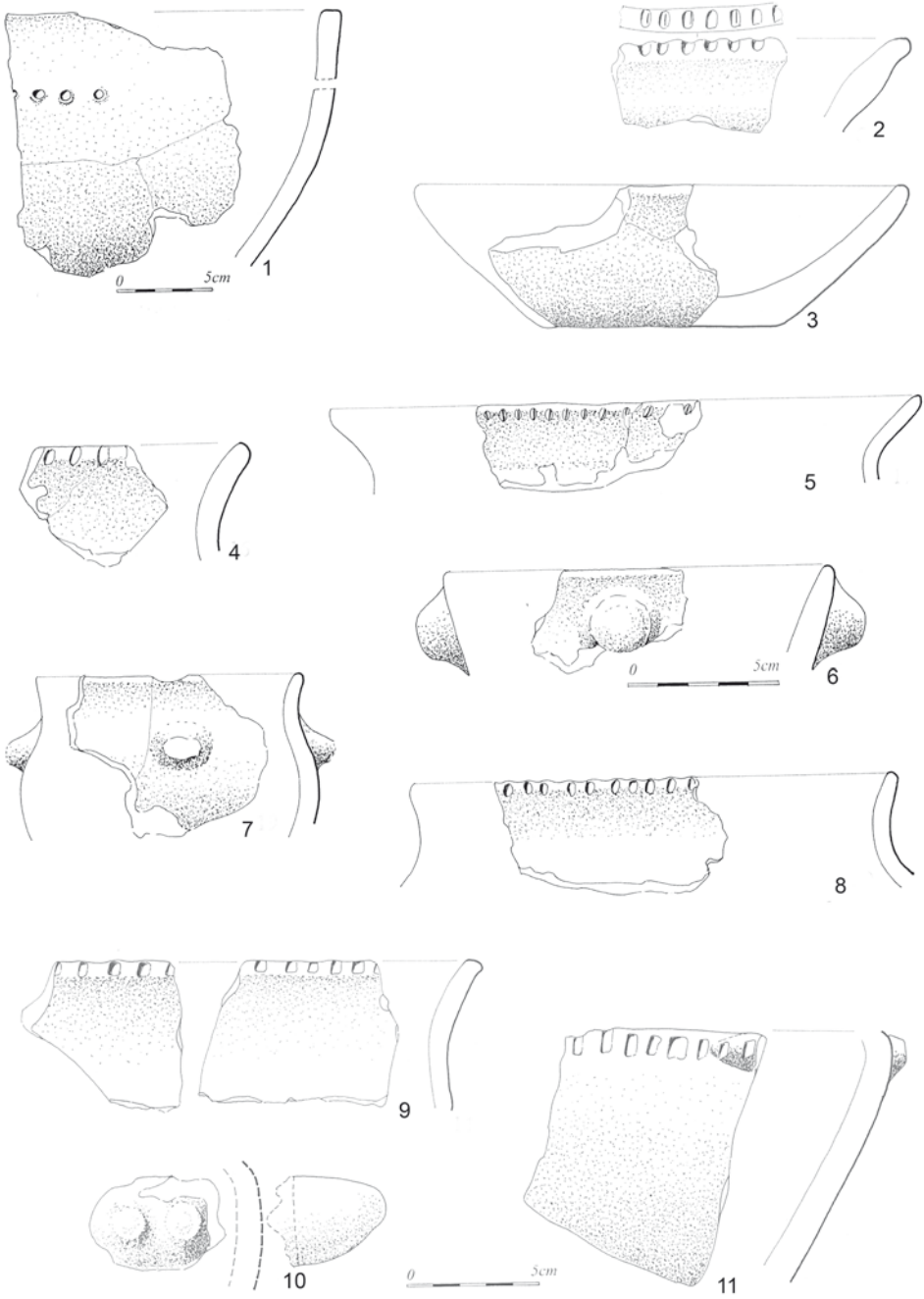

Fig. 6. Żegotki, Strzelno commune, Site 3. Selection of the BKC pottery. Feature C162 (House C153): 1-2. Feature C200: 3-10, 12. Feature C195: 11, 14. Feature C202: 13, 15

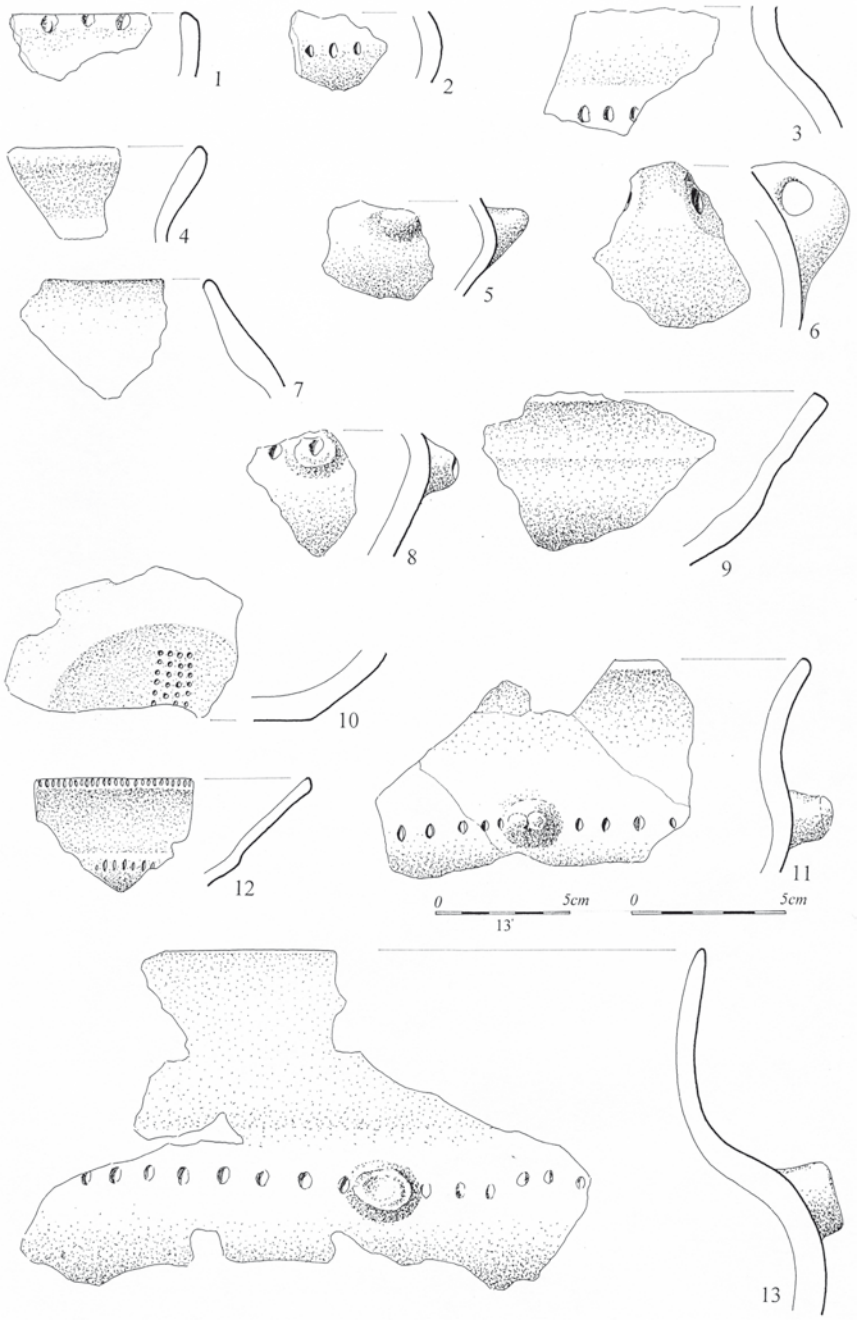

Fig. 7. Żegotki, Strzelno commune, Site 3. Selection of the BKC pottery. Feature D4 (well, probably House D49)

Feature D4 is a well, probably a communal one, but its location indicates a connection with House D49, of which only the front wall was examined. Its form and dimensions suggest that a high-ranking household inhabited it. Unfortunately, the well was examined only to a depth of 3.1 m from the ground surface, where a very intense outflow of groundwater occurred, threatening the collapse of the excavation walls. In the excavated part of the fill, 33 fragments of pottery, three flint tools and 47 animal bones were discovered. Among the pottery, generally not very characteristic, a bowl with a sharp profile, stylistically referring to the older phase and classic BKC (IIIa?, Fig. 7: 12), stands out.

2. Radiocarbon dating, calibration and chronological modelling

The Bayesian chronological modelling has been undertaken on the collected dates using OxCal 4.4 (Bronk Ramsey 1995; 2009), analysing two hypotheses. Firstly, to obtain dates for two Houses: C18 and C24. They form a pair built sequentially (with C24 being older than C18) by descendant groups from the same household, which allows us to establish how long a period of time could have separated the construction of the two houses. Interval modelling suggests that the probable time difference in the use of the houses was around 95 years (sigma 109.025; Fig. 8). Given the very short sequence, Bayesian modelling has allowed us to narrow down the time of use of both features slightly. Feature C113: from 4326-4052 cal. BC to 4322-4051 cal. BC and feature C105: from 4230-3977 cal. BC to 4227-3980 cal. BC (Fig. 8).

Secondly, based on all the dates, we attempted to establish the time frame for the functioning of the settlement (more precisely: its examined fragment) by adopting the following assumptions in the relevant model: (1) feature A32 (*i.e.*, House A51) is the oldest in the entire sequence studied in terms of its ceramic style, (2) features C113 and C105 (*i.e.*, Houses C24 and C18, respectively) are later than Feature A32 and between themselves they form the sequence described in the previous paragraph, (3) the remaining dated features (B88, C162 and D4) are later than Feature A32, but based on stylistic features it can be suggested that they are contemporary with Feature C113 and therefore (since C113 is older than C105 within the pair of houses) older than C105. In other words, we have the following chronological sequence:

A32 (oldest)

C113 – B88 – C162 – D4

C105 (latest).

Summarising, in light of the dating of six features from the Żegotki 3 site (Fig. 9), the BKC settlement began functioning around 4392-4064 cal. BC (95.4% probability) or 4294-4087 cal. BC (68.3% probability) and ended 4229-3900 cal. BC (95.4% probability) or 4160-3982 cal. BC (68.3% probability). Considering the difference between these dates, it can be assumed that the functioning of the BKC at the Żegotki 3 site lasted 163-492 years (95.4% probability) or 134-312 years (68.3% probability).

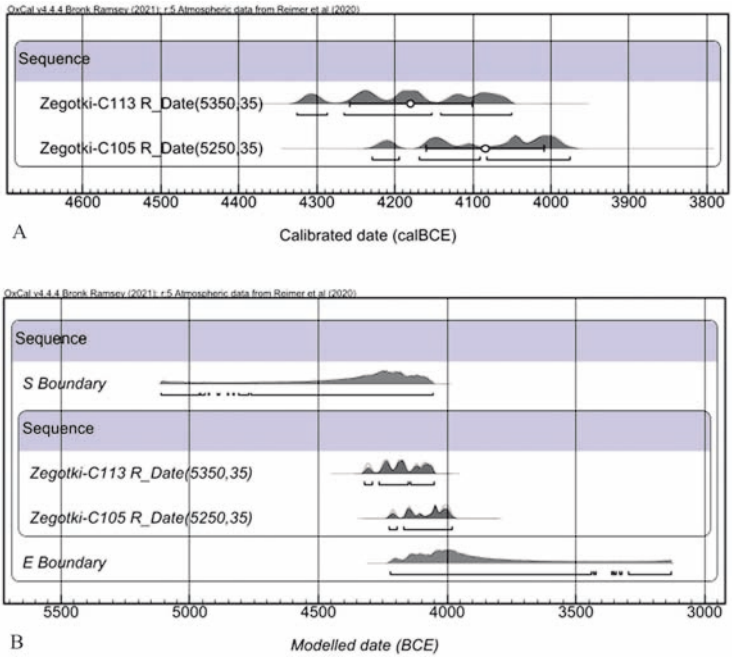

Fig. 8. Żegotki, Strzelno commune, Site 3.
Results of chronological modelling – two Houses (C24 and C18)

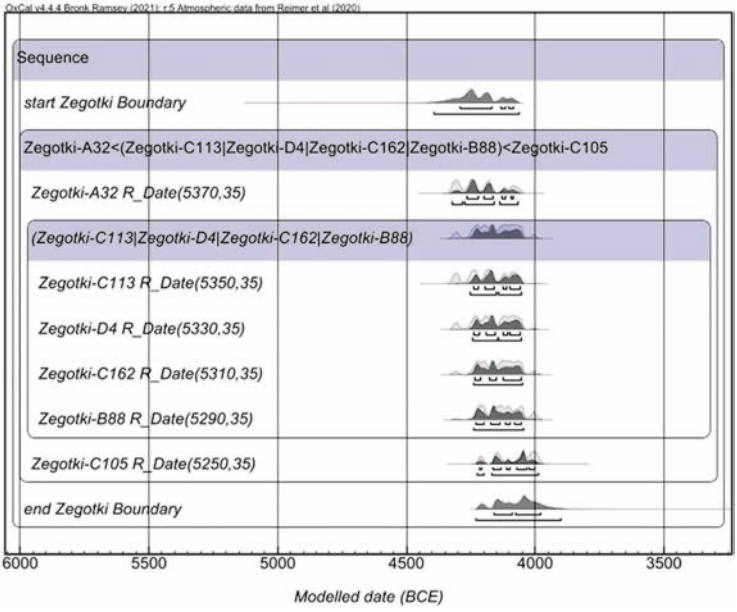

Fig. 9. Żegotki, Strzelno commune, Site 3. Results of chronological modelling of the settlement

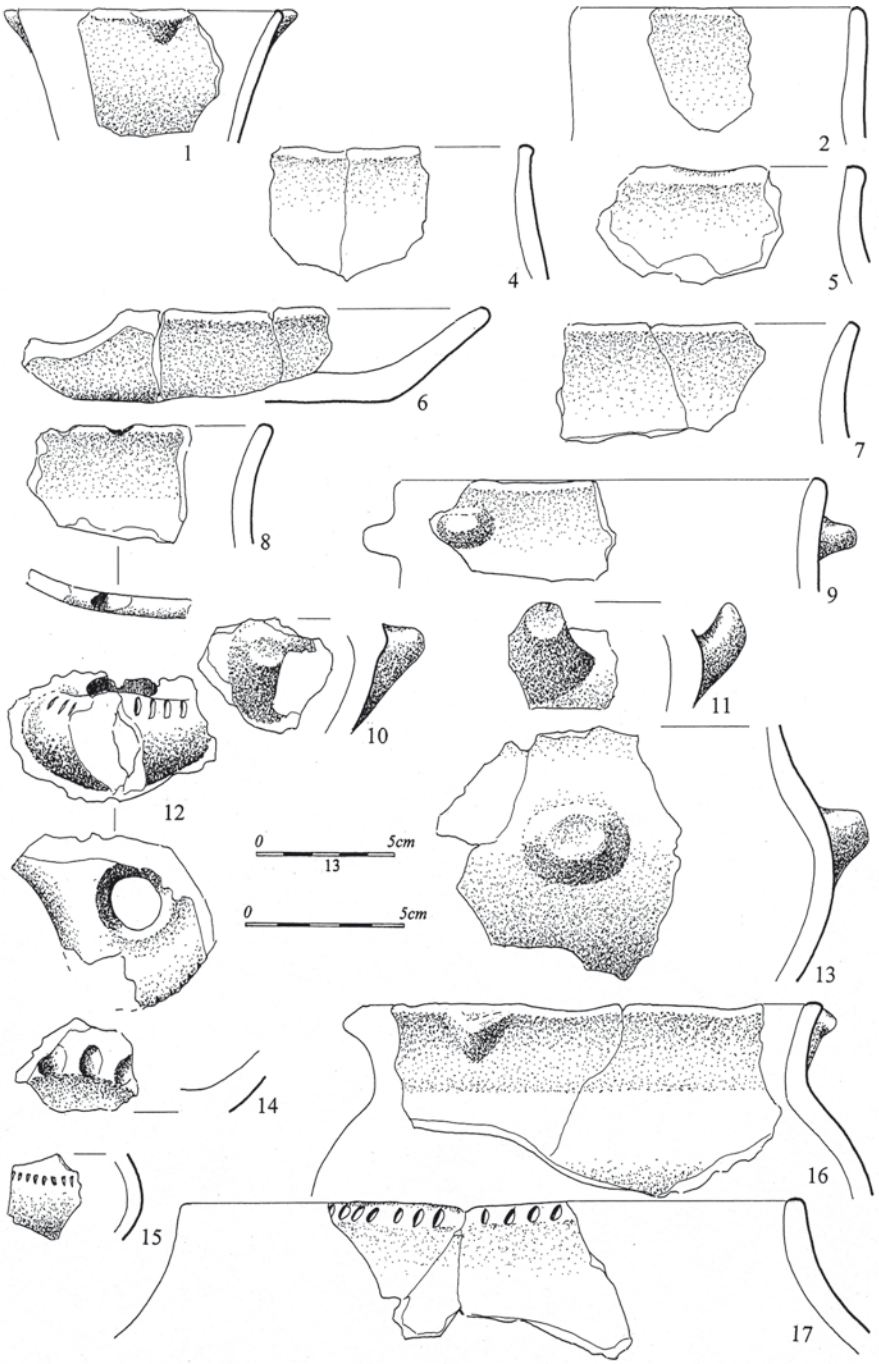

Fig. 10. Żegotki, Strzelno commune, Site 3. Selection of the BKC pottery. Feature B24 (House B44)

The presented dating results are very close to the dating of the settlement in Osłonki (Budd *et al.* 2020) and the general dating of the BKC in Kuyavia (Czerniak *et al.* 2016). There is little doubt that we are dealing with a multi-phase development. This is evidenced by the different orientations of the houses in relation to the cardinal directions, as well as by locational collisions. For example, it seems evident that House D48 could not have functioned contemporaneously with House D49 because it would have blocked the entrance. Houses C24 and C35 create a similar situation. There are also pairs of houses, the relationships of which we discussed earlier. However, the question is to what extent the dated features are representative of the entire settlement, as well as from the perspective of the chronological differentiation of the BKC pottery.

Using the criterion of typo-chronological dating of pottery, two reservations can be made. Firstly, pottery from features associated with House B44, from which we do not have dates (Features B24, B29: Fig. 10), may be slightly older than Feature A32 (the oldest within the dated sequence). Therefore, it is not possible to rule out obtaining slightly older dates, closer to the date of 4350 cal. BC (possibility that the site is older than the oldest dated feature is visible on the plot based on Bayesian modelling) considered to be the initial date for the BKC (Czerniak *et al.* 2016). Secondly, we do not observe the stylistic features of pottery typical of the final phase of the BKC among the examined archaeological features, despite obtaining dates consistent with the final phase of the BKC. It should be emphasised, however, that the clearly late stylistic features occur relatively rarely, and the latest phase of the BKC was distinguished primarily based on technological features (Czerniak 1994).

Table. 1. Żegotki, Strzelno commune (site 3).
Sample characteristics and radiocarbon dating results

Feature no.	Species	Element sampled	Collagen yield (%)	C (%)	N (%)	$\delta^{13}C$ ‰	$\delta^{15}N$ ‰	Lab ID	Radio-carbon age BP	Cal BC (95,4%)
Żegotki 3_A32	Pig	Humerus	7.4	6.5	2	-20.4	8.2	Poz-179621	5370±35	4331 – 4056
Żegotki 3_C113	Cattle	Metacarpus	5.6	9.7	2.9	-20.3	5.6	Poz-179474	5350±35	4326 – 4052
Żegotki 3_D4	Un id. (big mammal)	Un id.	3.6	7.9	2.3	-20.2	6.8	Poz-179473	5330±35	4317 – 4049
Żegotki 3_C162	Cattle	Ulna	3.3	6.2	1.3	-20.4	5.8	Poz-179622	5310±35	4311 – 4000
Żegotki 3_B88	Pig	Cranium	1	4.7	0.8	-20.5	7.8	Poz-179476	5290±35	4241 – 3993
Żegotki 3_C105	Sheep/ goat?	Mandible?	0.9	5.2	1.2	-19.4	5.6	Poz-179475	5250±35	4230 – 3977

Table 2. Żegotki, Strzelno commune (site 3). Chronological modelling results. Assumptions (applies to features with radiocarbon dates): 'Żegotki-A32' is stratigraphically the earliest. 'Żegotki-A32' precedes 'Żegotki-C113', 'Żegotki-D4', 'Żegotki-C162', and 'Żegotki-B88', which are contemporaneous. They precede 'Żegotki-C105', which is stratigraphically the latest

Name	Unmodelled (BCE/CE)				Modelled (BCE/CE)			
	from_ 68.3	to_ 68.3	from_ 95.4	to_ 95.4	from_ 68.3	to_ 68.3	from_ 95.4	to_ 95.4
start Żegotki Boundary					-4303	-4089	-4394	-4063
Żegotki-A32 R_Date(5370,35)	-4325	-4072	-4331	-4056	-4264	-4083	-4323	-4067
Żegotki-C113 R_Date(5350,35)	-4316	-4064	-4326	-4052	-4240	-4060	-4251	-4052
Żegotki-D4 R_Date(5330,35)	-4241	-4060	-4317	-4049	-4237	-4059	-4245	-4052
Żegotki-C162 R_Date(5310,35)	-4232	-4055	-4311	-4000	-4235	-4056	-4239	-4052
Żegotki-B88 R_Date(5290,35)	-4228	-4049	-4241	-3993	-4232	-4054	-4239	-4047
Żegotki-C105 R_Date(5250,35)	-4219	-3987	-4230	-3977	-4215	-4000	-4225	-3989
end Żegotki Boundary					-4160	-3985	-4229	-3901

SUMMARY AND DISCUSSION

The fragment of the settlement examined at Żegotki can be assessed as small in relation to its estimated overall size. On the other hand, the obtained sample area, measuring 357 × 13 m, covered its entire length, revealing 16 longhouses and was located near the central part of the settlement, within which the occurrence of buildings from all periods of use is most likely. In other words, both the framework of the absolute chronology of the functioning of the settlement at Żegotki and the typochronological features of pottery, which are comparable to observations in other well-dated BKC settlements, can be considered valuable material for verifying hypotheses concerning the chronology of the central BKC settlements. This material, similar to the dating of features from sites such as Osłonki, Racot, Krusza Zamkowa, Kruszynek Site 6, Dubielewo Site 8, and Bodzia Site 1, proves that the residential development of BKC settlements in the form of long houses functioned within the chronological framework of 4350-4000 cal. BC.

Referring to the discussion on the chronology of the Brześć Kujawski culture, it is necessary to consider what features should be taken into account as a criterion for recognising the beginning of this culture. The traditional criterion is the stylistic changes in pottery, which in this case (*i.e.,* in the LBPC-BKC sequence), can only be described as a process of gradual transformation. An arbitrary boundary can be assumed, marking the transition

from the use of the style of stroked pottery to the increased importance of Lengyel culture features. This is a dilemma that is well expressed in the discussion on the interpretation of Phase IIa and IIb of the LBPC (see Czerniak 1994 and later analyses: Czerniak 2018), and is probably the key to understanding the differences in the dating of the beginning of the BKC around 4600/4500 cal. BC by R. Grygiel and P. Bogucki (Grygiel 2008) or 4350 cal. BC (Czerniak 2018).

In our opinion, if we were to consider the BKC as a phenomenon of ethnogenetic change (in the meaning presented by Hu 2013; Voss 2014), the beginning of the BKC should be associated with the construction of characteristic longhouses (Czerniak 2018; more broadly: Więcaszek *et al.* in print). Of course, changes in the style of ceramic vessels, like many other features of material culture, also played a significant role in establishing a new identity. However, in their case, it is much more difficult to recognise which configuration of features was 'groundbreaking' and to justify its role in the process of ethnogenesis. Assuming that the construction of longhouses was of groundbreaking importance for the ethnicity of the BKC, we can refer to the phenomenon that Di Hu (2013) lists as one of the necessary conditions for the processes of ethnogenesis: settlement aggregation, mergers, displacements, and migrations, within the context of this change.

The post-LBK period began in the Polish Lowlands around 4800 BCE through the merger of several cultural groups and the emergence of a community that was characterised by a much more dispersed settlement and only sporadic appearance of longhouses, mostly built as semi-dugouts (Czerniak 2018). The emergence of the BKC was characterised by agglomeration and stabilisation of settlement, the establishment of large central settlements with which smaller satellite hamlets cooperated. However, the most emblematic element of the BKC were long, trapezoidal houses, which must have stood out significantly in the landscape occupied by the BKC, which included the areas of Kuyavia, Paluki, Chełmno Land and Greater Poland.

The role that longhouses played in shaping the identity of the BKC community warrants a closer examination of the process of their introduction, particularly in terms of the pace and accompanying circumstances. This should be served by a radiocarbon dating program that prefers to obtain dates as closely related to houses as possible. This means a preference for dating cellars located inside houses.

An additional aspect of focusing on dating houses will be the possibility of determining how long a single house was used. In the case of the settlement at Żegotki, we determined that Houses C18 and C24 were separated by approximately 95 years. However, it is not known whether the later house was built immediately after the older one was abandoned or after some time had passed. However, examining pairs of houses appears to be a good way to collect data that will enable a more precise interpretation.

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PATTERN IN DIVERSITY – KRZEMIONKI AND GRIME'S GRAVES. UNDERSTANDING COMMONALITY IN FLINT MINING ACROSS EUROPE

ABSTRACT

Bączkowski J. and Werra D.H. 2025. Pattern in diversity – Krzemionki and Grime's Graves. Understanding commonality in flint mining across Europe. *Sprawozdania Archeologiczne* 77/2, 85-117.

Across Europe, in the late 19th century, deep-flint mines dating to the Neolithic period were discovered. Since their discovery, it has been noted that the mines, located many kilometres apart, share common traits. Despite these connections, little research has compared the pan-European mining phenomenon. It is beyond this paper to review the numerous European mines, rather, two sites will be detailed: Krzemionki, southeast Poland, and Grime's Grave, eastern England. The comparison of these two prehistoric mines, located c. 1500km apart, expands knowledge of a mining methodology likely to have started in the mid-5th millennium BCE and spread across Europe, becoming associated with large and enduring complexes.

Keywords: Neolithic, Early Bronze Age, Flint mining, Axeheads, Britain, Poland
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INTRODUCTION

Extracting knappable rocks for producing implements was undertaken throughout European prehistory, from Neolithic quarrying for jadeite in the Italian Alps (Pétrequin *et al.* 2006) to Late Bronze Age flint mining in Poland (Lech *et al.* 2011). Of numerous rocks sought, the most extracted was flint, with mines located in the British Isles (Barber *et al.* 1999), Denmark (Becker 1959), France (Ghesquiere *et al.* 2021; Bostyn 2023), Belgium (Bostyn *et al.* 2018), the Netherlands (Felder *et al.* 1998; de Grooth *et al.* 2023), Germany (Fisher *et al.* 2023; Schyle and Weiner 2023), Poland (Lech 2023; Lech and Werra 2023; Schild 2023), Belarus (Gurina 2000), the Iberian Peninsula (Terradas and Ortega 2017; Díaz-del-Río *et al.* 2023; Tarriño *et al.* 2022a, 2022b), Italy (Galiberti and Tarantini 2023) and Ukraine (Kolesnik 2020; see Fig. 1). Most Neolithic flint mines are composed of pits and quarries. One method, shaft-galleried mining, resulted in amongst the most extensive Prehistoric mines in the world.

Shaft-galleried mining appears to start simultaneously across Europe at the end of the 5th millennium BCE (Edinborough *et al.* 2019). At present, Spiennes is perhaps the earliest shaft-galleried mine with extraction beginning around 4200 cal. BCE, although some caution is expressed with the earlier radiocarbon dates from the mines (Collet and Collin 2023, 112). Because shaft-galleried mining is a method that would have taken years to develop, being passed to new generations through the learned experience of mining, it is considered unlikely that it began independently across Europe at contemporary mines. Therefore, the knowledge of shaft-galleried must have travelled with communities well-practised in its intricacies (Wheeler 2011; Bączkowski 2014).

Nevertheless, the start of shaft-galleried mining is still a matter of dispute. The oldest dated shaft-galleried mines are known to date back to the 5th millennium BCE, when in the Dutch Limburg region, Michelsberg culture communities mined flint from shaft-galleried mines and produced flint long blades, and flint axeheads, which played an important economic role (Spiennes mine, Belgium; 4350-2300 cal. BCE; Rijckholt-St. Geertruid mine, the Netherlands; 4300-3400/2650 cal. BCE; Bostyn *et al.* 2018; Collet *et al.* 2016; Collet and Collin 2023; de Grooth 2023). However, the flint technologies of the Funnel-Beaker culture (FBC) communities from the Ćmielów site, southeastern Poland, the striped flint miners' settlement from the Krzemionki mining complex and the Świeciechów-Lasek mine have analogies in the lithic inventories of the Trypillia culture (Budziszewski 2006; Pellegrin 2012; Kadrow 2016). It has been suggested that the tradition of making exceptionally long flint blades and flint axeheads spread, along with shaft-galleried flint mining, from the East through the Trypillia region and the FBC communities areas in Poland and into Scandinavia (hoards with long blades: Nielsen 2017, 2021; see Immel *et al.* 2020).

Pellegrin suggests that if it is confirmed that the complete debitage at Spiennes was achieved using lever pressure with deer antlers, then its origin could be traced back to the Polish centre at the Ćmielów site (Pellegrin 2012, 26).

A comparison between Krzemionki and Grime's Graves, two seemingly unconnected mines, is significant because both adopted the shaft-galleried method early in their mining chronology. They also represent the western and easternmost extents of shaft-galleried mining. Finally, the comparison of these mines helps illuminate many unresolved questions about shaft-galleried mining, especially regarding how knowledge of the method spread with communities.

EUROPEAN MINING

Mining for flint dates to the Final Palaeolithic, c. 10,500 cal. BC, including mines at Orońsko (Werra and Kerneder-Gubała 2021) and Wołowice (Bańdo *et al.* 1992), both in

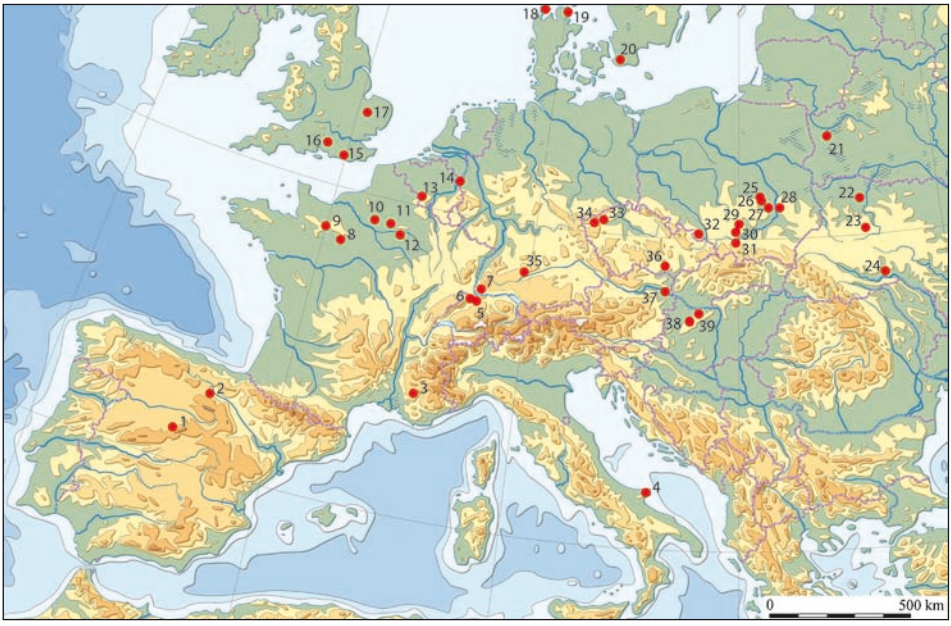

Fig. 1. Distribution of the main European prehistoric siliceous rock mines:
1 – Casa Montero (Spain); 2 – Pozarrate (Spain); 3 – Malaucčne (France); 4 – La Defensola (Italy); 5 – Olten (Switzerland); 6 – Löwenburg (Switzerland); 7 – Asch-Borgerhau (Germany); 8 – Ri (France); 9 – Espins (France); 10 – Jablines (France); 11 – Marais de Saint-Gond flint mine region (France); 12 – Villemaur-sur-Vanne (France); 13 – Spiennes (Belgium); 14 – Rijckholt-St. Gerrtruid (The Netherlands); 15 – Worthing Group (Blackpatch; Cissbury; Church Hill; Harrow Hill; UK); 16 – Wessex Group (Easton Down; Martin's Clump; UK); 17 – Grimes Graves (UK); 18 – Hov (Denmark); 19 – Aalborg (Denmark); 20 – Södra-Sallerup (Sweden); 21 – Krasne Selo (Belarus); 22 – Polovla (Ukraine); 23 – Gorodok, Višnevaya Gora (Ukraina); 24 – Studenica, Belaya Gora (Ukraina); 25 – Orońsko – Tomaszów (Poland); 26 – Wierzbica 'Zele' – Polany (Poland); 27 – Krzemionki – Borownia (Poland); 28 – Świeciechów-Lasek (Poland); 29 – Udorka (Poland); 30 – Sąspów (Poland); 31 – Wołowice (Poland); 32 – Maków (Poland); 33 – Tušimice (Czechia); 34 – Bečov (Czechia); 35 – Lengfeld (Germany); 36 – Krumlovský Les (Moravia, Czechia); 37 – Vienna-Mauer (Austria); 38 – Nagytevel (Hungary); 39 – Tata-Kalvariadomb (Hungary). After Lech 1981: fig. 2; Werra and Woźny 2018; Bostyn *et al.* 2023

Poland. Mesolithic mines are rare but include the Polish mines of Udorka (Sudoł-Procyk *et al.* 2021) and Tomaszów (5600-5400 cal. BCE; Schild 1995, 464).

Fint mining appears to have become more widespread across the 6th millennium BCE to early 5th millennium BCE (Kerig *et al.* 2015). Mines dated to the period include Defensola A, southeast Italy (the beginning 6010-5720 cal. BCE; Galiberti and Tarantini 2023, 42), Casa Montero (Díaz-del-Río 2023) and Pozarrate, central Spain (Tarriño *et al.* 2022a, 2022b), Krumlovský les, Moravia (Oliva 2022, 39), and Tomaszów, Central Poland (5000-4800 cal. BCE; Schild 1995, 462; Schild 2023, 204). Overall, these mines produce radiocarbon dates to the mid 6th millennium BCE, and earlier dates should be treated with caution, as the 'old wood' effect is often a problem for charcoal collected from mines (Díaz-del-Río *et al.* 2023), alongside samples that are poorly contexed (Consuegra and Díaz-del-Río 2018).

The oldest flint mining, before the late 5th millennium BCE, was from pits, in some cases up to 10m in depth, as found at Casa Montero (Díaz-del-Río *et al.* 2023), or occasionally niched mineshafts. The only galleries and chambers known from this period exist at Defensola A. These early mines are associated with the production of blades.

Shaft-galleried mining began in the late 5th-4th millennium BCE, with mine and appears to have quickly become widespread and associated with large mine complexes, such as, Spiennes, southern Belgium (Collet and Collin 2023), Rijckholt, the Netherlands (Felder *et al.* 1998; de Grooth *et al.* 2023), Jablines, the Paris Basin, France (Bostyn and Lanchon 1992), Krzemionki, Poland (Bąbel 2014), Södra-Sallerup, Sweden (Berggren *et al.* 2016; Högberg *et al.* 2023) and Krasne Siolo, Belarus (Gurina 2000). These complexes are predominantly connected with axehead production. Whilst extraction finished at most mines by the late 4th millennium BCE, mining continued at Spiennes and Krzemionki into the 3rd millennium BCE. The opening of new mines is rare, except for Grime's Graves, which is late in the shaft-galleried tradition.

Few mines postdate the 3rd millennium BCE, when flint industries are often based on the recycling of earlier mine waste or open quarries. One mine, Wierzbica, Poland, dates to 1800-800 cal. BCE and is associated with 'Zele' knives (Lech and Werra 2023).

COMPARISON BETWEEN KRZEMIONKI AND GRIME'S GRAVES

The excavation histories of both mines are covered elsewhere (Bąbel 2014; Bishop 2012; *Krzemionki* 2018; Healy *et al.* 2023). The 4000+ mineshafts at Krzemionki were discovered in the early 20th century (Fig. 2; Bąbel 2014; *Krzemionki* 2018, 154) and initially excavated in 1925. Excavations by Stefan Krukowski followed (Krukowski 1939; Borkowski 1995; Piotrowska 2014). More recent excavations were undertaken 1969-1970 (Balcer 1975), 1979-1984 (Bąbel 2015), and 2006-2008 (Jedynak and Wroniecki 2022).

Altogether, several shafts and chipping floors (workshops) were partly excavated (Bąbel 2015, 30-41).

Less than 30 of the 450+ known mineshafts at Grime's Graves (Fig. 3) have been excavated, with work periodically carried out from the late-19th century (Greenwell 1870) to the mid-20th century (Armstrong 1923). The last excavation of Grime's Graves was undertaken in 1971-1972 (Mercer 1981).

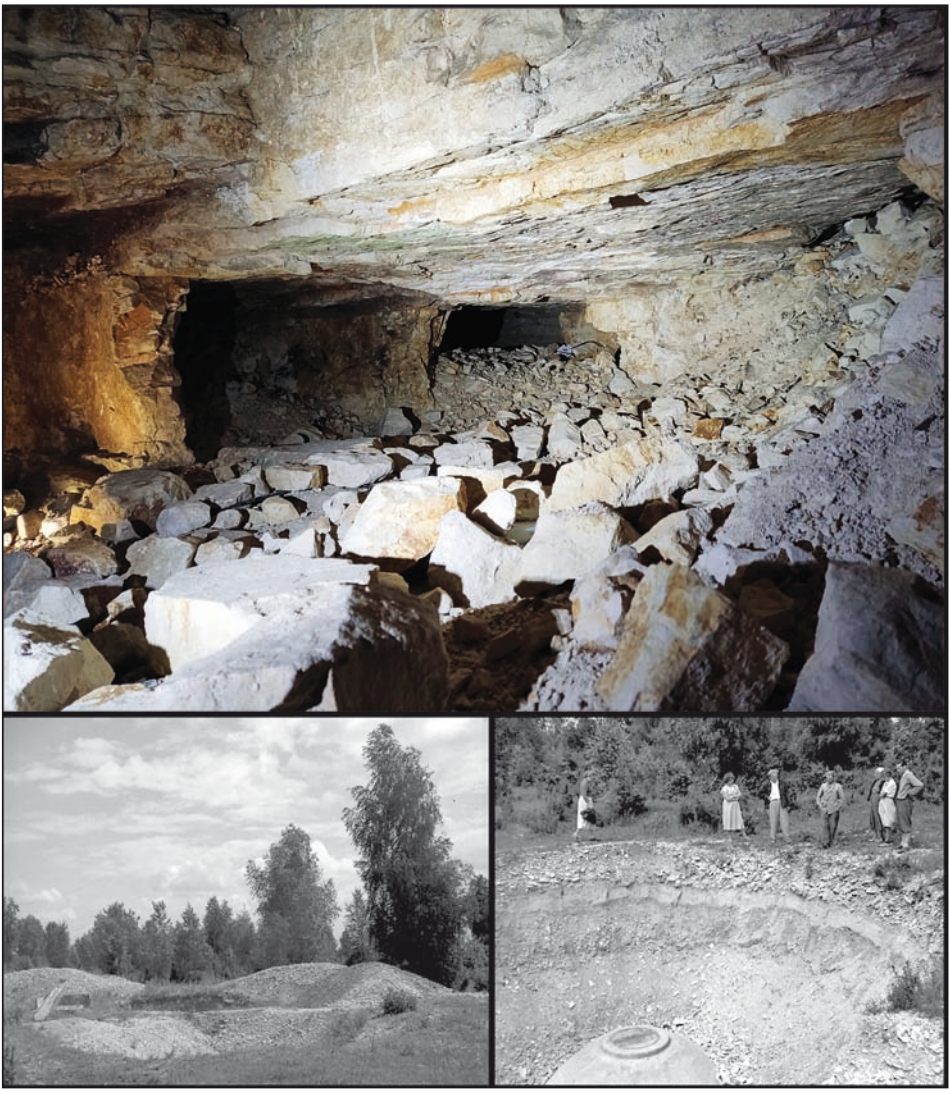

Fig. 2. Photographs of Krzemionki. Top, a pillar-chamber mine. Photo: D. H. Werra; bottom left, the mine field in 1957; bottom right, mineshaft protection in 1957. The photo was taken by S. Biniewski, IAE PAN Archive in Warsaw

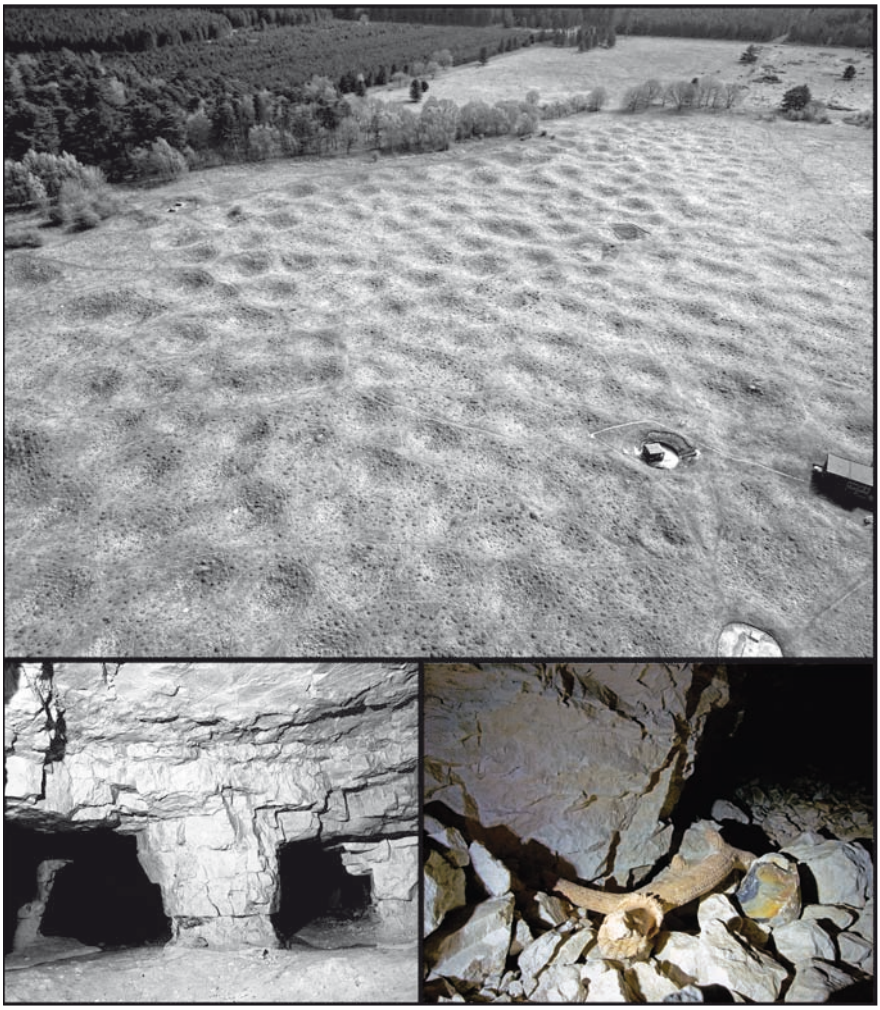

Fig. 3. Photographs of Grime's Graves. Top, the mining field; bottom left, gallery with pillars. Credit: English Heritage Trust; bottom right, abandoned antler pick in gallery. Photo: J. Bączkowski

THE EXTRACTION CHRONOLOGY

Krzemionki

Extraction at Krzemionki began in the early 5th millennium BCE and lasted until the mid-2nd millennium BCE (Fig. 4; Bąbel *et al*. 2005). Although no pre-36th century BC dates are known from the mines, striped flint axeheads were being produced at FBC settlements in the region surrounding Krzemionki from c. 3650 cal. BCE (Jedynak and Kaptur

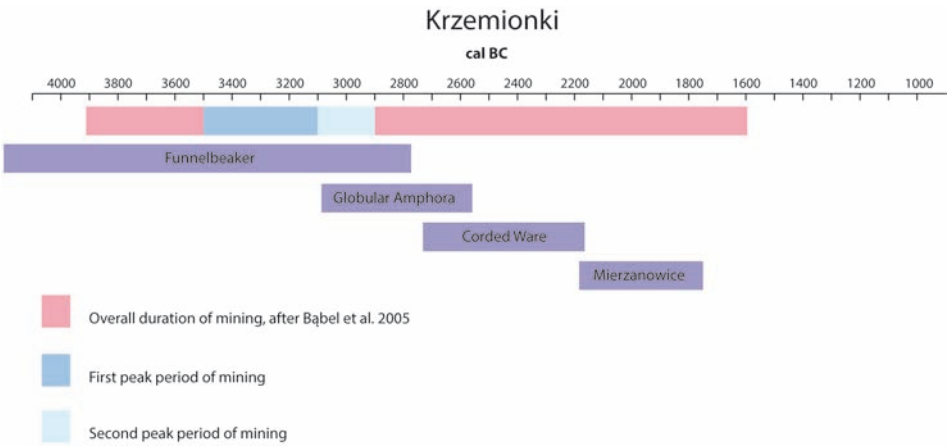

Fig. 4. Chronology of cultural periods at Krzemionki

2017; Sałacińska and Sałaciński 2022). Mining must have therefore been underway by the early 4th millennium BC (*Krzemionki* 2018, 136). Funnel-Beaker pottery dating to the 4th millennium BCE has been recovered from both pit and niche mines at Krzemionki (Sałacińska and Sałaciński 2022), and from the surface of the mine complex and surrounding fields (Bąbel 2015, 183-199). Although Globular Amphora culture (GAC) material was also found in the pit and niche-mines, confusing their chronology (Balcer and Kowalski 1978).

The earliest of 33 radiocarbon dates obtained from Krzemionki are from shaft 795 (Bąbel *et al.* 2005), dating to 3368-3100 cal. BCE (68.3% probability), and associated with GAC communities mining. Other pillar-chamber and chamber-mines, shafts 805 and 815, fall between 3100-2500 cal. BCE (Bąbel *et al.* 2005), when mining and axehead production at Krzemionki peaked (Jedynak and Kaptur 2017).

Deep mining concluded in the mid-3rd millennium BCE at Krzemionki, and although striped flint is still used by Corded Ware and Złota culture communities, the character of extraction in this period is unknown (Borkowski and Budziszewski 1995; Witkowska and Włodarczak 2021; Sałacińska and Sałaciński 2022). In the 2nd millennium BCE Mierzanowice culture communities recycled the spoil heaps of earlier mines (Balcer and Kowalski 1978; Budziszewski and Włodarczak 2010, 138, 139; Jedynak and Kaptur 2017).

Grime's Graves

A chronology for Grime's Graves results from 310 radiocarbon dates (Fig. 5; Healy *et al.* 2018). The earliest extraction is between the 27th century cal. BCE – early 24th century cal. BCE, associated with the most complex structures, shaft-galleried mines. Simple pits, located in the West Field, date to the late-27th century cal. BCE – 21st century cal. BCE

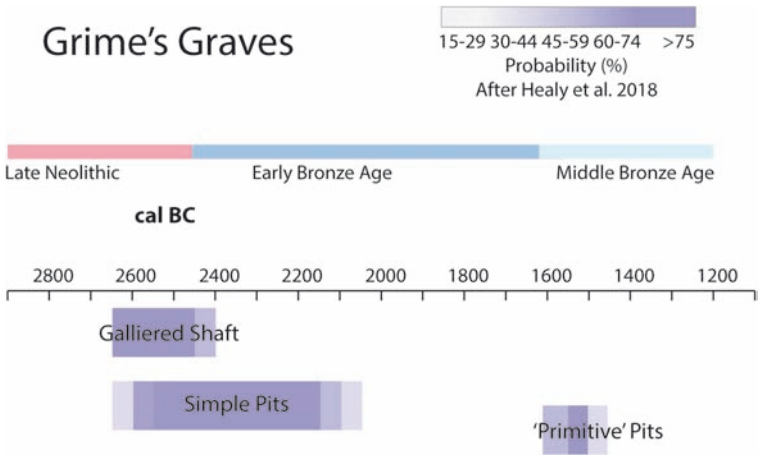

Fig. 5. Chronology of mining and cultural periods at Grime's Graves

(Healy *et al.* 2018, 287), overlapping with shaft-galleried mining but in use for a longer period.

After an extraction hiatus, 'primitive' pits (terminology originating from the original authors of Grimes Grave's research) were opened in the Early Bronze Age, c. 17th century cal. BCE, and worked until the 15th century cal. BCE. Midden deposits in the tops of mine-shafts (Mercer 1981, 13) date to the late 15th – early 13th centuries cal. BCE, the Middle Bronze Age (Healy *et al.* 2018, 288). There is no evidence of contemporary mining with midden formation; instead, flintworking focused on the recycling of earlier mine waste (Healy *et al.* 2018).

MINING METHODOLOGY

Krzemionki

Krzemionki is located at the north-east edge of the Świętokrzyskie (Holy Cross) Mountains and the north-west end of the Magonie-Folwarczysko Jurassic basin on Upper Oxfordian limestone (159.4-154.1 Mya) that faulted in Younger Kimmeridgian orogenic movements (Gutkowski 1998). Krzemionki is parabolic in plan, located on a syncline that dips between 3° and 20° along an 11km-long limestone outcrop (Fig. 6). Above the limestone are deposits of glacial sands and weathered clay. Within the limestone are three stripped flint seams that, due to tectonic movements, are unevenly distributed, vary in size, and are often cracked. The upper two seams comprise good-quality flint nodules. The low-quality bottom seam was rarely exploited (*Krzemionki* 2018, 100, 108-11).

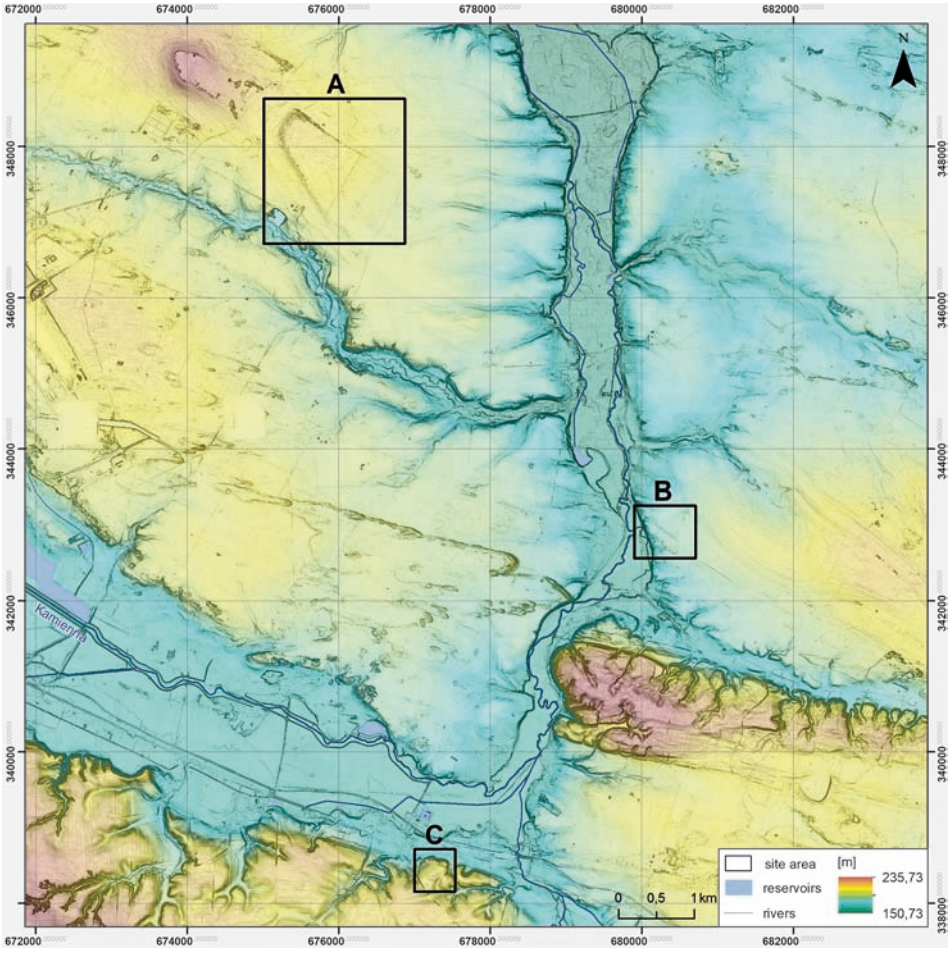

Fig. 6. Wider landscape of Krzemionki with Lidar map:
A – Krzemionki mining field; B – Borownia mining field; C – Gawroniec hill in Ćmielów – Funnel-Beaker culture settlement. Author: M. Skrzatek

Flint seams are not naturally exposed on the surface of Krzemionki, so it is unknown how miners discovered their existence. It is possible that flint fragments on the surface alerted the miners to the underlying seams, or it is possible that characteristic limestone flora (*Berberis vulgaris* L., *Padus avium Mill.*) forewarned miners to the presence of flint-bearing limestone bedrock (Borkowski and Budziszewski 1995, 72, 73; Bąbel 2015, 86; Barga-Więcławska 2016; *Krzemionki* 2018, 112-117).

There are four mine types at Krzemionki: 1) pit and shaft-niche-gallery, 2) shaft and gallery, 3) shaft, galleried and pillar-chamber, and 4) shaft, galleried and chamber (Table 1 and Fig. 7).

Table 1. Krzemionki mine types (after Bąbel 2015; Krzemionki... 2018)

	Mineshaft Dimensions	Gallery Dimensions	Mine Features	Mining tools
Pit	5m< diameter 2.5m< depth		Sometimes undercut/ niches.	
Shaft-niche-gallery	4m< diameter 4.5m< depth	1m< high 5m< long	Short galleries opened in multiple directions	Stone wedges Flint picks Antler levers and chisels
Shaft and gallery	3m< diameter 7m< deep	7m< long	Pillars	
Shaft, galleried and pillar-chamber	3m< diameter 7m< deep	1m< high 8m< long	Radial galleries Pillars	Flint picks Antler levers and chisels
Shaft-galleried and chamber	3m< diameter 9m< deep	1.2m< high 20m< long	3-4 radial galleries Timber props Slab supporting walls	Flint pickaxe

Pit and shaft-niche-gallery

Open pits are located on the outer edge of the complex, where shallow flint seams are weathered and of poor quality due to the syncline. These pits take on two forms: pits and shaft-niche-gallery. The pits were kept small and shallow, probably because of weak bedrock wall structure, although small undercuts were often developed in their bases (Fig. 7: 1).

Shaft-niche-gallery mines were opened to exploit deeper, better quality flint seams, extracted from the shaft bottom and by the opening of short galleries. They were worked with a variety of stone, flint, and antler implements (*Krzemionki* 2018, 123).

Shaft and gallery

Few shaft and gallery mines are recorded at Krzemionki, probably because the well-bedded limestone allowed large and stable workings, such as chamber mines (Fig. 7:2). One mine, no. 8/669 (excavated in 1985) is an example of a shaft and gallery mine which connected the gallery (*Krzemionki* 2018, 124).

Shaft, galleried and pillar-chamber

Shaft, galleried and pillar-chamber are amongst the deepest mines at Krzemionki (Fig. 7: 3). Their defining features are in situ bedrock pillars formed at the base of mineshafts and within galleries. Mineshaft spoil was often deposited into redundant shafts previously excavated shafts. Within the basal system, spoil was backfilled into exhausted galleries. To extract flint nodules from the bedrock, niches were cut above the nodule, which was then levered free with wooden wedges. Pine (Latin: *Pinus)* torches or firebrands were used to provide working light; these were maintained by scraping their charred tips against the mine wall, leaving distinctive charcoal 'cleaning' marks (*Krzemionki* 2018, 124, 125).

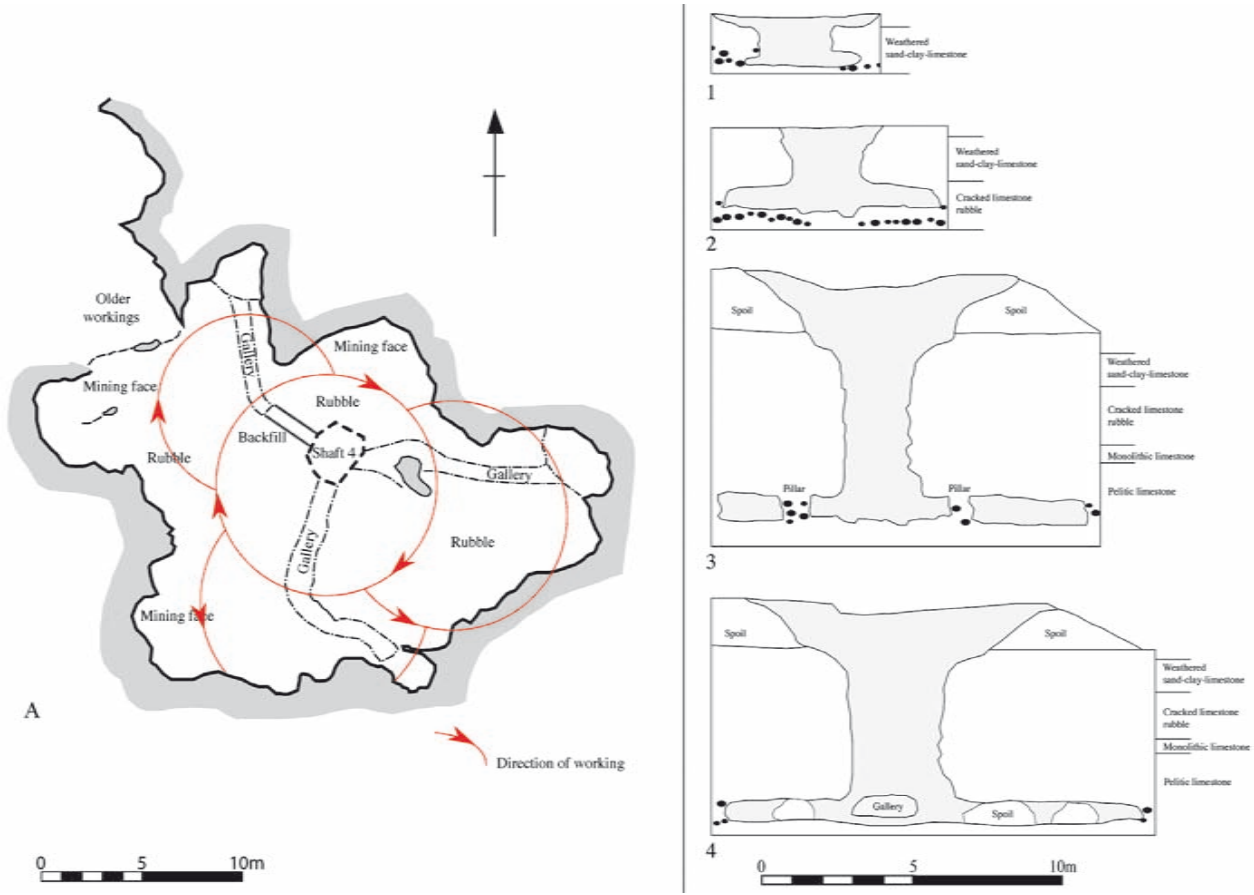

Fig. 7. Krzemionki; plans of mineshafts and galleries. After Bąbel 2015.
A – plan of working in a chamber mine with marked directions of mining work (fan-shaped working); 1 – Pit and shaft-niche-gallery; 2 – Shaft and gallery; 3 – Shaft, galleried and pillar-chamber; 4 – Shaft-galleried and chamber

Shaft-galleried and chamber

Shaft-galleried and chamber mines, the apex of mining at Krzemionki, comprise mineshafts which join radial galleries (Fig. 7: 4). In the chamber mines, galleries were dug radially in three directions, extending approximately 4 to 6 or 7 meters. This method allowed miners to determine the extent of the area to be worked. The next stage involved longwall mining on one or both sidewalls. Once the area was opened, flint was extracted from the gallery walls in a fan-like pattern, with extraction progressing from the 'longwall' working faces by removing flint nodules (see Fig. 7: A). Mine spoil was stacked within empty galleries to support the roof. Once the galleries reached a certain length, the chamber perimeter was extended in the same manner, sometimes a second or even a third time, progressively moving away from the shaft. The old galleries then became access routes, and as extraction continued, new chambers were opened. Additional access galleries were created from the mine spoil, which was supported by limestone blocks and wooden prop-like structures (Bąbel 2014, 25; *Krzemionki* 2018, 126).

A distinctive flint pickaxe, cigar-shaped, thick, and cylindrical with a sharp point and blunted hammerhead, was developed to work the shaft-galleried and chamber mines. Chamber-mines reached up to 500m^{2,} and it is estimated that enough flint to produce up to 7000 axeheads could be extracted from a single working (Borkowski *et al.* 1991, 616, 617; Borkowski 1995, 511-518; *Krzemionki* 2018, 122-126).

At the top of shaft 7/610, an arc of 16 postholes surrounded its entrance, interpreted as a cone-shaped shelter that covered the mineshaft to protect the workings and miners from the elements (Bąbel 2014, 97).

Grime's Graves

The Grime's Graves mine complex is located on Upper Cretaceous Late Turonian White Chalk (93.9-89.8 Mya) that contains nodular and tabular flint of the Brandon Flint Series (Mortimore and Wood 1986). The landscape is typified by undulating sandy heathland, the Breckland (Fig. 8). The upper chalk was subjected to Pleistocene glacial erosion and cryoturbation, and is covered by gravels, sands and tills, up to 2.5 m in depth.

Mine features at Grime's Graves are broadly divided into three forms: 1) galleried mines, 2) simple pits and 3) primitive-pits (Fig. 9).

Galleried-mines

The mineshafts of galleried mines were generally opened individually, although on occasion they were excavated in groups (Bishop 2012, 44). Floorstone flint was initially removed from the mineshafts' base, after which flint seams were followed by radiating galleries, eventually forming a basal system.

In the galleries, chalk pillars and walls were left in situ to support the roof. Empty galleries were backfilled with spoil from newly opened ones, negating their transfer to the

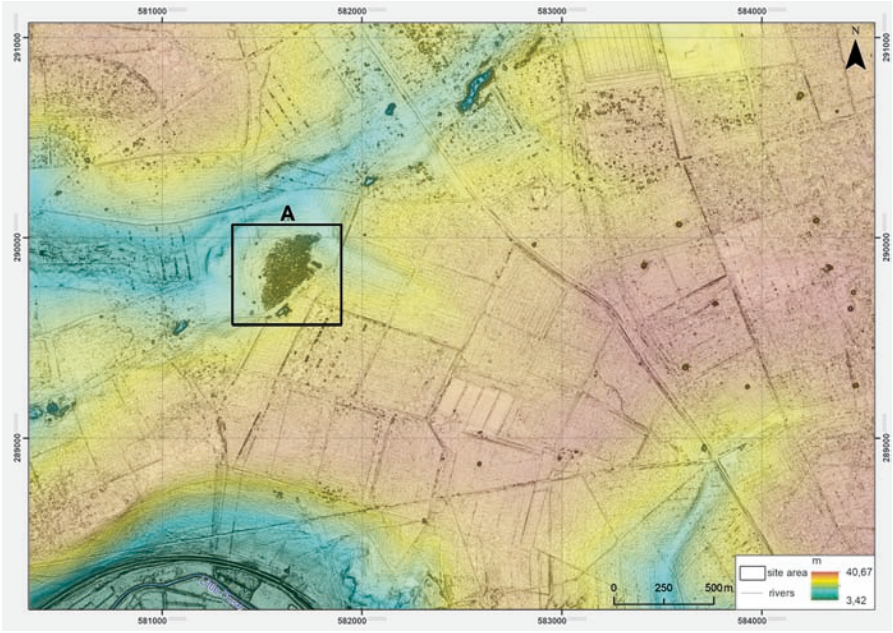

Fig. 8. Wider landscape of Grime's Graves with Lidar map. Author: M. Skrzatek

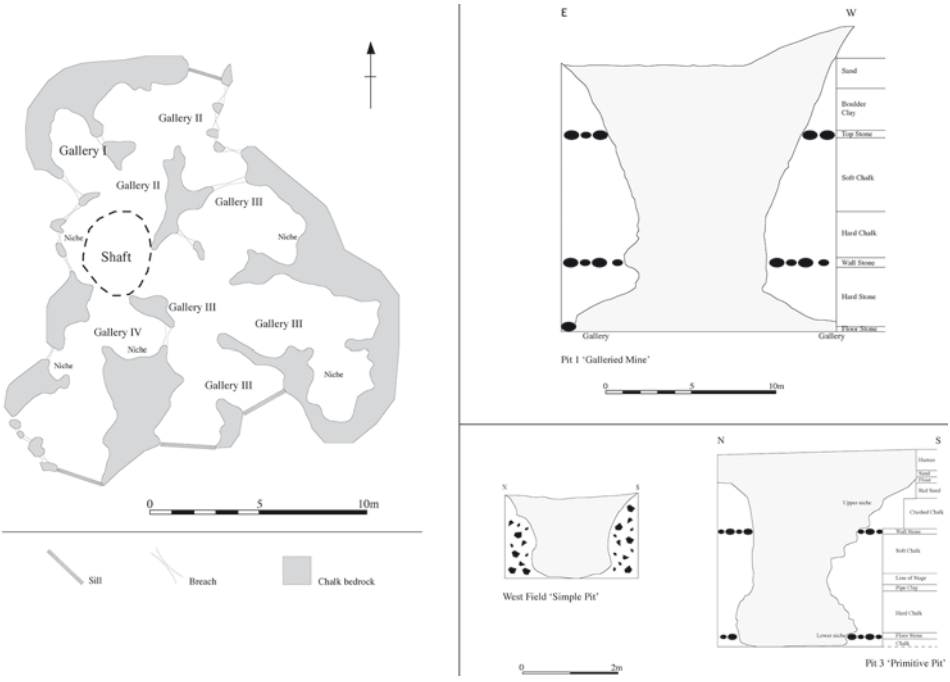

Fig. 9. Grime's Graves; plans of mineshafts and galleries

surface and helping to prop them up. Floorstone nodules were levered from the floor using red deer antler picks, large amounts of which were found abandoned.

Simple pits/primitive pits

Simple pits and primitive pits are in the north and West Field area of the complex, where the upper chalk flint seams are close to the surface but are glaciated and of low quality. In the simple pits, flint was extracted from superficial chalk geology, although floorstone was occasionally exploited (Healy *et al.* 2023).

The primitive pits are not named by chronology, but rather because they are technologically less advanced than the galleried mines. Flint was exploited in the Primitive-pits via undercuts from both the glacial deposits and floorstone. Unlike simple pits, working in the primitive pits was undertaken with animal bone picks, rather than antler.

Table 2. Grime's Graves mine types (after Bishop 2012; Healy *et al.* 2018; 2023)

Mine Type	Mineshaft Dimensions	Gallery Dimensions	Mine Features	Mining tools
Galleried-mines	12m< diameter 13m< deep	Radial galleries 1.5m< height 3.5m< wide >15m long	Pillars. Walls between galleries. Windows and doorways between galleries	Red deer antler picks Occasional flint and stone picks/axes
Simple-pits	4m< diameter 4m< deep			Red deer antler picks
'Primitive' pits	4m< diameter 5m< deep		Niches cut at mid-shaft and base of pit	Bone picks

WORKSHOPS AND PRODUCTS

Krzemionki

In Krzemionki, the primary processing of flint, mainly flint axeheads, was carried out at the tops of mineshafts (Bąbel 2015, 99-112). In the workshops, raw flint was sorted, with large nodules reduced on stone anvils before the shaping of axehead roughouts. Flint nodules were processed into blocks for transportation to settlements or for long-distance trade (Sałacinska and Sałacinski 2022).

The processing of flint was organised differently by the Funnel-Beaker and Globular Amphora cultures at Krzemionki (Borkowski *et al.* 1991; Borkowski 1995; see Fig. 10). Funnel-Beaker workshops are located both within and outside the mine complex. Their axeheads were tetrahedral, square, or wedge-shaped, and often polished across entire surfaces or just at their cutting end (see Fig. 10: 1; Borkowski *et al.* 1991, 622; Jedynak and Kaptur 2017). It is argued that axeheads were mass-produced by FBC communities for

Fig. 10. Striped flint axes, a typical Krzemionki mine product, by cultural period: 1 – Funnel-Beaker culture ('Gawroniec hill' at Ćmielów); 2 – Globular Amphora culture (Krzemionki mining site); 3 – Mierzanowice culture (Kichary Nowe, site 2, Sandomierz district). Photo: D. H. Werra

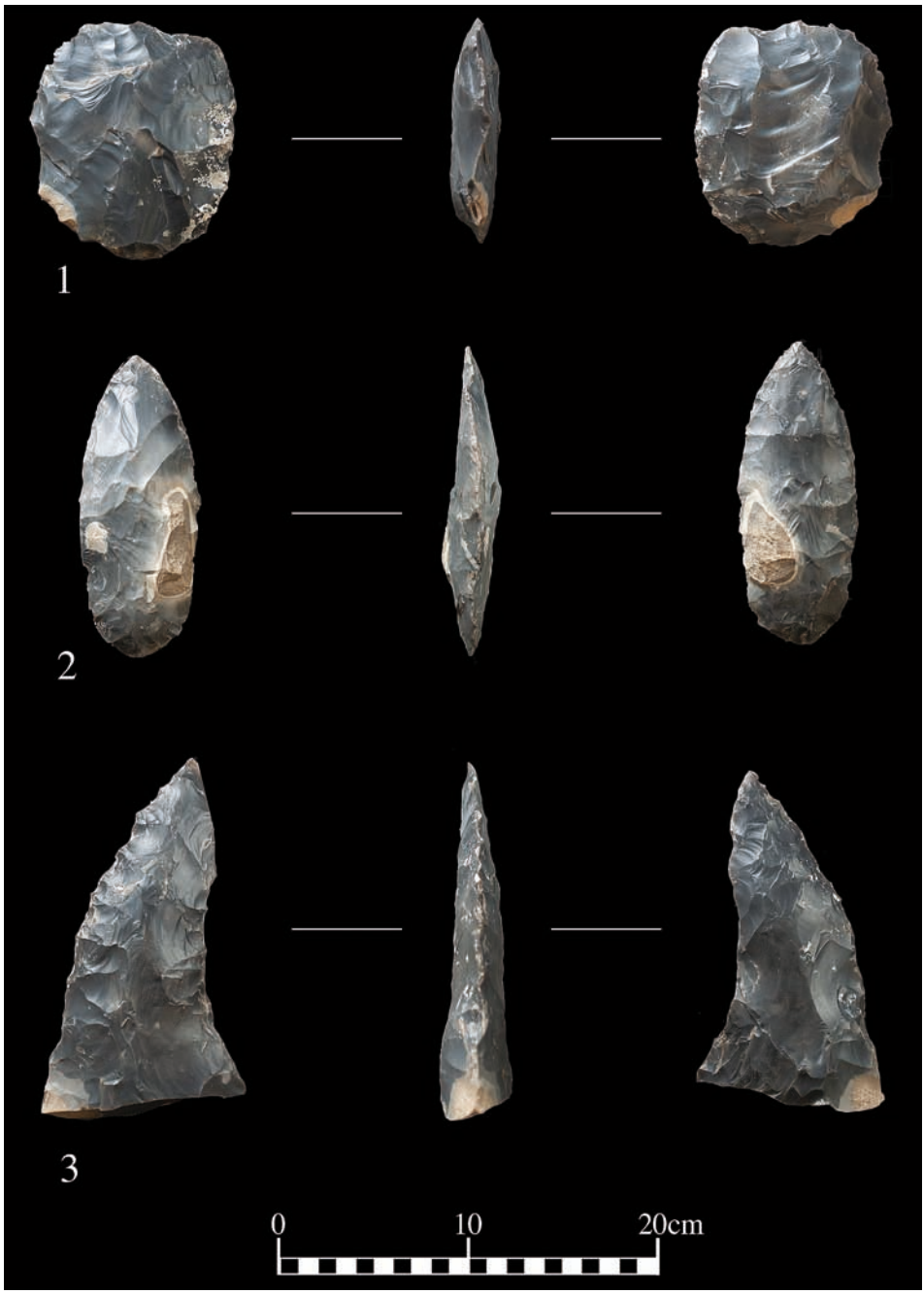

Fig. 11. Selection of typical Grimes Graves mine products. 1 – Discoidal knife roughout; 2 – Bifacial axehead; 3 – Irregular biface, a possible pick. Credit: English Heritage Trust. Photo: J. Bączkowski

woodland clearance (Bąbel 2015). Other FBC communities lithics included chisel blades, dihedral forms, and, occasionally, long blades, manufactured in workshops at the mine and at settlements in the wider region (Sałacińska and Sałaciński 2022).

During GAC communities mining, workshops are found mainly on the mine and are often accompanied by camps. At workshops, the entire technological cycle of axehead and chisel production is evidenced. The number of workshops and accumulation of production waste reflect the vast scale of exploitation.

Globular Amphora culture axeheads were flat, wedge-shaped, and often completely polished (Fig. 10: 2). They are recovered from a variety of archaeological contexts, including pits at settlements and human graves, leading to the proposal that they became symbolic objects, before or after use (Borkowski 1991, 622; Bąbel 2014, 14). During the Early Bronze Age, the Mierzanowice culture produced bi-facial polished axeheads from Krzemionki flint (Fig. 10: 3).

Grime's Graves

At Grime's Graves, primary dense flintworking floors were located close to mineshafts (Mercer 1981, 32). Working floors are also recorded 600m from the complex with smaller densities, although it is uncertain if they are associated with any mineshafts (Bishop 2012).

The full range of forms manufactured at Grime's Graves is not clear. Known products include flake axeheads and discoidal knives, as well as bifaces, including picks, points, waisted tools, and oblique arrowheads (Saville 1981; Bishop 2012; Lech 2012; see Fig. 11). A Levallois method was developed to produce discoidal forms (Saville 1981, 6, 7). There is often a lack of cortical flakes, large flakes, and cores in the working floors, indicating that primary working was carried out elsewhere and prepared cores were removed (Lech 2012; Healy *et al.* 2023). The production of these forms was continuous across the span of the galleried mines and simple pits, despite the differences in the quality of raw material (Lech 2012).

Little is known about flintworking in the 2nd millennium BCE. Limited production of multi-platform flake cores was carried out using recycled waste from earlier deep mines. Also, floorstone may have been used to produce quern stones as suitably abrasive rock is not locally available (Healy 1996, 96).

MINING AND SETTLEMENT

There is little evidence of settlement directly on both mines, possibly due to a paucity of immediate sources of fresh water. It is also likely that occupation evidence may have been buried or destroyed by continuous mining. The nearest year-round water sources are rivers, the Little Ouse at Grime's Graves and the Kamienna at Krzemionki, located 1.2 km and 3.7km from the complexes, respectively (Bąbel 2014; Healy *et al.* 2023).

Krzemionki

Located in the wider landscape of Krzemionki are karst sinkholes that provided seasonal water. One excavated sinkhole contained flint debitage from all stages of both FBC and GAC communities' axehead production (Zalewski 1996). The sinkholes are likely to have been the location of seasonal mining camps. Occupation evidence, including hearths, pottery, and animal bone, was also recovered from working floors surrounding the mineshafts. The structures capping the mineshafts presumably functioned as shelters. To date, no evidence of houses is recorded (Bąbel 2015, 112, 113).

Grime's Graves

Settlement evidence at Grime's Graves is lacking, although there is limited domestic evidence documented in the galleries in the form of hearths and Late Neolithic Grooved Ware pottery. The pottery is exclusively bowl-forms, suitable for cooking and eating rather than storage. It is reasoned they relate to short-term occupation (Longworth *et al.* 1988, 14), although this seems incompatible with the timescale of mining (Healy *et al.* 2023).

WIDER LANDSCAPE AND DISTRIBUTION

Krzemionki

There is good knowledge on the movement of stripped flint from Krzemionki, due to the distinctive character of the flint and its limited geological distribution. The only other source of striped flint, "Kraków-Częstochowa striped flint", is from the Holy Cross Mountains, and there is no evidence of it being mined (Sudoł-Procyk *et al.* 2021)

It has been calculated that Krzemionki flint accounts for over 90% of striped flint in assemblages (Borkowski and Budziszewski 1995). In the wider region of Krzemionki FBC communities settlements, including 'Gawroniec hill' at Ćmielów and Stryczowice, are located along river valleys below the Sandomierz Uplands. Both settlements contained large assemblages of striped flint, including axeheads (Sałacińska and Sałaciński 2022). It is considered that both settlements were the 'home' of miners who carried large quantities of flint from Krzemionki for mass processing (Kowalewska-Marszałek 2019). It seems that 'Gawroniec hill' (Balcer 2002, 161) was the central settlement in this raw material economy, as its inhabitants processed striped flint on a scale exceeding their needs. Other river valley settlements were smaller and lacked traces of intense flint processing. Likely, these communities did not have access to flint deposits (Krukowski 1939, 73; Balcer 1975, 180, 1995; Borkowski *et al.* 1991; Uzarowicz-Chmielewska and Sałacińska 2013).

The Sandomierz Uplands are also where GAC settlements associated with Krzemionki (Kowalewska-Marszałek 2019) were located, including Mierzanowice and Krzczonowice (Jedynak and Kaptur 2008; Sałacińska and Sałaciński 2022). These settlements differ in character and range from those of the FBC communities (Kowalewska-Marszałek 2019), because GAC communities are associated with increased mobility and a lifestyle centred on short-lived camps (Szmyt 2017). There is scant evidence of striped flint being worked at GAC communities settlements beyond those directly located at Krzemionki, indicating that the mine complex was the focal point for production during this period (Borkowski *et al.* 1991; Borkowski 1995, 522, 523; Jedynak and Kaptur 2008; Szmyt 2017; Kowalewska; Marszałek 2019; Sałacińska and Sałaciński 2022).

Grime's Graves

Settlement evidence in the Breckland area surrounding Grime's Graves is mostly presented by flint scatters (Healy 1998; Healy *et al.* 2023) and occasional pit groups along river valleys (Bishop 2012, 325). Analysis of lithic assemblages from settlements indicates flint was generally locally sourced rather than imported (Bishop 2012). Therefore, Grime's Graves flint is thought to have only supplemented local supplies (Bishop 2012, 330).

In the wider region, analysis of lithic scatters from eastern England is dominated by locally sourced flint from river gravels, till and beach deposits, with only a fraction possibly from Grime's Graves (Healy 1996, 52; Bishop 2012).

Evidence of Grime's Graves flint travelling long distances is rare but may include high-quality chalk flint found in assemblages in Mid-Wales and the East Midlands (Healy *et al.* 2023, 146). There are also four oversized 'keeled cores', weighing 15kg-26kg (Harding and Lord 2017). Three of the cores were recovered from within 40km of Grime's Graves. However, a fourth was recovered from West Kennett, close to Avebury henge, Wiltshire, located c. 200 km from the mines. Negative flake scars on the cores are for discoidal knives blanks (Harding and Lord 2017), a product associated with Grime's Graves. Finally, two Cornish axeheads found at Grime's Graves hint at long-distance connections, as their source is 500km away.

DISCUSSION

There are notable differences between the chronology of both mines. At Krzemionki, striped flint sourced from the mines was worked at FBC communities settlements in the early 4th millennium BCE (Sałacińska and Sałaciński 2022), contemporary with the start of shaft-galleried mining across Europe, including England (Edinborough *et al.* 2019). In contrast, Grime's Graves dates to the final centuries of the shaft-galleried mining tradition in the mid-3rd millennium BCE.

Comparable chronologies occur in later phases at both mines with shaft-galleried mining finishing before the 2nd millennium BCE, after which simpler extraction methods were employed. Flint industries at both mines in the 2nd millennium BCE were based on the recycling of older mine waste. Recycling of mine waste is also documented at other mines across the 3rd-2nd millennium BCE, including in southern England (Bączkowski 2022) and Sweden (Berggren *et al.* 2016; Högberg *et al.* 2023).

It is notable that recycling activity occurs after bronze had started to transform societies in Britain and Poland, a process impacting on flint reliant communities (Bradley *et al.* 2016; Kadrow 2017; Parker *et al.* 2019; see Lech *et al.* 2015; Oliva 2022, 67ff) who may have wanted to retain a connection to a deep-rooted tradition, shaft-galleried mining.

Methodology and origin

Similarities exist in shaft-galleried mining, which requires a sophisticated knowledge of bedrock conditions. At both mines, this knowledge is expressed in the careful placement of pillars and walls in galleries to support bedrock stresses.

Although, as found at all flint mines, geology governs extraction at Krzemionki and Grime's Graves, with shaft-galleried mines targeting deep flint seams and pits exploiting shallow ones, the difference in structures is not evolutionary. The chronology is not clear at Krzemionki, although shaft-galleried mines were most probably opened in the early 4th millennium BCE, as evidenced by the presence of striped flint at FBC settlements connected to the mines. However, there is still a lack of radiocarbon dates, which will evidently connect different types of mining features with the activities of particular prehistoric communities. However, there is no evidence of evolutionary development of extraction features. The simple workings also post-date subterranean workings at Krzemionki, as at Grime's Graves.

Mining at Krzemionki started in the 4th millennium BCE when FBC communities were expanding into areas beyond those previously settled by Linear Pottery Culture communities, including the opening of land along river valleys below the Sandomierz Uplands (Bąbel 1980, 592; Borkowski and Budziszewski 1995, 75; Nowak 2017; Krzemionki 2018, 977). Axeheads from Krzemionki were in demand for woodland clearance, and grey-white spotted flint from the Świeciechów mines was also used to produce axeheads and long blades for the processing of crops. Both Świeciechów grey-white spotted flint and Krzemionki striped flint are recorded at the 'Gawroniec hill' settlement at Ćmielów (Balcer 1995; 2002; Budziszewski 2006), showing the importance of mining to pioneer communities for providing material needed for woodland clearance and agriculture.

At Grime's Graves, the shaft-galleried mines are the earliest mining features chronologically. This strongly suggests that shaft-galleried mining was introduced specifically to Grime's Graves by communities already familiar with the method (Healy *et al.* 2018, 290), especially since no British shaft-galleried mines are chronologically close to the mid-3rd

millennium BCE. Although it is worth noting that shaft-galleried mining at the southern British mines began around 3900/3800 cal. BCE, it had all but ceased by 3400/3300 cal. BCE (Edinburgh *et al.* 2019), which meant an almost 800-year gap before it began at Grime's Graves. This infers that at that shaft-galleried mining is not an insular innovation, as it is unlikely that the knowledge, or memory, of shaft-galleried mining would have been retained for such a long break (Healey et al 2018, 290). It is further notable that when shaft-galleried mining started at Grimes Grave's the recycling of mine spoil, and possibly even the opening of new mines, also commenced at the earlier and long abandoned southern English flint mines in the mid-3rd millennium BCE (Bączkowski 2022), indicating a renewal of interest in lithic sources and production in the final centuries of the Neolithic.

Understanding the origins of Grime's Graves is difficult, with no contemporary mining in Britain and no obvious connection with any Continental mines, although shaft-galleried mining was underway at Spiennes (Belgium, 4350-2300 cal. BCE; Collet *et al.* 2008; Collet and Collin 2023), and mines in the Paris Basin (Bostyn *et al.* 2018), as well as Skovbakken (Denmark, Late Neolithic, 2300-2100/2000 cal. BCE; Sørensen 2015, 6, 25).

The proposed continental origin of Grime's Graves challenges the idea of insularity in the British Late Neolithic period (Allen *et al.* 2012). It is possible that the entire community, or some of the skilled miners, were incomers, possibly from the Continent, but this phenomenon has not been thoroughly examined. To understand how miners spread their knowledge, a comprehensive analysis of their work procedures is essential. This analysis should include a review of the technical aspects of underground exploration, as well as research into long-distance contacts and exchanges. The location of Grime's Graves is also significant for understanding this phenomenon, as the mines are situated less than 15 km from the modern coastline, within a vast area of wetland and estuary known as the Fens. Mining groups may have accessed the area through this coastline, which has a rich history of prehistoric activity (Healy 1996).

Other concentrations of finely worked Late Neolithic flintwork around the British Isles, including discoidal knives, indicate that coastal locales were important for the exchange of material culture (Bradley 2022). If Grime's Graves was connected to coastal trade, it might explain the scarcity of mined flint from local settlements if it was exported via maritime routes (Bradley 2022, 30), although it is acknowledged that direct knowledge on the wider distribution of Grime's Graves flint is lacking.

The origins of this cultural phenomenon, shaft-galleried flint mining, remain under investigation. In both presented sites, this extraction method appears as a fully developed technique. At the Krzemionki mining complex, this method was introduced alongside the emergence of FBC communities. Similarly, for the Grime's Graves mine, it seems that the innovation was not locally developed but rather introduced by incoming communities. The question remains: where did the impulses for this excitation method originate?

Products

At Krzemionki axeheads were produced throughout the entire working life of the mine, although the use of axeheads may have altered over time.

Initially, mining at Krzemionki appears to have been driven by necessity, as no striped flint can be surface sourced. However, it is difficult to interpret axehead production as driven solely by demand. Axeheads are not exclusively quotidian. They contain symbolism, signified by their deposition into pits, graves and other contexts across Europe throughout the Neolithic and Early Bronze Age periods (Davis and Edmonds 2011). Excessively polished Krzemionki axeheads were often deposited unused into pits, inferring that they were meant for deposition and not use. For example, later in the chronology of Krzemionki, the Globular Amorpha Culture deposited highly polished axeheads into graves and pits (Szmyt 2010; Przybyła *et al.* 2013; Bąbel 2014, 41ff). Also, it cannot be ruled out that the aesthetic value of striped flint may have increased the demand for polished axeheads in the history of Krzemionki mining (see Nobis 2018).

At Grime's Graves, axeheads were only a small component of the lithics being produced from mined flint. This is unlike the Early Neolithic southern British mines, which were associated with bi-facial axeheads produced for woodland clearance by incoming farming communities (Brace *et al.* 2019). The demand for axeheads had waned by the Late Neolithic, and extraction in mining areas had shifted to surface sources (Gardiner 1990). This makes Grime's Graves an oddity because there is no obvious need for large-scale flint procurement in the Late Neolithic. Mining at Grime's Graves may have therefore fulfilled a less prosaic role, and it is argued that the mines were a place for community gatherings associated with the production of 'special objects' (Bishop 2012). These 'special objects', such as discoidal knives, were often symbolically deposited into pits alongside Grooved Ware pottery (Healy 2012). Similar pieces were also produced on waste flakes from Early Neolithic mines, including the southern English mines (Bączkowski 2022) and Södra Sallerup, Sweden (Berggren *et al.* 2016; Högberg *et al.* 2023).

Cultural importance of mining

It has long been acknowledged that Krzemionki and Grime's Graves were production centres from which lithics were distributed, but this is only part of their narrative because mining has demands beyond the extraction face requiring complex social organisation. Entire communities must have been engaged in mining or related activities because miners needed support with sustenance and materials, including wood for structures, antlers for picks and stone for hammers. The scale and duration of mining at both mines indicate that extraction episodes lasted for many months. This infers that occupation was directly upon, or close to the mines. It is unlikely that miners settled far from the mines.

Water could be sourced within a practical distance from both mines, including from seasonal sinkholes and rivers, the Kamienna at Krzemionki and the Little Ouse at Grime's Graves. Settlements were probably located close to these water sources, with miners travelling short distances or supported by communities at these camps. The temporal character of evidence, including hearths, occasional animal bones and a paucity of large storage vessels, may support this model.

That both mines were close to rivers is further helpful for trading and exchanging mine products. Mined flint may have been traded along these watercourses between riverside settlements, forming long reaching distribution networks. Because Krzemionki striped flint is easily provenanced, research has shown that it was widely distributed from the mines. Material from GAC communities mining in the 3rd millennium BCE has been found up to 660km from the mine (Balcer and Kowaski 1978; Bąbel 1980, 595; 2015, 128).

Of the limited evidence of Grime's Graves flint being exported from the mines, the four oversized cores are most notable. If the oversized cores originate from Grime's Graves, they may represent similar export pieces only surviving because they were venerated (Harding and Lord 2017), or simply because they were a forgotten reserve waiting for reduction. Future analysis of these cores to provenance their source would help attribute them to Grime's Graves and possibly increase knowledge of the movement, and use, of mined flint.

During extraction episodes, the mines and wider environs would have been busy with community activities. In this respect, mines operated like large-scale community monuments (Edmonds 1999; Bishop 2012), increasing their significance. The experience of mining and the performance of lithic production would have enhanced the cultural and symbolic value of mines (Whittle 1995; Oliva 2018; Topping 2021).

Mines endured as meaningful locales for successive generations, and seasonal mining may have brought together disconnected communities, maintaining cultural links, knowledge transfer and social relationships (Bąbel 1997; 2015; Topping 1997; Berggren *et al.* 2016; Castańeda 2018; 2021; Bostyn 2023, 363; Díaz-del-Río *et al.* 2023; Högberg *et al.* 2023). After mining waned, non-mining communities continued to visit the mines to recycle mine waste, either because the spoil heaps of abandoned mines were an easily exploitable resource or because communities still held cultural links to the mines (Lech *et al.* 2015; Oliva 2022).

Wider significance of mining

Both mines reflect wider cultural narratives and transformations. At Krzemionki, mining arrives with incoming FBC communities who may have originated from a merger of farming communities with hunter and gathering groups in southern Scandinavia, northern Germany and Poland (Nowak 2017; Gron and Sørensen 2018). Although the origins of the

FBC communities are debated, with DNA analysis showing a complex mixing of FBC and post-FBC Neolithic communities (Fernandes *et al.* 2018; Gron and Sørensen 2018).

The cultural meaning of mining at Krzemionki shifted with the arrival of GAC communities, coinciding with a migration of groups from the Pontic steppe (Tassi *et al.* 2017). Although the lifestyles of GAC communities were based on mobility and pastoralism (Szmyt 2010), and mining at Krzemionki became more complex with the development of chamber mines. During this period, the distribution of striped flint axeheads from Krzemionki increased, and they were now deposited alongside human burials.

After mining finished at Krzemionki, the mines were visited by incoming Bell-Beaker communities, whose recycling of mine waste is documented by striped flint found at their Sandomierz Upland settlements (Budziszewski and Włodarczak 2010, 69). The same recycling is observed at Grime's Graves. Even after shaft-galleried mining ceased both mines therefore retained an importance in supplying flint, regardless of whether this recycling was for cultural or practical reasons.

At Grime's Grave, the arrival of Bell-Beaker communities into the British Isles in the second half of the 3rd millennium BCE marked a period of change when the cultural landscape shifted from an insular Late Neolithic (Parker Pearson *et al.* 2019). It may be no coincidence that in this period shaft-galleried mining was abandoned, and simple pit extraction began (Healy *et al.* 2018).

It is notable that, although galleried mining lost its importance, the production of 'special' lithics continued even after all forms of mining ceased, and only waste recycling remained. Throughout this cultural transformation, the same fine lithic forms are produced at Grime's Graves. This may show a community at odds with a world being transformed by bronze, preferring to continue previous traditions (Healy *et al.* 2018).

Analysis of DNA in this period shows both the eventual replacement of British Neolithic populations (Olalde *et al.* 2018) and the nuances of social relationships with incoming Bell-Beaker communities (Booth *et al.* 2021). The waxing and waning of mining links Grime's Graves to wider cultural shifts within a changing world, when old customs were being lost or renegotiated. It is possible that mining at Grime's Graves was founded by an incoming community because they decided to continue a mining and lithic tradition that was an important part of their cultural identity.

CONCLUSION

It is recognised that Grime's Graves and Krzemionki are located hundreds of kilometres apart, making any direct connection impossible. However, this paper has shown that both mines share an extraction methodology that originated in the late 5th millennium BCE, which by the early 4th millennium BCE had become associated with many mines across Europe.

Shaft-galleried mining presumably originated at a yet to be identified location in the late-5th millennium BCE, becoming the method associated with large, persistent mines. Grime's Graves, established in the mid-3rd millennium BCE, represents one of the last cultural expressions of a tradition that had its origins over a millennium earlier and underpinned extraction at Krzemionki.

Overall, both mines reflect wider narratives of cultural transition and were locales for lithic production and gatherings. They were manifestly more than just extraction sites.

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BEAKERS WITH CORDED ORNAMENTATION IN THE NORTHWESTERN PONTIC REGION (EARLY BRONZE AGE)

ABSTRACT

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Corded ornamentation is known on pottery from various Eneolithic and Bronze Age archaeological cultures in the Northwestern Pontic region. The ornamental patterns vary and are not associated with any particular type of vessel. This article examines beakers decorated with compositions of cord impressions. These have predominantly been found in the burials of the Budzhak/Yamna culture. Their distribution may be related to the influence of different cultural blocks – the northern block, associated with the Corded Ware culture, and the western block, linked to the cultures of the Early Bronze Age in the Balkan and Danube region.

Keywords: Northwestern Pontic, Balkan and Danube area, Budzhak/Yamna culture, Corded Ware culture
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INTRODUCTION

Corded ornamentation in the Eneolithic and Bronze Age was widespread in communities with marked differences in culture, economy, environment and social development. Researchers identify in it peculiar 'markers' – signs of wider interaction, such as the exchange of experiences on a pragmatic, technological, and cognitive-semiotic level (Kośko and Szmyt 2010, 58). In the Northwestern Pontic region, corded ornamentation has been found on pottery from various Late Eneolithic and Early Bronze Age archaeological cultures. Some cultures are considered incoming, while others are considered indigenous. Therefore, to determine the sources of the corded ornamentation in these cultures, specialised studies of ornamentation techniques and archaeological context are required. However, the stylistics of vessel ornamentation may indicate the influence of a particular society, as reflected in the similarity of ceramic forms and in the perception of specific ornamental features. Openness to cultural dialogue could have facilitated cultural exchange, the perception, transformation, and adaptation of new cultural elements, including corded ornamentation.

THE NORTHWESTERN PONTIC REGION AS A FRONTIER ZONE

The Northwestern Pontic area is highlighted in many studies as a distinct geographic and cultural-historical region, bounded to the east by the Southern Buh River, to the west by the Prut and Danube Rivers, to the north by the boundary between the steppe and forest-steppe, and to the south by the Black Sea.

In the Late Eneolithic, this area was considered a 'zone of contacts', or frontier. At the end of the 4th and the beginning of the 3rd millennium BCE, an Eneolithic population existed that can be termed the proto-Budzhak (proto-Yamna) horizon (Ivanova 2015). This includes groups from the late stage of the Trypillia culture, graves of the Zhivotylivka-Volchansk group, and graves with extended ('stretched') skeletons; some researchers associate them with the population of the Kvitianska culture (Rassamakin 1997), while others link them to various types and chronological periods of the Eneolithic (Manzura 2013). Some Eneolithic graves cannot be attributed to specific cultures.

The chronological range, spanning from the last quarter of the 4th millennium BCE to the first quarter of the 3rd millennium BCE, marks both the end of the Eneolithic period and the beginning of the Bronze Age. The beginning of the Bronze Age in the steppe zone of Ukraine is dated to 3300/3200 BC, which corresponds to the beginning of the CII stage according to the Tripillia chronology (Videiko 1999). The transition to the Middle Bronze Age is dated to 2700-2500 BC, and to the Late Bronze Age, about 1800 BC (Otroschenko *et al.* 2008, 219, 245, 304). During the Early Bronze Age, the region maintained its frontier status. The Early Bronze Age includes the Usatove culture and the Budzhak/Yamna culture,

one of the most prominent cultures not only in the Pontic steppe but also across the entire Yamna cultural area (YC). The Usatove chronology currently spans from 3550 to 2750 BCE, coinciding with the Trypillia stage CII of the chronological periodisation of the Pre-Cucuteni-Cucuteni-Trypillia Culture Complex (Nikitin and Ivanova 2022). According to Yuri Rassamakin and Alla Nikolova (2008, 65, 66), the chronological span of the YC in the Dnister-Danube rivers region can be defined as 2900-2200 BC; however, it is also possible to accept two groups of dates for this region: 3000-2600 BC and 2550-2200 BC. In the region, the graves of the Catacomb culture (CC), which coexisted with the Budzhak culture for a certain period, date back to the second half of the 3rd millennium BC. The population of the Early Bronze Age not only mastered the territory of the Northwestern Pontic zone but also moved westward: a small group of Catacomb burials was excavated in Romania, and burial mounds of the YC are known not only in the Balkan-Carpathian area but also in Hungary and Serbia (Jarosz *et al.* 2021).

Researchers have substantiated the concept of the Northwestern Pontic as a link between the Western world of farmers and the steppe pastoralists (Shmagliy and Cherniakov 1970), as a 'contact zone' of different cultures (Dergachev 1991). According to Igor Manzura, in the Middle Eneolithic, a communication system ('East – West bridge') was formed, where the Carpathian-Dnister region acts as a peculiar indicator of cultural processes in the European territories, and at the same time, as a medium of transmission, within which cultural transformation appears especially dynamic and multifaceted. In the Eneolithic and Early Bronze Age, the development of local groups in this area was determined by the interaction of two cultural blocks: the Eastern European and the Balkan-Danubian. In some stages, impulses coming directly (and more often, indirectly, through the forest-steppe formations of the Carpathian-Dnister lands) from the communities of the Central European circle intervened in this process (Manzura 1993).

Valentin Dergachev also noted that in the Carpathian-Dnister region, there is interaction between different cultural communities, and the region itself appears as a zone of interaction between several cultural-historical factors. The dominant factor throughout all the periods considered by the author (from the Neolithic to Antiquity) was the southeastern European one, with its position linked to Southeastern Europe's susceptibility to impulses from advanced cultural centres (the Mediterranean, the Near East). The Eastern European factor was the second most significant; the third (Central European) was quite secondary. The role of each factor changed in different eras, weakening or strengthening and blocking one another; in their interconnection, they formed a unified cultural-historical context, characterising the peculiarities of the development of the Carpathian-Danube region (Dergachev 1999, 211-218).

Piotr Włodarczak notes the effects of influence from four factors on the Northwestern Pontic in the Late Eneolithic and Early Bronze Age. These were:

– local Late Tripillian (Usatove),

– eastern, associated with the Pontic and Caspian steppe pastoral communities,

– western – with the Early Bronze Age cultures of Anatolia and the Balkans,

– northern, defined by the appearance of the Globular Amphora culture (GAC) near the region. The 'Western branch' of the YC was formed under significant influence from the Eneolithic communities of Southeastern Europe (Włodarczak 2010, 302, 303).

BUDZHAK CULTURE

In works dedicated to various aspects of the Yamna cultural and historical community, the sites of the Northwestern Pontic zone are consistently highlighted as a distinct society with its own defining features. There is a paradox: the existence of a separate culture was substantiated by Leo Kleyn (1975), who called it the 'Nerushay culture', but the most commonly used name is the one later proposed by Ivan Cherniakov (1979), in its various modifications (Budzhak culture, group, variant). In our opinion, the sites of this region deserve the status of a distinct culture, and the well-established, familiar name Budzhak culture should be preserved. The distinction of this culture is fully justified not only by its material culture's peculiarities but also within the framework of a systematic approach to reconstructing ancient history.

The terms 'archaeological culture' and 'cultural-historical community' are generally used as the central taxonomic units. The classic definition of an archaeological culture was formulated by Gordon Childe: 'We find certain types of remains – pots, implements, ornaments, burial rites and house forms – constantly recurring together. Such a complex of associated traits we shall call a cultural group or just a culture' (Childe 1929, v-vi).

The delineation of archaeological cultures is a traditional procedure in archaeology that, on the one hand, facilitates the study of ancient human societies and, on the other, structures archaeological material. Defining the concept of culture is an important step in archaeological research. Any study of a particular culture must first determine what it represents – the specific time period, geographical region, and group of people that constitute this culture (Roberts and Vander Linden 2011). It is assumed that the concept of an archaeological culture remains useful today for the classification and organisation of artefacts, particularly in European archaeology, which often tends towards cultural-historical archaeology (Johnson 2019).

A cultural-historical community is defined as a group of related «cultural variants» or cultures, united by an extensive territory, related material culture, economic structure and social organisation, as well as common developmental trajectories, and concentrated within a defined, bounded area. Almost fifty years ago, archaeologists proposed designating the Yamna culture as the Yamna cultural-historical community/area (Merpert 1974). This concept is broader than simply 'Yamna culture'; it reflects the diversity within the vast distribution area, as well as the existence of cultural variants and several distinct cultures that are part of the Yamna cultural-historical community. One of these is the Budzhak

culture. There are archaeological cultural traditions considered by some archaeologists to be separate cultures, while others include them within the Yamna cultural-historical area: the Kemi-Oba culture in Crimea (Toschev and Kashuba 2017), the Novotitorovka culture in the North Caucasus (Pustovalov 2000, 162) and the Poltavka culture in the Volga-Ural region (Morgunova 2014, 206).

Some archaeologists dispute the status of the Budzhak culture within the Yamna cultural-historical community, instead defining it as a 'cultural variant' (Merpert 1974; Dergachev 2023). The renowned cultural theorist and archaeologist Leo Kleyn examined the concept of archaeological culture from various theoretical perspectives, devoting a part of his monograph to it (Kleyn 1991). He repeatedly wrote about the existence of this distinctive archaeological culture (Budzhak/Nerushay) in the Northwestern Pontic region (Kleyn 2016). We share L. Kleyn's view: the Budzhak culture meets the principal criteria for classification as an archaeological culture.

The complexes in question are concentrated in a specific territory (the Northwestern Pontic region) and local features. Often, the Budzhak culture is associated with the late phase of the YC (Cherniakov 1979; Dergachev 1986). However, as the analysis of sources reveals, the characteristic features of this culture are already evident in the early stage. This pertains to various aspects of material culture, primarily pottery (Ivanova 2021) and metallurgy (Ivanova *et al.* 2021).

In the burial complexes from this area, there is a noticeable predominance of flat-bottomed ceramic forms (in contrast to the ovoid or rounded-bottom forms found in other regions of the YC) and the presence of vessels typologically similar to forms known in the Balkan-Carpathian area and Central Europe. Some of these vessels serve as a kind of 'trademark' of the culture (amphorae, beakers, 'Budzhak jars'), both unornamented and decorated with cord impressions. On the other hand, the distinctiveness of the Budzhak culture is determined by its geographic location — at the border with the late Neolithic/Early Bronze Age cultures of the Balkans (including the Cernavodă III-II, Coţofeni II-III, and Ezero cultures) (Włodarczak 2010, 302). It is also significant that in the Northwestern Pontic, there are sites of late Tripillia groups (phase C/II): Usatove, Ofatinţi (Vykhvatintsy), Brînzeni, and Gordineşti, as well as Zhivotylivka-Volchansk.

Contacts with surrounding cultures are reflected in the presence of ceramic types that have analogues in the contemporary cultures of neighbouring and distant territories, as well as in the assimilation and reworking of new traditions. Researchers have noted that in the ceramic complexes of the Budzhak culture, the connections are more pronounced with the cultures of Central and Southeastern Europe rather than with the Steppe cultures (GAC, Corded Ware culture (CWC), Ezero, Cernavodă II, Coţofeni, Glina III-Schnekenberg, and others) (Cherniakov and Toschev 1985, 18; Dergachev 1999, 209; Alekseeva 1992, 50).

What seems particularly interesting to us are the beakers decorated with cord impressions. Complete information about the burials with these beakers is presented in the Appendix (Catalogue) to this article.

BEAKERS AND BEAKER-SHAPED VESSELS FROM THE BURIALS OF THE BUDZHAK CULTURE

In the Budzhak pottery assemblage, certain similarities with CWC pottery are noted in two vessel types: amphorae (Iwanowa *et al.* 2014) and beakers. A few weapons finds are also attributed to the CWC (Klochko 2006). Beakers with corded decoration constitute a sufficiently representative group that, in our view, could be addressed in a separate article. The significance of these vessels also emerges in the context of one of the most topical subjects in European archaeology: the westward expansion of the Yamna culture, *i.e.*, a process associated with ancient population movements. Within this context, the Yamna culture was long presumed to have played a leading role in shaping the Central European Bronze Age cultures, particularly the CWC. These issues have gained renewed prominence in recent years, following advances in genetic research (Allentoft *et al.* 2015; Haak *et al.* 2015; Mathieson *et al.* 2015), which have revived the theories of Gordon Childe and Marija Gimbutas (Childe 1926; Gimbutas 1956).

Fig. 1. Map of sites mentioned in the article. The numbers on the map correspond to entries in the catalogue (drawn from public-domain Natural Earth data):
1 – Kartal/Orlovka, 2 – Bashtanivka, 3 – Butor, 4 – Cazaclia, 5 – Dyvizia, 6 – Efymivka, 7 – Găvănoasa, 8 – Hlinaia, 9 – Kamyanka, 10 – Kholodna Balka, 11 – Kurchi, 12 – Mayaki, 13 – Mologa, 14 – Myrne, 15 – Olăneşti, 16 – Ostrivne, 17 – Pererîta, 18 – Trapivka

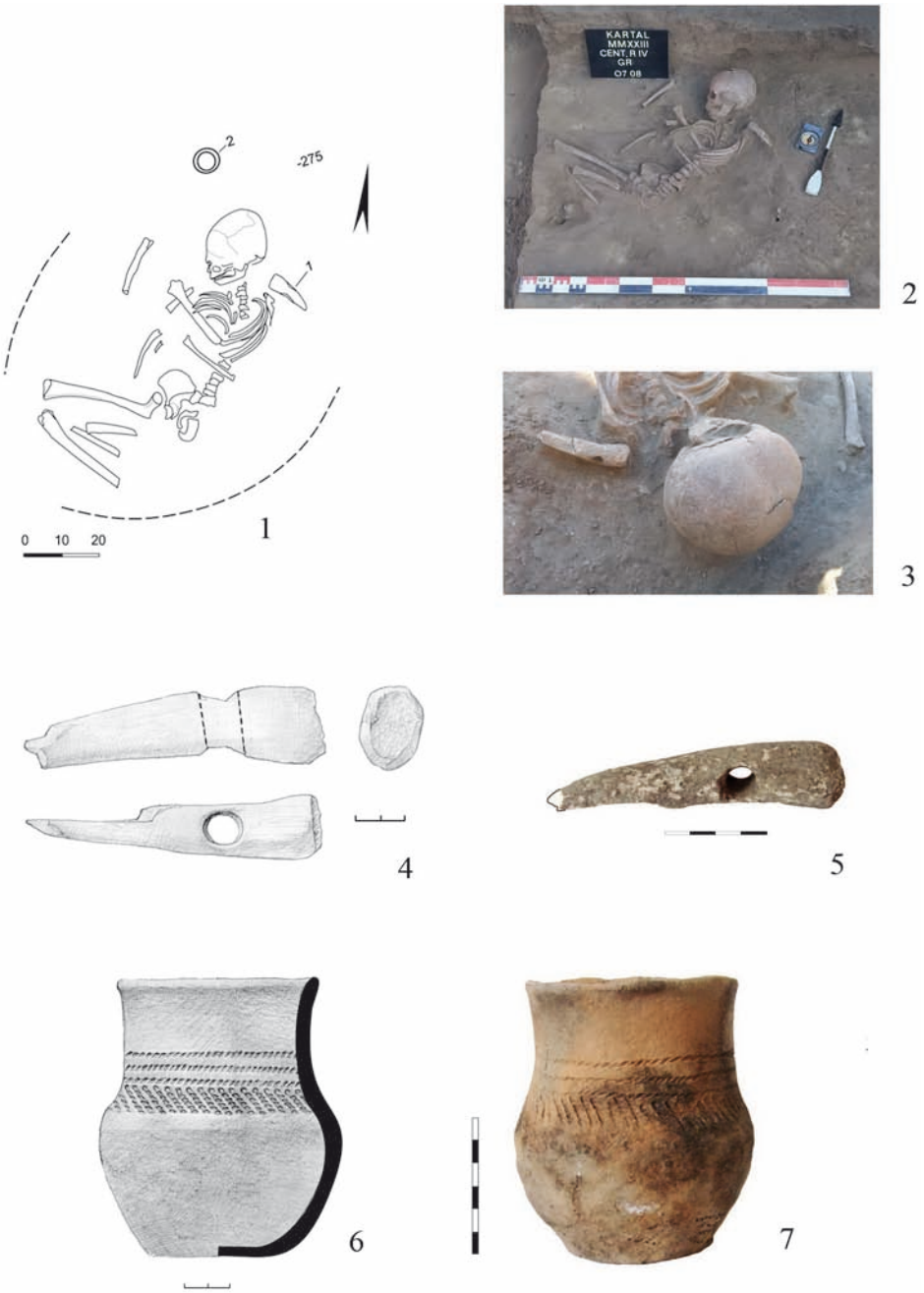

Fig. 2. Kartal/Orlovka, central area, excavation IV, burial 16:
1, 2 – burial 16; 3-5 – horn hammer (hoe?); 6, 7 – beaker from the burial site

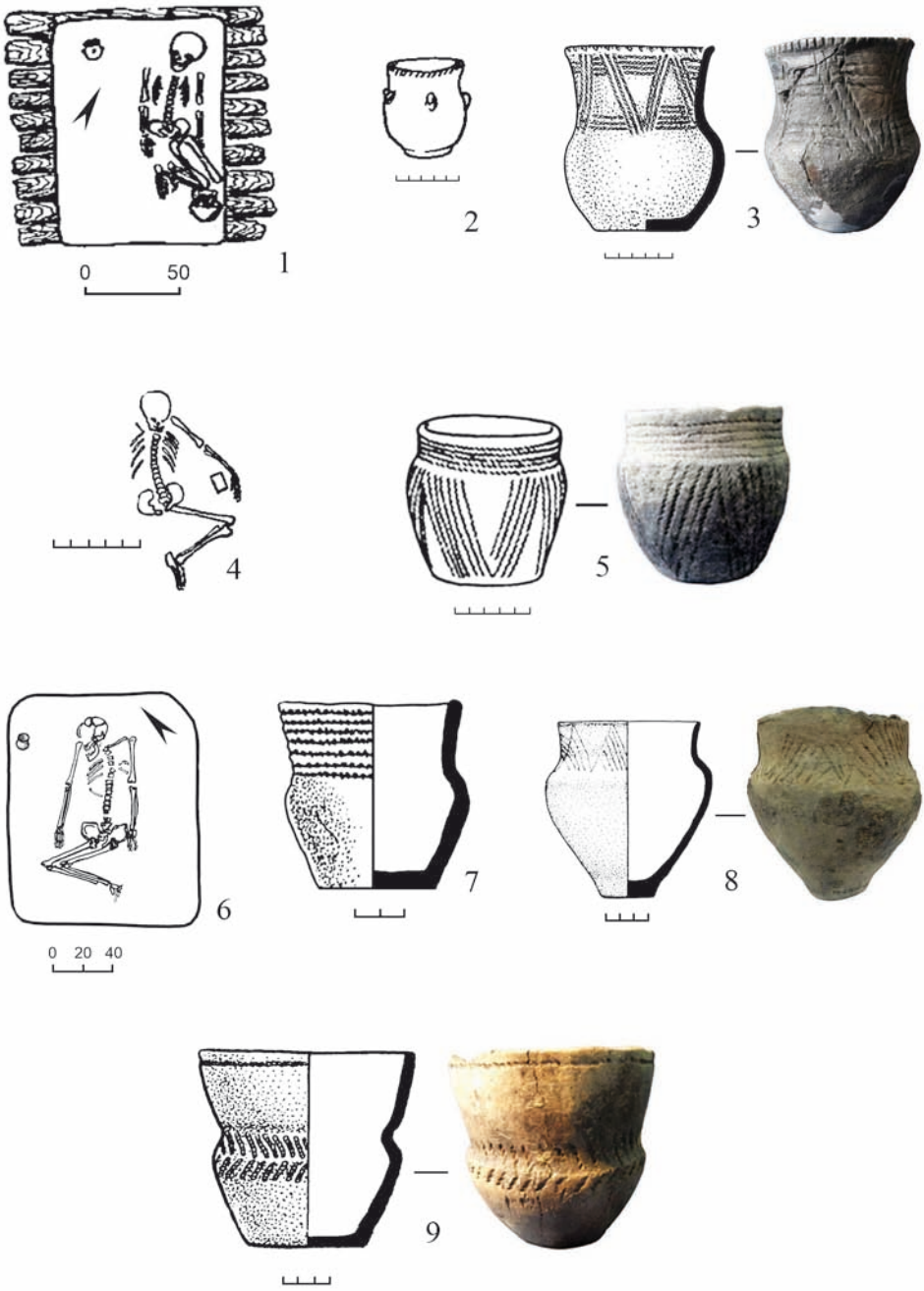

Fig. 3. Budzhak culture beakers with cord ornaments:
1-3 – Bashtanivka 7/12; 4,5 – Bashtanivka 7/21; 6, 7 – Butor 9/3; 8 – Cazaclia 5a/1; 9 – Dyvizia II 2/5

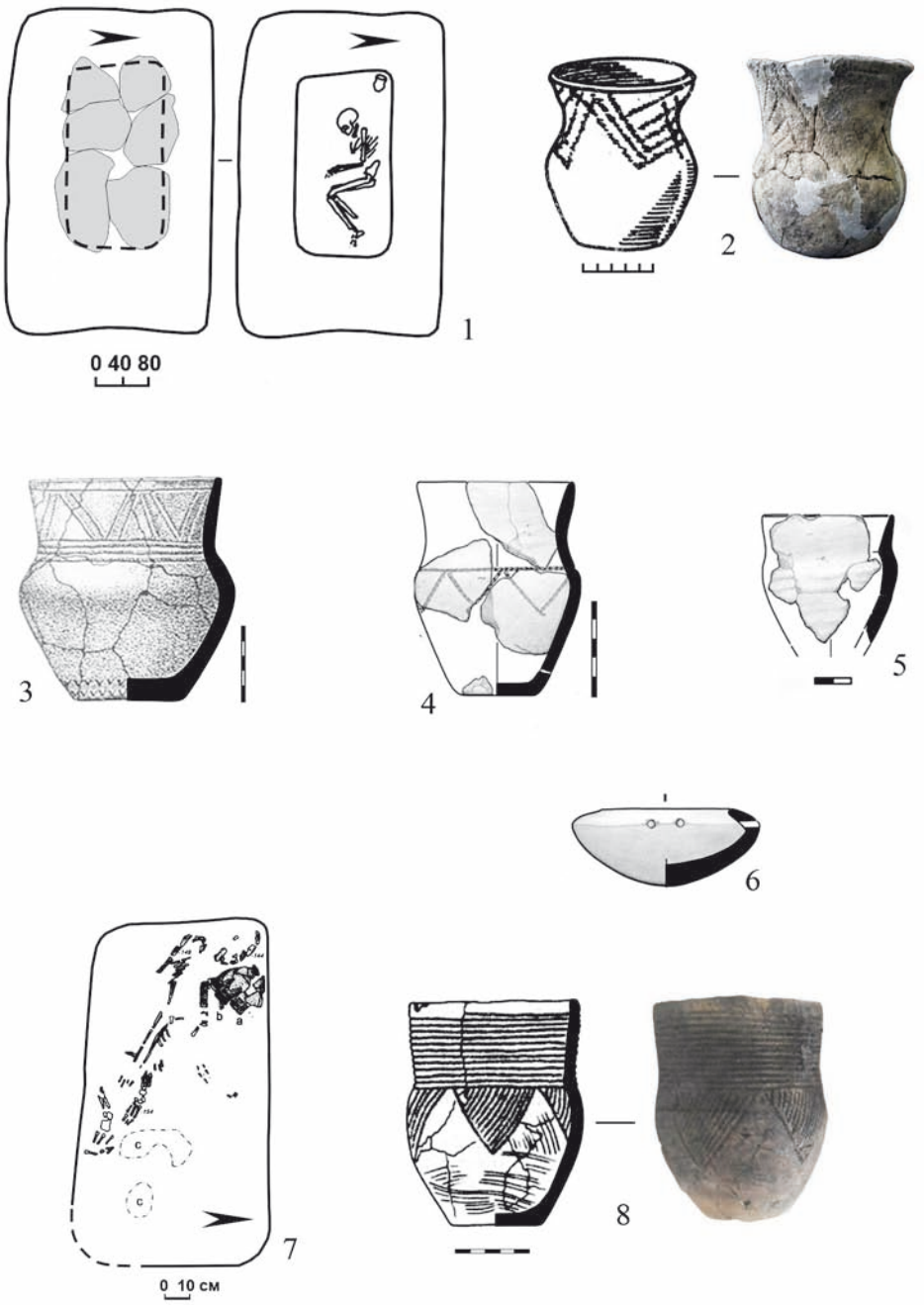

Fig. 4. Budzhak culture beakers with cord ornaments:
1, 2 – Efymivka 9/17; 3 – Găvănoasa 8/2; 4-6 – Hlinaia 'Dot' 1/6; 7, 8 – Kholodna Balka 1/13

Fig. 5. Budzhak culture beakers with cord ornaments:
1,2 – Kurchi 3/9; 3 – Mayaki III 2/13; 4-6 – Mologa 2/3; 7,8 – Myrne 1/12

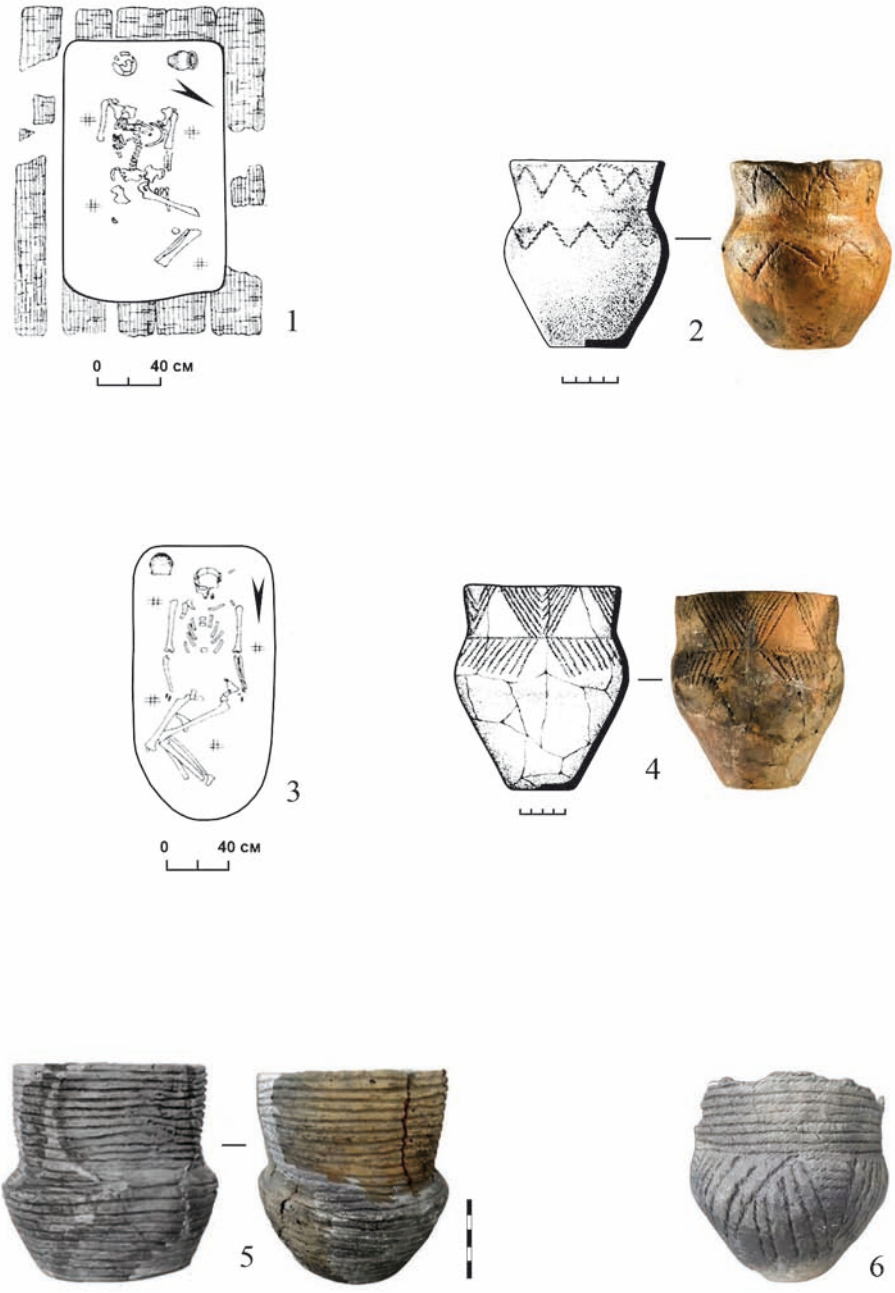

Fig. 6. Budzhak culture beakers with cord ornaments:
1,2 – Olăneşti 5/5; 3,4 – Olăneşti 15/4; 5 – Kamyanka, k. 1; 6 – Ostrivne, k. 2

Fig. 7. Budzhak culture beakers with cord ornaments:
1-3 – Pererîta 1/9; 4,5 – Pererîta 2/1; 6 – Trapivka 4/5; 7-9 – Trapivka 6/20

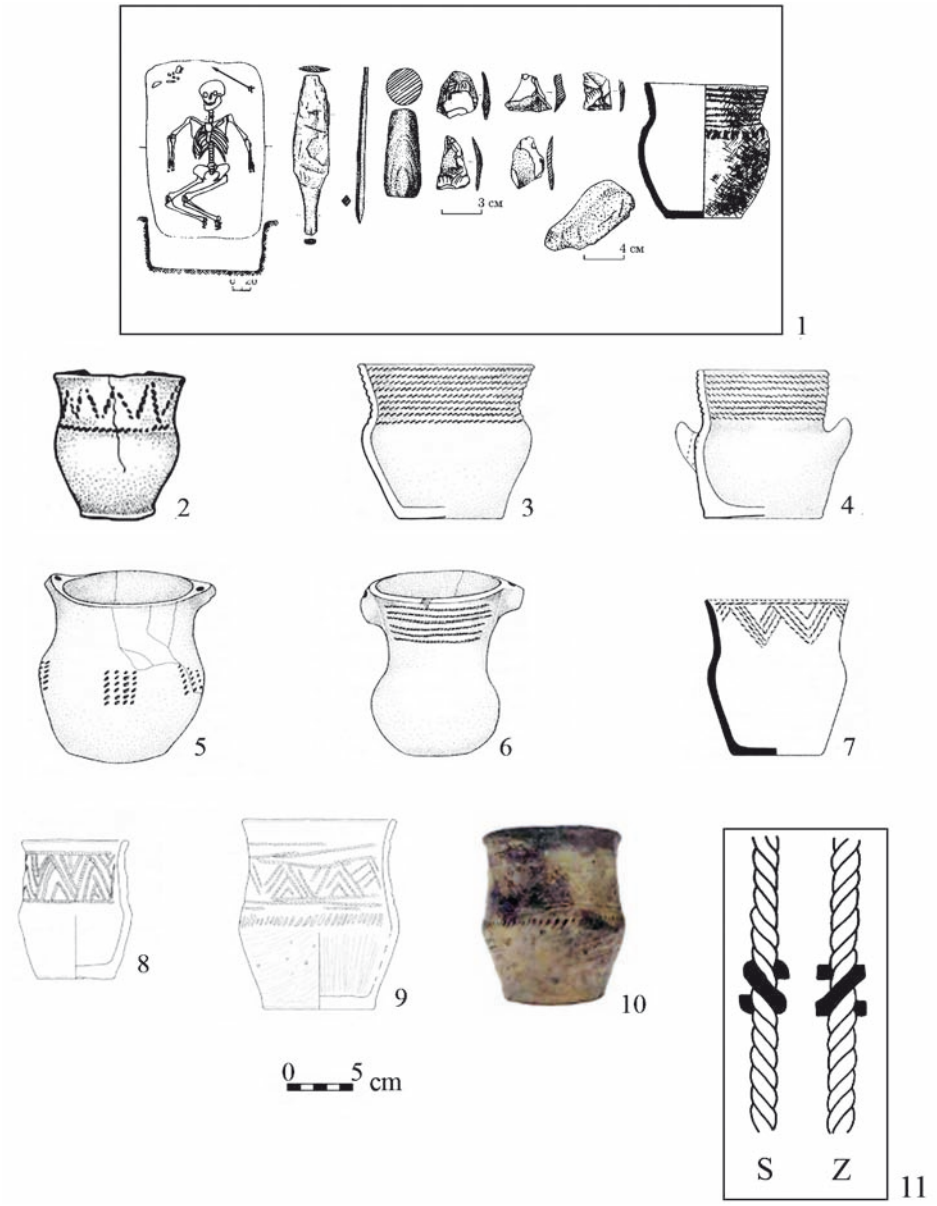

Fig. 8. Cord-decorated beakers of the Yamna culture in the Balkan-Carpathian area and Crimea: 1 – Istochne 12/5 (northern Crimea); 2 – Viile (Romania); 3 – Ploiești Triaj 2/20 (Romania); 4 – Ploiești Triaj 2/15 (Romania); 5 – Gurbănești 2/3 (Romania); 6 – Gurbănești 2/4 (Romania); 7 – Tarnava 2/1 (Bulgaria); 8 -Brăilița cemetery, grave 34 (Cernavodă II?) (Romania); 9 – Brăilița cemetery, grave 8 (Cernavodă II?) (Romania); 10 – Brăilița cemetery, grave 144 (Cernavodă II?) (Romania); 11 – S- and Z-spun thread (after: 1 – Gening and Korpusova 1989; 2, 10 – Frînculeasa *et al*. 2015; 3-9 – Semmoto 2023; 11 – Andersson Strand 2012)

In our opinion, it is more appropriate to speak not of an invasion, but of a gradual infiltration of Yamna populations to the west. Likewise, there are grounds to speak not of direct Yamna influence, but of bilateral intercultural contacts. Certain features in the CWC indicate some influence from the Yamna culture, while the Budzhak/Yamna culture also shows traits attributable to the CWC. We include among such traits pottery showing similarities to the CWC, specifically amphorae and beakers with corded ornamentation. The distortion of 'classical' ornamentation and canonical patterns may indicate that almost all of these beakers are not imports but imitations. Imports could point to a one-off contact, whereas the relatively large number of imitations may suggest longer-term (and non-hostile) connections.

The beakers and beaker-shaped vessels from the Budzhak culture burials (38 specimens, or 8.1% of the ceramic complex) exhibit considerable variety in shape and size. These vessels are traditionally characterised by a rounded or elongated body and a high, outward-turned rim (less frequently, a straight rim). Most beakers have slender, tall proportions, but rounded, sharply ribbed, or squat forms have also been recorded. Based on the shape of the body, two types can be conditionally distinguished: 1) with maximum expansion in the upper third of the body, and 2) with expansion in the middle part of the body. The majority of these vessels are of medium size, measuring up to 20 cm in height, although examples of greater and lesser heights are also present.

Among this group of vessels, 21 beakers have corded decoration. This ornament is quite varied, featuring parallel impressions along the rim, shaded triangles with their tips pointing downward along the shoulders, zigzags, and tree-like impressions. One specimen features a vessel decorated with incised parallel horizontal lines along its entire surface (Kamianka, Kurgan 1). This beaker is not decorated with cord impressions. However, it is in the same style as some beakers with cord ornamentation, so we felt it was possible to include it in this Catalogue.

In discussing the origins of the beakers within the ceramic complex of the Budzhak culture, it is necessary to focus on the mutual influence between two Early Bronze Age communities – the CWC and the YC.

Researchers note the influence of the YC on the CWC, particularly in burial practices: burial mounds, the use of ochre, wooden grave covers, and 'craftsmen's graves'. In the southern CWC groups, some types of copper knives are associated with YC influence (Włodarczak 2010, 306, 323-325). However, typical YC vessels have not been found in CWC burials, except for the 1149B complex at Święte 11 (Jarosław District, Lesser Poland). This vessel is described as a pot with a rounded bottom and a short rim decorated with diagonal stanchions impressed on the rim. The closest analogy is a vessel from the Cherkasy region on the Southern Buh River (Kośko *et al*. 2018, 74, 84).

Piotr Włodarczak has noted that 'oval' amphorae are known from the Early Bronze Age throughout the entire Balkan-Carpathian basin. However, in the CWC, they are found only in areas adjacent to the zones of YC distribution — specifically, in the vicinity of the Dnister region and in southern groups, including Bohemia, Moravia, and Lower Austria. According

to him, the Yamna people played a significant role in these transformations, acting as a transmission medium that facilitated the spread of innovations along the 'Danubian route'. It was through the Yamna population that the Corded Ware cultures adopted amphora types characteristic of some Carpathian cultures and some aspects of burial rites (Włodarczak 2010, 302, 305). According to Jaroslav Peška, elements linking the Moravian region with Eastern Europe appear in the Moravian CWC (MCWC) funeral ritual and inventory:

'…we can trace several links and contacts with Eastern Europe and, more specifically, with the North Pontic-Caucasian region in the context of cultures at the turn of the 4th/3rd millennium BC. The archaeological findings so far, in the form of individual (mound) burials and a selection of artefacts, demonstrate the interpenetration of individuals (or small groups) rather than the direct intervention of steppe nomads, but better still the influence of progressive commodities as part of the 'Yamna package' in the regions lying west of the Tisza' (Peška 2023, 169). He adds: 'The frequent representation of multiple types of selected artefacts in the North Pontus area (for example, the Budzhak Culture) found its reflection precisely in the content of the MCWC' (Peška 2023, 160).

In our opinion, this movement was not one-way, exclusively in a western direction; there was also a reverse movement of the Budzhak population from west to east, as well as a transfer of ideas, artefacts, and copper and silver ore.

The Budzhak culture was influenced by various factors and was in contact with different cultures. The population was open to cultural dialogue, adopting and reworking various traditions, reflected in the material culture's syncretic nature. Only the burial rite connects the Budzhak culture with the vast Yamna cultural and historical community, while the ceramics show distinct differences.

Some of the vessels found in Budzhak culture burials are imports from the Lower Danube cultures and from the GAC area (Szmyt 1999, 152-164). However, there are also coarsely made examples that local potters probably produced as imitations (for example, Novoselitsa 19/13, with GAC traditions).

Undoubtedly, all (or nearly all) of the beakers decorated with cord impressions were made by potters from Budzhak culture communities, as indicated by the similarities in decoration and technological techniques to other types of Budzhak culture pottery. However, the influence of the CWC is evident in some beakers with ornamentation that bears stylistic similarities, albeit with deviations from the 'standards' (for example: Figs 3: 7; 4: 3; 5: 2; 7: 2 and 7: 9).

The influence of 'foreign' ceramic styles does not necessarily imply their exact copying; instead, only certain details and elements of decoration may be adopted:

'Cultural forms are reproduced but also transformed by humans and things, like pots, potters, pottery mongers, and pottery users that are intermittently on the move… Many of the possible creative and mutual processes – appropriations, rejections, alignments, creolizations, etc. – that encounters with otherness can trigger, might become materialised in pottery vessels too. The vessel could have been made by local potters, taking a translocal

pot with its non-local style as a model… Only specific material properties, designs, shapes, decorative and/or functional features or technical solutions can be appropriated, integrated, or aligned to the local pottery production practices' (Heitz 2017, 282, 283).

Maintaining the standards of form and ornamentation is crucial for potters producing local pottery in accordance with local conventions. It is assumed that the practice of decorating vessels with cord or textile impressions was inspired by the magical and mythical meanings associated with these materials. Cords, representing decorative elements on vessels, can be seen as an example of their many ritual applications. The strength and power of the cord, braiding, and other textile patterns were probably transferred onto the cord-decorated objects. However, in this case, there is no contradiction between imbuing objects with power and cohesion and endowing them with aesthetic qualities. It seems that cord ornamentation retained these magical qualities while also carrying aesthetic value (Kowalski 2010, 72).

Over time, the 'sacred meaning' of ornamentation may have been lost, but potters probably continued to adhere to their own traditions.

For potters reproducing 'foreign' vessel types, the ornamentation appears only as decoration. Therefore, it is comparatively easy to transform, distort, or 'break down' into elements, depending on the potter's taste. Consequently, only some aspects of the ornamentation, its style, etc., can be 'appropriated'; on the other hand, the shapes of the vessels are not always identical to the prototype, though there is a tendency toward general similarity. Budzhak potters transformed not only beakers but also other types of pottery. Some oval amphorae, whose shape was most likely borrowed from the Lower Danube region, had additional small handles, similar to those known on other types of Budzhak pottery and were a local element.

CORD DECORATION TECHNIQUES

Researchers emphasise the importance of a comparative analysis of the cord-decoration technique to illustrate the cultural origins of the pottery makers (Semmoto 2023, 163). According to studies of ancient textiles, the method of making cords depends on the makers' cultural background (Andersson Strand 2012, 31-33).

The fibres can be twisted to the left, 'S', or to the right, 'Z' (Fig. 8: 11). Yamna burials in the Northwestern Pontic zone have yielded many vessels with cord decoration. Masao Semmoto's studies of Budzhak ceramics revealed no significant difference in the ratio between Z- and S-twisted cords. It is noteworthy that in the cord-decorated pottery of the Usatove group, Z-twisted cord predominated almost entirely over S-twisted cord. In the Horodiştea-Gordineşti group, most vessels had S-twisted cord (94%), while the remaining ones had Z-twisted cord (6%). Most vessels with cord decoration discovered in Yamna burials in the Lower Danube valley were decorated with Z-twisted cord. However, some vessels with S-twisted cord decoration were also found (Semmoto 2023, 173-176).

According to P. Włodarczak's observations, the S-twisted cord is more characteristic of the CWC, while the Z-twisted cord is more typical for the Lower Danube. At the same time, there are known situations where different CWC groups (but close territorially) used different cord directions. For example, there are differences between Western and Eastern Swiss CWC, and the cords for the typical decoration of vessels were even wound in opposite directions (Schultrich 2023, 295).

A study of the cord-decoration technique for the beakers from the Budzhak burials reveals that potters mastered both techniques, although the S-twisted cord predominates (Table 1). The presence of different techniques is probably linked to the influence of various cultural communities and the synthesis of different traditions by Budzhak potters.

By studying the making and mobility of pots, potters, pottery makers, and pottery users, researchers shift the focus from one-sided notions of stable 'cultures' to ideas of appropriations, transformations, and thus the negotiation of cultural forms (Heinz and Stapfer 2017, 11).

The Budzhak population likely contributed to the spread (both westward and eastward) of other types of vessels, besides amphorae, particularly beakers influenced by CWC traditions. Some vessel types similar to Budzhak pottery have been found in the YC burials of Crimea, as well as a wooden wagon find. However, in the context of this study, the most interesting find is the burial at Istochne 12/5 (northern Crimea), where a beaker similar to CWC beakers was found (Fig. 8: 1), as well as a beaker from Trapivka 6/20, Northwestern Pontic (Fig. 7: 9).

In the YC burials of the Balkan-Carpathian area, vessels with cord decoration have been found (Frînculeasa *et al.* 2015, 70, fig. 13), and several are in the shape of beakers (Fig. 8: 2-10). Some of these resemble those found in the Northwestern Pontic. For example, a vessel from Viile (Fig. 8: 2) resembles a beaker from Olăneşti 5/5 (Fig. 6: 2); a beaker from Ploieşti Triaj 2/20 (Fig. 8: 3) resembles a beaker from Butor 9/3 (Fig. 3: 6, 7); a beaker from Ploieşti Triaj 2/15 (Fig. 8: 4) resembles a beaker from Pererîta 1/9 (Fig. 7: 1.); a beaker from Târnavă 2/1 (Fig. 8: 7) resembles a beaker from Hlinaia 'Dot' 1/6 (Fig. 4: 3); beakers from Brăiliţa (Fig. 8: 8-10) resemble beakers from Bashtanivka 7/12 (Fig. 3: 3), Efymivka 9/17 (Fig. 4: 2), Olăneşti 15/4 (Fig. 6: 4), and Trapivka 4/5 (Fig. 7: 6). Some beakers (Fig. 8: 5, 6) are also similar to a vessel found in the North-Western Pontic (Taraclia II 14/16), but they should be attributed to the influence of the Coţofeni culture.

According to Alin Frînculeasa, Bianca Preda and Volker Heyd:

'This type of cord-decorated beakers, sometimes with handles, and amphora-type vessels, is also well known from Hungary and Serbia (site of Srpski Krstur). At the same time, they are relatively rare in Bulgaria. Amazingly, these cord-decorated beakers resemble the typical Corded Ware beakers of Central and Northern Europe remarkably. In fact, some of them are absolutely interchangeable, while both occupation areas always maintain a distance of at least several hundreds of kilometres between them' (Frînculeasa *et al.* 2015, 67).

Table 1. Cord types and their imprints of S-twisted and Z-twisted cord (left – twisted cord, right – twisted cord imprint)

N	Location	Type	Photo
1.	Bashtanivka 7/12	S	
2.	Bashtanivka 7/21	S	
3.	Dyvizia II 2/5	S	
4.	Efymivka 9/17	S	
5.	Kartal/Orlovka, gr. 16	Z	
6.	Kholodna balka 1/13	Z	
7.	Kurchi 3/9	Z	

8.	Myrne 1/12	S	
9.	Mologa 2/3	S	
10.	Olăneşti 5/5	Z	
11.	Olăneşti 15/4	S	
12.	Ostrivne b. 2	Z	
13.	Trapivka 4/5	Z	
14.	Trapivka 6/20	S	

Most likely, the movement of beakers followed the same 'Danube route' associated with the spread of amphorae: both the adoption of these vessels from the CWC regions and the dissemination of already transformed variants of these vessels into the Balkan-Carpathian region. Another possible route to the CWC area could have been along the Dnister River. In this context, particular attention should be given to the recently excavated flat Burial 16 at the Kartal/Orlovka site, located near the Danube crossing, 70 km from the Brăiliţa burial site— the first location of cord-decorated beakers along the 'Danube route,' in burials attributed to the Cernavodă II culture (Fig. 1). Burial 16 from Kartal can be dated to the Early Bronze Age (Fig. 2), and the vessel and the position of the deceased have certain similarities with CWC. This burial may serve as a 'link' between the cord-decorated beakers from the Northwestern Pontic and those from the Balkans-Carpathian area. However, a horn hammer (or hoe) was found in the burial, which is atypical for the CWC area, where stone or flint axes are typically found in graves. Deer antler artefacts are known in different cultures and territories, from the Neolithic to the Middle Ages. In the Northwestern Pontic, artefacts of a similar type are known in the Usatove culture (Razumov *et al.* 2023, 55) and in the Budzhak culture (Subbotin 2003, 214). An explanation for this may be connected to the semantics of the burial ritual: the deceased at Kartal was not an outsider from the CWC environment, but rather, the influence of this culture was reflected in the burial. It is likely that the symbolism of the artefacts, rather than their specific type or function, was important to the people who made this burial.. If we interpret this find not as a hammer, but as a hoe, then its semantics in the context of the burial rite change. In this case, there is no longer any need to look for analogies to the 'horn hammer' in the CWC burials.

CONCLUSIONS

The population of the Budzhak/Yamna culture was receptive to innovations in material culture, particularly within its ceramic complex. This influence came from various territories and was manifested in the culture of the Eneolithic and Early Bronze Age. These diverse impulses shaped the culture itself and fostered its 'openness to cultural dialogue.' This was reflected not only in the westward movement and intercultural connections within trade and exchange networks, but also in the reception of 'foreign traditions' and their transformation in relation to local ceramic forms. Therefore, in addition to actual imports from contemporary cultures, the ceramics of the Budzhak culture also include a series of imitations, in which the original features are distorted and conveyed only in general terms, focusing more on stylistic aspects than on creating exact copies. This transformation is evident in a series of beakers, whose appearance can be linked to the influence of the Corded Ware culture. Subsequently, these transformed forms spread westward along the 'Danube route,' which was already navigated by the Budzhak population by the end of the 4th millennium BC.

The finds of beakers are mainly associated with the southern part of the north-western Black Sea region (Lower Dnister and near the estuaries). The same can be said about amphorae (Iwanowa *et al.* 2014, 359, fig. 4.3.3:3). Metal artefacts were also found mainly in the same region (Ivanova 2021, 300-302, figs 5: 9-11).

There are two possible explanations for this situation:

1. The territory was convenient for living and extracting salt in the estuaries. Salt was used for exchange and trade.

2. The 'Danube route' (according to Włodarczak 2010) could probably also have worked in the opposite direction.

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Appendix 1

CATALOGUE

(symbols: D1 – diameter of the rim; D2 – maximum diameter of the body; D3 – diameter of the bottom; H – height of vessel; all measurements are in centimetres)

Flat Burials

1. Kartal/Orlovka, central area, excavation IV, burial 16 (Fig. 2). This burial with a beaker is the only one not associated with a kurgan, so we will examine it in more detail. The Kartal settlement is located on the left bank of the lower Danube River, near the village of Orlovka (Reni district, Odesa region). It is multilayered, but a layer corresponding to a settlement with a continuous habitation cycle for most of the Bronze Age has not yet been identified. The Eneolithic era is the first significant period in the site's history, concluding with the settlement of the Cernavodă I culture (Bruyako 2020). The subsequent major settlement at Kartal appears only in the Late Bronze Age. Meanwhile, the Early and Middle Bronze Age is comparatively well-studied in the surrounding regions between the Kagul and Yalpug lakes. The focus is mainly on kurgan-type burial sites. However, flat burials of the Bronze Age have been discovered in the nearby outskirts of the Kartal settlement (Bruyako and Agulnikov 2017).

Burial 16 was excavated in 2023. The level of the skeleton's burial was 275 cm from the reference point. According to the stratigraphy, the burial was inserted into a Late Eneolithic layer and covered by cultural deposits from the Late Bronze and Early Iron Ages. Presumably, the pit was oval in shape, oriented SSW-NNE. The skeleton, disturbed by earthworms, was lying on its back, with a turn to the right side. The arm bones were dis-

placed. Possibly, the right arm was extended along the body. The left arm was bent at the elbow and placed across the torso. The legs, bent at the knees, were positioned to the left. The skull was raised, with the parietal region facing upward (perhaps resting on a pillow?). The skeleton's orientation was north-south. Near the left shoulder, a small hammer (or hoe?), made from the branch of a red deer antler, was found. The sharpened end was broken, and a longitudinal fracture from it extended along the branch for 4.5 cm. The total length of the item was 12 cm, the diameter of the striking part was 2.3 × 3.5 cm, and the diameter of the hole was 1.6-1.7 cm. Below the hammer/hoe, an astragalus was found. Approximately 15 cm from the skull, between it and the northern side of the excavation, a beaker was found, with an ornamental design created with a cord impression. Height (H) – 11.2 cm, diameter of the rim (D1) – 8 (8.1) cm, diameter at the bottom (D3) – 10 (9.9) cm (Bruyako 2024).

Kurgans

2a. Bashtanivka 7/12 (secondary) was found 7 m to the northeast of the centre of the kurgan, at a depth of 2 m, in a burial with a ledge (Fig. 3: 1-3). The pit, measuring 1.15 × 0.8 m, was covered with 10 horizontally placed slabs. The walls of the grave were plastered with clay. At the bottom of the grave, under the northeastern wall, was the skeleton of an adolescent. The skeleton was lying on its back, with the legs flexed and the head facing northwest (325°). Its arms were extended along the body, and its legs were bent at the knees to the left. At the bottom of the pit, there was decay from what appeared to be bark bedding (?). In the northwest corner of the pit, there was a miniature amphora (D2 – 6; H – 7), and in the southeast corner, a beaker ornamented with cord impressions (D2 – 13; H – 14.3) (Shmagliy and Cherniakov 1970, 83).

2b. Bashtanivka 7/21 (secondary) was located 12 m to the southeast of the centre of the kurgan, at a depth of 1.8 m (Fig. 3: 4, 5). The buried person was lying on its back, with the legs flexed and the head facing southwest (240°). The left arm was extended, with the hand facing the knees. The bones of the right arm were not preserved (Fig. 3: 4, 5). Near the head, to the left, was a beaker-shaped vessel decorated with cord impressions (D1 – 11.5; D2 – 12; D3 – 8.8; H – 13.3). Near the skull, a bone awl (13 cm long) was found, and near the left hand, a fragment of a grain grinder was discovered. Beneath the skeleton were traces of bark bedding (Shmagliy and Cherniakov 1970, 85).

3. Butor 9/3 (secondary) was located 8 m to the northwest (300°) from the centre of the kurgan, at a depth of 2 m (Fig. 3: 6, 7). The pit, measuring 1.6 m × 1.2 m and 0.5 m deep, was covered with wood. The skeleton, painted with ochre, lay curled on its back, the head facing northeast (45°). The arms were extended along the body, and the right leg was bent at the knee. At the bottom of the burial, there were traces of plant bedding. In the northern corner of the pit, a beaker was found, decorated with seven horizontal rows of cord impressions (D1 – 8; D3 – 5, H – 7) (Sinika *et al.* 2013, 61).

4. Cazaclia 5a/1 (main?), cenotaph, was located 1.87 m to the south (180°) from the centre, at a depth of 0.6 m. The burial pit measured 1.59 × 1.02 m and was 0.68 m deep. The bottom was covered with dark brown decay. In the southeast corner of the pit, a beaker-shaped vessel was found (Fig. 3: 8), decorated with cord impressions (D1 – 10.5; D3 – 4.2; H – 14) (Sava *et al.* 2019, 125).

5. Dyvizia II 2/5 (secondary) was located 8 m to the northeast (30°) from the centre of the kurgan at a depth of 0.85 m, in a burial with a ledge. The ledge had dimensions of 2.7 × 2.2 m, and a depth of 0.54 m, with the pit measuring 1.5 × 1 m and a depth of 1 m. In the earth filling of the pit, there were remains of wooden twigs from the covering. Only a fragment of a hand bone, covered with ochre, remained from the skeleton. At the bottom of the chamber, traces of plant bedding were discovered. Near the bone, a beaker-shaped vessel was found (Fig. 3: 9), decorated with cord impressions (D1 – 13; D2 – 13; D3 – 7; H – 11.6) (Subbotin *et al.* 2001-2002, 569).

6. Efymivka 9/17 (secondary) was found 2.5 metres north of the centre of the kurgan, at a depth of 1.3 metres (Fig. 4: 1, 2). The burial pit had a ledge measuring 3.5 × 2.5 metres, and the pit itself measured 1 × 0.8 metres. The pit was covered with limestone slabs (sizes: 1.6 × 1.1 m; 1 × 0.8 m). The deceased was crouched on the right side, with the head facing west (265°). The right arm was extended toward the hips, and the left arm was bent at the elbow and placed across the body. The skeleton was stained with ochre. In the northwest corner of the grave, there was a beaker decorated with cord impressions (D1 – 10.5; D3 – 7; H – 11). It was made of clay with a coarse-grained sand admixture (Shmagliy and Cherniakov 1985, 109).

7. Găvănoasa 8/2 (main) was located in the centre of the kurgan at the level of the ancient surface, surrounded by a semi-ring of 'thrown out soil' on the south side. The pit was trapezoidal (1 × 0.7-0.6 metres) in size, with a depth of 0.35 metres. The burial was disturbed in antiquity. In the fill, scattered human bones were stained with bright red ochre. At the bottom, in the southwest corner of the grave, there was a beaker (Fig. 4: 3) decorated with cord impressions (D2 – 14; H – 15). It was made of clay with an admixture of fine chamotte, grey-brown in colour (Dergachev 2023, 339).

8. Hlinaia 'Dot' 1/6 (secondary) was located 6 metres southwest (230°) from the centre of the kurgan, in a pit measuring 0.75 × 0.5 metres (Fig. 4: 4-6). The burial was made on the edge of a ditch, with a strip of 'thrown out soil' on the southern side. Only fragments of the leg bones of a small child were preserved, lying in the southeast part of the pit. At the bottom of the pit was a dark-brown layer of bedding organic matter. On the ancient surface, between the edge of the pit and the moat, there were fragments of two vessels. One was a beaker, ornamented with cord impressions (D2 – 9, H – 11), and the

second was an undecorated pot (D2 – 7; H – 7.5). Under the northwest wall, a small bowl with two holes along its rim was found (D2 – 10; H – 3.8). It was made of clay with a chamotte admixture. Inside the bowl were small bone fragments and fish scales (Dergachev 2023, 68).

9. Kamyanka Barrow 1. A beaker made of clay with an admixture of chamotte, decorated with incised horizontal lines, was found 10 metres northeast of the centre of the kurgan at a depth of 1.8 metres (D1 – 12; D2 – 14; D3 – 10; H – 14) (Fig. 6: 5) Eight burials were found in the kurgan, seven secondaries belong to the Budzhak culture, and the primary burial is unidentified (Dergachev 2023, 282).

10. Kholodna Balka 1/13 (secondary) was located 10 metres south (175°) from the centre of the kurgan, at a depth of 1.41 metres (Fig. 4: 7, 8). The pit measured 1.4 × 0.8 metres. The bottom showed traces of dark-brown bedding decay. Scattered human skeletal parts (*juvenis*?) were found diagonally across the grave. The excavation's author suggests the body was dismembered. Near the skull, in the southwest corner of the grave, was a beaker decorated with cord impressions. The beaker's exterior was covered with soot. It was made of clay with an admixture of sand and rare microscopic fragments of crushed shell or bone (D1 – 11.8-12.6, D2 – 13, D3 – 6.8, H – 16) (Petrenko 2010, 334).

11. Kurchi 3/9 (secondary) was located 3.2 metres northwest (300°) from the centre of the kurgan, at a depth of 1.2 metres (Fig. 5: 1, 2). The burial was made with a ledge measuring 2.3 × 1.78 metres, and the pit measured 1.45 × 0.8 metres. The skeleton was poorly preserved, oriented with the head to the northeast (30°), and laid in a supine position, with the arms extended along the body. The skeleton was stained with ochre. Near the skull was a beaker decorated with cord impressions (D1 – 11.8, D2 – 13, H – 14.5) (Toschev 1992, 22).

12. Mayaki III 2/13 (main) was found in the centre of the kurgan. The pit measured 1.8 × 0.9 metres. The skeleton was destroyed. Near the northeast wall of the grave, there was a miniature beaker (Fig. 5: 3) with cord decoration (D2 – 5, H – 6.5) (Dergachev 2023, 99).

13. Mologa 2/3 (secondary) was found 6.2 metres southwest of the centre of the kurgan at a depth of 0.55 metres (Fig. 5: 4-6). The skeleton was missing (possibly destroyed by ploughing). Identified by a patch of dark grey decay from a mat (0.7 × 0.4 metres), fragments of clay-covered wood, and two vessels placed on the mat. Vessel 1 was a miniature amphora with a rounded body, a rounded bottom, and a short cylindrical neck. It had two horizontal handles with perforated holes. The clay contained an admixture of fine chamotte, slag, and sand (D1 – 4.7, D2 – 6.8, H – 7). Vessel 2 was a fragment of a beaker's rim, broken at the junction with the body of the beaker. The outer surface was decorated with two rows of horizontal cord ornaments, and the space between them was

adorned with cord impressions forming isosceles triangles with their apices pointing downward. The clay contained an admixture of coarse chamotte and plant material. Dimensions: fragment has a height of 7 cm (Maliukevich *et al.* 2017, 56).

14. Myrne 1/12 (secondary) was located 4.5 metres southeast (150°) from the centre of the kurgan, at a depth of 2 metres (Fig. 5: 7, 8). The burial was made with a ledge measuring 1.8 × 1.6 metres, and the pit was 1.3 × 1.1 metres. The pit was covered with wooden planks laid out in a longitudinal pattern. The skeleton was lying diagonally across the grave, crouched on the left side, with the head to the northeast (40°). The arms were bent at the elbows, and the hands were in front of the face. In the northern corner of the pit, there was a beaker decorated with cord impressions (D1 – 10, D2 – 10, D3 – 8, H – 11). At the bottom of the pit were remnants of chalk bedding (Alekseeva 1992, fig. 17: 2).

15a. Olăneşti 5/5 (main) was found in the northwest sector of the kurgan at a depth of 1.3 metres from the reference point (Fig. 6: 1, 2). The grave measured 2 × 1.6 metres and was 0.9 metres deep. It was covered with five oak beams, laid longitudinally. These beams were up to 2.5 metres long and covered with white clay. The skeleton was lying on its back, with the head facing southwest (225°). The left arm was straight, with the hand under the left femur. The right humerus lay along the body. The forearm bones were not preserved. The legs were slightly bent at the knees to the left. The skeleton was intensely stained with red ochre. At the bottom, there was brown decay from bedding (up to 0.5 cm thick). A thin layer of red ochre was found beneath the skeleton, and white traces of clay were found in other parts of the pit. In the western corner of the pit was a beaker decorated with cord impressions, made of clay with a significant admixture of finely ground shell and coarse chamotte (D1 – 12, D2 – 12.5, D3 – 6, H – 14) (Yarovoy 1990, 170).

15b. Olăneşti 15/4 (primary) was found in the southwest sector of the kurgan at a depth of 1.5 metres from the reference point (Fig. 6: 3, 4). The pit measured 2 × 0.8-0.95 metres, with a depth of 0.45 metres from the covering. The pit was longitudinally covered with oak planks, but a portion of it had already been destroyed in antiquity. The male skeleton lay supine, its head facing south. Both arms were lying along the body, legs bent with the knees to the right. The skeleton is intensely stained with ochre. Brown decay from the bedding was noted beneath it. In the south-eastern corner of the grave was lying a beaker decorated with cord ornament (D1 – 13.5; D2 – 15; D3 – 6; H – 17.5). The clay contains admixtures of fine chamotte, sand and vegetation (Yarovoy 1990, 211).

16. Ostrivne, Kurgan 2. The beaker was found in a kurgan, without a burial (Fig. 6: 6)**.** D1 – 10, D2 – 11,2; D3 -6; H – 11,2. Fifteen burials were found in the mound, including seven secondary burials and a single primary burial, which belongs to the Budzhak culture (Alekseeva 1976).

17a. Pererîta 1/9 (secondary) was located 7 metres to the northeast (70°) from the centre of the kurgan, at a depth of 1.4 metres (Fig. 7: 1-3). The burial measured 1.45 × 1.1 metres and was 0.3 metres deep. The deceased was lying in a crouched position on the left side, with the head facing northwest (330°). The arm bones were not preserved. Near the pelvic bones was a lump of red ochre. The entire bottom of the pit was covered with dark brown bedding decay. Behind the pelvis was a beaker decorated with cord impressions and with two handles on the shoulders (D1 – 9; D2 – 10.5; D3 – 6; H – 11). It was made of clay with a fine chamotte admixture, and the surface was burnished. Near the vessel was a flint flake measuring 2.3 × 2.1 × 0.6 cm (Kurchatov 2006, 275).

17b. Pererîta 2/1 (main) was located in the centre of the kurgan, at a depth of 1metre. The grave measured 2.1 × 1 metres, with a depth of 0.5 metres (Fig. 7: 4, 5). On the bottom, at the corners and along the walls, eight holes from stakes were recorded. The burial contained the skeletons of an adult and a child. The adult was lying on the right side, with the head facing west (270°). The right arm was extended toward the knees, while the left arm was bent, with the hand resting on the pelvis. The bones were evenly stained with red ochre. A lump of scarlet ochre was found in front of the facial bones. The child was lying in front of the adult, in a crouched position on the left side. The bottom of the chamber contained dark brown bedding decay. Near the eastern wall, an upside-down beaker was decorated with cord impressions (D1 – 7.5; D2 – 9; D3 – 5.2; H – 10). It was made of clay with a chamotte admixture (Kurchatov 2006, 275).

18a. Trapivka 4/5 (secondary, cenotaph) was located 11 metres to the southeast (100°) from the centre of the kurgan, at a depth of 2.7 metres, in a pit with a ledge. The ledge measured 1.5 × 1.4 metres, and the pit itself measured 0.9 × 0.55 metres, with a depth of 0.6 metres. The ledge contained remnants of poles from a transverse covering. In the northern corner of the pit, there was a beaker (Fig. 7: 6), decorated with cord impressions (D1 – 10.2; D2 – 10.4; D3 – 7.5; H – 11.9). Fragments of a second vessel were found along the western wall (Subbotin *et al.* 1995, 27).

18b. Trapivka 6/20 (secondary) was located 17 metres to the northeast (45°) from the centre of the kurgan, at a depth of 3 metres (Fig. 7: 7-9). The pit measured 1.1 × 0.7 metres, with a depth of 0.45 metres, and was covered with three stone slabs (measuring 0.65 × 0.25; 0.4 × 0.2 metres). The deceased (adolescent) was lying in a crouched position on the left side, with the head facing northwest (320°). The left arm was extended along the body, while the right arm was bent, with the hand raised toward the chin. The bottom of the pit contained remnants of bark bedding. Above the skull was a flint scraper (4 × 2.2 cm). Behind the head was a beaker, decorated with cord impressions (D1 – 9.4, D2 – 10.2; D3 – 4.8; H – 11). Behind the deceased's heels was the lower half of an undetermined pot with traces of soot, made of clay with an admixture of plant material and chamotte (Subbotin *et al.* 1995, 51).

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ONCE AGAIN ABOUT 'MISSING' CREMATED SKELETAL REMAINS. AN EXAMPLE OF THE CEMETERY IN RACZKOWICE IN THE CONTEXT OF TRANSFORMATIONS OF FUNERARY RITUALS OF THE PRZEWORSK CULTURE IN THE YOUNGER AND LATE ROMAN PERIOD

ABSTRACT

Skóra K., Lasota-Kuś A., Borowska B., and Marchewka-Długońska J. 2025. Once again about 'missing' cremated skeletal remains. An example of the cemetery in Raczkowice in the context of transformations of funerary rituals of the Przeworsk Culture in the Younger and Late Roman Period. *Sprawozdania Archeologiczne* 77/2, 149-176.

The aim of this paper is to evaluate the contents of cremation pit graves, urns and pyre sites from the cemetery of the Przeworsk Culture in Raczkowice from an osteological perspective, which is related to the issue of the small number of burnt skeletal remains. The collection was analysed in terms of weight, state of preservation, anatomical differentiation and frequency of different skeletal parts, addressing the question of whether the skeletal remains were selected from the cremation pyre and what proportion of them was deposited in the grave. The results obtained for Raczkowice are presented against the background of the Przeworsk Culture's funerary customs in the declining phases of the Roman Period.

Keywords: Raczkowice, cemetery, Roman Period, Przeworsk Culture, burial rites, osteological analyses
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1. INTRODUTION

In the funerary rites of the Przeworsk Culture from the Younger Roman Period onwards, it is noted that only a small part of the human skeletal remains collected from the cremation pyre is deposited in the burial pit (on this topic, recently, *e.g.*, Kaczanowski and Rodzińska-Nowak 2015; for the state of research and summary of the discussion, see Madyda-Legutko *et al.* 2015; also Makiewicz 2008; 2009). This situation has repercussions for anthropological and demographic research, significantly affecting the possibility of studying communities of Late Antiquity from the perspective of elementary identifications of personal characteristics (gender, age, biological condition) and relations to status, as expressed in funerary rites. Biological information on the deceased is thus reduced to a minimum, which excludes palaeodemographic studies within the basic scope, including the determination of age and sex structure, order of mortality, or the size of the cemetery-using population. From an archaeological perspective, the increasing tendency to reduce grave offerings on both quantitative and qualitative scales also has specific consequences, which result in problems in assessing the chronological stratification of the necropolis.

The Raczkowice cemetery exemplifies this change. We will present this problem in the article by analysing one aspect, namely the study of the conditions affecting the weight of bones in graves, as well as the anatomical representation in urns, cremation pit graves, and ossuaries. Cremation leads to bone fragmentation, deformation and shrinkage. The low number of skeletal elements observed in cremation graves may be influenced by cultural factors, post-funeral factors (weight of soil, frost stress, method of exploration, transport and storage), biological factors (elderly or osteoporotic individuals with significantly lower bone weights than younger individuals), taphonomic processes (erosion, animal action, depth of grave location – *cf.*, Großkopf 2004, 102, 106). The high variation in the weights of remains in the cemetery may indicate some causes responsible for this state of things (Großkopf 2004, 104). As C. J. Knüsel and J. Robb (2023, 99) note, 'the specific aim of funerary taphonomy is to identify patterns that are the result of human funerary practices'.

In the case of the Przeworsk Culture, it is assumed that ritual circumstances and the transformation of funerary customs in the later phases of the Roman Period to a large extent had an important influence on this phenomenon. We would like to analyse these issues using the example of the Raczkowice cemetery, emphasising the need for interdisciplinary anthropological and archaeological research, without which we cannot expect the development of research into past funerary rituals.

1.1. The burial ground in Raczkowice

The burial ground of the Przeworsk Culture in Raczkowice, Częstochowa District (Upper Silesia Voivodship), is located between the upper reaches of the Pilica and Warta rivers

(Fig. 1). The settlement situation in this area during the Roman and Migration Periods is currently poorly understood. The evidence for studying this comes not from regular archaeological research, but rather from accidental discoveries and surface surveys conducted in the second half of the 20th century. To the left of the Warta, there is a better archaeologically studied region on the Liswarta River, with cemeteries and settlements that functioned at a similar time to Raczkowice (for a general discussion of these, see Zagórska-Telega 2019, literature references there). To the east of Raczkowice, 20 km in a straight line, there is a cemetery at Drochlin, largely destroyed but dating from a similar time horizon (Kaczanowski 1987).

Raczkowice is a medium-sized necropolis with 90 features (Fig. 2). It is characterised by the presence of three *ustrina* and a feature that, according to the criteria proposed by J. Zagórska-Telega (2019), we classify as a cremation layer. It consisted of seven concentrations of human bones and accompanying artefacts. Most of the graves are cremation pit graves, with a minority of burials deposited in urns (Figs 3 and 4). The site has been damaged to some degree, and it is currently difficult to assess the extent of this damage. Excavations were carried out in 1976-1984 by Bożena Błaszczyk (from the Stanisław Sankowski Regional Museum in Radomsko). According to B. Błaszczyk, the western, southern, and northern boundaries of the cemetery have been identified. The situation in the eastern part of the cemetery is not fully known. The cemetery in this area is situated on a private parcel of land, where additional residential and farm buildings have been constructed since 1946. According to the owners of the land, ceramic vessels were discovered during the construction of a house in 1972. A 1984 survey located just off this lot revealed the presence of scattered materials of Roman Period grave goods.

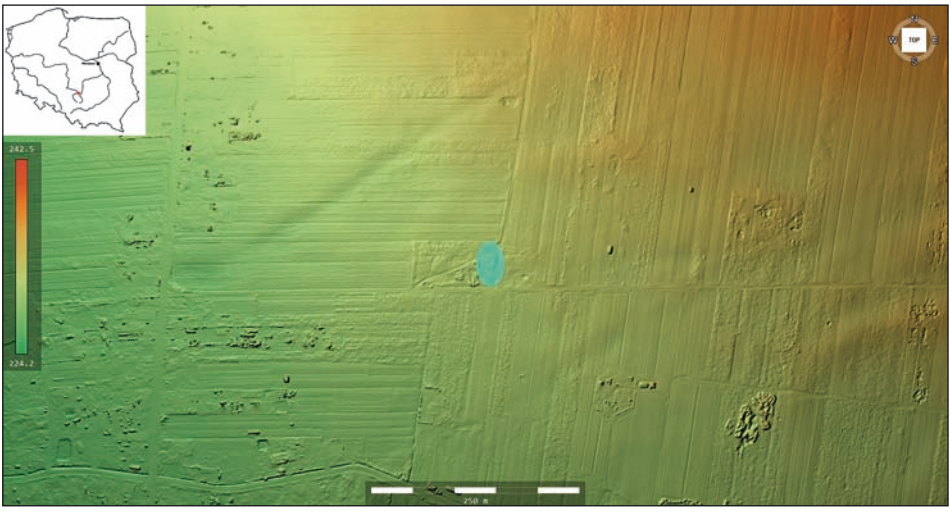

Fig. 1. Raczkowice, Site 3. Location of the burial ground. Graphic design: R. Zdaniewicz and K. Skóra

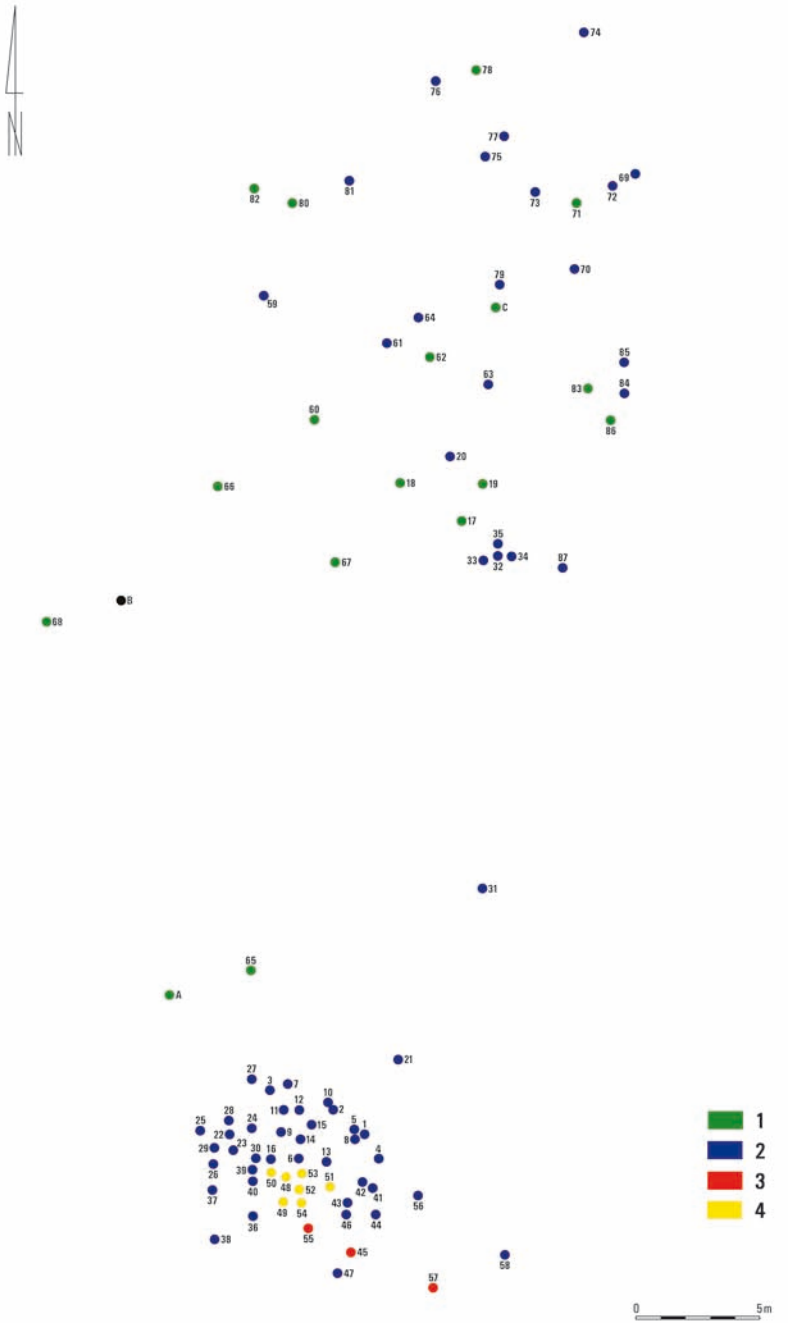

Fig. 2. Raczkowice, Site 3. 1 – cremation pit grave; 2 – urn grave; 3 – pyre site (*ustrinum*); 4 – cremation layer with concentrations of bones (Features 48-54). Graphic design: K. Skóra

Fig. 3. Raczkowice, Site 3. Urn Grave 60. Photo: Archive of the S. Sankowski Museum in Radomsko

Fig. 4. Raczkowice, Site 3. Urn Grave 78. Photo: Archive of the S. Sankowski Museum in Radomsko

The origins of the cemetery at Raczkowice correspond to phase B_2 of the Roman Period, rather its younger subphase. No materials have been distinguished that would allow the initial phase to be extended further into the Roman Period.

During the pre-Roman Period and phase B1, settlement of the Przeworsk Culture gradually developed in the area of Małopolska and parts of Silesia. The existence of a settlement vacuum in the upper basins of the Warta and Pilica rivers, as well as in most of Upper Silesia, was noted by Kazimierz Godłowski (1985, 47) when discussing cultural and settlement transformations. These areas were to remain unpopulated until the beginning of the younger stage of the Early Roman Period (B_2). The beginning of the colonisation of the Warta and Pilica riverside by the people of the Przeworsk Culture is referred to the stage B_{2b}. At this time, the same process is observed in Opole Silesia (Godłowski 1985, 59, map 4). During the stage B_2/C_1-C_{1a}, a settlement centre begins to take shape on the lower Liswarta River, accompanied by an extensive necropolis in Opatów, Kłobuck District (Madyda-Legutko *et al.* 2011a, 2011b). There are other cemeteries close to Opatów, *i.e.*, Mokra, Kłobuck District (Biborski 1998; 2000a; 2000b; 2001; 2002; 2004a; 2004b; 2006a; 2006b; 2010), Prusicko, Pajęczno District (*cf.*, Tyszler 2012, 66 and unpublished material by J. Ziętek from the State Archive in Piotrków Trybunalski) and Rybno, Site 1, Kłobuck District (see Zagórska-Telega 2019, 11, further literature there). On the right side of the upper Warta and in the upper Pilica zone, the development of settlements of the Przeworsk Culture can be observed, a significant example of which is the aforementioned cemetery in Drochlin, established in the stage B_2/C_1 (Kaczanowski 1987; Godłowski 1985, 86, 87, map 5).

The end of the use of the Raczkowice necropolis probably falls in phases C_3-D. There is little material of well-dated value from this phase. These include buckles with a bold frame (Group H, according to Madyda-Legutko 1987), tongue-shaped belt end fittings (Type 12, Variety 2, Madyda-Legutko 2011), and fragments of metal fittings for wooden buckets.

The typological-chronological analysis of the materials allowed us to recognise two zones of use of the cemetery, the northern (older) and the southern (younger). The northern part, referred to phases B_{2b} – C_{1a}-C_{1b}, is the initial part of the graveyard, which contains mainly the urn graves. The southern area contains only cremation pit burials, three pyre sites (ustrina), and a cremation layer, dating to the Younger and Late Roman Periods. The area between these two zones contains a few burials chronologically associated with the northern zone, as well as large areas without burials. The absence of graves in this part is to some extent due to the destruction of the site, but the lack of stray finds indicates the 'separate' functioning of these two concentrations of graves. The new (southern) burial zone may have been initiated by another kin group, marking its distinctiveness by designating a separate space for burials.

1.1. General characteristics of the population

The anthropological analysis was carried out on the skeletal remains from all the features (80 graves, three *ustrina* (45, 55, 57) and a cremation layer (48-54, in which seven bone assemblages were distinguished). The study was conducted using the methodology for handling cremation remains developed by Jacqueline I. McKinley (1994, 2004). No *infans* II remains were recorded in the bone material. There is a small representation of individuals who died before the age of 7 years, adolescents from the *iuvenis* group and old people (*senilis*). A low proportion of females relative to males was also observed in the bone material (Table 1).

Table 1. Raczkowice, Site 3. Age and sex structure of the population in the light of anthropological studies: pyre sites (*ustrina*), concentrations of bone remains within the cremation layer, graves

Age	Sex						Σ
	Unspecified	Σ	F	Σ	M	Σ	
infans I	8, 44, 70, 73, 82	**5**	-	**-**	-	**-**	**5**
infans II	-	**-**	-	**-**	-	**-**	**-**
infans I/*infans* II	3, 38	**2**	-	**-**	-	**-**	**2**
infans II/*iuvenis*	63	**1**	-	**-**	-	**-**	**1**
iuvenis	56 (?)	**1**	-	**-**	-	**-**	**1**
iuvenis/*adultus*	6, 12	**2**	-	**-**	-	**-**	**2**
adultus	18, 84	**2**	1, 13, 43 (?), 65 (?), 87 (?)	**5**	45 (?), 59, 75	**3**	**10**
adultus/*maturus*	40, 83	**2**	-	**-**	66	**1**	**3**
maturus	41 (?), 48 (?), 52 (?)	**3**	-	**-**	60 (??), 86 (?)	**2**	**5**
senilis	10, 62	**2**	-	**-**	-	**-**	**2**
Child	25, 30 (?), 35 (?), C	**4**	-	**-**	-	**-**	**4**
Juvenile/Adult	46 (?)	**1**	-	**-**	-	**-**	**1**
Adult	2, 15, 16, 20 (?), 31, 39, 47, 50, 54, 67, 69, 71, 80, 81, B	**15**	8 (?), 9 (?), 51	**3**	4, 19, 22, 37, 42, 49 (?), 68, 74 (?), 78	**9**	**27**
Unspecified	5, 10, 14, 17, 21, 23, 24, 26, 27, 28, 29, 32, 33, 34, 36, 57, 58, 61, 64, 72, 76, 77, 79, 85	**24**	7 (?)	**1**	53 (?), 55 (?)	**2**	**27**
Σ	**64**		**9**		**17**		**90**

The general poor state of preservation of the skeletal remains at Raczkowice does not allow far-reaching conclusions to be drawn about the mortality structure of the population. Although in terms of specific age, there was a predominance of individuals in the *adultus* category, it should not be forgotten that in most cases the age of individuals was only identified as 'adult'. The remains of children were identified in only 11 graves (including one double grave). The picture of the population from Raczkowice obtained as a result

of the anthropological evaluation is far from the expected demographic profile for a Roman Period community (*e.g.*, Czarnecka 1990; Skóra 2020).

2. ANALYSIS

2.1. General remarks

The temperature of the cremation pyre acting on the bone remains has a profound effect on their external appearance as well as their structure. Bones become extremely brittle and vulnerable as a result of burning. The skeletal remains are usually in the form of larger or smaller fragments, and in extreme cases, only a mass of small bone fragments remains. The delicacy of such material means that great care must be taken when handling it. The peculiarity of cremated material has given rise to several different types of research that can help extract the necessary information from it, despite the difficulties arising from the permanent modifications caused by burning (Mamede *et al.* 2017).

The main factor responsible for bone fragmentation and fragility is the pyre temperature (Piontek 2007). The effect of bone shrinkage is caused by the loss of water and organic components, including collagen, when exposed to high temperatures (Imaizumi 2015).

To determine the degree of bone shrinkage, studies were conducted in which domestic sheep ribs were burned at temperatures between 400°C and 1000°C, checking their effect at 100°C intervals. Temperatures up to 600°C showed no significant bone shrinkage. An increase occurred among samples at 700°C and 800°C, and the greatest bone shrinkage occurred at 900°C and 1000°C (Ellingham and Sandholzer 2020).

Changes in bone colour following heat treatment can be influenced by several factors, including the amount of oxygen and soft tissue, variation in soil composition or other environmental factors. However, recent studies have shown that heat-induced discolouration is not significantly affected by gender, age, or skeletal element type (Krap *et al.* 2019; Rubio *et al.* 2020).

The point of comparison for research into the question of the weight of burnt human bones going into graves in the Roman Period is the contemporary estimates obtained during archaeological experimental studies or collected from gas crematoria. The weight of the bones depends on gender, age and health, among other factors. According to various sources, the average weight of burnt bones of men is 3375-3379 g, while that of women is 1887-2625 g (Koczorski *et al.* 2014, 90, further literature there). The skeleton of an average man (70 kg) weighs 4159 g, while after cremation this value is reduced to 2829 g; for women, the weights are 2700 and 1840 g, respectively (Goldhahn and Oestigaard 2008, 231). Slightly lower values were obtained from experimental studies in a crematorium by A. Malinowski and R. Porawski (1969, 392-410): males – about 2000 g, females – about 1540 g. These data are partially reflected in the weight of bone remains from some prehistoric cemeteries (*cf.*, Malinowski 1969). However, they differ from the averaged results of the

weight of burnt bones compiled by Janusz Piontek for cemeteries, mainly from the Bronze Age. The ranges for men are 500-1150 g, for women: 350-1070 g, and for children, only 18-160 g (Malinowski 1969; Malinowski and Porawski 1969; Piontek 1996, 2002, 95-108, tab. 2; 2007, 64, tab. 2).

Also, from the studies done for selected cemeteries of the Przeworsk Culture, the conclusion emerges that the mass of burnt bone remains deposited in the graves is lower than expected (*cf.*, Szczepanek 2013, 88-91, figs 44 and 45). These differences are surprising, mainly as the bones from modern crematoria are characterised by a higher degree of burning and fragmentation (high cremation temperatures and mechanical grinding of the bones) (Wahl 2001, 158). It should be emphasised that modern cremation site data show a high degree of similarity in the issue considered here, something that is not observed in prehistoric cemeteries. The influence of several factors must therefore be assumed, shaping the revealed disparities in bone mass in the grave.

For comparison, calculations carried out for 11 sites of the Wielbark Culture (822 graves in total) revealed an average weight per grave of 390.8 g, with a cremation pit grave of 239.6 g, an urn grave of 697.1 g, a female grave of 528.4 g, a male grave of 718.3 g, a child grave of 47.7 g and a mass grave of 461.2 g (Skóra 2014, 54, fig. 1).

2.2. The manner of bone deposition in urn graves and cremation pit graves

In the documentation from the archaeological research at Raczkowice, an observation was made several times about the arrangement of the bone remains, regarding the deposition of the bones of the deceased into the vessel according to anatomical order, *i.e.*, from the cremation pyre in order, the remains were collected from the feet towards the skull. At the same time, this principle of deposition would only apply to urn graves. The bones of the crania would have been placed in the upper part of the urn. Little is known about the method of exploration of the interior of the urns from Raczkowice (Fig. 5).

Fig. 5. Raczkowice, Site 3. Vessels – urns: 1 – grave 66; 2 – grave 78. Photo: K. Skóra

We only have a description of the arrangement of the artefacts in relation to certain parts of the skeleton – the skull bones are the only point recorded. We can therefore assume that they were indeed deposited last into the vessel in several of the urns, but what principle was adopted in the deposition of the other parts of the skeleton cannot be ascertained.

The evaluation of whether the burnt bone remains were deposited in the burial pit with or without the remains of the cremation pyre is based on the drawn documentation and the survey diary. It is also unclear how the bones were treated after excavation, whether they were sieved, cleaned, or separated from the charcoal. This aspect of the funerary rites is challenging to analyse, given the above comments. Charcoal in small quantities was separated between vessel fragments and human skeletal remains during analytical work in the cabinet. The black or brownish-black fill of the grave pits, sometimes with charcoal fragments marked separately, makes it possible to identify the graves into which the remains of the cremation pyre were poured.

The separation of the burnt bone remains from the charcoal of the cremation pyre was one of the stages of the funerary ceremony. Clean bones were the result not so much of their selection from the pyre in a certain way, but also of their cleaning or washing. Little is known about this stage, from the removal of the bones from the cooled cremation pyre to their placement in the grave pit in relation to the materials of the Przeworsk Culture. We do not know who was responsible for this, how many days passed and how the remains, not only human but also the bones of animals and elements of equipment deposited on the pyre, were treated.

We know that the remains of the dead were subjected to various treatments, among other things, from written sources relating to other communities from different eras. Roman funerary practices are a case in point: most of the bones were collected from the cremation pyre with washed hands and wrapped in a linen cloth, then washed in wine and milk before being dried. However, they were placed in an urn with the ashes. The remaining bones from the cremation pyre (*os resectum*) were collected by the family of the deceased for additional burial in a domestic tomb or altar. However, the so-called Law of the Twelve Tables forbade this practice (Kuryłowicz 2020, 131).

2.3. Cremated human bone remains from Raczkowice

2.3.1. Condition of bone remains

The degree of burning of the bones from the Raczkowice cemetery was most often classified as high (78% of the features), followed by medium to high (13%), medium (6%) and, only exceptionally, very high (3%). The colour of the remains varies from light, light grey or light brown to dark, dark grey or dark brown (Fig. 6). Occasionally, colour variation, indicative of heterogeneous stack temperatures, characterises the remains of the same individual.

Fig. 6. Raczkowice, Site 3. State of preservation of bones from urn graves:
1 – Grave 18; 2-3 – Grave 66; 4 – Grave 83. Photo: K. Skóra

It is important to remember that a human skeleton exposed to heat is severely fragmented, and many of its parts are visibly deformed. Bone fragments that were collected into an urn or deposited in a burial hundreds of years ago are subject to external influences all the time before archaeologists discover them. It is therefore clear that the amount of information that can be obtained from anthropological studies of these materials will be limited. Another factor that affects the cognitive value of osteological materials is how they were stored after excavation and how their degradation is prevented.

2.3.2. Weight of the cremated bones

In Raczkowice, the total weight of the bones from the graves, the cremation layer and from the *ustrina* is nearly 16.5 kg (Table 2). Based on the analysis of the bone remains, it can be assumed that the bones belong to 91 individuals. It was not possible to determine whether the remains of the individuals discovered in the pyre sites (*ustrina*) were in any of the graves.

The graves contain the bone remains of one person. A double grave was selected once (Grave 8) – the remains of an adult female and a child (*infans* I), weighing a total of 274.8 g, were deposited there.

The sum of the weights of the skeletal remains from the urn and cremation pit graves is 14768 g, with an average (N = 77) of 191.8 g.

Table 2. Raczkowice, Site 3. Weight of cremated human bones in relation to the feature category

	Total weight of bones [g]	Average weight of bones in the feature [g]	Minimum weight [g]	Maximum weight [g]
Urns (n=15)	11142.1	742.8	8	2850
Cremation pit graves (n=62)	3625.9	58,5	0.01	316.3
Pyre sites / *ustrina* (n=3)	279.3	93.1	4.6	165.6
Cremation layer	1107	158.1	22.9	500

Sex and age

In Raczkowice, the average weight of skeletal remains in female graves is 242.9 g, while that of male graves is considerably higher – 485.9 g. Several factors contribute to this disproportion. In addition to those resulting from biological conditions (such as the greater bone mass of male individuals), another factor is the type of ritual and the chronology of the features. In the analysed group of male graves (n=13), five are urn graves, while in the case of women (n=8), there is only one burial in a vessel. The urn graves belong to the older horizon of the necropolis and stand out in terms of the number and assortment of equipment, and the quantity of bone remains corresponds to or is close to the expected mass obtained by cremation (2-3 kg).

In the case of the children's burials, the average weight of the bones is low (children from all age categories, n = 10), at 22.6 g, which is due to the lower weight of the skeletons in this age group. However, it is also a result of the form of the graves: nine cremation pit graves and only one urn grave. Most of the child burials are dated to the Younger Roman Period or lack grave goods of dating value. Only one grave (no. 82, urn grave) is dated earlier, *i.e.*, to stage B_2. The differences noted are also evident in the subsequent chronological sections (Fig. 7).

Chronological considerations

The chronological ranking of the set of cremation pit graves and urn graves in relation to the mass of bone remains leads to the conclusion of a significant decrease in this mass during the subsequent phases of use of the Raczkowice necropolis (Fig. 8). The average obtained for the features from stage B_2 is high, for which the urn graves (which mostly come from this chronological phase), are largely responsible. The average weight of bones from urns from this period is 821.7 g, while that from cremation pit graves is only 86.2 g. With the abandonment of urn graves in favour of cremation pit graves over time, the analysed average value decreases to just over 40 g.

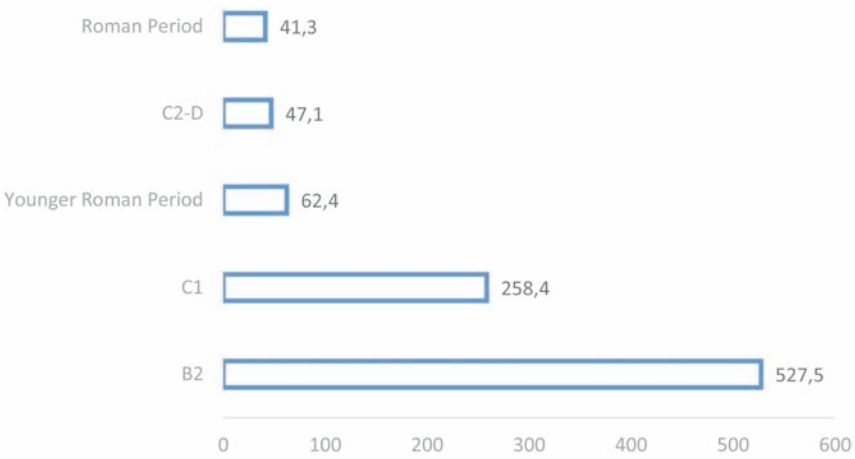

Fig. 7. Raczkowice, Site 3. Average weight of bones (g) from cremation graves in different stages of cemetery use – stages from B_2 to C_2-D, and separately features generally dated to the Roman Period (RP) and the Younger Roman Period (YRP) in relation to sex and age of the deceased

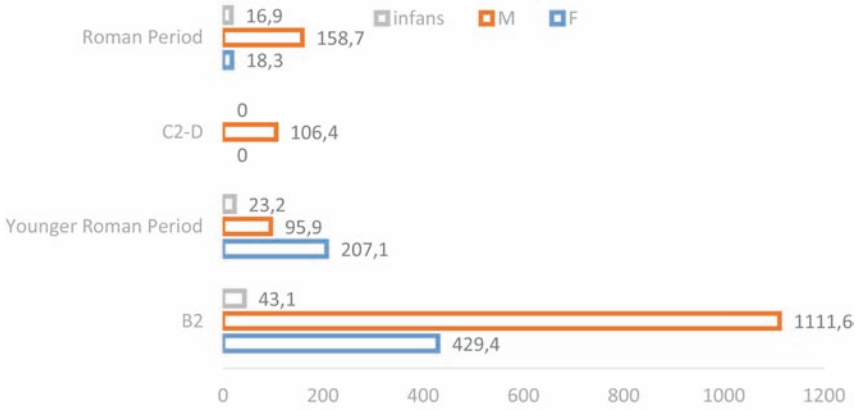

Fig. 8. Raczkowice, Site 3. Average weight of bones (g) from cremation graves in different stages of cemetery use – stages from B_2 to C_2-D, and separately features generally dated to the Roman Period (RP) and the Younger Roman Period (YRP)

In comparison, a clear decrease in the weight of bones in graves is also detectable in Opatów in the successive distinctive phases of cemetery use. The average weight is highest in the first phase (240.3 g) and decreases in the following phases, reaching values of 131.1, 140.68 and 106.15 g in the last of these (Szczepanek 2013, 88, 89, fig. 44). It is noted that most graves contain less than 100 g of bone. Higher average results were obtained in Mokra. The average for all graves is 279.6 g. In contrast, the initial two phases are 354.3 and 427 g and in the following phases, the averages fluctuate between about 200-300 g (from 175.2 to 262.8) (Szczepanek 2013, fig. 44). At the same time, throughout the life of

the cemetery, graves are present in each phase that deviate significantly from the norm. The weight of the bones in them is close to the actual weight expected from the cremation of the corpse of an adult person – in Mokra (range 713 to 1753 g) and in Opatów (range 1306 to 1830 g) (Szczepanek 2013, fig. 44).

2.3.3. Anatomical representation

Cremation pit graves and urns

In cremation pit graves, skull bones, upper limb bones, lower limb bones, teeth and vertebrae are most commonly identified in that order. Pelvic and thoracic bones are the least common. In urn graves, skull bones, teeth, lower and upper limb bones and vertebrae are most commonly identified in that order. The least represented are the bones of the thorax and pelvis. Thus, a similar proportion of individual skeletal parts is found in both types of graves. However, in the case of urns, several times we note situations in which all parts of the skeleton are represented, while in cremation pit graves, such a situation was not observed even once.

In both grave types, the presence of pelvic and thoracic bones is slight. This frequency of individual bone elements may be due to various factors. Leading the way are conditions related to the structure of the bones, and their different vulnerability to heat and soil conditions. Vertebrae, the epiphyses of long bones (practically unrecorded in the material studied) have a lot of spongy substance and are more rapidly subject to degradation processes (including burning). Another possible factor, which is difficult to assess objectively, is the attention paid to excavating these skeletal elements.

Ustrina (pyre sites)

Ustrina, which at Raczkowice are most likely to have been the site of a single cremation of corpses, were discovered in the southern part of the cemetery, which finds parallels in the cemeteries at Opatów and Mokra. They are dated from the Younger Roman Period to the stage C_3-D.

They are rectangular or near rectangular in shape, up to 200 cm long and sunk into the ground up to 60 cm. In addition to charcoal and burnt fragmented artefacts, a small number contained burnt bone remains, the anatomical arrangement of which was not recorded during the archaeological investigations. In addition, Feature 55 contained c. 400 burnt clay lumps, which are a trace of the preparation stage of the pit before the stack of wood was placed in it.

In contrast, no traces of long-term use were found, which could be manifested by the more numerous remains of the pyre or the enhancement of the structure with stones.

Based on the skeletal remains preserved in the three *ustrina*, it was determined that the skeletons belonged to a male (*adultus*), a male whose age could not be determined and a person whose age and sex could not be determined.

The degree of preservation of the bones from the *ustrina* was assessed as very poor. In Feature 45, the bone remains (weight 109.1 g) were light brown and burned to a medium to high degree. Skull bones, teeth, upper limb bones and vertebrae were distinguished. No pelvic, thoracic or lower limb elements were present.

In Feature 55, the skeletal remains (weight 165.5 g) were grey and distinguished by a very high degree of burn-through (Fig. 9). Skull bones, upper and lower limb bones were recorded there. No teeth were found, and, as in Feature 45, no thoracic or pelvic bones were identified.

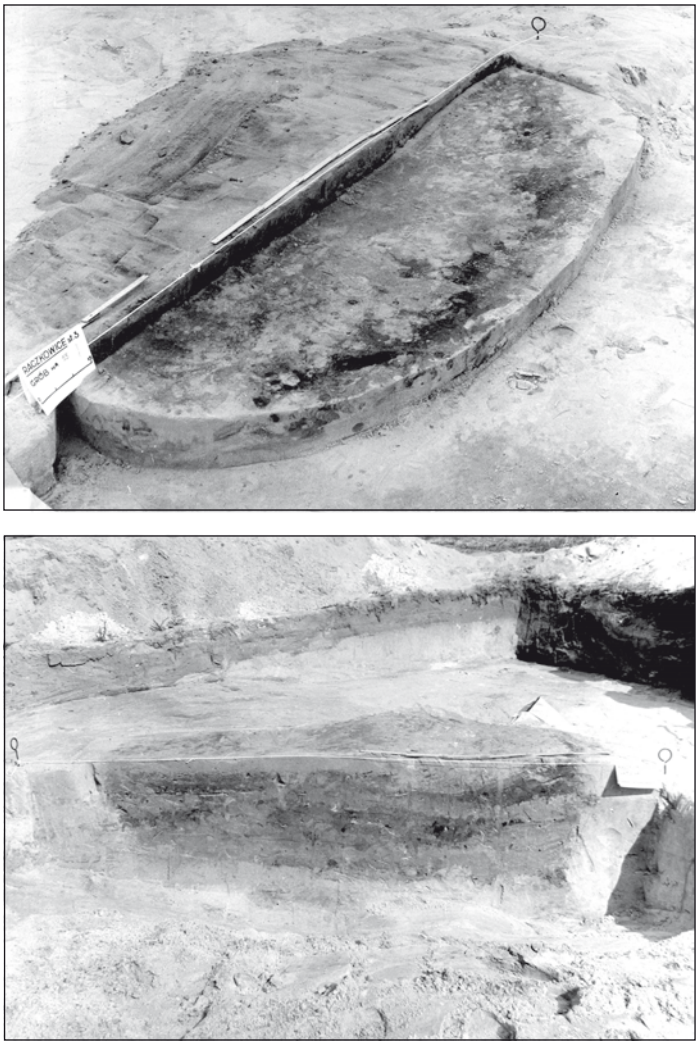

Fig. 9. Raczkowice, Site 3. Feature 55 – pyre site (*ustrinum*).
Photo: archive of the S. Sankowski Museum in Radomsko

Feature 57 contained clear bone fragments that could not be anatomically attributed (weight 4.6 g). They were distinguished by their high degree of burn-through.

Cremation layer

A feature that, in our opinion, can be classified as a cremation layer (Features/concentrations 48-54) was identified in the southern part of the cemetery in the area of the *ustrina*. Chronologically, it is placed in the C_3-D phase. The top of the layer, it seems, was not properly recorded and documented during the investigation. There were concentrations of material, the matrix of which was described as dark brownish-grey or brownish-grey-black, containing charcoal, burnt bones, a large amount of pottery, and a much smaller number of glass and metal objects (the latter usually in fragments of a size that excluded identification). No discolouration of the subsoil resulting from the high temperature of a pyre was documented. At the same time, each of the concentrations contained burnt clay lumps, ranging from a dozen to almost 200 fragments, among them those of a structural nature (Features 49 and 54). The charcoal from the stratum in question came primarily from Scots pine, with a small admixture of larch or spruce (Skrzyński, forthcoming).

Within the layer, several concentrations of bones were identified and attributed to seven adult individuals (adult age, *adultus*, *maturus*). Indicators of the female sex were noted only once, male sex was noted twice, in the other four cases there were no corresponding bone elements to identify sex.

The total weight of the bones from the layer is 1107 g, with an average of 158.1 g. The minimum weight is 22.9 g (Feature 50) and the maximum is 500 g (Feature 51). The bones from the stratum are distinguished by their high degree of burn-through. The colour of the bones varies greatly from light to dark in shades of grey and brown. Skull bones are prominent in all concentrations. Teeth and bones of the lower limbs (four concentrations), vertebrae and bones of the upper limbs (in three concentrations) are next in terms of proportion. Thoracic bones were identified in two concentrations, and pelvic bones were identified once.

3. STATISTICAL ANALYSIS

A total of 77 cremation graves were statistically analysed, including 62 cremation pit graves (80.5%) and 15 urn burials (19.5%). The occurrence of the remains of the cremation pyre (charcoal) in the graves, the general state of preservation of the bone material, the presence of animal bones, and the degree of burning of the skeletal material were analysed (Table 3). A chi^2 test was used to compare the significance of differences between graves. It showed that, while there was no statistically significant relationship between the type of burial and the presence of pyre remains in the burial, the presence of animal bones was significantly more frequently recorded in urn burials, as well as an overall better state of preservation of the skeletal material. A significantly higher degree of burning of skeletal material was also observed in pit graves.

Table 3. Raczkowice, Site 3. Characteristics of the graves included in the examination

Type of burial (n=77)	**Cremation pit graves n [%]**				**Urn graves n [%]**			
	62 [80.5]				15 [19.5]			
presence of remains of a cremation pyre	yes n [%]		no n [%]		yes n [%]		no n [%]	
	40 [64.5]		22 [35.5]		7 [46.7]		8 [53.3]	
	chi square test p=0.2034 (chi square =1.62; df=1)							
state of preservation of skeletal material	very low n [%]		medium n [%]		very low n [%]		medium n [%]	
	62 [100.0]		-		10 [66.7]		5 [33.3]	
	chi square test p=**0.000** (chi square =22.10; df=1)							
presence of animal bone	yes n [%]		no n [%]		yes n [%]		no n [%]	
	3 [4.8]		59 [95.2]		5 [33.3]		10 [66.7]	
	chi square test p=**0.0012** (chi square =10.53; df=1)							
degree of burning	1 n [%]	2 n [%]	3 n [%]	4 n [%]	1 n [%]	2 n [%]	3 n [%]	4 n [%]
	2 [3.3]	55 [88.7]	4 [6.4]	1 [1.6]	0 [0.0]	5 [33.3]	5 [33.3]	5 [33.3]
	chi square test p=**0.0000** (chi square =28.30; df=3)							

Where: 1 – very high; 2 – high; 3 – medium to high; 4 – medium

As a next step, information on the differences in the mean values of the depth of the grave pits and the mean weight of the skeletal remains was analysed (Table 4). The Mann-Whitney U test was used to compare the significance of the differences (after checking for correspondence to a normal distribution). In the case of grave depth, no statistically significant differences were observed between cremation pit graves and urn graves. However, the mean weight of the skeletal remains taken from the urn graves was significantly higher.

Table 4. Raczkowice, Site 3.
Comparison of the depth of the grave pits and the weight of the bone remains

	Cremation pit graves				**Urn graves**				p U M-W
	n	mean	range	SD	n	mean	range	SD	
Depth [cm]	62	23.0	6.0-101.0	17.59	15	21.5	7.0-45.0	12.00	0.9744 (U=462.0; U=0.03)
Weight [g]	62	58.5	0.01-316.3	76.57	15	742.8	8.0-2850.0	858.88	**0.0001** (U=165.0; Z=3.8)

From an anthropological point of view, it was also important whether, depending on the type of burial, the possibility of assessing the biological parameters of the deceased, the most important of which are sex and age at death, changed. To this end, it was checked in what proportion of the burials it was possible to determine both of these parameters (Table 5). While the type of grave, and therefore the degree of preservation of the skeletal material, does not affect the possibility of assessing sex, it does significantly affect the possibility of assessing age at death.

Table 5. Comparison of the possibility of assessing sex and age at death in relation to burial type

	Cremation pit graves [n=62]		Urn graves [n =15]	
sex estimation	yes n [%]	no n [%]	yes n [%]	no n [%]
	14 [22.6]	48 [77.4]	6 [40.0]	9 [60.0]
	chi square test p=0.1674(chi square =1.91; df=1)			
age at death	yes n [%]	no n [%]	yes n [%]	no n [%]
	38 [61.3]	24 [38.7]	15 [100.0]	-
	chi square test p=**0.0037** (chi square =8.43; df=1)			

It was also crucial to determine which parts of the skeleton were present in the analysed graves. This is significant because, depending on which of these are preserved in the graves, it is possible to make an assessment of the basic biological parameters and also to detail the osteobiography of the deceased (*e.g.*, by indicating the presence of specific palaeopathologies). Table 6 summarises the percentage of graves that contained bone fragments of specific skeletal parts. Based on the data obtained and the results of the chi² test, it can be observed that in the material studied, the presence of skull bones, as well as bone fragments of the upper and lower limbs, was observed with similar frequency in cremation pit graves and urn graves. On the other hand, the presence of teeth and finer bones of the post-cranial skeleton, such as rib fragments, vertebrae and pelvic fragments, was observed significantly more frequently in urn graves. These results are not surprising, as they can be regarded as a result not only of the higher degree of bone burning observed in cremation pit graves but also as a result of the greater exposure of the remains to diagenetic processes in this type of grave.

Table 6. Raczkowice, Site 3. Fragments of skeletal parts identified in graves

Presence of bones of:	Cremation pit graves [n=62		Urn graves [n =15]	
	yes n [%]	no n [%]	yes n [%]	no n [%]
skull	46 [74.2]	16 [25.8]	13 [86.7]	2 [13.3]
	chi square test p=0.3057 (chi square =1.05; df=1)			
teeth	21 [33.9]	41 [66.1]	10 [66.7]	5 [33.3]
	chi square testp=**0.0201** (chi square =5.33; df=1)			
upper limb	34 [54.8]	28 [45.2]	9 [60.0]	6 [40.0]
	chi square test p=0.7179 (chi square =0.13; df=1)			
chest	6 [9.7]	56 [90.3]	5 [33.3]	10 [66.7]
	chi square test p=**0.0188** (chi square =5.52; df=1)			
vertebrae	15 [24.2]	47 [75.8]	9 [60.0]	6 [40.0]
	chi square test p=**0.0072** (chi square =7.21; df=1)			
lower limb (excl. pelvis)	33 [53.2]	29 [46.8]	10 [66.7]	5 [33.3]
	chi square test p=0.3469 (chi square =0.88; df=1)			
pelvis	7 [11.3]	55 [88.7]	5 [33.3]	10 [66,7]
	chi square test p=**0.0347** (chi square =4.46; df=1)			

4. DISCUSSION

4.1. Conclusions of the statistical analysis

Statistical analysis revealed in Raczkowice a correlation between the presence of animal bones and urn graves and a better state of preservation of human bones in vessels. In the cremation pit graves, on the other hand, a significantly higher degree of bone burning was noted, while the average weight of bone remains was higher in the urn graves. The results of the chi^2 test showed that, anatomically, skull bones, as well as fragments of upper and lower limb bones, were present with similar frequency in both types of graves in the material studied. In contrast, teeth and finer bones of the postcranial skeleton, as well as parts of the ribs, vertebrae and pelvis, were observed significantly more frequently in urn graves. This would infer a slightly different treatment of the corpse: a stronger reburning and fragmentation of the human remains, which were deposited directly into the ground. It seems that special care was taken to select the skull fragments from the cremation pyre. Similar conclusions to the materials of the Przeworsk Culture have been made before (concerning the cemetery in Kuny, *cf.*, Makiewicz 2009, 200, 201; to the materials of the Wielbark Culture, *cf.*, Skóra 2014, 60-66). Fragmentation may have a cultural cause and not just be due to the cremation process itself. It is difficult to assess what dictated the selection of bones from the pyre. As experimentally proven (Piontek 1975), after the remains of the wood had burned and the pyre had cooled, the selection of bone fragments (*e.g.*, phalanges) or teeth was not a problem. On the other hand, the presence of animal bones in the graves, resulting from the custom of depositing food with the deceased on the cremation pyre, relates more to the older phase of the necropolis and to that part of the population that used urns. Over time, this custom disappeared in Raczkowice – only single animal bones (domestic chicken and domestic pig) are present in cremation pit graves from the Younger Roman Period and in the cremation layer.

4.2. The question of the fragmentation of grave goods

In comparing, among other things, the degree of bone fragmentation in cremation pit graves and urn graves, attention was also drawn to the issue of fragmentation of metal grave goods, made of iron or copper alloys (Fig. 10).

The analysis has shown that copper alloy items present an average level of fragmentation in terms of size. It should be noted, however, that they are known to be less numerous in the cemeteries of communities of the Przeworsk Culture than iron items. They also represent other categories, mainly items of clothing, such as brooches, belt elements, and ornaments (*e.g.*, pendants). In addition, they are more easily deformed in the fire of the pyre; perhaps for this reason, and as elements of the funerary dress of the deceased, they were subject to different ritual rules.

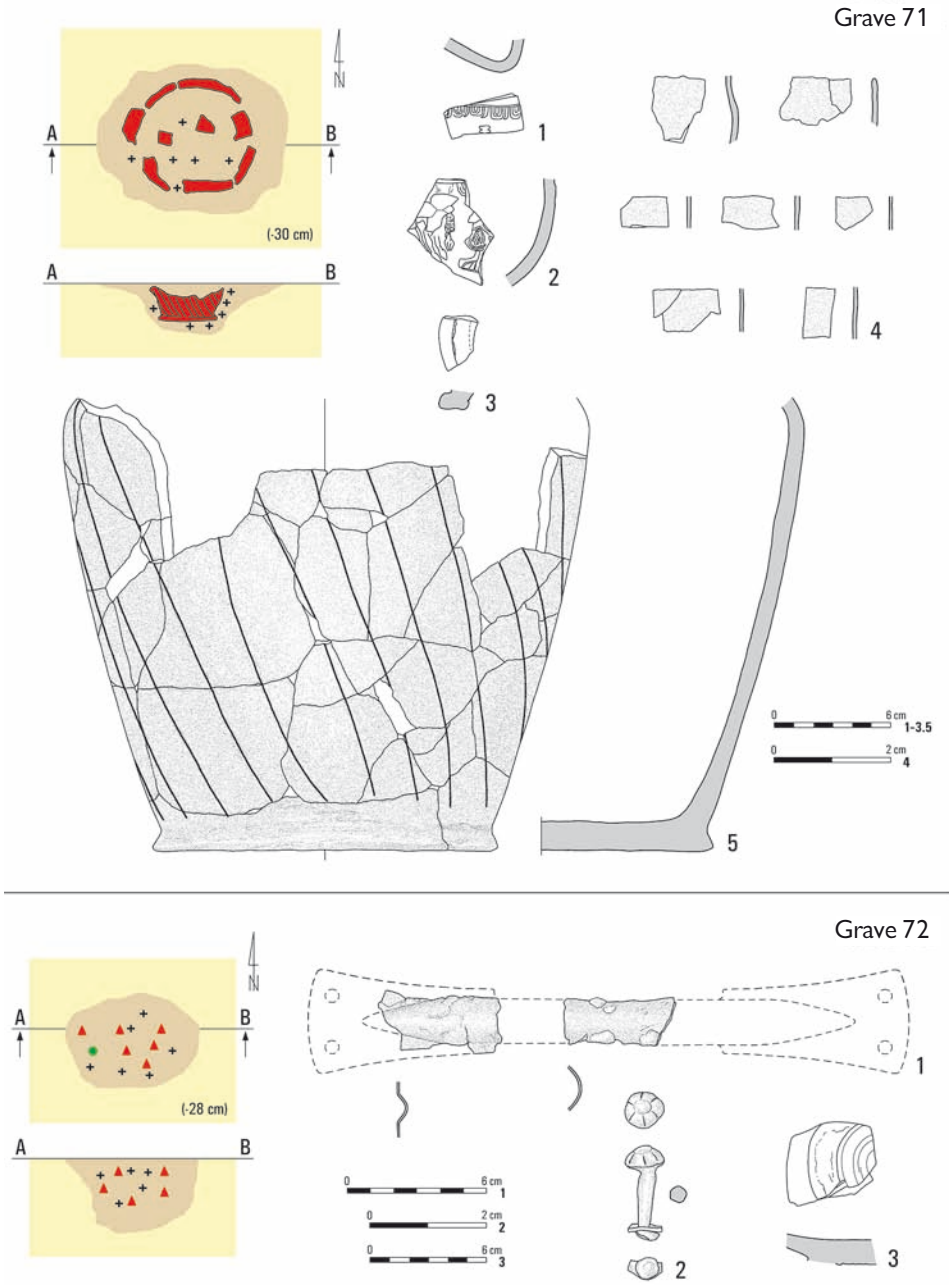

Fig. 10. Raczkowice, Site 3.
Example of cremation pit graves (Graves 71 and 72) with fragments of elements of the grave goods.
Drawing: E. Wtorkiewicz-Marosik

Iron artefacts, on the other hand, present different levels of damage: from very large damage (fragments of the order of up to 10 mm in size) to small damage (objects broken into larger fragments – up to 40-70 mm). However, with this, their degree of fragmentation is stronger. The presence in this assemblage of fragments a few millimetres in size allows one to wonder how the objects were selected after cremation and transferred to the burial pit. Such tiny fragments could not have been deliberately selected individually from the pyre. They may have been taken together with the bones en masse – using a pot, shifted by hand onto a linen shawl, into a pouch or a container. Notably, no correlation was observed between the type of grave (cremation pit grave or urn grave) and the degree of fragmentation of metal objects. The higher number of defaced objects from cremation pit graves is due to the greater number of artefacts in this category. Nor did the stronger fragmentation of metal items in the later grave assemblages become outlined as clearly as expected. Fractions of artefacts from phase B_2 graves belong to different size groups of up to 10, 20, and 40 mm, noting, however, that fractions of equipment items from graves dating from the Younger Roman Period to the Migration Period dominate the size range up to 20 mm.

4.3. On the question of the low mass of cremated bone remains in graves

Due to the analogous time of use and burial ritual rules, the material from the nearby necropolises in Opatów and Mokra comprise direct comparative material for Raczkowice. The average result obtained at Raczkowice is between the values calculated for these two sites. The average bone mass in the grave at Opatów is 151.3 g and at Mokra it is 279.6 g (Szczepanek 2013, fig. 44). The tendency for the weight of the bone remains to decrease in the successive phases of necropolis use is evident in the case of each site.

The issue of the low mass of cremated human bones in the graves of the Przeworsk Culture has been the subject of previous research in the context of transformations of the funerary rituals of the Przeworsk Culture and the limitations of demographic studies (most recently: Szczepanek 2013; Madyda-Legutko *et al.* 2015) and the rituals of the Wielbark Culture (Skóra 2014). In the literature, the issue of the 'lack' of skeletal remains has been explained from different perspectives (for a summary, *cf.*, Madyda-Legutko *et al.* 2015).

The successive decrease during the Roman Period in the volume of cremated bones placed in graves, sometimes leading to the representation of the deceased symbolically, was inscribed in the process of the disappearance of urn graves, the widespread use of cremation pit burials, and then the birth of layer features and cremation layer cemeteries, of the Dobrodzień type, characteristic of the southern zone of Przeworsk settlements (northern part of Upper Silesia and the Częstochowa region) in phases C_2 and D (Szydłowski 1964; Godłowski 1981, 117-120).

In light of recent discoveries from aquatic sites, this aspect of funerary rituals can be analysed from a different perspective. The low weight of the bones in the cremation graves may be responsible for their partial remains being left at the cremation sites (*cf.*, for example,

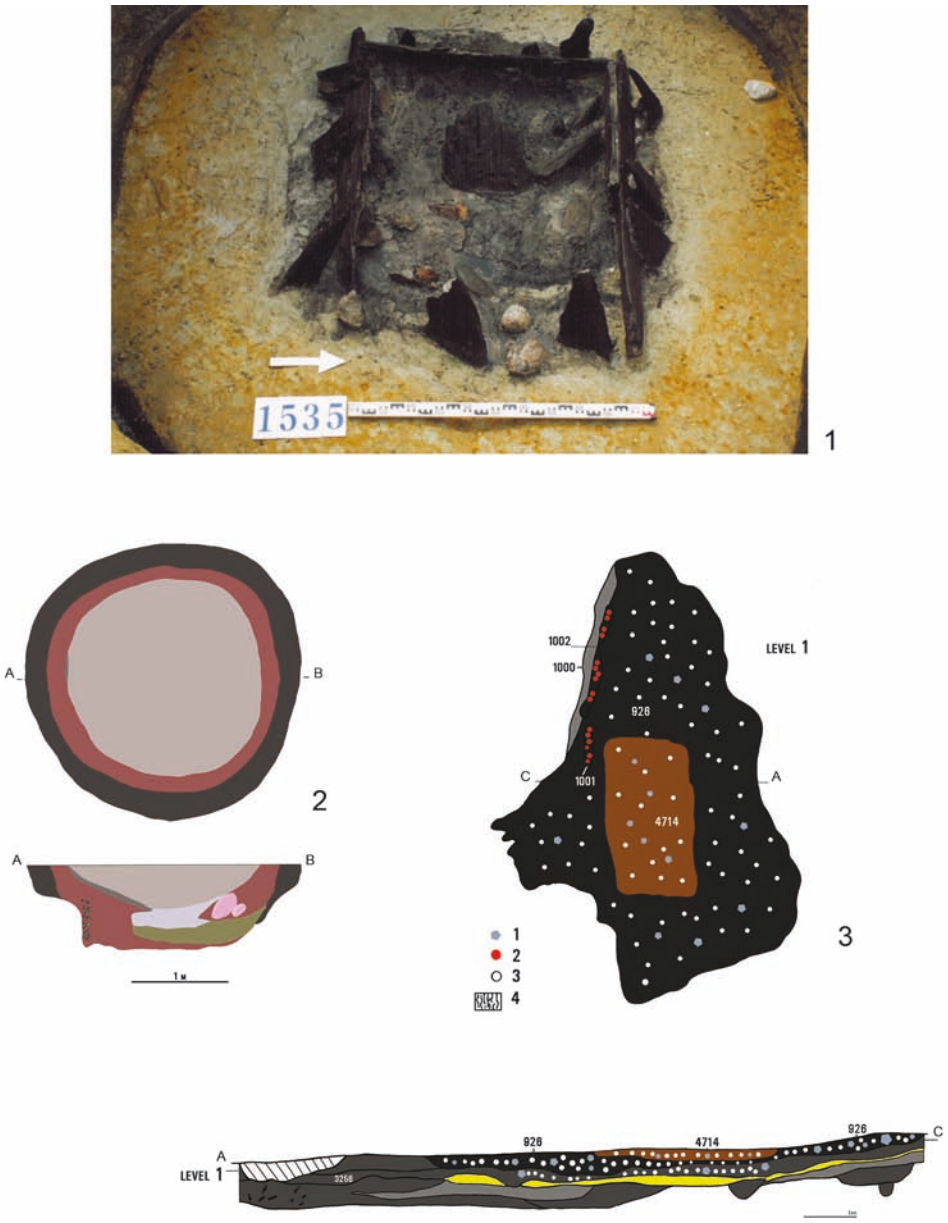

Fig. 11. Examples of sites from the Przeworsk Culture with deposits of burnt human skeletal remains in aquatic sites: 1 – well from Konarzewo, Site 5, Poznań District, Feature 1535, plan at a depth of 1.9 m (4670 g of bone, 30 individuals); 2 – Łęki Majątek, Site 2A, Kutno District, Feature 29, cremation pit grave in a rettery (780 g, M (?), adult and *infans* II); 3 – Modlniczka, Site 2537 ('bog deposit', 23280 g, at least 55 individuals). 1 – vessel fragments, 2 – charcoal, 3 – burnt human bones, 4 – wood. Based on: photo courtesy of Wojciech Kaczor (1); W. Siciński 2021 (2); Byrska-Fudali and Przybyła 2010 (3)

Arcini 2005). These, in turn, may have been periodically cleaned and the remains of the bones and cremation pyres moved to sites outside the cemeteries or in their surroundings (Fig. 11), for example, to aquatic environments, *i.e.*, ponds, wells, springs (*e.g.*, Konarzewo – Makiewicz *et al.* 2008; Modlniczka – Byrska-Fudali and Przybyła 2020; we do not take into account discoveries of unburned human skeletal elements in aquatic environments, *e.g.*, Polwica 5, Site P5/1407, *cf.*, Gralak 2019, 210). The discovery from Łęki Majątek, Kutno District, was also included in this group of objects (*cf.*, Skóra 2014, 65), but the issue remains unresolved. Feature 29 from this site, identified as a cremation pit burial (3rd-4th century) in a flax rettery, contained the burnt bones of an adult male and a child (*infans II*). It is uncertain whether the location of the bones in the centre of a disused rettery was intentional or accidental (Siciński 2021, 104, 105).

Such treatments would explain the 'scarcity' of bones in graves of the Przeworsk Culture from the Younger Roman Period onwards. However, it remains an open question whether similar practices, but on a smaller scale, were not already undertaken in the early Roman period.

In the case of Raczkowice, the pyre sites (*ustrina*), assessed as once used, are characterised by a minor number of human bones. Adding up the weight of the bones from these pyre sites (*ustrina*) with the highest weight of the bones from their contemporary cremation grave does not give a value that comes close to the expected weight of a cremated skeleton. We therefore do not know the answer to the questions raised about the fate of these missing remains.

5. CONCLUSION

The evaluation of the content of the graves from the Przeworsk Culture cemetery in Raczkowice from an archaeological and osteological perspective in the context of the 'missing' burnt bone remains has confirmed the previous observations and led to new conclusions, which, however, should be verified in the future, taking into account new materials and using new research methods. The collection of bones was analysed in terms of weight, state of preservation, anatomical differentiation and frequency of different parts of the skeleton, assuming an answer as to whether the skeletal remains were selected from the cremation pyre and what proportion of them was deposited in the grave. The results obtained for Raczkowice are presented against the background of the funerary customs of the Przeworsk Culture in the last phases of the Roman Period. It is extremely important to identify the taphonomic factors that are responsible for the state of preservation of the bone assemblages. This allows us to understand the social and cultural aspects of burials at a specific time and community (*cf.*, Knüsel and Robb 2023). 'The archaeology of cremation' is a developing discipline that is charting new research perspectives (*e.g.*, Cerezo-Román and Williams 2014; Harving 2015; Harvig and Lynnerup 2013). Cremation sites, once-used and reusable, are more widely analysed in the case of cemeteries between the

Oder and Vistula: features in the *bustum* type, groove features, layer features and cremation layers and pyre sites (*ustrina*) (*e.g.*, Zagórska-Telega 2019).

In the case of changes in the funerary rituals of populations using cremation during the Roman Period, it can be assumed that they occurred not only as a result of changes in belief and eschatology, but also to some extent as a result of shifting social relations. However, this assumption requires more extensive research, to which new data from studies conducted with new methods that take into account the research needs articulated here will be incorporated. Relying on archival research material brings with it too many cognitive limitations. A condition for progress in the study of funerary rituals is the interdisciplinary study of cemeteries and their infrastructures in the form of cremation sites using new documentation techniques.

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FIELD SURVEY AND MATERIALS

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OPTIONAL AND INCONVENIENT ADDITIONS: ROUNDED RETOUCHED TOOLS FROM THE MICOQUIAN SITE OF PIETRASZYN 49A, POLAND

We dedicate this article to Professor Stefan Karol Kozłowski, one of the more recent scientists to discuss the importance of rounded retouched tools in the Micoquian.

ABSTRACT

Wiśniewski A., Kobyłka A., Tokarz D., Zarzecka-Szubińska K., Pyżewicz K., Stefański D., Weiß M. 2025. Optional and inconvenient additions: rounded retouched tools from the Micoquian site of Pietraszyn 49a, Poland. *Sprawozdania Archeologiczne* 77/2, 177-194.

The rounded retouched tools that have been singled out in the Micoquian assemblages ('Keilmessergruppe') have long been an enigma. Even though their presence was recognised as early as the early 20th century, they received their formal name, the so-called 'groszaki', much later. More recently, similar tools have been recorded at the open-air site Pietraszyn 49a, SW Poland. These examples are slightly larger than average. They were made from flakes and a chunk. During production, marginal and invasive retouch and thinning were used. The same technical means were used to produce bifacial tools. These specimens were compared with other tools of this type in Poland, both in metric and morphological terms. On this basis, the tools differed in this respect within and between assemblages. Nevertheless, the repetition of the oval forms suggests that they may be the result of the transmission of cultural information.

Keywords: 'Groszaki', Micoquian, technology, geometric-morphometric, function, cultural information
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1. INTRODUCTION

Rounded or only partially rounded retouched tools, commonly referred to as *groszaki*, are part of a Micoquian tool group ('Keilmessergruppe') (Kozłowski and Kozłowski 1977; Jöris 2006; Frick 2020). The publications mentioning 'groszaki' treat them typically as an optional and inconvenient element of a site inventory. They function as a general marker rather than an essential unit in considering the functional-technological significance and chronological position of the assemblages (Bosinski 1967; Chmielewski 1969; Koulakovska *et al.* 1993; Burdukiewicz 2000; Kozłowski 2014; Jöris *et al.* 2022; Münzel 2024). Thus, the authors identified 'groszaki' as tools that take on the function of documentary classes in J-C's Gardin view (1980, fig. 16).

The paper presents the rounded retouched artefacts from the Micoquian site of Pietraszyn 49a, compared to other selected finds from Poland (Fig. 1). We aim to determine whether the artefacts from Pietraszyn can be treated as the so-called groszaki in the same sense as in other places. In doing so, we shall discuss whether there is a solid formal similarity between the specimens that have so far been typologically described. Are they all formally separate, or can they be perceived as the so-called Frison Effect or reduction model (Frison 1968; Dibble 1995)?

2. BACKGROUND

It is widely accepted that the first archaeologist who distinguished rounded retouched forms in the Middle Palaeolithic was S. Krukowski (1939). Krukowski separated quasi-'groszaki' (1) and sub-'groszaki' (2), which he also found in the Aurignacian, and typical quasi-'groszaki' (3). The quasi-'groszaki', according to Krukowski, were mainly scrapers (slicing and scraping tools), while the sub-'groszaki' were end-scrapers (scraping points) (Krukowski 1939, 55). Between these groups, he distinguished intermediate types.

It should be noted that these tools were identified a few years earlier by L. Kozłowski, who called them rounded scrapers (Kozłowski 1922, 9). He based his interpretations,

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however, on finds from the Okiennik Cave excavated by Kuźniar. Kozłowski distinguished three tool types: 1. worked on both sides with a flat retouch; 2. worked only on the edge in the marginal parts (the majority); 3. flakes worked with a surface retouch on the dorsal side. In the formulation of his ideas, L. Kozłowski relied on information from a monograph by Demetrykiewicz and Kuźniar (1914). In the archaeological section, the latter noted the presence of rounded scrapers, which he illustrated in Fig. 7 and Tables 14-15. He treated them as one of the distinguishing features of the Okiennik industry. Given these facts, we should move the period of interest in rounded retouched tools to the early 20th century.

It is also worth mentioning that, following the discoveries in Heidenschmiede (Germany) in 1930, E. Peters (1931) distinguished rounded tools but classified them as Acheulean, Mousterian, and Mesolithic (see also Hillgruber 2006, 120). He could not correctly interpret the finds, partially due to the lack of data on the site stratigraphy (see Münzel and Çep 2021). A little later, G. Bosinski called the finds from Heidenschmiede as 'umlaufend perlretuschierte Abschläge,' all-over beaded, retouched flakes of the Heidenschmiede type (Bosinski 1967, 33; Debénath and Dibble 1994, 101). The term 'groszaki' was also adopted in the Czech Republic and Ukraine (Valoch 1988).

Polish scholars have also studied these tools. Noteworthy is the contribution by S. K. Kozłowski (2006). Slightly later, the 'groszaki' were analysed by M. Sudoł-Procyk in her doctoral thesis (Sudoł 2013).

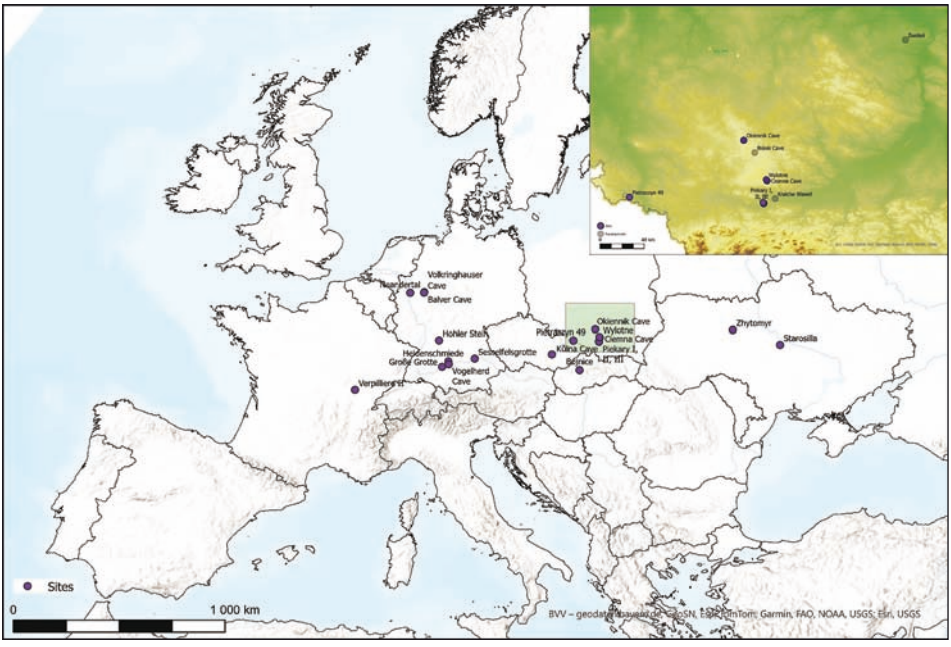

Fig. 1. Map showing sites with rounded retouched tools. Purple dot – Group 1 sites, 2 – white dot – Group 2 sites with uncertain specimens. Prepared by A. Kobyłka and D. Tokarz

Table 1. Middle Palaeolithic sites were attributed to Micoquian ('Keilmessergruppe'), where rounded retouched tools were identified (The list comprises Polish sites of Group 1)

Site	Country	Number	Reference
Kůlna Cave	CZ	?	Valoch 1988
Balver Höhle	DE	?	Günther 1964; Hillgruber 2007
Große Grotte	DE	1	Frick *et al. et al.* 2022
Heidenschmiede	DE	8	Münzel and Çep 2021
Hohlen Stein	DE	9	Freund 1968
Neandertal	DE	67	Hillgruber 2006, 2007
Sesselfelsgrotte	DE	67	Richter 1997; Freund 1968
Vogelherd Cave	DE	?	Schürch and Conard 2021
Volkringhauser Höhle	DE	67	Tafelmaier 2011
Grotte de la Verpillière II	FR	3	Frick 2016
Ciemna Cave	PL	1	Sudoł-Procyk 2014
Okiennik Cave	PL	11	Demetrykiewicz and Kużniar 1914; Kozłowski 1922; Krukowski 1939
Piekary I	PL	14	Kozłowski 2004
Piekary II	PL	3	Kozłowski 2004
Piekary III	PL	8	Kozłowski 2004
Pietraszyn 49a	PL	3	Fajer *et al*. 2000; this work
Wylotne Rockshelter	PL	14	Chmielewski 1970; Kozłowski 2006
Bojnice	SVK	1	Neruda and Kaminská 2013
Starosillia (rus. Sarosele, pl. Starosilla)	UA	?	Rybakov and Boriskovskiy1984
Zhitomir (rus. Zhitomir, pl. Żytomierz)	UA	?	Rybakov and Boriskovskiy1984

Table 2. Middle Palaeolithic sites from Poland that have provided ambiguously interpreted tools (Group 2)

Site	Number	Reference
Ciemna Cave	4	Sudoł 2013; Sudoł-Procyk 2014
Okiennik Cave	3	Demetrykiewicz and Kużniar 1914; Kozłowski 1922; Krukowski 1939
Biśnik Cave	6	Sudoł 2013; Cyrek 2013
Zwoleń	1	Schild 2006
Kraków Wawel	1	Sawicki 1955

The geographic distribution of 'groszaki' essentially overlaps with that of the Micoquian (Fig. 1, Tables 1 and 2). They were recorded in eastern France (Frick 2016), Germany (Richter 1997; 2000; Hillgruber 2006; Jöris *et al.* 2022), Poland (Chmielewski 1969; Chmielewski 1975; Kozłowski and Kozłowski 1977), the Czech Republic (Valoch 1988; Neruda 2011), Slovakia (Neruda and Kaminská 2013), and Ukraine (Rybakov and Boriskovskiy 1984). They occurred in assemblages dated to MIS 5, MIS 4 and MIS 3.

3. MATERIALS AND METHODS

The discussed finds come from the northern part of Site 49a in Pietraszyn 49a, known since the 1990s (Wiśniewski *et al.* 2019; Wiśniewski *et al.* 2020). Two of these artefacts were found in Layer 9, where clusters of finds associated mainly with the production of bifacial tools were documented. Currently, an assemblage of approximately 25,000 artefacts is known from this layer. The assemblage is dominated by fine waste (<2 cm) created during the various stages of tool production. Pre-forms and tools unfinished for multiple reasons are present in the collection, as well as diverse bifacial tools (Wiśniewski *et al.* 2020). The group also includes retouched flakes and scrapers. The third rounded retouched tool discussed here is currently in the collection of the Racibórz Museum, where it was donated by an amateur who discovered the site in the 1990s. The item was published by E. Foltyn and his team (Foltyn *et al.* 2000; Fajer *et al.* 2001a; 2001b).

Before the study, we developed 3D models of each object using photogrammetric techniques to facilitate the description of morphological and metric features. The two finds from Layer 9 were then microscopically analysed to check if they displayed use-wear traces and traces of using retouch techniques. For this purpose, we used a Keyence VHX-7000 series digital microscope (VHX-S770E; lenses VH-Z100R and VH-Z20R). The magnification (for the digital microscope) ranged from ×50 to ×300. The microscopic image was interpreted using a trace reference database. The reference base is located at the Faculty of Archaeology of the University of Warsaw and includes flint items made with techniques and methods known in the Stone Age and tools used by hunter-gatherer groups for various activities.

In the next step, the finds from Pietraszyn 49a were analysed morphometrically and technologically against a collection of similar specimens from Polish Micoquian sites (Ciemna Cave, Okiennik Cave, Piekary I, Piekary II, Piekary III and Wylotne Rockshelter). Unfortunately, we were not able to access all recorded finds. First, a geometric-morphometric analysis was performed, taking into account the outline of the tools. For recording each tool outline, we used 75 pseudo-landmarks. Then, by applying the Procrustes superimposition technique 2D, we reduced the objects to a single size using the traditional protocol (Richtsmeier *et al.* 2002; Zelditch *et al.* 2004; Buchanan and Collard 2010). Finally,

the data matrix was analysed using Principal Component Analysis (PCA). In addition, a set of metric-morphological and technological features was included in the study variation. We sought to record the type of tool treatment and its extent. Correlating these data with the metric features yielded some exciting insights.

4. RESULTS

4.1. Morphometric and technological analysis of the finds from Pietraszyn 49a

The tools were made from erratic flint of the same quality as the rest of the assemblage. Art 23296 was made from grey-coloured flint, while Art 23205 was made from a more brown-coloured raw material reminiscent of the Groszowice-type (Přichystal *et al.* 2022). The third specimen (MR-A-995-1) represents dull grey-brown flints (Fig. 2). Two tools were made from flakes and one from a flat chunk. The tools' diameters ranged from 49.7 mm to 63.9 mm, and were 13.8 mm to 21.9 mm thick. They were almost free of cortex or unworked surfaces. In two specimens, remains of natural surfaces were preserved near the edges. One tool was formed unifacially, while the other two showed traces of bifacial shaping.

Using the protocol for describing tool shaping at Pietraszyna 49a (Wiśniewski *et al.* 2020), three types of shaping-thinning patterns can be recorded on a tool made of a flake (Figs 2: A and 3: A, Art 23296). Traces of surface and edge forming are present primarily on the dorsal side. Bulbar thining is present on the ventral side in the butt region. The scars have been used as a striking platform to remove some flakes from the dorsal side. The first is the presence of inwards-directed scars adjoining a triangular or elongated oval outline in the central part. The second type represents invasive-short retouch, while the third is marginal. The cross-section is asymmetrical, with the dorsal side being convex.

The second find (Art 23205) is shaped bifacially but was created from a flake (Figs 2: B and 3: B). On one side, it features long scars with an oval outline. There are also isolated invasive short scars and traces of marginal retouching modifying the edge. In some cases, they were probably remains of a striking platform preparation for flaking. The other side displays scars reaching the central part. They are elongated (blade-like) and arranged in opposite directions. The invasive short and marginal retouches were also present. The cross-section is plano-convex.

The third tool (MR-A-995-1) is also bifacially worked (Figs 2: C and 3: C). It features the already listed types of scars on both sides. On one side, the invasive short traces prevail. The adjoining scars left rectangular or fan-shaped negatives. The cross-section is biconvex.

Tool-making, whether it concerns chunks or flakes, involves similar methods. First, the shaping and thinning were made, and thin striking platforms were sometimes prepared.

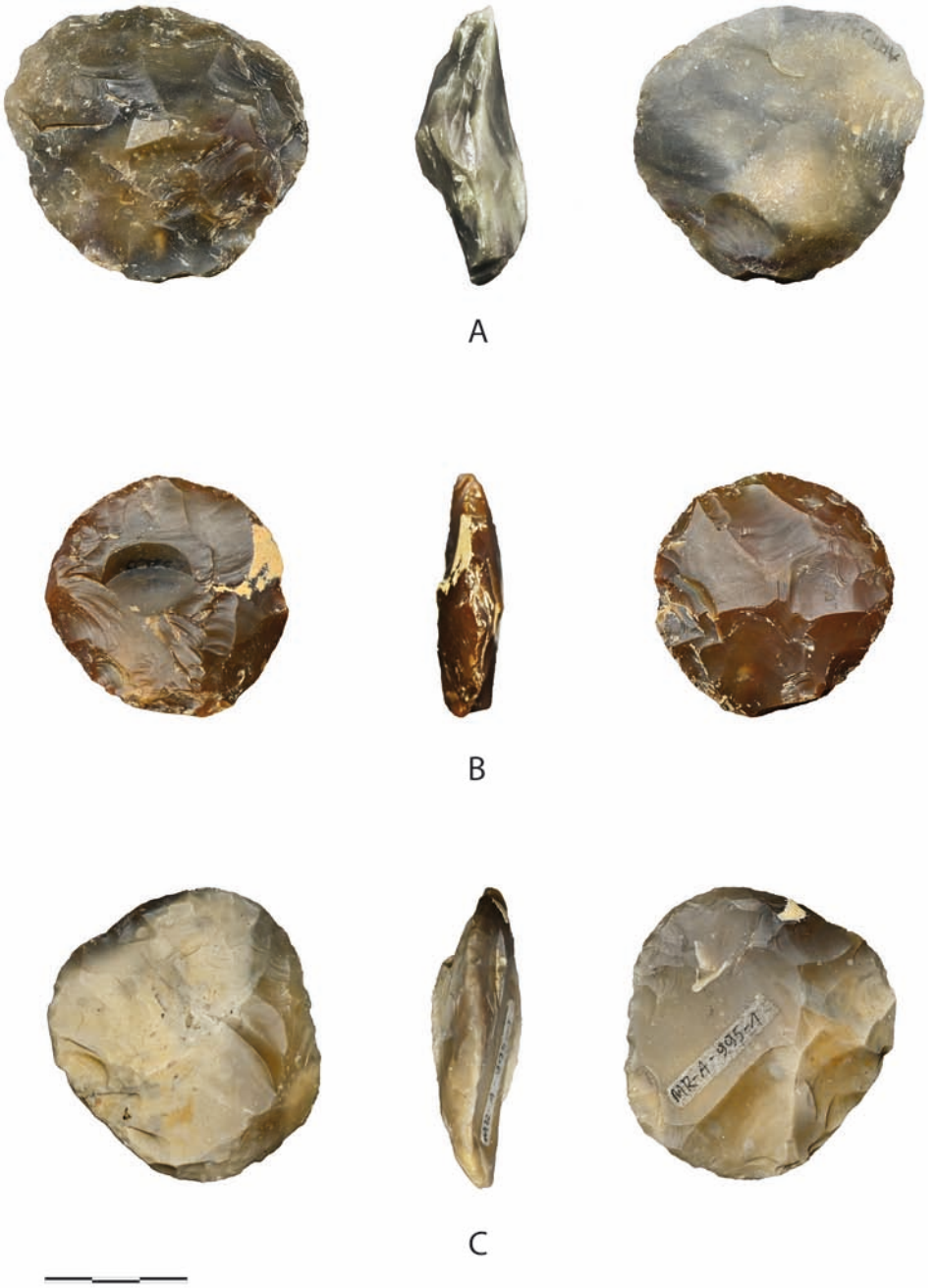

Fig. 2. Rounded retouched tools from Petraszyn 49a. Photos by D. Tokarz

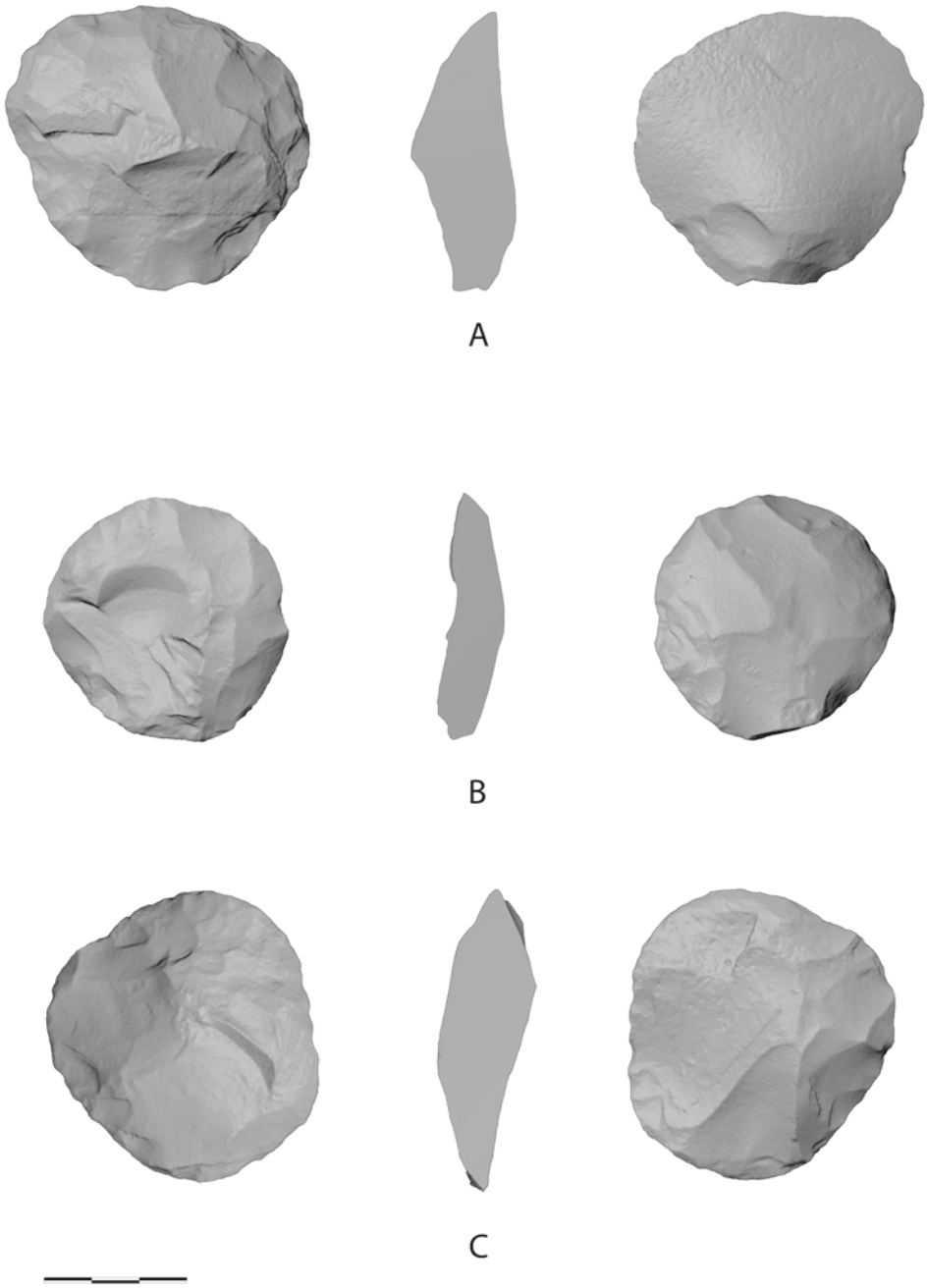

Fig. 3. 3D models of rounded retouched tools from Pietraszyn 49a.
Prepared by A. Kobyłka and A. Wiśniewski

The regularisation of selected edge parts followed these operations. The chain of operations is not as multifaceted as in the case of bifacial tools, but the technical requirements were no less complex. In addition, last year, an attempt to refit the studied items was made for several hours, unfortunately, without success. Theoretically, this could suggest that the tools were made outside the discovered clusters or the site.

4.2. Microscopic investigation

The first analysed flint tool (Art 23205) shows no preserved traces of use (Fig. 4). Its surface has not undergone significant post-depositional alterations that would affect the state of preservation of the potential use-wear. Only a very light, glossy patina was noted in some spots. The butt displays striations and a locally visible 'metallic' shine, which indicates that a stone hammer was used during the abrasion of the flaking surface edge and flake detachment (Fig. 4: A, B). In addition, one of the lateral edges on the protruding part of the retouch shows traces that may have been created using a soft organic hammer made of antler/bone (Fig. 4: C).

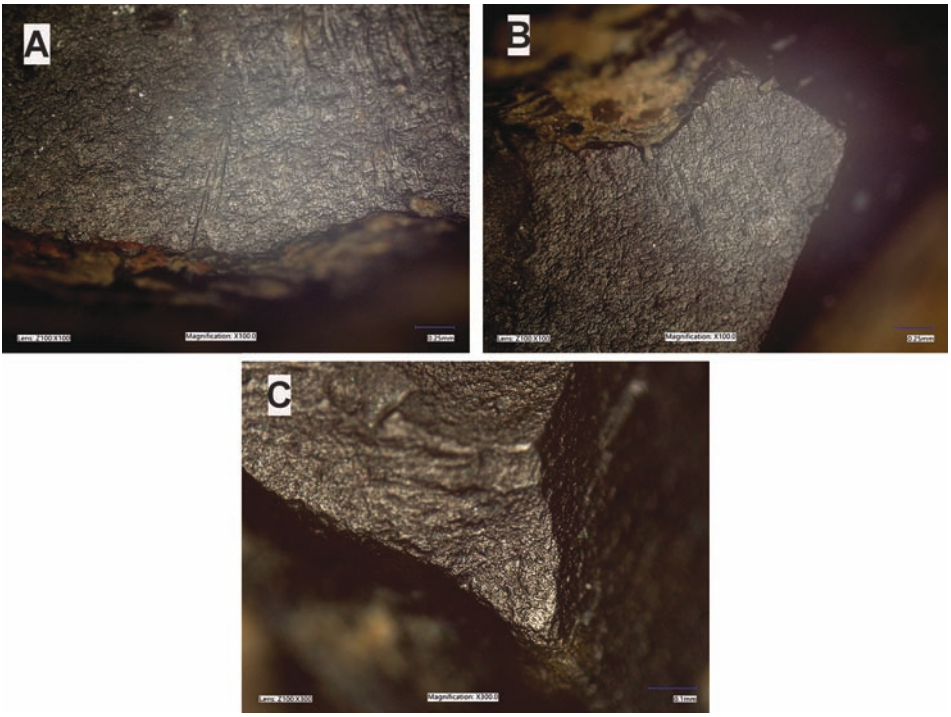

Fig. 4. Photographs showing technical marks (A, B) and changes due to contact with bone/ antler (C) on one of the artefacts (Art 23205) from Pietraszyna 49a. Photos by K. Pyżewicz

The second microscopically analysed specimen (Art 23296) does not feature any preserved traces of use or applied production techniques. Due to the shiny, spotted patina covering the artefact's surface, it is difficult to determine whether it was used.

5. DISCUSSION

5.1. An attempt at metric comparative analysis

To make a preliminary comparison, we selected a group (48 items) of the finds often referred to as 'groszaki' from six Polish Middle Palaeolithic sites (Table 1, Group 1). Such items occurred most abundantly at the sites of Piekary I and the Wylotne Shelter (Kozłowski 2004). Isolated specimens are known from Ciemna Cave (Sudoł-Procyk 2014). All sites listed in Table 1 are classified as Central European Micoquian. We excluded from the analysis finds that were regarded as uncertain by some researchers (Group 2). These specimens are included in a separate table (see Table 2).

Regarding the essential dimensions (length x width), the averages from all cases (51) are very similar: 34.70 mm x 35.22 mm. As we did not have the opportunity to access all the finds, we skipped the thickness parameter. The maximum L/W is 66.36/68.48 mm, while the minimum is 12.93/12.25 mm. If we consider the averages for the individual sites, the outliers can be observed in the tools from Piekary I and finds from Pietraszyn 49a and Ciemna Cave (Fig. 5). The skewness is positive, so most of the data are above the accepted average, while the spread is relatively significant, at over 50 mm. Descriptive statistics indicate that the collection is quite diverse in its basic parameters. Such differences also occurred at other sites. In the collection from Neanderthal, for example, among the 67 finds, the length varies between 5.5 mm and 19.9 mm and the width from 5.1 to 20.00 mm. The size distribution appears bimodal (Hillgruber 2006, 120, 121, tab. 2).

Qualitative attributes such as the retouch type and range were also considered. No correlation was found between the tool size and the retouch type (unifacial, bifacial and alternating). Interestingly, bifacial forms receive a higher median than the other two. The correlation between the length and the retouch continuation or discontinuation proved surprising. Rounded retouched tools have a median length, which shows they were not obtained by reducing larger items. Except for the Okiennik Cave, it is reasonable to believe these items were created as independent projects.

5.2. Results of the geometric-morphometric comparison

The entire set of rounded retouched tools was analysed using the landmark matrix describing the 2D shape and the Procrust approach. Using the Principal Component Analysis (PCA) method, a scree plot (Fig. 6: A) was obtained, indicating significant variation

in the analysed set, as evidenced by the dispersion of principal components. The cut-off occurs after the 6th component, and the first component does not exceed 33%. The deformations in the plot for Component 1 run from the more irregular, elongated shapes towards those that are more flattened. PC2, on the other hand, ranges from diamond-like shapes to irregular ovals (Fig. 6: B). Regarding the tool distribution, the finds from

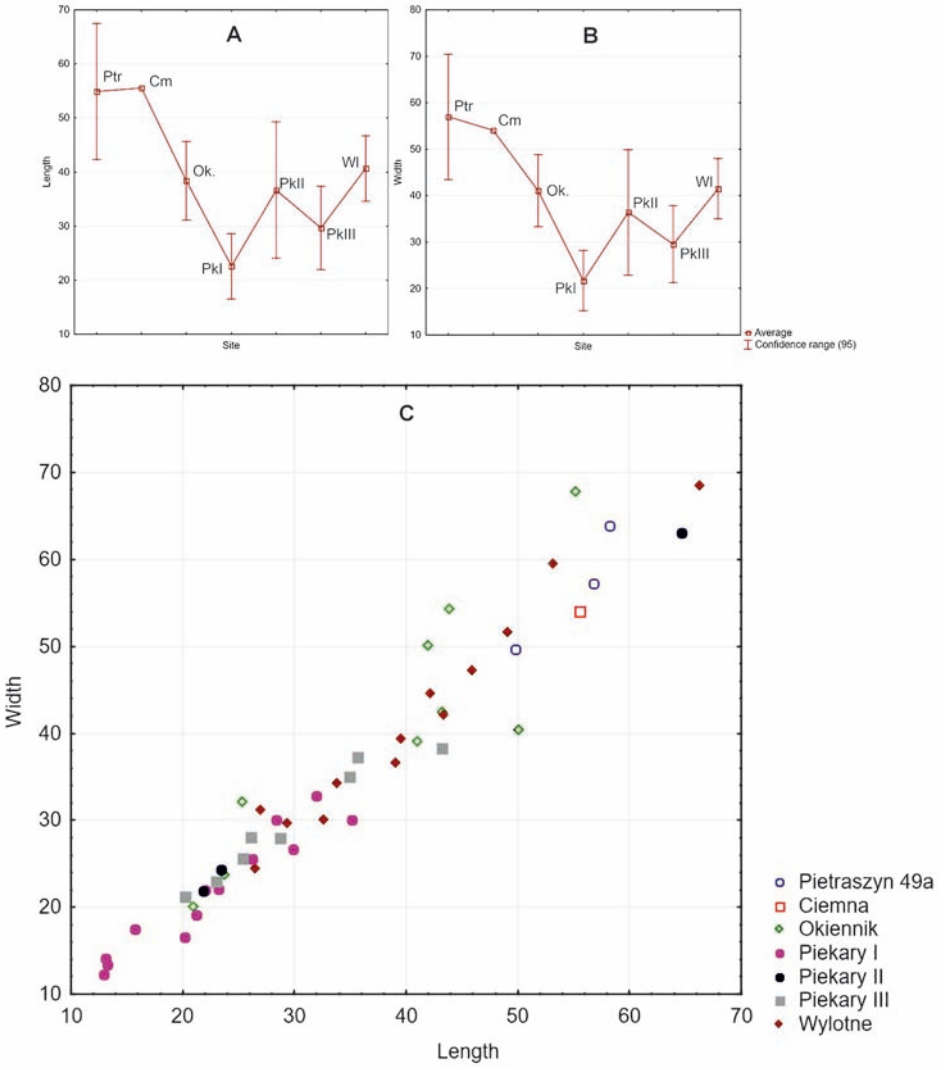

Fig. 5. A and B – scatter plot of mean length and width of all-round retouched tools from Poland (Group 1), Cm – Dark Cave, Ok – Okiennik, Pk – Piekary I-III, Ptr – Pietraszyn, Wl – Wylotne Rockshelter; B – scatter plot of length and width of rounded retouched tools from Poland (Group 1). Prepared by A. Kobyłka and A. Wiśniewski

Pietraszyn 49a are in the middle part of the graph. Specimens from Wylotne Shelter are also clustered in the central part of the diagram. The finds from Okiennik and Piekary I are the most varied. They also affect the overall variance of the assemblage.

If we consider only the characteristic 2D shape of the tools, it can be said that they form a homogeneous group. However, if we regard their technical characteristics and size, we must state that they are varied. Differences occur within sites (assemblages) as well as between them (Figs 5 and 6).

Assuming the makers manufactured this specific tool type by reproducing its production process, it did not result in 'standardisation' in the present understanding. Factors

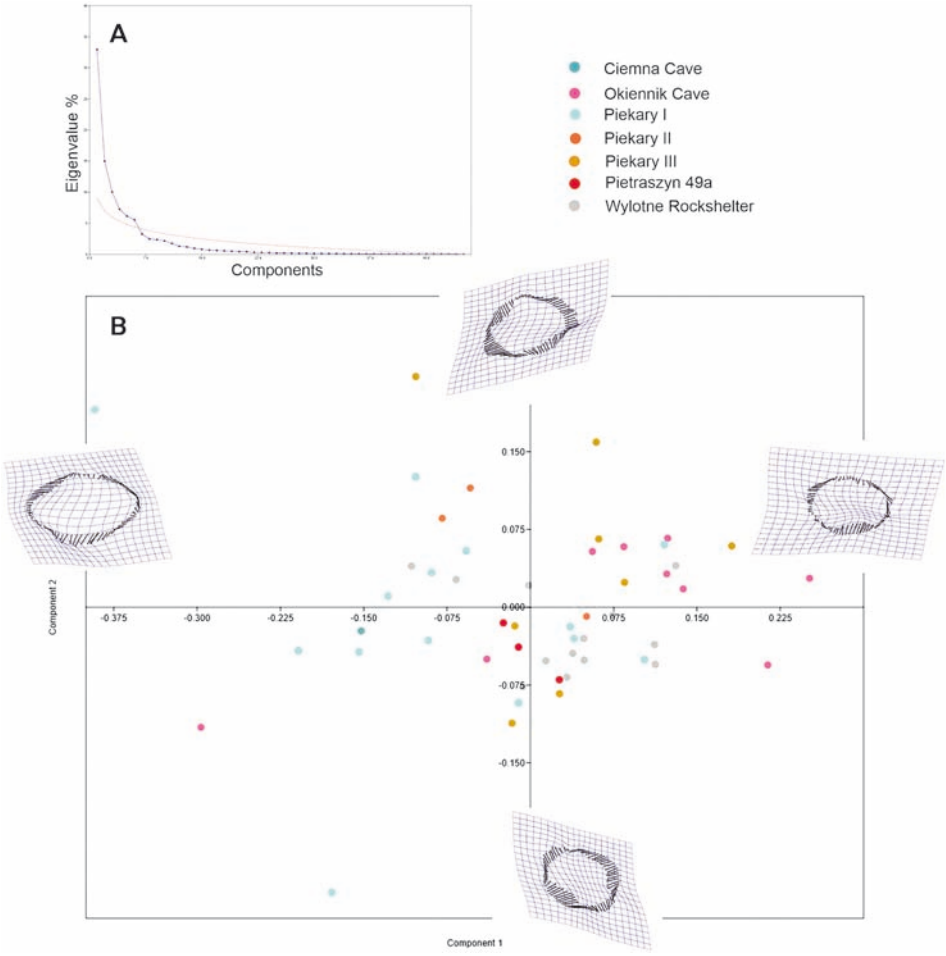

Fig. 6. Principal Component Analysis (PCA) of landmarks. A – Scree plot of components with the broken stick. B – Scatter plot with shape deformations. Prepared by A. Wiśniewski

such as the quality and access to the raw material may have effectively limited reproducibility. Some studies indicate that the standardisation level achieved by Middle Palaeolithic artisans for lithic raw materials did not differ from that attributed to anatomically modern humans producing Late Palaeolithic tools (Marks *et al.* 2001). In the Late Palaeolithic, it is possible to find other examples of the lack of modern metric standards. One of the most prominent examples comes from a Magdalenian camp at the site of Wilczyce 10. A group of 'female figurines' made of flint show a substantial morphological similarity but significant metrical differences (Boroń *et al.* 2013). The length discrepancy in the set of 50 specimens ranges from 27 mm to 83 mm. It is also worth noting that in the case of other Middle Palaeolithic craft areas, such as bone processing, regularity was sometimes maintained at an upper level (see Majkić *et al.* 2018) and sometimes at a lower level (Płonka *et al.* 2024). The reasons behind this behaviour are obscure. It does not seem, however, to have resulted from the different cognitive capacities of archaic and modern humans (*e.g.*, Monnier *et al.* 2010).

The presence of rounded retouched tools, primarily in the Micoquian assemblages, suggests that, like other tool types, they were the subject of social information transfer. The noticeable differences in 'groszaki' within the assemblages and between the sites are unsurprising, considering, for example, the variation in shaped tools. There seem to be several reasons for this. In addition to the apparent raw material and functional differences, the mode of social learning may come into play, which is sometimes crucial in transmitting specific patterns. Perhaps the information transfer became more liberal during the development of the classical Micoquian, or the observed picture results from the atomisation of social groups due to demographic problems (see Shennan 2002; Henrich 2004; Premo and Kuhn 2010; Wiśniewski 2012).

5.3. The problem of function

To date, it has not been possible to resolve whether rounded retouched tools were used in everyday practical activities. The finds are poorly preserved or lack use-wear traces. Traces were not found on the artefacts from Pietraszyn either, although they had previously been recorded on knives, scrapers and retouched flakes there (Wiśniewski *et al.* 2019). One of the authors (KP) conducted similar investigations of other Polish Micoquian culture collections, but with no more conclusive results. Studies of the most numerous collections from Neanderthal were impossible due to the patina (Hillgrube 2006, 121, 122). Only in Sesselfelsgrotte were positive results obtained for 43 pieces (Richter 1997, 184). The items displayed contact traces with 'soft, fleshy and sometimes woody plant material.'

Considering the size of 'groszaki', it was suggested that they may have been children's toys (Stapert 2007), which would also partly explain the lack of use-wear traces. Current research shows the important role that children's play plays in development (Dag *et al.*

2021; see also Riede *et al.* 2023). It is reasonable to believe that this was also important in the past.

The making of these objects seems intriguing. Tools from Pietraszyn, site 49a, must have been prepared by experienced knappers. All specimens contain traces of centripetal-directed invasive detachments, often preceded by preparing a striking platform.

6. CONCLUSION

The presence of rounded retouched objects at the site of Pietraszyn 49a was expected, as these tools have been previously recorded in the Micoquian contexts. It may be a surprise that they occurred at a site interpreted as a tool-shaping workshop.

The Pietraszyn tools, metrically compared to similar specimens from Poland, belong to the subset of larger objects. All three were prepared using thinning, invasive-short and marginal retouch oriented one- or two-sidedly. The combination of these three retouching methods in 'groszaki' is rare. Geometrically, the specimens from Pietraszyn are close to other oval tools of this type found at Poland's Micoquian sites.

Considering their technological and metric features, most of these tools were shaped to be oval. In individual cases, the possibility that they are reduced items made of less regular tools cannot be rejected. No use-wear traces were found on the finds from Pietraszyn, as on more than a dozen other specimens from central Europe. There are currently no premises to interpret them in purely utilitarian terms. In this situation, various other concepts must be considered, which, on the one hand, stimulate the imagination and, on the other, escape empirical evaluation.

It must be stated that 'groszaki' are, apparently, products of inter-generational and/or inter-group information transfer. Their variation probably does not differ from that observed in other tool categories used by the humans associated with Micoquian.

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Agnieszka Czekaj-Zastawny[1]

IMPORTED ARTEFACTS FROM THE SITE BRZEZIE 17 (LESSER POLAND) IN THE LIGHT OF THE LINEAR POTTERY CULTURE EXCHANGE CONTACTS WITH THE EASTERN-LINEAR CIRCLE

ABSTRACT

Czekaj-Zastawny A. 2025. Imported artefacts from the site Brzezie 17 (Lesser Poland) in the light of the Linear Pottery Culture exchange contacts with the Eastern-Linear circle. *Sprawozdania Archeologiczne* 77/2, 195-215.

In the second half of the 6th millennium BC, two cultural circles developed on both sides of the Carpathians – the Linear Pottery Culture and the Eastern-Linear Culture. Contacts between these two units were based mainly on the long-distance exchange of richly decorated ceramics and stone raw materials. Very strong connections are visible primarily between the area of the upper Vistula river basin and eastern Slovakia. A very good example of these contacts are imported objects from the LBK settlement in Brzezie Site 17. As the analyses carried out have shown, they come from the territories of eastern Slovakia – the Šariš Basin and East Slovak Plain. As the LBK developed, the exchange of goods gradually flourished. The intensification of contacts with the south is legible at most of the settlements in south-eastern Poland, mostly starting from the decline of the LBK II phase. These contacts ceased suddenly as the Linear Pottery Culture and the Bükk Culture diminished.

Keywords: Eastern Linear circle ornamentation, Eastern Linear circle, ornamentation, obsidian, Linear Pottery Culture, Tiszadob-Kapušany group, Bükk Culture, ceramic imports

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1. LOCATION OF THE SITE

Wide-area rescue excavations in Brzezie Site 17, Kłaj commune (AZP 104-59/36) on the line of the A4 Freeway under construction (Kraków-Tarnów section) started in 2000. The site is located in the so-called Wieliczka-Bochnia loess area, belonging to the Bochnia Foothills, the mesoregion of the Sandomierz Basin (Kondracki 1994). More precisely, it lies in the source area of the Tusznica River (the left-hand tributary of the Raba), on a small plateau bordered from the west by a steep slope cut by high escarpments. From the east is has a form of a promontory descending gradually towards the river valley. Towards the south, the raising ground merges with the slope water divider and on the north with a small elevation in the Vistula flood basin (Fig. 1). The site lies on loamy loess.

2. SETTLEMENT REMAINS

On Site 17 in Brzezie the were discovered and examined 2775 features. The largest number of pits was associated with the Linear Pottery Culture (1251 features), and significantly fewer with later units such as the Malice Culture, the Lengyel Culture, the Mierzanowice Culture, the Lusatian Culture, and the modern period (Czekaj-Zastawny 2014).

The most interesting result of the research was discovering the settlement of the Linear Pottery Culture (LBK), with traces of long houses of the post construction. These discoveries, combined with results of excavations on other sites of that type, throw new light on the question of the presence of long houses in the Lesser Polish LBK milieu, especially on the scale of that phenomenon.

In Brzezie the remains of 26 households of the Linear Pottery Culture were discovered. Each of them contained one long rectangular house of post construction, accompanied by constructional pits, all situated along (more or less) a N-S line. There were also other features, especially utility pits of medium size, most often to the north of the house.

A notable discovery was the excavation of four burials linked with LBK. They were situated on the western peripheries of the site, at the foot of the plateau with settlement features. Skeletal remains did not survive, but two of the burials were equipped with funerary goods. Another interesting feature of the site was a section of palisade by the group of houses and utility pits discovered in the eastern part of the site, in form of the foundation groove with remains of wooden posts within.

Stylistic analysis indicates that materials of the Liner Pottery Culture from Brzezie 17 come mainly from the LBK second (Music-Note) phase, from its early stage (NI) to the late stage (NIII), mainly with NII (classic). This is confirmed by ^{14}C dates: 5152±65 BC, 5129±62 BC (Poz-47716: 6200±40 BP, Poz-47715: 6170±40 BP; calibration afterCalPal, version March 2007; Weninger, Jöris 2004; Weninger *et al.* 2007; Czekaj-Zastawny 2014) which fall exactly into NI. In the absolute chronology of LBK in southeastern Poland, the II (Music-

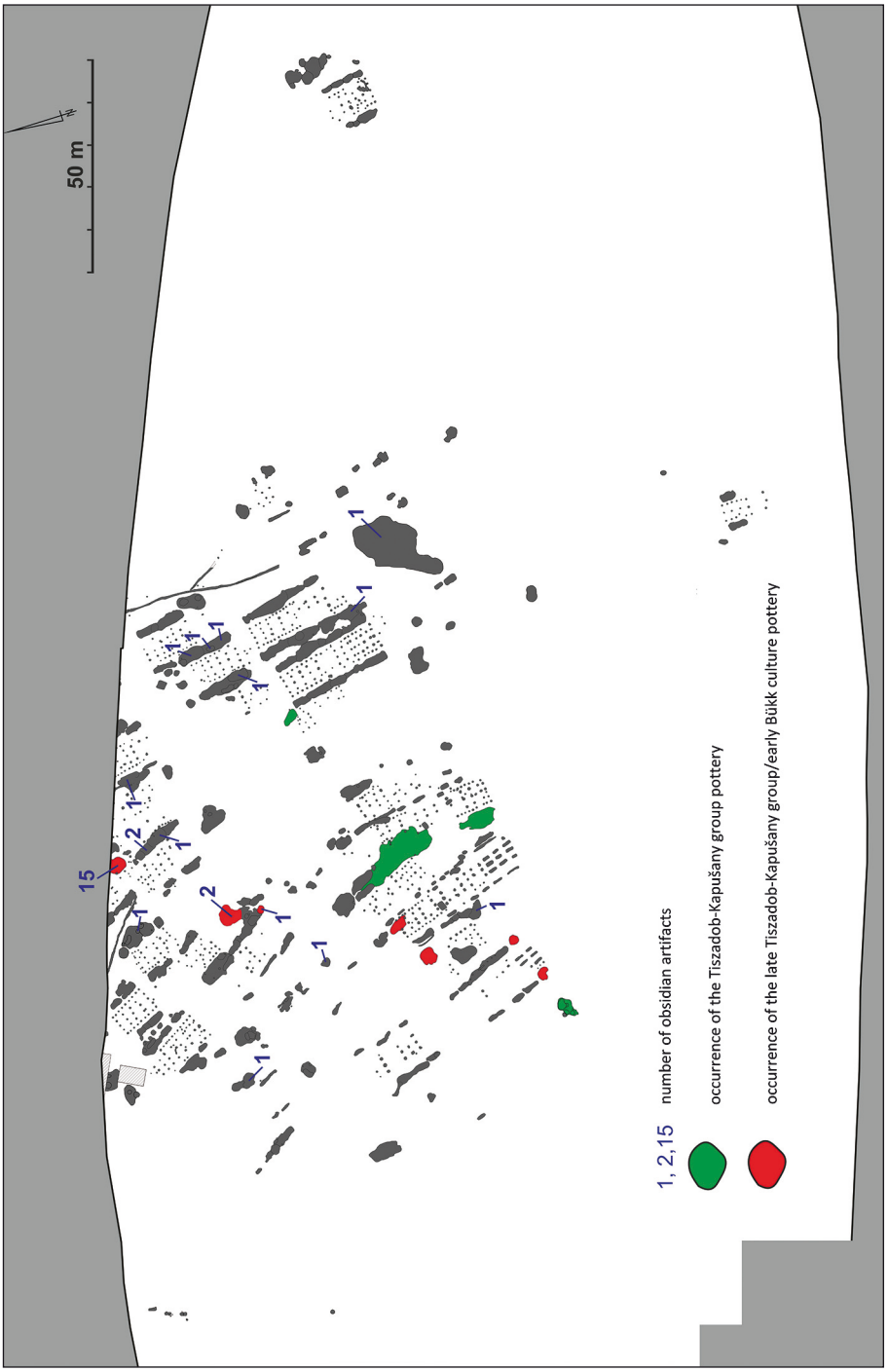

Fig. 1. Brzezie, Site 17, Kłaj commune. Distribution of imported Eastern-Linear pottery and obsidian artefacts in the LBK settlement. Drawn by K. Juszczyk

Note) phase was developing between *ca*. 5240/5219-5136/5084 BC (Oberc *et al*. 2022). Fragments of imported pottery from Brzezie come from the Eastern-Linear circle (ALPC) – the Tiszadob-Kapušany group and the Bükk Culture, Pre-Classic phase, contemporary with the LBK II (Music-Note) phase and the beginning of the III (Želiezovce phase; Hreha and Šiška 2015).

3. IMPORTED POTTERY

The imported pottery is represented by 89 fragments of vessels coming from the Eastern-Linear circle, or more precisely pots of the Tiszadob-Kapušany group and early phase of the Bükk Culture (Czekaj-Zastawny 2014). They have been attributed to 21 forms – six spherical bowls, five amphorae and ten unknown vessels (Table 1).

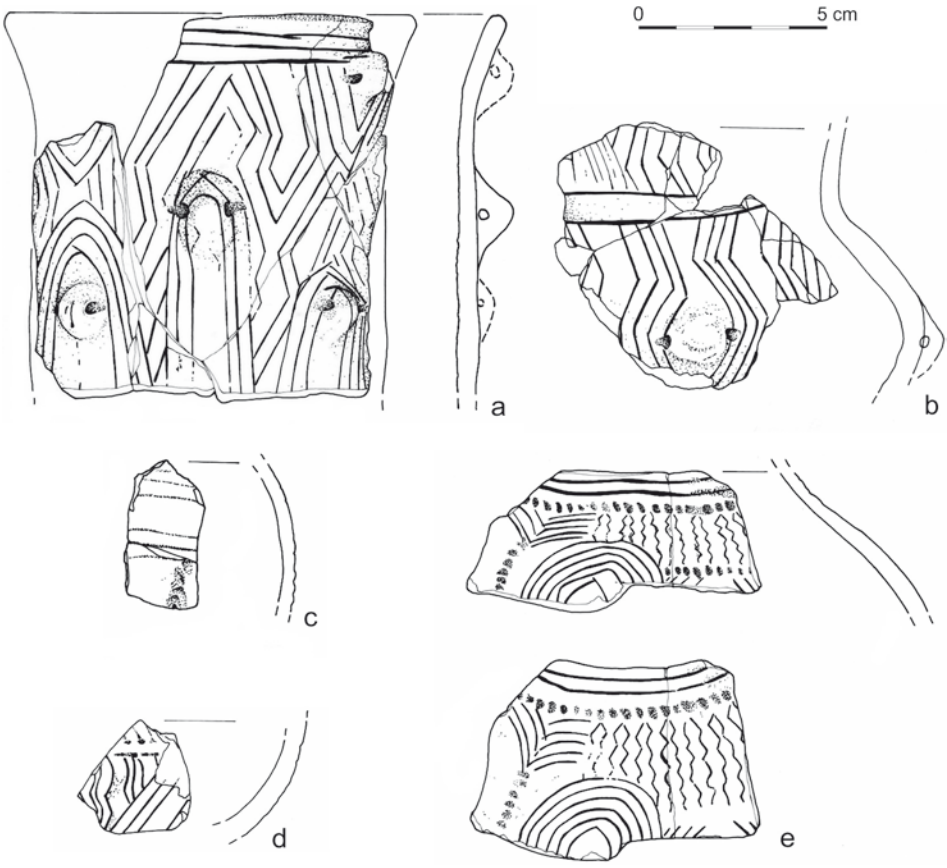

Fig. 2. Brzezie, Site 17, Kłaj commune. Imported Eastern-Linear pottery: a, b – House I (Feature 1); c, d – House II (Feature 762); e – House XII (Feature 400). Drawn by B. Grabowska and A. Krzywda

Table 1. Brzezie, Site 17, Kłaj commune. Fragments of vessels and obsidian artefacts imported from the Eastern-Linear circle

feature no./part/ depth	house no.	numbers of fragm/ number of forms	straight line and angular motifs	straight line and undulating motifs	arched and undulating motifs	chronology	number of obsidian artefacts	flakes	blades	chips	retouched tools
1/C2, F-G	I	19 fragments of rim and belly/ 1 amphora	1+ 4 round knobs horizontally perforated in the belly bilge	-	-	Tiszadob-Kapušany	-	-	-	-	-
1/C3,		8 rim and neck fragments/ 1 amphora	1+3 rows of round knobs horizontally perforated on the neck	-	-	Tiszadob-Kapušany	-	-	-	-	-
1/C3, D-E 1/D1, E-F		3 belly fragm./ 1 undeterm.	1	-	-	Tiszadob-Kapušany	-	-	-	-	-
762, C-D	II	3 belly fragments/ 2 undeterm.	1	1	-	Tiszadob-Kapušany	-	-	-	-	-
158	IV	-	-	-	-	-	1	1	-	-	-
238		-	-	-	-	-	2	1	1	-	-
245	V/VI	-	-	-	-	-	1	1	-	-	-
340	IX	-	-	-	-	-	1	1	-	-	-
376		-	-	-	-	-	1	-	1	-	-
377		-	-	-	-	-	1	1	-	-	-
450		-	-	-	-	-	1	1	-	-	-
400/B, F-G	XII	2 rim and belly fragments/ 1 spherical bowl	-	-	1	LateTiszadob-Kapušany	-	-	-	-	-
932		-	-	-	-	-	1	-	1	-	-

feature no./part/ depth	house no.	numbers of fragm/ number of forms	straight line and angular motifs	straight line and undulating motifs	arched and undulating motifs	chronology	number of obsidian artefacts	flakes	blades	chips	retouched tools
1167	XIII	-	-	-	-	-	1	-	1	-	-
709	XV	-	-	-	-	-	1	1	-	-	-
810/D, C-D		1 belly fragment/ 1 undeterm.	-	-	1	Bükk culture, Early Phase	-	-	-	-	-
857/B, J-K		1 neck fragment/ 1 amphora	-	-	-	Tiszadob-Kapušany/ Bükk culture	-	-	-	-	-
2393/C, C-D		8 belly fragment/ 1 amphora?	1+ indistinctive knobs on the bilge of the neck?	-	-	Bükk culture, Early Phase	-	-	-	-	-
2393/D, D-E		10 belly fragment/ 1 spherical bowl?, 2 undeterm.	1+ round handles vertically perforated on the belly bilge; 2	-	-	Bükk culture, Early Phase	-	-	-	-	-
996/A, D-E	XIX	9 rim and belly fragments/ 1 spherical bowl	-	-	1	Bükk culture, Early Phase	-	-	-	-	-
1287, F-G		2 belly fragments/ 1 spherical bowl?	-	1	-	Tiszadob-Kapušany	-	-	-	-	-
2229/C, C-D		2 belly and bottom fragments/ 1 spherical bowl?	1	1	-	Bükk culture, Early Phase	-	-	-	-	-
2330/C, I-J		6 rim and belly fragments/ 1 amphora	1	-	-	Bükk culture, Early Phase	-	-	-	-	-

2232/B2, E-F	XX	1 near-bottom fragment/ 1 undeterm.	1	-	-	Late Tiszadob-Kapušany/ Bükk culture, Early Phase	2	1	1	-	-
2446/A, D-E		1 belly fragment/ 1 undeterm.	1+ dense dots on ends if the line	1	-	Late Tiszadob-Kapušany/ Bükk culture, Early Phase	1	1	-	-	-
2749	XXI	-	-	-	-	-	1	1	-	-	-
216/A, F-G	unidentified house	10 rim and belly fragments / 1 spherical bowl	-	1	-	Bükk culture, Early Phase	15	12	2	-	1
216/B, K-L		1 belly fragment / 1 undeterm.	-	-	1	Bükk culture, Early Phase					
1127	separated pit	-	-	-	-	-	1	-	1	-	-
2269	seperated pit	-	-	-	-	-	1	-	1	-	-
2503	separated pit	-	-	-	-	-	1	-	1	-	-
Layer 314	cultural layer of LBK	-	-	-	-	-	1	1	-	-	-
846	secondary deposit	-	-	-	-	-	5	-	4	1	-
layer 1, A-B, 160/110	secondary deposit	1 belly fragment/ 1 undeterm.	-	-	-	Bükk culture, Early Phase	-	-	-	-	-
TOTAL		**89**					**39**				

SPHERICAL BOWLS. These are forms typical of the entire linear circle – in the shape of a segment of a sphere, with rims directed towards the interior of the vessel and a flat bottom, gently extending into the walls (Fig. 2: e; Fig. 4: c). It was possible to reconstruct one vessel in its entirety (from Feature 996), with a diameter of the mouth of 14 cm and a height of approximately 12 cm (4: a). The engraved ornamentation is very extensive, consisting of arrangements of densely spaced, multiple lines. Ornamental motifs fill entire zones on the surfaces of the vessels and, in the case of spherical bowls, these are rectilinear and wavy or arched and wavy motifs. One of the vessels was additionally equipped with round, nodular, vertically pierced lugs, placed on the bulge of the belly.

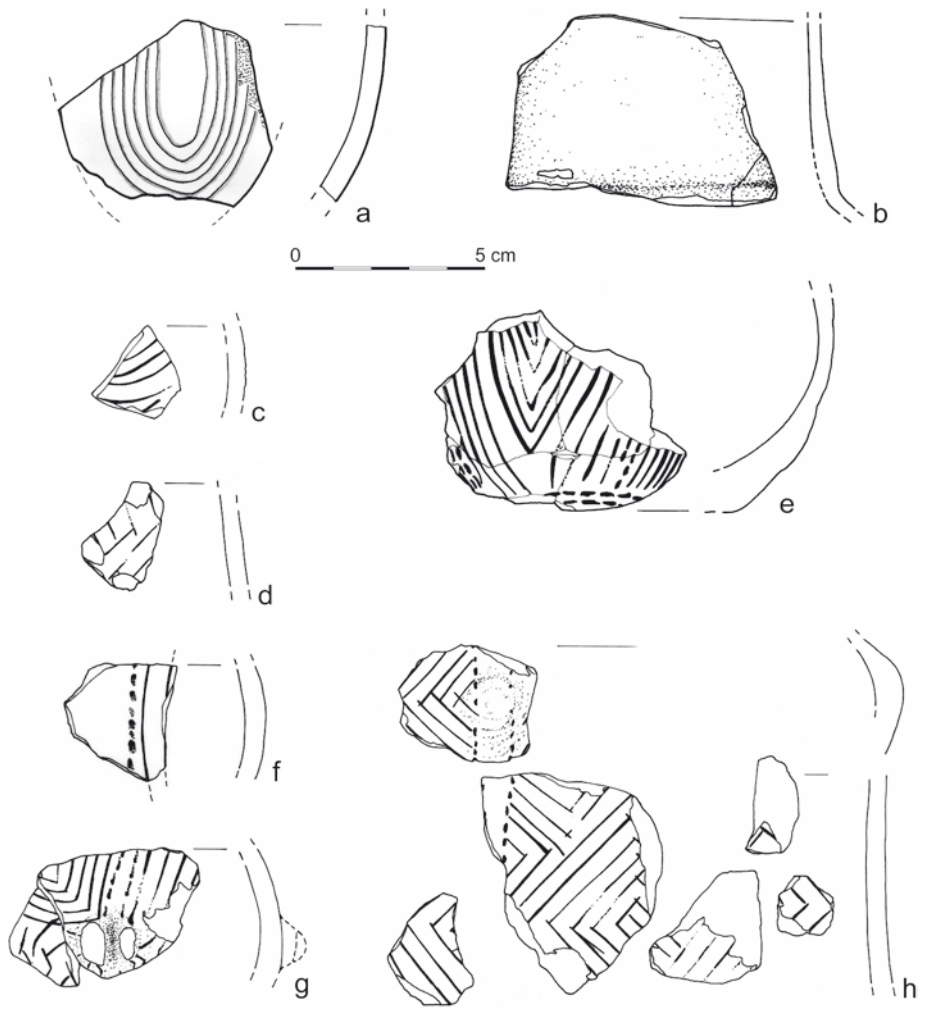

Fig. 3. Brzezie, Site 17, Kłaj commune. Imported Eastern-Linear pottery from House XV: a – Feature 810, b – Feature 857, c-h – Feature 2393. Drawn by B. Grabowska and A. Krzywda

AMPHORAE. They belong to the category of vessels with a neck. These are forms with squat, strongly swollen bellies, sometimes with a slightly visible bend, and necks that are lower (4-5 cm), slightly flared, or high (over 10 cm), cylindrical (Fig. 3: b, h; Fig. 4: e). Lugs in the form of round, pierced nodules or outwardly pushed nodules are located on the bulge of the belly and/or on the necks of these vessels. One of the neck fragments is undecorated,

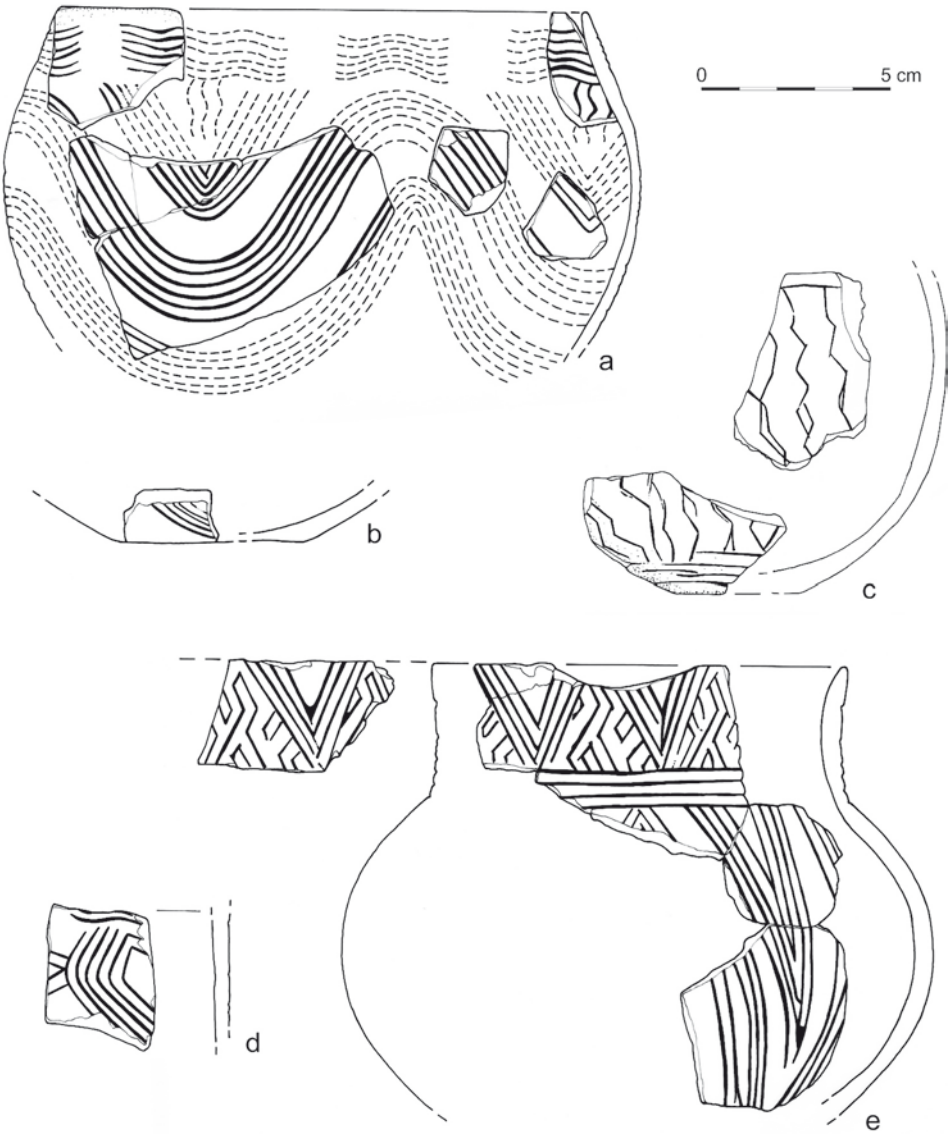

Fig. 4. Brzezie, Site 17, Kłaj commune. Imported Eastern-Linear pottery from House XIX: a – Feature 996, b, d – Feature 2229, c – Feature 1287, e – Feature 2330. Drawn by B. Grabowska and A. Krzywda

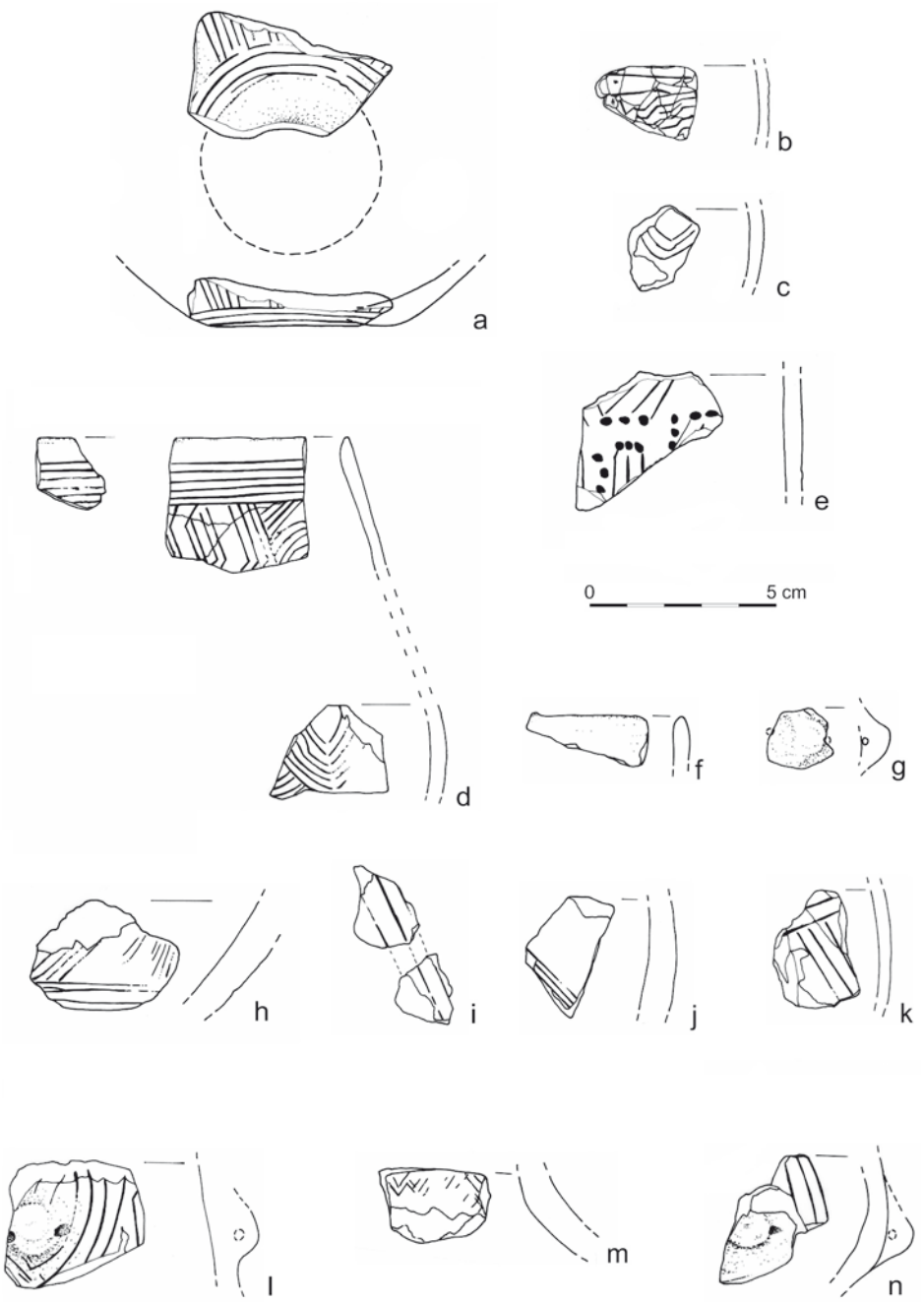

Fig. 5. Brzezie, Site 17, Kłaj commune. Imported Eastern-Linear pottery: a, b – House XX (Feature 2232, Feature 2446, c, d – Feature 216, e-n – secondary position. Drawn by B. Grabowska and A. Krzywda

the remaining amphorae, like the spherical bowls, are densely covered with an ornament of multiple engraved lines building angular motifs. Unlike the spherical bowls, there are no arched or wavy motifs. An amphora from which a high, cylindrical neck has been preserved (Fig. 2: a) was a particularly attractive vessel. Even in the Eastern-Linear circle these vessels were not common. An analogous form comes from Hungary, from the Öcsöd-Kováshalom site (Raczky 1999/2000).

The remaining small fragments of unidentified forms are decorated in the same style – densely spaced engraved, angular, arched or wavy lines (Fig. 3: c, d, f, g; Fig. 5: a-n).

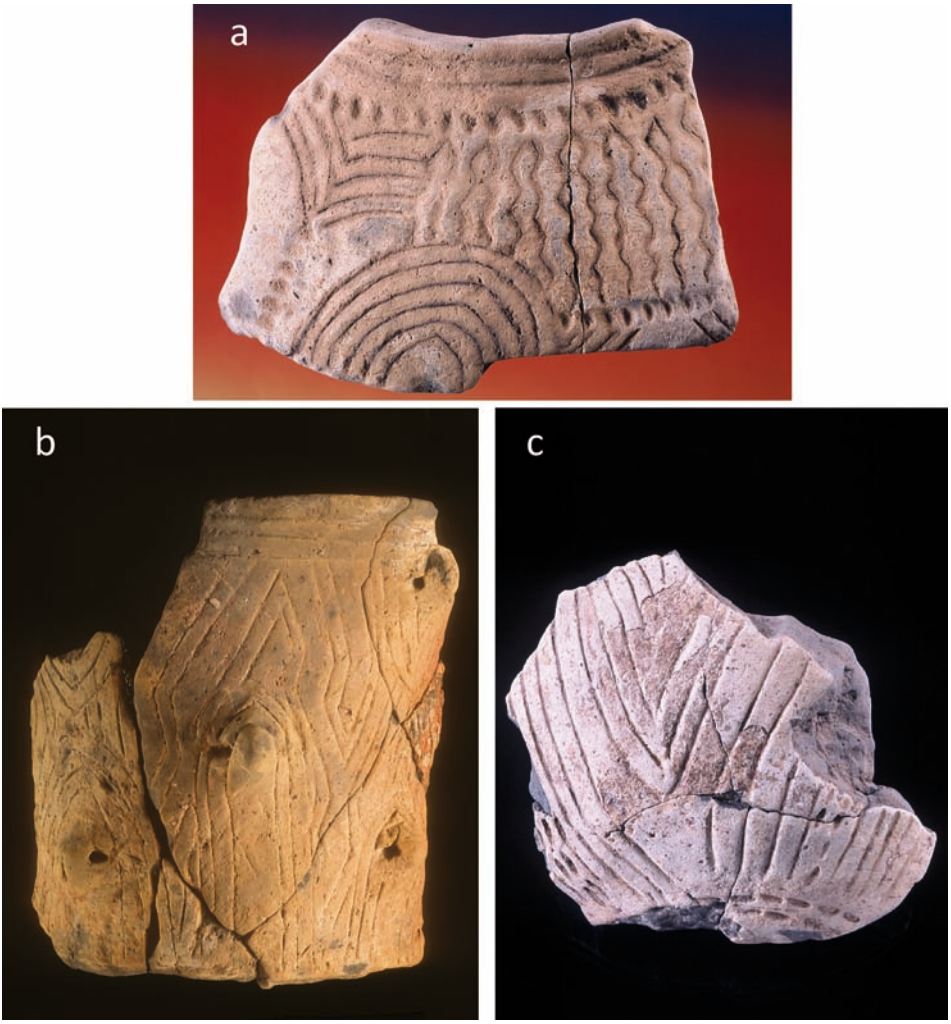

Fig. 6. Brzezie, Site 17, Kłaj commune. Examples of imported Eastern-Linear pottery from Features 400 (a), 1 (b) and 2392 (c). Photo R. Słaboński

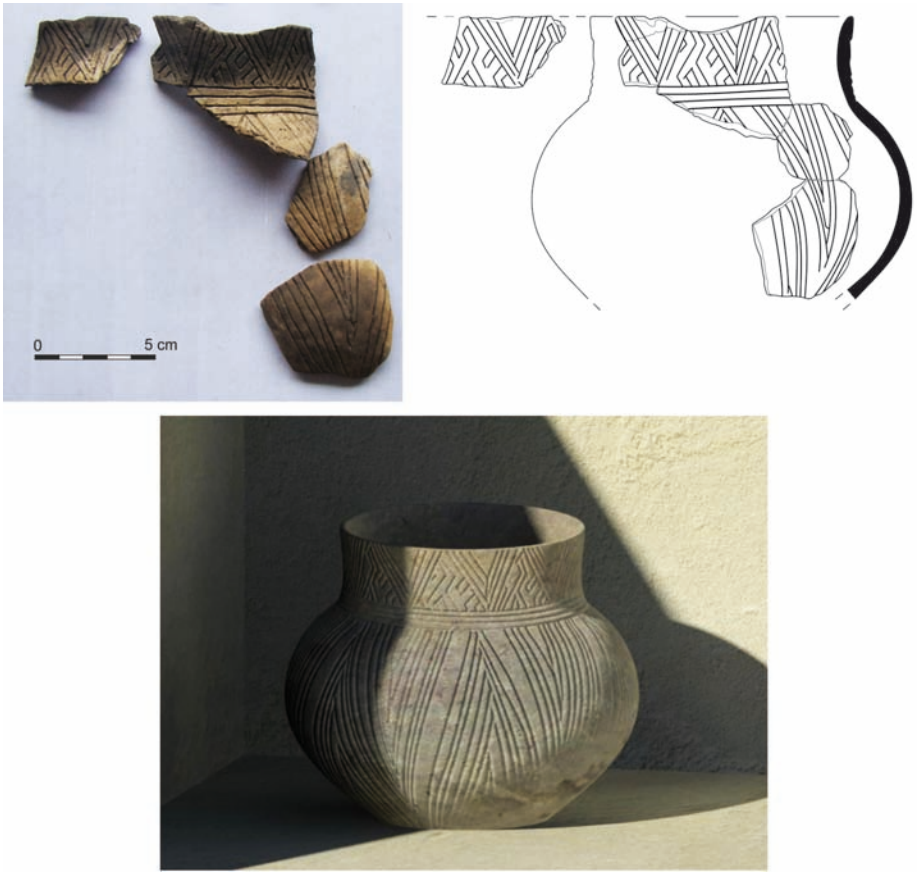

Fig. 7. Brzezie, Site 17, Kłaj commune. Imported Eastern-Linear pottery from Feature 2330. Drawn by J. Ożóg, reconstructed by K. Juszczyk

All fragments of the imported vessels represent small thin-wall forms with rich engraved ornamentation (Fig. 6; Fig. 7). Technologically, it was high quality pottery with smooth (matt or glossy) walls of thickness varying from 3 to 8 mm (most frequently 4-5 mm). The pottery fabric use for their production was very well made, homogenous, with very small amount of fine temper. Microscopic observations of 11 samples (Rauba-Bukowska 2014) resulted in distinguishing two basic types of them: (a) with small amount of fine sand and mica, vessels with soft 'floury' surface; (b) with very fine grain and high amount of mica, vessels with smooth 'hard' surface. Material of the first type was used in nine vessels, and of the second type in 12 vessels. It appears that pottery forms and their chronology were not related to any specific pottery fabric, neither in vessels of the Tiszadob-Kapušany group nor of the early Bükk Culture. Nonetheless, the imported forms are technologically distinctive from locally produced LBK vessels (Czekaj-Zastawny and Rauba-Bukowska 2014).

Decoration on seven vessels (wavy and angular motifs and meanders; *e.g.*, from Features 1, 400, 762, 2446) is typical for the Eastern-Linear Tiszadob-Kapušany group in northeaster Hungary and eastern Slovakia, contemporary with the II phase of LBK (Tompa 1929; Šiška 1979; 1995; Kozłowski 1998; Kaczanowska and Godłowska 2009; Hreha and Šiška 2015). Eight other vessels (*e.g.*, from Features 216, 810, 996, 2229, 2393) can be related to the early Bükk Culture (Šiška 1979), contemporary with the III phase of LBK. Inferring from decorative motifs (multiple arched and wavy lines) the finds from Brzezie are linked with the early phase of this unit.

As already mentioned, two main groups of pottery fabric were recognized in pottery from Brzezie: (a) with small amount of fine sand and mica; (b) with very fine sand and high amount of mica. According to Slovak archeologists, in the Eastern-Linear circle, vessels with 'soft' floury surface with negligible mica admixture (like fabric a) are typical mainly for sites in the Šariš Basin (*e.g.*, Prešov or Šarišské Michaľany), while pottery with high amount of mica (like fabric b) appears almost exclusively in the Zemplín region (Hreha and Šiška 2015). Relations with latter area are confirmed also by the presence in Brzezie of obsidian artefacts (this raw material was exploited by people of the Eastern-Linear circle in the Zemplín Mts. (Kozłowski 1997; Kalicki *et al.* 2007; Werra *et al.* 2021; 2024a; 2024b; Kozłowski *et al.* 2014; Wilczyński 2016; Czekaj-Zastawny *et al.* 2017; Szeliga 2022; Szeliga *et al.* 2021). Concluding, the imported pottery was brought to the Brzezie site from territories of eastern Slovakia – the Šariš Basin and East Slovak Plain.

4. IMPORTED OBSIDIAN ARTEFACTS

In the collection of 40 obsidian artefacts from Brzezie (Fig. 8; Fig. 9) there are 24 flakes, 14 blades, one chip, one retouched blade (Wilczyński 2014). They were found in eighteen features, mainly as single appearances (*cf.*, Table 1). However in Feature 216 there were fifteen of them, in Feature 846 of the Malice Culture in the secondary position – five, and in Features 238 and 2232 – two artefacts in each feature. It seems that the appearance of obsidian artefacts – in contrast to imported pottery – was not related to the house type (from pits of one-part House IX there are four artefacts, and from pits related to Houses IV and XX – three artefacts respectively). Therefore, it is not a very large inventory (such as the one discovered in the settlement in Olszanica; Milisauskas 1986). In any case, in Brzezie obsidian was only a secondary raw material, testifying to the contacts that the inha-bitants of the site maintained with the Eastern-Linear cultural circle (Wilczyński 2014).

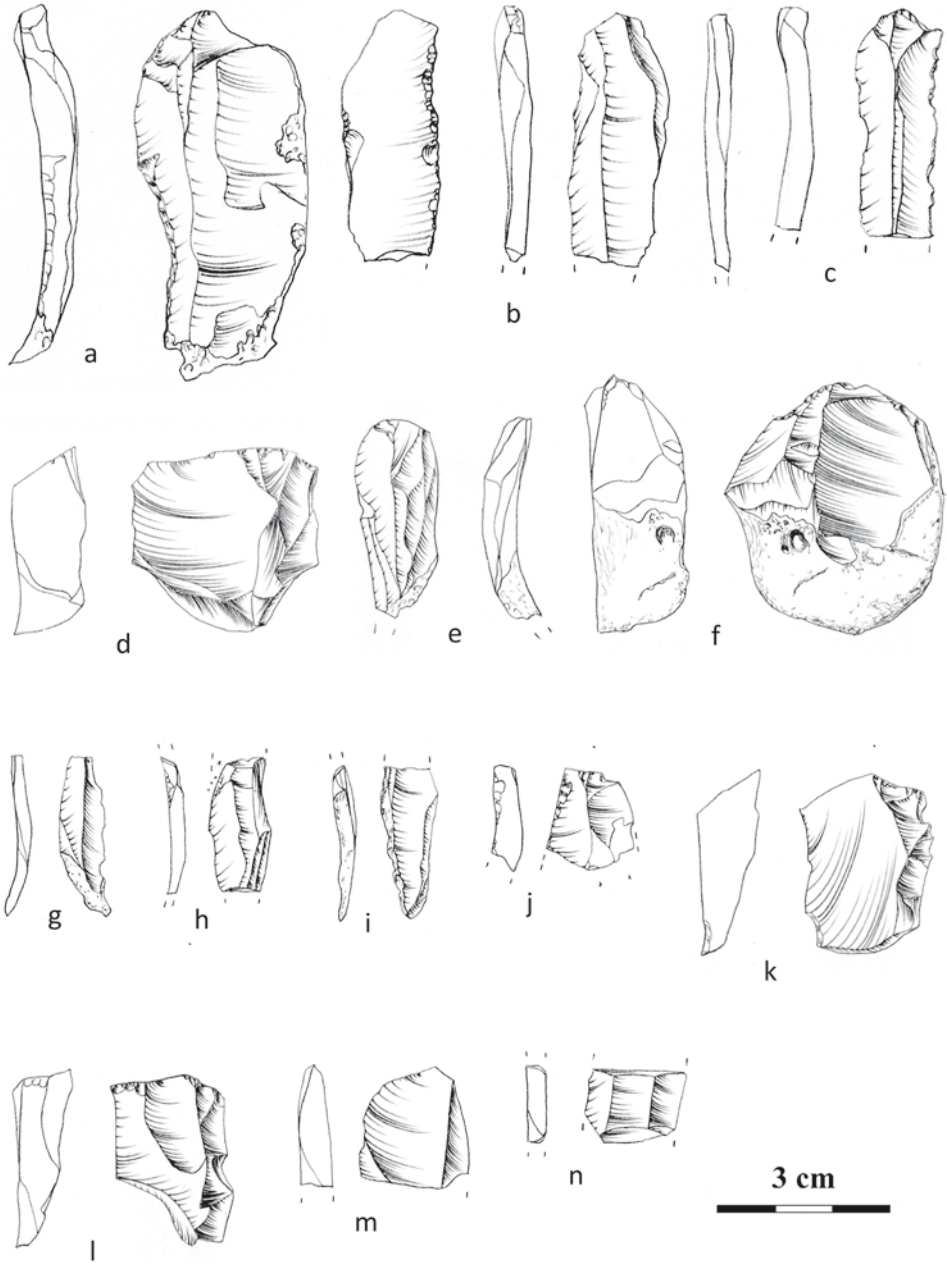

Fig. 8. Brzezie, Site 17, Kłaj commune. Obsidian artefacts from the LBK settlement:
a – retouched blade, b, c, e, g-j, m, n – blades, d, f, k, l – flakes; a, b, d, k, l – Feature 216, c – Feature 376, e – Feature 1127, f, n – Feature 2232, g – Feature 846, h – Feature 1215, i – Feature 846, j – Feature 2503.
Drawn by J. Wilczyński

Fig. 9. Brzezie, Site 17, Kłaj commune. Example of obsidian artefact.
Photo R. Słaboński

5. DISTRIBUTION OF IMPORTED ITEMS WITHIN THE SETTLEMENT

Almost all potsherds were found in fills of LBK features related with three-part houses (of Type 1 according to Modderman 1986). Thus, from Feature 2393 (at House XV) there are fragments of four vessels, from Feature 1 (near House I) – of three vessels, from Feature 762 (at House II) – of two vessels. Fragments of two imported forms were also found in Feature 216 (of a workshop character). The other fragments appeared as individual finds (*cf.*, Fig. 1, Table 1)

In Brzezie, in the subsequent development phases, there was always a tripartite building distinguished by its structure and length. These were Houses II, XII, XV, XVII, XIX (Czekaj-Zastawny 2014). This is a regularity observed in almost every LBK settlement (Czekaj-Zastawny 2008; 2009; 2013a; 2013b; 2017). These houses are also distinguished by other features, such as the nature of the inventories of their household. This is where imported ceramics are concentrated (Houses XII, XV, XIX), as well as unique objects, the only ones at the site, such as a graphite pendant (near House III), a clay bracelet and a miniature bowl with holes in the bottom (near House XV), and a vessel with a hole (House XIX). Moreover, the household features are characterised by the greatest variety of artefacts (*e.g.*, House XV – a bracelet, a bowl with holes in the bottom, imports, spindle whorls,

a shoe-last tool, a quernstone, pottery, flint products; House XVII – spindle whorls, shoe-last tool, pottery, including a miniature bowl, flint products; House XIX – vessel with a hole, imports, shoe-last tool, quernstone, pottery, including a miniature bowl and spherical bowl, flint products; House XX - imports, spindle whorls, shoe-last tools, quernstone, pottery, flint products).

Similar wealth of inventory is only present in Feature 216 – it is not known, however, whether it is connected with a particular house or relates to the settlement as a whole. It is unique in many ways. In addition to numerous fragments of vessels, including imported ones, and a cache of ochre, it contained six hundred flint artefacts and 14 items made of obsidian (mainly flakes). It can be assumed that there was a specialized workshop here that dealt with the processing of the above-mentioned raw materials. It appears, moreover, that, unlike imported pottery, the occurrence of obsidian was not related to house type. Apart from Feature 216, the majority of artefacts (four pieces) come from the pits of single-part House IX, followed by three each from the pits of Houses IV and XX.

6. EXCHANGE CONTACTS – DISCUSSION

In the second half of the 6th millennium BC, the cultural entities of the Eastern-Linear Pottery circle maintained regular contacts with the LBK for few hundred years. They had strongest links with the areas of the upper Vistula river basin. It is believed that their primary purpose was the exchange of goods, made perhaps during hiking through the Carpathian passes (Pelisiak 2018) or during summer grazing of cattle in the area (Valde-Nowak and Kienlin 2002-2004). High quality raw materials used for tool production – Jurassic flint from Lesser Poland exchanged for obsidian from the areas beyond the Carpathians – formed the core of this exchange. Additionally, this was accompanied by an inflow of pottery from the Eastern-Linear Pottery Culture. These contacts were certainly accompanied by the exchange of information, ideas and new technologies (Czekaj-Zastawny *et al.* 2017; Rauba-Bukowska and Czekaj-Zastawny 2020). The neighbouring areas on both sides of the Carpathians were rich in important natural resources. This applies especially to the area of the upper Vistula river basin, where perceptible are the two main areas where the sites were clustered, a bigger group on the left bank of the upper Vistula river, and a smaller one, on its right bank (Czekaj-Zastawny 2008; 2009; 2013a; 2013b; 2017). From the standpoint of current data, it can be stated that particular natural conditions were the cause of the emergence of these clusters as they affected the dynamic development of settlement, contacts, and exchange. Soil types favourable for the development of agriculture, as well as the climate of the time, and the region's well-developed river network (Czekaj-Zastawny 2008; 2009; 2013a; 2013b; 2017) should be mentioned among the factors, but, above all, natural resources (*e.g.*, flint deposits, salt springs), and location relatively near the area where the Eastern-Linear Pottery circle developed were crucial in

this respect. Generally, sites from the upper Vistula basin are distinguished by the presence of artefacts (Eastern-Linear ceramics, obsidian, amphibolite, graphite, Świeciechów flint, chocolate flint, Volhynian flint) indicating multidirectional expeditions (Czekaj-Zastawny 2014; 2017).

Based on research on the ceramics, among other things from the site in Brzezie Site 17, it is now possible to determine more precisely the regions from which imports came. Here, we should mention the areas of the Šariš Basin and the Eastern Slovak Lowland, from where almost from the beginning of the Music-Note phase of the LBK, vessels characteristic of the Tiszadob-Kapušany group arrived in the area, and towards the end of the II phase and in the III phase of the LBK, vessels of the Bükk Culture, as well as obsidian. Most probably that obsidian was obtained, like the imported pottery, from the Šariš Basin and the Zemplín region. The increased presence of obsidian in the II/III phase of LBK corresponds with the inflow of the imported pottery of the late phase of the Tiszadob-Kapušany group/Early Bükk Culture on LBK sites in Lesser Poland (Godłowska 1976, 89-92; 1982; Kaczanowska and Godłowska 2009; Hreha and Šiška 2015; Kozłowski *et al.* 2014; Czekaj-Zastawny 2017; Szeliga *et al.* 2021). This is also confirmed by the latest research on the deposits of this raw material. Based on the geochemical analyses performed until now, we can conclude that obsidian of the Carpathian 1 variant was most commonly utilised. The investigations conducted for obsidian materials from eight Early Neolithic sites in Slovakia (the Alföld Linear Pottery Culture, and the Bükk Culture) revealed that all of the artefacts were made of obsidian of the Carpathian 1 type, and that this raw material was recorded in all morphological groups. Analogical analysis performed for the Neolithic sites in Poland also revealed a predominant role of the Slovakian obsidian. Artefacts made of obsidian from Hungarian outcrops are recorded only sporadically. Noteworthy is the variability in the occurrence of this raw material in particular morphological groups (Szeliga 2009; Szeliga *et al.* 2021; Werra *et al.* 2021).

The LBK and ALPC communities maintained permanent contacts for a few centuries, and they kept the strongest relationships with the territories of the Upper Vistula basin (Kozłowski *et al.* 2014; Czekaj-Zastawny 2017). The contacts with the Eastern-Linear circle also reached the regions of Silesia (Kurgan-Przybylska 2013), Kuyavia, Pomerania, and the Chełmno Land (Kirkowski 1994). These contacts were based on the exchange of high-quality raw materials for tool production – Jurassic flint from Lesser Poland was traded for obsidian from beyond the Carpathians, which was associated with the inflow of Eastern-Linear pottery. Until the present there have been identified a few dozen sites where imported artefacts have been encountered (Kaczanowska and Godłowska 2009; Czekaj-Zastawny 2017, 52-55; Szeliga and Zakościelna 2019). In the oldest phase, these contacts seem to have been rather occasional, since in the territory of Poland there are no finds of pottery representing the early phases of the Eastern-Linear circle. On the other side of the Carpathians there are only few sites where artefacts made of Jurassic, chocolate, Świeciechów or Volhynian flints have been reported (Kaczanowska *et al.* 2001; Mateiciucová

2002; Szeliga 2014; 2022). As the LBK developed, the exchange of goods between the two linear circles gradually flourished. Sites dated to the II or III phases of LBK are much more numerous (Kaczanowska and Godłowska 2009; Czekaj-Zastawny 2017). The intensification of contacts with the south is legible at most of the settlements in south-eastern Poland, mostly starting from the decline of the II phase of LBK. This fact is observed mainly based on the increase in the amount of imported obsidian (up to 20% of utilised lithic materials in the Želiezovce phase at the Rzeszów-Piastów site; Godłowska 1976, 89-92; 1982; Kaczanowska and Godłowska 2009; Kadrow 1990). These contacts ceased rapidly as the Linear Pottery Culture and the Bükk Culture diminished. In the next period a gap in settlement on both sides of the Carpathians was recorded, and the issue of disappearance of the two cultural units in question is currently a subject of debate (Kaczanowska 1990; Kamieńska and Kozłowski 1990, 14-16; Kadrow and Zakościelna 2000, 187-255; Kulczycka-Leciejewiczowa 2002; Kozłowski 2004).

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LEAF IMPRESSION OF BURDOCK ON NEOLITHIC POTTERY FROM ZAGAJE SMROKOWSKIE (MIECHÓW UPLAND, POLAND)

ABSTRACT

Sobkowiak-Tabaka I., Worobiec G. 2025. Leaf impression of burdock on Neolithic pottery from Zagaje Smrokowskie (Miechów Upland, Poland). *Sprawozdania Archeologiczne* 77/2, 217-231.

This study examines Neolithic pottery from Zagaje Smrokowskie, Site 10, which features a burdock leaf imprint on one of the vessel bottoms. Burdock has been present in human settlements across vast areas of Eurasia, as evidenced by numerous discoveries of its macroremains. However, this is the first finding of a burdock leaf imprint on Neolithic pottery in Poland. The identification of leaf imprints on pottery enhances our understanding of pottery production techniques and provides valuable insight into the local flora.

Keywords: Neolithic, Lengyel culture, pottery, leaf impression, archaeobotanical analysis
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1. INTRODUCTION

Plants provide humans with essential resources, including raw materials, fuel, medicines, and food, forming a key component of the human diet. The remains, such as pollen, phytoliths, starch granules, and macroremains (charred, uncharred, and impressions), provide valuable evidence for palaeobotanical reconstructions. These remains help us to understand past environments and non-dietary uses of plants, such as the production of ropes, mats, or pottery temper (*e.g.*, Moskal-del Hoyo *et al.* 2017; Bakels 2020; Cabanes 2020; Henry 2020). In the present paper, we focus on the analysis of leaf imprints found on the bottom of a Lengyel culture vessel recovered during investigations at Site 10 in Zagaje Smrokowskie, Słomniki commune.

2. MATERIALS AND METHODS

2.1. Archaeological context

Site 10 in Zagaje Smrokowskie (50.273164, 20.020678) is located in the Miechowska Upland, north of the town of Słomniki, within the Nida Basin mesoregion (Kondracki 2009; Solon *et al.* 2018). More specifically, it is on a large peninsula formed at the confluence of two seasonal watercourses (Fig. 1).

Fig. 1. Location of Zagaje Smrokowskie, Site 10.
Prepared by I. Sobkowiak-Tabaka

The site was excavated between 2016 and 2019 as part of the construction of the S-7 expressway, specifically the Moczydło-Szczepanowice-Widoma-Zastów-Kraków section. The research, commissioned by the General Directorate for National Roads and Motorways, Kraków Branch, was conducted by a consortium comprising the University of Wrocław, Adam Mickiewicz University in Poznań, and the Archaeologia Silesiae Science Foundation. Inga Fabiszak led the excavations.

The excavations conducted over an area of nearly 2.5 hectares uncovered 399 features associated with multicultural settlement at the site (Minta-Tworzowska 2022). Of these, 224 were attributed to the Lengyel Culture (Pleszów-Modlnica phase), while a smaller number were linked to the Malice, Funnel Beaker, Mierzanowice, and Lusatian Cultures.

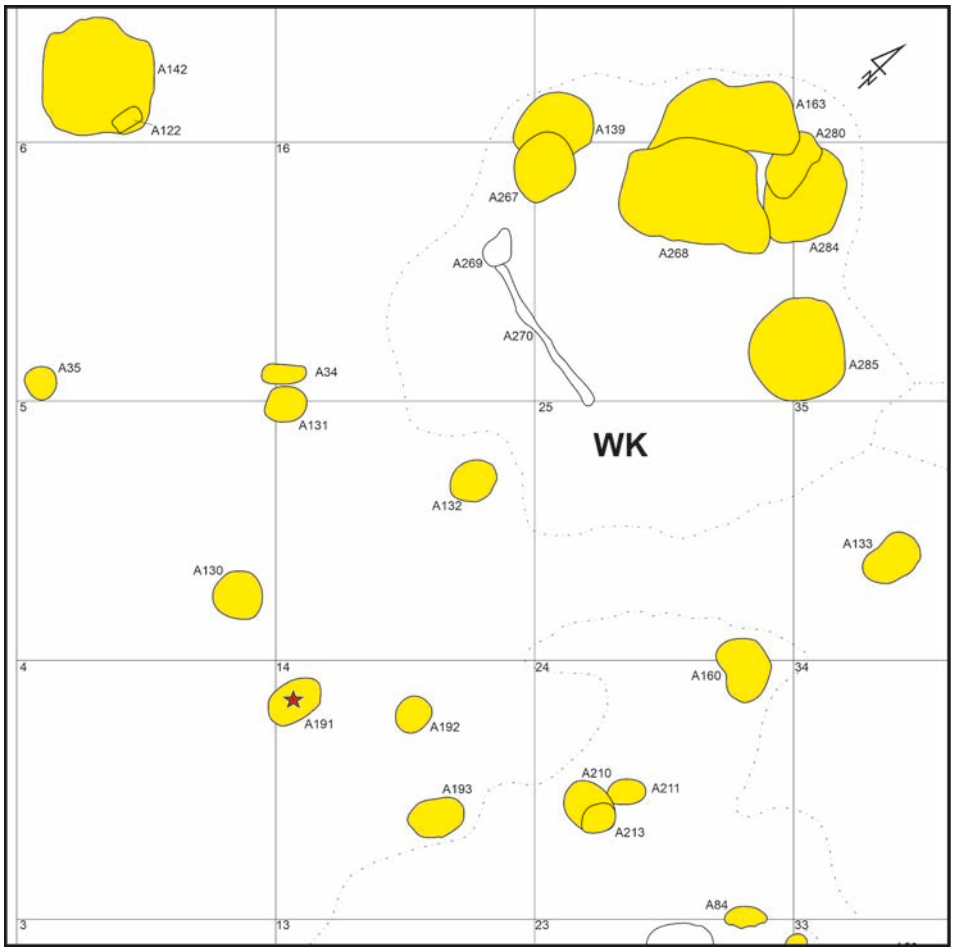

Fig. 2. Zagaje Smrokowskie, Site 10. Location of Feature A191 – red star.
Drawn by P. Wesołowska, graphic design by I. Sobkowiak-Tabaka

In total, nearly 11,500 pottery fragments were recovered, along with dozens of spindle whorls and weaving weights, lumps of daub, a fragment of an anthropomorphic figurine, several bone tools, as well as artefacts made of shell, flint, and stone. Additionally, human and animal remains were also found.

The analysis of feature distribution reveals a notable concentration of pits on the site, likely formed by the reuse of these locations after older structures fell out of use or were destroyed by fire. It is also possible that the creation of new economic pits was influenced by the presence of above-ground buildings, now invisible, which may have limited available space for such features. This could have led to the formation of a distinctive plaza-like

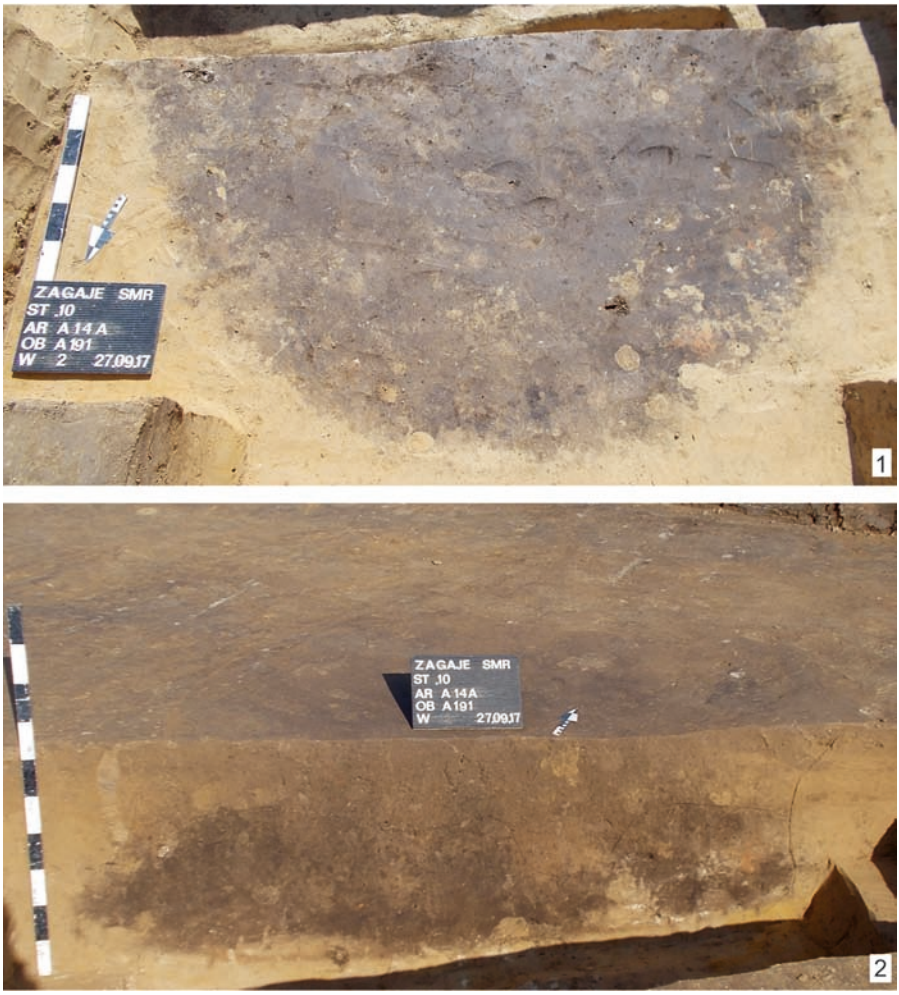

Fig. 3. Zagaje Smrokowskie, Site 10. Feature A191. 1 – plain of the feature, 2 – cross-section. Photo by I. Fabiszak

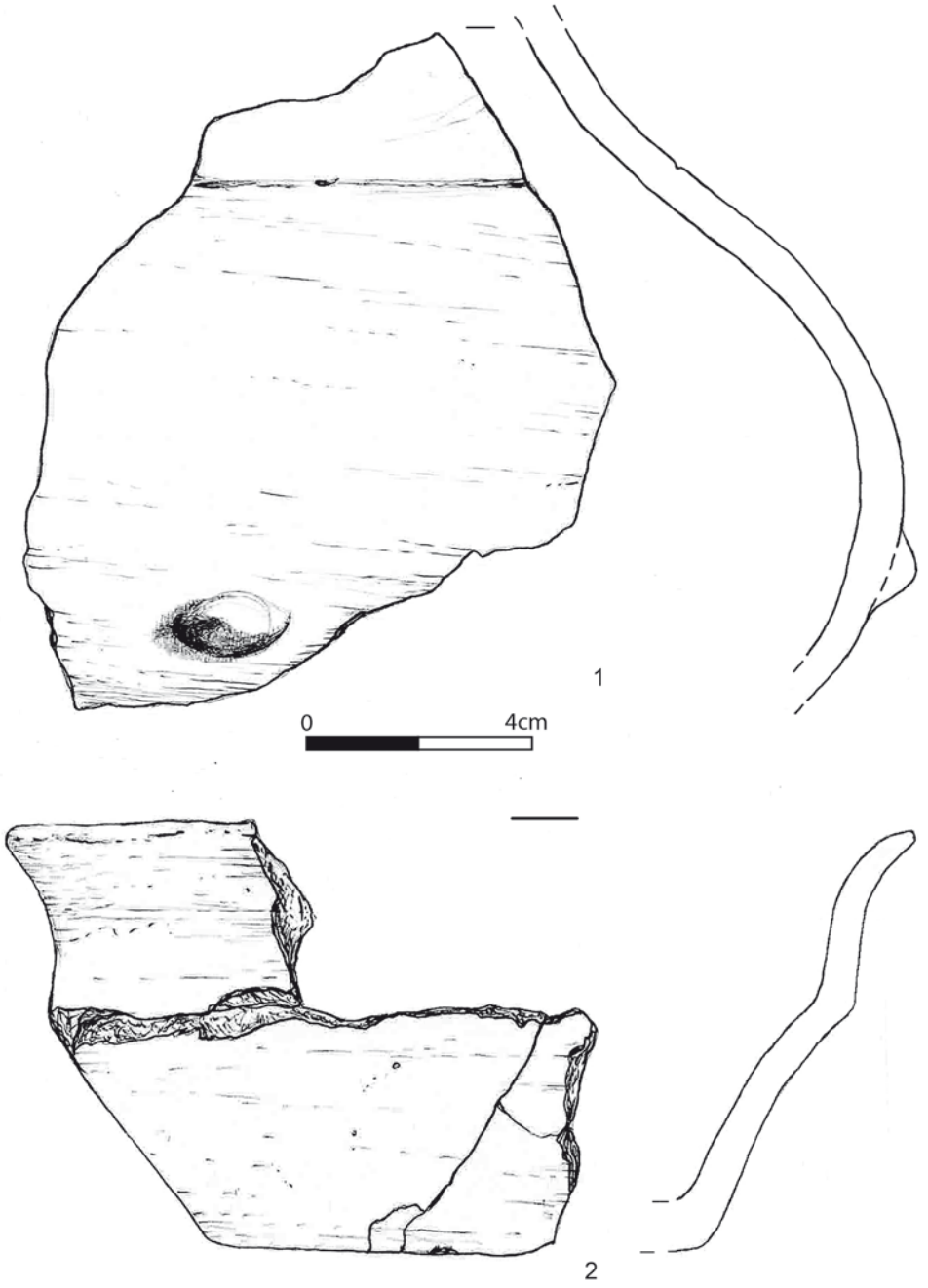

Fig. 4. Zagaje Smrokowskie, Site 10. Vessels from Feature A191.
1 – a fragment of an amphora, 2 – fragments of a bowl. Drawn by B. Piotrowska

area that is still recognisable today. A total of 11 feature clusters were identified, ranging from 5 to 21 features, comprising sunken features, pits, buried graves, post holes, and ditches.

Feature A191, which yielded the pottery fragment with leaf impression, was located in the southwestern part of the site, in the vicinity of the other Lengyel culture features (Fig. 2). It comprised an oval-shaped pit, measuring 220 cm in length, 150 cm in width, and 75 cm in depth (Fig. 3). The vertical cross-section of the pit was trapezoidal. The fill consisted of dense, clay-rich humus with highly decomposed daub.

The feature yielded 60 pottery fragments, including 10 rims, 45 body sherds, three bases and two lugs. The outer surface of the vessels was predominantly smooth and polished. Of the 56 fragments, the majority contained an admixture of grog, while four contained white and sporadically red stone grits. In 57 cases, the break was monochromatic, while in three cases, it was two-colored.

Only the forms of two vessels could be reconstructed: an amphora with a nodule beneath the most considerable swell of the belly (Fig. 4: 1), and a sharply profiled bowl with a mouth diameter of 16 cm and a base diameter of 10 cm (Fig. 4: 2). On one of the bases (approximately 10 cm in diameter, and 1 cm of thickness), the impression of a leaf was identified (Figs 5, 6: 1).

Additionally, eight worked flint pieces were recovered from the pit – one preparation flake, four flakes from single-platform cores, two blades from single-platform cores, and one chunk. All items were made from Jurassic flint (Sobkowiak-Tabaka 2022).

The technological, morphological, and stylistic analyses of the pottery have enabled us to establish the chronology of the Lengyel Culture (Pleszów-Modlnica phase) settlement, dated between 4800 and 4100 BC (Kamieńska and Kozłowski 1990; Kaczanowska 2006; Włodarczak 2017, fig. 1).

2.2. Methods

The macromorphological description of leaf impression is based on the nomenclature proposed by Ellis *et al.* (2009). The material was identified based on available publications and by comparison with fresh plant material collected for the purpose. Macrophotographs were made using a NIKON Coolpix 995 digital camera.

3. RESULTS

Systematics
Family: Asteraceae Dum.
Genus: *Arctium* L.
Arctium sp.
Material: Zagaje Smrokowskie Site 10, A191. One leaf imprint on pottery (Figs 5 and 6: 1).

Description: small fragment of a large leaf, 10.5 cm × 7.0 cm, leaf margin not preserved. Primary venation pinnate, primary vein (midvein) rather thick, 0.2-0.3 cm wide. Secondary veins are relatively thick, up to 0.3 cm wide, and distinctly protrude above the leaf blade. Three pairs of secondary veins are preserved, alternate, and form variable angles of 30-40° with a primary vein. Secondary veins are straight or slightly curved toward

Fig. 5. Zagaje Smrokowskie, Site 10. The base with the leaf imprint.
3D scan made on Keyence CMM Seria VL-700 by M. Gembicki, graphic design by I. Sobkowiak-Tabaka

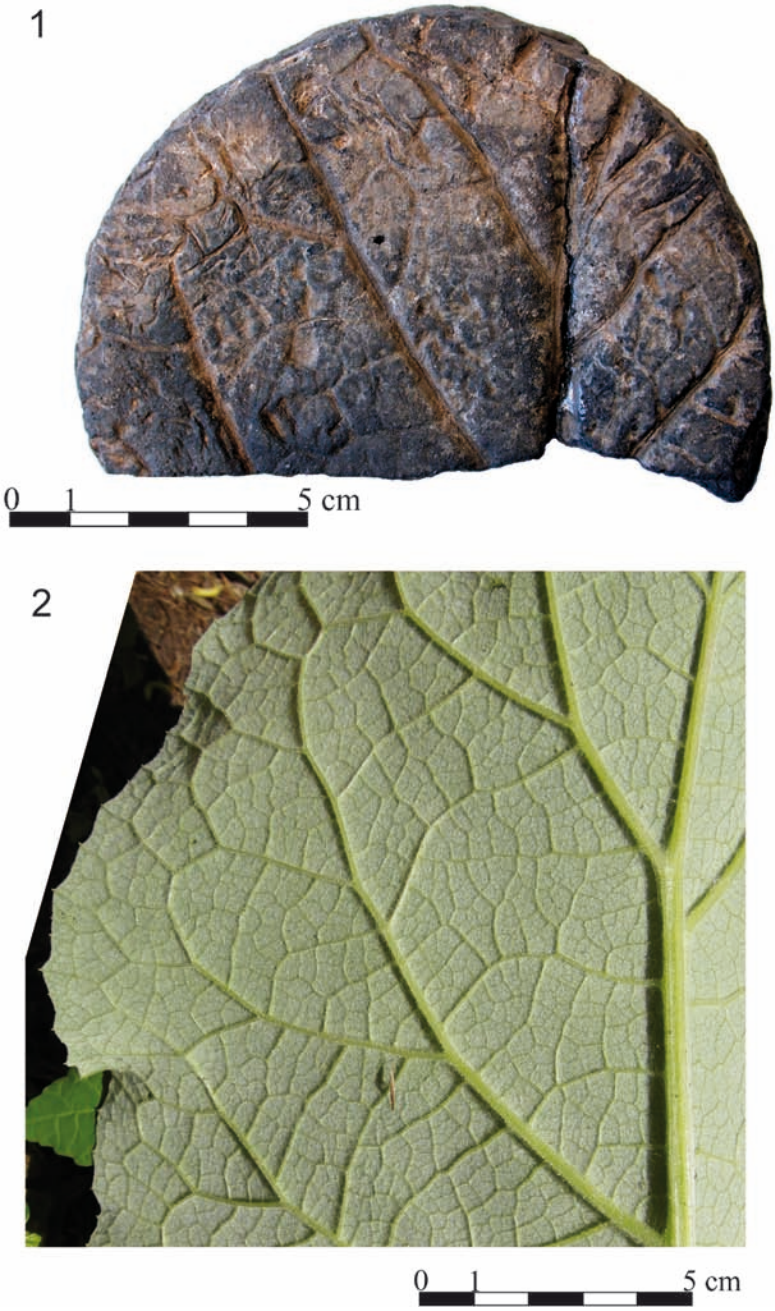

Fig. 6. 1 – Leaf imprint of *Arctium* sp., Zagaje Smrokowskie, Site 10.
2 – Apical part of the modern leaf of *Arctium* sp. Photo by G. Worobiec

the leaf margin. On the left side of the leaf, the lowest secondary vein and the branch of the following secondary vein form the loop. Still, its shape is not precise due to the deformation of the leaf lamina during pottery preparation. Tertiary venation is weakly percurrent; about 1-2 tertiary veins occur per 2 cm of secondary vein length. Quaternary venation is probably reticulate.

4. DISCUSSION AND CONCLUSIONS

The leaf described above, used as an underlay for the preparation of the pottery, must have belonged to a plant with relatively large and tough leaves. It must also have been easy for the prehistoric potter to obtain, which means it would have grown near the potter's workshop. Therefore, the list of native plants that could have made this impression is somewhat limited and restricted to those of the Miechów Upland, where Zagaje Smrokowskie is located. The leaf impression studied is somewhat incomplete (small fragment without leaf margin) and, therefore, a taxonomical determination is based only on the morphology of the veins, arrangement of the secondary veins and their shape, and the size and shape of third-order venation. The discussed impression presumably represents an imprint of a small fragment of the apical part of a rather large leaf. Strongly impressed veins, that is, grooves left in the bottom of the pottery by the veins protruding above the lamina, clearly indicate that the lower (abaxial) side of the leaf was impressed and the veins were rather large. These features along with pinnate venation, the preserved loop between the lowest secondary vein and the branch of the next secondary vein, and the shape and density of weakly percurrent tertiary venation (about 1-2 tertiary veins per 2 cm of secondary veins) point to the leaf of one of the species of the genus *Arctium* L. (burdock) (Fig. 6: 2).

The other plants whose leaves could be compared with the leaf impression from the pottery (namely those that have relatively large leaves and are common in the area of the Miechów Upland) are *Tussilago farfara* L., species of *Petasites* Mill., species of *Rumex* L., *Armoracia rusticana* G. Gaertn. *et al.*, as well as *Acer pseudoplatanus* L., *Acer platanoides* L., and species of *Verbascum* L. The leaf of *Arctium* could, however, be distinguished from these plants in several respects. Leaves of *Tussilago farfara* (coltsfoot) and species of *Petasites* (butterburs) differ from the impression on pottery described above in palmate venation and visible different venation networks. The same concerns the leaves of the maples *Acer pseudoplatanus* and *Acer platanoides*. Moreover, these leaves differ considerably in their distinctly lobate shape. Species of *Rumex* (docks), ruderal plants common near human settlements, have visibly thinner secondary veins compared to those from Zagaje Smrokowskie. *Armoracia rusticana* (horseradish) leaves have rather thick midveins and moderately thick secondary veins. This feature, along with the festooned semicraspedodromous secondary venation (forming multiple loops) of horseradish leaves, clearly differs from the discussed pottery impression from *Armoracia rusticana*. Finally,

the leaves of the *Verbascum* (mulleins) species are usually distinctly narrower compared to the presumed width of the leaf, which is impressed on pottery. Moreover, the leaves of mulleins are usually distinctly tomentose. Summarising the above discussion, we can conclude that the leaf impression from the pottery from Zagaje Smrokowskie represents a fragment of the apical part of the burdock leaf.

Another issue is to determine to which species of *Arctium* the impression in question belongs. Species of the genus *Arctium* (Asteraceae family) have leaves that are usually rather large and coarse, with a cordate base, and can reach several tens of centimetres in length. Budrocks are widely known for their mechanism of seed dispersal, which involves seeds easily catching on to animal fur and human clothing (epizoochory). Representatives of the *Arctium* genus are native to Europe and northeast Asia, including northern India (Lim 2015). There are four species of native burdocks in Poland: *Arctium lappa* L., *A. minus* (Hill) Bernh., *A. nemorosum* Lej., and *A. tomentosum* Mill. (Mirek *et al.* 2020). Among them, the most common species are *A. lappa* (great burdock), *A. minus* (lesser burdock), and *A. tomentosum* (woolly burdock) (Repplinger *et al.* 2007). They are apophytes (native plants that occur in man-made habitats), usually found in nitrophilous ruderal communities (*Arction lappae* alliance) in typical rural settings, such as abandoned fields, roadsides, pastures, verges, and woodland edges on fresh or slightly dry soils (Hadač 1978; Sudnik-Wójcikowska and Koźniewska 1988; Matuszkiewicz 2002; Mueller-Bieniek and Woch 2012; Tokarska-Guzik *et al.* 2012; Leuschner and Ellenberg 2017). *Arctium minus* can thrive in warm and dry habitats, whereas *A. lappa* and *A. tomentosum* are mainly found in wetter places (Leuschner and Ellenberg 2017). On the contrary, *A. nemorosum* is found infrequently in forest communities (Zając and Zając 2001). The leaf imprint from Zagaje Smrokowskie could be compared with leaves of *Arctium lappa*, *A. minus*, and *A. tomentosum*. However, it is rather fragmentary, and, therefore, it is not possible to determine to which of the three most common species of burdock it belongs (*A. nemorosum* as an uncommon species can be excluded). Nonetheless, among the discussed common burdocks, the leaf *Arctium lappa* seems most probable as the source plant of the imprint from Zagaje Smrokowskie, considering the size and leaf architecture of the leaves of *Arctium lappa*, *A. minus*, and *A. tomentosum*.

There is no doubt that in the Neolithic, burdock, as it is known today, was also a common plant near human settlements in the Miechów Upland. This conclusion can be supported by two other finds of remains of leaves considered burdocks at archaeological sites in Poland. Among numerous impressions of leaves and branches of willows, Giżbert (1960) reported a single leaf impression of *Arctium lappa* on fragments of fired clay from the hearths of pottery kilns collected from the Roman Iron Age site at Igołomia near Kraków. Unfortunately, this impression was not documented with a photo, and therefore, it is not possible to verify its taxonomic assignment. Another record of burdock leaves from archaeological sites concerns a Bronze Age hoard from Cierpice, Poland (Gackowski *et al.* 2023). Among the sieved plant macroremains from the burial context were found leaf fibres considered to be remains of great burdock (*A. lappa*). However, in the case of this

relatively small (less than 10 mm) fragment of a leaf (Gackowski *et al.* 2023, fig. 10: c), it is difficult to say what species of burdock it represents and even to confirm with certainty whether it is indeed a burdock remnant. Nevertheless, the aforementioned reports of the presence of *Arctium* leaf remains in archaeological sites suggest that burdock was most probably a common plant near human settlements.

Common burdock, as an apophyte, has long accompanied people. The roots and leaves of young burdock, as well as the seeds, were eaten as a vegetable (van Zeist and Palfenier-Vegter 1981; Kuhnlein and Turner 1991; Łuczaj 2011; Mueller-Bieniek and Woch 2012; Raemaekers *et al.* 2013; Colledge and Conolly 2014; Lim 2015), and the plant is also used in traditional medicine (Chan *et al.* 2011; Mueller-Bieniek and Woch 2012; Lim 2015; Tobyn *et al.* 2016). Therefore, the finding of a burdock leaf imprint on Neolithic pottery from Zagaje Smrokowskie, along with other reports on leaves of *Arctium* from Poland (Giżbert 1960; Gackowski *et al.* 2023), confirms that *Arctium* was at least occasionally used in the human economy as early as the Neolithic.

The use of burdock fibres has been documented since the late 19th century. The fibres found in the plant's stalks are coarse, stiff, and strong, making them suitable for crafting durable ropes that are ideal for hauling and lashing. To separate the fibres, the stalks can be beaten with a stick on a stone or split and scraped with a dull knife, particularly when the stalks are still green and fresh (Dodge 1897).

The use of burdock leaves to make pottery may be for several reasons: they are relatively tough, and they are large enough to provide a basis for the preparation of pottery vessels. This *Arctium* impression suggests that pottery was prepared during a warm period of the year (presumably May-October). It is not entirely clear whether the pottery was fired with the leaf still adhering to the vessel base or after the leaf was separated; no apparent signs of a charred leaf blade were found on the leaf impression.

However, considering some archaeological and ethnographic observations and experiments, the first hypothesis appears more reliable, as impressions could only have formed. At the same time, the clay body of the vessel was still soft. It is relatively straightforward that these traces are associated with the vessel's shaping and/or drying process. Materials such as mats or large leaves would help prevent the wet clay from sticking to the flat surface and also facilitate the rotation of the vessel during the shaping of its walls. The pressure applied by the potter during the forming process, combined with the weight of the clay, would have left a distinct underlay impression (*e.g.*, Chinaya 2017; Moskal-del Hoyo and Lityńska-Zając 2018; Cioubanu and Tenciaru 2022).

Conclusions resulting from the study of a burdock leaf impression on Neolithic pottery from Zagaje Smrokowskie along with data obtained from other investigations of leaves (Giżbert 1960; Vilaça *et al.* 2004; Baiamonte 2015; Frumin and Tchekhanovets 2016; Arobba *et al.* 2017; Rennwanz 2018) and seeds (Costantini 1984; Amblard and Pernčs 1989; Endo and Leipe 2022; Endo *et al.* 2023) or impressions preserved on pottery worldwide confirm the opinion of Frumin and Tchekhanovets (2016) that analysis of plant imprints on pot-

tery can provide valuable data for the reconstruction of ancient settlement life and its environmental conditions.

It is also worth noting that macroremains of burdock are very rare in Polish Neolithic materials, and the imprint of a leaf from this species is the first well-documented find in Polish Neolithic contexts.

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VYNNYKY-LYSIVKA, LVIV DISTRICT. CERAMIC RATTLE FROM A FUNNEL BEAKER CULTURE VILLAGE

ABSTRACT

Rybicka M. and Hawinskyi A. 2025. Vynnyky-Lysivka, Lviv district. Ceramic Rattle from a Funnel Beaker Culture Village. *Sprawozdania Archeologiczne* 77/2, 233-254.

A clay rattle, made using the technology of the Funnel Beaker culture, was discovered during research conducted in 2024 on the settlement of this culture in Vynnyky-Lysivka. It was found in Feature 3/2024, which contained pottery with the style of its eastern and southeastern groups, as well as fragments of tableware with characteristics of the Brînzeni group of the Trypillia culture. Clay rattles are very rarely recorded in the Funnel Beaker culture, but are more commonly found in the Trypillia culture. A distant analogy for this rattle from Vynnyky-Lysivka is found in the graves of children from the Vykhvatintsy cemetery. The settlement of the Funnel Beaker culture from Vynnyky-Lysivka dates, which are similar to those of Brînzeni and Vykhvatintsy. The presence of pottery imports from the Brînzeni group's environment suggests that the clay rattle is associated with the Funnel Beaker culture. It is probably the result of contacts with the Trypillia Culture groups.

Keywords: Funnel Beaker culture, Trypillia culture, Brînzeni group, ceramic Rattle
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INTRODUCTION

In 2024, during archaeological field research in Vynnyky-Lysivka, a ceramic rattle was recovered from the upper level of a feature attributed to the Funnel Beaker Culture (FBC). Sound instruments have never been a frequent find in the artefact assemblages found in Neolithic and Chalcolithic villages throughout Central Europe. The oldest ones in the lands of Poland are associated with the Neolithic (Tatoń 2021, 193). Another type that can be included in this group of artefacts is drums, which are a distinctive feature of archaeological cultures dating back to the second half of the 4th millennium BC in the Elbe River region. Communities of the Salzmünde Culture, the Deep Stitch Pottery Culture (die Tiefstichkeramik-Kultur) and the Walternienburg-Bernburg Culture are known to have used drums (Preuss 1980; Behrens 1973; 1981). Several drums are also reported to have been found east of the Oder River, in Beaker-Baden contexts of Kuyavia (*e.g.*, Radziejów Kujawski, Site 4; Gabałówna 1959, 111; Rybicka 1995), and some others belong to the Globular Amphora Culture (Gabałówna 1959, 111). They can be interpreted as the result of contact between past human groups inhabiting the Elbe River region and those living in the Polish Lowlands.

Rattles are rare artefacts to be found in the FBC. Such artefacts are also characteristic of the Trypillia culture (Voytyuk *et al.* 2022; Oliynyk 2024). They are relatively standard items in household inventories, including those from the Late Bronze Age, such as the Lusatian culture (Gedl 2007; Tatoń 2023).

Therefore, the discovery of a rattle in materials from the settlement in Vynnyky-Lysivka may arouse interest. The question of the investigated find's cultural affiliation is fundamental. An attempt to provide the correct affiliation is presented below.

LOCATION OF THE SITE IN VYNNYKY-LYSIVKA

The site in Vynnyky-Lysivka is situated on the plateau of Mount Lysivka in the southeastern part of the Roztochchia hills (Kondracki 1998). The plateau is 321 m above sea level (Fig. 1) and extends a distance of up to 400 m from west to east. Its usual width is from 80 to 100 m, and the maximum width reaches even 130-150 m (Fig. 2). The topography of the plateau is remarkable for its outstanding exposure. The difference in height between the level of the flat plateau and the bottom of the valley located to the east of the hill is about 80 m (The GPS coordinates are N49 48'43.9488" E24 7'55.0884" and N49 48'46.2564" E24 7'38.0172" for the eastern and western parts, respectively). At the southeastern foot of Lysivka is the broad valley of the Marunka River, a tributary of the Western Buh.

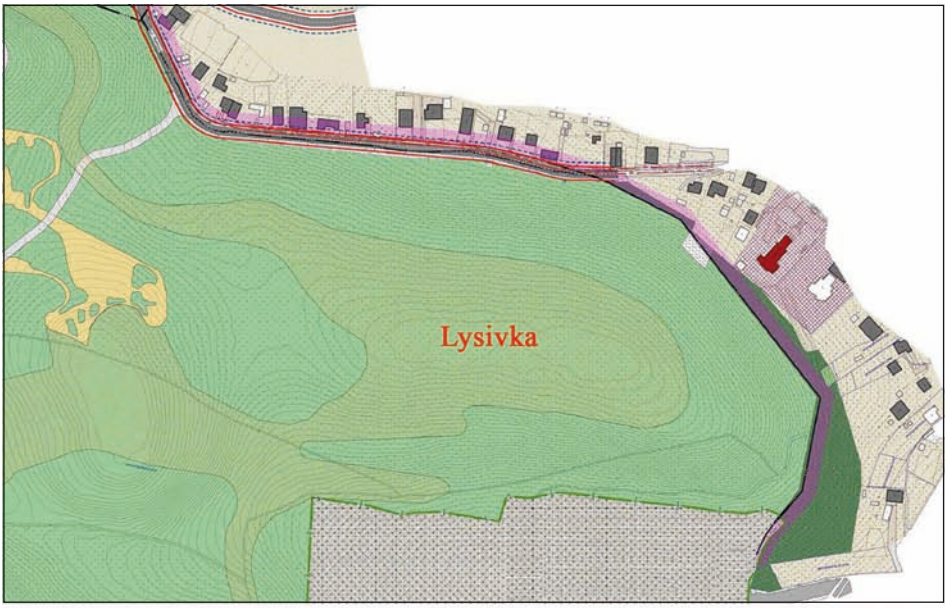

Fig. 1. Geographic location (1) of the prehistoric village in Vynnyky-Lysivka (2), Lviv district

EXCAVATIONS IN VYNNYKY-LYSIVKA, 2016-2024

Since 2016, excavations have been systematically carried out in the north and south of the site known as Vynnyky-Lysivka, located in the Lviv district. In the southeastern portion, the remains of a Funnel Beaker homestead were recovered (House No. 1; Hawinskyi and Rybicka 2021) (Fig. 2). In 2021-2023, exploratory units oriented east and west expanded to the northern and central portions of the village (Hawinskyi *et al.* 2024). As a result of these works, a ditch and a rampart were identified in the western part of the site, while in the centre, a feature of the Malice culture and a series of waste and storage pits of the FBC were revealed (Fig. 2; Hawinskyi *et al.* 2024). In 2024, another excavation unit was dug to expand the research area containing exploratory units developed in 2022-2023 further to the east (Fig. 2). Similarly to 2023, an occupation layer rich in finds was uncovered there, the bottom level of which was found at a depth of *ca.* 70-80 cm (Hawinskyi *et al.* 2024). In the unit of 2024, at a level of *ca.* 70 cm below the occupation layer, the remains of Feature No. 3/2024 were revealed (Figs 3-5), covering a relatively large expanse, from the upper level of which a ceramic rattle was recovered (Figs 6 and 7); the findspot was in the southwestern part of the Feature.

FEATURE NO. 3/2024

Feature No. 3/2024 had an irregular shape, approximately 12 m long and 2-6 m wide. The dark black filling of the feature was visible against the light-brown sediment layer. To clarify as many details as possible, five cross-sections were made every two meters (Figs 3-5). At a level of about 0.9 m below the present-day surface, the feature broke up into several smaller, irregularly shaped features up to 1.5 m long. The filling here was no longer as uniform as at 0.7 m depth. It was now often mixed with light-brown sediments marked by animal burrows and spotted with black-grey humus soil (Fig. 4). The outlines of one of them (No. 3/2024/7) were most distinct in the horizontal plane: 1.8 m in diameter with a flat bottom 15 cm deep (Figs 3-5). The shape and size of the features were similar to those characteristic of clay daub platforms at this site. The construction was not exposed to its limits, as it came up against the southern and eastern margins of the excavation area (Figs 4 and 5). On the upper level, in the southwestern sector of the feature, a ceramic rattle was discovered along with a rich sample (about 3000 sherds) of the Funnel Beaker pottery (Figs 8-13) and several sherds of Trypillia Culture vessels (Fig. 14). The findspot was at a depth of about 55 cm.

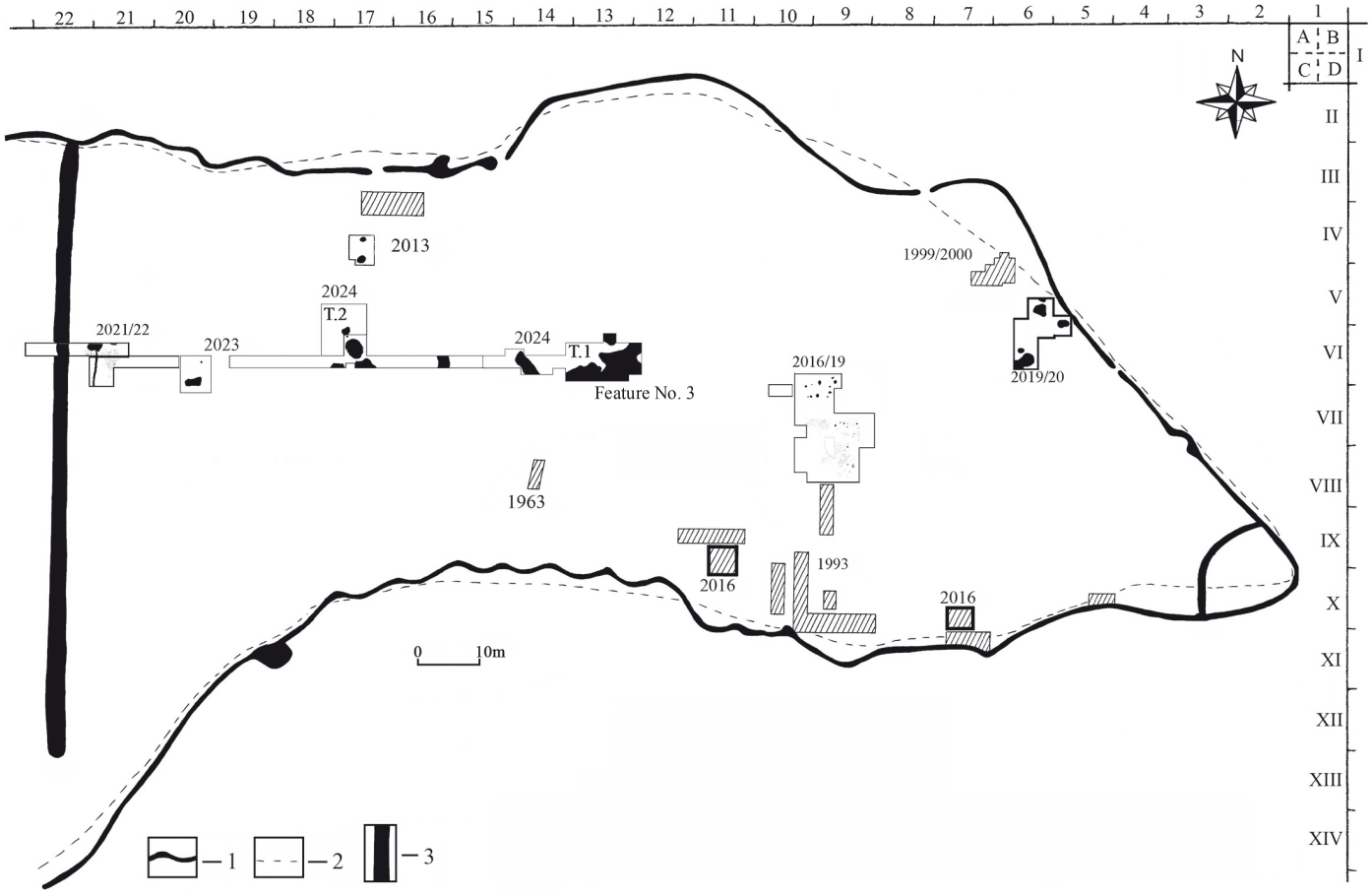

Fig. 2. Vynnyky-Lysivka, Lviv district. Location of excavation units. 1 – military trenches; 2 – Mount Lysivka; 3 – ditch

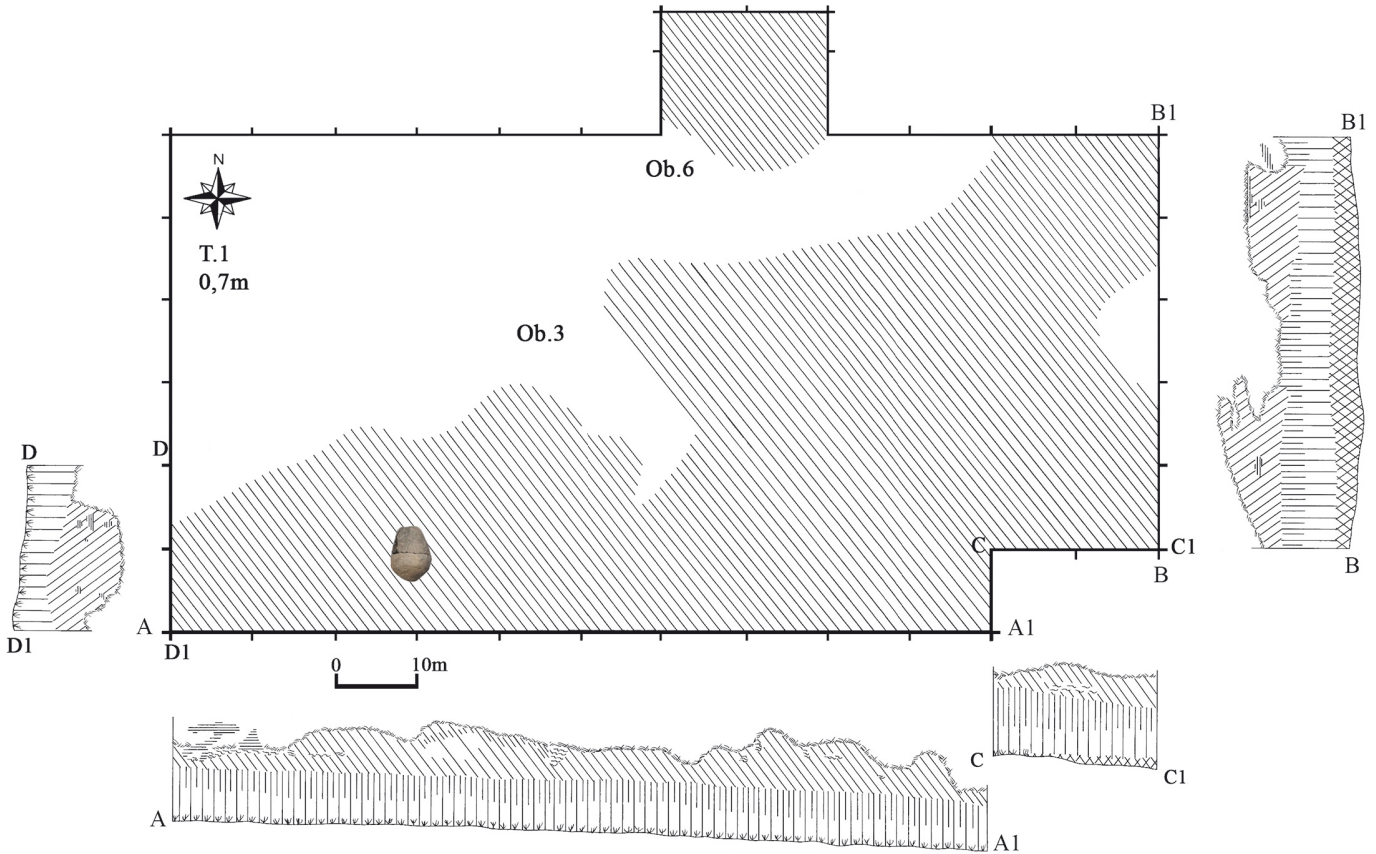

Fig. 3. Vynnyky-Lysivka, Lviv district. Plan and stratigraphy of prehistoric features covered by Trench 1/2024. A-A1, C-C1 – southern section of Feature 3; B-B1 – eastern section of Feature 3; D-D1 – western section of Feature 3. 1 – topsoil, 2 – tree roots, 3 – grey sandy loams, 4 – dark grey sandy loams, 5 – natural ground, 6 – stones, 7 – filling of features, 8 – yellow soil filling, 9 – animal burrows

Fig. 4. Vynnyky-Lysivka, Lviv district. View from the west of Feature 3/2024 in Trench 1

Fig. 5. Vynnyky-Lysivka, Lviv district. Southern section of Feature 3/2024

THE RATTLE

The oviform rattle is 4.3 cm in height. The maximum width is approximately 1/3 of the artefact's height and reaches 3.3 cm. The top part is 1.0 cm wide and flat. The thickness of the walls surrounding the inner cavity of the rattle is 0.4-0.65 cm. There is a pair of small ceramic balls (pellets of clay) in the cavity (Figs 6 and 7: 5). There is no decoration on the surface of the artefact. From a technological point of view, the fabric of the rattle is similar to that of the Funnel Beaker pottery.

POTTERY OF THE FUNNEL BEAKER CULTURE

The exploratory units excavated by us in 2022-2023 provided a rich sample of the FBC pottery from both the occupation layer and the features (Hawinskyi *et al.* 2024). Fragments of the Trypillia Culture pottery were regularly observed here and there, whereas the Mierzanowice Culture was not represented by a single identifiable artefact. Between 2016 and 2024, several pottery fragments of this culture were discovered (Hawinskyi and Rybicka 2021; Hawinskyi *et al.* 2024). Feature No. 3/2024, on the upper level of which the rattle was discovered, yielded a total of over 3000 fragments of vessels attributed to the FBC.

The ceramic sample consisted of fragments of beakers with flat and arched rims, under which there were motifs based on stamp impressions, or engravings, arranged in single or double row patterns (Figs 8: 1, 2, 8, 9, 11; 9: 1, 2; 10: 1). There were some fragments from undecorated vessels of the same type (Fig. 8: 3-7, 10). The sample contained numerous fragments of pots, on the rims of which were located one or, less often, two plastic cordons decorated with finger impressions (Fig. 10: 3, 4; 11). Fragments of undecorated jars and bowls are also present (Fig. 10). Of note are the *ansa lunata* cups (Fig. 13: 1-2) and cordoned flasks (Fig. 13: 3-5). Of particular interest is the body of a vase decorated with a segmented pattern of furrowed stitches arranged as vertical lines (Fig. 12: 1). Also worthy of attention is the rim fragment of the pot decorated with a notched plastic cordon and a rounded knob (Fig. 7: 3). Another noteworthy artefact is a fragment of a pot with a rim thickening inside (Fig. 10: 2). The shapes and decorations of the vessels described above have many similarities in Funnel Beaker settlement samples from the loess areas of Rzeszów and Przemyśl (*e.g.*, Pawłosiów, Site 52; Rybicka *et al.* 2014), as well as from the Western Bug region (Lezhnytsia-Chub; Rybicka *et al.* 2019).

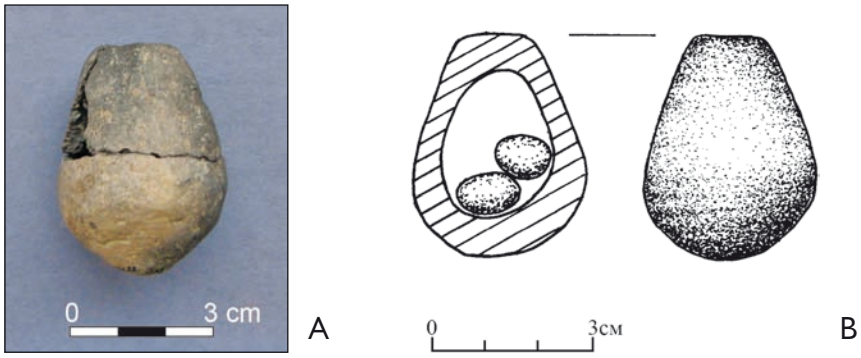

Fig. 6. Vynnyky-Lysivka, Lviv district. Ceramic rattle. A: photo; B: drawing

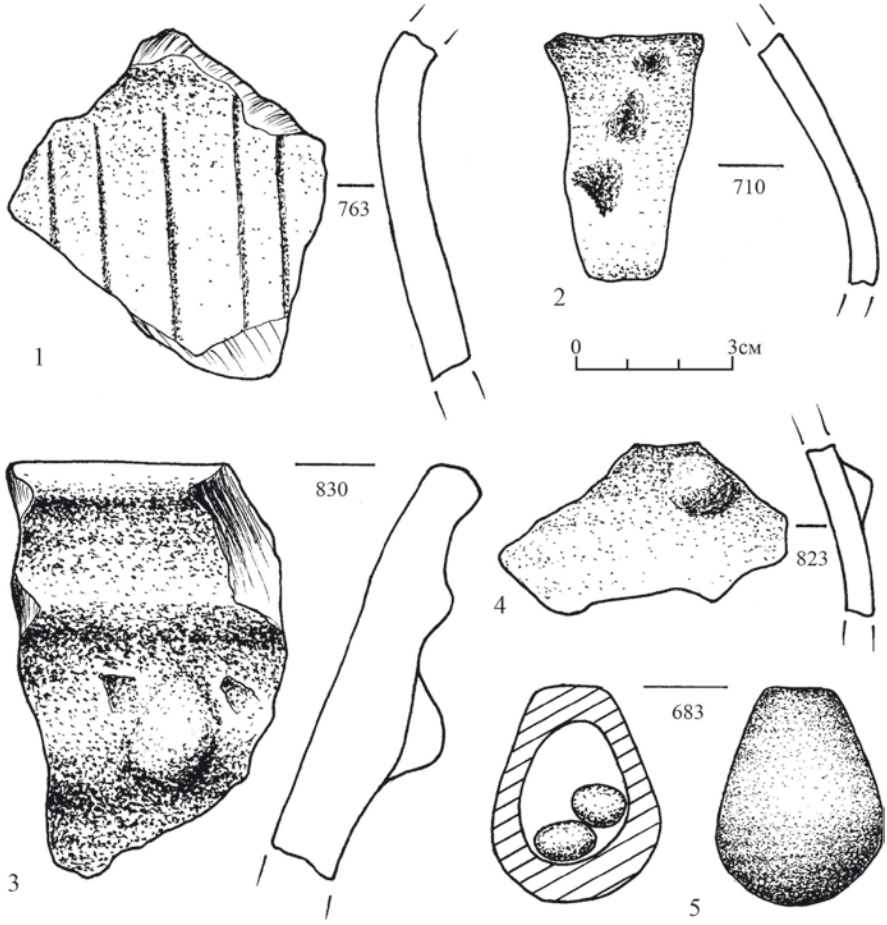

Fig. 7. Vynnyky-Lysivka, Lviv district. Pottery finds of the FBC. 1-4 – fragments of vessels; 5 – ceramic rattle

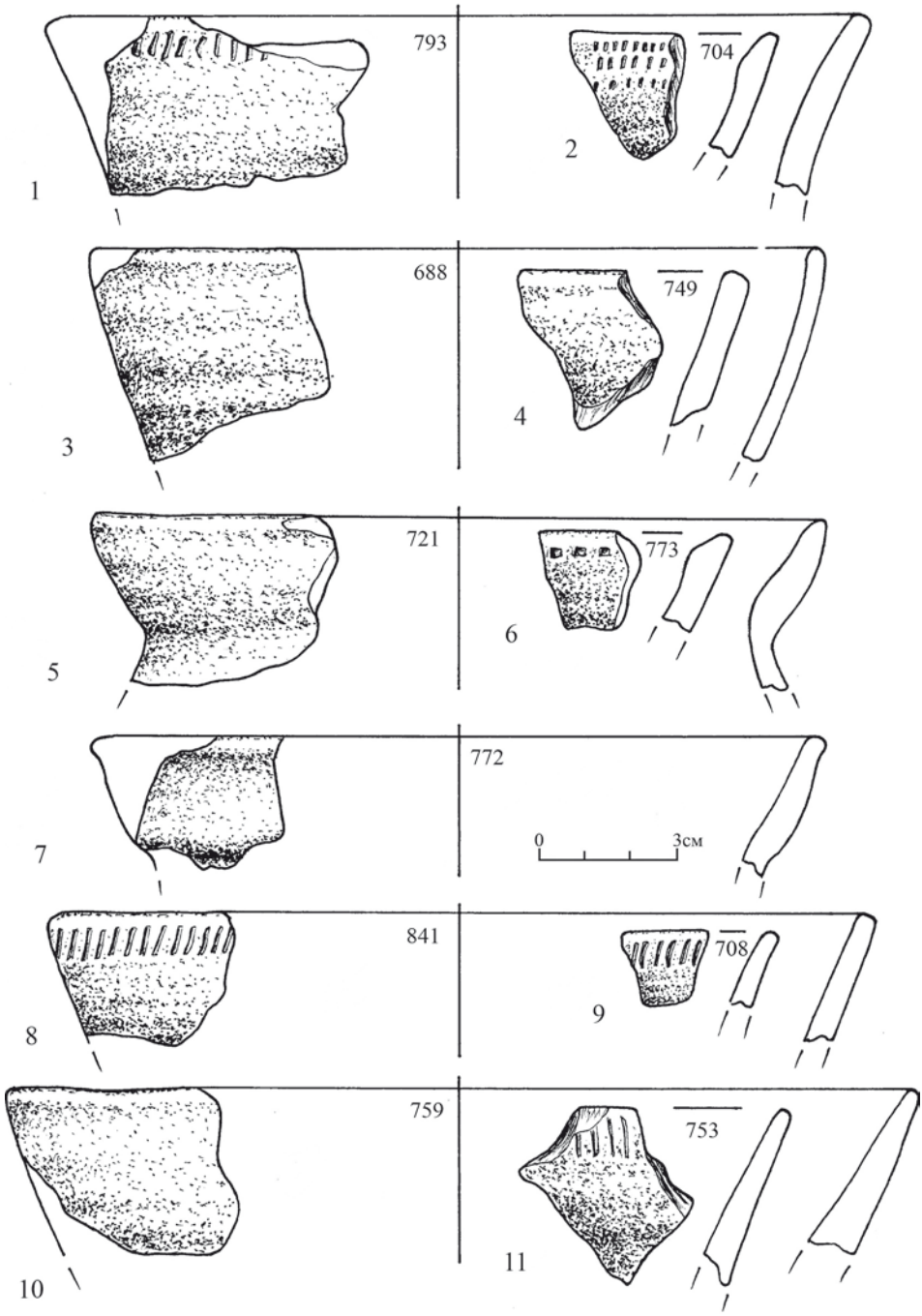

Fig. 8. Vynnyky-Lysivka, Lviv district. Feature 3/2024. Pottery finds of the FBC

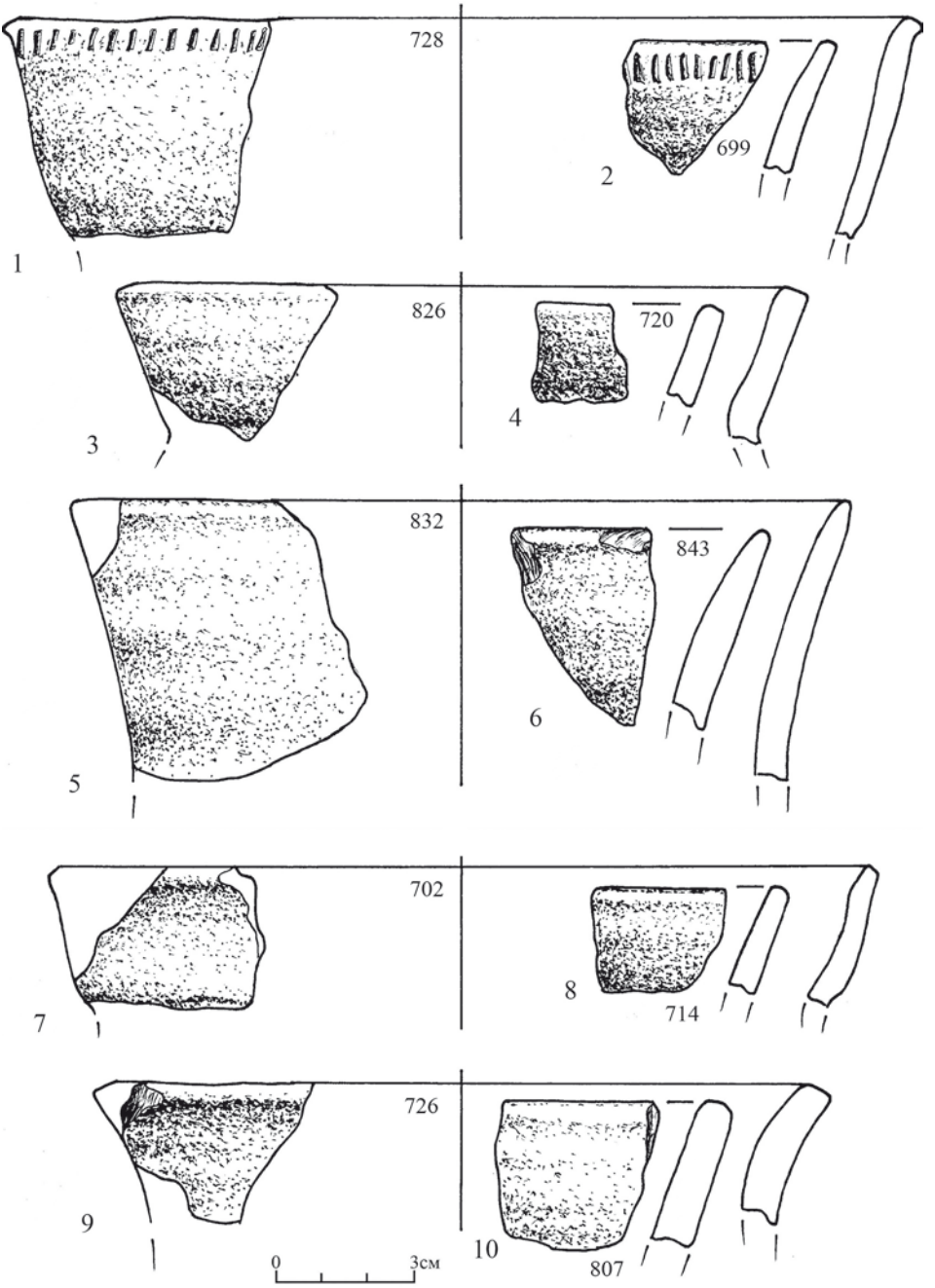

Fig. 9. Vynnyky-Lysivka, Lviv district. Feature 3/2024. Pottery finds of the FBC

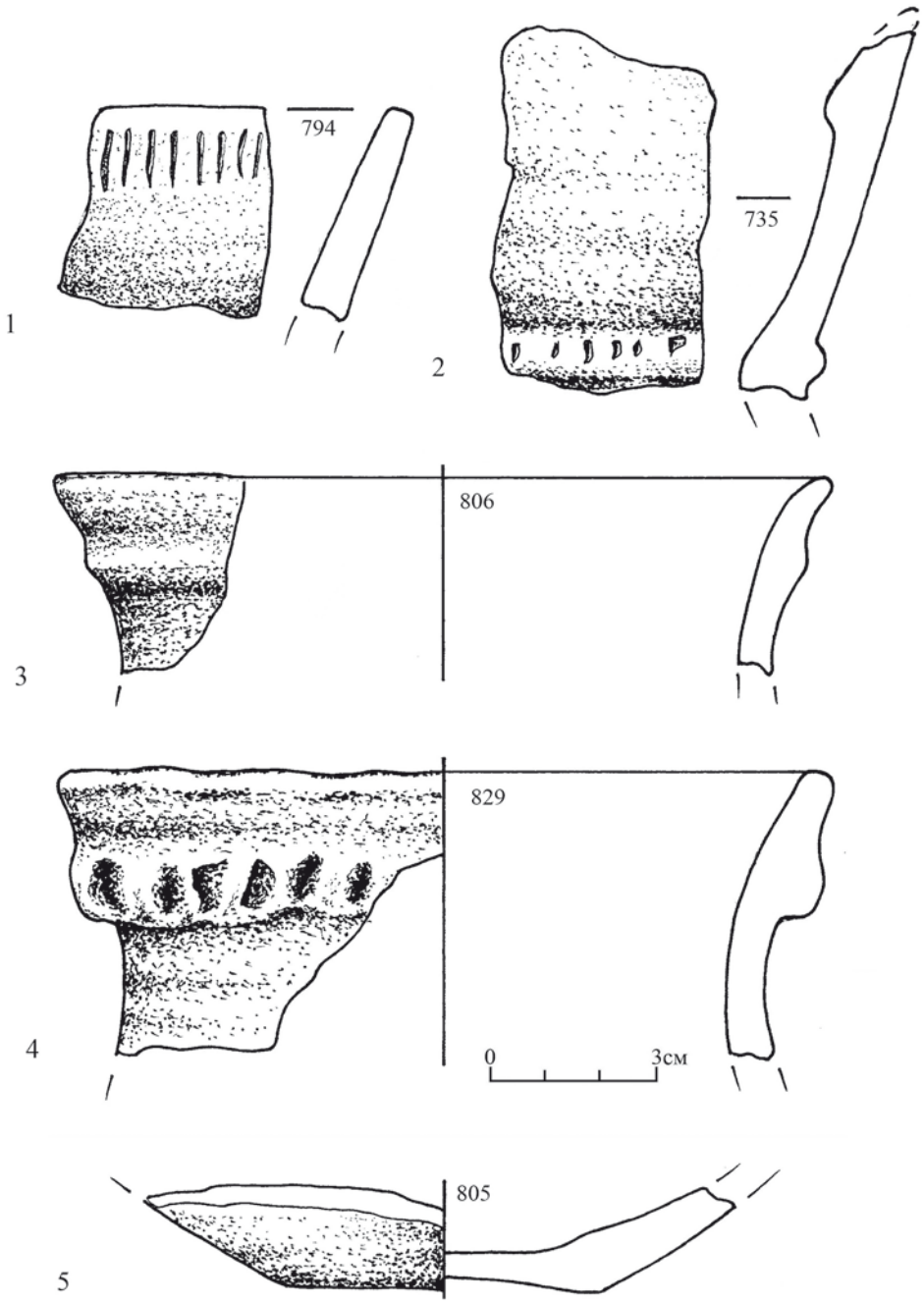

Fig. 10. Vynnyky-Lysivka, Lviv district. Feature 3/2024. Pottery finds of the FBC

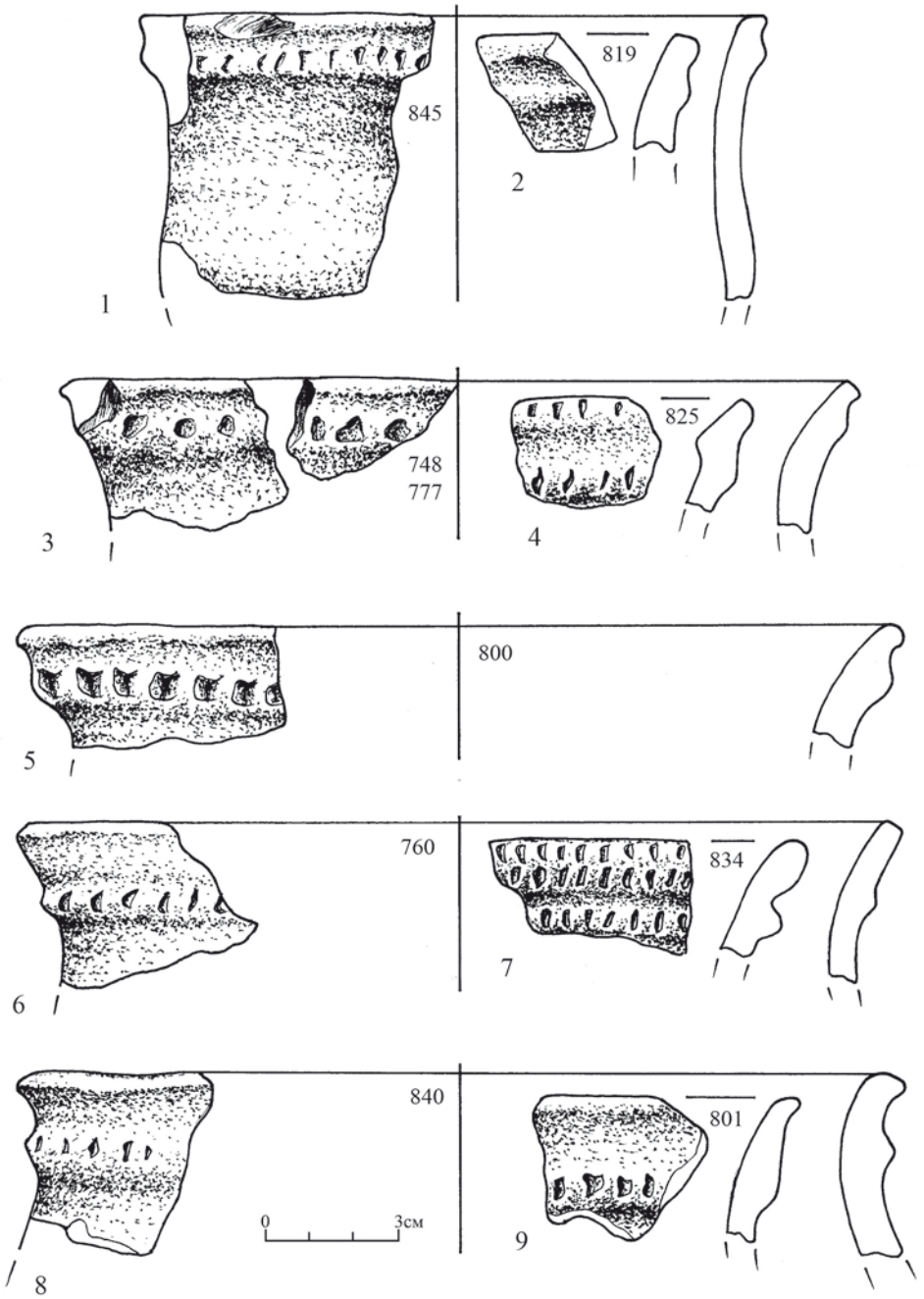

Fig. 11. Vynnyky-Lysivka, Lviv district. Feature 3/2024. Pottery finds of the FBC

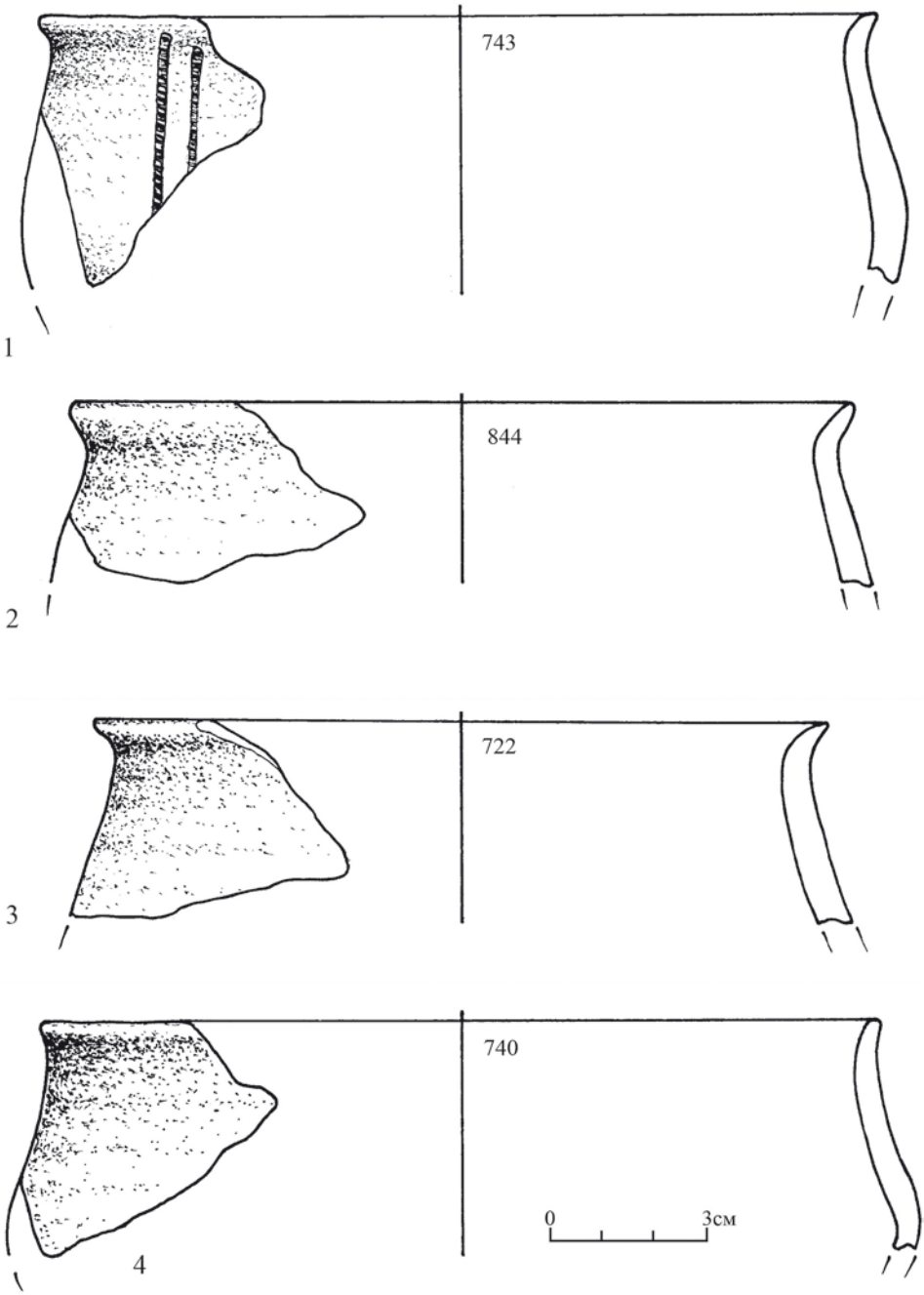

Fig. 12. Vynnyky-Lysivka, Lviv district. Feature 3/2024. Pottery finds of the FBC

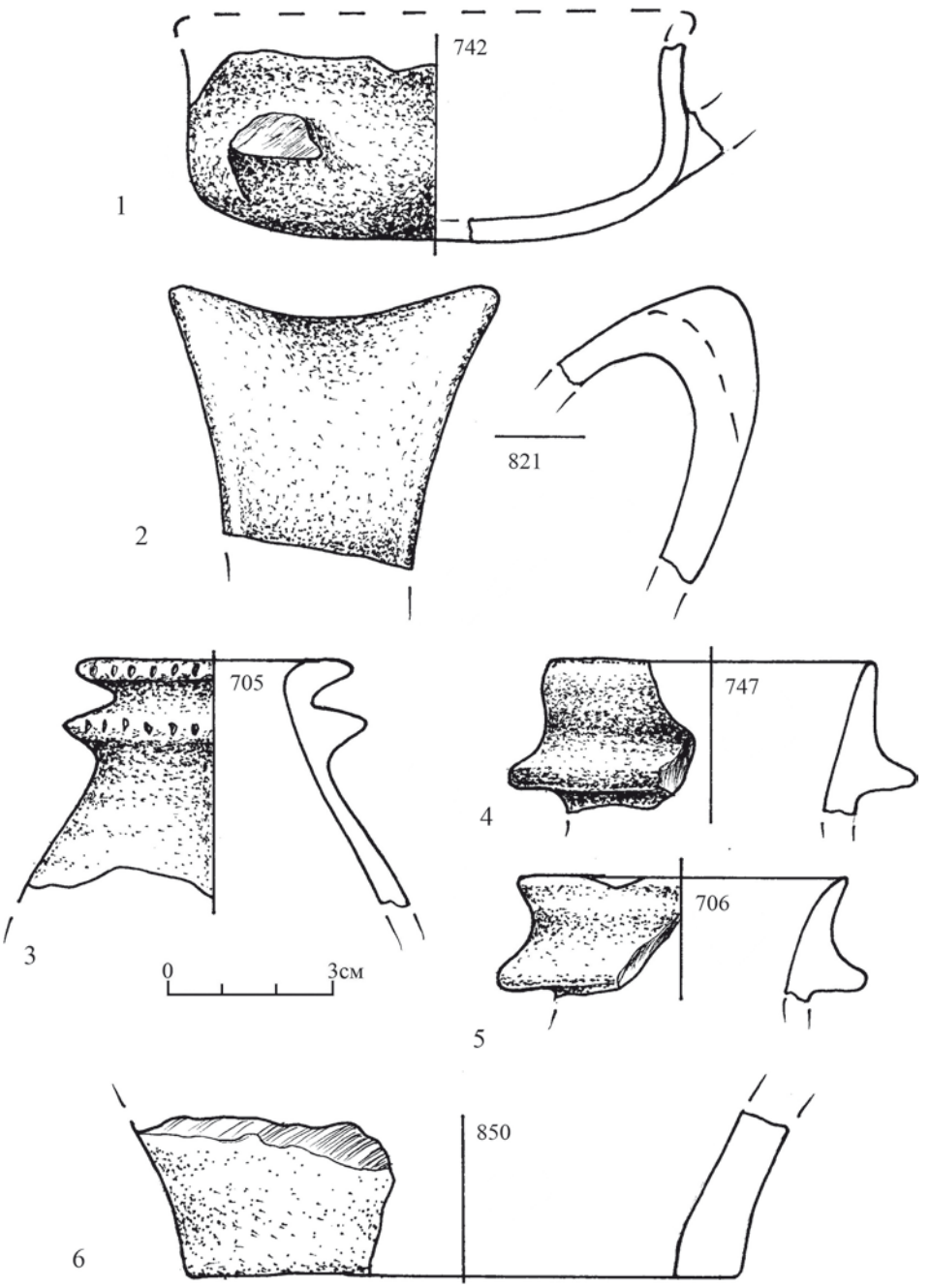

Fig. 13. Vynnyky-Lysivka, Lviv district. Feature 3/2024. Pottery finds of the FBC

DATING OF THE FUNNEL BEAKER CULTURE POTTERY FINDS FROM FEATURE NO. 3/2024

The shapes and decorations of the FBC pottery found in Feature No. 3/2024 are similar to those observed in the finds from House 1 in Vynnyky-Lysivka (Hawinskyi and Rybicka 2021). Numerous type IB beakers decorated with engraved, impressed, or cut column-like figures, as well as the cordoned flasks, are good representatives of the Wiórek phase of the eastern Beaker group (Jażdżewski 1936; Kośko 1981; Rybicka 2004; Grygiel 2016), while the *ansa lunata* cups are among the most recognisable signatures of the southeastern Beaker group (Włodarczak 2006; Kadrow 2009).

The above stylistics were previously identified on vessels found in the FBC Feature 2/2013 in Vynnyky-Lysivka (Havinskyj *et al.* 2021, fig. 5). This is a ^{14}C-dated sample to 4650±35 BP (Poz-111073), which, after calibration, yields a range of 3506-3368 (62.2%) and 3516-3365 cal. BC (95.4%) (Havinskyi *et al.* 2021, table 1). Pottery finds with the same features were also found in Features 1/2019 and 3/2019 at the same site (Havinskyi *et al.* 2021, fig. 6). The available ^{14}C values are as follows: (Ua-68160) 4566±34 BP: 3368-3119 cal. BC (68.2%) and 3487-3102 cal. BC (95.4%); (Ua-68162) 4639±33 BP: 3498-3367 cal. BC (68.2%) and 3516-3360 cal. BC (95.4%); (Ua-68163) 4660±33 BP: 3509-3371 (68.2%) and 3518-3367 cal. BC (95.4%) (Havinskyi *et al.* 2021, table 1). We also have a ^{14}C value for Feature 2/2023 (Poz-171023 4555±35 BP: 3368-3114 cal. BC (68.3%) and 3486-3102 cal. BC (95.4%). The stylistic attributes of the pottery finds from there are similar to those characteristic of the rest of the ^{14}C-dated features (Havinskyi *et al.* 2024, fig. 12). In general, the Beaker culture pottery discovered in Vynnyky-Lysivka can be placed within the time range of 3550-3350 cal. BC (Havinskyi *et al.* 2021, figs 4-6). This range of dates is entirely consistent with the chronology of the pottery finds of similar stylistics discovered in Pawłosiów, Site 52, in the loess area of Rzeszów and Przemyśl (Rybicka *et al.* 2014).

THE TRYPILLIA CULTURE

Both in Feature 3/2024 and in the occupation layer, tableware fragments of the Trypillia Culture were found (Fig. 14). In total, no less than 10 fragments of vessels were recorded.

Of the entire sample, the most notable are fragments of painted vessel bodies and a fragment of a bowl rim. The rim fragment represents a hemispheric bowl, both the outer and inner surfaces of which were painted. This technique is reminiscent of the style characteristic of the Brînzeni Group of the Trypillia CII stage (Markevich 1981; Verteletskyi 2016; 2020; Sîrbu *et al.* 2020; Dergachev 2021, 34-56). Prehistoric settlements with ceramics imitating Brînzeni ornamentation and vessel shapes have been discovered in Ostroh and its vicinity in Western Volhynia (Verteletskyi 2016, 2020). However, the method of decoration

they used to adorn the bowl from Vynnyky has no direct relation to the ornamentation used on the hemispheric bowls in Western Volhynia. We can only point out some indirect stylistic parallels in Novomalyn-Podobanka (Verteletskyi 2016; 2020) and Khoriv-Pidluzhzhia (Fig. 14; Verteletskyi 2020; fig. 8). Bowls decorated similarly are associated with the Trypillia component at the FBC site in Lezhnytsia-Chub (Rybicka *et al.* 2019).

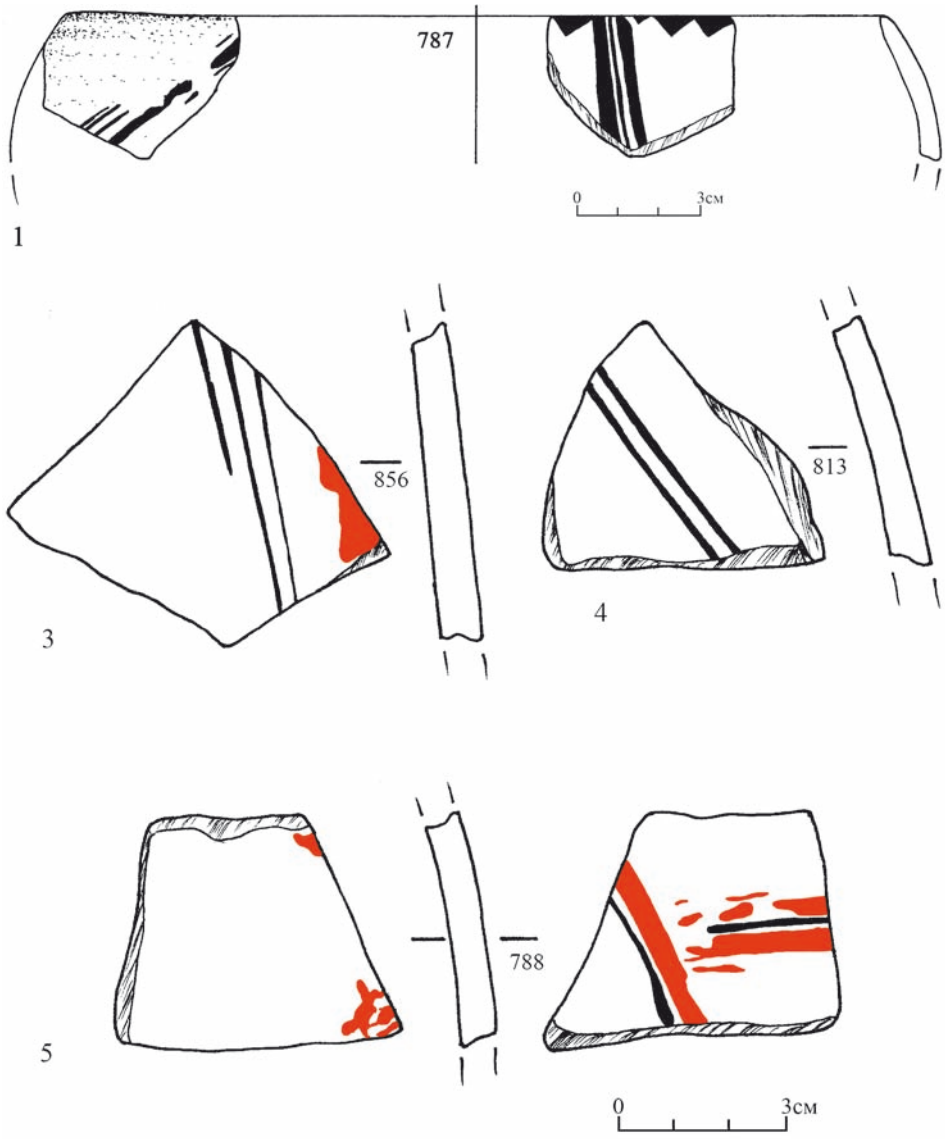

Fig. 14. Vynnyky-Lysivka, Lviv district. Feature 3/2024. Pottery finds of the Trypillia culture

DATING OF THE BRÎNZENI GROUP

The most notable syncretism is observed in the pottery finds from Novomalyn-Podobanka, where the features of the Trypillia Culture are combined with those of the FBC. Radiocarbon values were calculated from a sample of a beaker whose surfaces were painted red (Król and Rybicka 2016). This design is most likely associated with the Trypillia Culture. The ^{14}C value for Poz-55979 yields 4670±40 BP, which translates to 3516-3372 cal. BC (68.2%) and 3627-3363 cal. BC (95.4%). It is precisely the syncretism of the pottery finds observed in Novomalyn-Podobanka that we have in mind when extrapolating the values we have just mentioned to the dating of the village representing the Brînzeni component at this site.

According to A. Diachenko and T. Harper (2016, fig. 3), the analysis of currently available radiocarbon dates indicates that the Brînzeni Group of the Trypillia Culture can be dated to the range 3600-3300 BC. In recent years, a new series of radiocarbon dates have been obtained from habitation contexts in Northern Moldova, and these values fit perfectly into the above range (Rybicka *et al.* 2020; Sîrbu *et al.* 2020). Because the house debris in Brînzeni – Ţiganca and Costeşti contained specific Beaker pottery, it should be attributed to the same chronological range (Rybicka 2017; Sîrbu *et al.* 2020). The dates of the Funnel Beaker and the Trypillia Culture pottery are closely interrelated.

SOME REMARKS ON THE CULTURAL AFFILIATION OF THE VYNNYKY-LYSIVKA RATTLE

Ceramic rattles are unlikely to have been the kind of devices that Beaker people used regularly. The only known example is a conical rattle (height = 8.2 cm; base diameter = 3.5 cm) from the Funnel Beaker habitation context in Kietrz, Opole Voivodeship (Piwko 1987-1988).

Sound instruments of this type appeared more frequently in various subsequent phases of the Trypillia Culture (Balabyna 1998; Voytyuk *et al.* 2022; Oliynyk 2024). They vary in shape and ornamentation and were recorded in sacral contexts, particularly in graves. The rattle from Vynnyky-Lysivka has no direct parallels in the published pottery record of the Trypillia Culture. Some indirect associations can still be observed among the toys recovered from children's burials in Vykhvatintsy (Georgieva and Milanov 2005, fig. 2: 3-4; Oliynyk 2024). The body of one of the rattles from there has no decoration, and its shape is similar to the shape of the rattle we are now publishing. The difference is that the rattle from Vykhvatintsy has a knob with a hole on top. According to well-founded scientific proposals, the necropolis in Vykhvatintsy corresponds to the younger phase of the Brînzeni group (Dergachev 2021; Diachenko and Harper 2016).

Considering both the manufacturing techniques and the depositional context, it can be inferred that the rattle is associated with the FBC component of the site. However, it is

worth noting that the idea of rattles could have arisen after contacts between the inhabitants of Mound Lysivka and the people of the Brînzeni Group of the Trypillia Culture: it is not without reason that tableware imports and syncretic pottery types combine features of both formations.

CONCLUSIONS

Between 3600 and 3300 BC, direct contact between the communities of the FBC and those of the Trypillia Culture was by no means rare (Rybicka 2017). The now-visible result of this interplay is that imported Trypillia tableware is identified within the FBC framework, and FBC pottery is regularly found in Trypillia features (Rybicka 2017; Hawinskyi and Rybicka 2021). In the border areas, as a result of prehistoric contacts, innovative syncretic pottery types have emerged, combining features of both traditions under study, providing evidence of communication between their representatives. The site in Novomalyn-Podobanka, Western Volhynia, may serve as a good example of this process (Rybicka 2017).

Various evidence of FBC-Trypillia interactions can also be observed at Vynnyky-Lysivka, either in the form of syncretic pottery types or several tableware imports from the Trypillia milieu of the Brînzeni Group (Rybicka *et al.* 2018; Hawinskyi and Rybicka 2021).

Regarding the rattle from Vynnyky-Lysivka, it is worth mentioning that a ceramic whistle with a most distinctive bird-like shape was identified in a ceramic assemblage from the site of the eastern Funnel Beaker group in Kiełczewo, Western Poland (Sobkowiak-Tabaka *et al.* 2023). The avianomorphic design is nonetheless associated with the zoomorphic statuettes of the Trypillia Culture (Jakubenko 1998; Kiosak *et al.* 2014; Ovchynnykov 2014). The fact that the FBC contains artefacts with non-utilitarian functions (*e.g.*, rattles) allows one to assume that interactions between the communities of the cultures in question could have been very diverse and included both economic relations, such as exchange for artefacts made of Volhynian flint, pottery and copper goods, and direct contacts between the participants of those groups.

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SEPULCHRAL COMPLEX OF THE GLOBULAR AMPHORA CULTURE DISCOVERED AT SITE 50 IN SREBRZYSZCZE, DIST. CHEŁM, LUBLIN VOIVODESHIP

ABSTRACT

Przybyła M.M., Witkowska B., Michalczewski K., Szczepanek A. and Lasota-Kuś A. 2025. Sepulchral complex of the Globular Amphora Culture discovered at Site 50 in Srebrzyszcze, dist. Chełm, Lublin Voivodeship. *Sprawozdania Archeologiczne* 77/2, 255-284.

At Site 50 in Srebrzyszcze, a unique complex of sepulchral features of the Globular Amphora Culture was discovered, consisting of a single human grave accompanied by two deposits of animal remains. The uniqueness of this discovery lies in the fact that the person to whom this expanded ritual complex was dedicated was a child, and also in the construction of the complex itself, which represents a type of structure with stone surrounds, very rarely encountered in the East Lublin group of the Globular Amphora Culture. Therefore, the results of research conducted at Site 50 enrich the picture of the Globular Amphora Culture from the Lublin Upland territory, as the sepulchral complex under scrutiny represents the easternmost construction of the Nałęczów type. A radiocarbon date was obtained for the human burial, which may contribute to further considerations upon the chronological position of graves without stone surrounds within the GAC.

Keywords: Globular Amphora Culture, Lublin Upland, animal deposit, burial of a child, graves of the Nałęczów type, Late Eneolithic

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1. INTRODUCTION

Site 50 in Srebrzyszcze, dist. Chełm (Fig. 1: 1) is located on the southern slopes of a widespread, though relatively low elevation, limited on the south by the valley of a nameless watercourse, flowing into the Uherka River, 4 km to the west, being a left-bank tributary of the Western Bug River. To the north, the elevation is embraced by a vast marsh named Błota Serebryskie. The landform on which the site was established consists of Cretaceous marls with caps of Tertiary limestones, and constitutes a part of the Chełm Hills (Pagóry Chełmskie), namely a mesoregion contained within the macroregion of the Volhynian Polissia (Polesie Wołyńskie) (Kondracki 1981, 344, 345), belonging in turn to the megaregion of the East European Plain and the province of the East Baltic and Belarus Lowland (Solon *et al.* 2018).

The site was discovered in 2020 during a field survey commissioned by the General Directorate for National Roads and Motorways, Lublin division (Grabowski *et al.* 2021, 77).

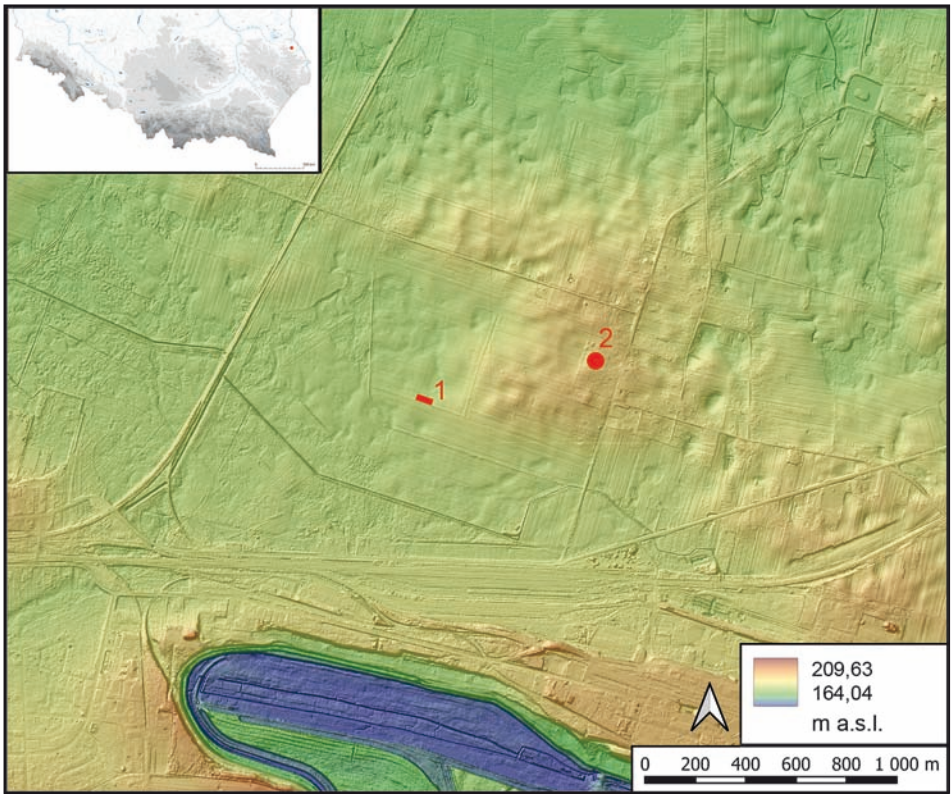

Fig. 1. Location of the GAC cemeteries in Srebrzyszcze, dist. Chełm.
1 – Site 50. 2 – Site 23. Elaborated by A. Sznajdrowska-Pondel and M. M. Przybyła

In the years 2023-2024, widespread excavations at the site were carried out by a company named 'Archeologiczny Serwis Konsultacyjno-Badawczy Mirosław Kuś'. These investigations were conducted in connection with the construction of a ring road for the city of Chełm. Apart from very numerous finds dated to the Early Iron Age and the Early Middle Ages, three sepulchral constructions of the Globular Amphora Culture (hereinafter referred to as the GAC) were also encountered. This was not the first discovery of this type in the Srebrzyszcze region. In 1987 (at Site 23), located slightly northward from Site 50 (Fig. 1: 2), a GAC human burial and an animal grave were uncovered (Gołub 1994; Bronicki 2021, 133-145). However, both of these sepulchral sites represent a different pattern of funeral rituals and cannot be considered analogues to each other. The discoveries made at Site 50 delivered new data on the funeral rites of the East Lublin subgroup of the GAC.

2. DESCRIPTION OF THE FEATURES AND THEIR INVENTORIES

The GAC funeral complex discovered at Site 50 in Srebrzyszcze consisted of two animal deposits of sacrificial nature (Features 119 and 120), as well as an individual human grave, Feature 121 (Figs 2 and 3). They were encountered in the lower part of the southern, gently descending slope of a local elevation, within a distance of 350 m from the nameless watercourse. The features in question formed a linear pattern extending along the W-E axis. The three features were 1 m and 1.2 m apart, respectively. The grave pits were carved into the Cretaceous rock, which constitutes the local substratum. In the extensive area investigated, within a distance of 50 to several hundred meters to the north, east and west, no traces of other GAC features were recorded. However, the southern boundary of the investigated area was 15 m away from the burials in question. These features seem to constitute an independent ritual complex rather than a part of any larger cemetery.

In the authors' opinion, the GAC features discovered at Site 50 in Srebrzyszcze should be considered simultaneous constructions, created during the same funeral ceremony, as supported by the alignment of the graves along a consistent axis, as well as their mutual complementary context. They evidence the existence of an advanced funeral ritual devoted, most likely, to the person buried in Feature no. 121.

Feature no. 119 – animal deposit

The smaller animal deposit, one of the two features of this type accompanying the human grave, contained the complete skeletons of 12 pigs and remains of a stone surround (Fig. 4). The feature was slightly irregular in plan, close to trapezoidal, 140 x 300 cm and 50 cm deep, and was oriented along the W-E axis. The stone surround consisted of medium-sized limestone blocks, preserved only along both shorter walls. In the arrangement of animal remains, despite their dense concentration over a small area, one can notice a diligence

Fig. 2. Level of detecting the GAC features at Site 50. Photo by M. Kuś

Fig. 3. Complex of sepulchral features of the GAC at Site 50. Drawn by M. Podsiadło

Fig. 4. Feature 119 at the level of detecting animal remains. Photo by M. Kuś

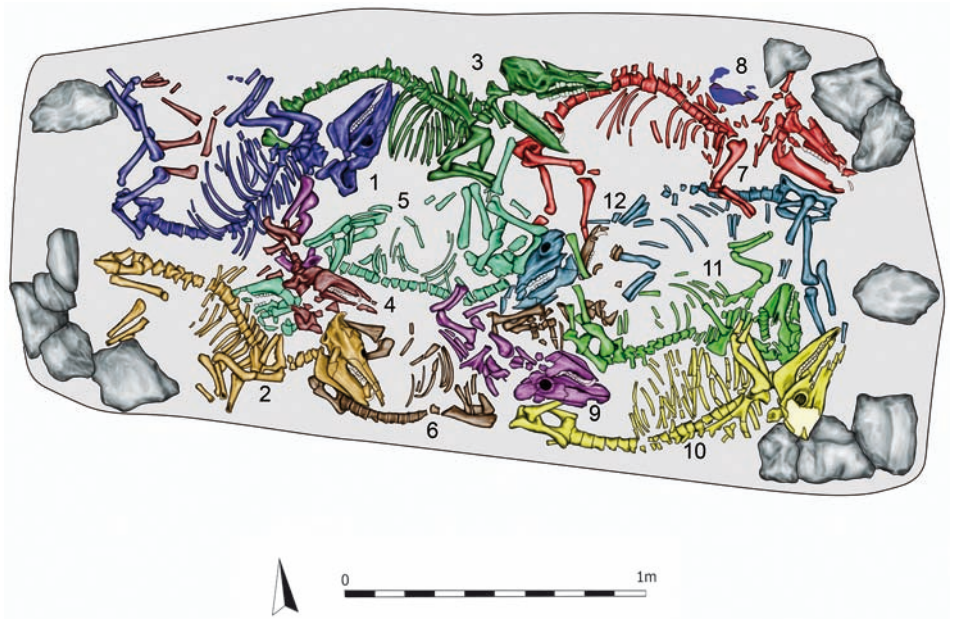

Fig. 5. Feature 119 – distinguished animal skeletons. Drawn by M. Podsiadło

in maintaining an even pattern characteristic of the GAC animal deposits (Wislański 1979, 294; Włodarczak and Przybyła 2013, 220; Müller 2023, 342, 343). In all of the cases, the skeletons of the pigs were placed on one side, along the longer axis of the grave pit. Most of them formed pairs aligned antithetically, by the northern and the southern walls of the pit, turning to each other with their abdominal part (individuals Nos. 7 and 10, 3 and 6), or back to back (individuals 1 and 2). Between the skeletons 7 and 10, another pair was placed, namely Nos. 11 and 12, aligned in a pattern of central symmetry. Between the skeletons Nos. 3 and 6, there was another pair, placed analogically (individuals Nos. 5 and 9). Other skeletons (8 and 4) were lying in a disordered arrangement in the opposite part of the pit (Fig. 5). Most of the pigs placed in feature 119 were juveniles. The individual No. 7 was slain at the age of merely 3-5 months, individuals Nos. 4, 9 and 11 – at the age of 12-16 months, and Nos. 2, 6 and 12 – at the age of 16-24 months. The individual No. 5 was 1-3.5 years old. Only the animals Nos. 1, 3, 8 and 10 were 6-8 years old.

Inventory

The animal skeletons were accompanied by a single flint flake, the nature of which is complex to determine; it may have been a random addition to the deposit.

The flake was made of the Rejowiec flint, detached from a core for flakes or being a waste product from the production of a core tool (Fig. 6: 1). Visible traces of flaking support the first possibility in the proximal part of the artefact that could have emerged, most likely, due to trimming of a platform edge. On the dorsal face of the flake, there are legible, slightly oblique scars running from its left side edge, and a few scars left by opposite blows. The butt is cortical. The artefact in question is 32 mm long, 41 mm wide and 8 mm thick. Its longitudinal section is straight, cross section – irregular, winged-shaped in the proximal part. Along both of the longer side edges, utilitarian retouch was detected.

Feature no. 120 – animal deposit

Feature 120 was a large, rectangular pit, with dimensions of 180 x 600 cm and 70 cm deep, containing skeletons of eight cows, nine sheep and one pig (Fig. 7). In the corners of the feature, there were recorded elongated dark patches, extending beyond the pit outline, most likely the relics of wooden construction elements. The animals deposited within this pit were carefully arranged, which was particularly legible in its eastern part, where the animal remains were grouped in pairs, in antipodal position. The skeletons of most of the cows were placed in pairs (Fig. 8), lying on one of their sides, along the longer walls of the grave pit. In two cases, they were laid symmetrically, turned with their abdominal parts towards each other (individuals Nos. 1 and 2, as well as 3 and 4). A pair of individuals, Nos. 7 and 8 were arranged in a central symmetry pattern. Between them, antithetically aligned skeletons Nos. 5 and 6 were placed. In the north-western corner of the pit, there was deposited an incomplete skeleton of a pig (No. 9), while in the south-western corner, the disturbed skeletons of sheep were encountered (No. 10). Most of the cows placed in Feature

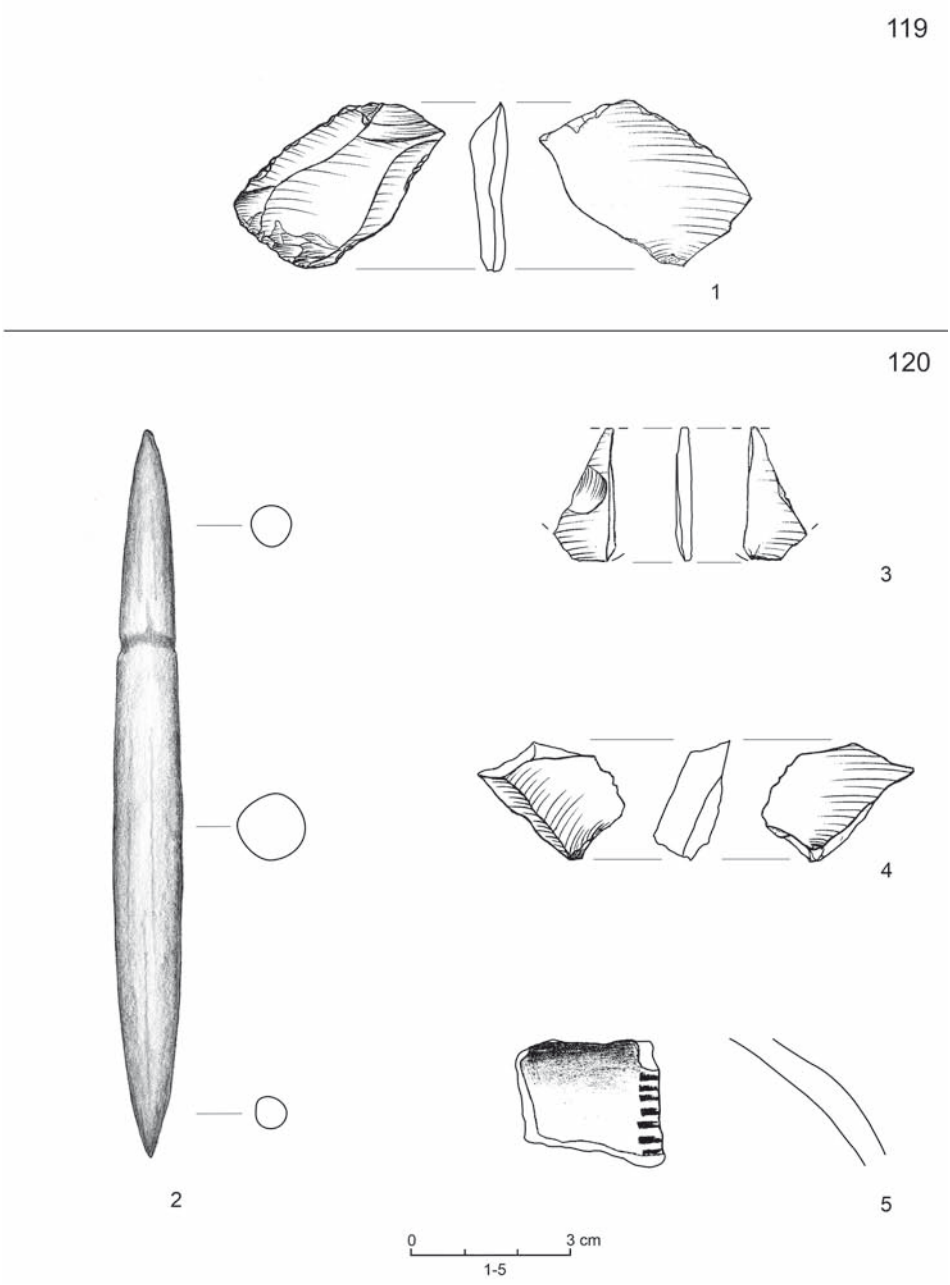

Fig. 6. Artefacts discovered in the features 119 and 120.
Drawn by M. Podsiadło and B. Witkowska. 1, 3-4: Rejowiec flint, 2: deer antlers, 5: pottery

120 were juveniles. Individuals Nos. 1 and 4 were determined as males of an age of ca. 3.5-4 years. The sex of the other individuals remains unknown. Individual No. 5 was slain at the age of 2-3.5 years, individual No. 2 was ca. 3.5 years old, while No. 7 was aged between 3.5 and 4 years. The remaining animals (3, 6, and 8) were 19-24 months old. The remains of the pig and sheep recorded in the pit were determined as juveniles. The latter stay within the age ranges: 18-24 months, 20-24 months, and beyond 2 years.

A fragment of pottery encountered in the upper part of the pit filling should be considered an accidental addition. Possibly, two flint artefacts recorded in the feature could have got into the pit randomly as well. Whereas, by the mandible of the cow No. 4, there was recorded a bone point, the intentional deposition of which raises no doubts. Moreover, in the mandible of the cow No. 8, there is a hole that must have emerged due to stabbing the animal with the use of such a point (Fig. 9).

Fig. 7. Feature 120 at the level of detecting animal remains. Photo by M. Kuś

Fig. 8. Feature 120 -animal skeletons distinguished. Drawn by M. Podsiadło

Inventory

Feature 120 contained a point made of antler, a fragment of pottery and two flint artefacts. Only the first specimen can be considered an intentional grave good without any doubts. The nature of the remaining artefacts is challenging to establish.

Spindle-shaped (double-ended) point

A perfectly preserved spindle-shaped point with a length of 150 mm, circular in cross-section, with a diameter reaching up to 14 mm. On its surface, there are visible traces of hafting covering the tool over a length of 47 mm. The upper end of the object, designated for hafting, is slightly rounded. The lower end is thoroughly sharpened (Fig. 6: 2; Fig. 10). As indicated by the archaeozoological analysis, the tool was made from the antler of a deer.

Fig. 9. Cow skull no. 3 with a visible hole left by stabbing with a point. Photo by K. Michalczewski

Fig. 10. Spindle-shaped point encountered by the cow skull in Feature 120. Photo by M. Podsiadło

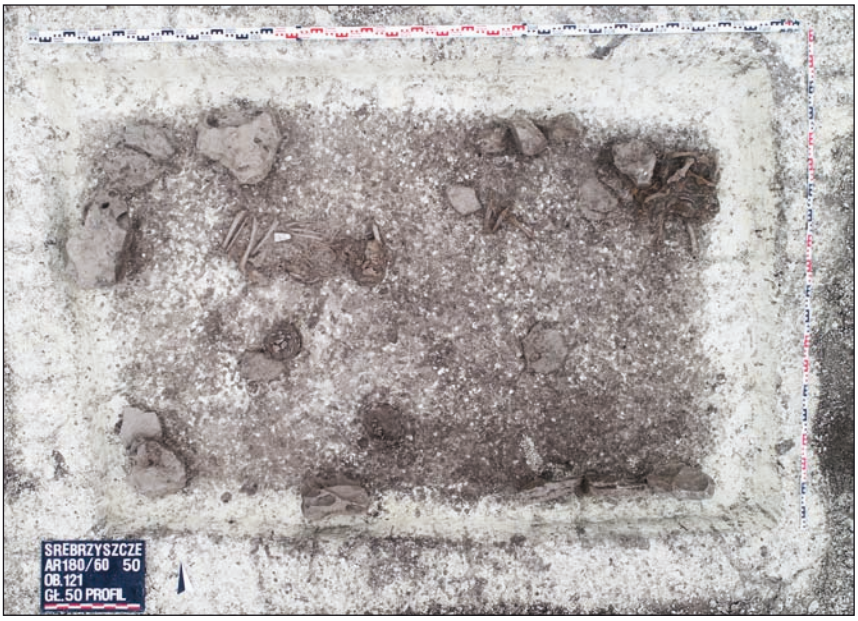

Fig. 11. Feature 121 – level of burial. Photo by M. Kuś

Fig. 12. Plan of Feature 121 with the grave inventory.
1 – human skeleton, 2-3 flint axes, 4 – amber disc, 5-6 vessels, 7- pig remains. Drawn by M. Podsiadło

Flint tools

One of the discovered flint tools lay just by the skull of a cow in the SE corner of the pit. It is a fragment of a flat flake, 27 mm long and 3 mm thick, with a partly cortical butt (Fig. 6: 3).

The other flint artefact is very irregular, with a fan-shaped form. On its dorsal face, there is a slightly oblique scar running from the right side edge and a part of a larger ventral surface removed by the detachment of a blank. The butt surface is strongly crushed, indicating an application of the hard-hammer technique. The artefact in question is 22 mm long, 30 mm wide and 11 mm thick. Its longitudinal and transverse sections are amorphic (Fig. 6: 4). Both of the specimens were made of the Rejowiec flint.

Pottery

Within the feature in question, a single fragment of a vessel was found, ornamented with a vertical bar composed of horizontal stamps, rectangular in shape, most likely constituting a fragment of a multi-element decorative motif. The wall is 0.6 mm thick. The fabric contains a slight admixture of sand, the firing degree is fine, and the firing colour is non-uniform. Although the artefact under analysis meets the technological criteria of GAC pottery, it was most likely not an intentional addition to the grave pit (Fig. 6: 5).

Feature no. 121

A human burial was encountered within Feature 121. The grave pit was quite regular, rectangular in shape, with dimensions of 150 x 260 cm (Fig. 11). The pit bottom was reached at a depth of 50 cm. The grave had a stone surround, consisting of medium-sized limestone blocks, placed around the northern, western, and southern walls of the pit. In the grave, there was placed a corpse of a child aged ca. 8-9 years (*Infans II*). The skeleton lay in the western part of the grave pit, along the W-E axis, in a flexed position on the right side (Fig. 12). The deceased's legs were strongly bent at the hips and knees. The upper limbs were strongly bent at the elbows and arranged along the body with hands turned toward the face (Fig. 12: 1).

Anthropological analysis

Anthropological analysis was performed using methods developed for analysing the skeletons of children (White and Folkens 2005). For determining the age at the time of death, two factors were considered: the state of development of teeth (AlQahtani *et al.* 2010) and the state of ossification and size of long bones (Bernert *et al.* 2007).

The skeleton was almost complete (Fig. 13), but most of the bones had been secondarily damaged during deposition in the ground. Amongst the skull bones, there have been preserved fragments of the delicate cranial vault bones with the right and left petrous parts of the temporal bones (Fig. 13: b). There was also recorded a fragment of the right zygomatic bone and fragments of the mandible (body with tooth sockets), as well as several teeth,

consisting of strongly worn down baby teeth, and permanent teeth at the stage of formation of their roots, and germs of permanent teeth (Fig. 13: c):

M2			P1	C				C	P1			M2		
	M1	m2								m2	M1			
	M1	m2	m1		I2				m1	m2	M1			
M2				C					P1			M2		

The postcranial skeleton was represented by fragments of cervical, thoracic and lumbar vertebrae as well as the sacral bone, ribs of the right and left side, both collar bones, the right shoulder blade, both humeri, the radial and elbow bones, a phalanx, fragments of pelvis bones, the right and the left thigh, tibial and fibular bones (Fig. 13: a). All epiphyses of long bones were ununited.

The preserved elements of the skeleton mentioned above allowed determining the individual's age at the time of death, namely at the age of 8-9 years. Determining sex with the use of anthropological methods was unsuccessful.

Grave inventory

The deceased was accompanied by burial goods, which included two flint axes, an end scraper, two retouched flakes, two flint chunks, an amber disc, a tusk from a wild boar, and two ceramic vessels. One of the axes lay between the hips and the elbows of the individual (Fig. 12: 3). The forehead encountered the other (Fig. 10: 3). The amber disc was located near the hips (Fig. 12: 4). One of the vessels lay directly behind the back of the deceased, supported by a large stone (Fig. 12: 5). The other was placed in the central part of the pit, close to the southern wall (Fig. 12: 6). The remaining elements of the burial goods were encountered in immediate proximity of the skeleton. In the north-eastern corner of the grave, there were deposited the incomplete remains of a pig at the age of 16-24 months (Fig. 12: 7), undoubtedly a grave offering placed together with the deceased during the funeral ceremony, and not bearing any traces of post-consumption nature.

Ceramic inventory

The remains of two vessels were encountered in the pit, preserved in a residual form, which is most likely due to the destruction of the shallow upper part of the grave by ploughing. They were placed within a certain distance from the corpse, behind the back, in the central part of the pit.

The first is represented by the bottom part of a medium-sized vessel (Fig. 14: 7). The preserved height of the specimen is 6.8 cm, with a diameter of 15 cm; the latter is most likely close to the maximum protuberance of the belly. The bottom is not distinguished, with a diameter of ca. 6 cm. The fabric of the vessel contains a medium amount of admixture consisting of sand and very small-grained crushed granite stones, the prevailing col-

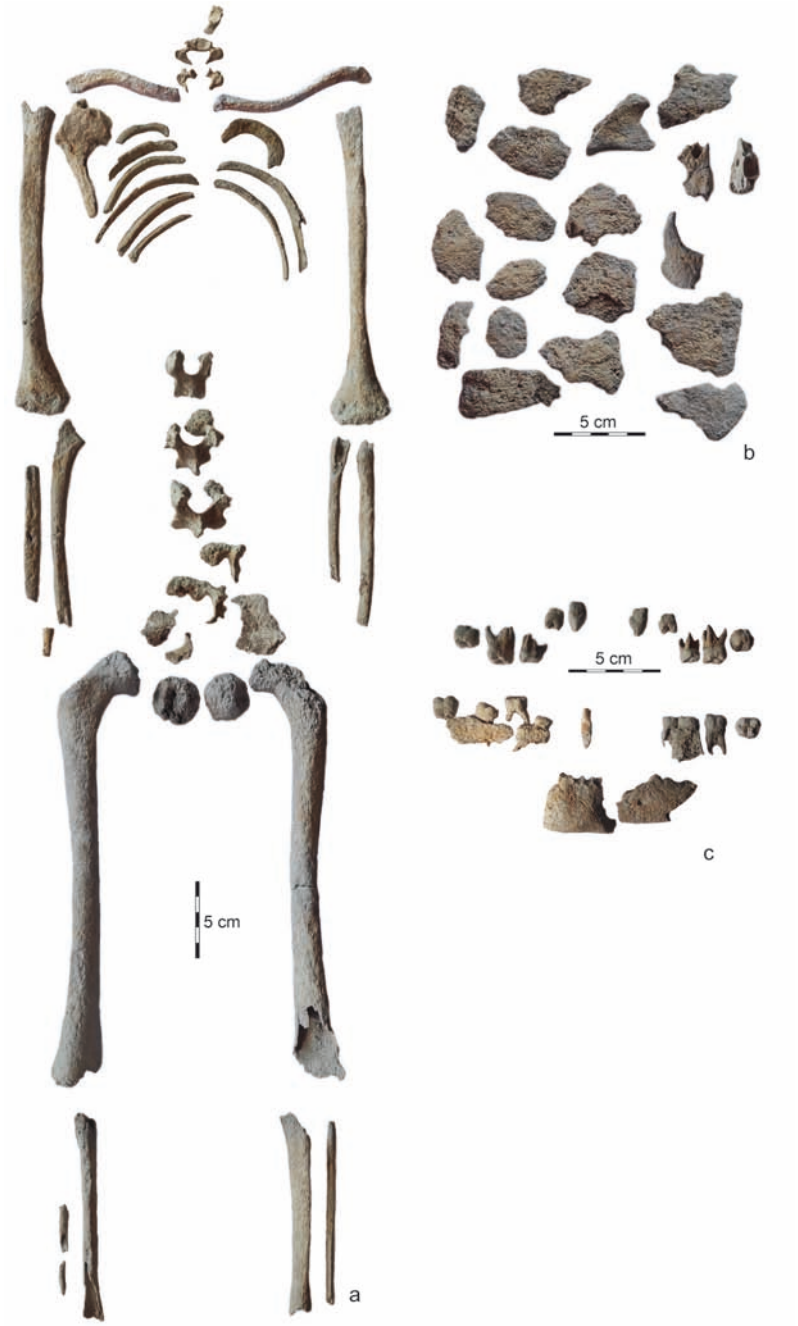

Fig. 13. Srebrzyszcze, Site 50, Feature 121, human remains:
a – postcranial skeleton, b- skull fragments, c – preserved teeth. Photo by A. Szczepanek

our of which is pink. The original external surfaces have not been preserved. The firing degree is medium, with a changeable firing colour ('spotted'), and the fracture is monochromatic. The vessel's wall thickness is 0.5 cm, and the bottom is 0.9 cm thick. Most probably, the fragment in question comes from an amphora with two handles, of the ovoid type, which is indicated by the undistinguished bottom. In GAC pottery, this trait is observed mainly concerning globular and ovoid amphorae (Nosek 1967, 291); the reconstructed curvature of the belly of the specimen from Srebrzyszcze supports the latter form.

The other vessel from Feature 121 is more difficult to classify. The specimen is the lower part of a thin-walled, medium-sized vessel (Fig. 14: 8). The preserved height is 10.5 cm, extending to the greatest protuberance of the belly, with a diameter of 16 cm. The vessel bottom is slightly convex, poorly distinguished, with a diameter of 8 cm. The fabric contains a pretty significant amount of admixture consisting of very small-grained crushed granite stones of pink colour, with no sand at all. The firing degree is poor, with a red colour and monochromatic fracture. The wall thickness is 0.3 cm, and the bottom is 0.5 cm thick. Due to the absence of distinctive traits, determining the type of vessel is challenging; it may have been an ovoid amphora or a small beaker.

Flint inventory

The flint inventory consisted of two axes and two flakes. Small artefacts were recorded amongst the animal bones. The core tools were deposited in immediate proximity to the human skeleton. One of the axes was placed by the skull, the other lay at the height of the pelvis. All of the artefacts were made of Rejowiec flint.

The larger of the axes, with a length of 98 mm and a thickness of 23 mm, has an almost completely polished surface, on which only a few scars are visible (Figs 14: 1 and 15: 1). The axe blade is slightly asymmetrical, 54 mm wide, while the width of the axe butt is 37 mm. The artefact in question was of massive, tetrahedral form, of slightly disturbed proportions, indicating that the final shape of the tool may be due to transformations of a larger specimen. The lack of a double sequence of the cutting-edge sharpening and the occurrence of deep scars on the frontal faces of the axe manifests a certain carelessness in its execution. Ground scar ridges evidence that they emerged during the production process, rather than being traces of utilisation. Whereas, scars of the latter nature are legible on the axe butt, with a strongly crushed surface that lost its primary flat form, becoming slightly convex in shape. Slight curvature was also observed on the frontal and side faces of the axe, resulting in an untypical, flat-convex cross-section of the tool, rarely encountered in the GAC assemblages (Balcer 1983, 209). Some of the utilisation scars running from the axe butt cross over onto one of the frontal faces.

The smaller axe, 74 mm long, is a classical example of the GAC core tool (Fig. 14: 2; 15: 2). It has a perfectly rectangular cross-section, straight walls and a small (12 mm) thickness. It was 39 mm wide, narrowing to 20 mm at the butt. The entire surface of the tool, along with its side faces, was thoroughly polished. Near the cutting edge, multi-sequence sharpening

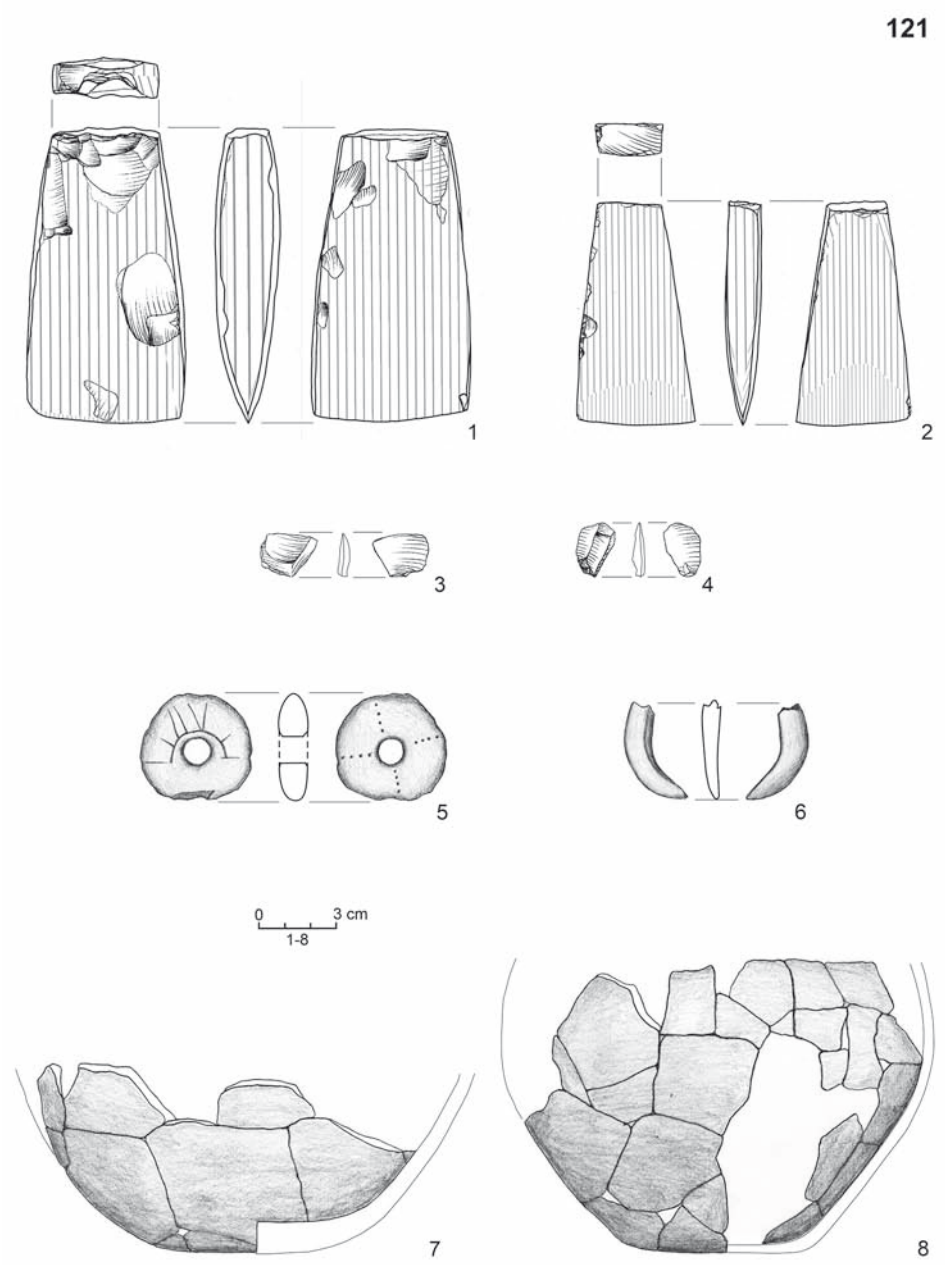

Fig. 14. Inventory of the human burial in Feature 121.
Drawn by M. Podsiadło and B. Witkowska. 1-4:
Rejowiec flint, 5: amber, 6: wild boar tusk, 7-8: pottery

Fig. 15. Flint axes discovered in the grave, Feature 121. Photo by T. Dytry

Fig. 16. Amber disc encountered by the hips of the deceased in Feature 121. Photo by M. M. Przybyła

is visible, involving polishing as well, which is a distinctive trait of the GAC axes (Borkowski and Migal 1996, 148).

Of the two other flint objects found in Feature 121, one is a flake, 16 mm long, 20 mm wide, and 4 mm thick. On its butt, along the left side edge, a crushed surface is visible that resulted from the application of the hard hammer technique (Fig. 14: 3). The other flake is 19 mm in length and 13 mm in width (Fig. 14: 4). On its dorsal face there are legible scars of blows oblique to the axis of the blank detachment; while on the butt an eolithic surface has preserved.

Amber disc

Near the pelvis of the child burial, an ornamented amber disc (Figs 14: 5 and 16), slightly damaged on its circuit, was found. It has a diameter of 35 mm and a thickness of 9 mm. Its cross-section is symmetrical and lens-shaped. In the central part of the specimen, a hole with a diameter of 7 mm was drilled through. Both faces of the disc are decorated. On one of the faces, there is an ornament in the form of an isosceles cross, created by drilling individual rows of shallow pinholes. On the other face, an engraved ornament is visible, composed around the central hole, which can be described as a 'solar' symbol. It consists of an engraved circle, from which irregular lines radiate. Some part of the ornament is very poorly preserved and rubbed away.

Tusk of a wild boar

A small tusk of a wild boar, 55 mm long (Fig. 14: 3), was found among the bones of the dead. It bears no traces of any intentional preparation.

3. ANALYSIS

At Site 50 in Srebrzyszcze, three features of the Late Neolithic chronology were discovered, being a manifestation of sepulchral rites of the GAC. The artefacts encountered within these features have many analogues in other assemblages of this cultural unit.

One of the forms of vessels accompanying the human burial was most likely an ovoid amphora with an undistinguished base. Vessels of this type are relatively commonly recorded in the GAC features from the Lublin Upland. They were discovered, among other places, in Cyców, dist. *loco*, Site 14 (Bronicki 2016, fig. 4: 1), in Grave no. I at Cemetery B in Klementowice, dist. Kurów (Bronicki 2016, fig. 36: 1), in Grave no. 7 at Site 4 in the above-mentioned locality (Bronicki 2016, fig. 55: 1), in Lublin – Czwartek, dist. *loco* (Bronicki 2016, fig. 99), Włostowice (Bronicki 2016, fig. 170: 1). Three such artefacts also come from Feature No. 1 at Cemetery G in Las Stocki, dist. Końskowola (Bronicki 2016, fig. 90: 2, 91: 1, 92: 1), another two were found in the grave in Sahryń, dist. Werbkowice, (Bronicki 2016, fig. 122: 1, 2). According to Stefan Nosek, a predominance of ovoid amphorae over

the globular forms is one of the characteristic traits of his Masovian-Lublin group (Nosek 1967, 344), the extent of which embraces the site under scrutiny.

Tetrahedral axes are the second numerous category of artefacts in the GAC assemblages (Bronicki 2016, 240-241, 245), frequently occurring in multiple sets (Nosek 1967, 273, 274; Włodarczak and Przybyła 2013, table 8). Even though in the related literature they are considered prestigious objects associated with male burials (Balcer 1983, 223), their occurrence in the GAC graves is not strictly connected with the sex or the age of the deceased, for instance, a small core tool of this type was discovered in a double female grave at Cemetery D in Klementowice, dist. Puławy (Bronicki 2016, 97-100), in Grave 7 at the same cemetery, containing remains of an adult female and a child (Bronicki 2016, 100-102), or finally in the child grave No. 223 in Mierzanowice, dist. Opatów (Bąbel 1979, fig. 11).

Whereas flint axes bearing traces of utilisation are far more rare in the GAC burials (Borkowski and Migal 1996, 164), nevertheless, in the territory of the Lublin Upland, their presence in the GAC grave assemblages has been recorded on several occasions, for example, in Grave II from Site 1 in Klementowice, dist. Puławy (Bronicki 2016, fig. 29: 4), in Feature 3 from Site 4 in the same locality (Bronicki 2016, fig. 52: 1), or in the burial from Ślipcza, dist. Hrubieszów (Bronicki 2016, fig. 159: 2).

Flint flakes are quite as rare in the GAC grave assemblages (see Włodarczak and Przybyła 2013, table 8), represented by four small artefacts encountered in all three features constituting the ritual complex under scrutiny. All of them, like the axes, were made of the Rejowiec flint. As the utilisation of local raw materials for the production of small flake tools is quite frequent in the GAC (Wiślański 1979, 286), the use of Rejowiec flint for the production of core tools seems particularly interesting. This raw material is rarely encountered in the GAC toolset, which is predominantly composed of striped flint. Axes made of Rejowiec flint were recorded in only five other graves of this cultural unit, namely in Feature II in Huta, dist. Chełm (Bronicki 2016, 23: 1), the burial from Site 1 in Poniatówka, dist. Chełm (Bronicki 2016, fig. 117), in Sahryń, dist. Hrubieszów (Bronicki 2016, fig. 123: 2) and at Stołpia, dist. Chełm (Bronicki 2016, fig. 152). All of the above-mentioned features were in cist graves. A single axe made of Rejowiec flint was also found in an accidentally discovered feature of an undetermined construction in Stadarnia, dist. Chełm (Bronicki 2016, fig. 140). No occurrence of artefacts made from this raw material has been confirmed for graves of the Nałęczów type to date (see Bronicki 2016, table 12).

The position of the tools recorded in Feature 121 represents an arrangement quite often encountered in the GAC tradition. The location of flint items near the pelvis of the deceased is known from many graves of this cultural unit. At the same time, axes deposited by the head of the deceased were recorded in the cist graves from Łopiennik Dolny – Kolonia, dist. Krasnostaw, Poniatówka, dist. Chełm, Sahryń and Stefankowice-Kolonia, dist. Hrubieszów (Bronicki 2016, 243), as well as in graves of the Nałęczów type from Site 2 in Klementowice and Las Stocki, dist. Puławy (Bronicki 2016, 245). This custom is not limited, in terms of territory, to the Lublin Upland exclusively; core tools were found, among others,

by the skulls of two males buried in a collective grave in Koszyce, dist. Proszowice (Przybyła *et al.* 2013, fig. 11).

The amber disc encountered by the pelvis of the deceased can be classified as type 4AIa according to the classification system developed for amber adornments by R. Mazurowski. This type encloses circular amber discs with a central hole, lens-shaped in cross-section, decorated on one of their surfaces with an ornament of a cross, composed of punctured or drilled lines. Such an ornament is most commonly interpreted as a solar symbol. Adornments of this type are typical of the GAC. However, they can also occur in the assemblages of the Złota Culture (Mazurowski 1983, 41-45, pl. 3). Such finds are encountered mainly in northern Poland (Mazurowski 1983, pl. 7: 15-19; 8: 20; Nosek 1967, fig. 96). Engraved ornaments on amber discs are recorded relatively rarely. Continuous lines of alignment slightly similar to those visible on the specimen from Srebrzyszcze are present on an oval-shaped disc from Wrocław (Mazurowski 1983, pl. 7: 23). In the Lublin Region and adjacent territories, quite numerous amber artefacts have been recorded within the GAC context. However, most of them belong to another type of adornment (see Bronicki 2021, fig. 28: 3-5, 7-9; 127: 4-6; 143: 3, 4; 209: 4-11). A fragment of a large bead with an undetermined hole shape, decorated with an ornament composed of circular dimples, was discovered in Cist Grave No. I in Rudno, dist. Parczew (Bronicki 2021, 105, fig. 109: 2; 114). The only amber disc known from the Lublin Upland is an undecorated specimen, lens-shaped in its cross-section, which came from a cist grave of an adult male uncovered in Stefankowice-Kolonia, dist. Hrubieszów (Bronicki 2021, 149-156, fig. 177: 2; 188). A similar, undecorated artefact was found in a collective human grave in Sandomierz-Kruków (Ścibior and Ścibior 1990, 184, fig. 25: c). In formal terms, the closest analogue to the specimen from Srebrzyszcze is a circular disc decorated with an ornament of a cross composed of a quadruple row of punctures on one side, and a poorly preserved engraved ornament on the other side, encountered in a cist grave in the locality named Ivanye in Ukraine (Maleev 1996, fig. 2: 1). The occurrence of circular discs in the Neolithic is interpreted as a manifestation of a solar cult (Šturms 1956, 15; Klein 1969, 33). In the GAC graves, they are found individually, without any other amber adornments (Mazurowski 1983, 43), which additionally supports their prestigious role in burial goods.

In terms of taxonomy, the least sensitive artefact accompanying the human burial at Site 50 in Srebrzyszcze is the tusk of a wild boar. Such objects are encountered in assemblages of various cultural units from the Late Eneolithic, Late Neolithic, and Early Bronze chronologies, such as the Corded Ware Culture and the Mierzanowice Culture (Włodarczak 2006, 38). They are frequently found in the GAC context. In territories adjacent to the site, tusks of a wild boar are known from graves in Strzyżów, dist. Hrubieszów (Bronicki 2021, 165-170, 219), Depułtycze Nowe – Kolonia, dist. Chełm (Bronicki 2021, fig. 28: 2) and Łopiennik Dolny, dist. Krasnystaw (Gołub 1996, fig. 4: 3, 4).

Double-ended, spindle-shaped points, analogous to the specimen found in Feature 120, are considered as one of the GAC markers (Nosek 1967, 329). In some cases, they

constitute the grounds for classifying animal graves without any other inventory for this cultural unit. In burials of the Catacomb Grave Culture, they are even considered evidence of the GAC influences (Szmyt 1996a, fig. 8: C2). However, it seems that the origins of the tools in question can be sought as early as in the assemblages of the Funnel Beaker Culture, from which there are known almost identical points, differing only in terms of dimensions (6.5-10 cm in length). However, in the latter cultural unit, these artefacts are encountered in settlement contexts, rather than funeral ones (Uzarowicz-Chmielewska and Sałacińska 2013, fig. 140; Kulczycka-Leciejewiczowa 2002, fig. 15: 2, 4; Matraszek 2001, fig. 14: j). Beyond the environment of the pure GAC, they also occurred, among other places, in a tomb containing syncretic elements of the GAC tradition, ascribed to the Radziejów group of the Funnel Beaker Culture and the Corded Ware Culture discovered in Krusza Podlotowa, dist. Inowrocław (Kośko and Kurzawa 1997, 116-120, fig. 6). Several dozen tools of this type are known to have been found in the GAC context. They are dispersed quite randomly over the entire extent of the cultural unit in question, not revealing any legible concentrations within any of the territorial groups, though a considerable number of such finds come from the Lublin Upland. At the cemetery in Złota 'Gajowizna', dist. Sandomierz, they were discovered in three features containing skeletons of cows (Krzak 1977, 23, 44, 45, 49, figs 24 and 60). One of the points from Złota lay between the ribs of a cow, which may indicate the act of stabbing the animal in the heart, a possible occurrence when the animal is laid on its side (Lasota-Moskalewska and Osypińska 2017, 214). Such points were also encountered at the site Sandomierz-Kruków, in a collective human grave (Ścibior and Ścibior 1990, 184, fig. 25: g), in Malice, dist. Sandomierz, within the sacrificial pit, Feature 31 (Witkowska *et al.* 2021, 54, fig. 5: 1), and in the collective human grave Feature 33 (Witkowska *et al.* 2021, fig. 9: 1), as well as in a human grave in Chwałki, dist. Sandomierz (Nosek 1967, 190, fig. 128: 7).

In the vicinity of Srebrzyszcze, in the Lublin Region, spindle-shaped points have been discovered within the burial of a young cow, found in the locality of Husynne-Kolonia, dist. Hrubieszów (Bronicki 2021, 41-43, fig. 35: 1), in a cist grave of an adult male in Sahryń, dist. Hrubieszów (Bronicki 2021, 112-123, fig. 127: 2; 135), in a human burial in Parchatka, dist. Puławy (Nosek 1955, 89), in the collective human Grave III in Klementowice, dist. Puławy (ibidem 1955, 71), and in the human Grave I at the same site (Nosek 1967, 217-219, fig. 157: 2). Even from Srebrzyszcze comes another analogical find, namely a spindle-shaped point found in a cist grave containing the skeleton of a dog, which accompanied the burial of two adults – a female and a male (Bronicki 2021, 133-145, fig. 159: 2; 165). In formal terms, the closest analogue to the point from Feature 120 is an artefact from Sahryń, dist. Hrubieszów, also with a clearly distinguished part for hafting (Bronicki 2021, fig. 127: 2; 135).

As the above-mentioned list of finds proves, spindle-shaped points made of antler do not reveal any direct connection with the ritual killing of animals, since they have been

found in both animal deposits as well as regular human burials. Nevertheless, their location near the skulls of buried animals seems highly suggestive, especially in the case of Feature 120 in Srebrzyszcze, where a hole was recorded on the skull of one of the cows that matches in size with the tool in question.

A separate comment is required regarding the age of the person buried in the grave at Site 50 in Srebrzyszcze. It was a child at the age of *Infans II* (*c.* 8-9 years old), the corpse of which was placed into a full-sized grave. The discovery of a single grave of a child with burial goods and dedicated animal deposits contradicts the conception developed by T. Wiślański, according to which child burials in the GAC were exclusively of a sacrificial nature, reflecting their inferior significance within the entire community (Wiślański 1969, 309). This belief results from a small number of child graves known from the cultural unit in question (see Włodarczak and Przybyła 2013, table 8), together with the discovery of extremely suggestive arrangements of the remains of children in ritual features (*e.g.*, Brześć Kujawski, dist. *loco* – see Wiślański 1979, fig. 179: 4). The dimensions of the grave pit discovered at Site 50 in Srebrzyszcze significantly exceeded the size of a space required for deposition of a single corpse and accompanying inventory. This may suggest that the pit was intended for multiple uses, but for unknown reasons, it had not been used again. Nevertheless, there is no doubt that in Feature No. 121 in Srebrzyszcze, a rightful member of the GAC community was buried. This is supported by the execution of the grave chamber for his/ her own needs, along with accompanying deposits, as well as the type of burial goods placed into the grave with the deceased. In the related literature, tetrahedral axes are considered an expression of the significance of adult males (Balcer 1983, 223); however, as shown above, they have also been found in female graves. Another example of prestigious objects mentioned in the existing literature are amber artefacts (Szmyt 1996b, 207).

The low frequency of child burials in the GAC does not contradict the general norms of rites practised by the Late Eneolithic societies in Poland (see, *e.g.*, Pyzel and Sobkowiak-Tabaka 2004). Individual child burials are known only from three graves of the GAC in the Lublin Upland (Kozak-Zychman and Winiarczyk 2016), namely from Site 6 in Mętów, dist. Głusk (Nogaj-Chachaj 2006), as well as two sites in Klementowice, dist. Kurów – Grave IV in Cemetery 2 and Grave 1 in Cemetery 4 (Bronicki 2016, 90, 91, 93-105). Outside of the region in question, features of this type are equally rare. In the Sandomierz Upland, they were recorded only at Site 1 in Mierzanowice, dist. Opatów, in Features 220 and 223 (Bąbel 1979), although it is possible that the latter feature could have been a settlement pit. In general, in the GAC child graves have been discovered almost exclusively in the companionship of remains of adults (Wiślański 1969, 283-285), which gives an impression of the inferior position of children in the social hierarchy of the GAC community. However, in light of the discovery made at Site 50 in Srebrzyszcze, another hypothesis should be considered, namely, whether this picture does not result from a general predominance in the GAC of collective graves over single burials.

4. CHRONOLOGY AND CULTURAL CLASSIFICATION OF FEATURES

As was mentioned above, the complex of ritual pits uncovered at Site 50 in Srebrzyszcze was most probably dug simultaneously as the result of a single funeral ceremony. Its cultural affiliation with the GAC does not raise any doubts due to numerous analogies within this cultural unit, in terms of both the forms of these features and their contents. However, a more detailed classification of the cemetery within one of the territorial subgroups of the GAC and a precise determination of its chronology pose greater difficulties.

The region of the Chełm Hills (Pagóry Chełmskie), where the cemetery is located, is counted as being within the extent of the so-called East Lublin subgroup of the GAC, for which the leading form of a burial was a cist grave of the Podillia type, built of massive stone blocks constituting a compact surround. Sepulchral constructions of this type have been discovered at 32 sites within this regional subgroup to date (Bronicki 2021, 211). This includes the finds from the very same locality, namely Srebrzyszcze, where at Site 23, a double human burial equipped with seven vessels and a flint axe was encountered, along with a separate accompanying animal deposit, containing remains of a dog with a spindle-shaped point (Bronicki 2021, 133-145). Both of these features were surrounded by large, flat slabs of sandstone and shell conglomerate, placed endwise along the walls of the grave pit. Therefore, they must be considered classic cist graves.

Site 50 lies within a distance of 800 m from the above-mentioned cemetery, yet the sepulchral features found there were, however, of a completely different nature. The grave pits were large, rectangular pits, in general, without any surrounding. The only stone elements recorded on the site were unworked limestone blocks, placed loosely along the eastern wall of the smaller animal deposit, with other stones marking the extent of the human burial. Within the feature containing the cow skeletons, however, relics of a wooden construction were identified. The occurrence of remains of stone block surrounds in Features 119 and 121 allows for classifying the ritual complex in question as Nałęczów-type graves, as distinguished by Józef Ścibior (1984, 51). This classification means that the complex of ritual pits of the GAC discovered at Site 50 in Srebrzyszcze is the easternmost complex of this type. Until present, the easternmost known grave of this type was the feature from Trzeszkowice, dist. Świdnica (Bronicki 2016, fig. 1, 226). However, the linear composition of the sepulchral features under scrutiny finds its best analogues outside of the Lublin Upland, namely on GAC sites in the Sandomierz Upland, where in two localities named Sadowie and Złota-Gajowizna, similar ritual complexes were encountered, consisting of rectangular grave pits and accompanying elongated animal deposits with skeletons aligned in pairs (Pasterkiewicz 2021, fig. 1; Krzak 1977, fig. 1; Witkowska 2021, figs 2-5). At the latter site, charred wooden beams were recorded in the features as well (Witkowska *et al.* 2020, figs 4 and 11).

Graves of the Nałęczów type, concentrating on the eponymic plateau, were usually located on culminations of terrain forms. In contrast, cist graves of the East Lublin subgroup of the GAC are mostly discovered in valleys or on their ridges (Bronicki 2016, tables 2 and 3). Nevertheless, this rule was not observed with regard to the two GAC cemeteries known from Srebrzyszcze, where the cist grave from Site 23 was encountered on a flattening of a slight elevation. In contrast, the complex of features from Site 50, described in this paper, was situated on the south-western slope of this elevation. Therefore, the situation of coexistence within one terrain, with burials of various constructions, raises a question of whether it is justified to consider this particular trait as a criterion for distinguishing territorial subgroups.

The differences in construction between the above-mentioned sepulchral features are probably due to the differing chronologies of those cemeteries. The occurrence of the GAC communities in the Lublin Upland is associated with the classical phase of this cultural unit's development, namely with its Phase IIb/IIIa, whereas its decline, in connection with numerous references to the eastern group, is synchronised with its Phase IIIB GAC (Ścibior 1991, 61; Szmyt 1996a). Portable artefacts encountered within Features nos. 120 and 121 are not sensitive enough, in terms of chronology; therefore, they hinder any further comparative studies. Most likely, the greatest potential in this respect would be provided by ceramic vessels, particularly their ornamentation (see Nosek 1967, 391; Szmyt 1996b, 63), yet they were only preserved in a residual form. According to the periodisation of the East Lublin subgroup of the GAC proposed recently by A. Bronicki, objects in the type of wild boar tusks and amber discs in the graves would be a specific trait of its Phases II and III (Bronicki 2021, 261, 262), however, they seem to have had an intercultural nature (see, *e.g.*, Mazurowski 1983, 41 and above remarks), and cannot be considered dating artefacts. The remaining elements of burial goods, namely flint axes and flakes, have a long chronology of occurrence in the GAC assemblages. In contrast, spindle-shaped points are artefacts encountered incidentally in the GAC features of various dates. Therefore, it seems that the largest chronometric potential is that of the forms of sepulchral features themselves.

In the related literature, it is assumed that the emergence of graves of the Nałęczów type preceded, in general, the occurrence of cist graves of the Podillia type (Włodarczak 2016a, fig. 1), which partly results from interpretations of radiocarbon datings obtained for features from the western Lublin Region (Müller 2023, 180-186). For grave pits with remains of stone surrounds from Las Stocki, Parchatka and two features of this type in Klementowice, the following dates were determined respectively: 4180±35 BP, 4230±35 BP, 4300 ±40 BP, 4175 ±30BP, 4235±35 BP, 4300±BP, 4175±30 BP, indicating a time interval of *ca*. 3000-2690 BC (Włodarczak 2016b, tables 1 and 2, Müller 2023, fig. 156). The youngest date obtained for a Nałęczów-type grave comes from the site in Puławy-Włostowice, where the result was 3995+35 BP, indicating that this form of grave prevailed until the beginning of the second half of the 3rd millennium BC.

For the complex of sepulchral features from Site 50 in Srebrzyszcze, a single radiocarbon date was obtained from a bone of a child buried in Feature no. 121: Poz-185766 – 2.3%N, 6.6%C, 5.3%coll (the radiocarbon dating was funded by the project of the National Science Centre, Poland, No.2020/39/B/HS3/00454, led by Anita Szczepanek). The result of dating 4250±35 BP after calibration lies within the ranges of 2909-2784 BC at the 68.3% of the probability distribution and 2920-2700 BC at the probability of 95.4% (Fig. 17), whereas, in both of these estimations, the highest percentage falls at the older part of the calibration range. Thus, dating obtained for the grave of the Nałęczów type from the site under scrutiny provides another argument for an older chronology of these constructions.

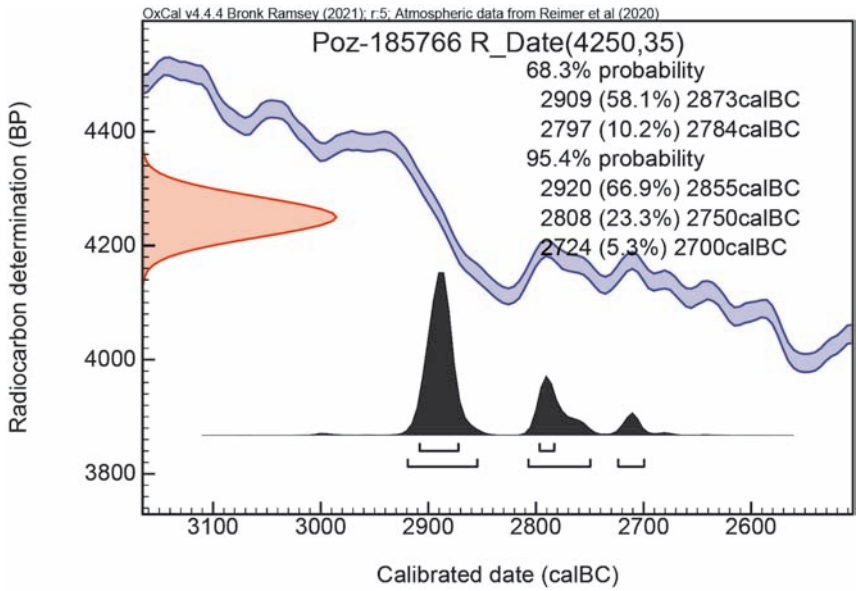

Fig. 17. Calibration of the date obtained from the grave, Feature 121 at Site 50 in Srebrzyszcze. Elaborated by B. Witkowska using the OxCal v4.4.4, acc. to Bronk Ramsey 2021; Reimer *et al*. 2020

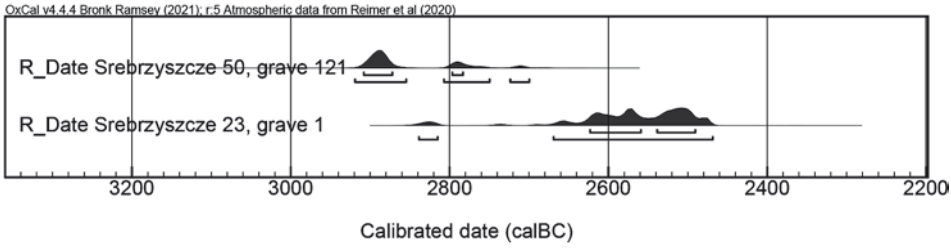

Fig. 18. Comparison of radiocarbon dating for both of the GAC cemeteries in Srebrzyszcze. Elaborated by B. Witkowska using the OxCal v4.4.4, acc. to Bronk Ramsey 2021; Reimer *et al.* 2020

At the same time, absolute datings of cist graves known from the territory of the Lublin Upland, although they indicate their younger chronology, are also contained within the time interval pointing to the first half of the 3rd millennium BC. Still, in the great majority, they do not exceed the lower limit, namely the plateau of the calibration curve, which proves that they cannot be older than 2880 BC (Włodarczak 2016b, 538). The upper chronological limit of constructions of this type is marked by the dating determined for a grave from Site 6 in Czułczyce-Kolonia, which, after calibration, gives a result of 2568-2299 BC (Włodarczak 2016b, table 1). Amongst the features of the Podillia type dated using the radiocarbon method, noteworthy is also the feature from Site 23 in Srebrzyszcze, described above, for which a date of 4045+35 BP was obtained, contained within the ranges of 2621-2491 BC (probability of 68.2%) and 2899-2469 BC (probability of 95.4%). The comparison of the absolute dating of both GAC cemeteries discovered within the same terrain form (Fig. 18) is extremely meaningful and explicitly evidences a chronological diversification of the types of funerary constructions recorded at these sites.

5. SUMMARY

At Site 50 in Srebrzyszcze, a complex of sepulchral features of the GAC was uncovered, consisting of a single human burial, accompanied by two animal deposits. The uniqueness of this discovery lies in the fact that the person to whom this expanded ritual complex was dedicated was a child. Additionally, the construction of the features themselves, which represent the type with remains of a stone surround, is very rarely encountered in the East Lublin subgroup of the GAC. Therefore, the results of the research conducted at Site 50 enrich the picture of the GAC in the Lublin Upland territory. The sepulchral complex here represents the easternmost features of the Nałęczów type, which contradicts the thesis formulated by J. Ścibior, who claimed that the construction of this type can be encountered exclusively within the eponymous plateau (Ścibior 1984, 56). Moreover, it should be stressed that considering graves of this type as a marker for distinguishing particular territorial groups of the GAC is not reflected by their spatial distribution. Having confronted the chronometric data presented in this paper with sepulchral features with stone surrounds known from the related literature (Fig. 19), a hypothesis can be raised that the differences in types of these constructions should be rather seen as a manifestation of chronological diversification of the GAC cemeteries, and within this cultural unit, they should be considered an interregional phenomenon.

The extent of the rescue investigations conducted at Srebrzyszcze Site 50 appears to exclude the possibility of discovering any further sepulchral features of the GAC in immediate proximity to the discovered funeral complex. Most likely, this complex was not part of any larger cemetery of the GAC, but rather the trace of a single, one-time act of sepulchral nature. At the same time, the occurrence of other settlement points within the close

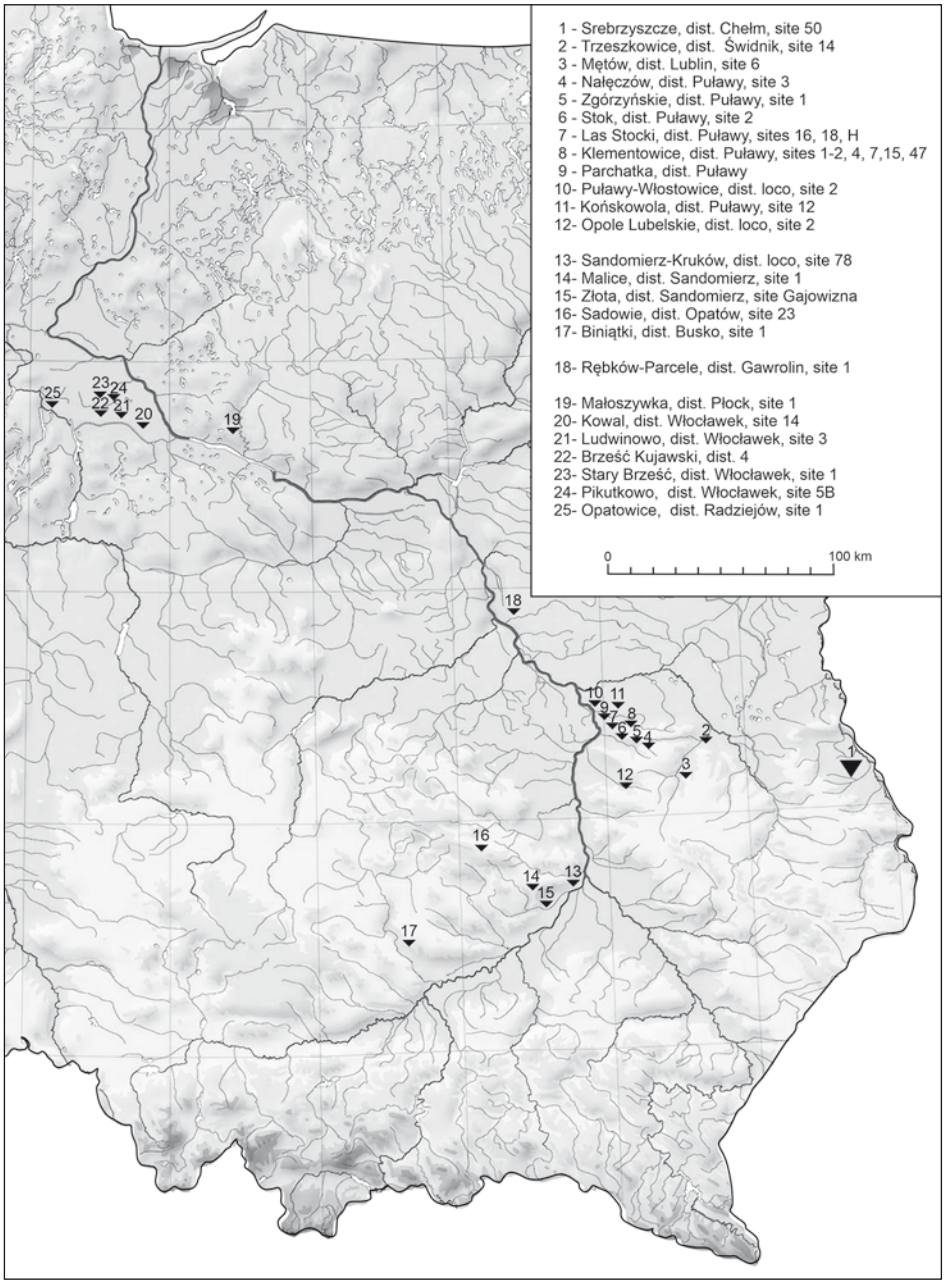

Fig. 19. Distribution of graves with residual stone surrounds within the extent of the central group of the GAC. Elaborated by B. Witkowska

surroundings of the site in question (in total, seven sites according to the AZP documentation, including an alleged cemetery at Site 44 in Srebrzyszcze), evidences a permanent penetration of this territory by the GAC communities. Therefore, one cannot exclude the possibility that further discoveries will shed fresh light on the issue of the diversity of funeral behaviours of the GAC societies in this microregion in the future.

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NEW DATA ON METAL ARTEFACTS OF THE CORDED WARE CULTURE IN LITTLE POLAND (MAŁOPOLSKA)

ABSTRACT

Kowalewska-Marszałek H. 2025. New data on metal artefacts of the Corded Ware Culture in Little Poland (Małopolska). *Sprawozdania Archeologiczne* 77/2, 285-328.

During archaeological excavations at Kichary Nowe, Site 2, near Sandomierz, five graves belonging to the Kraków-Sandomierz group of the Corded Ware culture were unearthed, three of which contained metal artefacts, including ornaments and tools made of gold and copper. The presentation of these finds in the context of other metal specimens belonging to this culture is the subject of this article. The results of their chemical composition analyses will also be discussed.

Keywords: Corded Ware Culture, Late Neolithic, Little Poland, gold, copper, ornaments, tools
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INTRODUCTION

Metal objects are still relatively rare in the assemblages of the Corded Ware Culture, both in the Little Poland (Małopolska) region and in neighbouring areas as well. This is why every new discovery of this kind deserves consideration. The existing list of metal finds related to the Kraków-Sandomierz group of this culture (Machnik 1966, 55; Włodarczak 2006, 40) may be completed now with a few more items originating from Kichary

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Nowe (the current name of the village: Nowe Kichary, Dwikozy commune, Sandomierz district, Świętokrzyskie voivodeship) in south-eastern Poland discovered there during recent archaeological excavations. The aim of this article is to present these finds in the context of other previously known metal objects belonging to this cultural circle (Fig. 1; Table 1). The results of analyses of their chemical composition will also be taken into account.

Site 2 (AZP: 99-74/18) at Kichary Nowe (the former name of the village has been left in this article according to the field documentation) is situated in the Little Poland (Małopolska) region, in the eastern part of the Sandomierz Upland. It is located on a prominent loess promontory on the left bank of the Opatówka River valley. Archaeological excavations conducted there in 1987-2020 revealed remains of a Neolithic and Early Bronze Age cemetery (see *e.g.*, Kowalewska-Marszałek 2000a; 2007; 2013; Kowalewska-Marszałek

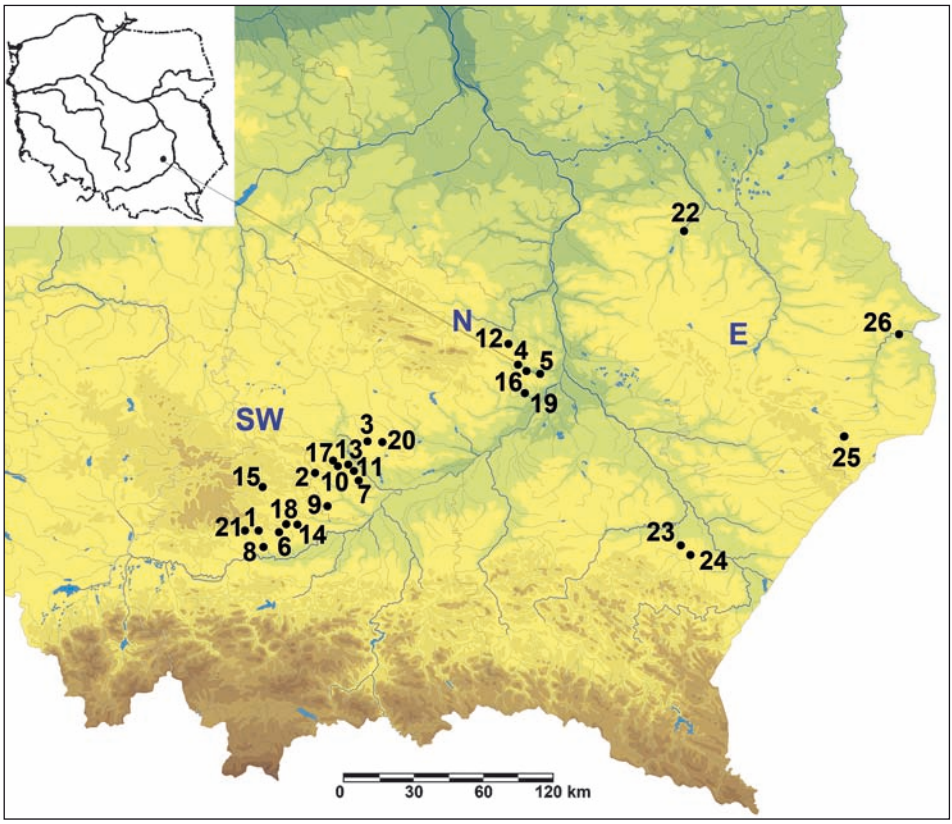


Fig. 1. Sites of the Corded Ware culture with metal finds, SE Poland: 1 – Bosutów, 2 – Bronocice, 3 – Chotelek Zielony (=Siesławice), 4 – Daromin (=Nowy Daromin), 5 – Kichary Nowe, 6 – Kocmyrzów, 7 – Kolosy, 8 – Kraków-Mogiła and Kraków-Mistrzejowice, 9 – Łękawa, 10 – Malżyce, 11 – Miernów, 12 – Mierzanowice, 13 – Pełczyska, 14 – Proszowice, 15 – Smroków, 16 – Wilczyce, 17 – Zagaje Stradowskie, 18 – Zielona, 19 – Złota Grodzisko II, 20 – Żerniki Górne, 21 – Modlnica, 22 – Lublin, 23 – Mirocin, 24 – Szczytna, 25 – Klekacz, 26 – Strzyżów. Processing: D. Wyczółkowski

Table 1. Sites with metal artefacts of the Corded Ware culture in the western part of the Little Poland

No	Site	Features with metal artefacts (and with traces of copper)	Type of finds							Total number of metal artefacts	Traces of copper	Notes
			Ornaments				Tools		Indeterminate			
			Ring	Spiral	Necklace	Other	Intermediate-retoucher	Awl				
1	Bosutów	1		1*						1		Spiral (1″ coils) or ring (*cf.* Krauss 1960, 63; Kempisty 1982, 68)
2	Bronocice	1							1(?)	1		After Włodarczak 2006, 180
3	Chotelek Zielony (= Siesławice)	1 (+2)				1*				1	2	*Remnant of indetermine ornament (Pyzik 1982 [1983], 63)
4	Daromin (= Nowy Daromin)	3		2	1	1*				4		*Fragment of ornament of copper wire (Antoniewicz 1925, 252)
5	Kichary Nowe 2	2 (+1)		3*	1		2			6	1	*copper - 1 item; gold – 2 items
6	Kocmyrzów 17	2		4		1*				5		*Diadem
7	Kolosy	1						1		1		
8	Kraków-Mistrzejowice	1		1						1		
9	Kraków-Mogiła	1		1						1		
10	Łękawa	1 (+1)		1						1	1	
11	Malżyce 30	2		2			1			3		
12	Miernów 2	(1)									1	
13	Mierzanowice 1	3	2	4	1					7	1	
14	Pełczyska	1	1*			1**				2		*Ring or spiral fragment ; **fragment of ornament (?)
15	Proszowice	1		1 (?)						1		„Earring" (*cf.* Włodarczak 2006, 182)
16	Smroków 17	1?							1	1		Uncertain relationship to the feature
17	Wilczyce 10	1					1		1*	2		*fragment of metal plate

Table 1.

No	Site	Features with metal artefacts (and with traces of copper)	Type of finds							Total number of metal artefacts	Traces of copper	Notes
			Ornaments				Tools		Indeterminate			
			Ring	Spiral	Necklace	Other	Intermediate-retoucher	Awl				
18	Zagaje Stradowskie	1							1 (?)	1		After Włodarczak 2006, 183
19	Zielona	1						1*		1		*awl or retoucher
20	Złota-Grodzisko II	2	2							2		
21	Żerniki Górne	5 (+2)	2	4		3*				9	3	*1 fragment of pin and 2 fragments of pendants (?)
22	Modlnica 5	(1)									1	
Total:		31+1? (+7)	7	23 +1?	3	7	4	2	2+2?	51*	9	*Cu: 49, Au: 2

Table 2. Kichary Nowe, Site 2. Graves with metal artefacts belonging to the Kraków-Sandomierz group of the Corded Ware culture

Grave No.					Grave goods								
	Sex	Age	Position	Orientation	Vessels	Battle-axe	Flint axe	Arrowheads	Small flint tools	Flint blanks	Tools of animal bones	Whetstone	Metal
23	F?	adultus	Left side	NE – SW	1		1		1			1	1?
26	M?	juvenis/ adultus	Right side	SE – NW	3	1	2	9*)	1	18	2		1
29	M?	adultus	Right side	SSE- NNW	2		2	13	4	26	1		5**)

Age and sex determination according to M. Pyżuk (Pyżuk 2006): *) Isolated arrowheads (9) and consolidated cluster of specimens, **) Copper artefacts (3) and gold spirals (2)

and Duday 2014). Five graves belonging to the Kraków-Sandomierz group of the Corded Ware culture were unearthed there, except for several human burials related to the Funnel Beaker culture (Duday and Kowalewska-Marszałek 2003; Kowalewska-Marszałek *et al.* 2006) and to the Mierzanowice culture of the Early Bronze Age. Two of those connected with the Corded Ware culture (Graves No. 26 and No. 29) contained metal artefacts made of gold and of copper; in another one (Grave No. 23), traces of a decomposed copper object have been detected. A detailed study of the golden ornaments has already been published (Kowalewska-Marszałek 2000b; 2000c); the presentation of the copper objects is the subject of this article.

The author of the anthropological analyses is Dr Mira Pyżuk (Department of Applied Sciences, Institute of Archaeology and Ethnology, Polish Academy of Sciences, Warsaw). The chemical analyses were carried out by Mrs Elżbieta Pawlicka and Dr ing. Zdzisław Hensel in the Central Laboratory of the Institute of Archaeology and Ethnology, Polish Academy of Sciences, Warsaw, using the EDAX spectrometer (Philips).

MATERIALS

Grave No. 23 contained a human burial placed on the left side, head to NE, face directed to SE, and legs strongly drawn up (Fig. 2, Table 2). These skeletal remains belonged to a gracially built adult, presumably female, approximately 20-25 years of age (Pyżuk

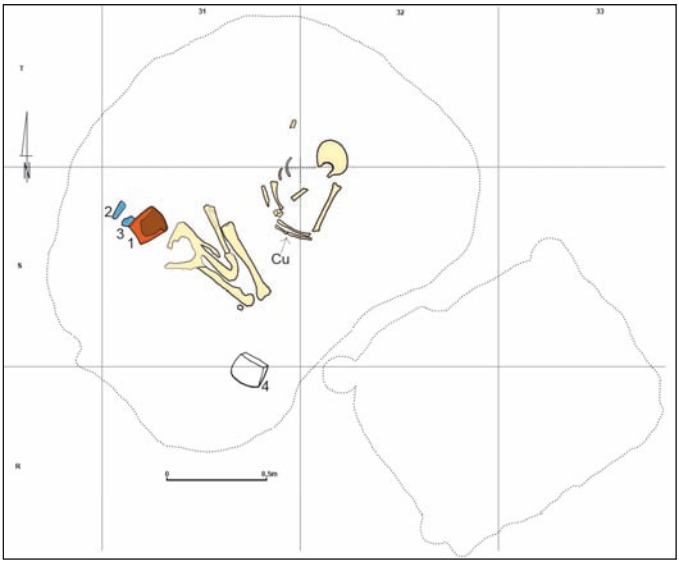


Fig. 2. Kichary Nowe, Site 2, Grave No. 23. Layout of burial and location of grave goods:
1 – vessel, 2 – flint axe, 3 – partially retouched flint flake, 4 – whetstone, Cu – traces of copper.
Drawing: E. Gumińska (after original field documentation by M. Krakowiak)

2006). A green-tinted area of the left ulna was visible for a few centimetres in the distal part of the diaphysis (Fig. 3). This is undoubtedly a trace of a copper object, probably an ornament, perhaps a bracelet or a metal appliqué of small thickness that has completely decayed.

Fig. 3. Kichary Nowe, Site 2, Grave No. 23. Human burial with traces of copper (probably of a copper object decayed) on the left ulna (x), and the grave goods at the bottom of the burial chamber (seen from the SW). Photo: H. Kowalewska-Marszałek

Grave No. 26 contained a burial of an individual in late adolescence or young adult (iuvenis/adultus), presumably male (Pyżuk 2006), lying on his right side, along the SE-NW axis, head to SE. A small copper spiral ornament was situated directly by the skull, near the left temporal lobe (Fig. 4: 12); it was completely covered with a greenish patina and slightly damaged. This is a small spiral (No. H27-286; Fig. 5, Table 3) made of narrow and rather thin copper strip, approximately rectangular in cross-section, and formed by 2¼ coils, with the left side twisted and cylindrical in shape. One end is slightly flat, hammered, and trapezoidal; the other one (defective) was probably straight. Analysis of the chemical composition (Laboratory reference: CL 11761) reveals that this artefact was made of copper (96.94%) with a relatively high content of Pb, As and Zn (more than 0.60% for each of them) and with low content (0.10-0.18%) of Ni, Sb and Ag (Table 4).

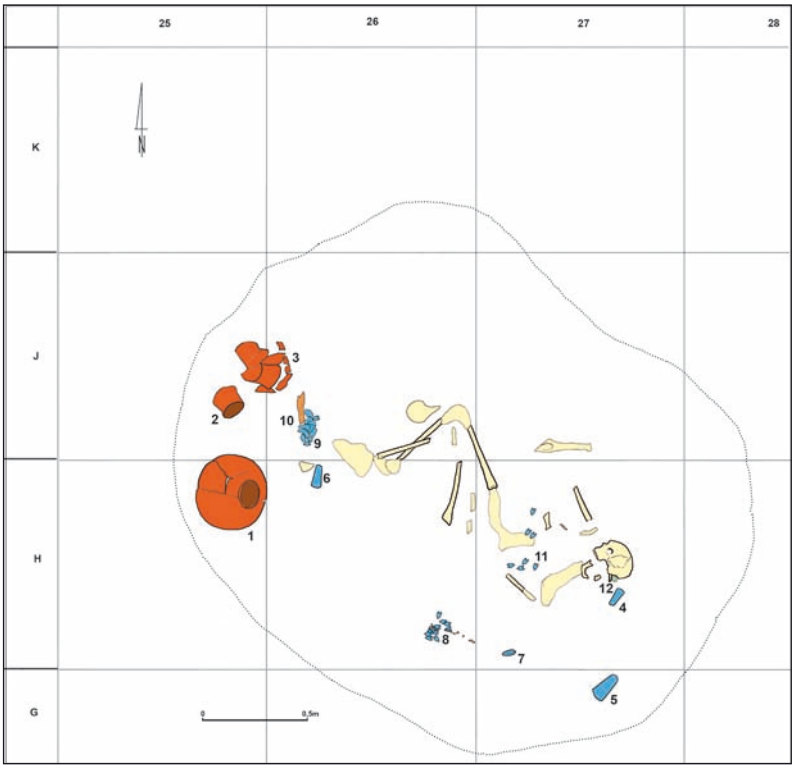


Fig. 4. Kichary Nowe, Site 2, Grave No. 26. Layout of burial and location of grave goods:
1-3 – vessels, 4 – stone battle-axe, 5-6 – polished flint axes, 7- – flint blade tool, 8 – concentration of flint arrowheads, 9 – deposit of flint blanks, 10 – tools of animal bone and of boar tusk, 11 – arrowheads dispersed in the region of the thorax, 12 – copper ornament (spiral).
Drawing: E. Gumińska, after original field documentation by M. Krakowiak

Fig. 5. Kichary Nowe, Site 2. Copper spiral ornament from Grave No. 26 (see Fig. 4: 12).
Drawing: E. Gumińska, processing: D. Wach

Table 3. Kichary Nowe, Site 2. Metal artefacts from graves belonging to the Kraków-Sandomierz group of the Corded Ware culture

No.	Grave No.	Type of find	Description	Metrics	Catalogue No.	Laboratory reference	Figure
1	29	Necklace	Circular with overlapping ends, made of copper wire, covered with a greenish patina Cu (99,23%) with a small addition of Ag, Ni, As and Sn	Diameter: - inner: 157- 160 mm - outer: 170 mm Wire thickness: 5-7 mm	X33-88 (KN-144/99)	CL: 16240	Fig. 6 (1), Fig. 7, Fig. 8
2	26	Spiral ornament	Made of copper tape, covered with a greenish patina and slightly damaged; 2Ľ coils. Cu (96,94%) with high content of Pb, As, Zn, and low amount of Ni, Sb and Ag	Ø: 15.35 mm height: 11.0 mm tape width: 2.6-2.8 mm tape thickness: 1.30 mm Flat part: lenght: 11.0 mm width: 4.65 mm	H27-286 (KN-239/97)	CL 11761	Fig. 4 (12), Fig. 5
3	29	Spiral ornament	Made of golden wire, left-side twisted, slightly conical in shape, 3l' coils; well preserved. Au (84,82 %) with Ag (10,76%)	Ø: 16.0-18.0 mm height: 16.0 mm wire thickness: 1.8 mm Flat part: lenght: 27.0 mm width: 5.0 mm weight: 7.7 g	X33-62 (KN-112/99)	CL: 12334	Fig. 6 (2), Fig. 9a
4	29	Spiral ornament	Made of golden wire, right-side twisted, cylindrical in shape, 3″ coils; well preserved. Au (89,55%) with Ag (9,66%)	Ø: 17.5-18.0 mm height: 14.0 mm wire thickness: 1.5-1.7 mm Flat part: lenght: 26.0 mm width: 5.0 mm weight: 7.1 g	X33-87 (KN-144/99)	CL: 12333	Fig. 6 (3), Fig. 9b
5	29	A miniature tool or a small-size tool tip	A small-size tool tip of the intermediate-retoucher type made of copper bar; well preserved, covered with a greenish patina. Cu (98,79%) with small additions of Ag, Sb, Fe, Pb	lenght: 13.6 mm width: 3.12 mm thickness: 1.4 mm	X32-38 (KN-144/99)	CL: 16241	Fig. 6 (4), Fig. 10a
6	29	A miniature metal tool tip	A miniature metal tool tip, probably a kind of intermediate-retoucher; presumably made of copper; completely covered with a greenish patina.	lenght: 8.1 mm width: 2.9 mm thickness: 1.95 mm	X32-38a (KN-144/99)	Not analysed	Fig. 6 (5), Fig. 10b
7	23	Copper ornament?	Traces of greenish tint of fragment of bone – probably trace of a copper object completely decayed	Few centimetres	S31-273 (KN-210/95)		Fig. 2, Fig. 3 (x)

Grave No. 29. The majority of the metal objects – five pieces – originate from this grave: the burial of an adult with a fairly strong body structure, presumably male, deceased at the age of 20-30 (Pyżuk 2006). He was lying on his right side along the S-N axis, head pointing towards S, the face directed to E, with legs strongly drawn up (Fig. 6). This grave contained a copper necklace (1), two golden spiral rings (2, 3) and two tapering ends of tools (tool tips) made of copper (4) and presumably of copper (5). Among the grave goods there were also: two vessels (beakers), two polished flint axes, a set of flint arrowheads (probably in a quiver), tools of flint blades and a set of flint knapping semi-products, mainly flakes, perhaps in an organic container, as well as a bone tool, probably a chisel (Table 2). Due to the number of elements and nature of this inventory, Grave No. 29 stands out not only from all the other graves of the Corded Ware culture at Kichary Nowe, but it is also among the 'richest' graves belonging to the Kraków-Sandomierz group of this culture in the Małopolska region (*e.g.*, Polańska 2016, 317).

All metal pieces were situated at the bottom of the burial chamber, at the same level as the skeletal remains. The necklace was lying flat at the height of the deceased's cervical vertebrae (Fig. 6: 1), and, at the moment of discovery, it was visible on both sides of those

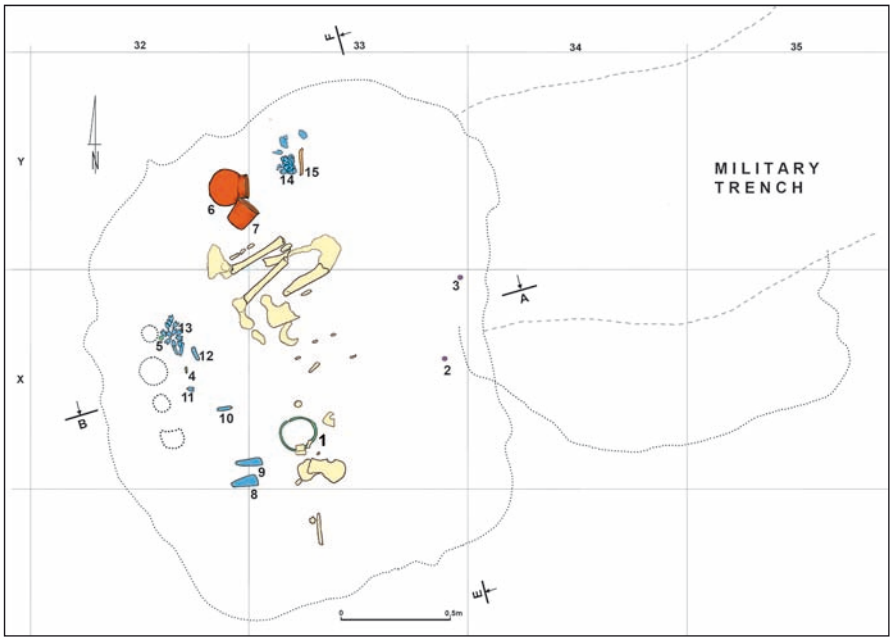


Fig. 6. Kichary Nowe, Site 2, Grave No. 29. Layout of burial and location of grave goods: 1 – copper necklace; 2-3 – gold spiral ornaments, 4 – bigger tool tip of copper, 5 – small tool tip, probably of copper, 6-7 – vessels, 8-9 – polished flint axes, 10-12 – tools of flint blades, 13 – set of flint arrowheads (probably remains of a quiver), 14 – deposit of flint blanks, 15 – tool of animal bone. Drawing: E. Gumińska, after original field documentation by M. Krakowiak

vertebrae (Fig. 7); its overlapping ends were on their thoracic side. Both spiral ornaments were found at the eastern edge of the chamber, below the entrance, in the proximity of the probable wooden timbering of the grave structure and some distance from the human remains: one of them (No. X33-62; Fig. 6: 2) was at a distance of about 0.45-0.60 m to the E of the deceased's head and slightly above the bottom of the chamber, the other (No. X33-87, Fig. 6: 3) was at the level of the bottom, at a distance of about 0.80 m to the E of the deceased's pelvis.

In contrast, the two tool tips were located in the western part of the burial chamber, behind the back of the deceased. The larger one (Fig. 6: 4) lay separately, flat on the bottom of the grave's niche, at the height of the lower torso of the deceased, approximately 0.30 m to the W of him. The smaller tip (Fig. 6: 5) was in the middle of a cluster of flint arrowheads (probably inside the remains of a quiver) situated at the height of the deceased's hips, at a distance of about 0.30 m to the W of them; this piece was inserted almost vertically among the arrowheads and pointed downwards with its tip.

(1) The necklace (No. X33-88; Fig. 8), in the form of a regular circle ('hoop') with overlapping ends, was made from a rather thick wire (0.5-0.7 cm in diameter), round in cross-section. Its inner diameter is 15.7 cm, the outer one – 17.0 cm; the ends overlap by 12 cm, or ¼ of its circumference. An analysis of its chemical composition (reference: CL 16 240) showed that it was made from almost pure copper (99.23%) with a small (0.1-0.2%) addition of Ag, Ni, As and Sn (Table 4).

(2-3) Two "twin", several-coil ornaments, each of them with one end flatly hammered, were made of spirally twisted, not very thick gold wire of circular cross-section. Both are dark yellow in colour, with a slightly reddish tinge in places. One of them (No. X33-62; Fig. 9: a) is left-side twisted, slightly conical in shape, with the other end slightly pointed; the other (No. X33-87; Fig. 9b) is right-side twisted, cylindrical in shape, and its other end is rounded. The flat parts of both specimens are hammered and flared over a rather long segment, with semi-circular ends. Both spirals were made of gold with silver, in the ratios 84.82:10.76 in the first case and 89.55:9.66 in the second. Both specimens are preserved intact; their metric data are given in Table 3 (see also Kowalewska-Marszałek 2000b; 2000c).

(4) A miniature tool, or (rather) a metal tool tip of the intermediate-retoucher type (No. X32-38; Fig. 10: a), made of a copper bar, is well preserved, covered throughout with a greenish patina. It is a small-sized specimen (Table 3), characterised by an elongated shape with an asymmetrical, flat-convex outline and a rectangular cross-section. The apical part is narrow, asymmetrically tapered; apex obtuse, lateral edges slightly raised. There are traces of transverse, arched indentations on one surface, occupying about 2/3 of the length of the specimen (in its medial and epi-basal parts). The results of the chemical composition analysis (reference: CL 16 241) indicate that the tool was made of copper (98.79%) with small additions of Ag and Sb (0.17-0.10%), as well as of Fe, and with a slightly larger quantity of Pb (Table 4).

Fig. 7. Kichary Nowe, Site 2, Grave No. 29. Copper wire necklace and human skeletal remains at the moment of unearthing (seen from the NNW). Photo H. Kowalewska-Marszałek

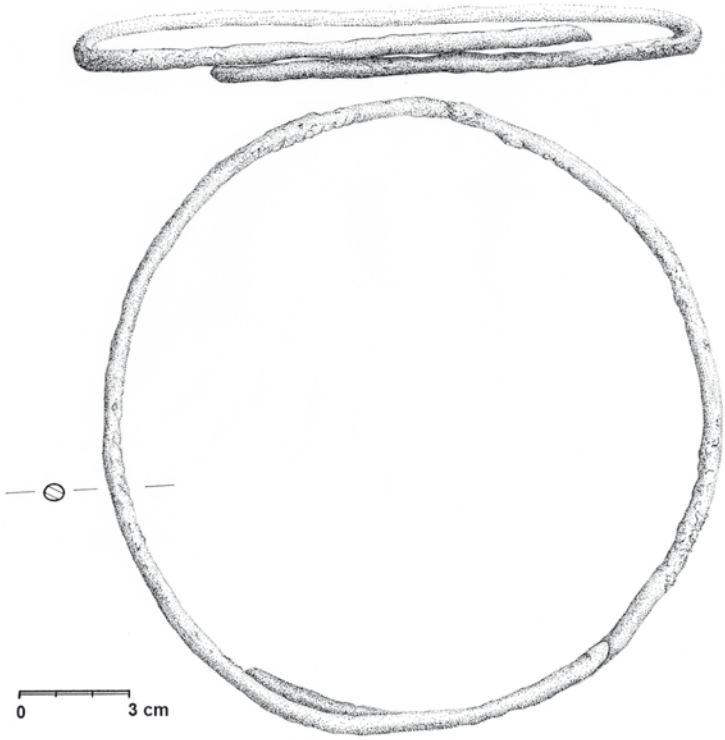


Fig. 8. Kichary Nowe, Site 2. Copper wire necklace from Grave No. 29 (see Fig. 6: 1). Drawing: E. Nos

Table 4. Metal artefacts of the Corded Ware culture from the western part of the Little Poland: results of chemical analyses and attribution to 'Copper compositional groups'. The colour scale represents the quantitative diversity of individual elements (Chemical analyses carried out by Bio- and Archaeometric Laboratory, former Central Laboratory, Institute of Archaeology and Ethnology, Polish Academy of Sciences, Warsaw)

Site	Laboratory Reference	Type	Cu	Al	Si	Ti	Cr	Mn	Fe	Ni	Zn	As	Ag	Sn	Sb	Pb	S	Au	Bi	Compositional Group	Group No.
Kichary Nowe 2, Grave 26	11761	spiral	96.94	0.00	0.21			0.02	0.05	0.18	0.60	0.72	0.10	0.06	0.16	0.95				AsSbAgNi	16
Kichary Nowe 2, Grave 29	16241	tool tip	98.79	0.07	0.00	0.07	0.00	0.01	0.19	0.00	0.03	0.00	0.17	0.00	0.10	0.48	0.01	0.08		SbAg	7
Kichary Nowe 2, Grave 29	16240	necklace	99.23	0.05	0	0	0	0	0.06	0.13	0	0.10	0.20	0.1	0.05	0	0.05	0.04		AsAgNi	15
Kolosy, Grave 4		awl	97.23	0			T	T	0.081	0.90	0	0.53	0.91	0.086	0.68	0.4		0.015	0.056	AsSbAgNi	16
Malżyce, Grave 2	14190	tool tip	95.4				0.00		0.19	0.09	1.07	0.00	0.79	0.18	0.21	1.15		0	0	SbAg	7
Malżyce, Grave 12	16048	spiral (10)	98.28				0.02		0.24	0.00	0.24	0.00	0.00	0.71	0.20	0.12		0.00	0.00	Sb	3
Malżyce, Grave 12	16049	spiral (11)	98.32				0.06		0.07	0.23	0	0	0.39	0.02	0.11	0.36		0	0	SbAgNi	13
Mierzanowice 1, Grave 81	1293	spiral	99.07				0.03		0.16	0.00	0.00	0.03	0.30	0.03	0.06	0.066		0.00	0.07	Ag	4
Mierzanowice 1, Grave 83	1299	spiral_1	98.46				0.01		0.09	0.00	0.00	0.68	0.18	0.00	0.053	0.48		0.00	0.04	AsAg	9
Mierzanowice 1, Grave 83	1300	spiral_2	98.45				0.01		0.07	0.00	0.00	1.40	0.05	0.021	0.00	0.00		0.00	0.00	As	2
Mierzanowice 1, Grave 83	1307	necklace	98.92				0.01		0.10	0.06	0.00	0.03	0.32	0.00	0.22	0.18		0.01	0.17	SbAg	7
Pełczyska, Grave 32	14189	ring	93.99		0.51		0		0.24	0.04	0.89	0	2.83	0.06	0.55	0.65		0	0	SbAg	7
Smroków 17, Grave 1?	16047	wire (fgm)	97.58				0.03		0.1	0.24	0.55	0.77	0.17	0	0	0		0	0	AsAgNi	15

Site	Laboratory Reference	Type	Cu	Al	Si	Ti	Cr	Mn	Fe	Ni	Zn	As	Ag	Sn	Sb	Pb	S	Au	Bi	Compositional Group	Group No.
Wilczyce 10, Grave 15	18188	retoucher	99.33				0.03		0.13	0.00	0.00	0.00	0.00	0.02	0.06	0.06		0.00	0.00	Cu	1
Wilczyce 10, Grave 15	18189	plate	98.21				0.01		0.05	0.00	0.00	0.53	0.13	0.00	0.00	0.55		0.00	0.00	AsAg	9
Zielona 3, Grave 3	?	Awl or retoucher	98.56	0	0.25		0	0	0	0.56	0.14		0.32	0	0	0.07				AgNi	8
Żerniki Górne, Grave 137	137_1	spiral (?)	99.35	0.015			0.01	0.01	0.03	0.09	0.07	0.00	0.05	0.11	0.11	0.10		0.00	0.07	Sb	3
Żerniki Górne, Grave 137	137_2	pendant?	92.38	2.00			0.001	0.30	1.00	0.02	0.30	0.00	0.10	0.00	0.40	2.50		T	1.00	SbAg	7
Żerniki Górne, Grave 137	137_3	pendant?	97.52	0.05			T	0.005	0.00	0.025			0.10		0.30	1.00			1.00	SbAgNi	13
Żerniki Górne, Grave 138	138	pin (fgm.)	98.878	0.025			0.016	0.01	0.05	0.03	0.1	0.80	0.10	0.00	0.00	0.00		0.00	0.00	AsAg	9
Żerniki Górne, Grave 33	1313	Ring	99.25	T			0.01	T	0.00	0.04	0.00	0.03	0.48	0.00	0.05	0.13		0.01	T	Ag	4
Żerniki Górne, Grave 78	1449	Spiral 1	97.76	T			0.00	T	0.04	0.07	0.00	0.06	0.52	0.01	0.28	0.88		0.01	0.37	SbAg	7
Żerniki Górne, Grave 78	1450	spiral_2	96.48	T			0.00	T	0.06	0.06	0.00	0.94	0.50	0.02	0.46	0.82		0.01	0.66	AsSbAg	12

According to: Kempisty 1978; Hensel 1990; Hensel 1992; Kempisty, Włodarczak 2000; Włodarczak *et al.* 2003; Włodarczak 2004; Rudnicki, Włodarczak 2007; Jarosz *et al.* 2009; Gan 2019)

(5) A smaller metal tool tip (probably a kind of intermediate-retoucher), presumably made of copper (chemical composition not analysed), its surface is completely covered with a greenish patina (No. X32-38a; Fig. 10: b; Table 3). It has an asymmetrical, wedge-shaped outline and one-sided flattened cross-section, irregularly rectangular at the apex and oval-rectangular further down the shaft. Its amorphous apex is blunt and "compacted", the lateral edges are slightly raised.

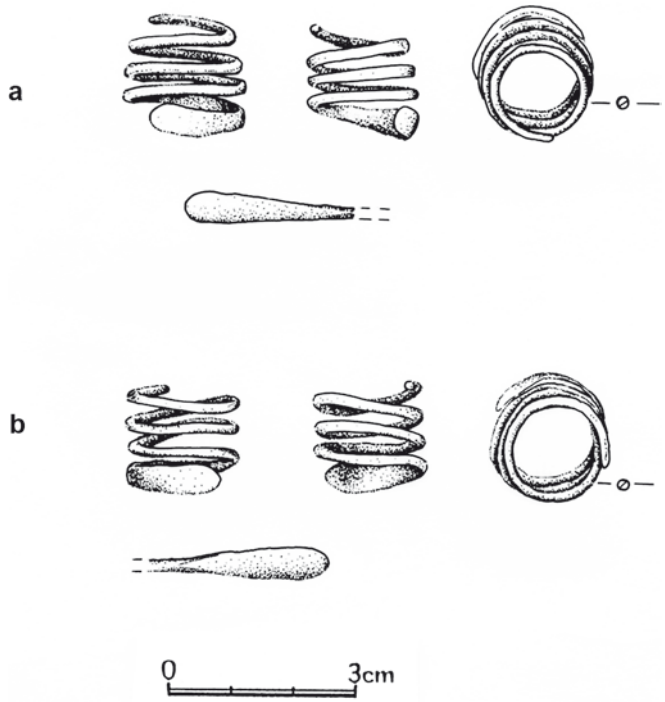


Fig. 9. Kichary Nowe, Site 2. Gold spiral ornaments from Grave No. 29: a – spiral No. X33-62 (see Fig. 7: 2); b – spiral No. X33-87 (see Fig. 7: 3). Drawing: E. Nos

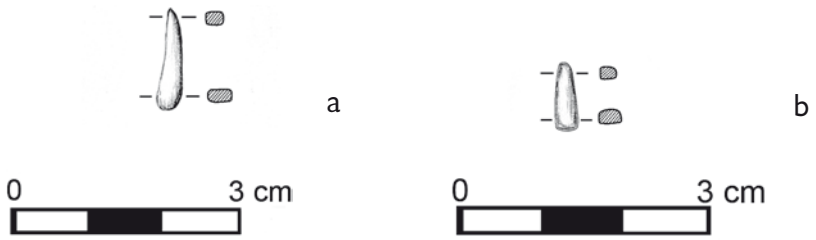


Fig. 10. Kichary Nowe, Site 2. Metal tool tips from Grave No. 29:
a – copper tool tip No. X32-38 see Fig. 7: 4); b – small tool tip, probably of copper, No. X32-38a (see Fig. 7: 5). Drawing: E. Gumińska (Processing: D. Wach)

DISCUSSION

The metal artefacts in question, as well as traces of copper, were discovered in three graves of a niche-construction. Each of these graves contained a primary individual inhumation (Kowalewska-Marszałek and Duday in print). The deceased were buried in contracted position, on their right (Graves No. 26 and No. 29) or on the left side (Grave No. 23). All of them were young adults (adultus in Graves No. 23 and No. 29; juvenis/adultus in Grave No. 26). Due to the poor state of preservation of the skeletal remains, the sex of the deceased could not be anthropologically determined for certain; thus, a person from Grave No. 23 was identified as 'presumably female', and those from Graves No. 26 and No. 29 – as 'presumably male' (Pyżuk 2006). This diagnosis seems to be confirmed by both the details of the arrangement of the dead and the nature of the accompanying grave goods (Table 2; see also Włodarczak 2006, 59).

All the metal objects discussed above are undoubtedly elements of grave inventories, as indicated by both their nature and their location within the burial chambers, which is usually in the direct vicinity of human remains. Personal ornaments were situated in the region of the head (the spiral from Grave No. 26), and at the neck (necklace from Grave No. 29) or on the arm of the deceased (presumed ornament from Grave No. 23). At the same time, tools (tool tips) were placed behind the back of the deceased (Grave No. 29), according to the rule respected in graves belonging to the Kraków-Sandomierz group of the Corded Ware culture (Włodarczak 2006, 68).

The two ornaments of gold wire from Grave No. 29, although they were found some distance from most of the human remains, were located near the floor of the burial chamber, as were the skeletal remains and other grave goods; moreover, one of these ornaments was found together with a few small fragments of bones (from the skull and thorax of the deceased). It must therefore be assumed that these artefacts were also elements of the grave inventory, and their location at the time of discovery resulted of post-depositional processes (Kowalewska-Marszałek 2000c, 351; Kowalewska-Marszałek and Duday, in print).

Necklaces

Copper wire necklaces are not among the finds frequently encountered in Neolithic inventories in Poland. Until recently, only two specimens of this type were known from the Kraków-Sandomierz group of the Corded Ware culture: one from Nowy Daromin near Sandomierz (Antoniewicz 1925, 244-247) and the necklace discussed above from Kichary Nowe in the same area. Another one, associated with this group but differing stylistically from the previous ones, is a necklace-pendant from Mierzanowice Site 1, Opatów district (Salewicz 1937, 54; Uzarowiczowa 1970, 204, 205). In recent years, the number of finds has increased thanks to recent discoveries in Eastern Poland: at Klekacz, Site 10, Tomaszów Lubelski district (Machnik *et al.* 2009, 31) and in Szczytna, Site 6, district of

Jarosław (Hozer *et al*. 2017, 96-100); as to a specimen from Strzyżów near Hrubieszów, its cultural affiliation is uncertain (Dąbrowski and Hensel 1983). However, these are still rare finds.

Nowy Daromin, currently part of the village of **Daromin, Sandomierz district.** The necklace, discovered in the 1920s, was part of the inventory of Grave I – the burial of a presumably young woman, placed in a contracted position on her left side, with her head to the N and face to the E (Antoniewicz 1925, 246, fig. 3). The grave also contained two vessels (an amphora and a beaker) as well as three blades and two flint flakes (Antoniewicz 1925, 245-247). The necklace, in the form of a regular circle 12.5 cm in diameter, was made of wire with a circular cross-section, approximately 0.5 cm thick. Its ends overlapped halfway around the circumference, forming 1.5 coils, and were shaped differently: one sharply, the other was thickened and bent 'hooked or in a circle' (Antoniewicz 1925, 246).

The necklace from Daromin represents the closest analogy to that from Kichary Nowe. In both cases, the artefacts were in a similar position in relation to the deceased (who presumably were different in gender but of similar age). Both belong to the specimens with overlapping ends ('Type 2', *cf.*, Novotná 1981, 121). They differ in the diameter size (the Daromin necklace is the smaller of the two), in the formation of the ends (straight and identical in the specimen from Kichary Nowe, and diversified in the case of Daromin), as well as in the 'degree of coiling': in the Kichary necklace the ends overlap by about Ľ of the circumference, while in the Daromin specimen – by about 1/2 (Table 5).

An interesting feature is the similar length of the wire pieces used to make these necklaces: it is 65 cm for the specimen from Kichary Nowe, and approximately 60 cm for that from Daromin. Hence, presumably, with the smaller diameter of the latter, the greater length of the section of overlapping ends. It seems, therefore, that the makers of necklaces, having at their disposal 'standard' pieces of copper wire of similar lengths, customised each product, perhaps by adapting the particular piece to the body-built of the person for whom it was intended.

Mierzanowice Site 1, Opatów district. The third specimen from the Sandomierz Upland is a necklace-pendant, distinctly different from those mentioned above. It was found in Grave 83: a burial of an adult male lying supine with his legs on his left side (Uzarowiczowa 1970, 204), along the NE-SW axis, with his head to the NE. The necklace was situated next to the skull of the deceased, under his mandible (Salewicz 1937, 54; fig. 20: c). The grave inventory also contains a vessel (a beaker), a flint axe, a small fragment of a bone object, and two copper wire spiral ornaments, as well as 33 small pottery sherds and 13-16 flint specimens. However, the attribution of these latter finds to this grave is not entirely certain, nor is their number (see Uzarowiczowa 1970, 204, 205).

The necklace-pendant was made of 'copper or bronze sheet' (Salewicz 1937, 54), also referred to as a 'flat bar' (Uzarowiczowa 1970, 205). According to the results of the chemical composition analysis (reference: CL 1307), this specimen is made of almost pure (98.92%) copper (Hensel 1992, 107). It is an approximately crescent-shaped object, asymmetrical,

Table 5. Copper necklaces in the Corded Ware culture, SE Poland

Site	Type of grave	Sex and age of the deceased	Orientation and position of the deceased	Necklaces dimensions	Radiocarbon dates (BP)	Comments, literature
Kichary Nowe Site 2, grave No. 29	Niche grave	Presumablymale, adultus	S-SE – N-NW, face to E or E-NE right side	Diameter: – inner: 157-160 mm – outer: 170 mm; wire thickness: 5-7 mm	4110±80 (Ki-7942)	The 'richest' burial inventory of this cemetery Kowalewska-Marszałek 2000c, 349; 2007, 94-96
Klekacz Site 10, grave 1	Central grave (pit grave?)	Adult male, age of about 30	W-SW-E-NE, head to W-SW; flexed, right side	Diameter: 168 x 200 mm; wire thickness: 3-7 mm	4045±35 (Poz.25614)	Burial with stone battle-axe; Machnik *et al*. 2009, 32
Mierzanowice Site 1, grave 83	Pit grave?	male	NE-SW, head to NE; lying supine with legs on his left side	Lenght: 200 mm; maximum width: 30 mm; thickness: 2 mm		Burial with two spiral ornaments of copper; Salewicz 1937, 54-55; Fig. 19-20; Uzarowiczowa 1970, 204-205
Daromin (= Nowy Daromin) Grave I	Pit grave	Young, female?	NE-SW, head to NE; flexed, left side	Diameter: 125 mm; wire thickness *ca* 5 mm		Antoniewicz 1925, 245-247
Szczytna Site 6, grave 4	Niche grave	Male, adultus, age of 20-30	N-S, head to S, face to E flexed, right side	Diameter: 200 mm; wire thickness: 3 mm	4050±60 (MKL-1047); 3951±37 (UB-28880)	Very 'rich' burial, with copper battle-axe; Hozer *et al*. 2017: 38-48

with side parts tapering unevenly from the centre of the specimen, where its width is greatest, towards the edges with straight-cut ends. A small indentation is visible in the middle of its longer inner edge. At the same time, a not very large projection is observable at the corresponding point on the outer edge, giving the whole a slightly triangular shape. Its cross-section is flat-convex. There are small circular holes at both ends: a single one (maybe, the only one preserved) on the narrower side of the specimen and two on its wider side. The length of the necklace is 20 cm, with a width of 1-3 cm and a thickness of 0.2 cm (Uzarowiczowa 1970, 205).

Both Kazimierz Salewicz, describing the object in question as a 'pendant' (Salewicz 1937, 54), and other researchers (*e.g.*, Machnik 1966, 55; Uzarowiczowa 1970, 218, 219; Kempisty 1982, 67) emphasise its similarity to boar tusk pendants, even considering it an imitation of an ornament of this kind. Such pendants, although already known in pre-Corded times (*e.g.*, Kulczycka-Leciejewiczowa 1979, 163, fig. 87: 5), are not encountered frequently in assemblages of the Corded Ware culture; they became more widespread only in the early Bronze Age (*e.g.*, in the assemblages of the Mierzanowice and the Strzyżów cultures). However, ornaments of this type, although not very numerous, are also known from the Corded Ware culture, for example, from the site of Velké Bílovice district. Břeclav in Moravia (Šebela 1999, 164; Pl. 120:3, 211:4) as well as from a few sites in Germany, *e.g.*, Friedrichsaue Kr. Aschersleben, 'Galgenberg' (Matthias 1968, 26, 27, Taf. 12: 6, 7), Artern Kr. Artern (Matthias 1974, 30, Taf. 7: 15), Burgörner Kr. Hettstedt (Matthias 1974, 80, Taf. 27: 6). In addition, boar tusk objects found in Corded Ware grave inventories are not always ornaments but may belong to the category of tools, probably used for scraping (Machnik 1966, 54) or in flint processing (Włodarczak 2006, 38). This type of use has recently been confirmed by traseological studies of finds from a grave associated with the Malice culture at Świerszczów, Hrubieszów district (Zakościelna and Osipowicz 2024, 345).

It can also be noted that the specimen from Mierzanowice reveals certain resemblances to the so-called 'diadems' originated in the Middle Dnipro culture (Artemenko 1967, 34-36, fig. 21, 23) or 'pectorals' known, among others, from the Řivnáč culture (*e.g.*, from Velvary okr. Kladno in Bohemia; Dobeš 2013, 57). Then, it cannot be ruled out that we are dealing here with some kind of transformation of the idea of such an object or with some kind of its imitation (not very successful). The latter eventuality could be supported by the observation that this specimen is 'quite primitively and unevenly made', as well as by the supposition that it may be a local product (Uzarowiczowa 1970, 219).

Other necklaces associated with the Corded Ware culture, originating from the territory of Eastern Poland, including those from Klekacz and Szczytna, as well as a possibly related specimen from Strzyżów, are open necklaces with flattened and curled ends, forming a type of earring (Table 5). They belong to 'Type 1' (Novotná 1981, 121), a less common variety, of which specimens with hooked ends are also found (Dąbrowski and Hensel 1983, 83).

Klekacz Site 10, Tomaszów Lubelski district. The necklace was found in a central grave (Feature 1) within the only barrow on the site, containing the burial of a young

male aged approximately 30 years. The burial was oriented along the WSW-ENE axis; the deceased rested in a contracted position on his right side, head to the W-SW. The necklace was located next to the remains of the skull. A single vessel (an amphora) and a 'boat-shaped' battle axe of diabase, as well as one triangular arrowhead made of Volhynian flint (Machnik *et al.* 2009, 32-35) were also discovered in this grave, forming a typical inventory of the Corded Ware culture (Włodarczak 2006, 66-77).

The necklace, of slightly flattened oval shape, is an open specimen with hooked ends. It was made of copper wire of varying thickness, circular in cross-section, except for the flatly flared central part, where the presence of remnants of tubular bone beads was noted (Machnik *et al.* 2009, 32-35, fig. 23). Dimensions of this specimen: 16.8 × 20 cm, wire thickness: 0.3-0.7 cm. Analysis of the chemical composition revealed that it was composed of copper with a small amount of Ag (Nosek and Stępiński 2011, 404).

The necklace from **Szczytna Site 6, Jarosław district** was part of the inventory of Grave 4 of a niche construction and N-S orientation, with the burial of an adult male lying on his right side, head to the S. The very rich inventory of this burial included six other metal objects (a copper axe, two intermediate-retouchers and three small rings of copper wire), in addition to five vessels, numerous flint implements (an axe, five arrowheads, two blade tools, two blades, 41 flakes and their fragments), a whetstone and an animal bone chisel (Hozer *et al.* 2017, 41-48).

The necklace was located in the region of the deceased's head and neck. It was approximately circular in shape, with a diameter of 20 cm, made of wire of circular cross-section and 3 mm thick. It is an open specimen, with one end straight and the other hooked; both ends gradually tapered and slightly pointed (Hozer *et al.* 2017, 43, fig. 25: 6, photo 35: 3, 5). According to the results of analysis of the chemical composition (Hensel and Pawlicka 2017, 222), it was made of copper with a rather significant addition of Pb and Au (more than 0.5%), as well as an addition of Al, Ag and Fe, with the traces of Sn; As, Ni and Sb were completely absent.

The necklace from **Strzyżów, Hrubieszów district**, found at a destroyed site, may also be associated with the Corded Ware culture, which seems to be supported by its similarity to the aforementioned specimens from Klekacz and Szczytna. Partly preserved (only two deformed fragments), it was fabricated from wire of circular cross-section. In contrast, the cross-section of its hooked end is rectangular (Dąbrowski and Hensel 1983, 73, fig. 1: 16). It is made from almost pure copper (Cu: 99.27%) with a few impurities in the form of trace amounts of As, Ag, Sn, Pb, Fe and Al (Dąbrowski and Hensel 1983, 71, table 1). Due to the conditions of discovery, no contextual data are available. This prevents the precise dating of this specimen and reduces the possibility of clarifying whether it should be associated with the Corded Ware culture, although it seems possible (Dąbrowski and Hensel 1983, 83).

As can be seen from the above review, the only close analogy for the necklace from Kichary Nowe is the specimen from Daromin. The object from Mierzanowice is completely

different, and three other finds, revealing a high degree of stylistic uniformity among themselves, diverge quite markedly, too.

Findings of copper necklaces are also rare in other areas of the Corded Ware culture (*e.g.*, Ottaway 1992, 283-285; Podborský 2004, 187; Hozer *et al.* 2017, 96). Few specimens originate from Central and Eastern Europe, with most of them – five or six pieces – from Bohemia (*e.g.*, Šumberová 1992, 122-124; Dobeš 2013, 57-60, further literature cited there). Single objects were found in Moravia, specifically in Dětkovice, district. Vyškov, Grave 1 (Šebela 1999, 48; pl. 13.2; 214: 2) and in Hoštice (Podborský 2004, 187) as well as in Ukraine, in Kryłos VI, Stanisławów district (Sulimirski 1968, 133, 134, fig. 11: 3; Sveshnykov 1974, 44, 45; see also Machnik 1979, 59). Necklaces of this kind are also known from assemblages of the Middle Dnipro culture, *e.g.*, from Strelica in the Homel region of Belarus (Artemenko 1967, 33-35, 90-99, fig. 22; 1976: 69-86), and of the Bell Beaker culture *e.g.*, Inzersdorf Grave 532 in Lower Austria (Neugebauer and Neugebauer 1992, 144, Abb. 6: 3).

Specimens with overlapping ends are even more scarce. As analogues to the necklace from Kichary Nowe, finds from Bohemia can be pointed out here: a necklace from Grave 5 at Kralupy on the Vltava River, Lobeček, okr. Mělník (Buchvaldek *et al.* 1997, 151, fig. 45: 4; Dobeš 2013, 57, 58, pl. 15: 1), probably a necklace from Grave 41/82 in Břešťany okr. Teplice (Buchvaldek and Velimský 1987, 76, fig. 20: 3-6; Dobeš 2013, 57, pl. 14: 2) and, possibly, that from Grave 41 in Čachovice, okr. Chomutov (Neustupný and Smrž 1989; Dobeš 2013, 57, pl. 14: 3), as well as necklaces from the aforementioned cemeteries in Dětkovice and Inzersdorf, and from Grave 43 in Strelica (Artemenko 1967, 35, 90; figs 22: 4 and 53: 10; 1976, 81, 82, fig. 7: 10).

It is worth noting that copper wire necklaces represent a wide temporal spectrum. They are present in assemblages earlier than the Corded Ware time, starting with the Bodrogkeresztur culture (Wilk 2014, 232, further literature there), they occur in inventories of the Baden culture in Slovakia and Lower Austria (Novotná 1984, 2; Podborský 2004, 187; Novotná and Soják 2013, 197) as well as in the hoard from Horodnica, Horodenka district (Sulimirski 1961, 92, 96, pl.1: 5) classified as belonging to the Trypillia culture. Three specimens belonging to the Lublin-Volhynia culture and originating from the cemetery in Książnice, Busko Zdrój district, Graves 2 and 8, are very close typologically to the finds from Kichary Nowe and Daromin, especially the necklace from Grave 2 (Wilk 2004, 227, fig. 4: 3; 2014, 227, fig. 10: A, C). Necklaces of this type also occur in later assemblages associated with the Early Bronze Age, *e.g.*, in Łubcze Site 38, Tomaszów Lubelski district in Poland (Machnik *et al.* 2009, 107, fig. 85: 3), in Sudoměřice II, Bez. Hodonín in Moravia (Šikulová 1961, 8-11, fig. 2: 4; Peška and Šebela 1992, 133, Abb. 2: 2) or in Jelšovce distr. Nitra, Grave 444/85 in Slovakia (Bátora 1991, 123, fig. 33: 10).

As shown in the list of graves with copper necklaces in the Corded Ware culture (Table 5), the majority of them were male burials (certain or probable); only in one case (Daromin) was the necklace probably part of the grave equipment of a young woman. It seems, however, that such a picture may be due to the small number of finds rather than the actual

rule: for example, in Bohemia, necklaces are just as common in women's graves and even in children's burials (*e.g.*, in the aforementioned graves in Břešťany and Čachovice).

What is noticeable, however, is the diversity of the graves in question in terms of "richness". Two of them, in Szczytna and at Kichary Nowe, belong to the 'very rich' category, standing out both in terms of number and the nature of the grave goods (gold ornaments at Kichary, a unique copper battle-axe in Szczytna). In contrast, the grave from Daromin contained a rather modest set of grave goods.

Another interesting point is the function of these necklaces. Their dimensions (diameters) indicate that objects of this kind could not be inserted over the head, but had to be twisted directly around the neck of the person in question (Antoniewicz 1925, 246), so it is possible that they were worn not very often (maybe only once?). Thus, it was probably not the 'usual' function of an ornament, put on and taken off at will. Two possibilities of interpretation arise here: first, the necklace was put on during the person's life and, maybe, was worn by this person permanently, for the rest of his (or her) life. In such cases, it would have to be put on after the individual's stage of growth had ended, or it would have to be prepared with some 'reserve', taking into account the growth of the individual. The second possibility is that the necklace was twisted around the neck of the deceased (Machnik 1966, 55).

The rarity of occurrence and the 'atypical' (in relation to 'ordinary' ornaments) way in which they were used suggest that copper necklaces may have a special function. It can therefore be thought that the presence of such an object was linked to the personal status or specific social position of the deceased rather than merely to their gender. A similar assumption can also be formulated regarding the presence of spiral ornaments (Jarosz 2016, 524).

Spiral ornaments ('earrings')

The cemetery at Kichary Nowe is another site in the Małopolska region where ornaments in the form of several coiled spiral twists with one end flattened have been discovered. All three specimens found there are similar in form and represent the same category; they differ in the type of raw material used and technological details: one spiral was made of copper strip, two – of golden wire. There are also differences as to their dimensions: the gold spirals are slightly larger and much more massive than the copper specimen, and the number of coils is also greater in their cases.

Spiral ornaments made of copper are very characteristic for graves associated with the Corded Ware culture (*e.g.*, Machnik 1966, 55; Kempisty 1982, 68; Włodarczak 2006, 40, 120). They are known from other cemeteries of the Kraków-Sandomierz group of this culture (Table 1), among others from Mierzanowice Site 1, Graves: 81 and 83 (Uzarowiczowa 1970, 203-205) and from Daromin, Grave II (Antoniewicz 1925, 248), the nearest territorially sites to Kichary, situated a dozen or so kilometres to the W and NW. They occur also in

grave inventories located to the E of the Vistula River: in Lublin-Sławinek, Site 1-2 Grave 2 (Polańska 2016, 315, 322) and Site 3 Grave 3 (Jarosz and Rejniewicz 2016, 337, 338), in Szczytna Site 5, Graves: 217 and 220 (Hozer *et al.* 2017, 19, fig. 8: 6-9, 26, fig. 13: 10, 11) and in Łubcze Site 37, Grave 3 (Machnik *et al.* 2009, 105; fig. 78: 4).

As mentioned before, the gold spirals from Grave No. 29 are almost identical in form. Their flattened parts are noticeably wide and elongated, with rounded ends that bring them closer to the later ornaments of the willow leaf style (Kempisty 1982, 75; see also Machnik 1982, 83; Kadrow 2000, 144-150). By contrast, the flattened part of the copper spiral from Grave No. 26 is only slightly widened and trapezoidally shaped, which in turn is typical of specimens from the Kraków-Sandomierz group of the Corded Ware culture (Włodarczak 2006, 118; Polańska 2016, 322).

The gold specimens are unique in the Corded Ware culture in terms of the raw material used (Kowalewska-Marszałek 2000c, 351). However, their form refers to several copper ornaments, *e.g.*, from the cemetery at Małżyce, Grave 12 (Jarosz *et al.* 2009, 222, fig. 35: 11) or from Lublin-Sławinek Site 3, Grave 3 (Jarosz and Rejniewicz 2016, 337, 338, fig. 8: 8) – these specimens are, however, slightly smaller and less massive than the finds from Kichary, with more stocky proportions of their flattened parts. In turn, the elongated flat parts of the spiral rings from Kichary bring them closer to the finds from Grave 261/64 from Kraków-Nowa Huta, the 'Kopiec Wandy' site (Hachulska-Ledwos 1967, 91, pl. 2: 11, 12), admittedly linked to the very beginning of the Bronze Age – the Chłopice-Vesele (proto-Mierzanowice) phase (Hachulska-Ledwos 1967, 98).

The spirals made of gold from Kichary Nowe do not find any analogy, as mentioned above, in the Corded Ware culture inventories, where finds from this raw material are very few. Three specimens of gold are known from Moravia: these ornaments are very similar to each other, made of a rather thin wire with overlapping straight ends: a spiral from Barrow 6 in Letonice, with a diameter of 12 mm (Šebela 1999, 88, pl. 43: 2) and two more, from sites: Olomouc-Nemilany 3, Grave 31, with a diameter of 8 mm and Olomouc-Slavonín 1, Grave 72, with a diameter of 11-12 mm (Peška 2004, 95, fig. 5: 1, 101, fig. 7). All of them were made of gold wire with thicknesses of, respectively: 1.7 mm, 1.4 mm and 1.2 mm, forming 1.25 (Nemilany) or 1.5 coils (Letonice, Slavonín). The specimens from Kichary differ from these in both form and size, and they are also much more massive.

Formally close to the gold spirals from Kichary are also some copper specimens from Bohemia, including one of the spirals from the site in Praha-Jínonice (Havel and Kovářík 1992, 98, Abb. 3: 6a, 6b; Buchvaldek and Kovářík, 1993, 130, fig. 16: 6), one specimen from Třebusice (Buchvaldek *et al.* 1997, 140, fig. 31: 8, 9; Dobeš 2013, 86, pl. 19: 12b) and two from Grave 14/1964 in Vikletice (Buchvaldek and Koutecký 1970, 50, 255, Abb. 90: 8, 9; Taf. 32: 14, 15; 45: 4, 5; Dobeš 2013, 87, pl. 19: 19). They are identical in shape although sometimes different in the number of coils.

Note that close analogues for the Kichary gold finds can also be seen among the artefacts associated with the Bell Beaker culture, such as the golden spirals from the site in

Přerov-Předmostí (Medunová-Benešová 1962, 235, 236, fig. 1: 7; more on this topic: Peška 2004, 105; see also Stuchlík 2011, 343-346, fig. 5: 6, 7). On the other hand, similar copper ornaments from the Praha-Lysolaje locality (Grave I), initially associated with the Bell Beaker culture (Hájek 1968, 63-64), are currently – despite some doubts – rather linked with the Corded Ware assemblages (Moucha 1992, 83, Abb. 2: 5, 6; Dobeš 2013, 85).

It is also noteworthy that, as mentioned above, both gold spirals from Kichary are very similar, each of them being a 'mirror image' of the other, which is reflected in their right – and left-handedness. Thus, these are not objects put together at random, but a deliberately selected pair of ornaments, made, perhaps, by a single maker (which is not contradicted by the noticeable slight differences between them). This situation does not seem unique: it is also the case with other grave assemblages, such a set of Grave 41/82 from Břešťany near Teplice, where four spirals formed two pairs, differing in size (Buchvaldek, Velimský 1987, 76, fig. 20:3-6; Šumberová 1992, 120) or that of Grave 24 in the Praha-Jínonice cemetery (Buchvaldek, Kovářík 1993, 130), as well as the above-mentioned Grave 14/1964 from Vikletice with a pair of 'twin' spirals (Buchvaldek and Koutecký 1970, 255, see above). The same could be applied to specimens from the Přerov-Předmostí locality of the Bell Beaker culture (Medunová-Benešová 1962, 235-236, fig. 1: 7). It can therefore be considered that the set of spirals from Kichary confirms a regularity more widely observed (Buchvaldek 1986, 92).

The copper spiral ornament from Grave No. 26 at Kichary has analogies among the currently known finds, both in terms of form and dimensions, as well as the raw material used in its manufacture. These artefacts come from both Polish sites and from neighbouring areas. The greatest formal similarity to the specimen in question may be observed in relation to one spiral (the larger one) from Grave 2 in Lublin-Sławinek Site 1-2 (Głosik 1968, 106, pl. 5: C-1; Polańska 2016, 322, fig. 6:16), to one item from Grave 83 in Mierzanowice (Salewicz 1937, fig. 20a; Uzarowiczowa 1970, 205, fig. 6: c) and to another one, from Grave 78 in Żerniki Górne (Kempisty 1978, 71, fig. 88: 3b) as well as both specimens from Grave 220 in Szczytna (Hozer *et al.* 2017, 26-27, fig. 13: 10, 11). The spiral ring from Grave II in Daromin (Antoniewicz 1925, 249, fig. 5: a) differs in the greater number of coils. Only the specimens from Lublin-Sławinek and from Szczytna were made of a metal strip, like the spiral from Kichary; the others represent the 'wire' variety of ornaments of this type (Kempisty 1982, 69).

The occurrence of one or two spirals in the same grave inventory is also typical of the Kraków-Sandomierz group. Ten grave assemblages contained two specimens each; in most of them, they were located near the head of the deceased, in three cases (Malżyce, Grave 12; Żerniki Górne, Grave 78; Lublin-Sławinek, Site 1-2, Grave 2) – on both sides of the head. In three other graves, the spirals occurred some distance from each other: in Grave II from Daromin one of them lay near the head of the deceased, the other was found above the shin bones (Antoniewicz 1925, 248), in Grave 3 from Lublin-Sławinek Site 3 one piece was located at chest level and the other below the legs of the deceased (Jarosz

and Rejniewicz 2016, 337), while in Grave No. 29 from Kichary Nowe both ornaments were found a short distance from the head and pelvis of the deceased (*cf*., above). Similarly, spirals occurring singly were mostly located on the temple of the deceased: right (Bosutów, Kraków-Mogiła, Łękawa, Żerniki Górne, Grave 137) or left (Kichary Nowe, Grave 26). Only in one case (Żerniki Górne, Grave 103) was the spiral found on the left forearm of a woman buried there (Kempisty 1978, 96).

Spiral ornaments are commonly interpreted as 'earrings' or 'rings', depending on their size and location in relation to the body of the deceased. As for the spiral from Grave No. 26 at Kichary, its location (near the skull, close to the left temple) clearly indicates that it should be considered a head ornament, most likely used to hold a strand of hair. Such an interpretation is also supported by the size of the specimen, which practically rules out the possibility of using it as a finger ring. This corresponds to the interpretation of most finds of this kind (*e.g*., Machnik 1966, 55; Kempisty 1978, 263; Ottaway 1992, 283; Peška 2004, 107; Włodarczak 2006, 40, 77). Also, both spirals from Grave No. 29 seem to have had an analogous function (Kowalewska-Marszałek 2000c: 351), although in this case, there are no direct indications derived from their location; this assumption is supported by their size, only slightly larger than that of the specimen from Grave No. 26.

Multiple spiral coils of copper wire or strip are relatively frequent in inventories of the Corded Ware culture in Central Europe, particularly from Bohemia, Moravia and Germany (*e.g*., Machnik 1966, 55; Kempisty 1982, 68; Buchvaldek 1986, 32; Jacobs 1989, 2-9; Ottaway 1992, 283-285; Šumberová 1992, 119; Dobeš 2013, 81-87), constituting the most common category within the group of fine copper ornaments (Ottaway 1992, 285). Twenty three (or twenty four) artefacts, preserved in whole or in fragments, are currently known from western Little Poland (Table 1); nine or eleven more come from areas to the east of the Vistula. Among them, it is possible to distinguish specimens with one end flattened and sometimes rounded, and those with one or both ends pointed (Kempisty 1982, 68). Both of these types can come in two varieties: of wire or of metal strip. Most specimens from the Little Poland region belong to the former and were made of wire; this also applies to the two gold spirals from Kichary. The third spiral from this cemetery, made of a narrow strip, stands out in this respect.

Until recently, specimens made of copper strip were known only from outside of Poland, mainly from German and Bohemian sites (Kempisty 1982, 68). Nowadays, they are also known from Polish lands: fragments of a spiral made of a splayed wire with a rectangular cross-section were found in Grave 12 in Malżyce (Jarosz *et al*. 2009, 222), and a fragment of an ornament made of a narrow copper strip occurred in Pełczyska (Rudnicki and Włodarczak 2009, 229). Narrow strip (or flattened wire?) was also used to make one of two spirals from Grave 2 in Lublin-Sławinek Site 1-2 (Polańska 2016, 315, 322, fig. 6: 16) and an ornament from Grave 3 in Łubcze Site 37, barrow 1 (Machnik *et al*. 2009, 105, fig. 78: 4) as well as four whole and two partially preserved specimens from Graves 217 and 220 in Szczytna Site 5 (Hozer *et al*. 2017, 19, fig. 8:6-9, 26, fig. 13: 10, 11). Therefore, the previously

drawn image concerning a certain 'regionalisation' of metal finds, according to which artefacts made of copper strips seemed related rather to the western zone of the Central European area of the Corded Ware culture (Kempisty 1982, 69), appears to have changed slightly.

Traces of copper patina – remnants of ornaments?

The greenish colouring of the bone fragment, noticeable in the case of the burial from Grave No. 23 at Kichary Nowe, was also noted in nine other cases in the Kraków-Sandomierz group (Table 1). What is noteworthy is the recurrence of the location of such traces: they were observed most frequently in the region of the head of the deceased (including three of them on the temporal bone: in Łękawa and in Żerniki Górne, Graves 120 and 135) and three times in the area of the neck and chest. The upper limb was concerned in two cases: Lublin-Sławinek Site 1-2, Grave 1 and Kichary Nowe Grave No. 23; in both of them, the greenish tint was located on the left ulna of the deceased (Polańska 2016, 307, fig. 2 (A): 4; Kowalewska-Marszałek and Duday in print). These discolourations are interpreted as traces of a 'copper object (probably an ornament' (Polańska 2016, 307). It is noteworthy that both are female burials (an adult woman buried in the grave of Lublin, presumably a woman – in that of Kichary). They appear almost identical as to the position and orientation of the deceased, especially the arrangement of the limbs (both the upper and lower) in both graves (Figs 2 and 3; see also Polańska 2016, fig. 2: A).

A rather obvious association with arm ornaments of the bracelet type comes to mind here, but, as Marta Polańska rightly points out, bracelets are so far not known from the inventories of the Kraków-Sandomierz group (Polańska 2016, 322). They would therefore be the only remains, so far, of such objects, both preserved in a form that does not allow for closer identification, if we do not consider the possible two specimens from Strzyżów, however, coming from a destroyed site, from feature (features?) of uncertain chronology (Dąbrowski and Hensel 1983, 80) and not belonging to this group as well.

The hypothesis of the presence of bracelets in the two graves mentioned above (*i.e.*, Kichary Nowe and Lublin-Sławinek), although impossible to prove at present, does not seem unfounded. However, bracelets, although not very common in the Corded Ware culture, are known from grave inventories from Bohemia (Ottaway 1992, 283-285; Šumberová 1992, 117-119; Dobeš 2013, 61-63), Germany (*e.g.*, Matthias 1982, 71, Taf. 40: 10; Kempisty 1982, 67; Jacobs 1989, 7, 8, fig. 3: 1, 7), as well as from the area of the Middle Dnipro culture, *e.g.*, from Strelica (Artemenko 1967, 36). These include objects made of thin copper strip: *e.g.*, Halle-Dölauer Heide, Barrow 17 (Matthias 1982, 71, Taf. 40:10, see also Kempisty 1982, 67) and Strelica Grave 4 (Artemenko 1967, 36, fig. 24: 5), and it seems that it is specimens of this type, probably less durable than the more massive wire objects, that may have been in the two graves in question. A second possibility is the presence of ornaments of a complex nature, being a combination of copper elements and others of organic origin (*e.g.*, cords, thongs, tissue…). This possibility seems a very likely

one, as Corded Ware grave inventories contain ornaments made from different types of raw material, *e.g.*, a necklace from Klekacz with strung bone beads (Machnik *et al.* 2009, 35) or bracelets from the Vrbice site in Bohemia, with pendants-imitations of dog teeth (Dobeš 2013, 62, pl. 15: 8). Bracelets made of several small copper plates are also known (Šumberová 1992, 117).

There is another possibility to explain this effect: the presence of some small copper object in proximity to the forearm, but not necessarily a hand ornament. Such a situation can be observed, for example, in the case of Grave 103 in Żerniki Górne, where a small copper spiral was found near the left forearm of a woman buried there (Kempisty 1978, 96). It is noteworthy that both the orientation and the details of the arrangement of the skeletal remains from this grave correspond very clearly with the burials from Kichary Nowe and Lublin-Sławinek mentioned above.

Tools and tool tips

As has been repeatedly pointed out, ornaments predominate among metal finds in the Central European Corded Ware assemblages, and tools are only rarely encountered there (*e.g.*, Kempisty 1982, 67; Ottaway 1992, 283; Włodarczak 2006, 40). In the Little Poland area, these are mainly the aforementioned so-called intermediary-retouching tools: small specimens of various sizes and no standard form. Copper awls are better distinguished, but their presence, however, is sporadic: they occurred only in Kolosy, Grave 4 (Kempisty 1978, 238) and in Zielona, Grave 3, the last specimen being also qualified as retoucher (Włodarczak 2004, 316, 318, fig. 10: 2; 2006, 40).

Both finds from Kichary belong to a group of tools described as intermediary-retouching ones, but their function is difficult to determine. They probably refer to miniature metal tool tips, placed in handles made of organic materials (see *e.g.*, Strahm 1990-1991, 18, fig. 5: 11) and used in various ways. The differences in size and shape of the two specimens, as well as their separate location inside the same burial chamber, seem to indicate a possible different functions of both: perhaps, the more universal nature of the larger of the two, or, in the case of the smaller one, its closer association with flint processing (*e.g.*, manufacturing of arrowheads?).

Tools of this type, although not very numerous, are also known from other grave inventories, both within and outside the Kraków-Sandomierz group. The closest analogies among the known artefacts may be the tip of an intermediary tool from Grave 2 in Malżyce, district of Kazimierza Wielka (Włodarczak 2006, 40; 2014, 35, fig. 14: 16) and that from Grave 15 in Wilczyce Site 10, Sandomierz district (Boroń and Włodarczak 2019, 25; Gan 2019, 127); however, they are larger than the specimens from Kichary. Similarly, the finds from Szczytna, Jarosław district, two from Grave 220 (Site 5) and one from Grave 4 (Site 6), although similar in terms of form (Hozer *et al.* 2017, 26, fig. 13: 9, 43, fig. 24: 7, 8, photo 35: 6-8), are significantly larger. In this context, the finds from Kichary stand out above all

because of their very small dimensions, making them miniaturised equivalents of the other specimens of this type or of their working parts. At the same time, this would be another example in support of the thesis of the 'economical' use of raw material in Corded Ware metallurgy (Ottaway 1992, 285).

Chemical composition of the finds

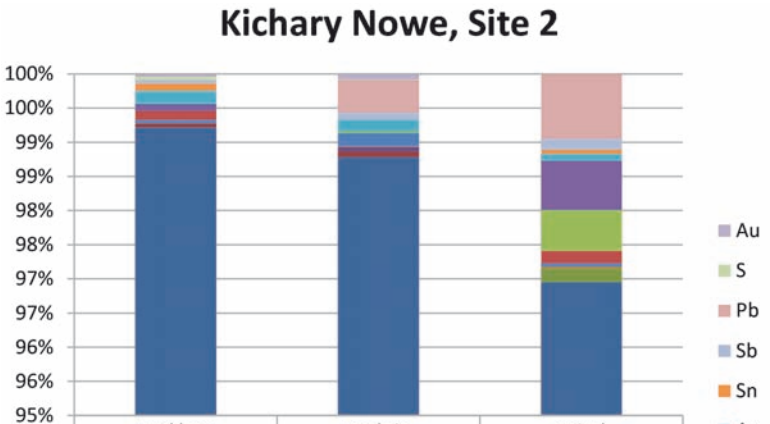
The results of the chemical composition analyses carried out for the Kichary Nowe artefacts complement the picture obtained for all metal objects associated with the Corded Ware culture from Little Poland and from adjacent areas to the east of the Vistula River (Kempisty 1978, 264, table 4; Hensel 1990, table 1; Hensel 1992, 107; Kempisty and Włodarczak 2000, 127, table 10; Włodarczak 2004, 318; Rudnicki and Włodarczak 2007, 229; Jarosz *et al.* 2009, 201; Nosek and Stępiński 2011; Polańska 2016, 322; Hensel and Pawlicka 2017, 221-226; Bugaj *et al.* 2019; Gan 2019, 128-130).

All three analysed copper specimens from Kichary Nowe reveal a copper content that is either very high (necklace: 99.23%, tool tip: 98.79%) or high (spiral ornament: 96.94%), with a small but distinct proportion of Ag (0.20, 0.17 and 0.10% respectively; lowest for the spiral). In contrast, they differ in the proportion of other elements, both in their assortment and quantity (Table 4; Fig. 11). The necklace has been worked from almost pure copper, containing (apart from Ag) small amounts of Ni, As and Sn (0.10%), with an almost complete absence of Sb, while the tool tip was made from copper with small amounts of Sb, Ag and Fe, and a relatively large addition of Pb; a complete absence of As is to note. The spiral ornament, on the other hand, was made of copper, in which the content of As (0.72%) significantly exceeds that of Sb (0.16%), and which also contains a significant admixture of Pb, a relatively large admixture of Zn, with small amounts of Ni and Ag. Such a composition allows the specimen in question to be considered as belonging to the so-called 'arsenical' copper (Dziekoński 1962, 82), contrary to the two other pieces from Kichary. According to the available data, one spiral ornament from Grave 83 in Mierzanowice (Hensel 1992, 107) and one from Grave 78 in Żerniki Górne were also made of 'arsenical' copper (Kempisty 1978, 264, table 4; Kempisty, Włodarczak 2000, 127, table 10). The spiral from Kichary is close to that from Żerniki, both in terms of the proportion of Cu (96.48%) and the relatively high content of Pb (0.82%). In contrast, they differ in the unequal content of As and Ag: in this respect, the specimen from Kichary is closer to the spiral from Mierzanowice (Fig. 12). In neither of these finds, apart from that of Kichary, was there any addition of Zn; also, the presence of Ni was evident. Traces of Sn were present in all three specimens.

It is worth noting that the chemical composition of the spiral from Kichary appears to be very similar to the characteristics of copper ore from the deposits known in the Kielce region, specifically from Miedzianka and Miedziana Góra (Dziekoński 1962, 86), which are approximately 50 km distant from the Kichary cemetery. But it is, of course, difficult to

judge the local provenance of the raw material used in this case. Interestingly, this similarity is not observed in specimens from Mierzanowice.

Both the necklace and the tool tip fit well within the general characteristics of metal artefacts of the Corded Ware culture in SE Poland. However, the spiral from Grave No. 26 stands out clearly because of the significant content of As, almost twice the average for all finds of the Kraków-Sandomierz group (Gan 2019, 129, fig. 2). Only a dozen other specimens belonging to the Corded Ware culture in Poland show similar or higher levels of As



	necklace	tool tip	spiral
Au	0,04	0,08	
S	0,05	0,01	
Pb	0	0,48	0,95
Sb	0,05	0,1	0,16
Sn	0,1	0	0,06
Ag	0,2	0,17	0,10
As	0,1	0	0,72
Zn	0	0,03	0,60
Ni	0,13	0	0,18
Fe	0,06	0,19	0,05
Mn	0	0,01	0,02
Cr	0	0	
Ti	0	0,07	
Si	0	0	0,21
Al	0,05	0,07	0,00
Cu	99,23	98,79	96,94

Fig. 11. Kichary Nowe, Site 2. Chemical composition of copper artefacts: necklace and tool tip (Grave No. 29) and spiral ornament (Grave No. 26). Using the results of chemical composition analyses carried out by Bio- and Archaeometric Laboratory, former Central Laboratory, Institute of Archaeology and Ethnology, Polish Academy of Sciences, Warsaw. Processing: H. Kowalewska-Marszałek

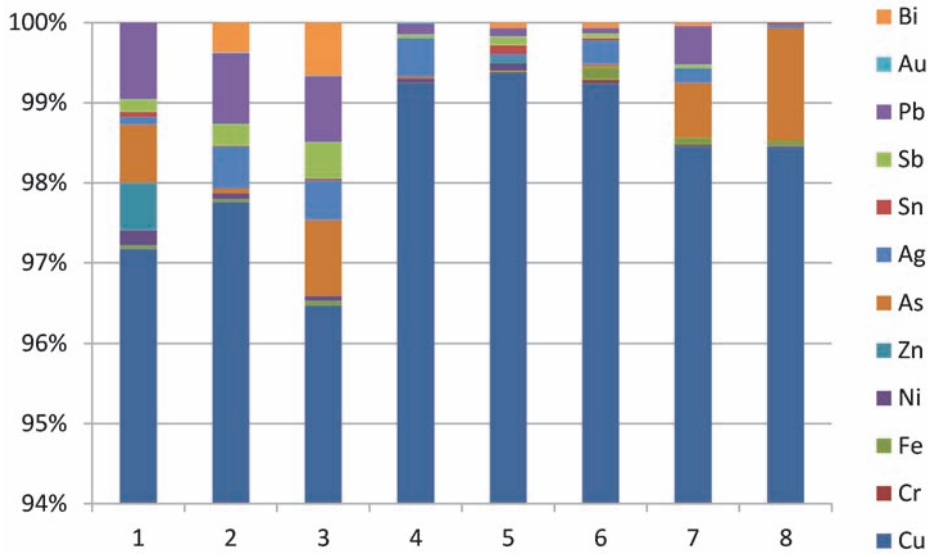


Fig. 12. Chemical composition of spiral copper ornaments (1-3, 5-8) and copper ring (4): 1 – Kichary Nowe, Grave No. 26; 2-3 – Żerniki Górne, Grave 78; 4 – Żerniki Górne, Grave 33; 5 – Żerniki Górne, Grave 137; 6 – Mierzanowice, Grave 81; 7-8 – Mierzanowice, Grave 83. Based on data by: Kempisty 1978; Hensel 1990; Hensel 1992; Kempisty and Włodarczak 2000; Gan 2019. Processing: H. Kowalewska-Marszałek

content: the above-mentioned spirals from Mierzanowice and Żerniki Górne, a fragment of a pin from the same cemetery, Grave 138 (Kempisty and Włodarczak 2000, 127, table 10), two spirals and twelve plates from Grave 217 in Szczytna, Site 5 (Hensel and Pawlicka 2017, 222) and one of the plates from Grave 54 in Mirocin, Site 24 (Bugaj *et al.* 2019, 198, table 2). The Ni content is also slightly higher than average in the case of Kichary, as is the Zn content. In turn, the high amount of Pb (0.95%), significantly higher than the average, places the specimen from Kichary among only a few finds with the highest Pb values, considered important for alloy properties (Hensel and Pawlicka 2017, 221; Gan 2019, 128). These include: two pendants from Grave 137 in Żerniki Górne, a spiral (a smaller one) from Grave 2 in Lublin-Sławinek Site 1-2 (Polańska 2016, 322), a retouching tool tip from Grave 2 in Malżyce (Gan 2019, 128, table 1) and one of the intermediary-retouching tools from Grave 4 in Szczytna Site 6 (Hensel and Pawlicka 2017, 222).

As can be seen from the data currently available, all the analysed artefacts related to the Corded Ware culture were made of copper, the proportion of which ranges from 91.77% to 99.35% and seems to be marginally higher for tools (mean: 96.61%) than for ornaments (mean: 96.55%). Specimens containing more than 96% pure copper account for about 2/3 of all finds, both ornaments and tools. At the same time some regional differences can be observed, related to the spatial grouping of sites belonging to the Corded Ware culture in three main regions: near Cracow (cluster SW), North-Little Poland (cluster N) and E from

the Vistula River (Fig. 1); the highest proportion of pure copper is shown by finds from cluster N, it is also higher than average in cluster SW, and clearly lower east of the Vistula (Fig. 13).

As additional components, Pb, Zn, Ni, Ag, As, Sb, and Sn are present in varying degrees of intensity. Their content varies, both in terms of the upper limits of their proportion and in terms of their average values (Gan 2019, fig. 2). Here, too, differences between ornaments and tools are marked, and some variation is also apparent between individual regional clusters of sites. It is worth noting that the 'cluster E' generally shows higher values than the averages for the whole set of finds; they are also higher than in the case of western Little Poland, *i.e.*, clusters SW and N (Fig. 13).

The grouping of metal finds according to Oxford system with the methodology of the Flow Model (Perucchetti 2015, 50, 57-63) developed as the FLAME project (Pollard *et al.* 2018, 5, 85-115), due to the presence or absence in their composition of the four (apart from copper) 'essential' components, *i.e.*, As, Sb, Ag and Ni, carried out for all Corded Ware finds from Little Poland and areas to the E of the Vistula (Table 6; Fig. 14) indicates a rather large dispersion: the finds belong to as many as 12 'Copper compositional groups', out of 16 defined (Perucchetti 2015, 50, table 2; Perucchetti *et al.* 2015, table 3). The most prominent of these are two: Group 7 (Cu-Sb-Ag: 18 specimens) and Group 12 (Cu-As-Sb-Ni:

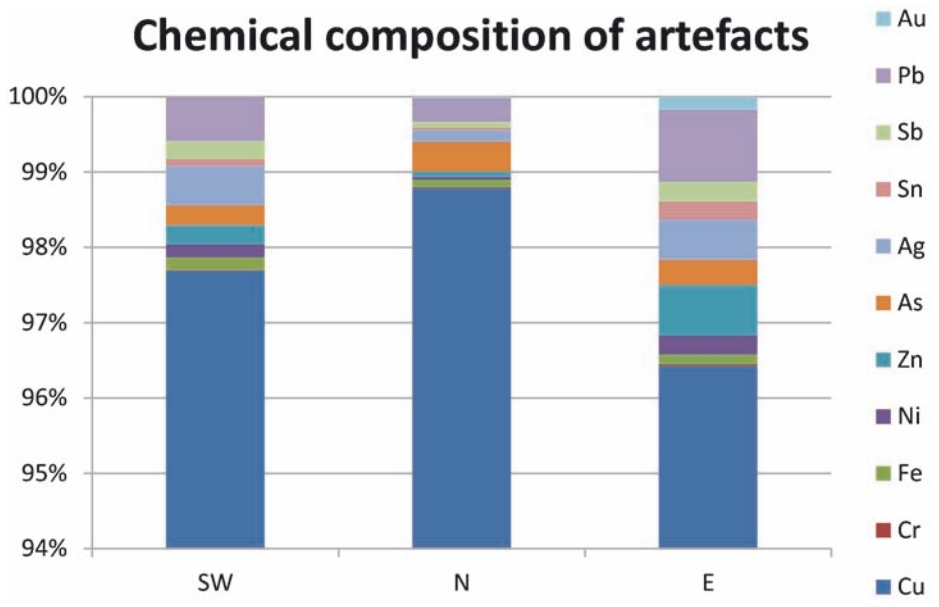


Fig. 13. Chemical composition of copper artefacts (average values) in three main regions: SW, N and E (see Fig. 1 and description in the text). Calculated based on data according to: Kempisty 1978; Hensel 1990; Hensel 1992; Kempisty and Włodarczak 2000; Włodarczak 2004; Rudnicki and Włodarczak 2007; Jarosz et al. 2009; Nosek and Stępiński 2011; Polańska 2016; Hensel and Pawlicka 2017; Bugaj et al. 2019; Gan 2019. Processing: H. Kowalewska-Marszałek

16 specimens). Quite distinct are also Groups 9 (Cu-As-Ag) and 16 (Cu-As-Sb-Ag-Ni), with 8 and 6 specimens, respectively; the others are much smaller and fairly even. Completely absent are finds belonging to four groups: 5 (Cu-Ni), 10 (Cu-Sb-Ni), 11 (Cu-As-Ni) and 14 (Cu-As-Sb-Ni).

Interestingly, the aforementioned differences between the eastern and western regions of the Corded Ware culture are also noticeable in this case. They concern above all the share of finds from the Group 12, dominant in the areas to the east of the Vistula, and almost absent in the western territory, where, in turn, the share of specimens from the Groups 1-4 is more distinct (Table 6; Fig. 14: b, c).

Generally, tools and ornaments are found within the same units. The exception is Group 12 (dominant in the areas to the east of the Vistula), which contains only ornaments: two spirals and 13 plates from Grave 217 in Szczytna, Site 5, as well as the only specimen from the western part of Little Poland: one of the spirals from Grave 78 in Żerniki Górne. Group 6 also stands out, to which only one tool belongs (one of the intermediate retouchers from Grave 4 in Szczytna, Site 6). It is-worth noting that the same specimen is also distinguished by the highest content of Pb (5.34%) in the whole assemblage of finds, which even makes it possible to classify it as 'lead bronze' (Hensel and Pawlicka 2017, 221).

Table 6. Frequency of metal artefacts of the Corded Ware culture in SE Poland in different 'Copper compositional groups' (based on data by: Kempisty 1978; Hensel 1990; Hensel 1992; Kempisty and Włodarczak 2000; Włodarczak 2004; Rudnicki and Włodarczak 2007; Jarosz et al. 2009; Nosek and Stępiński 2011; Polańska 2016; Hensel and Pawlicka 2017; Bugaj et al. 2019; Gan 2019)

Group No.	Description	Metal artefacts region W	Metal artefacts region E	Total
Group 1	Cu	2	1	3
Group 2	Cu As	2	1	3
Group 3	Cu Sb	2		2
Group 4	Cu Ag	2	2	4
Group 5	Cu Ni			0
Group 6	Cu As Sb		1	1
Group 7	Cu Sb Ag	6	12	18
Group 8	Cu Ag Ni	1	1	2
Group 9	Cu As Ag	3	5	8
Group 10	Cu Sb Ni			0
Group 11	Cu As Ni			0
Group 12	Cu As Sb Ag	1	15	16
Group 13	Cu Sb Ag Ni	2		2
Group 14	Cu As Sb Ni			0
Group 15	Cu As Ag Ni	2	3	5
Group 16	Cu As Sb Ag Ni	2	4	6
Total		25	45	70

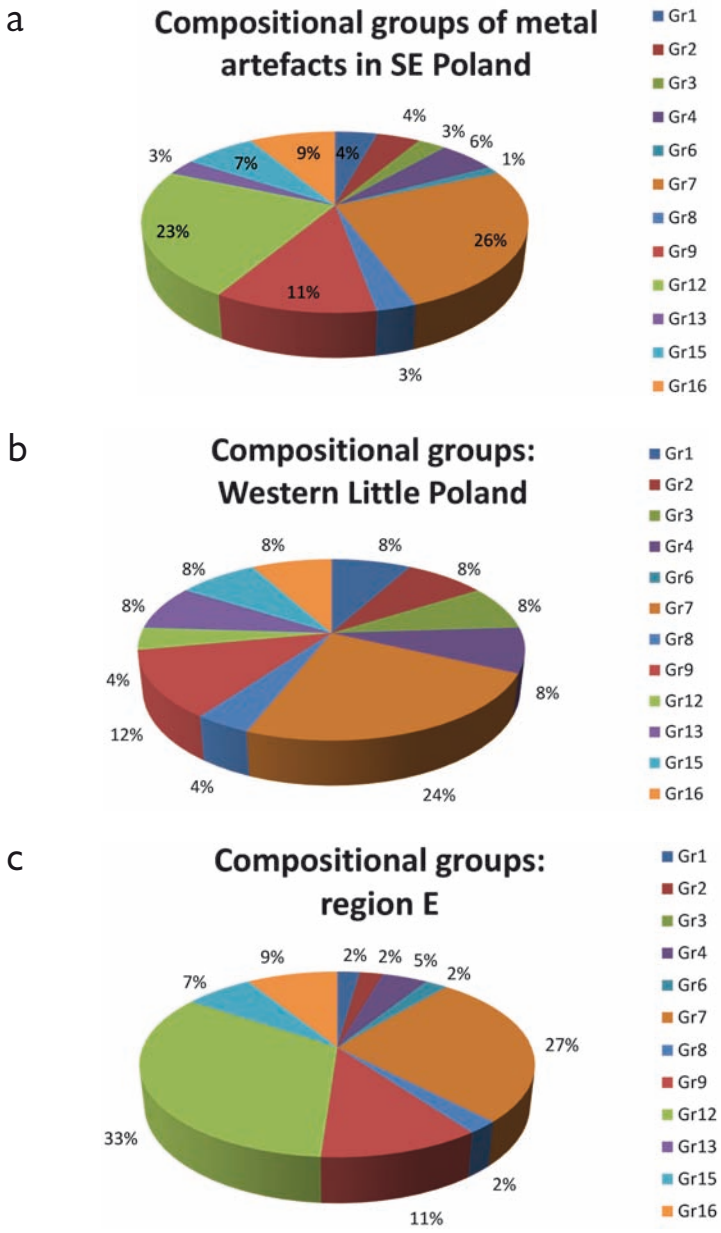


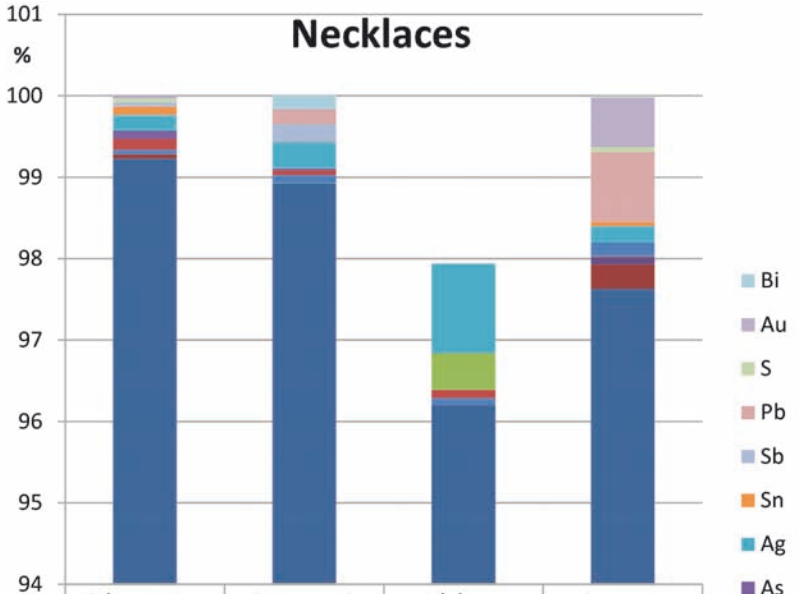
Fig. 14. Percentage of metal artefacts of the Corded Ware culture from different 'Copper compositional groups' (according to Oxford system): a – SE Poland (as whole); b – western part of the Little Poland; c – areas to the east of the Vistula River. Based on data by: Kempisty 1978; Hensel 1990; Hensel 1992; Kempisty and Włodarczak 2000; Włodarczak 2004; Rudnicki and Włodarczak 2007; Jarosz *et al.* 2009; Nosek and Stępiński 2011; Polańska 2016; Hensel and Pawlicka 2017; Bugaj *et al.* 2019; Gan 2019. Processing: H. Kowalewska-Marszałek

Group 7, which is dominant in the material of the Corded Ware culture of SE Poland, regardless of the location of finds, seems to predominate also among the Bohemian finds (although the small number of analyses requires treating this statement with caution). At the same time, it is a group whose presence is clearly marked in the Late Neolithic of southern France and Switzerland, and it is considered to be a unit of a rather 'western' pattern of distribution of finds (Perucchetti 2015, 181-184; Perucchetti *et al.* 2015, 611, fig. 8). In turn, Group 12 is well marked in the very beginning of the Early Bronze Age, above all in the areas to the NE of the Alpine region (more than half of all finds from this period belong to it), where it is very clearly associated, for example, with hoards and with finds of the Ösenringe type. The most frequent occurrence of artefacts from this group is observed in the areas of Central Europe (Perucchetti 2015, 204-210, 217, fig. 49; Perucchetti *et al.* 2015, 613, fig. 9).

Returning to the finds from Kichary, it can be noted that each of them should be placed in a different compositional group (Table 4). The necklace belongs to Group 15 (Cu-As-Ag-Ni) like the three plates from Grave 217 in Szczytna, Site 5, while the spiral is in Group 16 (Cu-As-Sb-Ag-Ni), together with other ornaments from Szczytna, Site 5: one spiral and one of the plates from Grave 217, as well as one spiral from Grave 220 (close to the spiral from Kichary also in terms of typology, *cf.*, above). There are also two tools in that group: an intermediary-retouching tool from the aforementioned Grave 220 in Szczytna and an awl from Kolosy (Kempisty 1978, table 4; Hensel 1990, table 1). The spiral from Kichary differs in having a higher proportion of Cu and Pb, and lower proportions of Sb, Ag and Ni; it also lacks the admixture of Au present in the specimens from Szczytna.

Differentiation is also evident with regard to individual categories of finds, *e.g.*, each of the four necklaces in question belongs to a different compositional group: the specimen from Kichary is attributable, as already mentioned, to Group 15, that from Mierzanowice can be associated with Group 7, the necklace from Klekacz – to Group 8 (as only one other artefact: awl-retoucher from Zielona) and that from Szczytna – to Group 4 (together with one plate from Grave 217 in Szczytna and two ornaments from Mierzanowice and Żerniki Górne). The necklaces from Kichary and Mierzanowice are similar in terms of the high proportion of Cu and of the clearly marked presence of Ag (respectively: 0.32% and 0.20%), but differ in the quantity of As and Ni (a more significant amount in the case of the Kichary specimen), as well as that of Sb (significant only in Mierzanowice). Moreover, there is also a small amount of Sn in the Kichary necklace, as well as Pb and Bi in the case of Mierzanowice. Differences are also evident in the other two necklaces: from Klekacz and Szczytna (Fig. 15).

The tool tip from Kichary should be placed in Group 7 (Cu-Sb-Ag), *i.e.*, the most abundantly represented among the finds of Corded Ware culture in SE Poland, together with two other tools: intermediaries from Grave 2 in Malżyce and from Grave 4 in Szczytna, Site 6. To the same Group 7 belong also ornaments: a necklace from Mierzanowice, a ring from Grave 32 in Pełczyska, one of the spirals from Grave 78 and a fragment of a pendant from



	Kichary Nowe	Mierzanowice	Klekacz	Szczytna
Bi	0	0,17		
Au	0,04	0,0083		0,61
S	0,05			0,06
Pb	0	0,18		0,86
Sb	0,05	0,22		0
Sn	0,1	0,00001		0,05
Ag	0,2	0,32	1,1	0,2
As	0,1	0,025		0
Zn	0	0	0,45	0
Ni	0,13	0,057	0,1	0
Fe	0,06	0,098	0,09	0,17
Mn	0			0,01
Cr	0	0,0105		0
Ti	0			0,09
Si	0			0
Al	0,05			0,3
Cu	99,23	98,92	96,2	97,63

Fig. 15. Chemical composition of copper necklaces from SE Poland: 1 – Kichary Nowe (Grave No. 29), 2 – Mierzanowice (Grave 83), 3 – Klekacz (Grave 1), 4 – Szczytna (Grave 4). Based on data by: Hensel 1992; Nosek and Stępiński 2011; Hensel and Pawlicka 2017; Gan 2019.
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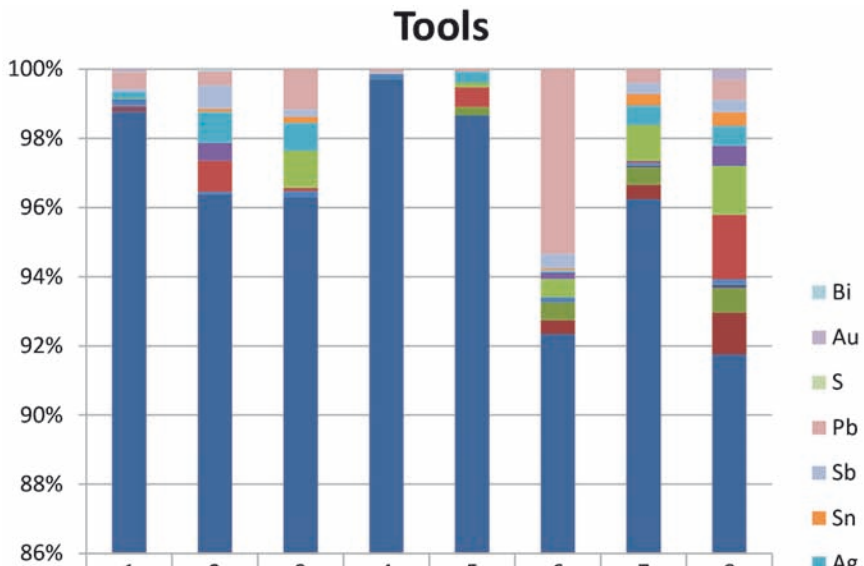

	1	2	3	4	5	6	7	8
Bi		0,056	0	0,00				
Au	0,08	0,015	0	0,00		0	0	0,31
S	0,01					0	0	0
Pb	0,48	0,4	1,15	0,06	0,07	5,34	0,4	0,57
Sb	0,1	0,68	0,21	0,06	0	0,41	0,32	0,37
Sn	0	0,086	0,18	0,02	0	0,05	0,33	0,39
Ag	0,17	0,91	0,79	0,00	0,32	0,07	0,56	0,58
As	0	0,53	0	0,00		0,19	0	0,58
Zn	0,03	0	1,07	0,00	0,14	0,54	1,04	1,41
Ni	0	0,9	0,09	0,00	0,56	0	0,04	1,86
Fe	0,19	0,081	0,19	0,13	0	0,14	0,08	0,13
Mn	0,01	0			0	0	0	0
Cr	0	0	0	0,03	0	0	0,02	0,05
Ti	0,07					0	0,04	0,07
Si	0				0,25	0,52	0,51	0,72
Al	0,07	0			0	0,39	0,41	1,2
Cu	98,79	97,23	95,4	99,33	98,56	92,36	96,27	91,77

Fig. 16. Chemical composition of copper tools and tool tips from the Little Poland: 1 – Kichary Nowe (Grave No. 29), 2 – Kolosy (Grave 4), 3 – Małżyce (Grave 2), 4 – Wilczyce (Grave 15), 5 – Zielona (Grave 3), 6-7 – Szczytna (Grave 4), 8 – Szczytna (Grave 220). Based on data by: Kempisty 1978; Hensel 1990; Włodarczak 2004; 2006; Hensel and Pawlicka 2017; Gan 2019.
Processing: H. Kowalewska-Marszałek

Grave 137 in Żerniki Górne, one spiral from Grave 220 and ten plates from Grave 217 in Szczytna, Site 5. However, they all differ from the specimen from Kichary by a greater amount of Sb and especially of Ag.

The 'retoucher' from Wilczyce 10, Grave 15 seems to be the most similar to the tool tip from Kichary in terms of chemical composition: both are made of almost pure copper (over 98%), with a small amount of Fe, without Ni and As. The tool tip from Kichary, with a small addition of Ag and Sb, and (relatively high) Pb, as well as trace amounts of Pb and Sb, were also found in the object from Wilczyce. A tool from Zielona, Grave 3 (Włodarczak 2004, 316-318, fig. 10: 2), similar in copper content, differs from the Kichary specimen in the presence of Ni, more Ag, and less Pb, as well as the absence of Sb (Fig. 16).

The compositional variety evident in the case of Kichary is also noticeable at other sites of the Corded Ware culture, from which several specimens each come: Malżyce (three specimens, three compositional groups), Mierzanowice (four specimens, four groups), and Żerniki Górne (seven specimens, six groups). The exception in this respect is Szczytna, showing much greater homogeneity (44 specimens belonging to nine groups, mainly to Groups 7 and 12).

Such a marked diversity seems to indicate that the population of the Corded Ware culture from this region used a variety of sources of raw material, which may be due, among other things, to their participation in an intensive, long-distance exchange of metal objects.

CONCLUSIONS

In the cemetery of Kichary Nowe, metal artefacts have been found in three of the five Corded Ware graves currently known; one of these (Grave No. 29) contained as many as five metal finds: three made of copper and two of gold. This is a relatively high accumulation of metal objects, placing this cemetery in a unique position within the Kraków-Sandomierz group of the Corded Ware culture, in which finds of metal artefacts are not very common. According to Piotr Włodarczak's estimations, they occurred in only 14.9% to 17.9% of all graves of this group (Włodarczak 2006, 77), *e.g.*, in only 11.1% of graves in the Żerniki Górne cemetery (Kempisty and Włodarczak 2000, 127). On the other hand, regional differences between the Sandomierz Upland and the southwest part of the Little Poland region are also apparent in this regard, with a slightly higher frequency of occurrence of metal artefacts in the former area. The data from Mierzanowice, with three grave inventories with copper specimens out of 11 graves belonging to the Corded Ware culture (Uzarowiczowa 1970), seem to confirm this opinion, and it also applies to the cemetery at Kichary Nowe.

Differences are also observed between the Little Poland region and areas to the east of the Vistula in terms of the chemical composition of the finds in both regions. The finds

from Little Poland reveal a higher content of pure copper in the individual pieces, with a lower proportion of other admixtures, which clearly distinguishes them from the eastern areas. In turn, in the areas east of the Vistula, the picture of the overall metal finds is much more uniform than in the Małopolska region.

It should be noted that the three artefacts originating from Kichary Nowe are unique. This is most clearly visible in the case of the finds from Grave No. 29: an exceptional copper necklace and two spirals of golden wire, which are, to date, the oldest gold specimens known from Poland. Their presence in the same funerary assemblage makes it possible to consider this burial as unique and suggests the special status and the high prestige of the deceased buried there. Perhaps two smaller specimens (miniature tool tips) were also associated with his social and/or professional position.

The copper spiral (Grave No. 26) has more numerous analogues in the Corded Ware culture and in the Kraków-Sandomierz group as well. However, this ornament should also be considered a sign of individual prestige related to the deceased (Jarosz 2016, 524).

In general, the unitary nature of metal objects from Kichary Nowe does not necessarily allow generalisation to be made in this respect. It is worth noting, however, that this cemetery retains the fundamental proportions evident in the Corded Ware culture, namely the clear predominance of personal ornaments over tools. These ornaments were mainly found in male burials; in only one case was a copper object (most likely an ornament) discovered in a grave with a presumed female burial. This result, however, is due to the gender population structure in this cemetery.

Although the finds of metal objects are relatively numerous, there is no indication of their local manufacture, if we do not count a certain similarity of the chemical composition of one of the specimens to the nearby copper deposits (for which, however, there is no evidence of their exploitation in prehistory). It seems more likely, therefore, that they came to the site as the result of some kind of exchange mechanism, perhaps a long-distance one. Here, one can point to the south-east as a very likely direction of intercultural contact, as indicated, among other things, by the analogies concerning the forms and ornamentation of the vessels (Kowalewska-Marszałek and Duday in print). In addition, the analysis of the chemical composition of the finds from Kichary Nowe provides an opportunity to integrate them into a more general discussion of the provenance and distribution of metal finds in the Corded Ware culture and the Late Neolithic of Europe.

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CORDED WARE CULTURE BURIAL RITES: NEW EVIDENCE FROM ORŁY, SITE 4 IN THE SUBCARPATHIAN LOESS REGION, SOUTHEASTERN POLAND

ABSTRACT

Król D., Głowacz M., Mączyński P., Rogóż J. and Szpila M. 2025. Corded Ware culture burial rites: new evidence from Orły, Site 4 in the Subcarpathian loess region, Southeastern Poland. *Sprawozdania Archeologiczne* 77/2, 329-354.

Archaeological investigations conducted in 2023 at Orły, Site 4, in the Subcarpathian loess region, revealed a niche grave associated with the Corded Ware culture. Inside, the remains of two adult men were found, accompanied by a rich assemblage of grave goods, including ceramic vessels, lithic tools, and a bone awl. This article presents the results of the analysis of the grave's construction, osteological material, and grave goods, relating them to the cultural and chronological issues of the Final Eneolithic communities in the 3rd millennium BC.

Keywords: Subcarpathian loess region, Corded Ware culture, niche grave, Final Eneolithic, chronology
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INTRODUCTION

The Subcarpathian loess region, encompassing the Rzeszów Foothills and the adjacent Lower San Valley (southeastern Poland), was of particular interest to the semi-nomadic communities of the Final Eneolithic Corded Ware culture (CWC) during the 3rd millennium BC. This relatively small area, which offered exceptionally favourable environmental conditions for the subsistence of prehistoric human groups (*e.g.*, Łanczont *et al.* 2001b; 2023), gained research significance during the excavations prior to the construction of the A4 highway (Machnik 2011, 62-70). During these investigations, several intriguing CWC burial sites were recorded, revealing the remains of destroyed barrows and various types of graves, including niche graves. These sites were most often scattered across well-exposed locations, including Mirocin, Sites 24 and 27 (Machnik *et al.* 2019), Skołoszów, Site 7 (Rybicka *et al.* 2017), Szczytna, Sites 5 and 6 (Hozer *et al.* 2017), and Święte, Sites 11, 25, and 20 (Dobrakowska and Włodarczak 2018; Janczewski *et al.* 2018; Olszewski and Włodarczak 2018). As Prof. Jan Machnik (2011, 62) highlighted, the results of these field campaigns did not merely add to the existing body of knowledge but rather paved the way for a revision of many important concepts (*cf.*, Hozer *et al.* 2017; Kośko and Włodarczak 2018; Machnik *et al.* 2019). Recently, in 2023-2024, three new CWC Sites were identified in the Subcarpathian loess region: Orły, Site 4, Skołoszów, Site 16 (both investigated by D. Król's team), and Żurawica (investigated by G. Płoskoń). The remains of niche graves at the first two sites were uncovered during subsequent rescue excavations of Funnel Beaker culture (FBC) settlements (*cf.*, Król 2018; Król and Niebieszczański 2019). This article presents the results of the study of the niche grave (Feature 15/2023) at Orły, Site 4, and discusses its significance in the context of similar discoveries in the southeastern CWC 'world'.

SITE LOCATION

The site is located on the southeastern edge of the Rzeszów Foothills, the southern part of the Sandomierz Basin (Kondracki 2002; Solon *et al.* 2018), about 7 km north of Przemyśl (Fig. 1: 1). It is situated on the gentle northeastern slope of a flattened hill (average inclination of 1.30°), offering an extensive view of the loess terrace platform of the Lower San Valley (Fig. 1: 2), which rises up to 30 m above the floodplain of the San River (*cf.*, Gębica 2023). The site's elevation ranges from about 253 m to 258 m a.s.l.; however, the niche grave is situated at 256.1 m a.s.l. The nearest significant watercourse, the Rada River – a left tributary of the San River – is located about 1.1 km west of the site. Slightly closer, at about 0.5 km, are the springs of three unnamed watercourses: one drains directly into the Rada River, while the other two flow toward the San River, merging with additional minor streams along the way. The entire site is covered with loess

soils. At the same time, various patches of chernozem are also observed in its vicinity, particularly to the north and east, in areas not exceeding 240 m a.s.l. (*cf.*, Dobrzański and Zbysław 1955; Gębica 2023).

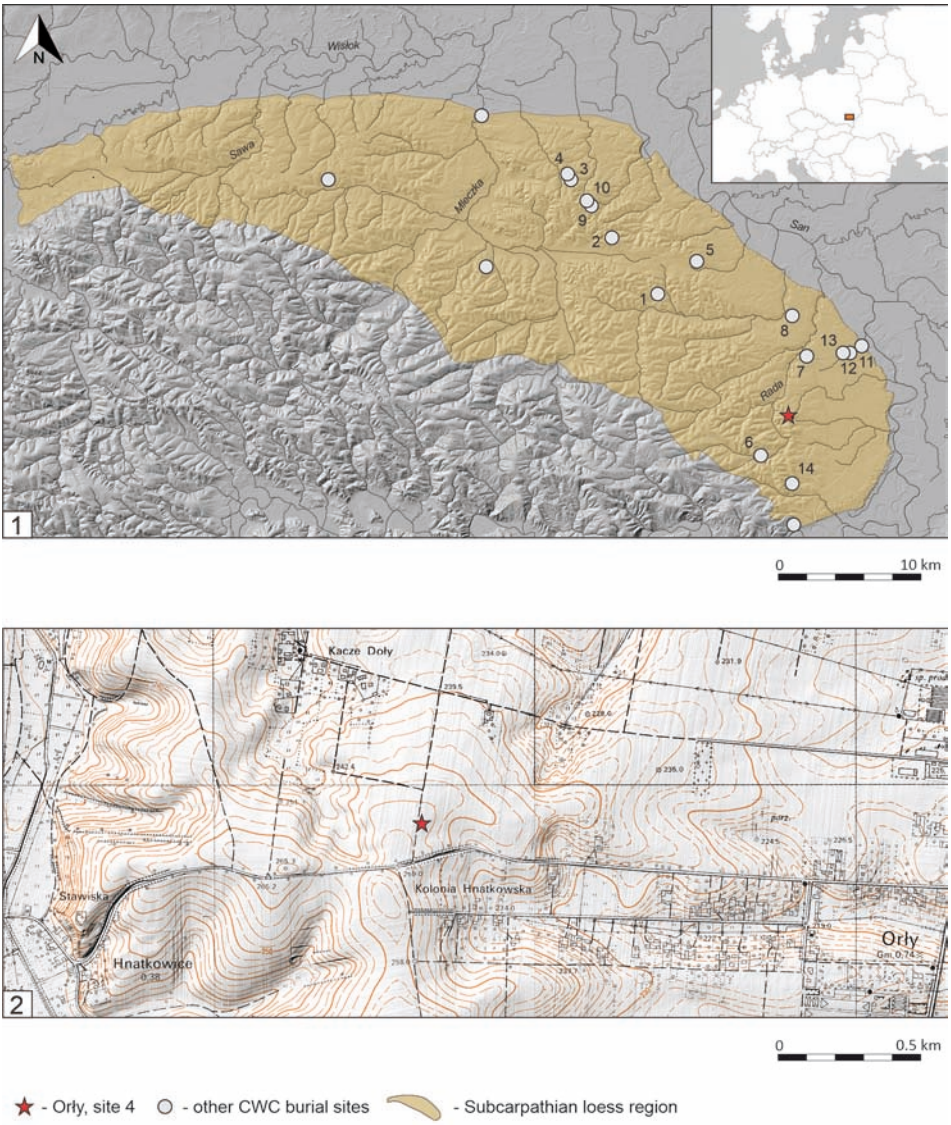

Fig. 1. Location of the Orły, Site 4, Przemyśl District. Burial sites mentioned in the article. 1 – Cieszacin Wielki, Site 37; 2 – Chłopice, Site 26; 3 – Mirocin, Site 24; 4 – Mirocin, Site 27; 5 – Morawsko, Site 8; 6 – Orzechowce; 7 – Skołoszów, Site 7; 8 – Skołoszów, Site 16; 9 – Szczytna, Site 5; 10 – Szczytna, Site 6; 11 – Święte, Site 11; 12 – Święte, Site 15; 13 – Święte, Site 20; 14 – Żurawica, Site 12. Edited by D. Król

GRAVE DESCRIPTION

The niche grave of the CWC, identified as Feature 15/2023, was discovered immediately adjacent to the western edge of the trench, defined by the N-S axis of a local road (Fig. 2). During the initial phase of investigations, only the entrance pit of the grave was uncovered, with the top of its upper fill located about 40 cm below the modern ground level. It appeared as an oval layer of yellow loess mixed with a light grey organic substance. The structure was found to have been cut into the accumulation (cultural) layer of the FBC from the 4th millennium BC, also partially disturbing a shallow older pit (No. 1/2023) of uncertain chronology. Additionally, the entrance pit was later intersected by a later ditch (Fig. 2). Further exploration revealed a classic niche grave layout, consisting of two spatially related elements: an oval-rectangular niche and an entrance pit, measuring 249 × 122 cm and 130 × 122 cm, respectively (Fig. 3: 1, 2). These were connected by a narrow and short corridor (65 × 30 cm), thus forming a T-shaped structure (Fig. 3: 2). The entire funerary structure was oriented along the E-W axis, with the niche positioned on the western

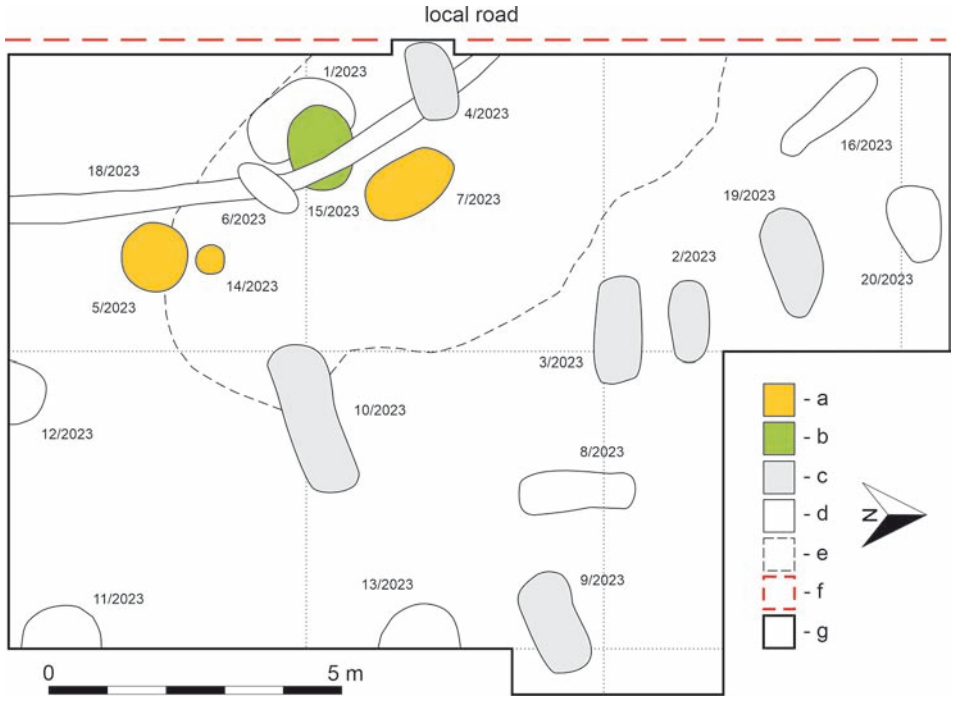

Fig. 2. Orły, Site 4, Przemyśl District. Layout of the trench from 2023. a – FBC features; b – CWC feature (entrance pit of the niche grave No. 15/2023); c – early Medieval features; d – features of undefined chronology; e – extent of the FBC cultural layer; f – boundary of the local road; g – area of the trench. Edited by D. Król

Fig. 3. Orły, Site 4, Przemyśl District. Construction of the niche grave No. 15/2023. 1 – cross-section of the niche grave; 2 – layout of the bottom of the burial niche. a – dark gray and black layer; b – dark gray layer; c – gray layer; d – grayish yellow layer; e – brown layer; f – light gray-yellow; g – burned layer. Edited by D. Król

side (Fig. 3: 1, 2). Its westernmost wall was located beneath the local road, necessitating several compromises in the excavation strategy to ensure its complete exploration (Fig. 3: 1, 2). The bottom of the niche was located approximately 2 m below modern ground level. In contrast, the bottom of the entrance pit was several centimetres higher (Fig. 3: 1). The stratigraphic characteristics of the entrance pit (filled with light grey-yellow sediments) indicate a very slow filling process. The niche was exceptionally well-preserved, showing no evident signs of collapse, although slight erosion of its walls was observed (Fig. 3: 1). Its fill suggests a gradual accumulation of dark sediments. Interestingly, a consistent, straight boundary between these layers indicates the possible presence of a partition that blocked the entrance to the niche (Fig. 3: 1).

At the bottom of the burial niche, the poorly preserved skeletal remains of two adult individuals were discovered in a flexed position (Fig. 3: 2). The body of Individual No. 1 was lying on its right side along the N-S axis, head facing south and face turned east. In contrast, that of Individual No. 2 rested on its left side, aligned with the NE-SW axis, with the head oriented toward the northeast and the face turned southeast. The human remains were accompanied by a set of pottery, lithic artefacts, and bone items (Fig. 3: 2).

In the southwestern part of the burial niche, at the level of Individual No. 1's shoulders, a stone axe and a poorly preserved bone awl – probably using bone from a sheep or goat – were discovered. At the level of the same individual's pelvis, near the western wall of the burial niche, a flint axe, an animal bone, a pottery fragment, and a miniature vessel (Beaker No. 3) were found. A flint tool was located near the pelvis, while three pottery sherds were identified near the skull. Additionally, near the western wall of the feature, a large beaker (No. 1) was placed close to the lower limbs of Individual No. 1 (Fig. 3: 2).

In the northern part of the burial niche, at the level of Individual No. 2's pelvis, another beaker (No. 2) – though in a very poor state of preservation – was identified. A flint arrowhead was found closer to this individual's ribs (Fig. 3: 2).

GRAVE GOODS

Beaker No. 1

A large, unornamented beaker with an S-shaped profile, a small, prominent foot, a distinctly swollen belly in its lower part, and a gently tapering neck that flares outward with a straight rim. The vessel is characterised by good firing, and its surface is smooth and floury, with a colour ranging from brown-grey to brick-red. It was made from fat clay with a small amount of mica and a medium temper of fine ceramic grog. Dimensions: height – 28 cm, rim diameter – 17 cm, base diameter – 7 cm, belly diameter – 17 cm, wall thickness – just over 5 mm, but in some parts – such as the lower belly zone – it exceeds 7 mm (Fig. 4: 1).

Beaker No. 2

A small beaker with an S-shaped profile, characterised by a very fragile structure. The belly of the vessel flows smoothly into the flattened bottom, while the clearly profiled neck ends at the rim, which is slightly tilted outwards. The vessel is poorly fired, its colour is light brown, and its fabric is the same as that of Beaker No. 1. Dimensions: height – 15 cm, rim diameter – 10 cm, base diameter – 5 cm, belly diameter – 13 cm, wall thickness – rarely exceeds 6 mm (Fig. 4: 2).

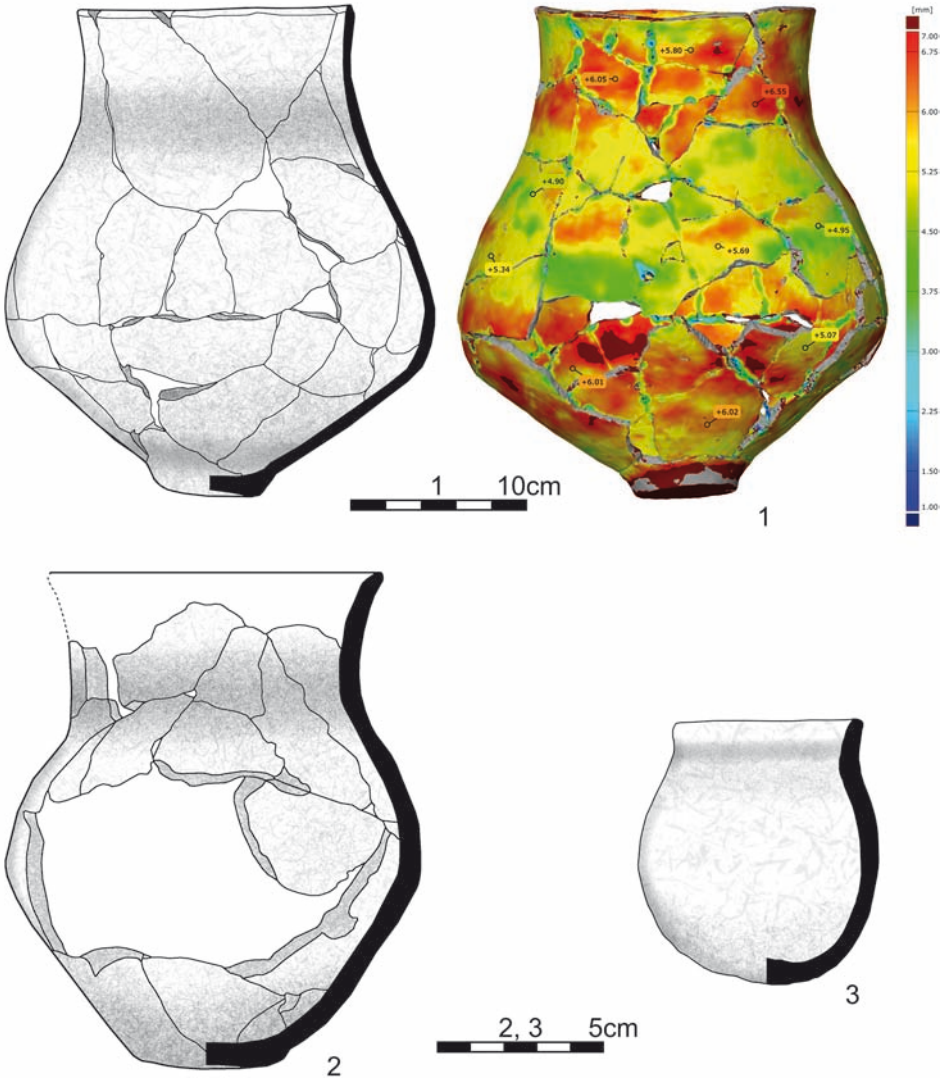

Fig. 4. Orły, Site 4, Przemyśl District. Grave goods from the niche grave No. 15/2023.
1-2 – beakers; 3 – miniature beaker. Draw by M. Głowacz and K. Orczyk; 3D scan by P. Maruszczak

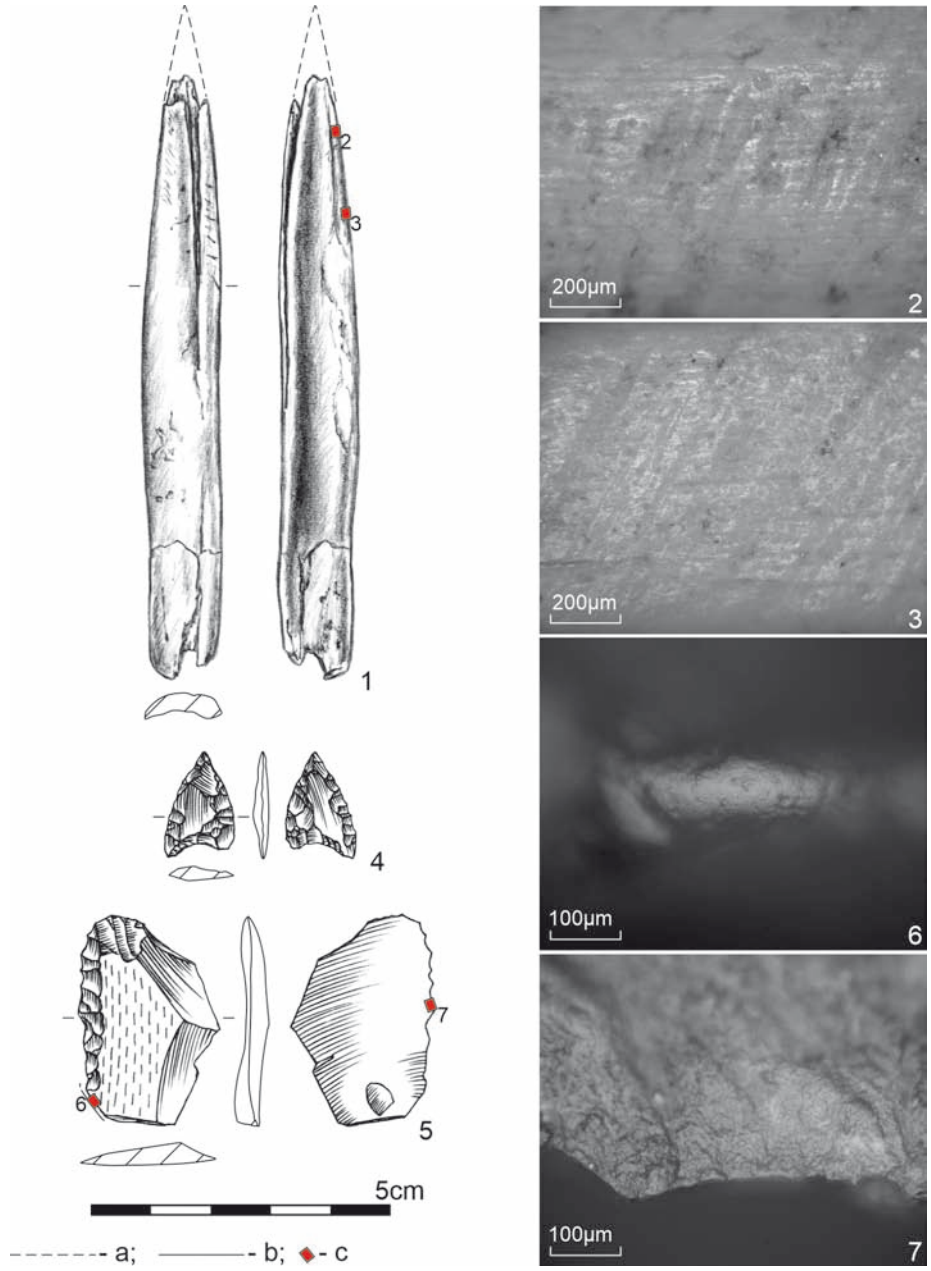

Fig. 5. Orły, Site 4, Przemyśl District. Grave goods from the niche grave No. 15/2023. 1 – awl; 2, 3 – technological traces visible on the awl; 4 – arrowhead; 5 – side scraper; 6 -processing wood, plants, or (less likely) soft bone/antler; 7 – natural surface of flint. a – tool reconstruction; b – use-wear traces; c – place where photograph was taken, the number indicates the photograph's number in the figure.
Draw by A. Jączek and P. Mączyński; Photo by P. Mączyński

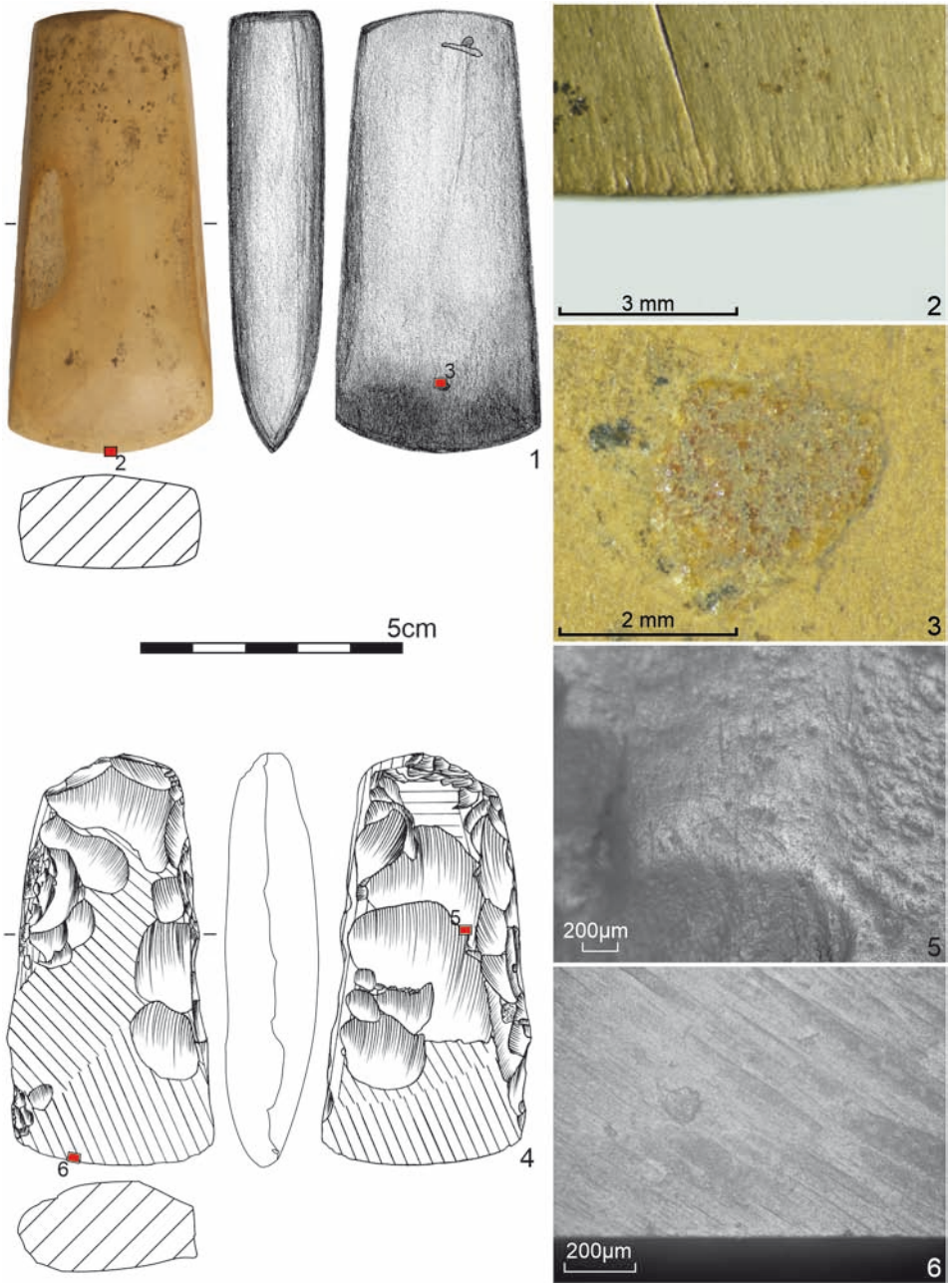

Fig. 6. Orły, Site 4, Przemyśl District. Grave goods from the niche grave No. 15/2023. 1 – stone axe; 2 – traces of unknown origin visible on the axe blade; 3 – residual substance; 4 – flint axe; 5 – hafting traces; 6 – traces of sharpening. Draw and photo by P. Mączyński

Beaker No. 3

A miniature fully preserved beaker with a slightly flattened base and an oval belly that transitions smoothly into a subtly defined neck, which minimally flares outward with a straight rim. The vessel was made of lean clay with a small amount of mica and a slight temper of ceramic grog. Its yellow-brown surface is partially smoothed but remains uneven and floury in texture. Dimensions: height – 8 cm, rim diameter – 5 cm, belly diameter – 7 cm, wall thickness – rarely exceeds 4-5 mm; however, in some places, it exceeds 6 mm (Fig. 4: 3).

Arrowhead

Triangular arrowhead with notched base. Raw material: Cretaceous flint (erratic?). Dimensions: 18×11×3 mm, weight: 0.5 g (Fig. 5: 4).

Side scraper

Made on a flake with an aeolian surface on the upper side. Raw material: unspecified type of flint (erratic?). Dimensions: 36×23×4 mm, weight: 3.5 g (Fig. 5: 5).

Axe No. 1

Trihedral axe, trapezoidal in the face view, with rounded butt and arched cutting edge; lenticular in longitudinal section; irregular in cross-section; polished only in the bottom part and on lateral edges; raw material: Volhynian flint. Dimensions: 79×39×17 mm, weight: 76 g (Fig. 6: 4).

Axe No. 2

Tetrahedral axe, trapezoidal in the face view; with arched cutting edge; wedge-shaped in longitudinal section; rectangular in cross-section. Polished on the entire surface. Raw material: chert or hornstone. Dimensions: 85×49×19 mm, weight: 90 g (Fig. 6: 1).

Bone awl

Made of a fragment of a split bone shaft, most likely from a sheep or goat; the tip was made with the use of polishing. Dimensions: 102×13×5 mm, weight: 3 g (Fig. 5: 1).

ANTHROPOLOGICAL ANALYSIS

The anthropological analysis of the two discovered skeletons was performed using classical, macroscopic research methods (Buikstra and Ubelaker 1994; Bass 2005; White and Folkens 2005). A significant limitation in the information obtained and in the final determinations is the state of preservation of the remains. In these particular cases, the skulls were incompletely preserved, almost without viscerocranium, but with dentition. Postcranial skeletal remains are fragmentary, represented mainly by poorly preserved pieces of long bone shafts. Age at death was determined based on the degree of wear of the dental crowns as well as the degree of obliteration of the cranial sutures. Sex was based on the morphology of the mandible, frontal bone, occipital squama, and the size of the mastoid process of the temporal bone. Unfortunately, the pelvic bones, of which only frag-

ments remain, were not useful in this regard. The measurements taken of the bones primarily reflect their state of preservation.

Individual No. 1

Maturus (?), male

The skull is mainly the calvarium (Fig. 7: 1-3). A small fragment of the right and left parts of the frontal bone, with the *bregma* point visible. Parietal bones damaged laterally; also present is a transverse fracture running through the sagittal suture – a highly probable perimortem cranial injury. Fragment of occipital squama with fragment of left parietal bone and the mastoid part of the left temporal bone (fused/connected? during analysis with parietal bones). Very prominent upper nuchal crest, marked external occipital protuberance (Fig. 7: 3), mastoid process long. In addition, three fragments of the calvarium. Bone loss in the region of the *lambda* point and right side, from which fractures begin, on the right side under and parallel to the sagittal suture, as well as two in the downward direction forming a triangle. Cranial sutures – coronal open, sagittal obliterated in S3, and its remnants obliterated partially, the lambdoid suture closed in L1, whereas in L2, L3 obliteration in progression.

In terms of the facial part, a fragment of the alveolar process of the right maxilla, mandible and dentition are preserved (Fig. 7: 1, 4). The mandible has a broken body between the right canine and lateral incisor; height at the canine 27 mm; prominent mental protuberance. Preserved right ramus with partially damaged processes. The left part of the mandible is essentially teeth stuck in a lump of earth with bone crumbs.

Table 1. Permanent teeth (showing wear): po – *postmortem* loss, ? – it is not known whether it was formed, u – unformed

8	7	6	5	-	-	-	-	-	-	-	-	-	-	-	?
u	7	6	5	4	3	po	po	-	-	-	-	-	6	7	u

Postcranial skeleton poorly preserved, incomplete, bones fragmentary (Fig. 7: 1), no signs of perimortem injuries. Vertebrae represent a bone conglomerate of two body fragments, in addition, three fragments of vertebral body from the thoracic or lumbar region. A fragment of the first rib and a fraction of a shaft are present. Preserved fragment of the right scapula including a sculptured infraspinous fossa, lateral border and part of the glenoid cavity. The sternum, clavicles are missing. Four fragments of the ilium bone were separated. Fragments remained of the long bones of the upper limbs, as well as of the lower limbs. From the left humerus is a fragment of the shaft, 92 mm long. From the right humerus, apart from small pieces, two longer fragments of the shaft (in longitudinal section) are present, that is a fragment with the head 157 mm long and a fragment of the lower half 153 mm long. The bones of the left forearm are small, brittle fragments connected to a lump of earth.

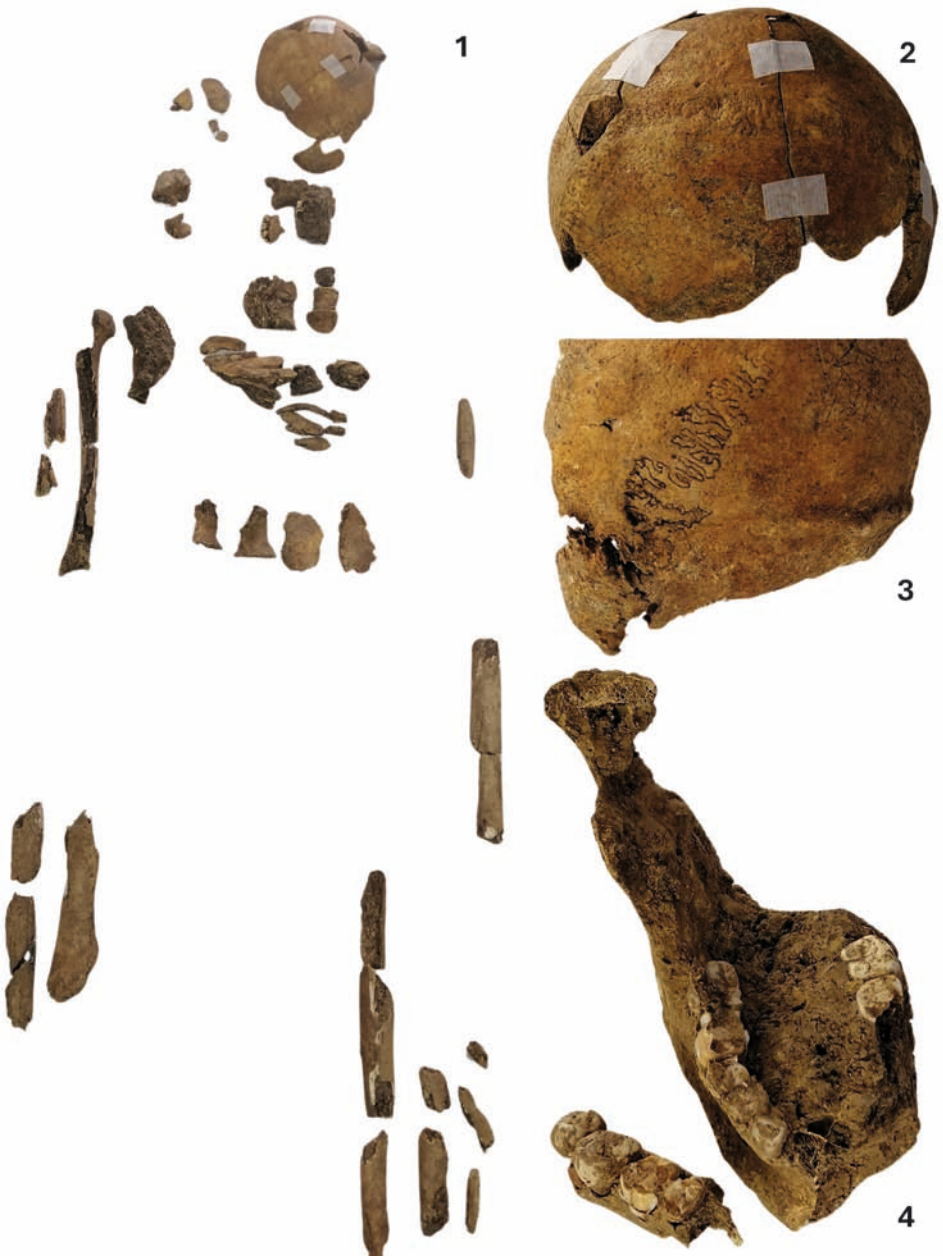

Fig. 7. Orły, Site 4. Przemyśl District. Human remains from the niche grave No. 15/2023. Individual No. 1, male, *Maturus* (?). 1 – preserved bones; 2 – calvarium; 3 – calvarium, view of the occipital squama, prominent superior nuchal line and external occipital protuberance; 4 – maxilla and mandible with teeth. Photo by J. Rogóż

Two shaft fragments of 120 mm and 85 mm in length remained from the left femur, while several fragments of 183 mm, 84 mm, 80 mm, and 77 mm in length remained from the right femur. Preservation of two tibias – from one three adjacent shaft fragments of 139 mm, 113 mm, 92 mm in length, and the other two shaft fragments of 91 mm and 45 mm in length. In addition, three fragments of fibula shafts, 59 mm, 55 mm, and 26 mm long. The bones of the hands and feet, patellae, are missing. To the skull and each of the long bones, the presence of small bone fragments should be added.

Individual No. 2

Adultus, male

The skull consists mainly of a damaged calvarium (Fig. 8: 1, 2), where no perimortem injuries were clearly detected on macroscopic examination. The right orbital area had white margins of *postmortem* damage. Frontal bone and parietal fragments are present. Coronal suture visible and open; glabella prominent, upper edge of the left eye socket rounded, right eye socket damaged, nasal bones also damaged (Fig. 8: 1-2). From the facial part, a fragment of the alveolar process of the left maxilla with teeth and the mandible with teeth has been preserved. This one has a massive, high body (33 mm), with a marked mental protuberance and mental triangle (Fig. 8: 1, 3). Preserved from the right lateral incisor through the entire left part, up to the separated ramus. The coronoid process is present, but the condylar process is absent. A fragment of the right part of the body remained separately, from the right first premolar to the obliterated socket of the second molar. The edges of the mandibular fragments are white, indicating their *postmortem* origin. Their perimortem origin cannot be confirmed.

Table 2. Permanent teeth (slightly worn): po – *postmortem* loss, r – only root present, obl – loss and obliteration of the socket, ? – it is not known whether it was formed, u – unformed; teeth of the right maxilla loose

?	7/8?	6	5	4	3	2	1	r	r	3	4	5	6	7	8
?	obl	6	r	4	po	2	r	r	2	3	4	5	6	7	u

The bones of the postcranial skeleton are represented selectively and fragmentarily (Fig. 8: 1). No perimortem injuries were observed. Together with the right upper limb, a fragment of the clavicle shaft (right?) was collected, with a total length of 66 mm, but broken into two parts. Fragments of the scapula. Long bones of the upper and lower limbs. There are four adjacent shaft fragments from the left humerus, length 227 mm, and from the right bone – three shaft fragments, length 130 mm. Bones of forearms and hands not preserved. The femurs are – on the left side, two fragments of the shaft, 181 mm and 154 mm long, on the right side, two fragments with a total length of 133 mm and two further fragments, each 63 mm long. A relatively well-preserved fragment of the shaft of the left tibia, in two pieces with a total length of 242 mm, with a visible nutrient foramen, and another,

Fig. 8. Orły, Site 4. Przemyśl District. Human remains from the niche grave No. 15/2023. Individual No. 2, male, *Adultus*. 1 – preserved bones; 2 – calvarium, frontal view, prominent glabella and eyebrow arch; 3 – mandible with teeth, visible morphology of the mental protuberance and the degree of dental crown wear. Photo by J. Rogóż

larger fragment of the shaft, 85 mm long. A larger fragment of the shaft, 56 mm long, remained from the right tibia. Additionally, there are small fragments of the shaft of the left fibula and fragments of the right bone. Two bones of the right foot are present, that is the second or third metatarsal bone, without the head, and the proximal phalanx. The presence of small bone fragments should be added to the skull and each of the long bones.

USE-WEAR ANALYSIS

The analysis of the use-wear traces recorded on the flint artefacts and the bone awl was conducted using two types of microscopes. In the initial phase, a stereoscopic Zeiss SteREO Discovery.V8 microscope was employed, which provided real magnification ranging from 10 to 80×. This microscope was equipped with a dedicated cold LED light source. During the first observation phase, the focus was on distinguishing potential working edges and determining their locations (Van Gijn 1989, 13). The artefacts were analysed at magnifications ranging from 10 to 40×. The next step involved using a Meiji Techno MC-50T metallographic microscope, which allowed for higher magnifications ranging from 50 to 500×. However, the flint artefacts were analysed at magnifications of 50×, 100×, and 200×. The obtained images enabled the determination of the nature of use-wear sheen and linear traces (D'Errico *et al.* 1984; Olsen 1984; Vaughan 1985, 5, 6, 10; Van Gijn 1989, 12; Małecka-Kukawka 2001, 22-23; Osipowicz 2010, 23-25; Orłowska *et al.* 2022).

All flint tools and the bone awl were subjected to microscopic analysis. The set of flint artefacts consists of four tools: a side scraper (unspecified type of siliceous material), a triangular arrowhead with a notched base (erratic flint?), a trihedral axe (Volhynian flint), and a tetrahedral axe (chert/hornstone?).

Use-wear traces were recorded on two of the three flint artefacts (Figs 5: 5 and 6: 4). The axe showed distinct traces resulting from hafting. The extent of these traces indicates that at least two-thirds of the tool was covered during use (Fig. 6: 5). Interestingly, no wear patterns were observed on the cutting edge (Fig. 6: 6). On the other hand, the polish was very distinct, which may suggest that the artefact was sharpened before being deposited in the grave.

Traces of similar preparatory procedures were also recorded on the side scraper (Fig. 5: 5). In this case, 'sharpening' involved covering the edge with flat, regular retouch. This interpretation is supported by the complete absence of use-wear traces on the tool's surface. Fortunately, the retouch did not cover the entire edge, allowing us to observe use-wear traces on a small section. These patterns were probably formed before the retouching occurred. Their characteristics suggest that the tool was used in processing materials rich in silica, such as plants, or possibly wood or soft bone, although the latter is less likely (Fig. 5: 6, 7). The final flint tool, the arrowhead, showed no use-wear traces (Fig. 5: 4).

One of the most intriguing tools discovered near Individual No. 1 is the axe made of a sedimentary rock, possibly chert or hornstone (Fig. 6: 1). This material is relatively soft, as indicated by the fact that the entire surface of the artefact, including the butt, was polished – an unusual feature for flint tools produced by the CWC community (*cf.,* Libera 2022). The most notable features were observed on the cutting edge, including rounding of the edge and linear traces. These patterns probably resulted from contact with a soft material. At this stage of research, it is difficult to conclusively determine whether these are use-wear traces or marks formed during the tool's shaping process (Fig. 6: 2). The latter interpretation is supported by the presence of similar patterns on other parts of the tool, such as the butt, though these are less distinct. Additionally, traces of a residual substance were found on the lower part of the axe, but due to the methods used, it was not identified (Fig. 6: 3).

The awl, made from the shaft of a split bone, was also analysed (Fig. 5: 1). The tip of this specimen, which probably served as the working edge, was damaged. Furthermore, the specimen's surface had been significantly altered by post-depositional processes. These factors greatly limited the possibility of conducting further analyses, which were restricted to identifying technological traces related to the production of the awl (Fig. 5: 2, 3). The only patterns observed were polishing scratches, visible on the lower side and the working edge. The tool was polished obliquely to its main axis. The artefact exhibits rounded edges and protruding points, and at least some of these features may have resulted from prolonged contact with wrapping or human handling during use.

ORŁY, SITE 4 IN THE CONTEXT OF THE CWC

The niche grave at Orły, Site 4, offers new insights into the burial practices of Final Eneolithic CWC communities in the Subcarpathian loess region. To date, several cemeteries within a 10 km radius of this site have been identified and excavated (Fig. 1). Among them are Skołoszów, Site 7 (Rybicka *et al.* 2017), as well as Sites 11, 15, and 20 at Święte (Dobrakowska and Włodarczak 2018; Janczewski et al. 2018; Olszewski and Włodarczak 2018), which were discovered during rescue excavations conducted prior to the construction of the A4 highway. These cemeteries are situated 4 to 6 km north and northeast of Orły, Site 4. The local funerary landscape is further enriched by three additional sites: Orzechowce, Skołoszów, Site 16, and Żurawica, Site 12. The first is known primarily from archival records, documenting the accidental discovery of a CWC grave during the construction of a defensive fort in the late 19th century (Demetrykiewicz 1898, 81-83). The latter two sites represent the most recent fieldwork conducted in 2023-2024.

Looking northwest, deep into the loess-covered Rzeszów Foothills, it is also important to highlight other significant burial sites (Fig. 1). For instance, about 12 km from Orły, Site 4, in Cieszacin Wielki, Site 37 and Morawsko, Site 8, numerous CWC barrows have been

documented (Machnik 1995; Poradyło and Kostek 2000; Łanczont *et al.* 2001a; 2023). Further northwest, more than 20 km from the analysed site, several noteworthy CWC cemeteries have been excavated, yielding exceptional data on ritual and ceremonial practices in the 3rd millennium BC. This group includes, among other sites, Szczytna, Sites 5 and 6 (Hozer *et al.* 2017), and Mirocin, Sites 24 and 27 (Machnik *et al.* 2019).

How does the discovery at Orły, Site 4, compare to other CWC burial sites? Drawing on insights from previous 'highway' excavations, it is plausible to consider that the uncovered grave may form part of a larger funerary complex. For instance, the nearby cemetery at Święte, Site 11, has yielded a total of 11 CWC graves (Olszewski and Włodarczak 2018, 9, fig. 2), while a slightly smaller number – nine graves – were found at Święte, Site 15, located less than 1 km away (Janczewski *et al.* 2018, 96, fig. 2). Comparable burial patterns have also emerged from other sites, such as Szczytna, Site 6, and Mirocin, Site 24, where seven and five graves were uncovered, respectively (Hozer *et al.* 2017, 104, fig. 51; Machnik *et al.* 2019, 14, fig. 3).

When discussing the arrangement of CWC cemeteries with niche graves, it is essential to consider the fact that such funerary structures sometimes appeared in association with barrows – either cut into the mounds or situated nearby (*e.g.,* Włodarczak 2006). In the Subcarpathian loess region, this pattern is well-represented at Szczytna, Site 6 (Hozer *et al.* 2017, 104, fig. 51). However, there are also burial sites where no direct evidence of barrows has been recorded, such as at Święte, Site 11 (Olszewski and Włodarczak 2018, 53, 54). Could similar structures have originally existed at Orły, Site 4? Given the minimal scope of excavation work at the site thus far, it is not possible to answer this question at present.

At this point, it is appropriate to focus more closely on the niche grave itself. Burial structures of this type display notable morphological variation at the regional level (Włodarczak 2006; Machnik *et al.* 2009). At Orły, Site 4, the burial niche is well preserved, enabling examination of its constructional details. As previously noted, the niche was filled with dark sediment, interspersed with layers of dislodged yellow loess. At the same time, the entrance pit contained a lighter grey-yellow fill (Fig. 3: 1). The clear boundary between these two layers (indicating the physical separation of the spaces) evokes comparisons with, for example, Grave No. 405A at Święte, Site 15 (Janczewski *et al.* 2018, 102, fig. 7) and Grave No. 360 at Mirocin, Site 27 (Machnik *et al.* 2019, 92, photo 28). Additional parallels can be drawn with other construction details. In both Orły, Site 4, and Mirocin, Sites 24 and 27, Szczytna, Sites 5 and 6, Skołoszów, Site 7, and Święte, Sites 11 and 15, the bottoms of the burial niches were positioned nearly level with the bottoms of the entrance pits, typically just a few centimetres lower, occasionally slightly more. This arrangement suggests a connection between the niches and the entrance pits through a horizontal, or possibly slightly diagonal, corridor (*e.g.*, Hozer *et al.* 2017, 75; Rybicka *et al.* 2017; Janczewski *et al.* 2018; Olszewski and Włodarczak 2018, 55; Machnik *et al.* 2019, 83). Outside the Subcarpathian loess region, this construction trait is also observed in the Sokal Ridge area, part of the western Volhynian Upland (*e.g.*, Machnik *et al.* 2009). The burial feature at Hubinek,

Site 4, stands out in this area as the most comparable to the one at Orły, Site 4, with both sites sharing a similarly domed structure for the niche vaults (Fig. 3: 1; Bagińska 1998, 71, fig. 2: a). In contrast, distinct burial constructions were identified in the Kraków-Sandomierz CWC group, where numerous burial niches were positioned much lower than the bottoms of the entrance pits (*e.g.*, Tunia 1979, 55, fig. 6; 1997, figs 5-7; Włodarczak 2006; Jarosz *et al.* 2009, 184, fig. 11).

The feature No. 15/2023 at Orły, Site 4, belongs to the category of double burials. According to the anthropological analysis, the remains of both individuals were those of men of *Maturus* (?) and *Adultus* age. This is relevant, as in the CWC tradition, men were most often buried in a flexed position on their right side (Włodarczak 2006). In the niche grave in question, Individual No. 1 lay on his right side, while the second lay on his left (Fig. 3: 2-4). The left-side position was characteristic of female burials, although there were some deviations from this pattern, which were not uncommon (Włodarczak 2006). These exceptions occurred when the individuals were buried with their legs facing each other and their faces turned towards the entrance of the niche. If they were of the same sex, the standard orientation rule could not be applied. Arrangements of this kind are known from niche grave No. 4 at Łubcze, Site 25 (Koman 1999, 52, fig. 8). This is exactly the case at Orły, Site 4, where the faces of the individuals were turned east and southeast, directly towards the entrance pit (Fig. 3: 2). The remains of both individuals show no signs of post-mortem manipulation, such as displacement to create additional space within the niche. They are neither disarticulated nor arranged in any form of a stack. This distinguishes them from, for example, the double burial No. 220 at Szczytna, Site 5, where the remains of two male individuals were identified within a slightly larger niche, *i.e.*, 320 × 250 cm (Hozer *et al.* 2017, 22, fig. 11). According to the funerary site's researchers, the disarticulated and repositioned remains may reflect ritual practices (Hozer *et al.* 2017, 24).

The assortment and arrangement of grave goods within the niche construction at Orły, Site 4, follows a pattern typical of the CWC (Włodarczak 2006, 69, 70, figs 38, 39). As previously highlighted, the largest beaker (No. 1) was placed near the lower limbs of Individual No. 1, while the miniature vessel (No. 3) was positioned behind his pelvis. Another beaker (No. 2) was found at the level of Individual No. 2's pelvis (Fig. 3: 2-4). Both S-profiled 'normal-size' vessels (Nos. 1 and 2) morphologically align with the widely represented PIV type of beakers (Machnik 1966, 27, 28; Włodarczak 2006, 14, 223-227, plates 2-5). Due to their specific characteristics (Beaker No. 1) and/or state of preservation (Beaker No. 2), it is, however, not possible to definitively assign them to a more narrowly defined category.

Overall, a relatively large number of IV type beakers have been identified in various niche graves in the Subcarpathian loess region. Among them, the undecorated beaker, distinguished by a distinctly defined base, discovered in burial feature No. 431A at Święte, Site 15, is particularly noteworthy (Janczewski *et al.* 2018, 121, fig. 25: 2). Due to its smaller rim width compared to the maximum belly width and the presence of the mentioned base, it is more similar to Beaker No. 1 (Fig. 4: 1, 2). Additionally, S-profiled beakers with

decorative elements have been identified within the Święte burial complex. For instance, a beaker from Grave No. 751 at Święte, Site 11, features sparsely placed incisions on the neck and upper belly, forming a distinctive herringbone pattern (Olszewski and Włodarczak 2018, 11, fig. 3: 1). In contrast, vessels from Grave No. 173 at Święte, Site 15 (Janczewski *et al.* 2018, 99, fig. 4: 1), and Grave No. 43 at Święte, Site 20 (Dobrakowska and Włodarczak 2018, 148, fig. 6: 1, 2), were adorned with cord impressions. The Type IV beakers were also recorded in the context of niche constructions at Szczytna, Sites 5 and 6 (Hozer *et al.* 2017, 85, fig. 43) and Mirocin, Sites 24 and 27 (Machnik *et al.* 2019, 95, fig. 54). Similar to the cemeteries in Święte, their proportions differ from the beakers identified at Orły, Site 4 (Fig. 4: 1, 2). Some of them, however, were also undecorated. This group is represented, for example, by a small vessel from Grave No. 220 in Szczytna, Site 5 (Hozer *et al.* 2017, 25, fig. 12: 6), as well as relatively slender ones from Grave No. 396 at Mirocin, Site 27 (Machnik *et al.* 2019, 81, fig. 48). Certain types of similarities to Beaker No. 1 can also be observed beyond the Subcarpathian zone, particularly in the Roztocze region. A noteworthy example is the beaker from niche grave No. 7 at Wierszczyca, Site 31, on the Sokal Ridge, which also lacks the characteristic ornamentation of the CWC (Machnik *et al.* 2009, 163, fig. 128: 1).

The third vessel, a miniature beaker (No. 3) (Fig. 4: 4), belongs to a category of forms recorded at other funerary sites within the CWC 'world' (Włodarczak 2006, 243, plate 21). On the Subcarpathian loess plateau, they were discovered, for example, in Grave No. 273 at Mirocin, Site 27 (Machnik *et al.* 2019, 60, fig. 33: 1) and in burial feature No. 220 at Szczytna, Site 5 (Hozer *et al.* 2017, fig. 12: 1, 6). The vessel morphologically most similar to the one under analysis appears to be the small beaker, decorated with uneven, incised vertical lines and vertical incisions, from niche grave No. 173 at Święte, Site 15 (Janczewski *et al.* 2018, 99, fig. 2: 2)

The flint artefacts were found in proximity to the two buried individuals. Both axes and the side scraper were associated with Individual No. 1 (Fig. 4: 2-4). The triangular arrowhead, on the other hand, was located near the pelvis of Individual No. 2. This artefact is probably part of the grave inventory; however, there remains a possibility that the arrowhead may have been the cause of the man's death (Borkowski and Kowalewski 2021). The general stylistic and metric features of the discussed tools are consistent with those of artefacts found in graves attributed to the Corded Ware culture across the Subcarpathian loess region (Libera 2022, 102-110). The set of tools discovered near Individual No. 1 warrants further discussion. Despite their modest number, these tools are notably significant and should be regarded as typical for the warriors of the CWC circle (Włodarczak 2006). Both axes are particularly interesting. The first one, made of Volhynian flint, is trihedral, slightly asymmetric, and stocky. One of its sides was shaped using picotage, which, together with the asymmetry of the sides, gives it a resemblance to a stone battle axe (*cf.*, Machnik 1966; Włodarczak 2006, 27, 28, 245, plate 23; Budziszewski and Włodarczak 2011; Libera 2016; 2022, 103-106). We can assume that it served a similar function. The other axe, made of a sedimentary rock – hornstone or chert – is a tetrahedral specimen,

polished on its entire surface. Such forms are typically found across the Subcarpathian loess region. However, they are rare in other areas, so their presence should be interpreted as part of the local cultural tradition (Libera 2022, figs 47 and 48). It is worth noting that the specimen from Orły was more precisely shaped than similar tools from the region. It was probably an equivalent of a symmetric flint axe.

Recent years have seen an increase in analyses of use-wear traces on flint materials from CWC-associated funerary features. These analyses have primarily been conducted on inventories discovered across the Sandomierz Upland (Winiarska-Kabacińska 2019; Libera and Mączyński 2024) and the eastern Lublin Region (Pyżewicz 2017; Osipowicz 2022). Previously, such analyses had not been performed on artefacts from the Subcarpathian loess region. However, the artefacts from Orły, Site 4, suggest that this could be an interesting research avenue. The elements of the grave goods deposited near Individual No. 1 appear to have been specifically prepared. The flint tools placed beside the buried man (the side scraper and dihedral axe) were 'sharpened' through retouch or edge polishing. These were accompanied by a stone axe that was unsuitable for processing wood due to the material used in its production, suggesting it might have been created specifically as a grave good (Libera 2022, 117, figs 47 and 48).

CHRONOLOGICAL ISSUES

An essential aspect of the present study is chronology. Due to poor preservation of the human remains, which prevented collagen extraction, radiocarbon dating could not be performed on either individual. Consequently, we are unable to determine, at the radiometric level, which of them was interred first. Other factors also preclude such an assessment, particularly the absence of any traces of *postmortem* interventions, such as the displacement of one individual's remains to make room for another. The typochronological characteristics of the grave goods accompanying the buried individuals (Figs 4-6) do not seem to allow for such precise chronological differentiation of burials within the same niche. It is essentially possible only to outline a general time frame for at least one of the burials, based on the radiocarbon date obtained from an animal bone found near the western wall of the niche, behind the pelvis of Individual No. 1 (Fig. 3: 2). This date is FTMC-DV47-6: 3996±36, *i.e.*, 2568 -2470 BC (1σ) and 2624 -2410 BC (2σ), respectively (Fig. 9). Assuming that the animal bone was part of the grave goods associated with this particular *Maturus* (?) man, it is plausible that the obtained date corresponds to the time of his burial. On the other hand, considering the overall spatial organisation within the niche grave (Fig. 3: 2), it may be inferred that both individuals were buried either within a very short time span or at least not significantly apart in time.

The obtained radiocarbon value aligns perfectly with the earlier phase of the nearby cemeteries at Święte, Sites 11 and 15, dated to 2575-2470 BC (Włodarczak 2018, 182). This

is represented, among others, by burial feature No. 431 at Świete, Site 15, in which, as previously mentioned, an unornamented S-profiled beaker was recorded (Janczewski *et al.* 2018, 121, fig. 25: 2). It also relatively matches the results of radiocarbon analyses for the grave at Szczytna, Site 6 (Hozer *et al.* 2017, 108, tab. 5; *cf.*, Włodarczak 2018, 187). However, it is older than the dates, for instance, from Święte, Site 20 (Włodarczak 2018, 180, table 1), and Skołoszów, Site 7 (Rybicka *et al.* 2017, 128, table 2), which fall within the general timeframe of the second phase of the cemeteries at Święte, Sites 11 and 15, *i.e.* 2434-2323 BC and 2454-2338 BC, respectively (Włodarczak 2018, 182). Broadly speaking, it aligns with an earlier stage of the later phase of the CWC, specifically the so-called niche grave phase in Lesser Poland (Włodarczak 2006; 2013; 2016; Jarosz and Włodarczak 2007).

As we have already highlighted, based on the results of 'highway' excavations, it is plausible to consider that the discovered Grave No. 15/2023 may form part of a larger funerary area. Therefore, this is most likely just a small piece of a potentially more complex chronological puzzle, similar to, for example, the cemetery at Święte, Site 11 (Włodarczak 2018, 181-183). These considerations are intriguing, especially in light of the previously discussed issue of the presence of both barrow and non-barrow burial sites in this area. Without resolving which category the Orły, Site 4 cemetery represents, it is impossible to determine whether the examined niche grave is related to the earliest phase of its use or not.

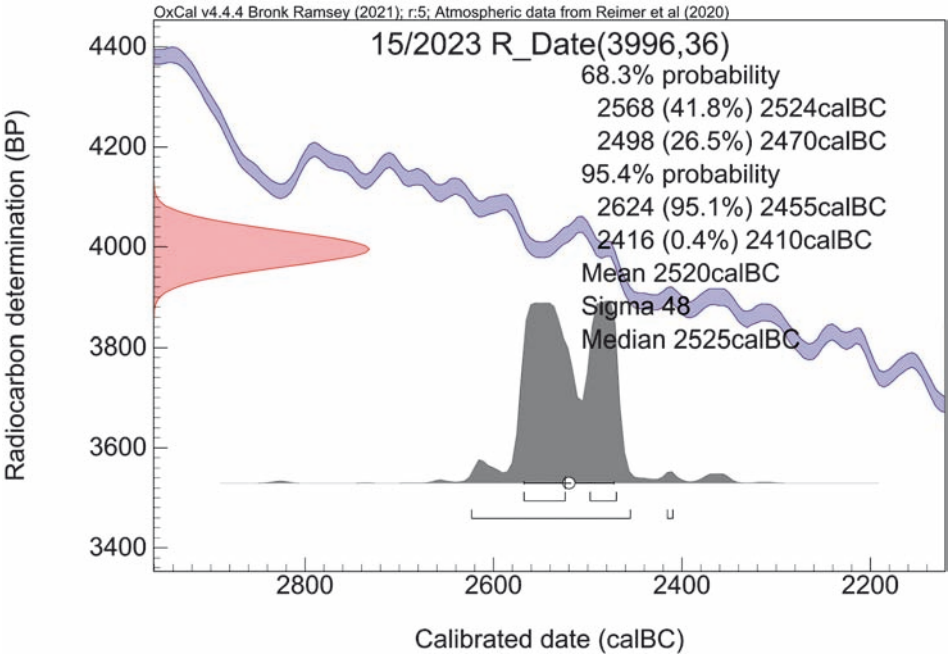

Fig. 9. Orły, Site 4, Przemyśl District.
Probability distribution of radiocarbon date obtained for the niche grave No. 15/2023.
Edited by D. Król

CONCLUSIONS

The cemetery in Orły, Site 4, is another point on the map of the funerary landscape of the Corded Ware culture in the Subcarpathian loess region (Fig. 1). Although the previous small-scale fieldwork has led to the identification of only one niche grave (Fig. 3: 1-4), its quality and research value seem to provide an excellent starting point for initiating broader investigate work. The identification of a well-preserved niche, which has not completely collapsed but only suffered typical (inevitable) wall destruction, provides an opportunity to compare its specifics with those of other burial features from the Subcarpathian loess region, the Sokal Ridge, and the Małopolska Upland. This is a significant added value, considering that many such graves have not survived in good condition, and if they have, they are often explored in a less-than-optimal way due to their intricate structure.

The contents of the discovered burial feature No. 15/2023 are also interesting. It is essentially unprecedented to find exclusively unornamented vessels as grave goods in CWC niche graves. Although the two larger beakers and the miniature vessel (Fig. 4: 1-3) can be broadly compared to similar forms documented in this cultural context, they also exhibit distinctive characteristics. This is especially true for Beaker No. 1 (Fig. 4: 1). Cross-referencing this fact with absolute chronological data raises a legitimate question about the grave's chronological and spatial position within the entire cemetery and beyond. This becomes a significant challenge in the context of the very close proximity to the exceptional ritual complex in Święte (Sites 11, 15, and 20), as well as to the equally important cemetery in Skołoszów (Site 7). It appears that research at Orły, Site 4, could significantly contribute to studies on the 'Subcarpathian' populations of the Final Eneolithic in the 3rd Millennium BC, their intra-group relations, and intercultural connections. It is particularly significant given the fundamental fact that during that period this region functioned as a cultural borderland between Western and Eastern Europe (*e.g.*, Włodarczak and Kośko 2018; Machnik 2019).

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PREHISTORIC AMBER ITEM AT ŽABALJ-NOVE ZEMLJE SITE (VOJVODINA, SERBIA)

ABSTRACT

Furholt K., Groß H., Schröder S., Serbe B., Medović I., Stanković Pešterac T., Riese E., Wilkes F., Medović A. and Furholt M. 2025. Prehistoric amber item at Žabalj-Nove Zemlje site (Vojvodina, Serbia). *Sprawozdania Archeologiczne* 77/2, 355-372.

This study focuses on a newly-discovered, perforated pendant from the Žabalj-Nove Zemlje site in Vojvodina, Serbia. The main settlement structure of this multiperiod site is primarily associated with the Late Neolithic Tisza and Vinča cultures (5400-4500/4450 BCE), where two burned houses were excavated from a total of 204 rectangular building anomalies detected archaeomagnetically. A unique, triangular-shaped and perforated pendant appeared on the top of the daub layer of one of the burned houses. The layer was disturbed in several parts by later pits; thus, the pendant cannot be directly linked to a closed Late Neolithic context. Material analysis, including Scanning Electron Microscopy with Energy-Dispersive X-Ray Spectroscopy (SEM-EDX) and Fourier-Transformed Infrared Spectroscopy (FTIR), confirmed the material to be amber, while excluding other likely options such as beeswax or citrine. The Žabalj amber pendant is contextualised within the local scale and in the broader framework of the Carpathian Basin to gain insight into prehistoric amber use, which was predominant during the Bronze Age. However, this pendant does not typologically fit with Bronze Age amber beads; thus, the possibility exists that it dates to the Neolithic.

Keywords: Amber, pendant, Prehistoric Vojvodina, provenance study, analytical measurement, exchange system

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INTRODUCTION

This paper presents a newly discovered perforated amber pendant from the Žabalj-Nove Zemlje site in southern Bačka, Vojvodina, located in northern Serbia. The site is a multiperiod one, representing the entire Neolithic (Starčevo, Tisza, Vinča pottery styles; 6100/6000-4500/4450 BCE (Borić 2009; Tasić *et al.* 2015; Hofmann *et al.* 2019; Marić and Mirković-Marić 2020; Marić *et al.* 2022). There is also evidence of activity here in the Late Copper Age (Baden; Bulatović and Linden 2017), Late Bronze Age (Dubovac-Žuto Brdo group; 1600/1500-1400/1200 BCE; Molloy *et al.* 2023), Iron Age (Bosut and La Tène periods; Tasić 2004a) and Roman periods (Vilotijević 1965, 31, 32; Medović 1998, 83, 84). The raw material of the pendant was unclear at the time of discovery, as the item was opaque and heavily worn. Based on the initial macroscopic observation, the object's raw material appeared to be amber, but the possibility of petrified beeswax was also considered. Accordingly, this paper focuses on the following questions:

(1) Is the pendant made of amber, a mineral like citrine, or beeswax?

(2) How many known amber finds have been recorded in Vojvodina and the broader context of the Carpathian Basin?

(3) What kinds of amber items are found in the region?

(4) How well does the pendant at Žabalj fit within this general find spectrum?

To answer these questions, we provide details on the archaeological context of the pendant, as well as a morphological description. Moreover, to investigate and identify its raw material, we used Scanning Electron Microscopy (SEM), including Energy-Dispersive X-Ray Spectroscopy (EDX) and Fourier-Transformed Infrared Spectroscopy (FTIR) to determine its elemental composition. A mineral origin could be ruled out after SEM-EDX measurements; the results were then compared to data from amber and beeswax, both acquired from the authors' own samples, as well as relevant literature. Finally, we aim to

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collect and compare known amber finds at the local and regional scales, specifically in the context of the Carpathian Basin, to offer insights into the prehistoric amber exchange system and use patterns.

THE SETTLEMENT SITE OF ŽABALJ-NOVE ZEMLJE

The site is situated on the south bank of the Jegrička River, a right tributary of the Tisza, 4 km northeast of the modern municipality (*opština*) of Žabalj (in Serbian: Жабаљ, in Hungarian: Zsablya) (Fig. 1). It was discovered in 1958 by Šandor Nađ and Bogdan Brukner. The first reconnaissance of the terrain was conducted in 1965 by Olga Brukner and Predrag Medović. Surface finds on the highest part of the Žabalj-Nove Zemlje site indicate traces of several prehistoric settlements with both vertical and horizontal stratigraphy. The most numerous finds were from the Neolithic period. It was discovered that this site represents the southernmost manifestation of the Tisza culture in Vojvodina and the first such site in the territory of Eastern Bačka (Medović 1998, 83, 84). The first preventative

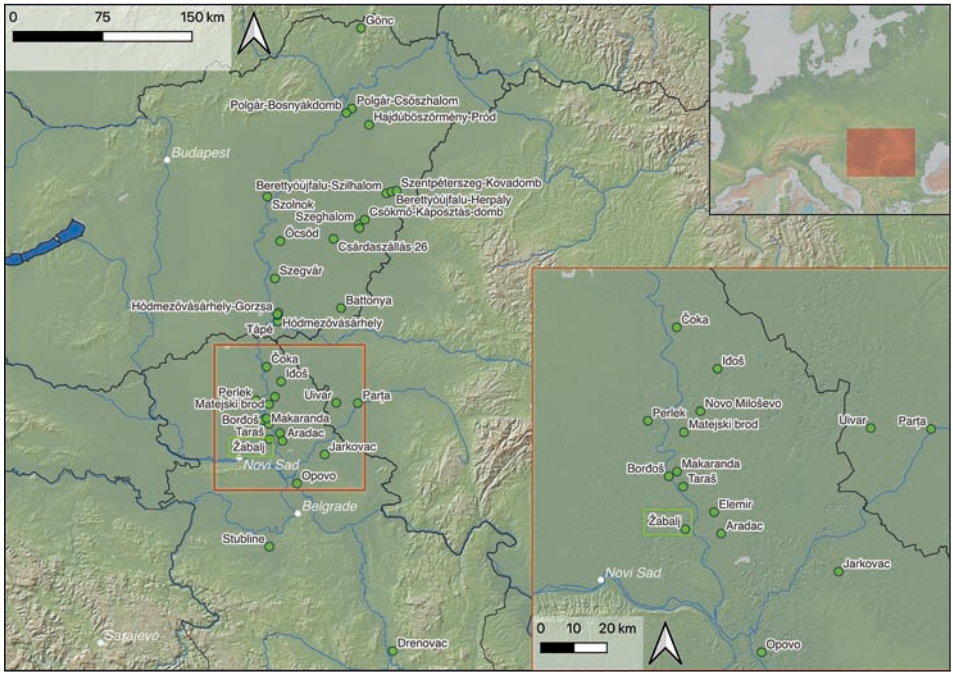

Fig. 1. The location of site Žabalj-Nove Zemlje (marked with a green rectangular frame) alongside other Tisza-Vinča tell and tell-like settlements (green dots) in the Carpathian Basin, as well as modern larger populated cities (white dots with white italic fonts). (Basic map: Global Multi-Resolution Topography (GMRT) Synthesis, source: https://www.gmrt.org/services/mapserver/wms_merc?, EPSG: 3857, made by Kata Furholt)

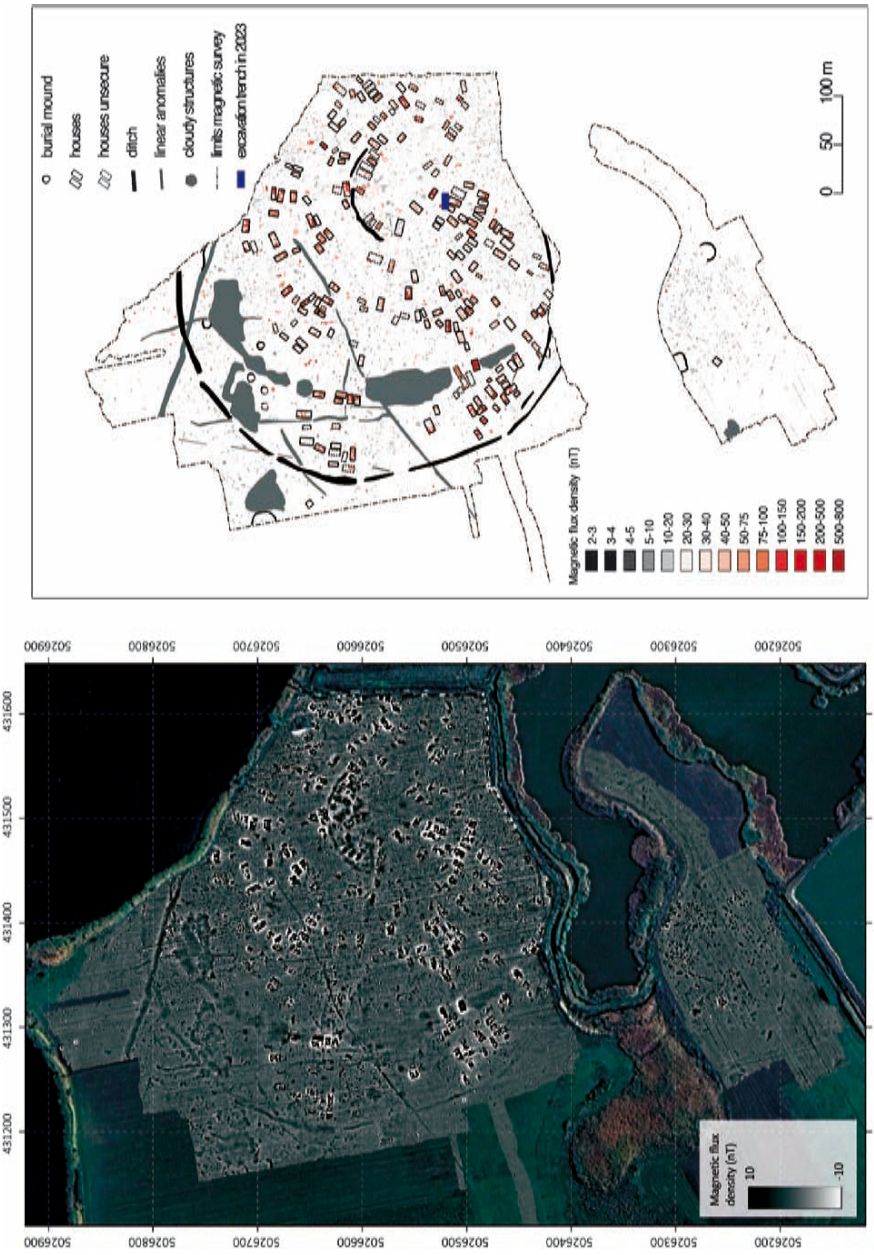

Fig. 2. Plan of the archaeomagnetic survey at Žabalj-Nove Zemlje (left side) and its interpretative plan with the excavation trench in 2023 (modified after Hofmann *et al*. 2025, 129, fig. 4, 131, fig. 5, made by Kata Furholt)

excavations at the site were carried out in 1965. During this time, an area of about 100 m² was examined. The first trench was placed in the most prominent part of the settlement to identify the stratigraphical correlation of the Neolithic cultural layers, while the second trench aimed to determine the extent of the settlement along the Jegrička River. During the excavations, no settlement remains were found except for a small part of a disturbed house floor at the periphery of the settlement and a fragment of a hearth. The conclusion after the excavations was that two settlements were formed at this location during the Late Neolithic: an Early Vinča (Vinča A) culture settlement and a classic Tisza (Tisza II) culture settlement (Vilotijević 1965). In the broader area of the settlement, smaller numbers of pottery fragments were discovered, associated with the Starčevo pottery style, the Middle and Late Bronze Age (Dubovac-Žuto Brdo and Gava-Belegiš), the La Tène, and the Medieval periods. Only a brief report and drawings of the diagnostic finds from the excavations are available, which have been stored at the City Museum of Novi Sad (Novi Sad, Serbia; in Serbian: Muzej grada Novog Sada).

The site was recently investigated through a geomagnetic survey and systematic field walking between 2018 and 2022 (Hofmann *et al.* 2025, 128-131), followed by drillings and small trench excavation carried out in the autumn of 2023. The field project was part of an international collaborative research effort involving Kiel University (Kiel, Germany; in German: Christian-Albrechts Universität zu Kiel), the Museum of Vojvodina (Novi Sad, Serbia; in Serbian: Muzej Vojvodine) and National Museum Zrenjanin (Zrenjanin, Serbia; in Serbian: Narodni muzej Zrenjanin). The geomagnetic prospection revealed a complex settlement structure featuring two circular ditches and numerous burned house anomalies spanning over 20 ha. The layout and orientation of the burned houses indicate several phases of the settlement, which will be studied further in the near future. The surveyed area measures 18.5 ha, and the reconstructed settlement covers approximately 15.6 ha (Hofmann *et al.* 2025, 126, table 1, 128-130, figs 3-5) (Fig. 2). The Jegrička River served as a natural border that limited the geomagnetic survey, as the northeastern and southern parts of the site are submerged. The recent modification to the channel path has likely caused flooding, potentially destroying parts of the site. The southern part of the surveyed area did not reveal specific structures, so we can assume that settlement activity ended at the southern edge of the large circular ditch. The main prospected area shows a very dense settlement structure. There is one primary linear anomaly that encircles the settlement and is interrupted at several points. We interpret this anomaly as an enclosure ditch around the settlement, as we see similar settlement layouts along the Tisza River and in the Balkans (*e.g.*, Szegvár, Hódmezővásárhely-Kökénydomb, Borđoš, Belovode, Opovo, Oreskovica, *etc.*) (Borić *et al.* 2018; Hofmann *et al.* 2019; Rassmann *et al.* 2021; Raczky *et al.* 2024; 2025). There is another ditch fragment in the centre of the eastern part of the prospected area, which also exhibits a circular shape. However, only a tiny part of it is visible. A total of 204 rectangular anomalies can be identified as burned houses (Fig. 2). All are located within the main ditch, with the majority concentrated in the southern and

eastern areas. The centre of the settlement might be located in the eastern section of the prospected area, as indicated by 10 burnt houses arranged radially and a small segment of a ditch to the north of the houses. An intact area exists in the centre of the settlement, a common feature of the enclosed and burned-house layout of the Late Neolithic period. The structures are not completely symmetrical, though there is no visible overlapping or superposition. In general, the dimensions of the houses range from 8 to 10 m in length and 5 to 6 m in width (Fig. 2).

A systematic field-walking activity using a 50 × 50 meter grid system was conducted in 2022, 2023, and 2024. A large number of ceramic, stone, and bone finds were recorded. The finds belong to cultures already known at this site. The dominant material dates to the Late Neolithic period. The highest concentration of finds was recorded in the eastern half of the investigated area. The rich assemblage of anthropomorphic figurines, including a two-headed anthropomorphic figure with two faces (Medović *et al.* 2025), a miniature figurine, an anthropomorphic protome, aryballoi, and other ceramic objects, characterises the Vinča-Tordoš pottery style. The number of vessels of the Tisza pottery style is represented in much smaller quantities, concentrated in the northeastern part of the settlement, closer to the Jegrička River.

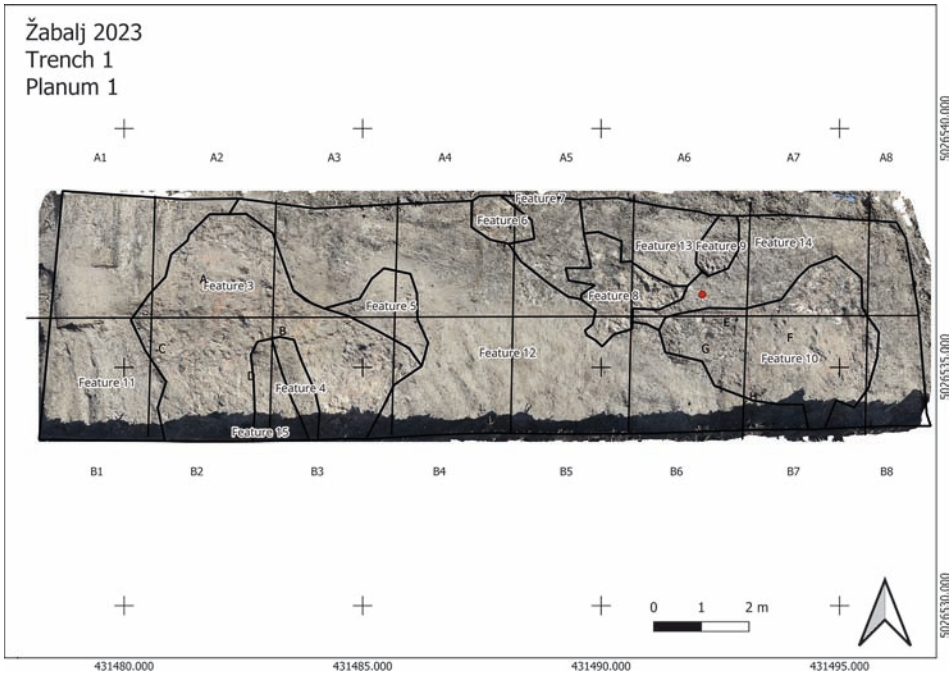

Fig. 3. The photogrammetry of the first excavated layer (Planum 1), the red point indicates the location where the amber item was discovered (level/spit 2) (made by Erik Riese)

In October 2023, a small trench excavation measuring 18 by 5 meters and oriented east-west was conducted at the proposed centre of the settlement (see the right side of Figure 2, marked with a blue rectangle). The trench was placed where two identifiable burned houses were probably situated near each other, and these were arranged towards an open area with no visible archaeological anomalies in the core settlement area. These burned houses (the western house is Feature 17 and the eastern house is Feature 22) align in a northeast-southwest direction and are part of the radially arranged house accumulation positioned towards the inner, smaller circular ditch. Based on radiocarbon dating, the Late Neolithic site was settled between 5060 and 4830 cal. BCE.

The amber pendant discussed in this text was discovered in Feature 14, which is identified as a feature in Planum 1, located in the eastern part of the excavated area. Feature 14 is bordered by Feature 9 to the northwest, Feature 8 to the west, and Feature 10 to the southwest (Fig. 3). The area of Feature 14 was documented in Planum 2 as Features 22, 26, 28, 30 and 31, from which Feature 22 is identified as the eastern house based on its heavily burned daub structure, which was scattered across A4-A8; B5-B8 quadrats (excavation grid units; Figs 3 and 4). Features 26, 28 and 30 were pits that cut the eastern house (Feature 22). Feature 31 is a mixture of burned daub and soil, which is also related to the eastern

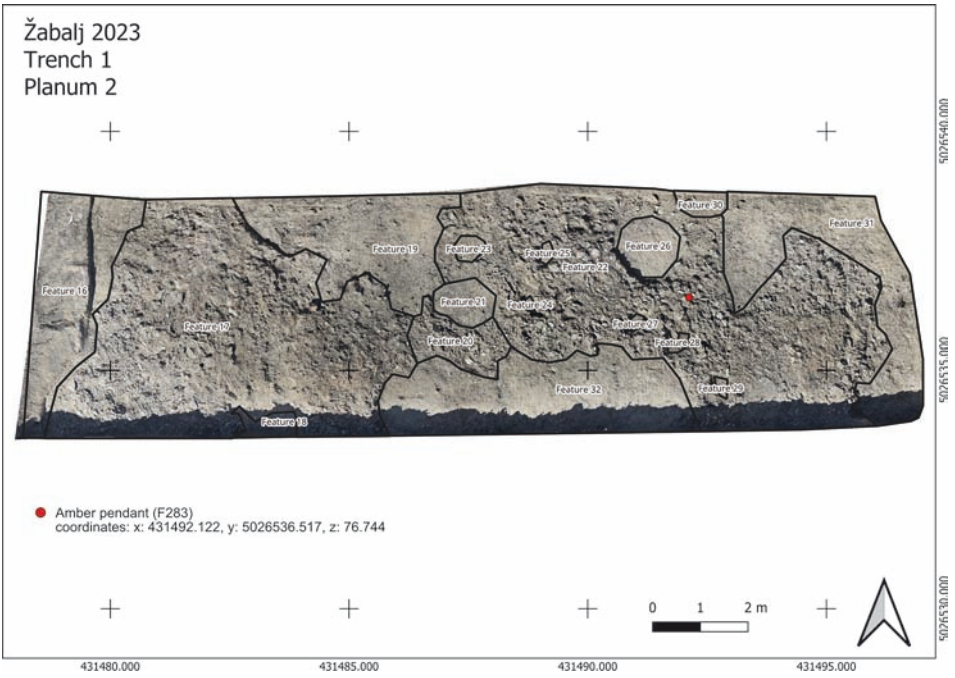

Fig. 4. The photogrammetry of the second excavated layer (Planum 2, the red point indicates the location where the amber item was discovered (level/spit 2), with its coordinates (made by Erik Riese)

house. This eastern house exhibits evidence of intensive disturbance, as several pits (Features 21, 26, 32, 37, and 42; see Fig. 4) show superposition and cut entirely through the house structure. The amber item was discovered in the second level/spit of quadrat A6, underneath Feature 14 (Planum 1) and above Feature 22 (Planum 2) in the daub structure of the eastern house. This means that the amber item did not come from a securely closed archaeological context but from the top of the burned daub structure of the Late Neolithic eastern house. The pendant item is registered as F283 (Find ID) and measured as a single find.

MATERIAL AND METHODS

The amber pendant

The object is made of a homogeneous, semi-transparent material in an orange-brown to honey-brown colour. The surface is carefully polished and heavily worn, as evidenced by the waxy, shiny edges. The item has a triangular shape (equilateral triangle); two sides are longer, and the acute angle is where the item was perforated. The third side is slightly

Fig. 5. The perforated pendant from the front, back and side views (made by Anna Sara Jagiolla)

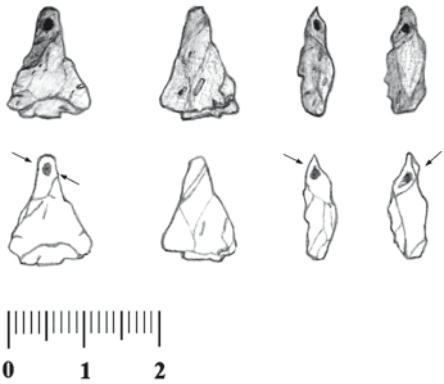

Fig. 6. The drawings of the perforated pendant (made by Finn Hülbrock)

curved and shows multiple minor areas of damage, which are worn and covered with a waxy, shiny surface. The middle part of the item is thicker than the perforated part and the curved bottom side. The perforation was made in a transverse direction, approximately 1 mm in diameter (Figs 5 and 6). The maximum length is 14.92 mm, the mesial width is 6.31 mm, and the thickness in the mesial part is 4.3 mm. The upper part with the perforation is 3.78 mm wide, while the bottom with the curved side measures 10.92 mm. The total weight is 0.6 grams.

Applied material measurement

To investigate and identify the material of the pendant, Scanning Electron Microscopy (hereinafter SEM), including Energy-Dispersive X-Ray Spectroscopy (hereinafter EDX), as well as Fourier-Transformed Infrared Spectroscopy (hereinafter FTIR), have been applied. The former is used to analyse the specific element composition and to rule out a possible mineral origin (*i.e.*, quartz or citrine). The latter is used to identify organic content, such as amber, to compare the object with previously investigated amber samples and to exclude the possibility that the object is composed of beeswax.

SEM-EDX measurements were performed in a Zeiss Gemini Ultra 55 with an Oxford Instruments EDX detector. The sample was used as-is, placed on an aluminium holder with a carbon adhesive pad and contacted with copper tape to reduce surface charging effects.

FTIR investigations were carried out on a Bruker Invenio R in total reflection mode (ATR). The required sample material was scraped from the bottom of the pendant, and the resulting powder was placed and measured in a stainless steel 2 × 2 mm holder. Three measurements were performed in total, and the resulting data were consecutively processed to compensate for atmospheric contaminants (H_2O, CO_2).

RESULTS

Elemental Composition

The elemental composition was determined via SEM-EDX over 14 data points (DP). Element detections below 1 atom percent (at%) are excluded due to being within the method's uncertainty (Table 1).

EDX was primarily performed to exclude the possibility of the object being quartz or its yellow variety citrine. These would be comprised of SiO_2, with citrine including Fe or Fe oxides. The respective elements could not be found in sufficient amounts. Traces of Al may originate from the sample holder, while other trace elements, such as Si and Ca, are commonly found in objects that have been in contact with soil. The source of P is unknown.

Table 1. Summary of EDX point measurements on the pendant, taken at data points 1-14. Results are given in at%. Elements detected below 1 at% are excluded, and values are rounded to whole numbers. Trace elements of Al, Si, P and Ca were found regularly, with a single data point further including K. An averaged composition of the object is given in the last column

Element/ DP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Ø
C	27	29	33	26	33	52	13	26	30	28	47	22	40	29	**31**
O	60	59	57	63	56	42	60	59	56	58	44	62	49	57	**56**
Al							6	2	3	3	2		2	2	**2**
Si							13	4	5	5	2	23	2	3	**3**
P	5	5	4	5	4	2	1	3	2	2	1	4	3	3	**3**
K							2								
Ca	7	7	5	6	6	3	2	4	3	3	3	6	4	5	**5**

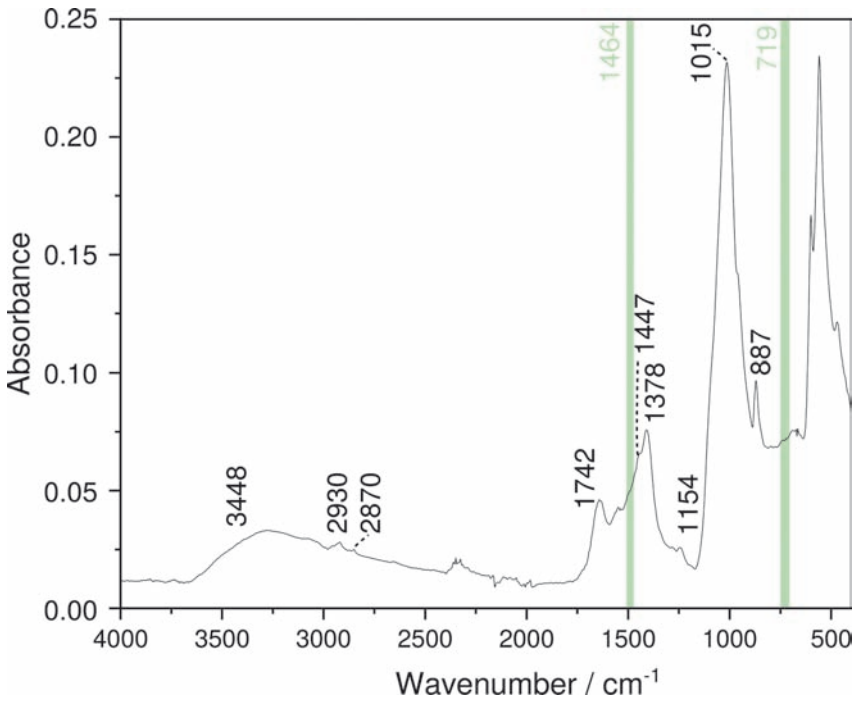

Fig. 7. FTIR spectrum of the pendant, averaged over 64 measurements and subsequently processed to compensate for the atmospheric contaminants.

Indexed bands correspond to: C-O stretches at 887 and 1154 cm^{-1}, C-OH stretch at 1015 cm^{-1}, C-H in-plane scissoring (bending) stretches at 1378 cm^{-1} and 1447 cm^{-1}, C=O stretch at 1742 cm^{-1}, C-H sp^3 hybrid stretches at 2870 and 2930 cm^{-1}, as well as the O-H stretch at ~ 3448 cm^{-1}. All of these correspond well to amber (Saleem 2023). Additional bands at ~700 cm^{-1} and ~2300 cm^{-1} stem from residual atmospheric CO_2. Bands at 719 cm^{-1} and 1464 cm^{-1}, marked in green, correspond to significant positions for beeswax (Chatzipanagis *et al.* 2024) (made by Stefan Schröder and Hendrik Groß)

FTIR spectroscopy

Previous work on (Baltic) amber (Saleem 2023) indicates that the central peaks identifying amber are at 887, 1015, 1154, 1378, 1447, 1742, 2870, 2930 and 3448 cm^{-1}, respectively (see indexed bands in Fig. 7). All of those, except one at 3448 cm^{-1}, are clearly present, giving a strong indication that the object is comprised of amber. The missing peak at 3448 cm^{-1} may be included within the broad peak between 3000 and 3500 cm^{-1}. An additional peak at ~2300 cm^{-1} and ~700 cm^{-1} stems from residual CO2 in the measurement atmosphere.

According to the literature, Chatzipanagis *et al.* (2024) found that beeswax shows significant peaks at 719, 1170, 1464, 1740, 2856, and 2922 cm^{-1}. Most of these overlap with peaks corresponding to amber. However, two peaks at 719 cm^{-1} and 1464 cm^{-1} are exclusive to beeswax and distinguishable from those of amber. In the object, both are present (green markers in Fig. 7), albeit barely identifiable, indicating that the sample is amber rather than beeswax. This is further supported by the high intensity of the peak at 1742 cm^{-1}, indicating a strong presence of carbonylic groups. This corresponds well with the composition of amber, mainly including succinine (Mills *et al.* 1985), which exhibits two carbonylic groups. In beeswax (myricyl palmitate), the long C-H backbone would constitute the majority of the signal and suppress the signal of the carbonylic group.

DISCUSSION

The applied SEM-EDX and FTIR spectroscopy confirmed that the pendant was made of amber, allowing us to rule out the possibility that it was either beeswax or citrine. The next step in the research is to collect additional prehistoric amber items in Vojvodina and, on a much broader scale, across the Carpathian Basin, to contextualise the Žabalj amber pendant. Amber items have been discovered in the archaeological materials of the Carpathian Basin dating to the Bronze Age (2700/2500-900/750 BCE) (Bouzek 1993; 141-144; Barta 2001; Gogâltan 2017; Staniuk 2021, Jaeger *et al.* 2023; Molloy *et al.* 2023).

The first appearance of amber is uneven across the Carpathian Basin. In some regions, the emergence of amber items dates to the Early Bronze Age, 2700/2500-2000/1900 BCE, and some of them to the Middle Bronze Age, 2000/1900-1600/1450 BCE (Jaeger *et al.* 2023; 2024; Ljuština 2019a; Staniuk 2021; Gogâltan 2016). The number of Early Bronze Age amber finds is very low; only Gligoreşti from Romania, HornýJatov from Slovakia, Csepreg, Budakalász, Százhalombatta and Szigetszentmiklós from Hungary were recorded (Gogâltan 2016, 147, fig. 2; Jaeger *et al.* 2024; Serbe 2024; 2025; Fig. 8).

During the Middle Bronze Age, the number of amber items increased, primarily found in the Danube and Tisza River Valleys and further south in the Drina and West Morava River Valleys (Belotić-Šumar, Bela Crkva-Cerik Bandera, Banjevac-Jovanin Breg, Brezjak-

Paulje, Vranjani-Veliki Lug and Jančići-Ravnine) (Palavestra 1993, 289, 290; Gogâltan 2016, 150, fig. 5; Jaeger 2016; Ljuština 2019a, 88; Serbe 2024; Fig. 8).

The distribution of amber finds shows a more scattered and non-clustered pattern in the Late Bronze Age (1600/1450-1000/900 BCE) (Molloy *et al.* 2023; Bruyčre *et al.* 2024), which is related to the smaller tributaries of the Danube (Hron/Garam, Váh/Vág) and the Tisza Rivers (Bodrog, Hernád/Hornád, Zagyva, Körös, Maros/Mureş, Bega/Begej, Timiş/Tamiš), in the foothill region of the Southern Carpathian Mountains and the Banat region in Vojvodina (Palavestra 1993, 289, 290; 2006, 32-40; Gogâltan 2016; Ljuština 2019a; 2022; Serbe 2024) (Fig. 8). It is worth mentioning regarding the chronology of Serbian territory that Nikola Tasić emphasised how difficult it is to clearly describe the distinction between the Middle and Late Bronze Ages in Vojvodina, particularly along the Tisza and Danube rivers, where strong influences are visible in the material culture, indicating interregional connections (Tasić 2004b, 28-30). The peak of the distribution of amber finds in the Carpathian Basin is dated to approximately 2000/1900 and 1600/1500 BCE, a period that is displayed in multi-layered settlements and necropolises with burial mounds (Brukner *et al.* 1974; Falkenstein 1998; Tasić 2004b; Ljuština 2022; Molloy *et al.* 2023).

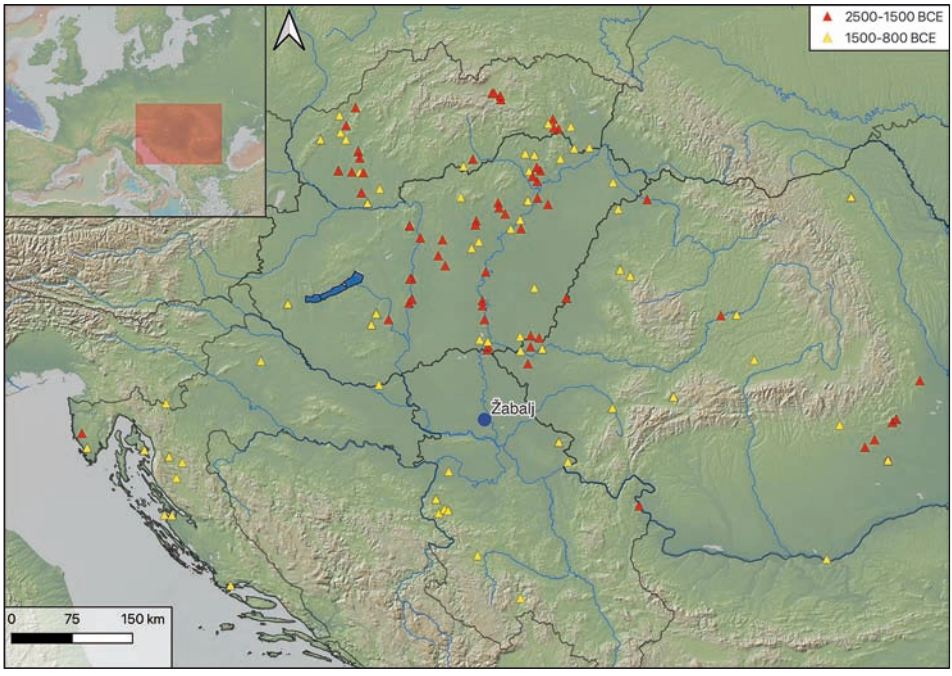

Fig. 8. Bronze Age amber finds in the Carpathian Basin and its surrounding area (made by Kata Furholt based on Gogâltan 2016, 152, fig. 6, 157, fig. 12; Ljuština 2019a, 88; Serbe 2024)

The vast majority of the Bronze Age amber finds were discovered as grave goods and hoards. The grave items, without exception, are essentially solely part of jewellery; the various kinds of beads were probably components of necklaces or armlets, although some might have served as clothing ornaments. In the case of cremations, we do not have information about the use of amber beads, which are often heavily damaged by fire, despite being placed in the urns. The common characteristic of these amber beads is the distinct circular perforations, which are often relatively large compared to the overall size of a bead. Their forms are diverse, like spherical, conical, biconical, prismatic, tabular, and flat cylindrical (Ljuština 2019b; 2020). In most cases, these beads are carefully polished, providing a nice shiny surface for these items. However, some of them have an amorphous shape and a rough, unpolished surface (*e.g.*, several perforated amber beads from the Jovanin Breg site in Banjevac) (Palavestra and Krstić 2006, 289, 290; Ljuština 2019a, 91, fig. 5).

The other groups of amber finds stem from Late Bronze Age hoards, but actually only one is known from Vršac-Majdan in the Serbian Banat (Ljuština 2019a). However, it is worth noting that altogether 18 hoards are known from the Carpathian Basin, dating to around 1600 BCE or later. The hoard from Vršac-Majdan contains 45 pieces of roughly polished amber beads as part of a necklace; many beads have biconical, flat-cylindrical, prismatic, elongated biconical, and amorphous forms. In 2008, a single small globular amber bead was discovered from a settlement pit context at the Banatski Dvor site, the neighbouring village of Žabalj (Ljuština 2019a, 97, 98).

Amber pendants – defined as objects with clearly off-centred perforation – have not until now been recorded for the Bronze Age in the Carpathian Basin. Mateusz Jaeger has noted typological and technological differences between Middle and Late Bronze Age amber beads in the Hungarian archaeological context, particularly that the later ones were produced using a more elaborate technique and displayed sophisticated forms such as cylinder beads with sharp edges and truncated biconical beads (Jaeger *et al.* 2023).

During the Middle and Late Bronze Age, a Baltic amber exchange system connected the North European region with the Balkans (Serbe in 2025, 211-215), integrating external influences into local traditions (Czebreszuk 2007; 2011; Jaeger *et al.* 2023). Chemical analyses have confirmed that most amber items in present-day Hungary (Jaeger 2016; Jaeger *et al.* 2023) and some amber beads from the Serbian sites (Ljuština 2019b; 2020) originated from the Baltic region, specifically the southern shores of the Baltic Sea. There is a Romanian amber variant called Romanite or Rumanite, which is chemically very similar to the Baltic amber (it is thermally altered succinite) (Stout *et al.* 2000; Teodor *et al.* 2009). The only difference between them is related to thermal alteration rather than botanical origin (Stout et al. 2000). Rumanite often exhibits a wide range of colours from light yellow to dark reddish brown. The core area of the original raw material source is in regions of Buzău and Colți in the historical region of Muntenia (often called Greater Wallachia), located between the Danube and the South Carpathians (Stout *et al.* 2000, 666). The Romanian amber type and its Southern Carpathian geological sources, which were distributed

towards Moldavia, Transylvania and probably other regions along the tributaries of the Danube and Maros/Mureş Rivers, have not yet been integrated into the common archaeological knowledge as a potential raw material (Stout *et al.* 2000, 665, 666, 676).

After an overview of Bronze Age amber finds in the Carpathian Basin, we can conclude that the Žabalj amber pendant does not align with the morphology of regional Bronze Age amber objects. It appears to be a raw piece that was polished and perforated for use as an ornament or a component of a necklace. The rarity of amber finds in Vojvodina, coupled with the fact that the Žabalj amber pendant is unlike Bronze Age amber beads, and amber pendants are not recorded in the Carpathian Basin. In addition to its discovery on top of a Late Neolithic burned house, this raises the possibility that the pendant is of Neolithic origin.

Further analytical studies are currently underway to identify the source of this amber pendant, including comparisons with potentially traded Baltic amber samples and more regional examples such as Simetite from Sicily and Rumenite from the southeastern Carpathian. The research focuses on determining a potential connection between northern Baltic amber and the source areas of eastern Romanian amber, as well as the distributed communities.

CONCLUSION

The discovery of a perforated amber pendant at the Žabalj-Nove Zemlje site in Vojvodina offers an outstanding opportunity to examine the significance of the socio-economic, temporal, and ritual dimensions of prehistoric amber use in the southern Carpathian Basin. According to the analytical measurements, including SEM-EDX and FTIR spectroscopy, the pendant was confirmed to be comprised of amber, ruling out alternative materials such as beeswax. Unfortunately, the Žabalj amber pendant was not uncovered from a securely closed archaeological context, which could have provided absolute chronological information about its date. Although the pendant is likely related to a Late Neolithic burnt house, we cannot completely rule out the possibility of younger (*e.g.*, Bronze Age) disturbances (pits which cut through the Late Neolithic house). The typological and contextual characterisation of the Bronze Age amber finds in the Carpathian Basin has identified general characteristics; however, the Žabalj pendant does not fit into this spectrum of amber beads, and the possibility that it dates back to the Neolithic remains valid. The Banatski Dvor and Vršac-Majdan sites are the only ones in Vojvodina where amber beads have been published, while more than a hundred sites with amber items are known in the Carpathian Basin. Most of the compared, typologically distinct Bronze Age beads were made of Baltic amber, which could explain the high degree of formal similarity. Some recent analytical studies have better defined Romanian amber and its archaeological use in the historical region of Muntenia, opening the possibility of identifying eastern connections between Bačka, Vojvodina, the Lower Danube, and the South Carpathian Mountain regions. The

Žabalj amber pendant requires further chemical analysis to determine its geological origin, which might assist in its chronological determination. This further provenance analysis could significantly expand our current knowledge of the early amber exchange system and the role of amber in the symbolic, economic, and social systems of prehistoric communities in Vojvodina.

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THE KRYSPINÓW TYPE STATERS

ABSTRACT

Bochnak T., Bul Ł. and Klisińska-Kopacz A. 2025. The Kryspinów Type Staters. *Sprawozdania Archeologiczne* 77/2, 373-399.

This article examines the type of Celtic coins known as Kryspinów type staters, represented by five known specimens. It provides an archaeological context, highlighting a complex cultural landscape of communities coexisting in the milieu of the La Tène tradition. The Kryspinów type is identified as a local issue, attributed to the Tyniec Group, yet primarily circulating among the population associated with the Przeworsk culture. The paper also presents the results of XRF analysis conducted on two specimens. The iconography of the type, which combines motifs borrowed from shell staters of the Boii and Republican denarii, is discussed, with three classes distinguished based on variations in the reverse design.

Keywords: Kryspinów type staters, Celtic numismatics, Celtic coin finds, Tyniec Group, Przeworsk culture, XRF analysis

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HISTORY AND STATE OF RESEARCH

Among the first coins minted in today's Poland is a relatively uniform group of Celtic staters, referred to in the literature as the Kryspinów/BN 8743 type, or simply as the Kryspinów type. The first recorded example of a coin of the type discussed here came from the collection of Félicien de Saulcy (Robert 1868, 424, no. 1; *ibidem*, 425), along with another one issued in the territory of present-day Poland – a stater of the Late Kraków type (Robert 1868, 424, no. 2; *ibidem*, 425). The former coin was attributed by P. Ch. Robert to the Belgic tribe of the Menapii, naming Utrecht as the findspot, although this information may be considered unreliable (Roymans and Van der Sanden 1980, 184, 246; Rudnicki 2012, 67-68). Robert challenged F. Streber's interpretation of shell staters, from which the Kryspinów type derives, as cult objects (Streber 1862, 158, 159 [704, 705]). Ultimately rejecting their purported religious significance, he described the obverse of the stater belonging to Félicien de Saulcy as 'perhaps a fish', resembling the issues of the Morini or Ambiani, and reverse as an indistinct depiction of a ship. The coin later became part of the collection of Bibliothèque nationale de France (BnF 8743, Catalogue no. 5, Fig. 1: 5). In 1889, E. Muret and A. Chabouillet listed it in a catalogue of 'Gallic' coins in the collection, repeating in a brief description the interpretation of the obverse and reverse proposed by P. Ch. Robert (Muret and Chabouillet 1889, 201, no. 8743). Three years later, the stater appeared in H. de La Tour's 'Atlas de Monnaies Gauloises' (de La Tour 1892, pl. 35, no. 8743). The design of both coins attributed to P. Ch. Robert to the Menapii, including the stater BnF 8743, was described by A. Blanchet (1905, 475) as a deformed 'Regenbogenschüsselchen'. He regarded them as supporting the theory of a Celtic presence on the left bank of the Rhine all the way to the sea, in the time preceding the arrival of Ariovistus. Later, R. Duval (1949, 92) acknowledged that the alleged findspot is not, in itself, sufficient to attribute the coin to the Menapii. Instead, the staters included in his study were considered as a means of identifying the type of ships that might have sailed the Danube and Rhine before the Roman conquest. He interpreted the crescent shape in the lower part of the reverse as a relatively long hull of a boat, devoid of rudder, oars, or main mast. Lines and pellets above the crescent were described as either figures or, in the case of pellets, stars.

Another specimen of one of these staters was excavated in 1995 in the upper layers of a shallow hut (Feature 108), located in the Przeworsk culture settlement in Kryspinów (Catalogue no. 4; Fig. 1: 4). The pottery assemblage from the hut indicates its use in the early Roman period (1st century AD in the absolute chronology), but it also included three fragments of the earlier painted ware of the Tyniec Group. P. Kaczanowski interpreted the presence of the stater alongside the painted ware as evidence of the continued use of products characteristic of the Tyniec Group during the early phase of the Roman period. This implied that the coin, assumed to have been minted around the middle of the 1st century BC, remained in circulation for a long time (Kaczanowski 1996; 1997). P. Kaczanowski attributed

Fig. 1. Kryspinów type staters. 1 – environs of Busko-Zdrój, photo Piotr Adamkiewicz archive; 2 – Charbinowice, Kazimierza Wielka County, photo Tomasz Bochnak; 3 – Orłowiny, Opatów County, Piotr Morawski, Łukasz Bul archive; 4 – Kryspinów, Kraków County, photo Tomasz Bochnak; 5 – Utrecht (uncertain), photo Bibliothèque nationale de France

the stater to the Kraków type, while highlighting the differences between the specimen from Kryspinów and the known coins of the Kraków type, treated as a 'non-homogeneous' group derived from shell staters (Kaczanowski 1996, 128, 129). He surmised that the obverse may depict a fantastic animal and described the motif above the left tip of the crescent on the reverse as a standing figure, with individual details presumably representing a teardrop-shaped head, torso, belt, and legs (Kaczanowski 1996, 128). The attribution of the coin to the Kraków type was rejected by M. Rudnicki (2012, 3, 16) and M. and M. Andrałojć (2012, 49, 50, fn. 36) on grounds of differences in iconography. M. Rudnicki included the coin in the 'Lesser Poland Group' consisting of several local Celtic coinages (Rudnicki 2012, 46, 47). He also pointed out that the BnF 8743 stater and the coin from Kryspinów belong to the same type (Rudnicki 2012, 67). M. and M. Andrałojć considered the prototype of the obverse of both staters to have been a coin depicting the head of the goddess Histiaia (Andrałojć and Andrałojć 2014, 73, 74, 103). They also postulated that the reverses were designed to display an 'illusory composition' of two different images, each revealing itself when the coin is oriented in a specific way. One of the images was allegedly borrowed from ¼ staters of the 'au bateau' series from *Gallia Belgica*, and depicted a ship. At the same time, the other was said to be based on the stater fractions of the Boii, with Athena Alkis standing to the left, holding a spear in her right hand and shield in the left (Andrałojć and Andrałojć 2014, 72, 73, 84, 85, 95, 96, 103). In turn, Ł. Bul has identified Roman Republican denarii depicting a biga as a secondary prototype of the reverse of the BnF 8743 stater, the primary one being a shell stater of the Boii (Bul 2022, 48). The specimen from Kryspinów was described by M. Grygiel and A. Kędzierski as resembling the Kraków type, but lacking some of its features, and they regarded it as perhaps an 'unfinished coin' (Grygiel and Kędzierski 2023, 9).

In 2024, three further staters came to light. The first one (Pazowska 2024, *passim*), found before 2020 in the environs of Busko Zdrój, comes from the archive of the late Piotr Adamkiewicz (Catalogue no. 1; Fig. 1: 1). The second coin (Catalogue no. 2; Fig. 1: 2) was discovered in 2021 by Jan Bulas and Magdalena Okońska in Charbinowice (Bulas and Okońska-Bulas 2024, *passim*). The third one was discovered by Kamil Bilski from the 'Wspólne Dziedzictwo' association in Orłowiny (Fig. 1: 3, Catalogue no. 3) during a field-walking survey using a metal detector. The coin was handed over to Marek Florek at the Sandomierz branch of the Provincial Heritage Protection Office (WUOZ) in Kielce. It is now part of the collection of Muzeum Zamkowe w Sandomierzu. A findspot is known for four of the five coins, which is a relatively high ratio compared to other local types.

Major Celtic minting activity in the present-day territory of Poland, excluding an earlier episode in the settlement at Nowa Cerekwia, Głubczyce County (Rudnicki 2014, 49), most likely began in the 30s BC or later and continued into the first half of the 1st century AD (Bul 2022, 47, 49; Bul, forthcoming). While the dates of the Roman Republican prototypes discussed below fall between 142 and 82 BC, the inflow and use of Roman Republican denarii within the European Barbaricum can often be associated with later periods

(Dymowski 2016, 99-124). Moreover, Roman Republican denarii have been found together with late Celtic coins in several settlements (Dymowski 2016, 80-82). The analysed specimens weigh between 6.72 and 4.9 g, consistent with the Kraków series. The heaviest coin of the Early Kraków type weighs 6.89 g (Bul 2022, 57, Cat. 1.1), while the lightest, an

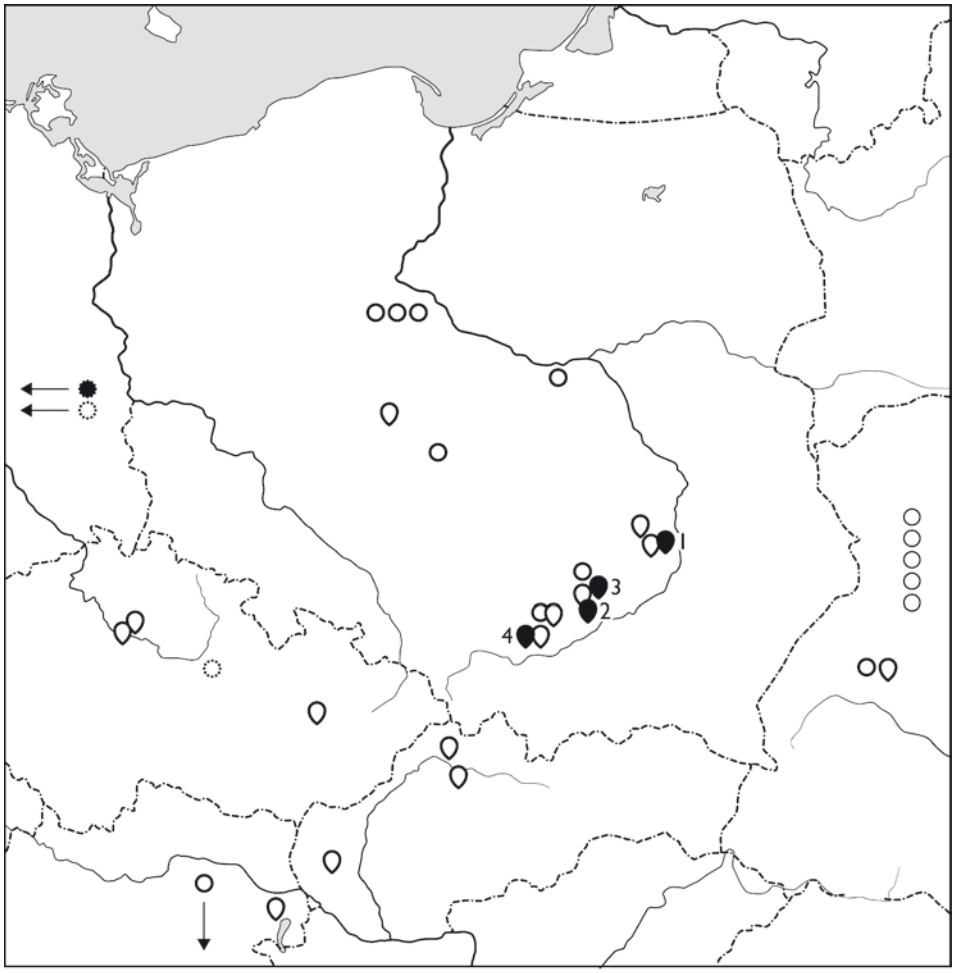

Fig. 2. Distribution of Kryspinów type staters compared to other coins of the Southern Group

unpublished specimen of the Late Kraków type found in Kolín District, Czechia, weighs 4.62 g. The gold content of the analysed Kryspinów type staters ranges from 58.86% to 47.3%, whereas for the Early and Classic Kraków types it ranges from 76% to 45.5% (Bul 2022, 57-58). The *terminus post quem* for the Kraków series is 42 BC (Bul 2022, 49), which, taking the available metrological and metallurgical data into account, allows the earliest issues of the Kryspinów type staters to be placed in the 30s BC or later.

For this period, we can distinguish two main areas of coin production and circulation: the Southern Group, comprising western Lesser Poland, and the Central Group, comprising Kuyavia and eastern Greater Poland. The staters of the discussed type belong to the Southern Group. As opposed to the Kraków series, especially the Late Kraków type, which circulated over a very large area (southern Poland, Kuyavia, Ukraine, Slovakia, Czechia, Austria [unpublished], and Croatia), the coins covered in the article appear to have been confined to a relatively small territory (Fig. 2). The findspots are distributed along the upper Vistula River, contributing to the main concentration of Celtic coin finds originating from the western part of Lesser Poland. The existence of a Celtic mint in the area of Lesser Poland was already considered by Z. Woźniak in 1967 (Woźniak 1967, 210). K. Castelin identified the vicinity of Kraków as the most likely location of the workshop where the coins designated as the Kraków type were produced (Castelin 1976, 266). Local production of coins in the late La Tène period was confirmed in 1976 by the identification of clay moulds for coin planchets, found in 1954 in Kraków-Nowa Huta (Mogiła, Site 1) (Hachulska-Ledwos 1976; Hachulska-Ledwos and Woźniak 1976; Woźniak 1978; 1984). Considering the available data, it can be presumed that the Kryspinów type staters were made in a workshop that operated in the same area as the mint (or mints) issuing coins of the Kraków series.

CONTEXT

As we have indicated, the issues of the Kryspinów-type staters are associated with the functioning of the Tyniec Group and constitute part of the heritage of the La Tène culture. By the term 'Tyniec Group', we understand a syncretic cultural unit that combines features of La Tène and Przeworsk cultures, sometimes with the participation of Dacian or Púchov culture elements, which occupied the territory of western Lesser Poland during the LT D phase. In doing so, we do not address the problem of determining the origins of the Tyniec Group (*cf.*, Bochnak and Dzięgielewski 2020). Economic and social conditions, as well as the clear parallels to the coinage of the Boii, favour such a view.

Western Lesser Poland at the end of the 1st century BC was an area characterised by the coexistence of communities whose material culture exhibited features typical of the La Tène and Przeworsk cultures. However, these elements were found in varying proportions. In some cases, the Celtic components were incidental and considered to be imports; in others, they constituted an important element contributing to the cultural character. The

situation was similar regarding the funerary rites. In most instances, the predominant rite appears to have been that typical of the Celts at the time, elusive with the research methods used today. However, a few cemeteries are known where cremation was used and where quadrangular funerary features have been found (Bejsce, Kazimierza Wielka County; Kryspinów, Site 3; Michałowice, Kraków County, Site 1; Pełczyska, Pińczów County, Site 6). Of special status are the finds from Modlniczka, Kraków County, Site 2, where a large number of pottery fragments and burnt human bones were found in the marshy oxbow lakes of the Wedonka River. Three inhumation graves found in Pełczyska (Rudnicki 2005a) should be regarded as exceptions to the rule.

In the LT D2 (A3) phase in the Kraków region, newly established settlements and cemeteries overlapped the network of older Tyniec settlements (with a clear Przeworsk component), associated with the influx of a new wave of newcomers – carriers of the Przeworsk culture. The new settlements are often adjacent to older sites of the Tyniec Group. The Tyniec and Przeworsk populations maintained contact with each other, as evidenced by finds attributed to the La Tène culture in the Przeworsk settlements. These artefacts formally have the status of imports (*e.g.*, in Kryspinów or in Jakuszowice, Kazimierza Wielka County).

The situation described above means that, in the case of the cultural landscape in western Lesser Poland in the 1st century BC, we observe numerous similarities linking the Tyniec Group and the Przeworsk culture. At the same time, we often face a lack of clearly defined cultural markers that allow us to indicate the differences between the aforementioned cultural units (with these factors changing over time, and this change is not always possible to grasp precisely). Not surprisingly, archaeologists have often referred to particular sites as 'Tyniec' or 'Przeworsk' arbitrarily, and sometimes their opinions have evolved. In the most widespread view, the Nida River, especially in its lower reaches, was the boundary separating the settlements of the Tyniec Group from the zone occupied by the Przeworsk culture. Towards the end of the La Tène period, the Tyniec Group decreased its range, concentrating mainly around Kraków, and was replaced by the Przeworsk culture communities south of the Nida River (Woźniak 1970, 208-201, 1981, 257; Godłowski 1995a, 83; Kubicha 1997, 305, map 3, 4; Garbacz 2000, 333, 334). This phenomenon can be observed, among other places, in Zagórzyce, Kazimierza Wielka County, Site 1, where a settlement of the Przeworsk culture appeared on the site of a former settlement of the Tyniec Group (Grygiel 2017). As mentioned above, opinions on the cultural affiliation of the sites in question vary considerably and continue to develop. Thus, the cemetery at Pełczyska, Site 6, established already in the A2 phase of the Late Pre-Roman period, was described as a necropolis of the Przeworsk culture, and the settlement contemporary with it was also considered to be a Przeworsk one (Rudnicki 2007, 97). In other more recent publications, M. Rudnicki has described the settlement in Pełczyska as a site of the Tyniec Group (Rudnicki 2004, 399, 400; 2005a, 2005b; Rudnicki and Włodarczak 2007, 220), of the La Tène culture (Rudnicki and Kontny 2002, 146) or the location of a 'Celtic mint'

(Rudnicki 2003, 11-14). It should be noted that Pełczyska and Zagórzyce, Site 1, are places where variously dated La Tène culture elements are particularly well defined and more abundantly represented than, for example, at the settlements in nearby Jakuszowice or Charbinowice (Grygiel 2017; 2022, 339, 340). For this reason, it is difficult to apply a geographical criterion and include all these sites in the Tyniec Group. A less nuanced approach was proposed by M. Grygiel, who referred to the entire phenomenon of settlement in western Lesser Poland in the last centuries BC and at the beginning of the 1st century AD as the Tyniec Group, including also the sites of the 'pure' Przeworsk culture (Grygiel 2022).

In this paper, following K. Godłowski (1995b, 125), we associate the 'La Tène-Przeworsk' settlements with the Tyniec Group, with older traditions, dating to before the D2 stage of the La Tène period or the A3 phase of the Late Pre-Roman period. We also identify the settlements characterised by pottery production (including painted pottery) and elements of the Celto-Dacian style – linked to the influx of people from beyond the Carpathians – as belonging to the Tyniec Group (Woźniak 1990, 76, 79; Poleska 122, 123; Rudnicki 2005b, 195). We associate the Przeworsk culture with sites in western Lesser Poland dating to the A3 phase of the Late Pre-Roman period, where features of the Przeworsk culture (including those of La Tène origin) are definitely dominant. We also associate the cemeteries, dating back to the Late Pre-Roman period, with the Przeworsk culture. However, the relatively small number of cemeteries in Lesser Poland should undoubtedly be seen as a remnant of the La Tène tradition. Regardless of the nomenclature used, the mosaic of cultural influences appears to reflect the influx of culturally distinct population groups from the south and north, as well as long-distance trade contacts. This conveys the syncretic nature of settlement in western Lesser Poland, suggesting a complex political situation that may be related to the multi-ethnic character of the population.

It was under such conditions that local issues of gold coins, including Kryspinów type staters, appeared in the milieu of the La Tène tradition. The exact or approximate location of four out of the five coin finds discussed here is known. Interestingly, their distribution and cultural context indicate a connection with the sprouting settlement of the Przeworsk culture in Lesser Poland during the A3 phase, rather than with the sites of the Tyniec Group. Of course, this cannot, however, determine where they were produced.

The stater from the settlement in Kryspinów, a site dating back to phase A3 of the Late Pre-Roman period, can be associated with the Przeworsk culture (Fig. 2, no. 4). As we have indicated above, the coin was found in the fill of a sunken-floored hut containing finds typical of the A3 phase and possibly the early Roman period. As the stater did not rest on the bottom of the feature – and we do not know the time of the filling of the feature – it is difficult to know precisely when the coin in question reached the layer in which it was found. This could have been the end of the A3 phase, but the beginning of the next phase cannot be ruled out. The settlement at Kryspinów extended across an escarpment above the Vistula valley, on its left bank. A cemetery (Site 1) was located in its immediate vicinity – the largest known necropolis of the Przeworsk culture in Lesser Poland. On the other

side of the Vistula stretched a zone inhabited by people of the Tyniec Group. Less than two km away, on the summit and slopes of a limestone hill rising above the river valley, there was a settlement in Tyniec, Kraków County, Site 1, and further, similar settlements existed at a site known as Tyniec-Zawąwozie (Zagrodziszcze) (Sites 10 and 13) (Godłowski 1995b, 120) and in Kraków-Skotniki (Sites 2 and 12) (Grygiel 2022, 320). In turn, a little further east, in Kraków-Pychowice, there was another settlement (Site 2), this time with clear elements of the Púchov culture (Naglik and Wichman 1992; Naglik 1996). Certain Púchov influence is also evident in the Kryspinów cemetery, where a Púchov culture vessel was used as an urn in Grave 66 (Godłowski 1995b, 125, photo 81). In Kryspinów, the influence of the Tyniec Group is evident in finds of painted pottery, which appear in both settlement and sepulchral materials (Godłowski 1995b, 125).

The coin find from Charbinowice (Bulas and Bulas-Okońska 2024, passim) is probably connected to the settlement of the Przeworsk culture that existed in the area (Fig. 2, no. 2). This settlement, designated as Site 1, functioned in the A3 phase of the Late Pre-Roman period, as evidenced by the finds of two M-type fibulae, as well as pottery with faceted edges and pottery with geometric decoration in narrow, circumferential bands (Grygiel 2017, 210; 2022, 311; Bratko 2023, 8, 62, 63). This is, so far, the oldest Iron Age-related settlement phase recorded at the site. Significantly, the next phase, *i.e.*, the B1 phase of the early Roman period, is very poorly represented in the archaeological material (Bratko 2023, 63, 64). It can therefore be assumed that the Kryspinów type stater find is more likely related to the settlement dated to the end of the Late Pre-Roman period. Situated by the Młyńska River, the settlement at Charbinowice is part of a settlement cluster located between the lower Nidzica and lower Nida rivers.

The Charbinowice settlement population probably maintained relations with the community from the settlement in Rzemienowice, Kazimierza Wielka County, located about 6.5 km downstream along the Młyńska River (Wroniecki and Barton 2018, 60; http://ug.opatowiec.pl/galeria,,,,,543,n.html, accessed 02.08.2024). There were also nearby settlements in Jakuszowice, Site 2 (approximately 7 km), and Bejsce, Site 1 (approximately 5 km). All these sites were in use during the A3 phase. La Tène imports, such as a glass bead, as well as graphite and painted pottery from Jakuszowice, or graphite pottery from Bejsce, confirm contact with the Tyniec Group. Not far from Charbinowice, there were also settlements in Zagórzyce and Pełczyska, where the Tyniec Group traditions dated back to the middle La Tène period. In Zagórzyce, just 4 km from Charbinowice, a significant collection of Celtic artefacts from the earlier phases of the La Tène period was documented. This included fragments of bracelets, links from men's and women's chain belts, and a Möttschwil type fibula (Grygiel 2017, 205-207; pl. 4). The finds from the settlement complex in Pełczyska, located about 8 km to the north, are similar in nature. The complex consists of a settlement where, among other things, a series of Celtic and Dacian coins were discovered, and a cemetery (Site 6), which functioned from the A2 to B2/C1 phases, the majority being from phases A3 and B1 (Rudnicki 2003, 4-12; Kontny and Rudnicki 2009, 30-37).

The precise findspot or circumstances of the discovery of the stater 'from the environs of Busko Zdrój' is unknown (Fig. 2, no. 1). In the Busko area, Przeworsk culture settlements expanded on a larger scale at the beginning of the Roman period. This horizon is marked by material from the biritual cemetery in Kawczyce, Busko County, located about 4 km south of Busko-Zdrój. However, we also have slightly older finds at our disposal. In this regard, we refer above all to the results of research by S. Nosek and T. Reyman, who not only conducted excavations at a necropolis from the early Roman period (Kawczyce, Site 1), but also located single settlement features dated to the end of the Late Pre-Roman period (Site 2) (Nosek 1947, 134-140, figs 34-38). Subsequently, scarce artefacts associated with the Late Pre-Roman period were also recorded in the cemetery previously investigated by S. Nosek and T. Reyman (Site 1) (Kaczanowski and Poleski 1985, 136, fig. 11: 5). The list of Przeworsk culture finds from the Late Pre-Roman period in Kawczyce is supplemented by the unpublished results of rescue research related to the construction of the Busko-Zdrój bypass. Excavations carried out in 2018 resulted, among other things, in the discovery of a series of artefacts from the 1st century BC, including a 1/8 stater of the Pełczyska type.

In the village of Orłowiny, Opatów County, finds of the Przeworsk culture from the Late Pre-Roman and early Roman periods were recorded at a site designated in the voivodeship monument register as Kaliszany-Folwark, Site 22 (AZP 86-72/431) (Fig. 2, no. 3). During the fieldwalking survey conducted by the 'Wspólne Dziedzictwo' association, a Kryspinów type stater (Catalogue no. 3; Fig. 1: 3) and a denarius of Octavian Augustus (RIC 86b) were discovered (information provided by M. Florek, head of the Sandomierz branch of the Provincial Heritage Protection Office in Kielce). The find of the stater corresponds with the settlement horizon of the Przeworsk culture documented at Kaliszany-Folwark, Site 22. A fieldwalking survey conducted in the area identified a cemetery with materials typical of the Late Pre-Roman period (Kaliszany, Site 1) and a similarly dated settlement in Buszkowice, Ostrowiec Świętokrzyski County, Site 1, situated approximately 2.5 km from Kaliszany-Folwark, Site 22. A fieldwalking survey was undertaken in 1997 by B. Bargieł, A. Zakościelna and J. Libera.

The environs of Orłowiny, as well as the whole area of the Sandomierz Upland, were outside the territory inhabited by the Tyniec Group. Therefore, the Kryspinów type stater found in Orłowiny is considered an import. This is not the only find of this kind from this region; in 2019, a stater identified by Ł. Bul as Late Kraków type was accidentally discovered in the Opatów area (Opatów County) (Bochnak 2020; Bul 2022, 60).

These finds, from the area between the Vistula River and the metallurgical centre in the Świętokrzyskie Mountains, fit the model proposed by M. Rudnicki, who drew attention to the role of the Vistula River in the distribution of staters belonging to the Kraków series, such as those found in Kunów, Ostrowiec Świętokrzyski County, and in the vicinity of Sochaczew, Sochaczew County. The distribution of the other issues, presumably minted in the vicinity of Kraków, also follows this pattern north of the territory occupied by the Tyniec Group (Rudnicki 2012a, 51; 2012b, 185).

In light of the above, the question arises as to whether the staters discussed here travelled north to the region of Ostrowiec and Opatów as a result of down-the-line trade, or whether they indicate the physical presence of the population representing a Tyniec Group population in the foreland of the Świętokrzyskie Mountains. Although conditions allowed for the development of metallurgy in the area, finds confirming the development of iron ore reduction techniques in the Late Pre-Roman period are few and inconclusive. Przemysław Urbańczyk noted that the objects of long-distance exchange were usually luxury goods, as the high cost of transport made trade in items of relatively low value unprofitable (Urbańczyk 1996, 4). In light of these remarks, small coins of very high value appear here as a model object of long-distance exchange, carried out with the participation of many intermediaries. However, this picture is incomplete, as other categories of La Tène imports, above all ceramics, cannot be overlooked. It should be recalled that Z. Woźniak pointed out connections between the Sandomierz Upland and the La Tène zone, above all with the Tyniec Group (Woźniak 1970, 192; 1994, 133, 134; Orzechowski 2007, 221). The presence of newcomers from the south is indicated, in particular, by finds of graphite pottery, *e.g*. from Grzegorzowice, Ostrowiec Świętokrzyski County, Samborzec, Sandomierz County, Świniary, Sandomierz County, and, above all, from the cemetery in Błonie, Sandomierz County, Graves 51 and 211 (Woźniak 1970, 162, 347, 349, 250; Orzechowski 2007, 54). As mentioned above, fragments of vessels typical of the La Tène culture were also found in settlements located between Nidzica and the Nida River. Such pottery serves as a good indicator of the physical presence of the newcomers from the south, as it is difficult to assume that it found its way into the lands occupied by the people of the Przeworsk culture as a result of down-the-line trade. It is more likely that the vessels – after all, a product of little value – were the private property of the southerners, who then disposed of the ceramic containers in which they brought, for example, foodstuffs for their own use. Imported glass beads, fibulae, and weapons are also known from the aforementioned necropolis at Błonie (Woźniak and Mycielska 1988). However, these categories of finds are less indicative of the physical presence of the La Tène population than ceramics (Bochnak 2014, 166). Nevertheless, these artefacts also bear witness to links with the Celtic world. Zenon Woźniak noted that La Tène cultural patterns are also evident in local ceramic forms, especially those from the Błonie cemetery (Woźniak 1994, 133). These findings are in line with the views of T. Dąbrowska and T. Bochnak on Celtic imports coming from the south to the area of the Przeworsk culture (Dąbrowska 1988, 123-125; Bochnak 2014, 191-193; fig. 82). The contacts between the people of the Tyniec Group and the Przeworsk culture may be important in the context of the metallurgical centre in the Świętokrzyskie Mountains, the origins of which certainly date back to the younger pre-Roman period. The Sandomierz Upland served as the population base for ancient metallurgy in the Świętokrzyskie Mountains. We should add that fragments of pottery of the La Tène culture (Pokrzywnica, Starachowice County, Stara Słupia, Kielce County) are known from the region of the Świętokrzyskie metallurgical centre (Mycielska 1968, 331; pl. 1: 9; Orzechowski

2007, 74, 75; pl. 1: 2, 3), as is the Late Kraków type stater from Kunów, Ostrowiec Świętokrzyski County, Świętokrzyskie voivodeship. These finds, on the one hand, point to the physical presence of members of the Tyniec Group population in the hinterland of the developing metallurgical centre, and on the other hand, to emerging economic relations on a significant scale.

XRF ANALYSIS

The study of historical objects, particularly ancient coins, often revolves around understanding their origin, manufacturing techniques, and authenticity. Among the key tools in this type of research is chemical analysis, which helps to uncover critical information about the composition of metals used in coins and artefacts. However, many historical gold coins remain unanalysed, leaving gaps in our understanding of ancient minting practices and trade routes. Analytical methods, such as X-ray fluorescence (XRF) spectroscopy, have emerged as crucial tools for performing non-destructive examination, while providing archaeologists and historians with valuable data without damaging precious artefacts (del Hoyo-Melendez 2015). XRF spectroscopy is a widely used technique for analysing metallic artefacts. It works by directing X-rays at an object, which excites the electrons within the material (Klisińska-Kopacz 2024). These electrons then emit secondary X-rays, which can be measured to determine the elements present in the sample. Since XRF focuses on the surface of the object, it provides a detailed analysis of the material's outermost layer. In contrast to other analytical methods, which may require the removal of a physical sample, XRF allows the preservation of the object's integrity. XRF can detect a broad range of elements from sodium to uranium.

One significant challenge in the analysis of ancient coins is the impact of corrosion. Corrosion can cause substantial changes in the surface composition of a coin, resulting in misleading results if the surface is analysed without taking these changes into account (Constantinides 2002). This is particularly problematic for coins made of alloys containing metals such as silver and copper, which are more prone to oxidation and corrosion than gold (Scott 1983). When silver and copper oxidise, they can form compounds that alter the surface of the coin, resulting in a composition that differs from the coin's interior. For example, silver-copper alloy coins often exhibit surface enrichment in silver due to copper depletion. This phenomenon is well documented and poses challenges for accurate chemical analysis (Nord 2020). Gold coins, although less prone to corrosion, can still show surface enrichment either due to the migration of silver or copper away from the surface over time (Blet-Lemarquand 2020) or from ancient metallurgical treatments aimed at enhancing the appearance of the coin. This results in a higher apparent gold content on the surface than in the coin's bulk material.

For a more comprehensive analysis, additional techniques that can probe deeper into the object are often required. One such complementary technique is laser ablation inductively

coupled plasma mass spectrometry (LA-ICP-MS). This method uses a laser to remove microscopic amounts of material from the coin's surface. The removed material is then analysed to determine its elemental composition at various depths, providing a more complete picture of the coin's overall composition (Blet-Lemarquand 2020). LA-ICP-MS can detect trace elements with extremely high sensitivity and is particularly useful for identifying minor components of the alloy that may not be detectable with XRF alone. LA-ICP-MS also enables depth profiling, which is essential for understanding how a coin's composition changes from the surface to its core. This technique is particularly useful for coins that show surface enrichment, as it can reveal the true composition of the underlying material.

One of the key reasons XRF has become so widely used in numismatic studies is its non-destructive nature. Unlike traditional chemical analyses, which may involve cutting or removing samples from an object, XRF preserves the integrity of the coin being studied. This is crucial for the conservation of historical artefacts, particularly those that are rare or hold significant cultural value. However, it should be noted that XRF spectrometry is a surface method, and the depth of X-ray penetration does not exceed several dozen micrometres.

The X-ray fluorescence analysis was performed in the Laboratory of Analysis and Non-destructive Investigation of Heritage Objects (LANBOZ) at the National Museum in Kraków. XRF measurements were performed using the S1 Titan LE spectrometer (Bruker) equipped with an X-ray tube (Rh) with parameters of 15 μA, 50 kV and a semiconductor energy dispersion detector. The radiation beam had a cross-section of less than 5 mm. The tests were performed in an air atmosphere. The spectrum accumulation time was 30 seconds. Measurements were performed in selected places of the objects in the first mode of spectrometer operation. During the measurement, a series of emission lines K, L, M with energy characteristic for a given element were recorded. The semi-quantitative composition of elements for each object was determined automatically using software based on standard-free analysis algorithms. To assess the expected accuracy of the measurements, a certified reference material with a composition similar to the tested object was used. The results are presented in Table 1. The summary of the results, including the percentage content of individual elements, their average values, and relative standard deviation (RSD), is presented in Table 2. The relative measurement uncertainties for the XRF method using the S1 Titan LE handheld spectrometer are: <0.3% for Cu Kα, and <1.3% for Sn Kα, respectively. The LOD (limit of detection) values in the tables do not indicate that a given element was not detected. It is information that its presence has not been confirmed with sufficient statistical verification. In accordance with the standard criteria, it was assumed that the calculated concentration must exceed the LOD at least three times.

The surface of the gold coin from Orłowiny revealed the presence of the following main elements: gold (Au) and silver (Ag). The average values of Au and Ag are 58.93% and 38.93%, respectively. Additionally, minor elements that are likely associated with impurities were identified: copper (Cu) and tin (Sn) in a total amount of 2.15%.

Table 1. Summary of the results of elemental composition measurements [%] of the surface of the certified reference material (MBH Analytical LTD)

Result	Cu [%]	Sn [%]	Pb [%]	Fe [%]	Ni [%]	Zn [%]	As [%]	Sb [%]	Ag [%]
Reference value	78.97	15.90	0.86	1.00	0.67	0.60	0.056	0.70	0.09
Measured value + measurement uncertainty	78.98 ± 0.16	14.93 ± 0.13	0.97± 0.03	1.45± 0.03	0.85± 0.02	0.64± 0.02	LOD	0.7± 0.04	0.10 ± 0.02

Table 2. Summary of the results of elemental composition measurements [%] of the surface of the analysed objects

Coin	Sample number	Au (%)	Ag (%)	Cu (%)	Other (%)
Orłowiny	1	59.97	37.56	1.73	Sn 0.74
	2	57.89	40.29	0.98	Sn 0.84
	Mean	58.93	38.93	1.36	Sn 0.79
W 49/95 Kryspinów	1	54.08	41.82	4.11	n.d.
	2	53.90	42.43	3.67	n.d.
	Mean	53.99	42.13	3.89	n.d.

The surface of the gold coin W 49/95 from Kryspinów revealed the presence of the following main elements: gold (Au) and silver (Ag). The average values of Au and Ag are 53.99% and 42.13%, respectively. Additionally, minor elements were identified: copper (Cu) with an average value of 3.89%.

While XRF excels in surface analysis, it is important to recognise its limitations, particularly regarding surface enrichment and corrosion, which may affect the accuracy of results. To obtain a more complete understanding of ancient coins, XRF is often complemented by other analytical techniques, such as LA-ICP-MS and depth profiling, which provide deeper insights into the object's overall composition. However, despite their limitations, the XRF results obtained for both staters – Orłowiny and W 49/95 Kryspinów – reveal similar gold and silver content, indicating that they were produced within a relatively short period, most likely by the same workshop. The results of the analyses, which were independently conducted for two other coins described in the article, do not differ significantly from those presented above either. The gold and silver contents are 53.23% (Au) and 43.94% (Ag) for the stater from Charbinowice (Bulas and Okońska-Bulas 2024, 127, fig. 3:1), and 47.3% (Au) and 47.95% (Ag) for the BnF 8743 specimen. This implies that the Kryspinów type staters represent a relatively short-lived issue, unlike the Kraków series. The minor variations between the Orłowiny and Kryspinów coins are noteworthy, both in terms of copper content and the presence of tin in one of the specimens. This suggests that a slightly different raw material base was used for subsequent batches of coins.

TYPOLOGY

The staters discussed in the article are designated as the Kryspinów type, named after the first recorded coin with a reliable findspot. As with the Early and Late Kraków types, the Kryspinów type originated by combining motifs borrowed from shell staters and Republican denarii. However, unlike the Early and Late Kraków types, where the crescent drawn from a shell stater became the hull of a boat copied from the denarius (Bul 2022, 46, 47, 53, 54), the Celtic and Roman themes on the reverse of the Kryspinów type are superimposed rather than incorporated into each other. The obverse depicts a laureate head, modelled on Republican denarii but reduced to very little detail. The reverse combines the crescent derived from shell staters of the Boii, and a minimal rendition of the common horse-drawn chariot theme borrowed from Republican issues. Within the Kryspinów type, three classes can be distinguished based on variations in the reverse design.

Class 1a is represented by a single coin – the stater found in the environs of Busko Zdrój (Cat. 1, dies O1-R1). The abstract depiction of the laureate head on the obverse is based on a Republican denarius, presumably the coin (RRC 361/1) issued by P. Crepusius (Crawford 1974, pl. 47, no. 9), although another type with a similar obverse cannot be excluded. The shape of the head (Fig. 3: 1) can be discerned above the prominent laurel wreath (Fig. 3: 2). Below are three locks of hair (Fig. 3: 3-5), and another hairlock or fringe to the right, above the eye on the denarius (Fig. 3: 6). Even the downy beard of Apollo is

Fig. 3. Obverse prototype of Kryspinów staters, a denarius issued by P. Crepusius (left) and a stater of Kryspinów type (right). Photos Bruun Rasmusen (left), Tomasz Bochnak (right)

Fig. 4. Possible model for Class 3 obverse details, a denarius issued by L. Memmius Galeria (left) and a stater of Class 3 Kryspinów type (right). Photo: American Numismatic Society (left), Bibliothèque nationale de France (right)

Fig. 5. Roman reverse prototype of Class 1a, a denarius issued by M. Baebius Tampilus (left) and a stater of Class 1a Kryspinów type (right). Photo: Classical Numismatic Group (left), Piotr Adamkiewicz archive (right)

reflected by a fine line adjoining one of the hairlocks, as in the prototype (Fig. 3: 7). Facial features are absent, but this by no means an isolated case when it comes to Celtic coinages. In fact, the obverses portraying a wreath alone or a wreath and hairlocks are very common. In particular, the Tótfalu, Simmering and Karancs types (*cf.*, Paulsen 1933, pl. 36, no. 831 – pl. 41, no. 939, pl. 47, no. 1064 – pl. 48, no. 1088; Pink 1939, pl. 19, nos 370 and 371, pl. 26, no. 534-535, pl. 27, nos 542-547; Göbl 1994, pl. 8: nos 19-33; Kostur and Gášpár 2018, 233-240, no. 198-199.2, 249, no. 201.19, 202, 250, 251, no. 204.2-206) should be mentioned, but there are many more examples further west, especially when it comes to the British issues (*cf.*, Sills 2003, 257, fig. 88a-o, 262, fig. 91a-d; Sills 2017, 120, fig. 150-153, 261, fig. 293-297, 269, fig. 300-301, 270, fig. 302-303, 271, fig. 307-308, 272, fig. 309-312 ff). The crescent on the reverse is accompanied by rays emanating from the centre, above. The focal point of the chariot scene is the diagonally arranged motif above the left tip of the crescent, depicting a charioteer. While the exact Roman prototype cannot be identified, due to the simplified nature of the derived image, the denarius (RRC 236/1) of M. Baebius Tampilus (Crawford 1974, pl. 36, no. 4) is a likely candidate. The charioteer on the stater shows similarity to his counterpart on the denarius in several details. The head (Fig. 5: 3), torso (Fig. 5: 2) and legs (Fig. 5: 4, 5) can each be linked to corresponding elements of the figure of Apollo on the denarius. The feature behind the charioteer (Fig. 5: 1) either depicts Apollo's right hand holding a laurel branch (off flan on the denarius shown in Fig. 5), or a wing of Victory copied from another model, like the denarius (RRC 200/1) of Pinarius Natta (Crawford 1974, pl. 32, no. 5). The meaning of the pellets overlaid with diagonal lines, immediately above the left part of the crescent (Fig. 5: 6, 7), is not obvious, but the similar treatment of the charioteer's head points to them also being heads. However, they are not necessarily human heads, contrary to R. Duval's proposal (Duval 1949, 92). The reverse of the denarius of M. Baebius Tampilus, shown in Fig. 5, bears horses with heads also rendered as diagonal lines, albeit in a more naturalistic style. This feature on the stater appears to be a subtle hint at a chariot scene, shown in more detail in Class 3. It cannot be ruled out that the scene was cut in the die first, then part of it became obscured once the crescent was added. Perhaps the traces of lines visible below the left part of the crescent are the remains of it.

Class 1b shares both dies with Class 1a, although the reverse die is recut. Two of the five known coins can be included in this class, the staters from Charbinowice (Cat. 2, dies O1-R1.1) and Orłowiny (Cat. 3 dies O1-R1.1). The obverse is the same as in Class 1a. The silhouette of the charioteer on the reverse is different, due to recutting following minor die deterioration. The feature behind the charioteer now consists of two parts, with a possible parallel on the reverse of the denarius (RRC 223/1) of C. Curiatius Trigeminus (Crawford 1974, pl. 35, no. 4). The globule-shaped upper part (Fig. 5: 2) corresponds to the head of Victory crowning Juno, while the lower part (Fig. 5: 1) is her body. As for the recut figure of the charioteer, similarities can also be found with the Juno depicted on the denarius – the shape of the head (Fig. 5: 3) and the right arm (Fig. 5: 4). In this case, however, there is no

Fig. 6. Roman reverse prototype of Class 1b, a denarius issued by C. Curiatus Trigeminus (left) and a stater of Class 1b Kryspinów type (right). Photo: Leu Numismatik (left), Tomasz Bochnak (right)

Fig. 7. Roman reverse prototype of Class 2, a denarius issued by C. Gargonius, Ogulnius and M. Vergilius (left) and a stater of Class 2 Kryspinów type (right). Photo: Tauler & Fau (left), Tomasz Bochnak (right)

certainty about the prototype, due to the level of abstraction and the existence of other possible models, such as reverses with a figure of the winged Victory in biga, triga or quadriga.

Class 2 is known from the coin found in Kryspinów (Cat. 4 dies O1-R2). The obverse die is the same as in class 1, but in a deteriorated state. The reverse die is new. The rays in the right part of the field above the crescent are replaced by densely packed short, irregular striations. The left part of the field retains the pronounced charioteer motif, surrounded by indistinct features. The motif was already recognised as a standing figure by P. Kaczanowski (Kaczanowski 1996, 128). An analogy can be found on the reverse of the denarius (RRC 350A/2) of C. Gargonius, Ogulnius and M. Vergilius (Crawford 1974, pl. 46, no. 6). The easily discernible features of the charioteer figure on the stater can be assigned to corresponding details on the denarius – the head of Jupiter (Fig. 7: 4), his torso (Fig. 7: 3), abdomen (Fig. 7: 2), and mantle (Fig. 7: 1).

Class 3 is represented by the stater kept in the Bibliothčque nationale de France (BnF 8743, Cat. 5, O2-R2). Both dies are new, unless the obverse is a heavily recut die O1. The differences between the obverse of Class 3 and Classes 1-2 are rather minor. The three hairlocks (Fig. 4: 1-3) are elongated with slightly hook-shaped ends, as on the denarius (see Crawford 1974, pl. 41, no. 18) of L. Memmius Galeria (RRC 313/1, mirrored image of obverse on Fig. 4). The BnF 8743 stater is the most important of all known specimens of the Kryspinów type in terms of iconography. In addition to the crescent and rays copied

Fig. 8. Roman reverse prototype of Class 3, a denarius issued by L. Flaminius Chilo (left) and a stater of Class 3 Kryspinów type (right). Photo: Classical Numismatic Group (left), gallica.bnf.fr, Bibliothèque nationale de France (right)

from a shell stater, its reverse bears the most complete chariot scene, depicting not only a charioteer, but also horses. This reinforces the identification of the motif depicted in reduced form on staters belonging to Classes 1 and 2. As has been noted before (Bul 2022, 48), the ubiquity of the theme on Republican denarii and its abstract portrayal on the BnF 8743 stater prevent the identification of a specific prototype. However, the denarius (RRC 302/1) issued by L. Flaminius Chilo (Crawford 1974, pl. 41, no. 1) serves as a good example. The elements on the reverse of the stater can be linked with the corresponding details on the reverse of the denarius: Victoria driving the biga (Fig. 8: 2) wearing a mantle (Fig. 8: 1), the horses' hind legs (Fig. 8: 3), the body of the right horse (Fig. 8: 4), the horses' heads (Fig. 8: 5, 6) and the horses' forelegs (Fig. 8: 7).

The phenomenon of combining the iconography of shell staters prevalent among the Boii with extremely simplified motifs borrowed from Roman coins is characteristic of the Southern Group. At least five stater types fit this pattern, including the Kryspinów one. The Southern Group types include the Early Kraków, Classic Kraków, Late Kraków, Kryspinów, and an exceptionally rare stater known from only two specimens (Bul, forthcoming). In contrast, instances of iconography derived from Roman denarii are found only occasionally in Central Group coinages. While the incorporation of Roman motifs into shell staters is unique to local issues, parallels can be found in coins from the Bratislava mint in terms of Roman influence. Shell staters bearing Latin inscriptions of Biatec and Nonnos (*cf.*, Musilová *et al.* 2015; Militký and Torbágyi 2021) provide the best analogy, but mention should also be made of silver tetradrachms, which not only bear Latin inscriptions but are often based on Roman prototypes (*cf.*, Ondrouch 1958; Göbl 1994; Röttger 2015). Finally, it should be noted that most of the Roman prototypes listed above are attested by multiple finds from Poland (Dymowski 2016).

CATALOGUE

1. Kryspinów type, Class 1a, dies O1-R1, 6.72g. Fig. 1: 1.
Findspot: environs of Busko-Zdrój, Świętokrzyskie Voivodeship, Poland.
Literature: Pazowska 2024.
Collection: private.

2. Kryspinów type, Class 1b, dies O1-R1.1, 6.51g, 16 mm. Fig. 1: 2. Au: 53.23, Ag: 43.94, Cu: 2.82. Mean values calculated from data provided separately for obverse and reverse, pXRF analysis by Jacek Soida, MA, from the Silesian Museum in Katowice.

Findspot: Charbinowice, Kazimierza Wielka County, Świętokrzyskie Voivodeship, Poland.

Literature: Bulas, Okońska-Bulas 2024.

Collection: Muzeum Historyczno-Archeologiczne w Ostrowcu Świętokrzyskim.

3. Kryspinów type, Class 1b, dies O1-R1.1, 6.29 g, 16.5 mm. Fig. 1: 3. Au: 58.86, Ag: 38.92, Cu: 1.09. The X-ray fluorescence analysis was performed in the Laboratory of Analysis and Non-destructive Investigation of Heritage Objects (LANBOZ) at the National Museum in Kraków.

Findspot: Orłowiny, Opatów County, Świętokrzyskie Voivodeship, Poland.

Literature: Bochnak 2024.

Collection: Muzeum Zamkowe w Sandomierzu.

4. Kryspinów type, Class 2, dies O1-R2, 5.8 g, 16.2 mm. Fig. 1: 4. Au: 53.99, Ag: 42.13, Cu: 3.89. The X-ray fluorescence analysis was performed in the Laboratory of Analysis and Non-destructive Investigation of Heritage Objects (LANBOZ) at the National Museum in Kraków.

Findspot: Kryspinów, Kraków County, Lesser Poland Voivodeship, Poland.

Literature: Kaczanowski 1996; Kaczanowski 1997; Rudnicki 2012; Andrałojć and Andrałojć 2014.

Collection: Instytut Archeologii UJ, Kraków (W. 49/95).

5. Kryspinów type, Class 3, dies O1-R3, 4.9 g, 16.7 mm. Fig. 1: 5. Au: 47.3, Ag: 47.95, Cu: 3.92.

The X-ray fluorescence analysis was performed by Sylvia Nieto-Pelletier (Institut de recherche sur les Archéomatériaux, Centre Ernest-Babelon, UMR 5060 CNRS-Université d'Orléans) and Camille Bossavit (Institut de recherche sur les Archéomatériaux, Centre Ernest-Babelon, UMR 5060 CNRS-Université d'Orléans).

Findspot: Utrecht, Netherlands (uncertain, see Roymans and Van der Sanden 1980, 184, 246; Rudnicki 2012, 67, 68).

Literature: Robert 1868; De la Tour 1892; Duval 1949; Castelin 1970; Roymans and Van der Sanden 1980; Rudnicki 2012; Andrałojć and Andrałojć 2014; Bul 2022, https://gallica.bnf.fr/ark:/12148/btv1b112909248, accessed on 28 April 2024.

Collection: Bibliothèque nationale de France, Paris (BnF 8743).

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In this text, for stylistic reasons, the term 'Celtic' is used as a synonym for 'that of La Tène culture.' It does not have the value of an ethnic designation in this case, since the identification and self-identification of the people of the La Tène culture in many parts of Central Europe remain unknown (Collis 2009).

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LADY FROM THE WEST BURIED IN THE MIDDLE OF NOWHERE? AN EXCEPTIONAL GRAVE FROM THE LATE PRE-ROMAN PERIOD AT BUDZISZKI AND THE QUESTION OF THE EMERGENCE OF THE PRZEWORSK CULTURE IN NORTH-EASTERN MAZOVIA

ABSTRACT

Maciałowicz A., Gawęda T. and Ludziejewska J. 2025. Lady from the West buried in the middle of nowhere? An exceptional grave from the Late Pre-Roman Period at Budziszki and the question of the emergence of the Przeworsk culture in north-eastern Mazovia. *Sprawozdania Archeologiczne* 77/2, 401-431.

A cremation grave from the Late Pre-Roman Period, discovered at Budziszki in north-eastern Mazovia, offers insights into the emergence of the Przeworsk culture in this poorly researched border region. The burial, probably of an adult woman, contained a bimetallic 'ball brooch', a clay urn and a stone polisher. Many features of this grave indicate western affinities. Some originate in the western zone of the Przeworsk culture and the so-called Jastorf culture in the Polish Lowland, while others trace back to the Jastorf culture of the middle Elbe and Oder regions. The grave, dated to phase A1b or early A2, predates the establishment of a stable settlement associated with the Przeworsk culture in the area. The evidence, including the Budziszki burial and other discussed finds, suggests that the presence of small, mobile groups from the west may have initiated the local development of this cultural unit. The Budziszki find exemplifies the hybrid character of the cultural processes shaping the Przeworsk culture in north-eastern Mazovia.

Keywords: Przeworsk culture, Jastorf culture, 'ball brooch' (Kugelfibel), Late Pre-Roman Period, burial rite
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INTRODUCTION

The middle Narew River basin formed the border zone of the Przeworsk culture settlement for over three centuries (phases A2-B2/C1), and at the same time, remains one of the least archaeologically explored regions of Poland. A grave from the Late Pre-Roman Period, discovered during rescue excavations at Site 2 at Budziszki, Ostrów Mazowiecka district, sheds new light on the elusive process of the formation of this cultural unit on the border of Mazovia and Podlachia, suggesting the involvement of newcomers from the west.

CONTEXT

Site no. 2 at Budziszki is located on the eastern side of the provincial road no. 677, which connects Ostrów Mazowiecka with Łomża, between the eastern outskirts of Gniazdowo and the western edge of Budziszki (Fig. 1). The site lies atop a small elevation of approximately 118 m a.s.l., bordered to the south and east by the marshy valleys of the Orz River and an unnamed stream flowing into it from the north (Fig. 2). The site was discovered in 2018 during a survey commissioned by the General Directorate for National Roads and Motorways, Białystok Branch. The results of this prospection formed the basis for the decision to conduct a rescue excavation prior to the planned construction of the S61 expressway. Excavations were conducted by the Ab Terra Foundation between October 1, 2021, and July 6, 2022, under the direction of Sławomir Miłek. During this time, an area of 169.73 ares was investigated, revealing 460 archaeological features, of which only 90

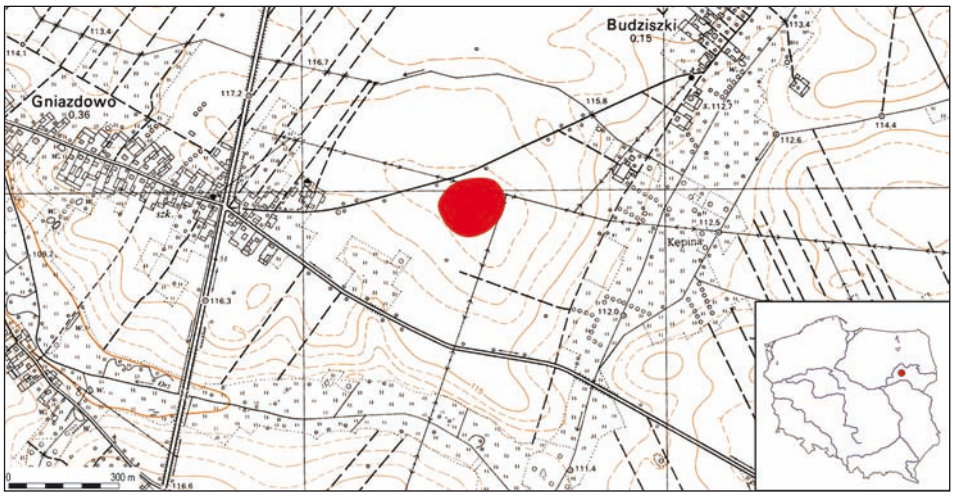

Fig. 1. Location of Site 2 at Budziszki. Graphics by T. Gawęda

(19.6%) contained datable material (Fig. 3). The vast majority of these (84) were functionally diverse features associated with settlement activity during the Roman Period, five features can be associated with the Late Middle Ages, and one – Feature 158 – with the Late Pre-Roman Period (hereinafter: LP-RP); the latter is the focus of the present study.

Feature 158 appeared at the level of the virgin soil, approximately 0.2 m below the surface, as an irregularly oval soil discolouration measuring 0.96 × 0.45 m, oriented along the NE-SW axis (Figs 4 and 5). Its dark brown fill was heavily mixed – especially in the central part – with large yellow inclusions of clayey sand, suggesting that the original

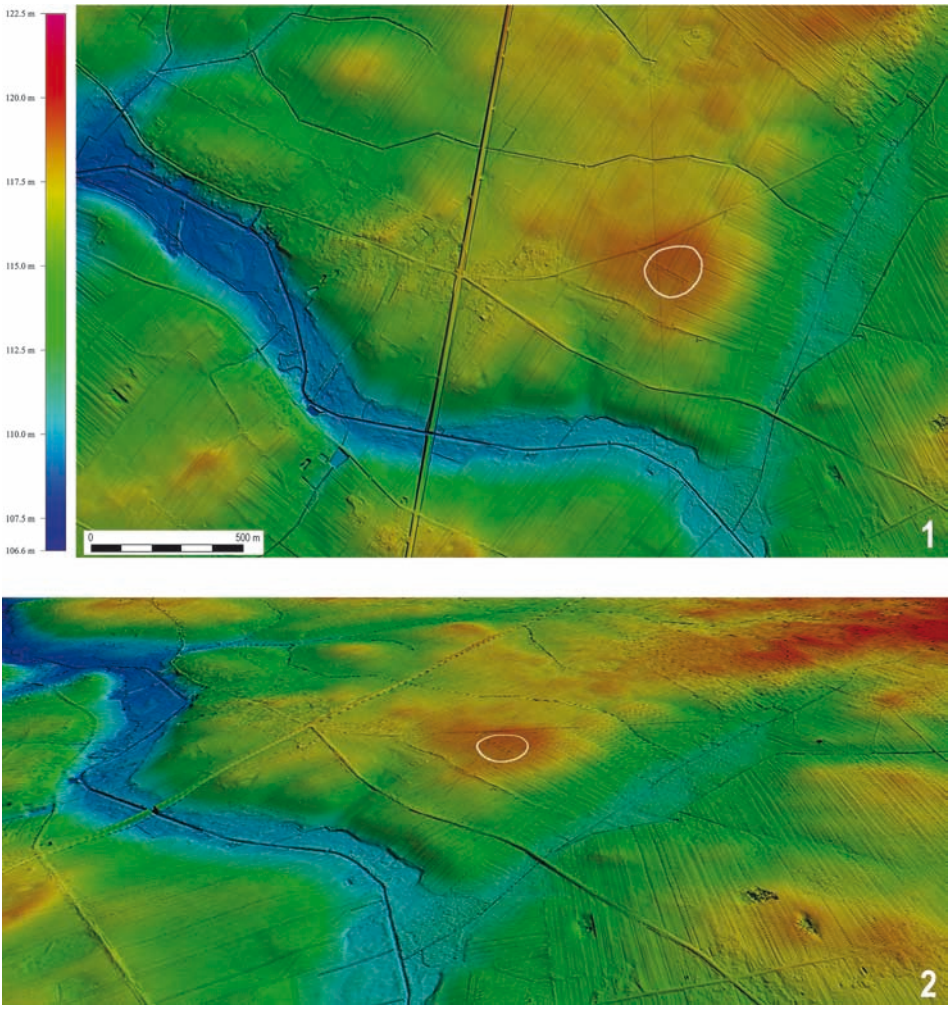

Fig. 2. Digital terrain model of the vicinity of Site 2 at Budziszki, with the site's location marked: 1 – plan, 2 – isometric projection (view from the southeast). Graphics by M. Woźniak and A. Maciałowicz

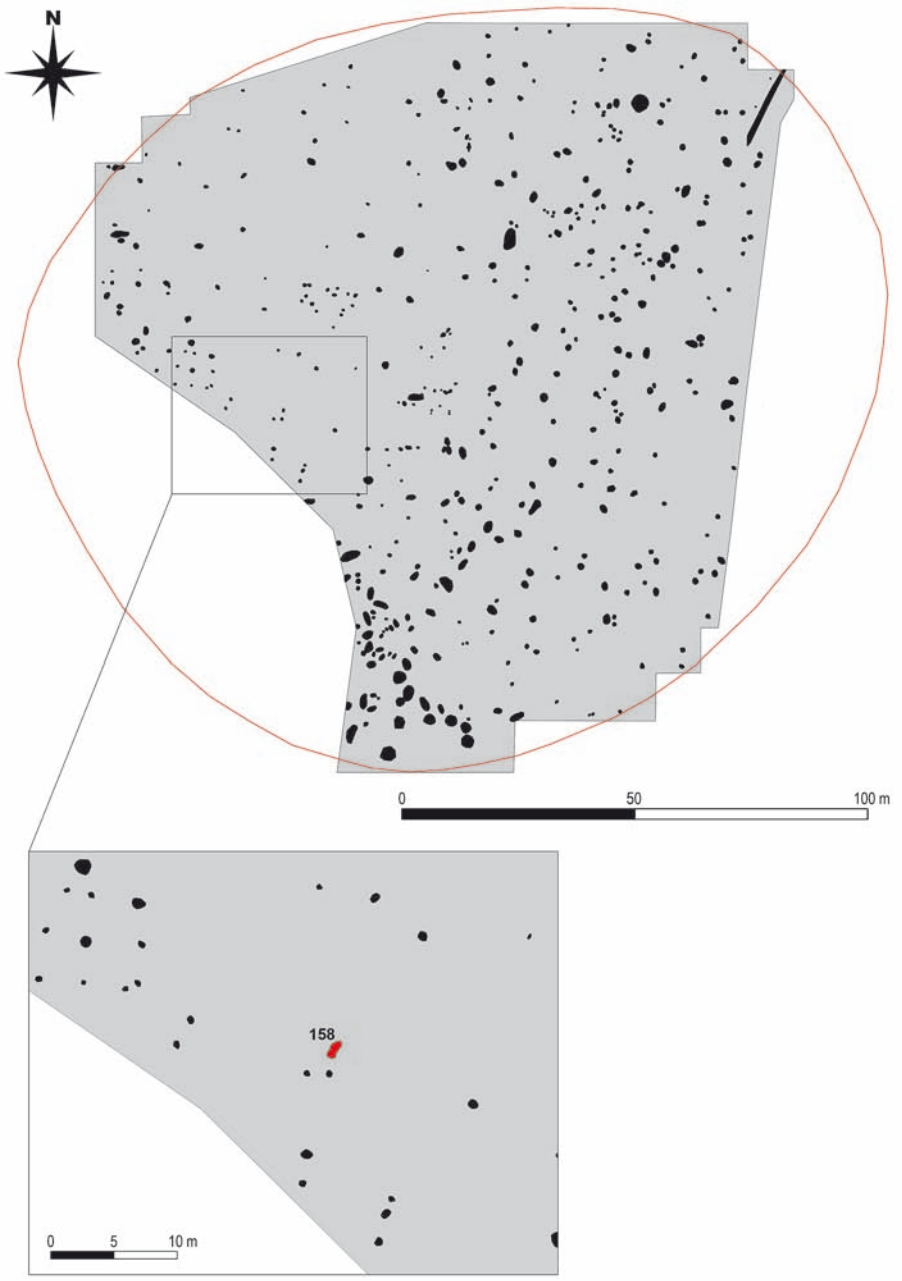

Fig. 3. Plan of the excavated area of Site 2 at Budziszki (in grey) with the range of the site based on fieldwalking surveys (red outline). Location of Feature 158 (urn grave) marked in red. Graphics by T. Gawęda

structure of the feature had been at least partially disturbed by mechanical means. The cross-section of the pit was nearly basin-shaped, with an uneven bottom and a maximum depth of 0.22 m. In the feature's top level, in its SW part, an upside-down clay vessel was uncovered. Inside the vessel were heavily burnt, small fragments of human bones, along with a bimetallic brooch and a stone polisher. No charcoal was present.

Fig. 4. Budziszki, Site 2. Plan (1) and cross-section (2) of Feature 158 (urn grave). Photo by J. Sosnowski

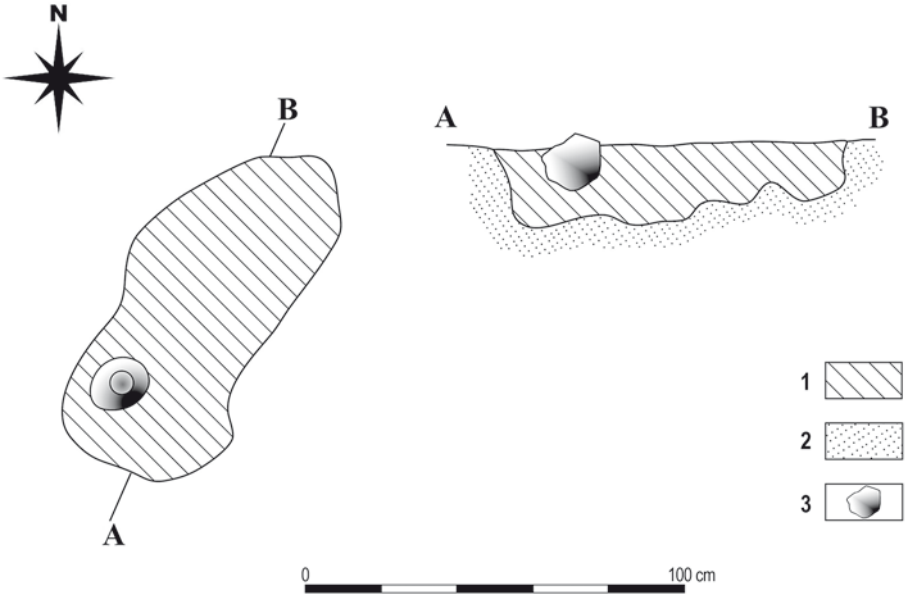

Fig. 5. Budziszki, Site 2. Plan and cross-section of Feature 158 (urn grave):
1 – dark brown sand with yellow inclusions, 2 – yellow sand (virgin soil), 3 – clay urn.
Graphics by T. Gawęda and A. Maciałowicz

An anthropological analysis of the highly fragmented bone remains (304 g), carried out by Dr Maurycy Stanaszek of the State Archaeological Museum in Warsaw, indicated that they probably belonged to a woman of *adultus/maturus* age (approx. 35 years old).

Grave inventory:

1. Iron wire brooch with bronze 'balls' on the bow; partially preserved (the front 'ball' and the end of the catchplate with the bend of the foot are missing), corroded. The bent foot runs along the bow and extends towards the spring, joined to the bow at its rear bend by a small, flattened spherical knob ('ball') cast in bronze. The brooch has a 6-coil spring with an upper chord. Preserved length of the brooch before conservation: 4.9 cm (now 4.6 cm); height: 1.6 cm; knob diameter: 0.85 × 1 cm; knob height: 0.6 cm (Fig. 6: 1a-1d).

2. Stone polisher, with one surface clearly flattened and strongly polished (working surface). Dimensions: 3.6 × 3.4 × 1.7 cm (Fig. 6: 2a, 2b).

3. Clay mug (urn) with a gently rounded transition in a slightly biconical body and a wide, multiple faceted rim; partially preserved (*e.g.*, missing handle). Both surfaces are initially smooth, now partially eroded, brick-grey-brown in colour. Abundant fine-grained mineral admixture. Height: 11.6 cm; rim diameter approx. 15.5 cm, base diameter: 6.3 cm (Fig. 7).

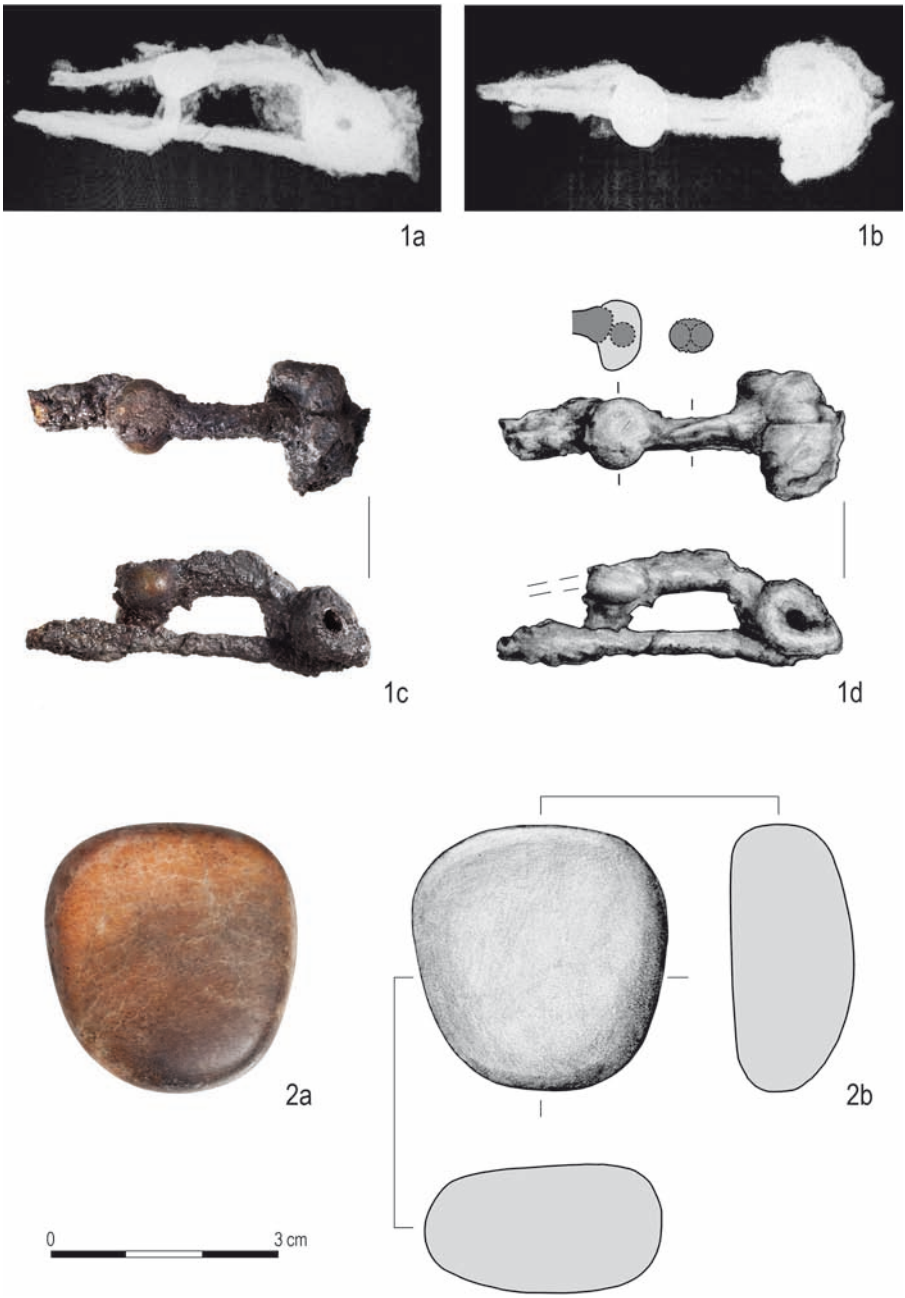

Fig. 6. Budziszki, Site 2. Small finds from Feature 158 (urn grave):
1 – iron brooch with a bronze knob (1a, 1b – before conservation); 2 – stone polisher. X-ray image by J. Ludziejewska (1a, 1b); photo by M. Bogacki (1c, 2a); drawing by A. Grzędzielska (1d, 2b)

Fig. 7. Budziszki, Site 2. Clay urn from Feature 158 (urn grave).
Drawing by A. Grzędzielska, photo by M. Bogacki

BROOCH

The most distinctive artefact from the grave in question – and at the same time unique in this part of Poland – is the small, bimetallic so-called 'ball brooch' (German: Kugelfibel). Based on its condition immediately after discovery (before the catchplate and bent foot partially disintegrated prior to conservation), it initially measured approximately 5 cm in length (Fig. 6: 1a, 1b). However, owing to the low height of the bow, clearly elongated catchplate, and short 6-coil spring, it can be described as very slender. At the point where the bent foot meets the rear bend of the bow, one of the 'balls' (the rear one) is preserved.

It takes the form of a small, flattened spherical knob cast in bronze. Based on parallels, it is reasonable to assume that a second, similar 'ball', now missing, was located closer to the spring, connecting the end of the extended foot with the front part of the bow.

'Ball brooches' constitute a large and morphologically diverse category of artefacts, for which there is no comprehensive classification covering their full diversity. Only a few specific types have been defined (the specimen from Budziszki does not match any of them). However, a more general division based on raw materials, morphology, and stylistic features has been proposed (Bieger 2003, 15-35). According to this framework, the Budziszki find can be broadly classified among small, slender bimetallic 'ball brooches' with a short spring and two small, undecorated 'balls'. Such specimens are particularly characteristic of Jastorf culture materials from the middle Elbe basin, especially Brandenburg, as well as the Gubin group from the middle Oder region, which shows strong cultural ties with the former area (Bieger 2003, 54-57, pls 42-44, 55-57; Grygiel 2018, 115, 116, fig. 55). In graves, they usually appear in pairs, and are often accompanied by an elongated belt hook, which is why they are interpreted as an element of women's costume (Domański 1975, 16; Bieger 2003, 53, 55, 56).

However, the Budziszki artefact stands out due to two features: the arrangement scheme and the shape of the decorative 'balls' (the latter of which, contrary to the term, are sometimes far from spherical). It represents the so-called scheme C according to A. Bieger (2003, 17, fig. 5), as the rear 'ball' encloses and covers the junction where the bent foot meets the bow, so that both these wires protrude from the 'ball' in different directions – backwards and downwards, respectively (Fig. 6: 1a). Moreover, this preserved 'ball', with its distinctly flattened form, corresponds to specific cast decorations found on some 'ball brooches' in the shape of lenticular or hemispherical knobs (Bieger 2003, 22, fig. 13). Scheme C and such more or less flattened 'balls' are primarily characteristic of bimetallic or all-bronze brooches from the northern part of the Jastorf culture (northern and north-eastern Germany), especially those classified as variant O by R. Beltz (*cf.*, Bieger 2003, 33, fig. 23, with references). These patterns probably spread from this region to Jutland and the Danish islands, including Bornholm, where – presumably – they gave rise to further brooch variants, occasionally featuring hemispherical bronze knobs cast together as a single element. The latter forms are now increasingly being recorded in northern Poland. However, most of these 'northern' specimens differ significantly from the Budziszki find. They tend to be stockier, have long, multi-coil springs, and their knobs are often decorated with incised ornamentation, sometimes filled with enamel (Bieger 2003, 41-53, pls 28-38, 105, 106; Andrzejowski and Maciałowicz 2017, 188-198, figs 9 and 10; Grygiel 2018, 118-120, fig. 56).

Meanwhile, among the aforementioned small, slender bimetallic brooches from the middle Elbe and Oder river basins, other 'ball' arrangement schemes are clearly predominant: in scheme A2, the rear 'ball' encloses only the bent foot and is not connected to the bow, while in scheme B – similar to scheme C – the 'ball' covers both the foot and the bow,

but is cast farther forward, away from the bend of the bow, so that both wires emerge from the rear of the 'ball', side by side (Bieger 2003, 54, 56, 60, figs 33A, 34A, 36A). Moreover, their bronze-cast decorations typically have the form of quite regular balls or are ring-shaped. Identifying specimens analogous to the Budziszki find in terms of the arrangement scheme and the shape of the 'balls' is challenging due to often imprecise illustrations and descriptions in the literature, as well as the poor preservation of many artefacts. However, a few more or less similar examples can be identified, mainly from western Brandenburg. The find from the settlement at Brück (Fig. 8: 1), although preserved only fragmentarily, confirms the presence in this region of small iron brooches fitted with pairs of flattened, undecorated bronze 'balls' arranged according to scheme C (Gustavs 1977, 66, fig. 3: e). A second example may be a brooch from the cemetery at Derwitz (Fig. 8: 2), which bears a close resemblance to the artefact from Budziszki (Bieger 2003, 81, 152: no. 343, pl. 42: 4). The state of preservation of four other brooches with flattened or hemispherical knobs – from Brielow (Grave 25), Bücknitz, Glienecke (Grave 19), and Großbeuthen (with three knobs) – makes it either impossible to determine their arrangement schemes or they represent the much more common scheme A2 (Bieger 2003, 150: no. 297; 151: no. 318; 154: nos. 373, 385, pls 43: 3, 13; 54: 3; 56: 6). Brooches with such features also occur sporadically in eastern Brandenburg, *e.g.*, in Frankfurt (Oder)-Nuhnen, Grave 2,

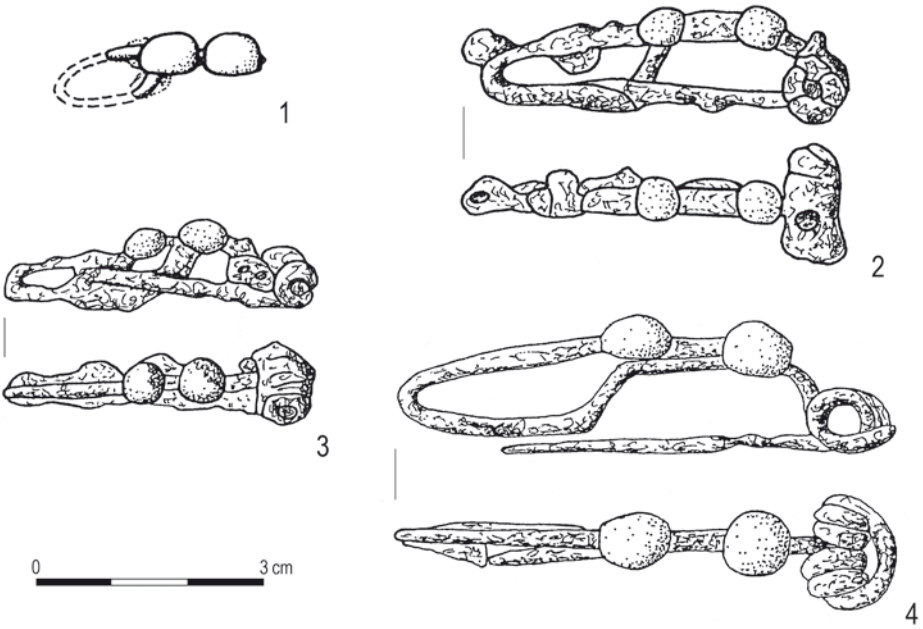

Fig. 8. Small, slender bimetallic 'ball brooches' with flattened knobs from Germany:
1 – Brück; 2 – Derwitz; 3 – Schwechow, Grave 24; 4 – Mannheim-Straßenheim.
After: Gustavs 1977 (1) and Bieger 2003 (2-4)

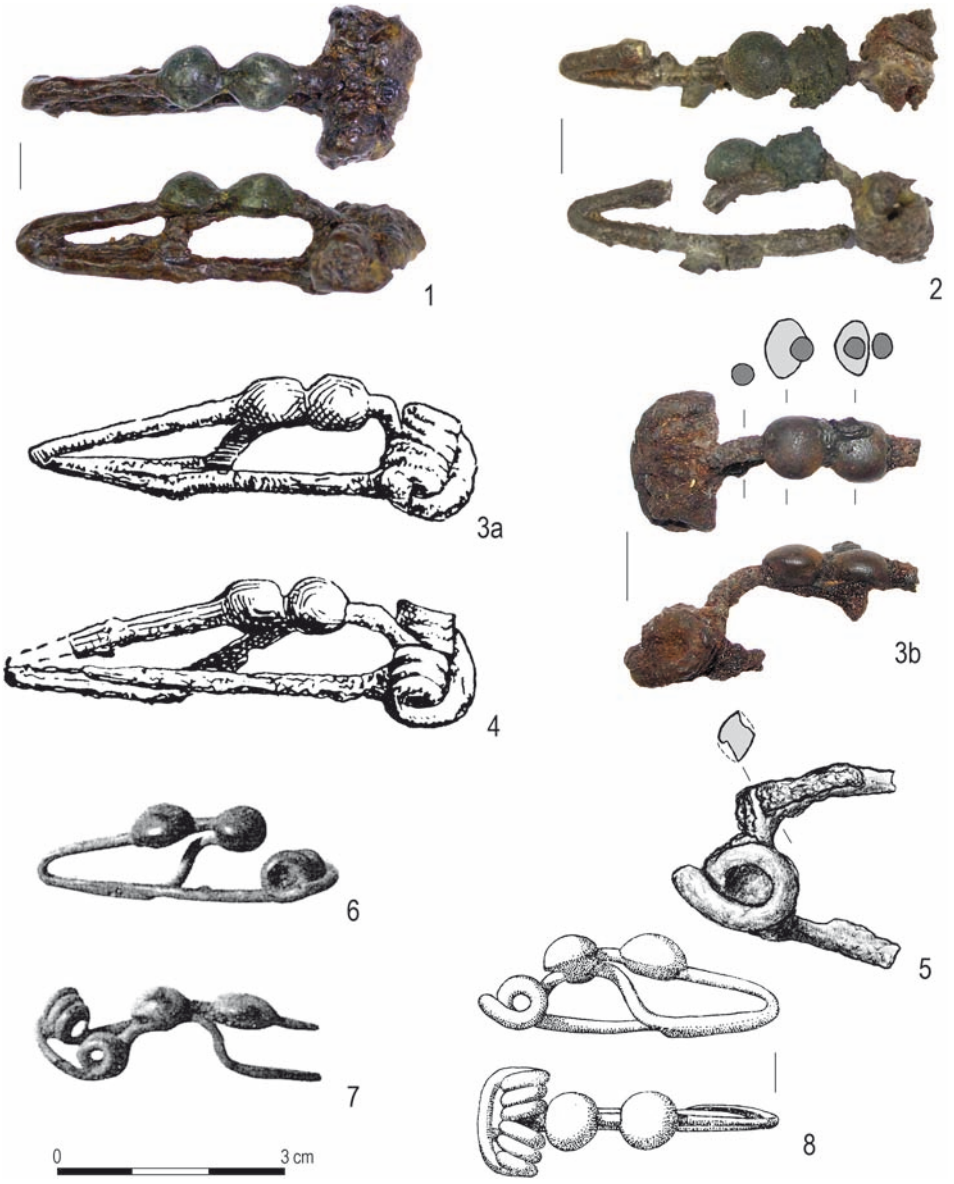

Fig. 9. Small, slender bimetallic (1-4) or bronze (6-8) 'ball brooches' with flattened knobs, as well as a fragment of an iron Gebhard Type 19d brooch (5): 1 – Domaniowice, Grave 85; 2 – Domaniowice, Grave 93; 3-5 – Nowe Miasteczko, Grave 2; 6, 7 – Ústí nad Labem-Neštěmice, Grave 39; 8 – Stradonice. After: Tackenberg 1929 (3a, 4), Mähling 1944 (6, 7), and Břeň 1964 (8); photo by E. Przechrzta, processesed by A. Maciałowicz (1, 2; collection of Archaeological Museum of the Middle Oder Region in Zielona Góra, based in Świdnica, inv./cat. nos MAŚN 2329/1969:1362, MAŚN 2337/1969:1388); photo & drawing by A. Maciałowicz (3b, 5; collection of Archaeological Museum, Branch of the City Museum of Wrocław, inv. no. MAW/III/2220)

in Mecklenburg, *e.g.*, in Schwechow, Grave 24 (Fig. 8: 3), and even – as a distant import – in Mannheim-Straßenheim in Baden-Württemberg (Fig. 8: 4; *cf.*, Lienau 1930, 221, pl. 6/I: 7, 8; Bieger 2003, 144: no. 197; 165: no. 559, pls 42: 6; 61: 4). It is also worth noting that small, slender brooches with flattened 'balls', though made entirely of iron, are also known from western Brandenburg (Bieger 2003, pls 77: 6; 102: 1, 2).

In the context of only partially analogous finds – those with different 'ball' arrangement schemes, sometimes featuring hemispherical knobs – it is important to highlight four brooches from the cemeteries of the Gubin group of the Jastorf culture in Lower Silesia (Fig. 9: 1-4): two from Nowe Miasteczko (formerly Neustädtel), Grave 2 (Tackenberg 1929, 244, fig. 5: 9, 10) and two others from Domaniowice, Graves 85 and 93 (Kołodziejski 1973, 128, fig. 7: f; Grygiel 2018, 120, fig. 56: 13, 14). The examples from Domaniowice differ not only in the arrangement scheme but also because both bronze hemispherical knobs were cast as a single, profiled decoration. Contrary to recent claims (Grygiel 2018, 120, 126), at least one brooch from Grave 2 at Nowe Miasteczko had two separately cast 'balls', as demonstrated by the preserved specimen with scheme A2 (Fig. 9: 3b). Very similar examples made entirely of bronze and arranged in scheme A2 are also known among 'ball brooches' of the Jüchsen variant. Several of these feature flattened or hemispherical, especially rear knobs (Fig. 9: 6-8), such as the specimen from Greppin in Saxony-Anhalt and three more from Bohemia: two from the Podmokly group cemetery at Ústí nad Labem-Neštěmice (formerly Nestomitz), Grave 39, and one from the Celtic oppidum at Stradonice – probably an import from the latter cultural milieu (Mähling 1944, 117, 200, pl. 29: 2a, 2b; Břeň 1964, 219: no. 276, pl. 5: 276; Bieger 2003, 32, pl. 1: 3-5, 12).

Despite the differences in arrangement schemes (C or A2) and variations in the exact shape of the 'balls' – which are, however, always flattened (flat-spherical or hemispherical) – it can be argued that the discussed artefacts represent the same stylistic phenomenon. They reflect a shared aesthetic within a group of small, slender 'ball brooches' characteristic of the middle (and upper) Elbe and Oder river basins. The fact that certain specimens from the Gubin group were decorated with hemispherical knobs (cast as a single element in a few finds from Domaniowice) has been interpreted as a possible result of northern European stylistic influences, especially from Bornholm (Grygiel 2018, 118-120). While such inspiration cannot be ruled out in specific cases, it seems more likely that the flattened 'balls' of the examples from Brandenburg (and Budziszki) reflect stylistic trends originating in northern and north-eastern Germany. This is supported by the closer connections – evident in the distribution of various 'ball brooch' variants – between Brandenburg and regions such as Holstein and Mecklenburg-Vorpommern, rather than with the aforementioned Baltic island (*cf.*, Bieger 2003, 56, maps 4, 5, 8, 14, 20). From the middle Elbe, this stylistic current, already somewhat modified, may have reached culturally related groupings such as the Gubin group in Lower Silesia and the Podmokly group situated around the Elbe ravine between Saxony and Bohemia (Fig. 10).

Small, slender bimetallic 'ball brooches' from the middle Elbe basin are generally dated to phases LT C1b-C2, with an emphasis on the latter (Bieger 2003, 80, 81, fig. 46). Specimens following scheme C appear to emerge slightly later, in LT C2, and may have remained in use into the early LT D1 phase. For instance, the aforementioned brooch from Brück can presumably be dated to the beginning of the Late La Tène period, as it was accompanied by fragments of a wheel-thrown vessel attributed to that time, confirmed by parallels from grave assemblages with well-established chronologies (Gustavs 1977, 66, 67, fig. 3: a; *cf*., Müller 1985, 119, pl. 71: 7). It is also possible that the brooch from Derwitz – closely resembling the Budziszki find – originates from a context dated to the beginning of phase LT D1 (Bieger 2003, 81, 152: no. 343). As for the brooches from the Gubin group, decorated with pairs of flattened or hemispherical knobs (arranged according to scheme A2), they are generally dated to phase A1b of the LP-RP, which aligns with the bulk of phase LT C2 (Grygiel 2018, 126, 134-135, fig. 62: 17). It is worth noting, however, that in grave 2 at Nowe Miasteczko, the pair of brooches was accompanied, among other items, by a fragment of a brooch of Gebhard Type 19d (Fig. 9: 5; Tackenberg 1929, 244, fig. 5: 7).

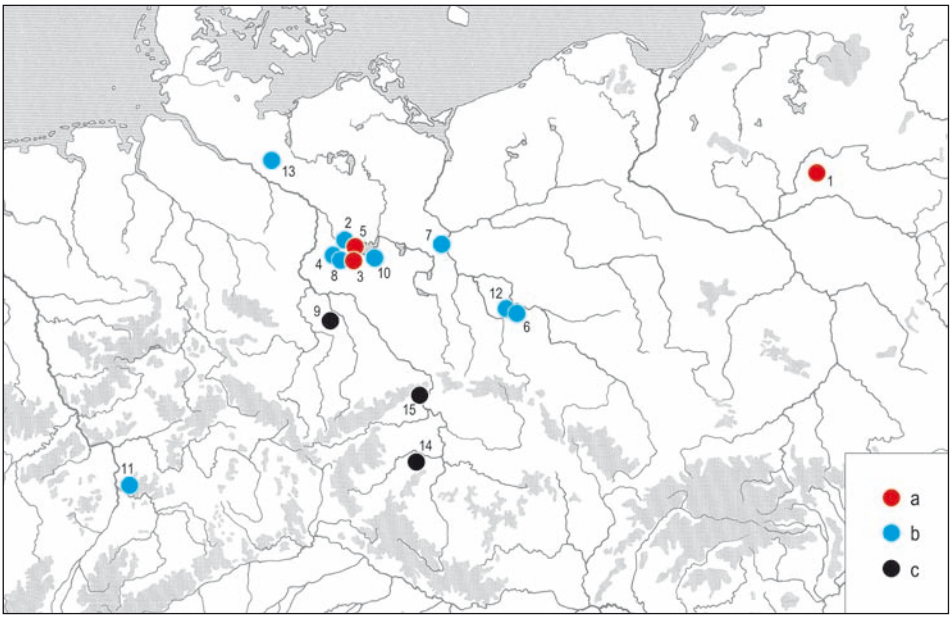

Fig. 10. Distribution of small, slender 'ball brooches' with flattened knobs, mentioned in the text: bimetallic specimens, possibly with scheme C (a) or other (b), specimens made entirely of bronze with scheme A2 (c). 1 – Budziszki; 2 – Brielow; 3 – Brück; 4 – Bücknitz; 5 – Derwitz; 6 – Domaniowice; 7 – Frankfurt (Oder)-Nuhnen; 8 – Glienecke; 9 – Greppin; 10 – Großbeuthen; 11 – Mannheim-Straßenheim; 12 – Nowe Miasteczko; 13 – Schwechow; 14 – Stradonice; 15 – Ústí nad Labem-Neštěmice. Graphics by A. Maciałowicz

Table 1. Chemical composition of the bronze 'ball' on the brooch from Budziszki (in wt%)

Al	Si	P	Mn	Fe	Ni	**Cu**	Zn	As	Ag	**Sn**	Sb	Au	**Pb**	Bi
0.12	0.85	0.04	0	0.21	0.01	**67.46**	0	0.17	0.07	**8.16**	0	0	**22.91**	0

This type represents a transitional form between Types B and C in J. Kostrzewski's typology (1919), and its dating within both the La Tène and Jastorf cultures falls at the end of LT C2 and beginning of LT D1. This corresponds well with its recently proposed dating in the Przeworsk culture to the newly defined A2a stage (Gebhard 1991, 82, fig. 42; Mistewicz *et al.* 2021, 96-102).

The decorative 'balls' were cast onto the formed bow and foot of the brooch, probably using the lost-wax technique. An analysis of the chemical composition of the preserved 'ball' on the brooch from Budziszki, performed using the SEM-EDS method at the Bio- and Archaeometry Laboratory of the Institute of Archaeology and Ethnology of the Polish Academy of Sciences in Warsaw (equipment: SEM Tescan Vega 4 and Ultim Max Oxford Instruments), showed that it was made of lead-tin bronze (Table 1). The addition of lead increases the alloy's fluidity and lowers its melting point, but the measured lead content of 22.91% is surprisingly high. There are no directly comparable data for similar 'ball brooches' from the middle Elbe or Oder basins. However, in the case of bronze brooch elements from northern Germany and either northern European imports or their local derivatives found in Poland, lead is often a significant component, typically up to ca. 10%; specimens exceeding 20% lead content are rare (*cf.*, Meier 2000; Andrzejowski and Maciałowicz 2017, 196, 197, table 1; Bokiniec 2005, 162, 163, appendix 4). Heavy leaded bronzes are also known from the La Tène culture, for example, in the Czech Republic. A sudden increase in lead content occurred during phases LT B2b-C1, *i.e.*, during the period of the so-called 'plastic style', which required casting small, sharply profiled decorative details (Danielisová *et al.* 2021, 278, 279, fig. 3). In turn, although the average lead content in bronze artefacts decreased during the Late La Tène period, some items found in oppida – such as '4-ray wheel amulets' or fragments of imported metal vessels – display chemical compositions very similar to that of the Budziszki brooch (Danielisová *et al.* 2018, 11, table 1; 2020, 38, table 2). Given the current lack of comparative data, particularly from 'latènized' cultures, it is difficult to draw definitive conclusions from this similarity. It is also important to consider alternative explanations for the high lead reading in this sample – for example, repeated remelting (recycling) of metal prior to casting (*cf.*, Meier 2000, 127), or the possible presence of a lead inclusion in the analysed portion, as this metal tends to form such inclusions in copper alloys (Schwab 2014, 177, 178, fig. 4; Mecking 2020, 10).

In conclusion, the Budziszki brooch was most likely produced within the Jastorf culture milieu of the middle Elbe basin, probably in western Brandenburg, where such items were a common component of women's attire. Given the presence of similar brooches in

the Gubin group on the middle Oder – strongly connected culturally with Brandenburg – the role of its communities in transmitting the object far to the east cannot be ruled out (Fig. 10). Based on the dating of counterparts in the Jastorf culture, the Budziszki brooch should most likely be assigned to stage A1b or possibly the beginning of phase A2 (probably stage A2a) in the relative chronology of the Przeworsk culture.

STONE POLISHER

A small pebble, made of quartzite or possibly sandstone (according to the expert opinion of Dr hab. Prof. PAN Łukasz Kruszewski of the Institute of Geological Sciences, Polish Academy of Sciences), was discovered in the grave. Its flattened and polished surface bears numerous, clearly visible traces of friction (Fig. 11). Similar artefacts are commonly found in burials of the Przeworsk and Oksywie cultures with a predominantly female grave goods and are usually interpreted as stone polishers (*e.g.*, Dąbrowska 1997, 98; Bokiniec 2005, 104; Czarnecka 2007, 90, 91). Although this interpretation was initially based solely on assumptions, a small number of traceological analyses have since confirmed that these tools were likely used to smooth the surfaces of clay vessels or leather (Mistewicz *et al.*

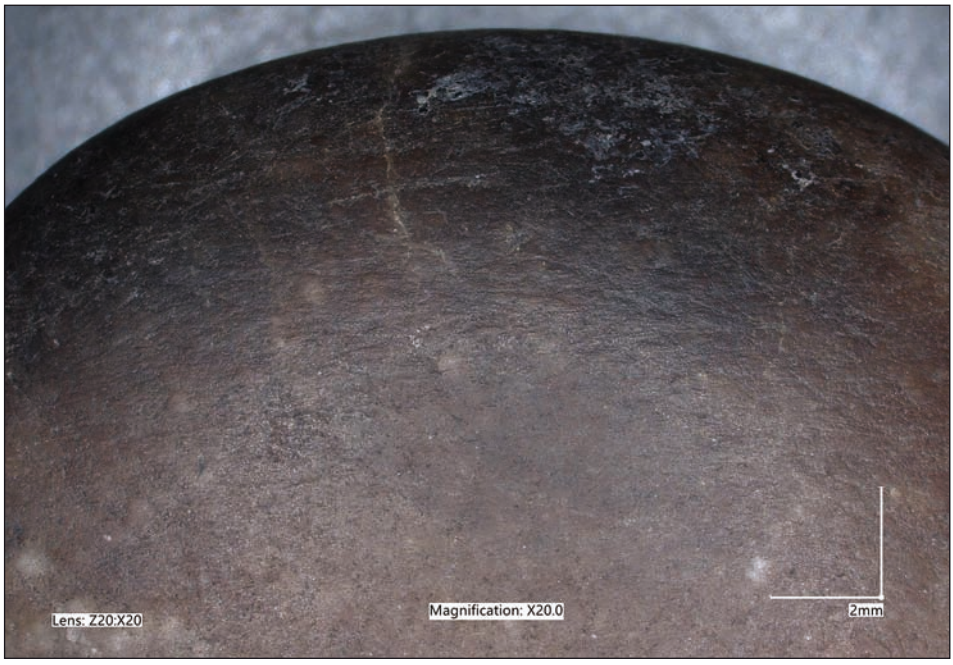

Fig. 11. Budziszki, Site 2. Traces of use of the stone polisher from Feature 158 (urn grave) viewed with 20x magnification. Photo by K. Pyżewicz

2021, 156, 157, with further references). In both of the aforementioned cultural groupings, stone polishers are documented as early as stage A1b following the chronology of M. Grygiel (2018), as evidenced by associated brooch types (Kaszewska 1962, pl. 16: 3, 4; 2023, pls 35/43: 1, 3; 60/154: 1, 4; Bokiniec 2005, pl. 67/160: 7-9). By contrast, such tools are absent from graves of the Jastorf culture in the middle Elbe region and appear only as exceptional finds in its Gubin group (Lewczuk 1993, 178, fig. 1: 7). Their presence there is probably the result of influence of the funerary practices of the Przeworsk culture.

VESSEL

The mug used as an urn, despite its slight asymmetry, has a clearly biconical shape, defined by a gentle inward inclination of the upper part of the body and a subtly marked carination, below which the walls narrow sharply toward a very small-diameter base (Fig. 7). Its precise classification is difficult, but it clearly refers to Przeworsk culture mugs, Types I.1 and I.3 (Dąbrowska 1973, 500; 1997, 102). The wide, horizontally extended rim with clearly defined edges, resulting from careful multiple faceting from the outside, corresponds to variant 'a' according to T. Dąbrowska (1973, 499; 1997, 101), or Type A.1 according to A. Mistewicz, A. Maciałowicz and M. Woźniak (2021, 166, 167). This rim form suggests an early date within the LP-RP, most likely phases A1b-A2a as per the latter authors.

Przeworsk culture mugs with a strongly profiled, biconical body are rarely found in phases A1-A2. Typically, the upper sections of these mugs are directed upwards, even if slightly rounded as in Type I.1. This trend clearly distinguishes early Przeworsk pottery from vessels of the so-called Jastorf culture in the Polish Lowland (hereinafter: JCPL), as well as from the Gubin group and the Oksywie culture, where mugs and vases with a distinct carination are relatively common (*cf*., Domański 1975; Strobin 2011; Grygiel 2015). Consequently, only a few A1-A2 vessels from the Przeworsk culture resemble the Budziszki find, and the generally poor preservation of both grave and settlement ceramics complicates direct comparisons. A few comparable vessels from Mazovian cemeteries are known (Fig. 12: 1, 4, 6); among them, only the specimen from Grave 77 in Warsaw-Wilanów is dated to A1b, while the rest belong to phase A2, most likely its later stage A2b (*e.g*., Marciniak 1957, pl. 70: 1; Okulicz 1971, fig. 44: f; Czarnecka 2007, pl. 223/274: 7; Mistewicz *et al.* 2021, pl. 19/30: 3). Some stylistically related but larger vessels from this region are closer to vases than mugs (Okulicz 1971, fig. 44: e; Oporska 2005, 21, pl. 8: 4).

More biconical mugs – including 'large', rather stocky examples – are found in the western Przeworsk zone (Fig. 12: 2, 3, 5), such as in Greater Poland, Kujawy, and Silesia (*e.g*., Seger 1902, fig. 4; Wydra 1939, fig. 1; Wiślański 1959, fig. 61: 1, 2; Kokowski 1989, figs 37: 2; 43: 3; Martyniak *et al*. 1997, pl. 61: 3; Kaszewska 2023, pl. 141/471: 2; possibly also Bokiniec 1999, figs 5/5: 1; 9/14: 4; 9/17: 1). Notably, some of these come from well-dated A1b and A2a assemblages. In Mazovia, this mug body style became more common only at

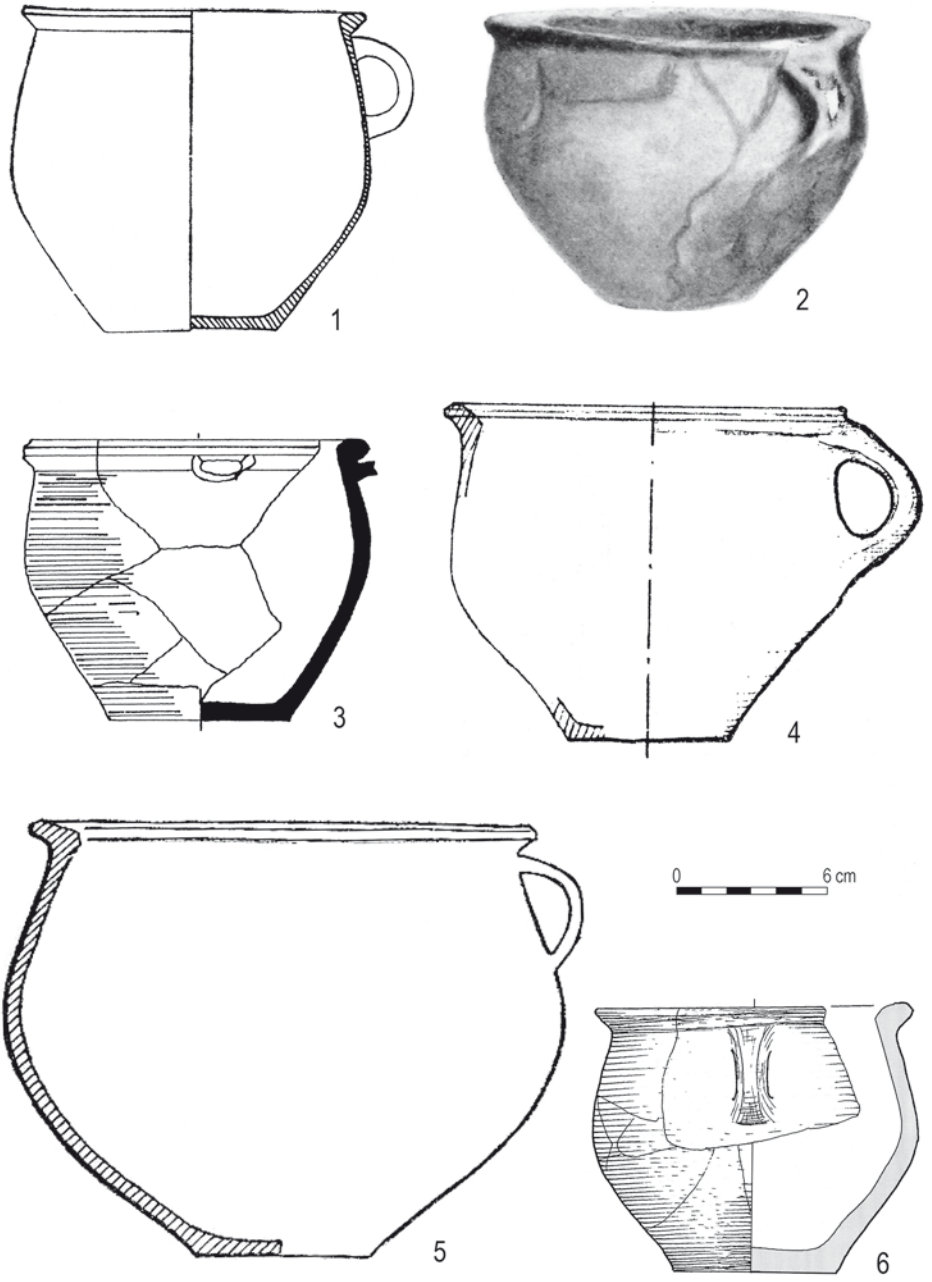

Fig. 12. Przeworsk culture mugs and the 'large mug' (5) with slightly biconical bodies.
1 – Warsaw-Wilanów, Grave 77; 2 – Bartodzieje, Grave 10; 3 – Zadowice, Grave 471; 4 – Dobrzankowo, Grave 34; 5 – Strzelce, Grave; 6 – Oblin, Grave 274. After: Marciniak 1957 (1), Seger 1902 (2), Kaszewska 2023 (3), Okulicz 1971 (4), Wiślański 1959 (5), and Czarnecka 2007 (6)

the end of the LP-RP, as shown by finds from Oblin cemetery (*e.g.*, Czarnecka 2007, pls 125/128a: 13; 133/134: 8; 244/292: 15), often accompanied by Nauheim and Ma.1-type brooches or Bohnsack Type 5/6 shield bosses, *i.e.*, indicators of the A2/A3 stage (*cf.*, Maciałowicz 2015, 423, 424, footnote 37; 2017, 91-94).

Very similar mugs, including 'large' ones, are also known from the Oksywie culture, especially in the lower Vistula region (*e.g.*, Heym 1961, figs 3: 12; 9: 21; 10: 13; Bokiniec 2005, pls 11/25: 1; 17/37: 1), and more sporadically in the Gubin group (Domański 1975, pl. 22: i). Indeed, pottery from both groupings shows strong parallels to Przeworsk culture ceramics.

Numerous examples of biconical mugs and vases – though typically with differently shaped rims – are also found among settlement materials of the JCPL, often predating the emergence of the Przeworsk culture proper, particularly in Kujawy, adjacent parts of central Poland, and western Mazovia. Some are dated to the Early Pre-Roman period (*e.g.*, Kaczor *et al.* 2017, pls I.105: 4; II.18: 6; II.24: 13; II.28: 12; Grygiel 2018, fig. 144: 7), others are associated with the LP-RP, probably phase A1 (*e.g.*, Tomaszewska 1998, fig. 55: 2; Grygiel 2018, pl. 59: 1; Tyszler and Nierychlewska 2018, fig. 42: 1).

The Budziszki mug is therefore most likely a product of the Przeworsk culture, though it represents a relatively rare form in its ceramic repertoire. This cultural attribution is supported particularly by the shape of the wide, horizontally extended rim, which is carefully faceted from the outside. This feature clearly sets the vessel apart from the mugs and vases of the JCPL. Given the strong stylistic and technological similarities between vessels of both these cultural groupings, rim shape and faceting style often serve – albeit imperfectly – as distinguishing criteria for identifying tableware from the JCPL's latest horizon versus the early Przeworsk culture (*cf.*, Grygiel 2015; 2018, 301-303, 314, 317, 323). Assuming that both cultures represent not two separate phenomena but successive stages of transformation within one cultural cycle originating in the Polish Lowland at the end of the Early Pre-Roman period (*cf.*, Grygiel 2004), then the biconical shape of the Budziszki mug (and other similar Przeworsk culture vessels) may be interpreted as a 'legacy' of JCPL ceramic traditions.

Finally, the rim – so significant for cultural attribution – also points to a date in phases A1b-A2a, consistent with the chronological position of the brooch found in the same grave.

BURIAL RITE

The characteristics of the grave from Budziszki – an isolated urn burial (*i.e.*, one located outside a cemetery) in an inverted mug, placed in a pit without the burnt remains of a funeral pyre – deviate from the general burial norms of the Przeworsk culture during the LP-RP.

Isolated burials are not typical for this cultural grouping. The few known cases may result from extensive destruction of the site, potentially leading to the total loss of other graves, or from limited exploration of the area (*cf.*, Antosik and Piotrowska 2023, 184,

185). This possibility also applies to accidental finds. In the case of Budziszki, the use of the site area for agriculture, the shallow depth of the grave (approximately 20 cm below the surface), and possible disturbance of the fill might, in theory, render the former explanation plausible. However, the archaeological research conducted at the site – including the use of a metal detector – would probably have revealed artefacts from destroyed graves, had a larger Late Iron Age cemetery been present. As for the latter explanation, the grave was located about 10 m from the south-western edge of the excavation area (Fig. 3), so the possibility of additional graves lying just beyond the explored zone cannot be entirely ruled out. Nevertheless, based on the dating of the grave goods and comparative evidence from other early finds in eastern Mazovia (see below), one may cautiously propose that this is indeed an isolated burial.

The absence of large cemeteries and the predominance of single, isolated graves are particularly characteristic of the JCPL, especially during phase A1 (Grygiel 2004, 50-59; 2015, 144). These burials show considerable variety, though urn graves predominate – both with remains of the funeral pyre and the so-called 'clean' burials without burnt debris. The accompanying inventories typically included one or two clay vessels, and sometimes a brooch or small metal tools (*cf.*, Grygiel 2018, 458-514, list 31). Very often, a mug was the only vessel deposited in the grave (though not always used as an urn), occasionally accompanied by fragments of a larger vessel. Of particular interest is an isolated urn grave with burnt debris discovered in Grodziszcze in the Lubusz Land (Żychliński and Przybytek 2008). As in the Budziszki find, a partially preserved, inverted cup was found, containing burnt human bones and a fragmentary small iron brooch. The latter – contrary to the source publication and a later study (Michałowski and Żychliński 2012) – probably represents a form of Middle La Tène construction, and according to M. Grygiel (2018, 298, 472), should be dated to stage A1a (LT C1).

Graves containing little more than a single mug – occasionally with an added brooch or small tool – occur sporadically across various Przeworsk culture cemeteries, but they are particularly numerous in several necropolises in northern and western Mazovia, central Poland, and Kujawy (Maciałowicz and Woźniak 2015, 245-248; *cf.*, recent find in: Antosik and Piotrowska 2023). These graves are primarily associated with child burials, though some contained adult remains (Maciałowicz 2006, 320, 321; Mistewicz *et al.* 2021, 195, 196), as was the case in Budziszki. In a few instances (*e.g.*, Oblin, grave 111; Suchodół, Graves 24, 27, 40, and 99; Zadowice, Grave 418), mugs were placed upside down (Maciałowicz 2006, 319; Czarnecka 2007, 36, pl. 115/111; Kaszewska 2023, 87, pl. 128/418: 1). It is possible that this distinctive model of grave furnishing – so different from standard Przeworsk culture practice – reflects the survival of certain elements of JCPL funerary traditions, although influences from Early Iron Age customs cannot be excluded (Maciałowicz and Woźniak 2015, 247, 248).

Despite the absence of a comprehensive, up-to-date study on Przeworsk culture burial customs, it is worth examining the occurrence of early urn burials to contextualise the

grave from Budziszki within the broader framework of this grouping. Such burials are recorded as early as phases A1-A2 across various regions, especially in western and central Poland, though they remained relatively rare at that time (*cf.*, Niewęgłowski 1981, 28-32, map II). Against this background, north-eastern Greater Poland and the adjacent part of Kujawy stand out. Early-established cemeteries from phases A1b-A2a – such as those at Krusza Zamkowa, Mogilno, Świerkówiec, and possibly Wszedzień (Sites I and II) – show a relatively high frequency of urn graves, both with pyre remains and so-called 'clean' types (Kostrzewski 1919, 345, 346; Kokowski 1989; Bokiniec 1999, 126; Smaruj 2023, 196-201). A second region with similarly early urn burials is the Wkra River basin in northwestern Mazovia. In some cemeteries in this area, urn graves dated to phases A1-A2 comprise between 36% and 70% of the assemblages (Table 2), although the lower range may be underestimated due to grave disturbance at Dobrzankowo. The oldest urn burials here – at Dąbek (Site 9) and Stupsk – can be dated to phases A1b and A2a (Mistewicz *et al.* 2021, 191, 192, 213). By contrast, in major cemeteries in other parts of Mazovia (*e.g.*, Kamieńczyk, Oblin, Warsaw-Wilanów), urn graves from phases A1-A2 are relatively infrequent. The higher frequencies (17-50%) cited by T. Dąbrowska (2008, 14, 15) are inflated by the inclusion of clearly later burials containing Nauheim, J, and Ma.1-type brooches and Bohnsack Type 5/6 shield bosses, which indicate a dating no earlier than phase A2/A3 (see above).

For this study, we re-examined early grave chronologies from the largest cemeteries across Mazovia, including only those with clear A1-A2 phase markers or exclusively early pottery forms (Table 2). The urn grave frequencies based on this stricter criterion are approximately 9-10% at Kamieńczyk and Oblin, and only 1.5% at Kleszewo – all three located in right-bank Mazovia. Only at Warsaw-Wilanów, situated on the left bank of the Vistula in central Mazovia, does the proportion exceed 16%. Notably, this is the only site where urn graves can be securely dated to phase A1b; elsewhere, there is no basis for dating them earlier than stage A2b, *i.e.*, the horizon of Type K brooches (*cf.*, Mistewicz *et al.* 2021, 98-102). Thus, in most parts of Mazovia outside the northwest (the Wkra river basin), early Przeworsk urn burials are rare (left-bank central Mazovia) to very rare (east of the Vistula), and the jump in their frequency occurred no earlier than in stage A2/A3.

In the Przeworsk culture, urns were generally placed upright in graves. Instances where a mug or bowl containing cremated remains was placed upside down are exceptional and, again, seem to be concentrated in north-eastern Greater Poland and Kujawy (*e.g.*, Kokowski 1989, 67, fig. 29: 1; Bokiniec 1999, 126, fig. 6/7; Smaruj 2023, 198). Urn burials – usually of the 'clean' type – were also frequent in the Jastorf culture, both in its core area along the middle Elbe and in the Gubin group on the Oder (Domański 1975, 74-77; Seyer 1982, 80, 81; Müller 1985, 44, 45). While some of these urns include mugs resembling Przeworsk culture Types I.1 and I.3 (Kasiński 2010), none precisely match the biconical vessel from Budziszki, and they were usually placed upright. A notable exception is the site at Ladeburg in eastern Saxony-Anhalt, where eight burials dated to the LP-RP were discovered in

Table 2. Frequency of urn burials among graves from phases A1-A2 in selected Mazovian cemeteries of the Przeworsk culture (based on: Marciniak 1957; Reinbacher 1964; Okulicz 1971; Dąbrowska 1997; Ziemlińska-Odojowa 1999; Czarnecka 2007; Mistewicz *et al*. 2021; Woźniak 2021; 2023; Grzymkowski 2023 and the collection of the Museum of Ziemia Zawkrzeńska in Mława; with the dating of the grave assemblages re-examined)

Region	Site	Frequency	Graves dated to phases A1-A2 (urn burials marked in bold)
north-western Mazovia	Dobrzankowo	**36.4%** (4/11)	4, 6, 8, **10**, 11, **12**, 15, **23**, 31, 32, **34**
	Dąbek (site 9)	**41.6%** (15/36)	**8**, 9, **11**, 12, 13, **20**, 22, **23**, **24**, **27**, 28, 29, 30, 31, 32, **33**, 38, **39**, 40, **41**, 42, **44**, **45**, **46**, 47, **49**, **50**, 51, 52, 53, **54**, 55, 57, 58, 68, 69
	Stupsk	**57.1%** (8/14)	**23/1917**, **24/1917**, **11/1988**, **12/1988**, 16/1988, 20/1988, **24/1988**, 34/1988, **20/1991**, 23/1991, 6/2004, **7/2004**, **2/2014**, 5/2014
	Niedanowo	**70%** (7/10)	**16**, 29, 46, **48**, **49**, **72**, **94**, 436, **469**, **470**
north-eastern Mazovia	Kleszewo	**1.5%** (1/68)	3, 9, 10, 12, 13, 22, 27, 28, 29, 37, 38, 41, 45, 47, 51, 59, 63, 64, 68, 70, 73B, 74, 77, 81, 89, 92, 102, 103A, 110, 111, 117, 122, 128, 144, 147, 157, 165, 200C, 200D, 203, 212, 236, 283, 314, 402, 407, 409A, 476, 591, 596A, 606, 608, 620, 637, 655, 692, 713, 714, 717, 797, 798, 830, 832, 837, 885, 920, 946, **985**
eastern Mazovia	Kamieńczyk	**8.8%** (3/34)	2, 5, 26, 28, 82, 83, 95, 96, **115**, 119, 176a, 318, 321, 323, 325, 330, **331**, 332, 356, 357, 364, 365, 367, 369, 372, **374**, 376, 377, 382, 383, 384, 386, 394, 396
southern Mazovia	Oblin	**10%** (1/10)	68, 101, **106**, 171, 187, 191, 205, 261, 273, 274
central Mazovia	Warsaw-Wilanów	**16.4%** (11/67)	**4,** 5, **7**, 10, 11, **12**, 14, **15**, 16, 17, 21, 22, 24, 25, 26, 27, **28**, 29, **31**, 34, 35, 36, 37, **38**, 42, **47**, **49**, 51, 53a, 53b, 55a, 55b, 56, 57, 59, 60, 61, 62, **66**, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 79, **81**, 82, 83, 85, 86, 87, 88, 89, 90, 91, 93, 96

an earlier Jastorf culture urnfield: five pit graves and three urn graves, all containing remains of a funeral pyre. In each of the three urn graves (Nos. 1, 2, and 5) there was a 'large mug' of Type I.1 placed upside down, inside which there were burnt human bones and – in the case of Graves 2 and 5 – small metal items (Grimm 1932; Müller 1985, 176, 177, pl. 108: 20-25; though later misclassified as pit burials – *cf*., Dąbrowska 1988, 160, 161; Meyer 2008, 164 – these clearly represent urn graves). The two associated brooches suggest a LT C2 date, roughly corresponding to the Przeworsk culture phase A1b. Despite their milder profiles and larger size, the urns from these three graves closely resemble the Budziszki mug in terms of general shape and proportions (Fig. 13). These finds are part of a broader phenomenon, where sites in eastern and central Germany yield Przeworsk-style pottery

Fig. 13. 'Large mugs' from urn graves in Ladeburg (from the left: Grave 1, 2, and 5). After: Grimm 1932

(*cf.*, Meyer 2008, 150-193). Recent studies devoted to the occurrence of 'large' mugs referring to Type I.1 (as in Ladeburg) among the materials interpreted as representing the Przeworsk culture may suggest, however, that their presence in the border zone of eastern Saxony-Anhalt and western Brandenburg is rather the effect of the kinship that this zone of the Jastorf culture shows with the Gubin group (Kasiński 2010 and pers. comm.). Notably, western Brandenburg also yielded the best analogies for the Budziszki 'ball brooch'.

In summary, the grave from Budziszki has no exact contemporaneous parallels within the Przeworsk culture of north-eastern Mazovia. Comparable early urn burials appear only in the Wkra basin and, to a lesser extent, in left-bank Mazovia. However, key aspects of the Budziszki burial find closer affinities with urn graves of the Przeworsk culture and the earlier, sparse sepulchral materials of the JCPL, found in western Poland. The striking resemblance to contemporaneous graves at Ladeburg – despite their inclusion of pyre debris – reinforces the broader cultural connections suggested by the imported brooch type.

DISCUSSION

Site 2 at Budziszki is located a dozen or so kilometres east of the previously recognised range of the LP-RP ecumene in north-eastern Mazovia (Fig. 14). It is situated approximately 60 and 45 km from the largest excavated cemeteries of the Przeworsk culture in the Narew and lower Bug river basins, namely at Kleszewo and Kamieńczyk, respectively. Both of these necropolises were most likely established during phase A2. The discovery of just one or two relatively early brooches of Middle La Tène construction, including Type C (Dąbrowska 1997, 114, 121, pl. 169/364: 1; Woźniak 2023, 139-141), suggests that this occurred towards the end of stage A2a (*cf.*, Mistewicz *et al.* 2021, 98-102). This aligns well with the overall picture of settlement network development in the eastern parts of Mazovia, as it is believed that this process took place markedly later here than in the western part of the country, specifically during phase A2 (Dąbrowska 2001, 29-31).

Unfortunately, the state of research in the immediate vicinity of the discussed site, *i.e.*, in the basin of the middle Narew, is far from satisfactory. Most of the sites recorded between

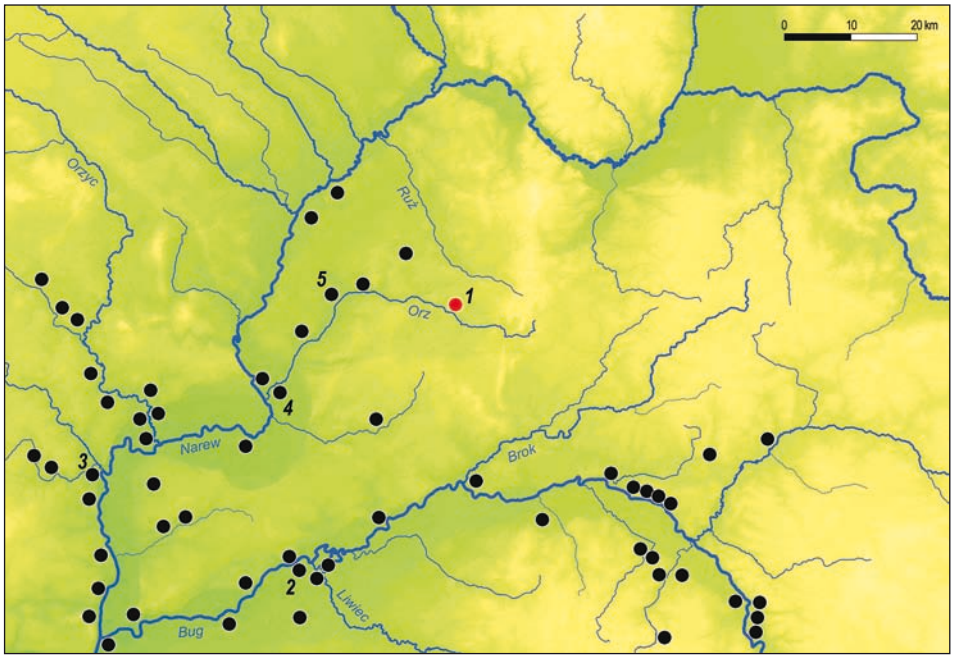

Fig. 14. Map of sites dated to the Late Pre-Roman Period in north-eastern Mazovia.
Locations mentioned in the text: 1 – Budziszki; 2 – Kamieńczyk; 3 – Kleszewo; 4 – Kunin; 5 – Tomasze.
Rendered by A. Maciałowicz, after: Dąbrowska 2008 with supplements

this river and the Orz and Ruż rivers are either so-called 'settlement spots' from which only a few pottery fragments were obtained during fieldwalking or settlements that were only slightly excavated, with the material from them not yet published (*cf.*, Dąbrowska 2008, 80, 81, 90, 91, map 2). As a result, there is no basis for a more precise dating of these finds beyond the general LP-RP framework. One of the exceptions is the Przeworsk culture settlement in Kunin, located at the mouth of the Orz river, where, among other things, an iron K-type brooch was found, confirming the use of this site since at least stage A2b (Przewoźna-Armonowa 1983). The second exception is a multicultural site in the village of Tomasze, located approximately 16 km west of the find from Budziszki. Among other discoveries, a Przeworsk culture settlement was found here, generally dated to phases A1-A2 based on pottery, but from which two artefacts associated with the JCPL also come: a small fragment of a clay 'firedog' and a bronze pin of the Holstein Type (Prochowicz 2017). These finds possibly represent a horizon preceding the emergence of the Przeworsk culture settlement, and should be attributed to the very beginning of the LP-RP (phase A1?) or even to the time of the turn of the Early and Late Pre-Roman Period, as suggested by the shape of the pin (*cf.*, Grygiel 2018, 172-174). A short distance from the settlement, a cremation cemetery was discovered and partially excavated, uncovering what are likely ten Przeworsk

culture pit graves (Oporska 2006). Based on the preserved artefacts – mostly small fragments of pottery (iron objects were lost, including pieces of unspecified 'brooches') – three of the graves (Nos. 3, 4, and 5) can be dated to phases A1-A2. The early dating is supported by a fragment of a mug or vase from Grave 5 (Oporska 2006, fig. 4/5: 3), whose wide band of ornamentation, placed directly under the rim, clearly refers to the decoration found on JCPL vessels from the beginning of the LP-RP (*cf.*, Grygiel 2018, pl. 26: 8; 37: 13; 58: 5; 77: 29, 30). Some early Przeworsk culture mugs (including 'large' ones) are similarly decorated, mainly found in western and central Poland, in graves dated by brooches to stages A1b and A2a (*e.g.*, Bokiniec 1999, fig. 5/5: 1; Kaszewska 2023, pls 34/44: 5; 35/43: 6).

The burial from Budziszki, dated to stage A1b, or possibly to the very beginning of phase A2, thus predates the establishment of stable, widespread settlement structures of the Przeworsk culture in north-eastern Mazovia. It is most likely associated with the formative stage of this grouping in the region and, therefore, with a period of increased human mobility, which was essential for the spread of cultural patterns. The presumably isolated character of the grave corresponds well with this context, suggesting the presence of a relatively small group of people and an unstable settlement. Moreover, the core elements of the cultural tradition reflected in this find – both in the burial arrangement and the form of the vessel used – show clear western affiliations, as the most significant number of analogies for both features can be found in the central and, especially, the western part of the country, where the Przeworsk culture had already taken shape during stage A1b and where its connections to the earlier JCPL substrate are clearly visible (which may also be the case with the grave in question). The surprising similarities in the form of the burial, which can be found in the three graves from Ladeburg in eastern Saxony-Anhalt, are currently difficult to interpret unequivocally, although they may not be entirely coincidental.

Distant western connections are also indicated by the 'ball brooch' discovered in the grave. It is undoubtedly the result of contact with the Jastorf culture milieu, most likely from western Brandenburg, although the involvement of communities from the Gubin group – closely culturally affiliated with that region – cannot be ruled out. In any case, it concerns the import of an object, rather than the origin of the woman buried at Budziszki, as the use of only one brooch to fasten her clothes and the lack of a belt hook correspond much more to patterns known from the Przeworsk culture than to women's fashion from the middle Elbe and Oder regions. Evidence of contacts with these areas, in the form of brooches, belt hooks, or the use of 'large mugs' for funerary purposes, has been recorded in phases A1-A2 in Silesia, Greater Poland, Kujawy, and Central Poland, as well as in some parts of Mazovia (*e.g.*, Grygiel 2018, 107-110, fig. 52: 8-13; Mistewicz *et al.* 2021, 93-97, 106-108, 128-134, 171, 172, figs 13, 15, 20; Teska *et al.* 2021). Interestingly, such artefacts are also found, for example, in the large necropolis at Kamieńczyk mentioned above, which suggests that impulses from the middle Oder – and perhaps even from more distant areas – could have reached eastern Mazovia as well (Mistewicz *et al.* 2021, 132 with footnote 140).

Surprising evidence of such – sometimes very far-reaching – connections with the broadly understood West is increasingly being recorded in right-bank Mazovia and the adjacent part of Podlachia. First of all, the number of sites with materials of the JCPL, of undoubtedly western provenance, has increased, suggesting a more intensive than previously thought penetration of these areas by the communities of this grouping at the very beginning of the LP-RP (Bryńczak 2017; Jurkiewicz 2021). In addition, from Kamieńczyk (though not from the mentioned cemetery site) and Grodzisk, both located along the lower and middle Liwiec River, come, respectively, a bimetallic 'winged pin' of the Eastern Mecklenburg-Vorpommern Type and a bronze torc with thickened cylindrical terminals (Andrzejowski and Maciałowicz 2017, 219, 220, fig. 28, with further references). These finds can be dated to the end of the Early Pre-Roman Period, or possibly to the very beginning of the LP-RP. Both artefacts, typical of the Jastorf culture proper in north-eastern Germany, stand out within the Przeworsk culture not only because of their bronze raw material and stylistic features, which did not match local aesthetic norms, but above all because such items were functionally alien to this milieu, where neck rings were virtually unknown as a form of ornament and pins were not used for fastening garments. The considerable distance between the core area of these forms and the places of their discovery, combined with the lack of other clear indications of contact between the regions, makes it difficult to account for their presence by indirect transmission alone. In light of numerous finds dated to the transition between the Early and Late Pre-Roman Period, they may be best understood as reflecting episodes of mobility among Jastorf culture representatives.

Also in the Liwiec area, fragments of two unique brooches were discovered – a bimetallic 'ball brooch' with analogies on Bornholm and a second, bronze brooch with a hemispherical decoration cast on the bow, which reproduces forms known from Gotland, but at the same time is ornamented in a way typical of brooches from Bornholm (Andrzejowski and Maciałowicz 2017, 188-205, figs 2: 1 and 13). These artefacts, despite their Baltic counterparts, are probably products made in the northern or western part of Poland, and can be dated to stage A1b, or possibly to the very beginning of phase A2, so they also generally preceded or were contemporary with the formation of the Przeworsk culture settlement network in the area in question. Similarly to the aforementioned torc and pin from the Jastorf culture, these finds attest to contacts in the borderlands of Mazovia and Podlachia with people for whom bronze costume fastenings were more familiar than they were to the Przeworsk population, where the use of brooches made of this metal is extremely rare at the beginning of the LP-RP (*cf.*, Maciałowicz 2021). Perhaps, therefore, the users of both of these loosely found brooches were individuals whose traditions were close to the JCPL, the inventory of which includes many different bronze costume accessories, including those with northern European connotations.

The unique burial from Budziszki broadens the spectrum of western connections from the beginning of the LP-RP recorded so far in right-bank Mazovia, reflecting the interplay of different cultural traditions. These may be associated with increased mobility of individuals

from the central or western part of the country, where the process of transformation of the JCPL into the Przeworsk culture had already begun, as well as with still unrecognised contacts with the Jastorf culture proper, whether its Gubin group on the Oder or other groupings in the Elbe basin, including the possible presence of some of its representatives in this region. These factors could have triggered profound changes, leading to the emergence of the Przeworsk culture here, based on the model already known from stage A1b in central and western Poland. It was only the complete formation of this grouping in stage A2b (horizon of Type K brooches) that led to the unification of the archaeological image of eastern Mazovia and the erasure of the mosaic of different, sometimes surprisingly exotic, cultural traditions recorded at the beginning of the LP-RP.

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CZERMNO / CHERVEN': SEASONS 2022 AND 2023. INTERDISCIPLINARY STUDIES ON SITE 2, *ZAMECZEK* (STRONGHOLD, SUBURB SETTLEMENT): CHRONOLOGY, ARCHAEOLOGICAL FEATURES, FINDS ANALYSIS

ABSTRACT

Dzieńkowski T., Trzeciecki M., Piątkowska-Małecka J., Ryndziewicz R., Jakubczak M., Chudzińska B., Rodzik J., Maziarczuk M., Florkiewicz I., Wajda S. and Wołoszyn M. 2025. Czermno / Cherven': seasons 2022 and 2023. Interdisciplinary studies on Site 2, *Zameczek* (stronghold, suburb settlement): Chronology, archaeological features, finds analysis, *Sprawozdania Archeologiczne* 77/2, 433-473.

The article discusses the results of the latest interdisciplinary studies on Site 2, 'Zameczek', a stronghold complex in Czermno (historical Cherven'). The fieldwork completed in 2022-2023 focused on Site 2 and included non-invasive investigations (GPR and LiDAR prospection), sondage excavation, laboratory analysis and conservation of archaeological finds, absolute dating, and desktop studies. The research objectives and questions formulated when embarking on the investigation of the suburb settlement addressed key issues related to its chronology and function. Another key task was recognising and recording the site's stratigraphy. The two seasons of sondage excavations yielded thirty-eight functionally distinct features interpreted as utility pits, remains of upright timbers, remnants of wooden communication structures, fragments of a rampart (?) and an eco-feature. The excavation of archaeological deposits and features belonging to Phases I and II yielded an assemblage of more than 37,000 objects, most of them pottery.

Keywords: Polish-Rus' borderland; Czermno/Cherven'; Site 2, stronghold suburb settlement; interdisciplinary research, chronology, archaeological features, fortification

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INTRODUCTION

For obvious reasons, research on the origins of Poland has long been dominated (and still is) by the study of Greater Poland, the region known as the cradle of the Polish nation and the domain of the Piast dynasty, the first ruling family (Kara 2020). Additionally, the focus of research was on the areas subjected to Piast expansion: the historical provinces of Pomerania, Silesia, Lesser Poland, and Masovia (synthetic studies: Buko 2021; see most recently: Urbańczyk 2024). Much less well recognised is the eastern periphery of Piast Poland, the region on the border between the Piast and Rurikid monarchies. Unfortunately, the same is true of the situation across the border, in Belarus', Ukraine and Russia, where the primary focus of archaeology has been, and continues to be, the study of Kyiv, Novgorod, the presence of the Vikings in Eastern Europe, and the role played by the Byzantine Empire and steppe nomads in the emergence of Rus'. The western periphery of the Rurikid realm has been studied much less extensively.

However, this region, which serves as a meeting point of two distinct religions, cultures, and civilisations on the periphery of Latin Europe and the Byzantine Commonwealth, definitely deserves special attention (*cf.*, Parczewski and Czopek eds 1996; Janeczek, 2011; Salamon *et al.* eds 2012). One of the major centres of the early medieval Polish-Rus' borderland was Cherven' (first written reference under the year in 981 [6489]; *cf.*, PVL, 95), a fortified town now identified by archaeologists with the settlement complex in Czermno (for literary evidence see Jusupović 2017). According to the Rus' chronicles, Cherven' was one of the Cherven' Towns, a name given to a borderland region mentioned in the Primary

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Chronicle under the year dates of 1018 [6489] and 1031 [6539] (PVL, 132 and 136). Although the term itself is probably the result of an error of a medieval copyist, the name Cherven' Towns has established itself in the historiography of Poland and Ukraine as a 'lieu de mémoire', a region of special significance related to the remembrance of these nations: in fact, in school textbooks written in Warsaw and in Kyiv the history of the relations between Poland and Ukraine starts with the reference to the Cherven' Towns. The discussion about the location, chronology, function and importance of the Cherven' Towns (and of the stronghold Cherven' too) has continued for more than 250 years (Błachowska 2017), and

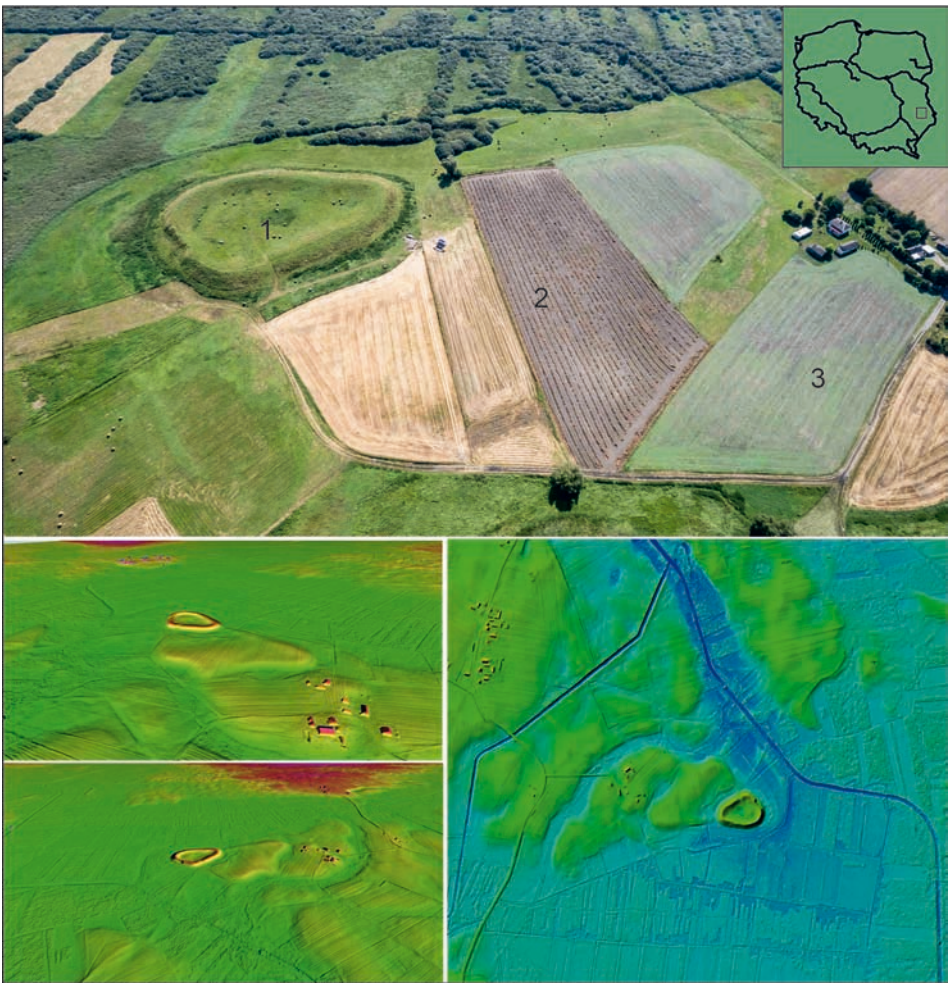

Fig. 1. The settlement complex in Czermno. Aerial photograph of the stronghold (1) and stronghold suburb settlement (2, 3); Digital Elevation Model (DEM) and 3D models. Photo M. Czarnecki, graphic design M. Jakubczak

their study has been of significant interest both for the research community and the general public (*cf.* Bagińska and Wołoszyn 2022).

For more than a decade, the site in Czermno/Cherven' has been investigated a team of researchers from the Institute of Archaeology of the Marie Curie-Skłodowska University and of the University of Rzeszów in cooperation with several other centres in Poland (Institute of Archaeology and Ethnology of the Polish Academy of Sciences) and the Leibniz Institute for the History and Culture of Eastern Europe (GWZO) in Leipzig (Germany). An important element of this activity is fieldwork aimed at establishing the chronology of the stronghold rampart (*cf.*, Dzieńkowski *et al.* 2020) and at determining the environmental conditions for the development of the settlement complex (Dobrowolski *et al.* 2018). Moreover, the excavations are a race against time and the destruction of the site, the effects of both natural and anthropogenic factors, the latter including the steady destruction of the stronghold by metal detectorists.

The fieldwork completed in 2022-2023, focused on Site 2 in Czermno (the suburb settlement of the Czermno stronghold), and took the form of non-invasive investigations (GPR – Ground-Penetrating Radar, and LiDAR prospection), sondage excavation, laboratory analysis and conservation of archaeological finds, absolute dating and desktop studies (Fig. 1).

PAST AND CURRENT STUDIES

Located at the marshy confluence of the Sieniocha and Huczwa Rivers, the early medieval settlement complex in Czermno comprised a stronghold and several settlements and cemeteries, connected by a network of causeways. Based on data from the nationwide fieldwalking project (AZP), the settlement complex could have occupied an area of up to 150 ha (Jażdżewski 1959; Sadowski 2008; Dzieńkowski and Sadowski 2016). This is suggested by archaeological material datable to the 10th-13th centuries recovered from more than 30 sites identified around the stronghold, with additional sites found at distances of 3-4 km from the stronghold (see Fig. 2: A; Dzieńkowski and Sadowski 2016).

Archaeological excavations, non-invasive projects and paleoenvironmental studies had been carried out over several seasons between 1952 and 2024 following upon a small-scale sondage excavation project carried out during World War II (1940) followed by further work after this: 1952, 1974-1976, 1979, 1981, 1985, 1997, 2010-2015, 2022-2023, 2024 (see Fig. 2: B; Poleski 2004; 2013; Florek 2016a, 2016b; Wołoszyn 2016). Investigations had focused on the site of the stronghold (Site 1), settlements in its hinterland (Czermno, Sites 2, 3, 6, 63, 68, 70; Wronowice, Site 1), and on the rampart enclosing the complex on its west side (Czermno, Site 66) (Florek 2016a; 2016b; Dzieńkowski *et al.* 2020, 418-423). The excavation and non-invasive fieldwork were carried out by different research teams and mostly took the form of sondages, except for larger-scale excavations conducted in the stronghold. Despite many seasons of investigation, the knowledge gained about the strong-

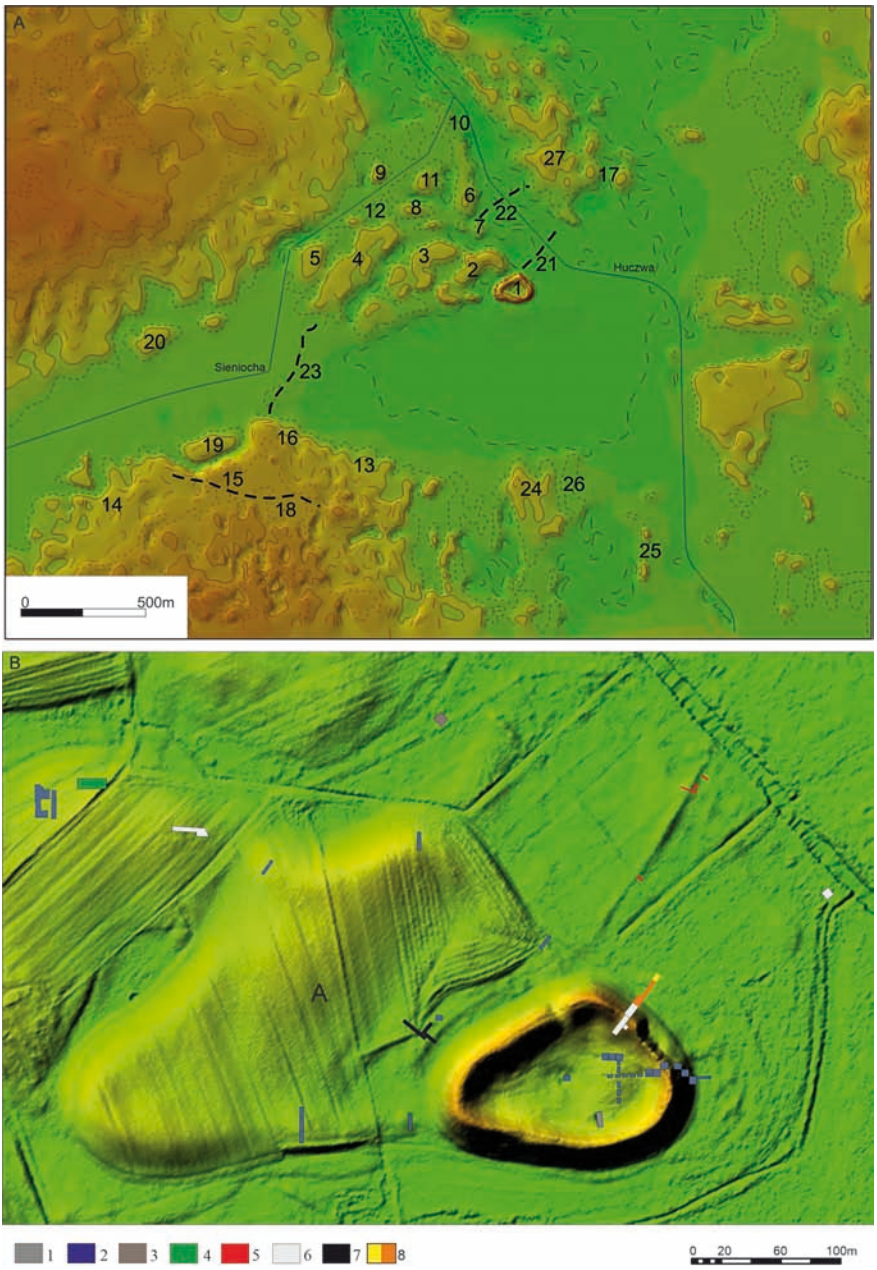

Fig. 2. Czermno: A – early medieval Sites 1-27 identified during the national fieldwalking survey (AZP) and archaeological excavations (1 – stronghold, 2 – suburb settlement *Zameczek*, 3 – further suburb settlement, 4-27 – others); B – location of archaeological trenches excavated between 1952 and 2024 (1 – 1952, 2 – 1976-1979, 3 – 1985, 4 – 1997, 5 – 2012-2015, 6 – 2013-2016, 7 – 2022-2023, 8 – 2023-2024; A – suburb settlement *Zameczek*). Graphic design T. Dzieńkowski, DEM P. Zagórski

hold and settlements in its catchment remains relatively modest, given the size of the complex and the quantity of recovered archaeological material. The results of past fieldwork were published only in 2016 based on the surviving documentation and MA dissertations (*cf.*, Florek and Wołoszyn eds 2016). The case of the results of current investigations is different – these are already in scholarly circulation (Piotrowski and Wołoszyn 2012; Wołoszyn *et al.* 2016; 2018; Musin and Wołoszyn eds 2017; Dzieńkowski *et al.* 2020; Wołoszyn ed. 2022; 2023; 2024). When made available, the findings from past research served as input for interdisciplinary studies of selected categories of archaeological objects, *e.g.*, glass and lead artefacts (Wajda *et al.* 2024; Merkel *et al.* 2024, respectively), Byzantine amphorae (Korokhina *et al.* 2024).

Described variously as a 'suburb settlement' or as the 'Wały' or 'Zameczek' settlement, Site 2 has a dating of 10th-13th centuries and occupies a 5-hectare elevated landform (flood terrace) within the valley of the Huczwa at its confluence with its minor tributary the Sieniocha, now with an altered channel (Figs 1 and 2; Janeczek 2016; Dobrowolski *et al.* 2018). In the research literature, Site 2 has been interpreted as a walled-in suburb of the stronghold, organised adjacent to it and associated with the stronghold in both functional and chronological terms (Jażdżewski 1959; Gurba 1988, 303-305). This term will be used in our article.

The suburb of Czermno was investigated for the first time in 1940 by the Ukrainian archaeologist Levko Chikalenko, with the permission of the German occupying authorities. A single trench was excavated at Site 2, the location of which is unknown at present, which yielded a large assemblage of finds (Chikalenko 1998; Wołoszyn 2016). Subsequent excavations were launched by Andrzej Kutyłowski in 1972. They were continued in 1976 and 1979 (Florek 2016a; 2016b). A fragment of a timber causeway connecting the suburb with settlements in the Huczwa valley was investigated in 1985. In 1997, timber samples for dendrochronological dating were obtained from the zone of contact between the suburb and the stronghold; the results of this project "startled" the medieval studies community in Poland because they established the earliest possible date of the settlement complex as mid-11th century (*cf.*, Urbański 2000; Kowalczyk 2000; Wołoszyn 2013; Dzieńkowski *et al.* 2020, 428, 429).

Approximately 100 m^2 of the suburb had been investigated over three seasons (1972, 1976 and 1979). However, their results were compromised by several issues, including a lack of comprehensive documentation, an uncertain trench location, and failure to excavate through to the natural soil. Furthermore, an analysis made by Marek Florek of site reports and MA dissertations (2016a; 2016b) revealed several flawed interpretations. Although the conclusions of this research are still being verified, it is worth recalling the key findings. Between 1976 and 1979, twelve trenches of different sizes and shapes were excavated (IIA-IIF; Fig. 2: B). Trenches IIA, IID and IIF had been laid out in an area of lower-lying ground between the suburb and the stronghold. Each of them revealed preserved timber structures interpreted as remains of a causeway or a timber road (IIA, IID), a suburb

rampart (IIB, IIC, IIF) and a stronghold rampart (IID). In each trench, two or three stratigraphic levels were distinguished, indicating a dynamic, yet long-term, occupation.

After a nearly three-decade pause, the investigation into the suburb was resumed. In 2010-2012, more than 3,000 archaeological finds were collected by fieldwalking from the surface of Site 2 and located in 3D; they are currently undergoing analysis (*cf.*, Florkiewicz *et al.* 2020; Wołoszyn ed. 2022; 2023; 2024). Their large concentration was an additional argument in support of intensive occupation and its diverse nature, documenting several different economic activities – agriculture (querns), crafts (the working of antler and bone, pottery), commerce (lead seals, weights, plates of weighing scales), and others, associated with lifestyle – *e.g.*, jewellery (bangles, finger rings), religion (icons, cross pendants), warfare – weapons, equestrian gear (*cf.*, Piotrowski *et al.* 2011; Wołoszyn ed. 2022; 2023; 2024).

In 2013 and 2014, a non-invasive study was conducted on the suburb settlement using fluxgate magnetometers as part of a large project funded by the National Programme for the Development of Humanities (Florek and Wołoszyn eds 2016). The magnetometry survey recorded a series of anomalies, indicating the presence of archaeological features – pits and dwellings (Pospieszny 2016), and in the N and W area of the site, a feature identified tentatively as a fragment of the rampart; its nature remains open as no follow-up excavations were made to confirm this interpretation. On the other hand, paleoenvironmental studies documented large-scale earth-moving, levelling and hydrotechnical activity aimed at altering the course of ditches and moats to drain off surface waters and improve defensibility (Dobrowolski *et al.* 2018, 258-273).

In 2022 and 2023, a study was conducted of the northern moat of the stronghold and the earth bank at Czermno Site 66 (Fig. 2: B; Wołoszyn *et al.* 2024). In 2024, fieldwork on the stronghold's eastern fortifications continued.

The findings from the investigation of the suburb settlement may be summarized as follows: 1) in its contour, the suburb followed the shape of the local elevated landform (terrace), roughly 5 ha in area, 2) apparently, the settlement was enclosed by a circumferential (?) earth-and-timber rampart, 3) outside and inside the suburb there were, respectively, causeways and timber tracks, 4) evidence was found of large-scale earth-moving, levelling and hydrotechnical projects, 5) two to three occupation levels were identified, establishing the dating of the site to between the 10th and 13th centuries. These data served as a point of departure for the research completed in seasons 2022 and 2023.

ARCHAEOLOGICAL FIELDWORK, SEASON 2022 AND 2023

The research objectives and questions formulated when embarking on the investigation of the suburb settlement addressed key issues related to its chronology (the date of its construction and later development) and function (open settlement in the hinterland of the stronghold, or fortified suburb settlement, possibly a tribal stronghold; Poleski 2013).

Another key task was to determine and document the site's stratigraphy. Other than that, there was a need to investigate the character of the buildings inside the settlement and its spatial organisation. Also in need of clarification was the construction design and layout of the fortifications. The decision was taken to investigate the zone between the suburb and the stronghold as the most promising. Additionally, this waterlogged, low-lying area was expected to produce well-preserved timber remains useful for dating. Complementary to the sondage excavation, the site surface was investigated using non-intrusive methods, *e.g.*, geophysical prospection (Ground-Penetrating Radar), aerial photography, and DEM (digital elevation model) analysis. The latter activities helped to recognise the broader context of the settlement, identify previously unknown archaeological features, and record the effects of erosion on the site.

Sondage excavation

Sondage trenches (Nos. 1-5), jointly covering an area of 60 m^2, measuring respectively 4 × 4 m, 11 × 1.5 m, 1.5 × 5 m, 1.5 × 3 m (Figs 2 and 3), were laid out in the south-eastern zone of the suburb. Aligned NW-SE, they uncovered 38 archaeological features, including the remains of a timber road inside the settlement (Nos. A and B), a causeway/road (?; Nos. C and D; *cf.* Fig where these features were marked distinctly), utility pits (19), the remains of a rampart (?), fragments of upright timbers (13), and an eco-feature – a hollow filled with peat (Feature 6). The assemblage of excavated finds comprised more than 37,000 objects, including a large group of special finds. The four trenches exposed a complex stratigraphy comprising two occupation levels, for which absolute dates were obtained using dendrochronology (2), thermoluminescence (3), and radiocarbon (10).

The largest group of archaeological features (17) consisted of oval pits with usable areas ranging from 0.7 to 1.5 m (17). Their fill, mainly of a few layers, contained animal remains and fragments of pottery vessels. The original function of these pits is hard to determine. Based on their plan, size, and contents, they were broadly classified as utility pits used for storage or waste disposal. Three features (Nos. 1, 5, and 10) apparently had more complex functions. Pits 1 and 5 had a fill of several layers marked by fire and contained finds (metal) suggesting production activity. Feature 10, approximately 3 m in width, with an evidently levelled area of ground underneath, contained the remains of a structure of vertical posts (Features 8 and 9) and was interpreted as a rampart (?). The features were too damaged to allow for a more in-depth analysis. On the other hand, none of them can be identified as dwellings.

In all of the trenches, archaeologists found the remains (ends) of wooden stakes and postholes. In diameter, the latter ranged from 15 to 35 cm and were dug at different depths (15-30 cm). The arrangement of the posts was apparently irregular, although some could have accompanied features (Nos. 3 and 10, and 11 and 28 *e.g.*, as elements of some sort of roofing.

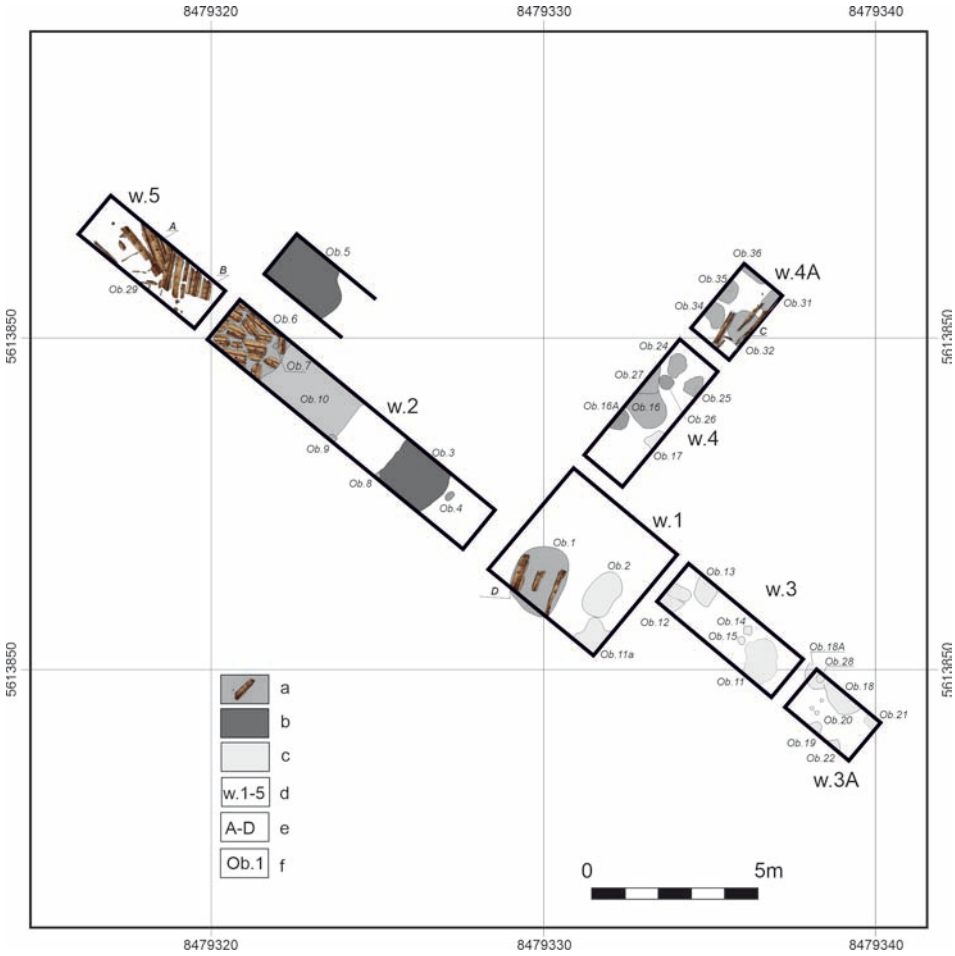

Fig. 3. Czermno, Site 2. Location of trenches excavated in 2022-2023:
a – Phase I, b – Phase II, c – early medieval feature, d – trench, e – timber remains; f – features (ob. 1-36).
Graphic design T. Dzieńkowski and

Timber structures interpreted as remains of a track (A), footbridge (B) and causeway/road (C, D) were recognised at some locations (Figs 4 and 5). Rough planks resting on a wooden substructure found inside Trench 5 were interpreted as a track – an inner road of the settlement (A) running NE-SW. The surviving width of the 'roadway' was 1.8-2 m. The planks rested over a waterlogged layer of loam, peat and brushwood. Unfortunately, the wood was too decomposed for dendrochronological dating, but it nevertheless yielded two radiocarbon dates. The following structure was a timber footbridge (B) laid over a natural peat-filled hollow (Feature 6). Three rough pinewood planks, aligned E-W, also yielded ^{14}C dates. Timbers identified as the remains of a road (or a causeway, Nos. C and D) were recorded inside Trenches 1 and 4A. Both trenches produced fragments of horizontal timbers

(most likely sleeper beams) aligned NE-SW. The planks from the upper part of this structure did not survive. The beam from Trench 4A yielded a dendrochronological date.

The stratigraphy of the site was established by analysing the sequence of layers and features, their relationships, and differences in structure and content (Figs 3-5). The results of this analysis suggest the presence of two occupational phases; their chronology was determined using absolute dating. The trenches contained 77 stratigraphic units corresponding to short-lived activities (single-episode backfills) and to deposits formed by prolonged processes associated with intensive use. The two groups of stratigraphic units had been subject to the destructive effect of post-depositional factors, both natural and anthropogenic. The last element of the site's stratigraphy is 38 archaeological features – pits and structures; the wealth of the recovered archaeological finds documents the heavy occupation of the site. Also recorded during the fieldwork were the remains of environmental processes, *e.g.*, eco-features (natural peat-filled hollows), wet ground, and peat deposits within man-made features such as the ditch. Considerable damage was observed, as evidenced by archaeological objects affected by erosion and the transport of earth masses, especially during Phase II of the occupation. The complex stratigraphy of the site, as recorded inside Trenches 1, 2, 4, 4A, and 5, is illustrated in Figure 5.

Phase I is represented by archaeological deposits, features, and roads/footbridge (A-B) dug into or resting over the natural layer (sandy loam characteristic of valley deposits). The stratigraphic sequence ends with horizontal timbers belonging to structures C and D, which have a later stratigraphic position within the occupation layer (Phase Ib [?]). At the present stage of the investigation, this situation appears to reflect a rapid change in occupation

Fig. 4. Czermno, Site 2. Timber roads in Trench 5: 1 – track, 2 – 'footbridge' over eco-feature filled with peat (Phase I), 3 – levelling layer, 4 – occupation layer in Phase II. Photo T. Dzieńkowski

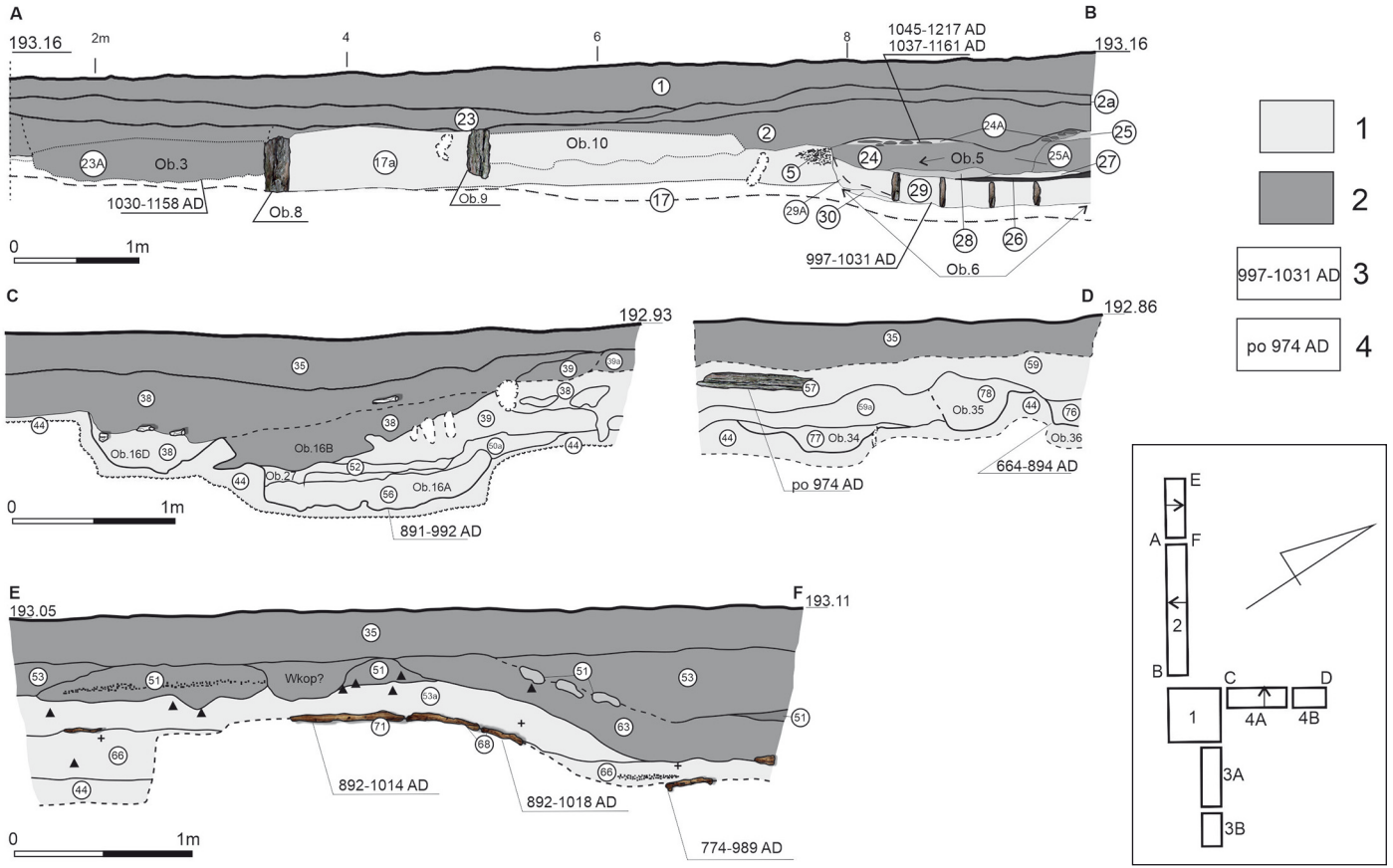

Fig. 5. Czermno, Site 2. Stratigraphy in Trenches 2, 4, 5 with absolute dates: 1 – Phase I, 2 – Phase II, 3 – radiocarbon dates, 4 – dendrochronology dates (Ob. – obiekt [feature], wkop – dig). Graphic design T. Dzieńkowski

within a single phase (I). These questions require further clarification through research and dating.

These remains document the occupation of this part of the site, and its use for economic activity – crafts, storage or production. Radiocarbon dates were obtained for seven samples of charcoal and wood recovered from Feature (1 sample), structures A-C (3), the peat-filled hollow Feature 6 (1 sample), Features 16 (1) and 36 (1) (Tables 1-3). The results from four samples, with a probability of 95.4%, fall within the 9th to late 10th centuries; for three other samples, within the early decades of the 11th century. The horizontal timber of the road (or causeway, no. D), stratigraphically the youngest, is dated by dendrochronology to after 974 AD (Table 2). A slightly later date, after 998 AD, was yielded by a stake belonging to the post-built structure in Trench 3. At the same time, we note that, with no sapwood layer available for analysis, the tree's felling date could not be determined in these two cases. The chronology of Phase I, corresponding to the first occupation and use of this part of the site, may be referred to the late 10th century and the first decades

Table 1. Radiocarbon dating by laboratory ETH Zurich (2022-2023)

	Sample	Trench	Feature	Material	Dating [95.4%]		Phase
1	ETH-129294	1	1	Charcoal	892	994	I
2	ETH-129295	2	3	Charcoal	1030	1158	II
3	ETH-129296	2	5	Charcoal	1037	1161	II
4	ETH-129297	2	6	Decomposed wood	977	1031	I
5	ETH-138986	5	-	Decomposed wood	892	1018	I
6	ETH-138987	4	16A	Decomposed wood	891	992	I
7	ETH-138988	4A	36	Charcoal	655	888	Ia
8	ETH-138989	5	24	Charcoal	1045	1217	II
9	ETH-138990	5	29	Wood (from track)	892	1014	I
10	ETH-138991	5	29	Wood (from track)	774	989	I

Table 2. Dendrochronological dates based on analysis of M. Krąpiec (2023)

	Laboratory code	Sample	Genus/species	Tree-ring count	Sapwood	Dating of tree-ring sequence	Felling date	Phase
1	CZER52	Peg	Oak (*Quercus* sp.)	86	-	906-991	after 998	I
2	CZER53	Beam		53	-	915-967	after 974	Ib

Table 3. Thermoluminescence dating of pottery (A. Ginter 2022)

	Sample	Trench	Feature	Material	Dating		Phase
1	18	2	3	Pottery vessels	1080	± 44	I-II
2	26	2	6		1023	± 52	I-II
3	32	2	6		1002	± 51	I-II

of the 11th century. The dating of Feature 36 (in the range 664-894 AD, or at the latest by the end of the 9th century) points to an earlier occupation (Phase Ia).

Phase II is represented by deposits and features with a later stratigraphic position that rest over the remains of Phase I occupation. The former include traces of earth-moving and levelling activity, as well as a vast quantity of pottery vessel fragments and features (Nos. 3 and 5). Radiocarbon dating of charcoal from utility pits (three dates from Feature 3 and 5) indicates their use between the second half of the 11th and early 13th centuries. Unfortunately, this phase is marked by a severe deterioration of archaeological finds.

NON-INVASIVE SURVEYS

Ground-Penetrating Radar prospection

The role of geophysical methods in understanding archaeological sites and their contexts has been increasing for several decades. GPR is one of the most commonly used geophysical methods in archaeology (Campana *et al.* 2009; Conyers 2013; Trinks *et al.* 2014; Milo *et al.* 2022). It enables the acquisition of three-dimensional information about subsurface structures based on their dielectric properties. The method itself is based on transmitting a high-frequency wave into the ground under test and observing its propagation. In 2022, we conducted large-scale GPR prospection in Czermno to obtain data on the spatial organisation of the settlement, the identification and location of archaeological features, and their preservation.

Geophysical data were collected using a single-channel Malå Ground Explorer with a 450 HDR antenna. The measurements were carried out along parallel profiles spaced every 0.5 m in a point-based grid, staked out using GNSS RTK. The survey covered approximately 4.8 ha – almost the entire area of the slightly elevated landform on which Site 2 lies (Fig. 6). The time-slices were derived from a set of over 2.500 particular 2D profiles to demonstrate the spatial distribution of electromagnetic wave reflections at different depth levels (Goodman *et al.* 1995). Subsequently, the GPR dataset was incorporated into the GIS database and integrated with other data categories, such as orthomosaics and digital elevation models. The obtained data are complex, both in terms of anomaly types and spatial distribution. We identified numerous electromagnetic-wave reflections just below the topsoil (Fig. 7). Many of these are likely due to archaeological remains. GPR data indicate the complex layout of structures organised in clusters, separated by walkways or roads. They can be interpreted as the remains of dwellings, or other types of buildings, most likely of wooden or constructed of wood and daub. The largest cluster of this type was identified in the highest part of the elevated landform occupied by the archaeological site. Conspicuous linear anomalies recorded on the margins of the landform were interpreted

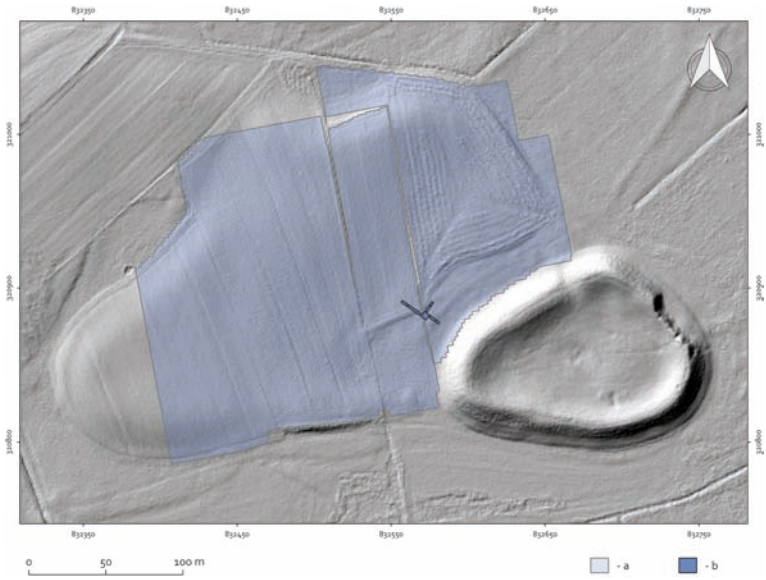

Fig. 6. Czermno, Site 2: a – area of 2022 ground penetrating radar survey (*ca*. 4.8 ha), b – location of trenches excavated in 2022-2023. Source of background map www.geoportal.gov.pl. Coordinate system: EPSG:2180 (Poland CS92). Graphic design R. Ryndziewicz

Fig. 7. Czermno, Site 2. GPR data at *ca*. 0.60-0.80 m below the ground surface. Antena Malå Ground Explorer with 450 HDR antenna. The yellow arrows mark the features interpreted as: 1 – clusters of buildings, 2 – remains of fortifications, 3 – deep ploughing. Measurement resolution – 0.5 x 0.03m (interpolated). Source of background map: www.geoportal.gov.pl. Coordinate system: EPSG:2180 (Poland CS92). Data processing and graphic design R. Ryndziewicz

as the remains of fortifications enclosing the settlement. They are more apparent in the north-western part of the studied area.

Generally, the viable prospection depth was not more than 140-150 cm due to strong electromagnetic wave attenuation in the ground (usually less than 1 metre). The entire area under investigation is heavily agricultural, which contributes to the erosion of archaeological remains and degrades the quality of the GPR data. Data from the eastern part of the site indicate significant damage to the archaeological remains caused by deep ploughing.

Spatial analysis

Analysis of data derived from LiDAR and drone detection was carried out on the site and its immediate surroundings to recognise the presence of archaeological features. The study covered an area of 45 km², using a point cloud from the ISOK project (2013). This input was used to create a digital elevation model (DEM) with a resolution of 50 cm and generate visualisations: Local Dominance, Local Relief Model, Analytical Hillshading and Sky View Factor. Orthophotomaps were created from data collected with a DJI Matrice 2 quadcopter equipped with RGB, radiometric, and multispectral sensors.

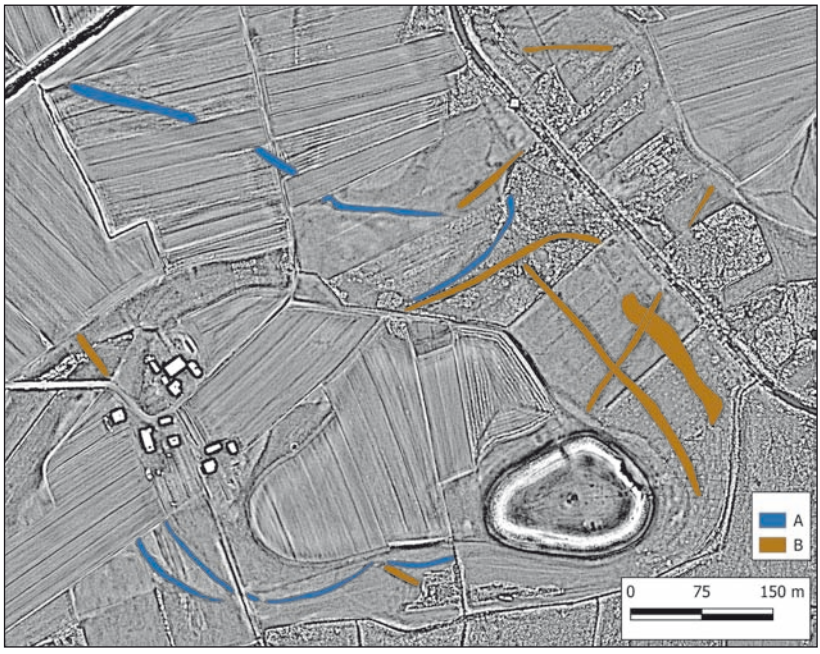

Fig. 8. The settlement complex in Czermno. Analysis of spatial data. Features recorded in the catchment of the stronghold: A – sunken features (possible ditches, ditches), B – raised features – causeways, banks. Graphic design M. Jakubczak

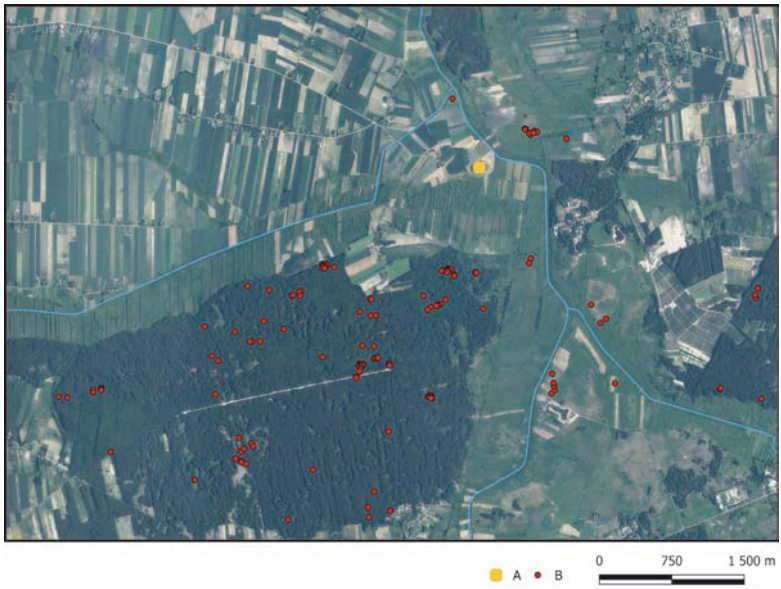

Fig. 9. Analysis of DEM data: A – stronghold, B – location of raised features identified as barrows, mounds – 143; twenty-nine recorded during AZP national fieldwalking project. Graphic design M. Jakubczak

Analysis of the site's microrelief and orthophotomaps enabled the identification of several archaeological features. Some of them may be interpreted as traces of ditches, earth banks, dykes, *etc.* (Figs 8 and 9). While dating these features recognised by remote sensing is problematic, at least some of them are likely to belong to the period when the medieval settlement was in use as elements of its spatial layout – the network of roads, dykes, causeways and crossings.

The analysis of the Digital Elevation Model of the area surrounding the settlement complex identified 143 features most likely to represent mounds/burial mounds, of which only 29 had been recorded during the AZP national fieldwalking survey (Sadowski 2008; Dzieńkowski 2023; Wołoszyn *et al.* 2024). The same study determined the course of the outer earth bank enclosing the settlement on its west side, some stretches of which had been investigated in the 1950s and more recently, in 2022.

ARCHAEOLOGICAL SOURCES

An analysis of selected groups of finds, artefacts, and biofacts sheds light on aspects of craft production and, more generally, on the economic activities of the medieval inhabitants of the complex. The excavation of archaeological deposits and features belonging to Phases I and II yielded an assemblage of more than 37,000 objects, most of them pottery.

A statistically smaller group included objects made of other materials, *e.g.* horn/antler (cheek-piece), bone (hafts, ice-skates), metal (small lead seals, valuable objects, personal ornaments), glass (bangles, beads, finger rings) and other. There was also a significant quantity of post-consumption animal remains.

Pottery

Fragments of pottery, due to their mass occurrence, are the key source for studies on the everyday life of the stronghold inhabitants. The entire assemblage from the site consists of 28,033 sherds, 99% of which represent the early medieval phase of occupation on Site 2. The assemblage included a single fragment of a prehistoric vessel, apparently of Early Iron Age date, and 55 fragments of late medieval and post-medieval pottery. Fragments of early medieval vessels primarily derive from the excavation of archaeological layers, as opposed to the fill of archaeological features, which have yielded only 1531 sherds (6.7% of the assemblage). Similarly uneven is the distribution of pottery finds in chronological horizons – no less than 80% fragments derive from layers and features allocated to Phase II, and only 5.4% can be identified with occupation during Phase I. It needs noting at the same time that the 'responsibility' for this disproportion rests mainly with the largest assemblages (jointly 11,261 fragments) deriving from layers nos 1, 2, 36-38, which accumulated only when the early medieval settlement complex had ceased to function. The other 14.6% comes from stratigraphic units dated to the early medieval period (phases I-II).

The assemblage of early medieval pottery was divided into four ware groups (see, *e.g.*, Auch 2017, 127-129; Auch and Trzeciecki 2021, 83-85; both publications provide a list of further literature). Roughly 92% finds are fragments of brownware vessels, made from iron-rich clays fired in an unstable firing atmosphere. Fragments of pottery made of white clays (whiteware) make up only 7.5%. Remarkably, this ware group is particularly characteristic of early medieval sites in western Ukraine and the Polish-Rus' borderland. Whiteware was manufactured from kaolinite clays, deposits of which occur in the Roztocze region, *e.g.*, in the vicinity of Potelyč, approximately 50 km from Czermno. The assemblage also included fragments of four glazed vessels and a body sherd of an amphora. All the brown- and whiteware vessels bear traces indicating coiling technique and turning on a slow wheel. Similarly, in pottery assemblages recovered at other sites within the settlement complex in Czermno, brownware included a relatively large percentage of vessels tempered with sand. Whiteware products contained temper of sand and/or crushed potsherds (Auch 2017, 144-145, 168-169). In both ware groups, the repertoire of vessel forms was modest: cooking pots account for approximately 99%. The brownware group additionally included a fragment of a jug, two bowls, three scooping vessels, and eight lids; the whiteware pottery assemblage included fragments of two jugs and two bowls. Glazed pottery was too fragmented to determine its function, but most likely the fragments belong to jugs. The only other vessel form represented in the assemblage is the amphora.

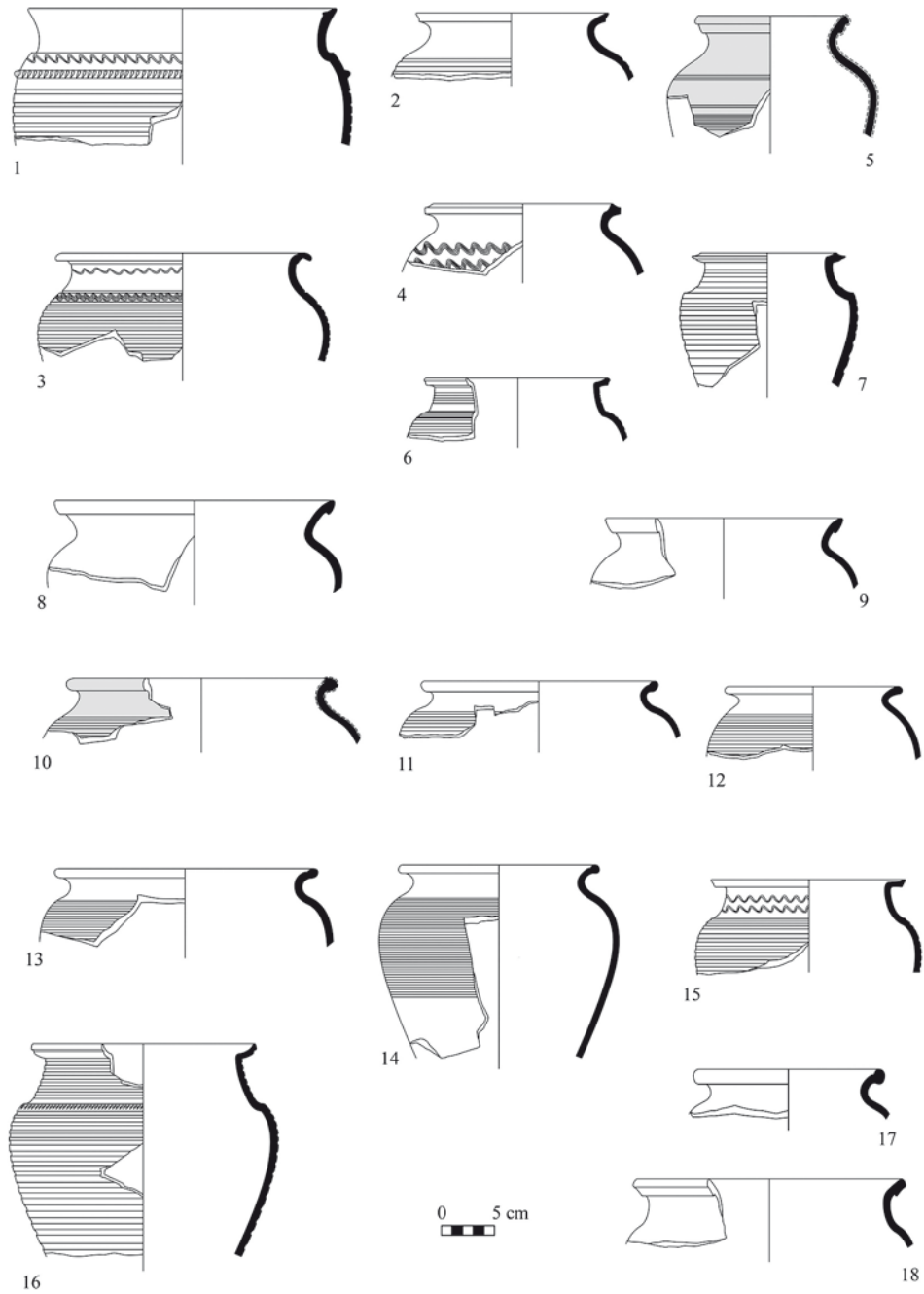

Fig. 10. Czermno, Site 2. Selected pottery from Phases I (1-9) and II (10-18). Brown (1-4, 6, 7, 11-16), brown slipped (5, 10), white (8, 9, 17, 18). Graphic design M. Trzeciecki

Preliminary analysis of the pottery assemblage revealed some chronological differences in the proportions of ware groups and stylistic features of vessels. The assemblage dated to Phase I includes only two types of pottery – brownware predominates (84%), but the percentage of whiteware is relatively high (16%). A minor percentage (*ca*. 2%) of the brownware vessels is coated with a white slip. Morphological analysis of brownware pots revealed the prevalence of S-shaped forms with rims either unthickened (Type III – 38.5%; Figs. 10: 2, 3), thickened and profiled (Type VII – 26%; Fig. 10: 4), or everted (Type VIII – 10.6%; Fig. 10: 5). Less frequent in the assemblage are vessels with separated neck and a nearly biconical profile (Type IV – 10.6%; Fig. 10: 7), and forms with a belly body (Type V – 13.5%; Fig. 10: 6). An exceptional form is a vessel with a cylindrical neck (Type II; Fig. 10: 1).

The percentage of decorated vessels falls slightly short of 50% of the whole, but the selection of decorative motifs is limited to five. The pattern of horizontal grooves is observed on the most significant number of vessels (74.4%; Fig. 10: 2, 5-7), followed by combinations of grooves and engraved wavy lines (16%; Fig. 10: 3, 4), grooves and stamped impressions (8.6%). The assemblage of white pottery is stylistically much less diverse. Vessels classified to Type VIII account for more than 96% (Fig. 10: 8, 9), the remainder represents Type VII. Only 6% in this ware group were decorated – most often, with a zone of several horizontal grooves or a wavy line placed over the maximum body diameter.

In the Phase II assemblage, the percentage of brownware increases to 93%, and the percentage of white vessels drops to 6.7%. The percentage of slipped brownware vessels is on the same level as in Phase I. Next to the two main pottery groups (brown- and whiteware) is a third – vessels with a green-glazed surface. The pottery assemblage from Phase II includes a truly exceptional specimen – a fragment of an amphora imported from the Byzantine Empire (Korokhina *et al*. 2024). On the other hand, there is a marked difference in the assortment of forms and decoration of brown and white wares. S-profiled pots with a rolled-up, circular-sectioned rim (Type IX; Fig. 10: 10, 11, 13, 14), absent in Phase I, make up 31.6% of the brownware. Type III vessels are less common, accounting for 20.6% (Fig. 10: 12), and Type VII for 15.9%. At 6%, Type VIII forms are significantly fewer in number. This is unlike necked vessels classified to Types IV and V – they remain at a constant level of around 10-12% (Fig. 10: 15, 16). The percentage of vessels with a cylindrical neck remains low.

In the Phase II assemblage, the proportion of decorated wares has not changed, but the number of decorative motifs has increased to sixteen. At the same time, horizontal grooves continue as the most common motif (83.7%; Fig. 10: 10-14, 16), occasionally, in combination with a wavy line (5.3%; Fig. 10: 15) or stamped impressions (4%); all other types of decorative motifs identified in the assemblage are observed once, at most, a few times only. Similar changes are observed in the assemblage of white wares. While Type VIII continues to prevail, the percentage of these vessels has dropped to 60% (Fig. 10: 18). Type IX vessels account for 31% (Fig. 10: 17); a handful of forms represent Types III and VII. No

change is noted in the percentage of decorated wares, and the assortment of decorative motifs remains as modest as in Phase I.

To conclude, it is important to note that the assemblage of early medieval pottery under discussion has numerous analogies in materials from earlier studies of the settlement complex in Czermno. Possibly the most noteworthy characteristic of all the pottery assemblages from Czermno is that they all demonstrate a stylistic shift in the 12th century, leading to the appearance of highly standardised vessel forms classified as Type IX. Another development is the gradual decrease in the percentage of white wares, and the occurrence of glazed pottery and amphorae, primarily in twelfth- and thirteenth-century contexts (Auch 2017, 214-230; see also Korokhina *et al*. 2024). It is also notable that the assemblage includes a relevantly low percentage of vessels with a separated neck, in particular, angular forms Type IV, prevalent in assemblages from the second half of 11th and early 12th centuries, and regarded as material evidence for the presence in Czermno of potters from the Western Slav environment (Auch 2017, 190-192, 228, 229). Also worth noting is the absence of partly turned brownware vessels from the discussed assemblage, of which only a very small number was recorded during past research; these wares are mostly regarded as evidence of occupation pre-dating the construction of the stronghold (Auch 2017, 143, 226, 227).

Glass finds

The assemblage of glass finds recovered during the fieldwork carried out in 2022 and 2023 numbers 24 finds: mostly fragments of glass bangles (13) and beads (6), a fragment of a finger ring, a finger-ring with a glass bezel, a glass vessel and two small glass balls (Fig. 11). The latter are identifiable as beads warped through exposure to heat (?). Most of the glass artefacts (15 specimens) had been excavated from Layer 2; a handful turned up in Layers 1 and 38. All three strata (nos. 1, 2 and 38) post-date the decline of the settlement. The rest (10) originate from deposits dated to the early medieval period; it is important to note that one bead was discovered in Layer 66, dated to Phase I of the settlement complex.

The assemblage of glass items from fieldwork seasons 2022 and 2023 shows a similarity to materials recovered in Czermno and Gródek-upon-the-Bug since the 1950s (*cf*., Wajda 2022/2024). Glass bangles fall into four types:

1. with a triangular-sectioned hoop made of blue glass – Wajda Type 2 (Fig. 11: 1; *cf*., Wajda 2022/2024, 104, Fig. VIIIA: Type 2:10, 36, 105, 90);

2. with an ornament of glass dots – Wajda Type 4a (Fig. 11: 2; *cf*., Wajda 2022/2024, 105, Fig. VIIIA: Type 4a:13, 96), one fragment found;

3. with an impressed ornament of spirally twisted grooves – Wajda Type 5b (Wajda 2022/2024, 105, 106, fig. 8: A: Type 5b), eight fragments found, four fragments made of green glass (Fig. 11: 3-5), three fragments of blue glass (Fig. 11: 6-8 [one fragment was too corroded to determine the colour of its glass]);

Fig. 11. Czermno, Site 2. Archaeological finds – selected glass finds, season 2022. Photo by S. Wajda

4. with an ornament of spirally twisted grooves and trailed glass – Wajda Type 6 (Fig. 11: 9; *cf.* Wajda 2022/2024, 106, fig. 8: a: Type 6), one fragment found.

Three translucent blue glass fragments are too small to determine their type.

Glass bangles were a popular ornament in the Eastern Slav environment and are abundant on the territory of Kyivan Rus' (Wajda 2022/2024, 107; Wajda *et al.* 2024, with a list of reference literature). In Poland, most of the finds of objects of this type are found in the eastern regions, belong to the 11th-13th centuries and are associated with Rus' (*cf.*, Wołoszyn 2007, fig. 14). Large assemblages of glass bangles are known from Przemyśl (Krzemińska and Zahel 2021), Gródek upon the Bug River (Wajda 2022/2024) and Chełm (Fituła 2008). The most significant number of these ornaments was in use between the 12th and mid-13th centuries.

Site 2 yielded glass beads – a total of six specimens made using the winding technique. Three beads are ring-shaped, two made of translucent yellow glass, one of translucent blue glass (Fig. 11: 10; *cf.*, Wajda 2022/2024, 110, fig. 8A: 3.2). A bead of violet glass, now nearly opaque, belongs to Type 3 (globular beads; Fig. 11: 11). Another bead made of blue glass was classified to Type 4 (segmented beads; *cf.*, Fig. 11: 12); it consists of two segments, without an intervening collar. Finally, a bead classified to Type 10 (Wajda 2022/2024, 111, fig. 8: A) has a dark brown body decorated with a broad zigzag trail of white glass inserted in the middle. Additionally, on one surface near the stringing canal, there is an inserted yellow coloured trail (Fig. 11: 13).

Glass finger rings include a fragment with a bezel, and another fragment of a ring (Fig. 11: 14, 15). Both were made of translucent green glass. Identical specimens have been identified among earlier glass finds from Czermno (Wajda 2022/2024, 114, fig. 8: A: 16). Glass finger rings were not as popular among Eastern Slavs as were bangles, but are known from many sites on the territory of Rus' and have a dating confined to the 11th and the 14th centuries (Shchapova 1972, 97; Stolyarova 2020, 241; Wajda 2022/2024, with a list of reference literature).

The most recent analysis of glass finds from Czermno failed to confirm the presence of a glass workshop in the settlement complex. Nevertheless, both past and most recent research have produced a large volume of slag that is not easily attributed to any specific industry. Some of these finds may, in fact, be melted-down glass. However, further research is needed to determine the origin of these remains and their original function.

To conclude, the glass assemblage uncovered during the most recent fieldwork in Czermno shows numerous analogies with materials from previous research. The largest group of finds are glass bangles of Type 5b (decorated with spirally twisted grooves). Glass beads make up a fairly large group, which – and this important to note – does not include earlier (11th-century) forms known from previous research (*cf.*, Wajda 2022/2024, fig. 8A: Type 1, Type 10: 141, 152, Type 11: 179).

Small lead seals of 'Drohiczyn type' and other lead finds

A group of finds: eleven small lead seals of 'Drohiczyn type' (examples – Fig. 12: 1-5), two globular small lead seal blanks, a lead casting with small seal blanks still in place (Fig. 12: 8), a lead scale weight (Fig. 12: 9), and a scale weight/weighted object (?) (Fig. 12: 6) was excavated from archaeological deposits and features or picked up on the surface of the site. They furnish an important clue to the function of the suburban settlement and the entire settlement complex, intimating involvement in long-distance trade. Other lead finds

Fig. 12. Czermno, Site 2. Selected lead finds : 1-5 – small seals of 'Drohiczyn type'; 6 – scale weight/weighted object (?); 7 – lump; 8 – casting with small seal blanks; 9 – scale weight. Photo by S. Wajda

include lumps (Fig. 12: 7) and castings identified with the production of a variety of objects from this metal. Most of the small lead seals and other objects in this group have analogies in the assemblage of finds recovered earlier in Czermno (small lead seals – *cf.*, Florkiewicz *et al.* 2020, *e.g.*, Catalogue nos. I.19, I.73, II.11, II.69; other lead finds – *cf.*, Florkiewicz 2022/2024, fig. 13: 42-49, 144, 149; Catalogue nos. XIII.48-55, XIII.217, XIII.226).

Other finds

Another remarkable object is a fragment of a fired clay egg, glazed and decorated with a floral design, brown in colour, interpreted as the Tree of Life (its surface covered with stems, touching, with symmetrically arranged, lanceolate leaves). Glazed pottery eggs of this description were manufactured in Kyiv between the 10th and 13th cc.; this would be the most likely provenance of the egg from Czermno (Hilczerówna 1970, 115; Siemianowska 2008).

ARCHAEOZOOLOGICAL FINDS

The assemblage of biofacts excavated in 2022-2023 at Site 2 in Czermno provides the first reliable, well-documented basis for assessing the interaction between the communities inhabiting this key settlement complex and the animal world. The analysis of the large assemblage of consumption waste (more than 6,000 bone fragments) and of objects made of bone (34 various items) has yielded the first conclusions about the local economy, methods of exploitation of natural resources, structure of animal husbandry, animal products use and valuable features of living animals of different animal species. Although archaeological investigations of the remains of the stronghold in Czermno (Site 1) and sites in its hinterland date back to the 1940s, the results of archaeozoological studies have so far received limited attention (Krysiak 1966; Makowicz-Poliszot 2016; Tomek 2016; Gwiazdowska-Nowak and Piątkowska-Małecka 2016). The recently obtained data can serve as a good point of departure for the study of the animal economy practised in the Cherven' Towns region and the Polish-Rus' borderlands in the early medieval period, a subject that has been treated only superficially and marginally previously.

The present article reports only the preliminary results of the archaeozoological analysis of the distribution of waste species. The comprehensive results of this research are currently undergoing an in-depth analysis and will be published in a separate volume dedicated to the archaeozoological evidence. Special attention has been paid to the new chronological findings, which were used in assessing a possible shift in the economy during the two phases identified in the development of the suburb settlement. The assemblage, numbering 6,083 animal bone fragments, consists of material in a fairly good state of preservation, as reflected by a relatively high percentage of taxonomically determined remains (75.0%). The character of the assemblage, the state of preservation of the fragments, the

Table 4. Archaeozoological consumption waste from Site 2 in Czermno

Trench no.	**1-4**	**1/2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3A**	**4**	**4**	**4**	**4A**	**4A**	**4A**	**4A**	**4A**
Layer/ Feature	Layers	Feature 1	Feature 2	Feature 6	Feature 3	Feature 5	Feature 11	Feature 12	Features 12/13	Feature 13	Feature 14	Feature 18	Feature 16	Features 24/26	Feature 27	Feature 31	Feature 32	Features 32/34/36	Feature 35	Feature 36
Chronology	10th-13th cc.	10th c.	11th-13th cc.	10th c.	11th-12th cc.	11th-12th cc.	10th-13th cc.	10th-13th cc.	10th-13th cc.	10th-13th cc.	10th-13th cc.	10th c.	10th c.	10th c.	10th c.	10th c.	10th c.	10th c.	10th c.	9th c.
Cattle	1248	33		4	20	34	5					5	14				1	1		1
Sheep/Goat	1162	18	8	5	32	74	3			1			5	2	1		1	2		
Sheep	46												1							
Goat	19	1			1															
Pig	1086	32	2	2	22	47	9	2	1		11	2	22			1	1	1	1	2
Horse	72				2		18						2					1	1	
Dog	50			1		3			1				6							
Cat	4																			
Aurochs/ *Bison bonasus*	3	6				1														
Red deer	39	1			3								1							
Roe deer	76				5	7						2								
Elk	11					2														
Wild boar	41	4																		
Hare	20				1	1														
Beaver	1																			
Rodent	1																			
Bird	155	6	1	2	1	7							2							
Fish	5	1				1														
Undetermined	1374	23	11		22	28	19		4			4	22	1	1	2	3	5	1	3

taxonomic and anatomical diversity of the remains, and marks observed on the surface of most bones caused by butchering and cooking processes suggest that the assemblage is mostly consumption waste. Bone fragments were excavated from archaeological deposits and seventeen features, mostly identified with household activities, more rarely, with production/crafts (Features 1 and 5). The bone material found in most of the features was allocated to the two chronological phases of the settlement – the earlier, corresponding to the 10th and early 11th centuries (Features 1, 6, 1, 18, 24/26, 27, 31, 32, 32/34/36, 35 and 36) and the later phase, dated to the second half of 11th – early 13th centuries (Features 2, 3 and 5).

Standard analytical procedures were used (Lasota-Moskalewska 2008; Rietz and Wing 1999; Gifford-Gonzales 2018). The taxonomic assessment of the assemblage showed that the remains all belong to vertebrates – mostly mammals, more rarely, birds and fishes (Tables 4-6). Among the mammal bones, the largest group belong to domesticated species (94.9%); animals living in the wild account for only a minor percentage (5.1%). The latter assemblage includes many bones of roe deer, wild boar, and red deer, and a smaller amount of hare, elk, European bison/aurochs and beaver. The four main livestock species accounted for approximately 30% of the assemblage. Bones of small ruminants were the most

Table 5. Distribution of archaeological remains in layers and features by species, Czermno, Site 2

Species determination	Layer		Feature		Total	
Cattle	1248	33.8%	118	25.3%	1366	32.9%
Sheep/Goat	1162	31.5%	152	32.6%	1314	31.6%
Sheep	46	1.2%	1	0.2%	47	1.1%
Goat	19	0.5%	2	0.4%	21	0.5%
Pig	1086	29.5%	158	33.9%	1244	30.0%
Horse	72	2.0%	24	5.2%	96	2.3%
Dog	50	1.4%	11	2.4%	61	1.5%
Cat	4	0.1%	0	0.0%	4	0.1%
Domesticated mammals total	3687	100.0%	466	100.0%	4153	100.0%
Aurochs/*Bison bonasus*	3	1.6%	7		10	4.4%
Red deer	39	20.4%	5		44	19.6%
Roe deer	76	39.8%	14		90	40.0%
Elk	11	5.8%	2		13	5.8%
Wild boar	41	21.5%	4		45	20.0%
Hare	20	10.5%	2		22	9.8%
Beaver	1	0.5%	0		1	0.4%
Wild animals total	191	100.0%	34		225	100.0%
Rodent	1		0		1	
Bird	155		19		174	
Fish	5		2		7	
Undetermined	1374		149		1523	

numerous (34.2%), with almost twice as many bones of sheep as of goats, followed by cattle (32.9%) and pigs (30.0%). Bones of the horse, dog and cat made up only a small percentage, 2.3%, 1.5%, and 0.1% respectively.

The distribution of bone remains of domestic and wild animal remains recovered from the archaeological deposits and features was similar (Fig. 13). The greatest difference was shown by bones of cattle: their percentage recovered from the feature fill was smaller (25.3%) as compared to the percentage deriving from archaeological deposits (33.8%). The percentage and species composition of wild animal bones were similar.

Analysis of the same values made for bone fragments recovered from features with a precisely determined chronology revealed differences in the species distribution of domesticated mammals (Fig. 14). In Phase I, the dominant species was pig (37.6%), followed by cattle (34.7%), followed by small ruminants (21.2%). Differently in Phase II, where the remains of sheep and goat were the most numerous (46.9%), followed by pig (29.1%) and cattle (22.1%). The difference in the percentages of horse and dog bones was negligible. This is also true of the remains of wild animals, which in each phase accounted for around 7.5%. The species composition of these animals was similar, except for a larger number of roe deer remains and the appearance of hare bones in the assemblage belonging to the second chronological phase.

Table 6. Archaeozoological remains distribution in features with a determined chronology, Czermno, Site 2

Species determination	Phase 1		Phase 2	
Cattle	59	34.7%	54	22.0%
Sheep/Goat	34	20.0%	114	46.5%
Sheep	1	0.6%	0	0.0%
Goat	1	0.6%	1	0.4%
Pig	64	37.6%	71	29.0%
Horse	4	2.4%	2	0.8%
Dog	7	4.1%	3	1.2%
Cat	0	0.0%	0	0.0%
Domesticated mammals total	170	100.0%	245	100.0%
Aurochs/*Bison bonasus*	6		1	
Red deer	2		3	
Roe deer	2		12	
Elk	0		2	
Wild boar	4		0	
Hare	0		2	
Wild animals total	14		20	
Bird	10		9	
Fish	1		1	
Undetermined	65		61	

The analysis of the animal bone assemblage from Site 2 in Czermno indicates that the mainstay of animal economy practised by the community inhabiting the suburb settlement during the early medieval period was animal husbandry, complemented to a certain extent by hunting game and – very probably – fishing. Animal protein and fat were supplied in similar proportions by cattle, sheep, goats and pigs. Occasional consumption of

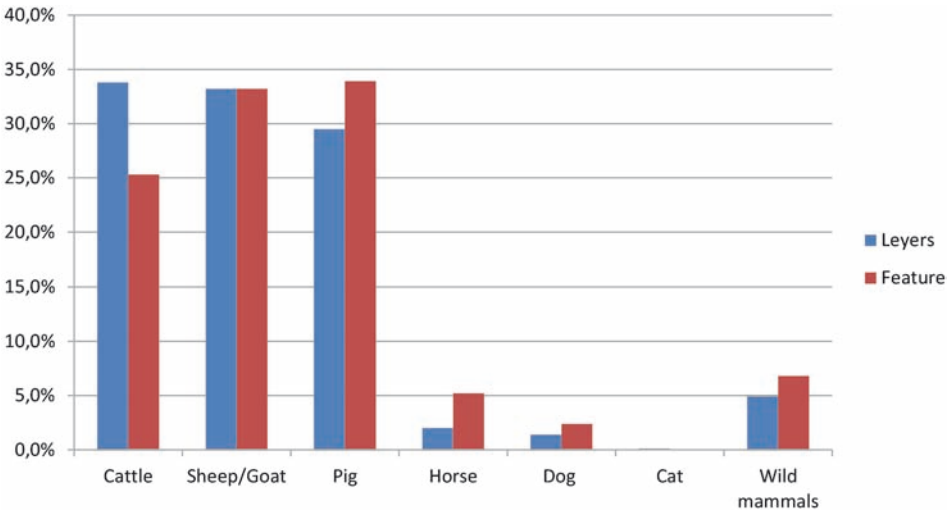

Fig. 13. Domestic and wild animal species recorded in archaeological deposits and features. Graphic design J. Piątkowska-Małecka

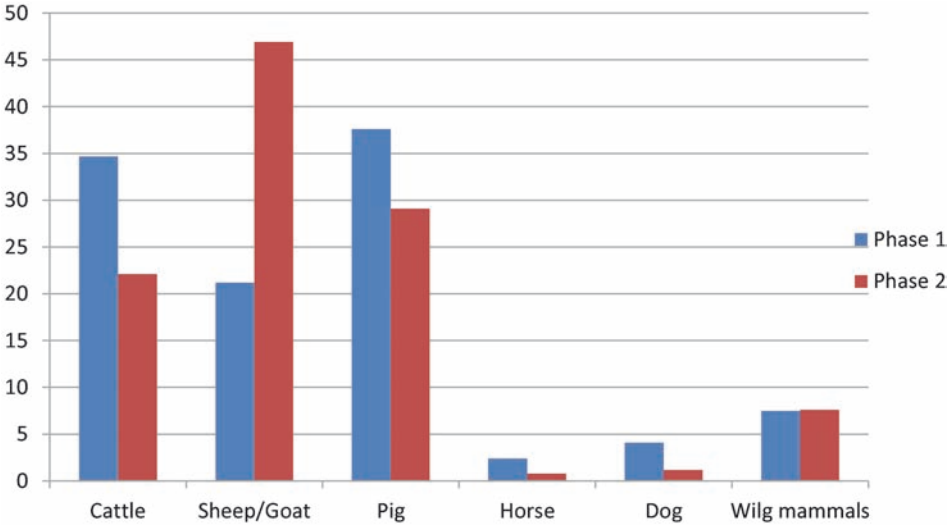

Fig. 14. Domestic and wild animal species recorded in archaeological features, Phase I and II. Graphic design J. Piątkowska-Małecka

horse meat cannot be discounted; it is suggested by butchery and cooking marks identified on the bones of this species. Game animals and birds apparently played a smaller role in the local diet. The general structure of animal economy suggests a mixed model of husbandry, without an apparent preference for any specific species. It is more than probable that things evolved over time. The faunal assemblage from Phase I is dominated by bones of pig, followed by cattle, and only then, small ruminants. The pig's leading role in the establishment of the suburb can be attributed to rising meat demand. During the second phase, when the settlement situation had stabilised, there was a shift in the direction of animal husbandry. The role of pigs and cattle was reduced, and there was an increase in the importance of small ruminants, which, next to meat, also supplied milk, and in the case of sheep, wool. During both phases of occupation, livestock breeding was supplemented by hunting. Game animals included in the first place, deer and wild boar, to a smaller extent, aurochs and European bison, hare and beaver. During the second phase, the number of roe deer bones increased; the remains of hares were observed for the first time. This suggests progressive forest clearance of the land in the immediate vicinity of the settlement complex. The results of archaeozoological studies suggest a shift in the animal economy of the suburb settlement in the 11th century, particularly in the structure of animal husbandry. Because of the small size of the analysed sample, these findings require verification.

FINAL REMARKS

Spatial organisation of the suburb settlement

Magnetometry and GPR data from 2013-2014 and 2022, respectively, were used to determine the boundaries of the site and the layout of the ditches; numerous anomalies were identified, indicating the presence of buried features throughout the settlement. When interpreted, the GPR prospection data revealed that the suburb settlement had an organised layout, with rows of dwellings aligned NE-SW, and a system of inner timber roads. Valuable information was secured in the NE part of the site – the remains of a large building (?), and several dwellings and outhouses (?) discovered at the centre of the settlement and in its southern area (see Piotrowski *et al.* 2011; Gazda 2010; Ryndziewicz 2023). Naturally, the view obtained from the non-invasive studies requires validation through excavation; nevertheless, it affords a good starting point. Notable in this context is the documentation from Levko Chikalenko's excavations of a dwelling with a hearth, but without a more detailed description or location (Chikalenko 1998; Wołoszyn 2016). On the other hand, the focus of archaeological studies of the 1970s was mainly on the recognition of the system of defences of the suburb settlement and contributed no data about the buildings within.

The two seasons of sondage excavations led to the discovery of thirty-eight functionally different features interpreted as utility pits (19), remains of upright timbers (13), remnants of wooden communication structures (4), fragments of a rampart (?) and an ecofeature (Figs 2 and 3). The absence of dwelling structures must be due to the site's location at the edge of a flood terrace, on the periphery of more close-knit habitation, the marshy ground, and the economic-defensive function of this zone (Dzieńkowski 2023).

The remnants of communication structures (Features A-D) were the following: a timber road (A), roughly 2 m wide, laid over a natural layer covered with fascine (brushwood and bark). Horizontal timbers used presumably as sleepers were poorly preserved, the rough planks resting on top of them were in a slightly better shape. The road ran NE-SW parallel to the edge of the terrace and the conjectured rampart. The presence of an inner track intimates the existence of an orderly spatial layout of buildings inside the suburb settlement. The existence of a road network and its plan was also confirmed by the data from GPR studies. A 'communication makeshift' was a footbridge of rough pinewood boards (D) covering the peat-filled hollow. This is a typical measure used in a marshy terrain for crossing it without getting one's feet wet (Figs 3 and 4). It is fairly safe to ascribe a similar function to structures C-D found in Trenches 1 and 4A (Fig. 5). They too are very likely the remains of a road of which only horizontal timbers had survived. Their NE-SW course, outside the terrace edge, suggests the function of a track outside the settlement, connecting the suburb with the stronghold (?). A similar structure, only interpreted as a causeway, was uncovered in 1972 in Trench IIA laid out to the east of the currently investigated area (Florkiewicz and Urbański 2016). With only limited fragments of these structures uncovered in the excavation trenches, these issues remain open for future research. Let us add that back in 1959 Konrad Jażdżewski already noted the possibility of communication between the two sites over causeways. At that time, using aerial photographs he traced a line interpreted as a causeway, noting that it 'ran from the conjectured gateway of the stronghold directly towards the edge of the suburb hummock on the opposite side' (Jażdżewski 1959, 73).

The riddle of suburb settlement defences

While the first references to the presence of earthworks in Czermno, other than the ramparts of the stronghold, go back to the 19th century, the first archaeological record of fortifications of the suburb settlement dates from the 1940s and 1950s (Pavlishchev 1865, 244-247; Chikalenko 1998, 623-635; Jażdżewski 1959, 71-74; Musin and Wołoszyn 2017, 422-423). Describing the archaeology of Czermno during the war, Levko Chikalenko noted that the settlement 'on an island', now known as 'Zameczek' [suburb settlement], was probably enclosed by a wall for the purpose of defence (Chikalenko 1998, 623-635; Wołoszyn 2016, 202). Similar conclusions were reached after field surveys and aerial prospection made in Czermno by the team of Konrad Jażdżewski. Writing about Site 2, the

Polish archaeologist recorded traces of a ploughed-out earthwork along the south-eastern edge of the elevated landform (Jażdżewski 1959, 71, 74). The reconstructed course of the earthworks was marked on drawings and maps with a line that either surrounded the site on all sides, or only enclosed a part of the suburb settlement. This lack of certainty was one of the reasons the fortifications of the suburb settlement were investigated in the 1970s (Fig. 2). Remnants interpreted as fragments of a rampart were uncovered inside Trenches IIB, IIC[?], IIF[?]; the structure was described as an earthen wall, 5-6 m wide, reinforced on the outside with a wooden palisade. The only surviving description and drawing of Trench IIB records the recognisable stratigraphy as an earth bank (Florek 2016b, Fig. 8). Subsequent non-invasive studies (geophysical magnetometry and GPR prospection) have failed to confirm the layout of the defensive earthworks. The first method has identified the remains of fortifications (?) on the edge of the terrace in the SW and NE area of the studied site. Analysis of GPR data suggests that the fortifications ran along the SE edge of the terrace. On the other hand, the examination of the Digital Elevation Model and aerial photographs suggest the earthwork ran along the north, east and west edge of the terrace, but do not rule out its presence in the zone between the stronghold and its suburb (Figs 1 and 6-8). This mixed, and somewhat chaotic image, currently leaves unresolved the question of the layout, construction design, phasing and dating of the conjectured rampart. The new evidence brought in by the more recent excavations on this part of the site are also inconclusive. Another open question is the function of Feature 10, possibly the remnant of a rampart from Phase I. This is suggested by its character: levelled sub-base, substantial width (3-4 m), construction material (earth) and presence of upright timbers – posts (Features 8 and 9; Fig. 5). Its identification as a defensive wall is supported by the location of this feature on the edge of the terrace, outside the area occupied by dwellings and the inner timber track. Furthermore, no other settlement features and/or structures have been uncovered in this zone. The construction of the conjectured rampart can be described only broadly as an embankment with a timber revetment (?). At the same time, stratigraphic evidence would place its construction and destruction in, respectively, Phase I and II, suggesting changes in the spatial organization of the suburb settlement. At the present stage of research, the proposed interpretation needs validation through continued excavation.

Chronology

In the preexisting and in more recent reference literature alike, the operation of the suburb settlement has a broad dating of between the 10th and 13th century (Gurba 1988, 302-305; Dzieńkowski *et al.* 2020, 460-466). This was dictated largely by the chronology established for the settlement complex by archaeological evidence (stratigraphy, assemblage of finds) and the historical record (written sources – the much-invoked reference in the Primary Chronicle found under the year date 981 [6489], and later; see Jusupović 2017, 66-74). The first absolute dates obtained for the archaeology in Czermno date to the

1990s, when the timbers of the rampart and causeways were dated using chronometric methods (Urbański 2000). A significant increase of the number of radiocarbon and tree-ring dates started in 2013 (Dzieńkowski *et al.* 2020, 424-452). By 2021, the total number of absolute dates secured for the whole settlement complex (79) includes 25 dendrochronological and 54 radiocarbon dates obtained from timbers of the causeways and timbers of the rampart (^{14}C dates – [24], tree-ring dates [25]), organic remains (peat – thirteen ^{14}C dates), inhumation (four ^{14}C dates), organic residues in the pottery (thirteen ^{14}C dates) (Auch 2017; Dobrowolski *et al.* 2018, 258-273; Dzieńkowski *et al.* 2020, 431-452).

Analysis of the dating results dates the origins of the settlement complex to the 10th century, the time of the construction of also the stronghold defences (Phase I), and later remodelling projects (Phase II; early 11th cent. and, very likely, the extension works in the middle/late 11th century). Intense use continued until at least the middle of the 13th century, possibly later (see Wołoszyn *et al.* 2018; Dzieńkowski *et al.* 2020, 431-452). For the suburb settlement, no absolute dates had been available, the time of its occupation determined by archaeological evidence was quite broad. Two dendrochronological dates of 'after 1030' and '1050' obtained from Trench IID, came from structural timbers used to stabilize the stronghold rampart. This rather unsatisfactory situation changed for the better after the investigations of 2022-2023 which recorded a complex stratigraphic sequence of the site, identified two phases of occupation, and secured fifteen absolute dates (10 radiocarbon, 2 dendrochronological and 3 thermoluminescence). This made it possible to establish a preliminary chronology for the site and refer these results to the general discussion of the origins of occupation in Czermno-Cherven'.

The chronology of Phase I is thought to belong to the period middle/late 10th century -1020s. This is indicated by the radiocarbon dating results with a probability of 95.4% deriving from Features 1 and 16, and from the timbers of the trackway (A, B) – *cf.*, Table 1-3. The tree-ring dates of 'after 974' and '998' probably also belong to this period (Phase Ib [?]), except that there was no surviving sapwood to make this dating conclusive. The only feature to obtain a dating as early as possibly the 9th century is no. 36 (Phase Ia [?]), suggesting that occupation could have started in that early period. Although a single date cannot be sufficient proof, traces of occupation during that age correspond with dates obtained from organic materials in pollen profiles informing about a major clearance in the 9th century (Dobrowolski *et al.* 2018). Furthermore, the results of dating obtained from the suburb settlement agree with evidence obtained previously about the construction of the stronghold rampart, at the latest, in the late 10th century, and its remodelling in the 1020s (Dzieńkowski *et al.* 2020, 424-452).

Phase II, easily discernible in the stratigraphy, is dated by three radiocarbon analyses confined to the period between the mid-11th – mid-12th, early 13th centuries (Table 2). Occupation during this period is confirmed fairly well by dates obtained from the timber of the causeways, stronghold rampart and from inhumation burials (Wołoszyn *et al.* 2018; Dzieńkowski *et al.* 2020, 431-455).

Based on stratigraphic evidence and absolute chronology, it is safe to argue for some form of occupation of the suburb settlement already in the 9th century (Phase Ia), but more close-knit occupation presumably started only in the 10th century (Phase I, Ib). It is very probable than this was also the time when the fortifications were raised (Feature 10 [?]). Phase II brought a change in the spatial organization of the suburb settlement which at that time was presumably expanded to the south-west; this is suggested by the presence of levelling layers and thickness of the occupation level, also found in this part of the site. These data suggest a change in solutions used to defend the southern zone of the suburb settlement, and very likely, its communication with the stronghold. The questions that arise here have to be resolved through further excavations, but definitely another research step has been taken.

While the size of the assemblage of finds recovered on the Huczwa River is an important consideration when planning future excavation work at this location, it is equally important in our attempt to understand the character of the Cherven' stronghold: it was definitely not a small garrisoned border outpost, but a large centre of commerce, a meeting ground rather than a place of separation.

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MEDIEVAL GLAZED CERAMICS FROM KRAKÓW-NOWA HUTA-ZESŁAWICE, SITE 88, LESSER POLAND VOIVODESHIP. THEIR FORMAL AND TECHNOLOGICAL ANALYSIS

ABSTRACT

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This study analyses medieval glazed ceramics from Site 88 in Kraków-Nowa Huta-Zesławice, focusing on their formal and technological aspects. The research examines macroscopic features, chemical composition, and production techniques, comparing them with finds from other sites in Lesser Poland. Results indicate a local glazing tradition in Lesser Poland linked to metallurgical activities, with continuity from the 11th to the 14th century. The study expands knowledge of the distribution and production of glazed pottery in medieval Poland.

Keywords: glazed pottery, specialists analysis, Middle Ages, Lesser Poland
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1. INTRODUCTION

The occurrence of glazed ceramics in early medieval Poland is a phenomenon of exceptional character. The discovery of the first glazed vessels, dated to the mid-11th century, sparked debate over their origin and production technology. Initially, due to the small number of finds, it was believed that the production of this type of ceramics was incidental and limited to a small area on the border of Lesser Poland and Upper Silesia. However, with the systematic increase in the number of discovered artefacts and their detailed analysis, including the research presented in this article, it has become possible to gain a better understanding of the scale of this phenomenon in Polish lands during the early medieval period.

The main objective of this study is to analyse the assemblage of glazed ceramics from Site no. 88 in Kraków-Nowa Huta-Zesławice (Fig. 1: A), focusing on the macroscopic characteristics and chemical composition of ceramic bodies and glazes. These results will be compared with analyses of glazed ceramics from other important sites, such as Dąbrowa Górnicza-Łosień, Dąbrowa Górnicza – Strzemieszyce, Sosnowiec, Lelów, and Bytom. This research will provide new data and contribute significantly to the ongoing discussion on the phenomenon of glazed vessels in this part of Poland

The presented assemblage of glazed ceramics, consisting of 64 fragments from 42 vessels, was recovered during rescue excavations conducted in connection with the planned construction of the S7 expressway (Moczydło – Szczepanowice – Widoma – Zastów – Kraków section). Site no. 88, located to the west and north of the boundary of the now-defunct brickyard in Zesławice, encompassed part of a plateau and the slopes of an elevation with a maximum height of 238.6 m above sea level (Fig. 1: B).

The remains of medieval settlement, both early and late, were located on the slope of an elevation descending southwestward toward the valley of the Dłubnia River. They were identified in the western part of the excavation, on both sides of the road leading to Krapkowice, which crossed the site along a north-south axis. The medieval remains were recorded over an area measuring 180 meters in length, divided into six sections (A, B, C, D, X, Y) (Fig. 1: B). Fragments of glazed vessels were discovered in 12 features (Table 1; Fig. 1: C).

The chronology of the features was determined based on the artefacts found within them, primarily ceramic vessel fragments. Using the results of technological and formal-stylistic analysis, the period of the settlement's occupation was established as the late 11th to the early 14th century. To further refine the chronology, two phases of construction (specifically ceramic production) were distinguished. The earlier phase (group 1 of the glazed pottery), containing vessel fragments dating from the late 11th century to the first half of the 13th century, and the later phase (group 2 of the glazed pottery), dated from the 13th to the 14th century.

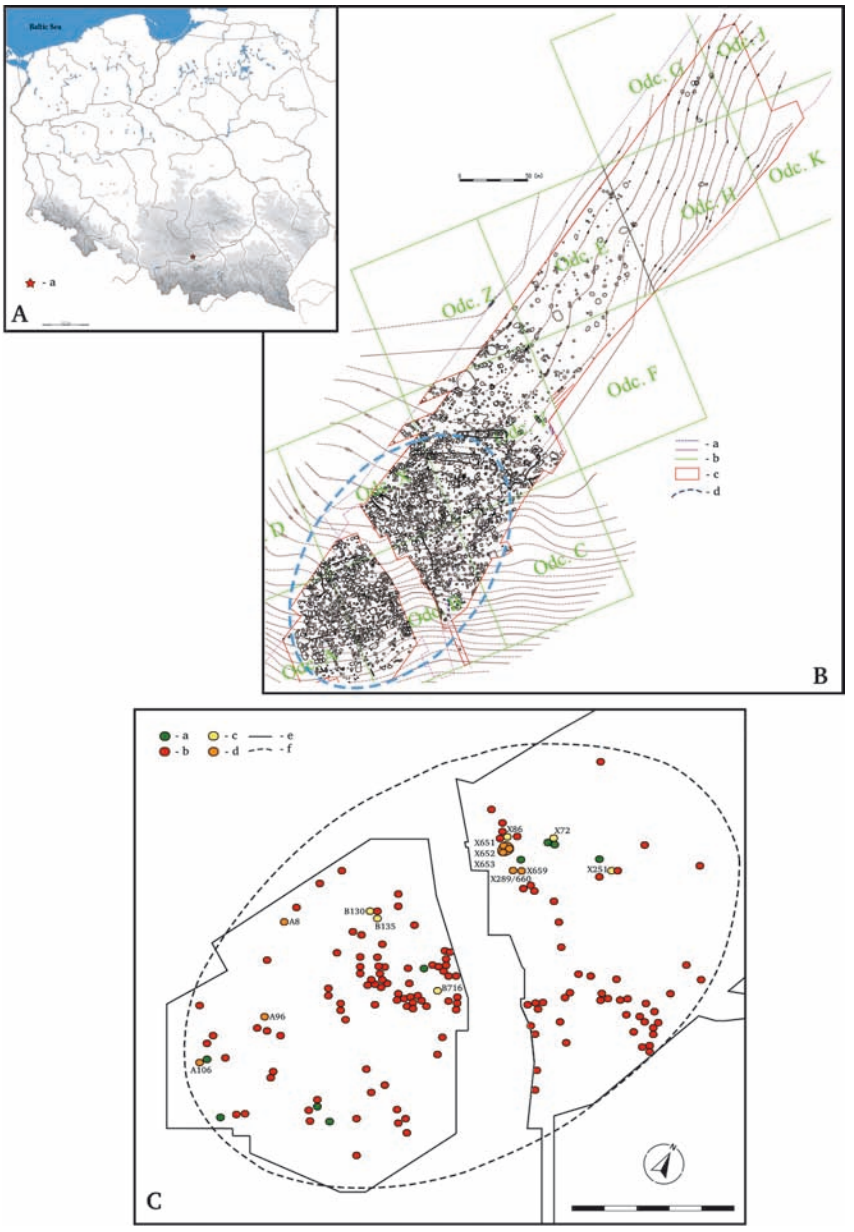


Fig. 1. A – Location of Site 88 at Kraków-Nowa Huta-Zesławice in Poland (a); B – Hiposmetric map of the site (a – area of the investment; b – trenches; c – d – area of the concentrated medieval features); C – Distribution of medieval features containing glazed pottery within the medieval settlement area (a – Early medieval features; b – late medieval features; c – early medieval features with glazed pottery, Group 1; d – Late medieval features with glazed pottery, Group 2; e – trenches; f – area of the medieval settlement). Drawing B. S. Szmoniewski, L. Żygadło

Table 1. Kraków-Zesławice, site 88, Lesser Poland Voivodeship. Characteristics of the features with glazed pottery

Ordinal number	Number of a feature	Dimensions Length and Width [cm]	Function	Glazed Pottery (Quantity)	Non-glazed Pottery (Quantity)	Other artefacts	Chronology	Plates
1	A8	221x164x75	Household pit	3	65	2 iron objects	Group II	
2	A96	630x382x79	Sunken featured structure	1	21	-	Group II	
3	A106	500x470x129	Household pit	1	8	-	Group II	Fig. 5: 1
4	B130	162x140x108	Hearth	3	28	-	Group I	
5	B135	224x178x102	Household pit	2	19	Fragment of iron knife blade	Group I	Fig. 3:3
6	B716	153x123x181	Household pit	2	79	-	Group I	
7	X72 (X63/64)	320x98x132	Household pit	3	70	Iron knife blade	Group I	
8	X86	160x88x64	Oven	2	360	Iron object; whetstone	Group I	
9	X251	574x558x185	Sunken featured structure	1	128	Fragment of a stone grinding plate; Iron fitting (?); 3 fragments of a Millstones	Group I	
10	X289/X660	359x195x70	Household pit	1	4	-	Group II	Fig. 5:4
11	X651/652/653	700x450X180	Sunken featured structure	17	185	-	Group II	Fig.3: 2 Fig.3: 4 Fig. 4: 1-3
12	X659 (X52/62)	624x450x70	Sunken featured structure	9	76	Iron knife blade; ground stone; quern stone	Group II	Fig.3: 1 Fig.5: 2, 3 Fig. 13

2. CONTEXTS IN WHICH GLAZED VESSELS WERE FOUND

The features in which glazed pottery was discovered are preserved in a severely damaged state, which, at this stage, hinders detailed formal analysis. Therefore, the most essential information regarding the discovery context is presented in Table 1.

Glazed ceramics were discovered in three sections – A, B, and X – across 11 underground features. In sections A and B, the ceramics were found exclusively in the fills of Features A8, A96, A106, B130, B135, and B716. These were sunken features that did not form any clusters, except for Features 130 and 135, which were adjacent to each other. In Section X, fragments of glazed vessels were found both within the features and in the layers above them. They were concentrated within the grid areas X51-X52-X53-X61-X62-63 and X83. One prominent feature stands out in this section (X651, X652, X653) (Table 1; Fig. 1: B, C).

3. THE GLAZED POTTERY FROM LESSER POLAND – AN OVERVIEW

The first glazed vessels in Polish territories were discovered in the 1930s at a unique cemetery in Strzemieszyce Wielkie, a district of Dąbrowa Górnicza (Marciniak 1929-1932, 238-241; Marciniak 1960, 141-186), dated to the mid-11th to mid-12th century. Among the dozen or so vessels, two cylindrical pieces stood out, adorned with wavy ornaments and a band glazed in a lemon-yellow hue, from vessels resembling small buckets. In the postwar period, there was a systematic increase in the number of sites yielding glazed ceramics, with the highest concentration on the border between Lesser Poland and Upper Silesia. In Kraków, the earliest glazed vessels discovered are dated to the second half of the 11th century (Okół and Wawel; *cf*., Wałowy 1979, 55). The frequency of glazed ceramics in assemblages from the in pre-location period of Kraków in this initial phase was below 1% (0.3%). Still, it increased to approximately 5% in assemblages from the first half of the 13th century (Radwański 1968, 67). In later phases of the early Middle Ages, the proportion of glazed ceramics in Kraków ceramic assemblages did not exceed a few percent (Radwański 1968, 68).

Unfortunately, we do not have data on the percentage share of glazed pottery at other sites within the studied area. So far, the largest assemblage of such ceramics, comprising several hundred fragments, comes from Dąbrowa Górnicza-Łośnia, Sites 2 and 8 (Rozmus and Bodnar 2004, 26; Bodnar *et al.* 2005, 59). Therefore, the assemblage of glazed pottery from Kraków-Nowa Huta-Zesławice not only represents the first such discovery beyond the Kraków settlement microregion but also constitutes the first comprehensive study of this type of pottery from western Małopolska.

Currently, 20 sites containing glazed ceramics are known from this area. Particularly interesting is the glazed pottery from the western part of the Kraków region, which indicates a local glazing tradition distinct from that known in Rus'. Glazed ceramics from Lesser Poland and Upper Silesia have been discovered at several types of sites, including production settlements, settlements and strongholds, as well as inhumation cemeteries. They were most frequently found at production settlements – specifically at metallurgical sites associated with early medieval lead smelting or trade in this raw material. The establishment of such sites, dating from the mid-11th century, was facilitated by shallow or

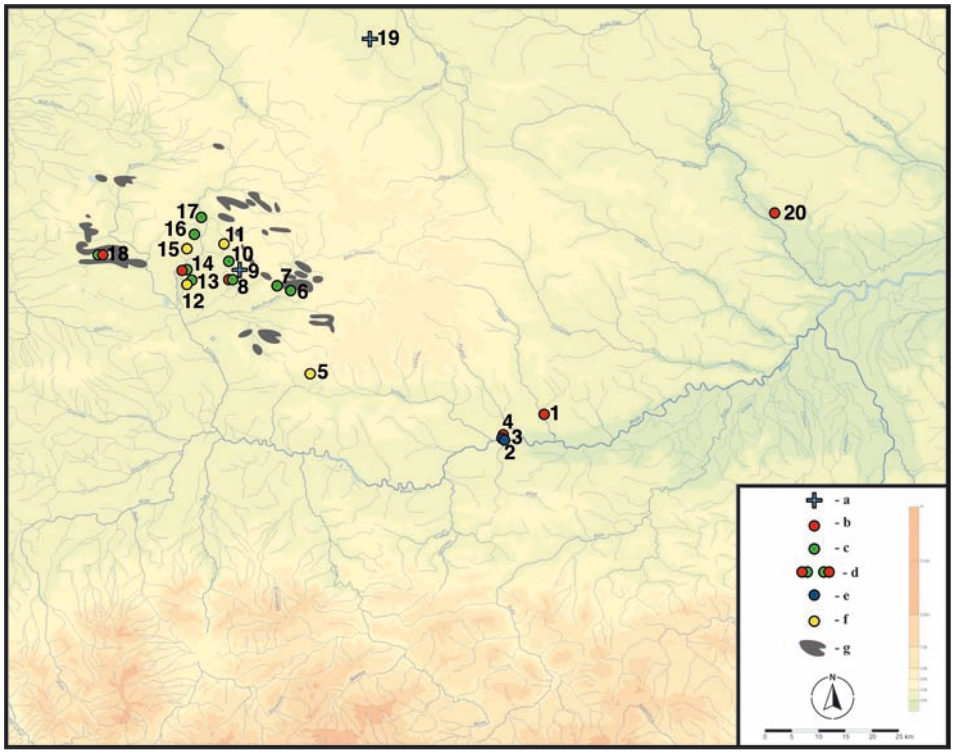


Fig. 2. Distribution of Early Medieval sites containing glazed pottery in Upper Silesia and Western Lesser Poland (a – cemetery; b – settlement; c – settlement with production zone, kilns; d – hillfort; f – sites identified during surface prospection (Polish Archaeological Record)

1. Kraków-Nowa Huta-Zesławice, Lesser Poland Voivodeship ; 2. Kraków -Wawel, Lesser Poland Voivodeship; 3. Kraków-Okół, Lesser Poland Voivodeship; 4. Kraków – Rynek, Lesser Poland Voivodeship; 5. Stare Bukowno, Lesser Poland Voivodeship; 6. Sławków, Silesian Voivodeship; 7. Bytom, Silesian Voivodeship; 8. Dąbrowa Górnicza-StrzemieszyceWielkie, Silesian Voivodeship, Silesian Voivodeship 9. Dąbrowa Górnicza-StrzemieszyceWielkie, Silesian Voivodeship; 10. Dąbrowa Górnicza-Łosień, Silesian Voivodeship; 11. Dąbrowa Górnicza-Tucznawa Przymiarki, Silesian Voivodeship; 12. Sosnowiec, Park Sielecki, Silesian Voivodeship; 13. Sosnowiec-Zagórze, Silesian Voivodeship; 14. Będzin, Silesian Voivodeship; 15. Malinowcie, Silesian Voivodeship; 16. Przeczyce, Silesian Voivodeship, Silesian Voivodeship; 17. Siewierz, Silesian Voivodeship; 18. Bytom, Silesian Voivodeship; 19. Lelów, Silesian Voivodeship; 20. Wiślica, Świętokrzyskie Voivodeship. Drawing B. S. Szmoniewski

surface deposits of lead ores containing silver compounds (Fig. 2). The primary raw material was galena (PbS), which was processed to obtain lead and silver. At these sites, glazed ceramics appear with varying frequency, indicating technological connections to metallurgical processes. In the case of the analysed glazed ceramics, the key material used for glaze production was lead oxide (litharge, PbO), obtained during the roasting of galena (PbS → PbO). Litharge was an intermediate stage in the process of extracting pure lead from lead ores containing lead sulphide (PbS) (Rozmus and Garbacz-Klempka 2017, 267, 268).

In the literature, two dominant theories explain the origins of glazed pottery production. The first theory posits that it was a result of local production, independent of external influences, and linked to the exploitation of local zinc and silver ores in the Olkusz region (Bodnar *et al*. 2005; 2006; Auch 2012). The second theory suggests that glazing technology was transferred from Kievan Rus', where it arrived from Byzantium. However, recent comparative analyses increasingly challenge the latter theory, highlighting significant differences in techniques, forms, and decorations between Rus' and the glazed pottery of Lesser Poland (Auch 2012, 239). Moreover, the latest research results confirm the use of lead deposits from the Olkusz area for glaze production, which rather indicates local production of this type of pottery (Szmoniewski *et al*. in print).

The phenomenon of glazed ceramics from Lesser Poland also stands out in comparison to early medieval pottery from Western Europe. It is worth noting that in the area of present-day Germany, glazed vessels did not become widespread until the 12th century (Höltken 2000, 17). Although glazing technology was known in Western Europe outside the Byzantine and Rus' territories as early as the 11th century, glazed vessels were primarily produced in present-day Belgium, Italy, and France – regions located at a considerable distance from the area under study (Verhaeghe 1969, 108; Whitehouse 1980, 68, 69; Husi 2003, 31; Jesset 2003, 62).

4. ANALYSIS OF GLAZED POTTERY – GENERAL CHARACTERISTICS (Figs. 3-5, 13)

A detailed analysis was conducted on 42 vessels, comprising 64 fragments. Among these, 19 fragments were classified into group I (Early Middle Ages) and 23 into group II (Late Middle Ages). The quantitative proportions of glazed pottery relative to unglazed forms are as follows:

– group I (Early Middle Ages): Glazed pottery accounts for only 3% of the total, while unglazed pottery dominates with 97%,

– group II (Late Middle Ages): The proportions shift significantly, with glazed pottery fragments making up 23% and unglazed fragments comprising 77% (Fig. 6). Most of the glazed vessels were preserved as small fragments, with only six reconstructed to a greater extent, from the rim to the lower part of the body (14%).

Fig. 3. Kraków-Zesławice, Site 88, Lesser Poland Voivodeship. Selection of glazed ceramics. 1 – Feature X659 (Sample 3); 2 – Feature X651 (Sample 10); 3 – Feature B135 (Sample 13); 4 – Feature X651/652 (Sample 16). Photo B. S. Szmoniewski

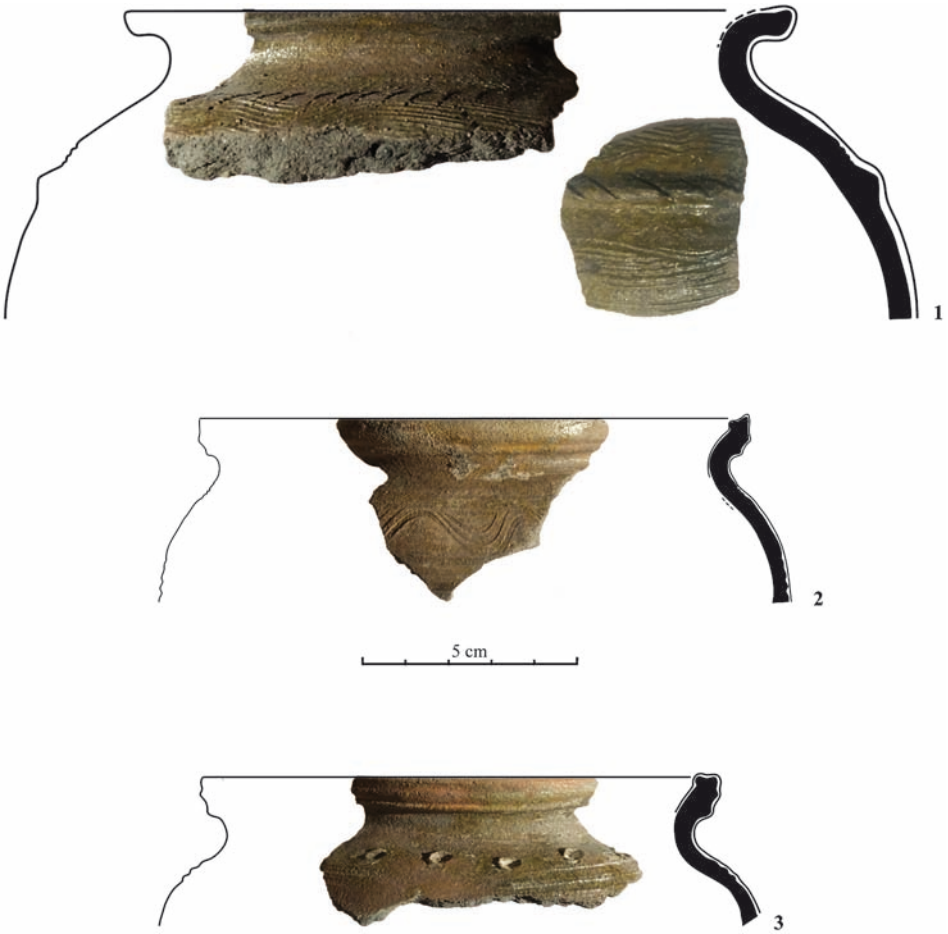


Fig. 4. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. Selection of glazed ceramics. 1-3 Feature X651/652, 1 – (Sample 15). Photo B. S. Szmoniewski

About 9% of the vessels were represented by rims preserved together with a part of the neck. Rim fragments combined with fragments of the body, most often up to the break line, constituted approximately 28% of the vessels. Isolated body fragments, without the rim, accounted for 21%. The percentage of bottoms, including fragments with the base part of the vessel preserved, was 9% of the analysed collection. The glazes displayed a variety of colours, including shades of yellow, brown, olive, and greenish. In both groups of glazed vessels, glazes in various shades of green, ranging from light green to dark olive, predominated. This colouration could be achieved by adding a significant amount of iron oxide to the mixture (*cf.*, Auch 2016, 239). In many cases, the glazed surface was significantly degraded, making it difficult to determine the original colour (Figs 3-5 and 13).

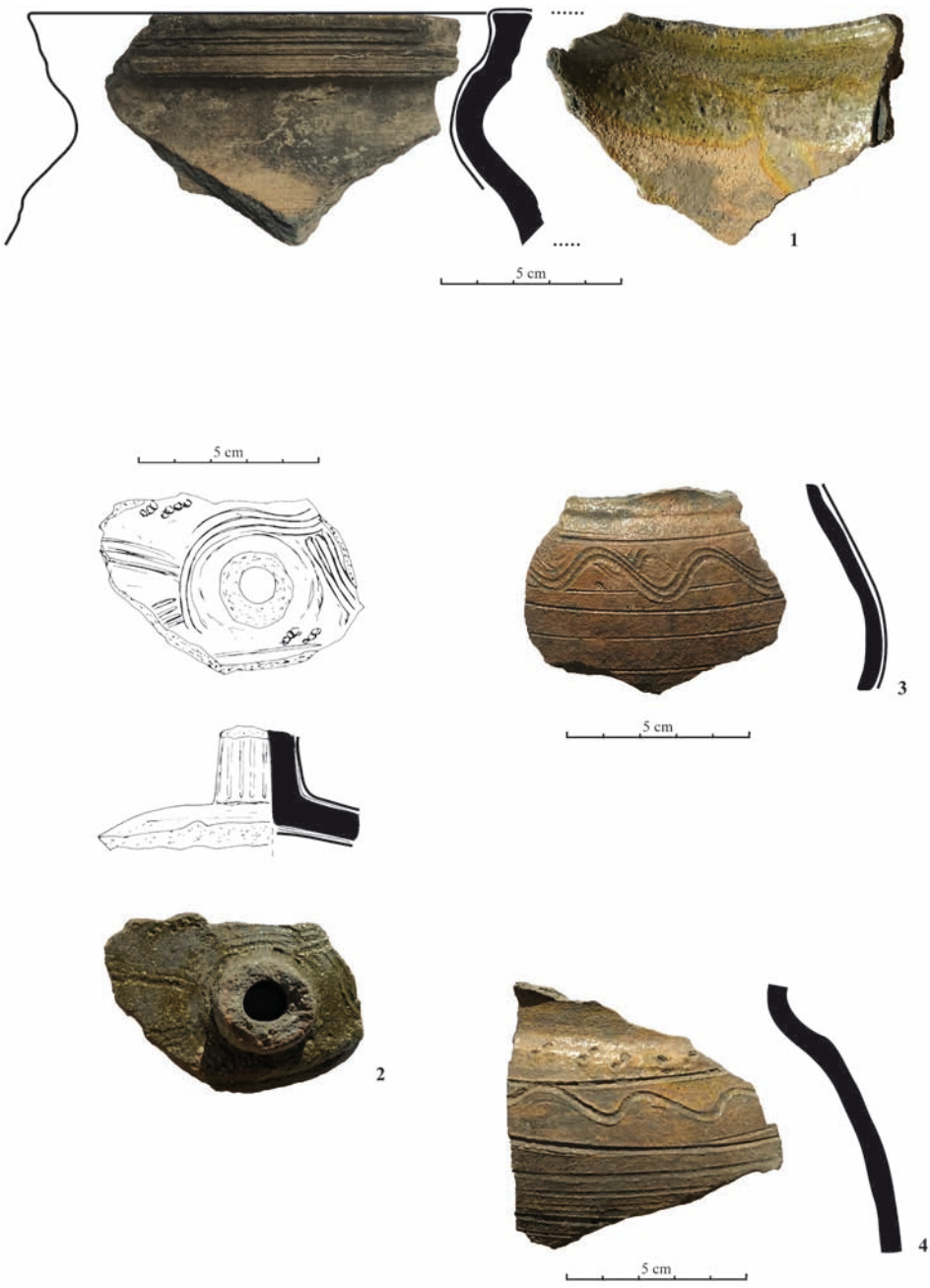


Fig. 5. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. Selection of glazed ceramics. 1 – Feature A106 (Sample 7); 2 – feature X659 (Sample 11); 3 – X659 (Sample 5); 4 – Feature X289/X660 (Sample 2). Photo B. S. Szmoniewski

4.1. Group I – Early Middle Ages

The majority of the glazed vessels in group I, originating from early medieval contexts, were made from ceramic fabric designated as Type 2. This fabric contains a fine-grained sandy temper with particles up to 0.5 mm, occasionally mixed with individual medium-sized grains, accounting for 52.63% of the analysed vessels. The second most common group was Type 1 (31.58%), characterised by a high content of fine-grained temper (up to 0.5 mm), which was weakly visible on the fracture surface of the walls and evenly distributed; some grains appeared as sharp-edged. Together, these two types constitute approximately 84% of all analysed vessels. The recipes of both of these fabrics are based on the dominant addition of very fine-grained mineral particles, evenly distributed throughout the clay mass. These fabrics can be classified as progressive and were also used in the production of completely wheel-turned vessels with the more modern stylistics typical of the late medieval period. Vessels made from fabric Type 3, distinguished by a very high mineral content, accounted for about 15% (15.79%) (Fig. 7). The ceramic recipes used in the production of glazed vessels classified by us as Group I did not differ from those employed in the manufacture of unglazed wares. As with the glazed ceramics, three types of fabrics – Types 1, 2, and 3 – were the most commonly used, accounting for approximately 97% of the vessels. More than half (57%) of the vessels without any traces of glaze on their surface were made from fabric Type 1, 25.5% from Type 2, and 14.7% from Type 3. Fractures in the vessel walls in Group I were observed, with a slight colour variation. The vast majority of

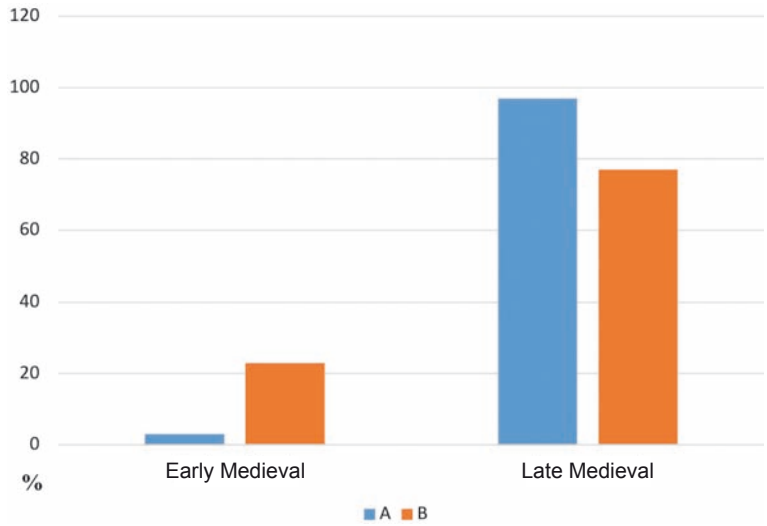


Fig. 6. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. Correlation between the presence of the glazed (A) and non-glazed pottery (B). Drawing K. Zamelska-Monczak

vessel wall fractures (84.2%) displayed a three-coloured stratification. The inclusion of fine-grained sand is quite common in ceramic materials from pre-location Kraków as early as the 11th century (Radwański 1968, 17, figs. 27-32; Radwański 1975, 301, figs 117-122). In this regard, the ceramics from Kraków-Nowa Huta Zesławice do not differ from those of nearby Kraków from the same period. This clearly indicates the existence of a specific pottery tradition in this part of Lesser Poland.

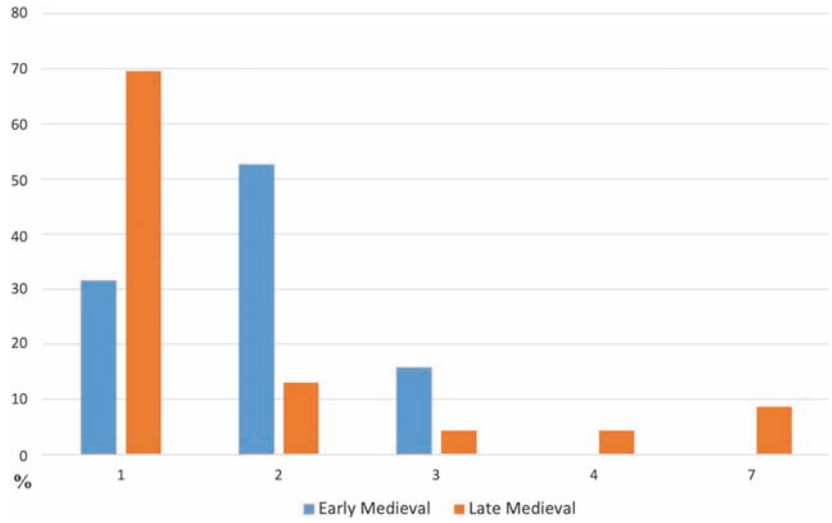


Fig. 7. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. Frequency of ceramic fabric group 1-7. Drawing K. Zamelska-Monczak

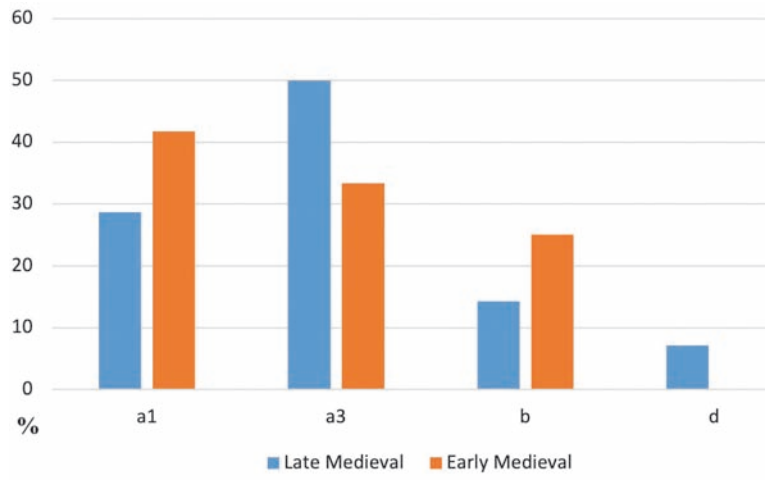


Fig. 8. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. Frequency of the main vessel types in the assemblages: a1 – vessels with a distinct neck; a3 – vessels without a distinct neck; b – vessels with a cylindrical neck; d – vessels with a 'spout'. Drawing K. Zamelska-Monczak

The glazed vessels exhibited a diversity of forms (Fig. 8); however, their range of shapes did not differ significantly from that of the remaining ceramic assemblage. Among the early medieval vessels (Group I), the most common type, accounting for 41.7%, was type a.1. These vessels featured a four-part structure consisting of a rim, neck, upper body, and lower body. Vessels without a neck (type a.3) constituted 33.3%, while those with a cylindrical neck (type b) made up 23%. The frequency of these latter forms appears to be high, not only in comparison to the unglazed forms within this assemblage, the percentage of which hovers around 6.5%, but also in relation to other Early Medieval ceramic assemblages.

The dominant vessel category in Group I was characterised by wall thicknesses of 4-6 mm. Nearly half (47.4%) of the items had walls measuring 5 mm thick. The frequency of vessels with 4 mm and 6 mm wall thicknesses was similar, at approximately 20% each (26.3% and 21.1%, respectively) (Fig. 9).

The classification of vessel rims (Fig. 10) followed the system proposed by Paweł Rzeźnik, which differentiates rim types based on the shaping of the external and internal surfaces of the rim and the form of the lip edge (Rzeźnik 1995, Fig. 28). In Group I ceramics, Group III rims, characterized by a shaped inner rim surface and lip edge, represented 40% of the total. The remaining rim types were less frequent. The second most numerous group was Group IV, in which shaping included both the inner and outer surfaces of the rim and the lip edge. The least frequent was Group II, defined by shaping limited to the outer rim surface and the lip edge (Fig. 11). The vessel rims classified into Groups 3 and 4

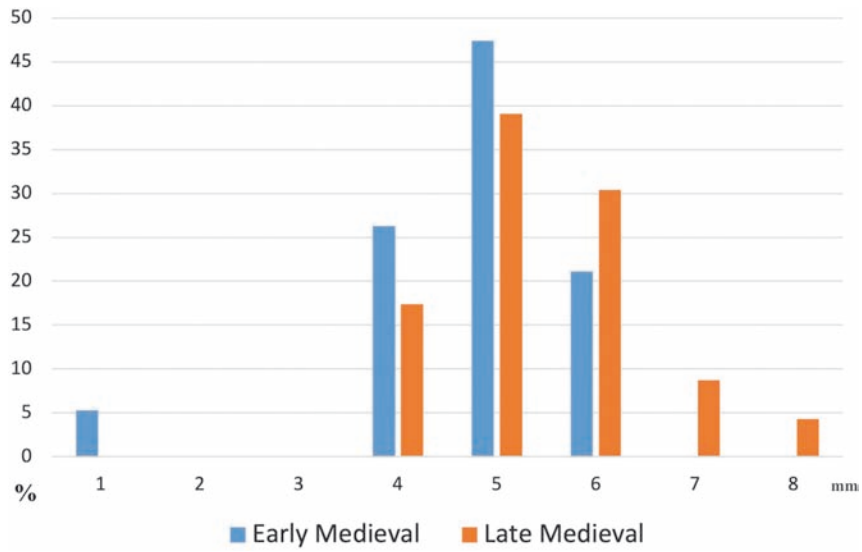


Fig. 9. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. Distribution of vessel wall thickness in millimetres. Drawing K. Zamelska-Monczak

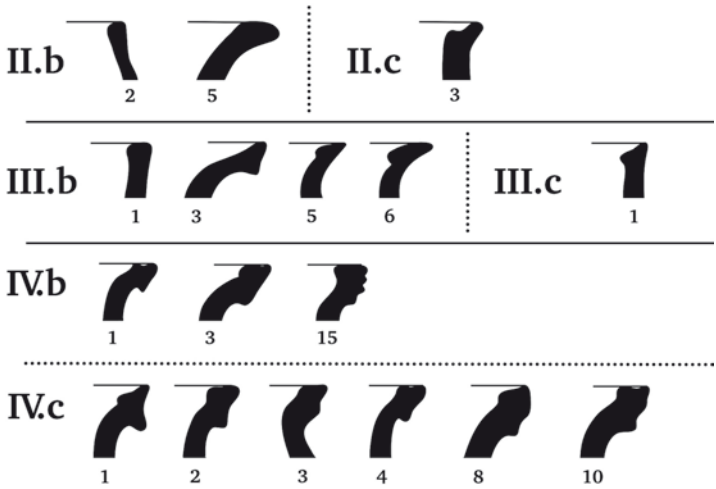


Fig. 10. Kraków-Zesławice, Site 88, Lesser Poland Voivodeship. Groups of rims. Drawing B. S. Szmoniewski

show connections to vessel rims from Kraków, where they are similar to profiled specimens, particularly Types 29, 30, 32, and 35. The chronology of these types is mainly dated to the 11th century, and primarily to the 12th to 13th centuries (Radwański 1968, 62, 64; fig. 39). The glazed vessels in this group were highly diverse in terms of both ornamental composition and motifs and patterns used. Considering that wheel-turned vessels typically featured extensive ornamentation covering larger areas of the surface in varied arrangements, the complete design could be reconstructed for only a small subset of the items. Identified decorations included flat circumferential grooves made with a stylus, appearing either alone or in combination with a band above them. This band often took the form of a wavy line applied with a stylus or comb. On three vessels, the grooved decoration was supplemented with several bands located in the upper part of the body. These bands featured diagonal comb impressions, wavy lines, or short horizontal strokes made with a stylus. One distinctive vessel had raised plastic bands on the neck, accompanied by a line of diagonal imprints and wavy lines created with a stylus.

The glaze varied in coverage, applied to different parts of the vessel: just the interior, the exterior, or both. In Group I ceramics, glazing was most commonly limited to the upper parts of the vessels, particularly around the rims. Approximately 47.4% of fragments were from vessels glazed only on the exterior, while slightly fewer (42.1%) showed glazing on both sides. Vessels with interior glazing alone were the least common, comprising just 10.5% of the fragments (Fig. 12). No correlation was observed between vessel form and the extent of surface glazing. The glazes exhibited colour variation. Shades of yellow, brown, olive, and greenish hues were identified, along with transparent glazes. In many cases, the glazed surface was heavily deteriorated, making it difficult to determine the original colour.

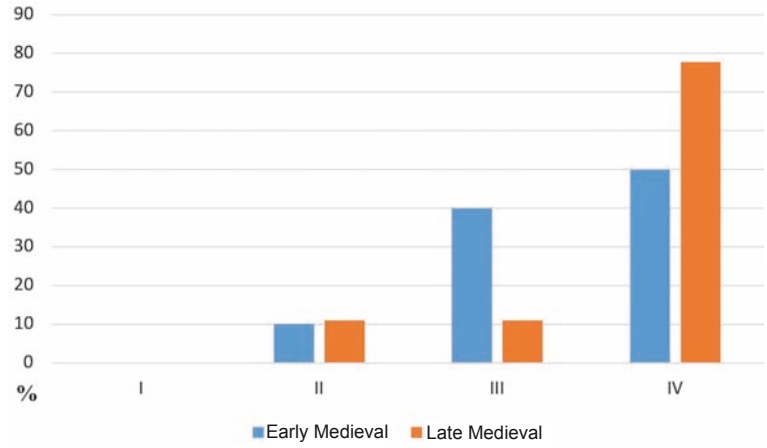


Fig. 11. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. Frequency of rims of groups II-IV. Drawing B. S. Szmoniewski

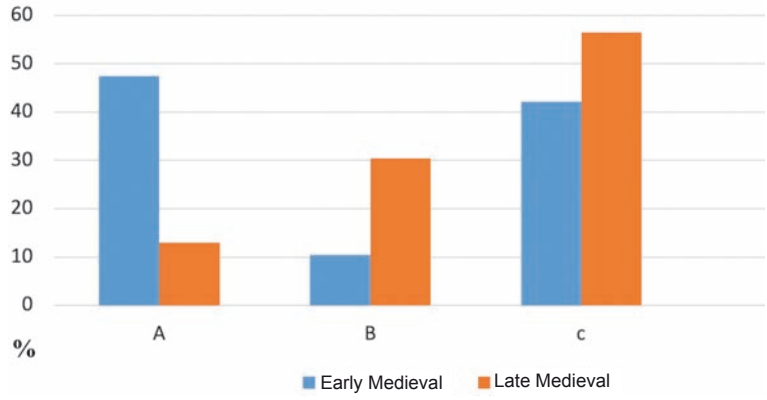


Fig. 12. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. Extent of glazing on the surface of vessels. A – external surface, B – internal surface, C – glazing on both internal and external walls. Drawing K. Zamelska-Monczak

4.2. Group II – Early Phases of the Late Middle Ages

Among the glazed vessels in Group II, associated with late medieval contexts, the majority were made using ceramic fabric No. 1, which accounted for nearly 70% (69.57%) of the assemblage. The ceramic recipe classifications are consistent across both Group I and Group II ceramics. Ceramics in this group were also produced using fabric No. 2 (13.04%) and, in individual cases, fabric No. 3 (characterized by a very high proportion of fine and medium-sized inclusions; significant mineral additives visible as a "friable" texture in the fracture), No. 4 (medium quantity of fine inclusions with medium-grain particles), and

No. 7 (a very high proportion of medium-grain inclusions, predominantly sand with grains up to 2 mm, and occasional charcoal fragments, distributed evenly and tightly packed in the clay). Overall, the glazed vessels in Group II demonstrated greater diversity in the ceramic fabrics used for their production (Fig. 7). For unglazed vessels in Group II, fabrics designated as Type 1 (55.4%) and Type 2 (28.4%) were also preferred. This indicates that the potters' preferences regarding ceramic recipes were similar for both glazed and unglazed vessels.

Examination of vessel wall fractures of vessels in Group II revealed slight variation, with the vast majority (91.3%) exhibiting a tri-coloured stratification in the cross-section. Half of the vessels from late medieval contexts (Group II) were forms without a distinct neck. The frequency of vessels with a neck was 28.6%, while those with cylindrical necks made up 13% (Fig. 8). The number of glazed vessels with cylindrical necks in this assemblage is lower than in Group I, yet remains relatively high. For comparison, the proportion of unglazed forms of this type within the same assemblage was 7.9%. One exceptional vessel form identified in this group featured a small cylindrical funnel, attached to the vessel wall, with an external diameter of 2.77 cm and an internal diameter of 2.03 cm (Fig. 5: 2). This unique item was found in a context dated to the late Middle Ages.

4.2.1. Dominating Characteristics of Group II Glazed Ceramics

The dominant category in both Group I and Group II glazed ceramics comprised vessels with wall thicknesses of 4-6 mm. Vessels with 5 mm-thick walls were the most prevalent, accounting for nearly 40% of the assemblage. The proportion of vessels with 6 mm-thick walls was also significant at 30.4%. Vessels with thinner walls (4 mm) were less common, comprising 17.4% of the collection. Ceramics with thicker walls, ranging from 7 to 8 mm, appeared only sporadically (Fig. 9).

In Group II ceramics, 78% of vessel rims belonged to Type IV, characterised by pronounced profiling. This trend became more widespread in medieval ceramics, especially in rims with an overhanging lip. Types II and III rims were comparatively rare (Figs 10 and 11). The vessel rims from this group of glazed ceramics show connections to rims from Kraków, particularly to Types 29, 35, and 51, whose origins date back to the early medieval period and can be broadly dated from the 12th to the 13th century and later (Radwański 1968, 62, 64, figs 38, 39). In Group II of glazed ceramics, the glaze most often covered both the external and internal surfaces of the vessel (56.5%), only the internal surface (30.4%), and, least frequently, only the external walls (13%) (Fig. 12).

Group II glazed ceramics exhibit greater diversity in decorative composition than Group I. However, it should be noted that the complete decorative scheme could be reconstructed for only seven vessels (Figs. 3: 1, 2; 4: 1-3; 5: 3, 4). In addition to circumferential surface grooves created with a stylus, there was also the so-called frieze ornament, featuring a single band of diagonal imprints below the rim. On one vessel, above the grooves,

three bands were observed: two wavy lines and a line of diagonal comb imprints. A composition was also used in which a strip of a wavy line was applied between grooves, at the height of the most significant bend of the vessel's body. The two glazed vessels stood out from the others in the group with their extensive, multi-motif ornament. One composition consisted of horizontal bands of diagonal imprints and wavy lines, further enhanced with a plastic strip of triangular cross-section, decorated with an additional line of impressions (Fig. 4: 1). The second composition featured numerous surrounding grooves, interspersed in the upper part of the vessel's body with multiple wavy lines and circular imprints (Fig. 5: 4). Unfortunately, the small number of vessels preserved well enough to allow identification of the ornament composition does not permit detailed comparative analysis. In Group II, the colour palette of glazes was less varied. Green glazes dominated, ranging from light green to dark olive shades, accounting for 91% of the collection. The glaze most commonly covered both the exterior and interior surfaces of the vessel (56.5% of the vessels), less frequently only the interior surface (30.4%), and occasionally only the exterior walls (13%). No correlation was observed between vessel form and the extent of glazed surface coverage.

4.3. Production and Glazing Techniques

Observations of the surfaces and cross-sections of vessel walls, forms, and unobliterated marks associated with their shaping indicate that all glazed vessels from the site in Nowa Huta-Zesławice were made on a potter's wheel, using the completely turned technique. On the two slightly concave bottoms of glazed vessels from Group II, so-called circular rings were present. These features are associated with the initial stage of forming and centring the vessel's base. The circular rings on the bottoms of the glazed vessels varied in shape: they could resemble a flattened "band" with a surrounding groove running from the interior side of the base or take the form of a rounded roller, slightly visible and irregular. On one base from this group, traces of inclusions in the form of fine sand were observed. Two bases from Group II showed marks from the movement of forming/kneading the clay associated with shaping the base and attaching the clay to the wheel's disc. One base also displayed lines at the joints of clay strips, horizontal or diagonal smoothing traces on the inner wall surfaces, and (on the external surface) imprints of a wooden texture, probably from the wheel's disc. Irregular, deeply incised grooves were also preserved inside one of the bases (Fig. 13).

It is difficult to determine unequivocally which method was used for glazing the vessels from Kraków-Nowa Huta-Zesławice. The glaze structure is heterogeneous, and discolourations are visible on the surfaces, which may result from the uneven distribution of colouring oxides or differences in access to the vessel walls during firing (Auch 2016, 103). Given the relatively broad chronological framework, several methods might have been employed. It is challenging to determine whether powdered lead compounds were applied directly or

combined with an organic substance or clay (Fig. 18). Some vessels, particularly those with a thicker glaze layer, were probably coated with a thin, watery suspension of powdered lead compounds, colouring oxides, and organic substances. Such organic substances could have included starch from wheat flour or barley meal (Auch 2012, 233). Cracking of the glaze and the presence of pinholes may indicate the use of this method (Fig. 5: 1). The latter could have resulted from the release of air/gas from dried walls (Auch 2016, 103, with references). With some probability, the microbubbles observed in sample 13 (Fig. 18) may have originated similarly. It is also possible that, in some cases, powdered lead compounds were applied to slightly dried vessels, which were then fired in a single step. The varied thickness of the glaze layer may suggest this approach.

Fig. 13. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. Vessel bottom from the feature X659. Photo K. Zamelska-Monczak

5. GLAZED CERAMICS IN THE LIGHT OF SPECIALISED RESEARCH

5.1. Instruments and Analysis

The most formally interesting fragments of glazed ceramics were selected for analysis. The technological analysis was performed using Scanning Electron Microscopy with Energy Dispersive X-ray Spectroscopy (SEM-EDS). The research was conducted at the Laboratory of Archaeometallurgy and Conservation of Archaeological Artefacts, Institute of Archaeology, Jagiellonian University, utilising a Tescan Vega 3 XMU microscope equipped with an Aztec X-Max 50 EDS system. Cross-sections of the artefacts were prepared and coated with a thin silver layer to enhance conductivity. SEM imaging in back-scattered electron (BSE) mode was performed at 20 kV, while EDS measurements were conducted at a working distance of <15 mm. The beam current and magnification were adjusted based on the sample surface morphology.

For area analysis, the acquisition time was optimised based on the sample characteristics, with EDS mapping conducted for at least 15 minutes. EDS spectra were collected with a dead time of 10% and a count rate of 8000 cps. A standardless calibration method (Trincavelli *et al*. 2014) was applied for oxide content analysis, with a lower limit of detection (LLD) of 0.1 wt%. The chemical composition analysis focused on the technological zones, specifically the glaze and clay. EDS spectra were acquired from specific points (glaze) and surface areas (clay) up to 1500 × 2000 micrometres, with measurements adapted to the material's heterogeneity. The obtained EDS results for both clay and glaze are presented in Tables 2 and 3. Phase composition analysis of pottery was conducted using the powder X-ray diffraction method (pXRD) on an X'Pert Pro diffractometer at the Faculty of Geology, University of Warsaw, with the following parameters: current of 30 mA, voltage of 40 kV, CoKα anode, step size 0.026 2θ, start position 4.01 2θ, end position 75.00 2θ, with no monochromator used. The results were interpreted using X'Pert HighScore Plus software, with access to the ICDD PDF-2 (RDB 2008) database.

5.2. Results. Technological Aspects

5.2.1. Glazing

Analysis of the chemical composition of the glazes from vessels found at the Kraków-Nowa Huta-Zesławice settlement (Site 88) revealed that, in all cases, their recipes were based on lead oxide (PbO). The content of this compound in the analysed glazes is relatively high, exceeding 60%. In several samples, it even exceeds 70% (Table 3, Fig. 14). An important component, alongside lead oxide, is silica, whose content typically ranges from 17% to 30%. However, in one case, a value of 11.05% was recorded (Table 2).

Table 2. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. Chemical composition of Pb-glaze on pottery (EDS, in wt%±1σ). '-' not determined, below detection limit (<0.1wt%)

Object no.	SEM mag	EDS point no.	Al_2O_3	SiO_2	CaO	Fe_2O_3	PbO	MgO	Na_2O	P_2O_5	K_2O	TiO_2	MnO
1	×100	1	5.1 ±0.2	18.9 ±0.3	0.5 ±0.1	1.54 ±0.2	74.1 ±0.3	-	-	-	-	-	-
		2	4.7 ±0.2	17.9 ±0.3	1.3 ±0.1	1.65 ±0.2	74.1 ±0.3	0.6 ±0.1	-	-	-	-	-
		3	5.0 ±0.2	17.4 ±0.3	0.6 ±0.1	1.76 ±0.2	74.9 ±0.3	0.5 ±0.1	-	-	-	-	-
2	×160	1	9.0 ±0.2	31.6 ±0.3	1.6 ±0.1	3.96 ±0.2	53.0 ±0.4	0.7 ±0.1	-	-	0.6 ±0.1	-	-
		2	5.4 ±0.2	21.9 ±0.3	1.0 ±0.1	2.42 ±0.2	68.5 ±0.4	0.6 ±0.1	-	-	0.5 ±0.1	-	-
		3	7.1 ±0.2	21.0 ±0.3	1.2 ±0.1	3.19 ±0.2	66.5 ±0.4	0.6 ±0.1	-	-	0.8 ±0.1	-	-
3	×200 2-side glaze	1 (right side)	6.6 ±0.2	20.9 ±0.3	0.8 ±0.1	1.98 ±0.2	68.2 ±0.4	0.5 ±0.1	0.6 ±0.1	-	0.7 ±0.1	-	-
		2	3.2 ±0.2	11.9 ±0.2	0.5 ±0.1	2.53 ±0.3	82.1 ±0.4	-	-	-	-	-	-
		3	4.2 ±0.2	15.3 ±0.3	0.5 ±0.1	1.54 ±0.2	77.1 ±0.4	0.5 ±0.1	0.6 ±0.1	-	0.4 ±0.1	-	-
		1a (left side)	5.7 ±0.2	19.5 ±0.3	1.0 ±0.1	2.31 ±0.2	70.7 ±0.4	0.6 ±0.1	-	-	0.3 ±0.1	-	-
		2a	5.5 ±0.2	18.9 ±0.3	1.3 ±0.1	2.42 ±0.2	71.5 ±0.4	0.6 ±0.1	-	-	-	-	-
4	×200	1	10.5 ±0.2	30.7 ±0.3	0.99 ±0.1	2.31 ±0.2	51.3 ±0.4	0.3 ±0.1	-	-	4.2 ±0.1	-	-
5	×300	1	8.1 ±0.2	23.9 ±0.3	1.1 ±0.1	1.98 ±0.2	62.6 ±0.4	0.6 ±0.1	0.5 ±0.1	0.6 ±0.1	0.9 ±0.1	-	-
		2	0.6 ±0.1	23.6 ±0.3	1.3 ±0.1	2.09 ±0.2	67.4 ±0.4	0.6 ±0.1	-	-	-	-	-
6	×200	1	5.6 ±0.2	18.7 ±0.3	0.5 ±0.1	1.65 ±0.2	73.1 ±0.4	0.6 ±0.1	-	-	-	-	-
		2	8.8 ±0.2	18.2 ±0.3	0.5 ±0.1	1.25 ±0.2	71.0 ±0.4	0.5 ±0.2	-	-	-	-	-
		3	4.9 ±0.2	17.0 ±0.3	0.6 ±0.1	1.32 ±0.2	75.7 ±0.3	0.7 ±0.1	-	-	-	-	-
7	×200	1	2.8 ±0.2	19.3 ±0.3	2.4 ±0.1	4.4 ±0.2	67.3 ±0.4	0.5 ±0.1	-	3.7 ±0.2	-	-	-
		2	3.6 ±0.2	23.3 ±0.4	1.1 ±0.1	4.18 ±0.2	67.1 ±0.5	-	-	0.5 ±0.2	0.6 ±0.2	-	-
8	×200	1	4.3 ±0.2	17.6 ±0.3	0.5 ±0.1	1.87 ±0.2	75.6 ±0.3	-	-	-	0.4 ±0.1	-	-
		2	4.7 ±0.2	17.5 ±0.3	0.5 ±0.1	1.65 ±0.2	74.8 ±0.4	0.5 ±0.1	-	-	0.6 ±0.1	-	-
		3	2.3 ±0.1	12.2 ±0.2	1.1 ±0.2	3.52 ±0.2	80.8 ±0.4	-	-	-	0.5 ±0.1	-	-

Object no.	SEM mag	EDS point no.	Al_2O_3	SiO_2	CaO	Fe_2O_3	PbO	MgO	Na_2O	P_2O_5	K_2O	TiO_2	MnO
9	×150	1	5.0 ±0.2	22.4 ±0.3	0.6 ±0.1	1.76 ±0.2	70.0 ±0.4	0.5 ±0.1	-	-	-	-	-
		2	4.1 ±0.2	20.7 ±0.3	0.8 ±0.1	1.98 ±0.2	71.5 ±0.4	0.5 ±0.1	-	-	0.6 ±0.1	-	-
		3	3.3 ±0.2	17.2 ±0.3	0.5 ±0.1	2.53 ±0.2	73.3 ±0.4	-	1.1 ±0.1	-	1.1 ±0.1	-	-
10	×300	1	4.7 ±0.2	26.6 ±0.3	1.1 ±0.1	2.31 ±0.2	63.4 ±0.4	0.5 ±0.1	-	-	0.7 ±0.1	-	-
		2	9.7 ±0.2	24.8 ±0.3	1.1 ±0.1	4.51 ±0.2	56.7 ±0.4	0.7 ±0.1	-	-	1.5 ±0.1	-	-
		3	7.0 ±0.2	36.4 ±0.4	0.9 ±0.1	2.53 ±0.2	48.6 ±0.4	0.5 ±0.1	0.5 ±0.1	-	2.1 ±0.1	-	-
		4	11.5 ±0.2	32.8 ±0.3	8.9 ±0.2	8.69 ±0.2	18.0 ±0.4	1.3 ±0.1	1.9 ±0.1	7.4 ±0.2	3.8 ±0.1	-	3.8 ±0.2
11	×100	1	5.2 ±0.2	23.2 ±0.3	0.6 ±0.1	1.54 ±0.2	69.0 ±0.4	0.6 ±0.1	-	-	-	-	-
		2	5.6 ±0.2	22.7 ±0.3	0.8 ±0.1	2.42 ±0.2	67.3 ±0.4	0.7 ±0.1	-	-	0.3 ±0.1	0.5 ±0.1	-
		3	5.5 ±0.2	23.9 ±0.3	0.8 ±0.1	1.54 ±0.2	67.3 ±0.4	0.6 ±0.1	-	-	0.6 ±0.1	-	-
12	×100	1	6.3 ±0.2	23.1 ±0.3	0.9 ±0.1	1.87 ±0.2	66.8 ±0.4	0.7 ±0.1	-	-	0.5 ±0.1	-	-
		2	4.8 ±0.2	24.9 ±0.3	0.9 ±0.1	2.31 ±0.2	66.7 ±0.4	-	-	-	0.6 ±0.1	-	-
		3	5.9 ±0.2	23.6 ±0.3	1.2 ±0.1	2.31 ±0.2	66.4 ±0.4	0.7 ±0.1	-	-	-	-	-
13	×150	1	3.5 ±0.2	16.0 ±0.2	10.1 ±0.2	1.76 ±0.2	58.2 ±0.4	0.8 ±0.1	-	9.5 ±0.2	0.4 ±0.1	-	-
		2	2.8 ±0.1	11.5 ±0.2	13.0 ±0.2	5.06 ±0.2	55.3 ±0.4	0.5 ±0.1	-	12.3 ±0.2	-	-	-
		3	4.6 ±0.2	19.5 ±0.3	6.0 ±0.2	1.65 ±0.2	61.9 ±0.4	0.6 ±0.1	-	5.6 ±0.2	0.3 ±0.1	-	-
		4	3.6 ±0.2	13.4 ±0.2	11.0 ±0.2	2.09 ±0.2	59.3 ±0.4	1.2 ±0.1	-	9.7 ±0.2	-	-	-
		5	8.2 ±0.2	25.8 ±0.3	2.7 ±0.1	1.87 ±0.2	55.6 ±0.4	0.5 ±0.1	2.9 ±0.2	2.2 ±0.2	0.4 ±0.1	-	-
		6	4.1 ±0.2	16.6 ±0.3	0.7 ±0.1	1.98 ±0.2	76.4 ±0.3	0.5 ±0.1	-	-	-	-	-
		7	4.7 ±0.2	17.2 ±0.3	0.8 ±0.1	2.09 ±0.2	74.4 ±0.4	0.5 ±0.1	-	-	0.6 ±0.1	-	-
14	×60	1	6.8 ±0.2	26.4 ±0.3	0.9 ±0.1	5.72 ±0.2	58.3 ±0.4	1.3 ±0.1	-	-	0.6 ±0.1	0.6 ±0.1	-
		2	5.8 ±0.2	22.3 ±0.3	0.9 ±0.1	4.95 ±0.2	64.3 ±0.4	1.0 ±0.1	-	-	0.6 ±0.1	0.6 ±0.2	-
		3	7.5 ±0.2	29.9 ±0.3	1.2 ±0.1	3.63 ±0.2	55.3 ±0.4	0.8 ±0.1	1.3 ±0.1	-	0.6 ±0.1	-	-

Table 2.

Object no.	SEM mag	EDS point no.	Al_2O_3	SiO_2	CaO	Fe_2O_3	PbO	MgO	Na_2O	P_2O_5	K_2O	TiO_2	MnO
15	×400	1	7.8 ±0.2	30.0 ±0.3	1.5 ±0.1	2.53 ±0.2	55.0 ±0.4	1.0 ±0.1	0.9 ±0.2	-	1.2 ±0.1	-	-
		2	5.5 ±0.2	28.9 ±0.3	1.2 ±0.1	1.98 ±0.2	61.0 ±0.4	0.6 ±0.1	-	-	1.0 ±0.1	-	-
16	×500	1	7.8 ±0.2	26.7 ±0.3	1.1 ±0.1	2.64 ±0.2	60.0 ±0.4	0.9 ±0.1	0.5 ±0.1	-	0.7 ±0.1	-	-
		2	6.2 ±0.2	23.1 ±0.3	1.2 ±0.1	3.19 ±0.2	66.1 ±0.4	0.4 ±0.1	-	-	-	-	-
		3	11.1 ±0.2	31.8 ±0.3	1.2 ±0.1	2.42 ±0.2	50.0 ±0.4	1.1 ±0.1	1.3 ±0.2	-	1.4 ±0.1	-	-
17	×200	1	4.9 ±0.2	22.2 ±0.3	0.6 ±0.1	1.76 ±0.2	69.8 ±0.4	0.5 ±0.1	-	-	0.5 ±0.1	-	-
		2	5.5 ±0.2	24.4 ±0.3	0.7 ±0.1	1.76 ±0.2	66.6 ±0.4	0.6 ±0.1	-	-	0.6 ±0.1	-	-
		3	4.5 ±0.2	23.3 ±0.3	-	1.21 ±0.2	70.5 ±0.3	0.6 ±0.1	-	-	-	-	-

Among the remaining components, iron oxide stands out as a colouring agent. Its proportion directly affects the colour of the glaze: a content of approximately 1 to 2% gives it an olive or dark green hue, while higher concentrations, exceeding 2%, result in shades of olive-brown and brown. It seems that iron oxide was intentionally introduced as a pigment. In some cases (Sample 10), the high iron oxide content may be due to contamination of the glaze sample during preparation. Figure 14 graphically presents the results of the chemical composition analysis of the glaze provided in Table 2. The obtained results have been compared with available literary data on high-lead glazes in early medieval ceramics from Lesser Poland (Auch 2012; Szmoniewski *et al.* in print). The comparison includes all results from the EDS analysis (*cf.*, Table 2 – orange circles on Fig. 15) as well as the averages from the measurements (orange circles on Fig. 14: b, c). As shown in Fig. 14, most of the analysed glazes can be classified as non-alkali Pb-glass. The glazes on ceramics numbered 4, 10, 14-16 correspond to the composition of Central European Pb-ash glass (*cf.*, Fig. 14: c). These glazes have an increased content of alkalis, *i.e.*, Na_2O and K_2O, as illustrated in Fig. 15. The points corresponding to the EDS spot measurements on the glazes that deviate in composition (Nos 4, 12, 28, 29, 45, 46 and 50, Table 2, Fig. 14: a, b – yellow markers) are associated with the increased content of Na_2O and K_2O in the glaze. According to Römer-Strehl *et al.* (2004, 82), high-lead glazes with a similar chemical composition (around 70% PbO) have melting temperatures of 710-740°C, which correspond to Groups I and II in our case, as shown in Figure 15. A decrease in the content of lead and alkalis increases this temperature. For lead glazes containing 45-60% PbO and 1% Na_2O+K_2O, the melting temperature range is 820-1030°C (Cooper and Lewenstein eds 1988, 41-59), corresponding to

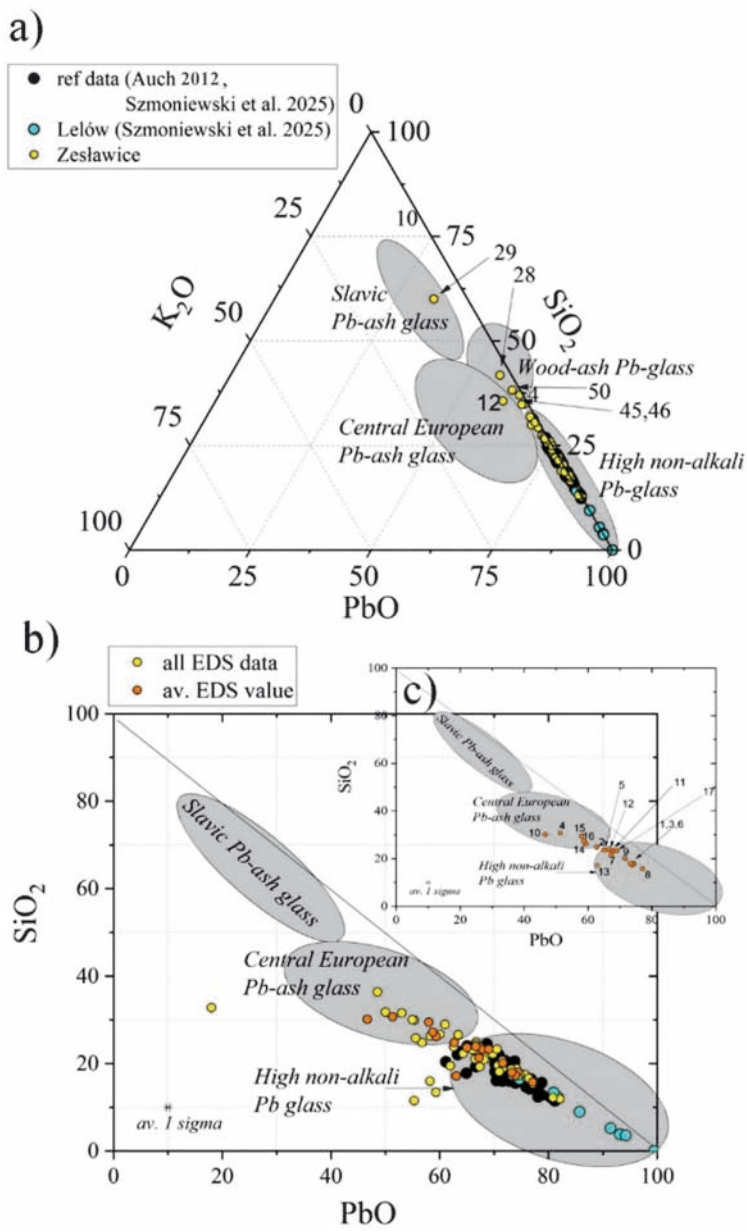


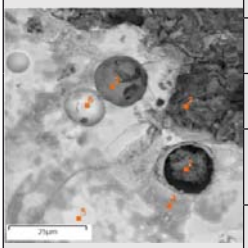
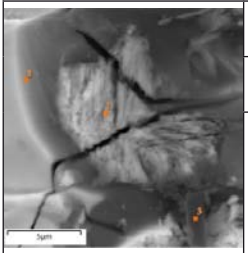
Fig. 14. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. EDS results obtained for Pb-glaze: (a) Ternary diagram showing the PbO, SiO_2, and K_2O content in the glaze (wt%, normalised to 100%); (b) PbO vs. SiO_2 content (wt%) in the glaze. The glaze data are compared with the technological study of lead glass for early medieval glass by Mecking (2013), Pb-glaze on early medieval ceramics by Auch (2012) and Szmoniewski *et al*. (2025), (c) PbO vs. SiO_2 content (wt%) in the glaze, taking into account the average value for n-measurements/object (Nos 1-17). Drawing E. Miśta-Jakubowska

Table 3. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. Chemical composition of clay (EDS, in wt%±1σ). '-' not determined, below detection limit (<0.1wt%)

Object no.	SEM mag	EDS point no.	EDS area [µm]	Al_2O_3	SiO_2	CaO	FeO	MgO	Na_2O	P_2O_5	K_2O	TiO_2
1	×100	1	500/600	18.9 ±0.2	66.1 ±0.3	-	7.2 ±0.2	1.8 ±0.1	0.6 ±0.1	0.7 ±0.1	2.3 ±0.1	0.9 ±0.1
		2	1000/500	18.0 ±0.2	68.8 ±0.3	1.7 ±0.1	5.8 ±0.1	1.8 ±0.1	0.6 ±0.1	0.4 ±0.1	2.1 ±0.1	0.9 ±0.1
		3	500/1000	19.3 ±0.2	64.5 ±0.3	2.0 ±0.1	7.2 ±0.2	1.9 ±0.1	0.5 ±0.1	0.6 ±0.1	2.6 ±0.1	1.1 ±0.1
2	×160	1	irregular	15.6 ±0.2	69.2 ±0.3	2.4 ±0.1	6.6 ±0.1	1.3 ±0.1	0.6 ±0.1	0.8 ±0.1	2.8 ±0.1	0.8 ±0.1
		2	1000/500	15.8 ±0.2	68.5 ±0.3	2.5 ±0.1	6.3 ±0.2	1.3 ±0.1	0.6 ±0.1	0.9 ±0.1	2.8 ±0.1	0.9 ±0.1
3		1	750/1000	13.9 ±0.1	74.1 ±0.3	2.1 ±0.1	4.7 ±0.1	1.2 ±0.1	0.4 ±0.1	0.9 ±0.1	1.9 ±0.1	0.8 ±0.1
		1a	700/1000	14.9 ±0.2	72.8 ±0.3	2.0 ±0.1	5.4 ±0.1	1.2 ±0.1	0.5 ±0.1	0.5 ±0.1	2.0 ±0.1	0.8 ±0.1
4	×200	1	500/500	17.5 ±0.1	69.4 ±0.3	1.5 ±0.1	4.8 ±0.1	0.8 ±0.1	0.8 ±0.1	-	3.6 ±0.1	0.8 ±0.1
5	×300	1	500/500	20.5 ±0.2	62.3 ±0.3	2.7 ±0.1	8.2 ±0.2	1.5 ±0.1	0.7 ±0.1	1.2 ±0.1	1.8 ±0.1	1.1 ±0.1
		2	1000/1000	14.7 ±0.2	75.6 ±0.3	1.5 ±0.1	4.2 ±0.1	1.4 ±0.1	0.4 ±0.1	-	1.5 ±0.1	0.6 ±0.1
6	×200	1	250/350	12.7 ±0.2	78.1 ±0.3	1.8 ±0.1	3.6 ±0.1	1.3 ±0.1	0.4 ±0.1	-	1.6 ±0.1	0.6 ±0.1
		2	500/500	17.4 ±0.2	70.1 ±0.3	2.4 ±0.1	4.8 ±0.1	1.6 ±0.1	0.5 ±0.1	-	2.1 ±0.1	1.1 ±0.1
		3	250/250	17.3 ±0.2	70.3 ±0.3	2.5 ±0.1	4.8 ±0.1	1.5 ±0.1	0.5 ±0.1	0.4 ±0.1	2.0 ±0.1	0.7 ±0.1
7	×200	1	750/500	19.6 ±0.1	67.0 ±0.2	1.9 ±0.1	5.7 ±0.1	1.8 ±0.1	0.5 ±0.1	0.5 ±0.1	2.2 ±0.1	0.8 ±0.1
8	×200	1	750/500	16.8 ±0.1	69.2 ±0.2	2.1 ±0.1	5.0 ±0.1	1.6 ±0.1	0.8 ±0.1	1.2 ±0.1	2.4 ±0.1	0.9 ±0.1
		2	500/500	13.1 ±0.1	73.6 ±0.3	2.0 ±0.1	5.7 ±0.1	1.2 ±0.1	0.6 ±0.1	1.5 ±0.1	1.9 ±0.1	0.6 ±0.1
9	×150	1	750/1250	14.9 ±0.2	69.8 ±0.3	1.7 ±0.1	6.3 ±0.2	0.6 ±0.1	0.6 ±0.1	0.6 ±0.1	2.3 ±0.1	1.0 ±0.1
10	×300		300/700	16.5 ±0.2	63.4 ±0.3	2.6 ±0.1	10.3 ±0.2	1.4 ±0.1	0.3 ±0.1	1.2 ±0.1	3.1 ±0.1	1.1 ±0.1
11	×100	1	1500/2000	14.6 ±0.1	74.6 ±0.3	1.3 ±0.1	4.5 ±0.1	1.3 ±0.1	0.6 ±0.1	-	2.3 ±0.1	0.7 ±0.1
12	×100	1	1500/1500	15.3 ±0.2	73.2 ±0.3	1.6 ±0.1	4.4 ±0.1	1.5 ±0.1	0.8 ±0.1	0.5 ±0.1	1.9 ±0.1	0.7 ±0.1
13	×150	1	500/1200	16.7 ±0.2	67.2 ±0.3	2.7 ±0.1	6.6 ±0.1	1.7 ±0.1	0.6 ±0.1	1.7 ±0.1	1.9 ±0.1	0.9 ±0.1
		2	1000/500	16.7 ±0.2	68.7 ±0.3	2.4 ±0.1	6.0 ±0.1	1.6 ±0.1	0.5 ±0.1	1.5 ±0.1	1.8 ±0.1	0.8 ±0.1
		3	700/700	14.5 ±0.2	71.5 ±0.3	2.1 ±0.1	6.6 ±0.2	1.4 ±0.1	0.4 ±0.1	0.6 ±0.1	2.0 ±0.1	0.9 ±0.1

Object no.	SEM mag	EDS point no.	EDS area [µm]	Al_2O_3	SiO_2	CaO	FeO	MgO	Na_2O	P_2O_5	K_2O	TiO_2
14	×60	1	1000/1000	14.5 ±0.2	74.2 ±0.3	1.6 ±0.1	4.3 ±0.1	1.3 ±0.1	0.8 ±0.1	0.6 ±0.1	2.2 ±0.1	0.6 ±0.1
		2	1000/1000	16.5 ±0.2	70.3 ±0.3	2.0 ±0.1	5.2 ±0.1	1.7 ±0.1	0.7 ±0.1	0.6 ±0.1	2.2 ±0.1	0.8 ±0.1
15	×400	1	300/200	11.2 ±0.1	76.3 ±0.3	1.1 ±0.1	6.2 ±0.1	1.0 ±0.1	0.5 ±0.1	-	3.0 ±0.1	0.6 ±0.1
16	×500	1	300/350	19.5 ±0.2	65.6 ±0.3	1.7 ±0.1	6.2 ±0.1	1.7 ±0.1	0.8 ±0.1	0.4 ±0.1	2.7 ±0.1	1.0 ±0.1
17	×200	1	300/750	14.1 ±0.1	75.7 ±0.3	1.2 ±0.1	3.9 ±0.1	1.4 ±0.1	0.6 ±0.1	0.5 ±0.1	2.1 ±0.1	0.7 ±0.1

Table 4. Kraków-Zesławice, site 88, Lesser Poland Voivodeship. Chemical composition of bubble area in Pb-glaze for object 13 (EDS, in wt%±1σ). „-' not determined, below detection limit (<0.1wt%)

EDS sampling point/ SEM mag	EDS point no.	PbO	Al_2O_3	SiO_2	CaO	FeO	MgO	Na_2O	P_2O_5	K_2O	TiO_2
 ×2.7kx	1	58.5 ±0.6	3.4 ±0.2	15.0 ±0.3	5.6 ±0.2	12.2 ±0.5	-	-	5.4 ±0.3	-	-
	2	31.7 ±0.4	2.4 ±0.1	7.5 ±0.2	23.1 ±0.2	8.8 ±0.2	1.7 ±0.1	-	24.7 ±0.3	-	-
	3	10.1 ±0.3	20.6 ±0.2	46.6 ±0.3	4.9 ±0.1	6.0 ±0.2	2.1 ±0.1	1.0 ±0.1	5.2 ±0.2	3.4 ±0.1	0.4 ±0.1
	4	54.3 ±0.4	3.7 ±0.2	16.7 ±0.2	10.7 ±0.2	2.4 ±0.2	1.1 ±0.1	-	11.1 ±0.2	-	-
	5	70.5 ±0.3	4.8 ±0.2	18.3 ±0.3	2.5 ±0.1	1.4 ±0.2	0.5 ±0.1	-	2.1 ±0.2	-	-
	6	61.3 ±0.4	2.7 ±0.1	17.9 ±0.3	6.3 ±0.2	5.6 ±0.2	0.3 ±0.1	-	5.5 ±0.2	0.6 ±0.1	-
 ×12.9kx	1	67.3 ±0.4	2.2 ±0.1	10.1 ±0.2	7.3 ±0.2	1.7 ±0.2	-	-	9.2 ±0.2	-	-
	2	64.7 ±0.4	5.5 ±0.1	25.4 ±0.3	1.1 ±0.1	2.9 ±0.2	0.4 ±0.1	-	-	-	-
	3	16.7 ±0.3	17.2 ±0.2	52.4 ±0.4	2.5 ±0.1	2.0 ±0.1	0.3 ±0.1	7.8 ±0.2	-	0.6 ±0.1	-

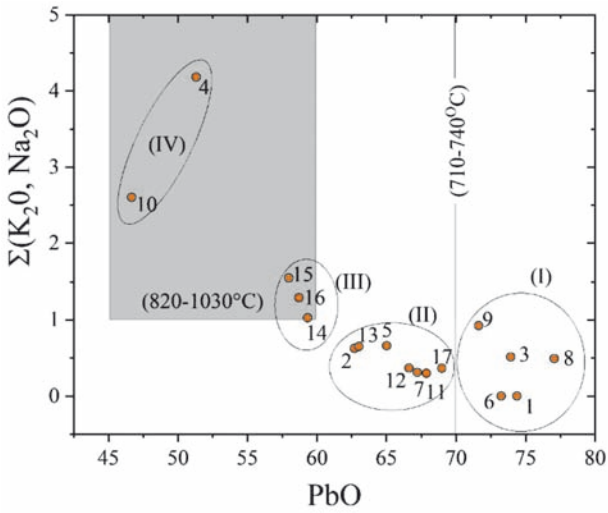


Fig. 15. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. EDS results. PbO vs. ΣK_2O, Na_2O content (wt%) in the glaze. The diagram distinguishes four groups based on data on the melting temperatures of lead glazes (after Römer-Strehl *et al.* 2004; Cooper and Lewenstein ed. 1988). Drawing E. Miśta-Jakubowska

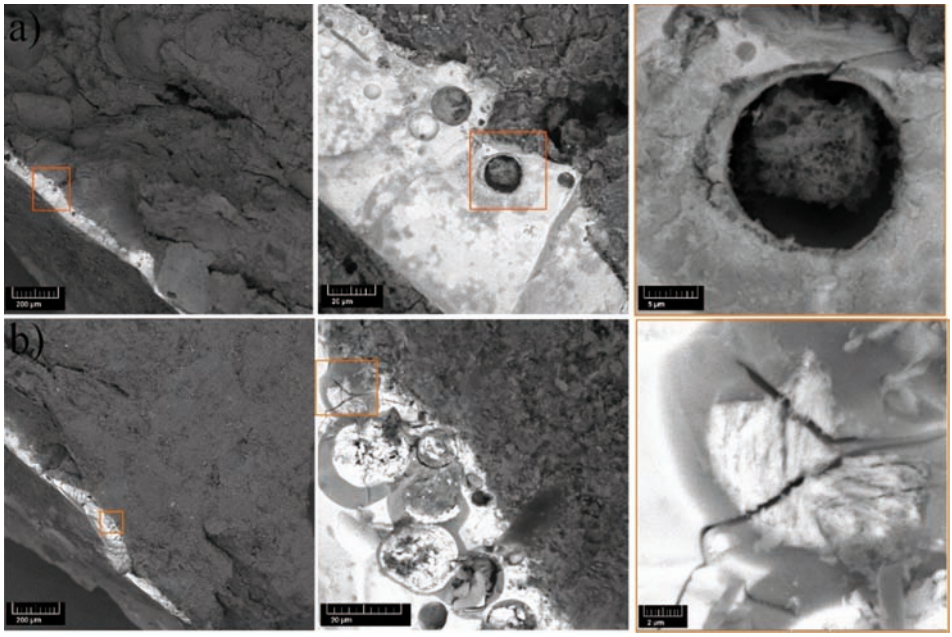


Fig. 16. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. SEM-BSE images of P- and Ca-rich structure bubbles in the Pb-glaze matrix registered for Sample no. 13. They are presented in two areas (a) and (b). In the images, the successive zoomed-in areas are marked with an orange outline, starting with the smallest on the right: a – mag×150, 1.6kx, 7.1kx; b – ×150, 2.5kx, 12.9kx. Drawing E. Miśta-Jakubowska

Groups III and IV. Additionally, an increased content of P_2O_5 and CaO was recorded in micro-areas (see Table 4) for some of the analysed glazes (Nos 5, 7, 10 and 13 from Table 2), which does not align with the division of glazes presented in Figure 15. Figure 16 shows SEM imaging of example structures for which such an analogy was observed.

As seen in Figure 16, these structures have a bubble-like shape but are also fibrous (as shown in the lower right corner of Fig. 16). They are present on the inner side of the glaze, so they should be associated with the glazing process itself rather than secondary treatment or the use of the vessel. Figure 17 shows the concentration of lead, phosphorus, calcium, and carbon in the lead glaze. Notable enrichment in phosphorus (24.7±0.3 wt%, Table 4, p. 2), calcium (23.1±0.2 wt%, Table 4, p. 2), and carbon is observed in the bubble area in the right corner of the SEM image (Fig. 16).

5.2.2. Ceramic clay

As shown in Table 3, the clay composition of the analysed pottery fragments is similar. The standard deviation of the obtained results is slight, with the following values (in weight %) for the components: Al_2O_3 2.3, SiO_2 4.1, CaO 0.5, FeO 1.4, MgO 0.3, Na_2O 0.1, P_2O_5 0.4,

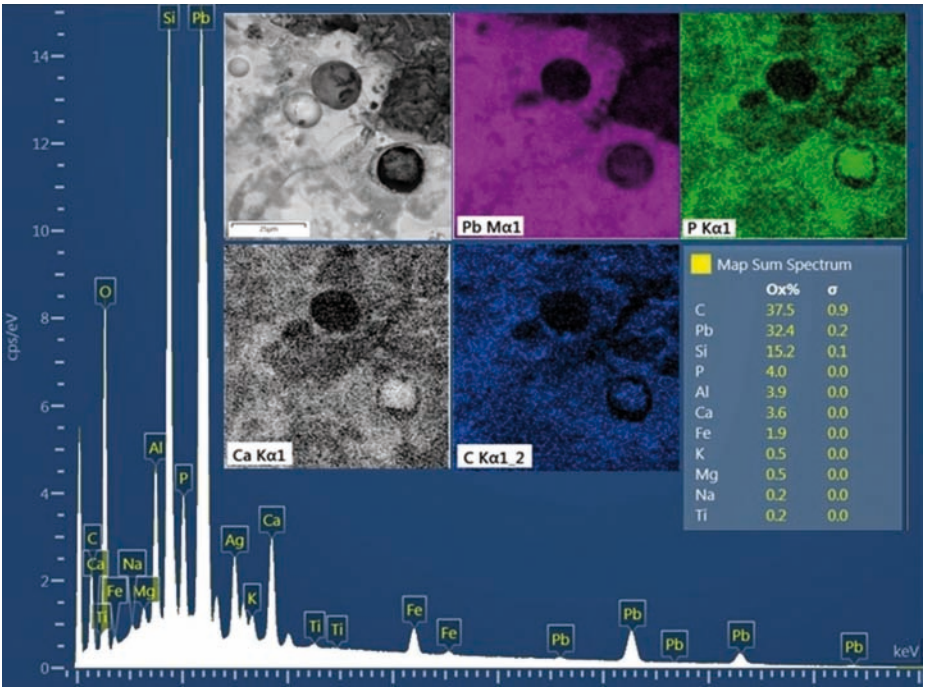


Fig. 17. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. SEM-EDS distribution of lead (Pb), phosphorus (P), calcium (Ca) and carbon (C) in bubble P, Ca-rich area of the Pb-glaze of Sample 13, is shown with EDS spectra and results. Drawing E. Miśta-Jakubowska

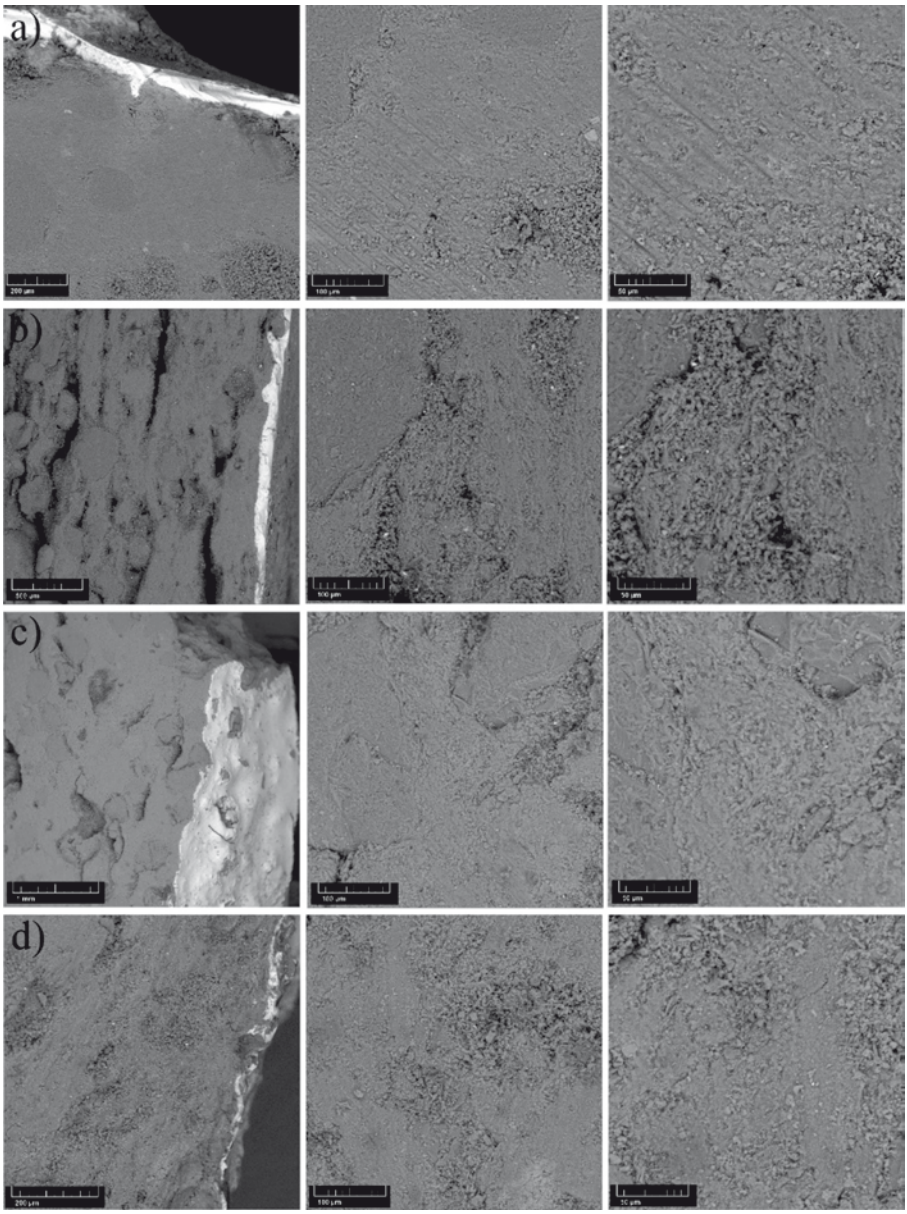


Fig. 18. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. SEM-BSE images showing the morphology of ceramics and glaze (first column of the figure) and ceramics distinguished based on glaze composition groups (Nos I-IV, *cf*., Fig. 15). a – Group 1 (Object 6: mag×200, 500, 1.0kx), b – Group 2 (Object 11: mag×100, 500, 1.0kx), c – Group 3 (Object 14: mag×60, 500, 1.0kx), d – Group 4 (Object 10: mag×30,500, 1.0kx). Drawing E. Miśta-Jakubowska

K_2O 0.5 and TiO_2 0.2. Figure 18 presents the SEM morphology of the clay (cross-sections) for sample fragments of ceramics, categorised based on the differentiation of glaze composition into Groups I – IV (*cf.*, Fig. 15).

The morphology of the clay indicates a low degree of vitrification in the ceramics for all groups distinguished according to glaze composition (*cf.*, Fig. 18). Based on the similar composition of the ceramic body and its microscopic analysis (Fig. 18), it can be inferred that the same clay deposit may have been used for the production of the vessels, which is also confirmed by the pXRD analysis results (Fig. 19) described below.

Identifying the presence of a particular mineral using pXRD is a valuable method for assessing the firing temperature of pottery. Based on the presence or absence of various minerals, it is possible to determine the temperature at which the ceramics were fired.

In the pXRD results of the bulk powdered pottery samples, the peaks of quartz, plagioclase, and alkali feldspar were recorded in every pottery sample. The presence of feldspar

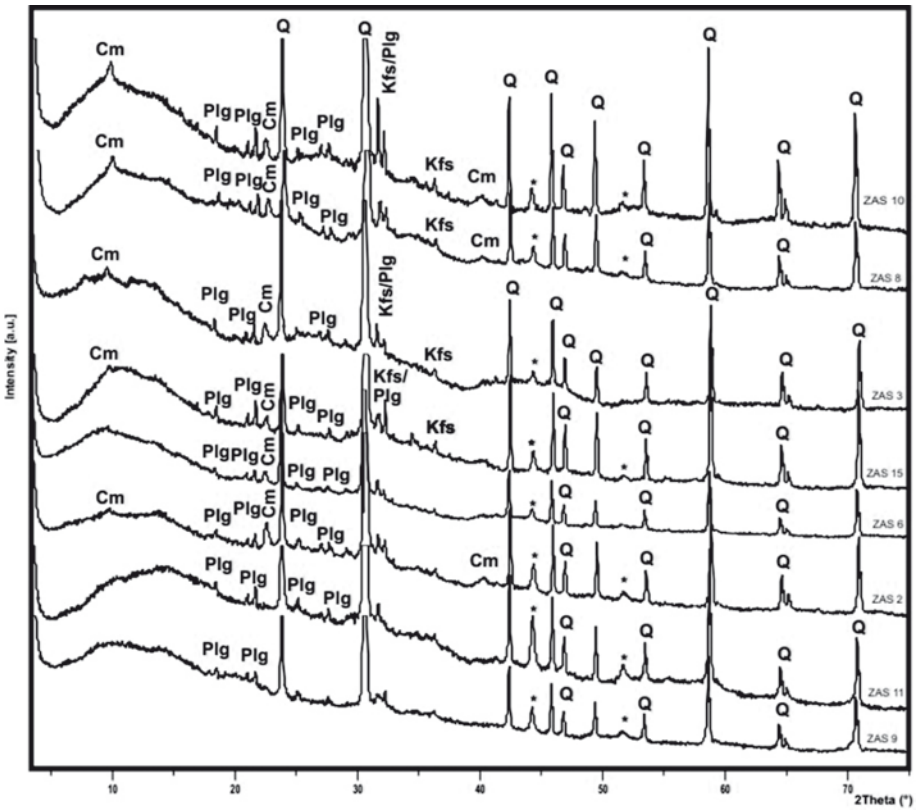


Fig. 19. Kraków-Nowa Huta-Zesławice, Site 88, Lesser Poland Voivodeship. X-ray deffractogram of spectra of pottery: Q – quartz, Plg – plagioclase, Kfs – K-feldspar, Cm – illite, * – peaks originating from silver used for sputtering samples during observation under an electron microscope. Drawing R. Siuda

indicates that the pottery's firing temperature did not exceed 1100°C (Quinn 2013; Maritan *et al.* 2006). Based on pXRD studies, it was found that the content of clay minerals (illite), a main component of typical ceramic raw materials used in the past for ceramic production, varies across samples. For ceramics fired at the lowest temperatures, the diffractogram shows peaks characteristic of undecomposed layered silicates (illite) (Nos ZAS_2, 3, 8, 10, 15). As the temperature increases, illite decomposes. This process causes the gradual disappearance of the mineral's characteristic peaks. In ceramics fired at the highest temperature, these reflexes disappear entirely, which is related to the decomposition of layered silicates. At the same time, in samples fired at high temperatures, the appearance of a broad peak in the low angular range (from 4 to 16 2 Theta) is observed (Nos ZAS_6, 9, 11). The peak of this type indicates partial vitrification of the minerals present in the ceramics. The presence of illite indicates that the firing temperature of some ceramics was around 800°C (Nos ZAS_2, 3, 8, 10, 15). For samples where the mineral was not found, the temperature had to be high enough to melt some minerals but below the spinel crystallisation temperature (about 950-1000 °C – Nos ZAS_6, 9, 11). The modal composition of the analysed pottery indicates that clay raw material from local glacial till was most likely used. Crushed granitic rocks rich in plagioclase and potassium feldspar were most likely used as the temper.

6. CONCLUSIONS

The study of medieval glazed ceramics from Site 88 in Kraków-Nowa Huta-Zesławice provides significant insights into the production and distribution of glazed pottery in Lesser Poland. The discovery of 64 fragments from 42 vessels, dated to the late 11th-early 14th centuries, expands understanding of this phenomenon beyond the previously known centres on the Lesser Poland-Upper Silesia border. Macroscopic and chemical analyses indicate that the glazes were lead-based, with compositions consistent with local production traditions rather than external imports. The findings suggest a connection between glazed pottery production and early medieval metallurgical activities in the region, particularly linked to lead processing. The study also confirms a technological transition from early medieval to late medieval glazed ceramics, with shifts in fabric composition, vessel forms, and glaze application methods. Comparative analysis with other sites, such as Dąbrowa Górnicza, Sosnowiec, and Bytom, highlights the regional specificity of Lesser Poland's glazed ceramics, distinguishing them from those of Kievan Rus' and Western Europe. The study supports the hypothesis of a local glazing tradition that developed independently, facilitated by access to lead ores from the Olkusz region. Advanced instrumental analyses, including SEM-EDS and pXRD, confirm that the ceramic fabrics were made from local raw materials and fired at 800-1000°C. The presence of high-lead glazes and their technological characteristics suggests knowledge transfer and innovation within the local pottery-making communities.

The findings from Kraków-Nowa Huta-Zesławice, Site 88 mark an important addition to the distribution of glazed ceramics in Poland, showing their expansion eastward beyond Kraków. The results contribute to ongoing discussions on the origins, production techniques, and trade connections of medieval glazed pottery in Central Europe.

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KAPTORGAS WITH 'HORSES' FROM THE SO-CALLED KRAKÓW PART OF THE DZIERZNICA II TREASURE. PART ONE

ABSTRACT

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This paper presents a detailed documentation of 12 kaptorgas with 'horses' from the Kraków part of the Dzierznica II treasure. These artefacts are currently housed in the National Museum in Kraków. Until now, these pendants have not been fully published, thoroughly described, or subjected to any archaeometric, technological, or contextual analyses. As part of the ongoing research project, meticulous macroscopic photographs were taken of each artefact. A micrometric magnifying glass was then used to examine details and construction techniques. Finally, preliminary instrumental chemical analyses were conducted using XRF. The material proved extensive and multifaceted, making it both possible and necessary to provide an initial summary of the findings at this stage of the research. This article focuses on descriptive aspects, offering preliminary suggestions regarding the composition and type of raw materials used, as well as initial observations on their stylistic features and manufacturing techniques. Based on these results, further research stages and procedures will be presented in forthcoming publications.

Keywords: early medieval Poland, early medieval hoards, silver jewellery, silversmith work, reliquary pendants, ornamental work

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INTRODUCTION

The subject of this article is a specific type of hollow pendant known in the literature as a kaptorga. These artefacts are primarily found in hoards of hack-silver and much less frequently in burial contexts. One of the Polish hoards that undoubtedly contained an exceptionally large number of these pendants is the so-called Dzierznica II hoard (the name of the town of Dzierznica was officially changed in 2010 to Dzierżnica, poviat Środa, Greater Poland Voivodeship. Due to the existing tradition of archaeological and museum literature, it was decided to use the older name Dzierznica in this article). The current state of research on the non-monetary part of this hoard, particularly regarding its jewellery, remains highly unsatisfactory. One of the most recent studies on early medieval silver in Poland (FMP I: 36.21235-21599) indicates that the hoard contains 365 fragments of kaptorgas. However, in the portion of the hoard stored at the National Museum in Kraków (MNK, the so-called Kraków part of the hoard), the authors have inventoried eight complete kaptorgas and 74 fragments not included in the FMP I inventory.

From this substantial assemblage, this study focuses exclusively on a single type of kaptorga – those adorned with a stylised horse motif. This group consists of seven complete specimens, five kaptorgas preserved in larger fragments, and 29 small, loose fragments that include horse figures or their elements.

The Dzierznica II hoard was discovered accidentally in 1909 and was the second such deposit found in that locality (Slaski and Tabaczyński 1959, 19, pls 3 and 4; Kmietowicz 1994, 161, 162). The fate of the discovery was complex and rather unfortunate. After its discovery, the hoard was divided, ending up in private hands and later dispersed among various museum collections. Sadly, part of the material was lost or deprived of its provenance. These circumstances were thoroughly documented by Anna Kmietowicz (1994, 161-167), one of the primary researchers of the oriental coins from the hoard. She gathered valuable information from the memoirs of Prof. Zygmunt Zakrzewski, who visited the discovery site at the invitation of the estate owner, Feliks Wize. Zakrzewski estimated that the hoard originally weighed about 30 pounds (approximately 15 kg of silver). More than half of the hoard reportedly went to F. Wize, while the remainder – including whole coins and ornaments (jewellery) – was probably taken by the finders. These objects were gradually sold and dispersed into various collections. Today, the hoard's known elements are housed only in the Archaeological Museum in Poznań and MNK.

The silver jewellery from the Dzierznica II hoard discussed in this study entered the MNK collection in 1910 as a donation from Henryk Mańkowski of Winnogóra. He transferred them, along with coins, to the Emeryk Hutten-Czapski Museum – a branch of the National Museum in Kraków (Korczyńska 2003, 57, 58). Notably, in 2005-2006, M. and M. Andrałojć conducted archaeological verification excavations at the hoard's discovery site, recovering an additional 2.852 deposit elements weighing 583.24 g (Andrałojć *et al.* 2010, 98; 2011, 44-50).

Fig. 1. Map with the location of the Dzierznica II hoard find

The Dzierznica II hoard is unique – it is the largest deposit of its kind found in Polish lands. Its contents are also extraordinary, comprising coins from 20 different Muslim dynasties, as well as Western European, Roman, and Byzantine emissions (over 21,000 coins and coin fragments). All known coins from the hoard have been published in an inventory (FMP I: 36. 1-22018, under 'Dzierżnica'; see also earlier literature). Numismatic analysis suggests that the hoard was buried at the end of the 10th century (terminus *post quem*: 980/1-989/90 or 983-985).

The jewellery items within the hoard are equally significant. Preliminary analyses have identified various types of earrings, beads, lunulae, necklaces, and kaptorgas (Slaski and Tabaczyński 1959, 19, pl. III-IV; FMP I: 36. 20989-22011, Taf. 17-22; Andrałojć *et al*. 2011, 44-50). However, none of these artefacts have been subjected to in-depth studies. As a result, even basic classification of the jewellery types remains incomplete, let alone more detailed conclusions or comparative analyses.

To contribute to the discussion on non-monetary silver in Polish hoards, and in particular, the jewellery from Dzierznica, it is necessary to begin with a description and cataloguing of at least part of this collection. This study focuses on a relatively small but particularly interesting subset – the kaptorgas with horse motifs. The present article serves as a catalogue, forming the first part of a broader study. In future publications, the results of archaeometric and technological research (analytical part) as well as contextual studies (systematic part) will be presented.

In this article, we use zoomorphic terminology, clearly suggesting the species attribution of the representations. We refer to them as 'horses,' consistently identifying the parts of these figures as the muzzle (nostrils), head, ears, neck, mane, back, hindquarters, and tail. Consequently, we propose that the band usually covering the back/hindquarters of the pony be referred to as a 'saddle cloth.' However, we are aware of their conventionality and disputability. One should not forget that the prevailing trend in literature of identifying such representations with horses is not the only possible solution (Gardeła *et al.* 2019; Michalak and Gardeła 2020; 2022; 2024).

MATERIALS AND METHODS

Kaptorgas are women's ornaments characteristic of the Slavic cultural space. They take the form of small pendants, creating a type of sealed capsule. In scholarly literature, two main types of these ornaments are distinguished – rectangular kaptorgas and trapezoidal kaptorgas. These two types differ in their manufacturing techniques, construction, dimensions, and decorative styles (*e.g.*, Jakimowicz 1933, 126; 1939; Tabaczyński 1958, 19-25; Kostrzewski 1962; Stattler 1966, 233; Kóčka-Krenz 1993, 87-90; Sztyber 2010; Wrzesiński 2011, 36, 37). This article focuses exclusively on rectangular kaptorgas from the part of the Dzierznica II hoard stored in the MNK, specifically those decorated with zoomorphic figures, commonly referred to in literature as 'horses.'

The analysis includes artefacts with MNK inventory numbers IV-Z-2725/ 64, 65, 67, 68, 69, 70, 71, 72, 73, 74, 94, 96, 98. Some of these objects underwent conservation between 2012 and 2013 and are currently displayed in the permanent exhibition at the Czapski Palace in Kraków, while the remaining ones have not been conserved. Five of the kaptorgas are fully preserved, while seven survive only in fragmentary condition.

As a first step, detailed photographic documentation of each artefact was prepared. This was carried out at the MNK Photographic Laboratory using a Canon EOS 5DsR camera with a Canon Macro Lens EF 100 mm (1:2.8 L IS USM). The level of image detail enabled the planning of subsequent research stages.

Next, an inventory of each item was conducted, including stylistic, typological, and technical descriptions (using a Peak Scale Lupe 7× and a Reading Microscope M10085-1 100×). Both conserved and corroded kaptorgas were subjected to XRF analysis at the

Laboratory for Analysis and Non-Destructive Testing of Historical Objects (LANBOZ MNK). A Bruker S1 Titan HH-XRF spectrometer (Germany) was used for the quantitative analysis of thirteen metal artefacts. The S1 Titan, equipped with a Rh tube and SDD detector, features a 5 mm analysis spot, operates at 50 kV and 15 μA, and was set to an acquisition time of 30 seconds. Due to the heterogeneity of the objects, the reported percentages represent averages from six measurements.

This instrument includes several internal calibrations for metal alloys based on the Fundamental Parameters (FP) method (Thomsen 2007). The average relative uncertainty for silver (Ag) concentration was 0.5%, while those for copper (Cu) and lead (Pb) were 1.5% and 6.0%, respectively.

1. Inventory number MNK IV-Z-2725/64; Fig. 2

This is a fully preserved kaptorga in good condition (length: 38 mm, width: 22.2 mm; body plate thickness: 0.2 mm; weight: 4.49 g).

On the obverse, there are five stylised horse figures (length: approx. 15 mm, width: 5 mm, height: 6 mm), whose muzzles are attached to the tubularly rolled edge of the pendant (kaptorga loop; diameter: approx. 0.2 mm). A filigree band 1.5 mm wide, consisting of a thin

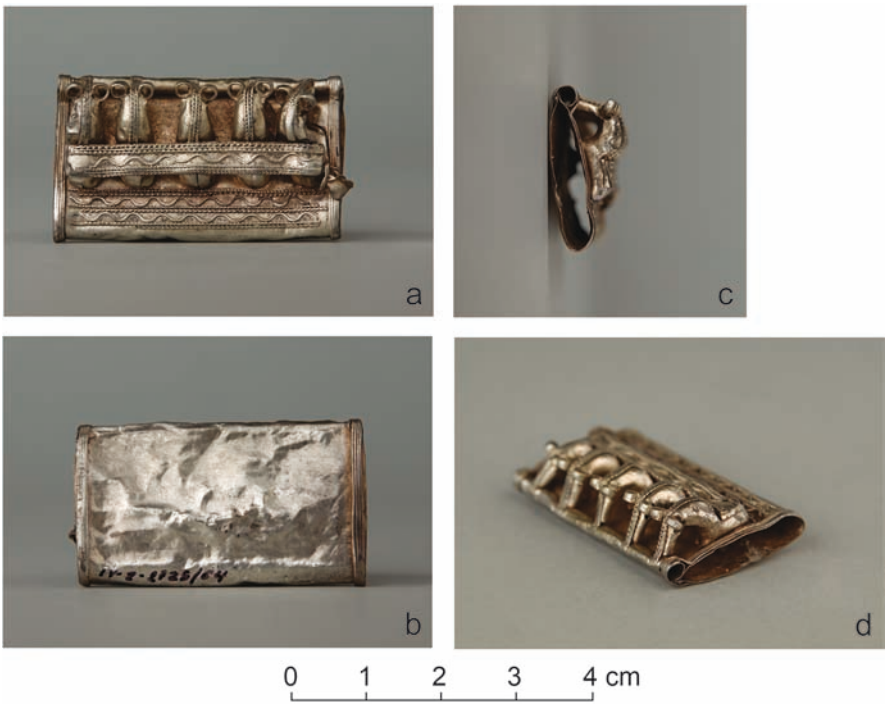

Fig. 2. Dzierznica II, inventory number MNK IV-Z-2725/64, illustrative photo: a – obverse, b – reverse, c – left side, d – oblique view. Photo A. Olchawska, MNK; graphic editing K. Niziołek, JUIA

straight wire enclosed between two torded [profiled and twisted] wires, runs along the upper part of each horse, from the back to the tip of the muzzle, mimicking a mane. The flattened end of this filigree is soldered to the tubular loop of the kaptorga. This decoration is worn, particularly at the highest relief points of the head and the tip of the muzzle.

The ears of the horses are made from a flat, narrow strip (approx. 1 × 0.2 mm), which pierces through the plates forming the head and is coiled at both ends (approx. 1.5-2 scrolls with an internal diameter of 1.3-1.5 mm). A horizontal filigree-decorated strip (length: approx. 33.6 mm, width: 4 mm, thickness: approx. 1 mm) is soldered to the backs of the horses. Its edges feature bands of two twisted wires with a straight wire between them (width: approximately 1.15 mm), while the central section contains a single wire (diameter: approximately 0.4 mm) shaped into a wide wave pattern. Below the figures, there is a filigree decoration band (approx. 5 mm wide) with a complex composition: three interwoven torded wire bands (braid pattern) alternating with two wavy lines arranged in mirror symmetry. At the ends, some wires are detached or broken.

The reverse side of the pendant is plain, smooth, and slightly bent, with no decoration. The body's side edges are wrapped with a wire (diameter: approx. 0.3 mm), forming four coils (width: approx. 1.2 mm). The ends of these coils are visible on both the obverse and reverse. The right sidewall is partially preserved (torn and bent), bordered by a single torded wire band (two torded straight wires, width: approx. 0.8 mm). The left side of the kaptorga is open, missing a sidewall.

2. Inventory number MNK IV-Z-2725/65; Fig. 3

This is a fully preserved kaptorga, though heavily bent and flattened (length: 38 mm, width: 19.4 mm; body plate thickness: 0.2 mm; weight: 3.56 g).

On the obverse, there are five stylised horse figures, though deformed, with their muzzles attached to the tubularly rolled edge of the pendant (forming a loop of internal diameter: approx. 2 mm). A filigree band (two torded wires interwoven; individual wire diameter: approx. 0.5 mm) runs along the upper part of the horses, from the back to the tip of the muzzle, mimicking a mane. This decoration has survived on three of the figures.

The ears of the horses are made from a flat, narrow strip (approx. 1.5 × 0.2 mm), which pierces through the plates shaping the head and is coiled at both ends (approx. 1.5-2 scrolls with an internal diameter of 1.5-2 mm). A horizontal filigree-decorated strip (length: approx. 35 mm, width: 4.4 mm) is soldered to the backs of the horses. Its edges feature a 'braid' motif, made of two torded wires (width: 1 mm). Below the figures, there is a filigree decoration band (width: approx. 4.7 mm), consisting of a thin strip (0.5 × 0.15 mm, soldered upright) and two torded wires (width: approx. 0.9 mm, not forming a braid) beneath it. The strip creates a mirrored, heart-like pattern.

The reverse side of the pendant is plain, smooth, heavily bent, and cracked in places, with no decoration. The side edges are wrapped with a wire (diameter: approx. 0.3 mm), forming three coils (max. width: approx. 1.5 mm). On the right side, both ends of this wire

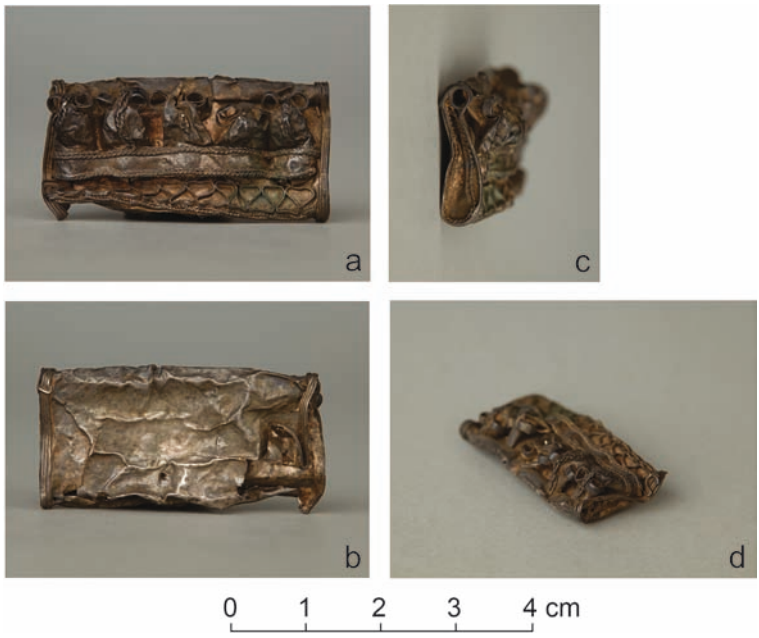

Fig. 3. Dzierznica II, inventory number MNK IV-Z-2725/65, illustrative photo: a – obverse, b – reverse, c – right side, d – oblique view. Photo A. Olchawska, MNK; graphic editing K. Niziołek, JUIA

are visible – one soldered flat (on the obverse), the other tucked under the rest (on the reverse). One of these ends is visible on the obverse. The edges of the right sidewall are bordered by a torded wire (diameter: approx. 0.4 mm). The left side of the kaptorga is open, lacking a sidewall. The bottom of the body was probably cut open along its length.

3. Inventory number MNK IV-Z-2725/67; Fig. 4

This is a fully preserved kaptorga in good condition (length: 28.4 mm, width: 18.3 mm; body plate thickness: 0.1-0.2 mm; weight: 3.55 g).

On the obverse, there are four stylised horse figures (length: approx. 13 mm, width: 4 mm, height: 7 mm), with their muzzles attached to the tubularly rolled edge of the pendant, forming a loop (diameter: 1.8 mm). The rightmost figure is only partially preserved. A filigree band (two torded wires with a straight wire in between; width: approx. 1.3 mm) runs along the upper part of the horses, from the back to the tip of the muzzle, imitating a mane.

The ears of the horses are made from a flat, narrow strip (thickness: approx. 0.2 mm, width: 1.2 mm), which pierces through the plates shaping the head and is coiled at both ends (approx. 1.5-2 scrolls with an internal diameter of approx. 1.5 mm). Each horse has only one ear preserved. A horizontal filigree-decorated strip (length: approx. 26.1 mm,

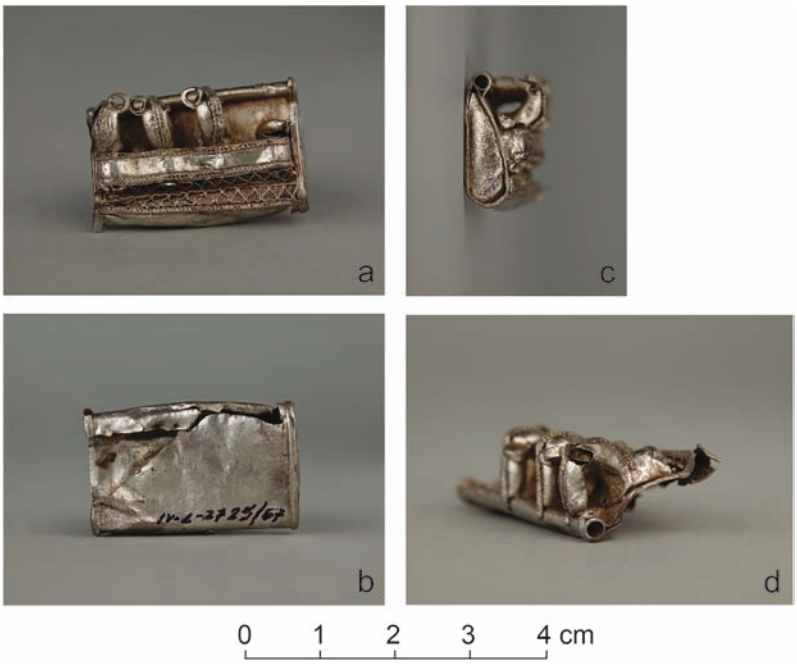

Fig. 4. Dzierznica II, inventory number MNK IV-Z-2725/67, illustrative photo: a – obverse, b – reverse, c – right side, d – oblique view. Photo A. Olchawska, MNK; graphic editing K. Niziołek, JUIA

width: 4.7 mm) is soldered to the backs of the horses. Its edges feature a 'braid' motif, made of two torded wires (width: approx. 1 mm).

Below the figures, a decorative pattern consisting of two thin strips (0.5 × 0.2 mm) and two twisted wires (not forming a braid) is located beneath them. The first strip (approx. 2.3 mm wide) is soldered vertically, resting against the hindquarters of the horses, creating a heart-shaped openwork design. The second strip (approx. 2.6 mm wide) is soldered horizontally on edge and shaped into a heart motif. Both strips form a symmetrical mirror-image pattern.

The reverse side of the pendant is plain, smooth, with some cracks and a missing section, and is undecorated. The body's side edges are wrapped with a wire (diameter approx. 0.2 mm), forming three coils (approx. 1 mm). The right sidewall is well preserved, while the left side of the kaptorga is open, lacking a sidewall.

4. Inventory numbers MNK IV-Z-2725/68-69; Fig. 5

This is a complete kaptorga, preserved in two fragments (total length: approx. 54 mm, width: 23.3 mm, body plate thickness: 0.15 mm; weight: 6.85 g).

On the obverse, there are seven stylised horse figures (length: approx. 14.5 mm, width: 5 mm, height: 8 mm), with their muzzles attached to the tubularly rolled edge of the pendant.

Fig. 5. Dzierznica II, inventory number MNK IV-Z-2725/68-69, illustrative photo: a – obverse, b – reverse, c – right side. Photo A. Olchawska, MNK; graphic editing K. Niziołek, JUIA

A filigree band (a thin, straight wire flanked by two torded wires; width: 1 mm) runs from the back to the tip of the muzzle on each horse, imitating a mane. This decoration is heavily worn, especially at the most protruding parts of the head and the tip of the muzzle.

The ears are made from a flat, narrow strip (approx. 1-1.5 × 0.2 mm), which pierces through the plates shaping the head and is coiled at both ends (approx. 2 scrolls with an internal diameter of approx. 1 mm). A horizontal filigree-decorated strip (length: approx. 49 mm, width: 5 mm) is soldered to the backs of the horses. Its edges feature a 'braid' motif, made of two torded wires (approx. 0.8 mm). In the central part, there is a single torded wire (diameter: approx. 0.2 mm), forming a zigzag pattern. The strip is broken and dented in one area.

Below the figures, a filigree decorative band (approx. 7.7 mm wide) runs. Its upper section consists of a band of two torded wires with a straight wire between them (width: 1 mm). Below this, antithetically arranged trapezoidal pairs form an hourglass-like pattern (height: 5 mm). Each trapezoid (bases: approx. 3 mm and 1 mm; height: 2.5 mm) is made of six torded wires, forming three braids (one braid width: approx. 0.6 mm). The lower part of the decoration repeats the band with two torded wires and a straight wire (width: 1 mm),

though this section is missing on the left fragment of the kaptorga. The tubular loop of kaptorga (diameter: 3 mm) is also decorated with a band of two wires torded in the same direction (width: 0.8 mm).

The reverse side of the pendant is plain, smooth, and cracked in some areas, without decoration. The body's side edges are wrapped with a wire (approx. 0.2 mm) to form four coils (approx. 1-1.2 mm). One end is visible on the reverse side. The right sidewall is outlined with a single torded wire (diameter: 0.2 mm), with an oval hole in its lower part (max. diameter: 2.3 mm). The left side of the kaptorga is open (lacking a sidewall).

5. Inventory number MNK IV-Z-2725/70; Fig. 6

This is a fragment (approx. ½) of a kaptorga, with the left edge preserved (remaining length: approx. 23 mm, width: 19.4 mm, body plate thickness: 0.1 mm; weight: 2.79 g). The lower part of the pendant is almost completely destroyed.

On the obverse, three stylised horse figures (length: approx. 14.6 mm, width: 5 mm, height: 6.5 mm) remain, with their muzzles attached to the tubularly rolled edge of the kaptorga (which forms a loop of diameter approx. 2.6 mm). A filigree band (a thin, straight wire flanked by two torded wires; width: 1 mm) runs from the back to the tip of the muzzle on each horse, imitating a mane.

The ears are made from a flat, narrow strip (approx. 1-1.5 × 0.2 mm), which pierces through the plates shaping the head and is coiled at both ends (approx. 1.5 scrolls with an

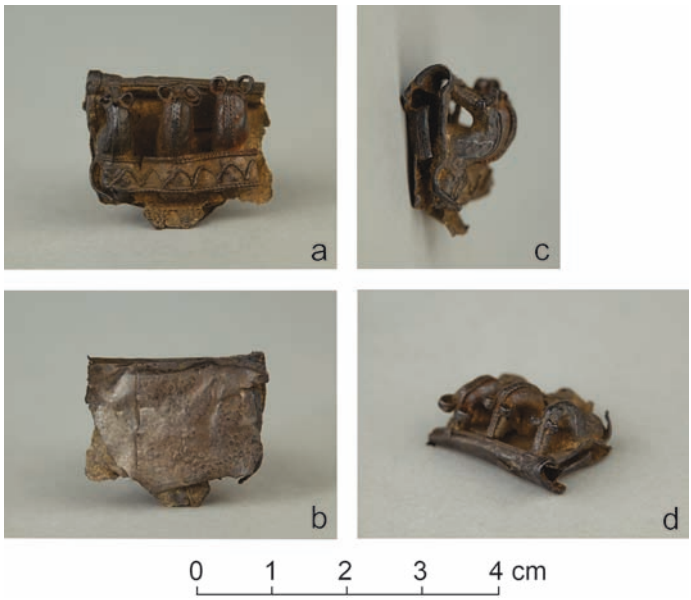

Fig. 6. Dzierznica II, inventory number MNK IV-Z-2725/70, illustrative photo: a – obverse, b – reverse, c – left side, d – oblique view. Photo A. Olchawska, MNK; graphic editing K. Niziołek, JUIA

internal diameter of approx. 1.4 mm). Both the manes and ears are heavily worn. A horizontal filigree-decorated strip (remaining length: approx. 20.6 mm, width: 5 mm) is soldered to the backs of the horses. Its edges feature a 'braid' motif, made of two torded wires (width: approx. 0.6 mm). In the central part, there is a single torded wire (diameter: approx. 0.3 mm), forming an arcade pattern.

Below the figures, only fragments of the filigree decoration remain. The upper part consists of a band of two torded wires with a straight wire between them. Below, there are two trapezoidal shapes, made of six bands of torded wires (probably originally forming an hourglass motif; see inventory no. MNK IV-Z-2725/68-69). The tubular loop of the kaptorga is also decorated with a band of two wires torded in the same direction.

The reverse side of the pendant consists of two undecorated plates – one is smooth, while the other is granular and cracked in some areas. The side edge of the body is wrapped with a wire (approx. 0.3 mm) to form four coils (approx. 1.5 mm). The left side of the kaptorga is open (lacking a sidewall).

6. Inventory number MNK IV-Z-2725/71; Fig. 7

This is a fragment (approx. 1/3) of a kaptorga, with the left side edge preserved (remaining length: 18.4 mm, width: 25 mm, body plate thickness: approx. 0.1 mm; weight: 1.57 g).

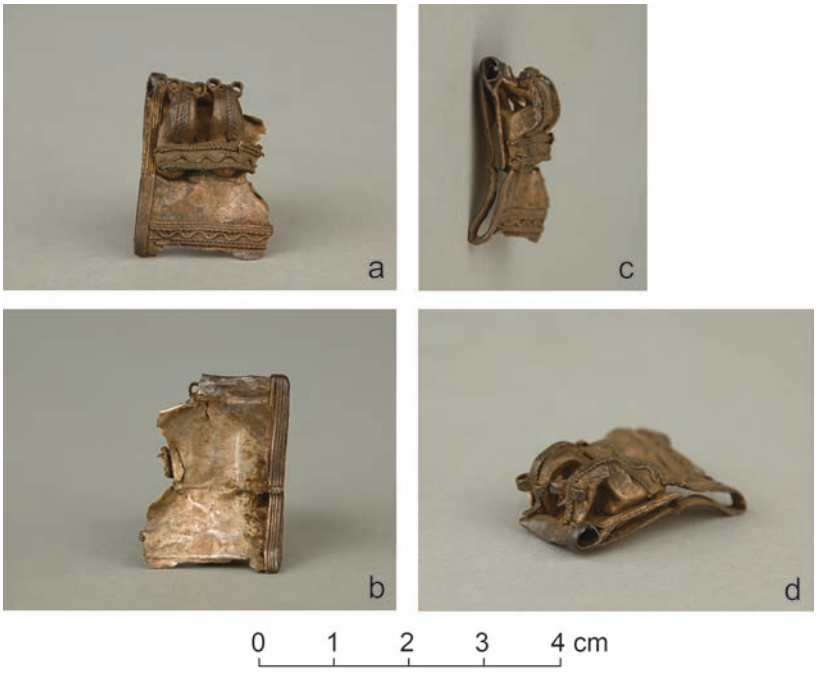

Fig. 7. Dzierznica II, inventory number MNK IV-Z-2725/71, illustrative photo: a – obverse, b – reverse, c – left side, d – oblique view. Photo A. Olchawska, MNK; graphic editing K. Niziołek, JUIA

On the obverse, two stylised horse figures (length: approx. 13.3 mm, width: 5 mm, height: 7 mm) remain, with their muzzles attached to the tubularly rolled edge of the pendant, forming a loop (diameter: 2.5 mm). A filigree band (a thin, straight wire flanked by two torded wires; width: 1 mm) runs from the back to the tip of the muzzle on each horse, imitating a mane.

The ears are made from a flat, narrow strip (approx. 1.2 × 0.2 mm), which pierces through the plate shaping the head and is coiled on both sides (approx. two scrolls with an internal diameter of approx. 1 mm). A horizontal filigree-decorated strip (length: approx. 14.6 mm, width: 4 mm) is soldered to the backs of the horses. Its edges feature a 'braid' motif, made of two torded wires (widths: approx. 1 mm and 0.8 mm). In the central part, a single wire (diameter approx. 0.3 mm) forms a wavy line.

Below the figures, there is a blank space (6.7 mm wide), but soldering marks suggest that some decoration once existed there. The lower part of the obverse is adorned with a filigree decoration strip (width: 3 mm). Upper section: a band of two torded wires with a straight wire in between (width: 1.2 mm), below it: a wavy line made of a single straight wire (diameter: 0.2 mm), further below: two torded wires forming a braid motif (width: 0.8 mm). The bottom edge of the kaptorga's body, along with a large portion of the rear plate, is broken off. The rear part is only partially preserved, with only the upper corner remaining. The left edge of the body is wrapped with a wire (approx. 0.3 mm) to form four coils (approx. 1.8 mm). One end of these coils is visible on the reverse. The left side of the kaptorga is open (lacking a sidewall).

7. Inventory number MNK IV-Z-2725/72; Fig. 8

This is a fragment (approx. 2/3) of a kaptorga with the right side wall preserved (remaining length: 20 mm, width: 22 mm, body plate thickness: 0.1 mm; weight: 2.79 g).

On the obverse, three stylised horse figures (length: approx. 13.2 mm, width: 4 mm, height: 7 mm) remain, with their muzzles attached to the tubularly rolled edge of the pendant, forming the loop of the kaptorga (diameter: approx. 2 mm). A filigree band (a thin straight wire flanked by two torded wires; width: 1.2 mm) runs from the back to the tip of the muzzle on each horse, imitating a mane. This decoration is heavily worn, especially at the top of the head and the muzzle tip.

The ears of the horses are made from a flat, narrow strip (approx. 2 mm wide), passing through the plate shaping the head, and coiled at both ends (approx. 1.3 scrolls with an internal diameter of approx. 1 mm). A horizontal filigree-decorated strip (remaining length: approx. 15.5 mm, width: 2.6 mm) is soldered to the backs of the horses. On its edges, there is a 'braid' motif, made of two torded wires (approx. 0.8 mm), with a single wire (approx. 0.2 mm diameter) forming a wavy line in the centre.

Below the figures, there is an openwork decoration (width: approx. 6.6 mm) made from two soldered wires (thickness: approx. 0.5 mm) forming an 8-shaped braid. The upper part of the braid is soldered to the figure's haunches, so that the previously described

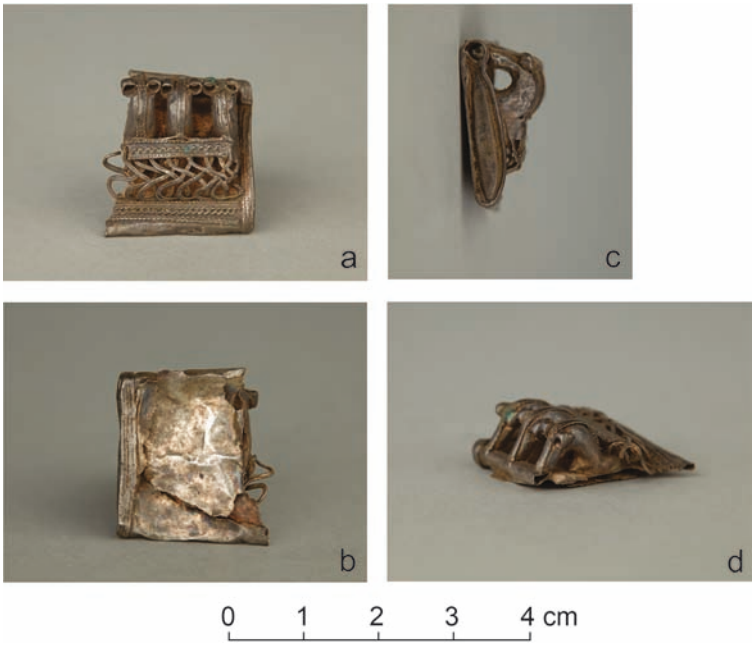

Fig. 8. Dzierznica II, inventory number MNK IV-Z-2725/72, illustrative photo: a – obverse, b – reverse, c – right side, d – oblique view. Photo A. Olchawska, MNK; graphic editing K. Niziołek, JUIA

filigree strip covers the connection. The lower part of the braid is soldered to the body of the kaptorga, creating a convex shape. The lower part of the obverse is adorned with a filigree strip (width: 1.1 mm) that repeats the motif of the previously described band, with the difference that the upper band consists of three wires: two torded and one straight in between (width: 4 mm).

The back side of the pendant's body (reverse) is undecorated, smooth, heavily bent, and cracked in places. The right edge of the body is wrapped with a wire (approx. 0.3 mm) to form four coils (approx. 1.5 mm). Their ends are visible on both the obverse and reverse. The side wall is enclosed by a single wire (0.25 mm in diameter). On the upper surface of the kaptorga, greenish tarnishing is visible.

8. Inventory number MNK IV-Z-2725/73; Fig. 9

This is a fragment (approx. 2/3) of a kaptorga with the right side wall preserved (remaining length: 25.3 mm, width: 22.8 mm, body plate thickness: approx. 1 mm; weight: 2.47 g).

On the obverse, two stylised, secondarily deformed horse figures (length: approx. 13.6 mm, width: 5.6 mm, height: 5.5 mm) remain, with their muzzles attached to the tubularly rolled edge of the pendant, forming the loop of the kaptorga (diameter: approx. 2.2 mm).

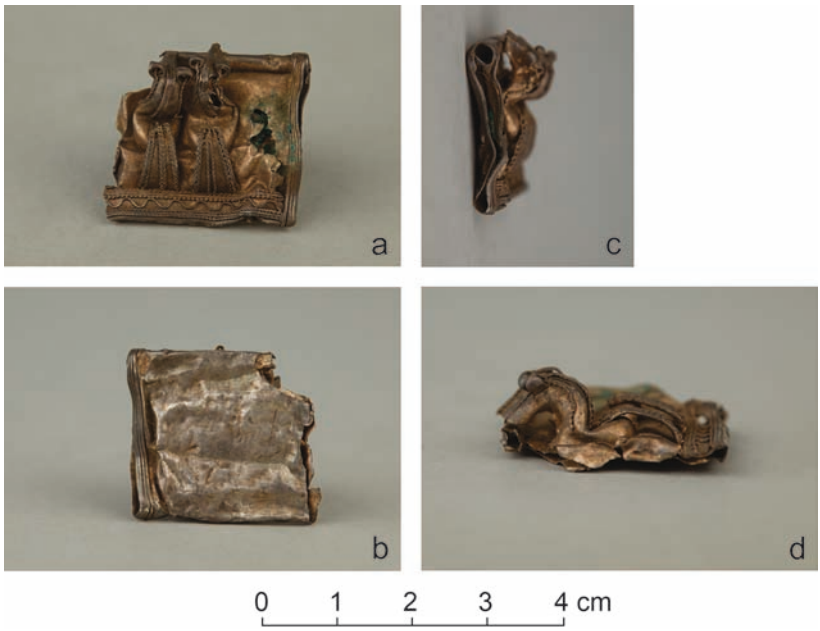

Fig. 9. Dzierznica II, inventory number MNK IV-Z-2725/73, illustrative photo: a – obverse, b – reverse, c – right side, d – oblique view. Photo A. Olchawska, MNK; graphic editing K. Niziołek, JUIA

Fig. 10. Dzierznica II, inventory number MNK IV-Z-2725/74, illustrative photo: a – obverse, b – reverse, c – right side, d – oblique view. Photo A. Olchawska, MNK; graphic editing K. Niziołek, JUIA

A filigree band (a thin, straight wire flanked by two torded wires; width: 1 mm) runs from the back to the tip of the muzzle on each horse, imitating a mane. This decoration is heavily worn, especially at the top of the head and the muzzle tip.

The ears of the horses are made from a flat, narrow strip (approx. 1.5 × 0.2 mm), passing through the plate shaping the head, and coiled at both ends (approx. 1.5-2 scrolls with an internal diameter of approx. 1 mm). Additionally, single torded wires (diameter: 0.3 mm) are soldered to both sides of each horse's neck, with one end inserted into the ear. At the rear of each horse, trapezoidal plates (length: approx. 8.2 mm, width: approx. 5.2 mm and 3 mm) are soldered, bent in an arc to imitate tails. Each plate is decorated with three strands of double torded wires, creating a braid motif (width: 0.8-1 mm). Soldering marks are visible at the top of the plates.

Below the tails, there is a horizontal filigree decoration (width: 5 mm) consisting of a single wire (diameter: 0.2 mm) forming a wavy line, enclosed between two filigree strands, each made of two torded wires with a single straight wire between them (approx. 1 mm and 1.2 mm wide). At the right edge of the kaptorga, a section of the body plate is missing, where a third horse figure was detached. Inside the kaptorga, green copper corrosion products are visible.

The reverse side of the pendant's body is undecorated, smooth, and heavily bent. The right side edge of the body is wrapped with a wire (approx. 0.5 mm) forming four coils (approx. 1.5 mm wide), with one end visible on the reverse side. The described example lacks the side wall.

9. Inventory number MNK IV-Z-2725/74; Fig. 10

This is a fragment (approx. ½) of a kaptorga with the right side wall (length: 19.5 mm, width: 22.5 mm, body plate thickness: 0.1 mm; weight: 2.23 g).

On the obverse, two stylised horse figures (length: approx. 16.3 mm, width: 5.4 mm, height: 6.6 mm) remain, with their muzzles attached to the tubularly rolled edge of the pendant, forming the loop of the kaptorga (diameter: 1.8 mm). A filigree band (a thin straight wire flanked by two torded wires) runs from the back to the tip of the muzzle on each horse, imitating a mane (width: 1.4 mm).

The ears of the horses are made from a flat, narrow strip (approx. 1.3 × 0.1 mm), passing through the plate shaping the head, and coiled at both ends (approx. two scrolls with an internal diameter of approx. 1.2 mm). A horizontal strip (length: approx. 12 mm, width: 5 mm) is soldered to the backs of the horses, decorated with filigree (on the edges, the braid motif is made from two torded wires, approx. 0.9 mm wide, and in the middle, a single wire, approx. 0.3 mm diameter, creating a wavy line). The lower part of the obverse of the kaptorga is decorated with a filigree band (width: 3.4 mm), consisting of – at the top, a single torded wire, at the bottom, two torded wires creating a braid motif, arranged in the same direction (width: 1 mm), and a single wavy-shaped wire (diameter: 0.3 mm) in the middle. The tops of the wavy lines overlap, partially covering the top filigree.

The reverse side of the pendant's body is partially preserved. It is undecorated and smooth. The right side edge of the body is wrapped with a wire (approx. 0.4 mm in diameter), forming four coils (approx. 2 mm wide), with one end visible on the reverse side. The side wall is enclosed by a single wire (approx. 0.4 mm diameter). In its lower part, a hole with ragged edges is punched (approx. 3.5 × 4.8 mm).

10. Inventory number MNK IV-Z-2725/94; Fig. 11

This is a fragment (approx. 1/2) of a kaptorga with the right side wall (length: approx. 18.6 mm, width: 20 mm; body plate thickness: 0.15 mm; weight: 2.07 g).

On the obverse, two stylised horse figures (length: approx. 12.5 mm, width: 5.7 mm, height: 8 mm) remain, with their muzzles attached to the tubularly rolled edge of the pendant, forming the loop of the kaptorga (diameter: approx. 2.7 mm). A filigree band (a thin straight wire flanked by two torded wires) runs from the back to the tip of the muzzle on each horse, imitating a mane (width: 1.2 mm).

The ears of the horses are made from a flat, narrow strip (approx. 1 × 0.3 mm), passing through the plate shaping the head, and coiled at both ends (approx. 1.5 scrolls with an internal diameter of 0.8-1.5 mm). A horizontal strip (length: approx. 16.5 mm, width: 4.8 mm) is soldered to the backs of the horses, decorated with filigree (on the edges, the braid motif is made from two torded wires, approx. 1 mm wide), and in the middle of the strip, a single wire (approx. 0.3 mm diameter) forms a wavy line, which was probably initially in the form of a spring. Most of the wire's distal portion is broken off.

Fig. 11. Dzierznica II, inventory number MNK IV-Z-2725/94, illustrative photo: a – obverse, b – reverse, c – right side, d – oblique view. Photo A. Olchawska, MNK; graphic editing K. Niziołek, JUIA

Below the figures, a layered openwork decoration (approx. 5.4 mm wide) is made of wires (approx. 0.4 mm in diameter). These form at least three layers of horizontally or vertically oriented figure eights, and at the bottom is a spring-like shape. The aforementioned horizontal strip covers part of this decoration. Additionally, on the right side, the decoration is bordered by a filigree band made of two torded wires with a single straight one in between (width: 0.9 mm). Below, near the lower edge of the kaptorga's body, a horizontal band of two torded wires runs in a braid motif (width: 0.9 mm).

The reverse side of the pendant's body is undecorated, smooth, heavily bent, and partially cracked. The right side edge of the body is wrapped with a wire (approx. 0.2 mm in diameter), forming three coils (approx. 1.5 mm wide), with one end visible on the reverse side.

11. Inventory number MNK IV-Z-2725/96; Fig. 12

This is a complete kaptorga, although it is heavily bent and partially damaged (length: 49 mm, width: 21.43 mm; body plate thickness: 0.1 mm; weight: 5.41 g).

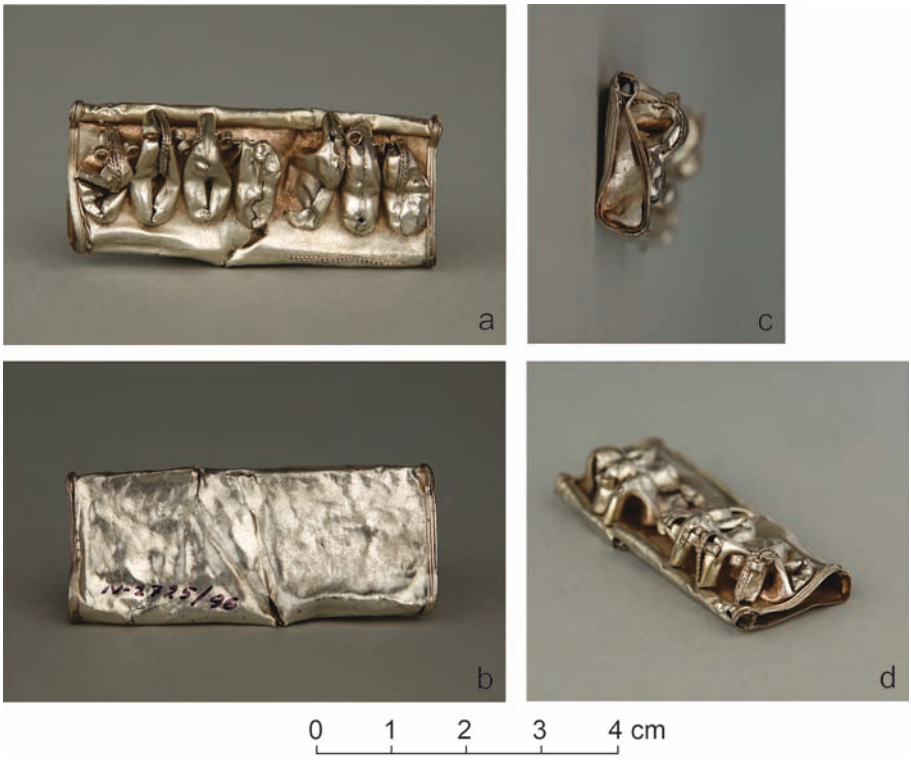

Fig. 12. Dzierznica II, inventory number MNK IV-Z-2725/96, illustrative photo: a – obverse, b – reverse, c – right side, d – oblique view. Photo A. Olchawska, MNK; graphic editing K. Niziołek, JUIA

On the obverse, there are seven stylised horse figures (length: approx. 15.6 mm, width: 5.6 mm, height: 6.5 mm), whose muzzles touch the tubularly rolled edge of the pendant (diameter: approx. 2 mm), but they are not soldered to it now. However, solder traces are visible in several places on the tube. A filigree band (a thin straight wire flanked by two torded wires), imitating a mane (width: 1.3 mm), runs across the top of three horses, from the back to the tip of the muzzle. The remaining horses do not have this decoration.

The ears of the horses are made from a flat, narrow strip (approx. 1.4 × 0.3 mm), passing through the plates shaping the head, and coiled at both ends (approx. 1.5-2 scrolls with an internal diameter of approx. 1.2 mm). Ears remain only on four figures. In the lower part of the obverse of the kaptorga, a fragment of filigree decoration remains, composed of two torded wires forming a braid motif (width: 0.6 mm).

The reverse side of the pendant's body is undecorated, smooth, slightly dented, and cracked in places. The side edges of the body are wrapped with a wire (approx. 0.2 mm diameter) forming three coils (approx. 1.3 mm wide), one of which is visible on the reverse. The right side wall is preserved, with its edges outlined by a simple wire. On the left side of the kaptorga, it is open (without the side wall).

12. Inventory number MNK IV-Z-2725/98; Fig. 13

This is a complete kaptorga, but it is cracked approximately halfway, heavily crushed, and worn (length: approx. 46.4 mm, width: 22.6 mm; body plate thickness: 0.1 mm; weight: 4.42 g).

On the obverse, four heavily deformed stylised horse figures remain, whose muzzles touch the tubularly rolled edge of the pendant, forming the loop of the kaptorga (approx. 2.7×1.4 mm). The rightmost horse is missing, and fragments of a plate are soldered to the body of the pendant in its place. A filigree band (a thin, straight wire between two torded wires), imitating a mane, runs across the upper part of the horses, from the back to the tip of the muzzle. This decoration is partially preserved on three of the figures.

The ears of the horses are made from a flat, narrow strip (approx. 1.5 × 0.2 mm), passing through the plates shaping the head, and coiled at both ends (approx. two scrolls with an internal diameter of approx. 1 mm). A horizontal strip of wire (approx. 30 mm long, 4 mm wide), soldered to the backs of the horses, is decorated along its edges with a filigree band composed of two torded wires arranged oppositely and one straight wire in between (width: 1 mm). This strip is preserved only partially.

Below the figures, there is a filigree decoration made of three braid-like bands formed from double-twisted wires (width: approx. 0.9 mm). Some of the wires are broken and detached from the plate of the kaptorga. A similar filigree decoration, made of two torded wires and one straight wire between them, also appears on the tubular loop of the pendant (width: approx. 1 mm). On the left side, the decoration is detached and bent.

The reverse side of the pendant's body is undecorated, smooth, heavily bent, cracked, and has a large loss. The side edges of the body are wrapped with a wire (approx. 0.2 mm

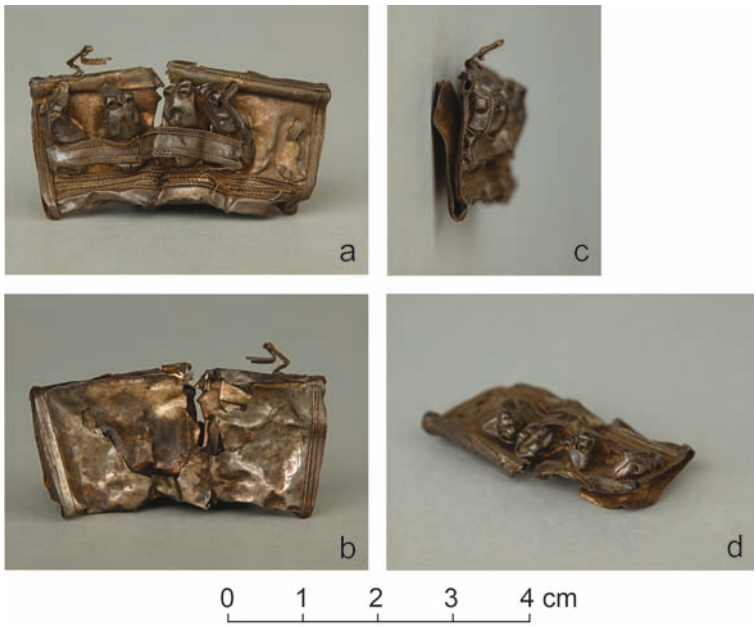

Fig. 13. Dzierznica II, inventory number MNK IV-Z-2725/98, illustrative photo: a – obverse, b – reverse, c – left side, d – oblique view. Photo A. Olchawska, MNK; graphic editing K. Niziołek, JUIA

diameter) forming five coils (approx. 1.4 mm wide), with the end of the coil visible on the left side of the reverse. The right side wall is preserved, with its edges outlined by a simple wire. The left side of the kaptorga is open (without the side wall).

CONCLUSIONS

The material presented in this text is only a small selection from the non-monetary part of the Dzierznica II hoard. It forms a stylistically homogeneous group. Given the incomplete publication of these artefacts, despite the very preliminary phase of analysis, we believe that introducing them into scholarly circulation is both justified and necessary.

The catalogue-like nature of this text is undoubtedly crucial for the following stages of publication, and through its deliberately detailed descriptions, it forms a substantial and cohesive whole. At this point, it becomes possible to begin discussions on a range of identified, specific research questions. Resolving them will ultimately lead to a more comprehensive synthesis.

During the research, descriptions, and preliminary archaeometric analyses conducted to date, several issues have arisen that require further study. Above all, there is a suggestion regarding the jewellery workshop where the kaptorgas might have been made. Was it

a single workshop? – It is difficult to confirm this at the current stage of research, definitively. However, there are already indications that this conclusion is worth considering.

It would be a truism to state that certain characteristic construction elements appear in the discussed artefacts. However, it is no longer a truism that there is significant similarity in the individual components of essentially every described kaptorga. This includes both metric features of the plates, wires, filigree, and other elements, such as the so-called 'embossed shapes,' as well as the manner in which they are joined and finished. One can observe a high degree of repetition in the tording method, joining individual elements into larger whole pieces (*e.g.*, the so-called braids or triple strands), their soldering, or assembly. It should be emphasised that these similarities are observed at the level of tenths of a millimetre (±0.1 mm), which, as can be assumed, was not (and could not have been) a subject of standardisation in early medieval workshops. At the same time, it can be assumed that this is neither a coincidence nor the result of the technological properties of the material. Hence, there is an emerging suspicion that the analysed products might have come from a single workshop. Kaptorgas decorated with a horse motif are known from

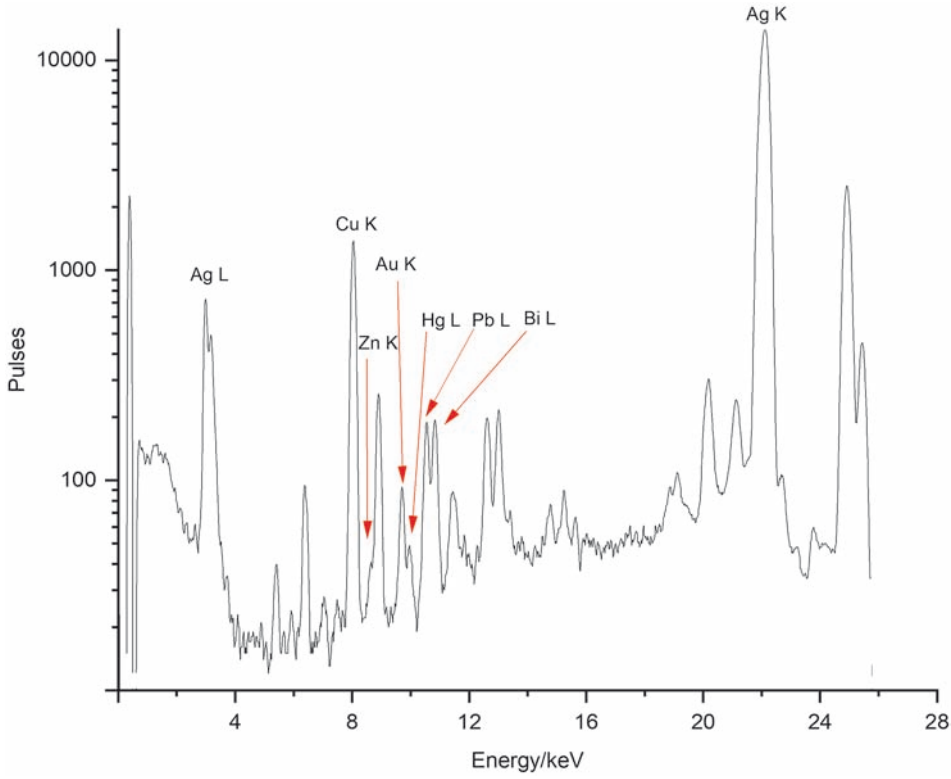

Fig. 14. An example of X-ray fluorescence (XRF) spectra obtained for kaptorga inventory number MNK IV-Z-2725/67

many sites in Poland (*e.g.*, Sztyber 2006, 2010; Kowalski and Kozłowska-Skoczka 2012; Poliński 2020), the Czech Republic (*e.g.*, Frolík and Smetánka 2014; Profantová 2022) or Scandinavia (*e.g.*, Kastholm *et al.* 2017; Miśta-Jakubowska *et al.* 2024). Therefore, the answer to the above question and the suggestion will be quite important in general, given the discussion of their origin and production.

Besides the aforementioned similarities, the shaped parts from the moulds used to make, for example, the bodies of the horses or other elements used to create the pendants, such as the strips, are almost identical. An interesting observation is also the lack of granulation decoration, which was very popular at that time (*e.g.*, Děd *et al.* 2016; Profantová 2022).

Many elements that make up the kaptorga serve a dual function: both decorative and structural. The best example of this is the mane – a filigree band securing each figure to the tubular loop of the pendant. Another such element is the transverse strip passing through the backs of the figures – the 'saddle', which simultaneously decorates the kaptorga and stabilizes the row of horses.

An interesting (though still preliminary) observation concerns the chemical (elemental) composition of the kaptorgas. The surveyed metal objects are primarily composed of silver (Ag) and copper (Cu), along with trace levels of lead (Pb), bismuth (Bi), gold (Au), mercury (Hg), and zinc (Zn) (Fig. 14). Quantitative analyses have revealed Ag contents in the range of 93.3% – 95.4%, and Cu contents in the range of 2.8% – 4.5%.

The trace element ranges are 0.3% – 0.8% for Pb and 0.3% – 0.5% for Bi, respectively (Merkel 2016). Gold was identified in all measured kaptorgas; however, the LOQ (Limit of Quantification) in the table indicates that the percentage of the identified element is below the quantification limit for the method used. Similarly, Hg was identified in most objects, except for two: MNK IV-Z-2725/68 and MNK IV-Z-2725/96, which were marked as LOD (Limit of Detection) in the table (Table 1). Zn was also detected in all items, with concentrations not exceeding 600 ppm.

Currently, the compositions of solders are also being analysed, and we have also found traces of the original content of the kaptorgs in one of the specimens (inventory no. MNK IV-Z-2725/73), which we considered interesting.

The craftsmanship of the analysed objects is also noteworthy. One kaptorga consists of about 180-200 components. A large part of them are semi-finished products, with dimensions not exceeding 1 mm (often even 0.1-0.5 mm). At the same time, the repeatability of the techniques used to make these semi-finished products stands out. As noted earlier, they are not only metrically (formally) similar but also stylistically.

Most of the analysed artefacts are damaged or crushed, which is typical for jewellery found in 'cut or chop silver' early medieval hoards. Nevertheless, they also bear traces of use. The areas with the most wear on the decoration elements and the pendants themselves indicate how they were suspended and worn, and, primarily, that they were worn for a long time. One of the pendants had been repaired (inventory no. MNK IV-Z-2725/70).

Table 1. The results of the XRF chemical analyses conducted on the examined group of kaptorgas

No.	Inventory number	Ag[%]	Cu[%]	Pb[%]	Bi[%]	Au[%]	Hg[%]	Zn[ppm]
1	MNK IV-Z-2725/64	94.5	3.6	0.3	0.4	LOQ	LOQ	300
2	MNK IV-Z-2725/65	93.9	4.1	0.5	0.4	LOQ	LOQ	300
3	MNK IV-Z-2725/67	94.8	3.6	0.4	0.3	LOQ	LOQ	300
4	MNK IV-Z-2725/68	94.1	4.3	0.7	0.4	LOQ	LOD	300
5	MNK IV-Z-2725/69	93.6	4.5	0.7	0.5	LOQ	LOQ	LOQ
6	MNK IV-Z-2725/70	93.7	4.1	0.7	0.5	LOQ	LOQ	600
7	MNK IV-Z-2725/71	93.3	4.5	0.6	0.3	LOQ	LOQ	500
8	MNK IV-Z-2725/72	95.0	3.4	0.4	0.3	LOQ	LOQ	300
9	MNK IV-Z-2725/73	95.2	3.3	0.4	0.3	LOQ	LOQ	200
10	MNK IV-Z-2725/74	94.7	3.1	0.5	0.4	LOQ	LOQ	200
11	MNK IV-Z-2725/94	94.4	3.7	0.3	0.3	LOQ	LOQ	300
12	MNK IV-Z-2725/96	93.7	4.2	0.8	0.4	LOQ	LOD	400
13	MNK IV-Z-2725/98	95.4	2.8	0.4	0.4	LOQ	LOQ	200

Another issue is the stylistic and symbolic significance of the analysed artefacts. As mentioned in the introduction, identifying the figurines as horses is not the only interpretation found in the scholarly literature (Gardeła *et al.* 2019; Michalak and Gardeła 2020; 2022; 2024). As a result of this line of thought, the question arises about the symbolic significance of the horse for the users of these pendants. Additionally, one could consider the number of figures. Does the fact that their number is repetitive have any significance, and could it possibly be used to estimate the degree of preservation of the artefact?

Finally, the observed constructional patterns are certainly not without significance. Of particular interest is the absence of the left lateral wall of the kaptorga. This could be a consequence of the prevalence of right-handedness among craftsmen or users, or it may also have a symbolic meaning.

Specialised archaeometric analyses, on the one hand, and the detailed stylistic and comparative studies the authors are currently conducting, may provide answers to these and many other questions. The conclusions will be presented in subsequent articles.

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CARGO ON WHEELS – MEDIEVAL CART COMPONENTS FROM GRANARY ISLAND, GDAŃSK

ABSTRACT

Dąbal J., Borowka D., Prager J. and Widerski T. 2025. Cargo on wheels – medieval cart components from Granary Island, Gdańsk. *Sprawozdania Archeologiczne* 77/2, 531-556.

This text discusses the remains of a late medieval cart with a partial cargo recovered on Granary Island during the 2024 excavation, along with their historical context. The wooden components found have been technically described and compared to the limited archaeological database. They are furthermore considered in the context of the construction details of other medieval carts. The discovery is dated to the beginning of the 15th century, based on artefacts found in layers containing the cart fragments and supported by ^{14}C analysis. The construction of the cart has been analysed with the aid of historical depictions from the period and undertaken in the spatial and functional context of the Granary Island. Although the formal constraints on the investigation limit the interpretation, the discovery is considered unique in Europe.

Keywords: archaeology, medieval, carts, wheels, Gdańsk
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INTRODUCTION

As a result of archaeological research in 2024 conducted on Granary Island in Gdańsk, elements of a wooden cart from the late medieval period were discovered. The find is unique on the European scale due to the recovery of large quantities of elements related to the construction of the cart, as well as its partial cargo. An additional feature of the find is its context, being found on Granary Island, a late medieval storage area.

ARCHAEOLOGICAL CONTEXT

The cart components were discovered during archaeological excavations on Granary Island in Gdańsk in 2024. The research was carried out in the area of the plots on today's Chmielna and Spichrzowa Streets within the historical plots of 1-4 Judengasse (Fig. 1).

The research carried out in 2024 was a continuation of the excavations undertaken in 2006 and 2007 by the Archaeological Museum in Gdańsk. A major issue affecting the possibility of a more complete interpretation of the find is the degradation of the site during the period 2008-2022, when rubbish was illegally dumped in the area, and the site was overgrown with lush vegetation. The re-clearing of the site has significantly constricted the opportunity to trace the continuation of the historic land use. In addition, previous archaeological work has been carried out partly down to the undisturbed soil level, thus detaching a small part of the 2024 study area from the broader context. The collaborative

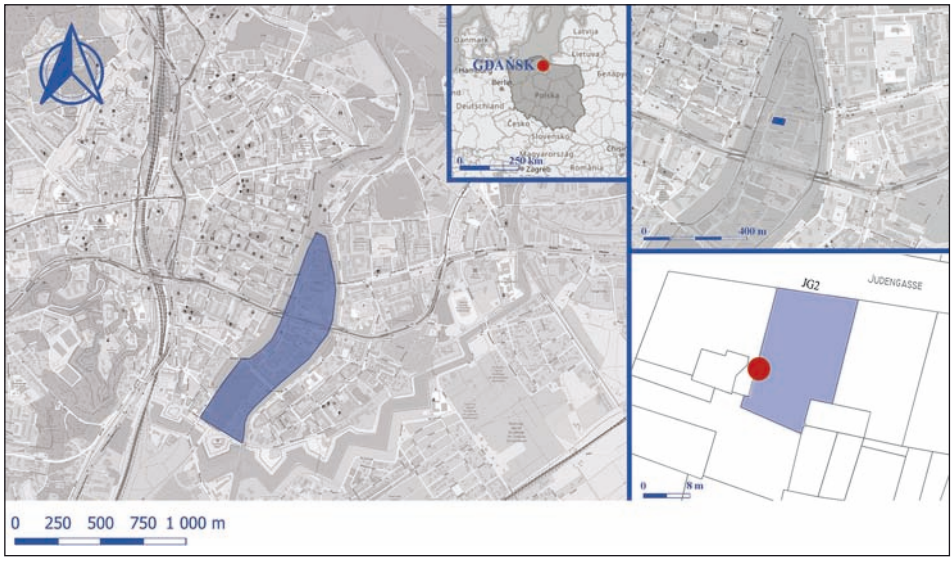

Fig. 1. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. Site location

effort to assemble data from the two seasons (2006 and 2024) enabled some of the information to be merged. However, due to site degradation, not all the data could be integrated. Because of these interpretational limits, detailed documentation of the find, its context, and additional analyses were undertaken to confirm its chronology and the nature of the raw materials used in its manufacture.

The components of the cart and probable cargo (construction: K115) were discovered in an area of approximately 8m² at the back of the historical plot Judengasse 2, about 15 metres from the contemporary line of Spichrzowa Street (Figs 1-3). The wooden elements

Fig. 2. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets:
1-2 – Cart components *in situ*, 3 – Wheel 1, 4 – Wheel 2. Photo: T. Widerski, J. Dąbal

were unearthed beneath the building layer (No. 168), from which the 2024 exploration began. The extent of the exploration on the south side was limited by the test trench from the 2006/2007 season, to the north its extent was determined by the area explored to the undisturbed soil in the previous excavations, to the west by the course of the wall (M86) and to the east by the continuation of the test trench from the 2006/2007 excavations. Elements were recorded at depths ranging from approximately 0.2 m to approximately

Fig. 3. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets.
1 – Cart components *in situ*. Photo J. Prager; 2 – Bodyshell plank. Photo: J. Dąbal

0.64 m below sea level. The surface was more than 0.6 m above the undisturbed soil layer (No. 173), which is homogenous peat (-1.27 m ASL). The excavations were held under challenging conditions in a waterlogged terrain.

Three layers were identified as the proximate context of the discovered timber elements:

1. A dark grey layer, 13 to 20 cm thick, of fine to medium-grained sands with inclusions of fine charcoal and organics, within which elements of the vehicle structure were embedded (Layer 170);

2. A deteriorated functional layer in the context of the structure visible only behind the main extent of the structure in the form of a level of wood shavings approximately 5-7 cm thick (Layer 169),

3. A dark brown layer containing a large amount of shavings, fine sand and other organic components, including a lot of offcuts and small wooden elements, the accumulation of which was noted around and above the elements of the structure (Layer 171). This last layer was interpreted as an accumulation layer associated with the cart's destruction.

The components of the vehicle were very poorly preserved, most of them lacking their original form and damaged by subsequent construction actions on the site.

A small number of artefacts (24) were recovered from Layer 170. These are represented by pottery (4 examples), one leather item, and 19 metal objects.

The pottery is represented by small fragments of grey pots, including a vessel 14 cm in diameter with the body surface covered with grooves (Fig. 4). Similar examples have been dated to the second half of the 14th century (Starski 2015, 94).

Fig. 4. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. Grayware. Photo: J. Dąbal

Fig. 5. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. Patten. Photo: J. Dąbal

Among the leather goods, a well-preserved patten with a double vestment, on a wooden tapered sole raised in the heel part, was registered (Fig. 5). The elements of the vestment were attached to the sole by rivets with rectangular heads preserved on the edge. They were fastened with an eight-sided, bipartite tin-lead buckle with a floral-decorated frame. Pattens were a protective element of the footwear. Their chronology has been determined to be late 14th to early 15th century (Ceynowa 2004; 2020, 550-552).

The 19 metal objects included a ring brooch, ten buckles, two folding clasps, three pilgrim badges, a bell, a pendant(?) and a coin. Amongst these, the only artefacts dated only to the 14th century were the ring brooch and the coin.

Ring brooches in a similar decorative form have been discovered in the Gdańsk area earlier and are generally recognised as distinctive Baltic region products (Trawicka 2010, 112). Nevertheless, the piece obtained as a result of the 2024 excavations differed from the one indicated from the 2004 season (Trawicka 2010, 112) and was made using the casting technique (Fig. 6: 2). Its frame, 35 mm in diameter, is decorated with an engraved herringbone motif and rosettes made using the *niello* technique. Their dating in Scandinavia is determined to the first half of the 14th century, while for the coastal areas of present-day Germany and Poland, they were in use around the second half of the 14th century (Polak 1998a, 219; Søvsø 2009, 185-187, 198; Wojciechowska 2022, 77, 90).

The coin found was a firchen ('kwartnik') of Winrych von Kniprode of the Teutonic Order, dated (in terms of the date of issue) to 1364-1379 A.D. and providing a late 14th century *terminus post quem* for the layer (Paszkiewicz 2013, 218).

The remainder of the collection is represented by buckles, mostly pewter with octagonal bipartite frames and decorative ears, and two of coloured metal single-divided with asymmetrical form (Fig. 6: 1, 4). Artefacts in this category have been dated over a wide range, most commonly from the second half of the 14th century (Whitehead 1996, 52-55; Trawicka 2010, 113, 114). Pewter shoe buckles from the 2024 excavations have been dated to the second half of the 14th to the early 15th century (Egan and Pritchard 2002, 22). Two other buckles have their parallels in material from Gdańsk (Trawicka 2010, 114, 115), with their chronology indicated to the 15th century.

Folding clasps made of non-ferrous metals were also distinguished (Fig. 6: 3). They are preserved in the form of plates and plates with frames. The examples are decorated using a carving technique with simple geometric patterns. Their chronology has been established as between the second half of the 14th and the early 15th centuries (Egan and Pritchard 2002, 117-120; Trawicka 2018, 353, 378).

The finds assemblage also contains three pilgrim badges; these have numerous analogues in material from Gdańsk, and these forms (GPPM variety 2) are defined as Pomeranian products (Paner 2013, 94-113; Dąbal and Borowka 2024, 358-381). The badges are rectangular with a triangular finial. In two situations, the pinnacles in the form of crosses are preserved. On the reverse of the badge, a very distinct regular diagonal grid is embossed (Fig. 6: 6, 7). The obverse schematically depicts Mary, facing left, wearing a crown

Fig. 6. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets:
1, 4 – Buckles, 2 – Brooch, 3 – Folding clasps, 5 – Bell, 6-7 – Pilgrim bages. Photo: J. Dąbal

surmounted by three lilies and holding an apple in her right hand. The throne is schematically depicted as a belt, filled with a diagonal grille. The head of the child standing to the left is encircled by a cross without a nimbus surround. Above the heads of both figures is a six- or five-pointed star. Of the examples found so far in Gdańsk, the most significant number are from Granary Island (Paner 2013, 107; 2016, 489). They have also been singly recorded in the Long Gardens area (pl. Długie Ogrody) (Paner 2013, 107; 2016, 489; Wołyńska 2021, 129, 130). Only several analogies are known from Europe. These include badges from Amsterdam and Dordrecht (van Beuningen *et al.* 2001, 343, figs 1429 and 1430). Additionally, a fragment of a lead frame with pseudo-filigree decoration was discovered, interpreted as a pendant or an unspecified part of a badge.

A category of finds that correlate with both pilgrim badges and are attributed to other spheres of life, such as entertainment, transport, or epidemic phenomena, includes bells, such as the one found in Layer 170. They were used for several different activities, including marking lepers and serving as accessories at dances (Egan and Pritchard 2002, 336, 337, 339, figs 220 and 221; Janowski 2016, 298). Another interpretation is that parents put them on their children to control their whereabouts (Egan 2005, 57, fig. 43: 246). The bell is made of a copper alloy and is preserved in its complete spherical form, with a diameter of 18 mm and a height of 17 mm (Fig. 6: 5). No mounting lug was preserved. The item was interpreted as a sound-emitting component. The artefact was dated to the late 14th-early 15th century (Trawicka 2018, 383, fig. 26: 388).

The recovered artefacts are dated to a very consistent range from the second half of the 14th century to the early 15th century and provide one element in determining the chronology of the cart components (K115). The chronology of the artefacts was completed with the dendrochronology and ^{14}C dating. Two samples were selected for dating using the dendrochronological method, while foreseeing the limited possibilities of their precise dating (the results are: after 1275 and after 1315) due to the state of preservation, samples were also taken for ^{14}C dating. In contrast, the result obtained using the C14 method indicates 1410 AD as the date of the wood used in making the object (wheels). The date obtained corresponds with the artefacts found in the archaeological context of the vehicle remains. Based on all the data, the cart's chronology was determined to be the early 15th century.

The chronology of the cart corresponds with the oldest phase of development of today's Granary Island, broadly defined as the 14th to early 15th century. This is the period about which we still have insufficient information in the context of the investigated area. This period has often been mistakenly identified with the full development of the area in question as a granary. Given the scarcity of historical data for this period, it can be inferred that this marks the beginning of the parcelling out of city plots. Wooden storage buildings may have been built on the plots, but they were not fully developed in terms of both architectural and spatial design at this time. The layout of the buildings also did not continue into the modern period, when the 15th-century layout of the plots was altered at the end of this period and at the beginning of the 16th century due to the construction of partially brick

walled granaries (fire walls) with fairly regular forms within regular plots (about 24 m long for the study area) (Volkholz 1922, 29). Based on historical data, the bare fact is that in the 15th century, the plot under analysis was delimited, but there is no information about its owner (Volkholz 1922, 52). The plot was used as a storage yard until the early 17th century. There is no historical data about its development during this period (Volkholz 1922, 52). The results of the excavations conducted in both 2006/2007 and 2024 confirmed the absence of timber construction within the plot. The results of both archaeological surveys were compared with the help of the Archaeological Museum in Gdańsk, which provided complete digital and photographic documentation to verify this data.

CART COMPONENTS AND CARGO

Wooden elements interpreted as components of a cart and its probable cargo (K115) were discovered in an area of 8 m^2 (Figs 7-9). The condition of the preserved components did not allow a clear interpretation of all the parts and their construction; therefore, no attempt was made to reconstruct the entire vehicle. However, their dispersion and the remains unquestionably identified as components of a cart make it possible to attempt to characterise and determine the probable size of the vehicle.

In the uppermost part, probable body components have been identified. Their disintegration could indicate the destruction of the body shell. The most important element is the side body panel (or a box board) (Fig. 3: 2). This is the only element preserved in its entirety, allowing for the identification with certainty of its location or how it was set in the context of other components. The side panel is made of pine wood and measures 190 × 42 cm; its width is 45 mm (Fig. 8: 4). The two sides have a symmetrical slot 26 cm wide and 1.5 cm deep. The panel has four 35 mm diameter holes spaced 16 cm (from the diameter) apart in two sequences every 40 cm. One vertical plank was attached to the slots in the central plank, with a groove beneath that protruded beyond the central plank's line. Such a component could only be located longitudinally on the stile and mounted to the base. Based on construction details, the plank is considered the longer part of the body shell, and the holes are interpreted as rope mounting to hold the cargo. A second similar element was also discovered in the trench profile (Fig. 3: 2; 8: 5). It had been partially destroyed. This is an analogous panel, preserved to a length of 67 cm with an original width of 42 cm. It also has retained two 35 mm-diameter holes, spaced 25 cm apart. Due to the different hole spacing, assuming the symmetry of the element, its full length could have been in the range of 90-112 cm. Very indicatively, this was taken as a reference point for visualisation as the shorter side of the body shell.

The formwork/lower body components were four pine planks, 28 to 30 cm wide and 84 to 106 cm long (Fig. 7). Their thickness was 45 mm. All components were severely damaged, and their dimensions are close to the presumed body width. The planks were laid

side by side transversely, with one of them overlapping the wheel (Wheel No. 1). In the context of the bodywork, two scantlings for the straight overlay joint were also discovered (Fig. 8: 2, 3). These, too, may have been part of the body frame or chassis, and, again, their condition does not allow structural details to be indicated. The size of the body can tentatively be estimated in the range of approximately 1.9 × 0,9-1.2 m and its height at 0.42 m. All components were made of pine wood.

Elements that could be identified as a cart chassis were not unquestionably recognised. These could potentially have been two components measuring 116 × 26 × 6 and 92 × 10 × 6 (Fig. 7). In addition, very poorly preserved pieces of studded scantlings were recovered (Fig. 8: 6). The holes were drilled through and studded halfway. It was not possible to determine how they were connected or how they would have been securely fitted into the cart's structure. The stubbing of one side of the surviving piece indicates that it was rather

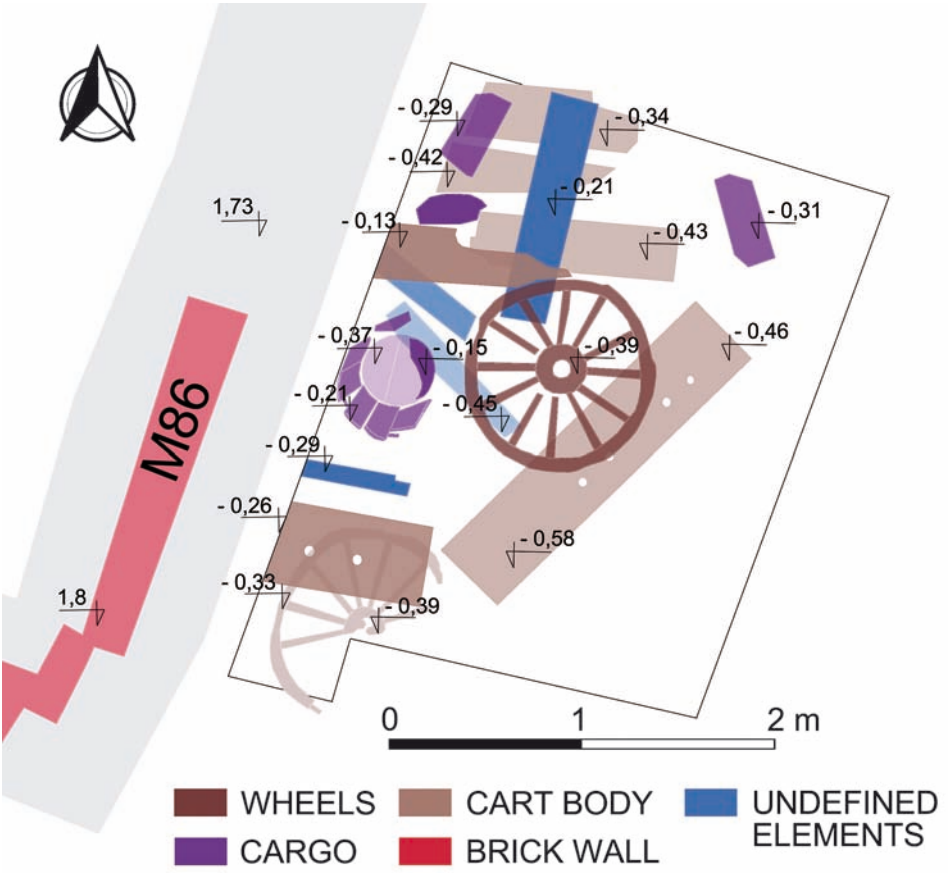

Fig. 7. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. Cart components and cargo dispersion, with elevation data. Prepared by J. Dąbal, T. Widerski and D. Borowka

attached horizontally. Elements were found folded perpendicular to each other under the wheel (Wheel No. 1) and body components. Their state of preservation did not allow any structural details to be identified.

The most interesting components seem to be the two wheels. They were found about 60 cm apart. One of them (Wheel 1) lay over the longer body shell panel, the other (Wheel 2) under the shorter one (Fig. 7). Both have been found with the inner side facing the ground (*i.e.*, the axle would have been mounted from the bottom in both cases). The circumference of the first wheel was preserved relatively completely. However, it was but damaged and with a destroyed hub (Fig. 2: 3). The second wheel is preserved in three sections, with the central section badly damaged (Fig. 2: 4). In addition, an adjacent section was uncovered in the earlier test trench, which appeared to have been better preserved (Fig. 8: 1). After measuring it, it was found that its diameter and width matched perfectly with Wheel No. 2. Its height is within the original parameters of the wheel, but the sections discovered *in situ* are more damaged. The internal spoke spacing also differs by 1 cm. Due to the convergence of certain features, the item was interpreted as part of a damaged wheel (Wheel No. 2).

Both uncovered wheels are of analogous design and have a diameter of 1 m (1.03 m). The hub is 31 cm high, 15 cm in diameter, and the widest point of the hub measures 22 cm (Fig. 8: 1; 9: 2, 3). It extends to 12 spokes, approximately 47-48 cm long, the upper part of which is jammed round and fits into the wheel. The lower part of the spokes fits squarely into the hub (Fig. 9: 4, 5). The spokes are offset about 7 degrees outwards (Fig. 8: 1). The wheels are made of six felloes joined together by pins, with two spokes embedded in each one (Fig. 8: 1; 9: 1). On the running side of one of the wheels (Wheel 2), reinforcements were made by studding. They took the form of symmetrically placed dowels located in the space between the spokes. Interestingly, no such reinforcement was noted on the other wheel.

The wheel components were made entirely of beech wood (Table 1). No traces of metal rim/tyre attachment were registered on the running surfaces of the wheel, but the pegs and spokes have small stones heavily indented into them, indicating that the wheel was at some stage used without a cover (Fig. 9: 1b, 1c). The hub on the bottom side is finished smoothly. The upper part of it is badly damaged.

Table 1. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. Wheel components wood identification. Author M. Krąpiec

Sample No.	Historical plot No.	Element specification	Raw material
P66	JG2A	K115/wheel_1/hub	*Fagus silvatica*
P67	JG2A	K115/ wheel_1/felloe	*Fagus silvatica*
P68	JG2A	K115/ wheel_1/spoke	*Fagus silvatica*
P69	JG2A	K115/wheel_2/felloes dowel	*Fagus silvatica*

The weight of the cart body, based on data from exposed components and raw material analysis, was estimated at 90 kg (for wood with a moistness of 15%). Based on similar characteristics, the wheels' weight was estimated at 20 kg. It is not possible to determine the weight of the chassis and body frames, but it would have been more than 15 kg. Thus, the total weight of the cart would have been between 125 and 160 kg.

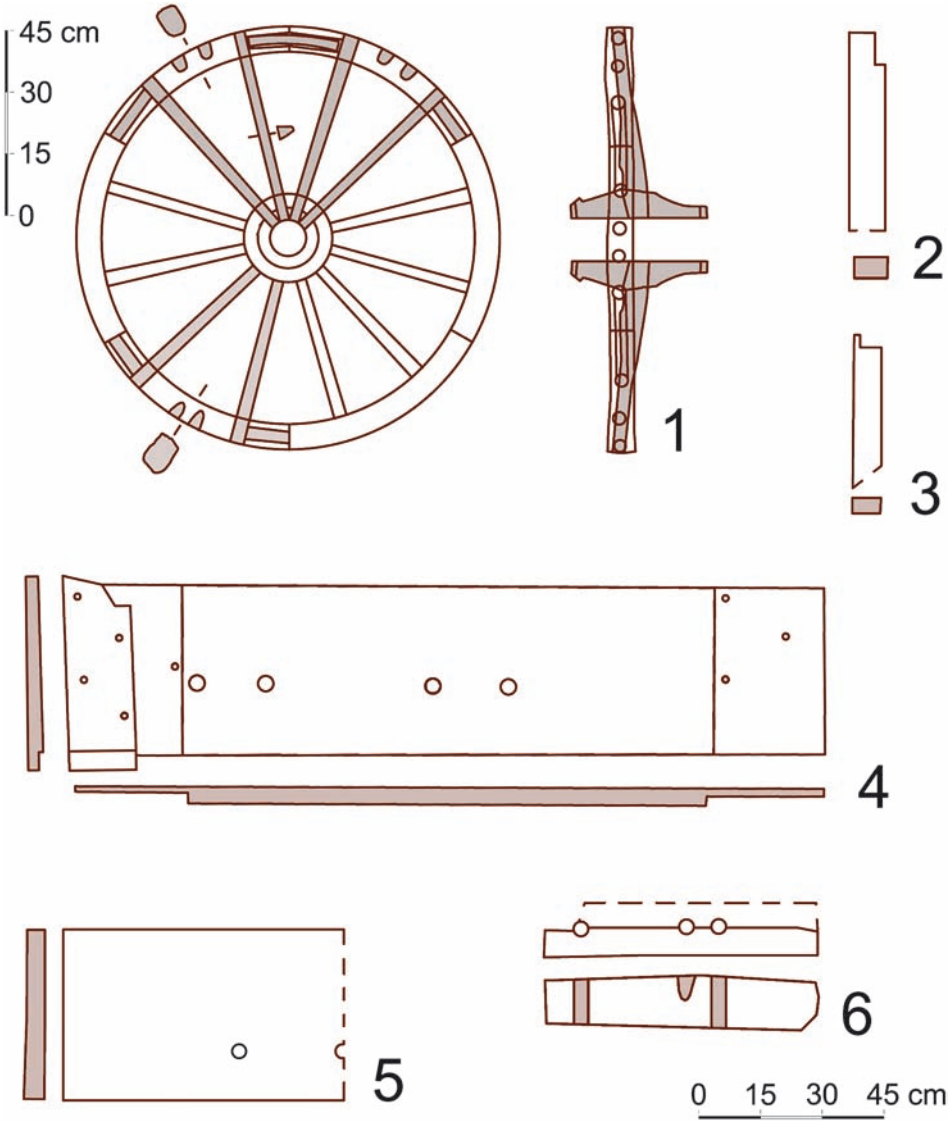

Fig. 8. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets.
1-6. Cart components. Drawn by J. Dąbal

Based on all the data relating to the discovered components, it was assumed that this was the remains of a two-wheeled cart. It should be noted, however, that approximately 4 m² on the western side of the find is covered by the wall. The possibility that the object was larger cannot, therefore, be confidently dismissed. A point that lends credence to the concept of a two-wheeled cart is the fact that the real extent of the find was defined by a line about 1 m wide, and no structural elements were discovered beyond this range. Nevertheless, the aforementioned doubts and the condition of the cart components prevented a final visualisation of the object.

Partially preserved elements of a barrel were found in addition to the above-mentioned components (Fig. 2: 1, 2; 7; 10). They were located on a piece of wood interpreted as part of the chassis (undefined element), at a distance of about 17 cm from the wheel and about

Fig. 9. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. 1-5 – Cart components details: 1 – Felloe, 2-3 – Hub, 4-5 – Spoke (ending from the hub side – 4; ending from the felloe side – 5). Photo: J. Dąbal

30 cm from the planks interpreted as the bottom of the body. The barrel was not preserved in its entirety – only the bottom, five staves and the barrel clamp were found *in situ*. A single stave and a fragment of the bottom were also located a short distance away. The barrel's elements were made of oak. The bottom, 36 cm in diameter, was made of two elements joined by pegs (Fig. 10). The barrel was initially made of 9 or 10 staves (circumference at the bottom 113 cm), of which five (preserved circumference 58 cm), 10 to 15 cm wide and 16 mm thick, were discovered *in situ*. The staves are preserved to a height of 29-33 cm. The triangular bevelled croze is approximately 5 cm high. In addition, wooden hoops approximately 3 cm high have been preserved in the context of the barrel (Fig. 10). Traces of a dark substance, presumably used for sealing, are visible on the inner surface and bottom of the barrel. Based on the preserved planks' dimensions and shape, it was

Fig. 10. Gdańsk, Granary Island, Żytnia/Spichrzowa Streets. Barrel elements and capacity reconstruction. Photo: J. Dąbal

determined that the barrel was originally 63-73 cm high and had a capacity of at least 65 litres. The weight of the empty barrel was approximately 14 kg. The barrel was secondarily damaged by the building level directly above the structure (layer no. 168) and subsequent construction activities at this location.

Barrels were excellent containers for liquids, loose substances, and other goods due to their resistance, ease of movement, and transportability (Świderski 1953, 13, 14). On late medieval sites, only their components are usually found (Polak 1998b, 253, 254; Starski 2015, 184; Uciechowska-Gawron 2019, 123, 124; Bobik 2023, 347). On urban sites, particularly in Pomerania, more of the better-preserved examples are known through having been secondarily used as drainage structures. Among the analysed examples, metrically and structurally similar barrels were recorded in Kołobrzeg (Polak 1998b, 254). In Gdańsk, the features of the barrels discovered so far indicate that they were used to store liquid substances (Kasprzak 2010a, 152; 2010b, 172, 173).

LATE MEDIEVAL TRANSPORTATION

Research into medieval transport in Poland has so far been addressed primarily in studies of the construction of tracks and spatial analyses, and of animal rigs and carts since the second half of the 20th century (Kaźmierczyk 1954; Matuszewski 1954; Rosset 1974; Kola 2000; Wrzesiński 2002; Niemiec 2011). Slightly older, dating back to the late 19th and first half of the 20th century, are studies of medieval transport in other parts of Europe (for example, Jusserand 1889; Salzman 1931). Due to the lack of relevant finds, studies of late medieval cart construction are even more sparse (see Willard 1932; Vermouzek 1983; Fansa and Schneider 1995; Haupt 1995; Ansorge 2005). At the same time, it was noted that the late medieval period was characterised by structural change in transport, including the technical development of land transport (Schreg 2003). During this period, communication in the Baltic coastal zone was mainly organised by sea. It was only with the development of the urban network that roads began to be built connecting port cities with inland centres. Research into the territories of Mecklenburg and Pomerania has shown that they were connected by a network of routes (Ansorge 2005, 153). Road usability was often disrupted by weather conditions. Often unpaved, the roads became impassable during the rains. The improvement of roads and developing their accessibility, as well as enhancing the durability and capacity of carts, were joint elements of the growth of the land transportation network.

The Granary Island in Gdańsk was designed to receive goods intended for transport from the hinterland, as well as to unload them from ships and transport them by cart. Loads must have arrived on the island in a variety forms of carts and wagons. Woodcuts and drawings of the 15th century present images of medieval porters with humped chests, wheelbarrows and handcarts, pack animals and two- and four-wheeled carts pulled by

draft animals (Vermouzek 1983, 319, 321; Ansorge 2005: 153, Abb. 1). Additional, relevant data on the type of late medieval carts and transport have come from details gleaned from medieval manuscripts. Although not including technical specifications, the medieval prayer books 'Books of Hours' and psalters introduce numerous pictures illustrating the variety of carts of the period. Based on these, only preliminary and tentative conclusions about the form of the cart's body, the type of harness or the construction of the wheels can be made. The details of the chassis, which are barely shown, are challenging to define. The chassis from the period is depicted on the drawing documenting the overturned carriage of Pope John XXIII (Baldassarre Cossa) in Arlberg while travelling to the Council of Constance in 1415. The chassis pictured is three-linked (Vermouzek 1983, 319).

The cart from Granary Island is considered a two-wheeled vehicle. In the studied sources including the 14th century 'The Romance of Alexander, Livre de la chasse', and 15th century 'Book of Mendel, Book of the Treasure', carts of this type appear to be the dominant mode of transport alongside four-wheeled carts (Fig. 11). Their bodies came in a variety of forms along with baskets, braids, platforms or ladders (see Fig. 11). The form of the body in the case of carts of the simplest design (Fig. 11: 1, 2, 6) may have been subject to change, and their owners probably altered them according to the loads. Carts with more advanced body designs probably did not have similar advantages. The wheels on the two-wheeled carts were presented as proportionally larger than those on the four-wheeled counterparts. In terms of capacity, they had to handle a heavier cargo. Just as in the example from Granary Island, the wheels were made of wood and frequently had metal tyres studded with what appear to be iron studs (Fig. 11: 4, 5). In the more detailed depictions, the wheels' division into felloes is discernible. Wheels were generally presented with fewer than ten spokes. However, this was probably not due to the actual construction of the wheels but to artistic convention or simplifications used by the artists making the drawings. At times, however, we find a 14th-century depiction of wheels with 12 spokes (Fig. 11: 5), similar to the ones from Granary Island (see above). The number of horses in the harness varied depending on the amount of goods being transported and the size of the cart itself. However, a disproportion is evident in the depictions; most often, the two-wheeled carts were pulled by a single animal, while carts pulled by more than two horses are relatively rare. An interesting aspect of the depictions is the cargo carried by the two-wheeled carts. As it turns out, it included both the transport of goods and people. Among the goods transported, valuable items are present, but commodities predominate. Present are depictions (Fig. 11: 3, 6) of carts carrying barrels, so important in the context of the find in question. The barrels were placed vertically on the wagon's body or laid on their sides. In both cases, their stability was probably provided by additional fastenings, which, however, are not visible in every depiction. They were depicted individually and with other goods to form a larger cart cargo (Fig. 11: 6). Other goods were also packed and fastened according to the carrying capacity of the respective cart. As the iconography from the turn of the 14th to 15th centuries indicates, two-wheeled carts were also used to transport people. Up to six adults

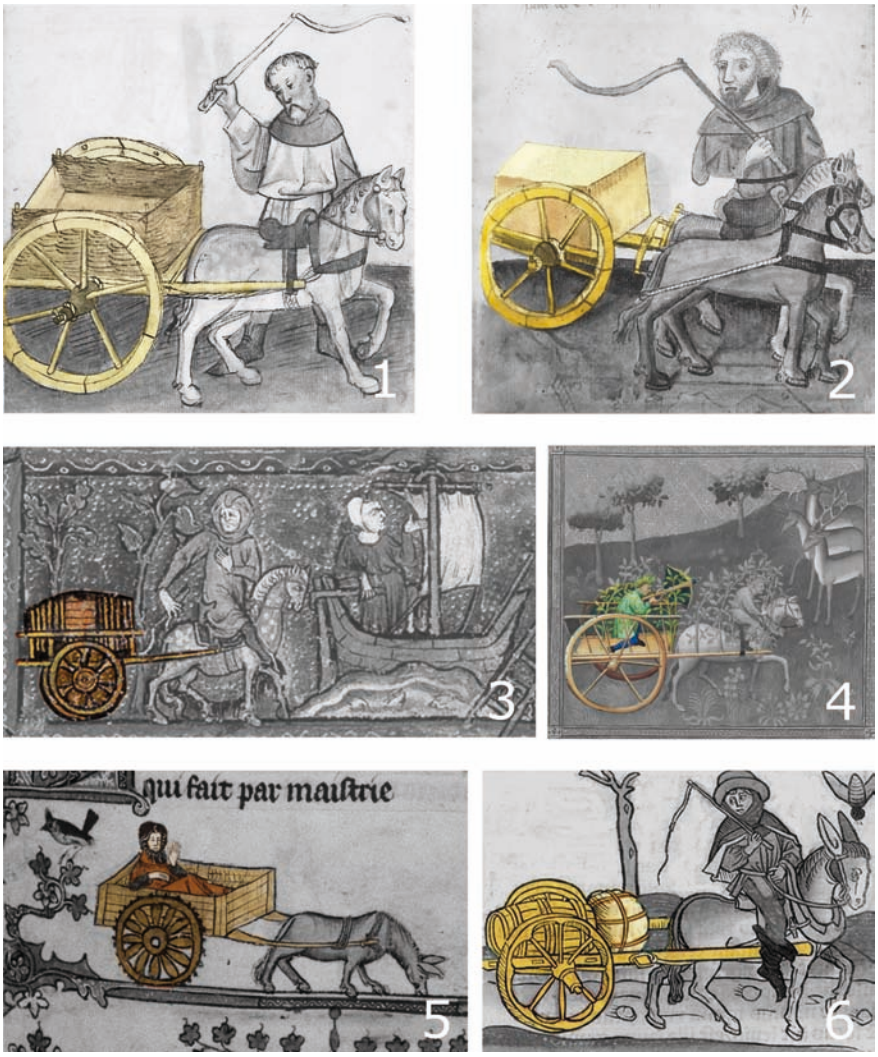

Fig. 11. Selected iconography of two-wheeled carts from the 14th-15th centuries A.D. 1 – *Book of Mendel*, 15th century, Stadtbibliothek im Bildungscampus Nürnberg, Amb. 317.2° Folio 27 verso (source: https://online-service.nuernberg.de/viewer/image/5d64f831-7a9d-47b4-9a01-d6a28f29ad99/57/LOG_0057/), 2 – *Book of Mendel*, 15th century, Stadtbibliothek im Bildungscampus Nürnberg Amb. 317.2° Folio 83 recto (source: https://online-service.nuernberg.de/viewer/image/5d64f831-7a9d-47b4-9a01-d6a28f29ad99/170/LOG_0170/), 3 – Brunetto Latini's *Livre du trésor, et autres traités,* ca. 1326 A.D., Bibliothčque nationale de France, département des Manuscrits, Français 571, fol. 66v. (source: https://classes.bnf.fr/ema/grands/ca001.htm), 4 – *Livre de la chasse,* 1406-1407 A.D., Pierpont Morgan Library, MS M.1044, fol. 103r (source: https://ica.themorgan.org/manuscript/page/75/77121), 5 – *The Romance of Alexander*, 1338-1344 A.D., Bodleian Libraries, University of Oxford, MS. Bodl. 264, pt. I fol. 109r. (source: https://digital.bodleian.ox.ac.uk/objects/8d17bc13-14b6-4a56-b3b5-d2e1a935c60d/), 6 – Ulm edition of Steinhöwel's collection of *Aesop's Fables*, ca. 1476/77 A.D., (source: https://de.m.wikipedia.org/wiki/Datei:Musca_et_mula-Ulm-1476_338516.jpg). Access: 05.10.2024. Modifications by the authors

are depicted on the back of this type of cart. For transporting a larger number of people, carts with more robust bodies and reinforced wheels were used. Most often, however, individuals were depicted as placed in a recumbent position (Fig. 11: 5), which may indicate that the carts were used to transport injured or sick people. Also characteristic is the depiction in the hunting treatise 'livre de chasse' (Fig. 11: 4), where a two-wheeled cart was adapted for deer hunting, and an archer was placed on its back.

The wide variety of medieval depictions, although introducing the functional use of carts, did not lead to elucidation of the details of their construction. Research into the design and construction of medieval carts is augmented by a small number of archaeological finds and (to some extent) ethnographic data. For the time being, the material evidence of cart construction in the Middle Ages is very infrequent and mainly limited to discovered wheels and their components. In the case of finds from Poland, the data is very slender, even including sources dated to the early medieval period. The issue of medieval transport in Polish publications began with finds at the sites of Gniezno (Wielkopolskie voivodeship), Bródno Stare (Mazowieckie voivodeship) and Opole – Ostrówek (Opole voivodeship) (Kaźmierczyk 1954, 174, 175). The discourse undertaken by Kaźmierczyk, then, in the context of wheels and wheel elements, was developed using ethnographic data on carts used in the Wschowa, Międzyrzecz, and Kożuchów areas. In addition, in his work, he addressed considerations relating to the carrying capacity of carts (Kaźmierczyk 1954, 178). The structural angle from an ethnographic perspective was introduced by Kazimierz Moszyński in 1929 (1967, 649-653). The catalogue of archaeological finds, cart elements for the early medieval period, has expanded marginally from the early works dealing with transport issues (Kaźmierczyk 1954, 174, 175). The list of finds includes wheel elements from Bródno, Opole, Gniezno, Ostrów Lednicki, Szczecin and Wrocław (Kaźmierczyk 1995, 103, 104; Cnotliwy and Rogosz 1983, 149, 150; Kowalska 2003, 300). The summary, including the data list (Robak 2009), was revised by the authors in the context of finds from Ostrów Lednicki and Szczecin (Stępnik 1996, 286, 287; Łastowiecki 2000, 38; Kowalska 2003, 300). Archaeological sources relating to the late medieval period are even scarcer. Late medieval wheels or their components have so far been discovered in Kołobrzeg, Bydgoszcz, Bytom and Puck (Wójcik and Podyma 1997, 174, 175; Polak 1996, 331-335; Siwiak and Siwiak 2014, 52; Starski 2015, 178, 183; Bobik 2016, 157). The find from Bytom has been interpreted as a hoisting wheel based on the presence of spoke embedment (Wójcik and Podyma 1997, 174, 175). However, structurally, it is consistent with other late medieval finds, also presented in this article.

Nine finds are associated with the Gdańsk area. These include unpublished finds from Tandeta Street – a wheel and two hubs, dated in the range of the 15th to 18th centuries (Archaeological Museum in Gdańsk: SAZ 255/99/4, cat. no. 1345), the find of a hub from Site no. 1 (Archaeological Museum in Gdańsk: inv. 1950/4977) and a wheel and two hubs discovered in 1953 at Site no. 2 (Archaeological Museum in Gdańsk: inv. 1953/337; 1953/360; 1953/372). The objects listed are broadly dated to the medieval period. Published

examples include a 14th-century hub fragment and a hub with an axle from excavations at 43-46 Św. Ducha Street in Gdańsk (Kasprzak 2018, 455; Krzywdziński 2018, 110).

The comparison of early and late medieval finds allows a preliminary observation of the changes in the construction of spoked wheels across the periods in question. Early studies, including remarks on wheel-making, consider making wheels from the circumference, i.e., a single bent part, as an older practice. Next, felloes were to be introduced. It is difficult to confirm these data in the context of archaeological finds, notably when such information is lacking in publications or the wheels are in poor condition. The relatively small wheels, about 50 cm in diameter, discovered at Opole and Bródno and dated to the 10th and 11th-13th centuries, were made from a single part (Kaźmierczyk 1954, 175). On the other hand, wheel elements from Wrocław and Szczecin dated to the 11th and 12th centuries are made of tenon-jointed parts (Kaźmierczyk 1995, 103, 104; Kowalska 2003, 300). These are also followed by the reconstruction of the 12th-century Oldenburg cart (Fansa and Schneider 1995, 163, 166).

Finds of early- and late-medieval wheels can be distinguished by their diameters. For the known early medieval finds, the diameters are: 50 cm, 64 cm, 80 cm, 92 cm, 100 cm (Kaźmierczyk 1954, 175; 1995, 40; Kowalska 2003, 300). For late medieval wheels from Gdańsk, Kołobrzeg, and Bytom, the diameters are 103 cm, 110 cm, and 118 cm (Polak 1996, 335; Wójcik and Podyma 1997, 174; Bobik 2016, 157). However, it should be stressed that the number of finds is insufficient to provide a strong indication of broader conclusions. Another issue is the number of spokes, which is more closely related to the wheel's diameter and strength. It is still unclear at what period those with more than ten spokes appear. In addition, the number of spokes can be inferred from the elements preserved in a certain completeness. These are a hub, a whole segment of a bell or a felloe. These situations are a few among the Polish discoveries. Concerning early medieval finds, these are specified as eight- or ten-spoke wheels (Kaźmierczyk 1954, 175), while late medieval examples are twelve-spoke wheels (Polak 1996, 335; Wójcik and Podyma 1997, 174; Siwiak and Siwiak 2014, 52; Bobik 2016, 157; Kasprzak 2018, 450). From Gdańsk, information on two hubs has been published. A 14th-century chronology has been determined for the twelve-spoke axle (Krzywdziński 2018, 110, 115). Some indication of the construction changes (extending the number of spokes to twelve) about the 13th century is also provided by German ten-spoke finds dated from the 12th to the 13th century, and by reconstructions from Oldenburg, Woldegk, and Greifswald (Fansa, Schneider 1995, 163, 166; Ansorge 2005, 105). Another issue is the height of the hubs. For finds from the 10th to 13th centuries, we have information about long hubs with heights ranging from 36 to 47 cm (Kaźmierczyk 1954, 177; Kaźmierczyk 1995, 103, 104). For 14th- to 15th-century finds, these numbers range from 31 to 46 cm (Polak 1996, 335; Kasprzak 2018, 450; Krzywdziński 2018, 110).

The comparison of the data led to a reflection on the proportions of the various elements. Early medieval wheels appear relatively low with massive hubs, while late medieval wheels seem to be taller with slightly less massive hubs. Despite the paucity of data, these

can presumably be completed using axle diameters, which for the early medieval period are reported as 4.5-5 cm. An exception is the 10 cm axle from Ostrów Lednicki (Stępnik 1996, 286, 287). Additionally, the inner diameter of the hub for the axle seating discovered in Gdańsk measures 9.8 cm. No further data was obtainable for comparison.

A supplementary issue is the material used to make the wheel components. The wood species were not identified in all cases. Available data indicate that for early medieval timber finds: oak, maple, birch, ash (Bukowska-Gedigowa and Gediga, 1986, 82, 149; Kaźmierczyk 1995, 39, 40; Stępnik 1996, 286, 287; Kowalska 2003, 300; Robak 2009, 185). Late medieval wheels were made of beech (Bytom), birch (hub from Kołobrzeg) and ash (also Kołobrzeg) (Polak 1996, 335; Wójcik and Podyma 1997, 174; Bobik 2016, 157). However, it should be noted that the material most often used probably resulted from the availability of a specific raw material at a particular time in certain regions, and, secondly, from craftsmen's preferences.

To date, interpretations of wheel element finds have been widely considered. Comparisons are made to carts known from iconography and developments taken from ethnographic data. Regarding the Gdańsk finds analysed here, the authors have not adopted such a broad interpretation. Despite known iconographic data depicting general features for visualising the body or wheels, the known parameters of vintage carts have so far not been considered in the broader context of their design-dependent purpose. The prevalence of two-wheeled carts in the late medieval period also seems to have been marginalised in the interpretive context. Furthermore, in the context of the discovery on Granary Island in Gdańsk, it can be presumed that the cart may have been dedicated to short routes for distributing loads within a limited area, rather than to longer destinations. As a result, its construction could be practically adapted to the condition of the area's tracks and the type of cargo.

Another element that has not been addressed to date is the type of cart-making techniques used, depending on the makers' origins and, essentially, the regions from which they drew their skills. Today's approach to understanding patterns drawn from specific geographical areas is bound to ethnographic analogies. This does not reflect the social image and the 'parcel of knowledge and patterns' of medieval makers or users in the discussed situation in medieval Pomerania.

Based on the state of preservation and the number of elements discovered on Granary Island in Gdańsk, the presence of two wheels was identified and the preliminary measurement of the components interpreted as the body and chassis were determined. All the components, together with the probable cargo in the form of preserved parts of a single barrel, co-occurred in one archaeological context (stratum). Details of the body and chassis construction have not been resolved based on the remains of the wooden components. The body dimensions (190 × 90 or 112 cm) were indicated based on the layout and metric parameters of the individual parts. An issue taken up extensively in the literature (Stępnik 1996, 286, 287) that the authors have been unable to address is the width of the wheel track and the resulting body width. The hub's inner diameter of 9.8 cm allows a robust,

long axle to be fitted. However, any strength calculations would have to be based on chassis data, which is missing. Known wheel axles from the early medieval period are approximately 105-115 cm with an estimated body width of 90 cm (Stępnik 1996, 287) and 206 cm with a reconstructed lower body base width of 116.5 (Fansa and Schneider 1995, 171).

However, these data were not adopted here as a reference due to the lack of precise data on the chassis design. The weight of the wood in the individual structural components, determined at over 125 kg, and the height of the wheels (103 cm) indicate that the cart potentially had a carrying capacity of over 300 kg (Kaźmierczyk 1954, 178). It could therefore have carried about five barrels of the dimensions of the excavated example. However, given the type of ground surface in the yard where the discovery was made (a sand-and-wood-shaving ground), the load could not have been much higher than the indicated amount.

Based on the collected data, these appear to be the remains of a two-wheeled cart, most likely discovered in situ in its original context of use. Its destruction must have occurred in a sudden accident. Within the small area excavated, there were no clear, tangible traces of, *e.g.*, fire other than charcoal flecks in the layer on which the components were discovered. The wood elements also bear no obvious signs of burning, but are mostly lacking in full dimensions. The secondary destruction of the context further limits interpretation through several building actions undertaken at the site (ground raising, pile structures, stone foundation). Nevertheless, the interpretation of destruction as a result of a sudden event is supported by the fact that the components were left together with a partial cargo. Better preserved barrels are only discovered on Granary Island in contexts of secondary use as drains or as parts of loads destroyed within the warehouses.

The context of discoveries of other Polish and European findings to date is varied, but none (except finds related to the craftsman's area) seem to have been discovered in the prime use context. An interesting and possibly originally deposited component may include the one discovered in the market of Bytom (Wójcik and Podyma 1997, 174). Interesting finds include a hub, interpreted as a wooden seating element discovered in Wrocław (Kaźmierczyk 1995, 103, 104) or a wheel discovered in a foundation in Greifswald (Ansorge 2005, 153-154). Another object worth noting is a hub embedded with its axle into the ground, found in the area of the butcher stalls in Gdańsk (Krzywdziński 2018, 110). Another category comprises single finds in the area of wheelwright activity (Kaźmierczyk 1995, 39-42). The context of discovery of the cart components on Granary Island in Gdańsk makes this find unique in Europe.

CONCLUSIONS

The cart components together with part of the cargo discovered during the archaeological excavations in Gdańsk on Granary Island, is a rather spectacular discovery due to their *in situ* context within the warehouse area. The precise dating of the find to 1410 AD,

based on ^{14}C analysis, is another asset of the data presented. Together with the dating of the cart components, the chronology of several categories of artefacts, including pattens, buckles, brooch and pilgrim badges, was also narrowed down, thus determining the potential time of their deposition.

The conditions and range of the excavations limited the interpretative possibilities of the finds, but allowed entirely new observations to be made in the context of medieval carts. An attempt was made to determine the dimensions of the body made of pine; the full structural parameters of the beech wheels were given, as well as the range of the weight of the cart and its carrying capacity. Because the organisation of the archaeological work depends on administrative decisions, the data contains gaps. However, it is the most complete material evidence of such an object from the late medieval period presented to date.

Cultural resource management issues arising from actions taken at the site should be the subject of a separate discussion. The interruption of continuity between the research seasons (2006-2007 and 2023-2024) led to the natural degradation of some of the data left behind, which, as a result, were only put into stratigraphic and chronological context with great effort. At the same time, with the cooperation between research teams and the exchange of documentation, some of the information was reconstructed, but not all the data were combined.

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ELEMENTS OF EARLY MODERN HAND-HELD FIREARMS FROM THE SITE OF THE CIOŁEKS' CASTLE IN ŻELECHÓW, GARWOLIN COUNTY

ABSTRACT

Bis W. and Strzyż P. 2025. Elements of early modern hand-held firearms from the site of the Ciołeks' castle in Żelechów, Garwolin County. *Sprawozdania Archeologiczne* 77/2, 557-576.

In 2022, fragments of hand-held firearms were discovered at the site of the castle of the Ciołek family in Żelechów, Garwolin County, Masovian Voivodeship. Based on the craftsmanship, analogies known from the literature, and museum artefacts, it can be assumed that these were elements of a 16th-century hackbut. They most likely originated from a single barrel, which was damaged during use. Metallurgical analyses have shown that the barrel was forged from iron. A formal analysis allowed for a graphical reconstruction of its original form.

Keywords: Żelechów castle, Ciołek family, fortalicium, Middle Ages, hackbut
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INTRODUCTION

The fortalice of the Ciołek family of Żelechów is one of the few knightly residences located on the borderland between Masovia and Lesser Poland, in the north-eastern part of the Sandomierz Voivodeship (referred to as the Stężyca Land from the late 16th century) (Pałucki 1993, 48). Due to the limited number of preserved written records and only a few

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identified archaeological sites from the medieval and early modern periods, this area has rarely been the focus of historians and archaeologists. Most archival records concerning the region, particularly the castle and land court books stored in the Central Archives of Historical Records in Warsaw, were destroyed during the Second World War in 1944 (Stobiecki 1957, 27; Wolff 1957, 205, 217-219). This has significantly hindered the study of estates in the area, including magnate and noble residences. Nevertheless, previous research has identified several private residential and defensive complexes, with relics preserved in four locations: Górzno (Górzno Commune), Kaleń (Sobolew Commune) (Górska *et al.* eds 1976, 49-50, 66; Wróblewski 2006, 38, 61, 66, 112), Wilczyska (Miastków Kościelny Commune) (Bis 2021), and Żelechów (Żelechów Commune) (Bis *et al.* 2018; 2019; 2021). Additionally, written sources mention two now-lost structures: the castle of the 'starost' (a royal administrative and judicial official (a reeve) for a district/county ('powiat'), a sheriff) in Stężyca (Wróblewski 2006, 112) and the residence of the Maciejowski family in Maciejowice (Dunin-Wąsowicz 1993, 86; Libicki and Libicki 2013, 313) (Fig. 1).

The seat of the Ciołek family was located in the north-western part of the present-day town of Żelechów, in the middle of a wide, marshy valley along a watercourse known as

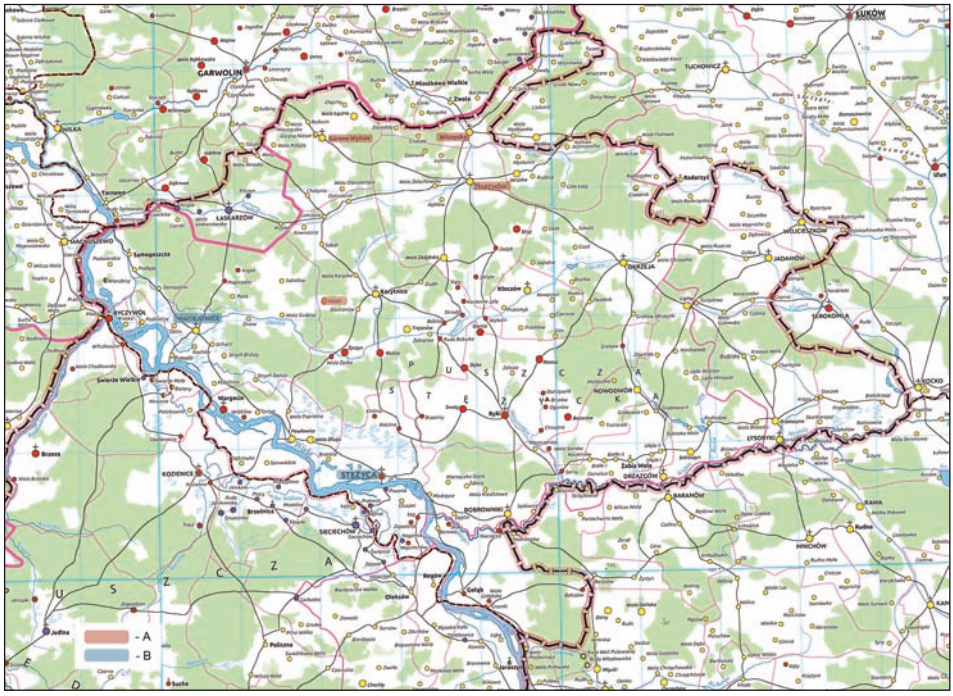


Fig. 1. Location of residential-defensive seats in the Stężyca Land. A – sites preserved in the landscape; B – sites known from written sources. Fragment of the map 'Ziemie polskie Korony w drugiej połowie XVI w.' (source: www.atlasfontium.pl). Compiled by W. Bis

Żelechówka, which currently flows in a regulated, deepened, and in part artificially shaped channel. The site is now a wasteland situated about 100 metres from the road leading towards Wilczyska, and in the immediate vicinity of contemporary fishponds (Fig. 2). Archaeological surveys conducted between 2016 and 2024 confirmed the location of the castle, allowing for the determination of its construction method, building materials, as well as the phases and duration of its use (Bis *et al*. 2019). The complex was quadrilateral in shape, with maximum dimensions of 85 × 90 metres. It consisted of a centrally located square platform (with a side length of 50 metres), surrounded by a moat (approximately 10 metres wide), beyond which was an earth rampart formed during the excavation of the moat (Fig. 3). The results of fieldwork, finds of movable artefacts (coins, ceramic vessels, and stove tiles), dendrochronological evidence, analyses of stratigraphic layers, and written sources suggest that the structure was built around the mid-15th century and was in use until the end of the 17th century. At least three main phases of its operation were distinguished. In the first phase, dated from the mid-15th to the mid-16th centuries, it served as the family seat of the Ciołeks, with a masonry residential tower and utility buildings in the courtyard. In the second phase, from the mid-16th century to the end of the century, after

Fig. 2. Location of the Ciołek fortalice within the town of Żelechów.
Compiled by W. Bis, base map from: https://polska.e-mapa.net/

extensive modernisation, the complex was transformed into a late Renaissance noble residence, featuring a wooden manor house in the courtyard. The moat was filled in, and residential and utility buildings were constructed on the ramparts, some of which were paved with stones. Inside the manor, an impressive heating stove made of Renaissance-style tiles was installed. The third phase, beginning at the turn of the 17th century, marked the end of the castle's representative function. The functional change was probably prompted by a large fire that destroyed the wooden buildings, as evidenced by the cultural layers. The structure was not rebuilt in its previous form but was instead transformed into a noble manorial grange ('folwark'), serving as an administrative centre for the surrounding estates. The agricultural and utilitarian function of this complex is further evidenced by a large wood-lined well with a crane for drawing the water, constructed on the site of the burned manor.

The surviving written sources indicate that the estate belonged to the Żelechów line of the Masovian Ciołek family, whose members held prominent state offices. Andrzej Ciołek (d. circa 1448) served as *stolnik* (pantler) of Sandomierz (1420-1421), then as 'podkomorzy' (chamberlain) (1422-1436) and 'starost' of Sandomierz (1425-1429, 1432) (Kurtyka *et al. eds* 1990, 326), and ultimately as the general 'starost' of Greater Poland (1434-1436) (Bielińska *et al.* 1985, 173). His father, also named Andrzej (d. 1396), held the office of standard-bearer of Płock and later became the voivode of Masovia. He was the brother of

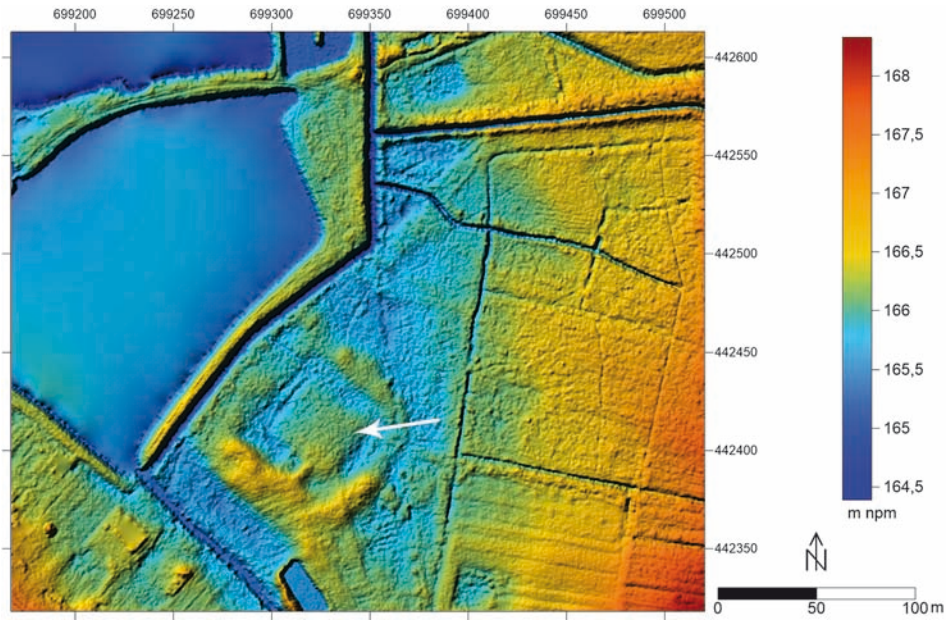


Fig. 3. Digital terrain model of the river valley and the Ciołek castle complex in Żelechów. Compiled by W. Małkowski (Faculty of Archaeology, University of Warsaw)

Stanisław, Bishop of Poznań (b. *circa* 1382 – d. 1437) (Piotrowicz 1938, 77). After the death of Andrzej, the 'starost' of Sandomierz, his son, also named Andrzej, settled in Żelechów, inheriting not only the local estate but also Wola Żelechowska, Kłębów, and Wilczyska (Boniecki 1900, 218). The first recorded mention of the Ciołek residence in Żelechów appears in the *Liber Beneficiorum* by Jan Długosz, which notes that the local knightly manor (*praedium militare*) contributed four 'grzywnas' in tithes to the church and parish priest of Żelechów (Długosz 1864, 560). The town of Żelechów had probably already attained urban law by the early 15th century, as evidenced by the 1418 record of Wojciech Crispus, the Żelechów 'vogt' (advocatus), in the Lublin land court registers. In 1447, King Kazimierz IV Jagiellon granted the town the right to hold an annual fair and weekly markets on Tuesdays (Bis *et al.* 2018, 354). In later records, the Ciołek residence in Żelechów is referred to as a fortalice (*fortalicium*). It was first mentioned in 1515 in connection with the division of the Żelechów estate between Andrzej Ciołek and his half-brother, Feliks of Zielonka. Andrzej transferred half of the local estate, including the town, fortalice, and several villages, to Feliks, while pledging the other half to him for 1,000 'grzywnas'. A second reference to the fortalice appears in a 1523 document concerning a family dispute in which Jan (Andrzej's brother) attempted to recover these properties from Feliks of Zielonka, who was then the 'starost' of Łuków (Bis *et al.* 2018, 355). The conflict escalated, leading to royal intervention. On 11 April 1523, King Zygmunt the Old issued a mandate to Mikołaj of Szydłowiec, castellan of Sandomierz, royal treasurer, and 'starost' of Radom, instructing him to restore Jan *Czolek de Zelechow* to the estates of *Feliks de Zyelyanka*, castellan of Chełm and 'starost' of Łuków, namely the town of *Zelechow cum fortalitio* and the villages of *Vola Zelechowska, Ostrozenye i Lomnycza* 'even by force if necessary' (Wierzbowski 1910, 243, no. 4208; Bis *et al.* 2018, 355). The resolution of the dispute remains unknown, but the Ciołek family likely regained the estate, as in 1527 another member of the family, also named Jan, styled himself as being 'of Żelechów' (AGAD, MK. 1527, fol. 264v; Wierzbowski 1910, 306, 307, no. 5208).

There is no written evidence regarding the later fate of the fortalice. It is possible that it was destroyed during the Second Northern War (1655-1660), perhaps as early as the end of 1655. It is known that on the night of 24-25 December that year, the Swedish army devastated the nearby village of Stężyca (Nagielski *et al.* 2015, 440). Extensive destruction was also recorded in Łuków, where most of the town's buildings, three wooden churches, and a hospital were burned down (Nagielski *et al.* 2015, 453, 454). The Swedes also occupied the castle in nearby Wilczyska, which they probably left in ruins (Chlebowski 1893, 462). The Żelechów complex probably continued to function in the second half of the 17th century, although its form and purpose remain unclear. In 1673, a poll tax register recorded that a tax of 8.5 florins was levied on the Żelechów manor, assessed on seven inhabitants: the estate manager and his wife, along with five servants (AGAD, ASK 1673, k. 486). The continued use of the site during the second half of the 17th century is further corroborated by numerous finds of Polish and Lithuanian copper alloy machine-struck shilling ('szeląg')

coins minted between 1659 and 1668 during the reign of King Jan II Kazimierz. Most of these coins were recovered from near-surface cultural layers across almost all archaeological trenches. It is likely that by the late 17th or early 18th century, the residence of the Żelechów owners was relocated to another part of the town. In 1722, the Żelechów estate was acquired by brothers Wacław and Seweryn Rzewuski from its then-owner, Stanisław Linkaus. According to an inventory compiled in 1729, following Wacław's complete acquisition of the estate, the wooden palace and farmstead buildings were situated 'outside the town, on a distinctive height' ('pod miastem, na miejscu osobliwym wzgórzystym') (Justyniarska-Chojak and Pielas 2016, 99), a location that can be identified with that of the 19th-century manor house that still exists today.

DESCRIPTION AND DATING OF THE ARTEFACTS

Fragments of hand-held firearms were discovered during archaeological investigations conducted in 2022. They were found in the north-eastern part of the castle courtyard, within a sub-turf layer near the moat (Figs 4 and 5). The assemblage consists of two unevenly sized barrel fragments, both forged from iron and featuring a polygonal cross-section. The larger of the two fragments (Fig. 4: 1-2; 5: 1) represents the breech section of the barrel. A short segment of this fragment preserves the whole circumference of the barrel, including the breech plug, while further along, approximately half of the circumference survives, comprising four of the original eight polygonal sides. Unfortunately, the attachment point for the rectangular priming pan plate with a touch hole for ignition has not been preserved. As mentioned, the iron tenon, originally used to seal the barrel, has been preserved in the breech. X-rays were taken at the IAE PAN Laboratory in Warsaw. Unfortunately, the obtained images do not allow for the resolution of the question whether the breech plug was screwed in or driven in and welded. It is heavily corroded, externally resembling a pyramid, while its internal form remains cylindrical. The diameter of the tenon corresponds to the internal bore diameter of the barrel, providing an estimate of the firearm's calibre, which was probably 1.9 cm. Following conservation, the dimensions of this fragment are as follows: total length (including tenon), 19.6 cm; length without tenon, 18.2 cm; tenon base, 1.6 × 1.2 cm; breech thickness, 3.95 cm; external width at the breech, 4.85 cm; barrel wall thickness at the breech, 1.35-1.45 cm; barrel wall thickness closer to the muzzle, 1.15 cm; total weight, 915 g.

The second barrel fragment (Fig. 4: 3, 4; 5: 2) represents a non-specific central section, of which only a small portion of the circumference has survived. This includes one complete side and two adjacent, partially preserved sides. As a result, it cannot be conclusively determined whether the barrel originally had an octagonal cross-section. There are also examples of 16th-century hackbuts with variable polygonal-round barrel cross-sections,

Fig. 4. Iron barrel fragments of the hackbut from Żelechów Castle: 1-2 – fragment of the breech section; 3-4 – fragment of the central section. Photo: W. Bis

for example, specimens in the Museum in Znojmo and the National Museum in Prague (Czech Republic) or Copenhagen (Denmark) (see Strzyż 2014, cat. No. 50, pl. 63; Šnajdrová 2014, 67, fig. 5; McLachlan 2010, 58). The preserved length of this fragment is 10.3 cm, with a wall thickness of 1.15 cm and a weight of 140 g. Due to its condition, determining the exact calibre is challenging. However, it appears to be slightly larger than that of the previously described section, measuring approximately 2.0-2.1 cm. It should be noted that this difference is minimal and may be due to barrel expansion caused by an explosion. The rupture of barrels was not an uncommon occurrence, as confirmed by other archaeological finds and, in some cases, written sources (*e.g.*, Fligel' *et al.* 2010, 477-479, fig. 2 and 3; Marek and Konczewski 2010, 111, 112; Chudzińska 2011, 205-211, fig. 2; Boguszewicz 2020, 261, fig. 18: a and c; Sawicki 2024, 199-201, figs 1-3). Among the relatively numerous lead projectiles for smoothbore firearms discovered during the archaeological investigations,

a lead ball with a diameter of 1.9 cm was found (Fig. 6). This projectile can hypothetically be associated with the remains of the hackbut described above.

The origins of hackbuts in Europe date back to the second half of the 14th century. They developed through the addition of a recoil-absorbing hook to the barrel of the earliest forms of hand-held firearms, known as *piszczel* guns. During the 15th century, hackbuts underwent rapid evolution, transforming from primitive short-barrelled weapons into highly effective battlefield arms by the end of the century. Several key improvements contributed to their enhanced functionality, including an increase in barrel length, the

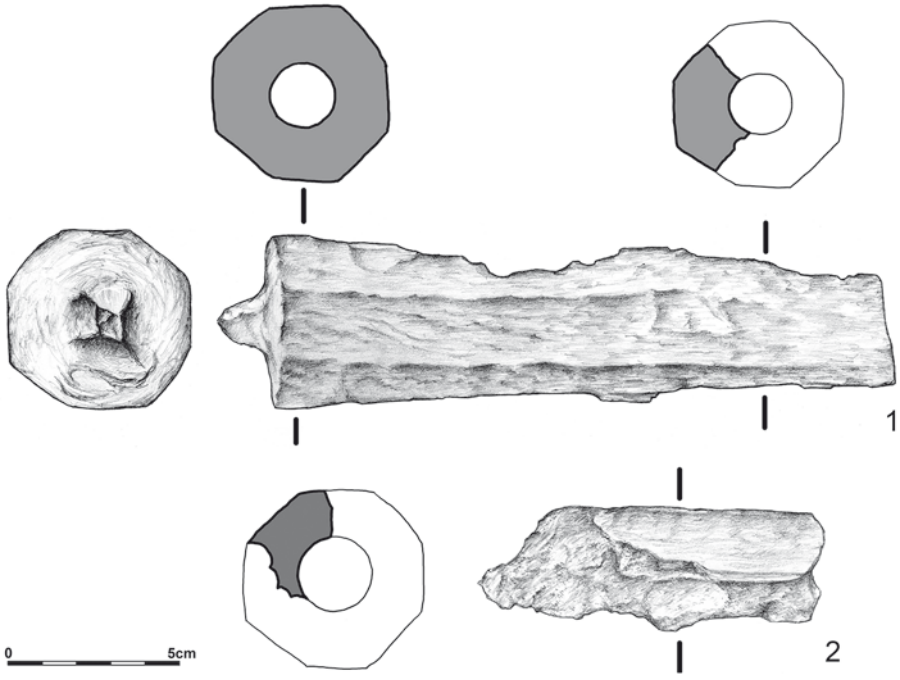


Fig. 5. View and cross-sections of the two barrel fragments from the Żelechów hackbut. Drawing: E. Gumińska

Fig. 6. Lead projectile (calibre: 1.9 cm) from the courtyard of Żelechów Castle. Photo: W. Bis

relocation of the touch hole to the right side of the barrel, and the introduction of rudimentary firing mechanisms. Additionally, simple sighting devices — a front sight and a rear notch — became more common, and barrels began to be mounted on wooden stocks with a slightly curved, downward-sloping butt (*e.g.*, Müller 1957, 123, fig. 185: b; Durdík 1979, 4; Szymczak 2004, 48, 49; for a broader discussion, see McLachlan 2010, 31-33, 36-37; Strzyż 2014, 56-62, pls 20-29, 34-54). Further developments occurred in the early 16th century, most notably the introduction of the matchlock mechanism, a relatively simple yet highly effective firing system that appeared in multiple variations (*e.g.*, Müller 1957, 123, fig. 184, 185: c; Durdík *et al.* 1977, 34, figs 1 and 2; Durdík 1979, 4; Szymczak 2004, 49, 50, fig. 10; McLachlan 2010, 54; Barbu 2013, 38-42, figs 56-61). Moreover, the breech was now sealed with a tenon featuring a cubic protrusion, which was either hammered or screwed into the barrel's end to reinforce the barrel-stock connection. The touch hole was supplemented with a rectangular priming pan plate containing a shallow depression for the priming powder. This method of ignition remained in use throughout the 16th and 17th centuries (Matuszewski 2000, 17, 18; Strzyż 2014, 62-64, pls 55-57; Strzyż *et al.* 2016, 100, 101).

The parameters and appearance of the partially preserved breech section of the barrel from Żelechów place it within the category of hand-held firearms characteristic of the 16th century. However, in attempting to determine its precise date of manufacture, it is necessary to rely on comparable artefacts, as the discovered fragments were found in a loose context within the humus layer. Unfortunately, the majority of such finds lack precise provenance information and, consequently, clear chronological attribution. Among Renaissance hackbuts preserved in Polish collections, the best analogue is a well-preserved specimen currently housed in the Museum of Jarosław. However, its original provenance remains unknown (Fig. 7). This hackbut has a total length of 90.5 cm (including the tenon), a breech diameter of 4.2 cm, a calibre of 1.9 cm, and a total weight of 4.4 kg.

Fig. 7. Hackbut from the Museum in Jarosław, first half of the 16th century: 1 – general view; 2 – breech section with touch hole and tenon; 3 – breech section with priming pan plate, tenon, and rear sight notch. After Strzyż 2019, fig. 1

These measurements suggest that it was a firearm designed for an infantryman fighting in open field engagements rather than one exclusively used from fortified city walls or castle defences. The weapon has been broadly dated to the first half of the 16th century (for a more detailed discussion, see Strzyż 2019, 308, 309, fig. 1: 1-5). This hackbut represents a relatively lightweight construction for its type, and its dimensions — particularly the breech diameter and calibre — are almost identical to those of the breech section of the barrel from Żelechów. Moreover, its excellent state of preservation allows for the reconstruction of the original appearance of the Żelechów firearm.

Among comparable finds from Poland, two iron hackbuts recovered in 2009 during archaeological excavations of the town hall remains in Chełm are also noteworthy. Both artefacts were found within the fill of a structure whose function remains unclear, and whose construction has been broadly dated to the 16th – early 17th centuries. The barrels have survived in varying states of preservation. The most relevant comparison to the Żelechów find is a hackbut (inventory no. CH-Ł/111W/09) with a polygonal barrel cross-section and a breech section ending in a tenon with a prismatic projection. It has a total length of 153.7 cm, a calibre of 2.3 cm, and a weight of approximately 21 kg. The chronology of both specimens has been established at around the mid-16th century (Strzyż *et al.* 2016, 102-105, tab. 1-2, figs 8: 1 and 9).

For Central Europe, there is a notable scarcity of hackbuts from the 16th century with precise archaeological dating. A particularly significant specimen is a hackbut barrel from Eger Castle in northern Hungary, currently housed in the local museum (inventory no. 80.24.1). This artefact is heavily corroded. However, it retains an octagonal cross-section at both the breech and muzzle ends, transitioning to a circular cross-section in the middle section. It was found in fire destruction layers associated with the 1552 siege of Eger by Ottoman forces. The firearm has a length of 85.5 cm, a calibre of 1.6 cm, and a breech diameter of 4.3 cm. It was probably made in the late first half of the 16th century, possibly just before the expected siege (see Strzyż *et al.* 2016, 103, tab. 1, fig. 11; Strzyż 2019, 311, fig. 3). The parameters of this hackbut indicate that, like the example from the Museum in Jarosław, it belonged to a lighter variant, which could be operated freely by a shooter without the need for additional support (Fig. 8). Additionally, historical sources concerning firearms in the Grand Duchy of Lithuania in the 16th century refer to firearms with a calibre below 2 cm as small hackbuts (*cf.*, Volkau 2019, 138, pl. 1).

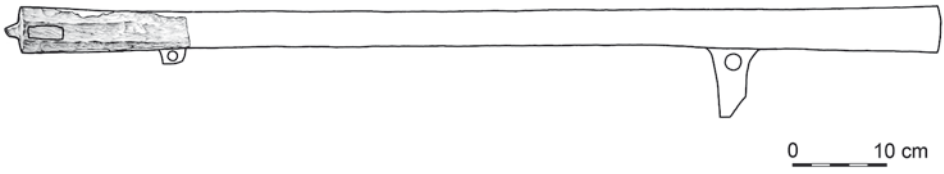


Fig. 8. Reconstruction drawing of the Żelechów hackbut barrel.
Drawing: E. Gumińska

In addition to the aforementioned more significant discoveries, fragmented remains of hand-held firearms are also encountered during archaeological excavations. One such example is a barrel fragment with a calibre of approximately 1.5 cm, discovered during investigations of the manor house in Zduny, Jarocin County. This artefact was found within the remains of the fourth construction phase of the site, dated to the late 16th – mid-17th centuries. The authors identified it as part of a musket barrel; however, given the fragmentary and non-diagnostic nature of the find, its precise classification remains uncertain (Grygiel and Jurek 1999, 144, 153, 154, fig. 118: 1).

Mentions, albeit scarce, of private castle owners possessing firearms can also be found in written sources. For example, in 1504, a court case was brought by Andrzej of Włodzisław against Benedykt (Bieniasz) Pogorski of Brzezie regarding the seizure of twelve '*bombardas alias foglari*' (Nowakowski 2006, 105). Similarly, in 1502, documents related to a dispute over the estate at Rytwiany castle recorded an arsenal including 40 hackbuts and as many as 200 'handgonnes' (Szymczak 2004, 331). Comparable firearm stockpiles were held in royal castles. In 1494, records from the Brześć Kujawski castle list seven hackbuts (Szymczak 2004, 322). In 1509, the Kazimierz Dolny castle had an even larger arsenal, containing 39 hackbuts (including 32 new ones), along with 1,200 lead balls and a barrel of gunpowder (Szymczak 2004, 328). Similarly, in 1516, the inventory of the castle in Bolesławiec on the Prosna included 28 hackbuts and nine 'handgonnes', and two decades later, an additional 10 hackbuts were purchased (Górski 1902, 229; Żemigała and Grabarczyk 1982, 43; Szymczak 2004, 329). Hackbuts were also an essential part of the armament of 16th-century castles in the Grand Duchy of Lithuania. In 1552, amid rising tensions with Muscovy, 605 hackbuts were sent from Vilnius to border castles, with the largest supplies reaching the region's key strongholds: Polotsk, Vitebsk, and Braslaw (Volkau 2023, 29-30). Between 1552 and 1562, Polotsk received 21 cannons and 256 hackbuts, Vitebsk eight cannons and 203 hackbuts, and Braslaw 90 hackbuts between 1556 and 1559 (Volkau 2023, 35, 47). Written sources also document large deliveries of firearms to the castle in Kamieniec Podolski during the reigns of the last two Jagiellonian kings. In 1522, a shipment from Kraków included 20 hackbuts, 12 barrels of gunpowder, and 20 centners of lead for casting bullets. By 1572, an inventory of the castle's armoury recorded 70 hackbuts and 140 demi-hackbuts (Hański 2022, 16, 21).

THE MANUFACTURING TECHNIQUE OF THE ŻELECHÓW BARREL IN A COMPARATIVE CONTEXT

A sample was taken from the chamber section of the barrel for specialist examination (Fig. 4: 1, 2). Metallographic analyses were conducted using a Neophot 21 microscope equipped with a Hanneman microhardness measurement system. In contrast, chemical composition analyses were performed using a Tescan VEGA GMS (S5153) scanning electron

microscope, integrated with an EDS Aztec Live Advanced – Ultim Max 40 X-ray microanalysis system. The metallographic specimen was extracted using a Secotom precision cutter, provided by Struers. It was then embedded in PolyFast thermosetting resin and subsequently polished on a Tegramin disc polisher (Hensel *et al.* 2025).

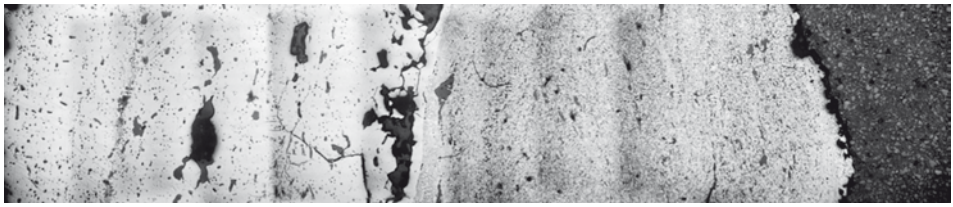


Fig. 9. Cross-section of the Żelechów hackbut barrel. Photo: Z. Hensel

Fig. 10. Structural composition of the Żelechów hackbut: 1 – middle section; 2 – transition zone between the outer casing and the 'core'; 3 – internal section. Photo: Z. Hensel

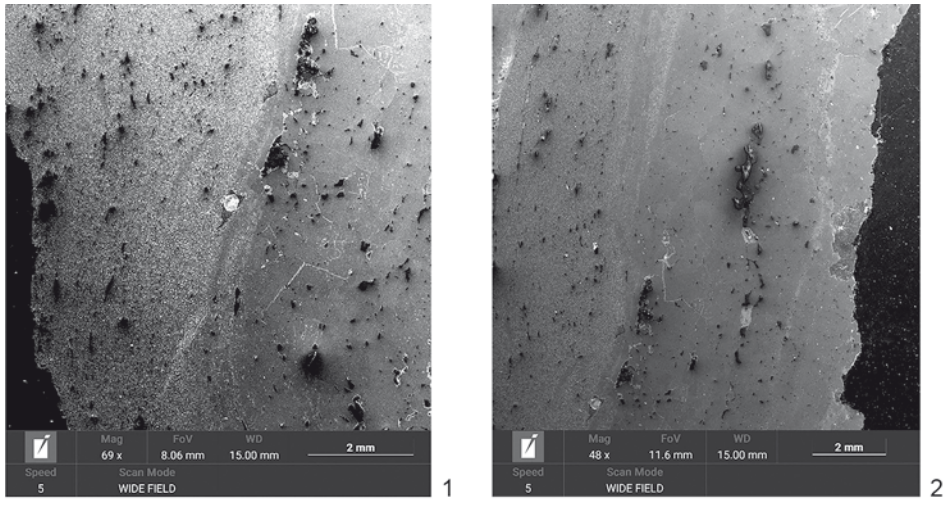


Fig. 11. Structure of the Żelechów hackbut: 1 – external section; 2 – internal section. Photo: Z. Hensel

Metallographic observations revealed that the barrel was forged from an iron-carbon alloy with a variable carbon content, ranging from trace amounts to approximately 0.2%. A higher carbon content, with ferrite-pearlite structures, was observed in the outer part of the barrel. At the same time, the core consisted of ferrite structures with a high phosphorus content (Fig. 9). No weld lines indicating the joining of multiple iron bars were detected. However, scattered non-metallic slag inclusions were observed, probably resulting from the metallurgical process and the inherent brittleness of the high-phosphorus raw material. This type of structural variability was also noted in other sections of the analysed fragment (Figs 10: 1-3).

The microhardness tests revealed the highest values in ferritic iron, reaching 274 HV0.1, while areas containing pearlite exhibited a hardness of 164 HV0.1. The high local microhardness of the analysed structures was caused by a significant phosphorus content, with measurements indicating a local increase up to 0.93%, while the minimum recorded content was 0.05% (see Table 1). The heterogeneity of the structural and chemical composition was further confirmed by scanning electron microscope analyses (Fig. 11: 1, 2). The considerable variation in phosphorus content resulted in a high degree of variability in the mechanical properties of the material used (Okamoto 1990; Stewart *et al.* 2000). The observed physicochemical characteristics and the nature of the non-metallic inclusions indicate that the metal was produced using the bloomery smelting technique. It is worth noting that high-phosphorus steel is brittle and lacks impact resistance. This characteristic may have been a direct cause of the characteristic fracture observed in the damaged hackbut, where the fibrous structure of the break is clearly visible.

The production of iron barrels for handheld firearms, as well as smaller-calibre artillery pieces (*e.g.*, terrace guns, light field cannons, and veuglaires), did not present significant technical challenges. The process primarily involved shaping a cylindrical or polygonal barrel from either a single thick iron bar or several thinner iron bars, which were forged around an iron mandrel (Smith 2000, 72-74, fig. 13). Written sources provide evidence of such mandrels used in barrel production, for example, in Görlitz (Zgorzelec), where in 1424, a payment of six groschen was made for an item referred to as a 'kerneysen', probably a mandrel used for shaping gun barrels (Strzyż 2014, 235). The final processing of an iron-forged handheld firearm barrel required the addition of several auxiliary components (*e.g.*, front sight, rear sight, and hook), which were then assembled with the barrel to form a functional unit. The crucial step was sealing the breech section of the barrel with a tenon, which was then securely hammered into place. This tenon is clearly visible in the breech section of the Żelechów barrel. Similar traces of this manufacturing process can also be observed in a hackbut housed in the Hungarian National Museum in Budapest (Strzyż 2014, 235, cat. no. 175, pl. 37: 5).

Spectrometric analysis of the Żelechów barrel fragments revealed that the material used for production was almost pure iron (Fe) with minor additions of carbon (C), phosphorus (P), and trace amounts of other elements (see Table 1). This composition is typical

Table 1. Results of the spectrometric analysis of the Żelechów hackbut (wt%). Prepared by P. Gan and Z. Hensel

Spectrum 1	Line Type	Wt%	Wt% Sigma
Al	K series	0	0,01
Si	K series	0,04	0,01
P	K series	0,8	0,01
S	K series	0,01	0,01
Ti	K series	0	0,01
Cr	K series	0,01	0,01
Mn	K series	0,02	0,02
Fe	K series	99,11	0,03

Spectrum 2	Line Type	Wt%	Wt% Sigma
Al	K series	0	0,01
Si	K series	0,06	0,01
P	K series	0,34	0,01
S	K series	0,01	0,01
Ti	K series	0	0,01
Cr	K series	0	0,01
Mn	K series	0,01	0,02
Fe	K series	99,59	0,03

Spectrum 3	Line Type	Wt%	Wt% Sigma
Al	K series	0	0,01
Si	K series	0,04	0,01
P	K series	0,14	0,01
S	K series	0	0,01
Ti	K series	0	0,01
Cr	K series	0,01	0,01
Mn	K series	0,01	0,02
Fe	K series	99,8	0,03

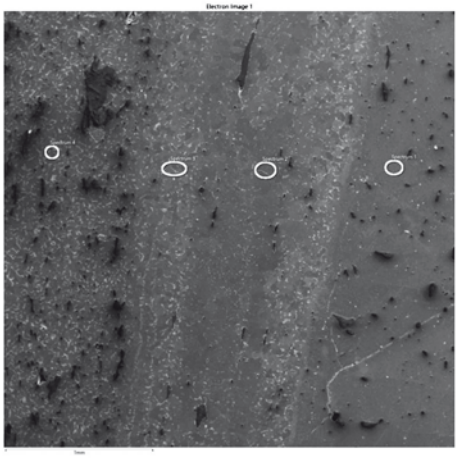
Spectrum 4	Line Type	Wt%	Wt% Sigma
Al	K series	0,01	0,01
Si	K series	0,05	0,01
P	K series	0,05	0,01
S	K series	0,01	0,01
Ti	K series	0	0,01
Cr	K series	0	0,01
Mn	K series	0,01	0,02
Fe	K series	99,87	0,03

Spectrum 9	Line Type	Wt%	Wt% Sigma
Al	K series	0,13	0,07
Si	K series	0,08	0,06
P	K series	0,93	0,06
S	K series	0	0,05
Ti	K series	0	0,06
Cr	K series	0,03	0,06
Mn	K series	0	0,08
Fe	K series	98,82	0,13

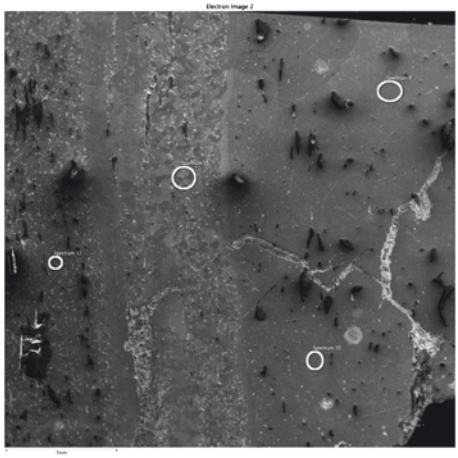
Spectrum 10	Line Type	Wt%	Wt% Sigma
Al	K series	0,03	0,06
Si	K series	0,32	0,06
P	K series	0,88	0,06
S	K series	0	0,05
Ti	K series	0	0,05
Cr	K series	0,01	0,05
Mn	K series	0	0,08
Fe	K series	98,75	0,12

Spectrum 11	Line Type	Wt%	Wt% Sigma
Al	K series	0	0,06
Si	K series	0,23	0,06
P	K series	0,17	0,05
S	K series	0,02	0,05
Ti	K series	0,01	0,06
Cr	K series	0	0,06
Mn	K series	0,04	0,08
Fe	K series	99,53	0,14

Spectrum 12	Line Type	Wt%	Wt% Sigma
Al	K series	0	0,07
Si	K series	0,15	0,06
P	K series	0,05	0,05
S	K series	0,03	0,05
Ti	K series	0,04	0,05
Cr	K series	0	0,05
Mn	K series	0	0,08
Fe	K series	99,72	0,1



Structure of the hackbut with marked measurement points for chemical composition analysis (1–4)



Structure of the hackbut with marked measurement points for chemical composition analysis (9–12)

of such products, which did not require the complex forging techniques employed in the manufacture of bladed weapons (*e.g.*, welding iron and steel bars, applying hardened overlays, or tempering). In the case of iron barrels, usually forged from soft ferritic iron, a certain degree of elasticity was even desirable. However, the key factor influencing barrel quality was the care taken in preparing the material. These firearms often contained a high concentration of non-metallic impurities (*e.g.*, phosphorus, potassium, and sulphur), which could serve as potential sites for microcracks and fissures. Specialist analyses of comparable finds confirm the presence of such defects. Although such studies are relatively rare, the available results are consistent in their general findings. For instance, the barrel from Ostrožská Nová Ves (Czech Republic), dated to the late 14th century, was forged from high-purity iron (Fe 99.82%) with trace amounts of manganese (Mn 0.05%), phosphorus (P 0.08%), and a low carbon content (C 0.05%). Analysis of the manufacturing technique revealed that the material was forge-welded at approximately 720°C, resulting in minimal deformation during subsequent cooling. The low carbon content resulted in a soft, ferritic structure. Overall, the weapon was produced from ore specifically selected to avoid sulphur contamination and minimise phosphorus content, leading to a high-quality final product (Ustohal *et al.* 1991-1992, 159-164, figs 4-7; Fligel' *et al.* 2010, 483, 485). A chronologically closer example to the Żelechów specimen is a hackbut barrel from Helfštýn Castle (Czech Republic), dated to the late 15th-early 16th centuries. Only the muzzle section with the hook has survived. Analysis of its surface revealed two areas with slightly different structures. The first was characterised by a uniform ferritic structure with a high phosphorus content (P 0.5-0.6%) and a hardness of 161±14 HV0.1, while the second was characterised by a ferrite-pearlite structure (C 0.2-0.3%), where a 4.2 mm-long crack was observed. As is well known, high phosphorus content in iron is highly detrimental, as it increases brittleness and susceptibility to cracking. The maximum acceptable phosphorus content that does not negatively affect material quality should not exceed 0.1%. Elevated phosphorus levels in iron could result from the use of hardwood charcoal in the smelting process and the reliance on bog ores. The Helfštýn barrel was forged at temperatures exceeding 950°C, which influenced its final quality. At such high temperatures, phosphorus diffused into the ferritic structures of the barrel, leading to the formation of microcracks during cooling. Continued use of the firearm would have progressively enlarged these cracks, eventually causing catastrophic failure (Fligel' *et al.* 2010, 481-483, 457, figs 9-11; Strzyż 2014, 237; Žákovský and Schenk 2017, 45, 127, cat. no. 254). Structural analysis was also performed on a hackbut barrel from Esztergom Castle (Hungary), dated to the late 15th-early 16th centuries. The chemical composition of the sample indicated a ferrite-pearlite structure (C 0.2-0.3%), with an average hardness of approximately 167 HV0.1 (Strzyż 2014, 238, cat. no. 146, pl. 33: 4-6). These values are consistent with those observed in other hackbuts and iron artillery barrels from the 15th-16th centuries. Similar results were obtained from the analysis of two iron veuglaire (chambered-gun) barrels housed in the Museum of Biecz. The barrels were made of iron with a ferritic and ferrite-pearlite structure,

with a high content of non-metallic impurities. The final hardness of the specimens was measured at 141 HV0.1 and 158-181 HV0.1 (see Klimek *et al*. 2013, 88-92, figs 4-16; Strzyż 2014, 235-236, cat. nos 103 and 104, pls 98 and 99; Smith and Brown 1989, 90-102, figs 73-83; Lazar 2015, 242-269, figs 73-97).

CONCLUSIONS

Despite the highly fragmented nature of the discovered barrel remains from Żelechów, the gathered evidence strongly suggests that it belonged to a firearm of the hackbut type. The form of its breech section allows it to be dated to approximately the first half of the 16th century, although the possibility of prolonged use cannot be excluded. This find represents one of the few examples of such firearms discovered through systematic archaeological excavations in Poland. Based on comparative material, it is estimated that the original barrel measured approximately 100 cm in length and had a calibre of 1.9 cm. This was not a particularly heavy weapon; its weight probably ranged between 4-5 kg, and when fitted with a stock and additional accessories (*e.g*., a ramrod mounted on the side of the stock),

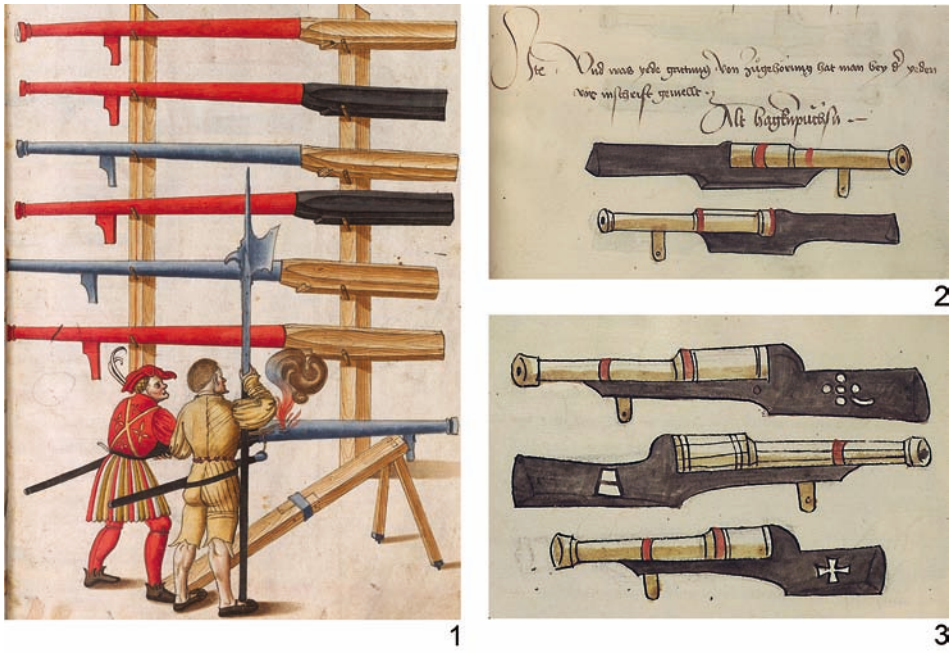


Fig. 12. Examples of hackbuts from the turn of the 16th century. 1. Innsbruck (c. 1502). Source: Zeugbuch Kaiser Maximilian I, Bayerische Staatsbibliothek, Cod. icon. 222, fol. 73. 2 & 3. Landshut (c. 1485). Source: Ulrich Beßnitzer, Zeughausinventar von Landshut, Universitätsbibliothek Heidelberg, Cod. Pal. Germ. 130, fol. 36v and 38r

it may have weighed around a kilogram more (Fig. 8). This made it significantly more mobile than heavier, longer, and more massive wall-mounted firearms, which typically required a support, such as a fortification wall. The specialist analyses revealed that the barrel of this hackbut was poorly manufactured, and the material contained high levels of phosphorus (up to nearly 1%). This highly undesirable characteristic increased brittleness and reduced the barrel's resistance to the high pressures of gunpowder gases. It is possible that these flaws in craftsmanship contributed to an explosion that ultimately destroyed the firearm.

Due to limited written sources, it remains uncertain who used this firearm and during what period. However, one possibility is that it was employed in the first quarter of the 16th century, during the family conflict and armed attempt by Jan Ciołek to reclaim the castle from Feliks of Zielonka, the 'starost' of Łuków. The intervention of the local 'pospolite ruszenie' (noble levy), as recorded in the 1523 entry, suggests a likely timeframe for the use of this firearm by the garrison occupying the fortalice. It is known that this was not the only firearm used at the site. A stone cannonball was found inside a building uncovered in the castle courtyard, dated to the late 15th – first half of the 16th centuries.

The possibility that this hand-held firearm was used at a later date cannot be ruled out either. Layers of burning were identified in most of the archaeological trenches, indicating a fire that destroyed the castle buildings in the second half of the 16th century. Whether this fire resulted from accidental ignition or was a consequence of defensive actions remains unknown at this stage of research.

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CULTURES OF MORTUARY PRACTICES INFERRED FROM ARCHAEOBOTANICAL AND ARCHAEOLOGICAL RESULTS FROM THE 17TH-18TH CENTURY PROTESTANT BURIALS OF THE VON GLASENAPP FAMILY IN BIAŁOWĄS (BALFANZ), WESTERN POMERANIA

ABSTRACT

Stankiewicz J., Badura M., Noryśkiewicz A. M., Michalik J., Majewski M. and Grupa M. 2025. Cultures of mortuary practices inferred from archaeobotanical and archaeological results from the 17th-18th century Protestant burials of the von Glasenapp family in Białowąs (Balfanz), western Pomerania. *Sprawozdania Archeologiczne* 77/2, 577-609.

The primary objective of this paper is to compile the results of archaeobotanical analyses (seeds/fruits, pollen, wood) of samples taken from 10 coffin burials dating to the 17th-18th centuries, belonging to the Protestant family von Glasenapp at Białowąs (Balfanz). This study provides new insights into local funerary customs and the role of botanical elements in funerals. The plant remains preserved in the coffins indicate considerable restraint in the quantity and type of plants used. The coffins were primarily filled with hop cones, hay, and wood shavings. When considering the history of the von Glasenapp family and the results of the archaeological and archaeobotanical research, it is possible to reconstruct Christian Protestant funerary traditions as practised at the household level.

Keywords: archaeobotany, funerary archaeology, funerary plants, Protestants, Poland
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INTRODUCTION

Among the various aspects of archaeological research that facilitate a deeper understanding of past customs and beliefs, funerary practices hold a special place (Grupa 2005; 2023). The analysis and interpretation of grave goods, human remains, and burial equipment gave rise to a separate branch of archaeology known as funerary archaeology (Czopek 2012, 11).

Incorporating archaeobotanical analysis into the study of burials has enabled an interdisciplinary look of the history of funerary ceremonies and the role of plants within them. Specific plants are used for various purposes. For example, some species had antiseptic properties that slowed the rate of decomposition in the body. The strong aroma of the plants often masked the unpleasant odour of decomposing remains and deterred necrophagous insects and animals. The plants' aesthetic qualities were also important (Lagerås 2016, 12; Kurasiński *et al.* 2018, 174; Pińska and Drążkowska 2020a, 103). However, the importance of plants in funeral rituals went beyond practical aspects. Plants were associated with religious and metaphysical symbolism, often based on their medicinal properties. The choice of plant species was influenced by beliefs and traditions, as well as by the time of death or the seasonal availability of plants in a particular place. Some plants were considered magical, with the ability to help the deceased soul on its journey to the afterlife. Others symbolised fertility and abundance in the afterlife. The botanical composition of a burial was also influenced by the deceased's religion, their social status, and their familial wealth (Badura *et al.* 2023).

Most often, plants were placed in burials within bouquets or wreaths. Live and artificial plants made of silk, paper, or glass were used in their construction and were often mounted on wooden and metal structures (*e.g.*, Drążkowska 2006; Neumann 2007; Lippok 2009, 2015; Grupa 2015; Grupa *et al.* 2014; Majorek and Grupa 2014; Grupa and Nowak 2017; Pińska and Drążkowska 2020b; Leinweber and Fettback 2021, 2024). Plants were also used as filling for pillows and mattresses (Jarosińska *et al.* 2019; Badura *et al.* 2023; Pińska and Drążkowska 2020b; Gałka *et al.* 2022). During archaeological excavations, these elements are preserved as visible seeds, fruits, or fragile flowers and vegetative parts. Interdisciplinary research, including the analysis of pollen, spores, wood, and moss, enables the identification of plants. In this way, burials from different periods and cultures can be studied in detail, and the significance of plants in funeral rituals can be clarified.

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The crypt of the von Glasenapp family in Białowąs (Balfanz) is one of the sites that contain traces of this important West Pomeranian noble family from the 17th to the 19th centuries. Archaeological investigation made it possible to halt the destruction of the crypt and to put all the coffins in order. In addition to cleaning the crypt, the work focused on documenting the coffin furnishings and conducting a bioanthropological investigation of the human remains present. These activities led to the discovery of botanical remains in several coffins. This article presents the botanical composition of materials from individual von Glasenapp burials and discusses the results in the context of the practical and symbolic aspects of plant use in modern burial customs.

THE ARCHAEOLOGY OF THE VON GLASENAPP FAMILY CRYPT

Białowąs (Balfanz) is a small village located a few kilometres north-west of Barwice (Fig. 1). Historical sources mention to it as one of the oldest fiefs of the von Glasenapp family. The family settled in the area around 1400. For many years, family members served as judges in Białogard or local leaders in Szczecinek. The church of Blessed Teresa Ledóchowska in Białowąs (Balfanz) was built at the end of the 17th century by Otto Casimir von Glasenapp as a family burial chapel (Glasenapp 1884; 1897). The crypt where the family members were buried is one of the largest in West Pomerania. The oldest burial in the crypt is likely to date back to 1665 and, according to current research, is believed to belong to Caspar Otto von Glasenapp. The last burial took place in the first half of the 19th century. Over the years, the crypt and the coffins and sarcophagi in it began to deteriorate. The

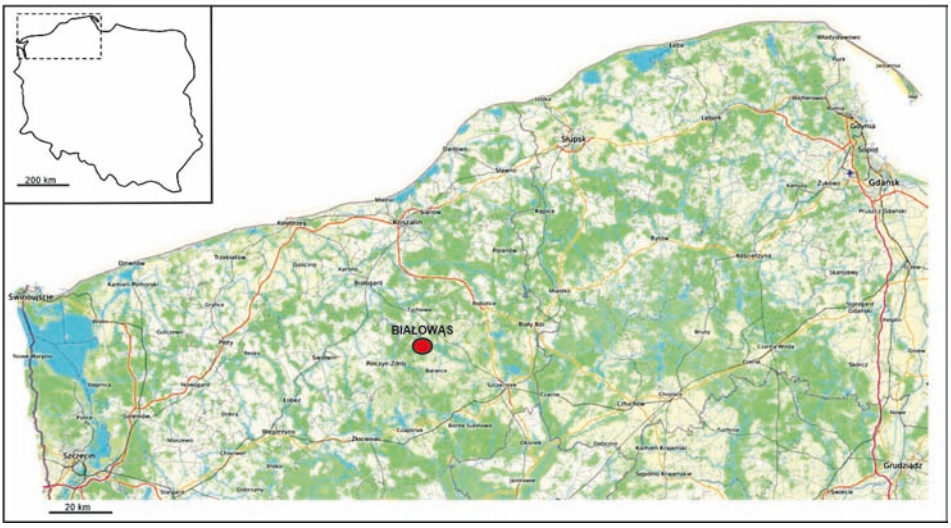

Fig. 1. Białowąs – location of the site (www.geoportal.pl, changed)

Fig. 2. Białowąs – the interior of the crypt before and after the archaeological work
Photo: M. Szeremeta and M. Majewski

first conservation work was carried out in the 1930s. After or even at the end of the Second World War, the crypt was looted. During this time, the church was unused and was located on the territory of the Białowąs State Agricultural Farm. The crypt remained open. It was systematically destroyed, looted, and the mummified bodies desecrated. In 2020, the West Pomeranian Provincial Conservator of Monuments in Szczecin commissioned the Stargard Museum of Archaeology and History to conduct an inventory of the crypt (Majewski *et al.* 2020).

Before the archaeological work, the crypt was in disarray. There was extensive damage (Fig. 2). Some of the sarcophagi's lids had been torn off, and the walls had collapsed. Many decorations and plaques had been torn from the coffins and dismantled. Human remains were found inside the coffins, but also scattered on the brick floor of the crypt (Majewski *et al.* 2020). The remains of burial garments (male and female) and additional grave equipment, including artificial flowers made of silk ribbons attached with brass pins, were found inside and outside the coffins.

The basic premise of the work was to reconstruct the sarcophagi's surroundings from photographs taken in 1934. The area of the crypt was 75.78 m^2 and was laid out on an east-west axis. The room's maximum height was 2.75 metres. The work resulted in the arrangement of the crypt, which is one of the largest modern tombs of the 17th and 18th centuries in West Pomerania. Inside, parts of 32 sarcophagi and coffins were preserved. The oldest is a wooden, trapezoidal, quadrangular sarcophagus (Coffin 22), painted black and originally resting on 10 pewter supports in the shape of lying lions with circular handles in their mouths. This sarcophagus was probably made for Caspar Otto von Glasenapp (before 1613-1665). We can assume that the sarcophagus was brought here by the founder of the church from the chapel that existed in Białowąs before 1648. Otto Casimir von Glasenapp (1642-1710) was buried in a sarcophagus with a coffin placed in the middle of the eastern row (Coffin 17) (Majewski 2021; 2022).

ARCHAEOBOTANICAL ANALYSIS

Due to the destruction of the coffins, the plant material was largely mixed and scattered across the bottom of the coffins, probably the result of looting in search of jewellery or other valuable items. This made it almost impossible to determine the plants' original location. In some cases, plant concentrations were found near specific parts of the body (*e.g.*, the head or feet). In the end, 17 archaeobotanical samples representing 10 burials were collected (Table 1, Fig. 3). They contained both organic (reproductive and vegetative plant parts, wood chips, insect remains, and animal faeces) and inorganic (sand, metal fragments) material (Fig. 4).

In the laboratory, the sediment for palynological analysis was first collected from each sample (at least 1 cm^3). The contents of the samples were then described and weighed. To

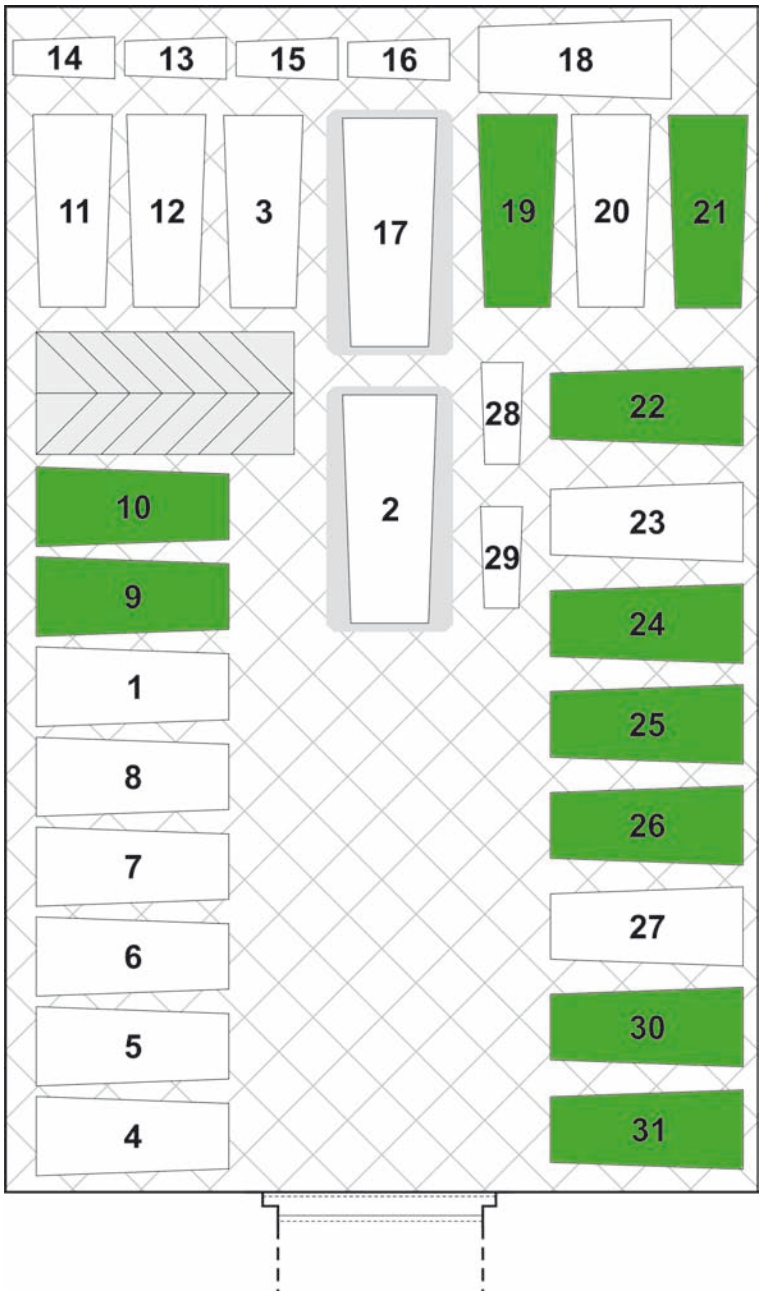

Fig. 3. Białowąs – plan of the crypt with the arrangement of the coffins. Coffins from which material for archaeobotanical analysis was collected are marked in green. Plan of the crypt based on architectural measurements by A. Stefanowicz and J. Chrzanowicz, Z. Wysocki (1964), prepared by M. Szeremeta, Archaeological and Historical Museum in Stargard

separate plant remains from other components, the samples were dry sieved in sieves with different mesh sizes (2.8 mm and 0.5 mm). Seeds, fruits, flowers, leaves, wood chips, and bryophyte fragments were isolated from the fractions identified using a LEICA EZ4 stereo microscope and placed in plastic containers. In the next stage, the seeds, fruits, leaves, and flowers were identified using a Zeiss Stemi SV11 stereo binocular microscope. The Carpological Reference Collection (CRefColl-UGDA) from the Laboratory of Palaeoecology and Archaeobotany, Department of Plant Ecology, University of Gdansk and dry specimens from the Herbarium Universitatis Gedanensis UGDA were used to confirm the identifications.

Table 1. Białowąs – characteristics of archaeobotanical samples, including the type of archaeobotanical analysis

Sample	Location inside the Coffin	Weight [g]	Archaeobotanical analysis			
			Diaspores/ flowers	Mosses	Wood	Pollen
Coffin 9						
9/1	upper part	8	+	+	-	+
9/2	lower part	3	+	-	+	+
Coffin 10						
10	bottom	11	+	-	+	+
Coffin 19						
19/1	upper part	11	+	-	-	+
19/2	lower part	15	+	-	-	+
Coffin 21						
21	bottom	5	+	-	-	+
Coffin 22						
22/1	near the pelvis	11	+	-	-	+
22/2	near the head	7	+	-	-	+
Coffin 24						
24	bottom	14	+	+	+	+
Coffin 25						
25/1	near the head	33	+	-	-	+
25/2	upper part	104	+	+	-	+
25/3	lower part	15	+	-	-	+
25/4	beneath the skull	10	+	-	-	+
Coffin 26						
26/1	near the feet	16	+	+	-	+
26/2	near the head	17	+	+	-	+
Coffin 30						
30	bottom	28	+	+	+	+
Coffin 31						
31	bottom	19	+	-	+	+

Taxonomic names were taken from Mirek *et al.* (2020). The moss gametophores were described according to Szafran (1961) and Smith (2004). Species names are listed according to the classification by Ochyra *et al.* (2003). The identified remains were counted for each sample, and the results are presented in Table 2. A descriptive scale was used for a very large number of finds. The grouping of potential sources from which the plants could have been collected was applied (Badura *et al.* 2023, 90). The naked, uncharred oat caryopsis (*Avena* sp.) was classified as a cultivated form (Table 2). When distinguishing between the cultivated form (*A. sativa*) and the weed (*A. fatua*), the diagnostic feature taken into account is the appearance of the scar on the lower glume. This feature cannot be determined in the absence of glumes (Wieserowa 1967; Jacomet 2006). In samples from Białowąs, a glume from the cultivated form was found, and, probably, the remaining grains are also associated with it.

Wood chips were found in five samples (Table 1). For xylological analysis, 10 pieces of wood shavings of different thicknesses were collected from each sample: the thinnest were less than 1 mm thick, and the thickest were up to 4 mm thick. The difference in chip thickness indicates the stages of board smoothing used for the coffin structure. The analysis of the wood chips was difficult not only due to the small size of the wood fragments but also because of

Fig. 4. Białowąs – archaeobotanical samples before segregation (numbering of samples according to Table 1). Photo: J. Stankiewicz

their state of preservation. The most difficult chips to analyse were the thinnest ones, which wereproduced during the final stages of smoothing the planks. The arrangement of the grain in the boards meant that the cross-section was the thinnest side of the chip, and the longitudinal sections were not evenly aligned with the cut slice. The largest chip surface area was a radial cross-section, which facilitated identification in the case of softwood (Fig. 5). Wood tissue was analysed using a Zeiss Scope.A1 transmitted-light microscope fitted with a Zeiss AxioCam ICc 3 camera and AxioCam software. Publications by Schweingruber (2011), Greguss (1959), Grosser (1977), and the digital version of the catalogue available at www.woodanatomy.ch (Schoch *et al.* 2004) were used for material identification.

Standard laboratory procedures were used to process the palynological samples. First, the organic material was treated with 10% HCl to remove carbonates. Next, the residue was boiled with 10% KOH and macerated using the standard Erdtman acetolysis method for palynology (Berglund and Ralska-Jasiewiczowa 1986). Samples were examined under an Axioskop 2 microscope at 400-630× magnification and photographed with an AxioCam ICc 3 camera from Zeiss and Jenoptik. Identification was based on atlases and keys (*e.g.*, Punt *et al.* 2003; Beug 2004) and on the comparative collection. The palynological material obtained after acetolysis was stored in the Department of Environmental Archaeology and Human Palaeoecology at the Institute of Archaeology, Nicolaus Copernicus University, in Toruń. Palynological results were presented as a percentage diagram showing the selected taxa (Fig. 6).

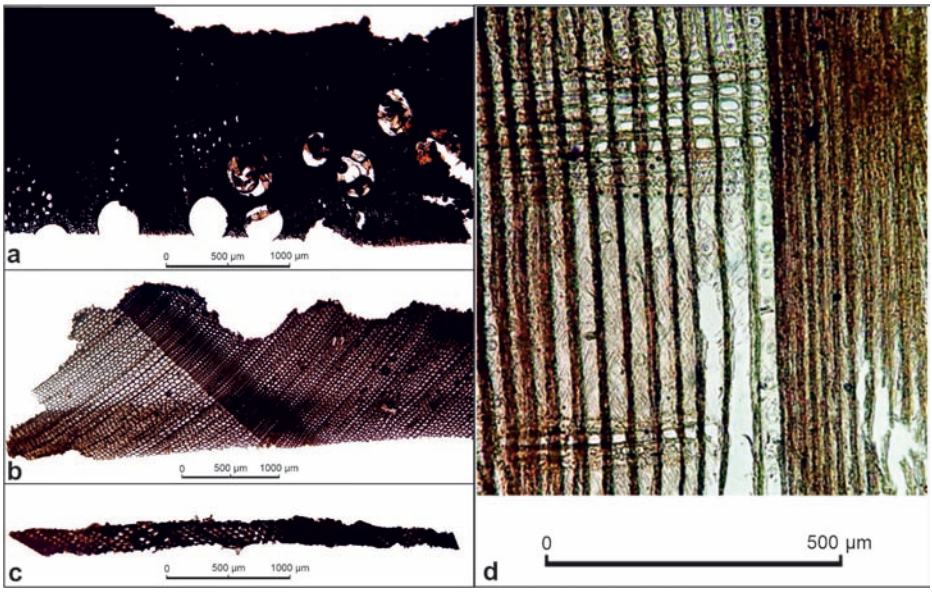

Fig. 5. Białowąs – xylological analysis of wood chips: a-c – cross-sections of chips of different thicknesses (a – *Quercus* sp., b-c – *Pinus sylvestris*), d – radial section of a chip resulting from processing wood of *Pinus sylvestris*. Photo: J. Michalik

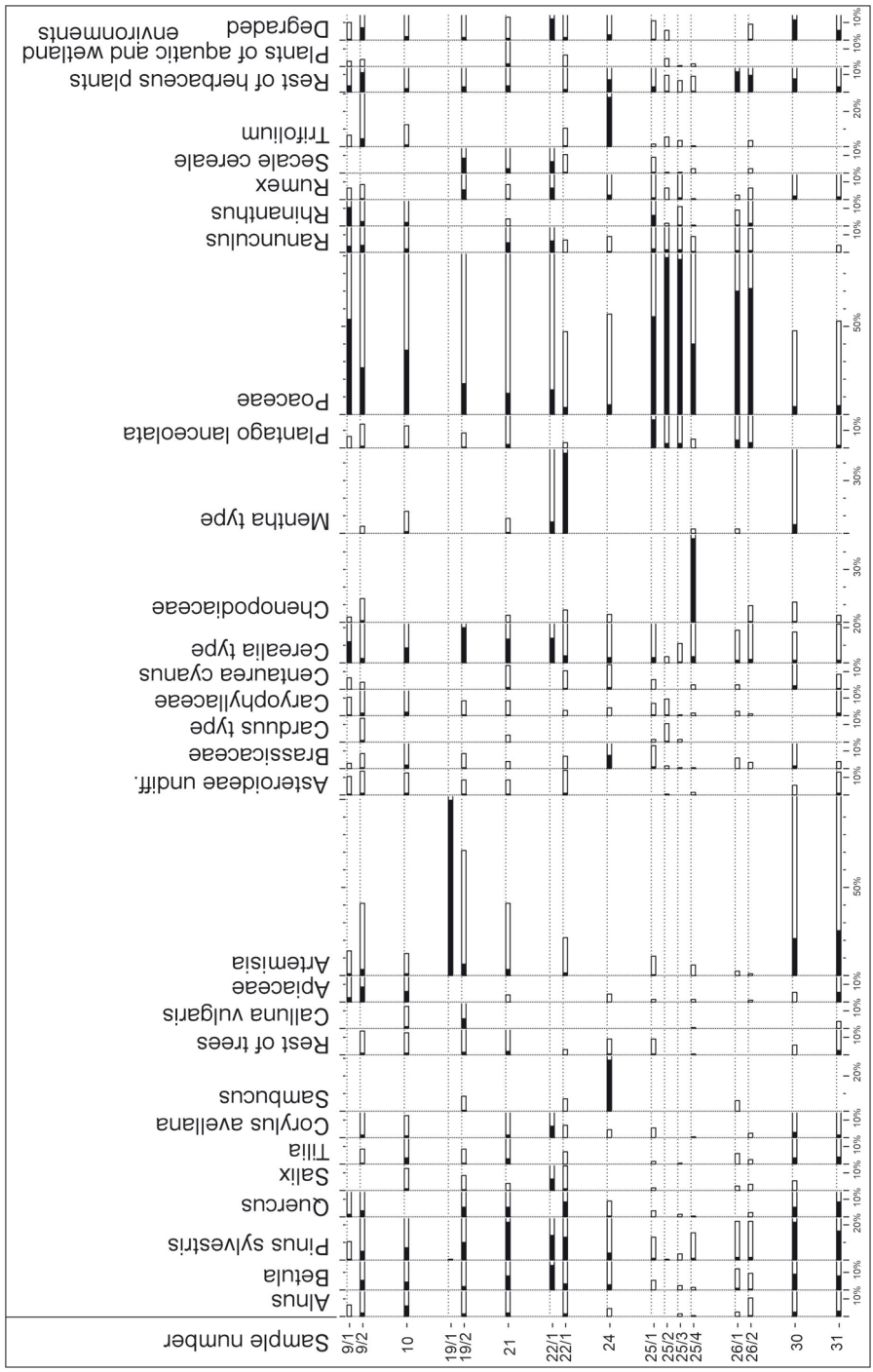

Fig. 6. Białowąs – pollen diagram with selected taxa (numbering of samples according to Table 1)

Table 2. Białowąs – list of vascular plants and Bryophyta in individual samples from coffins (numbering of samples according to Table 1); + – 55-70 specimens, ++ – 71-100 specimens, +++ – over 100 specimens; x – presence of mosses; CAT – ecosociological category of plants: CR – field crop, GA – garden plants, GR – grassland plants, WE – weeds, OW – other wild plants, UN – unclassified; *cultivated or weed; ** – cultivated or gathered

Taxon	CAT	Type of remains	Coffin 9		Coffin 10	Coffin 19		Coffin 21	Coffin 22		Coffin 24	Coffin 25				Coffin 26		Coffin 30	Coffin 31
			9/1	9/2	10	19/1	19/2	21	22/1	22/2	24	25/1	25/2	25/3	25/4	26/1	26/2	30	31
Adoxaceae																			
Sambucus nigra L. elder	OW	seed	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Alismataceae																			
Alisma plantago-aquatica L. european water plantain	OW	fruit	-	-	-	-	-	-	-	-	-	8	1	1	-	-	-	-	-
Amaranthaceae (=Chenopodiaceae)																			
Chenopodium album L. fat hen	WE	fruit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Apiaceae																			
Angelica sylvestris L. wild angelica	OW	fruit	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Heracleum cfr *sybiricum* L. hogweed	GR	fruit	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asteraceae																			
Asteraceae indet. aster family	UN	flower	-	-	-	-	-	-	-	-	-	2	25	-	-	-	-	-	-
		fruit	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-
Artemisia absinthium L. common wormwood	GA	flower	-	-	-	+++	-	-	-	-	-	-	-	-	-	-	-	-	-
Carduus crispus L. welted thistle	WE	fruit	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Centaurea cyanus L. cornflower	WE	flower	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Centaurea jacea L. brown knapweed	GR	fruit	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
Sonchus arvensis L. perennial sow-thistle	WE	fruit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Sonchus asper (L.) Hill. prickly sow thistle	WE	fruit	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2.

Taxon	CAT	Type of remains	Coffin 9		Coffin 10	Coffin 19		Coffin 21	Coffin 22		Coffin 24	Coffin 25				Coffin 26		Coffin 30	Coffin 31
			9/1	9/2	10	19/1	19/2	21	22/1	22/2	24	25/1	25/2	25/3	25/4	26/1	26/2	30	31
Taraxacum officinale L. common dandelion	GR	fruit	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Brassicaceae																			
Rorippa palustris (L.) Besser marsh yellow-cress	GR	seed	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cannabaceae																			
Humulus lupulus L. hop	CR	fruit	4	13	1	29	-	+	-	52	1	+++	6	+++	-	39	+++	+	-
		bract	7	-	-	+	-	11	-	-	-	+++	+	-	-	-	-	++	-
		strobilus	-	-	-	6	+++	-	+++	-	-	++	-	-	+++	-	-	-	-
Caryophyllaceae																			
Cerastium holosteoides Fr. em. Hyl common mouse-ear chickweed	GR	seed	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Lychnis flos-cuculi L. ragged-robin	GR	fruit	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-
		seed	-	1	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-
Stellaria media (L.) Vill. common chickweed	WE	seed	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stellaria sp. stitchwort	UN	seed	-	-	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Cyperaceae																			
Carex cfr *canescens* L. hoary sedge	GR	fruit	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Carex elata All. tufted-sedge	GR	fruit	-	-	2	-	-	-	-	-	-	-	13	-	-	31	-	-	-
Carex elata All./*nigra* (L.) Reichard tufted-sedge/common sedge	GR	fruit	-	-	-	-	-	-	-	-	-	-	++	4	-	-	2	-	-
Carex hirta L. hairy sedge	GR	fruit	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Carex nigra (L.) Reichard common sedge	GR	fruit	-	-	10	-	-	-	-	-	-	11	33	4	-	-	-	-	-

Carex ovalis Gooden. oval sedge	GR	spike	-	-	-	-	-	-	-	-	-	-	++	-	-	-	-	-	-
		fruit	-	-	-	-	-	-	-	-	-	15	52	+	-	-	-	-	-
		utricle	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Carex pallescens L. pale sedge	GR	fruit	-	-	-	-	-	-	-	-	-	2	+++	10	-	-	-	-	-
Carex panicea L. carnation sedge	GR	fruit	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Carex paniculata L. greater tussock-sedge	GR	fruit	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Carex cfr *pseudocyperus* L. cyperus sedge	GR	fruit	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Carex rostrata Stokes bottle sedge	GR	fruit	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		utricle	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1	-	-
Carex cfr *rostrata* Stokes bottle sedge	GR	fruit	-	-	-	-	-	-	-	-	-	-	31	-	-	-	-	-	-
Carex spicata Huds. spiked sedge	GR	fruit	-	-	-	-	-	-	-	-	-	1	-	4	-	-	-	-	-
Carex vesicaria L. bladder sedge	GR	fruit	-	-	-	-	-	-	-	-	-	-	14	-	-	-	-	-	-
Carex vulpina L. true fox-sedge	GR	fruit	-	-	-	-	-	-	-	-	-	-	8	3	-	-	-	-	-
Carex sp. sedge	GR	spike	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-
		fruit	-	-	1	4	-	-	-	-	-	-	-	26	-	-	-	-	-
		utricle	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
Eleocharis palustris (L.) Roem. & Schult./ *uniglumis* (Link) Schult. creeping spike rush/slender spike rush	GR	fruit	-	-	-	-	-	2	-	-	2	1	-	1	-	-	-	-	-
Fabaceae																			
Astragalus sp. milkvetch	UN	fruit	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
		seed	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Fabaceae indet. legume family	UN	flower	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2.

Taxon	CAT	Type of remains	Coffin 9		Coffin 10	Coffin 19		Coffin 21	Coffin 22		Coffin 24	Coffin 25				Coffin 26		Coffin 30	Coffin 31
			9/1	9/2	10	19/1	19/2	21	22/1	22/2	24	25/1	25/2	25/3	25/4	26/1	26/2	30	31
Lotus corniculatus L. common bird's-foot-trefoil	GR	fruit	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
		seed	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-
Trifolium pratense L. red clover	GR	calyx	-	-	-	-	-	-	-	-	2	-	+	-	-	7	-	-	-
Trifolium pratense L./ *repens* L. red clover/white clover	GR	petal	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-
Trifolium repens L. white clover	GR	calyx	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Fagaceae																			
Quercus sp. oak	OW	acorn	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	++	0,5
Juncaceae																			
Juncus cfr *effusus* L. soft-rush	GR	fruit	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
Juncus sp. rush	GR	seed	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lamiaceae																			
Galeopsis tetrahit L. common hemp-nettle	WE	fruit	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mentha aquatica L. water mint	GR	fruit	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prunella vulgaris L. selfheal	GR	fruit	-	-	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Linaceae																			
Linum catharticum L. fairy flax	GR	fruit	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-
cfr *Linum catharticum* L. fairy flax	GR	fruit	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Orobanchaceae																			
Rhinanthus serotinus (Schönh) Oborny. narrow-leaved rattle	GR	seed	-	1	-	-	-	-	-	-	-	-	4	14	-	11	2	-	-
		fruit	-	-	-	-	-	-	-	-	-	-	8	-	-	6	-	-	-

Poaceae																			
Agrostis vinealis Schreb. brown bent	GR	floret	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Avena sativa L. oat	CR	glume	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Avena sp. oat	CR*	fruit	-	-	-	-	2	4	-	-	-	-	-	-	-	-	1	-	-
Festuca sp. fescue	GR	floret	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
Glyceria fluitans (L.) R. Br. floating sweet-grass	GR	floret	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		glume	-	2	-	-	-	-	-	-	-	-	4	-	-	28	-	-	-
cfr *Holcus lanatus* L. yorkshire-fog	GR	glume	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-
Panicum miliaceum L. millet	CR	floret	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Poa angustifolia L. narrow-leaved meadow-grass	GR	floret	-	-	-	-	-	-	-	-	-	-	+++	-	-	-	-	-	-
Poa chaixii Vill. broad-leaved meadow-grass	GR	floret	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poa compressa L. flattened meadow-grass	GR	floret	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poa palustris L. fowl meadow-grass	GR	floret	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Poa pratensis L. common meadow-grass	GR	floret	-	-	-	-	-	-	-	-	-	-	+	5	-	11	-	-	-
Poa sp. meadow-grass	GR	floret	-	-	-	-	-	-	-	-	-	++	11	-	-	43	-	-	-
Poaceae indet. grass family	UN	ear	-	-	-	-	-	-	-	-	-	-	++	-	-	-	-	-	-
		floret	5	-	4	-	-	-	-	-	-	-	-	21	-	-	-	-	-
Secale cereale L. rye	CR	ear	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-
Polygonaceae																			
Fagopyrum esculentum Moench common buckwheat	CR	fruit	-	-	-	-	-	-	-	1,5	-	-	-	-	-	-	-	-	-
Polygonum aviculare L. knotgrass	WE	fruit	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-

Table 2.

Taxon	CAT	Type of remains	Coffin 9		Coffin 10	Coffin 19		Coffin 21	Coffin 22		Coffin 24	Coffin 25				Coffin 26		Coffin 30	Coffin 31
			9/1	9/2	10	19/1	19/2	21	22/1	22/2	24	25/1	25/2	25/3	25/4	26/1	26/2	30	31
Polygonum hydropiper (L.) Delarbe water-pepper	WE	fruit	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rumex acetosa L. common sorrel	GR	fruit	-	-	-	-	-	-	-	-	-	-	14	1	-	-	-	-	-
		perianth	-	-	-	-	-	-	-	-	-	-	27	-	-	-	-	-	-
Rumex acetosella L. sheep's sorrel	WE	fruit	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
Rumex crispus L. curled dock	WE	perianth	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Rumex obtusifolius L. broad-leaved dock	WE	fruit	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Rumex thyrsiflorus Fingerh. compact dock	WE	fruit	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1	-	-
Rumex sp. dock	UN	perianth	-	-	-	-	-	-	-	-	-	1	3	-	-	-	-	-	-
Ranunculaceae																			
Caltha palustris L. marsh-marigold	GR	fruit	-	-	3	-	-	-	-	-	-	4	+++	8	-	33	8	-	-
Ranunculus acris L. meadow buttercup	GR	fruit	3	-	1	-	-	2	-	-	-	4	+++	45	-	-	1	-	-
Ranunculus flammula L. lesser spearwort	GR	fruit	28	2	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-
Ranunculus repens L. creeping buttercup	GR	fruit	1	-	-	-	-	1	-	-	3	4	54	+	-	-	-	-	-
Ranunculus cfr *repens* L. creeping buttercup	GR	fruit	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rosaceae																			
Malus sp.** apple	CR	seed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-
Malus sp./*Pyrus* sp.** apple/pear	CR	seed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-

Rubus idaeus L. raspberry	OW	endocarp	-	2,5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sorbus aucuparia L. rowan	OW	seed	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Urticaceae																			
Urtica dioica L. stinging nettle	WE	fruit	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Undetermined																			
varia	UN	-	6	1	2	-	-	-	-	1	-	-	5	-	-	4	-	-	-
Bryophyta																			
Calliergonella cuspidata (Hedw.) Loeske pointed spear-moss	GR	stems	x	-	-	-	-	x	-	-	x	-	x	-	-	x	x	-	-
Drepanocladus aduncus (Hedw.) Warns kneiff's hook-moss	GR	stems	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-
Drepanocladus vernicosus (Mitt.) Hedenas slender green feather-moss	GR	stems	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Plagiomnium sp. plagiomnium moss	GR	stems	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	x	-
Rhytidiadephus squarrosus (Hedw.) Warns springy turf-moss	GR	stems	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-

RESULTS

Coffin 9 – Joachim Casimir von Glasenapp (1731-1780)

The archaeobotanical samples represented the upper (Sample 9/1) and lower (Sample 9/2) parts of the burial. A plant occurring at both locations was *Humulus lupulus*, preserved as fruits and bracts. In addition to hop, numerous other plant remains were found, particularly in the upper part of the coffin. Most remains included *Carex rostrata*, *Glyceria fluitans,* and *Ranunculus flammula*. These plants grow in wet meadows, swamps, or along riverbanks. *Calliergonella cuspidata*, a moss whose single-stemmed leaves were found in a sample from the upper part of the coffin (Table 2), also occurs in similar environments.

The palynological picture of both samples showed relatively high sporomorph participation (over 200 in each). Poaceae pollen was the most abundant, accounting for over 20% of the total amount in both samples. There was also relatively high participation of Cerealia type, *Rhinanthus*, Apiaceae, and *Trifolium* pollen (Fig. 6). *Juncus* pollen appeared individually, which, in comparison with the overall pollen pattern, may indicate that the plants that were put in the coffin were collected from wet meadows surrounded by mixed forests.

The wood chips present in the bottom sample were identified as *Pinus sylvestris* (Table 3).

Coffin 10 – probably Margaretha Christiane *de domo* von Podewils (1739-1799)

According to the excavation reports, the plant remains preserved at the bottom of the coffin were listed as straw; however, this description is incorrect. The main component of the sample was the vegetative parts of herbaceous plants. Among them, the fruits of *Carex nigra*, and *Prunella vulgaris* have been identified in fairly large quantities (respectively 10 and 18) (Table 2). Both plants can grow in meadows and pastures, as well as in swamps and on riverbanks (Nawara 2015, 80, 236). Less numerous were the fruits of *Polygonum hydropiper*, which can also grow in damp environments.

The palynological spectra presented a low proportion of sporomorphs (fewer than 100 grains in total). Many of them presented significant deterioration, including thinning of

Table 3. Białowąs – results of xylological analysis of wood chips; *- only coarser wood chips

Sample	Number of wood chips	Taxa	
		Pinus sylvestris	*Quercus* sp.
9/2	10	10	-
10	10	5	5
24	10	10	-
30	10	10	-
31	10	7	3*

the cell membrane. Poaceae and Cerealia type pollen were the most abundant in the sample, with *Artemisia*, *Lotus*, *Mentha* type, *Plantago lanceolata*, *Trifolium*, Asteroideae undiff., and Caryophyllaceae pollen recorded individually. The palynological spectrum indicated that the plants placed in the grave originated from an anthropogenic environment (a meadow or a field). The overall spectral pattern, combined with the relatively small amount of pollen, may suggest that flowering plants were not intentionally deposited here.

Pinus sylvestris and *Quercus* sp. wood chips were identified in the sample.

Coffin 19 – Female, died *in senilis*, around the mid-18th century

For this coffin, the two collected samples differed in the types of macroscopic plant remains. Material from the upper part of the coffin consisted of fragments of rigid stems of herbaceous plants. On some of the stems, flower heads (capitulum) were preserved. They belonged to *Artemisia absinthium*. *Humulus lupulus* remains were mixed in the sample, and they were the only element of the sample from the lower part of the coffin.

Significant variation in botanical composition was also observed based on pollen analysis, both in the number and taxonomic diversity of pollen. The sample from the upper part of the coffin showed a high pollen concentration, with more than 1000 grains counted. The pollen represented only one genus – *Artemisia*. The state of preservation of its pollen suggests that specimens with flowers at different stages of development were placed in the coffin. This palynological pattern was completely different for the sample representing the lower part of the coffin (Fig. 6). The sample from the lower part of the coffin was characterised by a low pollen content (112 specimens) and a relatively high taxonomic diversity (22 taxa). Among the trees and shrubs, *Quercus* (6%) and *Pinus* (10%) pollen dominate, and among the herbaceous plants: Cerealia type (20%), Poaceae (18%), *Secale cereale* (9%), *Artemisia* (7%), and *Rumex* (6%) were identified. Other taxa were represented by single pollen grains. The overall botanical picture of the sample in question suggests that the lower part of the coffin probably did not contain intentionally deposited flowering plant specimens. Taken together with the macrobotanical results, it can be inferred that the hops were collected from an agricultural area adjacent to fields sown with cereals.

Coffin 21 – Barbara Augusta von Glasenapp (1711-1785)

In the sample collected from the coffin of Barbara Augusta, only a few macroremains were found. Among them, *Humulus lupulus* fruits and single finds of Asteraceae, Cyperaceae, Fabaceae, Linaceae, Poaceae, Polygonaceae, and Ranunculaceae were isolated, and a few leafy stems of *Caliergonella cuspidata* were found.

The pollen spectrum is characterised by relatively high participation and high diversity of sporomorphs. 220 sporomorphs belonging to 36 taxa were counted on one slide. However, only 12 of these accounted for more than 2% (Fig. 6). As many as 10 of these represent trees and shrubs and account for 47% of the total pollen. Among the herbaceous plants, Cerealia type, Poaceae, *Artemisia,* and *Secale cereale* again accounted for the highest

share. The sharing of non-pollen palynomorphs in the form of residual mycelial hyphae is also relatively high. The obtained pollen spectrum suggests that the origin of the sporomorphs is accidental and does not involve the deliberate addition of some specific flowering plants into the coffin.

Coffin 22 – probably Caspar Otto von Glasenapp (before 1613-1665)

Both macroremain samples had similar botanical compositions. They contained a large quantity of *Humulus lupulus* in the form of fruits and strobili.

The palynological picture differs significantly from the macroremains. Samples differ in both the value of taxonomic diversity (11 taxa in the sample from the head area and 29 from the pelvic area) and the abundance of pollen recognised (275 and 14 specimens, respectively). Mycelial shreds were present in both samples. In the sample from the head area, up to 46% of the accumulated pollen belongs to the Lamiaceae family (of the *Mentha* type). Considering other herbaceous plants, *Artemisia* (2.2%), Cerealia type (4.5%), and Poaceae (4.5%) were also found (Fig. 6). For trees and shrubs, *Betula* (4%), *Pinus* (14%), *Quercus* (9%), *Alnus* (1.8%), *Salix* (1.5%), *Tilia* (0.7%), *Corylus* (0.7%), and *Sambucus* (0.7%) were present. Most of these reflect a general picture of the environment in which plant collection for funerary rites occurred. The distinct dominance of *Mentha* type pollen in the sample from the head area may indicate the intentional placing of flowering specimens of this plant in a coffin, perhaps in the form of a pillow. The botanical composition of the sample from the pelvic area is probably the result of accidental pollen deposition from outside of the coffin. It is not related to the plants put in the coffin.

Coffin 24 – unknown man, died at approximately 21 years of age, around the mid-18th century

The plant macroremains collected from the coffin were severely damaged. The best-preserved element of the sample was *Pinus sylvestris* wood chips. Among them, single fruits of *Humulus lupulus* and *Ranunculus repens,* and flowers of *Trifolium pratense* were preserved. In addition, a *Sambucus nigra* seed, fragments of a *Quercus* sp. fruit, and a *Secale cereale* ear were found.

The palynological sample is characterised by a relatively high participation of highly degraded sporomorphs. A total of 208 pollen grains were counted on two slides. Their poor state of preservation, especially the heavily damaged (unrecognisable) sculptures and a significant proportion of fungal spores, indicates unfavourable environmental conditions. The palynological spectrum is characterised by a dominance of *Trifolium*, probably *T. pratense* (29%) and *Sambucus* (29%). The remaining herbaceous taxa are fewer in number. Only Poaceae and Brassicaceae pollen occur above 4%. The resulting pollen picture may indicate that *Trifolium* and *Sambucus* flowers were intentionally placed in the coffin. The other pollen was likely deposited accidentally.

Coffin 25 – unknown man died *in senilis*, 18th/19th century

All four samples were the richest in plant macroremains and the most diverse considering other materials. Two of them (Samples 25/1 and 25/4) were collected near and below the head of the deceased, and these materials may have been used to form a kind of pillow. In both samples, *Humulus lupulus* remains were the predominant element, along with secondary contributions of sedge fruits.

Samples 25/2 and 25/3 consisted of vegetative parts of herbaceous plants (Fig. 4). Some of these were certainly sedges, as numerous fragments of ears and fruits of *Carex pallescens, C. ovalis, C. elata/nigra*, and *Carex vesicaria* were found in both. Sample 25/2 also contained significant amounts of fruits of *Caltha palustris*, and *Ranunculus acris* and florets of *Poa angustifolia*. A characteristic element of this sample was *Rhinanthus serotinus,* preserved as fruits and seeds. All of these species are associated with wet meadows. In addition, the material remains of ruderal plants in Sample 25/3 contained a similar composition, but much fewer diaspores were found. In Sample 25/2, stems with leaves of *Caliergonella cuspidata* and *Plagiomnium* sp. were identified.

All four pollen samples were characterised by a relatively high participation of sporomorphs (25/1 – 517, 25/2 – 1020, 25/3 – 1032, 25/4 – 935). Among these, the pollen of trees and shrubs was very poorly represented (4-0.1%) in all samples. A high participation of grass (Poaceae) pollen was found – 56% and 40% in the samples taken from the head area (respectively 25/1, 25/4), and 89% in each of the two other (Samples 25/2 and 25/3). In many cases, Poaceae pollen formed conglomerates, with some clusters exceeding 50 grains. Samples taken from the head area (25/1 and 25/4) exhibit a similar pollen pattern, except for the presence of three taxa: *Plantago lanceolata*, Chenopodiaceae, and *Rhinanthus*. A relatively high proportion of *Plantago lanceolata* and *Rhinanthus* pollen was recorded in Sample 25/1 (16.5% and 6.5%, respectively), which was virtually absent in Sample 25/4 (Fig. 6). It is worth mentioning that individual specimens of *P. lanceolata* were preserved in various sizes. Sample 25/4 is characterised by a significant proportion of Chenopodiaceae pollen (48%), which also occurred in clusters of up to 50 grains. No pollen of this type was found in Sample 25/1. Taking all these observations into account, it can be assumed that flowering plants with varying degrees of flower development were deposited in the head area, with the cushion filling under the skull consisting mainly of plants from the Chenopodiaceae family. In the pollen spectra, samples taken from this coffin also showed sporomorphs of aquatic and wetland plants such as *Juncus* sp., *Alisma plantago-aquatica* type, and *Batrachium trichophyllum* (included in the summary curve 'Plants of aquatic and wetland environments', Fig. 6). Although these are single grains, they may indicate that some of the plants, most probably grasses, placed in the coffin were collected from a wetland. The overall pollen spectrum suggests that the material deposited in Coffin 25 originated from wet, highly anthropogenically transformed plant communities.

Coffin 26 – unknown man died *in senilis*, 18th/19th century

The head and foot areas were sampled for organic material. The common element in both samples was *Humulus lupulus*, although material collected near the head (Sample 26/2) contained more hop remains. Sample 26/1 contained an average amount of *Carex* sp. and *Caltha palustris* remains, whereas they were rare in Sample 26/2. The latter also contained single seeds of *Malus* sp. and *Malus* sp./*Pyrus* sp. Three species of moss were noted. *Calliergonella cuspidata* was present in both samples, whereas *Drepanocladus aduncus* was present only in the material near the head and *D. vernicosus* near the foot.

The pollen samples collected from Coffin 26, like those from 25, were characterised by a relatively high proportion of sporomorphs, with trees and shrubs represented by a very low proportion of pollen (about 5%) and a high participation of Poaceae (about 70-72%). In some cases, Poaceae pollen formed clusters of dozens of pollen grains. This is likely the result of using grasses with inflorescences at various stages of flowering and flower development. In undeveloped specimens, the pollen remained in the anthers, hence the pollen clusters visible in pollen spectra. Of the remaining plants, only *Plantago lanceolata*, Cyperaceae, and Cerealia type pollen demonstrated significant proportions.

Coffin 30 – coffin with the secondary deposit of remains of six people: two men, two women who died *in senilis*, one man who died *in maturus*, and one gender-indeterminate adult, early 19th century

The macrobotanical composition of the samples from Coffin 30 was poor. It consisted mainly of numerous remains of *Humulus lupulus* together with fragments of fruits of *Quercus* sp. Stems of *Rhytidiadelphus squarrosus* and *Plagiomnium* sp. were also found. The wood chips collected were exclusively *Pinus sylvestris*.

The palynological sample showed a relatively low pollen concentration. A total of 224 sporomorphs were counted in this sample; however, up to 119 spores of the indicator were added at the beginning of the maceration. The proportion of degraded pollen, identified by loss of diagnostic features, was also high. Additionally, numerous fungal and moss spores were present. In the general pollen spectrum, almost half of the recognised specimens were pollen from trees and shrubs, mainly *Pinus* (22%), *Betula* (10%), and *Quercus* (6%). Among the herbaceous plants, the most common pollen were *Artemisia* (26%), *Mentha* type (6%), and Poaceae (5%), which could have been deliberately placed in the coffin. Among the NPP (Non-Pollen Palynomorphs), in addition to the spores of fungi and mosses, there are also vegetative microremains of plants from the Lamiaceae family, to which the *Mentha* type belongs. This clearly shows that the coffin contained flowering plants of the Lamiaceae family and the *Artemisia* genus. The other plants were less numerous, but in general, it can be assumed that the environment from which they came was anthropogenically transformed. It cannot be excluded that the image obtained was the result of selective pollen decomposition.

Coffin 31 – unknown man died *in senilis*, 18th/19th century

The samples from Coffin 31 contained numerous chips of *Pinus sylvestris* and *Quercus* sp. It is worth noting that only thicker chips (up to 3 mm) were from oak, and thinner ones (0.2-1 mm) from pine. There was only one fragment of a *Quercus* sp. fruit.

The sample was characterised by a very low pollen concentration. Similar to Sample 30, pollen from trees and shrubs was relatively high (17% – *Pinus*, 9% – *Quercus*, 8% – *Betula*, and 5% – *Tilia*). Of the herbaceous plants, as much as 26% was *Artemisia*, 6% – Poaceae, and 2.5% – *Plantago lanceolata*. The remaining taxa accounted for less than 2%. However, as in the case of the sample from Coffin 30, the overall picture of the pollen spectrum indicates an anthropogenically modified environment. It is likely that the only flowering plants intentionally placed in this grave were *Artemisia* and Poaceae. The pollen of other plants could have arrived there more or less accidentally, as the pollen fall coincided with the burial or collection period of plants deliberately placed there.

BOTANICAL ASPECTS OF THE VON GLASENAPP FAMILY BURIALS

Despite considerable damage to the individual burials, the archaeological work in the von Glasenapp family crypt has produced well-preserved archaeobotanical material. The majority of the identified taxa represent plants that are common in Poland and were probably part of the communities developing in the vicinity of Białowąs.

The most comprehensive picture is that of Coffin 25 (an unknown man who died in senilis), where 44 plant taxa were identified from macroremains and 46 taxa were determined by pollen analysis. The macrobotanical spectrum of all four samples from this burial is quite consistent. A small difference lies in the abundance of remains of individual plants. First of all, it can be noted that a high concentration of *Humulus lupulus* cones was preserved in the head area. However, the palynological spectrum from the same area showed a low percentage of hop pollen. This confirms the selective and targeted use of female *H. lupulus* specimens (Jarosińska *et al.* 2019, 192). However, in the sample taken from beneath the skull, a large proportion of Chenopodiaceae pollen was identified. Hop remains were also present in the other two samples, but mainly in the form of fruits and individual bracts, which could easily move in the coffin as a result of its destruction. It can, therefore, be assumed that hops were deposited in the upper part of the coffin, in the area where the pillow was usually placed. It is likely that flowering specimens of Chenopodiacea, whose pollen was abundant in this sample, probably grew near the collected hop.

The second component found in all four samples from Coffin 25 was the remains of plants originating from different types of meadows. Most of them represented communities within the order *Molinietalia caerule*, which includes meso- and eutrophic hay meadows, as well as permanently and periodically wet riparian tall herb fringes (Matuszkiewicz

2008, 124). One of the characteristic components must have been sedges (*Care*x sp.), preserved not only as fruits but also as fragments of spikelets. Significant accumulations of sedge remains, and their considerable taxonomic diversity (eight species), were found in Sample 25/2, representing the upper part of the coffin. This sample was dominated by *Carex pallescens*, *C. ovalis,* and *C. nigra*. The first of them prefers moist, grassy or rocky habitats at the edge of the forest, where it receives partial sunlight (Sikorski *et al.* 2020, 241), whereas *C. ovalis* is found on poor, dry grassland and damp pastures (Sikorski *et al.* 2020, 137), and *C. nigra* inhabits wet meadows or marshy riverbanks (Nawara 2015, 80). The latter may have occurred alongside *Caltha palustris*, which has been preserved as numerous fruits. It is possible that these species were accompanied by *Ranunculus acris, R. repens, Glyceria fluitans, and Lychnis flos-cuculi*. The results of the palynological analysis of Coffin 25 showed that a significant proportion of the pollen was from Poaceae, *Plantago lanceolata,* and *Rhinanthus*. The most obvious explanation for this situation would be the use of hay as 'bedding' material inside the coffins. Similar results have been observed in studies of burials in Europe from the Middle Ages to the modern period (*e.g.*, Deforce *et al.* 2015, 599; Tranberg 2015, 192). It is also possible that the sample taken near the head may have reflected a bouquet of wildflowers, including cereals (such as *Plantago lanceolata*, Poaceae, *Rhinanthus*, *Secale cereale*, and Cerealia type), and it cannot be ruled out that a bouquet of herbs was placed in the coffin near the head.

There is a clear difference in taxon diversity between Coffin 25 and the others. In stark contrast, Coffin 31 yielded the fewest taxa based on macrobotanical remains. This may be because this sample contained mainly pine and oak chips, possibly indicating that the coffin was lined primarily with wood shavings. However, the palynological analysis of Coffin 31 revealed the presence of plants (*e.g.*, Apiaceae, *Artemisia*, and Poaceae) that may have been deposited in the coffin, the macrobotanical remains of which have not been preserved. In addition, a relatively high taxonomic diversity and a high percentage of tree pollen are present (10 genera: *Acer*, *Alnus*, *Betula, Carpinus*, *Corylus*, *Fagus*, *Picea*, *Pinus*, *Quercus*, and *Tilia*).

In the other coffins, the number of taxa identified macroscopically ranged from 4 to 29 determinations. Most of these species were grassland plants characteristic of meadows and pastures (Fig. 7). Their remains were found in almost all samples. In Joachim Casimir von Glasenapp's burial (Coffin 9), of the 14 identified plants, 10 were associated with grasslands. The palynological spectrum also revealed the presence of plants typical of wet meadows. This may mean that hay and other plants were a part of the lining of Coffin 9, but due to the extent of its destruction, we do not have clear evidence of this, as in the case of Coffin 25.

While hop was prevalent in Coffin 25, it also appeared in other coffins, regardless of the location of the samples. Particularly large quantities of plant remains were noted in Burials 19, 22, and 26; however, it is not possible to determine whether the cones supported the heads of the deceased or lined the rest of the coffins. Hop remains are among the most

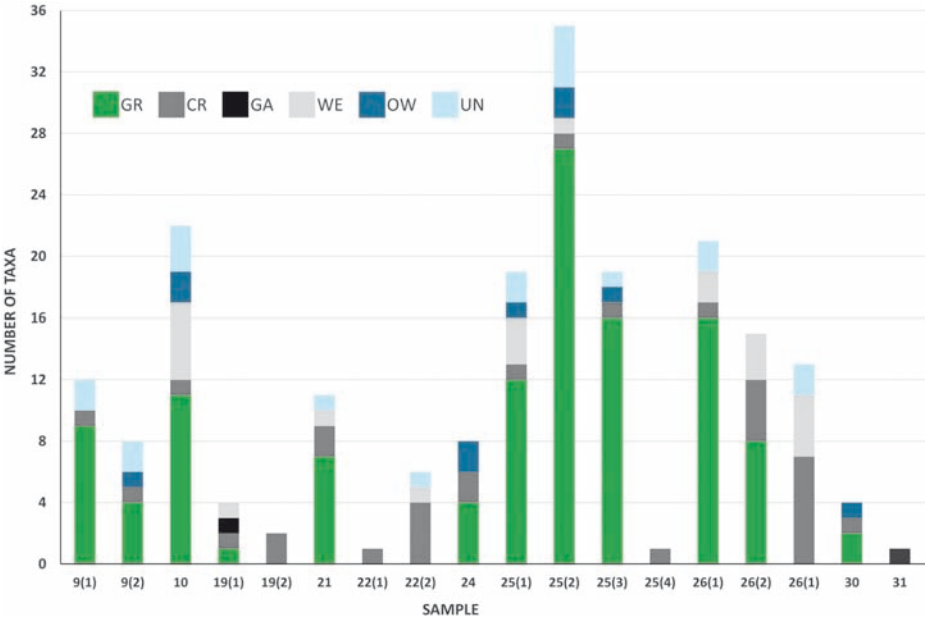

Fig. 7. Białowąs – number of taxa in groups of potential origin. GR – grassland plants, CR – field crop, GA – garden plants, WE – weeds, OW – other wild plants, UN – unclassified (numbering of samples according to Table 1)

common botanical remains found in burials dating to the early modern period in Poland (*e.g.*, Rożek 2009, 188; Jarosińska *et al.* 2019; Badura *et al.* 2023, 92; Badura and Noryśkiewicz 2023, 156) and Europe more broadly (*e.g.*, Wiethold 2005; Ströbl and Vick 2007, 52, 53). In all these cases, only female plants were used, which is connected with their botanical properties. Female specimens produce 2.5-5 cm long cone-like structures called strobili, which consist of yellowish-green, overlapping bracts attached to an axis. Each bract enfolds a small fruit, or achene. Unfortunately, in the case of Białowąs, we do not know whether these specimens were cultivated or gathered from the wild. In Coffin 22, the high proportion of macroscopic hop remains is accompanied by high percentages of *Mentha* type pollen. This could indicate the collection of hops from moist places, possibly from wild sites.

In addition to hops, traces of other useful plants were also found in the samples. These were both cultivated (*Artemisia absinthium*, *Avena sativa, Fagopyrum esculentum, Panicum miliaceum,* and *Secale cereale*) and gathered (*Malus* sp., *Pyrus* sp., *Rubus idaeus*, *Sambucus nigra,* and *Sorbus aucuparia*) plants. Cereals (millet, oats, rye) and buckwheat are often noted in burials as symbols of food and as an important element of Catholic church traditions. The presence of apple/pear, raspberry, or rowan remains is more problematic. It does not appear that these plants were used deliberately. It is more likely that they represent contemporary contamination, brought in by people or animals during the

abandonment and destruction of the crypt. Moreover, Sample 19/1 presented relatively homogeneous material. *Artemisia* pollen, at various stages of development, was abundant in the palynological spectrum. Flowers or whole flowering specimens of *Artemisia* were deposited in the upper part of the coffin and may have been its padding or filled the pillow. Macroscopic material allowed the determination that Artemisia absinthium was specifically used in this case.

It is well known that one of the significant difficulties in funerary research is determining the time of death and burial, notably when there are no archaeological or historical sources on the subject. The plant material may provide some information, primarily if the remains represent plants from a specific community. However, it must be noted that without other dating methods, plants can only indicate the season in which they were collected, an approach well known in archaeobotanical research (Lityńska-Zając and Wasylikowa 2005, 475-476). The considerable taxonomic diversity of Sample 25/2, combined with the fact that the identified plants were likely collected from a single location (a wet meadow), allows us to attempt a phenological description. Seventeen out of 21 taxa are plants that flower and fruit in June and July, that is, at the end of early and the beginning of the whole summer (Stankiewicz 2022, 31). It should be noted, however, that dried plants were usually placed in coffins so they could be used at any time that did not coincide with their flowering or fruiting period.

HOP AND HAY AS ELEMENTS OF THE FUNERAL RITES

With the Reformation came a rejection of the lavishness previously associated with Catholic funerary ceremonies. The belief in purgatory was abandoned (Korpiola and Lahtinen 2015, 15), and moderation in the preparation and burial of the individual was advocated (Grupa 2011, 23). Funerals were modest, with exceptions made for members of the upper social classes (Ogiewa-Sejnota 2020, 123). This may explain the ambiguous nature of the von Glasenapp family grave furnishings, both in terms of the botanical materials and goods (*e.g.*, rings, cufflinks). To some extent, Protestants adopted elements of Catholic ceremonial splendour (Chrościcki 1974, 54). However, they had rejected the belief that posthumous prayer and ceremony could influence the fate of the deceased's soul (Macionczyk 2023, 86). The focus shifted from the cult of death to the memory and care of the graves of the deceased (Guzowski *et al.* 2016a, 28). The Reformation changes also restricted the use of wreaths and plants, although the specifics varied from region to region (Grupa 2011; Łuczaj 2012, 229; Witkowska 2018, 287; Macionczyk 2023).

Protestants used both natural and artificial materials to create wreaths. Secular and ecclesiastical authorities also regulated the modesty of coffin furnishings; however, these rules were often not followed in the burials of nobility or distinguished individuals. On the other hand, branches of Protestantism, such as the Baptists, taught that death was the

separation of soul and body, and the funeral was an expression of respect for the deceased. The botanical composition of the graves in the church's crypt in Białowąs corresponds to Protestant funerary customs and their distinctive approach to death.

Indeed, the coffins in question were lined with hay. References to this practice have been known in Europe since the Viking times (Lempiäinen-Avci and Alenius 2017, 18). In Poland, specifically, this practice has been documented since the 17th-18th centuries (Pińska *et al.* 2015, 323). Dry herbaceous plants and mosses may have formed a kind of mattress or pillow (Hansson 2005, 50; Deforce *et al.* 2015, 601; Tranberg 2015, 196). Unfortunately, in the case of the materials from Białowąs, it is difficult to determine the presence of this element due to the considerable mixing of the botanical remains. However, the evidence presented here – both macrobotanical and palynological – confirms that Coffins 9, 25 and 26 were filled with hay.

The dying were laid out on dry grass to await the last rites, and after death, the washed bodies were placed on it. Some sources suggest that hay was used to prepare the body for the vigil in the chapel or for transport to the burial site (Macionczyk 2023, 25). The ascetic nature of hay as a funeral material may be associated with Protestant doctrines that criticised worldly life and materialism (Guzowski *et al.* 2016b, 323). Hay, as an important agricultural product used to feed livestock, was obviously valued when allocated for sepulchral rites, suggesting it held a significant role in the funeral ceremony (Hansson 2005, 50). Along with hay, wood shavings, sawdust, conifer needles, or mosses could have been laid out under the body. Dried plant material could absorb bodily fluids and keep the coffin dry for as long as possible (Lempiäinen-Avci and Alenius 2017, 138; Macionczyk 2023, 106). Moreover, hay and moss, due to their flexible yet durable structure, allowed the body to be positioned appropriately and prevented movement during the transport of the coffin. This was crucial because the deceased was meant to appear as if in a state of sleep (Grupa 2005, 32, 52-53; Macionczyk 2023, 37). Mosses were also present in the Białowąs hay samples, but their presence appears to be due to co-occurrence with other grassland species. The use of pine shavings to line the coffin's base is also justified. The shoots of coniferous trees (such as the *Pinus sylvestris* found in Coffin 9) contain aromatic essential oils with antiseptic properties. Additionally, even if these shavings were byproducts of the coffin-making process, they were placed with the deceased to ward off bad luck for the living (Macionczyk 2023, 102).

One particularly significant plant taxon in both Catholicism and Protestantism is the common hop (*Humulus lupulus*). Its frequent appearance in archaeobotanical analyses from modern burials is due to the ease with which its cones and seeds can be identified and its widespread use in funerary practices, especially in 17th- and 18th-century Northern and Central Europe, including the Baltic states (*e.g.*, Lagerås 2016; Jarosińska *et al.* 2019; Badura *et al.* 2023; Badura and Noryśkiewicz 2023). Due to its lupulin content, hops were a natural preservative used in the production of beer and mead (Kujawska *et al.* 2016, 116). Parts of the plant were woven into Easter palms and blessed during the Feast of the

Assumption of Mary. In some regions of Poland, hops were considered a symbol of the groom and an emblem of vitality due to the way the plant climbs its support. *H. lupulus* was also used in love rituals. In agricultural rituals, it was employed during the first ploughing to ensure a good harvest, and hop leaves were used during storms for fumigation. During the removal of the deceased from the house, hop cones were scattered across the threshold to prevent the soul's return (Szcześniak 2013, 139).

Alongside hay, hops were the most common material used to fill pillows and coffin mattresses. Due to its strong scent, hops masked the unpleasant odour of the decaying body. The antibacterial and antifungal properties of substances found in this plant helped slow the decomposition of the corpse (Lagerås 2016, 12; Macionczyk 2023, 105). Dried hop cones demonstrated the ability to absorb fluids produced during the body's decomposition (Wiethold 2005, 31).

Due to hops' calming effects on the nervous system, this plant was believed to induce eternal sleep and bring peace. Thus, the practice of filling pillows with dried hop cones from blessed wreaths and bouquets became a common tradition among both Catholics and Protestants (*e.g.*, Wiethold 2005; Grupa 2011; Karg 2012/2013; Lagerås 2016; Jarosińska *et al.* 2019). This allowed the pillow to take on the appropriate shape, particularly when combined with hay and wildflowers. Importantly, the use of hop cones as coffin filling was not regulated by Protestant church rules. Hops, a valuable natural resource, could have been cultivated in the estate's garden belonging to the von Glasenapp family.

CONCLUSIONS

Funerary archaeology involves the analysis of human remains in their archaeological context, which in this case includes the crypt and its accompanying furnishings. Analysis of the botanical materials preserved in the coffins provides deeper insight into the cultural and social aspects of past societies. The research carried out in Białowąs is no exception. It should be noted that it is uncommon to encounter such extensive botanical materials from a single crypt. Despite the considerable damage at the site, the preserved plant remains enabled the description of the burial customs in ten interments of the von Glasenapp family, who exhibited considerable restraint in the quantity and type of plants used. This may be related to the fact that Protestantism sought to counter the opulence and grandeur of the Catholic funeral liturgy.

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REMAINS OF A 1944 ARTILLERY POSITION IN MIEJSCE PIASTOWE, KROSNO COUNTY

ABSTRACT

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The article presents the results of rescue archaeological investigations conducted at Site 22 in Miejsce Piastowe. The excavations uncovered World War II remains associated with military activities during the Carpatho-Dukla Military Operation. A detailed analysis of the spatial organization of features and the distribution of artefacts enabled the reconstruction of the arrangement of howitzers and the associated trench infrastructure at the site. It also allowed for an estimation of the number of shells fired, thereby facilitating a reconstruction of the intensity of combat in the area. The findings confirm the presence of German artillery at this location in the second half of 1944, corroborating the course of events described in historical sources.

Keywords: artillery; archaeology of conflict; battlefield archaeology; Carpatho-Dukla Military Operation; trenches; World War II archaeology

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1. INTRODUCTION

In 2023, in connection with the construction of expressway S19, rescue excavations took place at Site 22 in Miejsce Piastowe, Krosno County, Podkarpackie Voivodeship, no. AZP 112-74/150 (Fig. 1; the excavations were conducted by the company Archeologiczny Serwis Konsultacyjno-Badawczy Mirosław Kuś; archaeological works were led by Mgr A. Lach). As a result, archaeological remains of World War II military operations were recorded in the northern and southern parts of the investigated area. During the excavations, a total of 29 ground structures related to the German artillery were uncovered and documented. The chronological attribution of the features was determined based on the historical material recovered from their fills, and in the case of twelve features – based on stratigraphic correlation (Fig. 2).

The site is located in the Jasło-Krosno Basin (Solon *et al.* 2018), on both sides of national road no. 28, between Miejsce Piastowe and Iwonicz. It is situated on a poorly pronounced fluvial terrace of the Iwoniczanka River and its minor tributaries.

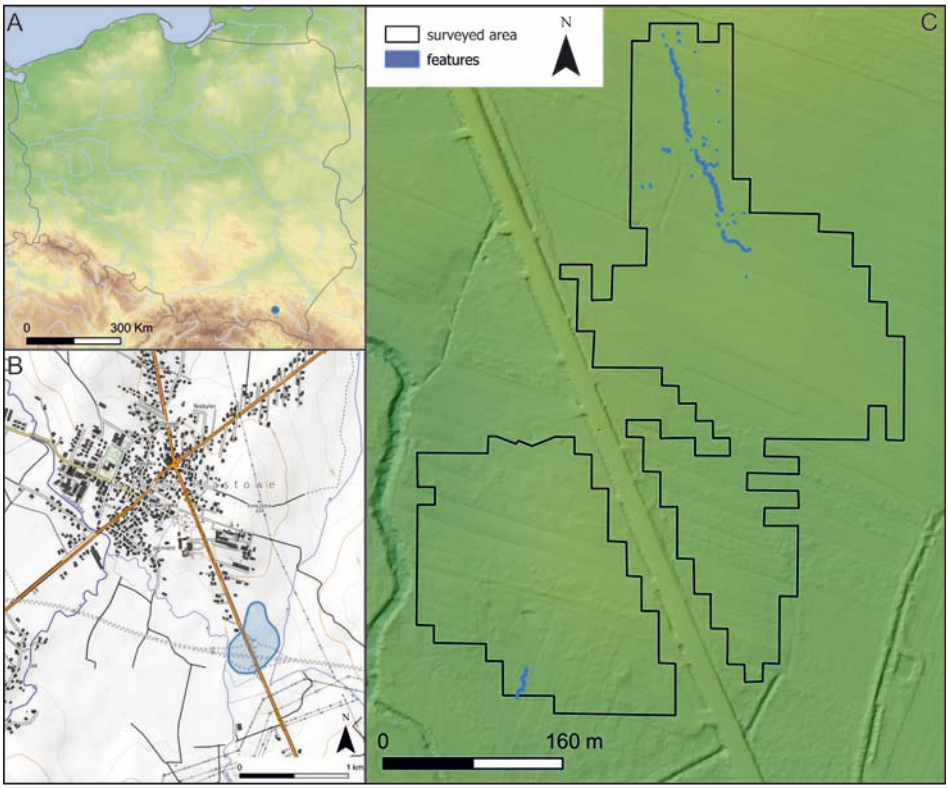

Fig. 1. Location of the site and research area coverage.
Drawing by E. Rydzewska

The most significant World War II military operations in the area took place in the second half of 1944, during the initial phase of the Carpatho-Dukla Operation (in older literature known also as the Prešov-Dukla Operation). Its aim was for the Soviets to break the line of German defence, capture the Dukla Pass and provide assistance to Slovak insurgents (Moskalenko 1974, 532-597). Miejsce Piastowe was located directly at the rear of the first line of German defences (Fig. 3), which ran from Gogołów to the western bank of the Wisłok River, then along it, through Krosno and Besko, and further to the south of Sanok. The work on the fortifications near Miejsce Piastowe did not begin until mid-August 1944. By 8 September 1944, only one-third of the planned field fortifications in this defensive section had been completed (Kotarski 1973, 235). The first line of fortifications extended from 1,200 to 2,000 m (Slipiec 2004, 89).

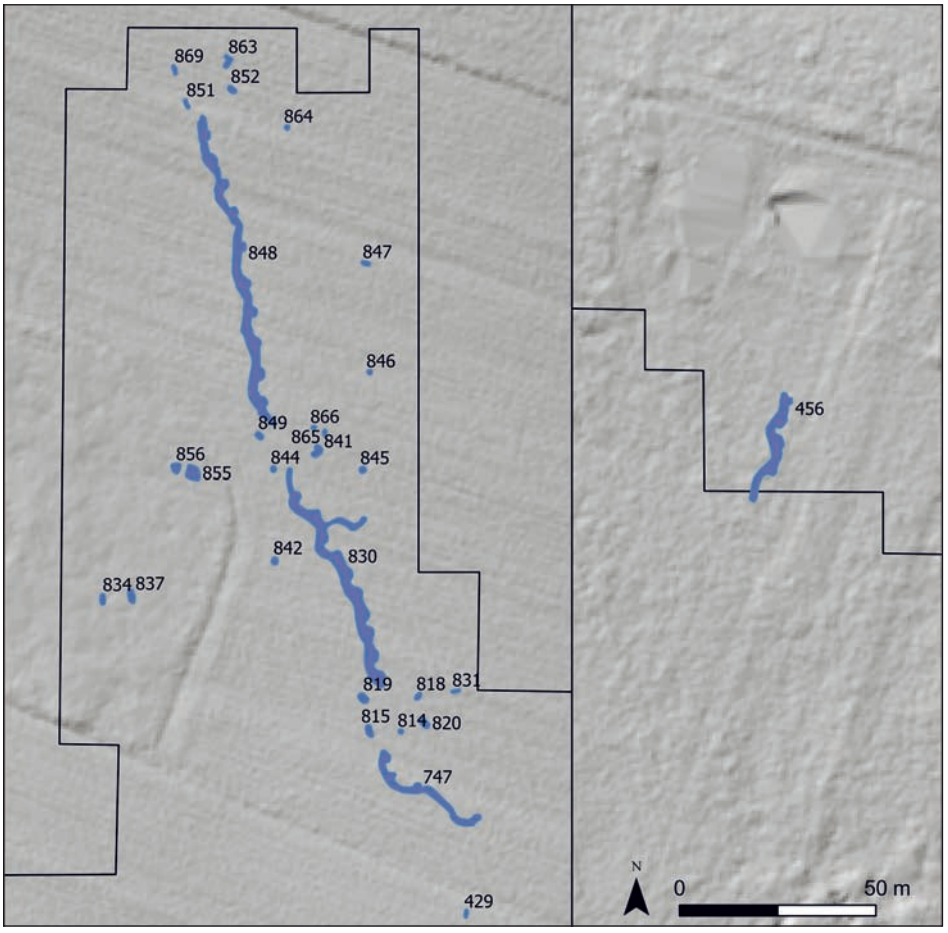

Fig. 2. Miejsce Piastowe, Krosno County, Site 22. Plan of the site.
Drawing by E. Rydzewska

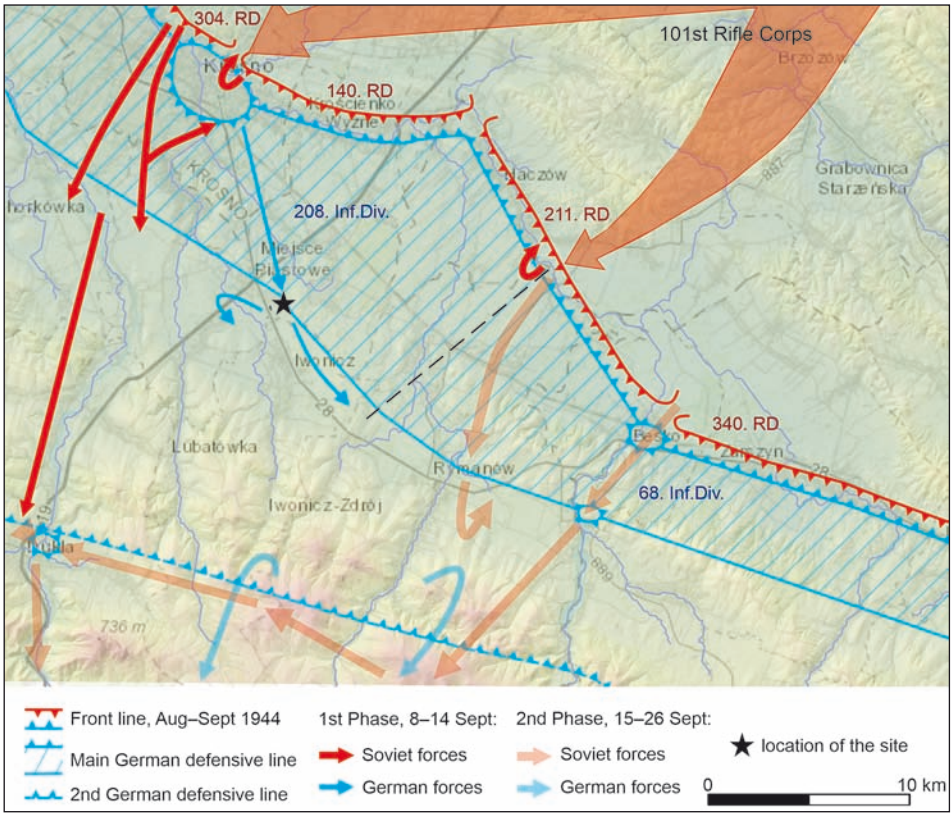

Fig. 3. Presov-Dukla operation from September 1944.
After Kotarski 1973, map 1; drawing by E. Rydzewska

On the German side, the main task on this section of the front was to prevent the Soviet troops from reaching the Dukla Pass, as it was the main passage leading to Slovakia. The region was defended by the 208th Infantry Division of the XI SS Corps (17th Army), which reached the Krosno area in mid-August. According to historical sources, the artillery was very weak in this section of the defence line. It consisted of 221 field guns and 140 mortars, which gave an average of 4.5 guns and mortars per 1 km of the front (Kotarski 1973, 234). On this section of the front, the Germans were opposed by the soldiers from the 101st Rifle Corps of the Red Army. The fighting began in the early morning of 8 September 1944. After a preparatory artillery barrage, the Soviet infantry, supported by tanks, attacked the front of the 208th Infantry Division. By the evening, it had managed to break through the German lines over an area of 8 km in width and 9 km in depth (Lexikon der Wehrmacht). After three days of fighting, the Russians captured Krosno, and a multi-day battle for the Dukla-Żmigród road began. The Dukla operation is considered one of the bloodiest battles of World War II on Polish soil.

2. RESEARCH RESULTS

Trenches

Four sections of fire trenches were discovered at the site. Three of them were found in the northern part of the investigated area (Fig. 4), and one shorter section was located in the southern part, approximately 420 m away from the others.

The northernmost, full-profile section of the trench (Feature 848) was approximately 55 m long. The trench ran in a zigzag pattern along a north-south axis, with a slight deviation. The individual bends were spaced 5-7 m apart. The width of the trench at the detection level for most of its length was about 1.2-1.4 m. The sides were mostly sloped, narrowing the width at the floor of the trench to about 0.6 m. In some sections on the western side, a small shelf was formed at a height of approximately 0.6 m from the floor of the trench. The maximum recorded depth of the trench was 1.17 m. Steps leading into the trench were located at its northern and southern ends. In its northern section, over a length of approximately 25 m, the floor of the trench was lined with concrete paving slabs. On the eastern side of the trench, 10 firing positions in the form of quadrilateral niches were dug, one in each section between the bends of the trench. Their shape in the upper part was disturbed, most likely due to the corners at the junction between the niche and the trench collapsing. Relative to the floor of the trench, the firing positions were shallower by about 0.2-0.3 m. Twelve artillery shell cases, a transport crate partition and a 23 mm aircraft shell were recovered from the feature.

Fig. 4. Miejsce Piastowe, Krosno County, Site 22. Aerial photo of the site: Feature 830 on the left, Feature 747 on the right. Photo by A. Lach

The next section of a full profile fire trench (Feature 840) was approximately 41 m long. The trench ran in a zigzag pattern from north-west to south-east. Its individual bends were spaced 4-6 m apart. The width of the trench at the detection level for most of its length was approximately 1.2-1.4 m. The sides were sloped, narrowing the width at the floor of the trench to 0.5-0.75 m. The maximum recorded depth of the trench was 1.14 m. On the northern side, the trench ended in a narrow corridor of 4 m in length and up to 1 m in depth. Steps leading into the trench were recorded at both its northern and southern ends. On the eastern side, 10 firing positions (analogous to those in the previous trench) were dug, one in each section between the bends of the trench. Relative to the floor of the trench, the niches were shallower by about 0.2-0.5 m. At 16 m on the northern side, a narrow corridor, approximately 7 m long and approximately 0.75 m deep, diverged from the trench and zigzagged in an eastward direction. A total of 131 artillery shell cases, the fin of a mortar shell with several fragments, metal remains of an artillery shell casing and a pocket knife were discovered in the fill of this feature.

The last fire trench (Feature 747) in this part of the site was approximately 23 m long. The trench ran in an irregular zigzag pattern from north-west to south-east. The width of the trench at the detection level for most of its length was between 0.7 m and 1.2 m. The sides were sloped, narrowing the width at the floor of the trench to 0.35-0.55 m. The maximum recorded depth of the trench was 0.93 m. Steps leading out of the trench were recorded at its northern end. Three firing positions were dug on the eastern side. Relative to the floor of the trench, the niches were shallower by about 0.3-0.5 m. The fill of this feature yielded 39 artillery shell cases, 6 primers and 3 bottle fragments.

The remote fire trench, recorded in the southern part of the excavated area (Feature 456), was approximately 20 m long. It ran in a zigzag pattern along a north-south axis. The width of the trench at the detection level for most of its length was between 0.7 m and 2.30 m. The sides were sloped, narrowing the width at the floor of the trench to 0.40-0.55 m. The maximum recorded depth of the trench was 0.86 m. Four fire steps in the form of quadrangular niches were dug on the eastern side of the trench. Relative to the floor of the trench, the niches were shallower by about 0.3 m. No archaeological material was recovered from this feature.

Trench infrastructure

The uncovered trenches were accompanied by 20 foxholes (Table 1). They were all oval or quadrangular pits, oriented along the NE-SW axis. Most of them were located in the gaps between the trenches.

Two features, most likely associated with ammunition storage, were discovered halfway along the northern line of trenches. They were located in the rear of the trenches, approximately 10 m from the main line of the installation. The larger of the two (Feature 855) was quadrangular in shape, measured 2.49 x 2.29 m and was 0.12 m deep. Its fill

contained charcoal and numerous burnt remains. Two artillery shell cases and completely corroded remains of at least four transport crate covers were discovered inside it. The second example (Feature 856) was in the shape of an irregular, shallow pit measuring 1.77 x 1.64 m. A layer of burnt material and the remains of three completely corroded transport crate covers were discovered inside its fill.

In the foreground of the trench line, three features of an almost circular shape and with similar diameters of approximately 0.75 to 1 m and depths of approximately 0.8-0.9 m were discovered (Features 845, 846, 864). A single primer was found in the fill of one of them. Given the nature and location of the features, it appears that they may be the remains of cesspits, probably constructed during the digging of the trenches.

Table 1. List of foxholes from Site 22 in Miejsce Piastowe

Feature	Shape	Profile	Dimensions in cm	Depth in cm	Inventory
429	rectangular	concave	140x51	7	7 artillery shell casings
814	rectangular	rectangular	79x58	19	9 primers
815	oval	irregular	216x107	63	
818	oval	rectangular	216x107	63	
819	oval	rectangular	172x120	79	3 primers
820	oval	rectangular	202x115	69	artillery shell casing; 9 primers
831	rectangular	rectangular	148x53	61	
834	oval	rectangular	174x90	64	
837	oval	irregular	174x90	59	
841	L-shaped	irregular	211x157	91	8 primers
842	oval	concave	101x119	79	
844	rectangular	concave	172x1202	7	
847	rectangular	concave	144x70	51	
849	rectangular	stepped	134x89	83	7 artillery shell casings
851	rectangular	stepped	159x63	51	22 primers
852	rectangular	stepped	150x92	68	fragments of a stick grenade; 2 artillery shell casings
863	L-shaped	irregular	194x141	111	3 burnt boards from ammunition boxes; 8 steel shell cases; 3 transport crate covers; fragment of a bottle
865	oval	concave	115x55	18	3 primers
866	oval	concave	80x57	72	
869	rectangular	stepped	166x64	51	6 artillery shell casings

Description of artefacts

10.5 cm shell cases

The most numerous among the artefacts recovered are the remains of German 10.5 cm calibre cases used in the leFH 18, leFH 18(M) and leFH 18/40 light field howitzer (Pataj 1975, 270, 291). A total of 210 such items were found, with Feature 830 yielding their largest number (131 pieces, Fig. 5). All the specimens recovered were made of steel (*cf.,* German... 148-151, figs 105-107). The shells were either one-piece specimens, made from a single piece of steel; two-piece specimens, with the casing and the base pressed together (Fig. 6: b); or consisted of multiple parts joined with screws (Fig. 6: a). Due to advanced corrosion, no stamped markings have been preserved on their bases. Most of the uncovered shell cases had primers installed, and, because they were fired, they bear an impact mark left by the firing pin. In the case of 11 shell cases, their primers had been unscrewed.

Primers

Apart from the shell cases, the most common artefacts are primers (62 pieces; German... 148, 155, figs 105 and 107), which are directly associated with the former items. On two primers unscrewed from their cases, it was possible to partially read the markings in the form of digits: 1944, which indicate the year of their manufacture (Fig. 6: c-d). Considering that primers were screwed into shell cases during production, the large number of artefacts of this type discovered at the site is puzzling.

Fig. 5. Artefacts from the features: 10.5 cm artillery shells discovered in Feature 830. Photo by A. Lach

Fig. 6. Artefacts from the features: shells from Feature 722 (a) and 820 (b); primers from Feature 820 (c-d). Photo by A. Lach

Artillery shell

During the exploration of Feature 830, an artillery shell packaged in a special individual box was recovered from the bottom of the feature (German... 146, 147, fig. 104; see Figs 7 and 8). This packaging was made of wooden slats joined together by metal bars forming its frame. The projectile was placed in a stabilising clamp and secured with a webbing or leather belt. It was packaged with the fuse already installed and set for immediate action. After removing it from the box, the shell was instantly ready for use. The find is no longer extant, upon discovery in the excavation, sappers were called in; they removed the shell from the packaging and took it away. What remained of the packaging were nine metal components of the container in the form of destroyed frame fragments and locking elements (Fig. 9).

Fig. 7. Firing position, summer 1941.
After: Engelmann 1995

Fig. 8. leFH 18 gun on the Oder front. Under the foot, a carrier for six shells.
After: Engelmann 1995

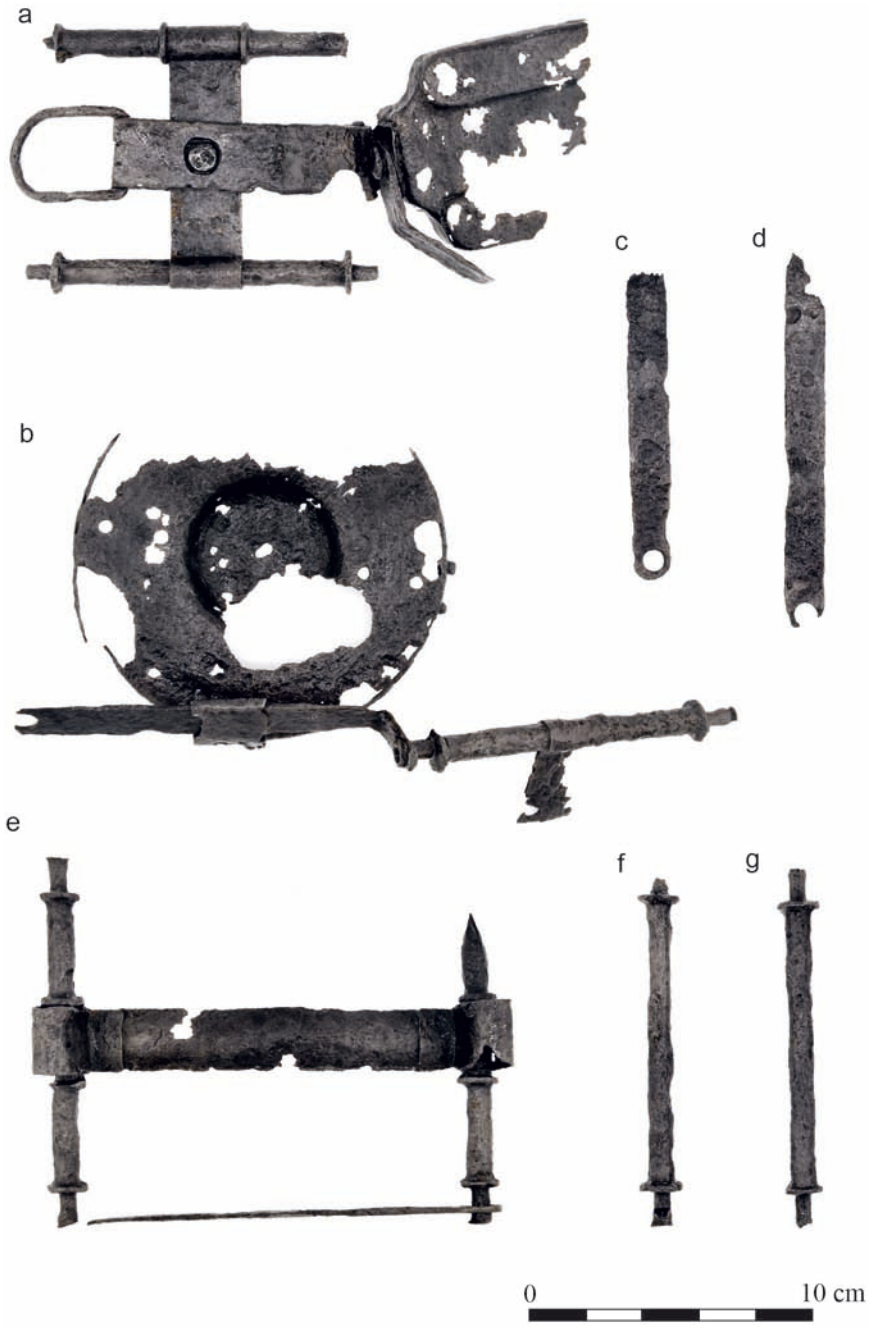

Fig. 9. Metal element of artillery shell packaging from Feature 830.
Photo by A. Lach

Ammunition boxes

The excavations at the site yielded three fragments of burnt boards from ammunition boxes. As indicated by the circular grooves on the inside of the boards, they came from boxes designed for 10.5 cm shell cases. Preserved on two of the fragments are markings drawn in white paint. The first fragment bears the inscription in the form of letters "le. F. H." (Leichte Feldhaubitze), indicating that the contents were intended for a light field howitzer (Fig. 10: a). A fragment of the marking preserved on the second board is in the form of two rows of letters: "Heer..." at the top is the remnant of the inscription Heeres-Munition, indicating that the crate contained military ammunition, while "Gesa..." in the lower row is the remnant of the word Gesamtgew, meaning total weight (Fig. 10: b). This was standard information placed on ammunition boxes.

Fig. 10. Artefacts from the features: fragments of ammunition crates from Feature 863 (a-b); 23 mm shell from Feature 848 (c). Photo by A. Lach

Fig. 11. Remains of transporting crates from Feature 848.
Photo by A. Lach

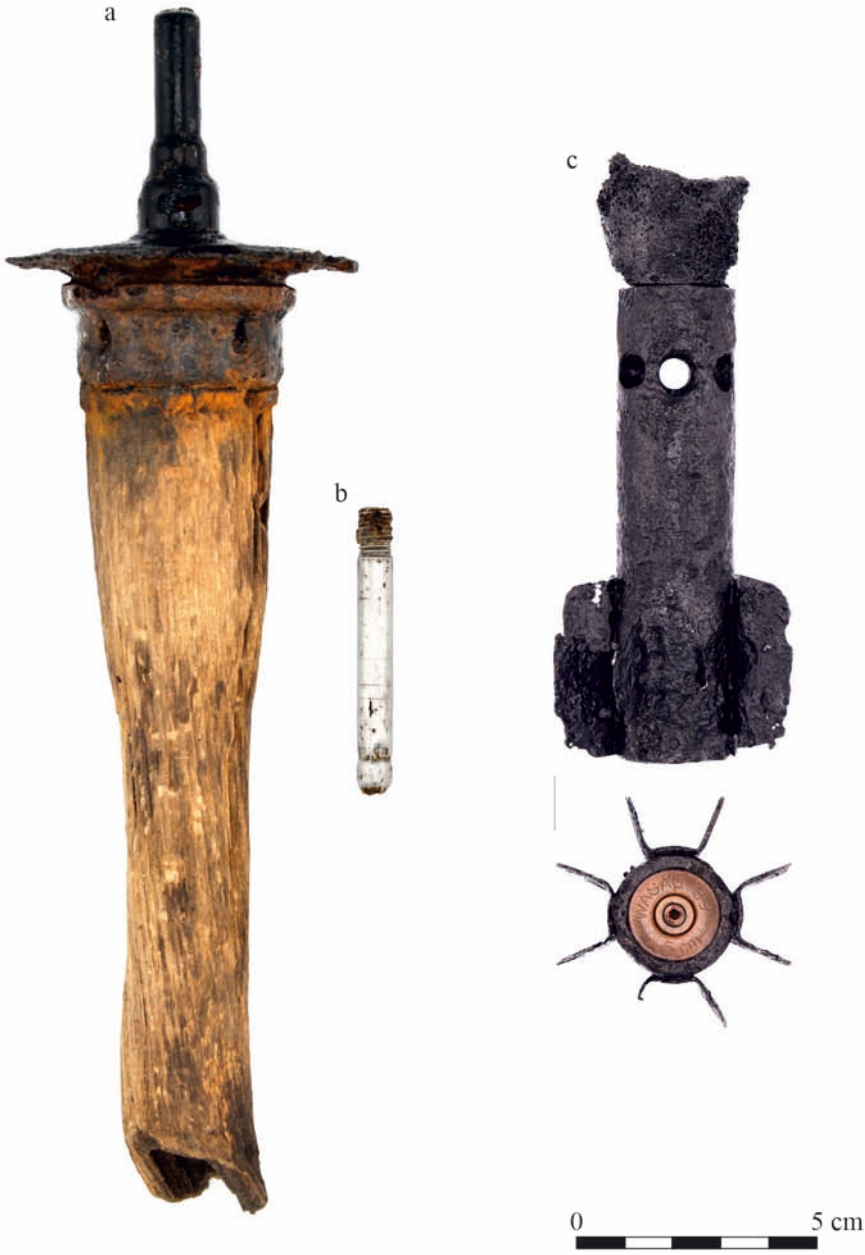

Fig. 12. Artefacts from the features: stick grenade from Feature 852 (a-b); mortar grenade from Feature 830 (c). Photo by A. Lach

Transport crates

The site also yielded the remnants of three steel covers (Feature 863; Fig. 11: a) and an aluminium partition (Feature 848; Fig. 11: b). The remains of covers of this type were also recorded in the top levels of Features 855 and 856; however, they were completely corroded. The pieces in question are the remains of transport crates used to carry six shell cases with a propelling charge. Such a case had a wood and metal frame, two covers on leather straps, an aluminium inner partition and webbing straps for carrying the crate (Fig. 8).

Mortar shell

A stabiliser of a German 5cm calibre mortar shell was discovered in Feature 830 (Fig. 12: c; *cf.*, GEO, 530, fig. 542). Together with a small, preserved fragment of the casing, it measures approximately 10 cm in length. An eight-fin assembly and six gas ports arranged circumferentially in a single row have been preserved. As indicated by the state of the primer, the projectile had been fired. The primer bears the following legible markings: WASAG – 39 – 5 cm. The marking on the body above the flash holes is illegible. Three shrapnel pieces, probably from the explosion of the projectile, were also discovered a short distance from the tail. Rounds of this type were intended for the 5cm leGr Wr 36 mortars, used by the German army during the early stage of World War II. Towards the end of the War, line units replaced it with the heavier 81mm calibre mortar (Bryja 1996, 118).

Stick hand grenade

Feature 852 yielded a destroyed German Model 39 stick hand grenade (Stielhandgranate 39). The bottom part of the head, with a detonator socket, set on a wooden handle and two small fragments of the handle's lower body with a cut-out for a ferrule have been preserved (Fig. 12: a). Discovered inside the handle was a destroyed Bz. 39 fuse in the form of an aluminium tube (Fig. 12: b). The artefact represents the basic type of grenade used by the German army during World War II (see Skotnicki 1997, 64-63).

23 mm projectile

Discovered in the fill of Feature 848, in are M81, was a Soviet BZ shell, a newer-type armour-piercing incendiary shell for a 23 x 152 mm B cartridge (Fig. 10: c; *cf.*, Koll 2009, 186-188). The preserved length of the projectile is approximately 8 cm. It has a hardened steel core with a remnant of a windshield and incendiary compound. The projectile has a driving band with visible grooves left by the barrel thread, indicating that it had been fired. This type of round was developed for the VYa-23 autocannon, 23 mm calibre, used from 1942 in the Soviet Union as an on-board weapon of the Il-2 ground-attack aircraft (Shirokorad 1999, 112-115).

Pocket knife

Found in one of the trenches (Feature 830) was a small, folded penknife, about 6.5 cm long (Fig. 13: b). Its handle scales are flat and made of light-coloured plastic, probably celluloid. They were attached with three copper rivets. The penknife most likely had only one blade, residually preserved inside the handle. It is impossible to say with certainty whether the uncovered knife was the property of a German soldier or some civilian who lost it when backfilling the trenches. During World War II, the German army did not have a regulation penknife (Sáiz 2009, 266-267), and knives obtained from the civilian market were in common use.

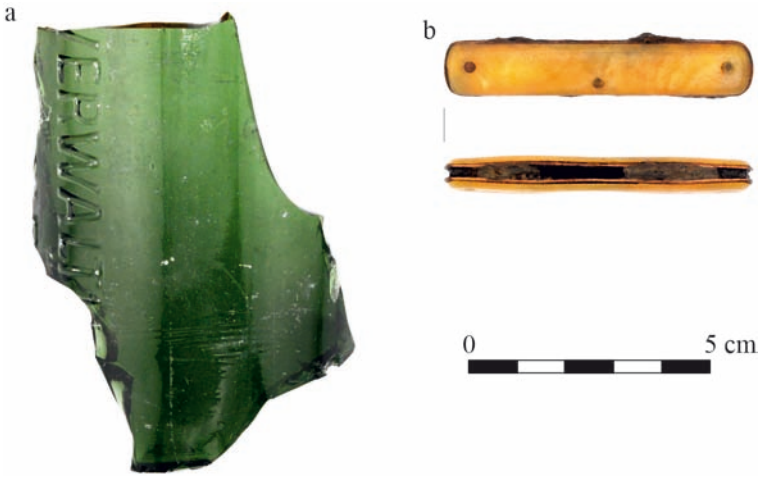

Fig. 13. Artefacts from the features: bottle fragment from Feature 747 (a); pocket knife from Feature 830 (b). Photo by A. Lach

Fig. 14. Bottom of Feature 848 lined with concrete paving slabs. Photo by A. Lach

Bottles

During the excavation of the site, three bottle fragments were recovered from Feature 747, while one bottle fragment was found in Feature 863. On the body fragment of a green bottle from Feature 747, there is a fragmentarily preserved inscription: "VERWALTU..." (Fig. 13: a). The full inscription most likely read: GRAFENORTER SAUER – BRUNNEN VERWALTUNG – FRIEDRICH WEBER (*cf.* MyViMu, FRIEDRICH WEBER), which means that the artefact is a German bottle from the mineral water bottling plant at 31 Klasztorna Street in Wrocław (Wenzel 1906, 175, 409, 410).

Paving slabs

At its northern end, the bottom of Feature 848 – a fire trench – was lined over a length of about 25 m with approximately 150 concrete paving slabs (Fig. 14). The slabs were squares with a side of 30 cm and thickness of 4.5 cm. They had been laid in two rows. Most of the slabs used were whole, and only a few were fragmented.

3. ANALYSIS

The recovered artefacts clearly indicate that the discovered features date to the Second World War, specifically the second half of 1944. Most of the features are the remains of ground positions of a German leFH 18 gun battery protected by an accompanying line of trenches.

The position uncovered consisted of at least three howitzers arranged in a straight line at intervals of 30 to 60 metres, which can be concluded based on the spatial layout of the features at the site and the structure of artillery regiments comprising German infantry divisions, known from the literature. Howitzer batteries in the infantry divisions of the *Wehrmacht* ordinarily consisted of four guns; however, as a result of losses incurred, maintaining the default status proved impossible in many cases, and most infantry divisions had three-gun batteries (Bryja 1996, 25).

For divisional artillery guns, round or roughly triangular dug-in firing positions (German: Geschützestellung) were constructed, which were usually surrounded by solid parapets providing protection against counter-battery fire (Rottman 2004, 36). No gun emplacements of individual cannons have been preserved at the site, which may mean that the guns stood directly on the ground or were only slightly dug into the topsoil, thus leaving no characteristic traces. Based on the uncovered spatial layout of the features at the site and the diagrams available in German sources (*cf.*, Bildheft..., figs 30 and 31; Fleischer 2004, 52, 53), it was possible to reconstruct the positioning of the individual guns. According to the artillery position layout schemes used by the Wehrmacht, the guns were most probably located in the gaps between individual sections of the rifle trench (Fig. 15). Each gun was accompanied by dug-in structures intended to serve as shelters (German: Unterschiupfe),

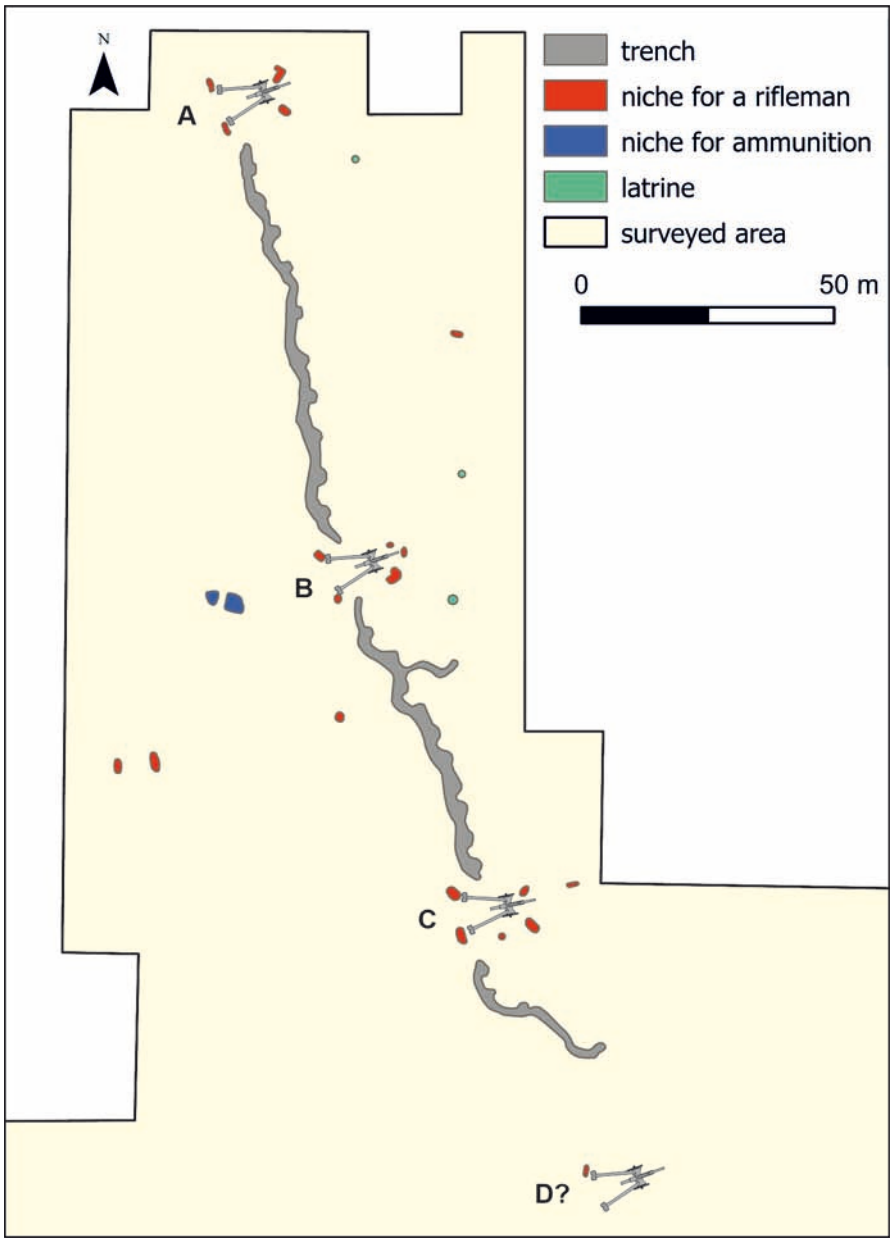

Fig. 15. Reconstruction of the artillery arrangement at Miejsce Piastowe, Krosno County, Site 22. Drawing by E. Rydzewska

ammunition niches (German: Munitionsnischen) and anti-tank positions (German: Panzerdeckungslöchern) for a soldier with an anti-tank weapon.

For the purposes of this study, the guns have been assigned the letters from A to D. The northernmost Gun A was located between Features 851, 852, 863 and 869. Gun B was positioned in a gap in the trench line, between Features 841, 844, 849, 865 and 866. Gun C, like the previous ones, stood in a gap in the communication trench, between Features 814, 815, 818, 819 and 820. If the battery had consisted of four cannons, it can be assumed that the fourth gun was located near Feature 429 (Gun D).

A full-profile fire trench with east-facing fire steps (Feature 848) was constructed between Gun A and Gun B. A similar trench (Feature 830) was dug between guns B and C. Another trench, which, due to its shape and size, should be considered unfinished, ran from Gun C in a southerly direction (Feature 747). Taking all this into account, it can be assumed that the small-sized Features 814 and 866 (Table 1) are probably imprints left by the foot of one of the gun supports rather than destroyed remains of foxholes. Feature 456, a short fire trench the furthest removed from the others, was probably constructed to secure the battery position from the Iwonicz side or it may be the remains of a subsequent artillery position under preparation.

The vast majority of the World War II artefacts discovered during the excavations are related to the German field howitzer positions and their shelling attacks. The investigated site yielded 210 artillery shell cases; however, it should be assumed that the battery stationed at this location could have fired significantly more shells. This possibility is indicated by the very uneven distribution of the shell cases discovered at the site. Most cases, as many as 139, were found near Gun B, then near Gun C – 51 cases, and near guns A and D – 18 and 7 cases, respectively. The 139 shell cases found in the features near Gun B may indicate that a similar number of shells were fired from the other howitzers. It is difficult to determine what percentage of shell cases was deposited in the features. Therefore, it can be estimated that the number of shells fired ranged from about 50 to about 150 per gun. The leFH 18 howitzer had a range of 10.675 to 12.325 kilometres, depending on the variant (Engelmann 1995, 13-18).

4. CONCLUSION

The artillery position uncovered was most likely constructed in the last days of August 1944. It was built following the standard principles employed by German troops at the time for establishing such positions; however, all evidence indicates that the work was not completed. According to an account by a resident of Miejsce Piastowe, Józef Rajs (2014, 31), before the start of the Soviet offensive, the Germans established a field depot for artillery ammunition in the parish cemetery in Miejsce Piastowe. During the day, in the adjacent fields, German soldiers would arrange positions for the guns that were soon to arrive.

One day, the Germans who were working in the fields were attacked by two Soviet planes that arrived unexpectedly from the east. The Germans, who suffered from the airborne gunfire and light bombs, supposedly incurred heavy losses in the raid. The positions mentioned in the account are probably the discovered site, located approximately 500 m from the cemetery. A remnant of the aforementioned raid may be the Soviet BZ missile, used in the Il-2 aircraft, which was found in Feature 848.

The artillery battery that was stationed at the discovered position was most likely part of the 208th Artillery Regiment of the 208th Infantry Division that defended this section of the front. The battery fired from this position during the initial period of the offensive of the Prešov-Dukla Operation, *i.e.*, on 8-9 September 1944. After the Soviet army broke through the defence line, the Germans withdrew from Miejsce Piastowe, abandoning their positions and ammunition depot. The artillery ammunition left behind by the German troops was taken by the Russians to the Łężany airfield and detonated there (Rajs 2014, 31). Over time, the area of the artillery position was cleaned up by collecting and burning the wooden pieces of artillery ordnance. The remaining artillery shell cases were thrown into the nearby structures, which were then levelled.

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CHRONICLE

Halina Dobrzańska[1]

ZENON WOŹNIAK
(1931-2025)

Fig. 1. Professor Zenon Woźniak. Photo. K. Tunia

On February 3rd, Professor Dr Hab. Zenon Woźniak passed away. Seven days later, we paid him the last homage at the Prądnik Czerwony Cemetery in Kraków. It was a very sad day for the Cracow archaeological community and those who were close to the Professor throughout his life. We lost an outstanding scientist and a man of great kindness, well-regarded by all who knew him (Fig. 1).

Professor Zenon Woźniak was born on November 29th 1931, in Starachowice, now in the Świętokrzyskie Voivodship. His school years fell during the difficult period of WWII

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and just after it. He was getting an education irregularly in various places. After completing the General Secondary School in Trzebnica, he applied, according to his interests, to study in the Department of Polish Language at the Jagiellonian University in Cracow. However, due to a lack of vacancies, his application was refused. Eventually, he enrolled in the three-year course on the history of material culture at the same school. University diploma of the first level, obtained in 1953 after passing the final exam with an outstanding note from the supervising Professor Rudolf Jamka. Throughout the next two years, he continued studies at the Poznań University (later the Adam Mickiewicz University, abbreviated as UAM), at that time the only institution in Poland offering MA courses in archaeology (framed into the School of the History of Material Culture). He obtained his master's degree in 1955 based on the thesis entitled 'Archaeological materials for the prehistory of the Rawicz district'. Interesting and little-known information about this period of Zenon Woźniak's life can be found in the paper by Lucyna Leśniak (2025), based on archival documents at UAM and references to the memoirs of Professor Jan Machnik (2017).

After returning to Kraków in 1955, Zenon Woźniak was appointed to a post at the city's Archaeological Museum. His employment there (initially in the Nowa Huta Branch) lasted till 1964. Then he became an employee of the Institute of the History of Material Culture of the Polish Academy of Sciences (abb. IHKM PAN), which today is the Institute of Archaeology and Ethnology (abb. IAE PAN). This institution is linked practically to all of his professional career, from 1964 up to his retirement in 2001. In the 1980s Zenon Woźniak assumed the post of the Head of the Archaeological Station at Igołomia, belonging to the Cracow Branch of IHKM PAN.

The Professor's professional interests focused on the Early Iron Age and the Hallstatt, La Tène, and Roman periods. He is the author of 200 scientific works, including five books (Dobrzańska *et al*. 2005, 7-15). His main research objective was the Celtic culture in Central and Eastern Europe. In this field, he was an unquestionable expert, recognised in Poland and abroad, beginning with the publication of his work on the Celtic settlement in Poland (Woźniak 1970). This significant study was based on his doctoral thesis, which was elaborated under the supervision of Professor Stefan Nosek and defended at the IHKM PAN in 1967. A series of other works and the habilitation thesis on the eastern borderland of the La Tène culture (Woźniak 1974) only augmented his reputation. The title of full professor was granted to Docent Zenon Woźniak in 1989.

The achievements of the Professor in studies on the Celtic culture in Poland and south-eastern Europe, based on a thorough analysis of archaeological evidence, still retain their value, despite the natural progress of our knowledge and discoveries.

It is not possible to list all the scientific achievements of the Professor in this short text. Among the most important, there is a significant revision of the chronology of Celtic culture in Lower and Upper Silesia, and the definition of the Celtic-Przeworsk group in Lesser Poland, later referred to by him as 'the Tyniec group'. Remarkable is the evidence for the existence of a Celtic mint workshop in this territory. It should also mention the mono-

graphic work on the painted pottery workshop in Podłęże, Kraków district (Woźniak 1990). Further, there is the study on ancient stone sculptures from the Ślęża Mountain, in which a hypothesis of a possible Celtic nemeton-type sanctuary was put forward (Woźniak 2004), and the chronological definition of the terminal phase of the Lusatian and Pomeranian cultures. In his focus, there were also the Púchov culture and, so far, unnoticed on Polish territories, materials of the Jastorf culture. It is not commonly known that the Early Slavic pottery on the settlement site Kraków Mogiła 1 was recognised by Zenon Woźniak. It resulted from his research visit to Bohemia in the 1960s, when the Prague-type pottery was being defined. Professor Helena Zoll-Adamikowa has many times underlined this fact.

From the late 1950s, Professor Zenon Woźniak led field research for several years at multicultural settlement sites: Kraków-Mogiła 1, Podłęże in the Wieliczka district, and Targowisko and Łężkowice, both localities in the Bochnia district. In the 1960s, as a member of the Carpathian Archaeological Expedition led by Professor Andrzej Żaki, he excavated sites associated with the Púchov culture.

For more than forty years, Professor Zenon Woźniak was associated with the international periodical 'Acta Archaeologica Carpathica', issued by the Archaeological Committee PAN, initially as an editorial secretary and, after Professor Żaki left Poland in 1975, as editor-in-chief. Under his supervision, over 35 volumes of AAC were published, highly ranked by Central European archaeologists. When the same institution created the series 'Prace Archeologiczne', Professor Zenon Woźniak resumed editorial responsibility for editing the first volumes. For many years, he was editorial secretary and then deputy editor-in-chief of 'Sprawozdania Archeologiczne', a periodical of IHKM PAN in Cracow.

Among the important achievements of Professor Zenon Woźniak are the elaboration of the concept of monographs on sepulchral sources from the Pre-Roman to Early Migration periods in Poland. They were to include not only archaeological materials but also anthropological, palaeozoological and metallographic evidence according to needs and possibilities. The project, truly of European magnitude, has so far resulted in the publication of 28 works in English and German, framed within the series 'Monumenta Archaeologica Barbarica'. The *Collegium Editorum* of the series was presided over by Professor Zenon Woźniak. This success was made possible by grants obtained, first (from 1993) from the Committee for Scientific Research, then from the National Science Centre. Additional organisational and financial support was provided by several other institutions, *e.g.*, the State Archaeological Museum in Warsaw, the Institute of Archaeology and Ethnology PAN, the Institute of Archaeology of the Warsaw University, and, finally, the Monumenta Archaeologica Barbarica Foundation.

The Professor was the editor of the collective study on contacts along the Amber Route at the turn of the eras (Woźniak *ed.* 1996) and the co-editor of the Jubilee Book offered to Professor Andrzej Żaki on his eightieth anniversary (Woźniak and Gancarski *eds* 2003).

Among Professor Zenon Woźniak's fields of activity was teaching. He supervised six doctoral theses on the La Tène and Roman periods, consulted on and revised many doctoral

Fig. 2. Professor Woźniak with his wife surrounded by his former PhD students and friends. Sitting (from the left): Halina Dobrzańska, Krystyna Jabłońska-Woźniak, Zenon Woźniak, Katarzyna Czarnecka, Paulina Poleska. Standing (from the left): Marcin Rudnicki, Tadeusz Makiewicz, Marek Bednarek, Vincent Megaw, Szymon Orzechowski. Photo: K. Tunia

and habilitation processes in Poland, France, and Germany, and served on many boards responsible for awarding scientific degrees. For several years, he lectured to students in the Institute of Archaeology of the Jagiellonian University and ran doctoral seminars in the Archaeological Museum in Cracow.

The scientific merits of Professor Zenon Woźniak were well recognised in Poland and abroad. He was being invited to various symposia, congresses and scientific associations. In 1959, he became a member of the Archaeological Commission of the Kraków Branch of PAN, serving as its secretary for many years and then as vice-chairman. In 1979, he was elected a corresponding member of the Deutsches Archäologisches Institut and the Arbeitsgemeinschaft LaTènezeit and invited to do L'association de fer in France. For several terms, he was a member of the Scientific Board of the IHKM PAN and then of the IAE PAN. In the Committee of Pre- and Protohistory PAN, he presided over the Committee for Evidences, and then the Committee of the Pre-Roman and Roman periods. Remarkable was also his cooperation with the Central European Commission of the Polish Academy of Arts and Sciences (abbr. PAU). In 1997, he was elected a corresponding member of the Historical-Philosophical Department of PAU. Twelve years later, the General Assembly of PAU Members granted Professor Zenon Woźniak the rights and the title of Full Member of this Department.

In 1977, Professor Zenon Woźniak received the Award of the Scientific Secretary of PAN for outstanding achievements in archaeology, and in 2003, the Józef Kostrzewski Award of the Association of Polish Archaeologists. He also received the state's Golden Cross of Merit.

The community of archaeologists of the La Tène and Roman periods honoured the Professor with two books dedicated to him. The first of them, published in 'Series Gemina'

(Andrzejowski *et al*. eds 2002), includes papers on Polish cemeteries from the Roman and People's Migration period. Most of their authors formerly collaborated with the Professor during his association with the series 'Monumenta Archaeologica Barbarica'.

IAE PAN in Cracow organised two jubilee events in honour of Professor Zenon Woźniak. The first one, in February 2002, for his seventieth anniversary, brought a large number of his archaeological friends and greetings from Poland and abroad. The second event, commemorating fifty years of Professor's research activities, was held in the same place in January 2006 (Fig. 2). During it he was honored by the book dedicated to him – 'Celts on the Margin', the common work of specialists in this field from Poland, Germany, Czech Republic, Hungary, Slovenia, Croatia, Bulgaria, USA and Australia (Dobrzańska *et al. eds* 2005).

I belong to those who had chances to develop their professional competence under the care and guidance of Professor Zenon Woźniak. He supervised my doctoral thesis, and after obtaining a PhD, he proposed me for the post of editorial secretary of 'Acta Archaeologica Carpathica'. I got to know him as a teacher, mentor, and experienced editor, very respectful of authors. From this time, I remember a very significant incident. The editorial board of AAC received a text in Polish written by a foreign author. To improve the language, I shortened some sentences, which, in my opinion, were slightly too long. However, such interference was not accepted by the Professor, who always followed the rule that any changes in someone's writing are acceptable only if the text is confusing or orthographically incorrect.

Zenon Woźniak was the only professor at Cracow's archaeological institutions who backed my idea to organise the Congress of the European Archaeological Association – 12th Annual Meeting Cracow 2006, and helped me with this challenging task (Fig. 3).

The man, unpretentious, taciturn, honest and empathetic, passed away. He will live in our memories.

Fig. 3. Professor Zenon Woźniak and Professor John R. Collis from Sheffield University at the opening reception of the 12 EAA Annual Meeting, Cracow 2006. Photo: L. Pizło

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(Review) Lubomír Šebela and Antonín Přichystal, *Silicite daggers in the territory of the Czech and Slovak Republics*. Spisy Archeologického ústavu AV ČR Brno 78. Brno 2024: Czech Academy of Sciences, Institute of Archaeology. ISSN 1804-1345, ISBN 978-807524-083-5 (print), ISBN 978-80-7524-084-2 (online, pdf), 198 pages with figures, plates and maps; DOI: 10.47382/arub2024-01.

In 2024, a monograph titled 'Silicite daggers in the territory of the Czech and Slovak Republics' was published by the Czech Academy of Sciences, Institute of Archaeology in Brno, as part of the series 'Spisy Archeologické hoústavu AV ČR Brno', volume 78. The book is another outcome of the long-term collaboration between two distinguished researchers of the Stone and Bronze Age: Lubomír Šebela (archaeologist) and Antonín Přichystal (geologist). It consists of 11 numbered chapters, as well as an excellently prepared illustrative section, which includes 55 figures (numbered consecutively within the chapters), four tables embedded in the text, and numbered according to the same scheme as the figures. A separate section, titled 'Annexes', contains 108 photographs and 39 plates. Additionally, 14 colour maps, marked with site locations, are included as inserts.

Essentially, the first four chapters serve as a comprehensive introduction to the research on silicite daggers in the Czech and Slovak Republics. They include a description of the issue, the region from which the materials originate (this section is complemented by Map II.1, illustrating the division of the Czech Republic and the Slovak Republic into geographical regions), a discussion of the history of research, and a compilation of sites with daggers (Tables IV.1 and IV.2). Table IV.1 provides information on the nature of the find, its potential context, and chronology. Table IV.2 provides a quantitative overview of the various types of finds discovered in Bohemia, Moravia, Czech Silesia, and, more broadly, in the Czech Republic and the Slovak Republic.

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Chapter V is dedicated to the siliceous raw materials represented in the analysed archaeological material. It discusses the methods used for characterising and comparing siliceous raw materials. The results of the analysis of the raw materials identified in the studied daggers are presented separately for materials found in the Czech Republic and Slovakia. Detailed data on the raw material used to craft individual daggers are provided in Tables V.1 and V.2. Table V.1 includes information on the location of the site within the administrative division of the Czech Republic (separately in the Czech lands, Moravia, and Czech Silesia) and Slovakia. It includes administrative data on the discovery locations, the inventory number of the institution where the artefact is stored, the raw material from which it was made, the type (classification and criteria for distinguishing types and varieties are discussed in Chapter VI), as well as references to illustrations and map numbering. Table V.2 presents the proportion of different raw materials identified in the archaeological material from the Czech Republic, Moravia, Czech Silesia, the Czech Republic as a whole, and Slovakia. The substantial variety of raw materials in the analysed materials is noteworthy. A total of 156 daggers were analysed. Over 25 different raw materials were identified (for 120 items). Additionally, for some items (for various reasons), the raw material was not determined. Most of the raw materials are represented by single artefacts, although there is a notable frequency of daggers made from Nordic flint (41 specimens), Nordic Danian flint (16), and Bavarian tabular chert (21).

Chapter VI provides a detailed discussion of the typological classification of silicite daggers. It begins with a presentation of existing typologies of such artefacts (pp. 41 and Fig. VI.1 and VI.2). The typological division proposed in the discussed work includes two main groups of daggers: those without handles and those with handles. A total of 11 basic types are defined, labelled as SDT I – SDT XI. Additionally, within types SDT XII and SDT XIII, fragmentary specimens are included, which, according to the authors of the publication, do not provide sufficient grounds for a more precise description and classification into one of the clearly defined types. Within type SDT I, 10 variants are distinguished, labelled as Variety IA – IK, and within variant ID, four subtypes labelled as subvarieties ID 1 – ID 4; within variant IE, two subtypes marked as IE1 and IE2; within type SDT IX, two subtypes labelled as IXA and IXB; and within type SDTX, two variants labelled as XA and XB. Specific examples are encompassed in type XI. This type includes two sets of chipped artefacts from graves associated with the Bell Beaker culture, identified as parts of two compound daggers made from organic materials. The distribution of daggers of different types, made from various raw materials, is illustrated by Maps IV.1-VIII.2.

Chapters VII and VIII contain information about the presence of silicite daggers in various cultural environments, with Chapter VII discussing those from the Eneolithic period and Chapter VIII focusing on the Bronze Age. The basis for cultural and chronological classification was the presence of daggers in settlement contexts or graves. Chapter VII discusses finds dating to the Eneolithic period from the territory of the Czech Republic. First, those from the Middle and Early Eneolithic: from the Czech lands (Cham and Řivnáč

cultures) and Moravia, followed by the Corded Ware culture (separately from the Czech lands, Moravia, and Czech Silesia), the Bell Beaker culture (from the Czech lands, Moravia, and Czech Silesia), and Slovakia.

Chapter VIII concerns silicite daggers recorded in Bronze Age contexts. The review follows a similar structure to the Eneolithic materials. It begins with a discussion of materials from the Czech Republic, starting with the Czech lands. Silicite daggers were recorded in contexts of the Únětice culture and Lusatian culture. The precise chronological classification within these cultures is preceded by a presentation of their chronological division (Fig. VIII.1). Such items were discovered in six graves, one settlement feature, and two hoards, dating to various phases of these cultures. Only one miniature dagger associated with the Lusatian culture was recorded in a grave at Lukovna. From Moravia, silicite daggers were discovered in contexts of the Únětice culture, Nitra culture, and Věteřov group. The cultural classification of individual specimens is preceded by a presentation of the cultural-chronological context (Fig. VIII.2). Chapter VIII concludes with a discussion of daggers found in the Czech Silesia region (Nitra group, Únětice culture, and Věteřov group) and Slovakia.

Chapter X is a catalogue of silicite dagger finds from the territories of the Czech Republic and the Slovak Republic. The finds are organised regionally, first from the Czech lands (Chapter X.2.1, sites numbered 1-65), followed by Moravia (Chapter X.2.2, numbers 66-114), Czech Silesia (Chapter X.2.3, numbers 115-117), from the Czech Republic but without a specific location (Chapter X.2.4, numbers 118-120), and from Slovakia (Chapter X.3, numbers 121-128). As noted by the authors, the catalogue reflects the state of knowledge up to 2019. Each site in the catalogue is described by the following characteristics: serial number, location within the administrative division, detailed site location, nature of the find (*e.g.*, surface find, excavation find, etc.), detailed description of the artefact and raw material characteristics, dating, associated finds, collections (e.g., private, museum, etc.), inventory number, and references to publications. Descriptions of the artefacts are accompanied by references to illustrative material (figures and plates).

The graphic section of this chapter, labelled as X.4 (Appendix – Catalogue of Daggers and Figures), contains drawings and photographs of silicite artefacts, ceramics, and other artefacts, as well as plans and photographs of selected objects. The 'textual' part of the book ends with an extensive summary in Czech.

An important and extensive part of the work consists of carefully prepared drawings and colour photographs (unnumbered chapter 'Annexes – Photos, Plates'). The first section features photographs of the artefacts, sometimes supplemented by detailed drawings, marked as Photos 1-109. It should be noted that Photos 1-81 present daggers from several angles, illustrating both the upper and lower sides of the artefacts and, in some cases, their cross-sections. In contrast, each of Photos 82-109, in addition to the photograph of the entire artefact, also includes an image taken with a stereoscopic microscope, showing the characteristic features of the siliceous raw material from which the depicted dagger was made.

The second part of this annexe consists of carefully executed drawings of the archaeological material. It consists of 39 plates depicting daggers, inventories, and plans of graves where such items have been recorded, as well as a deposit from the town of Litoměřice (Plate XIII). The work comprises 14 colour maps that illustrate the geomorphological division of the Czech Republic, the distribution of dagger sites, and the distribution of various types of daggers.

This book by Lubomír Šebela and Antonín Přichystal offers an extensive discussion of an essential group of artefacts. It provides a comprehensive presentation and thorough analysis, including chronological and cultural perspectives. The complete compilation presented in the catalogue includes information on silicite daggers, their methods of discovery, contexts, storage locations, and the raw materials from which they were made. A key complement to the analysis is the publication's well-developed, carefully prepared graphic section. What should not be overlooked, and this must be emphasised, is the critical organisation of this work, as well as the compilation of verified information, supplemented with solid data on the raw materials used, their origins, and the probable area where the dagger originated or was made. This information is particularly significant in attempts to reliably reconstruct the networks of connections and contacts during the Eneolithic and Bronze Age periods.

The discussed work is a significant event in the field of archaeological publications. Its value is multi-layered, with its primary importance found in archaeological source studies. The academic community has been provided with a comprehensive analysis of an essential category of materials. The archaeological and petrological descriptions of silicite daggers, as well as the chronological and cultural analyses of these artefacts presented in this publication, are, on one hand, a thorough and complete study, and on the other, an excellent starting point for exploring various issues related to the prehistory of Europe. Undoubtedly, 'Silicite Daggers in the Territory of the Czech and Slovak' *Republics* by Lubomír Šebela and Antonín Přichystal will occupy a prominent place in the bibliographies of researchers focused on the study of the European Eneolithic and Bronze Age.

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