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PREFACE

SARUNAS MILISAUSKAS
(1936–2024)

Professor Sarunas Milisauskas died April 1, 2024 in the Brothers of Mercy Nursing and Rehabilitation Center, Clarence (Buffalo USA). He was born in 1936 in Kaunas, Lithuania as the son of a business owner. He fled with his parents as a child ahead of advancing Russian troops at the end of World War II and lived in the American sector of occupied Germany before coming to Kenosha, Wisconsin USA. He met his wife, the former Vita Kriciunaite, who also came from Lithuania, in Chicago. They were married in 1961.

Sarunas Milisauskas served in the US Army before earning a bachelor's degree from the Ohio State University and was a member of Phi Beta Kappa (America's most prestigious academic honor society). He received his MA and PhD from the University of Michigan. He had begun archaeological research in 1965 at Neolithic and Bronze Age settlements in Central and Eastern Europe. After completing his doctorate in archaeology in 1970, he moved as an assistant professor to the State University of New York, University at Buffalo and stayed (as an associated professor and full professor) until his retirement in 2020. Sarunas Milisauskass served the University at Buffalo for over 50 years as Professor, Museum Director and Chair of the Department of Anthropology.

During his first year at University at Buffalo, Sarunas Milisauskas received a grant from the US government to study Stone Age inhabitants of Poland. This was the first grant ever received by the State University of New York, University at Buffalo in a foreign currency and it came from Polish payments for American wheat. Professor Milisauskas received also grants from the Smithsonian Institution's Foreign Currency Program Grants, the National Science Foundation, Fulbright Fellowship, the Wenner-Green Foundation and the American Council of Learned Societies for his studies of the chronology, environments, economies, and social organization of prehistoric communities. He published 14 books and more than 150 articles, book chapters, book reviews and commentaries. His

Fig. 1. PhD. Sarunas Milisauskas. University of Michigan, Ann Arbor (Archiv. J. Kruk)

books, *European Prehistory* (Academic Press), and *European Prehistory. A Survey* (Springer) follows the course of human activity in Europe from the Palaeolithic Age to the Roman Empire. He was elected to membership in the Polish Academy of Arts and Science. At the time of his death, he was working on a book about the history of European Archaeology.

*

As a PhD candidate at the University of Michigan in the fall of 1964, Sarunas Milisauskas initiated a project by applying for a Fulbright Exchange Program to Poland. His main area of interest was the Neolithic period of Central and Eastern Europe. At the time Americans has easier access to conducting archaeological work in Poland than in any other of the so-called Socialist countries.

A few months earlier in Spain, Professor James Bennett Griffin, Milisauskas' advisor at the University of Michigan, had met Konrad Jażdżewski, then professor at Łódź University and Director of the Archaeological Museum in Łódź, and discussed with him the possibility of Sarunas Milisauskas conducting research on Neolithic settlements in Poland. In the Fulbright application, Milisauskas identified Konrad Jażdżewski as the scholar with whom he would cooperate on the archaeological research in Poland. After receiving the Fulbright scholarship, Milisauskas arrived in Poland during the summer of 1965 to work with Konrad Jażdżewski. A housing shortage in Łódź made it impossible for the Milisauskas family to find housing, so Jażdżewski assigned them a room in the museum. At least the living conditions gave Milisauskas close contact with the archaeological material in the museum.

Because Konrad Jażdżewski was not about to be granted permission to conduct the American-Polish archaeological research project, Waldemer Chmielewski suggested that Milisauskas contact Professor Witold Hensel about project. At the time, Witold Hensel was head not only the Institute of History of the Material Culture, Polish Academy of Sciences but also the Archaeology Department of Warsaw University and a leading medieval archaeologist in Poland. He knew how the administration worked and advised Milisauskas to be patient. And indeed, it took 18 months to secure permission for the project.

In the meantime, Professor James B. Griffin wrote to Milisauskas to suggest applying to the Smithsonian Institution for funding with him as the Principal American Investigator and Sarunas Milisaauskas as Field Director. Professor J. B. Griffin continued in this role until 1970, when Milisauskas received his PhD and replaced him in this post.

In the spring of 1967, the long coveted permission to excavate was granted by the Polish authorities. The agreement for the cooperative archaeological work was signed on May 11, 1967 in Warszawa by James B. Griffin and Witold Hensel. Sarunas Milisauskas and Witold Hensel renewed the agreement twice during the 1970s. In 2016, and 2021 agreements were signed between the Institute for European and Mediterranean Archaeology at the University at Buffalo, the State University of New York, and the Institute of Archaeology and Ethnology Polish Academy of Sciences to continue research on Bronocice region.

Much of the success in obtaining permission to conduct field research and obtain funds for this particular initiative is owned to Witold Hensel and the late James B. Griffin who supported and encouraged Milisauskas to specialize in European prehistory, and was also instrumental in obtaining the initial funds from the Smithsonian Institution.

Sarunas Milisauskas owed his utmost gratitude to Professor Witold Hensel for enabling him to conduct research in Poland. He was given total scientific freedom to conduct research and Hensel never interfered in the field work. He also protected the project from devious moves by other archaeologists who were either against the project or who wanted to establish control over it.

Then, in 1967, with the assistance of Witold Hensel, Sarunas Milisauskas transferred from Łódź to the Institute of History of the Material Culture, Polish Academy of Sciences, section in Kraków in order to be able conduct a field project in southeastern Poland. Milisauskas and his family rented a room in the Wola Justowska district of Kraków. Living there, he had the opportunity to observe how pre-World War II and even pre-World War I Polish high society lived.

As an American archaeologist in Poland, Milisauskas was confronted with several challenging situations. For example, in the autumn of 1965, another American archaeologist arrived for several days in Poland to discuss the possibilities of conducting joint archaeological field research. His visit had positive and negative effects on Milisauskas' plans for field work. On the positive side, his presence indicated that American archaeologists had

Fig. 2. Professor Sarunas Milisauskas.
Department of Anthropology State University of New York, University at Buffalo (Archiv. J. Kruk)

an interest in working in Poland. On the negative side, this individual made some alarming statements while presenting himself as an expert on European prehistory, and suggested that Milisauskas join him instead in a field project. Sarunas rejected this proposition.

The archaeological project's objectives were to study the chronology, as well as the economic and social organization of the Neolithic and Bronze Age communities in south-eastern Poland. The majority of the project was founded by the Smithsonian Institution, *via* the Foreign Currency Program Grants. Source analyses were also founded by the grants from the National Science Foundation and the American Council of Learned Fellowships. Finally, the Institute of Archaeology and Ethnology (former Institute of the History of the Material Culture), Polish Academy of Sciences supported surveys and publications.

The cooperative agreement stipulated that American funds for the fieldwork would be evenly divided between American and Polish archaeologists. The project consisted of two stages. First, an excavation of individual Neolithic and Bronze Age sites such as Olszanica, Iwanowice and Niedźwiedź by American and Polish archaeologists was conducted. Next, a regional archaeological project involving American and Polish archaeologists in the Bronocice region of southeastern Poland was completed.

Sarunas Milisauskas directed the excavations at Olszanica. The Polish archaeologists used their allocated funds for excavation of two sites, Jan Machnik directed the excavations at Iwanowice, and Barbara Burchard conducted the field work at Niedźwiedź. Since the Polish antiquities law prohibits the removal of artefacts from the country, the analysis of the material from Olszanica was carried out in Poland by Sarunas Milisauskas with the help of young Polish archaeologists and students.

The goals of the Olszanica excavations evolved over two or three years. Many ideas came from the vigorous American archaeology of the 1960s. Sarunas Milisauiskas contemplated the possibility of such a study. The range and spatial patterning of human activities at Olszanica were studied by analyzing the intrasite (horizontal) distribution of artefacts and features in an area representing a relatively brief occupation. This type of archaeological investigation evaluates the proposition that different areas within the settlement were used for different purposes; hence, the spatial distribution of artefacts and features should reflect the *loci* of various activities.

In the Bronocice project, Sarunas Milisauskas conducted surveys and excavations of Neolithic sites in the region to investigate the prehistoric environment, chronology, economy, settlement system, and social organization. Furthermore, he wanted to contribute to the understanding of the social evolution of low-level hierarchical societies. This was the first systematic regional project conducted with such goals on Neolithic sites in Europe.

Professor Sarunas Milisauskas was interested in investigating the appearance of low-level hierarchical societies by using settlement data. The motivation for this research came from the work of archaeologists and cultural anthropologists at the University of Michigan. Richard Blanton, Kent Flannery, Gregory Johnson, Jeffrey Parsons, and Henry Wright were conducting research in Mesoamerica and Near East on the development of complex societies. Cultural anthropologists, such as Leslie White and Elman Service, had stimulated archaeologist's interest in the problems of social evolution. Professor Milisauskas considered the causes usually mentioned for the development of complex societies: population increase, warfare, ecological changes, trade, and internal conflict. Although a number of technological, economic, and social changes occurred during the Middle and Late Neolithic, the difficulty lies in trying to explain how these changes were associated with the development of a more complex society.

*

The original field research goals were accomplished at Olszanica and in the Bronocice region. Several studies, such as the intrasite spatial analysis and the origin of the low-level hierarchical societies, reflected the specific interests of American archaeologist's within the European context.

Numerous young archaeologists, and archaeology students from the universities in Kraków and Warszawa, received field training at Polish-American excavations. Some of

Fig. 3. Professor Sarunas Milisauskas at the Bronocice stone monument erected to commemorate the excavations (photo. J. Kruk)

them, such as Jerzy Kopacz, Jacek Lech, Krzysztof Tunia and Jacek Rydzewski became distinguished archaeologists. The Polish-American archaeological project and work of Sarunas Milisauskas, quite obviously changed the local landscape and local human relations. More importantly, however, the excavations have given the local communities a new visibility. Archaeological reports have made the names Olszanica and Bronocice familiar to archaeologists specializing in European Neolithic studies. And the local people are continuing in their efforts to publicize the results of the excavations that have already changed their lives to some extent.

*

Professor Sarunas Milisauskas was a distinguished scholar, a passionate teacher and mentor, a gifted administrator, and internationally renowned ambassador of American, and also Polish archaeology. But most importantly he was a wonderful friend and colleague, funny and authentic. He is deeply missed.

Janusz Kruk

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Maria Lityńska-Zając[1], Przemysław Bobrowski[2], Grzegorz Skrzyński[3]

THE EARLY HOLOCENE FLORA OF THE SOUTHERN PART OF THE WESTERN DESERT OF EGYPT

ABSTRACT

Lityńska-Zając M., Bobrowski P. and Skrzyński G. 2024. The Early Holocene flora of the southern part of the Western Desert of Egypt. *Sprawozdania Archeologiczne* 76/2, 13-35.

The article summarises archaeobotanical data and discusses the importance of plant remains for the reconstruction of ancient flora and vegetation during the development of Neolithic settlements in the southern zone of the Western Desert of Egypt. Such an attempt is possible thanks to archaeological and botanical research carried out there for many years. These studies have led to the identification of numerous plant remains that were found at different sites inhabited by nomadic tribes in various humid interphases of the Holocene.

The recognised subfossil flora includes at least 52 taxa. Archaeobotanical assemblages from individual sites are neither very diverse in plant species nor abundant in plant remains. The exception is Site E-75-6 at Nabta Playa, which yielded exceptionally rich plant material. The most favourable period for the development of flora, vegetation and settlement occurred during the Holocene Climatic Optimum, correlated with the El Nabta and Al Jerar settlement phases. This period was characterised by a relatively rich flora that grew in various habitats in the vicinity of the former settlements.

Keywords: Early Holocene, Western Desert, vegetation, settlement, archaeobotany, Egypt
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INTRODUCTION

In 1972, the Combined Prehistoric Expedition (CPE), founded in the early 1960s, began research and excavations in the Western Desert of Egypt, which have continued almost uninterruptedly ever since. As a result, dozens of prehistoric sites, with chronology ranging from the Lower Palaeolithic to the Neolithic, have been explored. Studies looking at early and middle Holocene settlements on the outskirts of dried-up palaeolakes (playas) in the southern part of the Western Desert proved to be particularly interesting. In 1974-1975, 1990-1992, 1994, and 1996-2008, work continued in the area of Nabta Playa, a fossil

Fig. 1. Location of fossil lakes (playas) with evidence of early and middle Holocene settlement activities in the Western Desert of Egypt (compiled by Przemysław Bobrowski, drawing by Paweł Wiktorowicz)

lake located at the foot of the mountain with the same name (Gebel Nabta). Some time later, the CPE explored several other settlements: in the area of Nab El-Dieb, another fossil lake not far from Nabta Playa (2000-2003); in the area of Gebel Ramlah (2000-2002, 2009-2022); and in the area of a palaeolake at Bargat El-Shab (2005-2006, 2011-2012, 2017-2019) (Fig. 1, see also Bobrowski *et al.* 2010; Schild 2019).

The excavations and interdisciplinary studies in the Nabta and Kiseiba area have made it possible to propose an early and middle Holocene chronological sequence, supported by a long series of radiocarbon and OSL datings. Spanning from the 11th to the 3rd millennium BC, the sequence includes seven humid climatic interphases separated by dry periods. Each humid period in the Western Desert was associated with the presence of specific hunter-gatherer and pastoralist groups (technocomplexes): El Adam (9250-800 cal. BC), El Ghorab (7550-7150 cal. BC), El Nabta/Al Jerar (6950-6150 cal. BC); Ru'at El Ghanam (5950-5550 cal. BC), Ru'at El Bagar (5450-4650 cal. BC), Bunat El Asnam (4550-3550 cal. BC) and Group C (2350-1350 cal. BC) (Schild and Wendorf 2013; Bobrowski *et al.* 2021, 15, tab. 1).

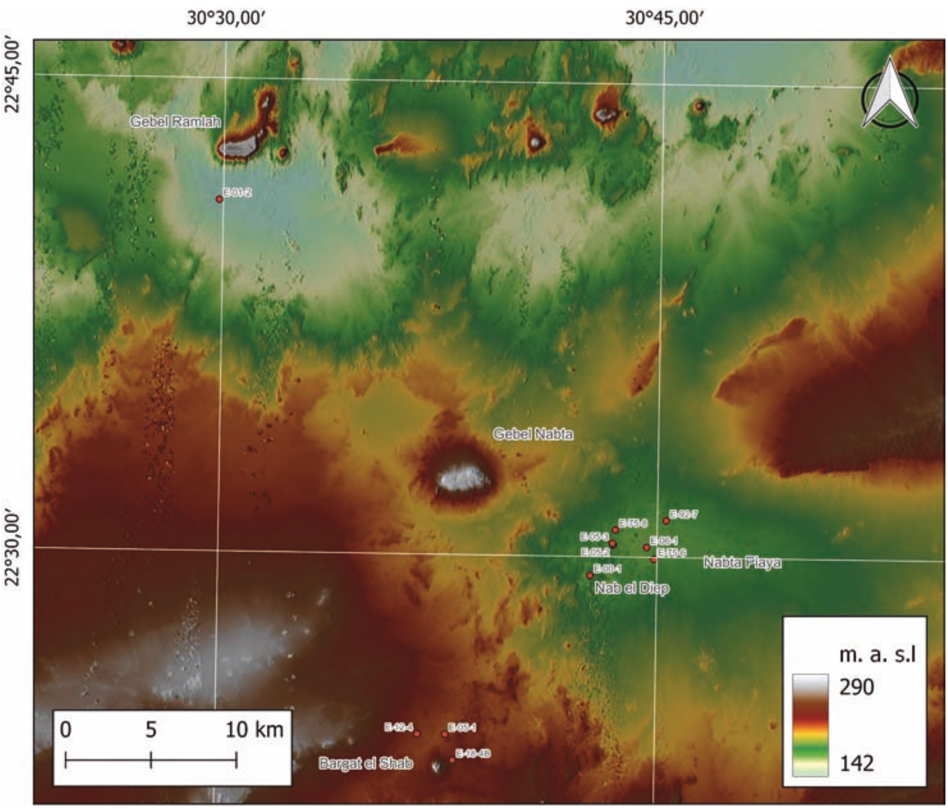

Fig. 2. Western Desert sites with sub-fossil flora remains
(compiled by Przemysław Bobrowski, drawing by Paweł Wiktorowicz)

The CPE has always been known for its multidisciplinary research approach. It has placed particular emphasis on archaeobotanical studies looking at the history of vegetation and plant use. This approach has allowed the reconstruction of past vegetation and plant life at and around the studied sites. This paper discusses the analysis of macroscopic plant remains, including seeds and, fruits and charcoal found during the exploration of eleven archaeological sites in the area of Nabta Playa, Nab el Diep, Gebel Ramlah and Bargat El-Shab. The chronology of those sites spans from the oldest Holocene settlement phase in the Western Desert (El Adam) through to the final Neolithic (Bunat El Asnam) (Fig. 2). The sites where macroscopic remains were found are presented below, with references to the aforementioned chronological sequence.

Botanical research in the southern part of the Western Desert of Egypt has helped identify a large number of plants over a dozen archaeological sites. The vast majority of the materials from the Nabta Playa, Gebel Ramlah, Nab El-Dieb and Bargat El-Shab sites have been published (*e.g.*, Neumann 1989, 1989a, 1993; Barakat 1995; 1995a; 1996; 2001; Wasylikowa 1997; 2001; Wasylikowa *et al.* 1995; 2001a; 2001b; Butler 2001; Wasylikowa and Lityńska-Zając 2012; Bobrowski *et al.* 2020; Lityńska-Zając 2010; 2019, in preparation; Lityńska-Zając and Skrzyński 2021). All of those authors have presented reconstructions of vegetation from the individual sites. This paper is intended to provide a summary of archaeobotanical data and discusses the significance of plants in reconstructing the flora and vegetation during the period of Neolithic settlement activity in southern Egypt.

SITES

The archaeological sites discussed in this paper lie in what is now the most arid part of the Sahara. As mentioned, in some periods of the Holocene, its climate was more humid, and in some periods, the area was located in the transition zone between semi-desert and desert ecosystems. Owing to the lie of the land and the structure of geological strata, water accumulated periodically in the local depressions. Thus, a kind of oases were formed, around which the archaeological sites analysed were located. The conditions at these localities triggered the emergence of relatively abundant vegetation, particularly during the rainy season. In wet periods, human groups would migrate to those locations, attracted by the presence of plant and animal food resources, and water. Traces of settlement activity left by those nomadic communities include graves, houses, various types of pits (including storage pits), wells, post holes, hearths, and campfires, where plant remains have been found.

Nabta Playa E-06-1 (El Adam)

Site E-06-1 is located in the central part of the Nabta Playa basin, on the eastern shore of an early Holocene lake, on the surface of a phytogenic dune (Fig. 3: B). A few settlement levels were recorded there, associated with the remains of residential structures (huts),

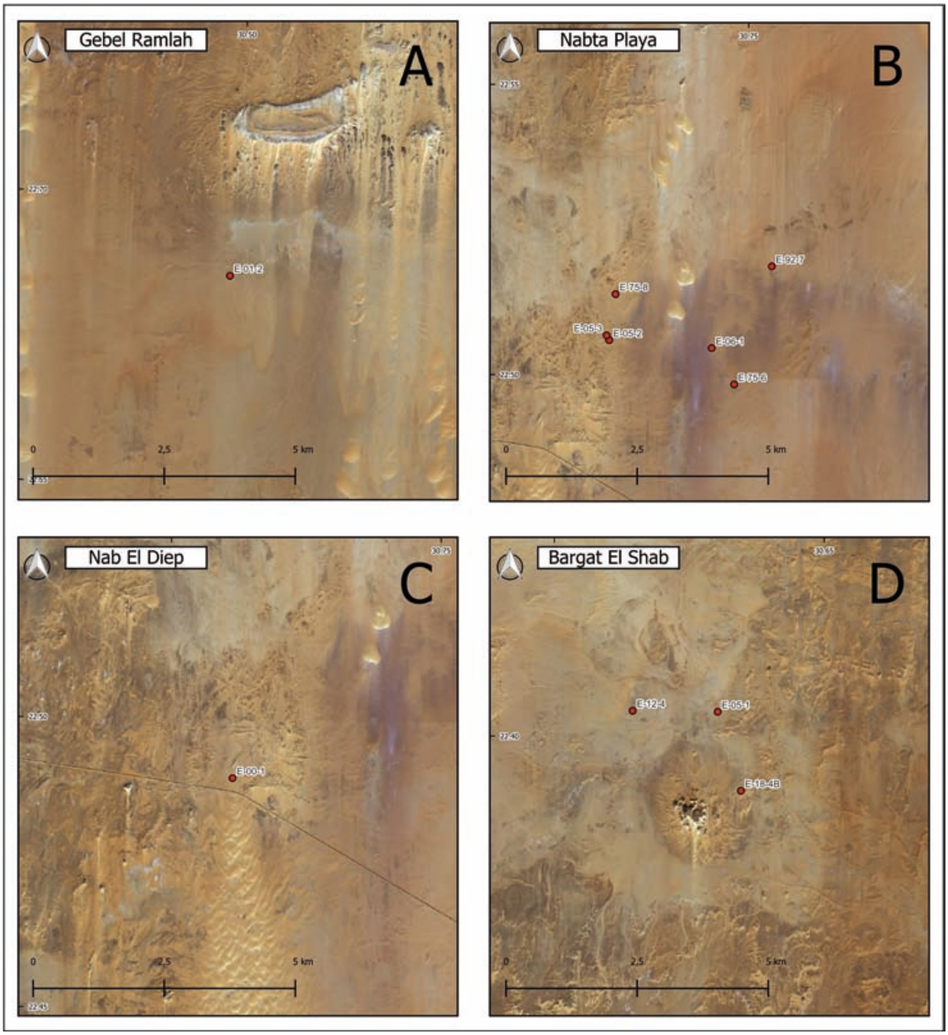

Fig. 3. Location of Western Desert sites with sub-fossil flora remains Gebel Ramlah (E-01-2); B – Nabta Playa (E-75-6, E-75-8, E-92-7, E-05-2, E-05-3, E-06-1); C – Nab el-Dieb (E-00-1); D – Bargat El-Shab (E-05-1, E-12-4, E-18-4B) (compiled by Przemysław Bobrowski, drawing by Paweł Wiktorowicz)

hearths and post holes (Jórdeczka 2021, 65-69). All those levels were associated with the oldest (probably recurrent) Holocene settlement activities in the Western Desert, in the El Adam humid interphase. A series of radiocarbon dates obtained from charcoal recovered from residential structures ranges from 8536 to 8011 cal. BC (Jórdeczka 2021, 214, tab. 37). Recorded remains come mainly from foci (*e.g.*, *Citrullus colocynthis*, although in light of recent research, the identification of *Citrullus* seeds at the species level is not justified see: Wolcott *et al.* 2021) and pits (*e.g.*, *Schouvia purpurea*).

Nabta Playa E-75-6 (El Nabta)

The site is located on the eastern shore of the Nabta palaeolake (Fig. 3: B). Traces of intense Early Holocene settlement activity in the El Ghorab and El Nabta/Al Jerar humid interphase were recorded there. Particularly significant were the traces left by the El Nabta period settlers in the form of numerous bell-shaped storage pits, hearths and a few wells. Owing to the specific preservation conditions, a unique collection of charred plant remains was found in the fills of these structures. The collection comprises more than 20,000 specimens representing more than 130 plant taxa, includes forms determined to the level of species, genus and family, but also those that were described as morphological types, identified based on preserved fruits, tubers, seeds, parenchyma and wood charcoal. The most important find is numerous remains of a wild form of *Sorghum bicolor* subsp. *arundinaceum* (Kubiak-Martens and Wasylikowa 1994; Wasylikowa 1997; Hather 2001; Wasylikowa 2001; Wasylikowa *et al.* 2001a; 2001b; Mazher 2005, 31, 32; Barakat 1995; 1995a; 1996).

Nabta Playa E-92-7 (Al Jerar)

The site is located on the northeastern shore of the Nabta palaeolake (Fig. 3: B). Traces of intense Early Holocene settlement activity from the El Nabta/Al Jerar humid interphase were recorded there. The examined features included numerous hearths with preserved charcoal. Radiocarbon dating indicates that the Al Jerar period settlement activity at this site continued from 7760±240 BP to 7040+80 BP. Plant remains found here include, among others, seeds of *Capparis decidua* (Fig. 5: 2), grains of *Echinochloa colona* (Fig. 5: 3), charcoal from *Tamarix* sp., and *Acacia* sp. (Wasylikowa *et al.* 2001b; Lityńska-Zając in preparation). Samples for botanical studies were collected from campfires.

Bargat El-Shab E-05- 1 (El Nabta/Al Jerar)

Site E-05-1 is located near a vast monadnock on the eastern shore of a palaeolake situated at the foot of the distinctive Bargat El-Shab rock massif (Figs 3: D and 4). Over an area of approximately 4 hectares, the researchers found traces of vibrant settlement activity from the Western Desert Holocene optimum coinciding with the El Nabta/Al Jerar humid interphase. Remains of recurrent settlement activity (hearths, storage and refuse pits, individual graves and potholes) were identified in several trenches. The fills of most of the features contained abundant plant materials (Bobrowski *et al.* 2021). The greatest number of macroscopic remains were recorded in and around Trench E-05-1/2, located on one of the two distinct culminations of the monadnock. These came from four hearths (H2, H3, H4, and H6), thirteen pits (P1, P3, P4, P5, P6, P7, P8, P9, P10, P12, P13, P15, and P16) and a pothole (F1) (Lityńska-Zając and Skrzyński 2021, 235, tab. 1). More plant remains were found in Trench E-05-1/5 at the southern end of the site, recovered from the fills of three pits and a hearth (The pits – Feature 2, 4, 7 – with an early Holocene chronology, were found under a mound of a presumed late Neolithic barrow, while a date associated

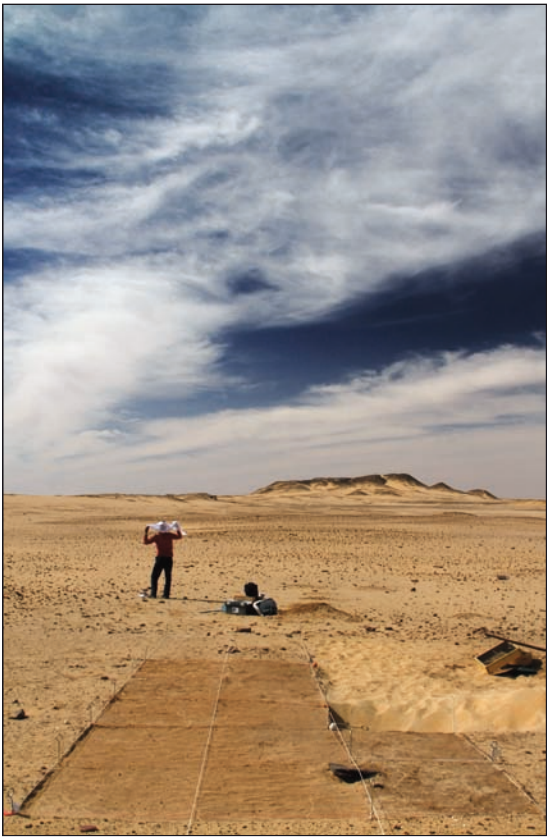

Fig. 4. Excavation in Bargat El-Shab at Site E-05-1/2 during research in 2006 (photo Przemysław Bobrowski)

with the settlement phase of the late Neolithic, Ru'at El Bagar, was obtained from a hearth-Feature 1- registered on its surface (see Bobrowski *et al.* 2021, 114, 115, 190), as well as from two other pits (P3 and P4) found in Trench E-05-1/4, in the central part of the site (Lityńska- Zając and Skrzyński 2021, 236, tab. 2, 3). The series of radiocarbon dates for this site spans the period from 7171 to 6232 cal. BC (Bobrowski *et al.* 2021, 190). Plant remains found here include, for example, *Sorghum bicolor* subsp. *arundinaceum* (Fig. 6: 1), *Echinochloa colona* (Fig. 6: 2), *Schouwia purpurea* (Fig. 6: 3), *Grewia* sp. (Fig. 6: 4), *Capparis decidua* (Fig. 6: 5), *Ziziphus* sp. (Fig. 6: 6), and *Astragalus* type (Lityńska-Zając and Skrzyński 2021, tab. 1).

Nabta Playa E-75-8 (Ru'at El Ghanam)

The site is located on the western shore of the Nabta palaeolake (Fig. 3: B). Traces of intense middle Holocene settlement activity in the Ru'at El Ghanam humid interphase

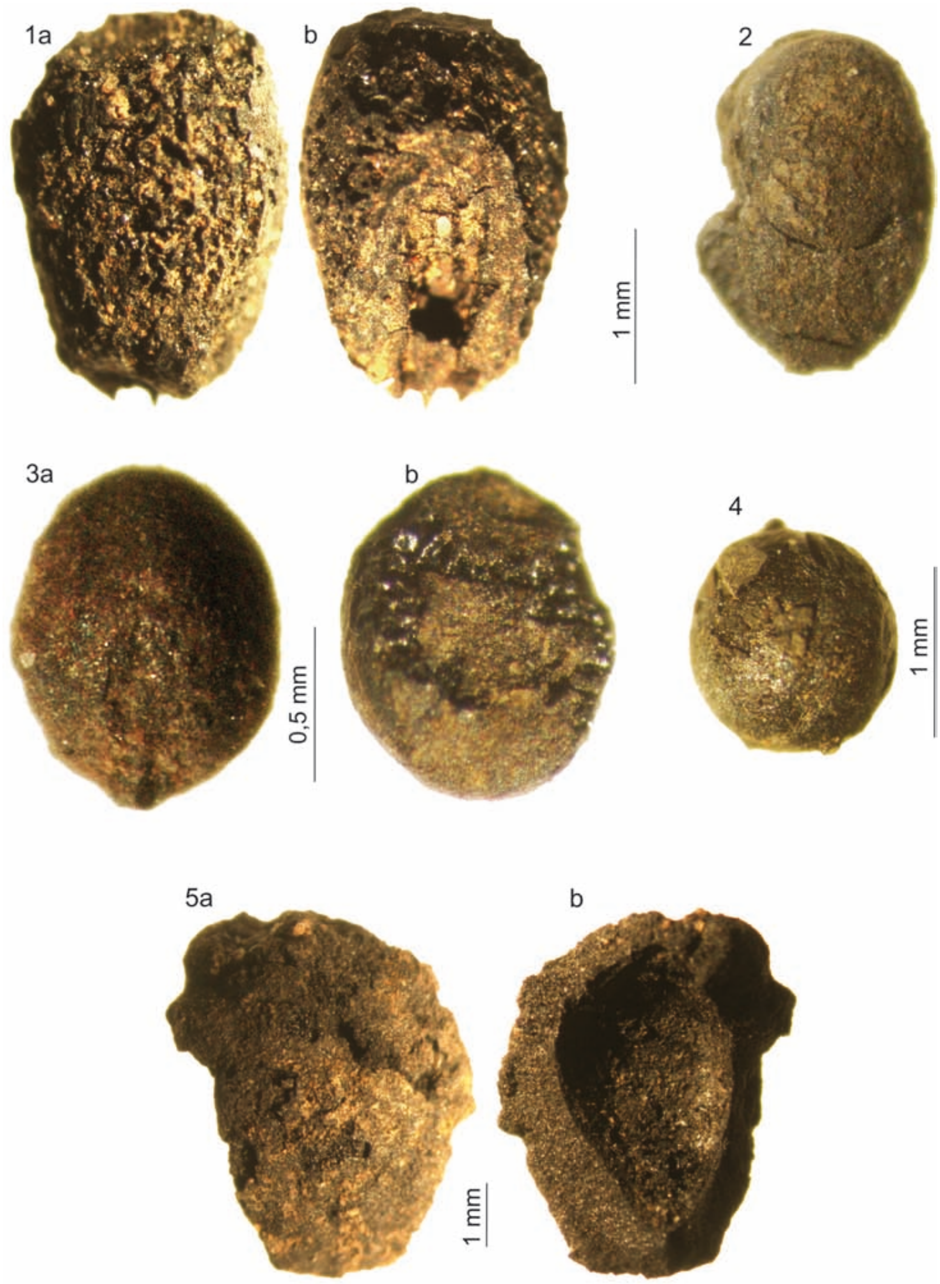

Fig. 5. Macroscopic plant remains from different sites in Nabta Playa (photograph by Krzysztof Stachowicz, compiled by Katarzyna Cywa). 1. *Sorghum bicolor* subsp. *arundinaceum*, caryopsis a – ventral and b – dorsal view; 2. *Capparis* cf. *decidua* – seed; 3. *Echinochloa colona*, caryopsis, a – dorsal view, b – ventral view; 4. *Schouwia* cf. *purpurea* – seed; 5. *Ziziphus* sp., a – fragment of fruit stone, b – side with seed cell

Fig. 6. Macroscopic plant remains from Site E-01-5 in Bargat El-Shab (photograph by Krzysztof Stachowicz, compiled by Katarzyna Cywa). 1. *Sorghum bicolor* var. *arundinaceum*, caryopsis, a – dorsal view, b – ventral view; 2. *Echinochloa colona* – caryopsis, a – dorsal view, b – ventral view; 3. *Schouwia purpurea* – seed; 4. *Grewia* sp. – half of seed; 5. *Capparis decidua* – seed; 6. *Ziziphus* sp. – broken fruit stones

include numerous pits and hearths. Their fills contained relatively numerous charcoal remains and a number of other finds, such as a few specimens of *Heliotropium* sp. (Wasylikowa *et al.* 2001b; Mazher 2005, 33, 34) and *Ziziphus* (Fig. 5: 5) (Lityńska-Zając in preparation).

Bargat El-Shab E-12-4 (Ru'at El Bagar)

Site E-12-4 is located on the western shore of the Bargat El-Shab palaeolake (Fig. 3: D). A complex of megalithic features (including barrows, cists, and steles) and hundreds of hearths were identified on a small monadnock and at its foot (Bobrowski *et al.* 2021, 125-142). Plant remains, such as *Echinochloa colona* and *Ziziphus*, were recovered from two campfires near a tumulus containing a child burial (Bobrowski *et al.* 2021, 140, 142). Only a single fragment of an unidentified fruit or seed was found directly in the hearth (H1), while 23 specimens came from its fill (H3). Radiocarbon dates were successfully obtained for both features. The first one was dated to c. 4320-3990 cal BC, and the other one to c. 4780-4500 cal BC. Hence, they seem to be linked with the late/final Neolithic settlement activity in the Western Desert (Bobrowski *et al.* 2021, 190).

Nabta Playa E-05-2 and *E-05-3* (Bunat El Asnam)

These two sites are part of a complex of prehistoric sandstone quarries associated with the ceremonial centre at Nabta Playa. Located on the western shore of the palaeolake, they were situated in close proximity to the so-called western stele group (Bobrowski *et al.* 2010, 17-21) – see Fig. 3: B. Charcoal fragments were found in the remains of several hearths surrounded by burnt stones, identified in the trenches. Their fills also contained a seed of *Schouwia purpurea* (Fig. 5: 4) and a caryopsis of *Sorghum bicolor* subsp. *arundinaceum* (Fig. 5: 1) (Lityńska-Zając in preparation). Based on the several dates obtained for these finds, they may be reasonably linked with the Bunat El Asnam communities of the final Neolithic.

Nab el- Diep E-00-1 (Bunat El Asnam)

Site E-00-1 is located on the shore of Nab el Diep, a small playa approximately 5 km south of the Nabta Basin (Fig. 3: C). Traces of final Neolithic settlement activity were recorded there. In the fill of one of the features (pit/hearth), three fragments of the fruit stone of *Ziziphus* sp. were found (Lityńska-Zając in preparation).

Gebel Ramlah E-01- 2 (Bunat El Asnam)

Site E-01-2 is located on the southwestern shore of the Gebel Ramlah palaeolake (Fig. 3: A). It is the first in a series of Neolithic cemeteries investigated in the area (Kobusiewicz *et al.* 2010; Kabaciński *et al.* 2019). The cemetery consisted of 15 richly furnished burials. Plant remains, usually charcoal fragments, were found in most of them. Two seeds of cf. *Grevia* sp. were found in the fill of one grave (Burial 4), and a single caryopsis of *Sorghum* *biocolor* subsp. *arundinaceum* was found in another one (Burial 6), deposited in a small vessel (Lityńska-Zając 2010, 242, tab. 7: 1). All the graves are associated with Final Neolithic communities, and the radiocarbon date series ranges from 4700 to 4350 cal. BC (Kobusiewicz and Kabaciński 2010, 119, 120).

Bargat El-Shab E-18-4B (Bunat El Asnam)

Site E-18-4b is located on the southern edge of a palaeolake at the foot of the Bargat El-Shab massif (Fig. 3: D). It is a cluster of ritual features consisting of a series of tumuli, stone steles and rings, as well as hundreds of hearths, presumably associated with the Late and final Neolithic settlement activity. The investigated features included a campfire (H1), radiocarbon dated to the middle Neolithic (Ru'at El Ghanam). Its fill contained a single seed of *Malva* sp. (Lityńska-Zając and Skrzyński 2021, 237, tab. 5; Bobrowski *et al.* 2021, 181).

RESEARCH METHODS

As mentioned, the present study is based on archaeobotanical remains from selected archaeological sites in the southern part of the Western Desert of Egypt. As briefly discussed above, the sites have been dated to different phases of the Holocene. The taxa and the numbers of identified specimens vary from site to site. All of them have been entered into a database, and for the purposes of this study, only those that may carry ecological information (*i.e.*, those identified at least at the family level) have been selected. The taxa described as morphological types given in the original papers from Nabta Playa (NP) or Bargat El-Shab (BS) were omitted as separate forms. They have been classified as belonging to a specific family. For instance, caryopses differ considerably in terms of structure and size, originally described as Poaceae indet. types BS1, BS2, BS 3, and BS 4 (Lityńska-Zając and Skrzyński, 2021) have been included in the aforementioned family, *i.e.* grasses. The results so obtained are shown in Table 1 which presents the taxonomic composition of the remains, their kind and the number of specimens of a particular taxon identified at each site. Importantly, all preserved plant remains are charred. Plant names are given according to L. Boulos (1995).

The plant material identified at the Western Desert sites served as a basis for palaeoecological reconstructions aimed at describing plant communities that may have existed in the past. This method is based on the principle of actualism, the assumption being that the ecological and edaphic requirements of the prehistoric plants and the communities they formed were similar to those of today. Importantly, this assumption may be more or less accurate and may lead to a number of interpretation errors, as species may change their status and now occupy habitats different from those occupied in the past. If so, present-day plant communities are unlike the prehistoric ones (Lityńska-Zając and Wasylikowa 2005, 437-455). A good example of such a species is *Echinochloa colona*. Today, it is found

Fig. 7. Bargat El-Shab. A single tamarisk *Tamarix* sp. (photo Maria Lityńska-Zając)

Fig. 8. Vegetation from the small oasis of Bir Nakhlai (photo Maria Lityńska-Zając)

on the banks of the Nile, the Mediterranean and the Red Sea, as well as along canals, in oases, and often as a weed growing on cultivated fields (Boulos 2005, 291). It is part of the plant communities in wet salt marshes (Zahran and Willis 1992, 89). Yet another research challenge associated with this particular species has not been definitively resolved thus far. Namely, *Echinochloa colona* is a species native to India (Subhashini and Swamy 2015), which seems to make its presence in Neolithic archaeological deposits in Egypt highly unlikely. The issue requires further research and discussion (see also Lityńska-Zając and Skrzyński 2021).

When interpreting the sources, studies on the present-day flora of Egypt were taken into account (Boulos 1983; 1995; 1999; 2000; 2002; 2005; 2008; Boulos and El Hadidi 1994; Boulos *et al.* 2001; Täckholm 1974). Also, a study looking at the flora of the analysed part of the Western Desert, which identified as few as 14 plant species (Bornkamm 1986), was also taken into account. Single trees may occur in this region, although given the current lack of rainfall, their life forms may vary (Fig. 7). To the north-west of the analysed Holocene settlement activity area, there is a small oasis known as Bir Nakhlai (Fig. 8). Its waterline is mainly overgrown by *Phragmites australis*. Several other angiosperm species can also be found here (*e.g.*, El Hadidi 1980).

GENERAL OVERVIEW OF THE FLORA

The remains of the Early Holocene flora recovered from the eleven archaeological sites in the southern part of the Western Desert of Egypt discussed here include at least 52 taxa of various ranks, including 17 taxa identified to the species level (Table 1). Importantly, this number does not include the morphological types from the Nabta Playa and Bargat El-Shab sites, as their taxonomy could not be at least approximated. This group includes herbaceous plants, such as grasses (Poaceae), *e.g.*, *Brachiaria* sp. and *Urochloa* sp., or sedges (Cyperaceae), *e.g.*, *Scirpus maritimus* and *Carex* sp. These were identified mostly based on their fruits and seeds. Trees and shrubs include various species of acacia (*e.g.*, *Acacia ehrenbergiana* and *A. nilotica*), tamarisk *Tamarix* sp., as well as *Salvadora persica,* and also a few representatives of the Chenopodiaceae family. They were recognised mainly based on the wood charcoal found in the features, usually in large quantities. Fruits and seeds were far less numerous (*e.g.*, *Capparis decidua* and *Ziziphus* sp.).

In general, it is reasonable to conclude that although a considerable number of samples from a dozen archaeological sites were examined, the qualitative variability of the preserved plant remains is rather small. In this respect, site E-75-6 at Nabta Playa is exceptional for its taxonomic diversity and quantitative abundance of plant material (Wasylikowa 1997; Wasylikowa *et al.* 2001a; Barakat 1995; 1995a; 1996).

The plant remains identified at the sites in question belonged to 17 plant families. The legume family Fabaceae is represented by the greatest number of taxa (at least 10). These

Table 1. Results of the analysis of macroscopic plant remains from archaeological sites near Nabta Playa and Bargat El-Shab

Taxa name	Kind of remains	El Adam	El Nabta	Al Jerar	El Nabta/ Al Jerar	Middle Neolitic	Middle Neolitic	Final Neolithic	Final Neolithic	Final Neolithic	Final Neolithic	Late/Final Neolithic	Number of sites
		Nabta Playa	Nabta Playa	Nabta Playa	Bargat El-Shab	Nabta Playa	Bargat El-Shab	Nabta Playa	Nabta Playa	Nab El Dieb	Gebel Ramlah	Bargat El-Shab	
		E-06-1	E-75-6	E-92-7	E-05-1	E-75-8	E-12-04	E-05-2	E-05-3	E-00-1	E-01-2	E-18-04B	
Arnebia hispidissima	fruit		630		10								2
cf. *Arnebia hispidissima*	seed		35										1
Astragalus vogelli	seed		7		11								2
Capparis decidua	seed			4	60								2
Citrulus colocynthis+ cf. *C. colocynthis*	seed	3											1
Coronilla scorpioides	seed		2										1
Echinochloa colona	grain	4	2806	1	8		5						5
Hyoscyamus cf. *muticus*	seed		3										1
Panicum turgidum	grain		576										1
Schouwia purpurea	seed	1	7588	5	29	3		1					6
Scirpus maritimus	fruit		46			6							2
Sorghum bicolor subsp. *arundinaceum*	grain		816	2	10				1		1		5
Sorghum bicolor subsp. *arundinaceum*	spikelet		8		1								2
Sorghum bicolor subsp. *arundinaceum*	glume		28										1
Abutilon type	seed		1										1
Astragalus typ	seed				9								1
Brachiaria sp.	grain		20		3								2
Boerhavia sp.	seed		1695		1								2
Capparis sp.	seed		295	4									2
Carex sp.	fruit					1							1

Digitaria sp.	grain		62		4								2
Fuirena type	fruit		69										1
Grewia sp.	seed		4		7						2		3
Grewia sp.	fruit		4										1
Heliotropium sp.	fruit		6			2							2
Indigofera sp.	seed		20										1
Malva sp.	seed											1	1
Rumex sp.	fruit		1										1
Salvia sp. vel *Stachys* sp.	fruit		8										1
cf. *Scirpus* sp.	fruit				5								1
cf. *Setaria* sp. + *Setaria* type	grain	1	33	3	3								4
Sida type	seed		2										1
cf. *Urochloa* sp.	grain		7		2								2
Ziziphus sp.	seed	3	24		6		2						4
Ziziphus sp.	fruit	6	677	9	115	9	9			3			7
Asteraceae indet. (syn.=Compositeae)	fruit		28		3								2
Brassicaceae indet.	seed	1											1
Capparidaceae indet.	seed			15									1
Caryophylaceae indet.	seed				2								2
Cucurbitaceae indet.	seed		27										1
Cyperaceae indet. (ic. Type, A, B, C, D, NP21)	fruit		16	3	12	2							4
Fabaceae indet. (type BS 1, BS 2, BS 3, BS4, NP. 13, 19, 30)	seed		1051		7								2
Lamiaceae indet.	seed				6								1
Paniceae indet.	grain		60		8								2

Taxa name	Kind of remains	El Adam	El Nabta	Al Jerar	El Nabta/ Al Jerar	Middle Neolitic	Middle Neolitic	Final Neolithic	Final Neolithic	Final Neolithic	Final Neolithic	Late/Final Neolithic	Number of sites
		Nabta Playa	Nabta Playa	Nabta Playa	Bargat El-Shab	Nabta Playa	Bargat El-Shab	Nabta Playa	Nabta Playa	Nab El Dieb	Gebel Ramlah	Bargat El-Shab	
		E-06-1	**E-75-6**	**E-92-7**	**E-05-1**	**E-75-8**	**E-12-04**	**E-05-2**	**E-05-3**	**E-00-1**	**E-01-2**	**E-18-04B**	
Poaceae indet. (BS1, BS2, BS 3, BS 4)	grain	11	70	4	27		7						5
Poaceae indet.	chaff				1								1
Trifoliaee	seed		1560										1
Acacia ehrenbergiana	charcoal		816	3		34							3
Acacia cf. *nilotica*	charcoal		77	8	4								3
Acacia raddiana type	charcoal		13			41							2
Capparis decidua	charcoal		113		23								2
Maeura crassifolia	charcoal		2										1
Senna alexandrina	charcoal		11										1
Salvadora persica	charcoal		18	5									2
Acacia sp.	charcoal	1	78	53	426	188	240		6	12	21		9
Tamarix sp.	charcoal	101	490	102	2284	149	2048	12	31	25	274	18	11
Ziziphus sp.	charcoal				39		8			1			3
Capparceae indet.	charcoal				5	4							2
Chenopodiaceae indet.	charcoal						21			1			1

include genera such as *Acacia*, *Astragalus* and *Senna*. Another richly represented group is the grass family Poaceae, with nine different taxa including the species: *Echinochloa colona*, *Panicum turgidum* and *Sorghum bicolor* subsp. *arundinaceum*. A few families are represented only by one genus (*e.g.*, Tamaricaceae, represented by *Tamarix* sp.) or one species (*e.g.*, Solanaceae, represented by *Hyoscyamus* cf. *muticus*).

VEGETATION CHARACTERISTICS

Plant materials from the oldest Early Holocene humid El Adam phase were found only at site E-06-1 at Nabta Playa (Table 1). These include rather scarce remains of *Echinochloa colona*, *Schouwia purpurea*, Poaceae and *Citrullus* sp. Woody plants are represented by tamarisk, which is the most common species and a single piece of acacia wood charcoal. This is indicative of relatively sparse vegetation (Neuman 1993; Jórdeczka 2021, 47-49), including grasses that are adapted to moist habitats. Conversely, *Schouwia* was presumably part of herbaceous communities growing in dry and sandy habitats. *C. colocynthis*, the present-day representative of the genus *Citrullus* in the Egyptian flora, is a xerophyte commonly found on sandy soils and desert wadis (Boulos 2000, 139, 140; Wasylikowa and Van der Veen 2004). The latter may have been a habitat for single tamarisk trees.

Another humid interphase (El Nabta, El Nabta/Al Jerar and Al Jerar) coincided with the Holocene climatic optimum. In the Egyptian Sahara, this period was characterised by relatively abundant rainfalls, resulting in the formation of permanent small lakes filling fairly deep basins (Wendorf and Schild 2001, 650). Plant material dated to this interphase comes from three sites: E-75-6 and E-92-7 at Nabta Playa and E-05-1 at Bargat El-Shab (Table 1). Notably, material from two of the sites (E-75-6 and E-05-1) contained plant remains that surpassed those from any other site in the vicinity of the palaeolakes discussed in this paper, both in quantity and diversity.

The quantity of remains recovered from site E-92-7 in Nabta Playa was significantly smaller. Nevertheless, it is reasonable to assume that the Early Holocene vegetation in the vicinity of Nabta Playa and Bargat El-Shab was fairly diversified. The distribution of plant communities, either in the form of a mosaic or a zonal arrangement, was determined by groundwater availability (Wasylikowa 1997). The communities comprised both herbaceous plants on the one hand and trees and shrubs on the other, many of which are typical of the Saharan or sub-Saharan flora. A fine example is *Setaria* sp., the remains of which were found at all three of the sites in question. Other important species, such as the already mentioned sorghum *Sorghum bicolor* subsp. *arundinaceum* are absent from the flora of present-day Egypt (Boulos 2005, 329), although they are fairly common in the African savannah (Wasylikowa and Dahlberg 1998). Similarly, species of the genus *Urochloa* sp. are characteristic of the savannah and are not found in the flora of present-day Egypt, although some of these grasses occur in Sudan (Wasylikowa 1997). The presence of the caryopses of these taxa (sorghum found at three sites and *Urochloa* sp. found at two sites) in Early Neolithic features may suggest that the plant zones were arranged differently than today and that the prehistoric Sahelian communities, including savannah, were shifted northwards (Lityńska-Zając and Skrzyński 2021).

A major group in the Early Holocene plant remains assemblages is made of various types of grasses (*e.g*., *Echinochloa colona*, *Boerhavia* sp. and *Panicum turgidum*). They may have formed communities in small areas offering favourable edaphic conditions. Various species of the genus *Brachiaria* sp., today common in the Nile valley and oases (Boulos 2005), may have been part of communities dominated by *Panicum turgidum* (Wasylikova 1997). Another important group were plants from the sedge family Cyperaceae, such as *Fuirena* type, and *Scirpus maritimus*. Their presence indicates moist habitats, mudflats and marshes, typically located on the shores of palaeolakes or wadis, where specific species may have found favourable conditions (Lityńska-Zając and Skrzyński 2021). Conversely, *Schouwia purpurea* probably grew in dry and sandy places.

In features dated to the Holocene climatic optimum, the remains of tamarisk (commonly found across all settlement phases, see Table 1) were accompanied by charcoal from the following trees: *Acacia ehrenbergiana* (two features), *Acacia* cf. *nilotica* (three), *Acacia raddiana* type (one), *Capparis decidua* (two), *Salvadora persica* (two) and unspecified fragments of the genus *Acacia*. In addition, *Maeura crassifolia* and *Senna alexandrina* were also found at site E-75-6 at Nabta Playa. These plants formed diverse communities (Neumann 1989; Barakat 1995a and other sources cited there, 2001; Lityńska-Zając and Skrzyński 2021). The various species of the genus *Tamarix* are drought- and salinity-tolerant trees or shrubs adapted to adverse and arid climatic conditions. They grow in desert areas, as well as in oases and wadis (Boulos 2000, 126-130, Barakat 1995a). Their presence in the archaeological record may suggest a climate with an annual rainfall below 100 mm (Peters 1998). Acacias require more moisture than tamarisks. It is generally assumed that they occur in habitats where summer rainfall totals remain between 250-750 mm (Lityńska-Zając and Skrzyński 2021 and other sources cited there). Today, acacias are typical, mainly in semi-arid and savannah areas (Neumann 1989; Barakat 1995a). *Acacia nilotica* has slightly different edaphic and, above all, moisture requirements, as it needs high groundwater levels. It is a Sahel-Saharan, Sahel-Sudanese and Sudanese species. The presence of its remains in archaeobotanical assemblages from the Early Neolithic indicates that the palaeolakes at Nabta Playa and Bargat El-Shab were permanently filled with water and recharged by abundant summer rains. Acacia communities may have additionally included small trees and/or shrubs such as *Capparis decidua* and the genus *Ziziphus*. Both of these woody species/genus suggest the presence of well-developed vegetation formations thriving under favourable conditions along the shores of lakes or the banks of seasonal rivers (Lityńska-Zając and Skrzyński 2021).

Site E-75-8 at Nabta Playa has been dated to the Middle Holocene humid Ru'at El Ghanam interphase. While the herbaceous remains are rather scarce here, charcoal remains have been frequently recorded. Remarkably, this is the only site discussed in this paper where acacia remains outnumbered tamarisk remains (Table 1). This taxonomic composition, with remnants of Capparceae, suggests the presence of desert vegetation similar to that known today from uninhabited oases in northern Sudan (Barakat 2001). An interesting genus is *Heliotropium* sp., represented by 17 species found in the present-day flora of Egypt (Boulos 2000, 271-281; Täckholm 1974; see also Wasylikova 1997). These include annual and perennial plants, as well as small shrubs growing in the deserts of present-day Egypt.

Site E-12-04 at Bargat El-Shab contains traces of settlement activity in the Western Desert from the late/final Neolithic period. The taxonomic composition suggests an even more limited flora than in the earlier periods. Charcoal from the Chenopodiaceae family appears here for the first time. The small quantity of acacia charcoal remains, the absence of *Acacia nilotica,* and the presence of Chenopodiaceae all suggest a gradual regression of savannah vegetation and the emergence of new desert elements, first and foremost trees or shrubs from the Chenopodiaceae family (Barakat 2001; Lityńska-Zając and Skrzyński 2021).

E-05-2 and E-05-3 at Nabta Playa are two other sites associated with the final Neolithic. Although a considerable number of samples from these sites were analysed, little plant material was found (Lityńska-Zając in preparation). The only remains include single seeds of *Schouwia purpurea* and grains of *Sorghum bicolor* subsp. *arundinaceum*. An anthracological analysis identified mostly the remains of tamarisk, accompanied by a small quantity of acacia (Table 1). Site E-00-1 at Nab El Diep is yet another site with the same chronology. The materials from here contained a few charcoal fragments of *Tamarix*, *Acacia* and Chenopodiaceae. In addition, single fragments of *Ziziphus* sp. fruit stone and one piece of wood charcoal of this genus were also found (Table 1). The plant remains from site E-01-2 at Gebel Ramlah were equally mediocre. They included charcoal of acacia and tamarisk, as well as sorghum grain and *Grewia* sp. seeds (Lityńska-Zając 2010). This scarcity of plant remains may be due to the nature of the finds from those sites (see above). However, it is also possible that the sites were affected by the gradual loss of vegetation, characteristic of the final stage of the Neolithic (Barakat 2001).

The last of the analysed sites (E-18-4B in Bargat El-Shab) yielded only a few charcoal pieces of tamarisk and a seed of *Malva* sp. This genus includes several species of herbaceous, annual and perennial plants known from various regions of present-day Egypt (Boulos 2000, 92-97). These scarce findings once again confirm the depletion of flora during the final Neolithic.

CONCLUSIONS

The plant material from these archaeological sites in the southern part of the Western Desert of Egypt is neither particularly diverse in terms of taxonomic composition nor abundant in quantity, with the notable exception of the finds from site E-75-6 at Nabta Playa. The macroremains assemblages primarily represent plants collected for food and fuel, and possibly also as raw materials. As a result, they likely reflect only selected components of the local vegetation. Scarce as they may be, the recovered remains indicate a degree of variation between older and younger chronological periods. The most favourable period for vegetation and, thus, for settlement activities was the Holocene climatic optimum, corresponding to the El Nabta and Al Jerar phases. The period saw the development of relatively rich flora composed of herbaceous plants and tree-shrub vegetation. Campsites from this period were probably set up in areas densely covered with such vegetation. The most common trees were tamarisks, accompanied by acacias and a few other species. Grassland communities were likely fairly common, too. During the Holocene climatic optimum, Cyperaceae communities flourished in moist habitats.

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TECHNOLOGY AND RAW MATERIAL ANALYSIS OF LINEAR POTTERY CULTURE CERAMICS FROM THE EASTERN CARPATHIANS, ROMANIA

ABSTRACT

Rauba-Bukowska A., Diaconu V. and Bukowski K. 2024. Technology and raw material analysis of Linear Pottery culture ceramics from the Eastern Carpathians, Romania. *Sprawozdania Archeologiczne* 76/2, 37-66.

Only a few Neolithic settlements attributed to the Linear Pottery culture 5100-4850 cal. BC) are known from the Sub-Carpathian area of Eastern Romania. From the Neamţ Depression, settlements were known from Târpeşti and recently from Topoliţa. The aim of the presented analyses was to determine data regarding ceramic technology at the Topoliţa site and to compare it with LBK ceramic technology in neighbouring areas. It was found that ceramic production patterns at Topoliţa were similar to those at nearby LBK sites in Romania and even to pottery from southeastern Poland. However, the selection of raw materials varied. At Topoliţa, only one type of raw material was used, while the nearest site at Târpeşti employed several different raw materials. These differences underscore the importance of local environmental factors in understanding ceramic production practices. The technological similarities between Topoliţa and Poland suggest that knowledge and practices were transmitted through cultural interactions and long-distance exchange networks.

Keywords: Northeastern Romania, Neolithic, Linear Pottery culture, ceramic petrography, XRD analysis
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INTRODUCTION

In the Sub-Carpathian area of Eastern Romania, only a few Neolithic settlements are known (Fig. 1), those being attributed to the Starčevo-Criş culture (Ursulescu 1984) and the Linear Pottery culture (hereafter LBK) (Cucoş 1992). The existence of salt resources represents an important factor that led those communities to the sub-mountainous area, some of which were exploited by human groups from the Early Neolithic (Dumitroaia 1994; Ursulescu 1996; Weller *et al.* 2007; Preoteasa and Diaconu 2018). Although several dozen sites attributed to the Linear Pottery culture are known in eastern Romania, we currently have very few absolute dates. We may mention here, for the Târpeşti settlement, two dates, but which are uncalibrated and too late for the Neolithic: 4220±100 and 4295±100 B.C. (Marinescu-Bîlcu 1981, 18; Ursulescu 2000, 274). According to the current relative chronology, east of the Carpathians the Linear Pottery culture can still be placed between 5100-4850 cal. BC (Garvăn *et al.* 2009, 8; Garvăn and Frînculeasa 2021, 431-435).

Although there are some conclusive data for Starčevo-Criş culture about the settlements and the relation between humans and the surrounding environment (Marinescu-Bîlcu 1975; Ursulescu 1985; Dumitroaia 1987; Marinescu-Bîlcu and Beldiman 2000; Diaconu 2022), the information on the Linear Pottery culture is still rather sparse. Significantly, over the past six decades, there has been a notable absence of research conducted within settlements of this cultural context. This has led to significant gaps in our understanding of LBK settlement patterns in these areas.

The only artefacts attributed to the Linear Pottery culture from the Neamţ Depression (in Neamţ county there are only six LBK sites) were known from the excavations at Târpeşti (realised in the 1960s; Marinescu Bîlcu 1981). Recently, during the systematic research from the multi-layered settlement of Topoliţa – *La nord-vest de sat* (Neamţ County), artefacts of the Linear Pottery culture have also been discovered (Diaconu *et al.* 2023).

The archaeological site of Topoliţa is in the Subcarpathian region of Moldavia, situated in eastern Romania. Specifically, it lies within the northeastern part of Neamţ County, positioned centrally within the depression bearing the same name (Fig. 1). The settlement is located approximately 6 km south of Târgu Neamţ city. It occupies a part of the low terrace to the right of the Valea Seacă stream, an affluent of the Topoliţa River (Diaconu 2007, 101, 103).

Since the site is multi-layered, in 2017, a geophysical scan was carried out by a German team from the University of Erlangen-Nürnberg. On that occasion, the traces of several residential structures (25), somewhat unevenly arranged over an area of approximately 2 ha, were identified (Preoteasa *et al.* 2018). The results of the non-invasive investigations were very promising. In 2019, systematic archaeological research began (Diaconu *et al.* 2020). Several stages of use of the site were documented: Neolithic (Linear Pottery culture, Fig. 2), Eneolithic (Precucuteni culture, middle and late phases), Late Bronze Age (Noua culture), Iron Age (Poieneşti-Lucaşeuka culture) and activity in Late Antiquity (IV century AD, Sântana

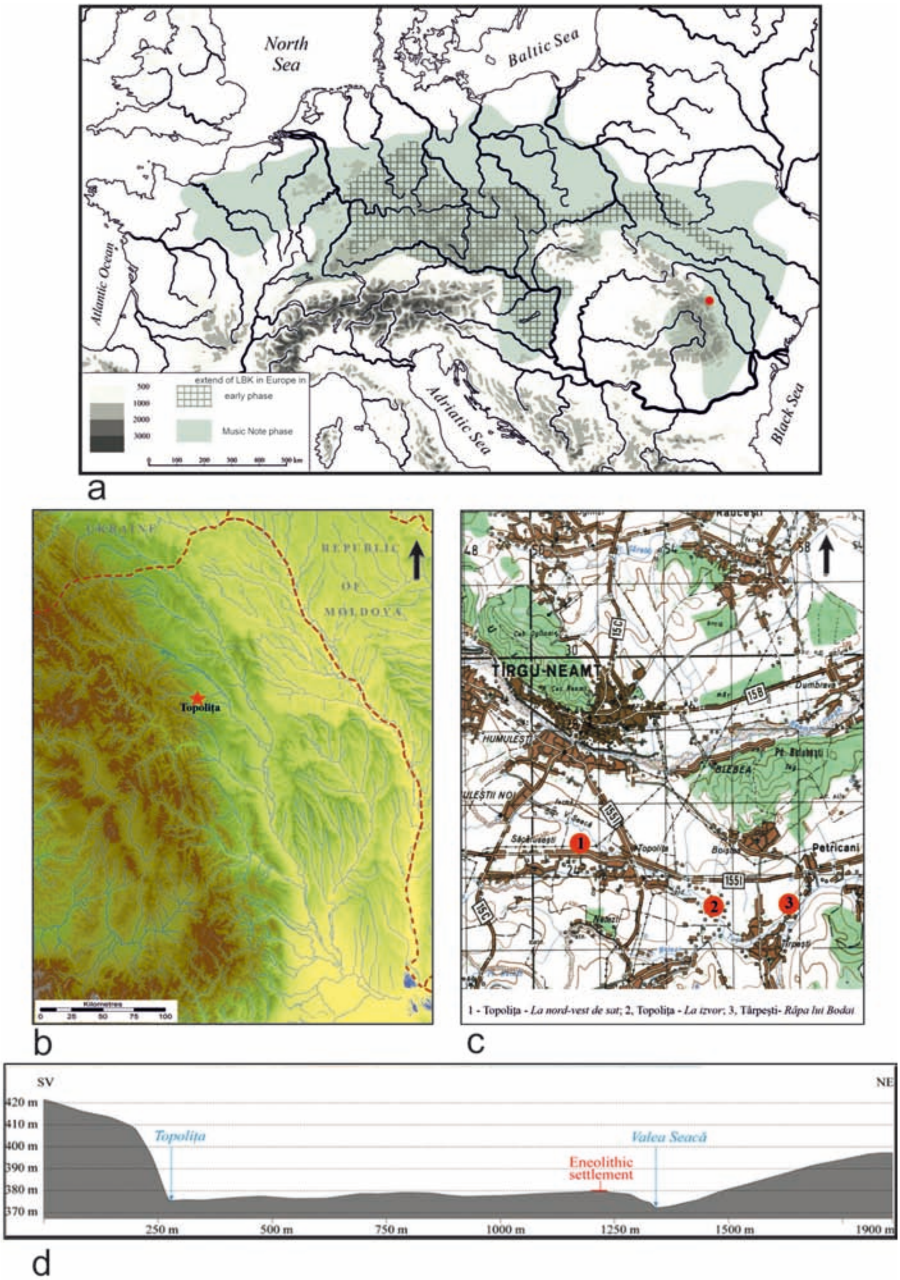

Fig. 1. Topolița, Neamț County; location of the site (red dot) against the background of the extent of the Linear Pottery culture in Europe (a) (after Czekaj-Zastawny 2008); site location in the north-western part of Romania (b); LBK settlements in the Neamț Depression (c); location of the site on the topographic profile (d) (according to Pîrnău *et al*. 2022)

Fig. 2. Topolița, Neamț County; aerial view of the site (a); the area where LBK pottery was discovered (b); pedological profile (c); a, b – photo V. Diaconu; c – soil horizons (according to Pirnau et al. 2022, 7); A – surface mineral horizon; B – subsurface horizon; C- horizon that is little affected by pedogenetic processes; h – accumulation of organic matter; t – illuvial accumulation of silicate clay; b – buried genetic horizon; w – development of colour or structure; k – accumulation of pedogenetic carbonates

de Mureş culture). The most consistent vestiges belong to the Early Eneolithic (second half of the 5th millennium BC).

In the 2022 archaeological campaign, the first artefacts specific to the Linear Pottery culture were discovered, but without a clear cultural context. The research from the summer of 2023 facilitated the discovery of a more consistent batch. A pit attributed to the Linear Pottery culture, in which numerous pieces of burnt clay were found, as well as pottery fragments and animal bones was excavated. The finds, however still sparse, demonstrates that those Neolithic communities also frequented the Sub-Carpathians area.

The aim of the conducted analyses was to determine fundamental data regarding LBK ceramic technology at the Topoliţa site and to compare it with LBK ceramic technology in neighbouring areas. We employed petrographic analysis of thin sections to characterize the compositions of ceramic vessels, along with XRD analysis. The mineral composition, any deliberate additives, clay mixing, and the atmosphere, as well as the approximate firing temperature, were determined. The analyses enabled the determination of the vessel ceramic technology at the Topoliţa site. Gathering data allowed for comparison with LBK ceramics from the Târpeşti site, where five LBK vessel fragments had been sampled for analysis (Kadrow *et al.* 2018). In further steps, we were able to technologically embed ceramics from Topoliţa within the context of other examined fragments from the further regions in Romania: Isaiia, jud.Iaşi; Olteni, jud. Covasna; Mihoveni, jud. Suceava; Preuteşti-Ciritei, jud. Suceava, Traian-Dealul Fântânilor, jud. Neamţ, Târpeşti, jud. Neamţ (Kadrow *et al.* 2018) and compare the results in this regard to ceramics from areas north of the Carpathians in southeastern Poland (Rauba-Bukowska 2014; Rauba-Bukowska 2021; Rauba-Bukowska and Czekaj-Zastawny 2020; Czekaj-Zastawny *et al.* 2017).

MATERIALS, AND METHODS

Eleven samples of LBK ceramics were selected for petrographic studies, guided by technological characteristics of the ceramic mass, form, and decoration (Table 1). The investigations were conducted using a Nikon Eclipse LV100N POL polarizing microscope for transmitted light at the Institute of Archaeology and Ethnology of the Polish Academy of Science in Kraków. The ceramics intended for specialized research consist of thin-walled forms, approximately 0.3-0.5 cm thick (five pieces), and thick-walled forms, approximately 0.6-0.8 cm thick (six pieces). These vessels were discovered in Surface B/2022 at Topoliţa and belong to the Linear Pottery culture, exhibiting the typical ornamentation of this culture (Fig. 3). The sampled fragments were marked with the label RumTop and differentiated by consecutive ordinal numbers 1-11 (RumTop1, RumTop2, *etc.*).

Thin sections were prepared from pottery fragments for microscopic examination in transmitted polarized light. Point-counting quantitative microscopic analysis was employed to determine the percentage composition of various components, including clay

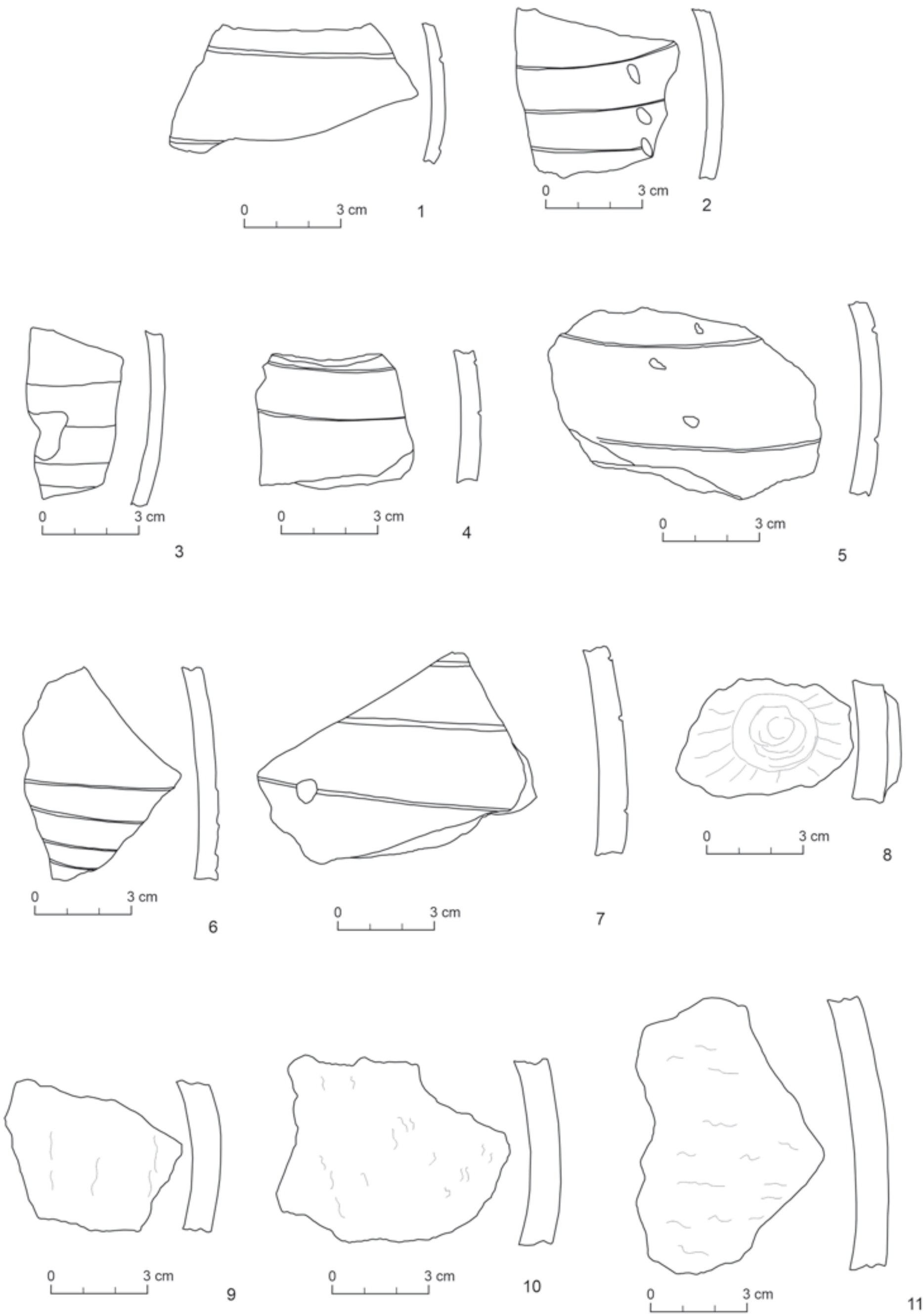

Fig. 3. Topolița, Neamț County. Drawings of vessel fragments (1-11) selected for petrographic analysis. Drawing by V. Diaconu, I. Ściana

Table 1. Topolița, Neamț County. List of the samples

Symbol of the sample	Site	Atmosphere of firing	Approx. Firing temperature in °C	Morphology	Fabric types	Petrographic group
RumTop1	Topolița, Neamț County	oxidizing	700-750	thin-walled	IIa	1a
RumTop2	Topolița, Neamț County	reducing	700-750	thin-walled	IIa	1a
RumTop3	Topolița, Neamț County	reducing	700-750, 750-800	thin-walled	IIa	1a
RumTop4	Topolița, Neamț County	oxidizing	850	thin-walled	IIa	1b
RumTop5	Topolița, Neamț County	oxidizing	700-750	thin-walled	IIa	1b
RumTop6	Topolița, Neamț County	redox	700-750	thick-walled	Ia	2a
RumTop7	Topolița, Neamț County	redox	700-750	thin-walled	IIa	1b
RumTop8	Topolița, Neamț County	redox	700-750	thick-walled	Ia	2a
RumTop9	Topolița, Neamț County	redox	700-750	thick-walled	Ia	2a
RumTop10	Topolița, Neamț County	redox	700-750	thick-walled	Ia	2b
RumTop11	Topolița, Neamț County	redox	700-750	thick-walled	Ia	2b

minerals, quartz, potassium feldspar, plagioclase, muscovite, biotite, carbonates, grains of sedimentary, igneous, and metamorphic rocks, fragments of secondarily used ceramics, as well as organic material. Petrographic descriptions of the ceramic sections were conducted, considering the degree of consolidation of the masses, firing conditions, and temperature (Whitbread 2016; Reedy 2008, 109-210). The collected data were utilized for comparative studies and to determine petrographic and fabric groups. The approximate firing temperature was inferred from the thermal transformations of clay minerals, as well as minerals such as biotite, hornblende, and glauconite (Stoch 1974, 484; Bolewski and Żabiński 1988; Quinn 2013, 190-203; Daszkiewicz and Maritan 2016). Grain size measurements were conducted using a micrometric scale under a polarizing microscope, following the guidelines of the Polish Soil Science Society (Polskie Towarzystwo Gleboznawcze 2009).

The mineral composition of two samples (RumTop7 and RumTop11) was determined by an X-ray diffractometer (XRD) on an ADP-2.0 diffractometer (Fe radiation, filtered Mn, 30 kV, 12 mA). The scanning rate of the powder preparations was 2°/min, and the step was 0.025°. Quantitative mineral content was determined using Profex-8.4 software, which simulates the calculated diffractogram profile as close to the experimental one (Döbelin and Kleeberg 2015).

Table 2. Topolița, Neamț County. Mineral composition; value in percentages

Symbol of the sample	Site	Clay minerals	grains <0.05 mm	Quartz	Chalcedony / flint	Potassium feldspars	Plagioclases	Fragments of sedimentary rocks	Fragments of igneous rocks	Fragments of matamorphic rocks	Muscovite	Biotite	Opaque minerals	Iron oxides and hydroxides	Grog	Clay pellet	Organic fragments	Heavy minerals	Others	Voids
RumTop1	Topolița, Neamț County	66.3	19.4	0.6	0.0	0.0	0.0	0.6	0.0	0.0	6.8	1.6	1.3	2.6	0.0	0.0	0.0	0.0	0.0	0.6
RumTop2	Topolița, Neamț County	63.8	17.5	1.3	0.0	0.5	0.0	4.8	0.0	0.0	4.8	0.8	2.8	1.8	0.0	0.0	0.0	0.0	0.3	2.0
RumTop3	Topolița, Neamț County	74.8	12.3	2.7	0.0	0.3	0.0	0.0	0.0	0.0	4.3	1.0	0.3	1.7	0.0	0.0	0.0	0.3	0.3	2.0
RumTop4	Topolița, Neamț County	76.0	12.8	2.5	0.0	1.2	0.0	0.6	0.0	0.0	2.2	0.3	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.9
RumTop5	Topolița, Neamț County	73.1	12.1	1.2	0.0	0.0	0.0	1.5	0.0	0.0	3.0	0.3	0.9	4.2	0.0	0.0	0.3	0.0	0.0	3.3
RumTop6	Topolița, Neamț County	64.1	16.0	6.6	0.0	1.5	1.1	0.0	0.0	0.3	3.8	0.5	0.5	2.5	0.0	0.0	0.0	0.0	0.0	3.1
RumTop7	Topolița, Neamț County	78.4	15.1	1.5	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.9	1.5	0.0	0.0	0.3	0.3	0.0	0.3
RumTop8	Topolița, Neamț County	49.5	20.1	3.5	0.0	0.6	0.9	0.0	0.0	1.9	4.0	0.5	0.0	2.6	0.0	0.0	5.1	0.0	0.0	11.2
RumTop9	Topolița, Neamț County	61.3	17.2	6.0	0.0	0.5	1.8	0.0	0.0	0.7	2.0	0.2	0.5	1.2	0.0	0.5	1.2	0.0	0.0	6.7
RumTop10	Topolița, Neamț County	48.9	17.6	14.6	0.5	2.5	1.2	0.2	0.0	1.2	4.0	0.5	0.7	1.0	0.0	0.0	1.7	0.0	0.0	5.2
RumTop11	Topolița, Neamț County	50.5	14.1	14.1	0.3	3.8	2.2	0.0	0.0	1.8	5.0	0.5	0.3	0.5	0.0	0.0	1.0	0.0	0.5	5.5

RESULTS

Thin section petrographic analysis

The mineral composition of the ceramic fabrics consists of clay minerals (49.3-79.7%), grains of silty fraction (5.1-35.6%), fine mica flakes (max. 9.4% in sample RumTop1), iron oxides and hydroxides (Table 2). Additionally, the ceramic fabrics contain a small number of opaque and heavy minerals. The coarser fraction (>0.05 mm) is represented by quartz grains (up to 19.3%), occasionally feldspars. Moreover, fragments of sedimentary rocks – mudstone and claystone are identified (more abundant in RumTop1, RumTop5, RumTop6, and RumTop7). Samples RumTop3, RumTop6, RumTop7, RumTop8, RumTop9, RumTop10, RumTop11 contain fragments of metamorphic rocks (mostly quartz-mica schist or quartz schists, *e.g.*, in sample RumTop7). Additionally, optically isotropic clay clasts, which were difficult to identify precisely, were noted in the samples RumTop2, RumTop3, and RumTop7.

The coarser grains are medium and well-rounded. Fine-grained quartz grains are moderately to well-rounded. Rock fragments are well-rounded.

XRD analysis

XRD analysis was performed for two ceramic samples representing two petrographically distinct groups: fine-grained raw materials (RumTop7) and coarse-grained raw materials (RumTop11). For these samples, the type and contents of minerals were interpreted based on the intensity of specific XRD peaks using Profex-8.4 software.

In the RumTop7 sample, the XRD analysis revealed the presence of quartz, plagioclases, and microcline. Similar to the situation in the microscopic observations, a significant presence of clay minerals was observed, including minerals from the smectite group (*e.g.*, nontronite), illite, and montmorillonite. Additionally, a substantial proportion of mica was observed, including muscovite and biotite, with glauconite and a small content of iron hydroxides and chlorites (Fig. 4).

In the RumTop11 sample representing coarse-grained raw materials, there is a high proportion of quartz, with feldspar grains, mainly plagioclases, and potassium feldspars – microcline. The background mass of the sample comprises clay minerals, in which XRD determined the high presence of illite. Small mica flakes, primarily muscovite and biotite, were also observed. Furthermore, glauconite and a small proportion of iron hydroxides (lepidocrocite) were also noted (Fig. 4).

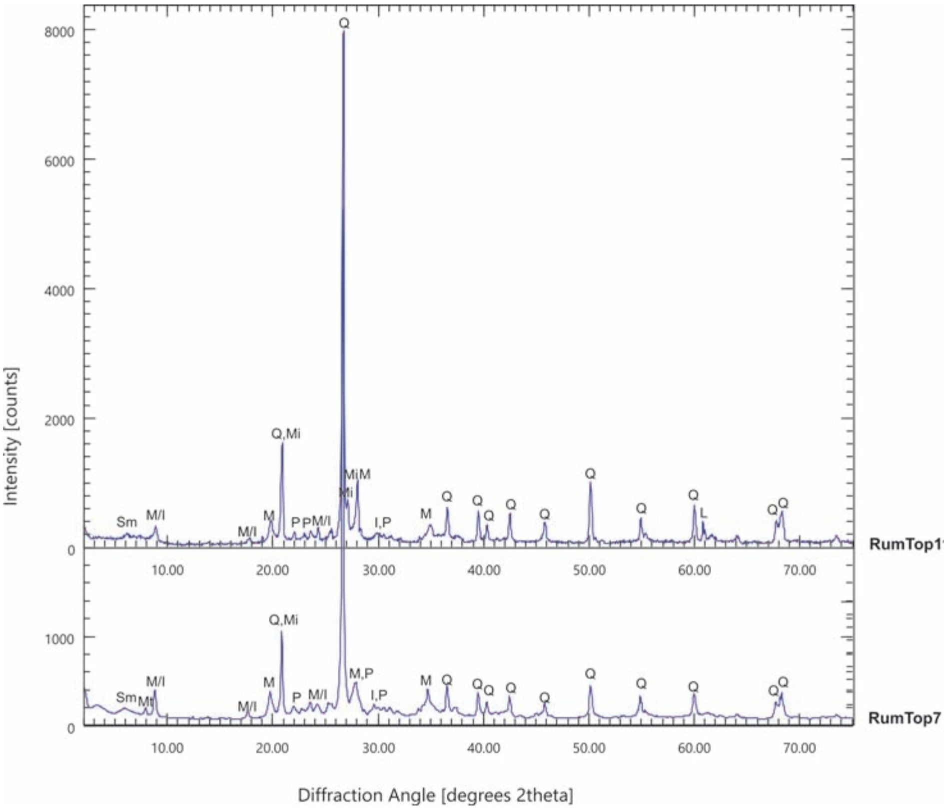

Fig. 4. X-ray diffractograms of the pottery samples RumTop7 and RumTop11 selected from Topolița. Main minerals: Q – quartz, P – plagioclases, Mi – microcline, M/I – muscovite/illite, Sm – smectite, Mt – montomorillonite, L – lepidocrocite

INTERPRETATION OF THE ANALYSIS

Source of the raw materials

Geologically, the research area is located within the Subcarpathian (Pericarpathian) nappes of the Eastern Carpathians (Matenco and Bertotti 2000). The Subcarpathian nappes, which were partially overlaid by the Carpathian thin-skinned nappes and exhumed by erosion, were formed by Oligocene and Miocene molasse (Grasu *et al.* 1999). Molasse sediments of the Oligocene-Miocene age are generally poorly consolidated sediments represented by rudites, sandstones, and arkoses without clear stratification (Grasu *et al.* 1999). Near the study area, molasse sediments mainly comprise the Middle Miocene (Badenian) deposits consisting of alternating layers of marl and fine sandstone and gypsum (Gypsum

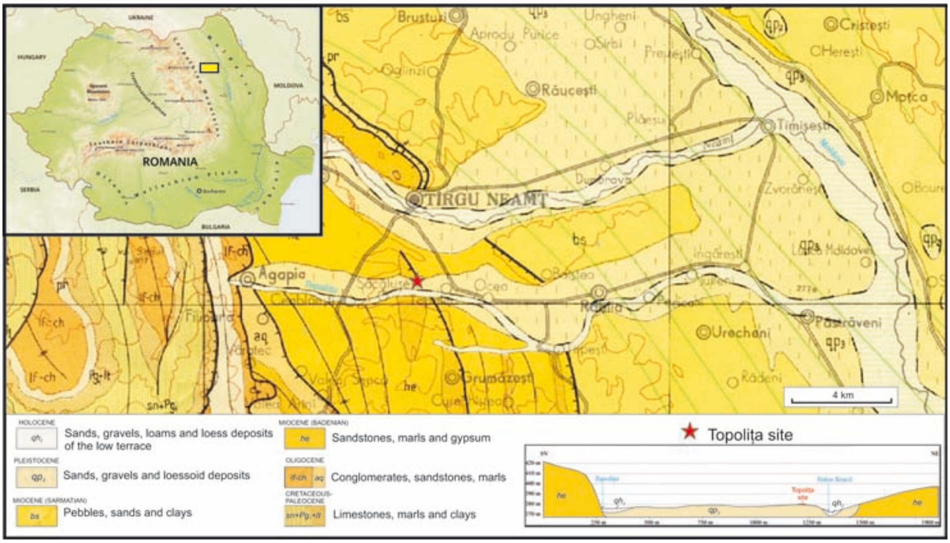

Fig. 5. Geological map of the area around Topoliţa (Joja *et al*. 1968); geological cross-section after topographic profile (Pîrnău *et al*. 2022)

de Parchiu) (Săndulescu *et al*. 1995). The archaeological site is located on the alluvial deposits of the Topoliţa River and its tributary, the Valea Seacă stream, represented by sands, gravels, and clays of Pleistocene and Holocene age. Eolian sediments (loess or loessoid sediments) are also observed (Măţău *et al*. 2021) (Fig. 5).

Based on the quartz-feldspar mineral composition, a large share of mica, the characteristic presence of glauconite found in several samples, and the sorting and rounding of quartz and feldspar grains, it can be assumed that the source material could have been sandy clays formed as alluvial river deposits. This material, resulting mainly from the erosion of older formations, was deposited in the Topoliţa River Pleistocene/Holocene terrace sediments. This is confirmed by the presence of individual fragments of sandstones and mudstones, and even lithoclasts of metamorphic rocks (quartz-mica schists) that could have been preserved from the source rocks that eroded to prosuce the Oligocene-Miocene molasse sediments (Sylvester and Lowe 2004).

The mineral composition shows no significant differences between the two sample groups (coarse-grained and fine-grained), suggesting a common or similar raw material source.

Petrographic groups

Due to their mineral-petrographic composition and granulation, the samples can be divided into two main groups (Table 3). The first group pertains to fine-grained raw materials. It is characterized by the presence of quartz and mica, as well as iron oxides and hy-

Table 3. Petrographic groups

Symbol of the petrographic group	Petrographic group description	Sample
1	fine-grained	
1a	fine-grained, micaceous clay with a higher number of silty grains	RumTop1, RumTop2, RumTop3
1b	fine-grained, micaceous clay	RumTop4, RumTop5
2	coarse-grained	
2a	coarse grained clay with quartz and fragments of Quartz-mica schists	RumTop7, RumTop8, RumTop9
2b	coarse grained clay with quartz, feldspars, glauconite and fragments of Quartz-mica schists	RumTop10, RumTop11

droxides, a small number of opaque and heavy minerals, and rounded fragments of sedimentary rocks such as mudstone and siltstone (Figs 6-11). Within this group, materials with a higher number of very fine-grained particles can be distinguished (Raw Material 1a, samples: RumTop1, RumTop2, RumTop3) and those with a lower number of very fine-grained particles (Raw Material 1b, samples: RumTop4, RumTop5, RumTop7).

The second group relates to coarse-grained raw materials (Raw Material 2; Figs 12-16). In this group, quartz grains are more abundant, along with moderately well-rounded fragments of metamorphic rocks such as quartz-mica schists (Raw Material 2a, samples: RumTop6, RumTop8, RumTop9). Within this group, two samples (RumTop10 and RumTop11) stand out due to their glauconite content in the clayey mass and a higher number of feldspars (Raw Material 2b, Figs 15, 16).

This conclusion, drawn from a comprehensive analysis, highlights the main difference in grain size distribution, particularly the larger portion of the sandy fraction. This variation could be attributed to the processing method, where raw coarse grain material was removed, and some vessels were made from such fine-grained clays. The low degree of grain sorting and rounding in some samples (*e.g.*, RumTop11) could indicate a relatively short transport of the detrital material, which could have significant implications for our understanding of material transport processes.

Admixtures

In the examined ceramics, two main types of admixtures can be distinguished – organic and mineral. The organic material consists of plant fragments. They are visible in the form of brown, opaque, lattice-like or cellular structures. These fragments are almost completely burnt out in areas where more air reached during firing. They leave behind charac-

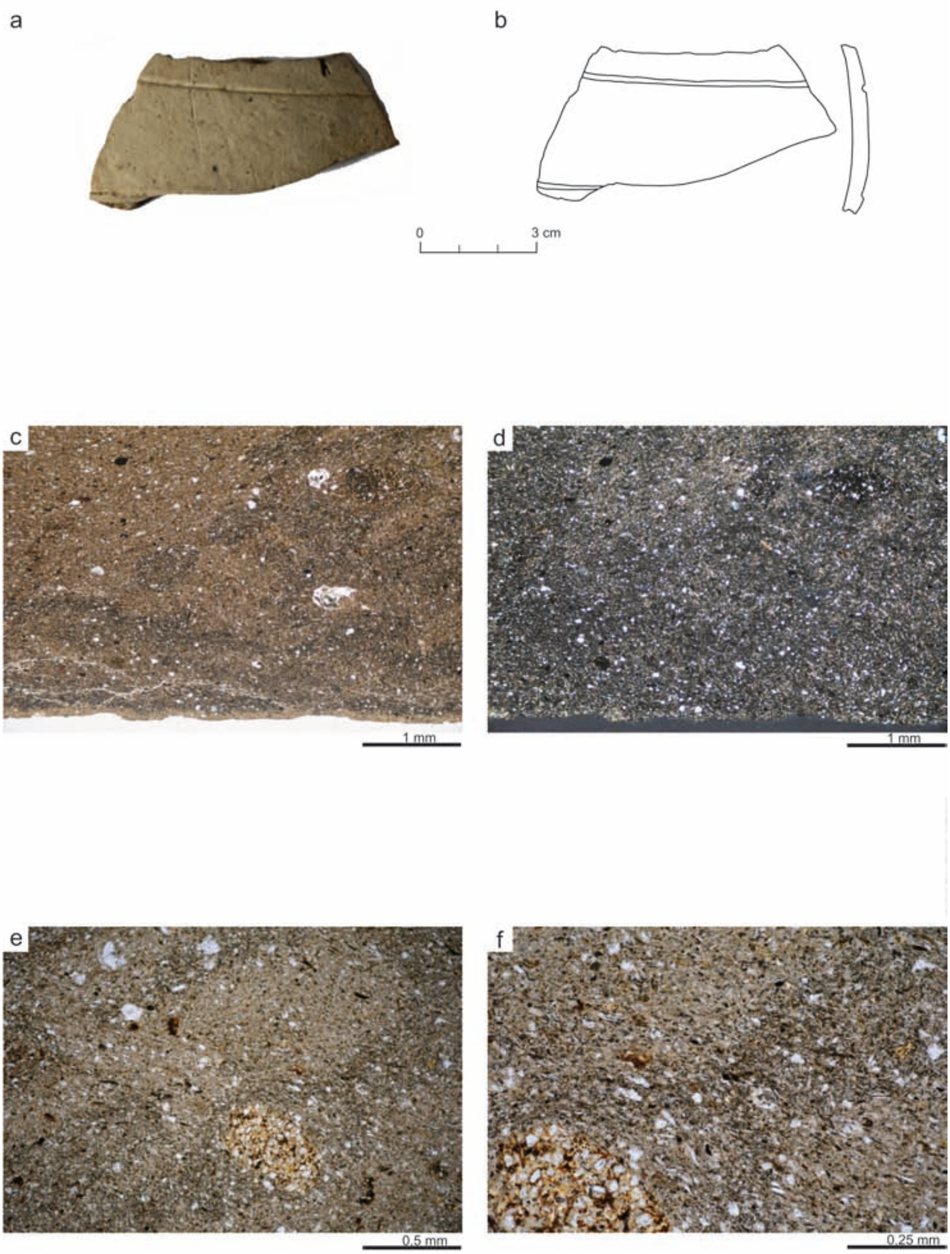

Fig. 6. Topolița, Neamț County, sample RumTop1, technological Type IIa; photography (a) and drawing (b) of the fragment; microphotographs of thin section (c-f); fine grained, homogeneous fabric (c, d); uneven coloration of the body matrix (e); rounded fragment of clay pellet – bottom left (f); plane polarized light (c, e, f); crossed polarized light (d)

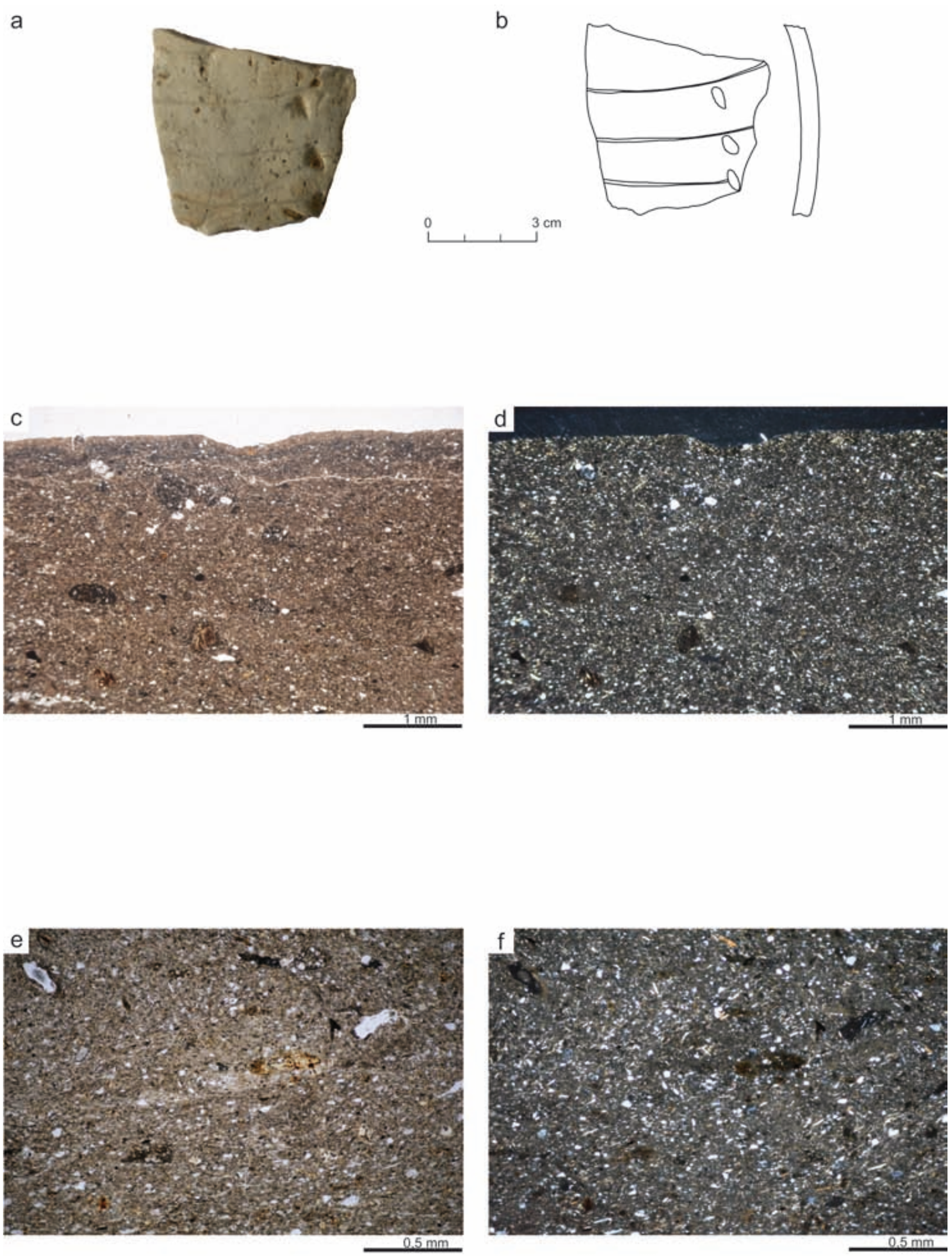

Fig. 7. Topolița, Neamț County, sample RumTop2, technological Type IIa; photography (a) and drawing (b) of the fragment; microphotographs of thin section (c-f); fine grained, homogeneous fabric, a small micro-crack parallel to the surface is visible (c, d); body matrix with small voids (e, f); plane polarized light (c, e); crossed polarized light (d, f)

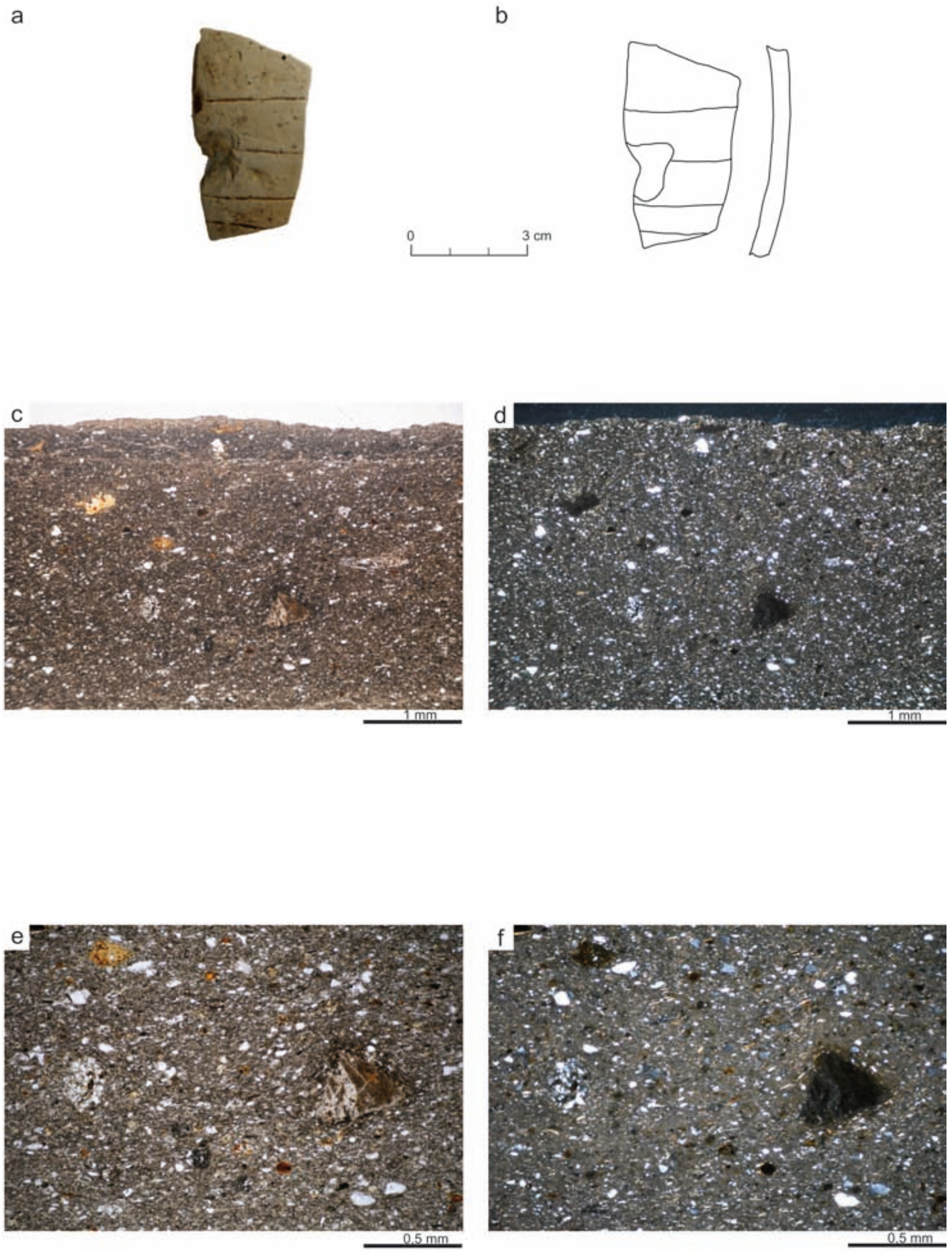

Fig. 8. Topolița, Neamț County, sample RumTop3, technological Type IIa; photography (a) and drawing (b) of the fragment; microphotographs of thin section (c-f); small inclusions within fine grained fabric are visible (c, d); chalcedony (right), rounded rock fragment (left) in ceramic body (e, f); plane polarized light (c, e); crossed polarized light (d, f)

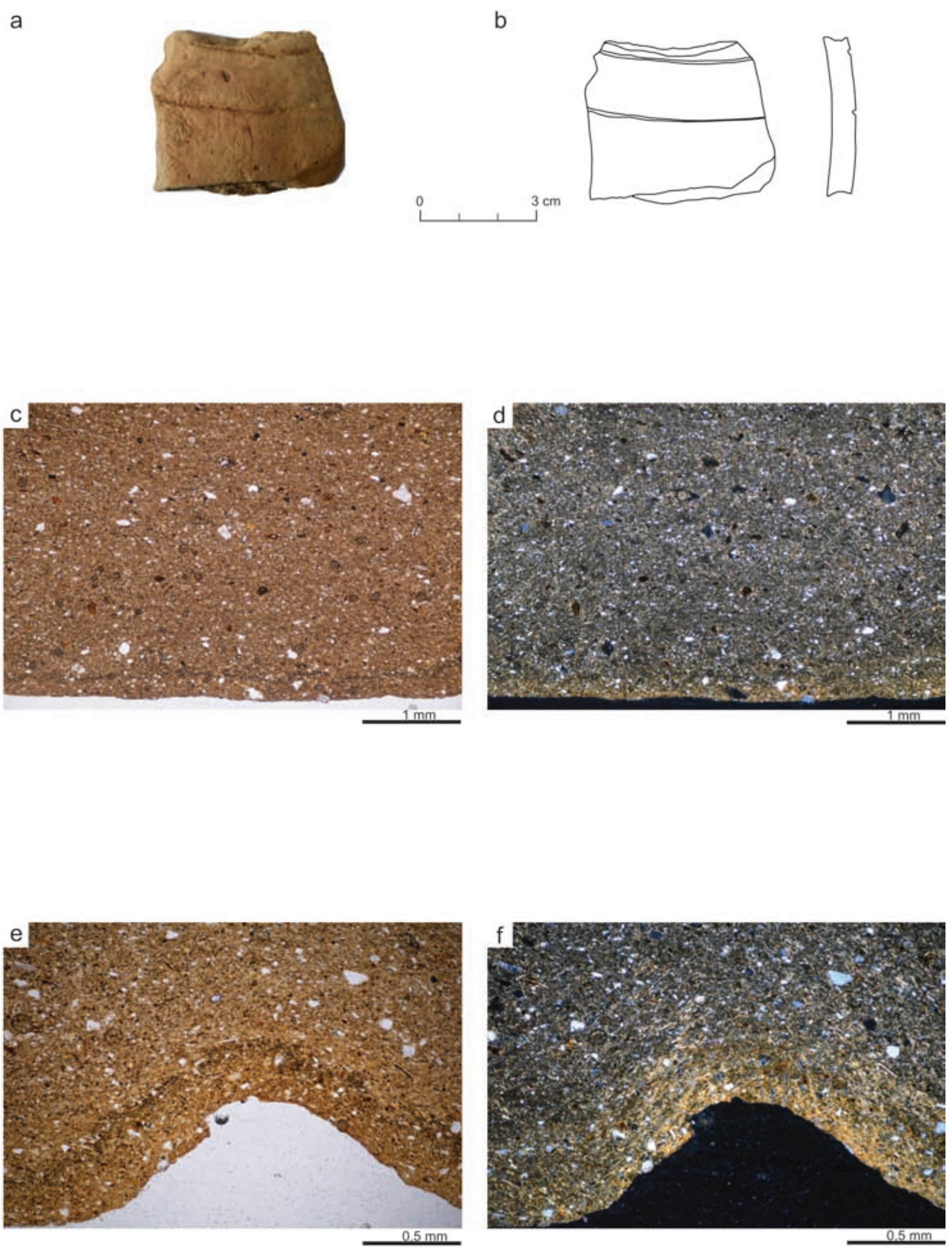

Fig. 9. Topolița, Neamț County, sample RumTop4, technological Type IIa; photography (a) and drawing (b) of the fragment; microphotographs of thin section (c-f); oxidized, fine grained, homogeneous fabric (c, d); detail of engraved line (e, f); plane polarized light (c, e); crossed polarized light (d, f)

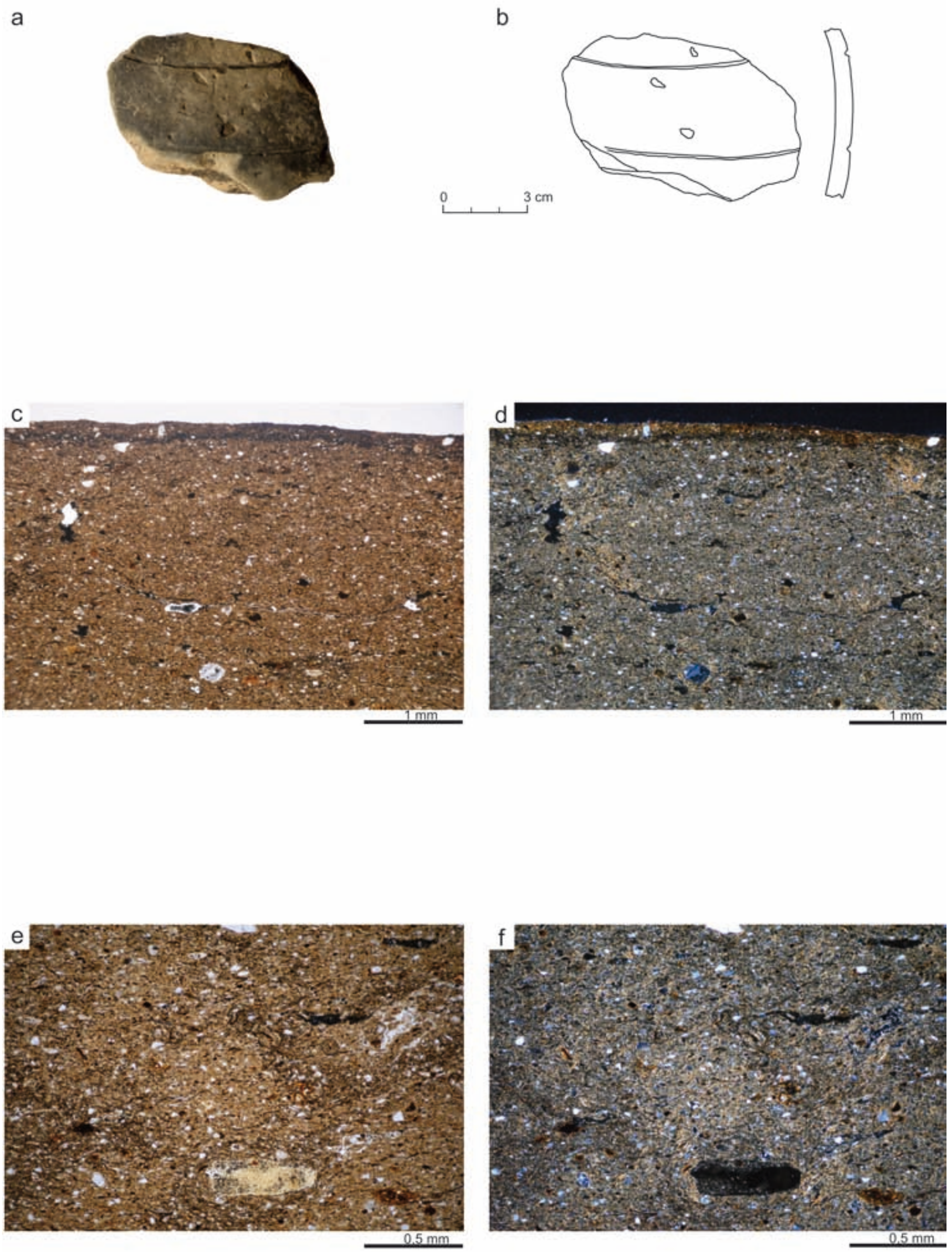

Fig. 10. Topolița, Neamț County, sample RumTop5, technological Type IIa; photography (a) and drawing (b) of the fragment; microphotographs of thin section (c-f); fine grained, homogeneous fabric, a thin layer of coloration parallel to the outer surface is visible (c, d); isotropic inclusion in ceramic matrix – in the bottom (e, f); plane polarized light (c, e); crossed polarized light (d, f)

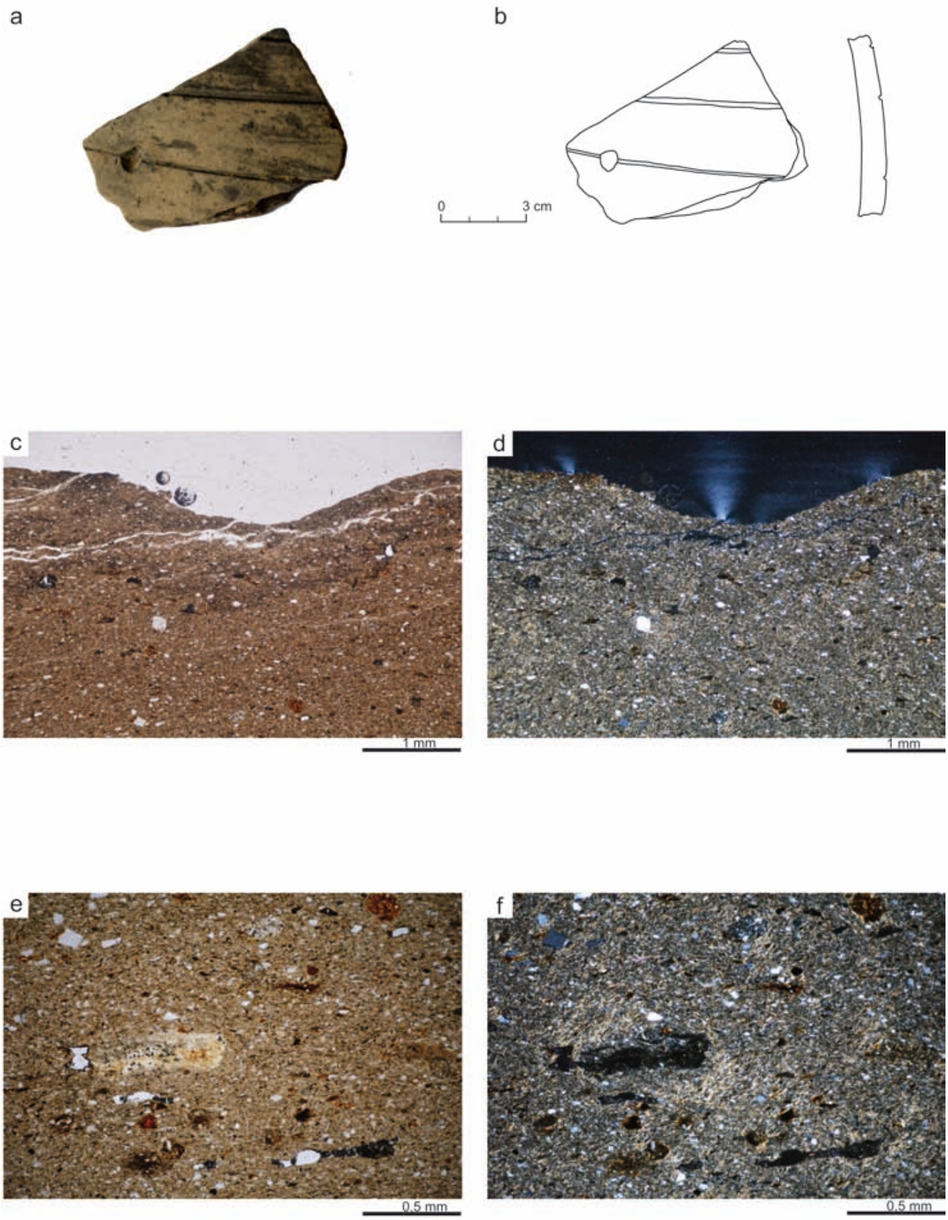

Fig. 11. Topolița, Neamț County, sample RumTop7, technological Type IIa; photography (a) and drawing (b) of the fragment; microphotographs of thin section (c-f); fine grained, homogeneous fabric, a small microcracks parallel to the surface are visible (c, d); isotropic inclusion in ceramic matrix – left (e, f); plane polarized light (c, e); crossed polarized light (d, f)

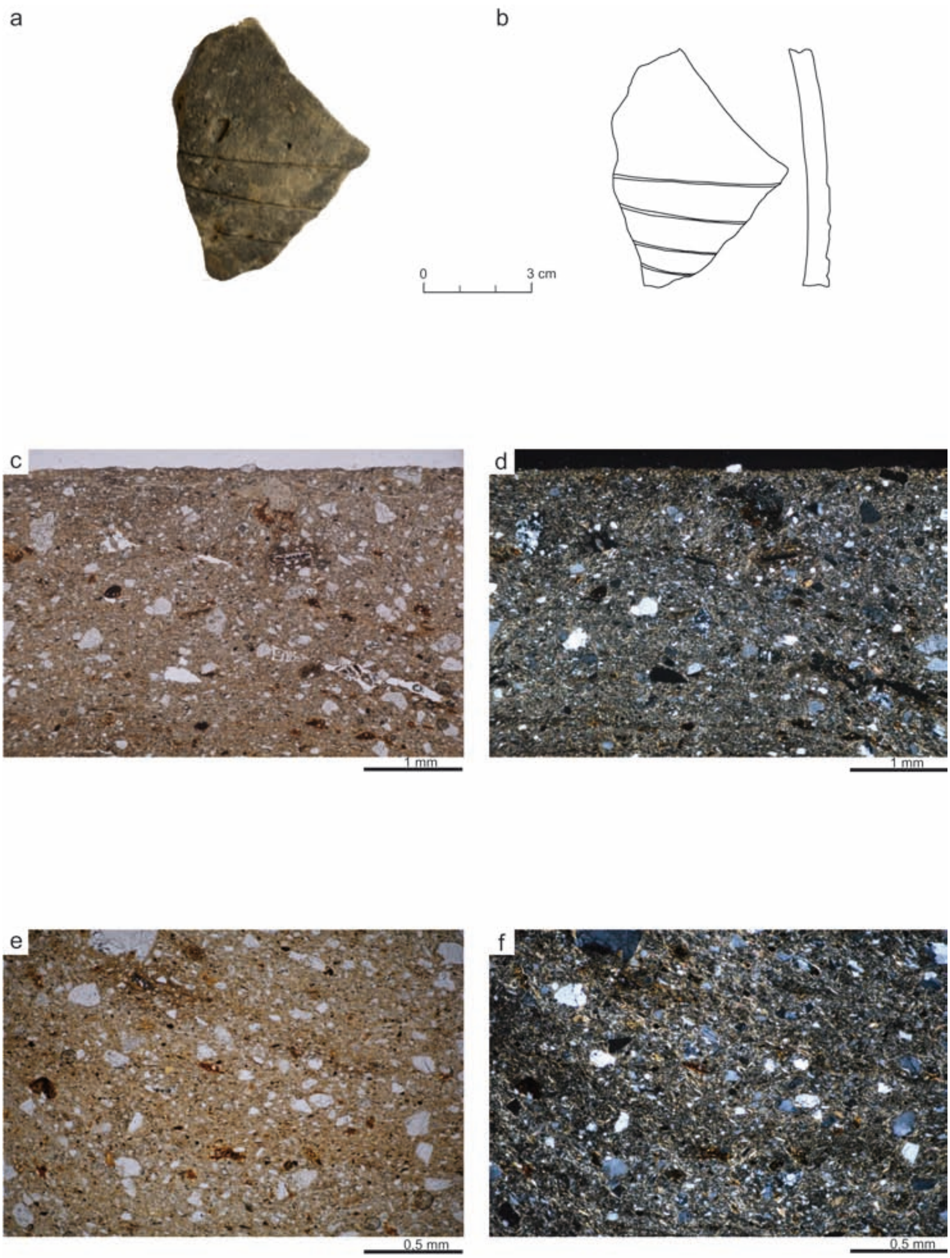

Fig. 12. Topolița, Neamț County, sample RumTop6, technological Type Ia; photography (a) and drawing (b) of the fragment; microphotographs of thin section (c-f); sand grains evenly distributed in the ceramic fabric (c, d, e, f); plane polarized light (c, e); crossed polarized light (d, f)

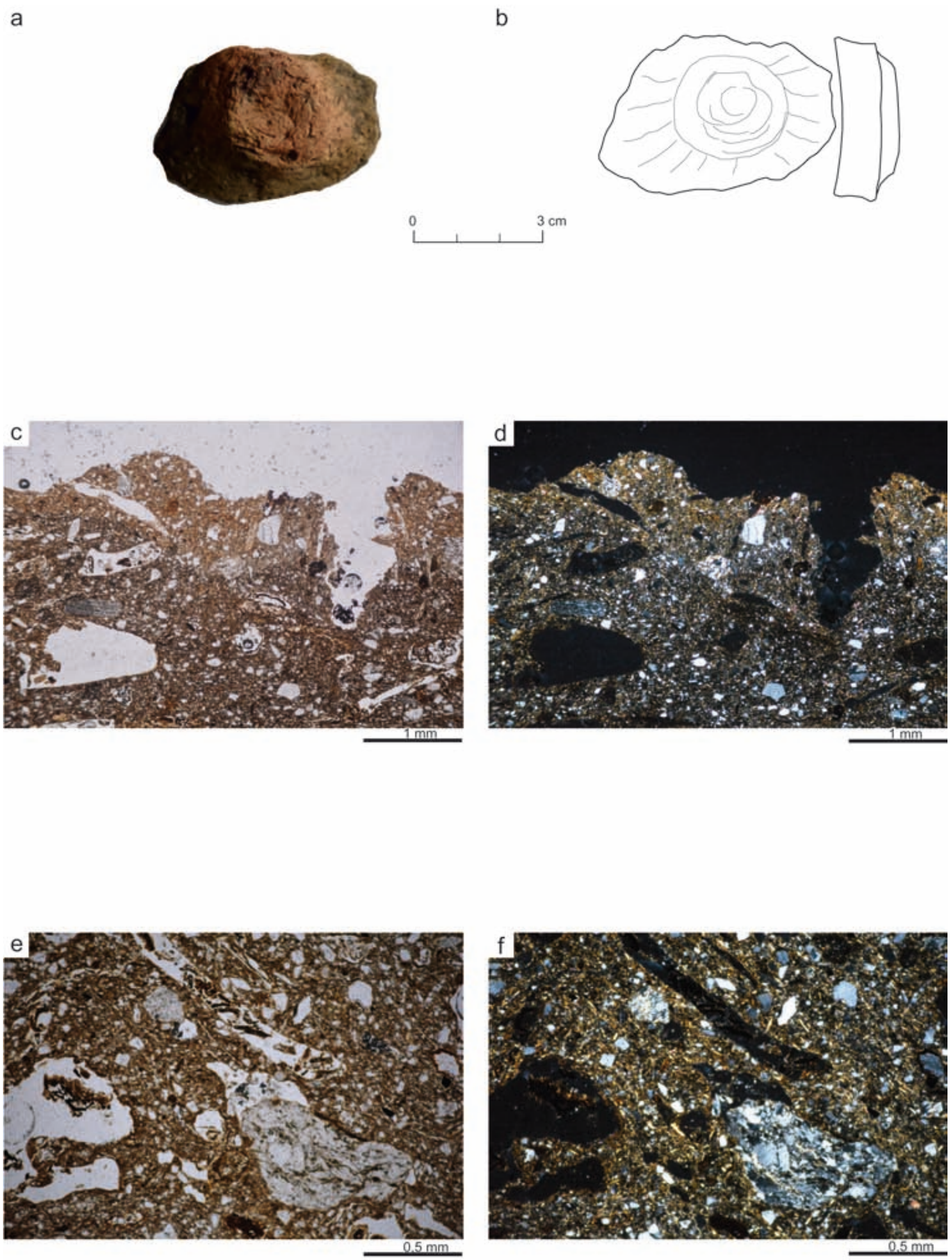

Fig. 13. Topolița, Neamț County, sample RumTop8, technological Type Ia; photography (a) and drawing (b) of the fragment; microphotographs of thin section (c-f); heterogeneous fabric, grains of quartz and feldspars and numerus voids after plant fragments are visible (c, d); fragment of rounded rock – left bottom, residues of plant fragments are visible (e, f); plane polarized light (c, e); crossed polarized light (d, f)

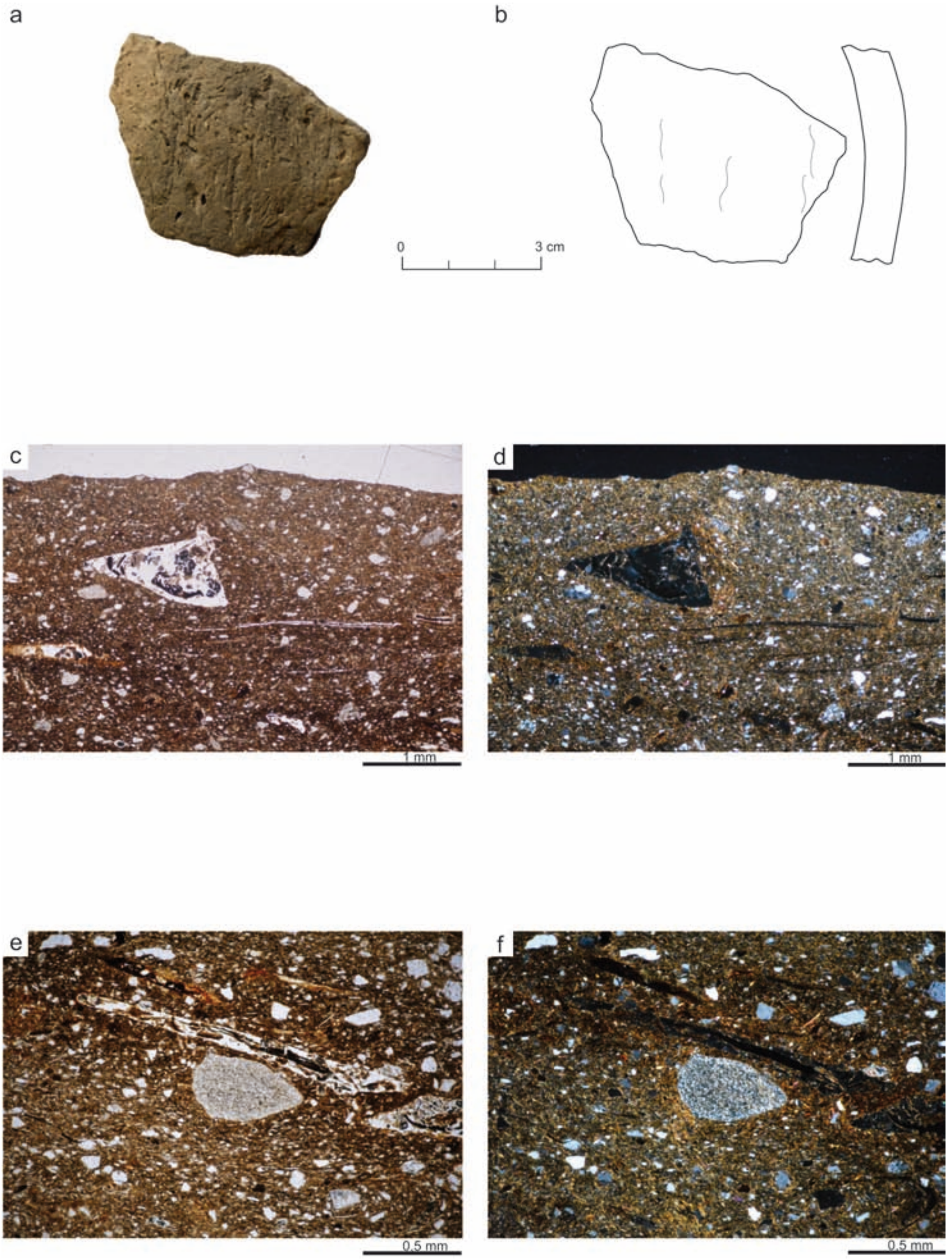

Fig. 14. Topolița, Neamț County, sample RumTop9, technological Type Ia; photography (a) and drawing (b) of the fragment; microphotographs of thin section (c-f); residues of plant fragments are visible in a well-mixed fabric (c, d); fragment of rounded rock – centre, and residues of plant fragments are visible (e, f); plane polarized light (c, e); crossed polarized light (d, f)

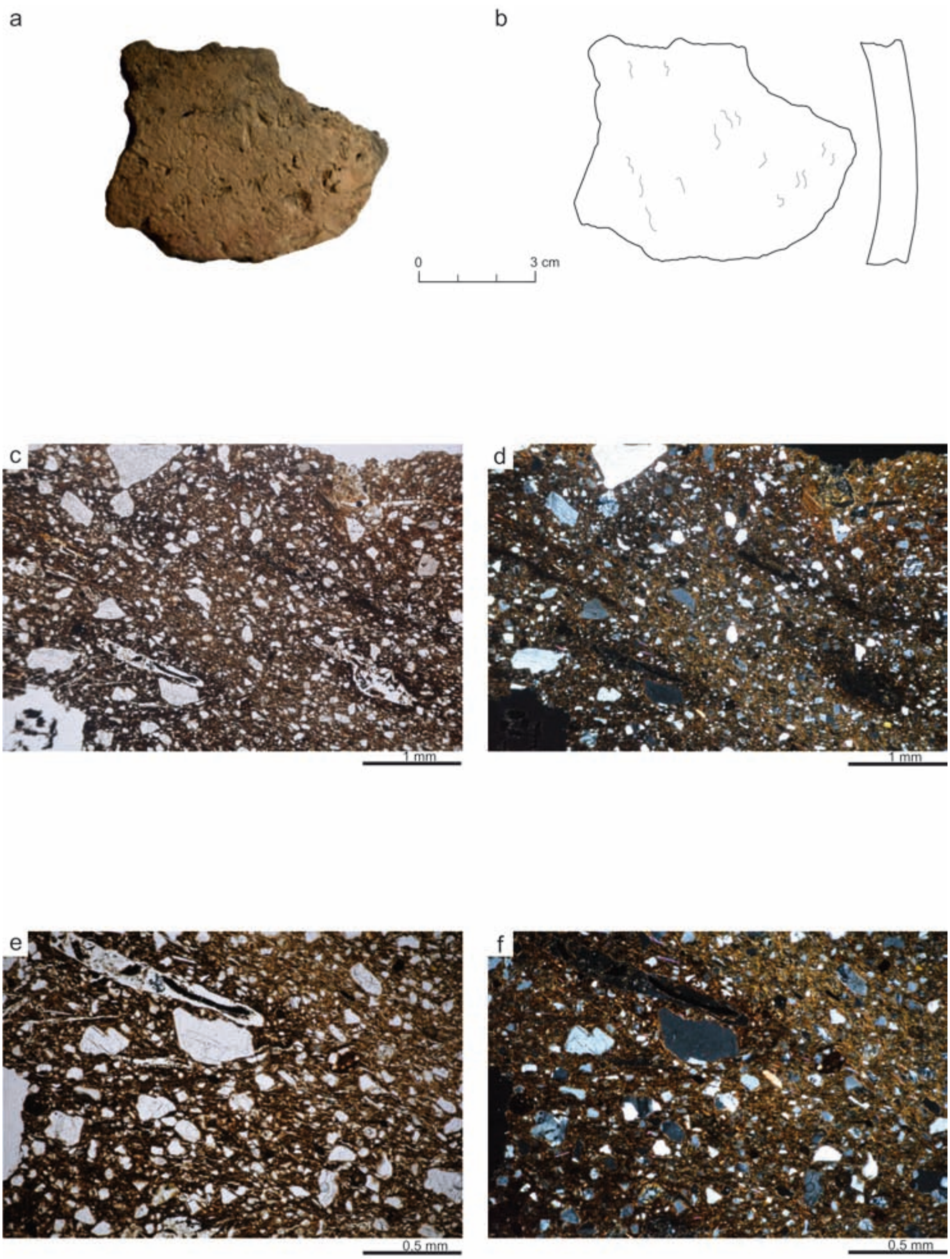

Fig. 15. Topolița, Neamț County, sample RumTop10, technological Type Ia; photography (a) and drawing (b) of the fragment; microphotographs of thin section (c-f); numerous sand grains and residues of plant fragments are visible in a well-mixed fabric (c, d, e, f); plane polarized light (c, e); crossed polarized light (d, f)

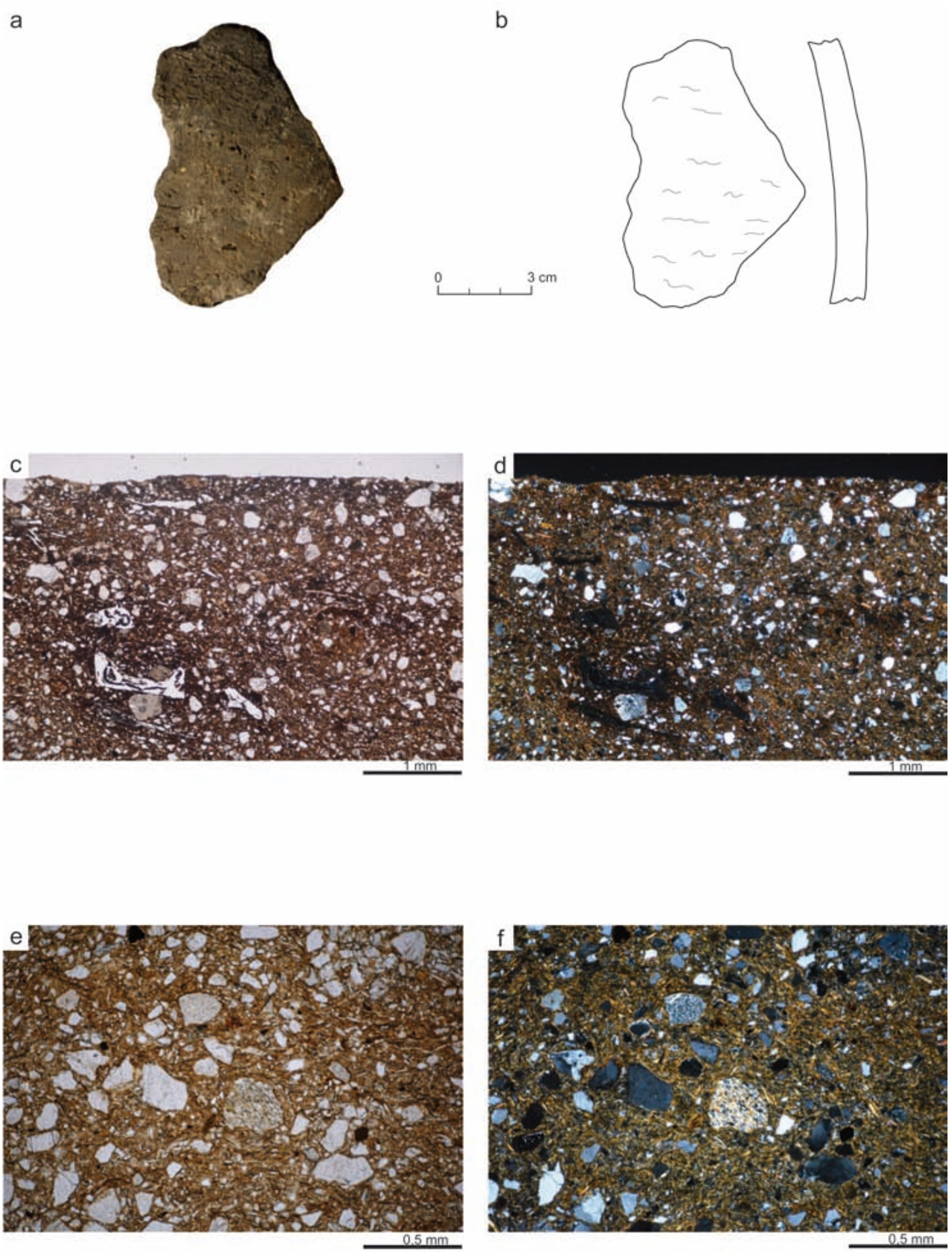

Fig. 16. Topolița, Neamț County, sample RumTop11, technological Type Ia; photography (a) and drawing (b) of the fragment; microphotographs of thin section (c-f); numerous sand grains and residues of plant fragments are visible in a well-mixed fabric (c, d); rounded fragment of rock in the centre (e, f); plane polarized light (c, e); crossed polarized light (d, f)

teristic voids, resulting in greater porosity of the pots walls. Plants fragments were intentional added to the clay.

The mineral inclusions primarily comprise sand and are identified in coarse ceramics. Sand consists of quartz grains, less frequently feldspars, and rounded fragments of metamorphic rocks. The latter were also sporadically noted in fine-grained ceramics (samples RumTop3 and RumTop7).

A significant correlation was noted between the presence of organic material and an increased number of mineral components (sand). It is difficult to determine conclusively whether the sand was deliberately added or if it was a natural component of the clay used. It is possible that coarse-grained clay was intentionally selected for making pots with thicker walls, while for thin-walled vessels, clay was purified from coarse grains.

Firing

The examined ceramic fragments exhibit various firing characteristics. The approximate firing temperature was determined based on the degree of alteration of clay minerals, observing their optical properties. Most fragments show signs of reduction firing or firing with the influx of air towards the end or during cooling. Only one fragment (TopRum1) displays features of oxidizing firing. Seven fragments show firing at temperatures around 700-750°C, while three fragments (TopRum4, RumTop10, RumTop11) were fired at temperatures around 800-850°C. The fracture of one fragment (sample RumTop3) is optically heterogeneous. Presumably, the wall's core reached a temperature of about 750-800°C, while the outer parts reached around 700-750°C.

Ceramic fabrics

Two main groups can we distinguished for analysed pottery from Topolița (Table 4).

Vessels RumTop1, RumTop2, RumTop3, RumTop4, RumTop5, and RumTop7 were made of very fine-grained ceramic fabrics, Type IIa according to the classification adopted for ceramics from Romania (Kadrow *et al.* 2018, table 4). They are characterized by good sorting, the absence of coarser mineral grains, and the lack of intentional admixtures. Neither organic nor mineral inclusions were observed. The clays were well mixed; all components are evenly distributed in the clay. There are no clear correlations regarding firing preferences. The vessels were fired in different atmospheres: oxidizing, reducing, and mixed. Firing temperatures ranged from 700°C to 850°C. Vessels with smoothed surfaces and engraved ornamentation and wall thicknesses ranging from approximately 0.3 to 0.7 cm were made from the described ceramic fabrics.

Vessels labelled RumTop6, RumTop8, RumTop9, RumTop10, and RumTop11 were made from poorly sorted, coarse-grained clays (Type Ia according to the classification adopted for ceramics from Romania; Kadrow *et al.* 2018, 11). Plant fragments and numer-

Table 4. Descriptions of fabric Types (after Kadrow *et al.* 2018)

Symbol of the fabric types	Fabric description	Sample from this study
I a	thicker grains in the ceramic body, organic admixture	RumTop6, RumTop8, RumTop9, RumTop10, RumTop11
I b	thicker grains in the ceramic body, presence of unmixed clay clasts (poorly mixed), organic admixture	
I c	thicker grains in the ceramic body, poorly mixed, without organic admixture	
II a	fine grained, homogeneous, compact, without organic admixture	RumTop1, RumTop2, RumTop3, RumTop4, RumTop5, RumTop7
II b	heavy clay, fine grained, with clay clasts and fragments of sedimentary rocks, without organic admixture	
II c	fine grained, homogeneous, compact, with organic admixture	
II d	fine grained, heterogeneous, with grog admixture	

ous sand grains were noted in these ceramic fabrics. Sand consists of quartz, feldspars (plagioclases, microcline), chalcedony, and fragments of metamorphic rocks. Clayey clasts and iron hydroxides (lepidocrocite) were observed. The fabrics are characterized by poor workmanship and greater porosity. Vessels made from these masses were more frequently fired under reducing and mixed atmospheres. The approximate firing temperature rangeed from 700°C to 850°C. The wall thickness of vessels varies from 0.5 to 0.8 cm. With one exception, these vessels have rough surfaces and lack engraved ornamentation. Sample RumTop6 originates from a vessel with smoothed walls and engraved ornamentation.

DISCUSSION

As part of earlier research, 23 fragments of ceramic vessels of the Linear Pottery culture from sites in northeastern Romania were examined (Kadrow *et al.* 2018). The sites closest to the Topoliţa site are Târpeşti, Traian, Preuteşti, and Mihoveni (n = 14); further southwest – Olteni (n = 4); and to the east – Isaiia (n = 5). Based on microscopic analyses, several ceramic types were distinguished. Generally, they can be divided into fine-grained and coarse-grained with various impurities and different clay preparation methods (Kadrow *et al.* 2018, table 4). Most thin-walled ceramics were made from fine-grained, homogeneous, compact fabrics (Type IIa). Two vessels were made from fabrics with organic admixture (Type IIc). Such fine-grained pastes with organic admixture were not found in Topoliţa.

The characteristic features of coarse-grained ceramics from Olteni, Târpeşti, Traian, Preuteşti, Mihoveni, and Isaiia are coarser-grained fabrics with sand and organic material admixture. The raw materials used for making vessels varied and had their characteristics depending on the site. Among others, heavy clays, sandy clays, and carbonate mud were identified.

The closest site to Topoliţa is Târpeşti, where (similarly to Topoliţa) no organic admixture was found in fine-grained fabrics. However, coarse-grained ceramics were made similarly at both sites – with sand and organic material admixture (Table 4). Significant differences can be observed in the raw materials used. In Târpeşti, several raw materials were identified, with a predominance of material rich in carbonates, primarily carbonate mud (three fragments), as well as pure heavy clay (one frag.) and clay with fragments of metamorphic rocks (one frag.). On the basis of the examined samples, only one type of clay was likely used in Topoliţa, which was prepared in various ways depending on the desired effect. This raw material is characterized by the presence of fine mica flakes and, within the coarser fraction, fragments of sedimentary and metamorphic rocks, mainly mudstone, quartz-mica schists, and quartz schists.

Several characteristic and consistent features exist for all examined fragments from Romania (n = 34). Thin-walled vessels were made from fine-grained, homogeneous, and compact fabrics (Type IIa or IIc). In contrast, vessels with thicker walls were made from poorly sorted fabrics with mineral admixture and with or without organic admixture (Type Ia, Ib, and Ic). This pattern is also characteristic of ceramics from southern and southeastern Poland (Rauba-Bukowska 2014; Rauba-Bukowska 2021; Rauba-Bukowska and Czekaj-Zastawny 2020; Czekaj-Zastawny *et al.* 2017).

Comparisons with the late Starčevo-Criş pottery from Tăşnad-Sere, Călineşti-Oaş, and Homorodul in eastern Romania did not reveal such a clear division into fine-grained and coarse-grained fabrics. Both thin-walled and thick-walled ceramics were made from fabrics with organic and mineral admixture (Kadrow and Rauba-Bukowska 2017). M. Spataro's (2019) research on Starčevo-Criş pottery from Romania (Banat, Transylvania), Serbia, and Slavonia revealed that both thin-walled and thick-walled vessels were made from clay fabrics with organic temper and, to a lesser extent, with a combination of organic temper and sand (Spataro 2019, 340–359). In this regard, there is a subtle resemblance to the earliest phases of LBK pottery from Poland (the Zofipolska phase, phase Ib of LBK in Poland) when organic admixture was predominant in the clay fabrics (*e.g.*, Moskal-del Hoyo et al. 2017; Rauba-Bukowska and Czekaj-Zastawny 2020).

By tracing the technology of LBK ceramic production in Małopolska, we know that it underwent continuous evolution. An important shift was observed in LBK pottery production in southern Poland between the Music-Note and Želiezovce phases. This was primarily associated with the introduction of grog admixture into the coarse ceramic fabrics at the expense of organic additives. It was also noted that during the Želiezovce phase, more homogeneous, compact, and often organic-free pottery fabrics were used for producing thin-walled vessels. Observing similar changes in LBK ceramic production from Romania is not currently possible. We only have material from one phase – the Music-Note phase. Comparisons of Romanian ceramic technology to ceramics from Małopolska suggest the Romanian ceramics might be assigned to a late stage of the Music-Note phase, when organic additives were used less frequently.

CONCLUSION

Similar ceramic production patterns were identified at the Topolița site and nearby LBK sites in Romania (Kadrow *et al.* 2018). Fine-grained, homogeneous, and compact ceramic fabrics without organic admixture were used to produce thin-walled vessels, while fabrics containing more sand and plant fragments were employed for vessels with thicker walls. This suggests a common technological tradition.

The raw materials used in Topolița were relatively uniform. Both microscopic and XRD diffraction analyses confirm that clay was locally sourced. The clay body is composed by illite/smectite and very fine mica flakes, mainly muscovite and biotite. Quartz and feldspars are the main inclusion in the clays. Microcline was distinguished within the potassium feldspar group, while albite and oligoclase were identified among the plagioclases. It can be assumed that the source material could have been sandy clays formed as alluvial river deposits. This material, resulting mainly from the erosion of older formations, was deposited in the Topolița River terrace sediment. A similar composition was obtained during the analysis of Bronze Age ceramics from the Topolița site (Mățău *et al.* 2021). This may indicate prolonged use of local raw materials. The reliance on locally sourced raw materials indicates self-sufficiency in ceramic production**.**

The raw material selection pattern was not similar everywhere. Contrast can be seen, for instance, with the nearest site in Târpeşti, where several different raw materials were identified (Kadrow *et al.* 2018, table 5, 34, 35). This disparity may reflect variations in geological formations and accessibility to different clay deposits between the two regions. Such differences highlight the importance of considering local environmental factors in understanding ceramic production practices.

The study of the technological aspects of pottery at Topolița (which is a new site on the settlement map of LBK), Târpeşti and other nearby sites provides valuable insights into the ceramic production practices in LBK in northeastern Romania. The similarities and differences observed shed light on regional variations in LBK ceramic technology and raw material procurement strategies. Furthermore, **similar technological patterns in Topolița and southeastern Poland**, especially during the Music-Note phase, suggest the transmission of knowledge and practices through cultural interactions and exchange networks.

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^{14}C-BASED ABSOLUTE CHRONOLOGY OF THE MALICE CULTURE REASSESSED

ABSTRACT

Chmielewski T. J., Przybyła M. M. and Fabiszak I. 2024. ^{14}C-based absolute chronology of the Malice culture reassessed. *Sprawozdania Archeologiczne* 76/2, 67-100.

This article addresses the absolute chronology of the Malice culture. It presents a Bayesian modelling based on an elementary assessment of accuracy and precision of all the relevant ^{14}C age measurements. Thanks to the preliminary qualitative evaluation, the newly built models are of higher statistical agreement than previous ones. Based on the refined models, the Early stylistic phase (Ia) of the Malice culture can be dated to around 4770-4600, the Classic one (Ib) – 4630-4440, Post-Classic one (Ic) – 4460-4390, and the Late one (II) – 4390-4290/4250 BCE. Accordingly, subphase Ia can be synchronised with: phase Polgár-Csőszhalom II, phase Lengyel I and the subphase Stichbandkeramik IVa; subphase Ib with: phases Polgár-Csőszhalom III and Proto-Tiszapolgár, the Santovka phase of the Lengyel culture as well as *Stichbandkeramik* IVb; Ic subphase with: the Classical phase-Tiszapolgár culture and the Lengyel II phase; phase II with: the late Tiszapolgár/earliest Bodrogkeresztúr culture and the Lengyel III phase.

Keywords: Lesser Poland, Upper Silesia, Western Volhynia, Malice culture, radiocarbon chronology, Bayesian inference

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INTRODUCTION

The progress in the research on the radiocarbon-based absolute chronology of the Malice culture has already been summarised twice since 2022 (see Zastawny 2022; Kadrow 2023). It might therefore be thought that chronometric studies have just gained such a momentum that approaching the problem for the third time in such a short period may not be justified.

Given the intensity of archaeological research conducted nowadays and the widespread use of ^{14}C dating over the past few decades, it is not surprising that the lists of radiocarbon age measurements published in the cited articles very quickly became outdated. Even the research conducted at the time those studies were written provided new ^{14}C dates. The newly performed ones include ^{14}C age determinations produced for two Malice culture burials discovered at site Kraków-Nowa Huta-Zesławice 88 and a few more graves unearthed at site Smroków 4. The resulting dates and the specification of dated organic remains, along with the key parameters characterising them, have already been published (Piotrowska *et al.* in press). Hence, only some of the archaeological contexts of the samples will be described in more detail here, namely the ones that are certainly worth disseminating. Radiocarbon dating of the contexts in question is certainly revealing. However, does a handful of additional data, even if quite important, justify writing yet another article on this topic?

The way these few additional ^{14}C age measurements will be presented below may rightly recall the old-fashioned formula of the article written by Jan Bakker and co-authors (1969), the publication of which 55 years ago created the ground for the research on the radiocarbon chronology of the Younger Stone Age in the Vistula and Oder basins. If such dates had appeared shortly after, they could have perhaps been considered groundbreaking. Also, every such data point would have certainly enriched significantly every following study and date list appearing over the next three decades, when the production of radiocarbon age determinations remained quite limited (*cf.,* Kurzątkowska 1985; Breunig 1987; Jankowska 1990; Forenbacher 1993; Czebreszuk and Szmyt 2001). Presently though, addressing a separate paper to a few additional ^{14}C dates may seem a somewhat obsolete idea. An increase in the number of radiocarbon age determinations performed by some laboratories is measured in tens, if not hundreds of thousands per decade. In order to keep them under any control, not only increasingly larger databases (see for example, Hinz *et al.* 2012; Barta *et al.* 2013; Capuzzo *et al.* 2014; Manning *et al.* 2016; Martínez-Grau *et al.* 2021; Vondrovský *et al.* 2023), but also dedicated data lakes or even data warehouses are being created all over Europe (see for example, Bronk Ramsey *et al.* 2019; Bird *et al.* 2022; Roe and Hinz 2022). Also, lists of newly obtained ^{14}C dates are published as compactly as possible (see for example, Chmielewski *et al.* 2021; Pospieszny and Nowaczyk 2022). So, are there any sound reasons for approaching again the ^{14}C -based absolute chronology of the Malice Culture?

In any case, the value of the pool of relevant results of ^{14}C age measurements cannot be measured solely by their number but also by their accuracy and precision. Regardless of the current perception of the work completed by Bakker and co-authors, one should bear in mind that they were already applying rudimentary quality criteria for assessing the precision and accuracy of their dates (Bakker *et al.* 1969, 5). Since then, the general 'chronometric awareness' has been constantly growing, and today it would not even be possible to do justice to and cite all the studies dealing with the reliability of radiocarbon dating of various archaeological finds. Let us just point out that also in the course of the studies directly addressing the ^{14}C -based chronology of the Neolithic and Eneolithic in the Odra and Vistula basins, considerable efforts have been made to sort this issue out either *ad hoc* (see for example Nowak 2017, supplementary material) or in a systemic way (*cf.*, Czebreszuk and Szmyt 2000, 69-70; Chmielewski 2020a, 55-69). And yet, the studies referred to at the beginning of this paper completely ignore the qualitative factor and equalise the reliability of all the statistically analysed ^{14}C dates.

In order to demonstrate and correct chronological miscalculations resulting from the chronological modelling carried out on the basis of overly simplified assumptions, we decided to perform the Bayesian statistical analyses anew, this time though preceding them with an elementary assessment of the accuracy and precision of all the radiocarbon age measurements constituting the output set. The architecture of the eventual sequential models included additional prior arguments resulting from the qualitative specification. All the discrepant results were critically analysed with a particular emphasis put on the effect of quantity and quality of the ^{14}C dates used for the modelling on the differences.

MATERIAL AND METHODS

Initially, the data pool consisted of 55 radiocarbon age measurements related to 42 contexts associated with the Malice culture in the vast area covering western Volhynia, Lesser Poland and Upper Silesia. The results of all the measurements, along with the specification of dated organic material samples and their archaeological contexts, are listed alphabetically in Table 1.

Except for the hitherto unpublished human burials from Kraków-Nowa Huta-Zesławice and Smroków, the description of all the archaeological contexts, for which the analysed radiocarbon ages were measured, is rather succinct; it has been limited to names of archaeological sites, numbers of features and their functional attribution. However, every record contains references to works providing a more comprehensive information on the given find and its wider context.

Each ^{14}C-dated and diagnostic archaeological assemblage of the Malice culture was assigned to its development phase in accordance with the widely accepted phasing, which originally was presented by Anna Dzieduszycka-Machnikowa (Dzieduszycka-Machnikowa

Table 1. List of radiocarbon ages that are connected with the Malice culture. A detailed explanation of the system of archaeological phasing of the Malice culture and the system of assessment of the accuracy and precision of the measurements is provided in the text

No.	Site	Feature no.	Type of feature	Phase	Material dated	Laboratory no.	Radiocarbon age (BP)	Date quality	References
1	Aleksandrowice 2 (AKD2)	376	settlement pit	Ia	charcoal (Quercus sp.; fragment of a twig)	Poz-121003	5890 ±35	Ba2	Micyk *et al.* 2020; Zastawny 2022; Kadrow 2023
2	Iwanowice Włościańskie (Góra Klin) 1 (IWW1)	8	settlement pit	Ia[1]	charcoal (undet.)	GrN-5977	5855 ±40	Bc2	Dzieduszycka-Machnikowa, Lech 1976; Breunig 1987
3	Kichary Nowe (Pole Bolenia) 2 (KNW2)	72	settlement pit	Ia	charcoal (undet.)	Gd-6967	5730 ±130	Bc4	Kowalewska-Marszałek 2004; Kaczanowska, Kozłowski 2006
4	Kraków-Nowa Huta-Zesławice 88 (NHZ88)	B820	human burial	Ib	human bone (♀, 25-30 yrs; left rib)	GdA-7310	5640 ±30	Aa2	Piotrowska *et al.*, in press; unpublished burial (Fig. 2)
5	Kraków-Nowa Huta-Zesławice 88 (NHZ88)	C150	human burial	Ib	human bone (♀, 20-25 yrs; left rib)	GdA-7312	5690 ±30	Aa2	Piotrowska *et al.*, in press; unpublished burial (Fig. 3)
6	Kraków-Nowa Huta-Zesławice 88 (NHZ88)	Y421	human burial	Ic	human bone (♀, 20-30 yrs; long bone)	GdA-7428	5545 ±40	Aa2	Piotrowska *et al.*, in press; unpublished burial (Fig. 5)
7	Kraków-Olszanica 2 (KRO2)	20	settlement pit	Ia	charcoal (Quercus sp.)	Poz-77984	5830 ±40	Ac2[2]	Zastawny 2022; Kadrow 2023
8	Kraków-Witkowice II (KRW2)	7	settlement pit	x[3]	animal bone (Bos sp.)	Poz-43316	5525 ±35	Da2[4]	Zastawny 2015; Zastawny 2022; Kadrow 2023
9	Las Stocki 7 (LST7)	57	settlement pit	x	charcoal (undet.)	Gd-4164	5400 ±140	Dc4	Zakościelna 1996; Kadrow, Zakościelna 2000; Chmielewski 2008; Włodarczak 2017; Zastawny 20232; Kadrow 2023
10	Las Stocki 7 (LST7)	57	settlement pit	x	charcoal (undet.)	Gd-2715	5400 ±80	Dc3	Zakościelna 1996; Kadrow, Zakościelna 2000; Chmielewski 2008; Włodarczak 2017; Zastawny 2022; Kadrow 2023

11	Las Stocki 7 (LST7)	28	settlement pit	x	charcoal (undet.)	Gd-1724	5350 ±60	Dc3	Pazdur *et al.* 1994; Kadrow 1996; Zakościelna 1996; Kadrow, Zakościelna 2000; Chmielewski 2008; Włodarczak 2017; Zastawny 2022; Kadrow 2023
12	Łoniowa 18 (LNW18)	9	settlement pit	Ia?	charcoal (undet.)	Poz-15978	5880 ±40	Bc2	Valde-Nowak 2009; Zastawny 2022; Kadrow 2023
13	Racibórz-Ocice (RCO)	9[5]	settlement pit	x	charcoal (undet.)	KN-I.357	5690 ±55[6]	Dc3	Breunig 1987; Kamieńska, Kozłowski 1990; Kulczycka-Leciejewiczowa 1993; Czarniak 2012; Chmielewski 2020
14	Rozbórz 42 (RZB41)	2645	posthole (timber house)	Ib	charcoal (undet.)	MKL-799	5820 ±90	Ac3	Sznajdrowska, Mazurek 2015; Zastawny 2022; Kadrow 2023
15	Rzeszów 31 (RZW31)	18	settlement pit	II	charcoal (undet.)	Poz-16473	5480 ±40	Ac2	Dębiec, Pelisiak 2008; Zastawny 2022; Kadrow 2023
16	Rzeszów 31 (RZW31)	18	settlement pit	II	charcoal (undet.)	Poz-16474	5450 ±40	Ac2	Dębiec, Pelisiak 2008; Zastawny 2022; Kadrow 2023
17	Sandomierz 6 (SWZ6)	26	settlement pit	II	charcoals (undet.)	Gd-2909	5930 ±130	Bd4[7]	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017
18	Sandomierz 6 (SWZ6)	24	settlement pit	II	charcoals (undet.)	Gd-4322	5740 ±130	Bd4[8]	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017
19	Sandomierz 6 (SWZ6)	49	settlement pit	II	charcoals (undet.)	Gd-4459	5680 ±140	Bd4[9]	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017
20	Sandomierz 6 (SWZ6)	16	settlement pit	II	charcoal (undet.)	Poz-57913	5590 ±40	Bc2	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023
21	Sandomierz 6 (SWZ6)	42	settlement pit	II	charcoal (undet.)	Poz-57916	5590 ±40	Bc2	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023

No.	Site	Feature no.	Type of feature	Phase	Material dated	Laboratory no.	Radiocarbon age (BP)	Date quality	References
22	Sandomierz 6 (SWZ6)	25	settlement pit	II	charcoal (undet.)	Poz-60513	5580 ±35	Bc2	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023
23	Sandomierz 6 (SWZ6)	43	settlement pit	II	charcoal (undet.)	Poz-57917	5565 ±35	Bc2	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023
24	Sandomierz 6 (SWZ6)	3	human burial	II	tar (undet.)	Poz-60512	5545 ±35	Ac2	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023
25	Sandomierz 6 (SWZ6)	1	human burial	II	charcoal (undet.)	Poz-62480	5525 ±35	Bc2	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023
26	Sandomierz 6 (SWZ6)	2	settlement pit	II	animal bone (undet.)	Poz-505596	5520 ±40	Bb2	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023
27	Sandomierz 6 (SWZ6)	7	settlement pit	II	animal bone (undet.)	Poz-505595	5490 ±40	Bb2	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023
28	Sandomierz 6 (SWZ6)	50	settlement pit	II	charcoal (undet.)	Gd-2910	5450 ±100	Bc3	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023
29	Sandomierz 6 (SWZ6)	18	settlement pit	II	charcoal (undet.)	Poz-63725	5452 ±35	Bc2	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023

30	Sandomierz 6 (SWZ6)	50	settlement pit	II	charcoal (undet.)	Poz-62494	5420 ±35	Bc2	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023
31	Sandomierz 6 (SWZ6)	67	settlement pit	II	charcoal (undet.)	Poz-57821	5360 ±35	Bc2	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023
32	Sandomierz 6 (SWZ6)	26	settlement pit	II	charcoal (undet.)	Poz-62493	5300 ±35	Bc2	Kowalewska-Marszałek, Cygnot 2017; Włodarczak 2017; Zastawny 2022; Kadrow 2023
33	Sandomierz-Kruków 20 (SKR20)	11	settlement pit	II?	charcoal (undet.)	Gd-1944	5030 ±50	Cd2	Michalak-Ścibior, Taras 1995
34	Smroków 4 (SRW4)	H16	human burial	Ic	human bone (sex undet., 10-11 yrs; ulna)	Poz-91125	5585 ±35	Ab2	Piotrowska *et al.*, in press; unpublished burial
35	Smroków 4 (SRW4)	H26	human burial	Ic	human bone (sex undet., 12-15 yrs; humerus)	Poz-91126	5605 ±35	Ab2	Piotrowska *et al.*, in press; unpublished burial
36	Smroków 4 (SRW4)	H17	human burial	Ic	human bone (sex indet., 18-35 yrs; femur)	Poz-91094	5230 ±50	Ad2[10]	Piotrowska *et al.*, in press; unpublished burial
37	Smroków 4 (SRW4)	H29	human burial	Ib	human bone (♀, ca 22 yrs; os longum)	Poz-127152	5640 ±40	Ab2	Piotrowska *et al.*, in press; unpublished burial (Fig. 4)
38	Smroków 4 (SRW4)	J57	human burial	Ib	human bone (sex undet., ca 10 yrs; os longum)	Poz-127153	5670 ±40	Ab2	Piotrowska *et al.*, in press; unpublished burial
39	Smroków 4 (SRW4)	G22	human burial	Ib	human bone (sex undet., ca 6 yrs; os longum)	Poz-127156	5610 ±40	Ab2	Piotrowska *et al.*, in press; unpublished burial
40	Smroków 4 (SRW4)	O45?	human burial	II	human bone (os longum)	Poz-127154	5470 ±40	Ab2	Piotrowska *et al.*, in press; unpublished burial

No.	Site	Feature no.	Type of feature	Phase	Material dated	Laboratory no.	Radiocarbon age (BP)	Date quality	References
41	Świerszczów Kolonia 28 (SWK28)	4 (grave 2)	human burial	II?	human bone (♂, adultus; bone undet.)	Ki-4193	5430 ±60	Bd3[11]	Kadrow, Zakościelna 2000; Kadrow 2009; Kadrow *et al.* 2009; Zastawny 2022; Kadrow 2023
42	Świerszczów Kolonia 28 (SWK28)	5 (grave 3)	human burial	II?	human bone (sex undet., infans I; bone undet.)	Ki-4189	5350 ±50	Cd2[xi]	Kadrow, Zakościelna 2000; Kadrow 2009; Kadrow *et al.* 2009; Zastawny 2022; Kadrow 2023
43	Targowisko 10-11 (TRG10-11)	2271	settlement pit	Ia	charcoal (Quercus sp.)	Poz-71637	5800 ±35	Cc2	Zastawny 2022; Kadrow 2023
44	Targowisko 14-15 (TRG14-15)	1	settlement pit	Ib	charred plant macro-remains (undet.)	MKL-A5167	5821 ±23	Cc1	Kadrow *et al.* 2021; Zastawny 2022; Kadrow 2023
45	Targowisko 14-15 (TRG14-15)	1A	settlement pit	Ib	charred plant macro-remains (undet.)	MKL-A5166	5779 ±24	Cc1	Kadrow *et al.* 2021; Zastawny 2022; Kadrow 2023
46	Targowisko 14-15 (TRG14-15)	1	settlement pit	Ib	charred plant macro-remains (undet.)	MKL-A5165	5755 ±23	Cc1	Kadrow *et al.* 2021; Zastawny 2022; Kadrow 2023
47	Targowisko 14-15 (TRG14-15)	1	settlement pit	Ib	charred plant macro-remains (undet.)	MKL-A5162	5741 ±23	Cc1	Kadrow *et al.* 2021; Zastawny 2022; Kadrow 2023
48	Targowisko 14-15 (TRG14-15)	1C	settlement pit	Ib	charred plant macro-remains (undet.)	MKL-A5163	5737 ±23	Cc1	Kadrow *et al.* 2021; Zastawny 2022; Kadrow 2023
49	Targowisko 14-15 (TRG14-15)	1	settlement pit	Ib	charred plant macro-remains (undet.)	MKL-A5168	5737 ±23	Cc1	Kadrow *et al.* 2021; Zastawny 2022; Kadrow 2023
50	Targowisko 14-15 (TRG14-15)	10	settlement pit	Ib	charred plant macro-remains (undet.)	MKL-A5164	5705 ±24	Cc1	Kadrow *et al.* 2021; Zastawny 2022; Kadrow 2023
51	Targowisko (TRG core)	x	sediment core	Ia	biogenic sediments	MKL-4183	5960 ±80	Dd3	Forysiak *et al.* 2021; Kadrow 2023
52	Tworkowa 20 (TKW20)	10	settlement pit	x	charcoal (undet.)	Poz-47533	5200 ±40	Dc2[12]	Valde-Nowak 2020; Zastawny 2022; Kadrow 2023
53	Zakrzowiec 8 (ZKC8)	359	well	Ib	charcoal (Betula sp.)	Poz-45435	5760 ±40	Aa2	Jarosz 2012, after Zastawny 2022; Kadrow 2023

54	Zakrzowiec 8 (ZKC8)	359	well	Ib	charcoal (Betula f sp.)	Ki-13694	5690 ±90	Aa3	Jarosz 2012, after Zastawny 2022; Kadrow 2023
55	Zawada 14 (ZWD8)	3	settlement pit	Ic	unspecified organic matter on the inner surface of a pot (tar?)[13]	Poz-96806	5570 ±40	Ab2	Szeliga et al 2023

1 The relative chronology of this context is based on the assessment of ceramic finds performed by Jadwiga Kamieńska and Anna Kulczycka-Leciejewiczowa (Jacek Lech, personal communication, March 9, 2024).

2 The dated charcoal was taken from remains of a fireplace.

3 According to Sławomir Kadrow (2023, table 1), the context should be related to the Rzeszów phase (II), whereas the pottery published by Albert Zastawny (2022, Fig 8: 1-8) is stylistically older (phase I) Nevertheless, the controversy appear to be of no importance as the stratigraphic and contextual relationships between these finds and the radiocarbon dated animal bone cannot be determined (see footnote iv).

4 The dated bone has apparently been discovered in a secondary position – in the pit of the Baden culture (see Zastawny 2015, tab. 5-6) The alleged contemporaneity of the dated bone and pottery finds of the Malice culture from a pit intersected by feature 7 is based solely on the presumption that the bone has been redeposited from the older pit.

5 Krzysztof Czarniak (2012, 69) connects the date calculated on the basis of the obtained radiocarbon age to the Malice culture However, according to Janusz K Kozłowski who explored the pit that yielded the radiocarbon-dated charcoal, this feature is related to the Lengyel culture (Kamieńska and Kozłowski 1990, 51).

6 Unlike all Polish scholars (Kamieńska and Kozłowski 1990, 51; Kulczycka-Leciejewiczowa 1993, tab 1; Czarniak 2012, 69), Peter Breunig (1987, 156) provides the radiocarbon age with an uncertainty of ±75 conventional years.

7 The LSC measurement was performed on a mixture of charcoals from five different anthracological samples (Kowalewska-Marszałek and Cygnot 2017, 73).

8 The LSC measurement was performed on a mixture of charcoals from six different anthracological samples (Kowalewska-Marszałek and Cygnot 2017, 71).

9 The LSC measurement was performed on a mixture of charcoals from three different anthracological samples (Kowalewska-Marszałek and Cygnot 2017, 108).

10 The low collagen yield (0.6%) of the original bone sample was indicative for a strong diagenesis of the bone, and consequently – possible contamination of the sample with foreign materials such as humic and fulvic acids (see Piotrowska *et al.* in press, supplementary material 2, for more details) This suspicion was then confirmed by measuring the C:N ratio, the value of which exceeded the threshold value of 3.343 (*cf.,* Schwarcz, Nahal 2021).

11 The samples were classified as class „d" due to the fact that the measurements were almost certainly performed on non-ultrafiltrated collagen, which increases the risk of leaving contamination in the dated organic matter (*cf., eg.,* Brown 1988; Bronk-Ramsey *et al.* 2004; Higham *et al.* 2006) Technically, ultrafiltration can be applied only for milligram-sized samples, radiocarbon age of which can be measured using non-radiometric methods (such as AMS; *cf., eg.,* Linick *et al.* 1989) During that time, the Kiev laboratory was using exclusively a radiometric method of measuring radiocarbon age (LSC) what requires larger organic samples.

12 Paweł Valde-Nowak (2020, 174) provided no information about traditional (chrono-typological) dating of the pit from which the radiocarbon dated sample was taken Seemingly, it was just the ^{14}C date that made him connect the context with the Malice culture.

13 Dating of carbonized organic residues from inner surfaces of walls of vessels (most likely – charred food remains) is generally burdened with the risk ofa reservoir effect Thus, they may result in very inaccurate radiocarbon age determinations (cf eg Pesonen 1999; Miyata *et al.* 2011) In this case though, assuming that the dated matter is indeed tar (which was commonly used in the Neolithic and Eneolithic in the Vistula-Oder interfluve; *cf., eg.,* Pietrzak 2010), the obtained date should be considered accurate (*cf., eg.,* Pesonen 1999; Kotova *et al.* 2021, 20-21; Manninen *et al.* 2021, 848).

and Lech 1976, 79; personal communication with Jacek Lech on March 9, 2024). In this division, based on the taxonomic and chronological findings of Jadwiga Kamieńska and Janusz K. Kozłowski (1970), two phases were distinguished, the first of which was divided into two subphases. Currently, the first of them (Ia) is referred to as the Early Classic or – more fitly – Pre-Classic one, the second (Ib) – as the Classic phase, and the third (II) – as the Rzeszów or simply Late phase of the Malice culture. During further research (Kadrow 1990, 70), a Late Classic or Post-Classic (Ic) subphase has been distinguished (for a different historical perspective on this research see: Kadrow and Zakościelna 2000, 194-197; Kadrow 2006, 63; 2009, 59; 2023, 59, 60). It must be pointed out that in the present study, the Samborzec-Opatów group was considered a regional group of the early Malice culture that is distinct with a strong Lengyel component (*cf.*, Michalak-Ścibior 1996, 47; Zápotocká 2004, 38-41). At the same time, we uphold the opinion (Chmielewski 2008, 82, 83) that the postulated division of the Rzeszów phase into two subphases (*cf.*, Kadrow 1988; 1996; Kadrow and Zakościelna 2000, 204-208) had never been convincingly justified. Despite dissent on the two points, the stylistic phasing of the Malice culture applied in the present study corresponded to the generalised divisions used in both reference studies (*cf.*, Zastawny 2022, 168; Kadrow 2023, 59-61).

Information directly relating to the dated organic samples and measurements of their radiocarbon age has been complemented wherever possible. These additional pieces of data were partly obtained from the literature, and partly from the personal communication with a number of scholars. The resulting description is still somewhat simplified and does not meet all current requirements for publishing radiocarbon dates (*cf.*, Millard 2014; Bayliss 2015, 681-690). Undoubtedly though, the specification of dates provided in our paper was intended to be as close to these standards as possible.

As already stressed, one of the main reasons for undertaking this study, and at the same time the very starting point of the statistical chronometric analyses carried out herein, was the necessity of a qualitative assessment of all the hitherto performed measurements of radiocarbon ages of organic remains that can be associated with the Malice culture. This evaluation was made in terms of precision and accuracy of the measurements in accordance with the criteria proposed only a few years before (Chmielewski 2020a, 55-69).

And so, considering the precision given by a value of uncertainty(σ) for every ^{14}C age measurement, the measurements were divided into four classes:

– class 1 (of very high precision: $\sigma \leq \pm 25$ conv. yrs);
– class 2 (of high precision: $\pm 25 < \sigma \leq \pm 50$ conv. yrs);
– class 3 (of low precision: $\pm 50 < \sigma \leq \pm 100$ conv. yrs);
– class 4 (of very low precision: $\sigma > \pm 100$ conv. yrs).

The accuracy of each measurement was defined on the basis of a definite or assumed chronological relationship between the target ‘depositional event’ (*i.e.* deposition of a given ceramic set) and the age of radiocarbon dated organic material that is contextually associated with the dated pottery assemblage. In this regard, the reliability of the archaeological context and the organic substance of every sample was subject to an independent assessment. In order to evaluate the samples in the former aspect, each of them was attributed to:

– class A (of unquestionable contextual reliability);
– class B (of conditional contextual reliability);
– class C (of uncertain contextual reliability);
– or class D (of questionable contextual reliability).

Depending on the organic material dated, every sample was categorised as belonging to one of four analogical classes:

– class a (of unquestionable substance reliability);
– class b (of conditional substance reliability);
– class c (of uncertain substance reliability);
– or class d (of questionable substance reliability).

Ultimately, on the basis of the foregoing dual assessment of accuracy, each measurement could be assigned to one of four (I–IV) quality groups in accordance with the weakest link rule. If then any measurement was classified as belonging to the 'double a' (Aa) class, the ^{14}C date was considered to be of the highest quality (group I). The lower its reliability, the more declassed it became. When any of the two attributes of the measurement was classified as 'B/b', the resulting date was assigned to the quality class II, when classified as 'C/c' – to the third (III) class, and when classified as 'D/d' – to the lowest one (IV).

Only the samples belonging to quality groups I and II were considered as coeval with the associated assemblages of the Malice culture. Consequently, the resulting ^{14}C dates were inserted into the corresponding 'ceramic phases' without any prior corrections as equally reliable elements of the proposed chronometric models.

The subset of dates classified under quality group III was a derivative of radiocarbon age measurements made mainly for anatomically undetermined or anatomically and species-wise undetermined charcoals. Their radiocarbon age was *a priori* treated as biased by the so-called old wood effect (see Bronk Ramsey 2009a, 1028, 1030-1032). As such, these dates were introduced into all the models as certain t-outliers, under the assumption that long-lived trees, whose charred remains occur commonly at Central European archaeological sites, can live up to a thousand years of age.

In accordance with the initially adopted principle (Chmielewski 2020a, 71), measurement results assigned to qualitative group IV, either due to the lack of any specification or non-homogenous character of dated organic remains (*e.g.*, mixed samples of charcoals), or due to justified doubts regarding the relationship of the obtained ^{14}C date to the targeted 'depositional events', were excluded from modelling.

After being classified and pre-selected accordingly, the radiocarbon age measurements related to the subsequent stylistic phases of the Malice culture were modelled with the use of Bayesian statistics. All the calculations and their visualisations were completed using the IntCal20 calibration curve (Reimer *et al.* 2020) with the OxCal 4.4 package (Bronk Ramsey 2009b).

The statistical modelling assumed that the distribution of these dates within individual phases is stochastic and uniform (uniform phase; see Bronk Ramsey 2009b, 342-347). Unlike the modelling performed by Sławomir Kadrow (2023, 56-58), which was based on the assumption of subsequent stylistic phases following each other consecutively, these analyses also tested an alternative contiguous sequence of the stylistic phases in which the transitions between them are assumed to be smooth (the trapezoid model according to Lee and Bronk Ramsey 2012). For comparative purposes, the latter model was run twice, once solely on the basis of the ^{14}C dates that were collected in the reference studies, and then using the set of dates extended with the newly obtained ones. CQL codes for both the models based on the updated data are presented (Appendices 1 and 2).

RESULTS AND DISCUSSION

At the outset, the analysed pool consisted of 54 radiocarbon age determinations produced with the use of the same number of samples from 41 archaeological features. An additional date was obtained for unspecified biogenic sediments from a drill core located near one of the sites where remains of the Malice culture settlement were recorded. Half of the entire corpus of measurements was related to the Late phase, and one third – to the Classic phase of the Malice culture. Only seven dates (13%) were associated with the Early phase, and five of them (9%) – with the Post-Classic phase. All the ^{14}C age determinations as well as their characteristics are listed in Table 1.

Although the unified tabular description provides some new important information both on the samples used for dating as well as the results of their radiocarbon ages' measurements, it is not standardised in full compliance with modern requirements in this regard (Millard 2014; Bayliss 2015, 681-690). It is still just a chronometric data puddle, though certainly a less muddy one. Despite this, the collected information allows for a comprehensive and consistent qualitative and quantitative analysis of radiocarbon dates currently available for the Malice culture.

The quality of the entire initial dataset was verified by an elemental analysis of all the constituent radiocarbon determinations, with a particular emphasis put on the nature of the ^{14}C-dated material and the reliability of the archaeological contexts that the relevant samples came from (Fig. 1). It transpires that in only 15 instances could the date obtained on the basis of radiocarbon age measurement be considered as unconditionally or conditionally corresponding to the given depositional event of interest, viz the archaeological context with an assemblage representing a definable stylistic phase of the Malice culture. Exactly half of the gathered set consisted of inaccurate measurements, most of which were made for unspecified charred wood. All the dates obtained on their basis, as implicitly affected by the 'old wood effect', were assumed to precede the targeted events. These radiocarbon dates were inserted into the sequential models as t-type outliers and corrected

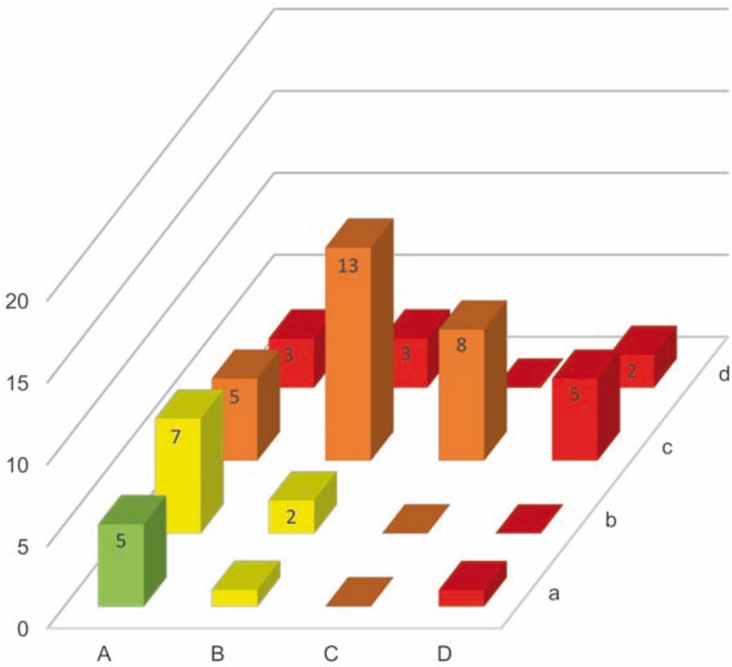

Fig. 1. Quantitative distribution of all gathered radiocarbon age determinations for the Malice culture in regard to reliability of archaeological contexts /classes A-D/ and samples of organic substances dated /classes a-d/ (illustration by T. J. Chmielewski)

accordingly. Due to the questionable substantive reliability of the samples used (category d) or their archaeological context (category D), as many as 14 radiocarbon age measurements (25%) were assigned to the lowest quality class and eliminated from the modelling.

As a result of this categorisation and pre-selection, a set of 41 radiocarbon age determinations was obtained, 37% of which can be considered as closely corresponding to the relevant phases of the Malice culture, while the rest should be treated as providing just a *terminus post quem* of a given event of interest. It should be emphasised that 8 out of 15 dates classified under quality class I and II (almost 20% of the entire collection) are either newly obtained or positively verified ones. The reliability of the latter was confirmed thanks to additional information regarding the nature of the dated prehistoric organic substance or the archaeological context from which these samples were taken. Particularly valuable among them are the dates for graves of the Malice culture recently discovered at the sites of Smroków 4 (Przybyła and Fabiszak 2021) and Kraków-Nowa Huta-Zesławice 88 (Chmielewski 2023). All of them contained very well-preserved skeletons buried with ceramic goods that are very distinctive taxonomically and chronologically (Figs 2-7). These are a few of the very scarce radiocarbon-dated graves of the Malice culture in general, and the first published ones from western Lesser Poland (see Zastawny 2022, 168, fig. 9).

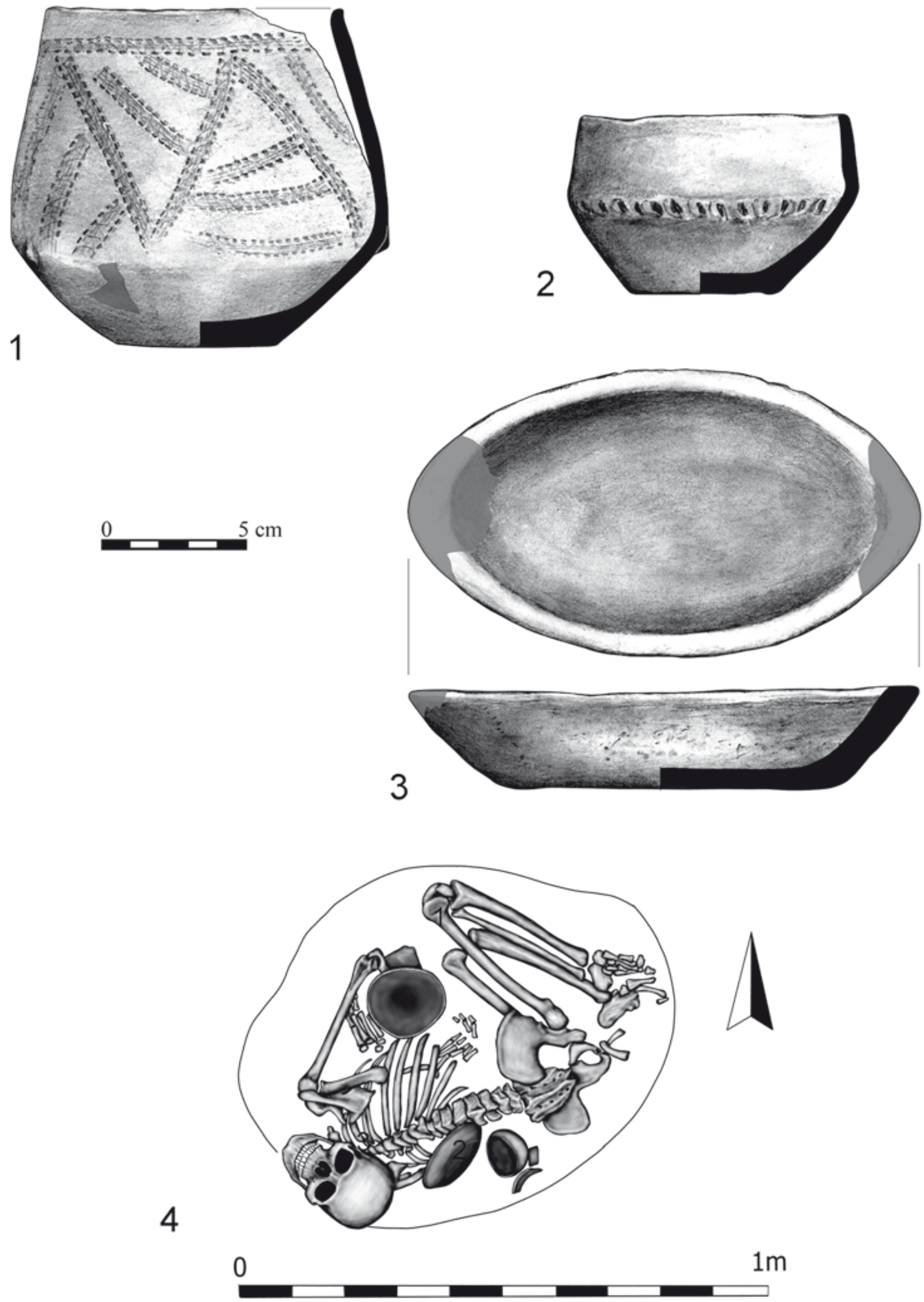

Fig. 2. Feature B820 at Kraków-Nowa Huta-Zesławice 88: 1-3 – ceramic grave goods (illustrations by N. Lenkow); 4 – arrangement of the burial (illustration by M. Podsiadło)

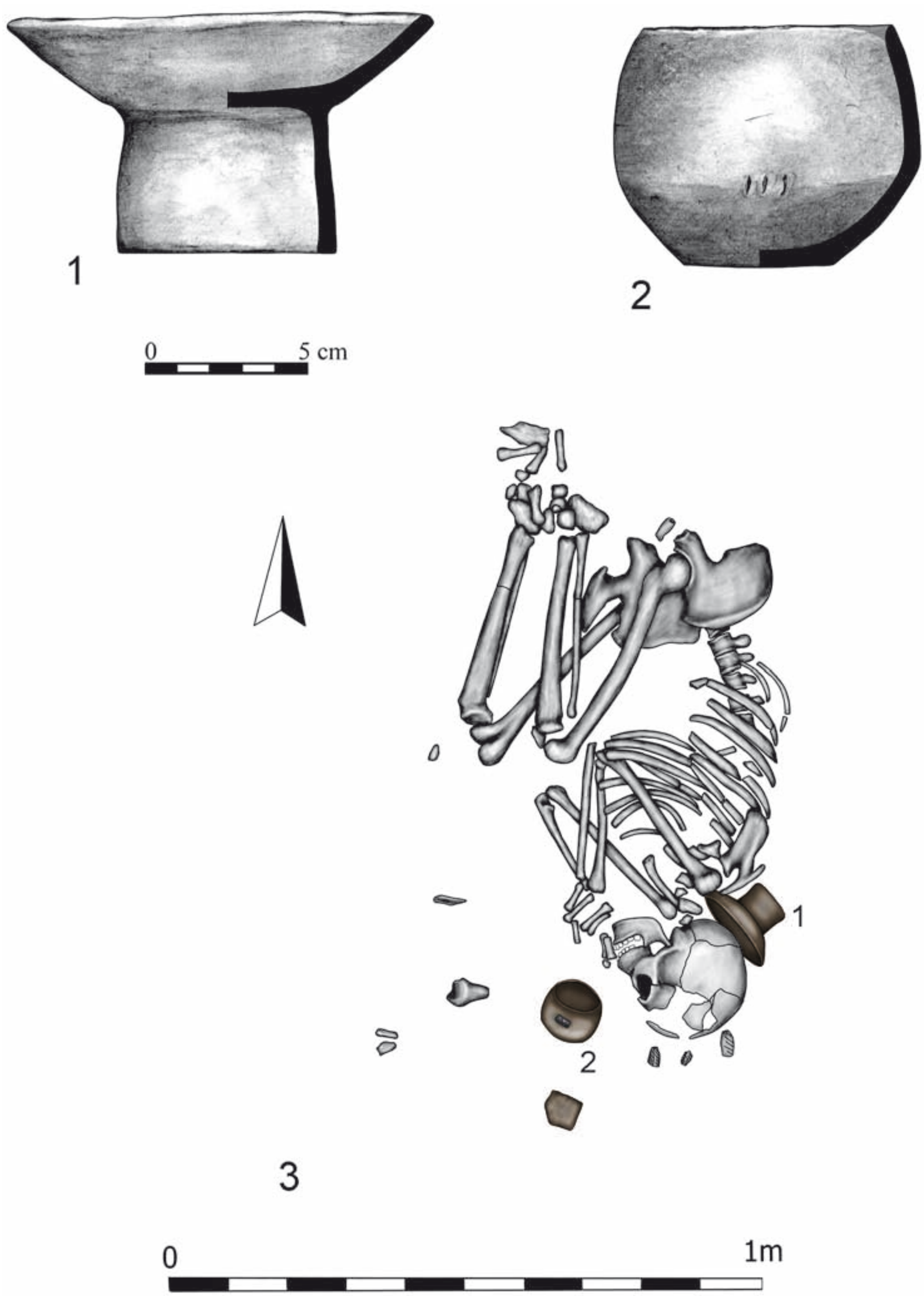

Fig. 3. Feature C150 at Kraków-NowaHuta-Zesławice 88: 1-2 – ceramic grave goods (illustrations by N. Lenkow); 3 – arrangement of the burial (illustration by M. Podsiadło)

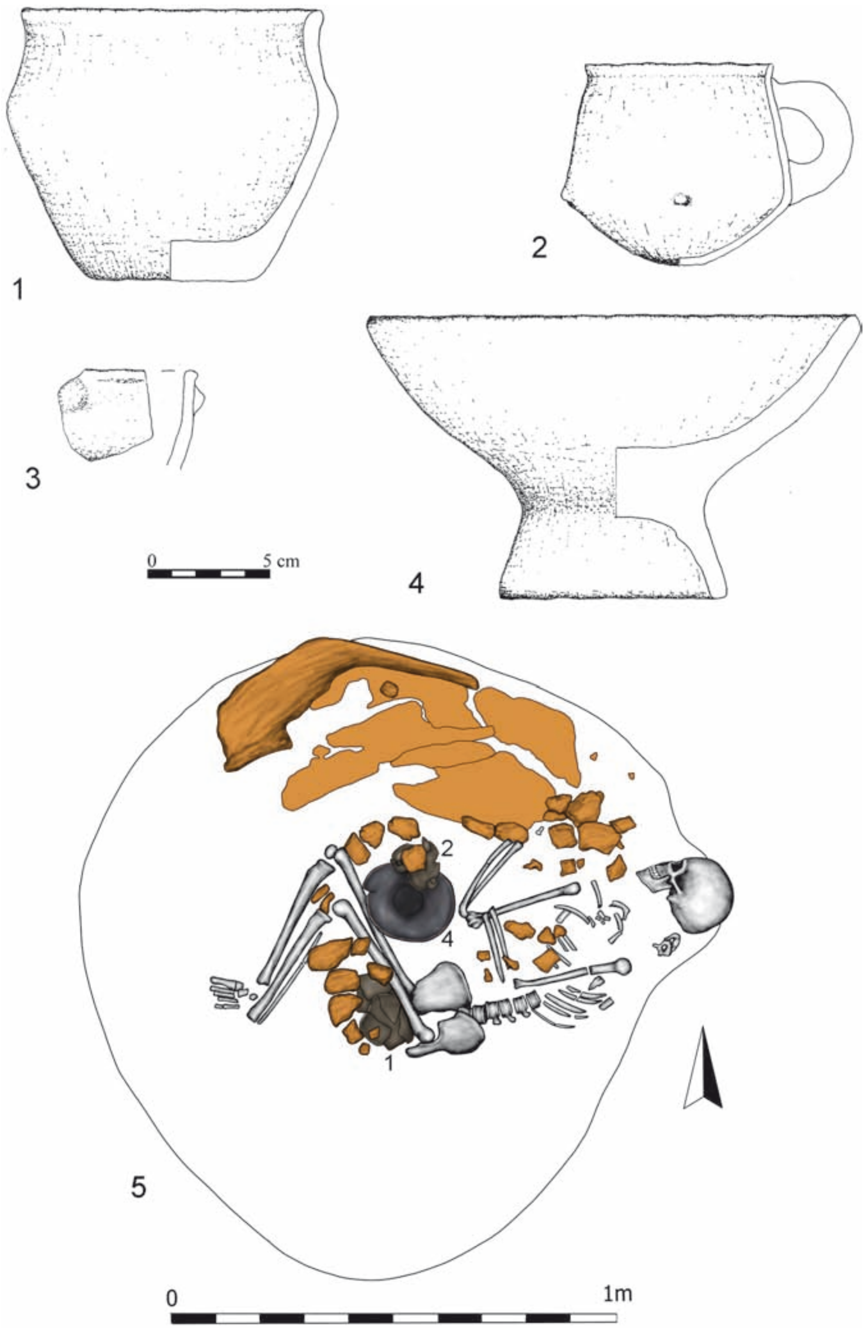

Fig. 4. Feature H29 at Smroków 8: 1-4 – ceramic grave goods (Ilustrations by I. Fabiszak); 5 – arrangement of the burial (illustration by M. Podsiadło)

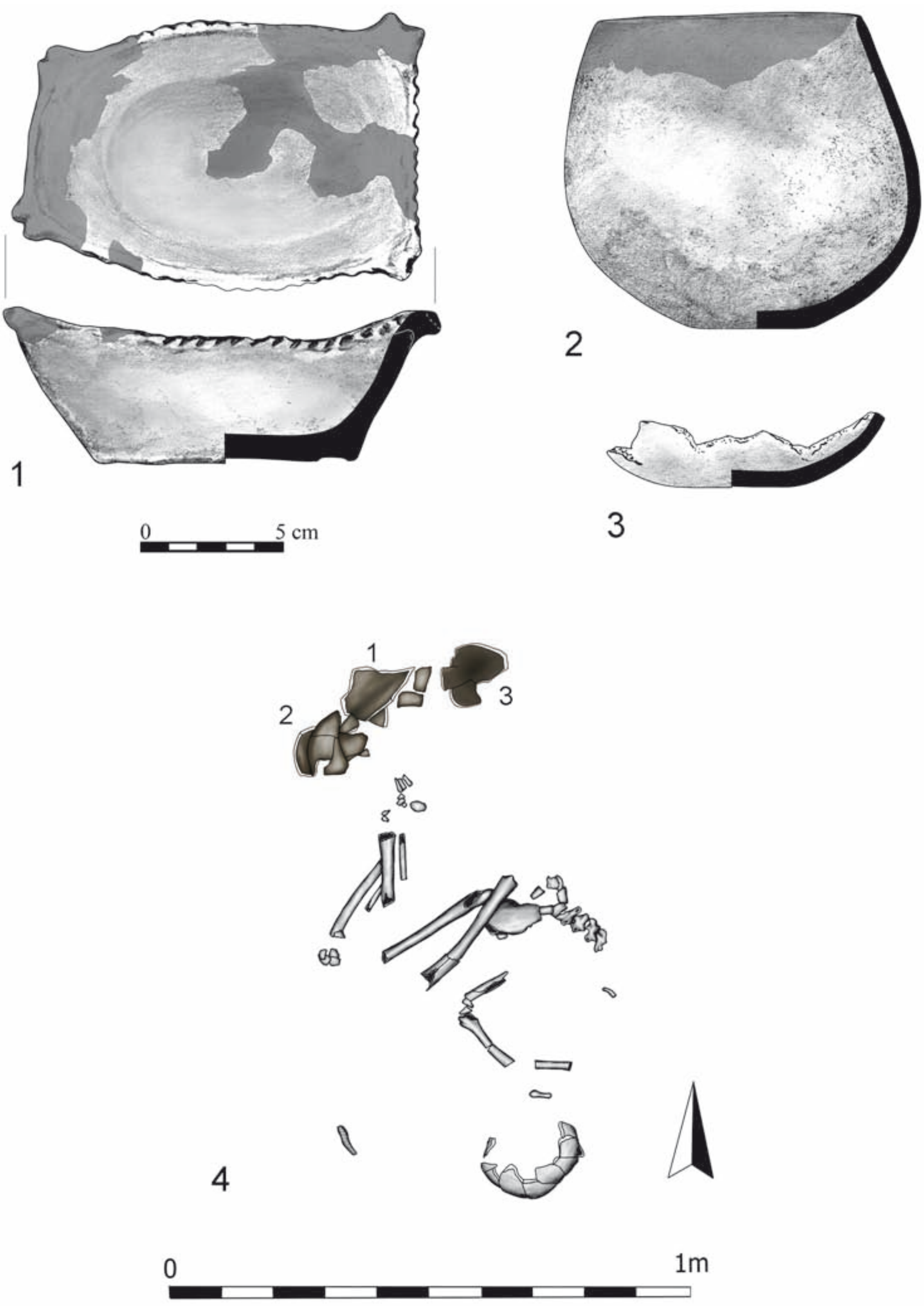

Fig. 5. Feature Y421 at Kraków-Nowa Huta-Zesławice 88: 1-3 – ceramic grave goods (illustrations by N. Lenkow); 4 – arrangement of the burial (illustration by M. Podsiadło)

1

2

Fig. 6. Photographs of the Malice culture burials at Kraków-Nowa Huta-Zesławice 88:
1 – feature B820 (photo by M. Kuś); 2 – feature C150 (photo by I. Fabiszak)

1

2

Fig. 7. Photographs of the Malice culture burials at Smroków 8 and Kraków-Nowa Huta-Zesławice 88: 1 – Smroków 8, feature H29 (photo by I. Fabiszak); 2 – Kraków-Nowa Huta-Zesławice 88, feature Y421 (photo by M. Kuś)

It is also worth noting that the modelled set of dates included mainly those obtained on the basis of radiocarbon age measurements of high or very high precision. Although a low or very low precision cannot be considered as suitable exclusion parameter in Bayesian statistics (see *e.g.*, Hamilton and Krus 2018, 191), it just occurred that most of the analysed dates of low or very low precision (8 out of 11) were discarded due to their questionable accuracy (Fig. 6).

The analysis of the gathered radiocarbon age measurements as a codomain of a function assigning them to the subsequent development phases of the Malice culture revealed other strengths and weaknesses of the discussed pool of dates (Fig. 7). First of all, it turned out that most of them can be connected with the Classic and Late phases, while the Post-Classic phase is underrepresented. In terms of quality, the weakest phase-defined subset of radiocarbon ages was the one related to phase Ia. In this case, only one ^{14}C date corresponds closely to the targeted 'depositional event'. The most significant difference between the currently collected set of radiocarbon age measurements and those gathered at the stage of completing the reference studies is the presence of accurate and precise dates for the Post-Classic (Ic) phase of the Malice culture (*cf.*, Kadrow 2023, 56).

The results of the statistical analyses carried out for both proposed models – the one assuming that the subsequent stylistic phases transited stepwise (contiguous uniform phases), and another, wherein the phases transited smoothly (contiguous trapezoid phases) – turned out to be convergent (Fig. 8). Nevertheless, considering the apparently continuous stylistic evolution of the Malice culture pottery, the second model seems to be more adequate. Thus, phase Ia should be dated to *ca*. 4770-4600 (rounded up to 10 years, at a confidence level of 1 sigma), beginning from around 4810 to around 4710 BCE. The transition between phases Ia and Ib took place between ca. 4650 to c. 4550 BCE, spanning no more than 50 calendar years. Phase Ib falls within the widest interval of approximately 4630-4440, whereas phase Ic occurred to be the shortest, lasting from c. 4460 to c. 4390 BCE. The probability distribution representing the boundary for the interstage between the two phases fell within the approximate interval of 4490-4420 BCE. The next transition period (Ic/II) was no longer than 30 years, with the distribution falling into c. 4400-4350 BCE. The pottery style typical of phase II of the Malice culture replaced the older one around 4390 and certainly lasted for some one hundred years, although a single measurement (with the lowest agreement index) indicates that it continued to about 4260/4250 BCE. The development of the Malice culture ended at around 4330-4270/4250 BCE.

Accordingly, the Early phase of the Malice culture can be considered contemporaneous with phase II of the development of the tell settlement at Polgár-Csőszhalom (Raczky *et al.* 2007, 64; Raczky and Anders 2010), an early part of phase I of the Lengyel culture in western Slovakia, Lower Austria and southern Moravia, as well as phase IVa (or the very end of phase III) of the Stroked Pottery culture in the Bohemian-Moravian-Silesian area (*cf.*, Stadler and Ruttkay 2007, 118-131; Riedhammer 2018, 91-109; Chmielewski 2020a). This is consistent with the cross-dating of all the cultural sequences (see for example Kaczano-

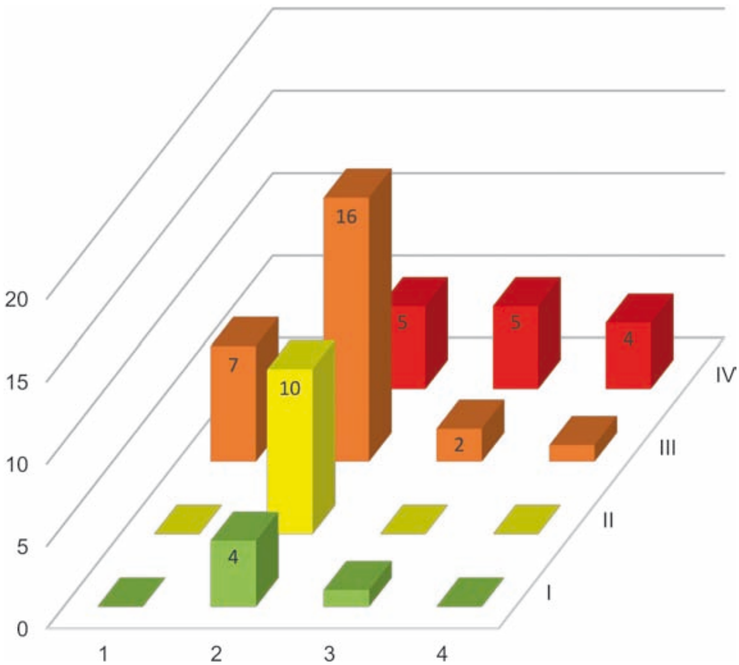

Fig. 8. Quantitative distribution of all gathered radiocarbon age determinations for the Malice culture in regard to measurements' accuracy /classes I-IV/ and precision /classes 1-4/ (illustration by T. J. Chmielewski)

wska *et al.* 1986, 112-118; Zápotocká 2004, 34-44; Kaczanowska and Kozłowski 2006, 35; Raczky *et al.* 2007, 54). The resulting absolute dates also allow us to synchronise the Classic phase of the Malice culture with phase III at Polgár-Csőszhalom (Raczky *et al.* 2007, 64; Raczky and Anders 2010) and the final stage of the Late Neolithic named Proto-Tiszapolgár (*cf.*, Horváth 2014, 310-316; Raczky and Anders 2016, 113-116). This complies with the presence of certain stylistic borrowings from the northern part of the Carpathian Basin in assemblages of the Malice culture dated to its Classic phase (Kaczanowska 1996, 24, 25). Consequently, its next phase (Ic) turns out to be younger than the Proto-Tiszapolgár phase (or Tiszapolgár A according to Dragoş Diaconescu – 2013; 2014) and contemporaneous with the Classical phase (B1) of the Tiszapolgár culture, whereas the Rzeszów phase turns out to be coeval with the Late phase (B2) of the Tiszapolgár culture as well as the Transitional and Early phases (A1/A2) of the Bodrogkeresztúr culture (see Chmielewski 2019; 2020b). The results obtained also allow us to synchronise phases Ic and II of the Malice culture with phases II and III of the Lengyel culture (respectively) in reference to its phasing proposed by Juraj Pavúk (*cf.*, Stadler and Ruttkay 2007, 118-131; Riedhammer 2018, 95-109; Chmielewski 2020a).

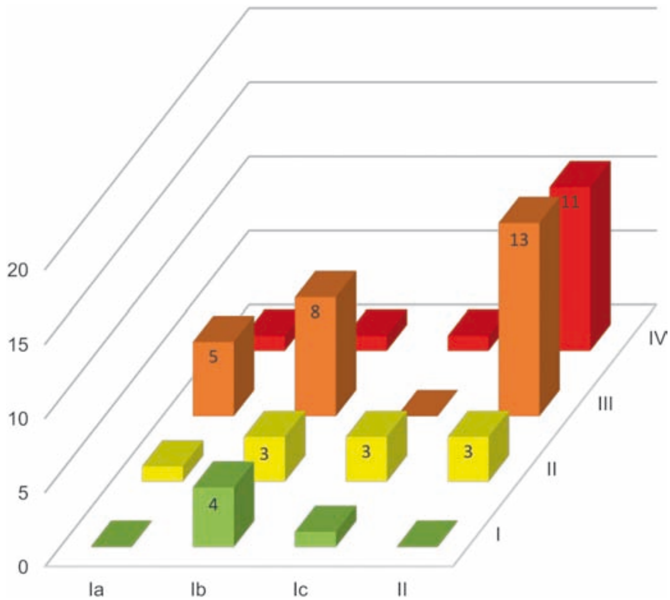

Fig. 9. Quantitative distribution of all gathered radiocarbon age determinations for the Malice culture in regard to their accuracy /classes I-IV/ and relative chronology of their archaeological contexts /phases Ia-II/ (illustration by T. J. Chmielewski)

There is an apparent dissonance between the results of modelling performed in this study and those presented in the reference work by Sławomir Kadrow (Fig. 9). The largest and most important differences concern the transitory border between phases Ia and Ib and the initial and final borders of phase II. In the first and second cases, the obtained results are mutually exclusive, with the lower levels of the probability ranges of the limits determined in the reference model corresponding to the upper limits obtained as a result of the analyses carried out presently. The difference is even several dozen calendar years. Similarly incompatible and distant on the scale of calendar years are ranges of phase II. In this case, however, the Rzeszów phase appears to end much later than inferred with the use of the reference model.

Due to different absolute chronologies of ceramic stylistic sequence of the Malice culture, there occurred serious discrepancies in the synchronisation of its phases with chronological units distinguished in neighbouring and closely related cultural areas. In the reference study by Sławomir Kadrow, a special emphasis was placed on linking the subsequent phases of the development of the former with the cultural and chronological sequence of the Polgár complex (no such attempts were made by Albert Zastawny in his earlier work). Our conclusions regarding the Early phase of the Malice culture turns out to be quite the same. The first controversy concerns the chronological correlation of the Classic phase of the Malice culture with the Proto-Tiszapolgár phase (Tiszapolgár A), which has already been proven above. In the opinion of Sławomir Kadrow, the latter was contemporaneous with the Post-Classic phase of the Malice culture. The second point of contention is related to the synchronisation of the Tiszapolgár culture (phase B) with phase II of the Malice culture. According to the reference study, they fully overlap, whereas the current analyses revealed that the duration of the latter was parallel only with the late stage (B2) of the Tiszapolgár culture. The earlier subphase of the Tiszapolgár culture (B1) is contemporaneous with the Post-Classic phase of the Malice culture. All in all, considering the new results and taking the sequence of stylistic phases of the Polgar circle as the point of reference, the Post-Classic and Late (Rzeszów) phases of the Malice culture must be moved one step down the scale. Consequently, the stylistic development of the Malice culture at the turn of the Neolithic and Eneolithic and at the beginning of the Eneolithic occurs to harmonise rather with the rhythm of evolution of the Lengyel and Stroked pottery cultures than with the pace of cultural changes taking place in the Upper Tisza basin.

The presented discrepancies stem not so much from the general architecture of the confronted models (both were based on the assumption of consecutiveness of stylistic phases), but rather from differences in the 'chronometric building material' used for their construction. These differences are not only quantitative (in the present study additional measurements could be used, including previously absent ones related to phase Ic), but also qualitative (the accuracy of all the ^{14}C age determinations used was verified and some of them were rejected). The significant effect of the assessment of the accuracy of measurements on the results can be clearly demonstrated by performing an additional modelling with the use of only those ^{14}C determinations that were already available for earlier studies, yet preceded by a verification of their accuracy. This remodelling was based on one more prior assumption that should have already been included in the reference model, *i.e.*, the existence of the intermediate stage (Ic) between the Classic and Rzeszów phases of the Malice culture, as explicitly postulated by Sławomir Kadrow himself (2023, 58). In the syntax of the new model the presence of such a separate stage in the stylistic evolution of the Malice culture pottery was declared as two non-shared boundaries – one at the end of phase Malice Ib and another at the beginning of phase Malice II (Fig. 10). The discrepancy between results obtained on the basis of the 'rebuilt' reference model and the current one (including, among other things, the previously unavailable dates for phase Ic of the Malice culture) are apparently smaller (Fig. 11). Expressed in calendar years, they generally do not exceed some three to four decades. The only serious difference concerns the end of phase Ib (by default also considered to be the beginning of phase Ic), which – according to the results of this chronometric exercise – falls into the timespan from around 4580 to 4490 BCE. In the light of the new statistical analyses, the Classic phase occurs to come to an end about a hundred years later. However, since radiocarbon age measurements for the contexts ascribed to this phase in the reference study were made almost exclusively for charcoals of indeterminate 'inbuilt age', resulting dates should be considered too old. Consequently, the end boundary of phase Ib, as calculated with the use of the 'rebuilt' reference model,

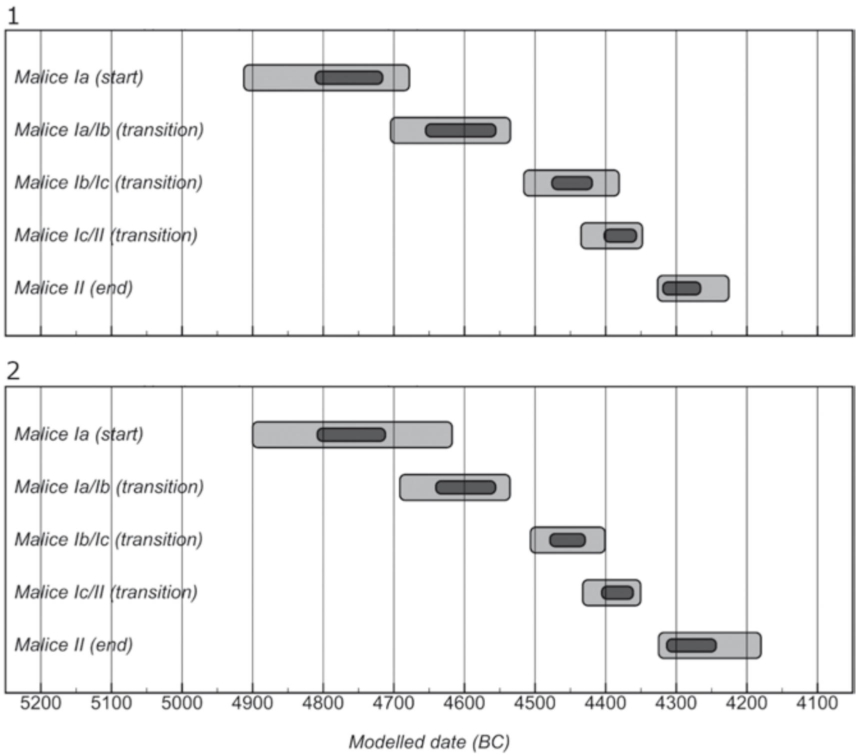

Fig. 10. 1 and 2σ confidence ranges for start and end boundaries as well as transitory boundaries (at 1 and 2σ) of subsequent stylistic development stages of the Malice Culture for: (1) contiguous phases, and (2) contiguous trapezoid phases. Agreement indexes of the models were 155.6 and 157.4% respectively, whereas individual agreement indexes were 158.1 and 159.6% (illustration by T. J. Chmielewski)

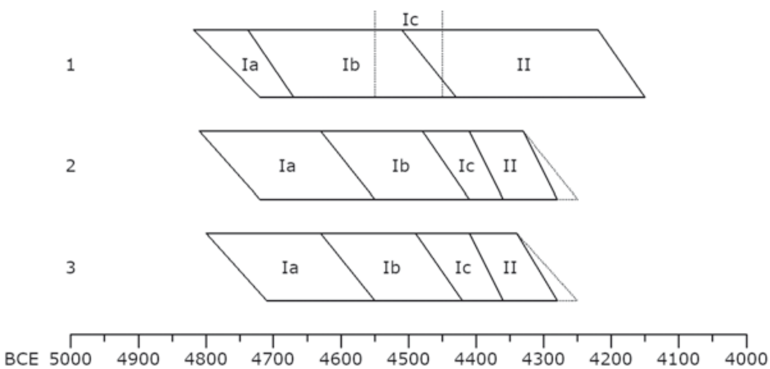

Fig. 11. Chronological sequences of subsequent stylistic development stages of the Malice Culture for: (1) contiguous phases, according to the original model presented in the reference study (Kadrow 2023); (2) contiguous phases, according to the current model; (3) contiguous trapezoid phases, according to the current model (illustration by T. J. Chmielewski)

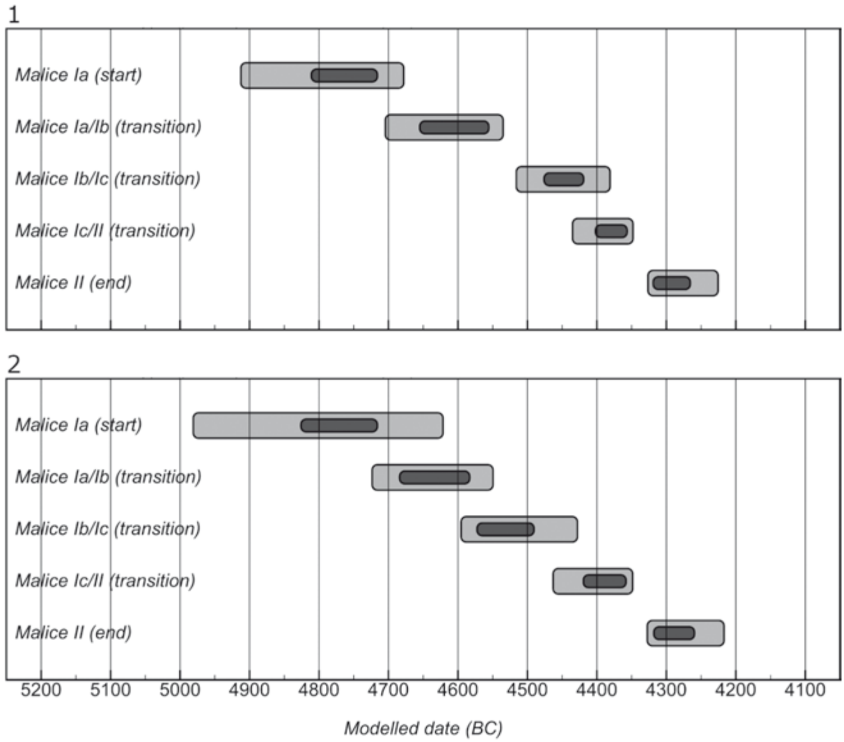

Fig. 12. 1 and 2σ confidence ranges for start and end boundaries as well as transitory boundaries of subsequent stylistic development stages of the Malice Culture for contiguous phases, based on: (1) currently available radiocarbon age measurements, and (2) measurements used in the reference study (Kadrow 2023). Agreement indexes of the models were 155.6 and 148.4% respectively, whereas individual agreement indexes were 158.1 and 150.7% (illustration by T. J. Chmielewski)

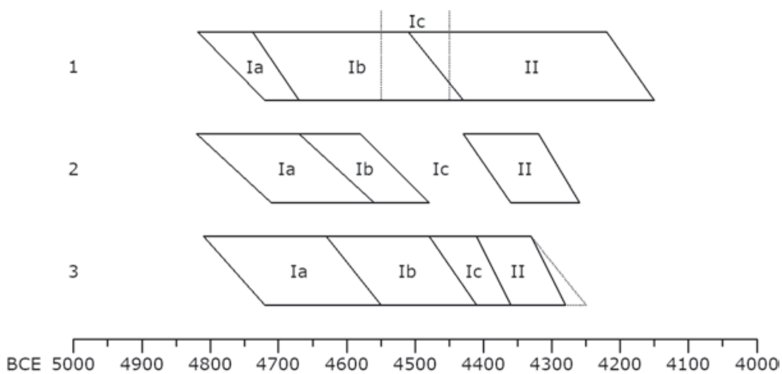

Fig. 13. Chronological sequences of subsequent stylistic development stages of the Malice Culture for: (1) contiguous phases, according to the original model presented in the reference study (Kadrow 2023); (2) contiguous phases, according to 'rebuilt' model from the reference study; (3) contiguous phases, according to the current model (illustration by T. J. Chmielewski)

provides only the *terminus post quem* for the beginning of phase Ic. Still, the previously available radiocarbon dates, if only proper ‘chronometric hygiene’ had been maintained, could already have served as the basis for a more accurate model.

All the arguments seem to resolve the controversy in favour of the statistical approach adopted in this study. Such a conclusion is strongly corroborated by the consistency of the eventual results of the analyses performed. The coherence of radiocarbon dates within the set modelled by Sławomir Kadrow (2023, 57) was low and barely exceeded the acceptance threshold of 60% (A_{model} = 60.4 and $A_{overall}$ = 66.5), while the consistency calculated on the basis of verified measurements and models proposed in this study is remarkably high (see captions to Figures 8 and 10).

CONCLUSIONS

Thanks to newly obtained accurate and precise radiocarbon age measurements as well as the verification of the previously published ones, a firm basis for establishing a robust absolute chronology of the Malice culture has been created. The larger and more carefully selected set of ^{14}C dates allowed us to perform more accurate chronological modelling, the outcomes of which proved to be more precise and coherent. However, can these be considered fully satisfactory? And if ‘not’, then what else can and should be done to achieve better results?

At present, there are 41 radiocarbon dates related to the Malice culture contexts that can be effectively modelled. Taking into account that this cultural formation evolved for several hundred years, the number is high enough only for establishing a robust chronology. However, the closer examination of the currently available radiocarbon age measurements revealed three fundamental weaknesses of this pool. These are: 1) the generally low accuracy of the measurements resulting from the fact that almost two thirds of them were produced either using samples with a questionable contextual attribution or wrongly selected or poorly defined organic remains; 2) the under-representation of high-quality dates related to the Early and Post-Classic phases of the Malice culture; 3) the uneven spatial distribution of the dated contexts, with a clear dominance of the measurements obtained for the finds coming from western Lesser Poland.

In a longer-term perspective, the diagnosed chronological problems will be solved by obtaining more precise and accurate radiocarbon age measurements referring to all the phases and the entire spread area of the Malice culture. This will take time and money. However, certain steps can be taken faster and without the additional expenses. In the short-term perspective, the most desired response to this diagnosis would be a democratisation and standardisation of all relevant data. As Daniel Keys Moran aptly put it, ‘you can have data without information, but you cannot have information without data’.

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Alisa Demina[1]

VIOLENCE AGAINST MEMORY: COMMUNICATIVE STRATEGIES OF SCYTHIAN BARROW REUSE

ABSTRACT

Demina A. 2024. Violence Against Memory: Communicative Strategies of Scythian Barrow Reuse. *Sprawozdania Archeologiczne* 76/2, 101-122.

This article provides a diachronic analysis of barrow reuse during the Bronze Age and Scythian times, focusing on a case study from the right bank of the Molochna river basin (North Azov, Ukraine). It compares the successive chronological phases of barrow-building cultures from the Yamna to the Scythian time regarding their spatial arrangement, patterns of secondary burial inclusions, and burial reopenings. The spatial analysis shows that all barrow clusters appeared in this territory during the Yamna phase. In all subsequent phases, barrows continued to be constructed exclusively within these pre-existing clusters. Various types of burial inclusions and mound modifications were typical for all Bronze Age phases. However, while Scythian burials maintained the reuse of predecessor's barrows, they seldom made secondary burials in contemporary barrows. Simultaneously, the number and scale of burial destructions significantly increased during the Scythian time. This shows a shift in attitudes towards barrows within distant and living memory and their role in communicating inheritance claims.

Keywords: Burials, barrow reuse, Scythian time, Bronze Age, spatial analysis, memory
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INTRODUCTION

In the Scandinavian saga of Hervor, a young woman visits her deceased father's barrow to claim his legendary sword. While she considers it her rightful inheritance, the dead are initially resistant to answer her request. Only after she threatens them, do the spirits open the entrance to the fiery underworld, where she obtains the sword – a decision that ultimately seals her tragic fate (*Hervararkviđa*, transl. T. Percy).

This story is an example of ongoing interactions between the living people and the dead through the places of remembrance. The burial mounds are other tangible remnants of these interactions, as they were rarely permanently completed after the initial funeral ceremonies but instead often underwent reconstruction and rearrangement over time. The inheritance dispute, being one of the reasons behind burial reuse, has long been discussed by researchers (Roymans 1995; Bradley 2002; Lee 2007; Crescioli 2020). According to them, establishing a symbolic connection with ancestors and creating links to the past could possibly provide a legal foundation for present power relations.

For the steppe nomads, land and pastures were arguably the most important resource. The burial mounds, as the most prominent landscape markers, could be useful for designating and controlling the borders, which might increase the political value of ancestors even more. In Herodotus' Histories, during Darius I's unsuccessful pursuit of the Scythians, he received this famous response:

> "But if all you want is to come to that quickly, we have the graves of our fathers. Come on, find these and try to destroy them: you shall know then whether we will fight you for the graves or whether we will not fight" (Herodotus IV: 127, transl. by A. D. Godley)

Whether it was a distracting trick or not, this quote shows how barrows could be engaged in negotiations about land.

However, Scythians were not the first pastoralists in the Pontic region. By the time of their appearance there, the steppe had already witnessed millenia of barrow-(re)building practices, each rooted in its own past. This article will attempt to diachronically compare strategies for the reuse of burial space through a case study of the right bank, Molochna valley in the Azov steppe.

Two main patterns of burial placement were distinguished by Sarah Semple in her study of Anglo-Saxon barrows, where she used the terminology 'associative' and 'intrusive' reuse (Semple 2008, 410, 411; Crewe 2012, 18). The first involved building new barrows in close proximity to the older ones, while the second – adding new burials into the barrows of the predecessors. Her research showed that these patterns could reflect the social hierarchy of the communities involved in these practices. Associative positioning was connected with the absence of centralised power and the presence of conflicting groups controlling the territory. In contrast, the intrusive placement of burials signalled the elite's right to appropriate older monuments (Crewe 2012, 18).

These two strategies of burial reuse will serve as a framework for the study and the general structure of the first half of the article. It will examine the Bronze Age attitudes towards barrow placement and secondary burial inclusions to better understand the context in which Scythian sites first emerged. However, the primary focus of the second half will be on the latter. This section will discuss whether the reopening of burials and post-funeral manipulation of the deceased's bodies could be viewed as a third burial reuse strategy. With this approach, the study will analyse changes in the role of barrows as a medium for memory and individuality that might have taken place in the region during the Scythian time.

DATASET AND METHODOLOGY

The database used for the current research consists of 92 barrows with 435 burials, excavated between 1978 and 1987 by the Kherson Archaeological Expedition (Kubyshev *et al.* 1979; Kubyshev *et al.* 1982; Kubyshev *et al.* 1983; Kubyshev *et al.* 1987). The earliest barrows in the region were attributed to the Eneolithic time, specifically the Mikhailivka and Kemi-Oba archaeological cultures. A larger group of 23 barrows belonged to the Yamna (Pit Grave) culture. For the purpose of this study, Eneolithic burials were integrated into a single phase with the Yamna burials. One barrow was associated with the Catacombna culture, while seven others – to the Zrubna (Timber Grave) culture. There were also seven sites associated with the Bronze Age, although their identification was less precise. Scythian barrows represented the majority of the sites (45 barrows), and all Scythian burials in the region with chronological identifications dated no earlier than the late 5th century BC while the youngest – no later than the 4th century BC. For the quantitative study of Scythian burial destructions, broader geographical data was used, which included 243 burials from the Azov steppe zone.

The sites were located within the territory of the Black Sea Lowland, which is part of the East European Plain in the middle watershed of the Velyky and Maly Utliuk rivers, as well as on the right bank of the Molochna River (Fig. 1). The total area of the investigated region was approximately 150 km^2. The topography of this region exhibited a minimal slope, indicating predominantly flat terrain. The lowest points, averaging 5 metres above sea level, were located in the river valleys. The highest points in the watershed areas reached 35 metres. At present time, this region has undergone significant alterations due to the construction of irrigation systems and dams.

This area was chosen for the study because it had been thoroughly explored during field research. Therefore, the current spatial data likely closely represents the actual barrow groups and their spatial interconnectedness, rather than being influenced by a sample selection bias during excavations. While the field reports were the primary source of information, there is partial support from maps of the region before and after the active excavation period. Notably, the 19th-century topographical military map of the Russian Empire does not show evidence of large numbers of barrows that were not documented during excavation. Additionally, apart from one barrow group, no other mounds were observed in the modern Wikimapia data, further supporting the assumption that the excavated barrows indeed represent genuine spatial clusters (Fig. 2).

Spatial analysis was implemented in the QGIS software along with statistical analysis in Python (Jupyter Notebook). The Digital Elevation Model (DEM) used for map creation and analysis is the Shuttle Radar Topography Mission (SRTM) 1 Arc Second dataset.

The dataset included a point layer containing the locations of barrows, each attributed to its corresponding time period based on field report evaluations. To identify statistically significant patterns and concentrations in the spatial distribution of barrows within the study area, the Spatial Clustering tool was used. The Distance Matrix was set to calculate Euclidean distances (straight-line) between all barrow points. In the resulting dataset, the mean, median, and range of distances within each group were calculated to understand the central tendency and spread of the data according to the time periods.

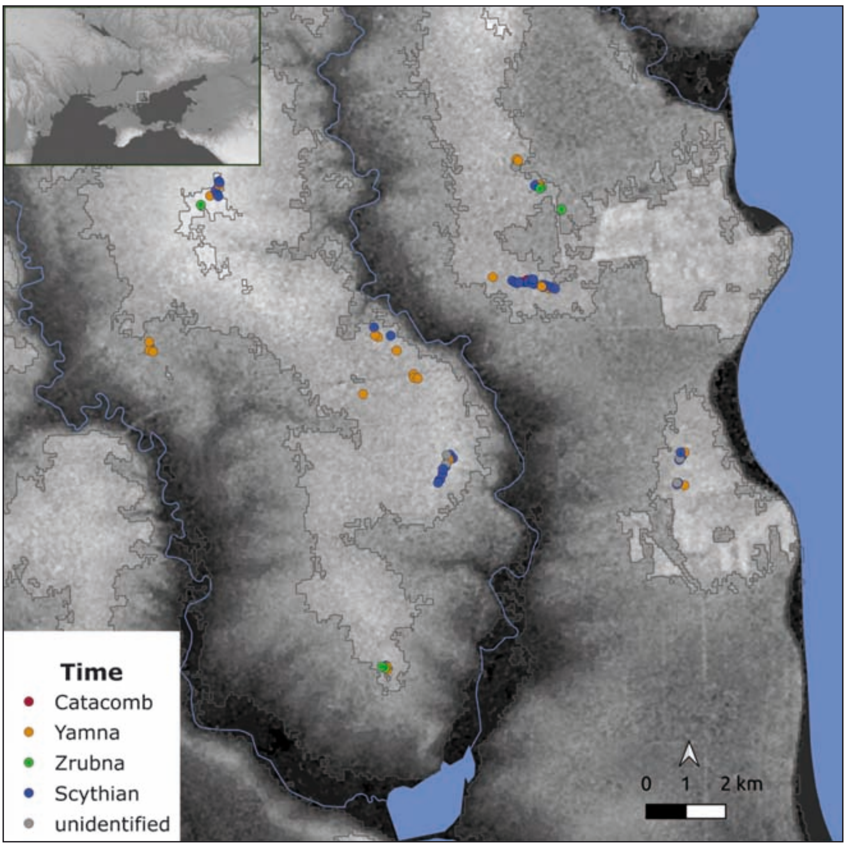

Fig. 1. General map of the studied area

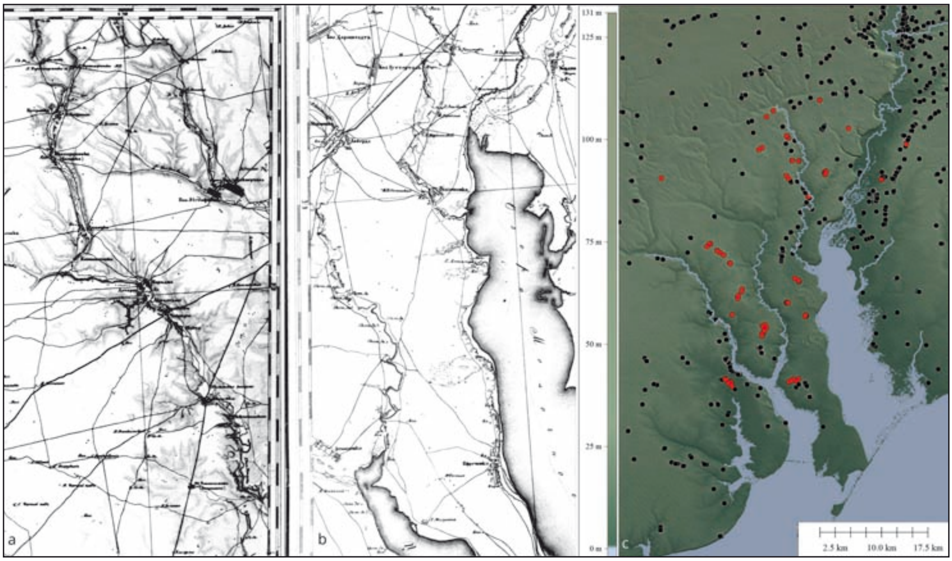

Fig. 2. a, b – 19th-century topographic military map of the region (after http://freemap.com.ua/); c – Wikimapia data of Molochna river valley: red dots are the locations of explored Scythian sites, black dots are currently visible barrows (after https://wikimapia.org/)

The Minimum Spanning Tree (MST) analysis was implemented to create a general network for all the sites by considering each barrow as a node and determining the links that create the most efficient network, minimising the total distance required to connect all nodes. Results based on these methods were analysed to explore the potential influence of the placement of Scythian kurhans by comparing their locations to those of earlier barrows and comparing their spatial patterns.

SPATIAL ARRANGEMENT

All barrow groups displayed linear patterns that followed the natural features of the landscape, primarily along riverbanks or valleys. The majority of groups contained sites from multiple chronological periods. While in the studied area new mounds were rarely constructed in the Catacombna and Zrubna periods, the largest number of barrows emerged there in the Scythian time. Notably, all spatial clusters had already formed during the Early Bronze Age. Although Yamna barrows constitute 36% of all barrows in the region, no new clusters were established in later phases; instead, the burial mounds were added to the existing clusters (Fig. 3).

The location of the barrows in all chronological stages gravitates towards the places of the highest elevation. While the mean elevation of the investigated region is 17 m above sea

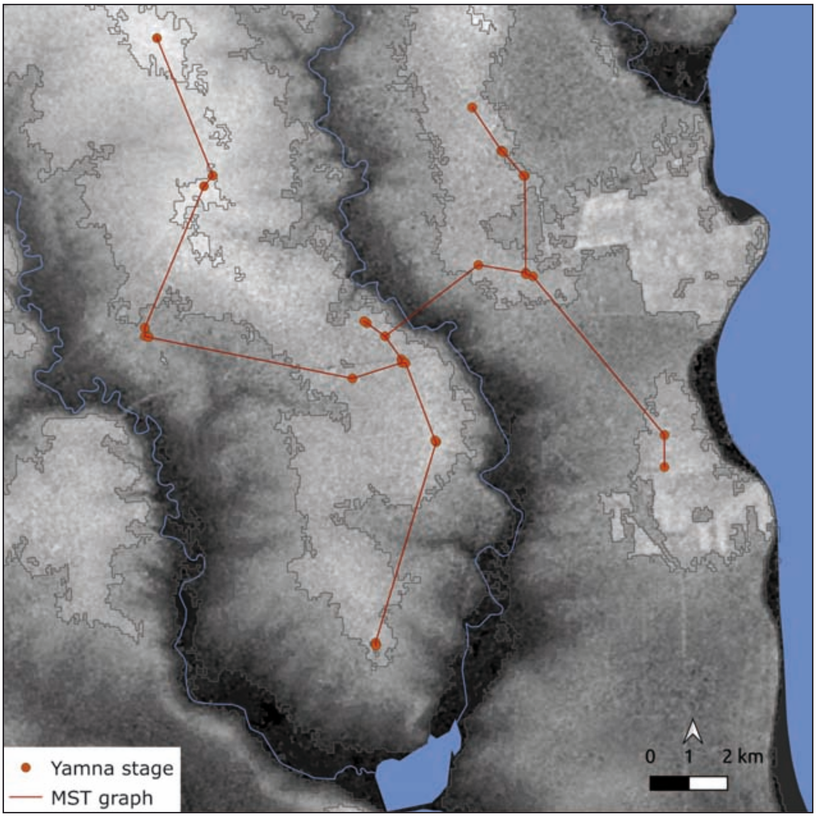

Fig. 3. MST graph of the barrow clusters of the Yamna phase

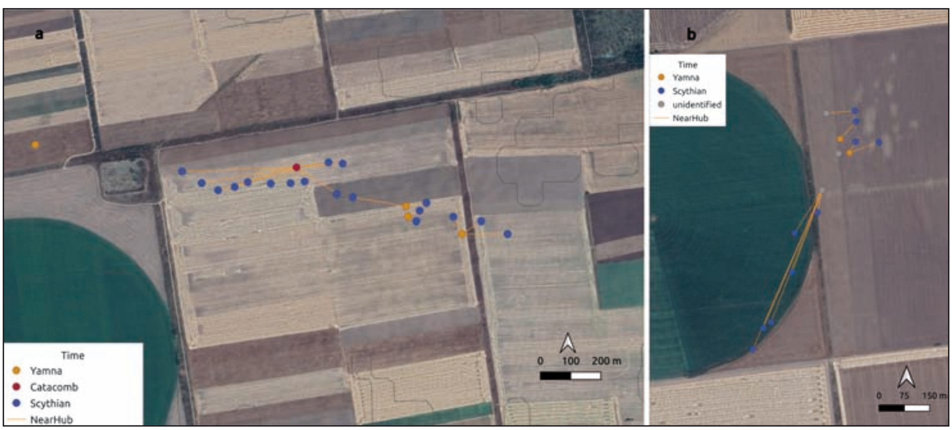

Fig. 4. a – Mala Ternivka barrow group; b – Vovchanske 1 barrow group. The connections between Scythian and the closest Bronze Age barrows

level, the mean terrain height of the barrows' locations is 23 m. This parameter is similar for all chronological groups, although Yamna barrows demonstrated a slightly larger variance in terrain preference.

The Scythian barrows were located in close proximity to the preceding barrows (Fig. 4: a). The median distance to the closest Bronze Age mound was 97 meters, while the minimum distance was 26 meters. In 23% of cases, the latter were the closest barrows to the Scythians. However, in the most numerous groups, this proximity became less significant, and the closest barrows also belonged to the Scythian period. It could be suggested that earlier barrows primarily served as points of reference during the initial stages of barrow construction. For instance, in the Vovchanske 1 group, which has a large number of Scythian barrows, the distance to the Bronze Age barrows significantly increased (up to 513 meters), but the average minimum distance remained the same (Fig. 4: b). This observation is slightly supported by the chronology of Scythian sites in that group, where the earliest Scythian barrows (from the late 5th century BC) were located closer to the Bronze Age barrows.

Despite having similar spatial patterning, the Yamna and Scythian stages demonstrated differences in terms of the within-group placement of the barrows (Fig. 5). Yamna mounds tended to be widely allocated in groups of 2-7 mounds. The average distance between groups was 6542 meters, while the within-group distance was 789 meters. In the case of Scythian barrows, which were located in the same territorial clusters as preceding barrows, the between-group distance remained similar. However, the within-group distance for Scythian time barrows was reduced to 380 meters. Moreover, the location of Scythian barrows also had a stronger linearity pattern, particularly in relation to other Scythian barrows.

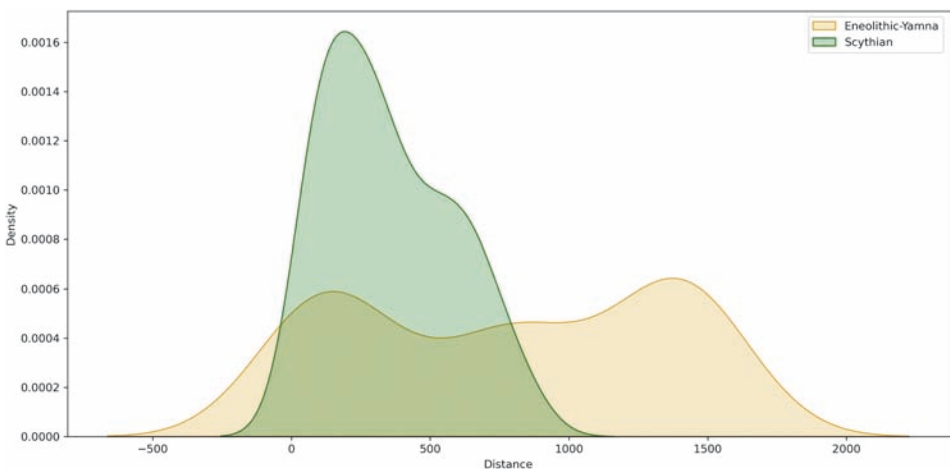

Fig. 5. KDE plot of within-group distance between barrows at Yamna and Scythian phases

Another difference that emerged during the Scythian time was related to topographical preferences. While the MST graphs of barrows from all chronological phases had a similar structure, a slight deviation from the original network appeared only in the Scythian time (Fig. 6), specifically within the group Vovchanske 2, which has the lowest topography. Interestingly, although one Yamna barrow was used for secondary Scythian burial, no new kurhans were constructed in that area. This observation could be explained by the fact that during the Scythian time, barrow placement was strongly associated with the highest geographical points, resulting in lesser importance for clusters located in valleys.

It needs to be once again addressed that these observations were mostly limited to the Yamna and Scythian stages, which both exhibited a higher preference for constructing barrows in lower river valleys. For example, the number of Zrubna barrows was significantly higher to the north and east of the Azov steppe. Despite this, the continuity of past monuments played a crucial role in determining the positioning of barrows across all

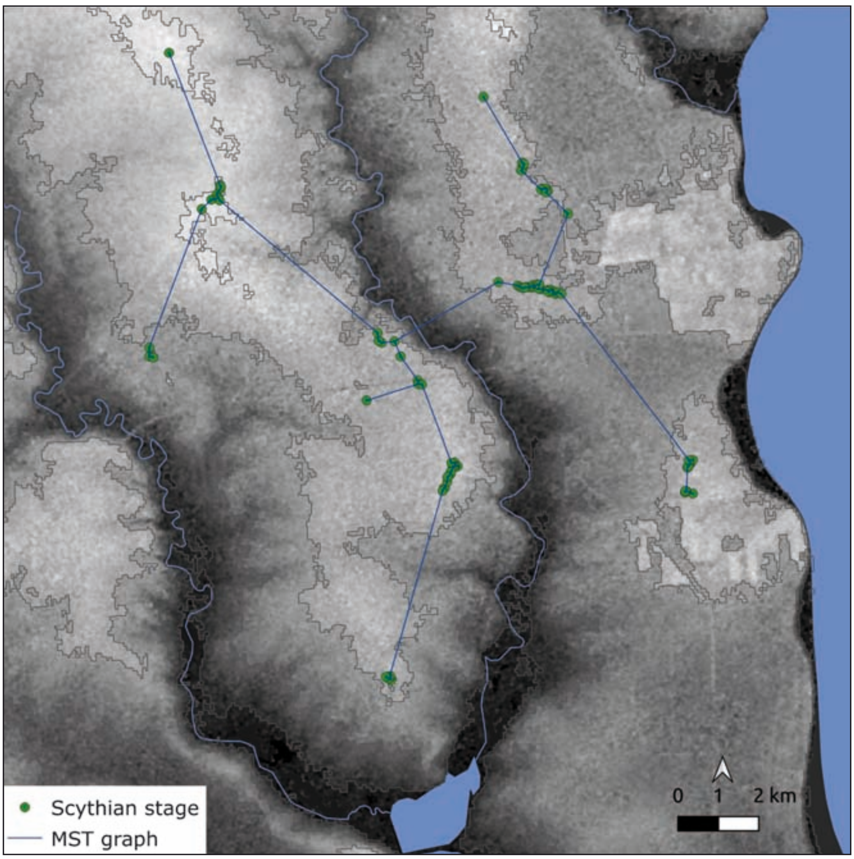

Fig. 6. MST graph of the barrow clusters of the Scythian phase

chronological stages. However, during the Scythian time, the tradition of barrow building reached its peak in this region, displaying a more deliberate attitude toward the placement of the burial mounds, emphasis on visibility, and supposedly territorial control through the strategic barrow locations.

SECONDARY BURIALS

In the studied area, various types of barrow reuse and secondary burials were common. However, each chronological stage exhibited distinct patterns of barrow construction and burial placement (Fig. 7).

During the Eneolithic-Yamna phase, 37% of all the barrows in the studied area were built, but these barrows were accompanied by an equally large number of secondary burials. On average, each barrow contained at least three burials, while those with only one burial were less common. The barrows with the earliest and most diverse Eneolithic layers had the largest number of secondary burials, mainly of the Yamna phase. For instance, Velykyi kurhan ("Big Barrow") near Volodymyrivka village contained 15 Yamna burials, and Vovchanske 1 barrow had 20 burials. Without more precise chronological dating, we can only speculate that these secondary Yamna burials occurred earlier than the majority of newly constructed Yamna barrows in the area.

The clear spatial hierarchy, which would later be observed in Scythian barrows, was not typical for Eneolithic-Yamna barrows. Although the mean diameter of the mounds was 32 meters, the burials tended to be placed within five meters from the centre, with a slight

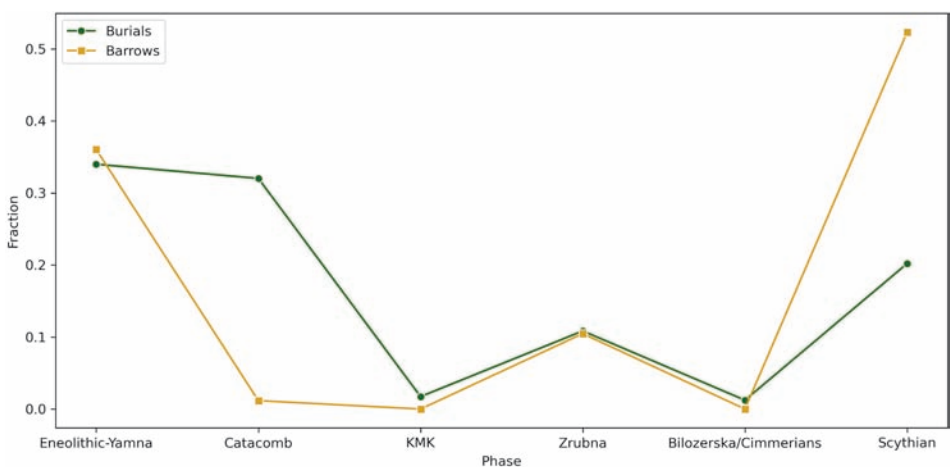

Fig. 7. The proportion of barrows and burials in the current sample, which shows the dynamics of barrow-building and barrow-reuse traditions

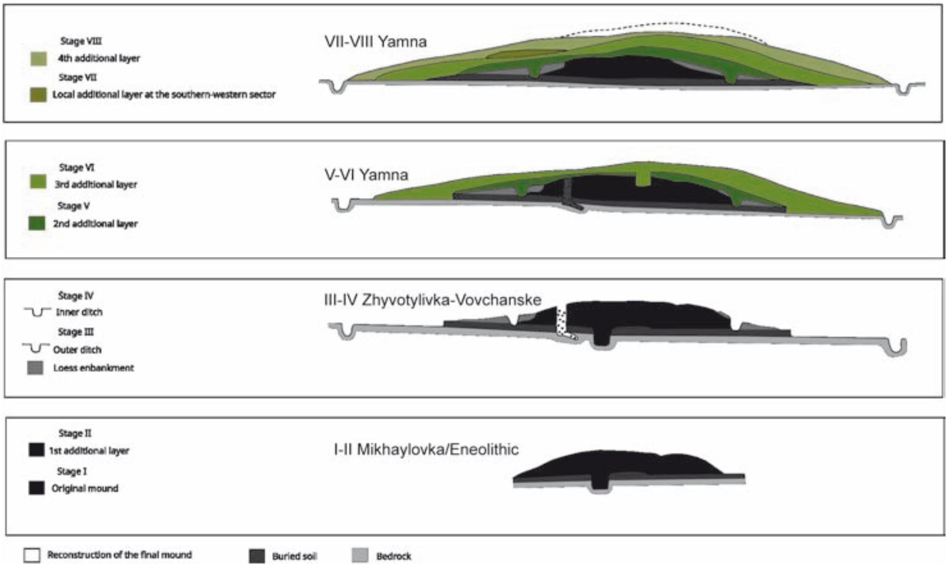

Fig. 8. Reuse stages of the barrow Vovchanske 1 (drawing by the author after Kubyshev *et al.* 1979)

preference for the western side of the mound. Burials were typically oriented latitudinally, with occasional variations likely connected to seasonal changes. The average burial depth was 0.7 meters below the level of the buried soil and remained consistent regardless of location. In most cases, graves contained only one person (79% of Yamna burials), while collective burials were less common (9%). Additionally, cenotaphs were observed in 11% of the Eneolithic-Yamna burials.

During this phase, various modifications to the mounds were widespread. Approximately half of the barrows (52%), had additional layers made for secondary Yamna burials. They were occasionally made locally, directly above the new burials. The longest-functioning barrows also had other types of modifications. For instance, the Zhyvotylivka-Vovchanske horizon of the Vovchanske 1 barrow (Fig. 8) contained three burials, two of which were accompanied by ring ditches but did not have new layers (Kubyshev *et al.* 1979, 38-39). Later additions during the Yamna phases increased its diameter fourfold, from approximately 15 to 60 meters.

During the Catacombna phase, inclusions in the earlier barrows were the primary type of burial. Only one new barrow was observed in the studied area within the Mala Ternivka group. However, the overall number of burials remained similar to the previous phase (32% of the subset), and they were distributed across all territorial clusters. Typically, there were multiple burials in one barrow, with an average of four.

In general, constructing additional layers for the mounds was less common during the Catacombna phase; this was observed only in four barrows. The location of the burials showed a strong preference for the peripheries of the mounds. The majority of Catacombna culture burials (63%) were situated at the eastern fringes of the barrows. Graves were usually oriented circularly, with their long axis perpendicular to the centre of the mound. The burial depth was typically around 1 metre from the level of the buried soil. Most graves contained a single individual, while collective burials usually consisted of an adult and one or more children. The observed patterns differ significantly from both previous and consequent attitudes to the barrow "geography", where the central position of the graves appeared to be the most important.

The Zrubna phase once again demonstrated dynamics similar to the Eneolithic-Yamna phase. In the studied territory, 44 Zrubna burials (11%) were discovered, along with seven new barrows (8%). Considering that the majority of barrows had only one Zrubna burial, we can assume that new barrows were built for approximately 16% of the Zrubna burials. However, this parameter may be lower for this particular case-study area. According to V. Zabavin's research, barrow-building tendencies for the Zrubna culture were more frequent in the arid, deeper watershed steppe zones of the Dnipro-Molochna area (Zabavin 2018, 71, 72).

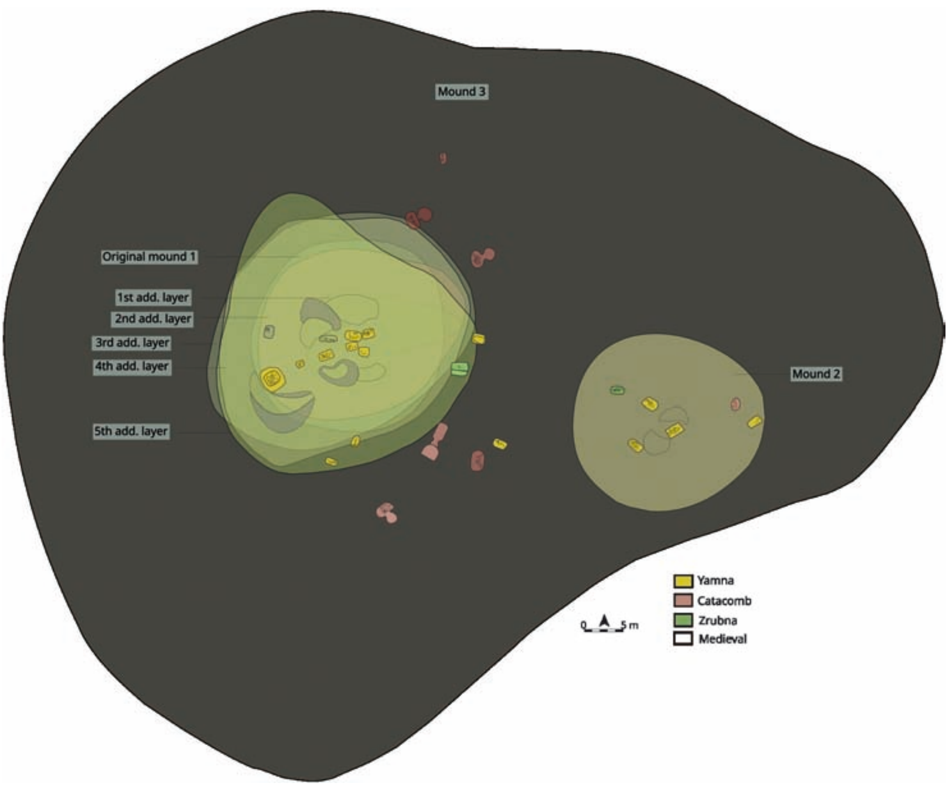

Fig. 9. Velyky Kurhan ("Big Barrow") near Volodymyrivka. Two Yamna barrows connected by a third mound of the Zrubna phase (drawing by the author after Kubyshev *et al.* 1982)

More than half of the burials (57%), both primary and secondary, were located close to the centre of the mound. The orientation of the graves followed a latitudinal pattern regardless of their location. Burials were usually no more than one metre in depth from the level of the buried soil, with peripheral ones often incorporated into the mound. In the majority of cases (86%), burials contained only one person, while the remaining cases involved adults with children.

Mound modifications, often quite labour-intensive, were frequently observed during the Zrubna phase burials. A particularly interesting phenomenon was the creation of mounds above burials situated in the space between two older barrows, resulting in a new, larger mound (Fig. 9). In the studied territory, the barrows Davydivka 1, 2, and Velyky Kurhan near Volodymyrivka belong to this type of mound and reached their final form (about 120 m) during the Zrubna phase. Similar "super-mounds" were also observed for Yamna barrows; for example, Yurovka 2 consisted of three mounds joined by another Yamna phase mound. V. Zabavin suggested that such Zrubna burials, placed beneath the joining mound, could have higher social significance (Zabavin 2018, 81).

A different situation appeared in this territory during the Scythian time. While 82 Scythian burials (20% of the burials in the sample) were discovered, there were also 45 barrows (53%), the construction of which was attributed to this phase. Almost half of the burials were the only one burial within the barrow (Fig. 10). Peripheral burials were more typical for "elite" barrows and, in most cases, were created simultaneously, serving an accompanying function (Boltrik 2000, 135). Notably, Scythian secondary burials in the earlier barrows were also predominantly single. They often had slightly earlier dates than the new Scythian barrows. The general chronological dynamics of the North-Western Azov region indicate that from the 6th to the mid-5th centuries BC, grave inclusions in the preceding barrows were the most widespread burial ritual in this territory. However, the case of the lower Molochna valley suggests that both secondary burials and the emergence of the kurhan necropolis were broadly dated to the late 5th century BC. Therefore, there is little evidence to suggest a significant chronological gap between them.

Most Scythian burials (67%) were located at the centre of the barrow. The orientation of the graves was predominantly latitudinal, with exceptions mainly typical to peripheral burials. Simultaneously, the depth of the burials was generally similar regardless of their location, distributed normally with an average depth of 2 metres from the level of the buried soil.

Most graves contained the remains of a single adult individual. In collective burials, there was a notable prevalence of pairs of different genders, with one exception: the burial at Radyvonivka 12, where the remains of a young woman with a child were discovered. However, observations across a broader area reveal that in the case of "elite" burial mounds, such as Berdyansky, accompanying individuals of the same gender were often interred together in the central burial.

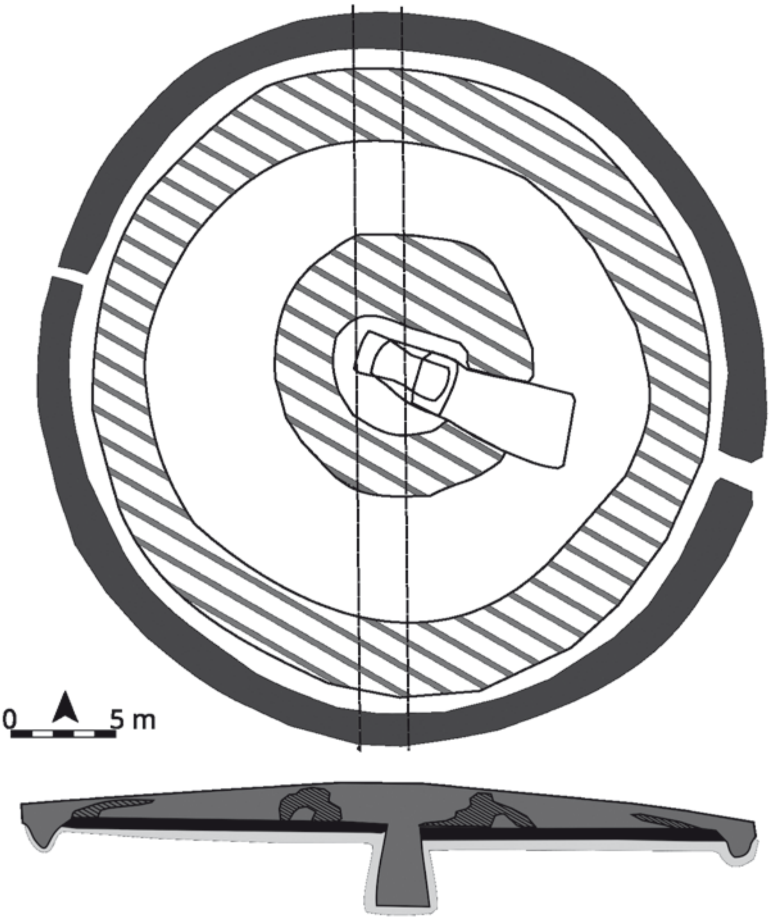

Fig. 10. Scythian barrow Volodymyrivka 4 (drawing by the author after Polin and Kubyshev 1997)

Modifications to the mounds were less typical for Scythian barrows, primarily due to the lower prevalence of secondary burials. However, a few cases demonstrate that such practices existed, albeit mainly for secondary burials in Bronze Age mounds. For instance, the construction of one of the burials inserted into the Bronze Age barrow Vovchanske 5 was accompanied by the addition of a new mound layer. Similarly, according to the report by S. Polin, the second burial in the Scythian barrow Volodymyrivka 1 was made later, along with an additional mound layer (Kubyshev and Polin 1997, 5, 21, 22).

These observations showed that the barrows of predecessors served as focal points for creating new ceremonial spaces for all pastoralist groups inhabiting the steppe. While the emergence of new barrows within the same territorial clusters could be explained by similarities in landscape features (such as high elevation points and proximity to river crossings), the patterns of secondary burials were more complex. As we have seen, the burial rites of some groups, mainly the Catacombna culture, strongly favoured inclusions in already existing barrows. However, most cases demonstrated some combination of barrow construction and secondary burials. Scythian secondary burials within the Bronze Age barrows in the current sample appeared approximately around the time of the first Scythian barrows. Furthermore, their spatial distribution (Fig. 11) indicates that they were uniformly spread across most of the barrow clusters. This pattern suggests a deliberate placement of one or two burials within each barrow group. The inclusion of burials into earlier mounds could be a feature of a symbolic claim to new territory and not just a lack of sufficient human resources for intensive architectural projects.

It is also important to differentiate between reuse across subsequent chronological phases and reuse within the same phase. Although the difference in chronological span

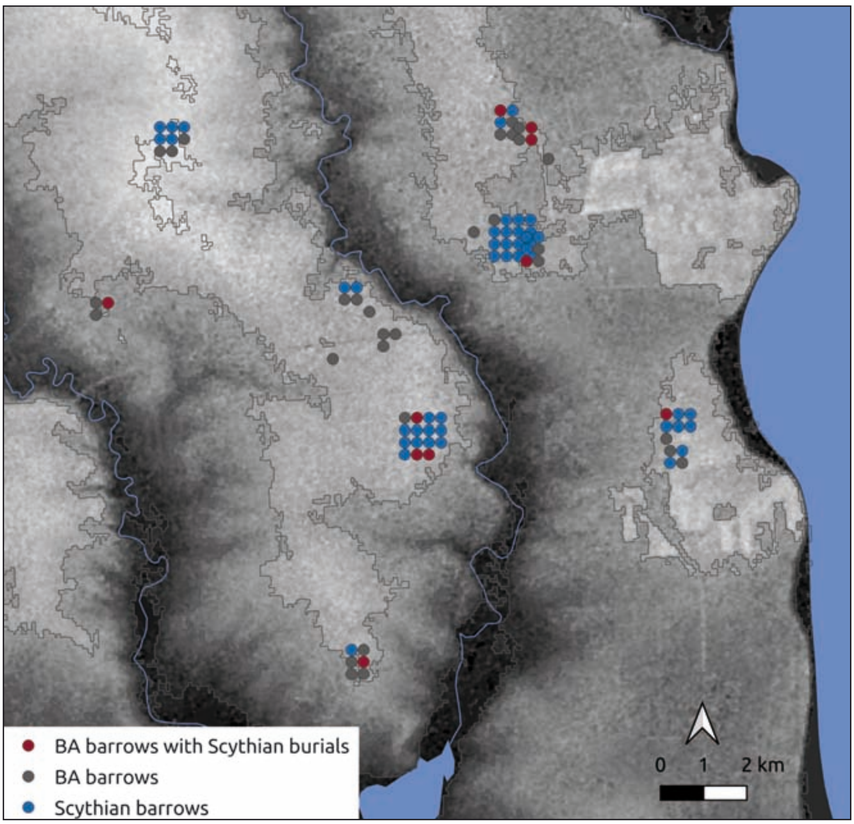

Fig. 11. Map of the distribution of Scythian secondary burials in BA barrows. Points are displaced around the centres of the groups

and the lack of precise dating within phases make it challenging to compare patterns directly, for this study, I propose assuming that similarity in burial customs implies some level of cultural continuity. Consequently, all groups exhibited a similar attitude toward barrows from previous phases; they either modified existing mounds or constructed new ones nearby. However, in the case of within-phase barrow reuse, the Scythians demonstrated a different approach compared to the Bronze Age, especially for groups with a tradition of building barrows. While Bronze Age barrows were reused throughout all phases, Scythian barrows were exceedingly seldom modified and used for secondary burials.

BURIAL REOPENINGS OR BURIAL DESTRUCTIONS

The reopening of graves, and particularly their destruction, can be seen as another form of post-funeral modifications to barrows. While this practice was quite widespread, its role in burial rituals remains a complex question.

The proportion of undamaged Bronze Age burials in the studied sample was relatively high, and even reopened burials mostly remained unscathed. Multiple instances of grave disturbances have been observed in Catacombna burials in the Molochna region. The burial of Mala Tervivka at 2/9 contained only partial remains (hand and leg bones) of the deceased individual, along with their tomb inventory, without any other signs of disturbance. According to research by S. Pustovalov, anatomically incomplete burials represented the cult of the head in Catacombna culture. Most of these graves consisted either of skull interments (notably with clay masks) or, conversely, bodies with skulls absent (Pustovalov 2015, 53). However, what I find particularly interesting is that some Catacombna burials exhibited minor changes in the anatomical position of bones. For example, there were cases of swapped left and right tibia bones or displaced distal and proximal ends of bones (Pustovalov 2015, 54). These potential mistakes not only serve as evidence of post-funeral manipulations with the deceased bodies but also reflect a careful treatment and intention to maintain their integrity even after death.

The picture of Scythian graves, however, is drastically different. Within the same region, only 29% of all Scythian burials have been identified as intact, with a similar percentage (33%) in the sample limited only to the secondary burials in Bronze Age barrows (Fig. 12). The extent of ruination also significantly impacted the preservation of entire burial complexes. To better understand this phenomenon, three main questions must be addressed: Were the burial reopenings made by Scythians? Is treasure hunting the most possible explanation for this? And, if not, were these actions contrary to or aligned with the original intentions of the creators of the burials?

The first question is perhaps the easiest to answer: The destruction of the original integrity of Scythian kurhans probably occurred repeatedly. While a major wave of grave

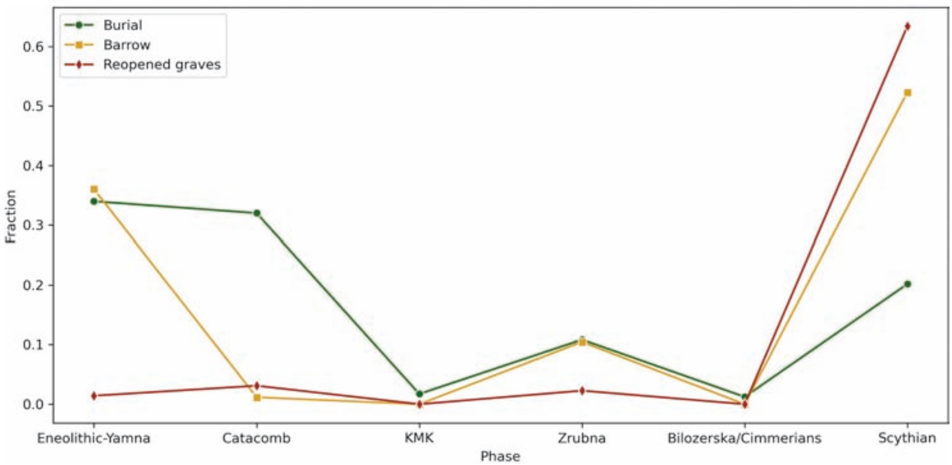

Fig. 12. The proportion of barrows and burials in the current sample, along with the proportion of reopened graves in each chronological phase

looting began with the colonisation of the steppe in the 18th century AD by a population not associated with nomadic traditions, researchers agree that many initial reopenings had already taken place during Scythian times (*e.g.*, Boltrik 2000, 135; Ochir-Goryaeva 2016, 114; Polin 2017, 527). According to S. Polin, the precise nature of the looters' shafts strongly indicates their exact knowledge of underground burial planning (Polin 2017, 530). However, Yu. Boltryk argued that the majority of these shafts, especially in "elite" barrows, were actually ritual dromos passages constructed by the barrow architects (although looters could later use them) (Boltrik 2000, 135).

The intentional choice of central graves for robbing could indicate motives beyond simple treasure hunting. In a detailed overview of post-funeral rituals among the Eurasian nomadic population, Maria Ochir-Goryaeva suggested that the primary purpose of reopening burials and manipulating the remains of the deceased was the legitimisation of power by successors through obtaining their status regalia (Ochir-Goryaeva 2016, 120). According to her observations, the most significant destruction primarily affected central, planigraphically "prestigious" burials within wealthy kurhans (Ochir-Goryaeva 2016, 122). To explore this further, I conducted a quantitative study of burials in the broader Northern Azov region, which revealed a consistent trend: overall, 89.5% of burials located in the centre of the barrow were robbed or otherwise destroyed, while among the side burials, this share was only 35.6%. Notably, the majority of surviving central burials were Scythian burials in Bronze Age kurhans, as well as female burials (Davydivka 4). When we focus on data from barrows where several burials were made during the Scythian period, the picture of the reopening ratio becomes even clearer: all but one central burial in such kurhans were destroyed, while among the side burials, such cases constituted 30.7%.

The fact that robbers often knew the layout of the central tomb in detail leaves no doubt that the existence of other burials was unknown to them. While different states of preservation contributed to a somewhat distorted picture, side burials in “elite” kurhans typically contained a significant number of items made from precious metals. Even in barrows where all burials were reopened, a significantly larger number of gold items (mostly costume details) were preserved in the accompanying female burials. For instance, the Northern catacomb of the Melitopol Kurhan, with a female burial also suffered damage. Despite this, a large number of valuables, including golden dress ornaments and decorations, were left in place. According to S. Polin, in this case, the robbers were able to take only the largest items, which were likely also present in the burial, while leaving the smaller ones behind (Polin 2017, 533). However, this confirms that the numerous golden ornaments, although also taken by the robbers (as evidenced by findings in the barrows), were not their main goal. Instead, the status attributes of leaders and warriors held greater interest. Repeated reuse of such artefacts also explains why Scythian prestigious artefacts often had slightly anachronistic features. A well-known example is the handle of a 5th-century BC Achaemenid sword found in the Chortomlyk Kurhan, dated to the late third quarter of the 4th century BC (Topal 2021, 297). While we cannot definitively determine the origin of such occurrences, it is clear that the connection with the past played an important role in increasing the value and status of these objects.

The practice of removing precious objects from graves appears to have been widespread among Bronze Age societies. According to research by Marie Louise Stig Sřrensen and Katharina Rebay-Salisbury, one form of post-burial treatment assumed that corporeal remains could lose their importance after a certain stage (possibly, decomposition), and the connection between these remains and associated objects also could change (Stig and Rebay-Salisbury 2023, 185-190). Consequently, the removal of objects may have been socially accepted and did not necessarily require careful handling of the remains. However, observations of reopened Scythian graves revealed treatment beyond mere disrespect for the deceased and the necessity of taking the valuables. M. Ochir-Goryaeva described several Pazyryk burials turned into chaos by the “grave robbers”:

> “...the robbers tore off the lid from the coffin, damaging it at one end, ... after emptying the coffin, the robbers placed the lid back on it in an inverted position...The sarcophagus was cut into pieces by the robbers ... parts of a woman’s body were found in various places within the burial chamber ... The male body, decapitated by the robbers, was oriented with its feet to the west” (Ochir-Goryaeva 2016, 126; Gryaznov 1950, 21; Rudenko 1960, 38, 39)

In the studied sample, skeletal remains were often found scattered within burial chambers as well. Another common situation involved mutilations, particularly decapitations, which natural factors could not explain. For instance, in the Vodoslavka 6 kurhan, the skulls of two buried individuals – a man and a woman – were found under the wall, separated from the bodies (Fig. 13). However, the bones of the rest of the skeletons were found

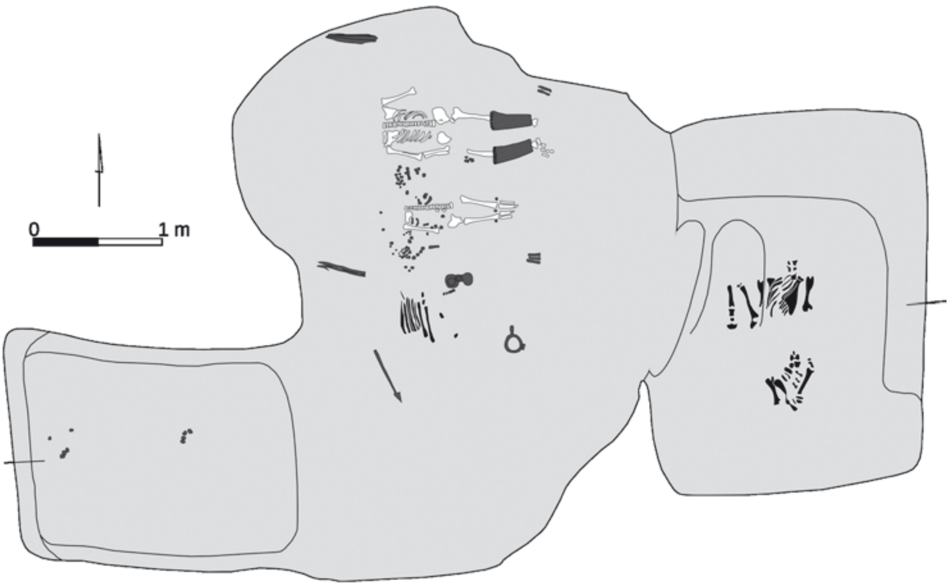

Fig. 13. Reopened grave Vodoslavka 6/1 with two beheaded individuals (drawing by the author after Kuprii *et al.* 2019)

in an anatomical arrangement, and a significant portion of the tomb inventory remained undamaged (Kupriy *et al.* 2019, 185).

This already brings us to the third question stated at the beginning of this chapter: whether these actions could qualify as violent since the post-funeral destructions could also be an intentional part of a burial ritual. Both ethnographic and archaeological evidence exists for such practices, involving the destruction of human remains and their symbolic substitutes. Richard Bradley referred to this as "remembering by forgetting":

> "Instead of a permanent memorial, the dissolution of the image provides a vivid metaphor for the decay of the human body, and it is this process that is called to mind. By destroying an object that has achieved renown, it is possible to ensure that it will form part of public tradition." (Bradley 2002, 42)

The key element in these phenomena lies in the duality of display-destruction activities. The personified object is exhibited to the community before its eventual demolition. However, this aspect was absent in the case of Scythian burial destructions. While their funeral ceremonies likely included such "incorporating practices" (Rowlands 1993) during wakening sacrificial rites, once the body was placed in the burial chamber, it remained hidden from public view. Scythian graves, especially during the Classic period, were typically located deep underground, 10 to 16 metres, and protected by layers of stone and eelgrass. These precautions made re-entering the grave an extremely difficult and dangerous process, therefore not suitable for prolonged post-funeral ceremonies.

Therefore, the data from Scythian burials tends to support the hypothesis that burial destructions resulted from violent actions toward the dead, aimed at altering their communal memory of them. These reopening could serve a similar purpose as placing secondary burials in Bronze Age barrows – asserting claims to land by conflicting groups. For example, Svitlana Bessonova associated Scythian burial reopenings with the cult of ancestors. According to her perspective, the destruction of male burials aimed to deprive enemy tribes of their protection (Bessonova 1983, 63). While the deceased, particularly their bodies and burial sites, remained active in the community's discourse, they could also become entangled in intertribal conflicts. The majority of "elite" Scythian barrows suffered from large-scale destructions. One notable exception is the Great Ryzhanowka Kurhan, which is one of the few intact barrows that could paradoxically support the aforementioned idea. Its chronology was dated to an uncommonly late period – around 280-260 BC, according to Serhii Skoryi and Jan Chochorowski (Skoryi and Chochorowski 2018, 143). By the 3rd century BC, Scythian society was already in decline, and the role of the kurhan shifted as burial practices gradually transitioned to flat graves.

CONCLUSIONS: FROM COMMEMORATION TO FORGETTING

One of the main observations of this study is the difference in Scythian's reuse of Bronze Age barrows compared to the treatment of barrows that emerged in Scythian time. In this section, I will attempt to explain this phenomenon by distinguishing how barrows and individuality could be communicated in the context of distant and living memory construction. Although the term "memory" in both cases does not refer to the cognitive process but rather to the learned and shared narratives about the past (Devlin 2007, 37), the concept of distant memory aligns more closely with societal mythology, unlike living memory, where events and names could still circulate in oral tradition.

The initial stages of colonising new pastures by the steppe nomads required the establishment of a symbolic connection with the distant past. In this context, kurhans served as a medium to invoke this connection through the conducting of mimetic funeral practices. As these barrows were essentially anonymous, they posed no threat and could be integrated into existing narratives as ancestral burials. Therefore, for example, the widespread practice of placing secondary burials in Bronze Age barrows still maintained the typical Scythian burial space organisation, which emphasised the centrality of the grave.

In contrast, Scythian kurhans were seldom, if ever, reused by contemporaries, as they were perceived not as anonymous but as being associated with individual people. These burials could serve as a material extension of the buried people who continued to live in

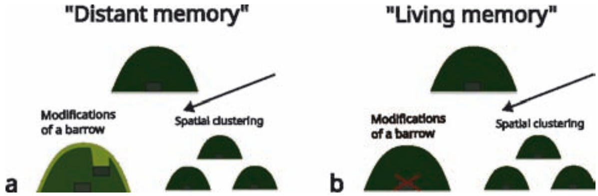

Fig. 14. Model of Scythian barrow reuse

the communal memory. According to Paul Treherne, for Homeric warriors, an oral tradition of epic poetry and a funerary monument both served as responses to the existential threat of death:

> "There was only one way that the self, the subject, could transcend death: in the minds of the living... In particular, by achieving a 'beautiful death', the warrior 'inscribes his reality as an individual subject on the collective memory of the group' thereby achieving a certain immortality" (Treherne 1995, 123).

Likewise, Patroclus' barrow served solely as a commemoration of him, not of his family or kindred. This individualistic view of death was deeply ingrained in the heroic ethos and may have also resonated with other steppe warriors.

At the same time, the materiality of remains associated with a people had the potential for manipulation of the memory about them. Considering the significant efforts that were dedicated to preserving the integrity of the body and arranging the inventory during the creation of the burial, destructive post-funeral actions should be seen in the opposite way – as disintegration or reappropriation of the memory. Loosely following Marshall Mcluhan's terminology, the connection between the funeral and individuality in these cases displays the communicative aspect of *reversal* (McLuhan and McLuhan 1988, 99): a medium created for commemoration turns into its opposite, an instrument for forgetting.

Considering this, the initial burial reuse model, which combined the patterns of spatial arrangement along with the modifications of the barrow, should be adjusted to fit these different types of memory treatment (Fig. 14). Distant memory allowed for a peaceful incorporation strategy that created an idealised version of the past to meet present needs. But when the monument's legacy and association were seen as potentially dangerous and contradictory, it needed to be destroyed and defeated. While these approaches were opposite in execution, both aimed to establish a new connection with the past, heritage, and land. However, the latter also expresses the volatility of social relationships happening in Scythian times, which probably involved not only the dead but also the living communities. In this way, Hervor's cautionary tale, in which she gained the sword and victories but lost her children, poetically mirrors the eventual decline in the barrow-building tradition, which also marked the end of the nomadic Scythian culture.

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METHODS FOR STUDYING THE RAW MATERIAL OF POTTERY OF ANTIQUITY (ON THE EXAMPLE OF MATERIAL FROM OLBIA)

ABSTRACT

Kotenko V. and Kushnir A. 2024. Methods for studying the raw material of pottery of antiquity (on the example of material from Olbia). *Sprawozdania Archeologiczne* 76/2, 123-142.

The aim of this paper is to demonstrate the methodology of researching the potential pottery raw materials of excavated material from the antique polis using the example of Olbia in the North Western Black Sea region. The historiography of the issue is considered and the main methods are defined. It includes fieldwork, laboratory analyses and their interpretation, as well as an experimental component. The discussion is based on the description of the stages of fieldwork, the study of the macromorphological structure of the clay deposits, micromorphological and granulometric analysis of ancient ceramics and experimental products made of potential pottery raw materials. According to the obtained results, it can be said that the population of Olbia used local materials in pottery making, although their characteristics are specific for the preparation of the clay mass. A comprehensive study confirmed the ability to find out the raw material base of the ancient polis and the possibility of its application at other sites.

Keywords: antiquity, Northern Black Sea region, Olbia, pottery, methods, interdisciplinary research
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INTRODUCTION

The ancient centres of the North-Western Black Sea region belong to the ancient Greek *Oikumena*, that has specific features of material and spiritual culture. The founding of Borysthenes (a settlement on Berezan island) and Olbia are key events in the history of this region. The economic development of these settlement structures can be traced archaeologically through the remains of the craft production among which the pottery played an important role for obvious reasons. Ceramic products provided not only for the everyday life of the settlers, but also were goods used for distribution to the barbarian population of the Forest Steppe region north of the coastal regions where it shipped through the mediation of these centres.

The significant information in the source base of Olbia, accumulated over a hundred years of research, is represented, first of all, by the ceramics that consist of local products and imported items. Nevertheless, convincing evidence of the development of local ceramic production is poorly shown there, although archaeological materials give reasons to hypothesize that it definitely took place in Classical, Hellenistic and Roman periods. Taking into account some discovered pottery kilns. we should pay special attention not only to the products but also to the resource potential of Olbia in ancient times. Deposits of mineral raw materials were a basis of pottery making as one of the most important branches of the Hellenic economy: ceramics were used both as a container for trade products but also separate goods. Moreover, it probably was one of the factors in the colonisation process if we talk about the place of *poleis* establishment and is often considered in the context of urban processes (Kotenko *et al*. 2023, 140-142). Currently, we have a situation when the creation of an economic model of Olbia is impossible because there is an information gap related to the basic criterion for evaluating the raw material deposits as a guarantee of the development of the *polis*. The issue is relevant also considering the fact that the erosion of the coastline of the estuary of the River Buh in the territory of Olbia is active here. Theoretically, this process can destroy the traces of the ancient development of deposits.

The study of the raw material base of Olbia and its surrounding area will allow the determination of the resource potential of the sites and therefore to reconstruct the economic model of the *polis*. Through interdisciplinary research, it will be possible to separate out the local ceramics from imports, which has been a debatable issue in ancient historiography for a long time. Therefore, the paper is based on the hypothesis that Olbia had a developed local pottery making industry, and that the selection of local products is possible namely on the condition of obtaining data on local deposits of mineral raw materials that were fit for the making of pottery.

Therefore, to cover this topic, we set ourselves the following tasks:

1) To investigate the potential locations of raw materials for pottery near Olbia by sampling; 2) To obtain and interpret the results of palaeogeographical laboratory studies of clay deposits in the context of the study of ancient pottery in Olbia;

3) To study the micromorphological composition of ceramic samples for comparison with deposits of potential local pottery raw materials.

In general, the main task has been to determine whether Olbia has the resource potential to develop pottery manufacture on a larger scale.

HISTORY OF RESEARCH

Interdisciplinary research of pottery is becoming increasingly popular. Similar studies of local raw materials and their mineralogical composition are an integral part of a number of scientific projects. For example, the analysis of mineral deposits in the area of the North Ionian *poleis* allowed us to consider the issue of local ceramic production in the Archaic period (Nezih Aytaçlar 2007), while for the other centres such methods are actively being implemented for the sites of the Roman period (Geerts *et al.* 2016; Istenič *et al.* 2003).

In recent years there have been a number of petrographic studies on ceramics carried out on material of different periods (for example, Ownby *et al.* 2016; Miše *et al.* 2020; Quinn and Burton 2010; Ting and Taxel 2020). The aspect of the source of the raw material needs to be considered with the application of different research methodologies that on the one hand can be seen as universal for all archaeological material (including that from sites of classical antiquity), but on the other hand taking into account some regional specifics.

The development of the methodology for studying the raw material base of the pottery of Olbia is at a preliminary level. Some initial steps to the development of this topic were taken by the authors (Kotenko and Kushnir 2022, 44). The historiography of the study of pottery as a craft in ancient Borysthenes and Olbia is covered in a separate publication (Kotenko 2017, 126-133; Kotenko *et al.* 2021). Special attention should be paid to the papers that include interdisciplinary research even in the first half of the 20th century (Knipovich 1940). It is also worth mentioning attempts to study ceramics and building remains using geological data (Shevchenko 2017). However, this information, despite the perspective of the tasks, did not give a comprehensive answer to the question of the raw material base of Olbia in ancient times. Significant shifts in the development of the methodology of studying ancient pottery in the region were made due to instrumental researches. The method of Neutron Activation Analysis revealed the resemblance of the ceramics, proved the local pottery making in Borysthenes in the 6th century BCE and the presence of such products in Olbia (Krutilov *et al.* 2021).

Despite the fact that ceramics are a major source in the study of Olbian local pottery making, it is also worth mentioning the papers deal with the palaeoecological conditions in the Lower Buh region in antiquity. For example, the article by K. K. Shilik on the palaeogeography of Olbia (Shilik 1975) contains information about the geological structure of the bedrock of the bank of the Buh estuary near this *polis*, the geomorphology and geology of different sites of the settlement. However, this research was more related to the topography of the city than to its raw resources. The creation of the maps of minerals and the great geoarchaeological contribution of V. F. Petrun allowed a closer study of the geology and palaeogeography of the North-Western Black Sea region (Ostroverkhov and Smyrnov 2012). Episodic finds of pottery production traces and ceramics from Olbia brought to the foreground the topic of local pottery, but the comparison with local raw materials was postponed for a long time.

In this paper, an interdisciplinary approach to pottery studies is based on the comparison of ceramic products from the period of the site's functioning with potential pottery raw materials near the Olbia settlement, its *chora* and nearest territories. First of all, it can be represented by the comparison of petrographic, geochemical and mineralogical characteristics of ceramic products with deposits of different geological periods (*e.g.*, Matviishyna *et al.* 2021). The results of paleogeographic research of Olbia and other sites are represented separately (Kushnir and Leiberiuk 2022). Given the above, studying the raw material base of Olbia pottery is theoretically grounded and relevant for now.

IMPLEMENTATION OF RESEARCH METHODOLOGY AND METHODS

The proposed methodology for studying the raw material base of Olbian pottery consists of several consistent and interconnected stages. At the first stage, points with deposits of different geological periods were investigated in the field; their preliminary stratigraphic dissection and macromorphological description were made, along with aerial photography.

The study area is represented by deposits of the following geological eras:

1. Modern Holocene sediments (hl) are represented by soils, mainly chestnut, in particular dark chestnut residual-saline soils;

2. Upper Quaternary deposits (dIII+IV). Deluvial deposits of the slopes of river valleys and gullies. Loam, sandy loam, in places with the inclusion of crushed stone;

3. Upper Quaternary deposits (vd III). Aeolian-deluvial deposits. Loess loam with fossil soil.

4. Neogene deposits. Early Pliocene. Pontic layer (N_2pn). Sands, clays, limestones. Clays are grey and greenish-grey.

5. Neogene deposits. Late Miocene. Meoetic tier (N_1m). Clays with interlayers of limestones, sands, siltstones. Marine deposits. Clays are greenish-grey.

A detailed macromorphological description of the studied deposits is presented in Table 1.

Aerial photography, in turn, showed that we studied all available deposits within Olbia and its nearby chorus.

In the second stage, the selection of ceramic products, most typical for this site, took place. As a part of these two stages, catalogues with indexing of sediment samples and ceramic fragments were compiled.

All selected ceramic samples are presented in Table 2. The sample set is at the first stage of completion, but it allowed us to conduct analysis and relevant comparisons. In the future, we will plan to expand the selection and compile relevant catalogues.

The third stage involved laboratory studies, namely micromorphological and granulometric analyses. Micromorphology made it possible to study the structure of deposits of potential raw materials and ceramic products, to make their comparison. Along with this, based on the granulometric analysis of potential pottery raw materials, we found out its suitability for pottery making from physical and chemical points of view.

A comparison of the microstructure of deposits of different geological eras and ceramics of ancient times allows us to reveal similarities in certain mineral composition, aggregation of material, and concentration of individual mineral rocks (sand, clay, *etc*.). The granulometric composition of such components as, for example, physical clay and sand (Table 3) allows us to determine, based on previous studies (Matviishyna *et al*. 2021), the degree of suitability of raw materials for pottery making.

The last stage was represented by experimental research, i.e. reproducing pottery items in modern conditions from different combinations of selected raw materials. The micromorphological analysis of these products made it possible to make a background comparison of them with the microstructure of ancient ceramics and natural deposits.

At this stage, we combined different sediment samples that were collected in the field at the pottery production site (the workshop of a working potter). We made nine variants (Table 4) of mixtures. The most successful combinations were examined through a microscope and their micromorphological analysis was carried out.

Each stage is described in more detail below. At the same time, we note that this methodological approach was applied for the first time to the ancient ceramics of Olbia Pontica.

Macro- and micromorphological analysis

Selected monolith samples of potential pottery raw materials and fragments of ceramics were prepared in the laboratory of the Semenenko Institute of Geochemistry, Mineralogy and Ore Formation of the National Academy of Sciences of Ukraine). Thin sediment and ceramic sections (0.02-0.03 mm) were analysed through an Optika B-150POL-B 40×-640× polarising microscope at the Institute of Geography of the National Academy of Sciences of Ukraine. The interpretation of the micromorphological structure was made according to the methodology of M. F. Veklich and Z. M. Matviishina *etc*. (Veklich *et al*. 1979; Karmazynenko 2010). The analysis of ceramic samples was based on recent developments in ancient petrography and general works on the study of ceramic micromorphology (Ownby *et al*. 2016; Miše *et al*. 2020; Quinn and Burton 2010; *Soil Micromorphology*; Ting and Taxel 2020).

Granulometric analysis

Some samples were taken to determine the physical and chemical features of potential pottery raw materials, namely sand, dust and silt fractions. They were investigated at the Landscape ecology laboratory of Taras Shevchenko National University in Kyiv. The classification of the material according to the mechanical composition, which is based on the ratio of physical sand and physical clay, was made according to characteristics defined by N. A. Kachynskyi and those of the deposits according to the classification of M. M. Godlin (Tykhonenko *et al.* 2008, 88-104).

Experimental firings

This stage involved the reproduction of products from raw materials in the modern pottery workshop for the purpose of verifying the previous results of laboratory studies. Vessels were modelled on a potter's wheel with an electric drive. Clay samples were also made from seven different combinations of components to evaluate the physical properties of the mixture without technological influence on it. These samples (fired and unfired) were submitted for micromorphological analysis. Firing of samples and vessels was carried out in an electric muffle furnace in the mode of moderate temperature increase from 20°C to 1000°C for 8 hours (holding mode).

RESULTS AND DISCUSSION

Field research

The methodology included paleogeographic studies of Cenozoic sediments that came to the surface within the ancient city of Olbia and the settlements of the *chora* (Fig. 1).

According to the relief map, this is the territory of the Black Sea Lowland and Olbia with its area are located on the shore of the Buh estuary which led to a lowering of the territory and its dismemberment. It is worth noting that access to these deposits was also possible in ancient times, but probably in other places, as this was influenced by the water level of the sea and affected directly by coastal erosion. In order to investigate the degree of erosion of the coastline and its grassiness, aerial photography was also carried out using a UAV (DJI Mavic Pro). This method is effective for tracing the extent of natural deposits in places with difficult access. Today, the coastal line is represented mainly by the slopes of the right bank of the Buh estuary, which range from steep slopes with visible exposed deposits and gentle ones with grass-grown meadows covering any deposits. Therefore, panoramic images of the powerful stratigraphic layering on this large area are also informative (Fig. 2).

As a part of the fieldwork, the area of ancient sites was surveyed, a map of the researched sampling places and hypothetical places of potential pottery raw materials exploitation were made (Fig. 3). In total, nine points with deposits of various dates in natural outcrops were explored (Table 1), and samples were taken for the different analyses.

Fig. 1. Fieldwork: a – sampling at Point 3 (Kozyrka-1 settlement);
b – data recording at Point 4 (Voloska Kosa settlement)

Fig. 2. Aerial photography of the vicinity of Olbia: a – Katalyne; b – Parutyne

As a result of conducting fieldwork on potential pottery raw materials occurring within Olbia and the surrounding areas, it was established that the most common types of sediments are Neogene and Pleistocene deposits. Neogene sediments are mainly represented by Pontic (N_2pn) and Meoetic (N_1m) layers, stratigraphically determined at points 4 and 7. Pleistocene deposits are mainly represented by Buh (bg Q_3) and Vytachiv (vt Q_3) horizons, stratigraphically determined at points 1, 2, 6 and 8.

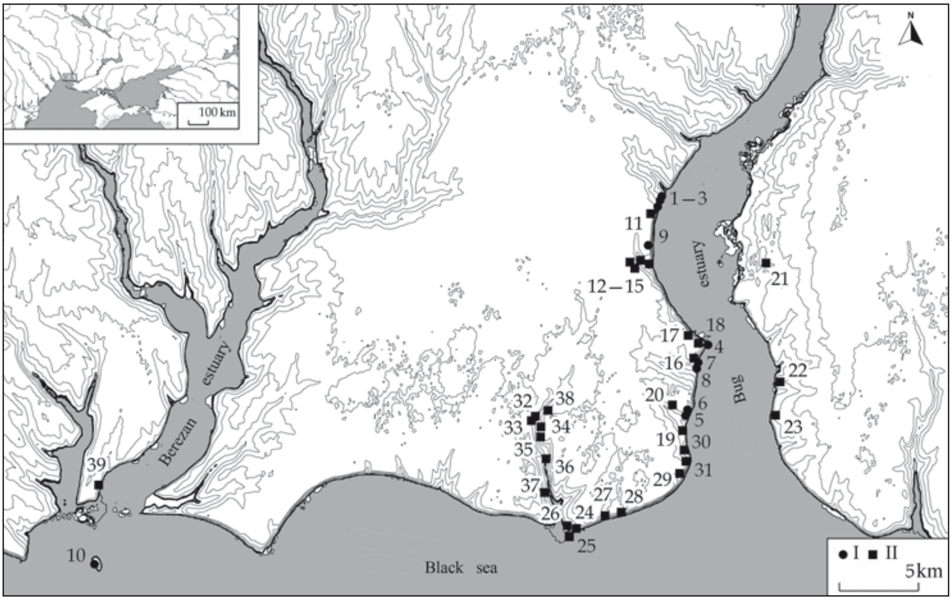

Fig. 3. Map of the of location of researched points (I) and archaeological sites (II): 1 – Point 1; 2 – Point 2; 3 – Point 3; 4 – Point 4; 5 – Point 5; 6 – Point 6; 7 – Point 7; 8 – Point 8; 9 – Point 9; 10 – Point 10; 11 – Kozyrka-1; 12 – Katalyne-1; 13 – Katalyne-3; 14 – Katalyne-4; 15 – Extra-urban sanctuary (ash heap) near Katalyne village; 16 – Voloska Kosa-1, 3; 17 – Voloska Kosa-2, 10, 13, 14; 18 – Voloska Kosa-5, 6; 19 – Shyroka Balka-1, 6; 20 – Shyroka Balka (necropolis of Olbia); 21 – Lisgosp-2; 22 – Lupareve-1; 23 – Lupareve-2; 24 – Adzhigol-1; 25 – Adzhigol-2; 26 – Adzhigol-3; 27 – Dniprovske-2; 28 – Dniprovske-3; 29 – Dniprovske-4; 30 – Zakysova Balka-1; 31 – Zakysova Balka-2; 32 – Adzhigolska Balka-2; 33 – Adzhigolska Balka-3; 34 – Adzhigolska Balka-5; 35 – Adzhigolska Balka-7; 36 – Adzhigolska Balka-8; 37 – Adzhigolska Balka-9; 38 – Adzhigolska Balka-10; 39 – Viktorivka-1

In the next step, samples of the ceramic products that chronologically belong to various stages of the existence of Olbia were selected (Fig. 4). These products are represented by tableware, ceramic slag, pieces of baked clay, *etc*., which expands the spectrum of the researched issue. The samples were selected directly from the Olbia settlement. The main features of the materials, including macroscopic characteristics of pottery, will be presented below (Table 2).

As a result of the fieldwork, the main vectors of research and specific tasks were outlined with reference to the completed source base for data processing.

Laboratory studies

The next stage involves the implementation of a multidisciplinary approach in order to analyse the potential raw materials and compare them with ancient ceramic products. Ceramic fragments were selected for the study according to the catalogue presented in Table 2. In this paper, in order to demonstrate the application of the methods, we present only in-

Table 1. Description of the potential pottery raw material samples

No.	Point name	General description of the samples (potential pottery raw material)
1	Kozyrka-1	Deposits of light pale brown (8/3 – 7/3 10YR) material in the left side of the northern wall. Material with visible pieces of carbonates in the form of white granules and concretions. Light loess loam. Non-cohesive, lumpy and crumbly. Active reaction with 10% HCl. Visible stratigraphic layer in the slope – up to 3 m.
2	Kozyrka-1	Deposits of two layers: 1. Light (8/2 – 7/2 2.5Y) dusty loam, lumpy and crumbly. Clayed and ferrous material can be traced throughout the profile. Active reaction with 10% HCl. 2. Light brown to dark brown (5/8 2.5YR) light loam (to sandy loam). Easily crumbly. There are traces of carbonation in the form of a white spot. The brown material has not reaction with 10% HCl, and white material has active reaction with 10% HCl.
3	Kozyrka-1	Alternation of 2 types Neogene-Pliocene sediments, which indicate sharp changes in the alternation of shallow and deep sea. 1. Light (8/1 2.5Y) material. Deposits are sugar-white, sandy very crumbly. 2. Clayed and clay loam. It is pale-brown (7/3 2.5Y) and very dense. The thickness of alternation – 10-15 cm (each layer). Sand material is less thick. The clay deposits contain bright residues of molluscs.
4	Voloska Kosa	The deposits locate ashore of the Bug estuary, actively suffer to marine (estuary) abrasion. The total thickness of stratigraphy is about 4 m. Samples of 2 types were selected. 1. A material from the layer of 3.4-3.6 m is light pale (7/3 5Y), dusty, lumpy and crumbly light loam; it has an active reaction with 10% HCl. 2. A material from the layer 3.0-4.3 m is light greenish-dark-grey (7/2 5Y), medium to clay loam. The deposits are laminated, sticky in wet condition; lumpy and crumbly in dry condition. The material contains brownish interspersed (6/6 10YR), has an active reaction with 10% HCl.
5	Shyroka Balka	Shore wall. The total thickness of stratigraphy is from 2.5 to 1.5 m and below along the shore. In cross-section, it looks like a homogeneous light brown material, but three layers stand out in the morphological description. 1. The layer of 0.3-0.4 m represented by lumpy and crumbly medium loam (5/4 10YR); it has an active reaction with 10% HCl. 2. The layer of 0.45-0.95 m is represented by light loam to sandy loam. It is dusty, lumpy and crumbly (6/6-5/6 7.5YR). 3. This layer (0.95-1.35 m) is the sandiest material in the profile (6/6 10YR). Bright strips of crushed molluscs and minerals are observed.
6	Shyroka Balka (a road)	A heavy layer of homogeneous deposits with a total thickness of 2-4 m. It is a homogeneous light pale (7/3 2.5Y), dusty, medium-compacted, light to medium loam. Crumbly (lumpy and crumbly) sediment structure has an active reaction with 10% HCl.
7	Parutyne (a pier)	There are sediments along the estuary at a distance of 5 m from the water. A length is more than 100 m with a thickness of 15 m or more. Two samples were selected. 1. The densest horizon in section (10-11 m). It is light yellow to pale yellow (8/2 5Y). The structure is dusty; the material has an active reaction with 10% HCl. 2. Light green (7/2 5Y) sediments with dark orange (rusty) admixtures (11-15 m); the material has a weak reaction with 10% HCl.
8	Parutyne (a road)	A homogeneous light brown (6/66 7.5YR) deposits. The structure of medium to light loam is lumpy and crumbly; the material has an active reaction with 10% HCl. Visible micellar forms of carbonates and black veins of iron and/or manganese of the horizon are observed in the sediments.
9	Katalyne	The area is completely covered with grass, both at high hypsometric levels and at the estuary. Sediments and the general appearance of the territory (the right bank of the estuary) may indicate that the stratigraphy and nature of the sediments are correlated with section T.7. During the existence of the polis, the territory was probably not covered with grass, and these sediments could be used for the needs of the population.

Table 2. Description of the ceramic products *(reaction with HCI means that a small amount of HCI was added to the fresh chipping of each ceramic fragment in order to determine the presence of carbonates in the dry mass at the macromorphological level that reacted with acid. The intensity of boiling directly depends on the concentration of carbonates in the material. Designation: "+++" – intensive reaction; "++" – medium reaction; "+" – slight reaction; "-" – no reaction.)*

Code	Notes	Reaction with HCI
K/O-1	slags of ceramic production (?), O-2000, P-25, 5th cent. BCE (?). A coarse mix of homogeneous light-pale material with visible inclusions of carbonate rock grains and voids due to decomposition/burning of organic residues can be observed.	+++
K/O-2	a fragment of the wall of adobe amphora, P-25, 1st cent. CE, O-85. A light pale porous material, small inclusions of quartz and carbonate grains. Voids formed during the burning of organic matter can be seen.	+++
K/O-3	a fragment of louteria, O-2019/T-4, 828, 5th-4th cent. BCE. A light grey mass can be seen along the edges, that turns into a dark grey mass closer to the centre. The different colours were formed as a result of short firing/low temperatures. The mass shows voids formed during the burning of organic matter.	–
K/O-4	a wall of the greyware bowl (0,6-0,7 mm), T-4, backfill, 5th cent. BCE, (local production?). Homogeneous dark pale material with dark grey on the outer edge. Small single inclusions of quartz grains can be traced.	++
K/O-5	a wall of the greyware vessel (Cherniakhiv culture, 3rd-5th cent. CE), T-4, backfill 2021. Homogeneous dark grey material with isolated carbonate grains and voids formed by burning organic matter.	+
K/O-6	a wall of the red-glazed vessel (1st-2nd cent. CE, local production?), T-4, backfill 2021. Homogeneous light pale material. No visible inclusions of mineral grains.	++
K/O-7	cooking ware (bottom part), 5th-2nd cent. BCE, T-4, backfill 2021. Dark pale porous mass with inclusions of carbonate grains.	+++
K/O-8	a fragment (rim) of the greyware bowl (local imitation of the Attic product?), 4th cent. BCE, T-4, backfill 2021. Mixed grey-pale, layered and porous mass.	++
K/O-9	a wall of the red clay vessel (local production?), 5th cent. BCE, T-4, backfill 2021. A light pale mass. It contains voids formed during the burning of organic matter.	+
K/O-10	a fragment of the lamp, 5th cent. BCE, surface find, 2019, Lower city. Dark grey mass with inclusions of light quartz grains.	–
K/O-15	a fragment of a baked clay, Suburb, O-2021, 5th cent. BCE. Mixed dark-pale porous material, slightly fired, dusty. There are inclusions of carbonate grains and lighter-coloured quartz minerals.	+++

dividual samples that belong to different stages of the functioning of Olbia (Greek period – classical period, fragment K/O-9, 5th cent. BCE and the Roman period – K/O-6, 1st-2nd cent. CE). They are represented by "red clay" products. Ceramics of this type are widespread in Olbia so the issue of its production is important.

K/O-6 (Fig. 5) is a light brown densely packed mass. There is a proportionate amount of sand and clay in the raw material. There is a relatively drastic change in colour observed, in particular in images 'b' and 'd'. This can be evidence of some kind of mechanical influence on the vessel (in general use) after its manufacture and/or insufficient mixing of the clay mass before firing. Sporadic small grains of quartz and carbonates are present in the

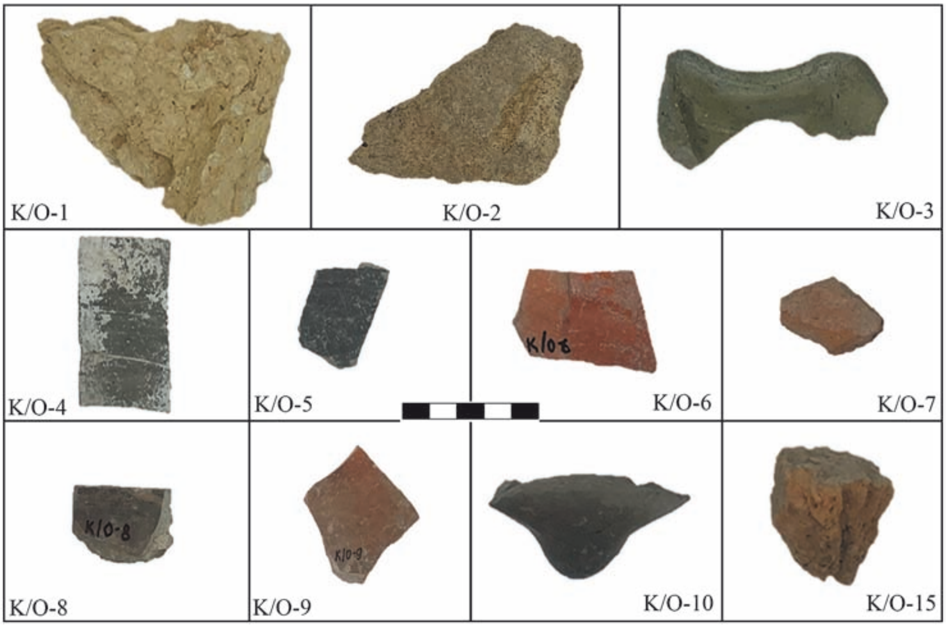

Fig. 4. Samples of ceramic products from Olbia

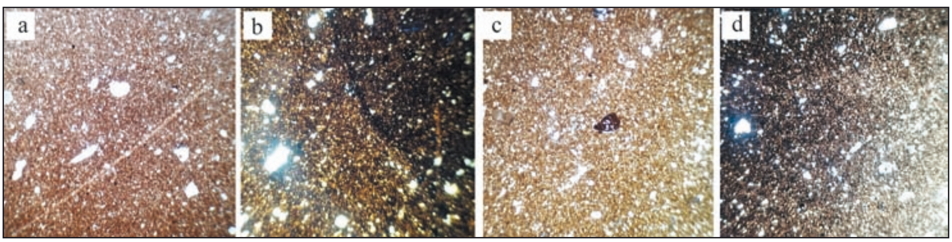

Fig. 5. Micromorphological structure of a ceramic fragment K/O-6. All images are magnified at 40x. Images a and c were taken in parallel nicols, images b and d were taken in crossed nicols

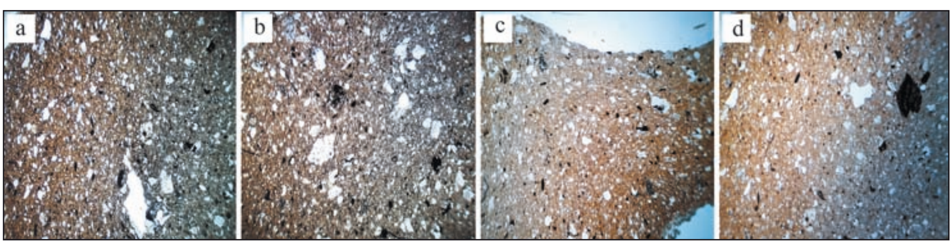

Fig. 6. Ceramic fragment K/O-9. All images are magnified at 40x. Images a to c were taken in crossed nicols, image d was taken in parallel nicols

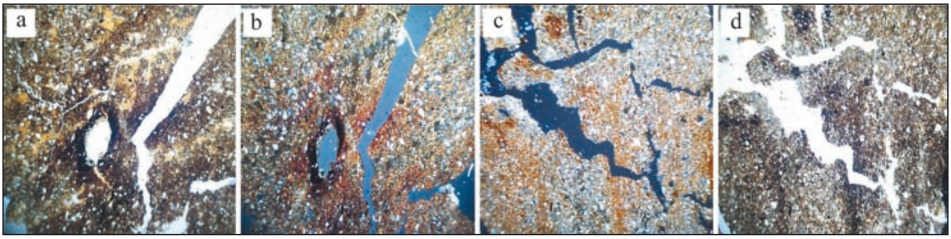

Fig. 7. Micromorphological structure of potential pottery raw material VK 1/21 (Voloska Kosa, sampling depth 3.4 – 3.6 m, 7/3 5Y, inclusions 6/6 10YR). All images are magnified at 40x. Images a and d were taken in parallel nicols, images b and c were taken with crossed nicols

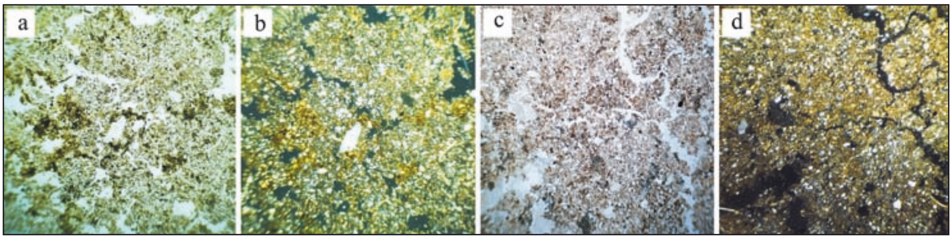

Fig. 8. Micromorphological structure of potential pottery raw materials ShB 2/21 (Shyroka Balka, deposits of Buh pleistocene, 7/3 2.5Y). All images are magnified at 40x. Images a and c were taken in parallel nicols, images b and d were taken with crossed nicols

clay matrix. We also note that the inclusion in microphoto 'c' is quite similar to basalt but is rather one of the types of carbonate inclusions.

K/O-9 (Fig. 6) has a light grey mass with a greenish tint, densely packed. There is a proportionate amount of sand and clay in the raw material. There is a relatively drastic change in colour observed, in particular in photos 'a' and 'd'. This can be evidence of some kind of mechanical influence on the vessel after its manufacture and/or insufficient mixing of the material before firing.

Figures 5 and 6 show photos taken in parallel and crossed nicols. We used the same approach to other types of ceramics and potential raw materials.

The next step involves conducting laboratory studies of natural deposits. There are represented the most typical sediments of this territory in the description of the micromorphological structure of potential pottery raw materials (Neogene sediments from point 4 (VK 1/21) and Buh Pleistocene sediments from point 5 (ShB 2/21). These deposits are found in the most complete of the investigated sections, namely at the point 7 Parutyne-pier, and singly in other investigated points. The micromorphological structure of deposits of potential pottery raw materials is as follows:

VK 1/21 (Fig. 7) – the material is heterogeneous, weakly aggregated, and cracked, but at the same time densely packed in blocks (c). The main mass is ferruginous with concentrations of iron deposits near the pores (b), organic matter and a relatively significant content of clay matter (a, d) can also be traced in the mass. The mineral skeleton consists mainly of small grains of carbonates and quartz.

ShB 2/21 (Fig. 8) – the material is well aggregated, a mass of spongy composition with carbonate and clay microaggregates separated by a system of winding pores. Carbonate and clay composition fills the structure of the sediment sample. The mass has a flat relief and uneven light brown colour. The rounded grains of quartz and silt prevail in the mineral skeleton (about 70% of the ground area).

We note that the description of the micromorphological structure of potential pottery raw materials and ceramic products is also briefly described when describing the corresponding photos. In the framework of this publication, we did not aim to provide detailed micromorphological characteristics of each section. The description of the micro photo was carried out in the context of the general approach of the proposed method of studying the pottery of Olbia. A separate publication will be devoted to the detailed micromorphological structure of all thin sections.

Comparing the micromorphological structure of ceramic samples and potential pottery raw materials, it is possible to make a conclusion about a certain similarity of the structure and filling of the mineral skeleton. We also note that there are organic remains in the form of clots and impregnations in the micromorphological structure of samples of potential pottery raw materials. At the same time, this feature is not noted in the microstructure of ceramic fragments (only isolated remains are present here) because the material was subjected to thermal effects and the organic matter burned out as a result of firing. At the same time, we record the compaction of the material in the ceramic samples, both in the structure and in the filling. The second case probably indicates a good mixing of the material and/or it is a consequence of the fact that the ceramics were made on a potter's wheel.

Analysing the physical and chemical properties of potential pottery raw materials according to the granulometric composition (Table 3), we note a significant content of physical

Table 3. Granulometric composition of the pottery raw material samples

Fraction name, size (mm)	Quantitative, %	
	VK 1/21	ShB 2/21
Coarse sand (1,0-0,25)	0.1795158	0.77453819
Fine sand (0,25-0,05)	6.5548042	29.64933741
Coarse dust (0,05-0,01)	43.53774	40.1416376
Medium dust (0,01-0,005)	0.660288	0.0814232
Fine dust (0,005-0,001)	13.288296	18.32022
Silt (<0,001)	35.779356	11.0328436
Clay (<0,01)	49.7279	29.4345
Attribution according to the classification of N. A. Kaczynskyi and M. M. Godlin (after Tykhonenko *et al.* 2008)	Heavy loamy deposits / sandy and heavy loamy deposits	Light loamy deposits / light sandy and loamy deposits

clay in the sample VK 1/21. This material could therefore have served as the basis for the manufacture of ceramic products in this region. At the same time, the main admixture could be the material from sample ShB 2/21. In particular, it has a significant quantity of fractions of fine sand, which helped in the formation of products.

Experimental studies of potential pottery raw materials

The last stage of the proposed methods is the verification of the obtained results based on the making of ceramic samples and products from the selected raw materials. For this, the materials that were taken from points 4 (Fig. 2), 7 and 8 (Table 2), plus sand from the coastline of the Buh estuary and water. That is, the necessary minimum components for the reproduction of a pottery product have been selected.

Through various combinations of components, the optimal clay mass suitable for pottery was found (when it does not deform and has specific product features). Firstly, with this purpose, samples were made from seven different combinations of components (Table 4, Fig. 9) in order to evaluate the physical properties of the obtained clay mass without technological influence on it. These samples (fired and unfired) were also analysed by comparing the micromorphological structure of ancient and modern products.

Table 4. Component combinations of the experimental samples

No.	Code	Components
1	1C/21 1B/21	Point 4 sample 2 (greyly green clay deposits), not crushed or sifted mass – 100% Water (30% from the total mass)
2	2C/21 2B/21	Point 4 sample 2 (greyly green clay deposits), crushed and sifted mass – 80% Point 7 („Bug loess”) 20% Water (30% from the total mass)
3	3C/21 3B/21	Point 4 sample 2 (greyly green clay deposits), crushed and sifted mass – 70% Point 7 («Bug loess») 10% Point 8 (red loam) 20% Water (30% from the total mass)
4	4C/21 4B/21	Point 4 sample 2 (greyly green clay deposits), crushed and sifted mass – 85% Sand – 15% Water (30% from the total mass)
5	5C/21 5B/21	Point 8 (red loam) – 60% Sand – 40% Water (30% from the total mass)
6	6C/21 6B/21	Point 7 («Bug loess») – 50% Sand – 50% Water (30% from the total mass)
7	7C/21 7B/21	Point 4 sample 2 (greyly green clay deposits), not crushed or sifted mass – 80% Sand – 20% Water (30% from the total mass)
8	1P/22	1st product (1st variant of the moulded mass) greyly green (T.4, sample 2, 100%) and water (30% from the total mass).
9	2P/22	8th product (2nd variant of the moulded mass) Point 8 (red loam – 80%), sand (20%) and water (30% from the total mass).

Fig. 9. Samples of pottery paste with different component composition

Fig. 10. Pottery making (a) and products from potential pottery raw materials (b)

Then there was an attempt to make pottery from authentic raw materials. Five test vessels were made on the potter's wheel (Fig. 10). The products were made from the best three types of pottery paste:

1) material from Point 4 (Sample 2) – grey-green mass (100%) and water (30% of the total mass) – three products (*e.g.*, Fig. 11).

2) material from Point 8 (red loam – 80%), sand (20%) and water (30% of the total mass) – one product. The mass showed good plasticity during making on the potter's wheel.

Fig. 11. An example of a product from the first type of pottery paste: 1 – before firing; 2 – after firing

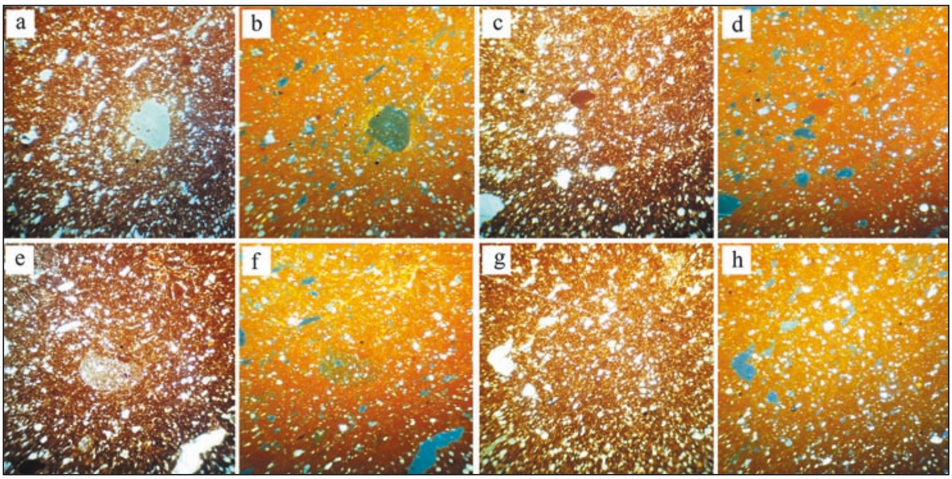

Fig. 12. Micromorphological structure of the experimental product (sample 1P/21).
All images are magnified at 40x. Images a, c, e, and g were taken with parallel nicols, pictures b, d, f, and h were taken with crossed nicols

3) material from Point 8 (red loam – 100%) and water (30% of the total mass) – one product. The mass showed low plasticity which indicates its unsuitability for pottery making.

In order to assess the methods, the results of the micromorphological structure (Fig. 12) from the most successful product (sample 1P/21) are presented (according to the potter's opinion). This mass of raw materials showed a good plasticity during making on the potter's wheel. The sample has a minimum number of components, because the determination of admixtures requires more extensive research. At the same time, these micromorphological data are the background for comparison with the micromorphological structure of ancient ceramics.

The sample 1P/21 (Fig. 12) is a homogeneous narrowed light-yellow mass with significant seepage, clumps of clay material (c-d) and proportional distribution of carbonates. There are also large (a-b) and fine (g-h) quartz grains in the matrix, as well as concentration of microcrystalline calcite (e-f).

Comparing the micromorphological structure of the presented samples of raw materials, fragments of ancient ceramics and experimental products, it is possible to conclude that they are similar. The micromorphological structure of the product made by the potter is quite similar to ancient ceramic fragments. They are similar in colour after thermal treatment, in the composition of the main mineral components (carbonates, clay, *etc.*), and in the general microstructure of the product. At the same time, we note that ancient ceramics were made with the addition of a certain fine sandy material which represented, for example, by deposits from sample ShB2/21 from the Buh. It is also likely that the firing temperature in the modern potter workshop was higher, as indicated by the colour of the product and the absence of an organic component in the microstructure. In this case, the sand saturation of the mass was sufficient. This may indicate that sand was not always added to the pottery as an admixture.

CONCLUSIONS

The study of the raw material base of Olbian pottery has produced the following results. During the implementation of the methodology, different kinds of components were covered. They include various aspects of the source base. In general, all stages can be divided into fieldwork, laboratory analyses and verification of results through experiment.

The proposed methods of studying the potential pottery raw materials of Olbia make it possible to talk about the characteristic features of ancient pottery in the Lower Buh region. Field paleogeographic studies showed that this region is characterized by the occurrence of geological deposits of different ages, composition and properties. Some of them are (and were in ancient times) suitable for making pottery. Laboratory studies demonstrated that Neogene and Pleistocene sediments with a significant component of physical clay and a small amount of sand could be used for the production of pottery paste in ancient times. They are quite suitable due to their physical and chemical properties. At the same time, the study of the micromorphology of ceramic fragments and these potential pottery raw materials proved a certain similarity of the materials. In addition to the discovering of pottery kilns, the raw material base confirms the existence of local pottery production in Olbia.

On the one hand, the results of the research show that ancient ceramics and raw materials are generally similar. But on the other hand, the forms of carbonates and quartz that we find in ancient ceramics can also be traced in the sediments. Therefore, our study demonstrates the general composition of Olbian ceramics and raw materials, which should be taken into account in further researches.

The properties of the studied raw material showed that it is quite specific and difficult for use in pottery manufacture, at least in the combinations that we have been able to investigate. Therefore, it is possible that this clay mass was suitable for production of other ceramics such as roof tiles, water pipes, building materials. These are known from the excavations of Olbia in the Roman period (Vetshtein 1975, 173-180). The production of tableware also developed here, but it seems to have been mainly for domestic use. For example, the so-called greyware (Late Archaic – Early Classical periods) (Krapivina and Lejpunskaja 2009, 67, 68), as well as ceramics with green tint (Late Hellenistic and Early Roman period) are now considered to be of local production. But these groups of material have not yet been specifically studied in terms of the raw materials base required to make them. In this paper, we did not aim to investigate the entire raw material base of ancient Olbia pottery. First of all, we wanted to demonstrate the methodology of researching this issue and focus on an interdisciplinary approach, due to the fact that such studies have not been carried out for this *polis* before. We have shown that the proposed methodology may be useful in the future for the study of different types of ceramics.

In addition, the stratigraphic study of local deposits in the Olbia settlement and its surroundings gave an opportunity to talk about the use of the lower layers as a local building material. This concerns mainly the so-called Pontic limestone with remains of small molluscs. It is quite a durable material and its discovery is associated with a number of archaeological objects in Olbia and settlements of the *chora*.

In general, speaking about the methodology of studying ancient pottery, it can be stated that it is necessary to take into account all the elements of the source base for the objectivity of the results: natural deposits, ceramic products and the remains of workshops. The proposed stages and methods can be applied to the study of pottery of different regions and periods.

It is also worth noting that at this stage, we have only limited ourselves to general observations within the framework of our proposed methodology for studying the ancient pottery of Olbia. Our further research will be aimed at expanding the laboratory data and specifying the results for individual groups of ceramics.

Acknowledgements

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FIELD SURVEY AND MATERIALS

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EARLY HOLOCENE SETTLEMENT IN THE MIDDLE NOTEĆ VALLEY. NEW EVIDENCE FROM THE MESOLITHIC SITE IN UJŚCIE

ABSTRACT

Mugaj J. and Kabaciński J. 2024. Early Holocene settlement in the Middle Noteć Valley. New evidence from the Mesolithic site in Ujście. *Sprawozdania Archeologiczne* 76/1, 143-164.

The paper present the newly registered early Mesolithic Ujście Site 37 located on the edge of Toruń-Eberswalde ice-marginal valley. Inferring from techno-typological analysis of collected lithic materials, the site consists of two settlement horizons of Preboreal/Boreal chronology: the older related to the Duvensee/Komornica complex and the younger correlated with the Maglemosian complex. The chronological sequence is comparable with that known from the adjacent sites Krzyż Wielkopolski 7 and Żuławka 13. The paper presents the results of preliminary studies of Ujście Site 37 and its potential for future research on Mesolithic settlement in Central European Plain.

Keywords: Early Holocene, Mesolithic, ice-marginal valley, Duvensee/Komornica complex, Maglemose complex

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1. INTRODUCTION

Mesolithic research in Poland is characterised by two phenomena. On the one hand, the intensity of excavations results in an abundance of registered open-air sites on sandy terraces or dunes. On the other hand, the acidic environment of the sandy sediments where Mesolithic settlements are located causes almost complete decomposition of organic material – bone, antler, wood, *etc*. Therefore, Mesolithic sites in Poland, on which the narrative of the distant past is based, consist mainly of numerous flint specimens recorded in large scattered concentrations (Kobusiewicz 1999, 91; Domańska and Wąs 2007, 143). For this reason, the cognitive potential of such sites is significantly limited. The lack of organic material for precise dating of settlements determines a greater reliance on techno-typological methods (Sørensen 2006), often in the absence of a certain homogeneity of assemblages.

For many years, researchers have emphasised the key role of stratified sites located in such a sedimentary environment that would provide more non-lithic, organic sources, broader possibilities for palaeoenvironmental research and dating of settlement horizons, which could significantly increase the potential of Mesolithic research (Kobusiewicz 2000; Sørensen *et al*. 2018, 310; Kabaciński 2022).

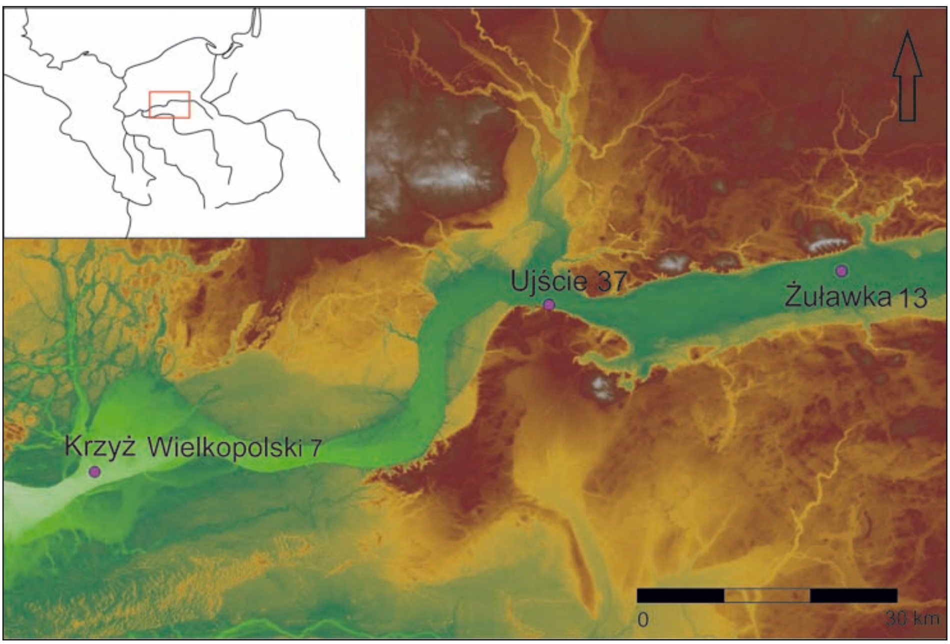

Fig. 1. Digital terrain model of the Middle Noteć Valley with Early Mesolithic sites mentioned in text marked

Fig. 2. Location of Ujście Site 37 plotted on the Prussian *mestischblatt* from the early 20th century. Note the passage for cows "*kuhbrücke*" where the antler adze was found

The presence of such sites is related to the occurrence of ice-marginal valleys – geological forms endemic to the areas of the Central European Plain, particularly Poland and Germany. A series of latitudinal proglacial valleys in central Poland undoubtedly provided an important corridor for human group movements and favourable conditions for settlement (Kozłowski 1989, 131; Kabaciński 2022, 104). Mesolithic sites in Poland, especially from the early Holocene, are often located on the edges of such ice-marginal valleys.

Special attention can be paid to the Toruń-Eberswalde ice-marginal valley (Fig. 1), where significant traces of Early Mesolithic settlement, in particular Site 7 at Krzyż Wielkopolski associated with the Late Preboreal and Boreal periods, have been recorded and studied in recent decades (Kabaciński *et al*. 2008; Kabaciński 2017). A very rich collection of wooden objects, bone and antler tools, fibre objects and faunal material was recovered from the Krzyż Wielkopolski Site 7, located at the northern edge of the Noteć valley, by an oxbow lake that was filled with peat deposits in the present day. Another site in the middle Noteć valley is Żuławka Site 13, where an Early Mesolithic settlement was recorded on the dune formed on the lower terrace of the river (Dmochowski 2005; Pyżewicz 2019).

In order to widen the scope of the observations, the authors, on behalf of the Institute of Archaeology and Ethnology PAS, have in recent years carried out intensive archival research, surveys and initial excavations along the terraces and in the middle Noteć valley in order to detect similar Mesolithic settlements. During the intensive melioration of the Noteć valley in the 19th and early 20th centuries, numerous individual finds of Mesolithic chronology were found in the peat bog. These finds were handed over by local people to various museums, including the Archaeological Museum in Poznań. Special attention was paid to the area around the towns of Ujście and Nowa Wieś Ujska in the northern part of the Wielkopolska Region along the middle Noteć Valley, near the mouth of the Gwda River into the Noteć River (Fig. 1). In the 19th and early 20th centuries, several tools made of deer antler were found there and transferred to the Poznań Archaeological Museum.

The exact location of finding of one of the artefacts is known from the letters of its discoverer and the notes of the local authorities – documents currently kept in the archives of the Poznań Archaeological Museum. The adze was found in 1899 during the construction of a small bridge that allowed cows to cross from the village of Nowa Wieś Ujska, located on the southern bank of the Noteć, to the pastures on the other (northern) side of the river. From the valley, together with Mesolithic tools, a medieval sword and an iron axe were found. When analysing an old map from a slightly later period, a “bridge for cows” can be seen, which is undoubtedly the one described in the archive notes (Fig. 2).

The above mentioned findings were the reason for initiating a new archaeological project connected with a wider recognition of the research potential of the site located at the former bridge in Ujście.

2. UJŚCIE SITE 37

2.1. Geomorphology

The site is located on a slight rise, right next to the steep edge of the valley (Fig. 3). In the context of the overall morphology of the Toruń-Eberswalde ice-marginal valley, the section near Ujście is characterised by a large narrowing bottleneck. At this point, the Noteć River flows along the southern bank of the ice-marginal valley. The site is therefore located between its present bed and the bank of the ice-marginal valley. The edge of the proglacial valley at this site is characterised by numerous water streams cutting its edge. The high energy discharge caused the formation of an alluvial cone at the mouth.

The elevation where the river crossing was built and where the Mesolithic settlement was located is on such an alluvial cone. As the results of the examination of borehole data from 2014 and 2017 the complicated dynamics within the proglacial valley was revealed and the presence of gyttja in the lowest part, overlain by fluvioglacial deposits on which archaeological material was present, then covered by peat layers from the younger phase of the Holocene accumulation (Fig. 4). Modern ploughing in the valley has exposed some of the material lying beneath the upper peat layer on the surface.

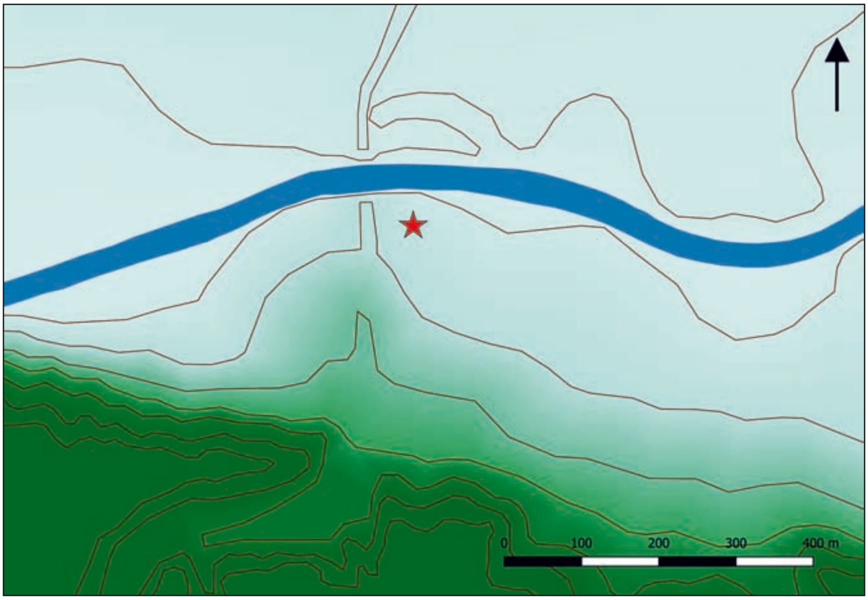

Fig. 3. Digital terrain model of Ujście site

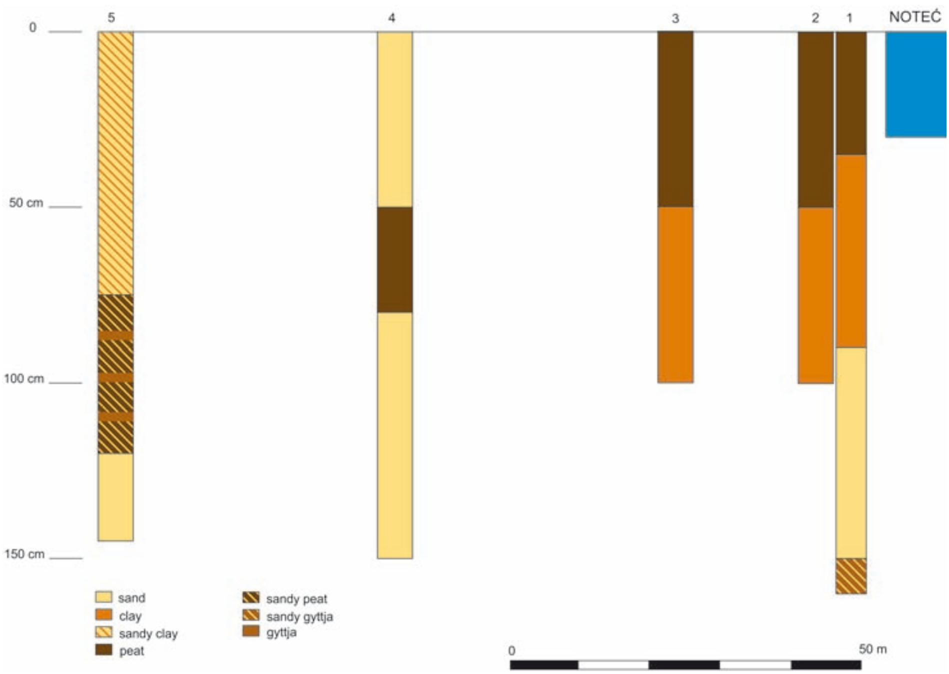

Fig. 4. Cross-section through Noteć valley at Ujście Site 37. Location of drillings marked on Fig. 8

2.2. Material in the Museum collection

A collection of five Mesolithic antler artefacts from Ujście is currently kept in the Archaeological Museum in Poznań. Four antler tools were found in the 1930s. The exact location of the findspots is unknown. Two of them are adzes made from the basal part of a shed deer antler (Fig. 5). The brow tine was cut close to the base. The working edge, which was placed on the beam, was prepared by grinding. The third tool is a mattock made from the middle part of a beam, the perforation is drilled perpendicularly through the beam (Fig. 6: A). The fourth artefact is a long object made of basal and beam parts. It has a perforation in the base and a shaped brow tine (Fig. 6: B). This type of object is often considered to be a non-utilitarian zoomorphic artefact, associated with symbolic and social significance (Kabaciński *et al.* 2011). The other tool was found at the end of the 19th century. It is an adze made from the basal part of a deer antler (Fig. 7). The tool is elongated, with the working edge formed on the beam perpendicular to the axis of the perforation. The morphology of the tools is diverse, but typical for early Mesolithic industries (Pratsch 2011); analogous types of antler tools are also known from Krzyż Wielkopolski Site 7 (Kabaciński 2009; Winiarska-Kabacińska and Kabaciński 2017).

2.3. Field Evaluation and Test Excavation

The area east and west of the former 'cow bridge' was initially surveyed in the spring of 2014 to locate the site. It appeared that there was a concentration of lithic material and individual animal bone fragments to the east of the bridge, suggesting good preservation of organic materials. Some initial surface geology and geomorphology drilling was also undertaken in that year. The archaeological investigation continued in 2017, when a two-stage survey was undertaken consisting of a further surface survey but also a trial excavation. Flint and animal bone fragments were recorded during this research. The surface survey identified the location of a relatively dense scatter of archaeological material and two trenches of limited size (Fig. 8) were dug. The detailed survey, from the river bank to the edge of the lower terrace of the two sides of the bridge scarp, covered an area of approximately 1000 m^2. On the surface, along with concentrations of flint artefacts, individual bone fragments were recorded. The area with the highest concentration of lithics was to the east of the remains of the bridge, close to the modern channel of the Noteć River. Two small trenches were set in this area. Trench 1/2017 (2 m × 2 m) was located 24 m south of the river bank, while trench 2/2017, 1 m × 3 m, was located 4 m further north. Sediments from the excavations were screened using water pumped from the river.

The profiles of both trenches showed a simple sequence of a main layer of black peat, well decomposed, with the humified peat soil on top and a layer of clay underneath (Fig. 9). The bottom of the peat layer was located between 40 cm (trench 1/2017) and 70 cm (trench 2/2017) below the surface. The archaeological material was recorded from the surface through the entire depth of the peat layer to the top of the clay.

Fig. 5. Antler adzes from the Ujście region discovered in the 1930s (Photo: J. Kabaciński; archive of Poznań Archaeological Museum)

Fig. 6. Antler tools from Ujście region discovered in 1930s.
(Photo: J. Kabaciński; archive of Poznań Archaeological Museum)

Fig. 7. Antler adze from the Ujście site discovered in 1899
(Photo: J. Kabaciński; archive of Poznań Archaeological Museum)

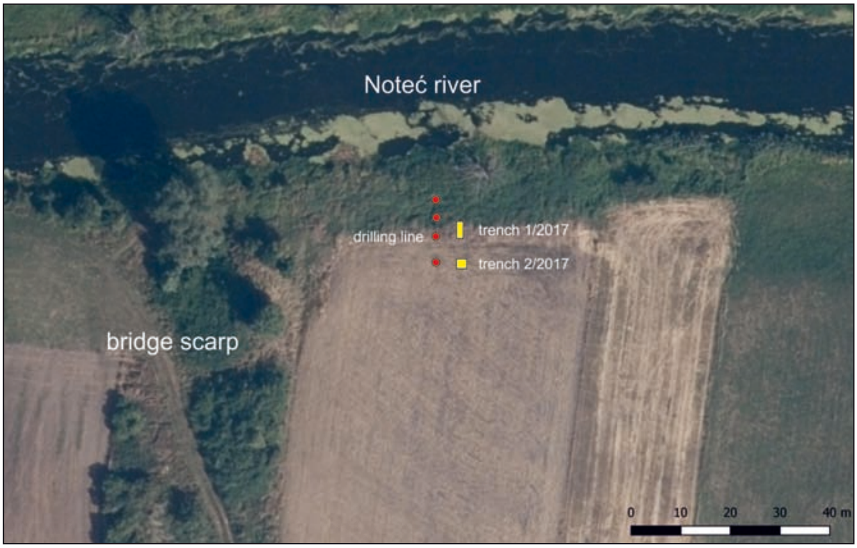

Fig. 8. Ujście Site 37. Location of Trenches and drillings

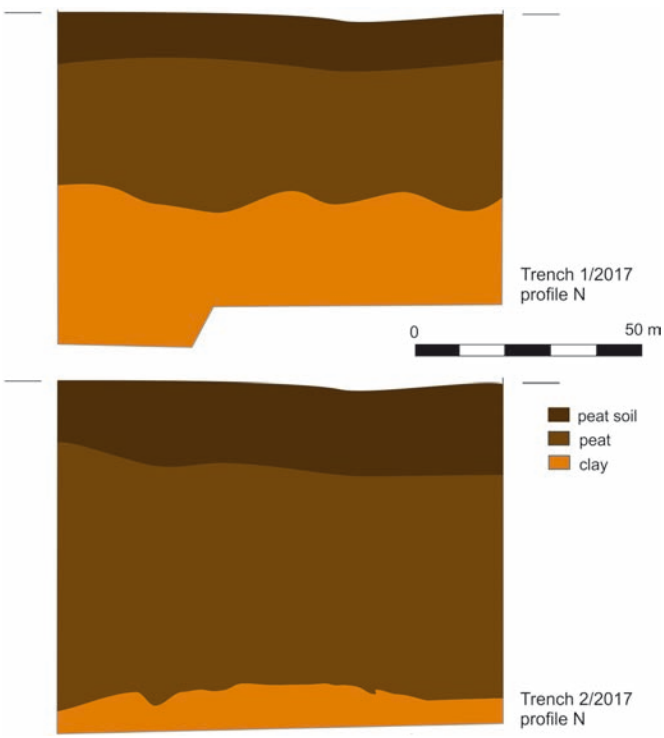

Fig. 9. Ujście Site 37. Profiles of Trenches 1/2017 and 2/2017

2.4. Material

The flint assemblage obtained from both investigations (the surface survey and the excavation) consists of 341 pieces (198 pieces from the excavation and 143 pieces from the surface survey). The assemblages were analysed using the dynamic technological classification method (Schild *et al.* 1975; Schild 1980). The summarised results of the analysis are presented in Tables 1 and 2.

Within the debitage group, the number of blade and flake samples is almost equal. Blades come exclusively from the processing of single platform cores, while flakes also come from opposed platform cores and cores with changed orientation. The group of technical forms is relatively common with dozens of crested blades, several core-trimming flakes and flakes from platform rejuvenation. The group of cores is dominated by single platform cores for blades. Out of a total of 32 cores, 10 are single platform cores for blades. Four of them were exploited using a pressure technique (Fig. 10: 1, 3, 4), the others a direct

Table 1. Ujście Site 37 – debitage classification with overall frequencies and main metrical data

		Excavation			Surface		
Group	Type	Amount	Largest (mm)	Smallest (mm)	Amount	Largest (mm)	Smallest (mm)
I	cortical flakes	9	50 × 50 × 27	19 × 24 × 6	12	42 × 36 × 19	14 × 16 × 4
	cortical blades	3			3	50 × 15 × 10	33 × 14 × 6
	initial core	1	54 × 36 × 38		2		
	crested blades	8	58 × 33 × 20	24 × 10 × 13	4	30 × 14 × 9	22 × 17 × 7
	core trimming flakes	1			3	41 × 40 × 19	22 × 17 × 7
II	Single platform \ cores for flakes				3	29 × 21 × 38	
						17 × 24 × 23	
						35 × 34 × 30	
	Flakes from single platform cores	13	44 × 43 × 20	18 × 13 × 3	13	32 × 23 × 9	20 × 16 × 3
	Opposed platform cores for flakes	2	22 × 20 × 11		2	31 × 31 × 28	
			29 × 21 × 16			33 × 21 × 14	
	Flakes from opposed platform cores	1			1		
	Cores for flakes with changed orientation	2	28 × 28 × 24		5	27 × 40 × 18	
			21 × 17 × 14			39 × 29 × 25	
						24 × 51 × 42	
						33 × 35 × 37	
						23 × 18 × 36	
	Flakes from cores with changed orientation	2	20 × 19 × 11		4	59 × 69 × 23	18 × 19 × 4

Table 1.

		Excavation			Surface		
Group	Type	Amount	Largest (mm)	Smallest (mm)	Amount	Largest (mm)	Smallest (mm)
III	Single platform cores for blades	5	40 × 24 × 6		5	56 × 41 × 36	
			28 × 19 × 18			46 × 17 × 31	
			27 × 20 × 15			29 × 16 × 13	
			38 × 24 × 10			37 × 25 × 13	
			21 × 20 × 18				
	Blades from single platform cores	17	29 × 12 × 4	23 × 6 × 3	13	43 × 14 × 5	29 × 14 × 4
	Opposed platform cores for blades				1	20 × 22 × 9	
IV	Scaled pieces	1	28 × 17 × 16				
V	Core tablet	1	24 × 22 × 23				
	Rejuvenation flakes	2	26 × 20 × 7				
VI	Core fragments	4			1		
	Non-identified flakes	14			12		
	chips	65			5		
	chunks	26			18		
	Total	176			107		

percussion technique (Fig. 10: 2, 5; Fig. 12: 2, 4, 7, 8). The cores are small – not exceeding 50 mm in length, usually with a plain platform and a prepared side or back of the core. Less frequent are cores for flakes with changed orientation (5 pieces – Fig. 10: 6, 7), opposed (4 pieces – Fig. 10: 8, 10; Fig. 12: 6) and single platform cores for flakes (3 pieces – Fig. 12: 1, 5). They also tend to have plain or cortical platforms and limited preparation. Three cores have a facetted platform. Only one example of opposed platforms core for blades was recorded (Fig. 12: 3). Relatively small nodules have plain platforms and lack any preparation. All core angles are acute within 75-90 degrees. Single scaled piece was registered in the inventory (Fig. 10: 9).

A total of 57 tools were recorded in both contexts – surface and Trench. Burins and flake axes were the two main tool types recorded in relatively large numbers. The group of burins is very diverse and includes dihedral burins (Fig. 11: 5; Fig. 13: 1), burins on the natural surface (Fig. 11: 6), on a truncation (Fig. 13: 2), multiple burin (Fig. 11: 4; Fig. 13: 3) and one tool made on an exhausted core (Fig. 13: 4). Flake axes (eight examples) are made on highly exploited cores (two specimens – Fig. 13: 11, 12), chunks (three specimens – Fig. 11: 12-13; Fig. 13: 15) or flakes (three tools – Fig. 11: 11; Fig. 13: 13, 14). End scrapers are less frequent (three specimens – Fig 11: 1-3). Other types such as side scraper (Fig. 13: 8), side-scraper with burin (Fig. 11: 9), perforator (Fig. 13: 6) and borer (Fig. 13: 5) are

Table 2. Ujście Site 37 – tool classification with overall frequencies and main metrical data

	Excavation			**Surface**		
Type	Amount	Largest (mm)	Smallest (mm)	Amount	Largest (mm)	Smallest (mm)
sidescraper	1	38 × 21 × 8				
endscrapers				3	43 × 21 × 10	10 × 30 × 11
dihedral burin	1	26 × 19 × 10		1	31 × 13 × 13	
burin on truncation	1	33 × 35 × 12		1	40 × 10 × 9	
burin on core	1	29 × 27 × 12				
burin on natural surface	1	22 × 25 × 12		3	44 × 36 × 20	29 × 25 × 12
burin spall				3		
axes	4	43 × 22 × 11	39 × 30 × 16	3	60 × 29 × 19	43 × 26 × 11
notches				1	37 × 20 × 3	
perforator	1	17 × 9 × 7				
borer	1	24 × 14 × 8				
shouldered point	1	21 × 16 × 2				
scalane triangle	1	25 × 6 × 4		1	17 × 5 × 1	
zonhoven point	1	20 × 10 × 4				
microlith non-identified	1					
combined tool (burin on truncation + endscraper)				1	36 × 22 × 14	
retouched flakes	2	47 × 29 × 13	13 × 17 × 2	7	33 × 22 × 8	21 × 13 × 4
retouched blades	2			4	54 × 14 × 11	25 × 9 × 4
retouched chip	1					
retouched chunk	1			5		
non-identified tool	1			3		
Total	22			36		

present as single specimens. The group of microliths includes two scalene triangles (Fig. 11: 10; Fig. 13: 9), a shouldered point (Fig. 13: 10) and a Zonhoven-type point (Fig. 13: 7). The remaining three categories of tools, the most numerous in total, are retouched non-distinctive debitage: retouched blades, flakes and chunks.

2.5. Faunal remains

During the survey, a total of 43 fragments of animal bones and antlers were recovered, generally small, about 10-20 mm in size. These included the remains of roe deer and large cervids (deer or elk). Although fragmented, the faunal material is well preserved. At this stage of the study, it is not possible to link the faunal assemblage to a specific phase of settlement.

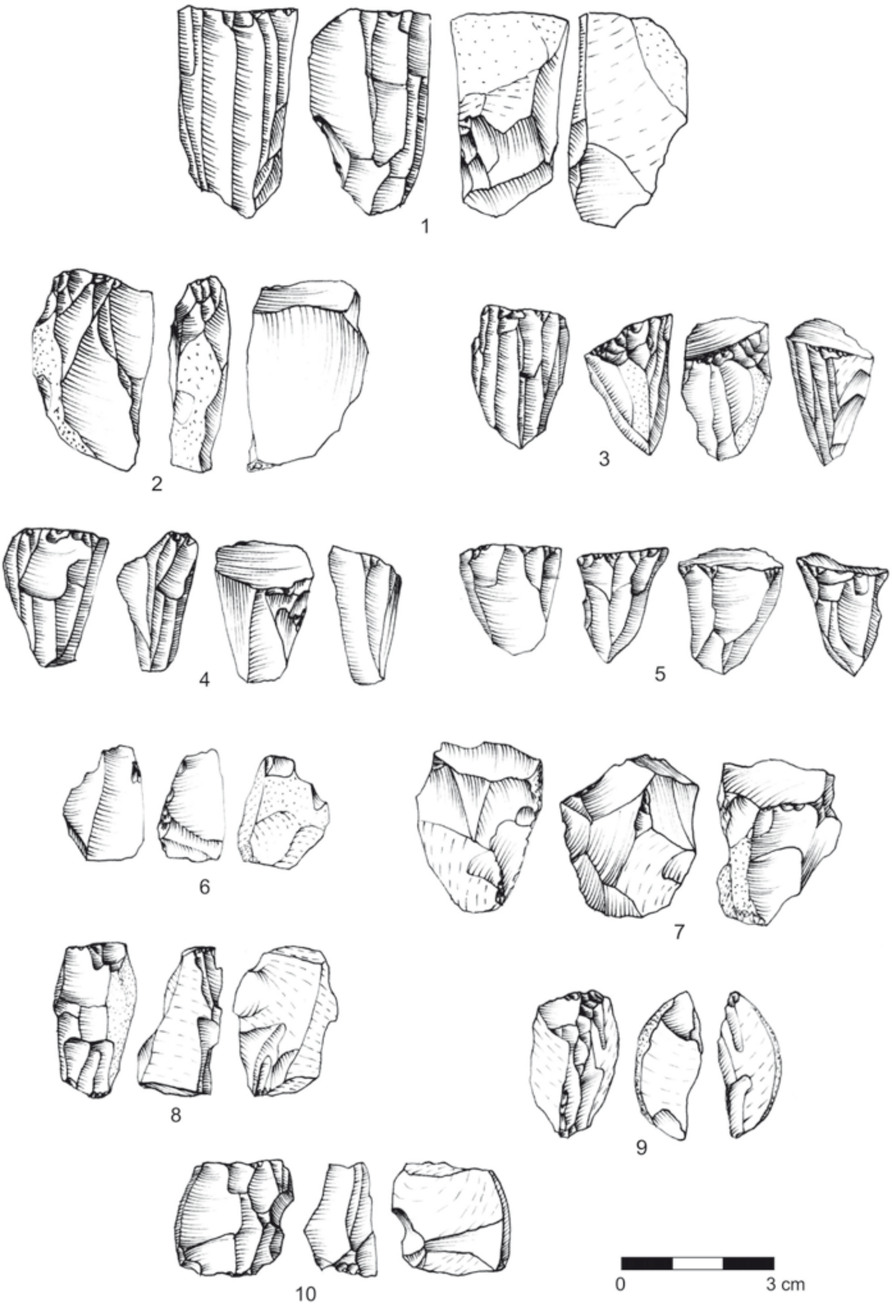

Fig. 10. Ujście Site 37 – cores and scaled pieces from excavations:
1-5 – single platform cores for blades; 6,7 – cores for flakes with changed orientation; 8, 10 – opposed platform cores for flakes, 9 – scaled piece

Fig. 11. Ujście Site 37 – tools from surface survey: 1-3 – endscrapers; 4 – combined tool; 5-6,8-9 – burins; 7 – notched tool; 10 – scalene triangle; 11-13 – axes

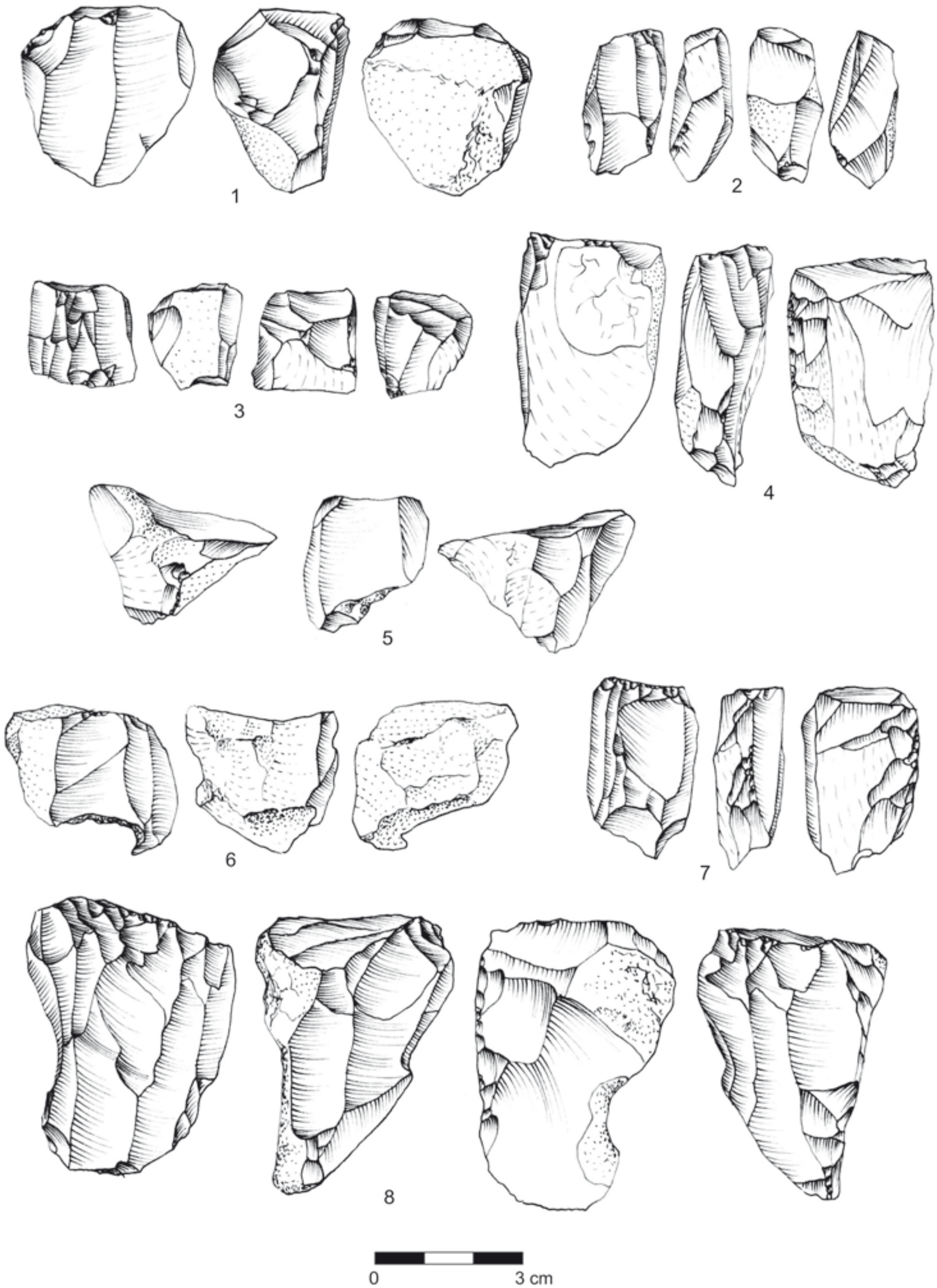

Fig. 12. Ujście Site 37 – cores from surface survey:
1, 5 – single platform cores for flakes; 6 – opposed platform core for flakes; 2, 4, 7-8 – single platform cores for blades; 3 – opposed platform cores for blades

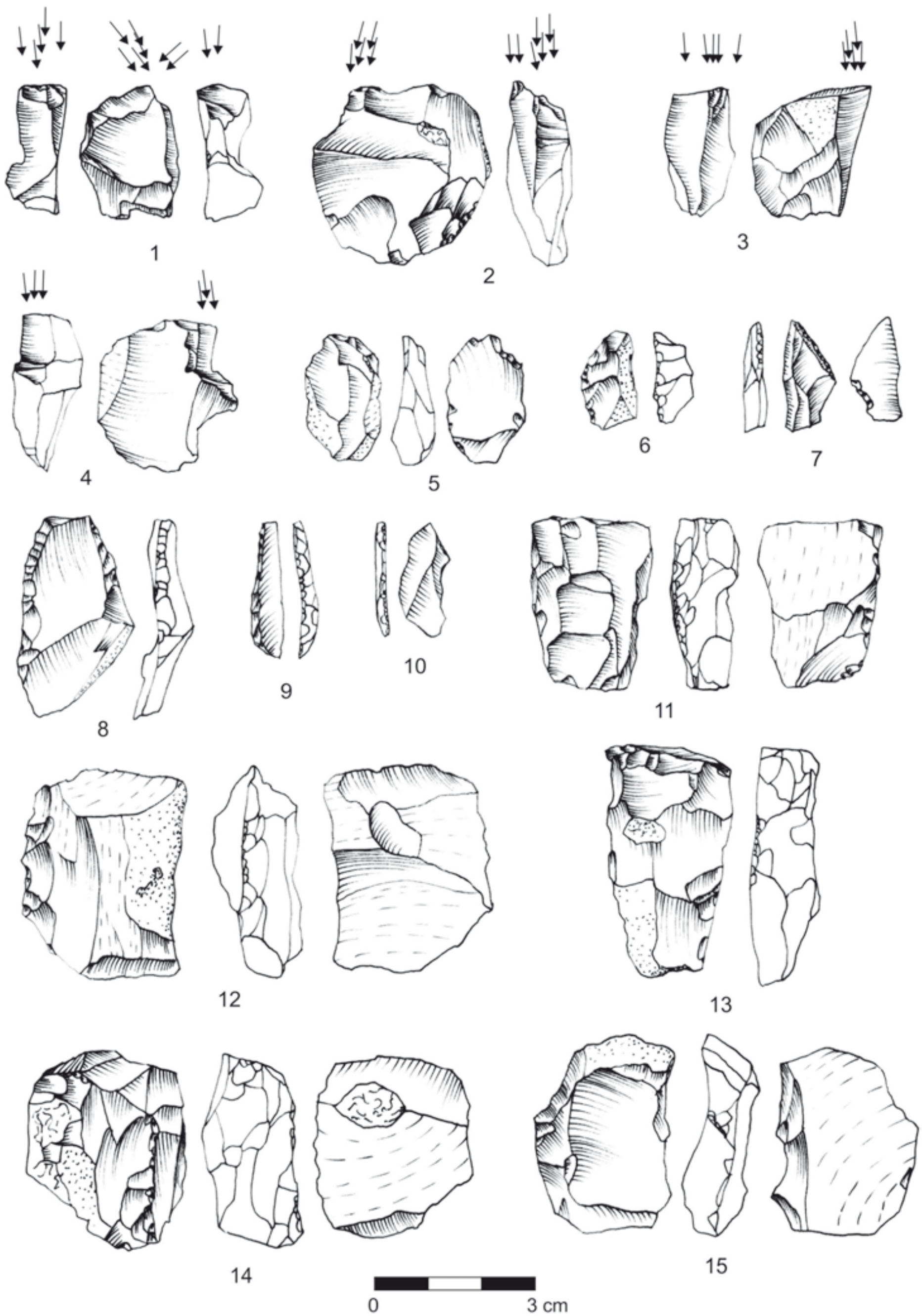

Fig. 13. Ujście Site 37 – tools from the excavations: 1-4 – burins; 5 – borer; 6 – perforator; 7 – Zonhoven type point; 8 – sidescraper; 9 – scalene triangle; 10 – shouldered point; 11-15 – axes

2.6. Chronology

An attempt was made to establish the absolute chronology of the Ujście settlement using ^{14}C dating. For this purpose, a fragment of deer antler and a fragment of long bone were sent for dating. Unfortunately, the antler could not be dated due to an insufficient amount of collagen, while the bone date was much too young for the lithic material (Fig. 14). Therefore, the only way to establish a more precise chronology for the site is through a techno-typological analysis of the lithic assemblage.

A preliminary techno-typological analysis of the archaeological material from the excavation and surface survey allows two main chronological horizons to be distinguished. The first is related to the occupation of hunter-gatherer groups of the Early Mesolithic, which can be typologically linked to the so-called Duvensee-Komornica complex, dated to the Preboreal and Early Boreal. This phase can be associated with unidirectional blade technology, which used the direct impact technique for the production of blanks. The tool inventory belonging to this older phase of occupation consists of numerous burins and flake axes made on flakes and chunks. A single specimen of a Zonhoven type point may also be associated with this Early Mesolithic phase.

However, the lithic assemblage also contains frequent elements that indicate the presence of a more recent settlement horizon. These elements are of both technological and

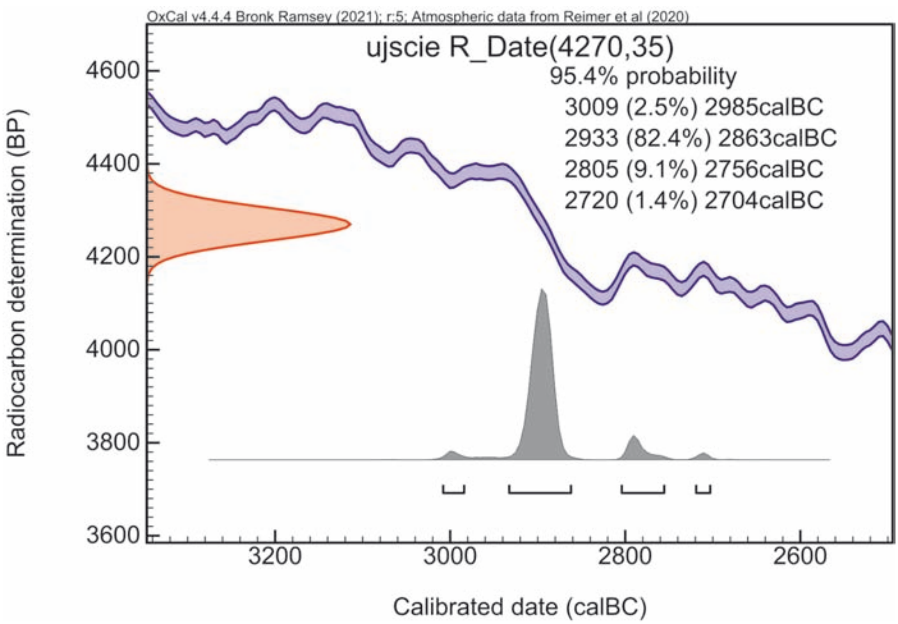

Fig. 14. Ujście Site 37 – radiocarbon date obtained from bone fragment. Calibrated using OxCal v4.4 (Bronk Ramsey 2021)

typological nature. The most significant feature is the evidence of a pressure technique used to obtain small, regular flakes. The presence of a scalene, an elongated triangle and a shouldered point can also be associated with a younger horizon. The later tool in particular can be associated with the northern cultural zone – the Maglemose complex.

3. DISCUSSION

A chronological sequence analogous to that of the site Ujście 37, consisting of an older – Duvensee – and a slightly younger – Maglemosian – phase, is observed at Krzyż Wielkopolski Site 7, located not far to the west. The settlement at Krzyż, located on a promontory between oxbow lakes in the central part of the Toruń-Eberswald proglacial valley, near the mouth of the Drawa River into the Noteć River, has provided a number of indications confirming and detailing such a chronology. The sequence of over 40 radiocarbon dates produced for the settlement at Krzyż indicates a long and relatively undisturbed continuous occupation, with no visible gaps in occupation. It falls into the early Holocene, from the second half of the Preboreal to the end of the Boreal. The analysis of the stratigraphy and the correlation of dates with the sequence of biogenic sediments of the oxbow lake suggest the existence of two settlement horizons: the first falls in the late Preboreal and the beginning of the Boreal (c. 8700-8100 cal BC), the second covers the middle and late Boreal (c. 8100-7300 cal BC) (Kabaciński 2016; 2017). This division is confirmed by the techno-typological analysis of the archaeological material.

In the flint inventory, the first settlement phase is associated with tool types characteristic of the Duvensee/Komornica tradition: Komornica type truncations, isosceles triangles and, above all, a large number of macrolithic tools: pikes and axes made of flakes and chunks. There are also numerous types of burins. In the younger phase, however, in addition to the earlier tool types, there is a much greater abundance of Stawinoga type backed blades; there are also lanceolate and Maglemosian-backed blades, as well as shouldered points. From a technological point of view, the presence of a group of cores and blades processed with the pressure technique is noteworthy.

A group of aurochs bone tools should be considered as a very important element associated with the younger Maglemosian horizon. The absence of aurochs remains indicates that these tools were not made locally but brought to the site from elsewhere. The radiocarbon date of the aurochs metapodial bone axe is 7600 cal BC, placing it in the middle of the younger occupation phase (Kabaciński 2016).

The phenomenon of this type of cultural sequence, clearly visible and described for Site 7 in Krzyż Wielkopolski, is also present at Ujście Site 37. Further down the proglacial valley, a similar cultural sequence can also be found at the Żuławka 13 site. Although the authors of the research suggest that the younger horizon is associated with post-Maglemosian communities and the Atlantic period (Pyżewicz 2019a), there is no clear evidence to exclude an earlier, Late Boreal chronology and a scenario analogous to that observed in sites Krzyż Wielkopolski 7 and Ujście 37.

In the light of the data presented, it can be hypothesised that traces of the developed Maglemose complex (characteristic of the third phase of the Maglemose technocomplex – Sørensen 2012) appear as early as the Boreal Period among the Duvensee/Komornica communities inhabiting the margins of the ice-marginal valleys of Central Europe. The nature of this phenomenon of "Maglemosation" (Galiński 2002, 176) is still unclear, and it is difficult to determine whether this phenomenon reflects the exchange of cultural information, or whether it is associated with at least a partial migration of Maglemosian communities from the north, reflecting a wider process of migration in northern Europe caused by the rise of the sea level and the flooding of the Dogger Bank (Terberger 2006; Coles 1998; Lampe 2002). The presence of aurochs bone tool imports at Krzyż Wielkopolski Site 7 may at least suggest a flow of cultural goods. Certainly, in the Late Boreal, the proglacial valley corridor became part of the wider Maglemosian exchange network. However, while the emergence of pressure technology and the direction of diffusion of this innovation is still debated (Derosiers 2012), the presence of pressure technology at the Polish sites before the onset of the Atlantic Period can strengthen the hypothesis of its transmission from the east (Kunda culture) to the west (Maglemose culture) (Sørensen 2012; Sørensen *et al.* 2013; Damlien *et al.* 2018).The proglacial valley of the Polish Plain would be a cultural crossroads of different social networks.

4. CONCLUSION

The archaeological research carried out in 2017, the first at the site, was of a preliminary nature. However, it confirmed the extraordinary research potential of Site 37 in Ujście. Its scientific value is mainly due to the presence of favourable biochemical conditions at the site, which preserve artefacts made of organic materials (bone, antler, wood). This is a unique situation, extremely rare in Mesolithic sites on the European Plain. The importance of the site is increased by the presence of two phases of Mesolithic settlement associated with the occupation of the first Mesolithic groups of the Duvensee/Komornica complex in the Polish Plain and the early presence of the Maglemose complex.

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THE "TALYSH" TYPE DAGGERS IN UKRAINE

ABSTRACT

Klochko D. 2024. The "Talysh" type daggers in Ukraine. *Sprawozadania Archeologiczne* 76/2, 165-173.

The article presents several daggers from Ukraine that have yet to be interpreted. The available data allows us to connect them to the bladed weapons of the Late Bronze Age Middle East. In addition, new, previously unpublished materials are introduced. The chronology of the spreading of so-called Talysh daggers as far as to the North Pontic Region for approximately half a millennia is reconstructed. Most of these items are unique in terms of geography and technology, so they are vital to studying the Talysh daggers of the Middle East.

Keywords: Talysh daggers, Bronze Age, Hakkari stelae, Middle East, North Pontic Region
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1. INTRODUCTION. PECULIAR FINDINGS FROM UKRAINE

Around 2014, the Museum of Local History in Romny (Sumy region, Ukraine) received a bronze dagger approximately 20 cm long (Fig. 1: 1). It has a mushroom-shaped pommel, simple vertical ornament on the handle, a semicircular guard with rounded edges and a wide blade with double rib. The closest Ukrainian analogy is the find from Stepantsi village

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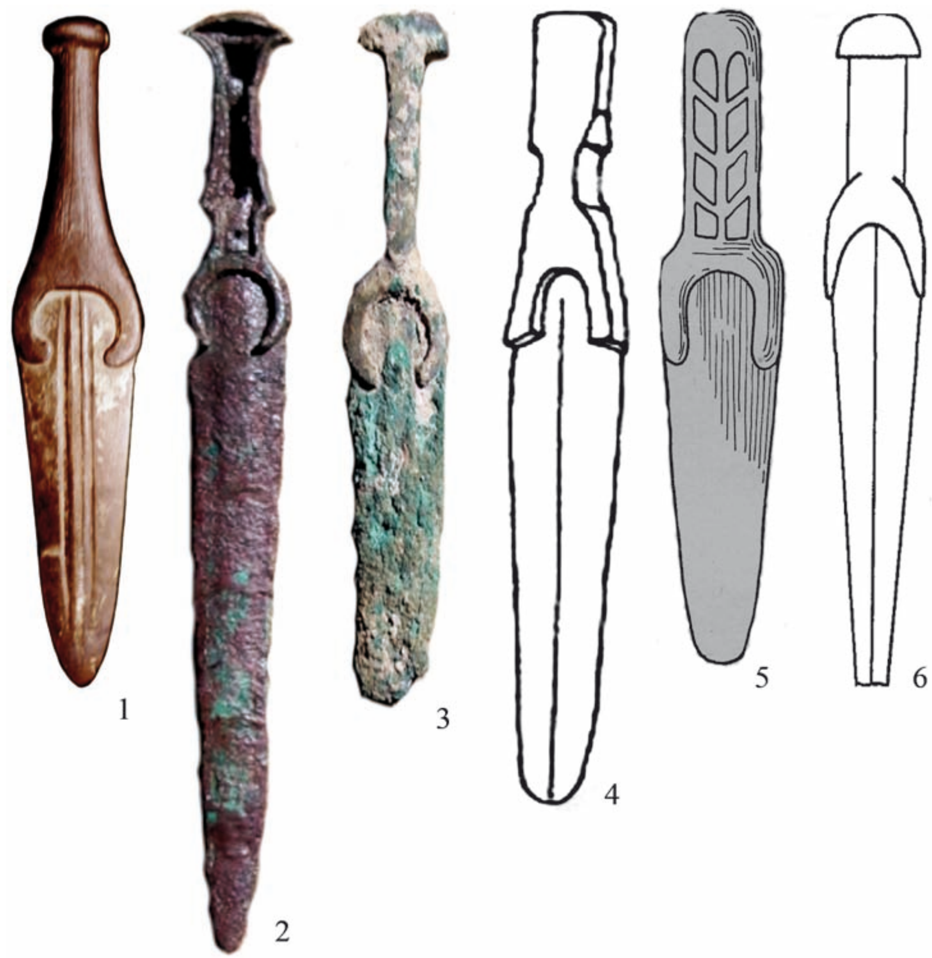

Fig. 1. Daggers with semicircular guard:
1 – Romny, Ukraine (from the collection of Romny museum of local history), 2, 3 – Haft Tappeh, Iran (from Rafiei-Alavi 2019, fig. 1), 4 – Beshtasheni burial ground, Georgia (from Shaeffer 1948, fig. 280), 5 – Stepantsi, Ukraine (from Terenozhkin 1961, fig. 90), 6 – Hasanlu-4, Iran (from Dyson 1964, fig. 2), 6 – iron, the remainder – bronze

in the Cherkasy region (Fig. 1: 5). It is 25 cm long; there is an ornament on the handle in the form of four rectangles, the guard also has the shape of a semicircle. According to O. I. Terenozhkin, such a guard imitates an organic one – made of bone or horn (Terenozhkin 1961, 135). The blade of the dagger is also wide but without a rib and with a rounded edge. Based on the geometrical ornament, O. I. Terenozhkin attributed this find to the Chornolissia culture (Terenozhkin 1961, 135).

Generally speaking the semicircular guard is common among the European types of Bronze Age bladed weapons (Klochko 2006, fig. 95: 1-5, 10, 11). Initially such technology would be represented by the organic materials (wood, bone *etc.*), which is indicated by the swords with tongue-shaped handles (Klochko 2006, fig. 95: 6-9): on them we see the holes for rivets used to connect the organic part of the handle. Rivets in identical places are seen on the items with semicircular guard. This was probably the reason for O. I. Terenozhkin’s assumption about the guard of the Stepantsi dagger imitating an organic one.

However, upon closer examination it becomes obvious that the resemblance of Stepantsi and Romny findings to the weapons of Urnenfeld cultures is merely general. Although their guards are different from one another, their form differs from the European items: they are thinner, more attenuated (in the case of the Stepantsi dagger) or rounded (in the case of the Romny dagger). The absence of rivets on both items indicate a different connection of the blade and handle.

2. “PROTO-” AND “POST-TALYSH” DAGGERS FROM THE CAUCASUS AND THE MIDDLE EAST

The closest geographical analogy comes from the Beshtasheni burial ground in Georgia (Fig. 1: 4). This one is also made of bronze, has a flat handle (although – non-ornamented) as well as wide blade with a rib and rounded edge. Generally speaking, the semicircular guard was common in the Caucasus region during the Bronze Age, however its form is different – shorter and wider.

Daggers similar to these three can be found in the archaeology of the Middle East. The earliest daggers of this type (nine known as of 2019) are dated back from the 15 to 13th centuries BC. They consist of separately cast blade and handle with the guard serving to join them (Rafiei-Alavi 2019, 315-317) (Fig. 1: 2, 3). The same would be fair for the later variant of these daggers, except those made of iron. One comes from Hasanlu-4, northern Iran (Fig. 1: 6). It is an iron dagger with mushroom-shaped pommel, lost edge and a semicircular guard resembling those seen on the finds from Ukraine. According to the British archaeologist R. Dyson, such a guard is the result of evolution of a semicircular piece on the base of the dagger that was initially purely decorative in function. The evolution gave it a practical function – making a connection between the blade and the handle. This and other similar items were attributed to the 9th century BC (Dyson 1964, 42). In 2019, there were thirteen iron daggers with semicircular guard known; all of them come from Western and South-Western Caspian regions and are dated within the range of 11-9th centuries BC (Rafiei-Alavi 2019, 318). There is quite a variation between them, however all possess the specific form of aguard.

3. THE HAKKARI STELAE

Such daggers are depicted on eleven of the thirteen stone stelae which had been found in the city of Hakkari (south-eastern Turkey) in 1998 (Figs 4 and 5). These stelae strongly resemble the sculptures of the Yamna and Catacomb cultures of the North Pontic Region. Their foreign origin was also obvious to the researchers, who noted that depicted motives are typical for the northern nomadic tribes rather than local peoples (Sevin 2005, 131). Based on the weapons depicted, the Hakkari stelae were attributed to the second millennia BC: the axes date to the first half of the 14th century BC (Sevin 2005, 130) which belongs to the chronological line of the initial daggers with semicircular guard. Therefore, if the Hakkari stelae were indeed created by the Indo-European nomads whose ancestors used to inhabit the North Pontic Region, it explains the appearance of the daggers with semicircular guards from the Middle East in Ukraine.

More recent study suggests that the Hakkari stelae had been crafted in the period of two and a half centuries (Cesaretti and Dan 2021, 141) and places them in the first millennium BC, based on the depicted daggers (Cesaretti and Dan 2021, 140). However, such dating ignores other possible chronological markers (axes and original daggers with semicircular guard) as well as the Indo-European context.

4. TALYSH DAGGERS

Around the 13th century BC, daggers with semicircular guard were transformed. The evolved items have several names in different sources. Their initial name – the Talysh type (Shaeffer 1948) comes after the region near the Caspian Sea where such daggers were first discovered. Later the name was downgraded to that of a 'variant' as more context and relation to other types of bladed weapons of the region became known. Currently the names 'the dagger with crescent-shaped guard' or '...with penannular guard' (Rafiei-Alavi 2019) can be found. The reason for such a change is most likely dictated by the larger context which will be shown further below. However, we will use the name 'Talysh' here because, as was shown in the introduction, the semicircular guard itself is not rare outside of the Middle East.

As was briefly mentioned before, the daggers which existed between bronze and iron items with functional semicircular guard, had a similar piece on the base of the blade, which, however, was purely decorative. It is important to note that this semicircle was not a separate detail, but a part of the blade, cast on and with it. The appearance of such piece is believed to be a byproduct of the evolution. Unlike its predecessors (which consisted of a separate blade and handle), the classic Talysh daggers were cast as a single piece and thus the necessity of a joining element vanished. Therefore, the presence of a semicircle on such items is considered purely symbolic – a tribute to the tradition (Rafiei-Alavi 2019,

Fig. 2. Talysh daggers: 1 – Klardasht, Iran (from Rafiei-Alavi 2019, fig. 7), 2 – Marlik, Iran (from Vahdati and Piller 2018, fig. 13), 3 – Zhovnino, Ukraine (from the personal archive of V. I. Klochko), 4 – Dnipro region, Ukraine. 1 – gold; 2, 3 – bronze; 4 – bronze and copper

Fig. 3. Semicircular detail on the daggers from Zhovnino (1) and Dnipro region (2)

Fig. 4. Stelae from Hakkari (A) and Ukraine (B) (from Klochko 2007, fig. 8)

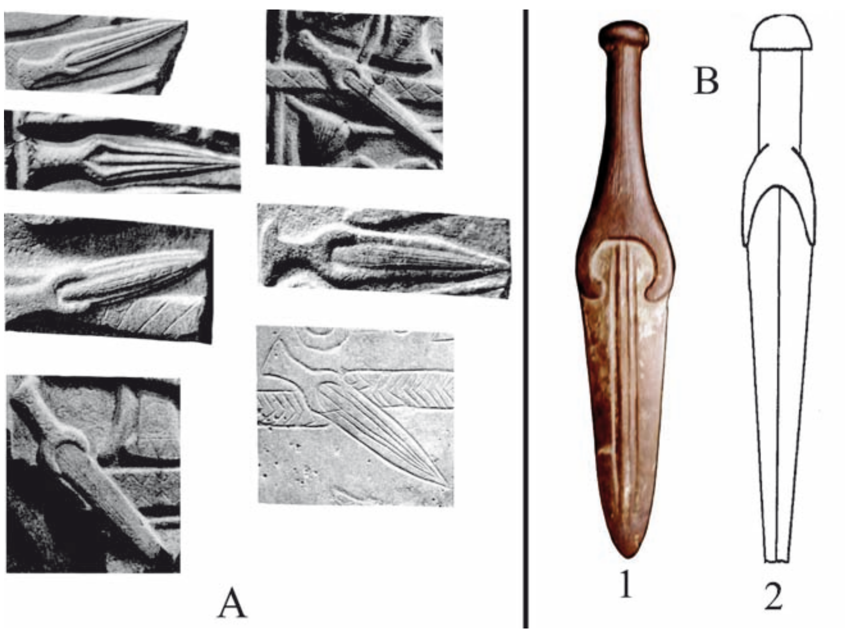

Fig. 5. Daggers on the Hakkari stelae (A) and their analogies (B). 1 – Romny, Ukraine, 2 – Hasanlu-4, Iran

327). Among other features of the Talysh daggers are the large size of some items (meaning they can be described rather as short swords), the flat handle (with relief decoration in some cases) and also the wide pommel. There are 44 finds of such items known in the Middle East as of 2019 (Rafiei-Alavi 2019, 318). Aside from the bronze ones, most likely used in combat (Fig. 2: 2) there is also the gold one (Fig. 2: 1) that was found near Klardasht village in morthern Iran (Rafiei-Alavi 2019, fig. 7). Also the Talysh type dagger is one of three depicted on the golden bowl from Hasanlu-4 (Winter 1989, fig. 14). Therefore, it is clear that in those times the such daggers were the main bladed weapon all over the Middle East.

In the 1970-s in Zhovnino village of the Cherkasy region, Ukraine a broad bronze blade (26-27 cm long) was discovered. The handle is absent, as it was probably made of organic materials. There is a separate semicircular detail on the blade, the cone-shaped part of which was used to connect the handle to the blade. Also it has a hole, presumably for some decoration (Fig. 2: 3). The find resembles classic Talysh daggers, however it also differs: firstly, due to the separate handle (which is absent); secondly due to the semicircular detail being a separate item rather than a part of the blade; moreover, the latter actually had a purpose beyond the symbolic on this dagger as it connected the handle and the blade (Fig. 3: 1).

Recently a similar item was found in the Dnipro region of Ukraine (Fig. 2: 4). It is 44 cm long, and has a stand-alone semicircle on the base of the blade, and it is notable because it is made not of bronze (as the rest of the dagger) but of copper (Fig. 3: 2). The bronze handle is wide, rod-shaped, ending with the bronze pin, which was probably used as an attachment for the absent pommel.

5. RECONSTRUCTION AND INTERPRETATION

In the first half of the 2nd millennia BC, the Indoeuropean tribes reached the Middle East and Asia Minor. Their ancestors inhabited the North Pontic Region as the peoples of Yamna and Catacomb cultures. Those nomads brought their own art to their new homeland while appropriating local weapons, including the bronze daggers with the semicircular guard (the 'proto-Talysh' type). This whole process is indicated by the stelae from Hakkari. Presumably the Indoeuropean migration could have influenced the spreading of proto-Talysh daggers to the north – first in the Caucasus region (as evident by the dagger from the Beshtasheni burial ground) and eventually to the North Pontic Region, which is indicated by the dagger from Romny.

Later (around the early 13th century BC), daggers with a semicircular guard evolve into the classic Talysh daggers, with the guard losing its original purpose. Such an evolution was known in the North Pontic Region, considering the findings from Zhovnino and the Dnipro region. There are two possible interpretations for the former item: it can be an

Fig. 6. Map of items presented in the article.
Red dots – daggers with semicircular guard. 1 – Romny, Ukraine; 2 – Stepantsi, Ukraine; 3 – Beshtasheni burial ground, Georgia; 4 – Haft Tappeh, Iran; 5 – Hasanlu-4, Iran. Blue dots – Talysh daggers. 6 – Zhovnino, Ukraine; 7 – Dnipro region, Ukraine; 8 – Marlik, Iran; 9 – Klardasht, Iran. Green star – Hakkari stelae

imitation of the Talysh daggers, made by someone not deeply familiar with their technology, or a transitional variant between the proto-Talysh type and its evolved form. Neither theory currently has any support, as the Zhovnino find is unique. However, it can be safely assumed that in both options this dagger is not native to Ukraine but an import. Regarding the find from the Dnipro region, it is most likely an imperfect imitation rather than early variant, as the semicircular detail on it possesses no obvious function, having only the symbolic meaning, while the handle resembles those of Talysh type only loosely. Also, we can assume that this item was an import, rather than a local production, as there are no classic Talysh daggers currently known in Eastern Europe.

Eventually (around 9th century BC), with the discovery of iron, the semicircular guard re-emerges. The post-Talysh daggers strongly resemble the proto-Talysh type, as evident by the example from Hasanlu-4, the main difference being the raw material – iron instead of bronze. In Ukraine, however, this tradition remains within the same metal as before, as evidenced by the dagger from Stepantsi. This one is most likely a local imitation rather than an import – firstly, it is made of bronze, not iron; secondly, the geometrical ornament on its handle was quite widespread in North Pontic Region during the finale of the Bronze Age.

6. CONCLUSION. ACHIEVEMENTS AND FURTHER POTENTIAL

Currently, the number of finds relative to the subject is small. However, even such a number clearly shows that the inhabitants of the North Pontic Region had been quite familiar with the bladed weapons of the Middle East for around half a millennia – from the 15th to the 9th centuries BC. This is indicated by the analogies of proto- and post-Talysh type daggers, as well as the imitation of a classic Talysh item and possibly its direct predecessor. These finds are essential to studying weaponry of such types as they extend the geography of their spread and also may show “blind spots” in the known typology during the transition from one stage of evolution to another.

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ARCHAEOLOGICAL MAPPING OF THE VERTEBA CAVE

ABSTRACT

Sokhatskyi M. 2024. Archaeological mapping of the Verteba cave. *Sprawozdania Archeologiczne* 76/2, 175-195.

Verteba Cave is an atypical archaeological site of the Cucuteni-Trypillia cultural complex. Based on years of research, a significant amount of information has been generated which has not yet been spatially represented. The main issue was the lack of a professional topographic map for the site. This article discusses the first attempt to create an archaeological map of the cave. It describes the methodological and practical process of mapping archaeological features both inside the cave and on the surface above the cave. A technological scheme for mapping using laser scanning of the cave's interior is presented. The results of this work have provided new insights into the chronological periods of the cave's occupation and its functional use.

Keywords: Verteba Cave, archaeological map, Cucuteni-Trypillia cultural complex, mapping, archaeological features

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INTRODUCTION

Ukraine has exceptionally rich cave resources – more than 1,500 explored natural caves, about 1,200 of which are in Crimea. One of the most important cave regions is the Podolian-Bukovinian karst area, where Verteba Cave is located (Klimchuk 2007, 8-10). Besides the recreational value of cave resources, in the last two decades there has been a sharp increase in awareness of the scientific importance of archaeological sites in natural caves in Ukraine.

Humans began inhabiting caves as early as the Lower Palaeolithic era. Archaeological research has shown that the earliest humans initially used caves as shelters from the weather, and later as homes and sanctuaries. Since then, interest in caves has accompanied the entire history of humanity (Sklenář 1984; Slimak 2022, 8). By the Neolithic and Eneolithic periods, this process largely concluded, with caves and grottoes rarely used as homes and burial sites.

Nowadays, about 6,000 sites of the Cucuteni-Trypillia cultural complex (c. 5000-3000/2950 BC) are known. However, across the vast area of its spread, there are no instances of active and long-term occupation of cave spaces by the populations of this cultural complex. In this context, Verteba Cave is a unique archaeological site. Here, the early agricultural population actively utilized the cave environment for a long period, totally

Fig. 1. Location of Verteba Cave

lasting almost 800 years. Stratigraphic methods in the cave have identified three Trypillia cultural horizons, corresponding to the chronological periods Trypillia CI and CII, which are related to the Shypyntsi, Koshylivtsi, and Kasperivtsi (Gordineşti) local groups (Sokhatskyi 2001, 39-66).

As a result of many years of cave research, a collection of artefacts has been gathered. Compared to the above-ground settlements, a significant percentage here belongs to carefully crafted and ornamented ceramic vessels, anthropomorphic and zoomorphic terracotta figurines, artistically processed bone artefacts, and copper items. All tools and items are in their finished form and appear to have been specially selected.

The site provides an unprecedented opportunity to study and understand the ritual traditions of the Eneolithic era people in Eastern Europe. Unlike most Cucuteni – Trypillia sites, the cave contains well-preserved human skeletal remains suitable for bioarchaeological and genetic studies. However, there is a problem with interpreting the functional use of the cave by ancient people. To make more objective interpretative conclusions, it is necessary to form a spatial representation of the distribution of archaeological features and artefacts across the cave's entire area and their distribution in various sections of the labyrinth.

Therefore, it became evident that a comprehensive archaeological map was needed, capable of providing a panoramic view of archaeological features both within the cave and on the surface, as well as tracing their connections. This map should be capable of being updated with new information and be accessible to researchers. The aim of the study is to create an archaeological map of Verteba Cave as a specialized collection of Trypillian features, expressed spatially by plotting them on a cartographic base. The map will allow for spatial analysis of all archaeological data from the cave, to better understand the motives and reasons that led to the active and long-term use of the cave by the first farmers.

MATERIALS AND METHODS

History of Archaeological Research and Mapping of the Cave

Verteba Cave is located 2 km northwest of the village of Bilche-Zolote in the Ternopil region (Ukraine). It is situated on a flat plateau on the left bank of the Seret River at an altitude of 274 metres above sea level (Fig. 1).

The entrance coordinates are 48°47′19″N 25°52′17″E. The cave entrance is easily accessible but well hidden in the lower part of a karst sinkhole, making it inconspicuous on the flat field surface (Fig. 2). The karst cavity formed in the middle part of a 10-metre thick layer of coarse-crystalline gypsum. Morphologically, it differs from other caves in Podolia. The gypsum layer is so karstified that the labyrinth forms a complex system of spacious passages and halls located on two hypsometric levels (Klimchuk 1996a, 263-278).

Fig. 2. View of the current entrance to the cave

The site was discovered in 1820 by J. Khmeletskyi (Zawadzki 1822, 160) and was excavated in 1876 by A. Kirkor (Kirkor 1879, 34-37). Between 1890 and 1892, G. Ossowski conducted further excavations in the cave (Ossowski 1891, 52-67). From 1898 to 1904, V. Demetrykiewicz continued the research (Demetrykiewicz 1900, 7, 8). In 1929, O. Kandyba conducted small exploratory excavations (Kandyba 1937, 1-12). From 1996 to 2023, an archaeological expedition led by M. Sokhatskyi has been studying the cave (Sokhatskyi 2017, 39-66).

The research revealed a significant Trypillia cultural layer, attributed to stages CI and CII. Preliminary C^{14} dating of Verteba Cave indicated that it was most intensively used during the late Eneolithic, around 3800/3750-3000 BC (Harper *et al.* 2021, 276-296; *cf.*, Kadrow *et al.* 2003, 53-144; 2010; Ledogar *et al.* 2018, 141-158).

In recent years, comprehensive studies of archaeological, bioarchaeological, paleogenetical, archaeozoological, and geoarchaeological data have been conducted here (Nikitin *et al.* 2010, 9-18; Karsten *et al.* 2015a, 562-579; Lilie *et al.* 2017, 306-324; Madden *et al.* 2018, 44-53; Potekhina 2018, 25-33; Ledogar *et al.* 2019; Sokhatskyi 2019, 31-36; Schmidt *et al.* 2020, 1-10; Bondar *et al.* 2021, 238-251). Materials from late 19th-century research are now stored in the Krakow Archaeological Museum (Kadrow 2013, 9-11), while materials and documentation from recent research are held in the Borshchiv Museum of Local Lore (Sokhatskyi 2001, 207-227).

The practical needs of archaeologists and speleologists that arose during their research, drove the development and improvement of the cartography of the Verteba Cave. The first description and mapping of the cave's near part were done by J. Khmeletskyi in 1820. The plan was based on a basic study of the cave, resulting in a low-accuracy sketch without any measurements (Fig. 3: A).

The first archaeological survey was conducted by A. Kirkor in 1876. He dug a 2.8-metre-deep shaft, described the right part of the cave, and sketched an estimated plan of his route through the labyrinth (Kirkor 1879, 34-37). This is the only plan from early archaeological research indicating the excavation site (Fig. 3: B).

G. Ossowski's three years of work resulted in a fairly accurate cave plan published in 1892 (Ossowski 1893). This was the first professional topographic map of the cave, made with the help of surveying instruments (Fig. 3: C). Some of Ossowski's symbolic systems for Verteba Cave are still relevant for modern speleological research. Unfortunately, the

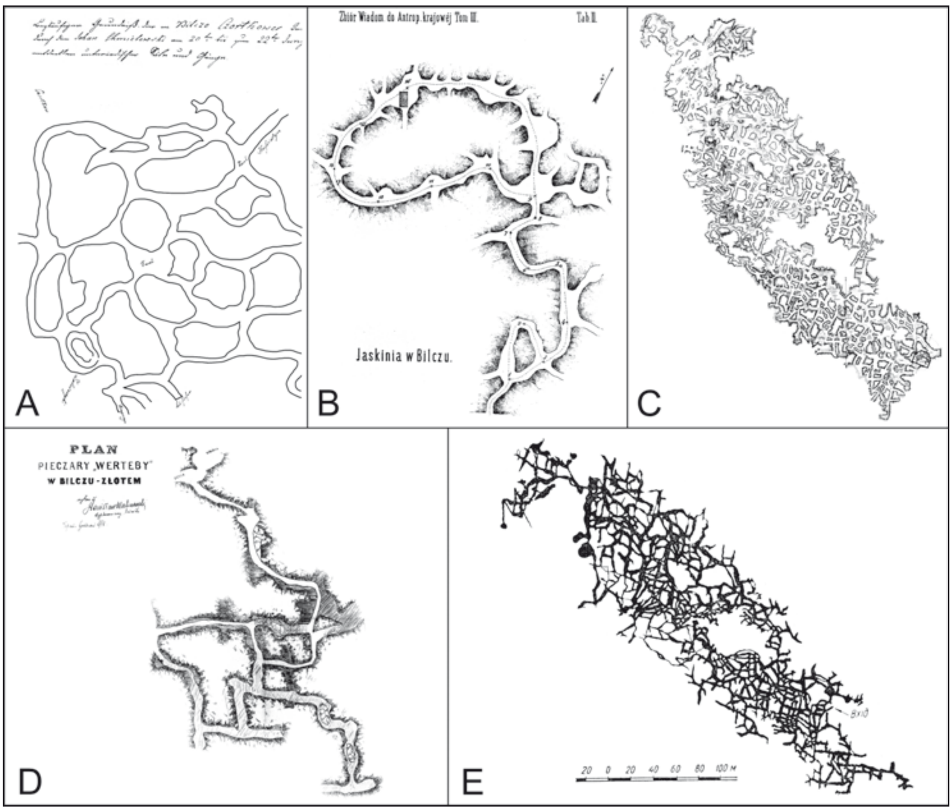

Fig. 3. Topographic plans and maps of Verteba Cave, created in previous years:
A – J. Khmeletsky, 1822; B – A. Kirkor, 1876; C – Ossowski G, 1893; D – Demetrykiewicz W, 1906;
E – B. Radzievsky, 1967

excavation results were not fully processed or published, as the scholar had to leave Galicia for Siberia (Talko-Hrunzewicz 1923, 186-189). Consequently, the map did not include archaeological features or excavation sites.

W. Demetrykiewicz managed to discover new passages and mapped the southern part of the labyrinth (Fig. 3: D). This plan was drawn in 1906 by the engineer K. Malinovsky, who worked on measuring forests and land plots, at Demetrykiewicz's request (Woźny 2018, 460).

In 1967, a group of speleologists led by V. Radzievskyi mapped almost the entire known area of the cave. The map graphically marked the main passages and galleries without detailing speleomorphic features. This map was used by speleologists to navigate the intricate cave labyrinth (Fig. 3: E).

Creation of Topographic Maps

An essential part of archaeological excavations in caves involves creating topographic maps and studying the internal structure of caves. Mapping is conducted under challenging conditions, as most of the cave is dark, damp, and cold, often with a complex labyrinth of passages (Doggouris *et al.* 1986, 188-221). The most traditional method used in practice involved measuring cave corridors with a compass and tape measure (Corvi 2018, 49-56). Currently, the creation of topographic maps often employs modern technical tools and paperless mapping methods (Trimmis 2018, 399-407). This approach provides precise measurements and eliminates errors caused by human factors (Stratford 2011, 11-116).

The primary stage of documenting archaeological features in the cave was the creation of topographic maps. Mapping was divided into two main categories: 1) mapping the above-ground territory; and 2) topographic surveying of the underground labyrinth.

Our research team conducted a topographic survey of the surface area above the cave in 2023. The topographic plan detailed the features of the relief, including buried karst sinkholes and deep depressions. Before starting the geodetic work, we surveyed the area and identified the territory to be mapped. We established a survey network, which included a system of benchmarks and datum points. Considering the geodetic support of the area, we chose the YNSS observation method in the RTK network mode from the ZAKPOS/YNSS network. Observations were performed using the SOUTH 660p receiver. Field materials were processed using licensed software Digitals/Delta XE @ for Windows 5.0 professional.

A permanent stationary reference point was established on the gypsum rock near the cave entrance. Topographic reference for archaeological features was conducted from this general benchmark. It also served as a reference point for both surface and underground topographic work, as well as for projecting the cave plan onto the surface relief.

Additionally, an important point for verifying the accuracy of the cave plan projection onto the surface was an open ventilation channel. This channel was cleared of its soil plug during an archaeological excavation (Fig. 4).

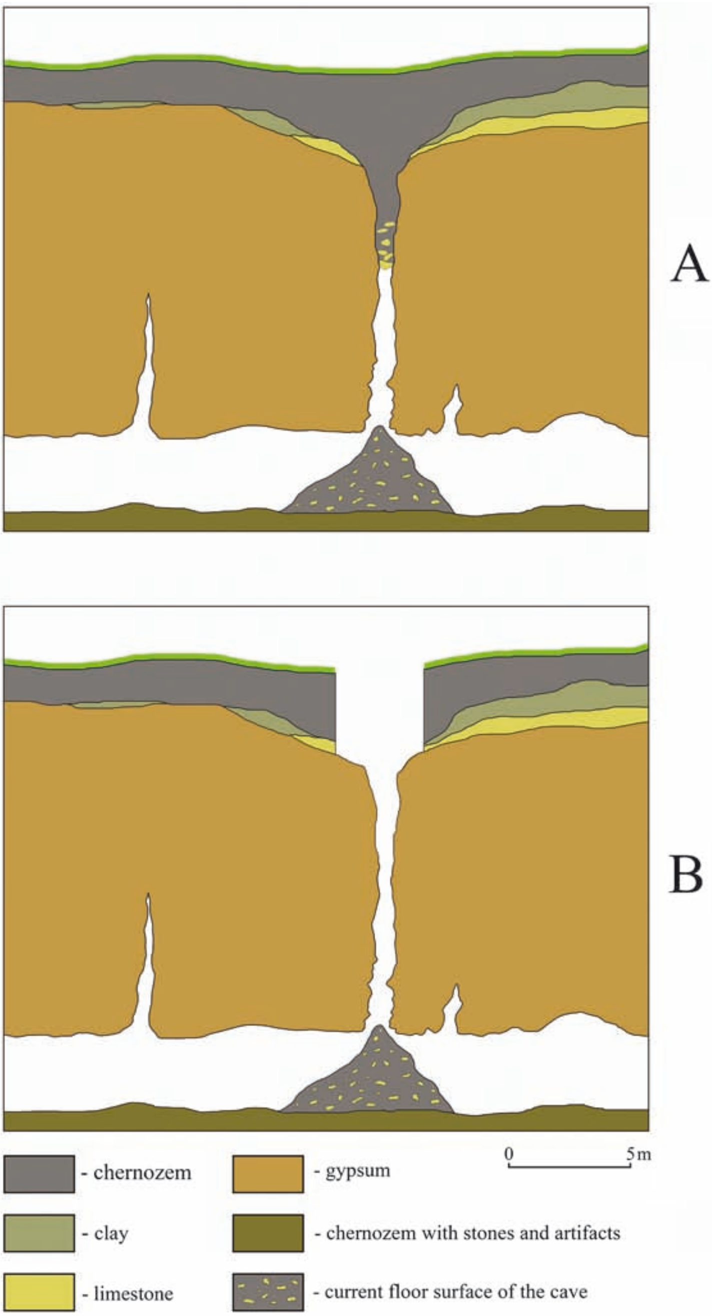

Fig. 4. Schematic profile of a vertical smoke channel:
A – before cleaning; B – after cleaning

Fig. 5. The process of creating the topographic map of the cave: A – preliminary measurements in the cave; B – results produced by the laser distance meter; C – cartographic design of the cave area

The next stage was the topographic surveying of the cave labyrinth, with detailed mapping of the morphological elements of halls and galleries. Mapping was performed using a semi-instrumental topographic survey method at a scale of 1:500. Surveying work of the fourth class of cave topographic accuracy was conducted in Verteba Cave (Klimchuk 1996b, 22).

Topographic work was carried out using a modern high-precision laser distance meter, the LEICA Disto X310, with a built-in three-axis electronic compass and clinometer, combined with non-magnetic batteries and tripods. Our custom tripod design resolved the problem of the reference point, as it allowed the LEICA Disto X310 to perform measurements from the centre of the tripod, no matter how it was positioned. It also allowed convenient use of the timer, eliminated instrument vibrations, and helped achieve high measurement accuracy. The LEICA Disto X310 device was connected via Bluetooth to a Pocket PC (using PocketTopo software).

A survey network with long-term fixed points (numbered datum points) was created. The survey grid was constructed in a rectangular coordinate system. Mapping was carried out using mass fan measurements of orientations and lengths of "rays" from primary and auxiliary points (Fig. 5). The cave wall contours were drawn by frequent radial measurements of morphological features. The rays were displayed on the Pocket PC screen, and the end points of these rays were connected into a curve using a stylus. For accuracy, direct and reverse measurements of distances and azimuths were conducted.

The main data for constructing the map included the details of the traverse line, the relief of vaults and passages, the length, height, and width of cavities, as well as details that could potentially complicate navigation in the cave labyrinth.

Identification and Mapping of Archaeological Features in the Cave

The first step was to collect and systematize all available data on archaeological research in the cave and analyze it. The obtained information was divided into two groups: 1) information from archaeological research reports of the late 19th century; 2) information from our own research conducted from 1996 to 2023.

This is the initial stage of creating a comprehensive multi-layered archaeological map of the cave. Only archaeological features were marked on the topographic base. These include structures artificially created during human activity in the underground environment. They include remnants of hearths, vertical channels for smoke ventilation to the surface, ritual and refuse pits, clay sleeping platforms, human burials, and other entrances to the cave that functioned in the Trypillia time. We also marked the locations of our archaeological excavations on the map (Figs 6 and 7: F).

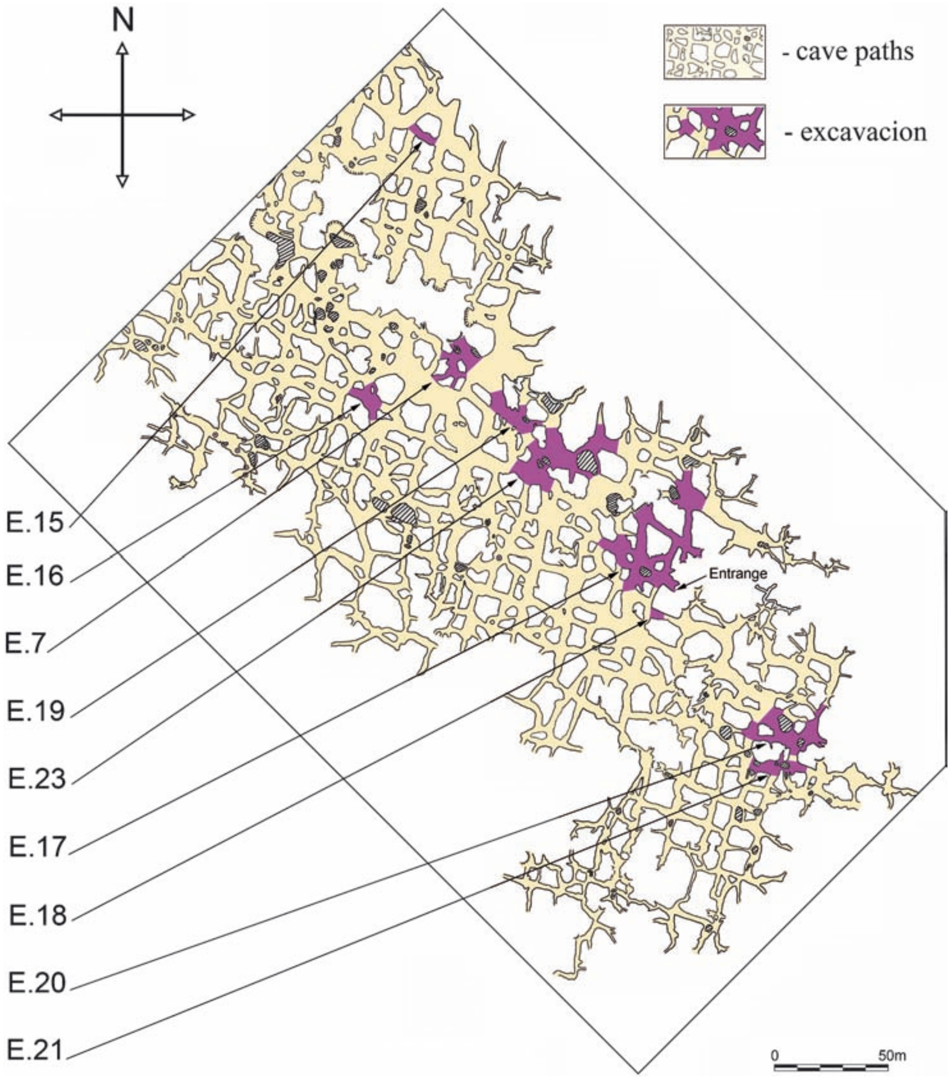

Fig. 6. Map of archaeological excavations in the cave

A brief description of the archaeological features in the cave is provided below.

Traces of open hearths are localized throughout the cave areas used by the Trypillian populations. Clear white spots are preserved on the gypsum walls where the hearths were, resulting from the fire's effects. Due to the high temperature, the surface of the gypsum wall was fired. Overfired fragments of gypsum would crumble and fall to the floor. The modern appearance of the hearths remains consists of ash accumulations, overfired gypsum pieces, charcoal, and a dense layer of burnt clay with a smooth surface (Fig. 7: A).

To facilitate movement and orientation in the dark and confusing labyrinth, people used both portable and stationary lamps. At intersections of passages and on natural protrusions of gypsum walls, ceramic bowls filled with animal fat with a wick inside were placed. In various places in the cave, at a height of 0.7 metres from the floor, accumulations of overfired gypsum were recorded, indicating the locations of open flame lamps.

Ventilation shafts are natural vertical channels formed by pressurized water during cave formation. In the Trypillia time, some were connected to the surface. They are now

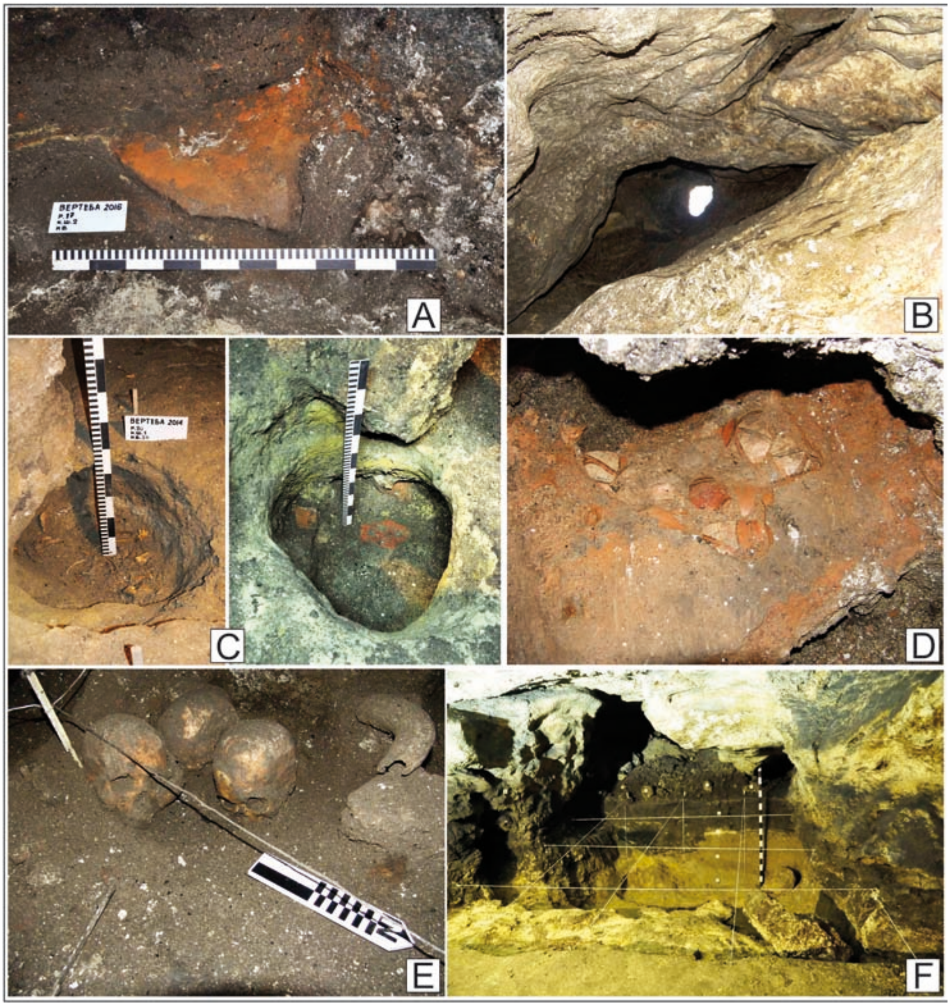

Fig. 7. Archaeological features in Verteba Cave:
A – remains of a hearth; B – ventilation shaft; C – pits; D – clay platform; E – skulls; F – archaeological excavation

sealed with soil and stones. The walls of the channels are heavily fired at the bottom by flames (Fig. 7: B).

Utility, ritual, and refuse pits were recorded during excavations. Pits, 80-120 cm deep, were dug into the sterile light clay layer of the cave floor. The pit infill consists of a conglomerate of dark-grey loam, ash, charcoal, animal bones, pottery fragments, terracotta figurines, bone, and flint artefacts (Fig. 7: C).

Clay sleeping platforms are rectangular elevations made of homogeneous clay and well-fired. The bottom part of the structure consists of a dense layer of ceramic vessel fragments. On top lies a layer of clay coating. The surface of the platform is smooth, with remnants of an open hearth (charcoal, ash). The structure likely served as a heat accumulator (Fig. 7: D).

Human skeletal remains were found in various sections of the cave. Due to the constant temperature and humidity, as well as the favourable preservative properties of the soil, they are well-preserved and suitable for bioarchaeological and genetic research. All human skeletal remains were observed to be secondary burials as indicated by their disarticulated state (Karsten *et al.* 2015b, 121-144). Skulls were found in various parts of the cave, both singly and in groups, carefully placed in side niches of the walls and small grottoes (Fig. 7: E).

During the Trypillia times, the surface relief above the cave had a different appearance. In many places, the gypsum massif's rocks were exposed and not covered by turf. In some areas, through cracks and karst sinkholes, there were passages to the underground labyrinth. Thus, the cave could have had several entrances used by ancient people. Other probable entrances to the cave are round holes in the stone ceiling completely filled with soil. Below them, on the cave floor, there are significant cone-shaped soil heaps with mixed cultural layer.

To identify the location of archaeological features in the cave, we first worked through reports, cartographic materials, and publications from the late 19th century. Textual information proved insufficient for marking ancient excavation sites on the modern map, so we based our work on the results of contemporary research.

Moreover, specialized search operations were conducted in the cave according to a pre-developed plan. The first stage of these operations involved dividing the cave's topographic map into six separate traverses. For convenient visual fixation of archaeological features, the topographic base of these traverses was printed in an enlarged scale. The next stage was detailed surveys of the entire area of the cave passages and halls. These were conducted sequentially in each traverse. Through detailed visual inspections of the cave floor, walls, and ceiling, we identified the locations of archaeological features, rock-falls, and water infiltration sources. We then used topographic methods to anchor and record these on the digital map. Pre-established datum points were used for accurate measurements.

The main factors for determining the boundaries of inhabited areas and the locations of permanent settlements of the Trypillian populations in the cave labyrinth were archaeological features, remains of cultural layers, and artefacts.

To achieve better search results, we also used data from comprehensive geophysical methods, including magnetometry, electrical resistivity tomography (ERT), and ground-penetrating radar (GPR). Measurements in the cave were conducted to assess the thickness of the cultural layer, identify new archaeological features, and determine potential directions for extending the cave labyrinth (Bondar *et al.* 2021, 238-251).

RESULTS

During the fieldwork, a topographic survey of the area above the Verteba Cave was conducted, covering a total area of 8 hectares. A map was created at a scale of 1:500 using the Baltic height system, with a relief contour interval of 0.5 metres. During the surface mapping, 22 karst sinkholes and depressions were identified.

Our previous research had revealed a Trypillian cultural layer on the surface of the arable field, near the entrance to the cave. To refine the stratigraphy and localization of the settlement, reconnaissance trenches and excavations were conducted. As a result, the boundaries and area of the Trypillia settlement above the cave were determined (Fig. 8). It became evident that the settlement was linked to the entrances of the cave labyrinth, and the archaeological materials from the surface were similar to those found inside the cave.

During survey of the territory, the locations of archaeological features were established. They were marked on the topographic map using conventional symbols. The projection of the cave labyrinth map onto the surface relief was then performed. As a result, the area occupied by the cave was delineated. It forms a narrow strip extending northwest for 510 metres, with the cave labyrinth's width being 120 metres.

In various parts of the cave labyrinth, traces of probable entrances to the cave, which functioned during the Trypillia time, were discovered. The precise coordinates of these features were fixed on the topographic map of the cave. Through the projection of the cave plan, points on the surface were determined (Fig. 8). These points correlate well with the forms of the surface relief (depressions, sinkholes), thus confirming previous hypotheses.

The projection of the cave map onto the surface also confirmed the correspondence of the locations of vertical natural channels in the cave ceiling with the geomorphology of the surface relief. This helped establish the points of smoke ventilation exits, which were marked on the map.

Topographic work covered the entire known territory of the underground labyrinth. New, previously unknown sections of the cave with remnants of the Eneolithic cultural layer were discovered. Topographic surveys were conducted on the newly discovered sections, and the results were reflected on the map (Fig. 8). Thus, the total length of the cave passages amounted to 9250 metres.

Based on the obtained data, three separate maps of the cave labyrinth were created, indicating the territories occupied in different Trypillia chronological stages. The topo-

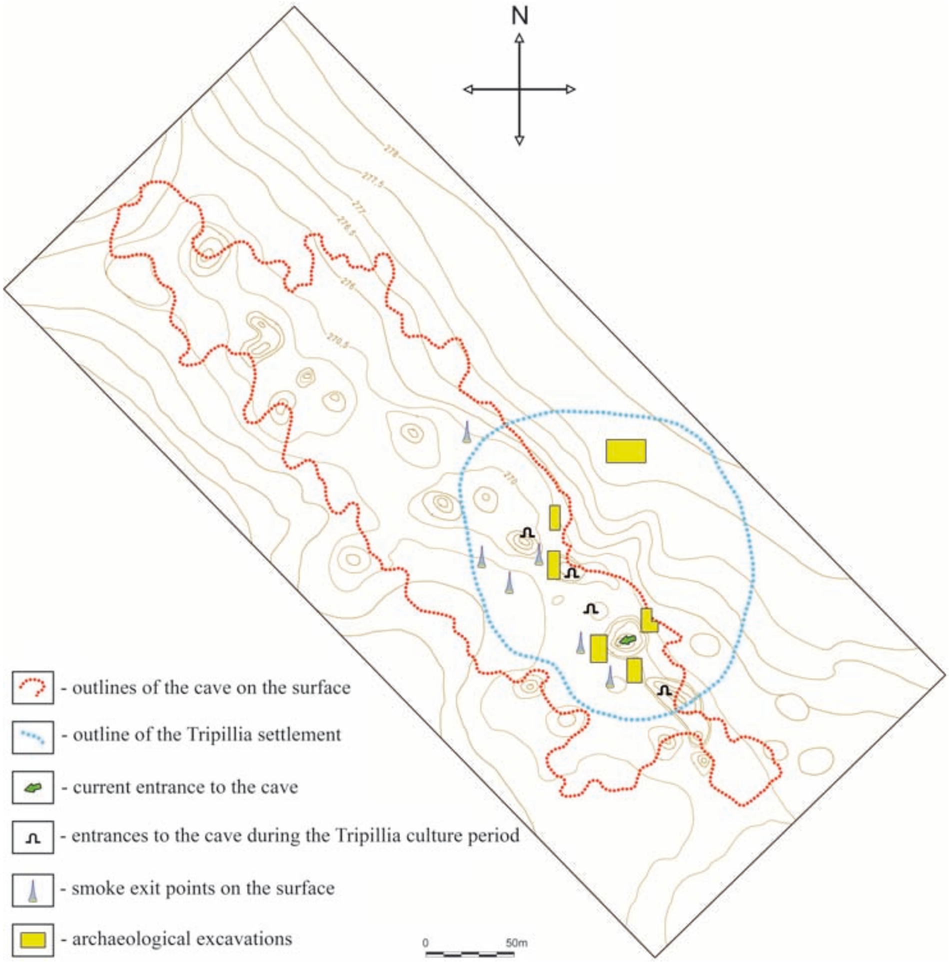

Fig. 8. Map of archaeological features above the cave

graphic results showed that over 30 percent of the total area of the cave was actively inhabited by the Trypillian populations. The areas indicated on the map suggest that ancient settlers chose the most spacious and voluminous passages, halls, and galleries for their underground habitation. The areas they inhabited correlate well with the nearby entrances that were in use at that time.

As a result of the work performed, two thematic maps (surface and cave) containing 162 points of archaeological interest were produced. The surface map marked four probable entrances to the cave from the Trypillian time, five points of smoke ventilation exits, and six areas of archaeological excavations. The cave map marked 147 points of archaeological interest, including 105 fireplace remains, ten pits (domestic and ritual), 14 skull burials, four clay sleeping platforms, five vertical smoke channels, and six areas of archaeological excavations.

DISCUSSION

The complexity of this research stemmed from the need to produce two topographic plans: one for the surface relief above Verteba Cave and another for the cave labyrinth itself. This represented a large-scale and prolonged process.

Additionally, the task was hindered by the limited information regarding the early archaeological research on the cave, and the lack of topographic maps and plans related to that work. For instance, cave researcher Włodzimierz Demetrykiewicz never published plans of archaeological excavations or maps showing the locations of artefacts or features (Woźny 2018, 461). Large-scale archaeological excavations were conducted in the cave at the end of the 19th century, covering the entire near part of the cave. These efforts focused mainly on finding artefacts, with the textual reports also mentioning discovery of hearths and skull burials. However, it is currently impossible to pinpoint the exact locations of these finds within the cave.

The archaeological map marks the features reflected in our topographic plans, scientific reports, and publications. On one hand, we had positive results, such as a series of radiocarbon dates, a collection of stratified artefacts and bone remains, as well as data on geology, bioarchaeology, paleogenetics, and archaeozoology (Ledogar *et al.* 2018). On the other hand, complex processes of accumulation and destruction of cave deposits introduced negative factors into the obtained data.

It is noteworthy that the ancient population began to use the underground spaces of the cave during the late Trypillian stage. They inherited traditions from their ancestors in various aspects of life (beliefs, house-building, crafts, agriculture, animal husbandry, hunting, *etc.*). However, the previously acquired experience was not entirely applicable to the new and unusual natural conditions of the cave environment. For the local Trypillian populations, the process of mastering the underground environment was complex and lengthy.

We were able to document the temporal settlement of the cave. Stratigraphic observations of the cultural layer in different parts of the cave and artefact analysis played a crucial role in this process.

Topographic analysis of the distribution of the cultural layers shows that not all inhabited areas of the cave were settled evenly and proportionally. There is a noticeable pattern in this localization. For instance, the cultural layer is thicker closer to the entrance and thinner in more remote parts of the cave, and it is absent in places where water drips periodically.

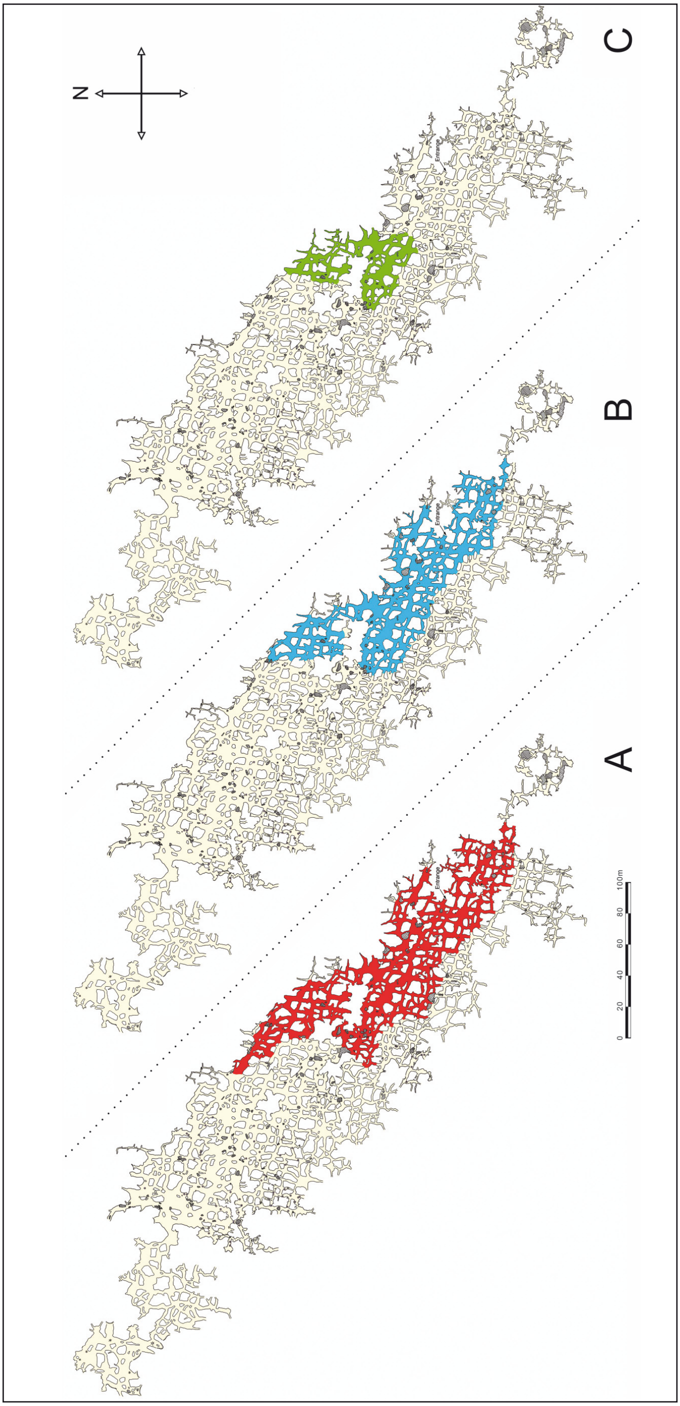

Fig. 9. Maps of the cave with areas inhabited by different Trypillia groups:
A – Shypyntsi local group; B – Koshylivtsi local group; C – Kasperivtsi local group

The most abundant materials belong to the Shypyntsi local group (Fig. 9: A). The territory covered by the Koshylivtsi population was smaller (Fig. 9: B). The Kasperivtsi layer was found only in one area, in the centre of the cave, 200 metres from the modern entrance (Fig. 9: C). It is possible that during the Kasperivtsi group's occupation, other cave entrances were blocked by landfalls.

The archaeological map reveals a pattern in the arrangement of living spaces in side grottoes and the ends of dead-end passages. The thickness of the cultural layer indicates active and prolonged use of these areas. Constant humidity and cold forced people to improve the conditions in their underground quarters. They might have created artificial partitions (from skins) to protect themselves from air currents and retain heat in living areas. If this was a temporary underground shelter, why were human burials found in the

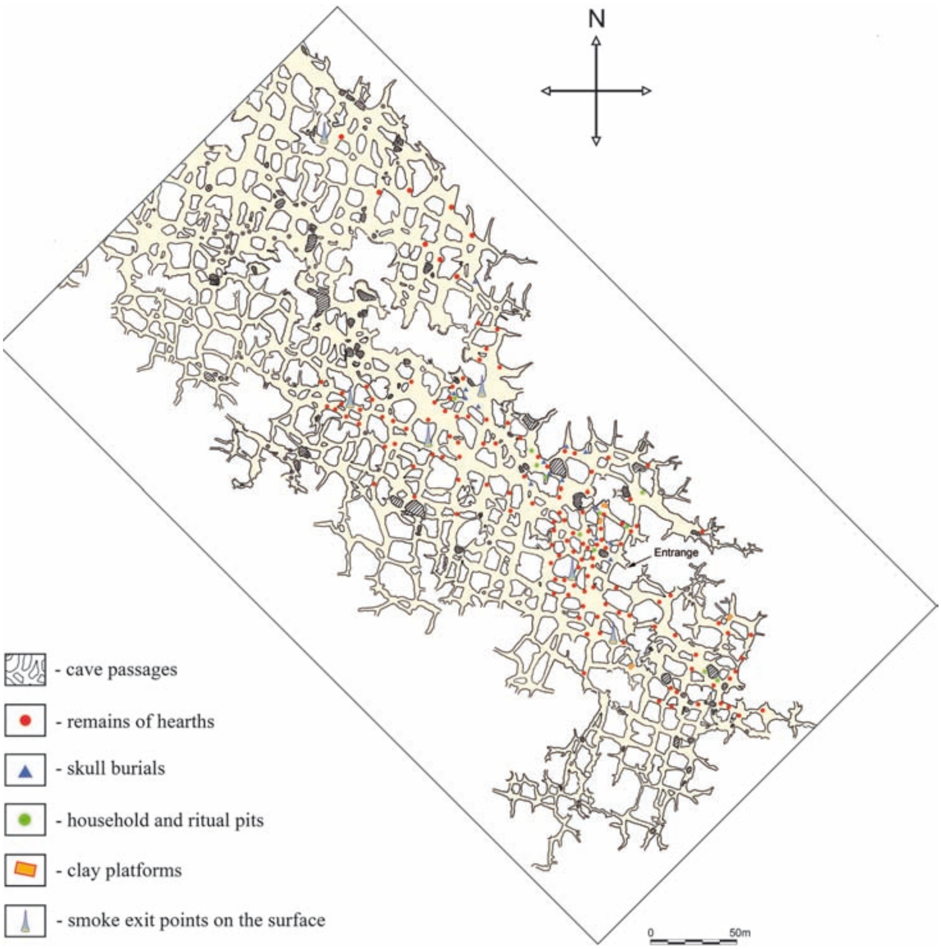

Fig. 10. Map of archaeological features in the cave passages

cultural layer in almost all residential areas of the cave? Was there a tradition among the Trypillian people to perform burials in dwellings? Despite the small number of Trypillian burials, some of them (Luka-Ustynska, Nezvysko III, Kosenivka) were found in dwellings (Gokhman 1958, 127-132; Chernysh 1962; Fuchs *et al.* 2023, 1-84).

Mapping the hearth remains in the cave provided new insights into the function of fire in the underground environment. For the Trypillian peoples, fire was a constant source of light and heat. However, open hearths in a confined space with high humidity produced a lot of carbon monoxide and smoke, which could have been deadly. Adequate ventilation was essential for maintaining fires. Evidently, natural fissures in the cave's stone ceiling served as ventilation channels and chimneys.

It became clear that only hearths near ventilation channels could serve as a constant source of light and heat. However, most of the hearths were scattered throughout the labyrinth, far from vertical chimneys (Fig. 10). This raises new questions. Perhaps these hearths were lit only during burial rituals. Similar traditions are found at other Eneolithic sites (Fernandes 2010, 261-264).

The spatial representation of inhabited areas showed a trend of decreasing activity in cave habitation. This could be attributed to natural factors, such as periodic collapses of existing entrances and flooding of certain cave sections. It is possible that complex disintegration processes occurring at the end of the CII stage of the Trypillian culture's development played a role (Tkaczuk 2005, 87-119). During this period, the local population experienced pressure from the culturally distinct population groups. When choosing settlement locations, factors ensuring life safety became crucial.

CONCLUSION

The systematized spatial and attributive information presented on the archaeological map of Verteba Cave provides researchers with new data on the nature, quantity, and locations of studied features. This map offers, for the first time, a comprehensive spatial perspective on the multifunctional use of the cave and its relationship with the surface settlement. It is now possible to delineate zones of ritual and economic activities.

Currently, the archaeological map is a crucial component of a comprehensive database for the cave. The cartographic results of the conducted research will form the foundation for future traditional and electronic versions of a large-scale, multi-layered archaeological map of the cave. Further additions to the map will depend on the results of new archaeological investigations.

The created archaeological map will be essential for:

• Reconstructing the chronological stages of cave settlement.

• Better understanding the functional use of the cave (long-term habitation, temporary shelter, place for ritual ceremonies).

• Creating a geoinformation infrastructure to support future archaeological research and predict various phenomena.

• Accurately recording human burial sites to obtain additional information about burial rituals.

• Analyzing and identifying prospective areas for discovering previously unknown sections of the cave, possibly containing Trypillian materials.

• Investigating the spatial and graphic features of the cave labyrinth's use and the degree of anthropogenic impact on the natural environment.

• Modelling the dynamics of human-cave interaction (behaviour during long-term stays underground, effective use of the cave's natural features, methods of lighting and navigation in the intricate labyrinth).

• Estimating the probable number of people who could have simultaneously occupied the cave.

• Identifying cave sections with varying degrees of usage intensity.

• Preserving the site and turning it into a museum.

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FUNNEL BEAKER CULTURE SETTLEMENT IN JASIENICA SUFCZYŃSKA SITE 5 AS AN EXAMPLE OF THE ENEOLITHIC COLONISATION OF THE PRZEMYŚL FOOTHILLS (WESTERN CARPATHIANS, SE POLAND)

ABSTRACT

Król D., Sobkowiak-Tabaka I., Verteletskyi D., Głowacz M. 2024. Funnel Beaker Culture settlement in Jasienica Sufczyńska Site 5 as an example of the eneolithic colonisation of the Przemyśl Foothills (Western Carpathians, SE Poland). *Sprawozdania Archeologiczne* 76/2, 197-226.

Until now, the question of the Eneolithic settlement of the Funnel Beaker Culture in the 4th millennium BC in the area of the Przemyśl Foothills (Western Carpathians, SE Poland) has not been studied in detail. This was due to the relatively limited state of the sources, which were mainly collected during field surveys. These investigations resulted in the discovery of a relevant settlement in Jasienica Sufczyńska Site 5. The various artefacts collected from its surface have been used to formulate puzzling hypotheses concerning the chronology and the relations of its inhabitants with outer territories. It has been, for instance, suggested that it may have developed earlier than 3700/3650 BC (or even about 3800-3700 BC). These intriguing opinions were the main reason for the excavations carried out in 2017. This invasive research has provided new data about the nature of the settlement. They revealed pottery and stone materials, and the remains of several features. In this paper, we present the results of macro- and microscopic analyses of these materials and discuss them in the context of the current state of research on the Funnel Beaker Culture in the Przemyśl Foothills and adjacent areas. Based on newly collected data, it is debatable whether to date this settlement can be dated as early as previously thought.

Keywords: Eneolithic, Funnel Beaker Culture, pottery, lithic artefacts, phytoliths
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INTRODUCTION

The question of the Eneolithic colonisation of the Przemyśl Foothills in the Western Carpathians by populations of the Funnel Beaker Culture (FBC) in the 4th millennium BC has not yet been discussed in detail. It has usually been commented on as a marginal element of broader studies of this culture in southeastern Poland – south of the Vistula and San confluence (*e.g.*, Pelisiak 2005; 2018; Zych 2008; Nowak 2009, 343; Rybicka 2015; 2016; 2017; 2020; Rybicka *et al.* 2018). This is due to the extremely modest amount of source data, mainly collected during the field survey carried out as part of the Polish Archaeological Record Project (AZP), or accidental discoveries (*e.g.*, Valde-Nowak 1988; Poradyło 2003; Dobrzyński *et al.* 2014). In this area, with a few exceptions (*e.g.*, Jabłonica Ruska Site 1; Sznajdrowska-Pondel 2020), no sites with FBC materials have been invasively investigated. However, field surveys have revealed several FBC sites of varying sizes and functions (?), of which the settlement of Jasienica Sufczyńska Site 5 seems particularly noteworthy. On the surface of this site, M. Parczewski identified sparse but interesting artefacts belonging to two groups: a) made of clay (pottery) and b) made of lithic raw materials. They were scattered over a relatively small area, strongly restricted by modern residential and farm buildings (Dobrzyński *et al.* 2014). This collection, consisting of poorly decorated pottery sherds and lithic artefacts (made exclusively from Volhynian raw materials), became the basis for a discussion (*e.g.*, Rybicka 2016; 2017; 2020; Rybicka *et al.* 2018; *cf.*, Pelisiak 2018) on the chronology of the settlement and the contacts of its inhabitants with the easternmost 'world' of the FBC and indirectly with Trypillian Culture (TC). The main characteristics of these materials led to the following research hypotheses:

a) Jasienica Sufczyńska Site 5 could represent the early stage (*i.e.*, before 3700/3650 BC) of colonisation of the Przemyśl Foothills by representatives of the FBC,

b) the significantly high frequency of Volhynian flints could be evidence of their adaptation at an early stage of the local FBC, *ergo* the existence of some kind of Eneolithic distribution chains between west and east at that time (Rybicka 2016; 2017, 117-125; 2020; Rybicka *et al.* 2018).

Such considerations, while undoubtedly intriguing, were expressed based on observations of a very limited dataset, in particular heavily damaged pottery sherds (Dobrzyński *et al.* 2014). With this in mind, and aware of the accelerating erosion of the site, it was decided to carry out a more extensive rescue excavation in 2017, covering an area of 350 m^2. These investigations provided important data on the issues highlighted. They revealed more artefacts in different stratigraphic contexts (humus and eroded accumulation layer), as well as the remains of several settlement features. In this article, we would like to present the results of various macro- and microscopic analyses of the identified materials and then discuss them in the background of the current state of research on the FBC in the Przemyśl Foothills and neighbouring areas in the Middle and Lower San River basin. In particular, we would like to discuss the question of whether the settlement in Jasienica Sufczyńska Site 5 can indeed be considered an example of the colonisation of these territories by FBC populations already before 3700/3650 BC.

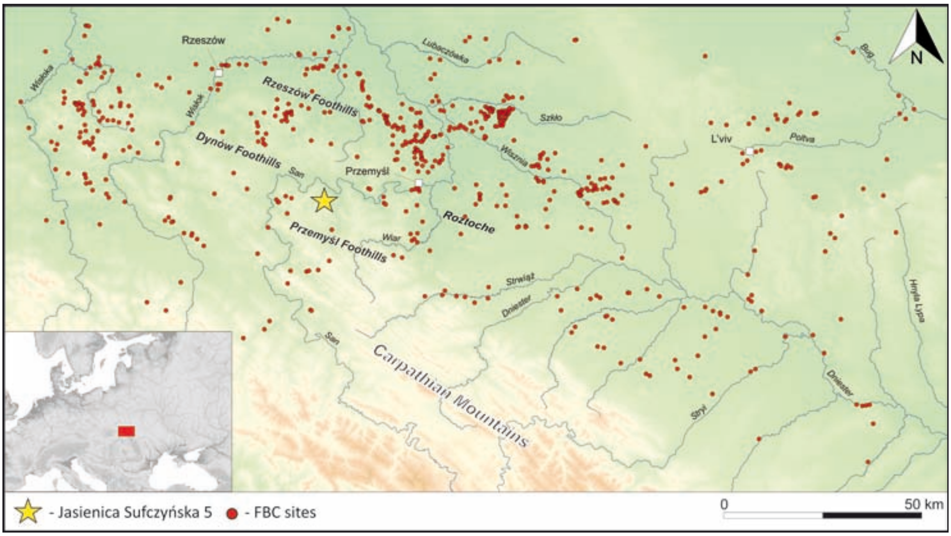

Fig. 1. The Jasienica Sufczyńska Site 5 in the context of the southeastern zone of the FBC (Southeastern Poland and Western Ukraine) (created by D. Król)

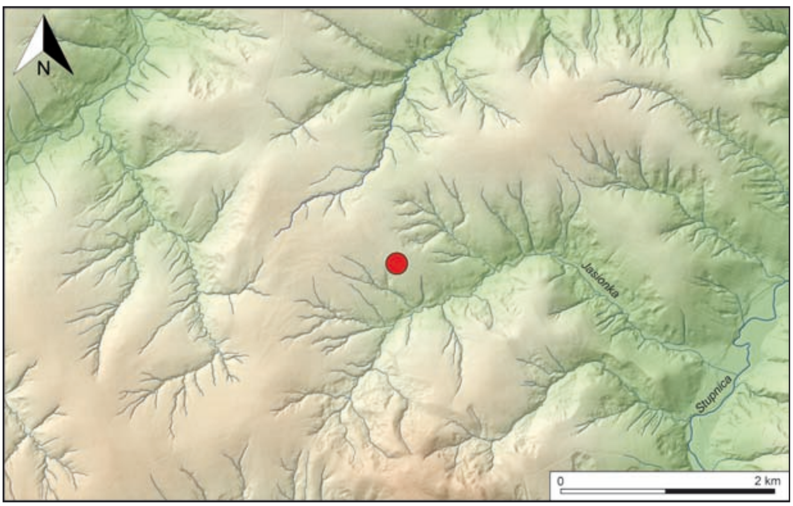

Fig. 2. Jasienica Sufczyńska Site 5 in the Przemyśl Foothills (created by D. Król)

SITE LOCATION

The FBC settlement in Jasienica Sufczyńska Site 5 is located in the northern area of the Przemyśl Foothills, part of the Western Carpathians (Kondracki 2002; Solon *et al.* 2018), about 40 km southeast of Rzeszów (Fig. 1). It is situated on the left bank of the Stupnica River watershed (a right tributary of the San River) on a gentle slope of a large, unnamed hill (437 m asl) facing southeast, at a distance of about 400 m from the local stream Jasionka and about 50 m above its bottom (Fig. 2). The highest points of the settlement rise to 376 m asl, but they are located in a part that is inaccessible for archaeological research (due to modern buildings). The parts of the site available for invasive field activities are situated at altitudes of 375-376 m asl. Broadly speaking, the settlement of Jasienica Sufczyńska Site 5 is located in a region consisting of Carpathian flysch covered by carbonate-free loess sediments, usually referred to as loess-like dust or the Carpathian variety of loess. Such sediments are the basis for the different types of Luvisols (Skiba and Drewnik 2003).

SETTLEMENT RELICS

The excavations covered an area of 350 m^2. Due to the inaccessibility of the cultivated field, it was not possible to focus on the potentially most prospective zone of the site, characterised by the highest density of artefacts on the surface (as documented by M. Parczewski). However, moving the trenches a few metres to the southeast did not adversely affect the results. The survey revealed six morphologically distinct features (Fig. 3: A) and a large (cultural) accumulation layer containing numerous sherds of pottery and other artefacts (Fig. 3: B). Most of these features were poorly preserved common pits, mainly located in the northeastern sector of the surveyed area (Fig. 3: A). Interestingly, a distinct feature (No. 3) was also discovered between Pits 2 and 4, which could cautiously be interpreted as part of a dwelling (Fig. 3: A). It was a relatively small (less than 15 m^2) and shallow (about 15 cm) structure with a trough-shaped cross-section, within which a posthole (No. 6) was identified (Fig. 3: A). In total, almost one thousand pottery sherds and 40 stone artefacts were recovered during the excavation. Regarding the main group of materials (pottery), they were identified in different stratigraphic contexts: a) humus – 135 (14.7%), b) (cultural) accumulation layer – 769 (83.9%), and c) the fills of features – 12 (1.3%). Artefacts made of lithic raw materials were found in two layers: a) humus – 10 (25.0%) and b) cultural layer – 30 (75.0%).

As noted above, relatively few pottery sherds were identified within the features. The second stratigraphic context of pottery sherd distribution – the yellow-orange cultural layer – appears to be more valuable due to the density of these finds (Fig. 3: B). This thin (up to 10 cm) anthropogenic substance, recorded practically throughout the trench, was characterised by the presence of a large amount of FBC pottery material, concentrated (like features) mainly in the northeastern part of the excavated area (Fig. 3: A). Using the kernel density estimation (KDE) technique in GIS software (QGIS Desktop 3.18.1), we can

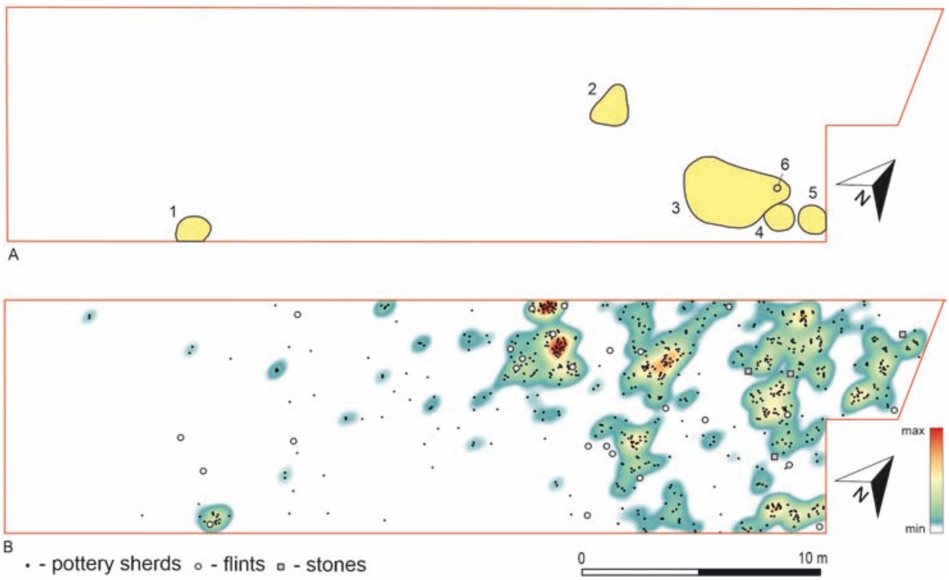

Fig. 3. Jasienica Sufczyńska Site 5. A – features; B – results from the KDE analysis of the pottery sherds (created by D. Król)

observe some characteristic clusters of such artefacts (Fig. 3: B). Significantly, their distribution fits well with at least the area of the putative dwelling (Feature 3) and the functionally related (?) two pits (Feature 4 and 5). Larger assemblages of pottery sherds were recorded clearly outside the former structure, or more precisely, outside an area of just over 25 m^2, which itself was poor in such materials (Fig. 3: B). This is a crucial fact, as it may roughly indicate the original size of the presumed house structure. Relying on this type of observation when attempting to estimate the size of unpreserved dwellings is reasonable in the light of research experience from FBC settlements in the Central European Plain (*e.g.*, Pelisiak 1985; Papiernik and Rybicka 2002). Last but not least is a set of pottery sherds identified in the humus (about 20 cm depth). Their horizontal dispersion can be compared with the position of pottery in the cultural layer. Importantly, we can observe a quite similar spatial distribution in the case of artefacts made of lithic raw material. Leaving aside the features in which no such materials were discovered, their presence right next to the pottery clusters in the cultural layer is noticeable (Fig 3: B).

POTTERY

Nearly a thousand pottery sherds were recorded in three stratigraphic contexts at Jasienica Sufczyńska Site 5. As a whole, they can be described as a homogeneous data set. Most of these pottery artefacts, regardless of the context of deposition, were characterised

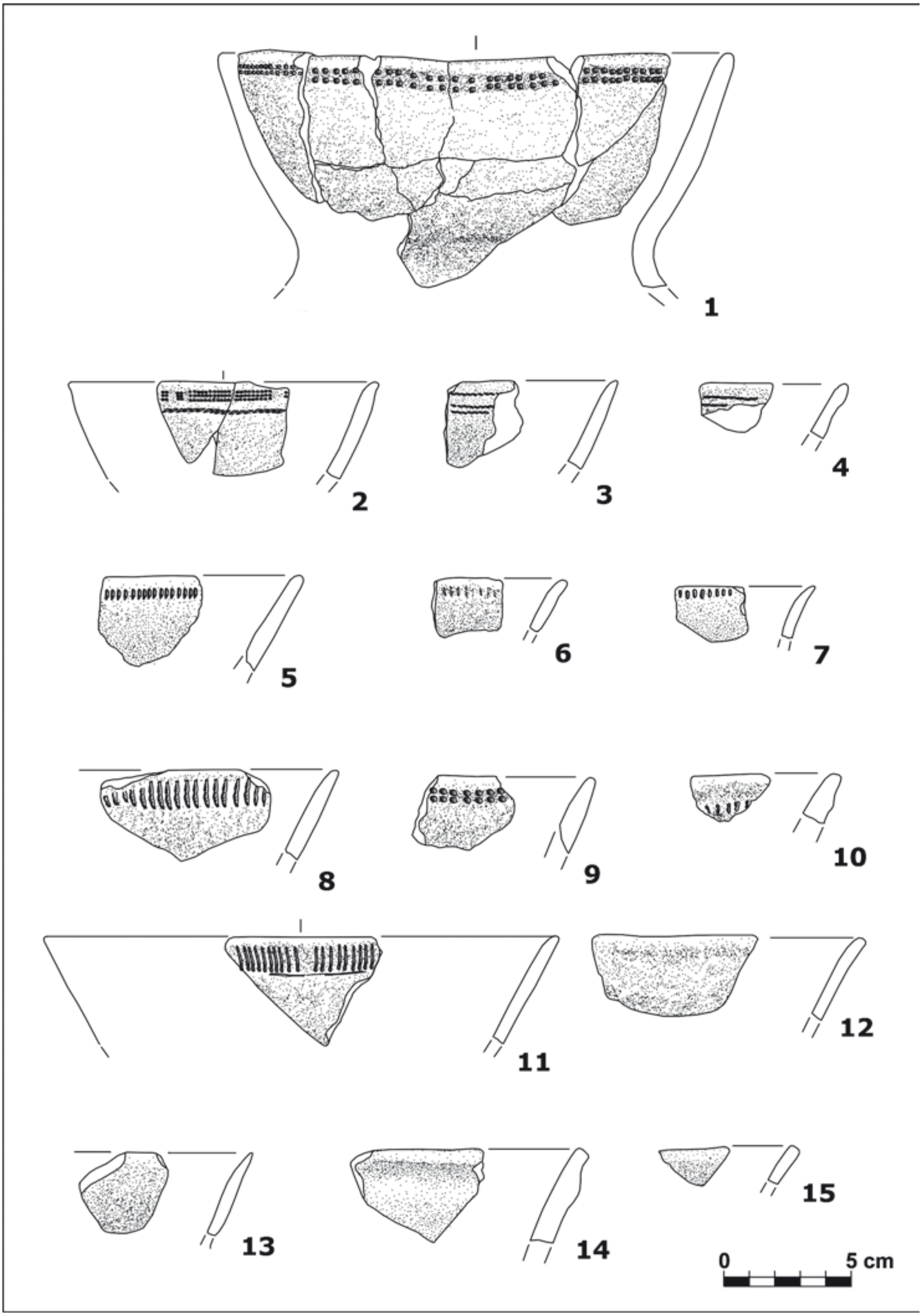

Fig. 4. Jasienica Sufczyńska Site 5. Pottery sherds identified in the cultural layer (drawn by D. Verteletskyi)

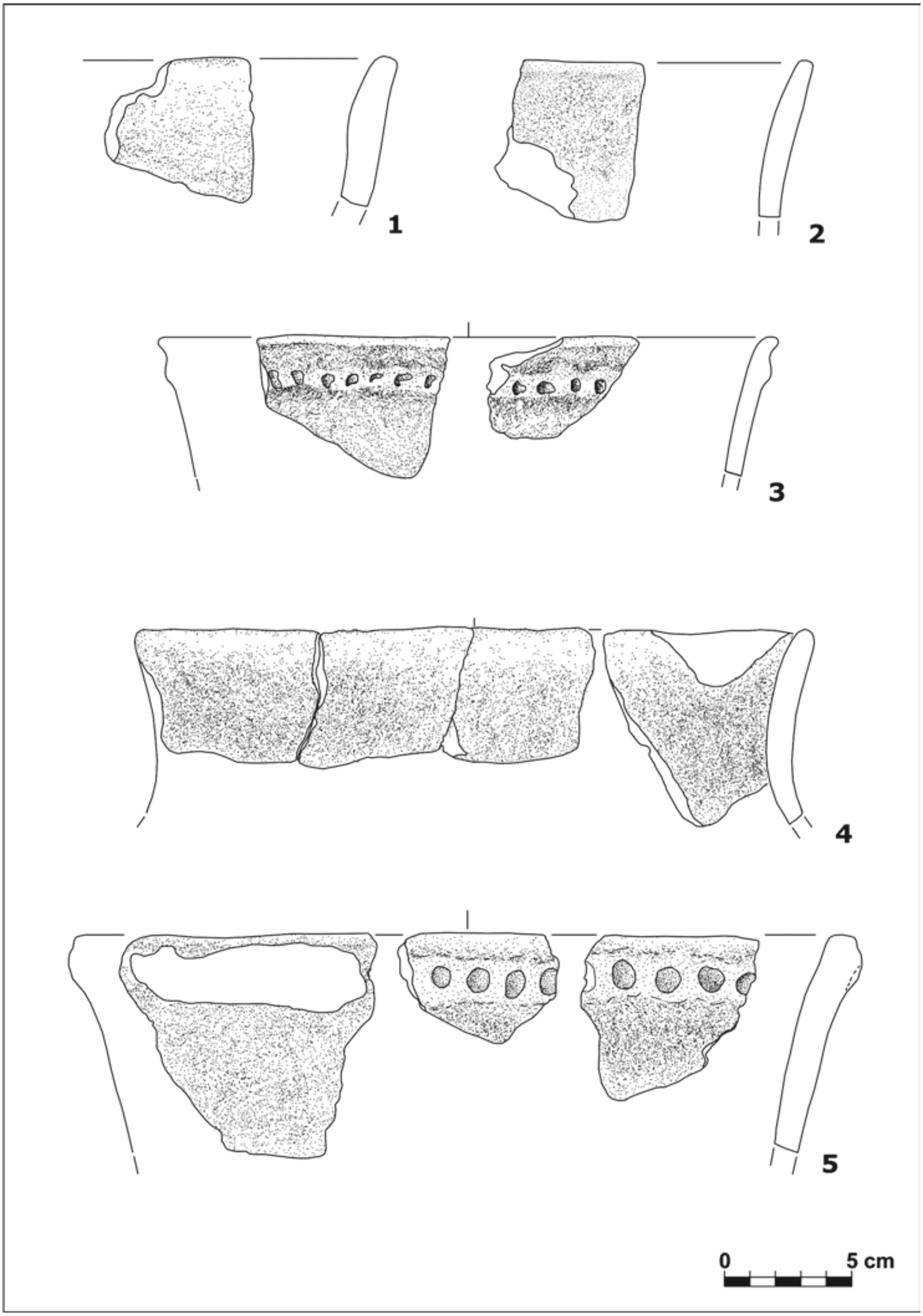

Fig. 5. Jasienica Sufczyńska Site 5. Pottery sherds identified in the cultural layer (drawn by D. Verteletskyi)

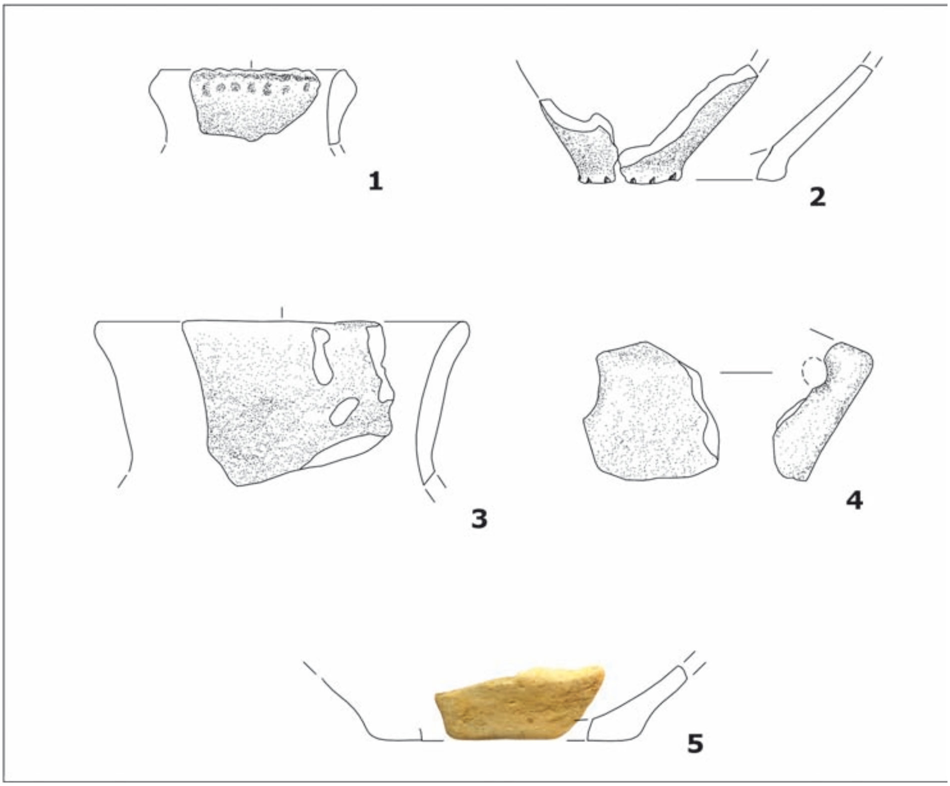

Fig. 6. Jasienica Sufczyńska Site 5. Pottery sherds identified in the cultural layer (drawn by D. Verteletskyi)

by a high degree of fragmentation and severe damage to their internal and external surfaces. This has probably resulted in the complete obliteration of the decorations originally visible on the surface in some cases and their distortion in others. Moreover, the state of preservation of these artefacts often makes it difficult to determine which vessel forms the individual sherds come from. Of the total number of materials analysed, 43 rims, 36 bases, one handle, and 22 decorated sherds can be distinguished (Figs 4-7). Except for one case (a handle fragment from the humus layer), the distinctive artefacts were recorded within the thin cultural material. All the sherds identified in the different contexts were analysed in the following areas: technological, morphological, and stylistic.

ANALYSIS OF THE TECHNOLOGY

The most practical schemes (Czerniak and Kośko 1980; Czebreszuk *et al.* 2006; Kukawka 2012) were used to characterise the technological properties of the vessels. The following elements of the pottery sherds were considered in the analyses: temper (type,

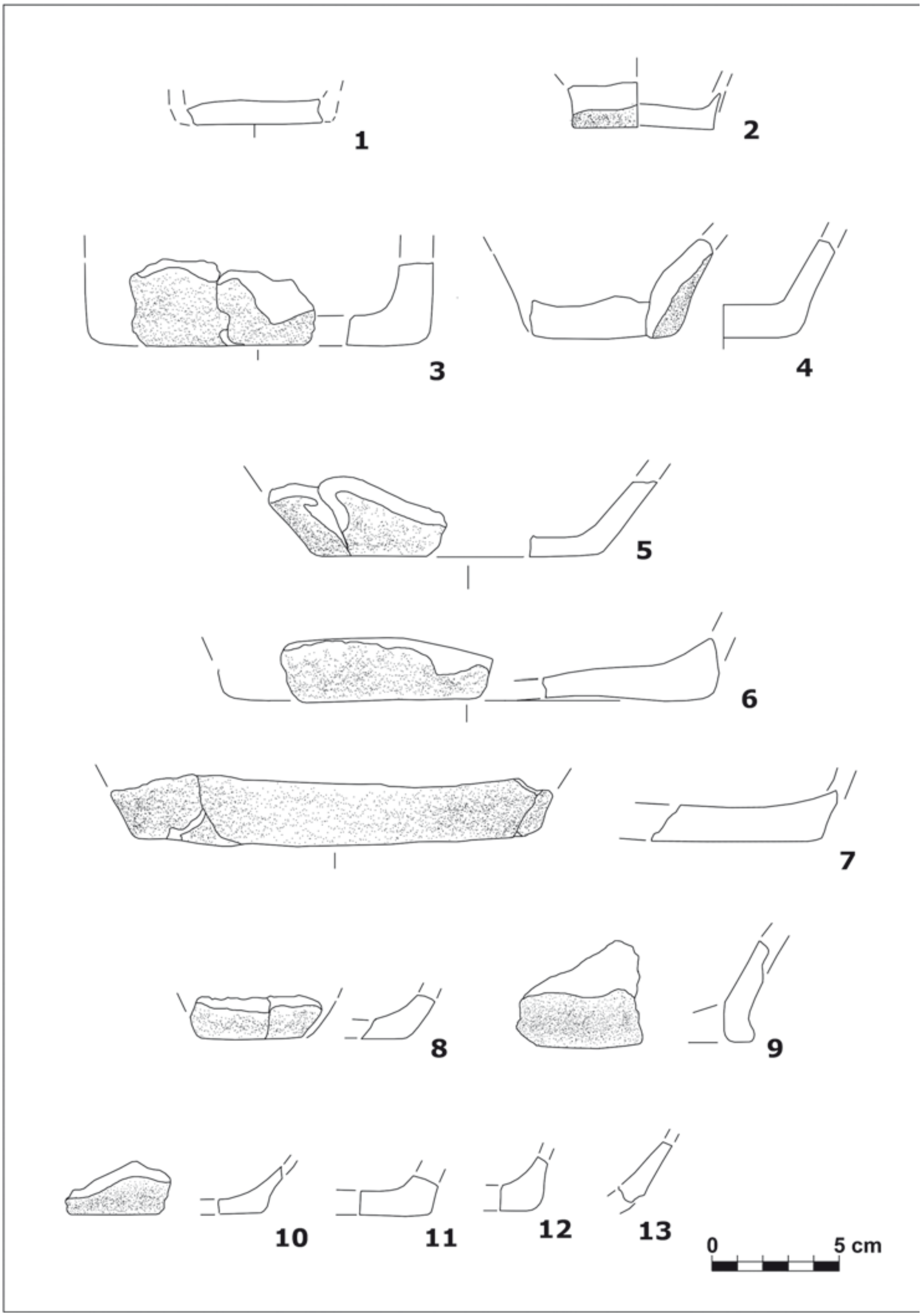

Fig. 7. Jasienica Sufczyńska Site 5. Pottery sherds identified in the cultural layer (drawn by D. Verteletskyi)

size, and density), surfaces (colour, texture), cross-sections (colour, layering), and wall thicknesses.

Based on basic observations, we should emphasise the extreme technological standardisation of the composition of the pottery fabrics from the Jasienica Sufczyńska Site 5. Almost all of the analysed pottery samples contained crushed pottery, *i.e.* grog (95.7%), which improved the mechanical and thermal properties of the vessels. Two categories can be highlighted: a) 0-4 mm (85.0%) and b) 5-9 mm (25.0%). Smaller grains of grog were identified in both thinner and thicker sherds, while larger ones were only visible in sherds of medium and thick walls. Other types of mineral inclusions occurred by chance and cannot be clearly described as intentional (*cf.*, Rzepecki 2014, 164). They always occur together with grog, resulting in the following assemblages: a) grog-sand (2.3%) and b) grog-stone (1.6%). The presence of one thick-walled, indistinct pottery sherd with a grog-mineral-shell admixture was also recorded. The last and least represented group consists of materials without any macroscopically defined compounds – the so-called 'fat clay'.

Given the poor state of preservation of the pottery, it is difficult to determine exactly how their surfaces were treated. Only three categories of external surfaces can be identified by careful observation: a) powdery (49.0%), b) smooth (34.1%), and c) rough (16.0%). Concerning the firing atmosphere, three types were observed based on the colour of the sherd cross-section: a) reduction (grey-black colour), b) oxidation (yellow-orange-red colour), and c) variable (mixed colour). Materials characterised by greyish cross sections with a thin oxidised outer layer are the most numerous in the analysed assemblage (83.3%).

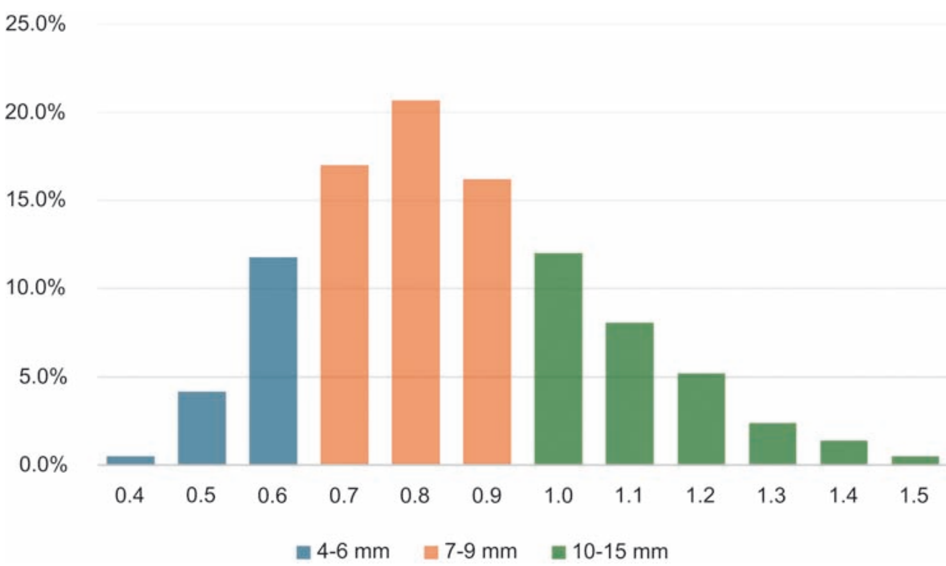

Fig. 8. Jasienica Sufczyńska Site 5. The thickness of pottery sherds (not including bases)

This peculiarity can be explained, for example, by the fact that the vessels were turned upside down during firing. This resulted in cutting off the access of oxygen to their interior (Glushkov 1996; *cf.*, Chmielewski 2015, 63; Starkova and Zakościelna 2018). It is also worth noting the presence of fully oxidised pottery sherds with minimal or no grog temper. An example of this is a fragment of the base of a vessel identified in the northeastern part of the excavated area (Fig. 7: 5).

The largest group of pottery sherds analysed were those 7-9 mm thick (53.9%), followed by those thicker than 10 mm (29.6%). The smallest, but not the least, category of sherds corresponds to the most fragile pottery up to 6 mm wall thickness (16.5%). Specifically, the most common sherds were 8 mm (20.7%), and the extremely rare were 4 mm and 15 mm (both 0.25%) (Fig. 8).

ANALYSIS OF THE MORPHOLOGY AND DECORATION

The lack of matching fragments from different parts of vessels complicates the optimal reconstruction of their morphology (*cf.*, Rzepecki 2014). Despite the objective inconveniences caused by the high fragmentation of the pottery, an attempt was made to minimise this problem by cross-analyzing the shapes of the rims with the types of decoration on their external surfaces. The scheme developed by A. Kośko (1981) with its modification (Czebreszuk *et al.* 2006) was used to describe/identify the vessel shapes. The assemblage analysed contains such fragments that could be assigned to specific forms, such as funnel beakers (Fig. 4: 1-15), pots (Fig. 5: 1-5), collared flasks (Fig. 6: 1, 2), amphorae (Fig. 6: 3, 4), and (with extreme caution) bowls (Fig. 6: 5).

The funnel beakers fulfilling the general criteria for the type B forms were characterised by various types of necks, including, for example, arch-shaped (Fig. 4: 1-3) or turned inside out (Fig. 4: 6, 7, 12). The exact diameters were determined only for the two funnel beakers, *i.e.*, 20 cm (Fig. 4: 1) and 12 cm (Fig. 4: 2), respectively. The diameters of the others seem to vary between 15 and 20 cm. Most of these vessels were decorated but only on the outer surface of the upper part of the neck (Fig. 4: 1-12). The simplest and most widespread patterns in the FBC 'world', such as a continuous row of stamps under the rims of the vessel (Fig. 4: 5-8, 10), sometimes segmented and underlined by a narrow incision (Fig. 4: 11), were observed. There are also sherds decorated with two (Fig. 4: 4) and three horizontal cord imprints (Fig. 4: 3), as well as a single cord imprint underlining the segmented stamps made with a comb-like instrument (Fig. 4: 2). The last-mentioned technique was also used on the arch-shaped neck, however with a constant pattern (Fig. 4: 1).

A smaller group of vessels identified in the Jasienica Sufczyńska 5 Site was represented by more massive thick-walled pots (Fig. 5) that were widely used in FBC communities. They were larger in shape than the funnel beakers, with diameters of up to 30 cm (Fig. 5: 3-5). Two of the sherds were decorated with finger impressions on a thickened rim (Fig. 5: 3, 5).

Analysing the pottery, single sherds were also identified that can be carefully interpreted as belonging to collared flasks, although they do not have the characteristic under-rim collar (Fig. 7: 1, 2). Despite the absence of this basic diagnostic element, it seems that the other characteristics of these sherds may support such an interpretation. The reconstructed diameter of the rim of one of these sherds was 7 cm, a value that does not exclude it as a possible collared vessel (*cf.*, Kulczycka-Leciejewiczowa 2002). In addition, this sherd was decorated by irregular impressions on the rim and 'plastic' elements underneath (Fig. 7: 1). The small surface area of the base of a second sherd does not rule out the possibility that it represents such a pottery form (Fig. 7: 2).

It is difficult to conclude much about the amphorae. Only two undecorated artefacts like parts of the neck and the knee-like handle, were identified during the excavation (Fig. 7: 3, 4). These are banal forms that are common in FBC circles.

LITHIC ARTEFACTS

The collection of lithic artefacts from surface survey and excavations conducted at the Jasienica Sufczyńska 5 Site comprises 40 artefacts, including a whetstone made of slate with cut marks on its edges. Due to the questionable relationship of the latter to the FBC materials, this item was excluded from further analysis. The artefacts occurred mainly in the central and southern parts of the study area (Fig. 3: B).

The technological characterisation of the artefacts was made using the assumptions of the so-called dynamic typology by R. Schild *et al.* (1975, 12, 13), adapting them to the specificities of Neolithic and later materials (Domańska 1995, table 1; Domańska and Kabaciński 2000, 379, 380).

Three tools exhibiting traces of 'sickle gloss' were selected for phytolith analysis (Samples W25, W26, and W51 – Figs 9: 2, 11: 3, and 11: 2). The extraction was carried out according to the procedure described by Polcyn *et al.* (2005), using a heavy liquid, lithium metatungstate (LTM), with a specific gravity of 2.35. After removal from the sediment matrix, the phytoliths were mounted on slides, viewed, counted, and photographed at 400× magnification. Identification of phytoliths was undertaken, when possible, with the use of reference material at the Royal Belgian Institute of Natural Sciences, as well as published documents (*e.g.*, Pearsall 2000; Piperno 2006; ICPN 2.0).

ANALYSIS OF THE LITHIC MATERIAL

There were six items belonging to the group of finds related to core preparation, initial core trimming, and the early stage of core processing: three cortical flakes and three trimming flakes. In the first group, there are two flakes measuring 48 × 26 × 5 mm and 79 × 45 × 15 mm,

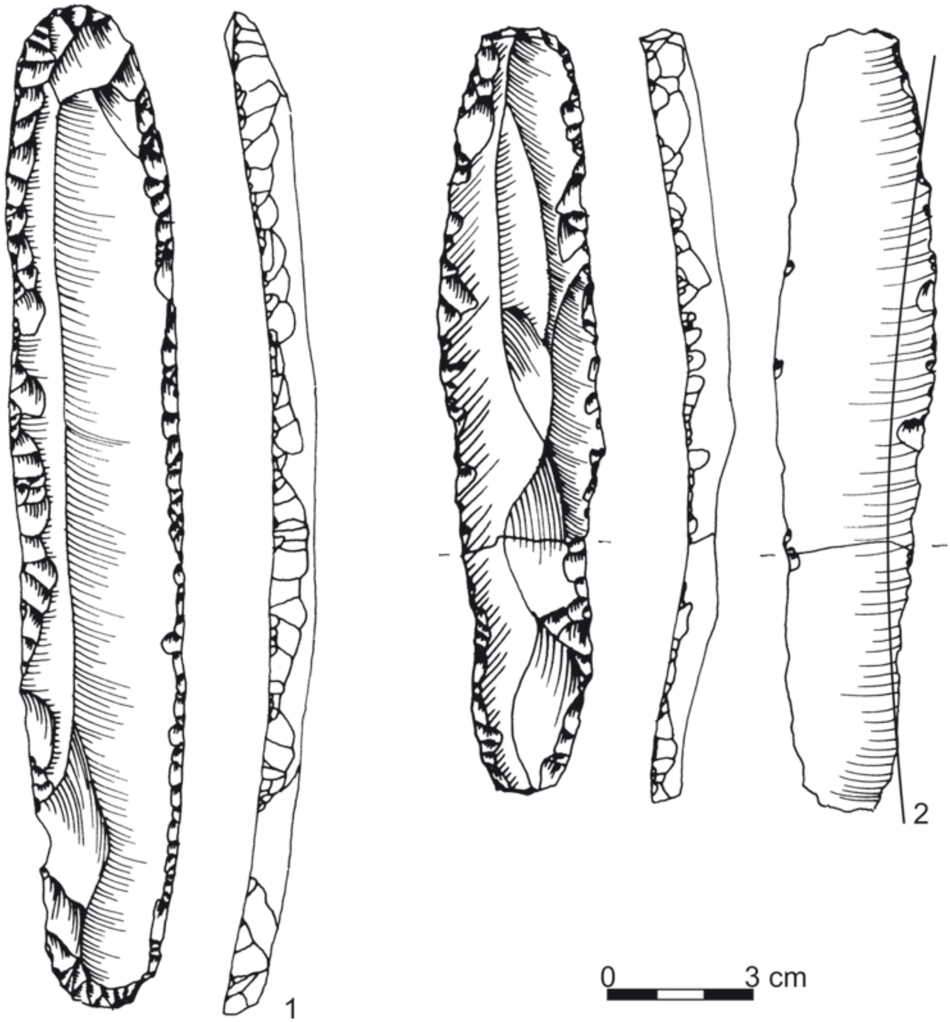

Fig. 9. Jasienica Sufczyńska Site 5. 1-2 – retouched blades (drawn by J. Mugaj)

along with one broken item. In the second group, the smallest flake measures 23 × 18 × 6 mm, and the biggest one is 79 × 45 × 15 mm. All artefacts were made of Volhynian flint.

The group related to flake exploitation consists of four flakes detached from single-platform cores. The smallest one measures 25 × 27 × 5 mm, and the biggest one measures 61 × 47 × 15 mm. Three of them were made of Volhynian flint, and the largest was made from fine-crystalline sandstone.

The blade exploitation group consists of ten items. Only one blade is whole and measures 29 × 12 × 6 mm. The rest of the items are broken (five proximal parts, two central,

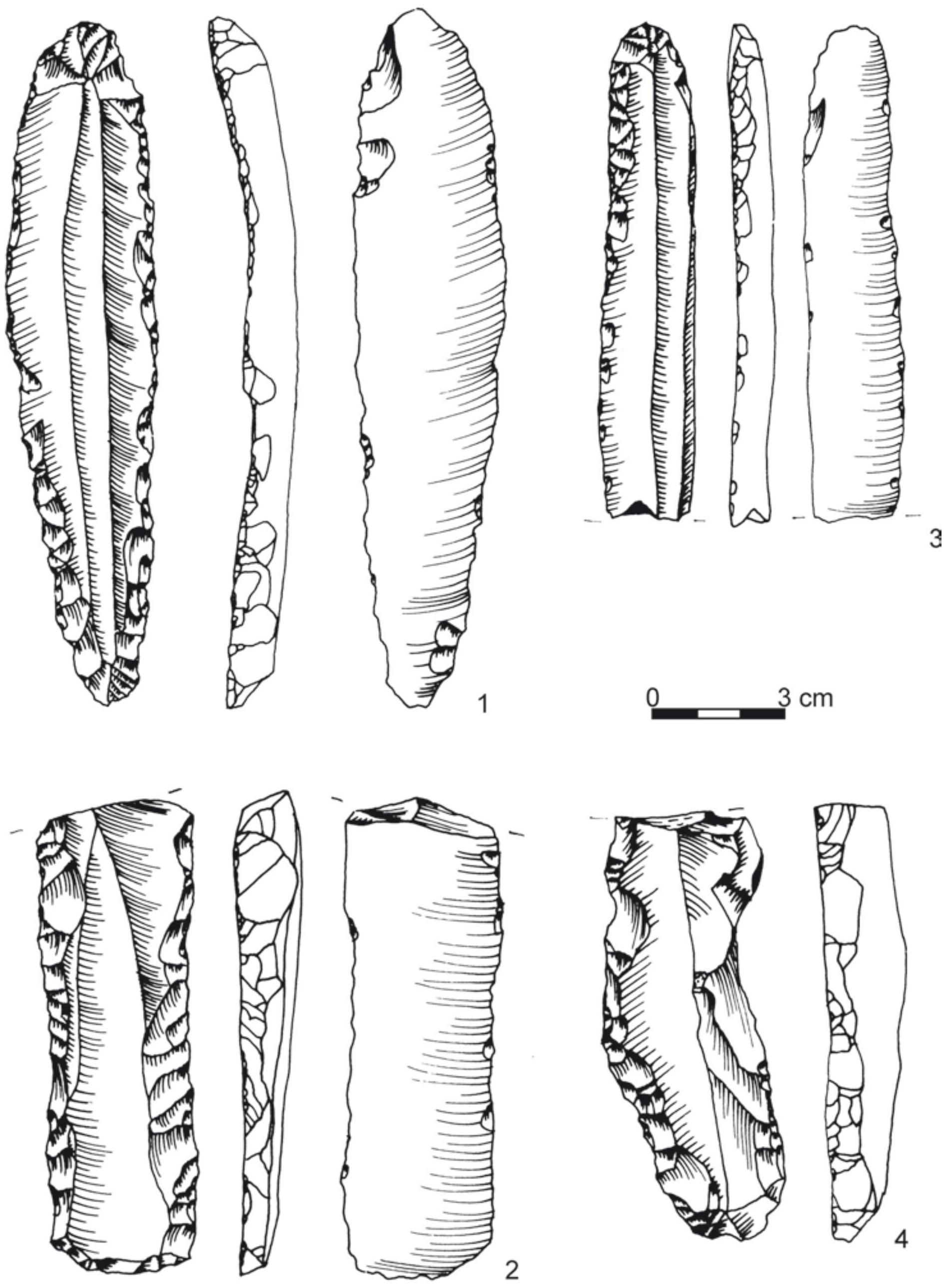

Fig. 10. Jasienica Sufczyńska Site 5. 1-4 – retouched blades
(drawn by J. Mugaj)

and two distal ones). The blades were made of Volhynian flint, chocolate flint, and erratic Baltic flint.

The collection of unclassified artefacts, including debris from knapping and retouching, comprises one unidentified burned flake, one unidentified blade made of quartzite, and three chunks (two fashioned from Volhynian flint and one burnt).

Tools

The tool category encompasses 14 items: one end scraper, seven retouched blades, five partially retouched blades, and one dagger.

End scrapers

Within the assemblage of tools one fragment of end scraper occurred. The working edge is asymmetrically rounded, high, and steep, and both edges of the tool are retouched.

Retouched blades

Among this category of tools, there are three whole items. The first of them is an item measuring 146 × 26 × 5 mm. It has a slightly curved profile and an omnidirectional steep retouch. On the right edge, the retouch overlaps the upper surface of the tool (Fig. 9: 1). The second measures 114 mm × 24 × 7 mm, and the steep retouch covers all edges of the tool. On the lower left edge, a 'sickle gloss' was observed. The tool has a slightly bent profile (Fig. 9: 2). The last was a whole blade measuring 109 × 24 × 7 mm. The steep retouch covers the distal part of the left edge and the entire right edge. On the left and right edges of the bottom side, a single chipping is visible (Figs 10: 1 and 13: 4).

Four more partially retouched blades are broken specimens. The first one has all edges retouched with a steep retouch. On its right edge, the retouch overlaps the upper surface of the tool. On the top and bottom sides of the left edge, a 'sickle gloss' is visible (Figs 11: 2 and 13: 2).

The other specimens are distal parts of the partially retouched blades. The first one has all edges retouch a semi-steep retouch, overlapping deeply on the upper surface of the tool (Figs 10: 2 and 13: 3). In the case of the second one, both edges have been refracted on the top side with a steep retouch overlapping the top surface of the tool. The last of this category of tools has all edges retouched with a steep retouch. In the case of the right edge, the retouch overlaps the top surface of the tool slightly (Figs 11: 1 and 13: 1).

Retouched blades are tools that reach a considerable size in this assemblage, up to nearly 15 cm, and are 2.4 to 2.6 cm wide. Their side edges are finely worked with continuous, steep retouch, sometimes extending onto the upper surface of the tool. In a few cases, traces of a so-called 'sickle gloss' were observed (Figs 9: 2 and 11: 2, 3). Some retouched blades are broken in the middle of their length.

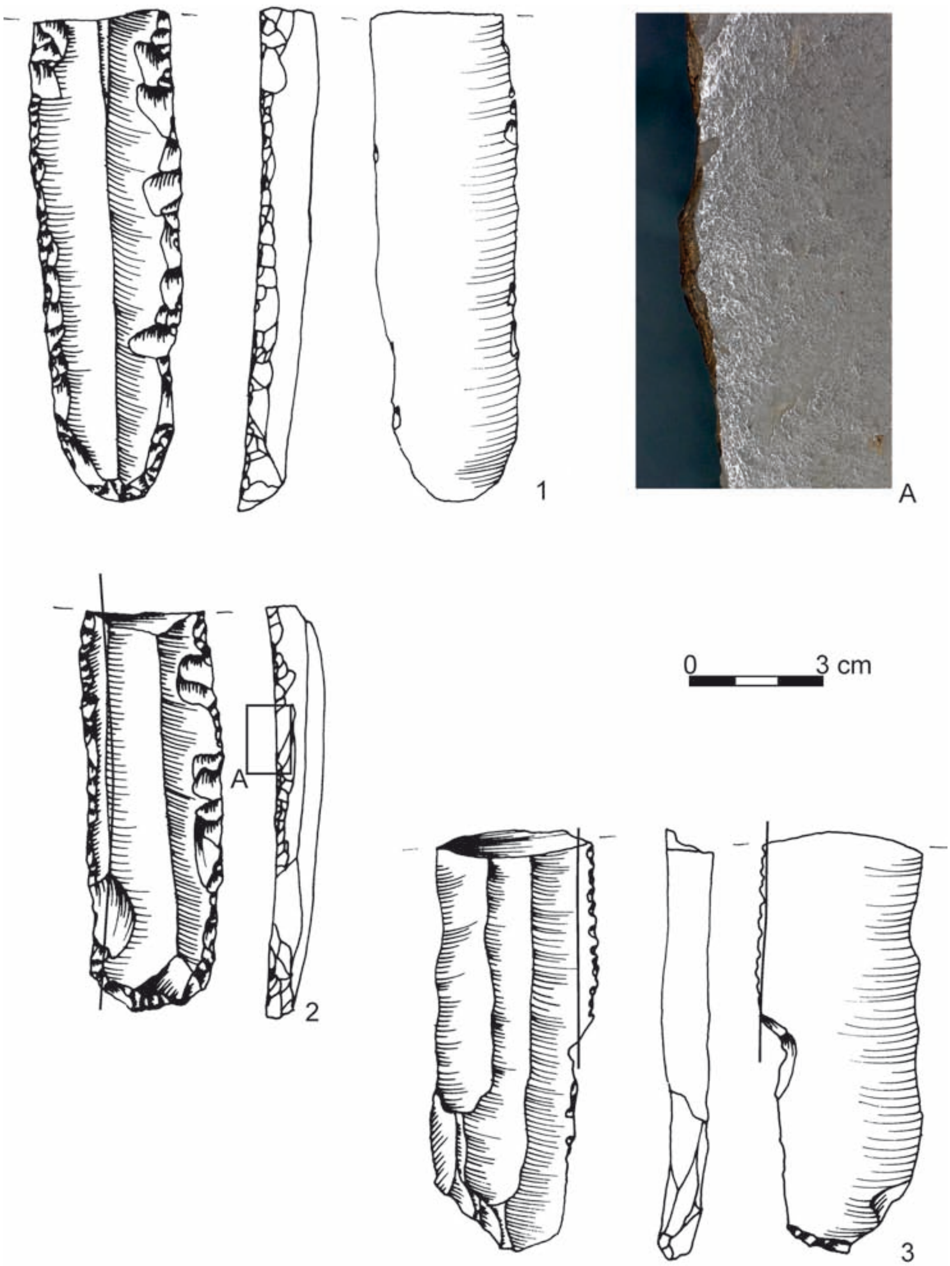

Fig. 11. Jasienica Sufczyńska Site 5. 1-2 – retouched blades 3 – partially retouched blade; A – 'sickle gloss' traces (drawn by J. Mugaj; photo by I. Sobkowiak-Tabaka, taken with the Keyence VHX 6000 digital microscope from the ArcheoMicroLab of the Faculty of Archaeology, Adam Mickiewicz University, Poznań, magnification 100×)

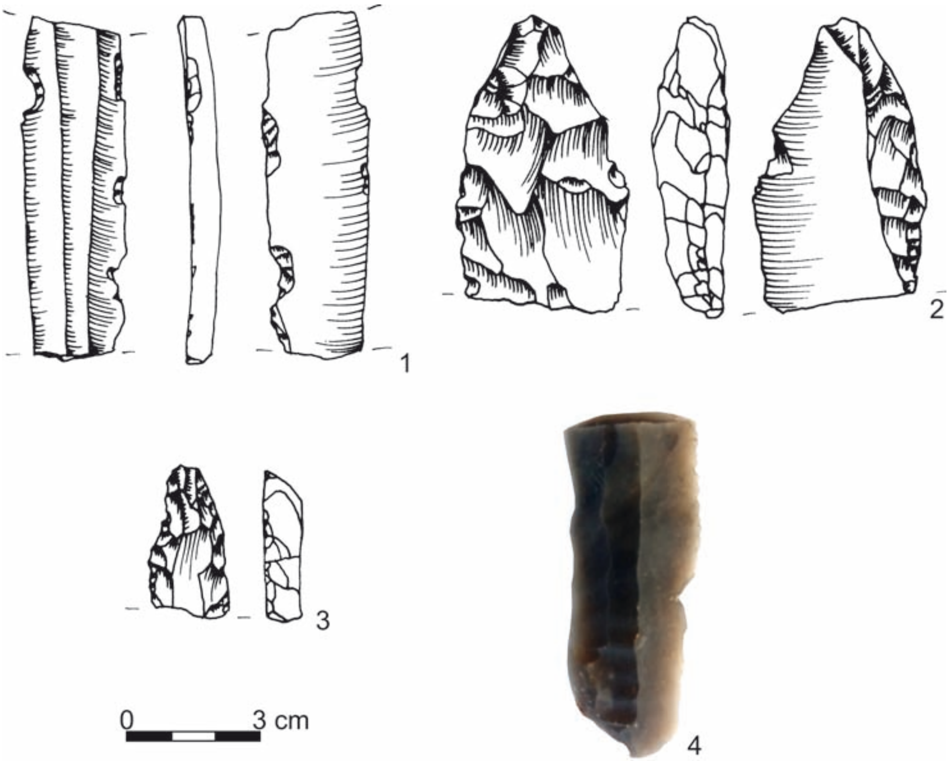

Fig. 12. Jasienica Sufczyńska Site 5. 1, 3, 4 – partially retouched blades, 2 – a fragment of a dagger (drawn by J. Mugaj; photo by I. Sobkowiak-Tabaka)

Partially retouched blades

The first is a proximal fragment of a retouched chip, made of Volhynian flint. Steep retouch is present on the proximal part of the left edge. Minor chipping is visible on both edges, on the bottom side (Fig. 10: 3). The second is also a proximal fragment, made of quartzite (Fig. 12: 3). Retouching is present on a part of the right edge on the top side. A third one is a central fragment of a retouched blade, detached from a single-platform core made of Volhynian flint. The tool has one retouched notch on the left edge on the top side and two, finer ones, on the right edge on the bottom side (Fig. 12: 1).

The last two examples of this category of tools are distal fragments. One of them was made of chocolate flint. Both edges of the blade show small chips, resembling retouch, resulting from intensive use. The 'sickle-gloss' observed on the edges may have resulted from the processing of silica-containing plants (cereals?). The second is a fragment of a retouched blade made of Volhynian flint with a retouched section of the right edge. On the top and bottom side of the right edge, a 'sickle gloss' is visible (Figs 11: 3 and 12: 4).

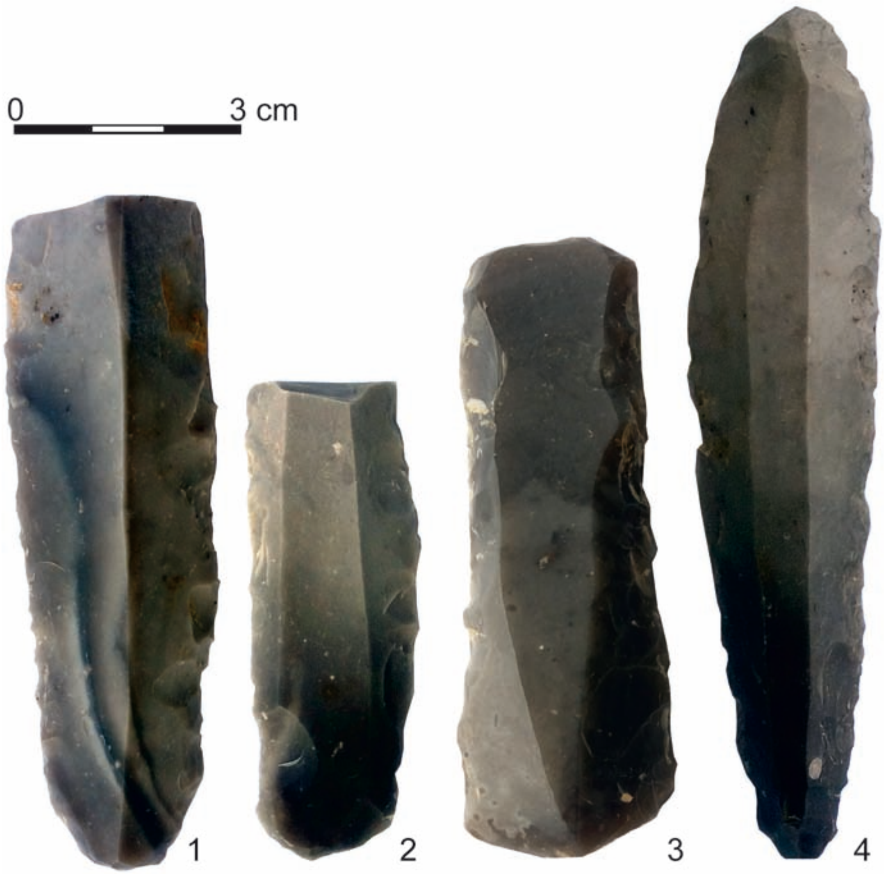

Fig. 13. Jasienica Sufczyńska Site 5. 1-3 – partially retouched blades; 4 – retouched blade (photo by I. Sobkowiak-Tabaka)

Daggers

One fragment of a dagger made of chocolate flint was registered (Fig. 12: 2).

RAW MATERIAL

The vast majority of the artefacts were made of Volhynian flint of the Turonian age, characterised by a dark grey or black colour. A thin white cortex was present on the surface of some of the objects. In the flint mass of some specimens, grey spots or stripes of various sizes could be observed. The nearest outcrops of Volhynian raw material are located in limestone formations in the area of the Bug, Styr, and Ikva rivers, which are about 200 kilometres from the site (Konoplja 1998; Petrun 2004). However, it is important to mention the possibility of using deposits from the upper Dniester region (Rybicka 2017, 123, 124).

Three artefacts were made from chocolate flint, two more from quartzite, and one from Baltic erratic flint. The chocolate flint was most likely obtained from mines in the Holy Cross Mountains region (Schild 1976). However, outcrops of such raw materials are also known from the Kraków-Częstochowa Upland (Krajcarz *et al.* 2014), while other raw materials were available in the vicinity of the site.

In the case of two artefacts, it was not possible to identify the raw material from which they were made due to their being burned through.

The largest of the specimens made from the Volhynian flint, a retouched blade, reaches a length of about 15 cm. Additionally, several artefacts exceed 10 cm in length. Thus, it appears that the size of the exploited cores could have reached up to 20 cm. In the analyzed collection, several artefacts were covered with cortex and originated from the initial phases of core processing. This suggests that whole lumps of raw material were brought to the site.

KNAPPING TECHNIQUE

During the processing of the flint raw material at the site, the classic method of tool reduction was almost exclusively used. This technique was employed to produce all the analysed artefacts from siliceous rocks. Only one flake from scaled cores originated from field surveys conducted several years earlier (Dobrzyński *et al.* 2014).

The flint production was almost certainly geared toward the extraction of blade blanks. In both the currently analyzed collection and that from earlier studies (Dobrzyński *et al.* 2014), tools made from blades, or fragments thereof, predominate.

The second, quite numerous, group comprises partially retouched blades.

PHYTOLITHS

Phytoliths were successfully retrieved from only one tool (Fig. 11: 3 and 14). Three types of phytoliths were identified: elongate entire (Fig. 14: 1), roundel (Fig. 14: 2), and cruciform (Fig. 14: 3). Elongate entire morphotypes are the most commonly produced phytoliths among terrestrial taxa. However, the taxonomic diagnostic value is very low; nonetheless, these cylindrical cross-sections seem to be associated with fibre cells in, for example, grasses (*Poaceae*). The last two types belong to the so-called grass silica short cell phytoliths (GSSCP), which form in specialised, silica-accumulating short cells in the epidermis of members of the grass family (*Poaceae*) – ICPN 2.0.

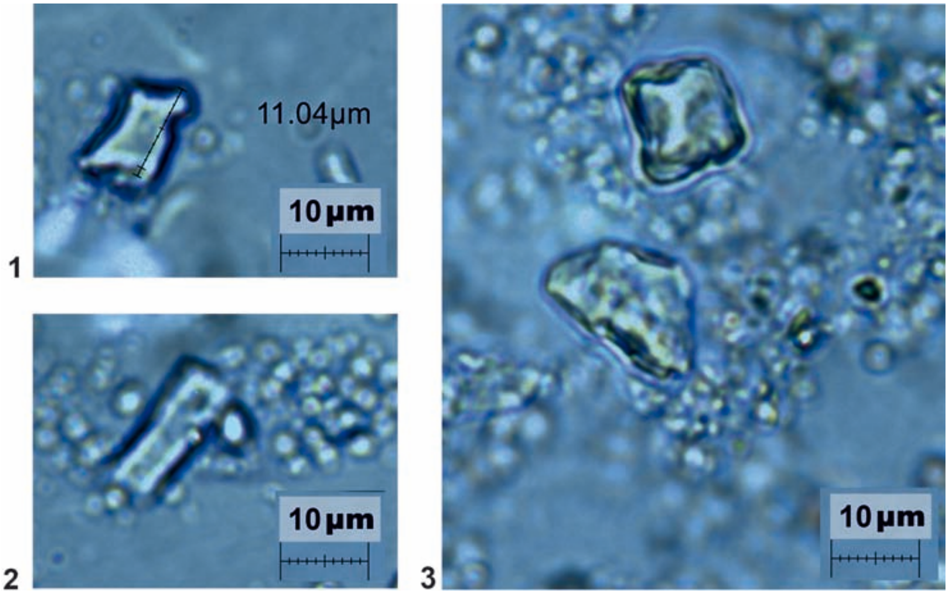

Fig. 14. Jasienica Sufczyńska Site 5. Phytolith morphotypes (acc. to ICPN 2.0) found on the partially retouched blade with 'sickle-gloss'. 1 – elongate, 2 – roundel, 3 – cruciform.
Photo by I. Sobkowiak-Tabaka with confocal microscope (Zeiss Axioplan 2) from the Royal Belgian Institute of Natural Sciences; magnification 400×

DISCUSSION

As mentioned above, the question of FBC colonisation of the Przemyśl Foothills has not been widely discussed due to the limited state of research. The artefacts found during the excavations at Jasienica Sufczyńska Site 5 are practically the only collection that we can consider more suitable for discussing the development of the FBC in this area. A much smaller amount of material was found at the Jabłonica Ruska Site 1 (Sznajdrowska-Pondel 2020), located on the terrace of the San River about 16 km southeast of Jasienica Sufczyńska Site 5. Their research value on this issue is rather limited; therefore, all the more important is what the artefacts from the investigated settlement at Jasienica Sufczyńska Site 5 can reveal.

Taking into account the pottery sherds, it is essential to comment on some facts. The results of the technological analyses generally agree with data from other FBC sites in the Western Carpathian foothills (*i.e.*, Przemyśl Foothills and Dynów Foothills), such as Jabłonica Ruska Site 1 (Sznajdrowska-Pondel 2002), Manasterz Site 7 (Zych 2003), and Tarnawka Site 9 (Zych 2004). They also correlate with observations from the following sites on the neighbouring loess plateau – the Rzeszów Foothills: Pawłosiów Site 52 (Rybicka *et al.* 2014), Mirocin Site 27 (Sznajdrowska 2016), Skołoszów Site 31 (Sieradzka and Głowacz 2017), Skołoszów Site 16 (Król and Niebieszczański 2019), Orły Site 4, and Hnatkowice Site 15 (recent investigations carried out by D. Król's team in 2023-2024). Although there are some variations in the percentage of pure grog or its combination with other tempers, the general technological picture of the FBC vessels in these areas is quite consistent. The presence of relatively small differences is difficult to take as a clear chronological indication and may be due to various reasons, including soil conditions, local preferences, the number of data sets analysed, or perhaps even unavoidable limitations in macroscopic observation of pottery cross-sections.

The above comment is worthy of consideration in light of the materials from the Jasienica Sufczyńska 5 Site. The findings presented regarding the technology of pottery sherds obtained from the excavation are inconsistent with the results of previous analyses of such artefacts found during field surveys. These materials were characterised as eminently 'fatty', with a low frequency of grog in the pottery paste, *i.e.*, 10% (Dobrzyński *et al.* 2014). This remark seems to be essential, as these results of the technological analysis have become one of the key points in the discussion about the placement of the settlement in Jasienica Sufczyńska Site 5 explicitly before 3700/3650 BC on the FBC timeline (Dobrzyński *et al.* 2014; Rybicka 2016). In our view, such technological inferences on chronology are difficult to accept in light of the analyses of newly discovered larger assemblages of pottery sherds.

During excavations at Jasienica Sufczyńska Site 5, several fully oxidised fragments with minimal or no grog temper were recorded. They bear some resemblance to pottery from the areas occupied by the TC populations, but their firing does not appear to be as strong (*cf.*, Matau *et al.* 2013). These eastern features are not unexpected in the FBC sites spread across the Western Carpathian foothills and adjacent areas in the Middle and Lower San River Basin. However, they are usually imitations rather than true imports (*cf.*, Rybicka 2016; 2017), such as at the Gródek Site 1C site in the Hrubieszów Basin (Jastrzębski 1985; Gumiński 1989; Zawiślak 2013). In the nearby area of the Rzeszów Foothills, materials with TC characteristics have been discovered, *e.g.* in Jankowice Site 9 (Dębiec *et al.* 2015), Mirocin Site 27 (Sznajdrowska 2016), Pawłosiów Site 52 (Rybicka *et al.* 2014), Skołoszów Site 16 (Niebieszczański and Król 2019), Skołoszów Site 31 (Rogoziński 2014; Sieradzka and Głowacz 2017), and more recently in Hnatkowice Site 15 (investigations by D. Król's team in 2024). Given the lack of radiocarbon data for assemblages containing such pottery, the question of defining the chronological framework of their occurrence in the study area(s) is a crucial research challenge for the future (*cf.*, Rybicka 2015; Rybicka 2017). At the Pawłosiów Site 52, one of the pottery materials with 'Trypillian' characteristics was found in the context of numerous FBC sherds in Pit 1665 (Rybicka *et al.* 2014, 103). A sample of plant remains was extracted from one of these 'Funnelbeaker' clay artefacts (including cord decoration) and dated to 4780±60 BP (Rybicka *et al.* 2014, 192, Fig. 54), *i.e.*, 3638-3521 BC (1σ) and 3650-3376 BC (2σ). Leaving aside the question of the duration of the settlement, it can be dated no earlier than about 3650-3400 BC (Rybicka *et al.* 2016; *cf.*, Król 2019; Król *et al.* 2024). This period is within the range of phases II-IIIA (about 3650-3400/3300) when the presence of TC elements is already observed in the areas of the southeastern FBC, mainly in their easternmost parts (Włodarczak 2006). Could FBC settlers have arrived in the Przemyśl Foothills earlier and organised an efficient network of contacts with the eastern neighbours at that time?

The early chronology of the settlement in Jasienica Sufczyńska Site 5 was argued by the presence of modestly ornamented pottery sherds identified during a field survey (Dobrzyński *et al.* 2014; Rybicka 2016; Rybicka *et al.* 2018). Leaving aside the question of the extremely scarce sources on which such conclusions were formulated, it should be underlined the fact of stylistic 'conservatism' recorded at several sites in the area of the so-called Rzeszów-Przemyśl loess, *e.g.*, Skołoszów 31 (Rogoziński 2014; Sieradzka and Głowacz 2017), and Mirocin 27 (Sznajdrowska 2016). These sites together with Jasienica Sufczyńska Site 5, have been interpreted as a manifestation of the colonisation of these territories by FBC populations before 3700/3650 BC, even about 3800-3700 BC (Rogoziński 2014; Rybicka 2016; 2017; 2020; Sznajdrowska 2016; Rybicka *et al.* 2018) corresponding roughly to the oldest FBC horizon in Western Lesser Poland (Nowak 2009, 347; 2017; 2019). In the case of Skołoszów 31, significant stylistic similarities with assemblages of the Podgaj-Przybranówek type (Czerniak and Kośko 1993) and the Gnojno type (Nowak 2004; 2006) have been pointed out, which would justify the relatively early dating of this settlement (Rogoziński 2014; Rybicka 2016; Sieradzka and Głowacz 2017). Such an inference, although highly interesting, does not correlate at all with the radiocarbon datings obtained from Pit 3/2013: 4745±35 BP and 4720±40 BP (Sieradzka and Głowacz 2017, 100, table 5; *cf.*, Król 2019), *i.e.*, 3629-3386 BC (1σ), 3635-3378 (2σ) and 3623-3379 (1σ), 3631-3373 (2σ) respectively. On the other hand, however, older dates came from Pit 41 at the Mirocin 27 Site: 4955±35 BP and 4920±40 BP (Sznajdrowska 2016, 55, figs 35 and 36), *i.e.*, 3768-3655 BC (1σ), 3891-3646 BC (2σ) and 3756-3644 BC (1σ), 3781-3638 BC (2σ) respectively. These slightly disputable dates (Król 2019), therefore, fit into the earlier FBC stage (Sznajdrowska 2016), but the pottery artefacts identified in this settlement are in turn more diverse than those from the Skołoszów Site 31, sharing inconsistent stylistic traits – also more 'classic' (Sznajdrowska 2016; *cf.*, Sieradzka and Głowacz 2017). How should we interpret all this? Looking at the data from the Middle and Lower San River Basin, one of the main questions to ask is whether relatively simple vessel decoration is a valuable chronological marker for local FBC sites at all (Król 2019).

These reflections are naturally relevant to the Jasienica Sufczyńska Site 5 case. During the excavations, a collection of pottery sherds was found that can be described as decoratively sparse. The vessels of this settlement were enriched by the use of almost exclusively simple motifs under the rims and in the upper parts of the necks (Figs 4 and 5). They are, therefore similar at first glance to those 'conservative' decorative schemes known from Skołoszów Site 31 (Rogoziński 2014; Sieradzka and Głowacz 2017), Mirocin Site 27 (Sznajdrowska 2016), or Jankowice Site 9 (Dębiec *et al.* 2015) in the nearby area of the Rzeszów Foothills and Kotoryny on the upper Dniester (Hawinskyj *et al.* 2013). However, the morphological analysis of the pottery sherds revealed the presence of funnel beakers with different types of necks, including arch-shaped ones (Fig. 4: 1-3). This fact is interesting if we consider S. Kadrow's opinion that this type of neck is a peculiar feature of the southeastern group of FBC (Kadrow 2009). Such a trait was recognised in the diverse assemblages from the Mirocin Site 27 (Sznajdrowska 2016). On the other hand, it is not present at the Skołoszów Site 31 (Sieradzka and Głowacz 2017), which is taken as an example of the early colonisation of these areas by FBC populations when key features of the southeastern group of this culture (Kadrow 2009) are not yet visible (Rogozinski 2014; Rybicka 2016; 2017; 2020; Rybicka *et al.* 2018). The question of dating the settlement in Jasienica Sufczyńska Site 5 is therefore not so obvious and still leaves room for discussion. It is worth recalling M. Nowak's opinion (2009, 343) that it is an extremely difficult task to use only pottery for typological-chronological considerations in the case of southeastern FBC. Hence, based on the doubts expressed and the lack of valuable radiocarbon datings, it is debatable to place the discussed settlement on the timeline clearly before 3700/3650 BC.

In the broad discussion on the possibility of an earlier FBC colonisation of the Western Carpathian foothills and adjacent territories such as Rzeszów Foothills, the question of the distribution of the flint products is also relevant. In addition to artefacts from previous research (Dobrzyński *et al.* 2014), the collection of flints from the Jasienica Sufczyńska Site 5 site comprises 55 specimens. Despite being surface finds, they hold significant cognitive value. The assemblage's technological and typological structure, as well as the raw material used, exhibit many characteristics typical of the southeastern group within the FBC populations.

The primary raw material utilised at the site was Volhynian flint, which also predominated in flint production at FBC sites like Gródek (Balcer 1983, table 25; Budziszewski 2000; Gumiński 1989, 115) and Kotoryny (Konoplja 2013). It maintained a significant presence in assemblages from 'Funnelbeaker' settlements in southeastern Poland, such as Mirocin Site 27 (Pelisiak 2016), Skołoszów Site 31 (Dobrzyński and Piątkowska 2014a), Pawłosiów Site 52 (Dobrzyński and Piątkowska 2014b), Przybówka Site 1 (Gancarski *et al.* 2008), and Tarnawka Site 9 (Zych 2004). The tools were predominantly crafted from macrolithic blades – retouched blades, partially retouched blades, or end scrapers – reflecting similar patterns found at FBC sites throughout the region. Examples include Drohojów Site 3, Łazy Site 3, Majdan Nowy, Małkowice Site 22, Olszynka Site 10, Orły Site 4, Orzechowce Site 39, Skołoszów Sites 15 and 33, Walawa Site 21, and Zabłotce Site 6 (Balcer 1983; Bronicki and Kadrow 1998; Gumiński 1989; Pelisiak 2017). Many of these tools display traces of heavy use, such as chipping along their edges and 'sickle gloss.'

A significantly high frequency of Volhynian flints at the sites with poorly decorated pottery vessels such as Jasienica Sufczyńska Site 5 or Skołoszów 31 was perceived as evidence of the existence of some kind of distribution chains between west and east already before

3700/3650 BC (Rybicka 2016; 2017; 2020; Rybicka *et al.* 2018). There are no grounds to exclude the idea that the Jasienica Sufczyńska Site 5 is indeed an example of the earliest colonisation of the area of the Przemyśl Foothills by representatives of the FBC. However, their appearance in this area may not have been as early as suggested. This problem also well illustrates the issue of the Skołoszów Site 31 in the nearby Rzeszów Foothills, which can hardly be considered very early in light of the dating of the Pit 3/2013 (*cf.*, Król 2019). Although the possible chronological inconsistency of this site, *i.e.* an older cultural layer containing 'conservative' pottery sherds and a later 'classical' pit, has been taken into account, these two parts are impossible to compare statistically (Sieradzka and Głowacz 2017). Firstly, they are represented by extremely quantitatively different collections of pottery artefacts, and secondly, there are no reliable radiocarbon dates for the cultural layer (*cf.*, Król 2019). Another, but no less relevant issue is the fact that the 'radiocarbon-classical' pit contained only Volhynian products, which fits perfectly with the situation observed in the context of the cultural layer (Dobrzyński and Piątkowska 2014a; Sieradzka and Głowacz 2017).

What else can be said regarding the settlement in Jasienica Sufczyńska Site 5, except that it is debatable to date it earlier than 3700/3650 BC? Based on the information obtained during the excavations and previous surface surveys, it is also challenging to formulate a clear opinion about the length of use of this site. Although it is unlikely to be interpreted as a short-lived settlement episode, there is no broader evidence for considering it to be as large and eminently stable as it has sometimes been referred to (*e.g.*, Pelisiak 2018, 77). Currently, there is insufficient information to allow putting this settlement in line with sites such as Pawłosiów Site 52 (Rybicka *et al.* 2014) or Skołoszów Site 16 (Król 2018; Król and Niebieszczański 2019), which are among the largest and most long-lasting FBC settlements of the period in the Middle and Lower San River basin. It is also worth bearing in mind, however, that the area of the Przemyśl Foothills is a sub-mountainous Western Carpathian zone with slightly different geographical conditions than the mild loess area of the Rzeszów Foothills. Hence, it may be questionable to expect identical patterns of settlement to those recognised in the nearby loess plateau (*cf.*, Król 2018). This does not change the fact that the inhabitants of the settlement in Jasienica Sufczyńska Site 5, regardless of its size and chronology, were economically active in the local territory and maintained wider contacts with the easternmost 'world' of the FBC and indirectly with TC, which is well demonstrated by the set of analysed artefacts.

CONCLUSIONS

Jasienica Sufczyńska Site 5 is certainly an intriguing Eneolithic settlement seen in the context of the remarkably little-known area of the Przemyśl Foothills in the Western Carpathians. As we believe, there is rather no reliable evidence to date it earlier than 3700/3650 BC and/or to interpret it as similar to the largest sites investigated in the loess Rzeszów Foothills. This site requires further research, focusing not only on spatial-chronological questions but also on economic ones. Archaeobotanical, archaeozoological, and further phytolith analyses would also be desirable. Despite the wide application of phytoliths analyses internationally (*e.g.,* Hardy 2009; Hardy *et al.* 2001*),* such kind of methods have seen relatively limited use in Poland, with a single example of phytolith analyses conducted on tools from the Polwica-Skrzypnik site and for indicating the presence of phytoliths at *Poaceae*, *Cyperaceae*, and Panicoideae (Kufel-Diakowska *et al.* 2019). Even though the results of the analysis conducted on materials from Jasienica Sufczyńska Site 5 are more modest, as they included residues from the broad group of *Poaceae*, encompassing both grasses and cereals, it is worth applying such analyses to establish more comprehensive data records for Polish materials. Finally, it is also worth noting that several more important 'Funnelbeaker' sites in this part of the Western Carpathian foothills have yielded equally puzzling materials during field investigations such as, for example, Hołuczków Site 15, Olszany Site 5, and 7, Śliwnica Site 13, and Załazek Site 9 (*e.g*., Poradyło 2003; Parczewski – unpublished research). The latter two may be productive for research due to the relatively large pool of artefacts identified on their surfaces – mainly pottery sherds but also Volhynian flint items. It would be interesting to compare these materials with those identified in Jasienica Sufczyńska Site 5 and to conduct some preliminary research on these sites.

Acknowledgements

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ENEOLITHIC GRAVE WITH SO-CALLED "MILK JUGS" FOUND IN ZAKRZOWIEC, SITE 7, LESSER POLAND

ABSTRACT

Brzeska-Zastawna A., Grabowska B., Rodak T. and Zastawny A. 2024. Eneolithic grave with so-called "milk jugs" found in Zakrzowiec, Site 7, Lesser Poland. *Sprawozdania Archeologiczne* 76/2, 227-251.

In 2005, during rescue archaeological excavations preceding the building of the A-4 motorway, at Site no. 7 in Zakrzowiec, Wieliczka district, a feature interpreted as a grave of the Wyciąże-Złotniki group of the Lengyel-Polgár complex was discovered. The human skeleton was not preserved, but the grave furnishings consisted of two amphorae of the 'milk jug' type (German term: Milchtopf, Hungarian term: tejesköcsög). Vessels of this type belong to the basic taxonomic distinction of the Wyciąże-Złotniki group and are known from both graves and settlement sites. One of the vessels from the grave in Zakrzowiec has a unique decoration in the form of disc-shaped handles (German term: Scheibenhenkels) and a circumferential zigzag pattern formed of short engraved lines. This is the first such decoration on "milk jug" type amphorae known from the Lesser Poland region.

Keywords: Eneolithic, milk jug, Milchtopf, Scheibenhenkel, Lengyel-Polgár, Wyciaże-Złotniki group, burial
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INTRODUCTION

Large-scale rescue excavations along the construction route of the A-4 Kraków – Tarnów motorway produced many interesting and numerous discoveries for the Stone Age, connected mainly with the early Neolithic settlement of the Linear Pottery and Malice cultures. Less numerously represented were the Eneolithic units: the Funnel Beaker culture, the Lengyel and Polgàr complex groups, the Baden culture, and the Corded Ware culture. Against this background, the traces of settlements found at several sites in the area of Podłęże and Zakrzowiec, Wieliczka district, related to the Wyciąże-Złotniki group of the Lengyel-Polgàr complex, stand out. Most finds come from a large settlement at Site 17 in Podłęże, surrounded by a system of ditches and palisades (Dzięgielewska *et al.* 2006; Nowak *et al.* 2007; Nowak 2010). Meanwhile, a single grave and two utility pits were discovered at the neighbouring Site 7 in Zakrzowiec just to the south (Jarosz and Rodak 2006). The materials of the Wyciąże-Złotniki group found at these two sites together form a single settlement complex, consisting of a settlement and a funerary zone (grave or cemetery?) on its periphery (Fig. 1).

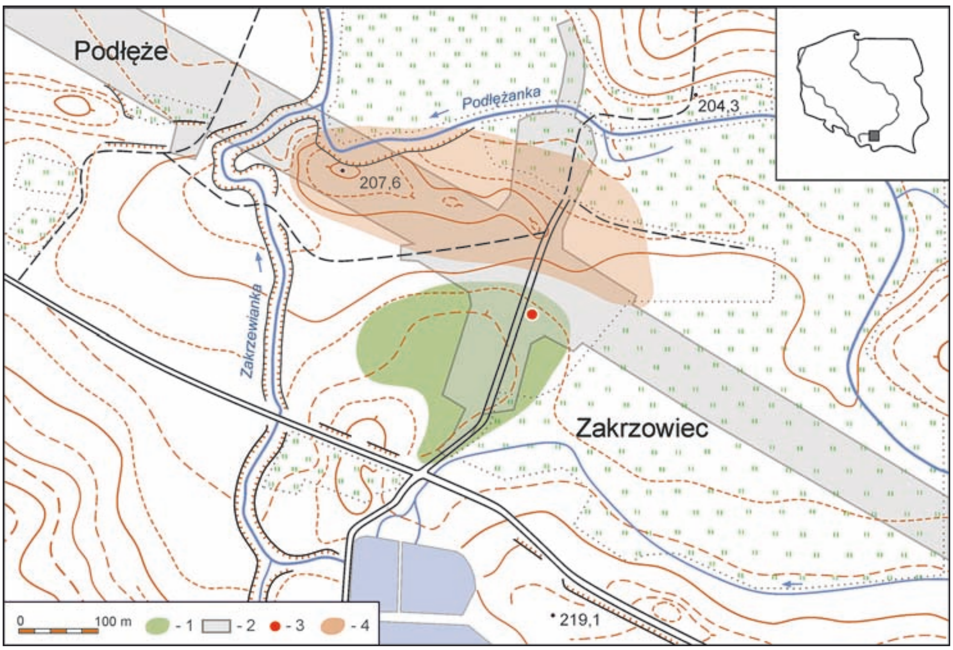

Fig. 1. Location of Site 7 in Zakrzowiec, Niepołomice commune, Wieliczka district: 1 – range of the archaeological site delineated on the basis of surface surveys, 2 – A-4 motorway, 3 – findspot of Grave 2128, 4 – extent of the Site 17 in Podłęże. Illustration by authors

The subject of this article is a single grave from Site 7 at Zakrzowiec, in which no human skeleton was preserved, and the grave goods consisted of two amphorae, the so-called 'milk jugs' (German term: Milchtopf, Hungarian term: tejesköcsög; on the function of vessels of this type see Craig *et al.* 2013). One of them has a unique decoration in the form of disc-shaped handles (Scheibenhenkels) and a circumferential zigzag pattern formed of short engraved lines (for a brief account of this find see Grabowska and Zastawny 2011, 127). This type of decoration on a 'milk jug' type amphora was previously unknown in the materials of the Wyciąże-Złotniki group.

SITE LOCATION AND RESEARCH HISTORY

The archaeological Site No. 7 in Zakrzowiec (Niepołomice commune, Wieliczka district, Lesser Poland voivodeship) is located within the Bochnia Foothills in the western part of the Sandomierz Basin. In geological terms, it is an undulating terrain, built of salt-bearing Miocene formations partly covered by Quaternary sediments, including loess (Kondracki 2011, 307; Solon *et al.* 2018). The Bochnia Foothills area is dominated by brown and rusty soils, while the river valleys are covered by muds (Richling and Ostaszewska 2009, 239, mapa 53.1). The site is located on a small elevation, sloping gently north-eastwards towards the Podłężanka stream bed and westwards towards another watercourse called Zakrzewianka (Fig. 1). In the south, the site is bounded by village buildings.

Site 7 in Zakrzowiec (AZP 103-58/95) was discovered in 1996 during surface surveys related to the planned construction of the A4 motorway (survey by J. Górski, E. Trela and M. Zając). Archaeological excavations began in 2000 and continued intermittently until 2007. The work was directed by the Cracow Team for Archaeological Supervision of Motorway Construction (Krakowski Zespół do Badań Autostrad), and the work was carried out by several teams led by: W. Machowski, I. Mianowska, M. Nowak, I. Wójcik, B. Roczkalski, J. and T. Rodak, P. Staniucha and O. Sabat-Maj. A total of 253.92 ares of area were surveyed. The result of the works was the investigation of a large number of stratified context and the recovering of over 65,000 portable artefacts, mostly attributed to the Lusatian culture of the Bronze and Early Iron Ages. The Eneolithic assemblage is the next most numerous, followed by artefacts generally dated to the Stone Age, Pomeranian culture, the Mierzanowice culture, the Late Bronze Age and modern period, and those without a defined chronology. More than 1,800 features (mainly utility pits) have been identified, including 71 Eneolithic features representing several units: the Funnel Beaker culture, Wyciąże group, Wyciąże-Złotniki group, and the Lengyel-Polgár complex in general.

DESCRIPTION OF THE FINDS

In the northern part of the surveyed area, at 30 m from the boundary of the excavation trench, a feature (No. 2128) interpreted as a grave of the Wyciąże-Złotniki group was discovered and surveyed in 2005 (Fig. 2). The shallow burial pit (Fig. 3), measuring 220 × 110 cm and 22 cm deep, was almost rectangular in plan-view and had a hollow-shaped bottom outline in the vertical section (Fig. 3: 3). It was orientated on the N-S axis (Fig. 3: 1). The fill of the feature in question on the south side was partially destroyed by a small pit No. 3235 (Fig. 3), the cultural affiliation of which has not been established (it contained no material). Two layers were identified in the burial pit: a shallow bottom layer, formed by greyish-yellow earth (Layer 2677a), and a grey earth layer of uniform structure, which was the main part of the feature's fill (Layer 2677). In the latter layer, burial furnishings were discovered, consisting of two vessels, placed side by side in a horizontal position (on their side) in the central part of the pit (Figs 3 and 4). The vessels, composed of almost 300 sherds of various sizes, were almost completely reconstructed (Fig. 5). They were placed in the shallow hollow of the main fill layer (Fig. 3: 2, 3). No other archaeological material was recovered from the feature under discussion. There were no skeletal remains.

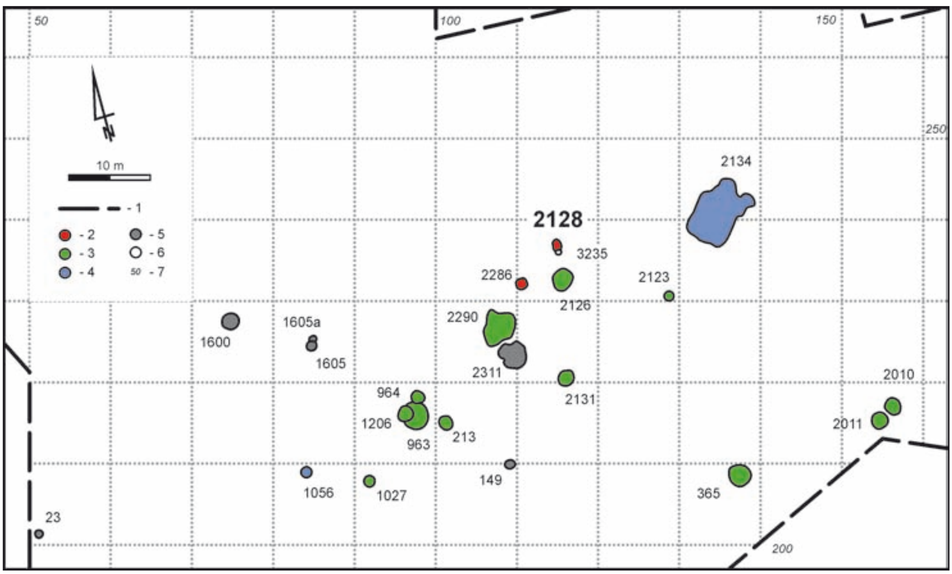

Fig. 2. Zakrzowiec, Site 7, Wieliczka district.
Plan with the distribution of archaeological features in the northern part of the excavated area: 1 – boundary of the excavated area, 2 – Wyciąże-Złotniki group, 3 – Wyciąże group, 4 – Lengyel-Polgár complex, 5 – Eneolithic, 6 – undetermined chronology, 7 – designation of the measuring grid.
Illustration by authors

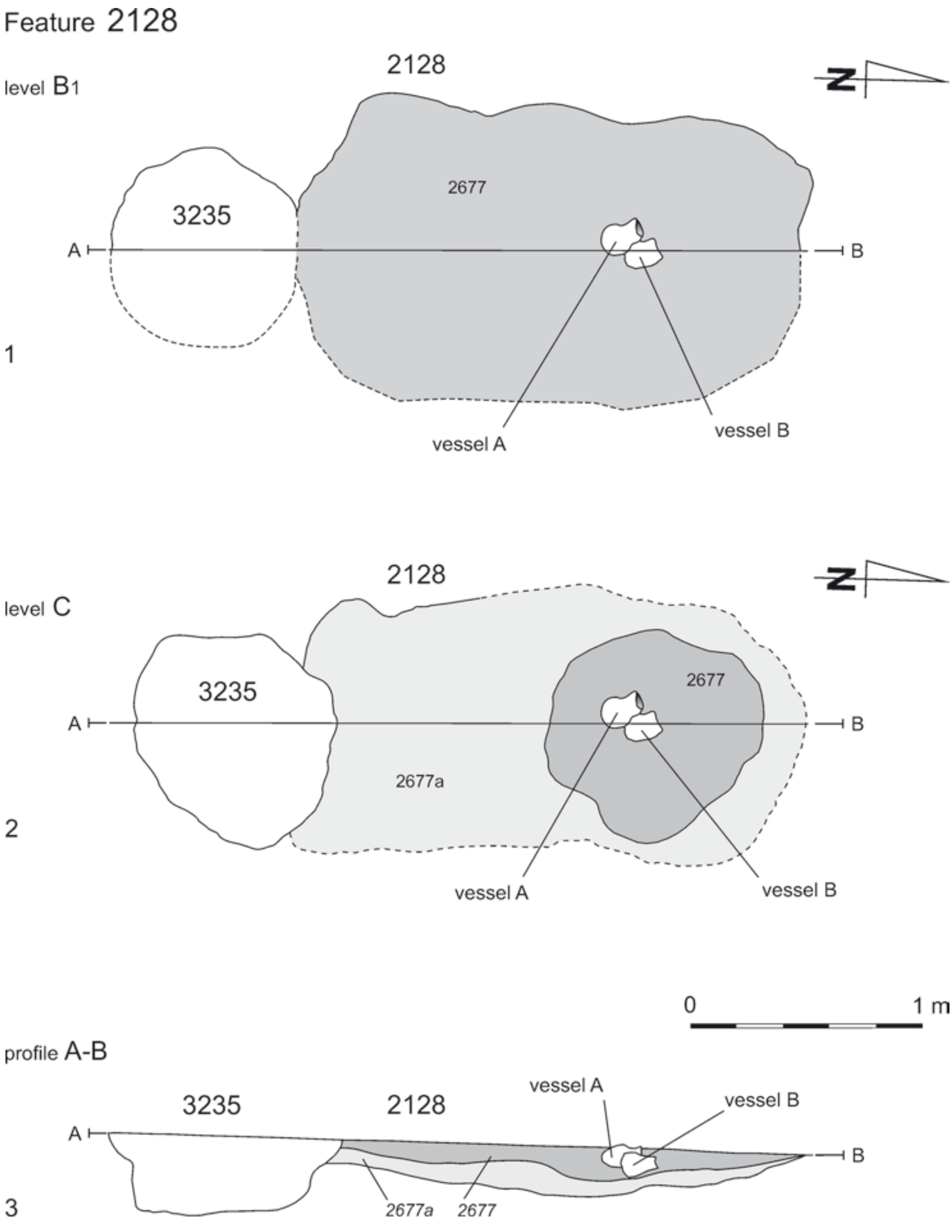

Fig. 3. Zakrzowiec, Site 7, Wieliczka district.
Plan views (1, 2) and cross section (3) of Grave 2128.
Illustration by authors

Fig. 4. Zakrzowiec, Site 7, Wieliczka district.
The view of Grave 2128 at different stages of excavation.
Photo by B. Roczkalski

Grave inventory

Vessel A

'Milk jug' type amphora, undecorated (Fig. 5: 2). A medium-sized, thin-walled vessel with a hemispherical belly and a high, arched neck, narrowing toward the rim and slightly everted lip. The boundary between the neck and the body is marked by a characteristic ledge in the form of a shallow groove and occurs exactly at the mid-height of the vessel. The vessel has two small handles protruding from the edge of the rim. The mouth of the vessel is not circular, but clearly oval. In the clay body, medium- to coarse-grained grog pellets are present, often with a diameter of more than 1 mm, fine-grained sand is also present in small amounts. The surface of the vessel is well finished and smooth. A thin layer of brick-beige colour is visible underneath the external brown slip layer, with a brown-black core of the vessel wall underneath. The vessel is well fired, but in many parts the external slip layer is peeling off.

Dimensions: height: 15.5 cm; diameter of the rim: 10.0-10.8 cm; diameter of the belly: 14.5 cm; diameter of the base: 5.0 cm, wall thickness: 0.5 cm.

Vessel B

Amphora of the ‘milk jug’ type with decoration (Fig. 5: 1; 6). A medium-sized, thin-walled vessel with a hemispherical belly and a high, conical tapering neck. The edge of the mouth, at which the two small handles are placed, is thickened and slightly everted. The neck is separated from the belly by a characteristic ledge in the form of a shallow groove and occurs exactly at the mid-height of the vessel. The mouth has a circular outline, while the base is oval. Both handles were formed in the Scheibenhenkel style, which means that

Fig. 5. Zakrzowiec, Site 7, Wieliczka district. ’Milk jug’ type amphora from Grave 2128: 1 – vessel B, 2 – vessel A. Illustration by authors

Fig. 6. Zakrzowiec, Site 7, Wieliczka district."milk jug" type amphora (vessel B) with decorative details. Photo by A. Susuł

an ellipsoid disc was applied to the attachment of the handle (see Fig. 5: 1 and 6). On the neck below the rim of the vessel is a 2 cm high horizontal zigzag pattern formed by short engraved lines (Fig. 5: 1; 6). This decoration occurs around the neck. The surface of the vessel is well finished and smooth. As in the case of vessel A, a thin brick-beige coloured layer is visible underneath the external brown coloured slip, with a brown core of vessel wall underneath. The vessel is well-fired, but the external slip layer is peeling off at the rim and the handles (Fig. 6). Medium to coarse-grained grog pieces are noticeable, and fine-grained sand is also present in small quantities. The clay body is well formed and non-staining.

Dimensions: height: 16.2 cm; diameter of the rim: 8.7 cm; diameter of the belly: 14.8 cm; diameter of the base: 5.2-5.8 cm, wall thickness: 0.5 cm.

DISCUSSION

Grave form

Despite the lack of skeletal remains in Feature 2128, its burial function is attested by several other features, most notably the structure of the feature and the uncovering of two whole (crushed) vessels lying side by side in the centre of the pit (Fig. 4). The burial pit, near-rectangular in plan-view and hollow-shaped in cross-section, was filled with earth forming two layers of identical texture and a slight difference in colour (Figs 3 and 4). This indicates that the pit in which the deceased and grave goods were deposited was backfilled once. The absence of skeletons in grave features (soil acidification) is a typical feature of Neolithic and Eneolithic burials discovered in the Wieliczka-Bochnia region south of the Vistula Valley, as well as in other neighbouring areas. The sepulchral character is confirmed in such cases precisely by the structures of the features, the type of fills, the presence of grave offerings and, in exceptional cases, the staining of the soil indicating that the deceased were interred in a crouched position (Czerniak *et al.* 2006; Grabowska and Zastawny 2014). Examples are the graves of the Linear Pottery culture from Brzezie 17 (Czekaj-Zastawny *et al.* 2009, 191-193), Targowisko 12, 13 (Czerniak 2013, 48, 49) and Łoniowa 18 (Valde-Nowak 2013, 100), the graves of the Malice culture from Targowisko 10, 11 (Grabowska and Zastawny 2014, 263-264) and Targowisko 12, 13 (Czerniak *et al.* 2006, 542, 543), as well as graves of the Wyciaże-Złotniki group from Modlniczka 2 (Czekaj-Zastawny and Przybyła 2012, 182-185) and Zagórze 2 (Kadrow *et al.* 2020, 14, 15).

The closest analogy to the Zakrzowiec grave discussed here is the aforementioned feature from Site 2 in Zagórze, Wieliczka district (Kadrow *et al.* 2020, 14-15, fig. 53). This feature (No. 494) is twice as small (110 × 60 cm), but has an identical rectangular outline, orientation on a near N-S axis, consistent fill, and no traces of a skeleton. The grave goods consisted of a copper axe. The second feature with very similar characteristics is the burial from Site 2 in Modlniczka, where an oval pit without a skeleton was oriented on the NW-SE axis and three vessels were placed in its northern part (Czekaj-Zastawny and Przybyła 2012, fig. 58: 1, 59). The oval or near-rectangular shape of the grave pits also characterises other burials of the Wyciąże-Złotniki group, discovered in two major funeral sites in Kraków Wyciąże 5 and Igołomia 1 (Kozłowski 1971, fig. 1; Kaczanowska 2009, 77). However, the orientation of the graves with skeletons in the cultural group in question differs, although arrangements on the N-S axis and with deviations from this axis prevail here, as in Zakrzowiec (Kaczanowska 2009, 77). This orientation of the burial pits is also typical of the Lublin-Volhynian culture (Zakościelna 2010, 65, 66). In the grave from Zakrzowiec, two 'milk jug' type amphorae were placed in the central part of the pit, closer to its northern edge. A similar arrangement of ceramic grave goods was found in the cemetery in Kraków Wyciąże 5, where skeletons arranged with their heads to the N and NE were accompanied by vessels placed near the skull and chest in the northern and central parts of the grave pit (Kozłowski 1971, fig. 1, tables II, III; Kaczanowska 2009, 79). The location of vessels at the NW edge of the pit was also recorded in the grave from Modlniczka 2 (Czekaj-Zastawny and Przybyła 2012, fig. 58: 1). Based on the above analogies, we can presume that Feature 2128 originally contained a human skeleton placed in a crouched position on its side, with the head to the N. Given the considerable size of the grave pit, it cannot be ruled out that this may have been a double burial. An example of probably such a burial is Grave 4-5 at Kraków-Wyciąże 5, in which three vessels were found, including an amphora of the 'milk jug' type (Kozłowski 1971, 69).

The grave discovered at Zakrzowiec therefore fits the general characteristics of the construction of the grave pits and the location of the grave inventory in the Wyciąże-Złotniki group. However, the rules of burying the dead were not uniform in this group (Kaczanowska 2009, 76-79). The lack of a preserved skeleton is a disadvantage in interpreting the find discussed here, as well as similar ones, which should be referred to as assumed burials.

The comparison of the features of the Zakrzowiec burial site should also be referred to the funerary ritual elements of the Eneolithic groups from outside the Lesser Poland region, especially the late Bodrogkeresztúr and Hunyadihalom-Lažňany cultures from the Carpathian Basin (see Nevizánsky 1984; Häusler 1994; Lichter 2001; Šuteková 2005), with which the Wyciąże-Złotniki group shows the most correlations (Kozłowski 1971, 95; 1989, 196; Kaczanowska 2009, 86; Nowak 2010, 80). The shape of the burial pit from Zakrzowiec (close to rectangular) finds good analogies in the cemeteries of the Bodrogkeresztúr culture, where a regularly rectangular outline of graves prevails, with the presence also of oval-shaped graves, *e.g.*, at Tiszapolgár-Basatanya (Bognár-Kutzián 1963, suppl. 2) and Tiszavalk-Kenderföld (Patay 1978, Abb. 2). This shape of grave pits is not surprising, as it is prevalent in the early Eneolithic cultures of southern Poland (see Zakościelna 2010; Wilk 2016; Mozgała-Swacha and Murzyński 2017). The untypically large dimensions of the feature from Zakrzowiec (220 × 100 cm) also have parallels in the aforementioned cemeteries (*e.g.*, Grave 123 at Tiszapolgár-Basatanya; Bognár-Kutzián

1963, 203 and Grave 29 at Tiszavalk-Kenderföld; Patay 1978, 21). In contrast, the orientation of the longer axis of the burial pits is different, with a dominance of the W-E axis in the Bodrogkeresztúr culture cemeteries (*e.g.*, Tiszavalk-Kenderföld; Patay 1978, Abb. 2, Szihalom-Sóhajtó; Szabó 1997, fig. 44) and Hunyadihalom-Lažňany (Šebastovce; Šiška 1972, 145). The location of grave goods, in particular ‘milk jugs’, is interesting. The set of pottery, usually placed near the head and chest of the deceased, generally includes one ‘milk jug’ (Bognár-Kutzián 1963, figs 109, 120, 131). Pairs of vessels of this type, *i.e.*, as at Zakrzowiec, are rarely encountered. Burials with two ‘milk jugs’ placed side by side are known (Tiszavalk-Kenderföld, Graves 48 and 51; Patay 1978, 29-31), as well as with three ‘milk jugs’ (Tiszapolgár-Basatanya, Grave 111; Bognár-Kutzián 1963, plate 104: 3, 5, 7). These vessels were placed at the head of the deceased (Tiszavalk-Kenderföld, Grave 48; Patay 1978, Abb. 45; single ‘milk jug’ in Urziceni-Vada Ret, Grave 39; Chmielewski *et al.* 2021, fig. 3), as well as next to the head and legs (Tiszapolgár-Basatanya, Grave 111; Bognár-Kutzián 1963, fig. 105). The discovery of two ‘milk jugs’ in a grave from Zakrzowiec therefore deserves to be highlighted. This is the first such case so far in the Wyciąże-Złotniki group in Lesser Poland, where burials equipped with only one such vessel have previously been known, *e.g.*, in Kraków Wyciąże 5 – Graves 4-5, 13, Igołomia 1 – Grave I (Kaczanowska 2009, 80).

Pottery

‘Milk jugs’ in the Wyciąże-Złotniki group

The vessels discovered in Zakrzowiec represent the so-called ‘milk jug’ type of amphorae. According to the authors of the article, they are thin-walled vessels of medium size, with a globular body, a conical neck tapering upwards and two small handles under the rim, symmetrically placed (Fig. 7). A characteristic morphological feature is the ledge in the form of a shallow horizontal groove that separates the belly from the neck and falls about in the mid-height of the vessel. The above definition corresponds to the characterisation of amphorae with handles in the type of ‘milk jugs’ by J.K. Kozłowski and J. Kamieńska (Kozłowski 1971, 76; Kamieńska and Kozłowski 1990, 80) and differs from the definition proposed by M. Kaczanowska and later by M. Nowak, who include in the group of ‘milk jugs’ (or more precisely, the amphorae-like vessels in the ‘milk jug’ type) both forms with and without handles (Kaczanowska 2009, 80; Nowak 2014, 253, 254). The ‘milk jugs’ known from the Lesser Poland area are deduced from the Bodrogkeresztúr culture (Kozłowski 1971, 76-78), in which the vessels described as ‘milk jugs’ are forms that vary in shape and proportion, but, originally, always with a pair of handles on the necks (Bognár-Kutzián 1963, 276; Patay 1975, 20, 21; 1976, 251; 1978, 49). Forms considered to be classic ‘milk jugs’ from the Carpathian Basin area are those with a slender neck, the height of which is clearly greater than that of the globular belly, with two handles on the neck (Bognár-Kutzián 1963, pl. 134: F1 2a, 92: 1, 103: 8; 109: 2; Patay 1978, Taf. 3: 9, 4: 6,

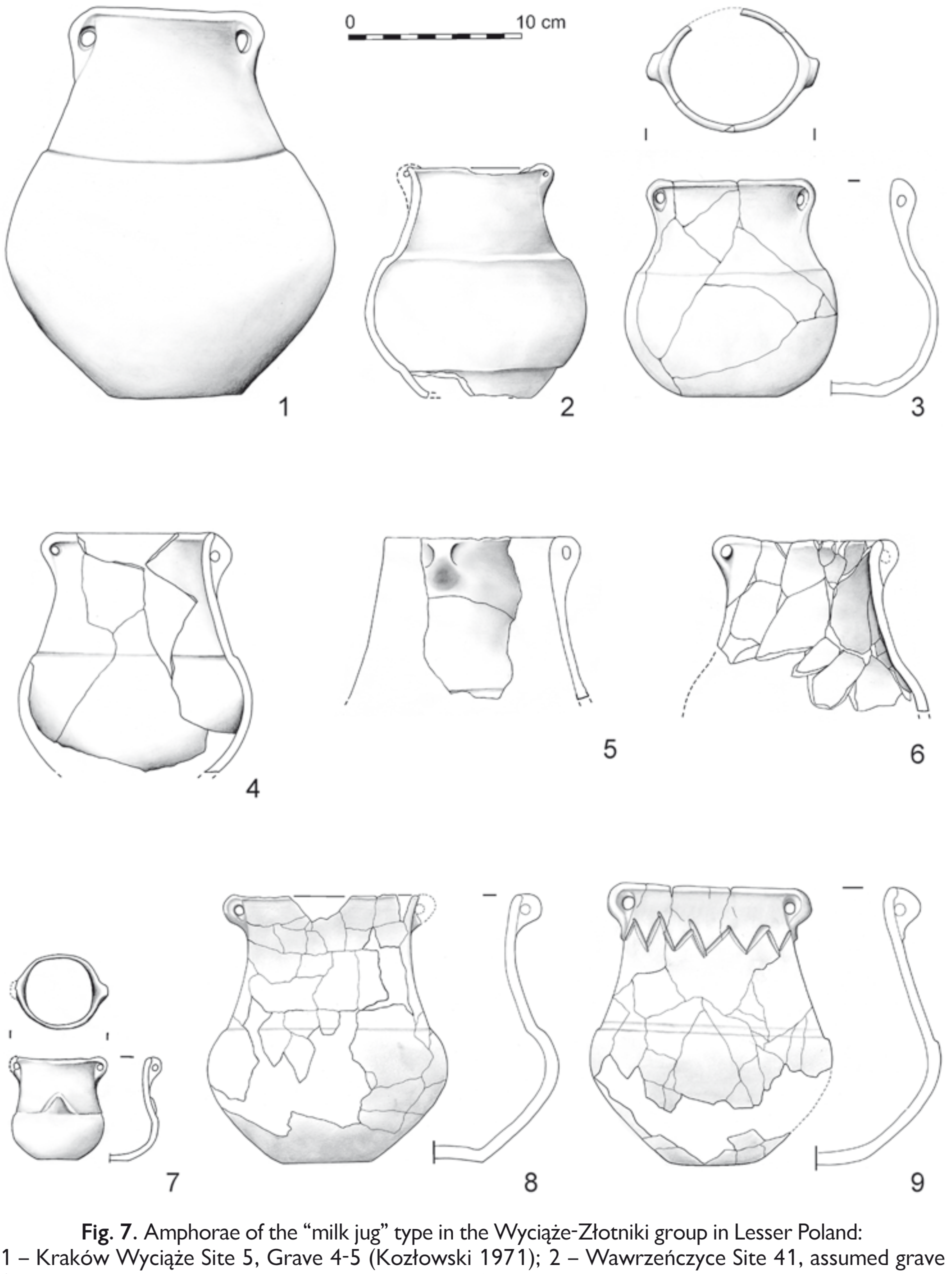

Fig. 7. Amphorae of the "milk jug" type in the Wyciąże-Złotniki group in Lesser Poland:
1 – Kraków Wyciąże Site 5, Grave 4-5 (Kozłowski 1971); 2 – Wawrzeńczyce Site 41, assumed grave (collection of the Archaeological Museum in Kraków); 3 – Kraków Krzesławice Site 68, assumed grave (unpublished); 4 – Złotniki Site 1, settlement (Dzieduszycka-Machnikowa 1966); 5 – Kraków Krzesławice Site 41, settlement (Kaczanowska 1988), 6 – Targowisko Site 16, settlement (Włodarczak 2004); 7 – Kraków Wyciąże site 5, grave no 13 /47/ (Kozłowski 1971); 8, 9 – Zakrzowiec Site 7, Grave 2128.
Illustration by authors

10: 8; Szabó 1997, 45, 176). Undecorated forms predominate, but there are also vessels with plastic decoration (mainly knobs, but also bands) and very richly ornamented (Bognár-Kutzián 1963, pl. 1: 1, 6; 6: 3, 4; 17: 5; Patay 1960; 1975, 21; Taf. 7, 8, 16: 1; 1976, 2. t. 2, 5; 9. t. 6; 1978, 49; 2008, fig. 1: 1, 5, 7, 8; fig. 2: 3; Virag 2013, 184).

Milk jugs belong to the basic taxonomic distinguishing features of the Wyciąże-Złotniki group in Lesser Poland (Dzieduszycka-Machnikowa 1966; 1969; Kozłowski 1968; 1971; 1986; 1989; 2006; Kamieńska and Kozłowski 1990) and are known from both settlement and grave sites (Figs 7 and 8), including two sites that are eponymic for this group: the cemetery in Kraków Wyciąże 5 (Kozłowski 1971) and the settlement in Złotniki 1 (Dzieduszycka-Machnikowa 1966). Entirely or almost entirely preserved 'milk jugs' (at least 11 vessels from eight sites) come from settlement pits from Złotniki 1 (one vessel; Dzieduszycka-Machnikowa 1966, fig. 6: a), Kraków Krzesławice 41 (two vessels; Kaczanowska 1988, pl. 1: 26, 27), Targowisko 16 (one vessel; Włodarczak 2004, fig. 12: 1), from graves in Kraków Wyciąże 5 (two vessels; Kozłowski 1971, tabl. 2. 4, Kaczanowska and Tunia 2009, figs 78 and 86), Igołomia 1 (one vessel; Kozłowski 1971, ryc. 2; Kaczanowska and Tunia 2009, fig. 71), Zakrzowiec 7 (two vessels; in this article) and assumed graves in Kraków Krzesławice 68 (one vessel; unpublished, collection of the Archaeological Museum in Kraków) and Wawrzeńczyce 41 (one vessel; Nosek 1937; collection of the Archaeological Museum in Kraków). Fragments of the discussed vessels (mainly lugs and upper parts of the neck) are known from further sites of the Wyciąże-Złotniki group, such as Chełm 1 (Zastawny and Brzeska-Zastawna 2018, fig. 4: 5), Brzezie 36 (Olejarczyk and Tyniec-Kępińska 2006, ryc. 2: D), Modlnica 5 (Grabowska and Zastawny 2011, ryc. 25: B), Zakrzów 8 (Fraś and Pawlikowski 2015, ryc. 2: h), Kraków Bieżanów 8 (Zastawny 2014, 46; Kaflińska 2012, fig. 14: d), Kraków Pleszów 17-20 (Kulczycka-Leciejewiczowa 1969, pl. 39: 4), Pobiednik 1 (collection of the Archaeological Museum in Kraków), Złotniki 1 (Dzieduszycka-Machnikowa 1966), as well as from settlement pits from the already mentioned sites with burials: Kraków Wyciąże 5 (Kozłowski 1968, 78) and Igołomia 1 (collections of the Institute of Archaeology and Ethnology of the Polish Academy of Sciences).

In addition to the inventories of the Wyciąże-Złotniki group, 'milk jugs' or forms similar to them are known from the Lublin-Volhynian culture assemblages (Gródek 1C; Zakościelna 2010, pl. 13: 3; 14a: 6), from Lower Silesia, from the graves of the Jordanów culture (Mozgała-Swacha and Murzyński 2017, 56, tabl. 47: 5) and from the famous find from Janówek (Czarniak 2012, ryc. 44a), which is interpreted as a burial of the Bodrogkeresztúr culture (Nowothnig 1939; Patay 1961; Kamieńska and Kozłowski 1970).

Vessel form and decoration

Both 'milk jugs' from Zakrzowiec have almost identical dimensions and proportions (Fig. 5), but differ in the decoration, which only one of the vessels has (vessel B; Fig. 6). In terms of shape and proportions, the vessels from Zakrzowiec are distinguished from other 'milk jugs' in the Wyciąże-Złotniki group by a relatively high neck, the height of which corresponds to exactly mid-height of the whole vessel, which is marked by a characteristic ledge (Fig. 7). Except for the miniature 'milk jug' from Kraków Wyciąże 5 (Fig. 7: 7), all other specimens (preserved whole) have shorter necks, *i.e.*, shorter than the height of the belly (Fig. 7: 1-3). This feature causes them to be generally squat vessels, making them similar to Ludanice culture 'milk jugs', considered evidence of contact with the Bodrogkeresztúr environment (Virág 2002, 99, figs 11, 12; Szilas and Virág 2017, 37, 41). In the Polish literature, the accepted opinion is that they differ from the 'classical' or 'original milk jugs' of the Bodrogkeresztúr, for which slender forms were considered (Dzieduszycka-Machnikowa 1966, 24; Kaczanowska 2009, 80; Nowak 2014, 254). However, it is worth noting that among the Bodrogkeresztúr 'milk jugs' there are very diverse forms. Among them, one can point out the common low 'milk jugs', with shorter necks of more squat proportions (*e.g.*, Bognár-Kutzián 1963, pl. 91: 3; 100: 3; 104: 3; Patay 1950, 25. t. 2; Patay 1961, 1.t. 17, 4. t.6, 9. t. 1, 21. t. 8; Patay 1978, 1. t. 3, 10. t. 8, 13. t. 5), to which the vessels of the Wyciąże-Złotniki group relate. The 'milk jugs' from Zakrzowiec are close to the F1 2b and 2c types according to the division of I. Bognár-Kutzián for the Tiszapolgár-Basatanya cemetery (Bognár-Kutzián 1963, pl. 134, 135, 103: 4, 104: 3, 106: 8), as well as forms from other sites, *e.g.*, Tiszasas-Kelem (Patay 1975, Taf. 8: 7) and Tiszavalk-Kenderföld (Patay 1978, Taf. 1: 2, 4: 8). The ledge, separating the neck from the belly, characteristic of the Wyciąże-Złotniki group, is also noted, although rarely, on 'milk jugs' of the Bodrogkeresztúr culture (Patay 1978, Taf. 6: 7; Virag 2013, pl. 6: 4).

The most important distinctive feature of the 'milk jugs' from Zakrzowiec is the decoration of one of them with plastic and engraved ornamentation, in the form of Scheibenhenkels and a circumferential zigzag (Fig. 5: 1; 6). The presence of these two types of decoration on one vessel and, at the same time, the presence of disc-shaped handles on a 'milk jug' find no analogy so far. From the inventories of the Wyciąże-Złotniki group, only one 'milk jug' with an ornament is known thus far, the already mentioned miniature vessel from Grave 13(47) from Kraków Wyciąże 5 (Kozłowski 1971, tab. 4), decorated with a plastic triangle, modelled from the wall, whose base coincides with the line of the ledge, separating the neck from the belly. For greater convexity, the upper arms of the triangle were edged with grooves (Fig. 7: 7).

The Scheibenhenkels on the 'milk jug' from Zakrzowiec are horizontally pierced handles emerging from the rim and ending at the neck with small, oval (elliptical) discs (Fig. 6). Handles of this type, differing in size and shape of discs, are known in western Lesser Poland from several sites with assemblages associated with different Eneolithic units (Fig. 8). In the Wyciąże-Złotniki group alone, they are known from Kraków Mogiła 55 (two handles on bowls; Kaczanowska 1986, figs 4 and 5), Modlniczka 2 (two handles on a bowl and vessel of indeterminate type; Czekaj-Zastawny and Przybyła 2012, fig. 53: 2, 3), Podłęże 17 (three fragments from vessels of undetermined type; Nowak 2010, fig. 13) and Zakrzowiec 7 discussed here (one vessel with handles from a grave and one handle from a settlement pit/unpublished/). From Site 5 in Modlnica come two vessels with discoid attachments under the handles (a pot and an amphora), associated with the so-called Modlnica type assemblages with pottery of mixed Funnel Beaker culture/Baalberge, Furchenstichkeramik, Epi-Lengyel traits (Zastawny and Grabowska 2011, fig. 11: 2). Several small fragments of Scheibenhenkels from vessels of unspecified types are known from the Funnel

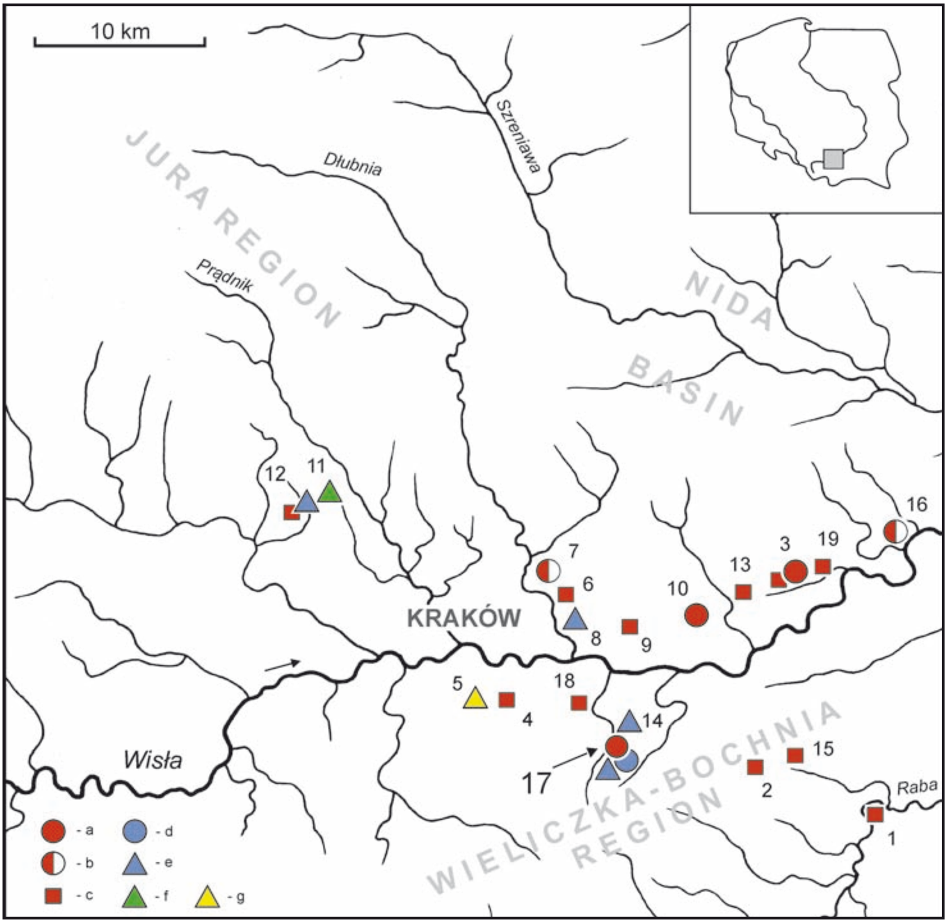

Fig. 8. Finds of vessels of the 'milk jug' type and vessels with *Scheibenhenkels* in Eneolithic assemblages in the Kraków region: a – 'milk jugs' from graves of the Wyciąże-Złotniki group, b – 'milk jugs' from probable graves of the Wyciąże-Złotniki group, c – 'milk jugs' from settlement sites of the Wyciąże-Złotniki group, d – Scheibenhenkels from grave of the Wyciąże-Złotniki group, e – Scheibenhenkels from settlement sites of the Wyciąże-Złotniki group, f – Scheibenhenkels from settlement site with assemblages of the Modlnica type, g – *Scheibenhenkels* from settlement sites of the Funnel Beaker culture
Sites: 1 – Brzezie Site 36, 2 – Chełm Site 1, 3 – Igołomia Site 1, 4 – Kraków Bieżanów Site 8, 5 – Kraków Bieżanów Site 30, 6 – Kraków Krzesławice Site 41, 7 – Kraków Krzesławice Site 68, 8 – Kraków Mogiła Site 53,55, 9 – Kraków Pleszów Site 17-20, 10 – Kraków Wyciąże Site 5, 11 – Modlnica Site 5, 12 – Modlniczka Site 2, 13 – Pobiednik Wielki Site 1, 14 – Podłęże Site 17, 15 – Targowisko Site 16, 16 – Wawrzeńczyce Site 41, **17- Zakrzowiec Site 7**, 18 – Zakrzów Site 8, 19 – Złotniki Site 1. Illustration by authors

Beaker culture settlement of Kraków Bieżanów 30 from the same horizon as the Modlnica type assemblages (Zastawny and Grabowska 2017, fig. 7; Zastawny 2018, fig. 2). From the Lublin-Volhynian culture cemetery in Książnice 2, a fully preserved vessel with handles of the type in question is known (Wilk 2016, figs 5 and 7). Almost all the above-mentioned fragments of vessels with Scheibenhenkels come from settlement pits. The exceptions are the vessel from the grave in Książnice 2 and the amphora from Zakrzo-wiec discussed here, which is the first 'milk jug' with Scheibenhenkels in Poland. Disc-shaped applications below the handles on vessels other than 'milk jugs' are also known from the Upper Silesian area (Kietrz-Łęgi, Racibórz Studzienna; Chmielewski 2014, figs 4 and 5). The occurrence of vessels with Scheibenhenkels (or Hunyadihalom) has a wide chronological and spatial range in central Europe, although the Middle Copper Age groups in the eastern part of the Carpathian Basin, the late Bodrogkeresztúr culture and above all the Hunyadihalom-Lažňany culture are considered to be the starting point for this style (Bognár-Kutzián 1969; Raczky 1991; Šiška 1972, 139; Patay 2005; 2008, 23; László and Sztáncsuj 2013). These handles are found in the Epi-Lengyel, Baalberg and 'transitional' units, characteristic of the end of the Lengyel-Polgár complex and the Funnel Beaker culture (see Ruttkay 1988; 1997; Raczky 1991; Koštuřik 2007; Zastawny and Grabowska 2011; 2017; Chmielewski 2014; Šmíd and Kalábková 2015; Šmíd 2017). This horizon actually closes with the appearance of the Boleráz culture (which we can synchronise more or less with the beginning of the 'classic' Funnel Beaker culture boom in Lesser Poland). As far as 'milk jug' forms with Scheibenhenkels are concerned, only two such vessels are known to the authors of this article: from Grave 133 in Tiszapolgár-Basatanya (Bognár-Kutzián 1963, 213, 277, 112: 14) and from Szabolcs (Patay 1950, 113, 32: 2). Both of these vessels have handles placed below the edge of the rim and are associated with the late Bodrogkeresztúr culture.

The decoration in the form of grooves arranged in a horizontal zigzag at the level of the attachments of the Scheibenhenkels is the second type of ornament on 'milk jugs' from Zakrzowiec (Fig. 5: 1; 6). This ornament has so far no analogue in the ornamentation of the pottery of the Wyciąże-Złotniki group. A similar motif in the form of a zigzag, located on the maximum protrusion of the belly (made in the Furchenstich technique in the opinion of P. Roman 1973, 72), can be indicated on a vessel of the Bodrogkeresztúr culture in the form of a vessel from Unirea, Romania (Vlassa 1964, fig. 2: 5, 359). Zigzag arrangements, however, mostly made with a different technology (plastic bands) have been recorded on vessels of the Hunyadihalom-Lažňany culture (Šiška 1972, abb. 29: 5). The most similar motif to the zigzag from Zakrzowiec occurred on a single quadrilateral goblet from Tiszalúc (Patay 2005, 83, Taf. 21: 16). Engraved motifs also occur in various arrangements in the Jordanów culture (*e.g.*, Mozgała-Swacha and Murzyński 2017, pl. 12: 1). The ornament of the horizontal zigzag made by the engraving technique is therefore an exceptional motif in the development horizon of the Wyciąże-Złotniki group and chronologically similar groups of the Carpathian Basin. Instead, it evokes associations with vessel decoration in slightly younger units: the"classic" Funnel Beaker culture (*e.g.*, on a vase from Bronocice, where it symbolises water; Milisauskas *et al.* 2016) and the Boleráz and Baden cultures (*e.g.*, on wagon models and many vessel types; *e.g.*, Bondár and Raczky 2009; Farkaš 2010; Burmeister 2011).

CHRONOLOGICAL AND TERRITORIAL CONTEXT OF THE FINDS

It was not possible to obtain material for radiocarbon dating from the burial feature from Zakrzowiec 7. Both amphorae in the 'milk jug' type are interesting material for analysis in the scope of relative chronology, however. The typological form of both vessels reliably links them to the group of Wyciąże-Złotniki of the Lengyel-Polgár complex in western Lesser Poland. A 'milk jug' decorated with disc-shaped handles and a horizontal zigzag pattern arranged with grooves has no direct analogy in the cultural units of the Eneolithic of Central Europe. As previously written, two 'milk jugs' with Scheibenhenkels (without additional ornamentation) are known in the Bodrogkeresztúr culture, from Tiszapolgár-Basatanya (Bognár-Kutzián 1963, pl. 112: 14) and from Szabolcs (Patay 1950, pl. 32: 2). The location of the 'milk jug' in the Tiszapolgár-Basatanya cemetery is particularly interesting. It was discovered in Grave 133, belonging to the southeastern cluster of burials (D cluster; Patay 2008, 44), linked to the late Bodrogkeresztúr culture and at the same time the latest phase of the cemetery's use (Bognár-Kutzián 1963, 277; Patay 2008, abb. 7; Raczky and Siklósi 2013, 566, fig. 2). At least some of the assemblages from cluster D in the Tiszapolgár-Basatanya cemetery (Patay 2008, 44, fig. 7), to which Grave 133 with the 'milk jug' with Scheibenhenkels belongs, represent elements typical of the end of the Middle Copper Age, characteristic of the Hunyadihalom-Lažňany horizon. The time of development of the latter is placed within the period c. 4000/3900-3800 BC (Brummack and Diaconescu 2014).

The development of the Wyciąże-Złotniki group is placed in the broad time frame of 4300-3800/3750 BC (Nowak 2014, 250) or between 4250-4050 and 3650-3550 BC (Nowak 2017, 262, fig. 22). As already indicated, the pottery from Zakrzowiec has features corresponding to the late B2 stage of the Bodrogkeresztúr culture and can, according to the findings of absolute chronology in the Carpathian Basin, be more closely associated probably with the very late phase of this unit, the transition period to the Hunyadihalom culture (4050-3950 BC according to Chmielewski 2019, 29, 31). Synchronicity with a slightly younger episode corresponding to the latter phenomenon also cannot be ruled out (4000/3950-3800/3750 BC; Brummack and Diaconescu 2014, 252; Chmielewski 2019, 29). These proposals are supported by the suggestion of M. Nowak (2010, 82-85) regarding the dating of the settlement of the Wyciąże-Złotniki group in Podłęże 17.

As mentioned previously, in addition to Grave 2128 discussed here, only two more settlement pits associated with the Wyciąże-Złotniki group have been discovered at Site 7 in

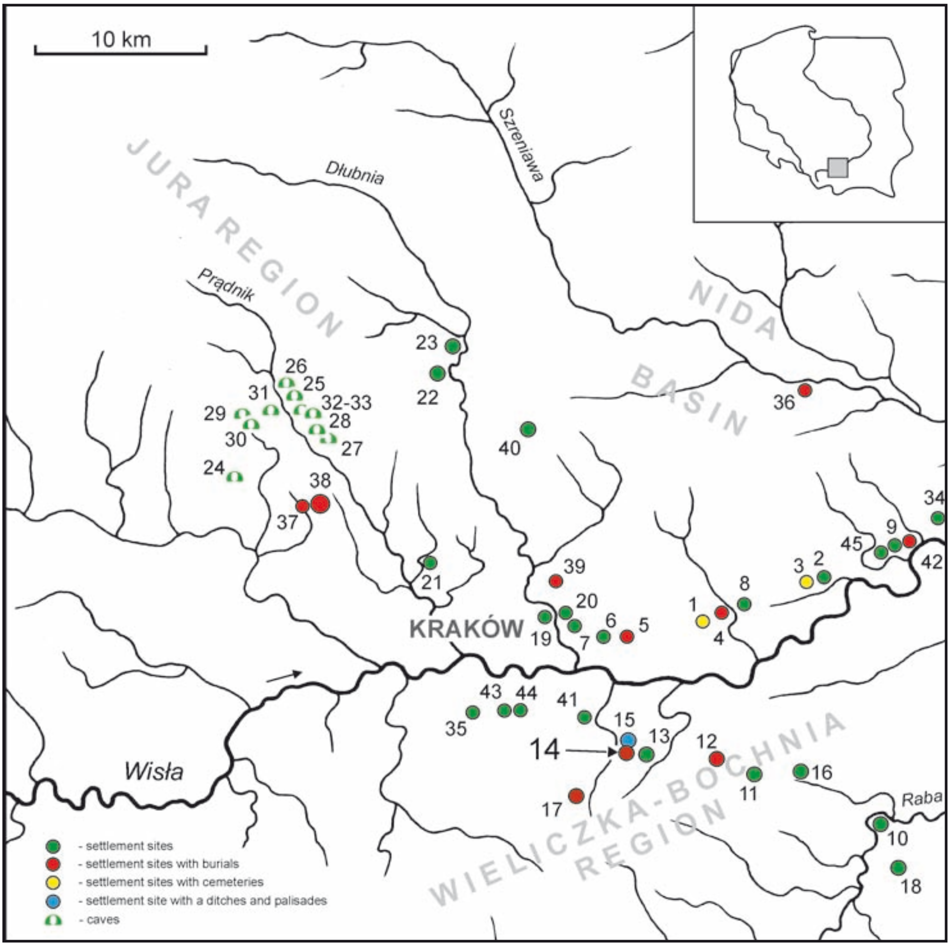

Fig. 9. Sites of the Wyciąże-Złotniki group of the Lengyel-Polgár complex in the Kraków region (Grabowska and Zastawny 2011, supplemented; Nowak and Tunia 2021)

Sites: 1 – Kraków Wyciąże Site 5, 2 – Złotniki Site 1, 3 – Igołomia Site 1, 4 – Kraków Cło Site 7, 5 – Kraków Pleszów Site 17, 6 – Kraków Mogiła Site 62, 7 – Kraków Mogiła Site 53,55, 8 – Pobiednik Wlk., Site 1, 9 – Wawrzeńczyce Site 37-40, 10 – Chełm Site 1, 11- Brzezie Site 36, 12 – Zagórze Site 2, 13 – Zakrzowiec Site 6, **14 – Zakrzowiec Site 7**, 15 – Podłęże Site 17, 16 – Targowisko Site 16, 17 – Bodzanów Site 1, 18 Moszczenica Site?, 19 – Kraków Bieńczyce Site 12, 20 – Kraków Krzesławice Site 41, 21 – Kraków Witkowice Site II, 22 – Damice Site10, 23 – Iwanowice Dworskie Site 1 (Babia Góra I, II), 24 – Bolechowice Site 1 (Bezimienna Cave), 25 – Ojców (Oborzysko Małe Cave), 26 – Ojców Site 18 (Ciemna, Oborzysko Wielkie Cave), 27 – Maszyce Site 12 (Górna w Ogrojcu Cave), 28 – Ojców Site 14 (Główna w Kopcowej Górze Cave), 29 – Wierzchowie Site 2 (Wierzchowska Górna Cave), 30 – Wierzchowie Site 1 (Mamutowa Cave), 31 – Biały Kościół Site? (Nad Dziurawcem Cave), 32 – Ojców Site 2 (Główna w Okopach Cave), 33 – Ojców Site 3 (W Okopach Wielka Dolna Cave), 34 – Nowe Brzesko Site 24, 35 – Kraków Kurdwanów Site 8, 36 – Proszowice Site 24, 37 – Modlniczka Site 2, 38 – Modlnica Site 5, 39 – Kraków Krzesławice Site 68, 40 – Pielgrzymowice Site 9, 41 – Zakrzów Site 8,42 – Wawrzeńczyce Site 41, 43 – Kraków Bieżanów Site 8, 44 – Kraków Bieżanów 15, 45 – Wawrzeńczyce Site 32, 33, 35.
Illustration by authors

Zakrzowiec. One of them (Feature 2286) is located in the immediate vicinity of the grave (Fig. 2), while the other (Feature 510), is located in the southern zone of the study area and more than 100 m away from Features 2128 and 2286. The close distance (approx. 150 m) that separates Zakrzowiec from the large settlement of the Wyciąże-Złotniki group from Site 17 in Podłęże (Nowak 2010) makes it possible to merge the two sites into a single settlement complex (Fig. 1), consisting of a settlement and a funerary zone (grave or cemetery?) located on its periphery. Zakrzowiec and Podłęże belong to a larger cluster of traces of prehistoric settlement associated with the right-bank part of the Vistula basin near Kraków, known as the Wieliczka-Bochnia region. More than a dozen sites of the Wyciąże-Złotniki group originate from here, marking the southern limit of the range of the entire settlement of this cultural group (more than 40 sites), with the centre on the left bank of the Vistula east of the centre of Kraków (Fig. 9). Currently, 29 graves of the Wyciąże-Złotniki group are known in the Lesser Poland region (*cf.*, Kaczanowska 2009, 75, 76; Grabowska and Zastawny 2011, 118, fig. 35). Eighteen inhumation burials come from two cemeteries accompanying the settlements (13 graves in Kraków Wyciąże 5; five graves in Igołomia 1). The others include three single skeletal burials (Kraków Pleszów 17-20, Kraków Cło 7, Proszowice 24), four graves in which no skeletons were preserved (Zakrzowiec 7, Zagórze 2, Modlnica 5, Modlniczka 2) and four probable graves (Bodzanów 1, Kraków Krzesławice 68, Wawrzeńczyce 41, Koniecmosty 1).

SUMMARY

Investigations at two neighbouring archaeological sites, no. 7 in Zakrzowiec and no. 17 in Podłęże resulted in the discovery of interesting settlement relics of the Wyciąże-Złotniki group of the Lengyel-Polgár complex. The large settlement in Podłęże, partly fortified, and the single grave and two settlement pits from Zakrzowiec probably constituted a spatially and chronologically coherent settlement complex. The grave from Zakrzowiec, located on the periphery of the settlement zone, may have been part of a larger cluster of graves located outside the surveyed zone. In the grave discussed in the article, human remains were not preserved, and the equipment consisted of two 'milk jugs', one of which has a unique decoration in the form of Scheibenhenkels and a circumferential zigzag pattern formed of short, engraved lines. This is the first such decoration on 'milk jug' type amphorae known from the Lesser Poland region. The decorative features of this vessel make it possible to connect the time of the grave's creation with the period corresponding to the late Bodrogkeresztúr culture (stage B2), with pottery decorated, among other things, with *Scheibenhenkels*, *i.e.*, to the period of the turn of the 5th and 4th millennium BC and the beginning of the 4th millennium BC.

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VYNNYKY-LYSIVKA, LVIV DISTRICT. COMPARISON OF THE RESULTS OF ARCHAEOLOGICAL AND GEOMAGNETIC RESEARCH

ABSTRACT

Hawinskyi A., Przybyła M. M. and Rybicka M. 2024. Vynnyky-Lysivka, Lviv district. Comparison of the results of archaeological and geomagnetic research. *Sprawozdania Archeologiczne* 76/2, 253-276.

Archaeological research in 2023 at the Vynnyky-Lysivka site provided the basis for interpreting the results of geomagnetic work carried out in 2017. The excavations in 2016 resulted in the discovery of clusters of fired clay daub fragments, constituting the remains of the Funnel Beaker Culture household. It was assumed that non-invasive research would show the locations of other such features. However, the results of geomagnetic surveys were difficult to interpret- just like in Gordineşti II-Stînca goală. In the course of the investigation, numerous anomalies were identified, mainly of a dipole nature and less numerous point-positive anomalies.

A very weak source of anomalies turned out to be a clearly visible Eneolithic ditch cutting of the Funnel Beaker Culture settlement. The discovery in 2023 in the central part of the Vynnyky-Lysivka settlement of a cluster of pits in the place where anomalies were distinguished in non-invasive studies provided the basis for a reinterpretation of geomagnetic surveys.

Keywords: Funnel Beaker Culture, western Ukraine, geomagnetic research, Late Trypillia Culture, Gordineşti group

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INTRODUCTION

The Funnel Beaker Culture (FBC) site in Vynnyky-Lysivka, near Lviv, is situated upon a plateau of the elevation of land, which is well visible from all sides and afar (Figs 1 and 2). Archaeological excavations have repeatedly been performed there, including those led by Mykola Peleschyshyn, as a result of which, a great series of Funnel Beaker pottery finds as well as some agglomerations of fired clay daub were discovered (Havinskyj 2013). However, it seems not so easy to define the exact function of the latter. The archaeological discoveries have nonetheless clearly signalised that there is a settlement site of the FBC on Mount Lysivka. The most important fact, however, was that in 2013, Andrii Havinskyi identified a series of storage and/or waste pits containing copious finds attributed to the FBC (Hawinskyj *et al.* 2021). These pit features became another valuable piece of evidence for a permanent FBC habitation area upon Lysivka.

To answer the questions whether fired clay daub agglomerations recovered upon Mount Lysivka were house debris (since they do not represent some sort of furnaces), and if so, what kinds of structure those houses might have been regular field research was relaunched in 2016, due to which FBC house debris was observed, the residues of which looked like multiple clay lumps of various degrees of burning (Diachenko *et al.* 2019; Hawinskyj and Rybicka 2021). This research was carried out as part of the project entitled: 'Between the East and the West. Dynamic of Social Changes from the Eastern Carpathians to the Dnieper in the 4th – beginning of 3rd Millennium BC'. Both the construction technology

Fig. 1. Location of Vynnyky-Lysivka, Lviv region (Ukraine) and Gordineşti II-Stinca goală, Edinet region (Moldova) on the map of Europe

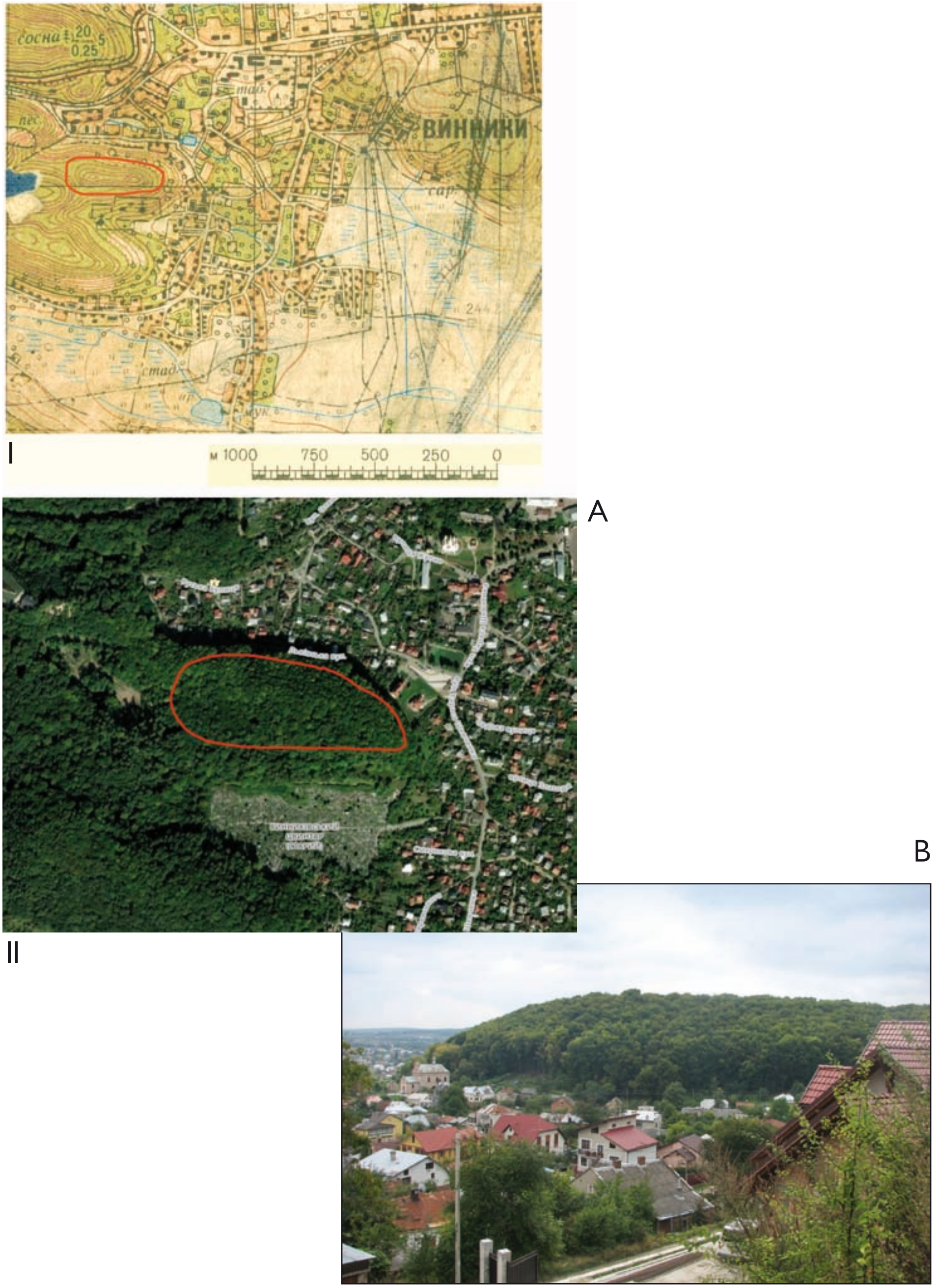
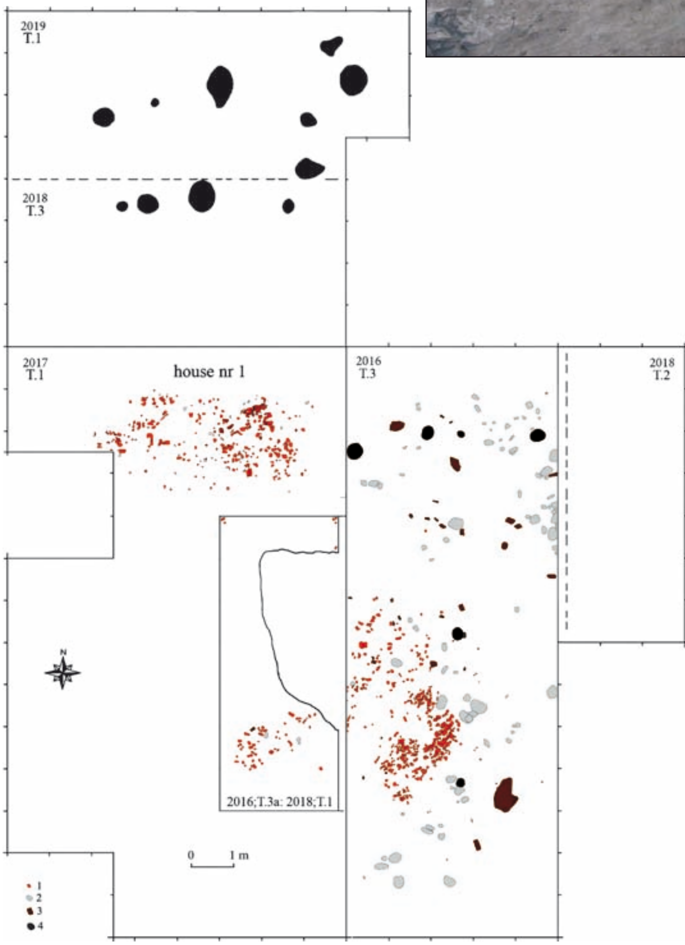


Fig. 2. Vynnyky-Lysivka, Lviv region. A: Location of Funnel Beaker culture site. After Hawinskyj and Rybicka 2021, fig. 1; modified. I – map at scale 1: 25000; II – after https://lv.2ua.org/vynnyky/mapa/sat/; B: View of the site from the north side. After Hawinskyj and Rybicka 2021

A



B

Fig. 3. Vynnyky-Lysivka, Lviv region. A: cluster of burnt daub fragments from the southeastern part of House No. 1 from 2016 (after Hawinskyj and Rybicka 2021); B: distribution of burnt daub in the trenches from 2016-2019: 1 – burnt daub; 2 – sandstone; 3 – preserved wood; 4 – post-holes (after Hawinskyj and Rybicka 2021, fig. 5; modified)

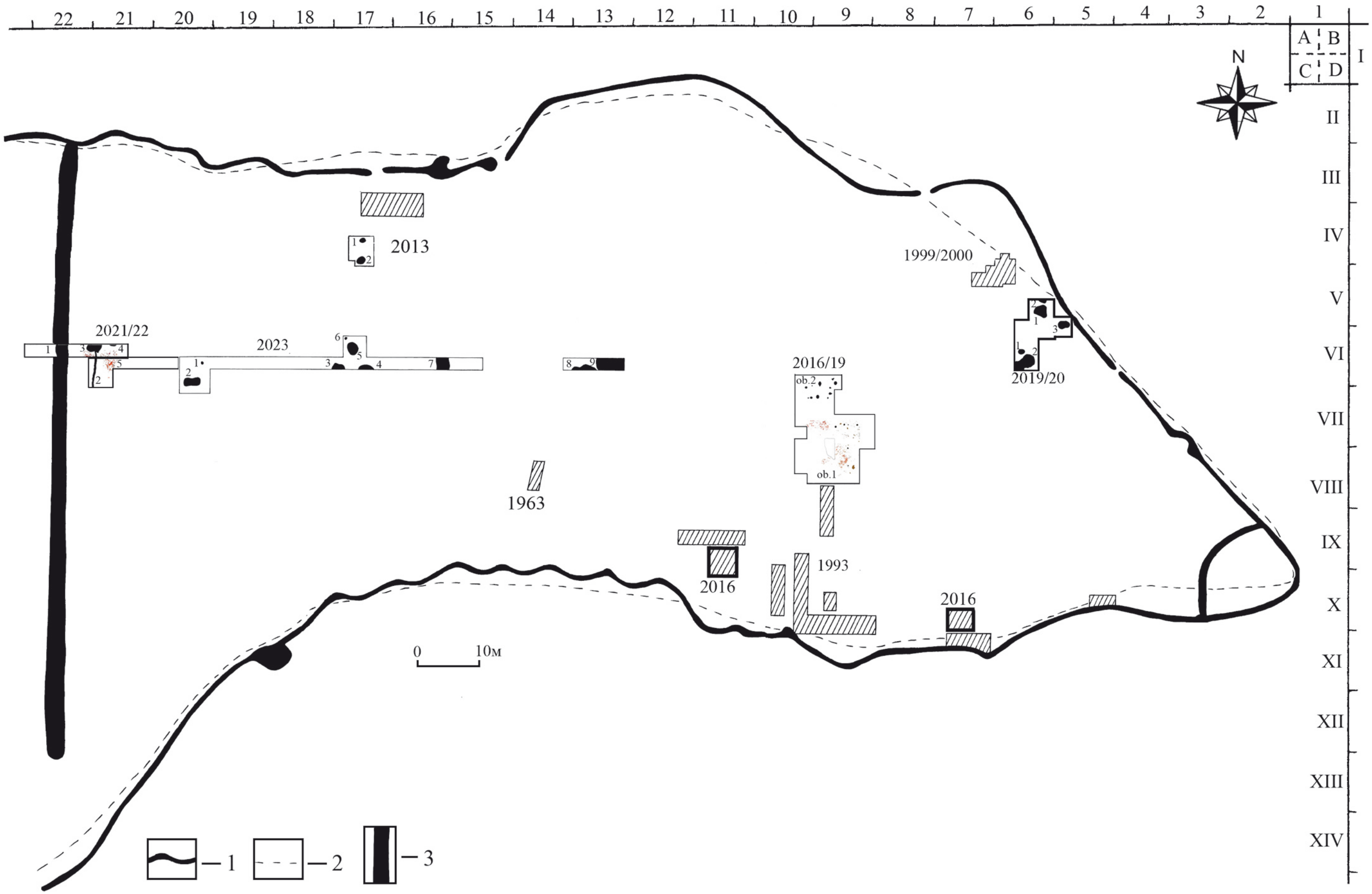


Fig. 4. Vynnyky-Lysivka, Lviv region. Location of trenches: 1 – border of military transects; 2 – elevation flattening border; 3 – ditch (after Hawinskyj and Rybicka 2021, figs 1 and 3; modified)

specific to the building and the structural elements of this latter clearly relate to those of the domestic structures reported to be characteristic of the Eastern Group of the FBC and do not correspond to the famous ‘platforms’ of the Trypillia Culture (Fig. 3: A; Hawinskyj and Rybicka 2021). The discoveries in 2016 in Vynnyky constituted the basis of defining the research framework for further excavations at the archaeological site upon Mount Lysivka. This aimed above all to specify how many houses might have been there, and then whether all of them had a similar structure, and what the spatial development of the village was; another interesting point was the chronological position of the examined FBC features.

The hill of Lysivka is now covered with an age-old mixed forest, a fact that hinders the search for visible evidence of the earlier habitation, regardless of whether one is observing the surface of the earth or digging through it (Figs 2: B and 3: A). Since 2016, relatively small expanses from 50 to 200 square meters were only covered by field research (Fig. 4). It is the forest upon Lysivka which causes the excavation units to be only placed in the free spaces where they will not harm the trees (Fig. 3: A). In 2016 and 2017, such gentle diggings were primarily located in the centre of the plateau as well as in its southern and northeastern portions. The evidence of dwelling structures is basically marked by clay daub debris (house No. 1), and it was only observed in the unit situated in the south-to-centre part of the highland (Figs 2 and 4). The discovery of the clay daub cluster, along with the difficulties of identifying more similar features, has formed the basis for attempting to use some non-invasive approaches to detecting the archaeological features. Hence, in 2017, the highland’s terrain was subjected to geomagnetic surveys by Marcin M. Przybyła. It is again the woods on the hill which cause troubles to geomagnetic surveys, especially in the northeastern part of the site, with dense bushes and thick windfall. It was assumed, however, that it is exactly this approach that enables the identification of further clay daub agglomerations similar to those forming the debris of House No. 1 (Fig. 3; Hawinskyj and Rybicka 2021). Thus, in the following years, 2018-2023, the excavation works continued, the outcome of which partly corresponded to the results of non-invasive fieldwork.

The following section of the paper is going to represent some effects of geomagnetic surveys and provide some introductory data on archaeological exploration that took place throughout the expanse covered by the non-invasive work. The outcomes of these both are then compared with each other.

GEOGRAPHICAL LOCATION OF THE SITE

The free-standing Mount Lysivka is located in the southeastern part of the Roztocze hills (Kondracki 1988). Its height is 321 meters above sea level (Fig. 2: A), and the mountain body is mostly oriented east and west. The broadness of the plateau lies between 80 and 100 meters; it reaches 130 and even 150 meters in its western part, with a length of 400 meters (Hawinskyj and Rybicka 2021, 15). The GPS coordinates for the eastern and western parts of the hill are N49 48'43.9488" E24 7'55.0884" and N49 48'46.2564" E24 7'38.0172", respectively. On its southeastern side, Mount Lysivka borders the broad valley of the Marunka River, a tributary of the Zakhidnyi Buh River, while the FBC settlement is on the plateau of the hill, and the height difference between the plateau and the river valley reaches 80 meters.

The stratigraphy of this area varies greatly. The upper layers are composed of contemporary humus. Beneath it, strata of sediments resembling loess are found, coloured grey to dark grey; in the central part of the hill, they are found at a depth of 0.4 to 1.0 m. Even lower, a level of a dark orange stratum is observed, up to 20 cm thick, with the sandstone and, in places, limestone formations lying underneath it; these both are the bedrock of the place. On the northern edge of the hill, rocks are found already at a depth of c. 0.3 to 0.4 m; the same is true for the south-to-centre part of the hill (*e.g.*, close to House No. 1; Fig. 3; Hawinskyj and Rybicka 2021). The sedimental strata of the upper part of the sequence are not so thick there. The sandstone slabs are so soft that they are often drilled through by the roots of the trees. The level of rocks is uneven. Both in the centre and the north-to-centre part of the area, the fill of the storage and/or waste pits is basically black.

ARCHAEOLOGICAL RESEARCH (2016-2023)

In 2016-2019, remnants of an FBC dwelling feature were investigated (Hawinskyj and Rybicka 2021), represented by loose pieces of baked clay daub along with a row of postholes that remained from the eastern wall of the building (Fig. 3). The house debris was found lying in the loess-like sediments having c. 0.2 m of thickness just beneath the contemporary humus layer. There were no rather big agglomerations of large-sized pottery sherds around the house. The bedrock was reported to be found already at a depth of c. 0.4 m below the present-day surface (Hawinskyj and Rybicka 2021, Fot. 3: A).

In 2019-2023, both the central and western parts of the site in Vynnyky-Lysivka were subjected to field research. In 2021, the excavations expanded along the segment of the moat, which was well observable against the terrain in the centre of the site. The moat once served as a fortified border in the west of the FBC village, and the excavations have uncovered some 34 square meters of it. The outlines of the moat itself were detected primarily at a depth of 0.6 m below the present-day surface, while at a depth of 0.8 m, they appeared to be well visible (Fig. 5: A). The refill of the moat consisted of black sediments. The moat was 1.9 and 2.1 m wide in its southern and northern parts, respectively. In profile, the moat has a trapezoidal shape, with a flat bottom of some 0.8 m wide and a depth of 1.2 m below the present-day surface (Fig. 5: B). The local bedrock is formed of sandstone lying below the present-day surface at a depth of c. 0.8 to 1.0m. In the fill of the moat, a total of 37 FBC

A

B

Fig. 5. Vynnyky-Lysivka, Lviv region. A: View of the moat (60 cm below ground level); B: Vynnyky-Lysivka, Lviv region. View of the moat (80 cm below ground level)

Fig. 6. Vynnyky-Lysivka, Lviv region.
A cluster of burnt daub, which is a remnant of the sealing of the palisade

pottery shards were recovered, while at a depth of 0.8 m, only two fragments of vessels attributed to the Trypillia Culture were found. It is interesting that at a depth of 0.6 m, a small pottery sherd was recovered, displaying attributes of the technology of making pottery of the Mierzanowice Culture.

In the year 2022, archaeological research continued in the region near the moat. On the eastern side of it, another trench was excavated, with an area of 20 square meters. An agglomeration of burnt clay daub was recovered within the area of 2.2 × 2.4 m next to the eastern wall of the moat, at a depth of 0.6 to 0.8 m (Figs 6 and 7). In addition, with an eye to clarifying the situation around the moat, a trench (12 × 2 m) was made east of it (Fig. 4). The agglomeration of the debris was 6 × 1.2 m east and west, and 3.6 × 2.2 m north and south. Basically, the pieces of dark orange clay daub in the agglomeration were small, and some pieces of clay appeared to be visibly overheated. It was only in the centre of the agglomeration that the pieces of clay daub were 10 to 20 cm in size. The outside of the burnt clay daub was smooth, with no imprints of wood there, while other pieces displayed impressions of stakes, up to 8 cm in diameter, from the inside; the biggest blocks of daub were observed to contain some timber impressions as well, having 12 to 20 cm in diameter.

In the agglomeration of burnt clay daub, 30 FBC pottery fragments and seven flint artefacts were recovered, while 21 FBC pottery fragments and four flint artefacts were recovered from beneath the agglomeration.

A

B

Fig. 7. Vynnyky-Lysivka, Lviv region.
A: view of the moat and palisade trench; B: View of the palisade trench

Next to the cluster of clay daub fragments, a trench was identified east of the moat. When looking east and west, the clay daub debris was superimposed upon this trench, which showed from under the agglomeration on both sides of the latter (Fig. 7). A metre to the west of the burnt clay debris, the trench was up to 40 cm in width (Fig. 6).

The trench was 14 to 40 cm deep, 40 to 50 cm wide, and had a flat bottom 20 cm across. In some parts of the feature, a series of postholes was observed, with a diameter of 25 to 34 cm. In cross-section, three of these appeared to be placed next to each other and pointed on their bottom. The fill of the trench consisted of black sediment resembling loess; in total, 60 small-sized FBC pottery fragments and some flint artefacts were recovered there. The feature under study was primarily detected at a depth of 80 cm below the present-day surface, and is interpreted as representing the remains of a palisade (Fig. 7) that ran parallel to the moat (Figs 7 and 8). The agglomeration of burnt clay daub could hardly represent debris of a dwelling structure, since the pieces of clay from which it consisted have rather been used for plastering the palisade, as the description of the daub has already shown.

In the year 2023, two more exploratory Trenches (numbered 1 and 2) were excavated in the central part of the hill (Fig. 4). Trench 1 was 50 × 2 m, and Trench 2 south of the first was 1 × 2 m. Trench No. 1 was then expanded to reach 128 square metres, and so it became big enough to cover the newly discovered features Nos 2/2023 (Fig. 9), 4/2023 (Fig. 10) and 5/2023 (Fig. 11). The stratigraphy of the explored area was as follows:

Fig. 8. Vynnyky-Lysivka, Lviv region.
View of post-holes of the palisade

Fig. 9. Vynnyky-Lysivka, Lviv region. Profile of Feature No. 2/2023

Fig. 10. Vynnyky-Lysivka, Lviv region. Profile of Feature No. 4/2023

Fig. 11. Vynnyky-Lysivka, Lviv region. Profile of Feature No. 5/2023

(a) forest root grass-turf, 10 to 20 cm thick;
(b) grey sediment resembling loess to a depth of 0.4 to 0.5 m;
(c) dark grey sediment to a depth of 0.6 to 0.7 m;
(d) dense sand under-layer, coloured brown, to a depth of 0.7 to 0.9/1.0 m;
(e) sandstone bedrock.

The layers from 20 to 0.6/0.7 m deep yielded most of the archaeological record.

In Trench No. 1/2023, archaeological material was recovered from within the occupation layer: c. 4000 FBC pottery fragments (Features 2/2023 – Fig. 12 and 4/2023 – Fig. 13), along with a dozen of pottery sherds attributed to the Malice Culture (Feature No. 5/2023 – Fig. 14). Here, a series of large-sized storage and/or waste pits were explored as well; two of these, Nos 4/2023 and 5/2023, were found next to each other in the western part of the unit (Fig. 4).

However, the pit Feature No. 4/2023 was not explored in full since there were many roots of an old tree in its southern part. Its outline was detected at a depth of 0.6m below the present-day surface. The feature had an oval shape, 3.7 m in length and 1.6 m in width, and its uneven bottom lay 0.5 m deep below the pit's mouth. A series of 401 FBC pottery fragments were found there (Fig. 13).

The flat-bottomed and 20-cm-deep pit Feature No. 5/2023 was primarily detected below the present-day surface at a depth of 0.6 m. It had an oval shape, 3.4 × 2.2 m, and

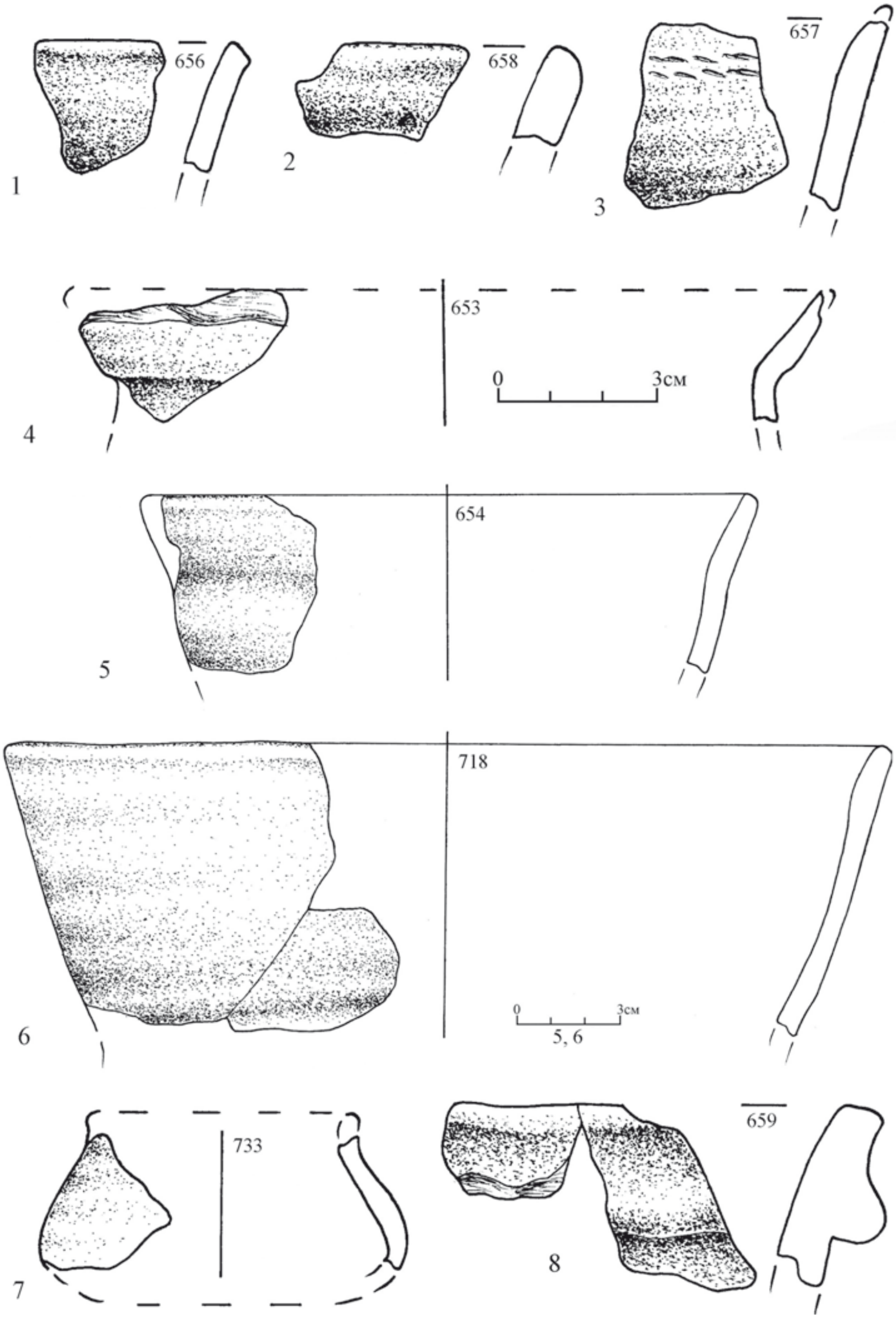


Fig. 12. Vynnyky-Lysivka, Lviv region. Vynnyky-Lysivka, Lviv region. FBC pottery

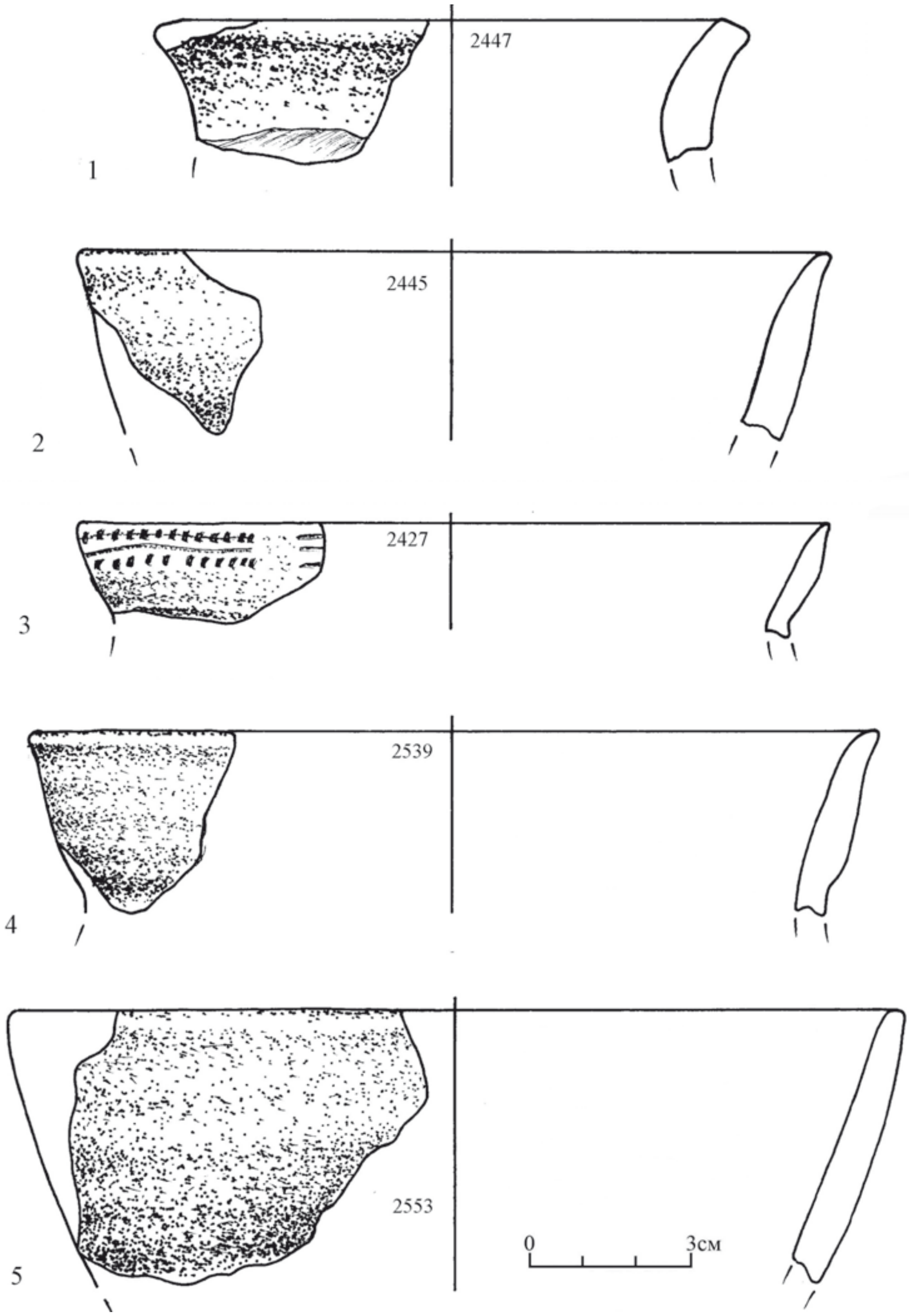


Fig. 13. Vynnyky-Lysivka, Lviv region. Vynnyky-Lysivka, Lviv region. FBC pottery

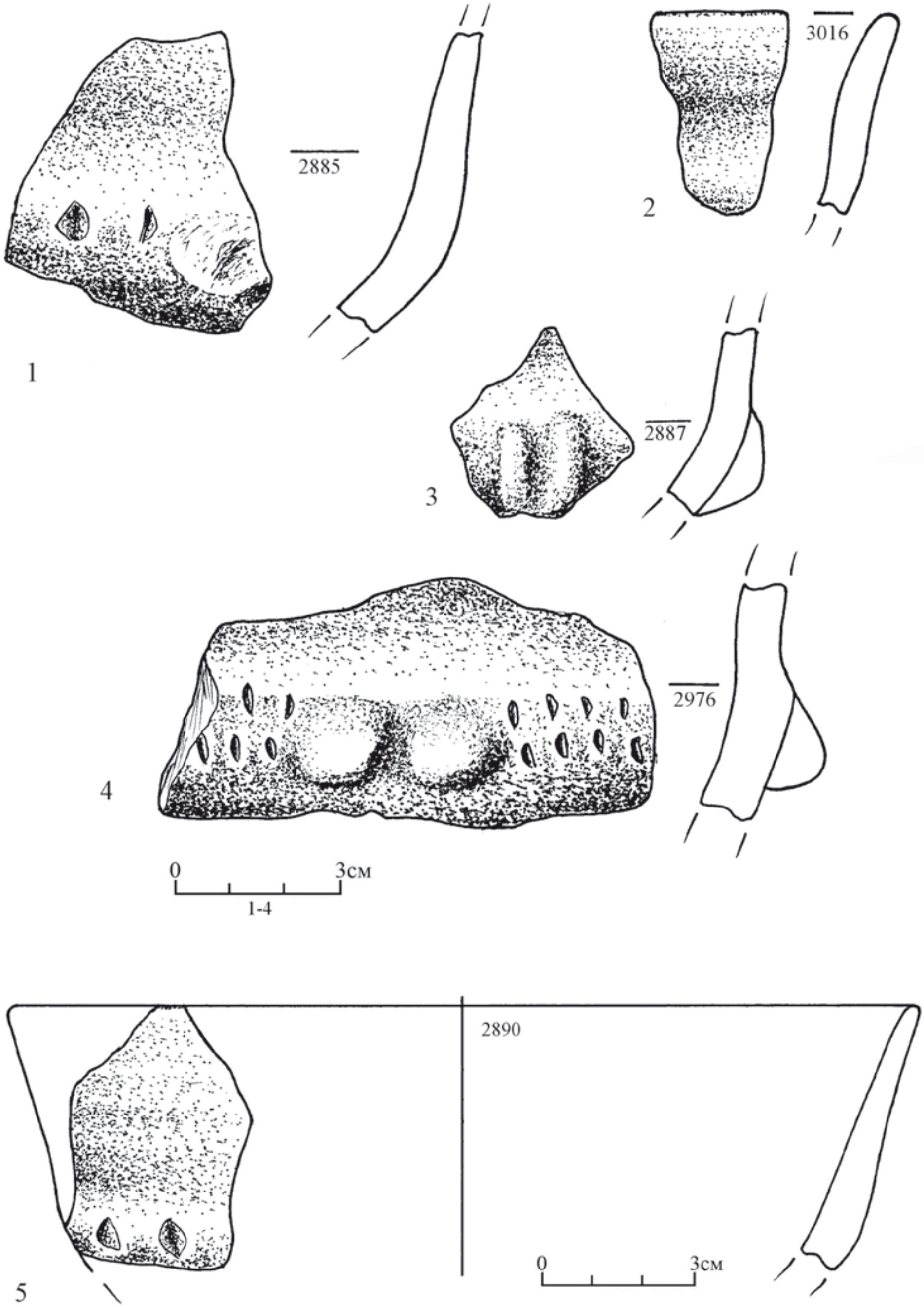


Fig. 14. Vynnyky-Lysivka, Lviv region. Feature No. 5/2023 pottery of the Malice Culture

a basin-shaped outline in profile; a sandstone block was recovered from beneath the bottom of the pit. The fill of the pit consisted of black loess-like sediment containing a series of 597 Malice Culture pottery fragments (Fig. 14). In the eastern part of Trench 1/2023, Feature 2/2023 was found, 34 cm deep with a series of 149 FBC pottery fragments (Fig. 12). It had an oval shape and the fill in the form of a dark-coloured sediment resembling loess.

Overall, the results of the 2021-2023 archaeological campaigns may clearly suggest that the central portion of the plateau upon Mount Lysivka had been intensively used in the past.

GEOMAGNETIC SURVEYS UPON MOUNT LYSIVKA IN VYNNYKY

A. The Research Scope. Magnetic measurements were made using the Foerster Ferrex 4.032 DLG fluxgate magnetometer (Misiewicz 2006, 74-98), which measures the gradient of the vertical component of the magnetic field and was equipped with two probes (0.2 nT resolution). The measurement lines were located 1 m from each other, while the measurement step was 10 cm along the line. The data logging operated in bidirectional mode. When creating magnetic maps, Terra Surveyor 3.0 software was used.

It is not the woodland conditions only that hindered prospecting the terrain. Similar effects are produced by sand- and/or limestone bedrock formations hidden underneath soil sediment strata of variable thickness. Relics of the times and events of World War II, such as trenches, shell explosion craters, and multiple small-sized items of iron, mainly fragments of artillery shells, also cause difficulties in collecting data and interpreting observations.

Non-invasive surveys were focused on a region of the FBC site that was defined on one side by the prehistoric moat (which is still visible on the modern ground surface) and separates the western part of the hill from the rest of it and on the other by the hill's tip with the small portion of land in front of the moat (Figs 4, 15-17). Necessarily, the data logging has stopped in the northeastern part of the area. While this was initially designated for research, the area could not be covered due to the dense thickets and the felling area overcrowded with stumps trunks and branches of trees. Eventually, the surveyed field reached 227 m in length, 50 to 116 m in width, and 1.54 hectares of area (Figs 4 and 15).

B. Results. In the course of the geomagnetic surveys, multiple dipolar anomalies, as well as less numerous point-positive anomalies, have been detected.

The FBC site's borderline, a Chalcolithic moat feature, has only been partially backfilled and, being now well-visible in the terrain, turns out to be a weak anomaly emitter (Figs 16 and 17: 1). Magnetic maps only display it in the northern part of the terrain in the form of an oblong irregular anomaly; some portions display positive values, and some negative, which is probably due to the diversities of the moat's fill. In the southern part of the moat's course, no legible anomalies associated with it were logged at all.

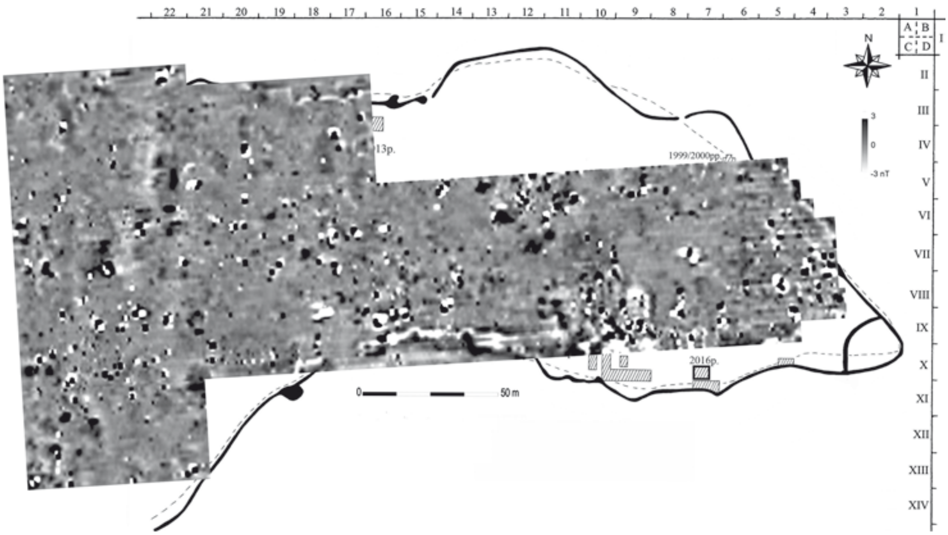


Fig. 15. Mount Lysivka. The geomagnetic map is represented in greyscale; the range is -3/3 nT

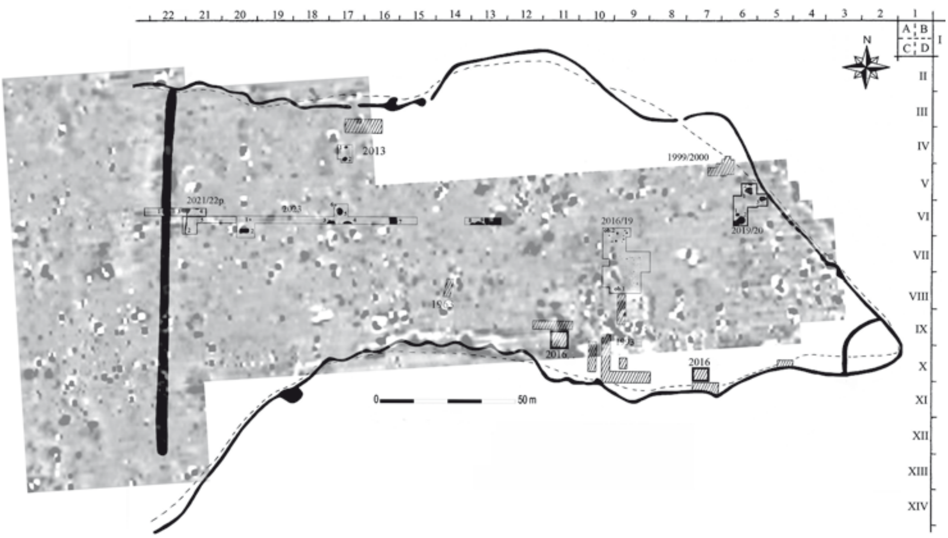


Fig. 16. Mount Lysivka. The geomagnetic map juxtaposed with the effects of excavations

Point-positive anomalies were found in large numbers throughout the surveyed expanse (Fig. 17; green areas). They are the anomalies of higher values and were induced by features like pits and fireplaces. These, of course, may be associated with the prehistoric village, yet it should be kept in mind that things like backfilled artillery shell explosion

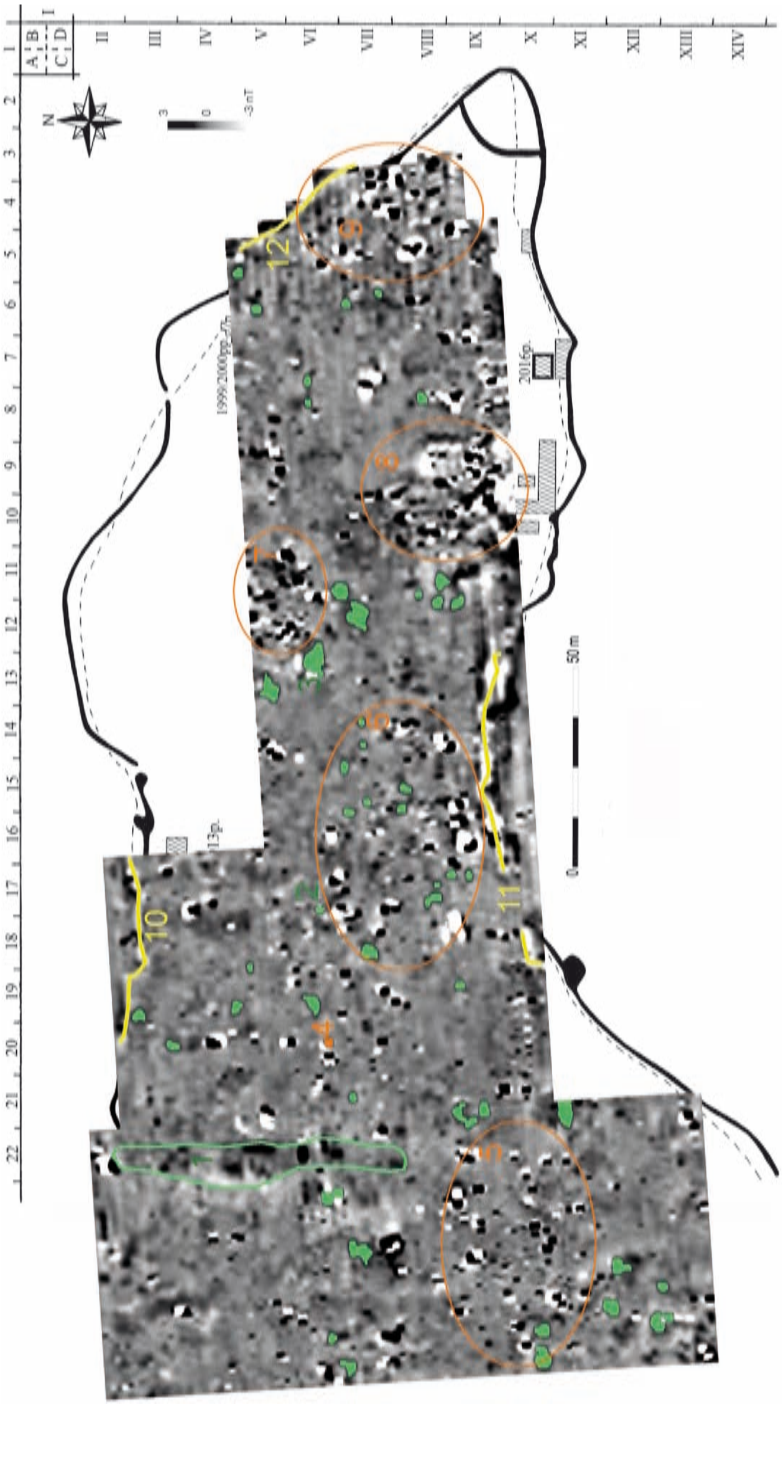


Fig. 17. Mount Lysivka. The magnetic map displaying the most significant geoanomalies which were mentioned in the paper. Green is the colour to mark the positive geoanomalies associated with the moat and various sorts of pit features; orange marks the clusters of geoanomalies presumably associated with the burnt clay daub concentrations; linear geoanomalies associated with World War II period entrenchment are marked with yellow

craters or the variability of natural pits, such as animal dens, burrows, and tree uprooting hollows, may well have been among these emitters. In 2023, the origins of two point positive anomalies have been positively verified by excavating them (the pits Features 2/2023 and 4-5/2023 – Figs 17: 2, 3; 4). Point positive anomalies are concentrated mainly in the central part of the survey area as well as in the portions where soil sediments are up to 100 cm thick above the bedrock underlayer. Less intensively, they appear, however, throughout the site, particularly west of the Chalcolithic moat.

The vast majority of anomalies in Vynnyky are dipolar anomalies, with their positive and negative poles well accentuated. Among them, minor anomalies dominate, their poles oriented north and south. They are caused by tiny iron artefacts and, therefore, have nothing to do with the Chalcolithic village. Bigger than these, reverse dipolar anomalies are known to have inverted orientation of their poles. Some of these can also be caused by the presence of iron artefacts, yet some others may well represent thermoremanent magnetism. Such anomalies basically demonstrate broad amplitudes of values and thus signalise substances subjected to high temperatures. They are emitted by archaeological features containing signatures of intense burning, such as residues of burnt buildings, furnaces, hearths, *etc*. (Fassbinder 2015, 87; Smekalova *et al*. 2008, 10, 11, 19). By the very nature of the site, it seems most probable to interpret this type of anomaly as the one produced by concentrations of burnt clay daub, which, in turn, are residues of FBC ground-floor buildings (Diachenko *et al*. 2019; Hawinskyj and Rybicka 2021). Both values of the gradient of the vertical component (-10/10 to 100/100 nT) and the shape of the anomalies can be associated with the presence of clay daub that remained from the structures of burnt buildings. This type of anomaly is very often reported from prehistoric tell-sites in the Balkans and, say, Trypillia Culture settlements (Pickartz *et al*. 2019). Moreover, the shape and values of anomalies may positively reflect both structural types of buildings and degrees of ignition. As for the site upon Mount Lysivka, excavations show that house debris takes the form of rather insubstantial irregular agglomerations of clay daub (Diachenko *et al*. 2023; Hawinskyj and Rybicka 2021). The anomalies detected are images which seem to correspond very well to this type of archaeological context, with all irregularities and spread of values. It seems complicated, however, to define the particular types of buildings that could be marked by the anomalies discussed. Concentrations of thermoremanent anomalies are well detectable instead. Three were located in the eastern part of the survey area (Fig. 17: 7-9). Within them, one may be dealing with a large number of anomalies, most probably indicating clay daub concentrations. In the central part of the site, there was another concentration of this type of anomaly (Fig. 17: 6). This one was much more dispersed in kind, and there, point-positive anomalies were many as well, to mark some pit-like terrain features. Finally, a concentration of dipolar anomalies was spotted in the western part of the survey area, where the moat no longer reached (Fig. 17: 5). In this area, the anomalies were relatively few and small. Possibly, they had nothing to do with clay daub fragments but represented another sort of magnetic substance instead, like fragments of iron or the like. Smaller dipolar anomalies were scattered throughout the survey area as well. Could they indicate the presence of real pits there (Fig. 17: 4)? Whatever they were, they should contain a sufficient amount of materials of high magnetic susceptibility.

The last type of anomalies detected in Vynnyky are linear anomalies with negative values (Fig. 17: 10-12). These anomalies are attributed to the military earthworks created during World War II.

ARCHAEOLOGICAL EXCAVATIONS VS GEOMAGNETIC SURVEYS: A COMPARISON

The 2017 magnetic surveys have contributed to a limited extent to expanding and improving our knowledge of the spatial patterning of the prehistoric settlement upon Mount Lysivka, and it is largely due to the very nature of the hilltop site. Usually, the pit features dug through the loose and sediment sandy or loess soil can hardly accumulate much humus containing organic matter of high magnetic susceptibility. In woodland environs, naturally modified ground should also be considered responsible for many magnetic anomalies still indistinguishable from those associated with prehistoric site contexts. The whole image is additionally complicated because the terrain is densely strewn with ferrous artefacts producing strong anomalies.

The remains of buildings in the form of agglomerations of baked, and less often burnt, clay daub are nonetheless among the positive traits of the site. Obviously, some agglomerations may well correspond to the concentrations of magnetic anomalies. It seems risky, however, in view of local conditions, to try and interpret this or that building, especially when one takes into account well-identified and carefully excavated concentrations of clay daub representing waste material residues called ‘House No. 1’ (Figs 3 and 4). What was left of it was a series of collapsed structures consisting of slightly burnt clay daub fragments (Fig. 3: A; Hawinskyj and Rybicka 2021). Relatively limited in size, they were not too deep in the ground, while the constituent layers of pieces of clay were neither compact nor dense. On this basis, one may positively suggest that the non-invasively surveyed area might have contained nothing less than four ground-floor buildings of the FBC (Fig. 17). Here, clay was not burnt through and through, yet rather strongly baked and loosely distributed. Neither compact clusters of FBC pottery finds nor pits and pithouses backfilled with humic sediments were found next to the clay daub. All these discoveries may pose sufficient evidence when interpreting dispersed signals visibly provided by geomagnetic maps.

The Eneolithic moat, an essential boundary between the FBC village and the western part of the hill, turned out to be a very weak source of anomalies, although there was no problem observing it on the present-day surface (Figs 4 and 17: 1). An irregular oblong anomaly in the northern part of the moat is all that can be seen on magnetic maps. The situation was clarified by archaeological means as soon as the unit within the verified area came across a well-defined outline of the moat at a level of 80 cm below the present-day surface; its dark-coloured fill lacked either much organic below the present-day surface material or many pottery finds. Remarkably, the narrow foundation trench of the palisade structure, running alongside the moat, was only testified by the spade and never produced legible magnetic anomalies. The palisade itself, being reinforced with clay in the past, was by no means very well visible too. In the debris that remained, the clay daub was not deeply burnt at all (Figs 6-8). Although sometimes poorly readable, geomagnetic indications are nonetheless important evidence when estimating patterns of spatial development at the prehistoric hilltop village in Vynnyky-Lysivka (Fig. 17).

Significantly, excavations have resulted in confirmation of the fact that dug-out features really existed, producing both dipolar and point anomalies on magnetic maps. Indications like these are scattered throughout the surveyed area. After overburden removal, it transpires that pit features in the central part of the hill were responsible for dipolar anomalies (Fig. 17: 2-4). The stony bedrock was recovered there at a depth of 80 to 100 cm below the present-day surface, while above, a loess-like sediment was found. In 2023, an exploratory trench explored rich samples of both organic and inorganic materials between 40 and 80 cm below the present-day surface, in storage and/or waste pits too (Figs 4 and 9-11); a geomagnetic map shows all of them very well. The verifying experience of such a character gives helpful clues for interpreting similar anomalies in due course.

Conclusively, further discoveries of the moat encircling the village and of its various dug-out features by digging them in 2023 have made the results of early noninvasive works more reader-friendly. The reverse is true as well. The excavations that led to the discovery of House No. 1 (Figs 3 and 4) preceded the geomagnetic surveys, so they are going to give good possibilities for interpreting dispersed thermoremanent anomalies as the signatures of dispersed agglomerations of clay daub.

SYNOPSIS

The question arises whether the difficulty in interpreting the remains of houses built using clay and situated on a stone base is only a peculiarity of Vynnyki-Lysivka.

In the year 2017, in Northern Moldova, geomagnetic surveys of the Late Eneolithic habitation contexts were carried out at the fortified settlement of the Late Trypillia Culture Gordineşti Group in Gordineşti II-Stînca goală (Przybyła *et al.* 2017). The Gordineşti Group dates back to the time range between 3300 and 3000 BC (Król and Rybicka 2022; 2023). Similar efforts have been made at the aforementioned site in Vynnyky-Lysivka, Western Ukraine, where a fortified settlement of the FBC existed between 3600 and 3300 BC (Hawinskyj *et al.* 2021). The sites under study have many similarities in terms of spatial and landscape localisation. Both are situated in fully exposed highland loci, with rocks as the natural ground of the hills (Hawinskyj and Rybicka 2021; Rybicka *et al.* 2023); this was limestone in Gordineşti and sandstone in Vynnyky. Moreover, as invasive techniques like excavations were applied, lightweight dwelling structures were recovered here and there, residually manifested at present in the form of detached clay daub agglomerations of various sizes (Sîrbu and Król 2021; 2023; Hawinskyj and Rybicka 2021; Rybicka *et al.* 2023). Geomagnetic surveys, both at Gordineşti and Vynnyky, did not produce exactly the same results that one normally expects, namely, a precise identification of houses and house structure types. They only indicated some loci with minor anomalies originating probably from baked materials such as clay daub, and it is perhaps due to the relatively small amount of the daub remaining after the buildings have crumbled. In the case of Gordineşti, no dug-out house features were recovered, and this was obviously due to the fact that limestone was only covered there with a layer of loess sediment 30-40 cm thick, and just below it was the solid rock of Mount Stînca goală. In Vynnyky, the situation was rather different; although the covering sediment upon Mount Lysivka was usually up to 40 cm thick, there were spots as well where this layer had a thickness up to even 100 cm. The deeper was the rock, the greater were chances of finding dug-out features with many movable finds all around. The juxtaposition of the results of the diggings with those of geomagnetic surveys enables the prediction of spaces and loci, many of which may be promising for further invasive works on the sites. Although debatable *per se*, geomagnetic data have triggered many seminal observations and conclusions in the end.

Acknowledgements

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AN AXE HEAD FROM A PRZEWORSK CULTURE SETTLEMENT IN JANOWIEC: PICTURES FROM THE LIFE OF WARRIORS OF EUROPEAN BARBARICUM

ABSTRACT

Kontny B. and Kuś G. 2024. An axe head from a Przeworsk culture settlement in Janowiec: Pictures from the life of warriors of European Barbaricum. *Sprawozdania Archeologiczne* 76/2, 277-291.

The paper presents a stray find of an axe head from the Przeworsk culture settlement at Janowiec. It is a medium weight head attributed to sub-Group II.2 after B. Kontny (2018), dated generally to the Roman Period (Phases B2-C1a). Its shape does not allow the function to be determined univocally. Most probably it was a multifunctional tool. The aforementioned axes were used mainly in the Balt milieu, but they were also known but rather not used as weapons in the Przeworsk culture. Single finds from northern Europe may be explained by the participation of the Balt warriors in the military events at these areas. One may consider the possibility that the axes and some other parts of the military equipment became commonly used thanks to multi-ethnic military expeditions and the migrations with a military background connected, among other things, with the crisis of the Roman Empire in the 3rd century.

Keywords: ancient weapons, Germanic tribes, crisis of the third century, blunt weapons, West Balt Circle, Wielbark culture

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So far archaeologists have focused their interest on the historic periods in Janowiec, Puławy district (*cf.*, Supryn 2008; Cichomski 2014; Kruppé 2017). The issues of prehistoric settlement were dealt with only when prehistoric materials were discovered during the excavations conducted in the old town. Until recently the materials connected with the Przeworsk culture coming from Janowiec were not numerous. They included an accidental discovery of a Roman denarius in the vicinity of Janowiec (Gurba 1959, 96; Kokowski 2021, 138) and the finds made during the excavations near Wolności Square (*cf.*, Balke 1991, 79, pl. 3: 6-9; Dąbrowska 2017, 54-56). One should also mention more than a dozen fragments of Przeworsk culture pottery discovered during a field survey at Site 3 (Bargieł and Zakościelna 1995, 318). Some new perspectives on the problems of prehistoric, Early Mediaeval, but also modern settlement have been opened by the excavations near Janowiec, especially at Site 3 (*cf.*, Kuś 2019; 2021a; 2021b; Kuś *et al.* 2022).

Site 3 (AZP 76-75/47) in Janowiec, Puławy district, is located at a sandy edge of a terrace enclosing the Vistula valley from the north-west. In the vicinity there is a small river called Nieciecz, flowing into the Plewka river, which joins the Vistula above Janowiec. At present the bed of the Vistula is c. 2 km away from the site (Fig. 1). In geographical terms, the site is located within the Vistula River Gorge of Lesser Poland (Gajek and Chabudziński 2021, 425-427).

Site 3 was discovered in 1981 during a field survey conducted within the framework of the Polish Archaeological Record (Bargieł and Zakościelna 1995, 318). Successive field sur-

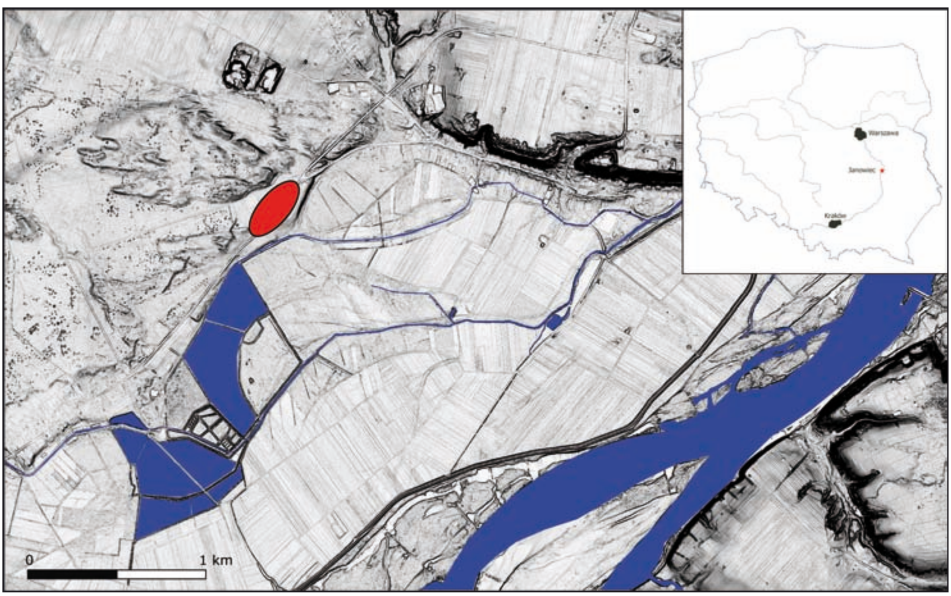

Fig. 1. Position of Site 3 in Janowiec, Puławy district with the application of a digital terrain model (DTM)

veys were conducted in 1986, 1996 and 2016, whereas since 2017, archaeological excavations and detailed surface prospection with metal detectors have been carried out. So far the excavations embraced an area of 2,1 ares and uncovered 66 settlement features and a sepulchral one. The majority of the features are connected with a settlement dating to the Roman Period and the Early Middle Ages (the 11th-12th century). The sepulchral feature, which consisted only of burnt human and animal bones, has been tentatively dated to the Early Middle Ages. The field survey (including the work with metal detectors) was conducted over the whole available area of the site, which is estimated at c. 3 hectares. The finds from that research embrace a broad time span from the Bronze Age till the modern times. The earliest materials connected with the Przeworsk culture are single pottery fragments from the Younger Pre-Roman Period, which represent the so-called Early Pottery Cycle (Dąbrowska 1988, 28, 29). The most numerous materials are those dated to Phases B2 and B2/C1-C1a, whereas the youngest horizon of the Przeworsk culture settlement is determined by the Almgren 158 brooch, Jakuszowice variant (Almgren 1923, 74-76, pl. 6: 158; Jakubczyk 2014, 139, pl. 30), and a buckle similar to Type H12 (Madyda-Legutko 1987, 64, pl. 19: 12). It is also worth mentioning two Balt brooches dated to the Migrations Period, which, however, cannot be conclusively related to the Przeworsk culture settlement (*cf.*, Kuś 2021b).

Of the several dozen finds related to the Roman Period (not including pottery fragments), some are particularly interesting because they differ from the standard Przeworsk culture finds from Central Poland. One of them is an iron axe head, discovered during a field survey with the use of a metal detector. It was located in the topsoil at the depth of c. 20 cm and was not accompanied by any other artefact.

This artefact has a symmetrical head, faceted at the butt (as a result of which this part is octagonal in cross section), with a relatively narrow blade, oval-shaped eye (clearly separated from the neck), and a slightly flattened butt (Fig. 2). The head was made from a single piece of iron, bent in half along the axis of the future eye, which is indicated by a seam visible in the bottom part of the eye and the neck, close to the longitudinal axis of symmetry (*cf.*, Nørbach 2009, fig. 123:a; Kotowicz 2018, 25, fig. 5). Dimensions: length 15.5 cm; width of the blade 5.2 cm; height of the butt: 4.7 cm; length of the butt: 4.7 cm; width of the eye: 3.4 × 2.3 cm (upper part), 3.2 × 2.3 cm (lower part); weight: 0.441 kg. The artefact represents Type II.2 according to B. Kontny (2018). It is not practical to use G. Kieferling's classification (1994) due to the fact that as the boundaries between many of the types distinguished in it are unclear; the discussed artefact can be assigned to Group 1-2 (Kieferling 1994, fig. 3: 6, 8) of the western series of Group 5 (Kieferling 1994, fig. 7: 1, 3) and Type Żarnowiec (Kieferling 1994, fig. 6: 5), which makes it impossible to make clear conclusions about the dating and distribution of the analogical forms.

The different diameters of the butt indicate that it narrowed down to the bottom, which is related to the way the hafts were fastened in the Roman Period. The sources (in their majority coming from water sacrificial sites) indicate that the handles narrowed down-

Fig. 2. Axe-head from Janowiec, Puławy district

wards, thanks to which they were wedged in the eye of the butt with their upper wider part. To increase this effect sometimes the upper part of the haft was dome-shaped rather than tapering and sometimes nails or rivets were used as wedges. No traces of the use, known from the Middle Ages, of leather straps to fasten the haft to the head (Kontny 2018, 80, 81, fig. 12, with further literature) have been found. As no remains of wood have been traced, it is not possible to determine which species were used to make the haft. On the basis of the 64 finds from northern Europe (Vimose, Nydam, Illerup, Kragehul) it may be assumed that hard wood was used, mainly of ash and fruit trees (*pomaceae*) less frequently hazel or oak wood, and very rarely beech, maple and holly; the same materials were used to make hafts of socketed axes (Malmros 2020, 97, 118, fig. 3: 26, table 3: 6, 18). One should mention here the 30 hafts from Thorsberg in Schleswig, mostly made from ash (for the remaining ones it was not possible to determine the kind of tree – see Westphal 2008, fig. 2; Matešić 2015, 225, 552, pl. 109: M1184). The find from the sacrificial site of Alken Enge is radiocarbon dated to the Pre-Roman Period, but also in this case the haft is made from ash wood (Iversen 2019, 94, fig. 6). The handle of the axe abandoned during a robbery of a rich burial in Poprad-Matejovce was made from oak wood (Lau *et al.* 2022, 89, pl. 158: 417). The hafts are usually 60-90 cm long. The analysis of the West Balt finds (the Bogaczewo and Sudovian cultures) indicate that heads usually weighed 500-600 g, but there are also much lighter specimens and, more rarely, heavier ones (Kontny 2018, 81, with further literature). The majority of the finds from the south Scandinavian lake sacrificial site in Illerup are specimens weighing 400-500 g, but there are also quite a few lighter ones (200-400 g) as well as some heavier ones, going beyond the standards and reaching up to 1225 g (Nørbach 2009, 262, 263, fig. 122).

The artefact belongs to the category of medium weight heads but its shape does not allow us uneqivocally to determine its function. Most probably it was a multifunctional tool used rather for agricultural jobs (cutting wood for fuel, making clearings in the forest, *etc.*) rather than for some specific craft, albeit it was possible to use it to work with wood. It was natural that such tools had many functions in the context of the busy life of the warriors, so it may be also inferred that axes were also effective weapons. In some regions of European Barbaricum they were the main kind of offensive weapon and even replaced the sword. This concerns the West Balt Circle (Kontny 2018), the Luboszyce culture (Domański 1979, 51, 52), the Elbe Circle in the Younger and Late Roman Period (Bemmann 2007, 76, 77), the Wielbark culture and Gothic cultural circle in general, also in the Younger and Late Roman Period (Kontny in print) and of the Tsebelda culture in Abkhazia (Voronov and Shenkao 1982, 127, 128, fig. 3), located beyond the European Barbaricum but strongly influenced by it, including in military equipment (Kazanskii 2015). The sources (especially the archaeological ones, but to some extent the iconographical and written ones as well), however, do not confirm any substantial military use of combat axes among the *Germani* as they are extremely rare in burials (also those with weapons) (Kontny 2008, 130, diagram 15; 2019a, 39). Thus the find from Janowiec was rather a tool, but its secondary use as a weapon cannot be excluded.

Interesting conclusions may be drawn from the distribution of the analysed axe heads (Fig. 4; List 1). The axe heads from Group II.2 are the most numerous in the West Balt Circle (Fig. 3: 2-4, 8). They can be found in the Bogaczewo (Fig. 3: 2, 3, 8), Sudovian (Fig. 3: 4) and Dollkeim-Kovrovo cultures, but not in Lithuania (*cf.*, Malonaitis 2008, figs. 13, 14, 16). In the Przeworsk culture they are considerably less numerous (Fig. 3: 5), especially if we take into account thousands of known burials with weapons from that culture. The recent studies show that they were also present in the Gothic circle, namely the Wielbark (Fig. 3: 1), Sântana de Mureş and Cherniakhiv cultures. One should also mention the few finds from northern Europe: single axes from sub-Group II.2 are known from the

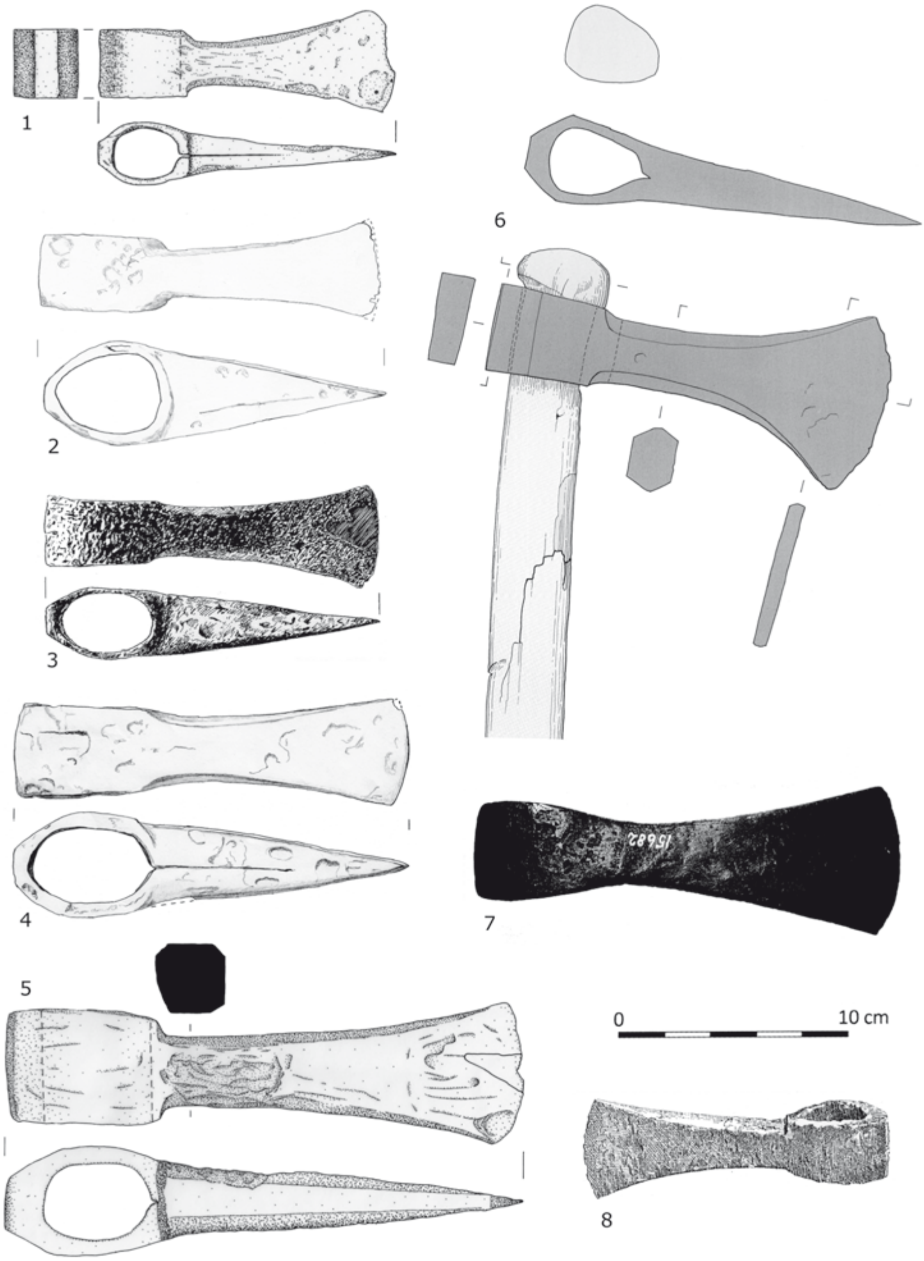

Fig. 3. Examples of axe heads Type Kontny II.2. 1 – Żuków, stray find (Wielbark culture); 2 – Bargłów Dworny, stray find (Bogaczewo culture); 3 – Judziki, Grave 12a (Bogaczewo culture); 4 – Suwałki region (Sudovian culture); 5 – Radymno (Przeworsk culture); 6 – Illerup; 7 – Vimose; 8 – Spychówko, stray find? (Bogaczewo culture). 1, 5 – drawing: P. Kotowicz; 2, 4 – drawing: B. Kontny; 3 – after Engel, Iwanicki and Rzeszotarska-Nowakiewicz 2006; 6 – after Nørbach 2009; 7 – after Kontny 2017; 8 – after Gaerte 1929

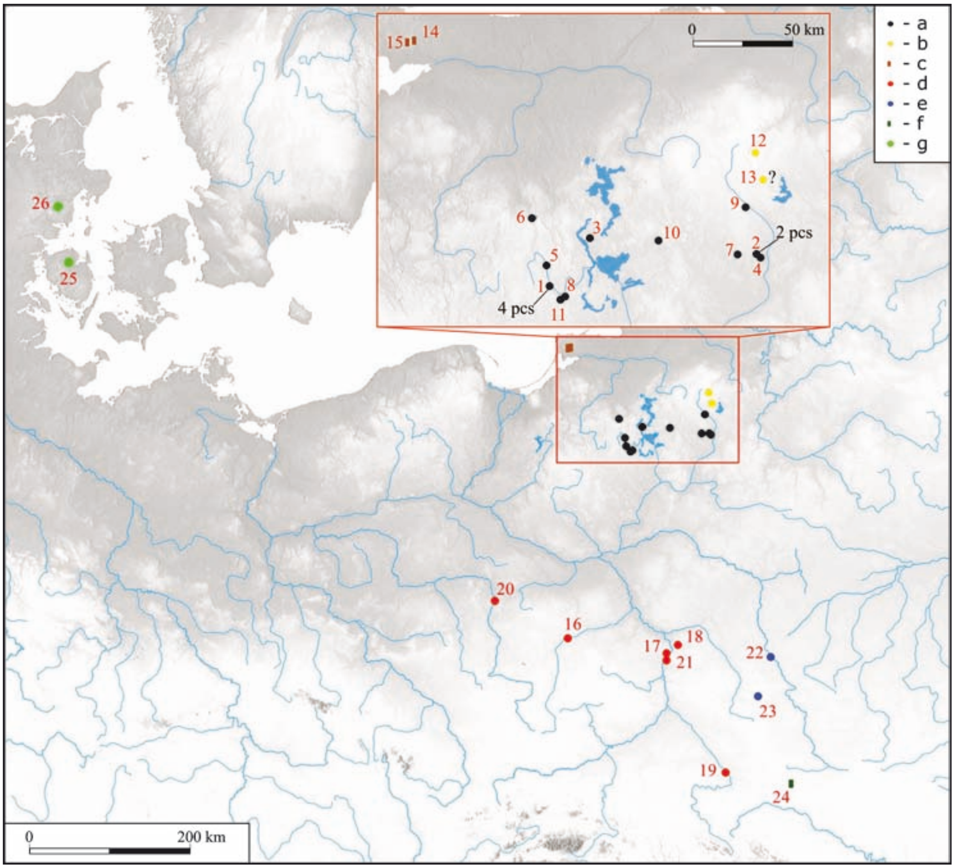

Fig. 4. Distribution of axe heads Type Kontny II.2 (List 1)
a – Bogaczewo culture; b – Sudovian culture; c – Dollkeim-Kovrovo culture; d – Przeworsk culture; e – Wielbark culture; f – Sântana de Mureş and Cherniakhiv cultures; g – Scandinavia.
Map background: https://maps-for-free

sacrificial sites at Vimose (Fig. 3: 7) in Fünen and Illerup (Fig. 3: 6) in Eastern Jutland. At the site of Vimose, some other Balt culture artefacts were found, including axes, which allows us to suggest that the deposits from Phase B2 there (Vimose 1 and 2a) contain weapons won from the Balt invaders, who invaded the island together with the Przeworsk culture warriors (Kontny 2017, 34-40), and possibly also Wielbark culture ones, as that culture occupied the coastal areas and probably was able to build boats (Kontny 2019b: 164, 176, fig. 5). This may be also the explanation of the presence of a 'Balt' axe Kontny II.2 in Illerup, even if there were no other Balt artefacts. However, there can be another answer: the axe may have reached Scandinavia with a single warrior who came from the areas to the south or southeast of the Baltic. The axe head should be linked rather to the early deposits of Illerup A or B from sub-Phase C1b than with the later Illerup C, from the turn of the Roman Period and the Migrations Period (Ilkjær 1990, 333-337), as they are dated to Phases B2-C1a (Kontny 2018, 76, 78); similar artefacts from the Dollkeim-Kovrovo culture allow us to suppose that they were used even till as late as the end of the Roman Period (Kontny 2018, 79, 80), yet still earlier than Illerup C. A good example of such contacts is Grave 1 from Barrow 2 in Szwajcaria, the richest known burial in the Sudovian culture. It is dated to sub-Phase C1b, and the eclectic character of the military equipment indicates that the deceased had broad military contacts, suggesting that he took part in long-distance military expeditions, especially to southern Scandinavia (Kontny 2013a).

The case of the Przeworsk culture is quite different. There are many more finds and they come from burials, and not from sacrificial deposits which consist of the invaders' weapons captured by the locals, as in Scandinavia. It seems that in the Przeworsk culture such weapons were used for military purposes only in some cases, but the form was quite well known there. Their finds from the Gothic circle were not deposits made in the sacrificial contexts either, even though weapons, including axes, were found in water-related contexts in the Wielbark culture (Kontny in print). It seems that this may be connected with another phenomenon, namely, the crisis of the third century. There were in those times, among other things, large-scale military undertakings shared by warriors from different parts of European Barbaricum, fighting in ethnically mixed retinues. Besides southern Scandinavia where military activities were of inter Barbarian character, the martial activity was directed southwards, which can be exemplified by the clashes with the Romans in 236 near today's Harzhorn in Lower Saxony where Germanic military equipment, including heads of shaft weapons were found (Meyer and Moosbauer 2013). The southern direction is confirmed by population movements of the Przeworsk culture to the Middle Danube region (Olędzki 1996). The shifts to the south-east are confirmed by the appearance of the Przeworsk settlement in the Tisa river basin (Madyda-Legutko and Rodzińska-Nowak 2019) and the process of the migrations of the Goths that started in the early 2nd century (Godłowski 1994, 72; Kontny 2005, 228; Madyda-Legutko and Rodzińska-Nowak 2019). They are confirmed by the changes in the areas occupied by the Przeworsk and Wielbark culture at the beginning of the Younger Roman Period (Andrzejowski 2019, with further literature). The pressure from the north was probably one of the causes of the Marcomannic Wars, but these migration trends continued also after those wars, which is exemplified by the military activity in the Middle Danube in 188 and then in 196-203 and 214-215 (Kozłowski and Kaczanowski 1998, 239). Besides the Wielbark culture warriors, those from the Przeworsk culture also contributed to weakening the limes; some probably fought together with the Goths. This idea is based on the finds of the scarce cremation burials in the Cherniakhiv culture (Magomedov 2001, 34, 82). However, this is not so simple as these weapons are not direct copies of the Przeworsk culture originals. It is also worth mentioning the Przeworsk culture, and Balt artefacts together with Wielbark culture, north-European, Sarmatian and Roman ones found at the necropolis of Chatyr-Dah in Ukrainian Crimea, which probably belonged to the multi-ethnic retinues, attacking these lands together with the Goths in the mid-3rd century and then settled there (Kontny 2013b). These events may be also related to the adaptations of the Germanic military equipment by the inhabitants of the Ancient Tsebelda region.

The analysis of the axe head from Janowiec, presented at a broad cultural background, shows the popularity of sub-Group II.2. Even though the aforementioned axes were used mainly in the Balt milieu, they were also known but rather not used as weapons in the Przeworsk culture. Single finds from northern Europe may be explained by the participation of the Baltic warriors in the military events in these areas. However, the artefacts found in the Wielbark culture are probably adaptations of those weapons from the West Balt Circle (Kontny in print). It is not possible to determine whether they came to the southeast with the migrating Goths or with the Baltic or Przeworsk culture mercenaries who accompanied them (in the latter case, regardless of whether they were used as tools or weapons included in the military equipment under the influence of the Baltic or Wielbark culture models). It seems clear, however, that the axes and some other parts of the military equipment became commonly used thanks to the multi-ethnic military expeditions and the migrations with a military background (*cf*., Kontny 2019b).

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List 1. Distribution of axe heads Type Kontny II.2

Bogaczewo culture

1. Babięta (ex-Babienten), Piecki commune, Mrągowo district, Site I, grave 48a and a stray find, also Site II, grave 50 and stray find.

2. Bargłów Dworny, Bargłów Kościelny commune, Augustów district, grave 4b and stray find.

3. Bartlikowo (ex-Bartlickshof), Ryn commune, Giżycko district, grave 20.

4. Brzozówka, Bargłów Kościelny commune, Augustów district, Site 1, grave 36 (Iwanicki 2021, 237, pl. 4: 4).

5. Dłużec (ex-Langendorf), Piecki commune, Mrągowo district, Site I, grave 140.

6. Lake Legińskie, Reszel commune, Kętrzyn district, stray find.

7. Judziki, Bargłów Kościelny commune, Augustów district, grave 12a.

8. Koczek (ex-Kotzek), Świętajno commune, Szczytno district, Site II, grave 121.

9. Raczki, Raczki commune, Suwałki district, grave 6.

10. Skomack Wielki (ex-Skomatzko), Stare Juchy commune, Ełk district, Site 1, grave 84.

11. Spychówko (ex-Klein Puppen), Świętajno commune, Szczytno district, stray find? – it is not clear to which assemblage it belonged (Kontny 2018, 84-87, fig. 8, with further literature).

Sudovian culture

12. Szurpiły, Jeleniewo commune, Suwałki district, barrow XV, grave A3.

13. Suwałki region, site unknown (Kontny 2018, 88, 89, fig. 11: 1).

Dollkeim-Kovrovo culture

14. Hrustalnoe (ex-Wiekau), Zelenogradsk rayon, grave XIV (Kontny 2018, 79, with further literature). The affiliation of the mentioned artefact to Group II is certain, yet since only the view from the top is available at the illustration, it is not certain if it can be assigned to Group II.2.

15. Kotelnikovo (ex-Warengen), Zelenogradsk rayon, grave 31 (Kontny 2018, 79, with further literature). The artefact from Bartlikowo, quoted as an analogous one to the latter fint, however, allows tentatively to assign it to sub-Group II.2.

Przeworsk culture

16. Ciebłowice Duże, Tomaszów Mazowiecki commune, Tomaszów Mazowiecki district, grave 48 (Dzięgielewska and Kulczyńska 2008, 22, 37, 61, pl. 37: 7) and 122 (Dzięgielewska and Kulczyńska 2008, 37, 61, pl. 76: 8).

17. Janowiec, Janowiec commune, Puławy district.

18. Opoka, Końskowola commune, Puławy district, grave 77 (Szarek-Waszkowska 1971, 104, pl. 41: 4).

19. Radymno, Radymno commune, Jarosław district (Koperski 1980; collection of the National Museum of the Przemyśl Land, inv. no PM-A 1328; personal communication: Piotr Kotowicz, Ph.D. from the Museum in Sanok).

20. Spycimierz, Uniejów commune, Poddębice district, grave 42 (Kietlińska and Dąbrowska 1963, 151, pl. 7: 5).

21. Szczekarków, Wilków commune, Opole Lubelskie district; the find presented during the lecture M. Stasiak-Cyran 'Wstępne wyniki ratowniczych badań przedinwestycyjnych na wielokulturowym stanowisku nr 2 w Szczekarkowie, pow. opolski' on conference: 'Badania archeologiczne w Polsce Środkowowschodniej, zachodniej Białorusi i Ukrainie w roku 2023, Zamek Królewski w Sandomierzu, 11-12 June 2024 r.'

Wielbark culture

22. Świerże, Dorohusk commune, Chełm district (Kontny in print).

23. Żuków, Miączyn commune, Zamość district (Kontny in print, fig. 2: 2). The authors would like to thank dr Piotr Kotowicz from the Museum of History in Sanok for the drawings of the axes from Żuków and Radymno.

Sântana de Mureş and Chernykhiv cultures

24. Sokolniki, Pustomyty rayon, settlement find (Radûš 2022, fig. 56: 6).

Scandinavia

25. Vimose Bog, Fünen, Denmark, Inv. no 15682 (Christensen 2005, 72, fig. 4; Kontny 2017, fig. 15: 3).

26. Illerup, near Skanderborg, Denmark, axe head PWU (Nørbach 2009, 278).

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A BARROW OF THE WIELBARK CULTURE AT LEŚNICTWO WILCZY JAR SITE 2 IN THE BIAŁOWIEŻA FOREST – NEW DATA ON ROMAN PERIOD SETTLEMENT IN THE UPPER NAREW AND MIDDLE BUG INTERFLUVE

ABSTRACT

Dariusz Krasnodębski, Hanna Olczak, Jagoda Mizerka, Kamil Niedziółka. 2024. A barrow of the Wielbark culture at Leśnictwo Wilczy Jar Site 2 in the Białowieża Forest – new data on Roman Period settlement in the Upper Narew and Middle Bug interfluve. *Sprawozdania Archeologiczne* 76/2, 293-340.

For many years, the Białowieża Forest has been one of the archaeologically least known areas of present-day Poland. Although the first excavations there were carried out as early as 1917-1918, until recently, knowledge of the prehistoric and Early Medieval settlement in the region has been negligible. Thanks to surface surveys and excavations undertaken at the beginning of the 21st century, it has so far been possible to record more than 600 archaeological sites in the Białowieża Forest. The great potential of this best-preserved lowland natural forest in Central Europe is evidenced, among other things, by the results of excavations carried out at Leśnictwo Wilczy Jar, Site 2. A barrow of the Wielbark culture, which is the first grave of its kind located so far to the east, was investigated there. Despite the limited scope of excavation of the mound, it is a significant contribution to the knowledge of the Roman Period in the Upper Narew and Middle Bug interfluve.

Keywords: Białowieża Forest, Upper Narew and Middle Bug interfluve, Younger and Late Roman Period, Wielbark culture, barrows
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INTRODUCTION

The Upper Narew and Middle Bug interfluve is one of the least destroyed and human-transformed areas of the borderland between the Central European Lowlands and the Eastern European Lowlands. A large portion of it is covered by forests and wetlands, some of which are now part of the Białowieża Forest (Fig. 1). It is the only remaining large-scale relict of the forests of the boreo-nemoral zone, which covered most of the European continent in the past. Compared to modern forests, the area is distinguished by a significant share of tree stands of natural origin that are over a century old, with a diversified species, age, and layer structure (Faliński 1986, 17-23; Jaroszewicz 2010, 216; Jaroszewicz *et al.* 2019). The Białowieża Forest is not only a unique region on the European scale in terms of its natural resources (listed as a UNESCO World Natural Heritage site), but also, as recent archaeological research has shown, is characterised by an exceptionally good state of cultural heritage preservation. Due to the fact that this forest complex was protected as early as the turn of the 14th and 15th centuries, traces of human activity have survived here in very

Fig. 1. Location of the site Leśnictwo Wilczy Jar on a topographic map (source of the map: Open Street Map). Compiled by K. Niedziółka

good condition, creating a unique cultural landscape that was largely destroyed in the deforested areas as a result of Late Medieval and Modern Period settlement and agricultural exploitation. Despite the insufficient state of reconnaissance in the past by the method of the Polish Archaeological Record (Archeologiczne Zdjęcie Polski or AZP in Polish), which has been carried out in about half of the area of the Polish part of the Białowieża Forest (Krasnodębski and Olczak 2018, 11), more than 600 archaeological sites are currently known there (Krasnodębski 2022, table III.27). Most of them have been recorded only in the last twenty years (Krasnodębski and Olczak 2018, 6-17; Olczak and Krasnodębski 2022, 35-69). The state of archaeological research in the Belarusian part of the Białowieża Forest is much less advanced than in the Polish part (*e.g.*, Beliavets *et al.* 2009, 20-53; Tkachou 2015, fig. 2; Tkachou and Vashanau 2017, fig. 1; Tkachou *et al.* 2018).

Although the first excavations in the Białowieża Forest were carried out as early as in 1917-1918 (Götze 1929), for many decades after that, the area received little interest from archaeologists (Walicka 1958; Dzierżykray-Rogalski and Jaskanis 1961; Żurowski 1963; Górska 1976). It was not until 2003 that systematic excavation and surface surveys began here, carried out by the Institute of Archaeology and Ethnology of the Polish Academy of Sciences in Warsaw (hereafter: IAE PAS) and the Mammal Research Institute of the Polish Academy of Sciences in Białowieża. As part of this cooperation, more than a dozen archaeological sites from different periods were excavated, the selection of which was led by the desire to understand the history of the area, with particular emphasis on the last two millennia (*e.g.*, Krasnodębski *et al.* 2005; 2008; Krasnodębski and Olczak 2006a; 2006b; 2012; Samojlik *et al.* 2014; Olczak *et al.* 2018). In 2014, the scope of this research was broadened with the implementation of the grant 'The Beginnings of Christianity on the Mazovian-Rus' Borderland', led by Prof. Andrzej Buko and financed by the Ministry of Science and Higher Education (National Programme for the Development of the Humanities, Grant No. 11H 12 0330 81). Its aims included, among other things, DNA studies of human bones from Slavic cemeteries (Molak *et al.* 2019; Krasnodębski and Olczak 2019; Olczak and Krasnodębski 2019; Buko *et al.* 2020). In 2016-2019, a project called *Cultural Heritage Inventory* was carried out, first by the IAE PAS in Warsaw and then by the Hereditas Foundation. It was conducted on behalf of the General Directorate of the State Forests as part of the 'Evaluation of the state of biodiversity in the Białowieża Forest on the basis of selected natural and cultural elements' programme. In the first year of its implementation, surface surveys covering almost two thirds of the area of the Polish part of the Białowieża Forest were carried out (Krasnodębski *et al.* 2016; Krasnodębski and Olczak 2018, 11-17; Olczak and Krasnodębski 2022, 59-63). In addition to the excavations, the project included large-scale non-intrusive research, which consisted of identifying any earthworks by airborne laser scanning data, as well as geophysical survey and exploratory boreholes for botanical sampling. An important part of this project was also gathering all available information on previously known archaeological sites as well as sorting out their nomenclature and numbering. Between 2017 and 2020, another similar grant, called *Cul-*

tural and Natural Heritage of the Białowieża Forest, which was led by Prof. Przemysław Urbańczyk and funded by the National Science Centre (Project No. 11H 12 0330 81), was carried out (Urbańczyk and Wawrzeniuk 2021, 10-12). It was coordinated by the Institute of Archaeology of the Cardinal Stefan Wyszyński University (hereafter: UKSW) and conducted jointly with IAE PAS.

The vast majority of archaeological sites currently known from the Białowieża Forest consists of earthwork sites. They are mostly earthen or, much less frequently, stone mounds, the number of which in the Polish part of this forest complex can be estimated at about 1,400 (Urbańczyk and Wawrzeniuk 2021, 12; Krasnodębski 2022, tables III.1-III.26). The function and chronology of most of the mounds remains unknown, and only a few groups of them can be interpreted as prehistoric or Early Medieval barrows. The reason for this is both the insufficient degree of excavation research and the lack of distinctive features of the mounds that would allow their classification based on non-invasive research. It is also not without significance that the function and age of some of them could not be determined even after excavations (Olczak and Krasnodębski 2022, 373-408; further literature there). The second group of archaeological earthworks consists of the remains of Modern-Period timber production (Samojlik *et al.* 2022, 335-370; older literature there). These are mainly regularly circular earthen banks (tar kilns) and mounds of varying size and shape with a large number of charcoal fragments on the surface (charcoal piles). The archaeological landscape of the Białowieża Forest is completed by low earthen banks discovered in recent years thanks to the analysis of ALS data, which are interpreted as relics of former field systems (*e.g.*, Krasnodębski and Olczak 2016; 2018, 29 f., 48-50; Zapłata and Stereńczak 2016, 247; Stereńczak *et al.* 2020; Krupski *et al.* 2022; Olczak and Krasnodębski 2022, 408-430; Niedziółka *et al.* 2023), of the type known so far mainly from Northern and Western Europe under the name of 'Celtic fields' or 'fossil fields' (*e.g.*, Gerritsen 2003, 167-180; Lang 2007, 103-105; Arnberg 2009; Arnoldussen 2018; further literature there). Unfortunately, the specific nature of the area (*i.e.*, dense forest) and the concentration of surface surveys on the earthworks have resulted in the fact that very few settlements are known from the Białowieża Forest so far, and the number of excavated sites of this type does not exceed a few. Despite this, a still very incomplete but increasingly clear picture of the settlement of this region in prehistory and the Early Middle Ages is gradually emerging.

Among the sites that were discovered in recent years is that at Leśnictwo Wilczy Jar 2. It was identified thanks to the analysis of data from the 'IT Country Protection System' (Informatyczny System Osłony Kraju or ISOK in Polish) and later verified in November 2016 during surface surveys conducted by IAE PAS (Krasnodębski and Olczak 2018, 22). Its unusual (as it seemed at the time) shape prompted us to carry out excavations here. These took place in August and September of 2017 as part of the aforementioned *Cultural and Natural Heritage of the Białowieża Forest* project and were led by Dariusz Krasnodębski.

LOCATION AND STRATIGRAPHY

The site Leśnictwo Wilczy Jar 2 is located in the western part of the Białowieża Forest, in the Hajnówka Forest District (forest plot 306C; Fig. 1). It is situated in the valley of a small stream named Dubitka (Dubinka), about 1 km south of its confluence with the Łutownia River, a left tributary of the Narewka River (Fig. 2). It is a difficult place to access, surrounded on three sides by vast depressions that are periodically flooded by water. Approximately 100-150 m to the east, on elevated ground, lies the settlement Leśnictwo Wilczy Jar, Site 8.

Geographically, this is the eastern part of the Bielsk Plain mesoregion, which in turn belongs to the North Podlasie Lowland macroregion (Kondracki 2009, fig. 33; Solon *et al.* 2018, map). The topographical relief of this region was formed as a result of transgression and recession of the ice sheet of the middle stage of the Warta Glaciation and subsequent denudation and erosion processes (Kwiatkowski *et al.* 2011, 9-12, 29-32; Kwiatkowski *et al.* 2012; Stepaniuk 2017). It is an undulating moraine plain, composed of boulder clay underlain by thin covers of sands, gravels, and erratic boulders. In the immediate vicinity of the site, in the poorly developed valley of the Dubitka River, humus sands and alluvia

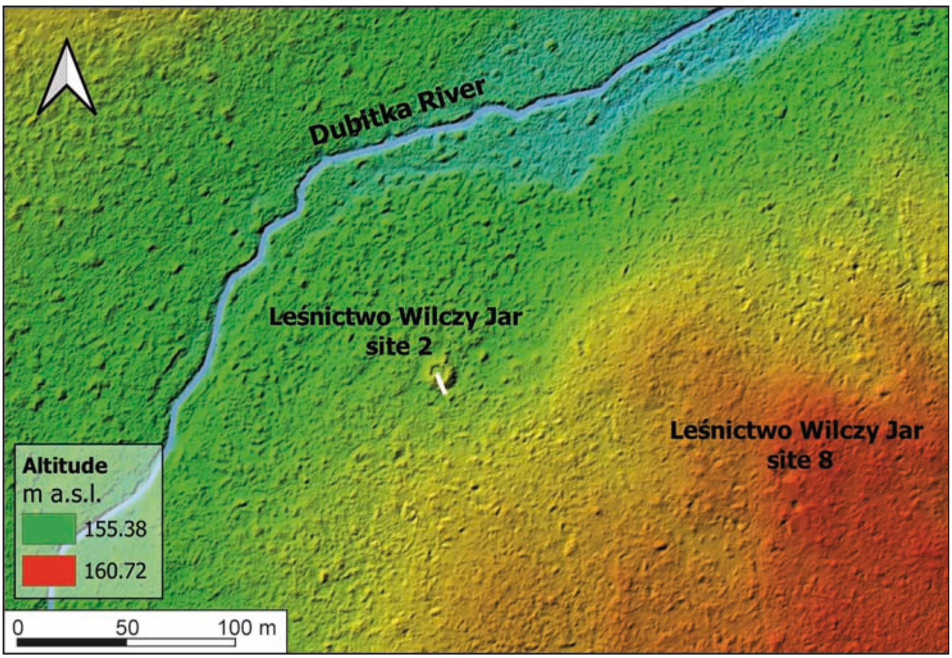

Fig. 2. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2. Digital Elevation Model with the location of the archaeological trench (source of ALS LiDAR data: Head Office of Geodesy and Cartography). Compiled by K. Niedziółka

Fig. 3. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2. View of the site from the south (December 2016). Photo by H. Olczak

are found, developed on boulder clay. A large aggregation of small-sized erratic boulders was found in the area. In terms of the nature of the vegetation cover, it is a transitional area between deciduous forest with a predominance of hornbeam and ash-alder flood plain forest (Murawska 2022).

The site has the shape of a circular mound with a diameter of about 17 m and a height of up to about 0.7 m (Figs 3 and 4). Its outer part is a low embankment with a width of about 3 m, which surrounds a centrally located depression that is about 7-8 m in diameter. The height difference between the embankment and the depression does not exceed 0.3 m. Individual stones are visible on the surface of the mound, mainly on the outer side.

A 10 × 2 m archaeological trench (later extended on the north side by 0.5 m, over a width of 1 m) was marked out in the southern and central part of the mound (Fig. 4: 1). The location and shape of the trench were imposed by trees overgrowing the area. Under the plant litter and modern humus (Layer 1) at the top and outer slope of the mound, there was a stone mantle (Layer 10) approximately 4 m wide, consisting of two layers of stones between 0.2 and 0.5 m in diameter (Figs 5-7). The arrangement of the mantle suggested that the stones had been selected at random or that they had been partly displaced secondarily. The mound beneath the mantle was made up of light fuscous sand with yellow patches (Layer 4), reaching a thickness of 0.40-0.45 m (Figs 5; 7; 8). It contained fine charcoal fragments, mainly of Scots pine (*Pinus sylvestris*), but also of European ash (*Fraxinus excelsior*) and oak (*Quercus* sp.) (Skrzyński 2021). One fragment of burnt pine wood

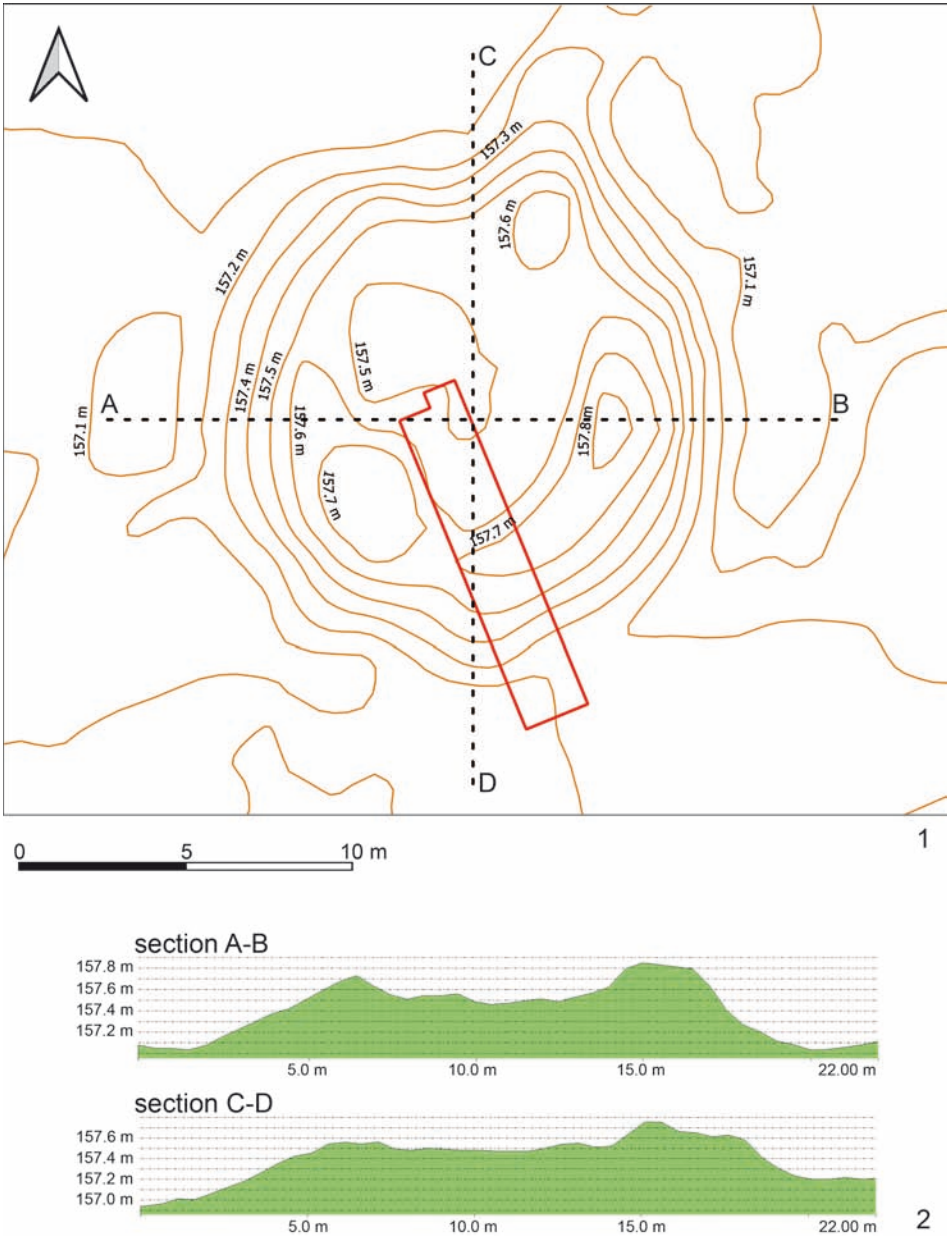

Fig. 4. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2.
Contour plan with the location of the archaeological trench (1) and sections through the mound created on the base of ALS LiDAR data (2). Compiled by K. Niedziółka

Fig. 5. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2.
Stone mantle (Layer 10) at the top and on the exterior slope of the mound.
Photo by D. Krasnodębski

Fig. 6. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2.
The southern part of the trench with the stone mantle (Layer 10). Photo by D. Krasnodębski

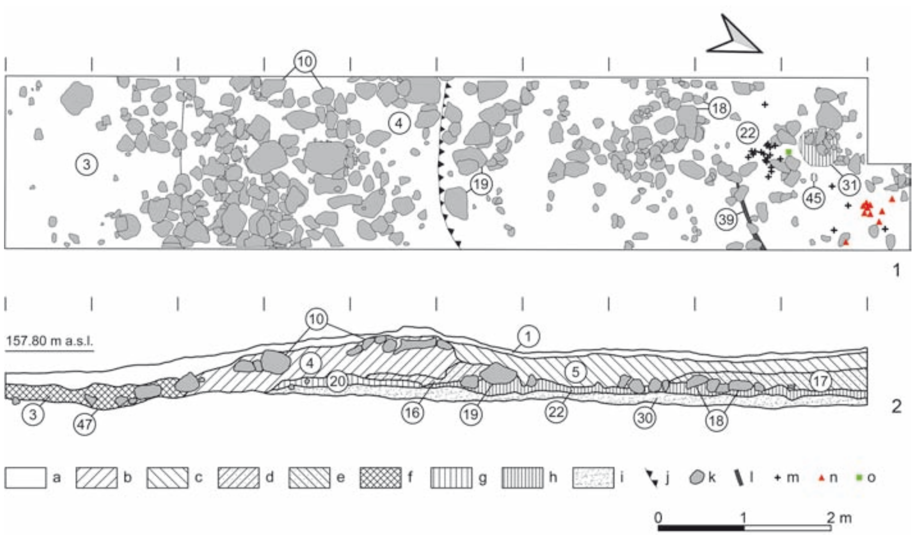

Fig. 7. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2. Plan (1) and the east-facing profile of the trench (2): a – plant litter and modern humus; b – light fuscous sand with yellow patches; c – brown, humus-rich sand; d – beige-yellow sand with brown patches and streaks; e – yellow-grey sand with brown and fuscous patches; f – dark fuscous sand; g – fuscous-grey sand; h – dark fuscous-grey and black sand with fragments of burnt bones; i – clayey yellow sand with fuscous and grey patches; j – boundary of the disturbed area; k – stones; l – remains of a wooden beam or plank; m – burnt bones; n – pottery; o – fragments of bone or antler comb.
Drawn by K. Niedziółka and Z. Tragarz

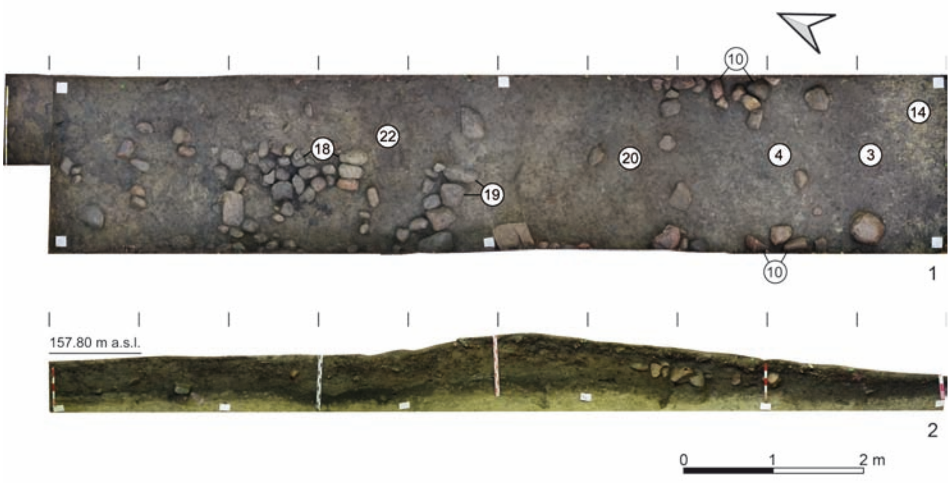

Fig. 8. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2. Photogrammetric documentation of the trench: 1 – remains of the stone core (Layers 18 and 19) revealed at the base of the mound; 2 – west-facing profile of the trench. Compiled by K. Niedziółka

showed traces of a green patina, presumably resulting from the corrosion of an unspecified object made of bronze (Skrzyński 2021). Below Layer 4 was beige-yellow sand with brown patches and streaks (Layer 16), which may be interpreted as the remains of decomposed organic material such as branches (Figs 7: 2; 9; 10). The thickness of this layer generally did not exceed 0.06-0.08 m, only occasionally did it reach 0.2 m. It contained charcoal fragments from birch (*Betula* sp.), European hornbeam (*Carpinus betulus*), ash, oak, and a deciduous tree of an unknown species. In the central part of the mound, brown, humus-rich, and root-strewn sand (Layer 5), with a thickness of 0.1-0.4 m, was present beneath the humus (Fig. 7: 2). A secondarily burnt pottery fragment was discovered on its top. It also contained single stones and small charcoal pieces, almost exclusively from Norway spruce (*Picea abies*), with a small admixture of birch and larch (*Larix*). A clear vertical boundary was visible between Layer 5 and the above-mentioned Layer 4. In the northeast corner of the trench, a pit at least 1 m in diameter and about 0.2 m deep (Feature 12) was recorded dug into Layer 5. Inside this pit, a small glass fragment from the turn of the 19th and 20th centuries and partially burnt pieces of spruce wood and bark were found. Layer 5 covered yellow-grey sand with brown and fuscous patches (Layer 17), with a thickness of approximately 0.20-0.25 m (Figs 7: 2; 9; 10). It, too, contained numerous fine charcoal fragments, mainly of Norway spruce, with minor admixtures of Scots pine, ash, and alder (*Alnus*). These layers, to a depth of about 0.4 m relative to the present ground level, seem to have been heavily disturbed. This was evidenced by traces of digging, particularly visible at their bases and at the top of Layer 22 below (Fig. 11; 12), resulting from the robbing of stones. Layers 5 and 17 were clearly distinguishable from the darker coloured ones below,

Fig. 9. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2.
The middle part of the trench with the boundary of the barrow core (Layer 19).
Photo by D. Krasnodębski

Fig. 10. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2.
The northern part of the trench with the remains of the barrow core (Layers 18 and 19) and Layer 22, containing burnt bones. Photo by D. Krasnodębski

Fig. 11. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2. A fragment of the east-facing profile of the trench with traces of digging at the base of Layer 17 and the top of Layer 22. Photo by D. Krasnodębski

Fig. 12. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2. The northern part of the trench with Layer 22. Photo by D. Krasnodębski

which, near the outer part of the mound, consisted of fuscous-grey sand with a thickness of about 0.10-0.20 m (Layer 20), with small patches of yellow clay, individual small pebbles, and numerous European ash charcoal fragments (Figs 7: 2; 8: 1; 9). On the other hand, closer to its centre was a more homogeneous dark fuscous-grey and, in places, black sand (Layer 22; Figs 7: 2; 8: 1; 9; 10; 12). Its thickness generally did not exceed 0.1 m, and only at the border with Layer 4 did it reach 0.2 m. At the top of Layer 22, there were medium-sized stones (Layer 18), over a dozen of which formed a compact pavement measuring

Fig. 13. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2. Fragments of a pottery bowl in Layer 22. Photo by D. Krasnodębski

1.5 × 1.0 m (Figs 7: 1; 7: 2; 8: 1; 10). In contrast, at its southern boundary were several somewhat larger stones, about 0.3-0.4 m in diameter (Layer 19), arranged in a slightly arched row with an approximately east-west orientation (Figs 7: 1; 7: 2; 8: 1; 9; 10; 12). Layer 22 contained a small number of charcoal fragments from oak, birch, elm (*Ulmus* sp.), and twigs of an unknown deciduous tree. Ten partially burnt pottery fragments from a single vessel (Figs 13; 14) and approximately 145 small fragments of burnt bones have also been found within this layer. The pottery was concentrated in the north-eastern corner of the trench, mainly in an area of about 0.2 m^2 and a depth of up to 0.40-0.45 m relative to the modern ground level (Fig. 7: 1). The bones were scattered over a slightly larger area of approximately 2 m^2, mostly at the same depth as the vessel fragments. Some of them formed a distinct cluster, located at a distance of about 1 m from the pottery. Among the bones stood out two small fragments of a comb or combs (Fig. 15).

Below Layers 20 and 22 was clayey yellow sand with fuscous and grey patches (Layer 30) with a thickness of up to 0.15 m, which was most probably the remains of buried soil (Fig. 7: 2). Only at the edge of the mound was this layer removed. In the northern part of the trench, a small circular pit (Feature 31) was unearthed at the top of Layer 30 and the base of Layer 22. The pit was about 0.5 m in diameter and had a depth of 0.1 m. Several medium-sized stones were laid inside it (Fig. 7: 1). Nearby, a negative of a stake (Feature 45) was found. It was sharpened at the bottom, had a diameter of about 0.1 m, and a depth of 0.16 m. In the same part of the trench, an oblong structure that was about 0.8 m long, 0.08 m wide, and up to 0.1 m thick was also recorded (Layer 39). It presumably was the remains of a decomposed wooden beam or plank, oriented northeast-southwest (Fig. 7: 1).

The mound was surrounded by a shallow ditch (Feature 47), over 2 m wide and about 0.2 m deep (Fig. 7: 2), which was presumably dug to obtain building material for its construction. It was filled with dark fuscous sand (Layer 3; Fig. 6; 7; 8: 1) with a high content of organic material formed in an aquatic environment as well as individual European ash charcoal fragments. In its upper part were a few stones that had probably slid down from the top of the mound.

FINDS AND PLANT REMAINS

Eleven fragments of pottery were recovered from the excavated part of the site. They are heavily damaged and have traces of secondary burning in the form of vitrification and wall deformation. Almost all the sherds, with the exception of one, were discovered in Layer 22 and originated from the same vessel (Fig. 14). Most of its fragments were in a cluster about 0.4 m in diameter, and only one was found a few dozen centimetres away (Figs 7: 1; 13). It is a small, partially reconstructed, handmade bowl, about 8.5 cm high, with a rim diameter of about 13 cm and a base diameter of 5.6-6.0 cm. It is characterised by a concave neck and a clearly accentuated shoulder. The rim of the bowl is everted and bevelled, and the base is slightly convex. The wall thickness ranges from 0.5 to 1.1 cm (most at the transition to the base), while the base thickness is 1.0-1.2 cm. The walls are well smoothed but uneven in places, especially in the lower part, with adhering pieces of charcoal. The surface of the base is also uneven, with no obvious remains of gritting. The present colour of the bowl (orange, dark fuscous, and grey) is the result of secondary burning, and therefore, the atmosphere in which it was originally fired cannot be determined. Grains of temper, probably crushed stone, with a grain size up to about 1.5-2.0 mm are visible in the sections of the sherds.

Approximately 1.5 m from the bowl, on the top of Layer 5, a small, strongly burnt fragment of another vessel was discovered. It had perhaps a slightly everted rim with a rounded edge.

As already mentioned, the bones found in Layer 22 were heavily burnt and fragmented (Tomczyk 2017). Despite this, it was possible to establish that at least some of them were archaeozoological material (Gręzak 2018). Two rib fragments most likely belonged to a pig. The species affiliation of the remaining 143 fragments could not be determined. These included 106 long bone fragments, 26 flat bone fragments, two cranial vault fragments, and seven unidentified ones. Among them, two fragments of a bone or antler comb (or possibly

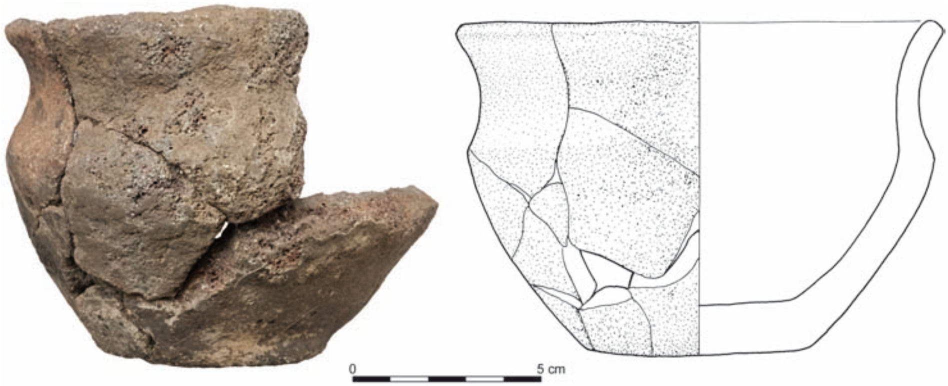

Fig. 14. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2.
Reconstructed pottery bowl from Layer 22. Drawn by G. Nowakowska, photo by M. Osiadacz

Fig. 15. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2.
Fragments of bone or antler comb from Layer 22. Photo by D. Krasnodębski

combs) were also identified. The first of these, measuring 1.48 × 1.04 cm and with a thickness of 2.4 mm, is a small arched piece with three smoothed sides and a partially preserved circular hole that is 1.3 mm in diameter (Fig. 15: 1). Its surfaces were smoothed, with the bone structure more clearly visible on the 'inner' side. The second piece measures 0.56 × 0.45 cm and is 2.1-2.4 mm thick (Fig. 15: 2). All its edges have traces of fracturing. On one of the edges there is a circular hole, while on the opposite one there is a base of five teeth that are about 1 mm wide. This fragment is also arched, probably due to exposure to high temperatures. Both fragments are most likely from a three-layer comb of type B (Thomas 1960, 62-66), the first being a piece of handle lining with a rivet hole and the second an insert, also with a rivet mark and teeth base.

A separate category of archaeological material obtained during the excavations consists of plant remains in the form of burnt wood and macro-remains. The anthracological analysis included 48 samples taken from Layers 3, 4, 5, 16, 17, 20, and 22, from which 236 charcoal fragments were examined. Most of these were small, approximately 0.5-1.0 cm in diameter. Observation and species identification was hampered in many cases by vitrification, glossing, and surface cracking, possibly resulting from the process of burning damp wood at high temperatures or the rapid cooling thereof (McParland *et al.* 2010, 2679). Only a few fragments, up to 2 cm in diameter, could be identified as twig remains. Charred bark fragments were noted in one sample.

The anthracological spectrum of the site was dominated by European ash, which accounted for more than 38% of the total remains (Skrzyński 2021). Its presence was recorded in five layers, at different stratigraphic levels. The second most abundant was the Norwey spruce, accounting for 24.7% of the collection. In addition, charcoal fragments from oak, birch, Scots pine, European hornbeam, alder, elm, and larch were distinguished, with none of them having a proportion exceeding a few percent. Norwey spruce charcoals, occupying the second place in the total number of analysed samples, were found only in the disturbed Layers 5 and 17 and in the contemporary Pit 12, while the remaining layers were dominated by charcoal from deciduous trees. Layers 5, 16, and 17 were characterised by the most diverse taxonomic composition. Of particular interest was the composition of the sample taken from Layer 16, which contained only vestiges of deciduous trees from at least four species (oak, birch, ash, and hornbeam). By contrast, only charcoal of European ash was isolated in Layer 20. The presence in Layers 4 and 17 of pieces of burnt pine wood, which is classified as having high caloric value, *i.e.*, reaching high combustion temperatures, may indicate that it was selectively chosen as fuel. It appears to have been specifically brought to the site from at least several hundred metres away, as there are no natural pine habitats in the immediate vicinity (Faliński 1986, 54; Kwiatkowski 1994, 70-74; Kwiatkowski and Stepaniuk 2008, 31 f.).

Among the organic macro-remains, sedge seeds were the most abundant group, with 44 coming from lesser pond-sedge (*Carex acutiformis*), two from hedgehog grass (*Carex flava*), and one from an unspecified species (*Carex* sp.). These were found in Layer 22 at the base of the mound, which, due to the site's location in a wetland area periodically inundated by water, may indicate their natural origin. Sedges occur in ash-alder flood plain forests, bog-oak forests, and bog-alder forests (Rutkowska 1971, 290-318; Kwiatkowski 1994, 63-66).

RESULTS OF RADIOCARBON DATING

In order to determine the chronology of the site, seven radiocarbon analyses were carried out, for which five charcoal samples taken from the central part of the mound (from Layers 5 and 22) and two from its periphery (from Layer 4) were selected (Table 1; Fig. 16). The charcoal collected from the greatest depth (more than 0.5 m from the contemporary

Table 1. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2. List of radiocarbon dates.
The dates were calibrated using the OxCal v4.4.4 software (Bronk Ramsey 2021) and the IntCal20 atmospheric curve (Reimer *et al.* 2020)

Laboratory code	Stratigraphic context of the sample	^{14}C age (BP)	Calibrated age (68.3% probability)	Calibrated age (95.4% probability)
Poz-99067	Base of layer 22 / top of layer 30	2250±30	386 BC (25.9%) 353 BC 285 BC (42.3%) 228 BC	392 BC (30.5%) 347 BC 314 BC (64.9%) 204 BC
Poz-129539	Layer 4	1760±30	246 AD (13.2%) 260 AD 278 AD (55.1%) 338 AD	234 AD (95.4%) 381 AD
Poz-129538	Layer 5	1745±30	249 AD (13.1%) 266 AD 272 AD (19.8%) 296 AD 308 AD (35.5%) 352 AD	242 AD (95.4%) 401 AD
Poz-129540	Layer 5	1720±30	258 AD (20.3%) 280 AD 330 AD (48.0%) 383 AD	250 AD (27.9%) 295 AD 310 AD (67.6%) 411 AD
Poz-97064	Layer 22	1695±35	263 AD (9.8%) 275 AD 346 AD (58.4%) 410 AD	250 AD (20.2%) 294 AD 312 AD (75.2%) 426 AD
MKL-3871	Layer 4	1170±90	774 AD (68.3%) 977 AD	671 AD (95.4%) 1022 AD
Poz-96965	Layer 5	260±30	1528 AD (13.3%) 1546 AD 1634 AD (46.4%) 1664 AD 1784 AD (8.6%) 1794 AD	1515 AD (29.4%) 1590 AD 1620 AD (52.6%) 1674 AD 1766 AD (13.5%) 1800 AD

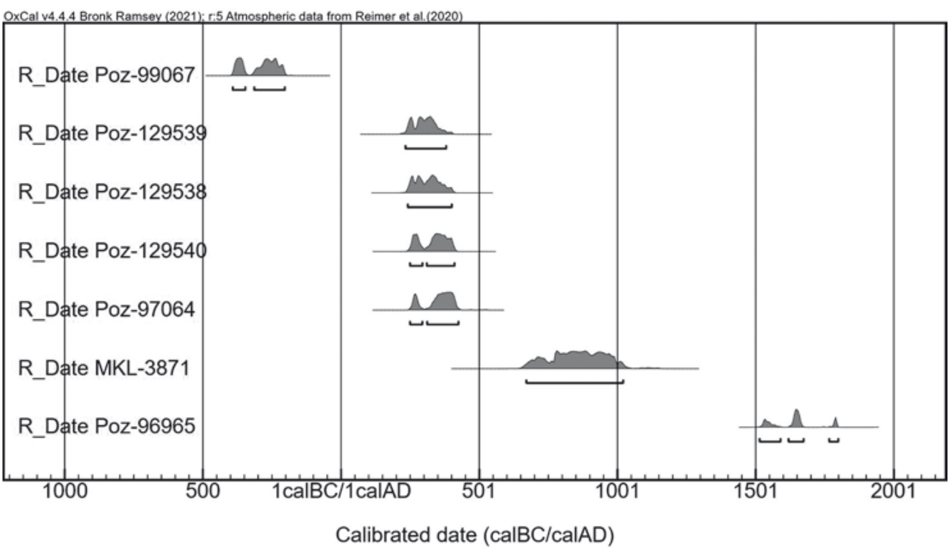

Fig. 16. Białowieża Forest, Leśnictwo Wilczy Jar, Site 2.
Distribution of radiocarbon dates

ground surface) was located at the base of Layer 22 and at the top of the buried soil (Layer 30), in the vicinity of the bowl fragments described earlier, but several centimetres lower (Poznań Radiocarbon Laboratory, Poz-99067). This gave a radiocarbon date of 2250±30 BP, which, after calibration with a probability of 95.4%, lies within the range between 392 BC and 204 BC (see Table 1). The next analysis was performed for a sample taken from the top of Layer 22 (Poz-97064). The result obtained (1695±35 BP) after calibration with a probability of 95.4% ranges between 250 AD and 426 AD. A further three analyses were carried out for charcoals from the disturbed Layer 5 (Poz-129538, Poz-129540, and Poz-96965). The first two samples yielded radiocarbon dates of 1745±30 BP and 1720±30 BP, which, after calibration with a probability of 95.4%, gave the years 242-401 AD and 250-411 AD, respectively. The third analysis gave a radiocarbon date of 260±30 BP. The calibrated age of this sample lies within the range between 1515 AD and 1800 AD (probability of 95.4%). Charcoal taken from Layer 4 yielded a result of 1760±30 BP (Poz-129539), which, after calibration with a probability of 95.4%, spans between 234 AD and 381 AD. Analysis of another sample from the same layer, this time obtained from its base at the outer edge of the mound (near Layer 3), yielded a radiocarbon date of 1170±90 BP (Laboratory of Absolute Dating in Cianowice Małe, MKL-3871). The calibrated age of this charcoal falls between 671 AD and 1022 AD (probability of 95.4%).

Thus, the analyses of as many as four samples (Poz-97064, Poz-129538, Poz-129539 and Poz-129540) from different layers and locations gave consistent results. The calibrated age of all of them (see Table 1; Fig. 16) lies between the middle of the 3rd and the turn of the 4th and 5th centuries AD (probability of 95.4%) and between the middle of the 3rd and the middle or late 4th centuries AD (probability of 68.3%). However, the dating results of three other samples differ significantly. The first of these indicates a period that is at least 600 years older. Such a result does not seem to be related to the origin of the sample from the heartwood of a tree (the so-called 'old wood effect'), as the most long-lived oaks in the Białowieża Forest probably lived up to about 400 years (Faliński 1986, 51; Zin *et al.* 2022, 126-135). It can, therefore, be assumed that this dating reflects some kind of use of the site at a time prior to the building of the mound, such as vegetation burning or a forest fire caused by natural factors. The charcoal, the radiocarbon age of which has been determined to be 260±30 BP (Poz-96965), is most likely associated with some activity in the Modern or contemporary period, perhaps a bonfire lit at the site, or possibly a fire (on fires in the Białowieża Forest during the 17th to early 20th centuries, see Niklasson *et al.* 2010). This supposition is confirmed by its deposition at a low depth, in the disturbed Layer 5. Interpretation of the result of the last analysis (MKL-3871) is also problematic, but given the origin of the charcoal (from the outer edge of the mound) and the low dating precision, it can be considered coincidental.

FUNCTION AND CULTURAL AFFILIATION

The unusual shape of the mound and the ambiguous nature of the finds pose problems for its interpretation. The most likely hypothesis is that it is a heavily destroyed barrow of the Wielbark culture. This conclusion is based primarily on the results of the radiocarbon dating. Despite the wide range of dates obtained, four of them fall within the period between the middle of the 3rd and the beginning of the 5th century AD, and therefore from phase C_{1b} or C_2 to phase D of the Roman Period and the Migration Period (Godłowski 1974, 86-92; 1988; more recently Mączyńska 2016; 2019, 43). During this period, the settlement of the Wielbark culture was spread over most of the area east of the Lower and Middle Vistula River (see *e.g.*, Wołągiewicz 1986, fig. 14; Andrzejowski 2005, fig. 4; Cieśliński 2014, fig. 1; 2016, fig. 8). Admittedly, today's Białowieża Forest is located near to the eastern boundary of the area of this culture, but several previously unknown sites dated to the Younger and Late Roman Period have been discovered here lately (see further on).

The hypothesis of the Wielbark culture barrow is also supported by other indications, including the character of the discovered relicts. Despite the location of the site in an area that is difficult to access and its form, which is somewhat reminiscent of minor strongholds, a defensive function is unlikely, mainly due to its small size and the lack of traces of any fortifications. There are many indications that the present shape of the mound is the consequence of the destruction, which resulted in the formation of an extensive depression in the central part of the barrow, extending nearly all the way down to its base. In terms of its diameter, which is approximately 10-12 m, it is similar to the pits found in the central parts of many burial mounds of the Wielbark culture from the Upper Narew and Middle Bug River basins, for example, in Rostołty, Białystok district, Site 1, Barrow 2, Jasionowa Dolina, Sokółka district, Site 1, Barrows 2, 7, and 10, and Kutowa, Hajnówka district, Site 1, Barrow 4 (Jażdżewski 1939, figs 2-4, 7, 9, 10, 44, 45; Jaskanis 2012, 16, 70, 72, 75, 134, pls 34, 38, 42, 77). They were created as a result of grave robbery or stone extraction (*e.g.*, Jaskanis 1973, 175-177; 1976, 228; 2012, 7). Due to the high degree of destruction of the barrow and its small extent of excavation, it is currently difficult to determine the type of construction originally located in it. It is most likely that in the central part of the mound, a multi-layered pavement of small and medium-sized stones was laid. Admittedly, the cobblestones that survived at its base, at the top of Layer 22 (Figs 7: 1; 8: 1; 10), did not form a compact structure at the time of the excavation, but this can be explained by the fact that many of them had been taken out before. The lack of stones besides a few small ones at the edge of the mound (in Layer 20) indicates that the construction occupied only its central part. At the same time, the survival of a stone mantle on the slope of the mound (Layer 10), quite visible on the surface, and the robbing of only stones from its centre suggests that the largest specimens were located there, and their occurrence there in large numbers facilitated their extraction. Both of these premises suggest that the stone construction that had originally been at the base of the barrow, took the form of a core covering only its central part, about 10 m in diameter. Its outer boundary appears to have been formed by a row of somewhat larger stones (Layer 19), with a slightly arched shape (see Figs 7: 1; 8: 1; 9; 10; 12). Thus, the barrow probably belonged to Type 4 of graves with stone constructions according to Ryszard Wołągiewicz's classification (perhaps Type 4b), in which the core was almost completely destroyed and only the lowest layer of stones survived (Wołągiewicz 1977, 71 f.; see Cieśliński 2014, 66-68; 2020, 66 f.). In the vicinity of the Białowieża Forest, Type 4a graves have been found in Kotłówka, Hajnówka district, Site 1 (Barrows 1 and 3) and possibly in Cecele, Siemiatycze district, Site 1 (*e.g.*, Barrows VII and VIII) (Jaskanis 1996, pls 88 and 89; 2012, pls 50 and 57; Cieśliński 2014, fn. 63), while Type 4b graves are known from, among other places, Skiwy Małe, Siemiatycze district, Site 3 (Jaskanis 1973, 174 f., figs 2-4) and Szpaki, Bielsk Podlaski district, Site 1 (Rusin 2008, fig. 3). However, it cannot be ruled out that the stone construction was similar to the Type 1, which was less common in north-eastern Poland, but was present, for example, in Barrow 1 from nearby Kutowa (Jażdżewski 1939, fig. 44; Jaskanis 2012, pl. 61) and in Barrow 1 from Pielgrzymowo, Nidzica district, Site 1 (Lau 2012, 78). Due to the high degree of destruction of burial mounds and especially stone constructions at cemeteries from north-eastern Poland, classification attempts are not always uncontroversial. It seems that, in addition to the five main types of barrows with stone constructions distinguished by Ryszard Wołągiewicz (Wołągiewicz 1977, 71-73), there were also intermediate forms (see Cieśliński 2014, 67). The stones (Layer 10) lying on the outer slope of the mound at Leśnictwo Wilczy Jar were the remains of a mantle (Figs 5-7). Probably some of them, especially the larger ones, were not *in situ* but ended up in this place as a result of the destruction of the core (see Cieśliński 2014, 72; 2020, 68). Undoubtedly, stone mantles covered only some of the burial mounds from the area in question, for example in Kutowa (Barrow 4; Jaskanis 2012, 134, pl. 77), Jasionowa Dolina (Barrows 7 and 12 and possibly Barrow 1; Jaskanis 2012, 68, 72, 76, pls 30, 31, 38, 45), and in Rostołty (Barrows 1 and 2 and possibly Barrow 3; Jażdżewski 1939, 3, fig. 10; Jaskanis 2012, 14 f., 18, pls 3, 8, 13). In general, however, the presence of this type of construction is difficult to confirm due to the poor state of preservation of the barrows (Cieśliński 2014, 72; 2020, 67 f.).

The present dimensions of the mound, apart from its height, are probably not much different from the original ones, so that its diameter did not originally exceed about 17-18 m. This is within the average for graves of the so-called Rostołty type from the area of the Upper Narew and Middle Bug River basins (Cieśliński 2014, 65, fig. 15; 2020, 65 f., fig. 2). In Jasionowa Dolina, the diameter of the barrows ranged from 8 to 21 m, in Rostołty – from 19 to 26 m, and in Kutowa – from 18 to 21 m (Jażdżewski 1939, 4, 16, figs 2, 4, 7, 44, 45; Jaskanis 2012, 14-16, 18, 21, 27 f., 68, 70-72, 74, 76, 78, 126, 129 f., 132, 134, 136). The diameter of about 20% of the Wielbark culture burial mounds in north-eastern Poland lies in the range of 15-19 m (Cieśliński 2014, 65). The height of the barrow at Leśnictwo Wilczy Jar is difficult to determine. At present it is about 0.5 m in relation to the surrounding trench, but it could have been much higher, depending on the number of stones taken out from the central part of the mound.

If there was a burial in the barrow, it was probably cremated and originally deposited in its central part, at the base of the mound. Evidence of this ritual is provided by the presence of a layer of dark sand (Layer 22) that contained burnt animal bones as well as burnt grave goods of the deceased in the form of fragments of a comb and a clay bowl. It extended from the northern boundary of the trench to the edge of the stone core, so it can be assumed that it had covered the entire central part of the barrow. Similar burnt layers have been discovered at mound bases at several cemeteries of the Wielbark culture in the area, including Barrows 1, 7, and 10 in Jasionowa Dolina (Jaskanis 2012, 68 f., 73, 75, 78), Barrow 5 in Grochy Stare, Białystok district, Site 1 (Rusin 2005a, 214, 223, fig. 2), Barrow 5 in Rostołty (Jaskanis 2012, 27, 29), and Barrow 1 in Teolin, Sokółka district, Site 1 (Rusin 2016, 61, 75). They are interpreted variously – as cremation burials, *ustrina*, or evidence of other ritual activities, such as burning of vegetation preceding the building of the mound (*e.g*., Rusin 2005a, 223; Jaskanis 2012, 78; Cieśliński 2014, 78-80). Due to the small number of charcoal fragments and the lack of traces of ground burning, it can be assumed that, in the case in question, the cremation of the deceased took place elsewhere, and only the vestiges of the funeral pyre were deposited under the stone core. Burials involving the deposition of the funeral pyre remains directly on the ground surface, have been discovered at several cemeteries from the Upper Narew River basin, including in Teolin (Barrow 1; Rusin 2016, 74), Kutowa, Site 1 (Barrow 3; Jaskanis 2012, 133, 215 f.), and Jasionowa Dolina (Barrow 10; Jaskanis 2012, 75). The burnt layer found at the base of the last of the mentioned barrows is also sometimes interpreted as an *ustrinum* (Jaskanis 2012, 78). The function of the layer discovered beneath the stone core in the central part of Barrow 1 at Szpaki, which was located approximately 2 m east of a pit burial, is unclear (Rusin 2005b, 37 f.; 2008, 296, 305, fig. 3). In addition to the conjecture that this is a second burial, it is also possible to interpret it as the remains of a funeral pyre preserved *in situ* (Cieśliński 2014, 78 f.). Such a hypothesis is also, of course, not completely ruled out in the case of the barrow at Leśnictwo Wilczy Jar, as the incomplete degree of its excavation and the lack of human bones do not allow us to make clear conclusions regarding the type of burial deposited there. It is necessary to mention here the complicated burial ritual of the Wielbark culture and the discovery of scattered items and sometimes burnt human bones in very different parts of the barrows, which are difficult to interpret as proper graves (*e.g*., Rusin 2005a, 215, 222; 2016, 72-74).

Due to the species composition of the charcoal found in Layer 22, it can be assumed that the wood of deciduous trees like oak, birch, and elm was used as fuel for the funeral pyre. Small branches were also used. The taxonomic composition of charcoal from the Wielbark culture burial grounds of this region varies so much that it does not allow concrete conclusions to be drawn (Czeczuga and Kłyszejko 1976; Jaskanis 2012, 213; Rusin 2016, 61 f.). This may be due not only to the variation in the species composition of the forests adjacent to the cemeteries, but also to the different sampling locations within the barrow and, consequently, to the various purpose of the individual wood species. This is evident in Barrow 1 in Teolin, where charcoal fragments from Scots pine and maple mainly occurred within the core, oak and hornbeam were additionally distinguished in the surrounding burnt layer, while only birch was found in the supposed cremation grave itself (Rusin 2016, 61 f.). It is noteworthy that in Layer 20 at Leśnictwo Wilczy Jar, extending at the outer part of the stone core, charcoal fragments of a single tree species, namely European ash, were found. Both this fact and the absence of artefacts in the layer lead to the assumption of different circumstances of its formation compared to Layer 22, for example, as a result of vegetation burning to prepare the place for the burial. The European ash is a natural component of the ash-alder floodplain forest overgrowing the Dubitka River valley in the vicinity of the site (Kwiatkowski 1994, 63 f., map; Murawska 2022).

What is puzzling is the absence of human bones in the excavated area, the presence of which would allow to unequivocally confirm the sepulchral function of the mound. This can be explained, on the one hand, by the limited size of the trench and, on the other hand, by the great fragmentation of the osteological material, which made it impossible to identify the majority of bones. Therefore, it is not completely ruled out that among the bones found, there were also human remains (such doubts arise whenever the burnt bone material is highly fragmented, see *e.g.*, Gręzak and Tomek 2021, 335 on the cemetery in Dąbek, Mława district, Site 9). It should also be noticed that numerous examples of Wielbark culture graves, including barrows, in which no human bones were discovered, are known (Skóra 2014, 49). These include the aforementioned Barrow 10 from Jasionowa Dolina, at the base of which there was a layer with burnt animal bones, vitrified pottery fragments, and grave goods, but no human remains (Jaskanis 2012, 75). The complete absence of human remains in the graves or the small number of bones has been interpreted in various ways, including symbolic or partial burials (Skóra 2014, 50-67; further literature there). The sepulchral function of the mound in question, however, is confirmed by the presence of burnt animal bones. These were frequently discovered in cemeteries of the Wielbark culture, for example, in Barrow 3 in Grochy Stare (Rusin 1999, 226) and in Kutowa, Sites 1 and 2, where, interestingly enough, fragments of combs were also found (Stanaszek 2012, 268, 278). Animal bones, although only partially burnt, were also recorded at Rostołty (Jaskanis 2012, 15 f., 18, 20-23, 37) and Jasionowa Dolina, including in the cremation burial pit in Barrow 1 (Jaskanis 2012, 68-70, 83) and in a presumed cremation grave or *ustrinum* in Barrow 10 (Jaskanis 2012, 75). The latter two burial grounds showed a predominance of livestock bones, with cattle remains dominating (Jaskanis 2012, 212 f., table 1). As in the case of the site in question, pig bones were also found in Rostołty, which accounted for 20% of the total archaeozoological material (Jaskanis 2012, 22 f., 37). However, a direct relationship between the animal remains, and the burials at this cemetery is not certain. The presence of burnt animal bones, in addition to human ones, was also recorded in the necropolises of the Masłomęcz group (Rogatko 1991, 153, 165, table 1).

A few words should be written regarding two small features (31 and 45) discovered at the base of the mound. Due to the lack of any finds in their fills, their function is not clear. One of them (Feature 31), due to the presence of several stones, can be interpreted as a potential hearth, while the other (Feature 45) is probably the negative of a sharpened wooden stake. Pits situated under the mounds, which are believed to have ritual function, are known from several cemeteries of the Wielbark culture in north-eastern Poland (Cieśliński 2014, 80; further literature there). Shallow features, interpreted as hearths associated with the burial rite, have been discovered, for example, in Barrows 1 and 2 in Jasionowa Dolina (Jaskanis 1976, 229 f.; 2012, 69-71, 79, pls 31, 34) and Barrow 4 in Rostołty (Jaskanis 2012, 21 f., pl. 17). Unlike the grave in question, these were generally located at the edge of the mounds and contained charcoal with fragments of animal bones and pottery. No artefacts were found in the eight shallow hearths located at the base of Barrow 2 in Rostołty (Jaskanis 2012, 16, pl. 8). Pits of various types, including hearths, were also recorded in Barrow 1 at Teolin, both within and outside the stone core, but their relationship to the grave is not certain (Rusin 2016, 61-64, 76, fig. 14). In contrast, at Grochy Stare, hearths and negatives of vertically driven wooden stakes were discovered at the base of Barrow 5 (Rusin 2005a, 214 f., 223).

A shallow ditch with a width of more than 2 m was located at the edge of the barrow. It is difficult to say whether it served only a practical function (obtaining building material for the mound) or whether it acted, for example, as a symbolic marker of the grave boundary. A similar ditch surrounding Barrow 5 was recorded at Grochy Stare (Rusin 2005a, 214).

At this point, it is necessary to look at the items found in Layer 22. A three-layer comb made of bone or antler, of which two small fragments were preserved (Fig. 15), undoubtedly belonged to the grave goods. Items of this type have relatively frequently been found at cemeteries of the Wielbark culture in north-eastern Poland. The closest find of a bone comb is one discovered in a child's grave at the Hajduki Range in the Białowieża Forest (Leśnictwo Nowe, Site 4, forest plot 396C), which is located approximately 7 km southeast of the site in question (Dzierżykray-Rogalski and Jaskanis 1961). It is preserved almost completely and consists of three plates joined by bronze rivets (Dzierżykray-Rogalski and Jaskanis 1961, fig. 6; Olczak and Krasnodębski 2022, fig. IV.52: 1). The shape of the handle approximates to a triangle with a truncated and rounded vertex, which, according to Sigrid Thomas' classification, indicates Type II of three-layer combs (Thomas 1960, 94-104). At the flat cemetery in Kutowa, Site 2, small comb fragments were discovered in 17 cremation graves (Jaskanis 2012, 161, 166-173, 180, pls 82/5: 1; 82/8: 1; 85/44: 1; 86: Grave 58/1; 87/60: 1). However, only three of them were classified as three-layer specimens. Fragments of a three-layer comb were found at Site 1 in Kutowa, in Barrow 2 (Jaskanis 2012, 131, pl. 70: 1), and fragments of an item of type B II in Pielgrzymowo, in Barrow 3 (Lau 2012, 72 f.). Many more combs were recorded at the cemetery in Cecele – in Barrow V (Burial 2J) and in 117 flat graves (Jaskanis 1996). Some of them were preserved in larger fragments, which made it possible to assign them to five types according to the classification of Sigrid Thomas (Thomas 1960). There were at least 77 specimens of three-layer combs (Jaskanis 1996, 13-80, pls 4/21: 2; 11: 6; 20/143: 1; 23/163: 1; 24/175: 4; 25/174: 1; 27/204: 4; 29/219: 2; 33/263: 1; 38: 5; 40/346: 1; 48: 3; 53/441: 1; 53/444: 2; 57: 4; 68: 2; 71: 4; 74/548: 3). Bone or antler three-layer combs were also found in Barrows 1 and 2 in Rostołty (Jażdżewski 1939, 10, fig. 16; Jaskanis 2012, 14, 17, 33, pls 4: 2; 10: 9, 9a) and in Graves 219, 279, and 297 at the flat cemetery in Krupice, Siemiatycze district, Site IA (Jaskanis 2005, 55, 65, 67, 105 f., pls 62 and 72), while fragments of a burnt two- or three-layer example were discovered in Barrow II in Skiwy Małe (Jaskanis 1973, 178; 1974, 438, 441, fig. 4). During the research at the Brest-Trishin cemetery in Belarus (Brest District), 24 diverse combs, including three-layer ones of Types I and II, were found (Kuharenko 1980, 52-59, 99-121, pls 6-28). Thus, it is clear that bone and antler combs were one of the more common grave goods of the Wielbark culture, and this was true both in barrows and flat cemeteries.

The second item, found approximately 1 m north of the comb, is a shattered pottery bowl that could be partially-reconstructed (Fig. 14). Its fragments, mostly secondarily burnt, with pieces of charcoal attached to the outer surface, were generally concentrated in an area about 0.4 m in diameter. Although analogies can be found between the shape and manufacturing technology of this vessel and the pottery of many cultural units from the Pre-Roman and Roman Periods, it has the most equivalents among the ceramics of the Wielbark culture. Due to its shape and size, it can be considered a small bowl, classified by Ryszard Wołągiewicz as Type XIVA (Wołągiewicz 1993, 18). The form of these vessels is reminiscent of the large bowls of Type XaA, but they are sometimes characterised by less careful workmanship. They are dated to phases B_2/C_1-D of the Roman Period and the Migration Period (Wołągiewicz 1993, 26). A very similar bowl was found in Grave 3 in the flat cemetery of the Wielbark culture at Białowieski Park Narodowy, Site 33, located approximately 15 km east of the site at Leśnictwo Wilczy Jar (Krasnodębski *et al.* 2008, 368, fig. 8: 6). In general, however, among the finds from the Upper Narew and Middle Bug interfluve, small bowls with a similarly shaped upper part are relatively rare, and this form was given much more often to larger vessels, which were sometimes additionally provided with a handle. Bowls of Type XIVA have been found, among other places, in Barrow III (Jaskanis 1996, 79, pl. 86: 3) and five flat graves at the necropolis in Cecele, while Type XIVB vessels were discovered in another 17 flat graves from this site (Jaskanis 1996, 13, 23, 27, 31, 33 f., 36, 42, 50, 56, 61, 64, 74 f., table 7, pls 17: 4; 19: 3; 23/163: 3; 28/199: 1; 34: 5; 41: 4; 52: 5; 75/556: 4). At least a few bowl fragments of Type XIV have been discovered at the cemetery in Rostołty, including in Barrows 1, 4, and 5, for example, in burial pits and fireplaces (Jaskanis 2012, 15, 22, 24-27, 35 f.; pls 20: 12; 21: 4; 25: 4). The majority of these were classified as Type XIVB. A fragment of a similar vessel also comes from Barrow 1 in Jasionowa Dolina (Jaskanis 2012, 69, 82, pl. 32: 5). Analogous bowls also belonged to the grave goods of two burials at the cemetery in Krupice. A vessel of Type XIVB was found in Grave 147, while an XaA or XIVA type vessel was discovered in Grave 229 (Jaskanis 2005, 41, 57, 110, pls 42 and 64).

Similar to the bowl from the site at Leśnictwo Wilczy Jar, some vessels from the aforementioned cemeteries were also secondarily burnt. Fragments of burnt and sometimes completely vitrified pottery were discovered, for example, in graves and in the burnt layers in Barrows 3, 4, and 5 in Grochy Stare (Rusin 2005a, 223), in Barrow 1 in Szpaki (Rusin 2008, 305), in Barrows 10 and 12 in Jasionowa Dolina (Jaskanis 2012, 75, 77), and in Barrow II (Burial 1) in Skiwy Małe (Jaskanis 1973, 178). It is believed that the vessels were placed on the cremation pyre as grave goods and sometimes ritually smashed during funerary ceremonies (Gałęzowska 2007, 172; Rusin 2008, 305; Jaskanis 2012, 79, 240). As the fragments of the bowl were found at the border of the trench, it is impossible to determine whether it was deposited at the base of the mound in its entirety and shattered under the influence of the weight of the stones, or whether only fragments of it had been placed there. Little can also be said about the small fragment of a rim from Layer 5 other than that it came from another secondarily burnt vessel.

The final element to be discussed in terms of the function and cultural affiliation of the mound is its location. All known barrow cemeteries of the Wielbark culture in north-eastern Poland are located near watercourses, sometimes at a distance of 20-50 m from them, such as the ones in Kuraszewo and Szpaki (Jaskanis 1963, 323, fig. 1; 1976, 227; 2012, 197; Rusin 2008, 295, fig. 1; Cieśliński 2014, 58-62). At the same time, there are also some burial grounds or parts of them that were situated in floodplains, perhaps waterlogged during water surges (Lau 2012, 12-14; Cieśliński 2014, 59; Cieśliński *et al.* 2019, 13). There is no doubt that the barrow in Leśnictwo Wilczy Jar is one of the lowest located of those identified so far, and such processes undoubtedly took place here (a steady process of drying up of watercourses and lowering of groundwater levels is observed in the Białowieża Forest area, see Grygoruk *et al.* 2022, 19, 44). Some reservations regarding the suggested function of the mound in question may also be raised by the fact that it is an isolated grave, which is unusual in the case of cemeteries of the Wielbark culture (Cieśliński 2014, 62-64). However, in north-eastern Poland, cemeteries with a small number of barrows are more common than in Pomerania and Greater Poland (Cieśliński 2013, 70 f.). Those include, for example, Bielawa, Nidzica district, Site 4 (Michalski 2001) and Kuraszewo (Jaskanis 1963). Despite a careful surface search and a dozen or so boreholes made with a window auger, located to the west, south and east of the barrow (Stepaniuk 2017), no traces of flat graves were found around it, and, besides, their presence has to be ruled out by the waterlogged nature of the area. This can be explained by suggesting that the barrow was an initial one at a newly established cemetery that was not subsequently continued. So far, no traces of a settlement of the Wielbark culture have been discovered in its vicinity. From the settlement Leśnictwo Wilczy Jar, Site 8, located about 100-150 m to the east (see Fig. 2), comes pottery preliminarily dated to the Bronze and Early Iron Ages (Krasnodębski *et al.* 2018; Jakubczak 2021, 312 f.) but nothing later.

In conclusion, both in terms of the character of the stone constructions and the finds, the site in question fits well into the image of the Wielbark culture's funerary customs in the Upper Narew and Middle Bug interfluve. The excavated mound should be considered as a Rostołty type barrow or, as it was recently proposed, a Rostołty horizon barrow (Cieśliński 2014, 85; 2020, 70 f.). Belonging to this group of graves is not ruled out by the small size of the mound nor the lack of valuable grave goods, which may, moreover, be due to the limited scope of the excavation. As already mentioned, the calibrated age of four charcoal samples lies within the range between 234 AD and 426 AD (Table 1; Fig. 16), which corresponds to the times from phase C_{1b} or C_2 to phase D of the Roman Period and the Migration Period. This coincides with the chronology of the Wielbark culture barrows in north-eastern Poland, most of which are dated from phase C_1 (probably C_{1b}) to phase D (Jaskanis 1976, 219-226; Cieśliński 2013, 55 f.; 2014, 53-58). The artefacts found in the barrow are not distinctive enough to make the dating of the burial more precise.

BIAŁOWIEŻA FOREST IN THE CONTEXT OF CULTURAL CHANGES AT THE END OF ANTIQUITY

Excavations at Leśnictwo Wilczy Jar, Site 2 have yielded further information on the area of today's Białowieża Forest during the Roman Period. The settlement in this region, as well as in the whole interfluve of the Upper Narew and Middle Bug Rivers, is still not satisfactorily researched. This applies not only to the Wielbark culture but also to a wider temporal range, from the Pre-Roman Period to the time of the expansion of Slavs (*e.g.*, Barford *et al.* 1991, 133-139, figs 5-7; Andrzejowski 1999, 41-48, fig. 14; 2005, 109-112; Vyargej 1999, fig. 95; figs 1-4; Dąbrowska 2008, maps 2-6; Beliavets 2016a, fig. 2). Suffice to mention that only in 1959 was the first Roman Period site in the Białowieża Forest discovered by accident – a single child's grave in the aforementioned Hajduki Range (Leśnictwo Nowe, Site 4). For a long time, this was the only and isolated testimony of the presence of a 'Gothic' population in the area (Dzierżykray-Rogalski and Jaskanis 1961). In 2003, a small-scale excavation was carried out at a newly discovered necropolis of the Wielbark culture in the Wielka Kletna Range – Białowieski Park Narodowy, Site 33 (Krasnodębski *et al.* 2008), and a year later the first settlement from the Roman Period – Leśnictwo Podcerkiew, Site 1, was tentatively researched. The latter site was associated with communities of a local group of the Hatched Pottery culture (Olczak *et al.* 2018). As a result of excavations and surface surveys carried out in the following years, the number of known archaeological sites from the Pre-Roman and Roman Periods in the Białowieża Forest has increased significantly (Fig. 17). Despite this, the source base for understanding the settlement of this period is still insufficient.

According to the current state of knowledge, the region of today's Białowieża Forest was settled on a larger scale only in the younger Pre-Roman Period (on the sparse evidence of settlement in earlier periods, see Wawrusiewicz *et al.* 2022). It was probably at this time, or slightly earlier, that the settlement of the local group of the Hatched Pottery culture,

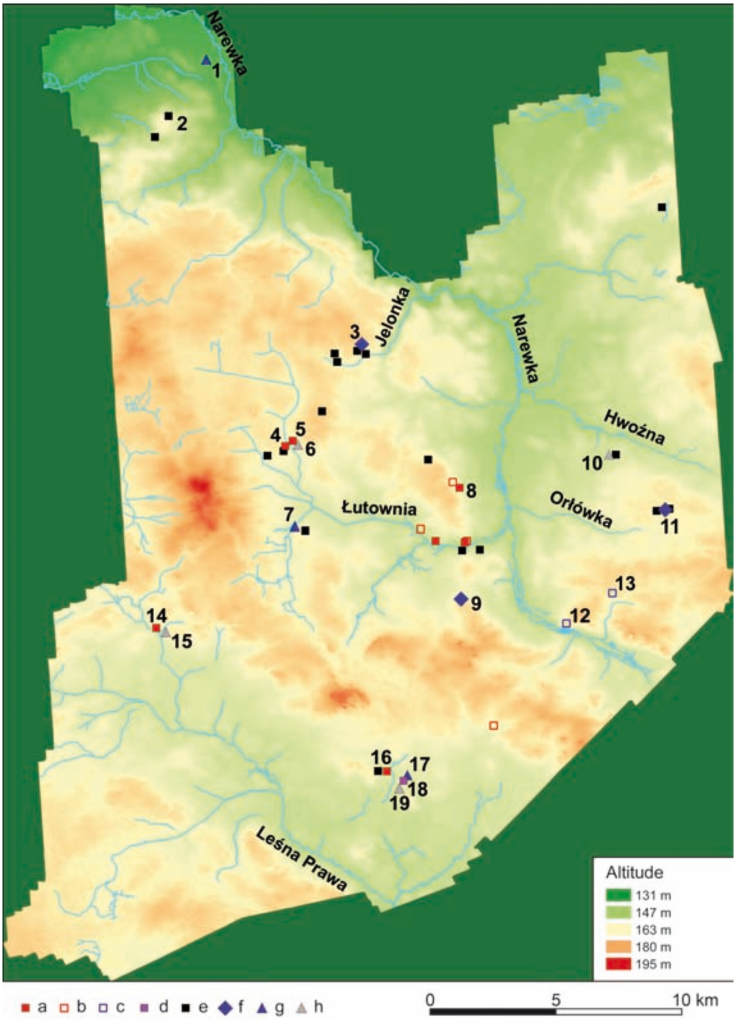

Fig. 17. Location of the sites dating from the Early Iron Age to the end of the Roman Period, situated in the Polish part of the Białowieża Forest: 1 – Leśnictwo Rybaki, Site 3; 2 – forest plot 764B (Krynica forestry); 3 – forest plot 124A (Przechody forestry); 4 – Leśnictwo Postołowo, Site 6; 5 – Leśnictwo Postołowo, Sites 3 and 5; 6 – Leśnictwo Postołowo, Site 4; 7 – Leśnictwo Wilczy Jar, Site 2; 8 – Leśnictwo Teremiski, Site 3; 9 – Leśnictwo Nowe, Site 4; 10 – Białowieski Park Narodowy, Site 22; 11 – Białowieski Park Narodowy, Site 33; 12 – Białowieża, Site 1; 13 – Białowieża, Site 2; 14 – Leśnictwo Sacharewo, Site 9; 15 – Leśnictwo Sacharewo, Site 3; 16 – Leśnictwo Podcerkiew, Site 1; 17 – Leśnictwo Podcerkiew, Site 11; 18 – Leśnictwo Podcerkiew, Site 4; 19 – Leśnictwo Podcerkiew, Site 12. Explanation: a – settlements of the Suraż group of the Hatched pottery culture; b – settlement points and supposed settlements of the Suraż group of the Hatched pottery culture; c – settlement points and supposed settlements of the Wielbark culture; d – settlements of the Wielbark culture and the Suraż group of the Hatched pottery culture; e – settlements and settlement points of an unknown cultural affiliation; f – flat cemeteries of the Wielbark culture; g – barrows and supposed barrows from the Roman Period; h – earth mounds of unknown purpose from the Roman Period or the Migration Period. After Olczak and Krasnodębski 2022, fig. IV.1 (revised)

the so-called Suraż group (*e.g.*, Krasnodębski and Olczak 2002, 220; Olczak 2009; Olczak and Krasnodębski 2018, 153-155) or Suraż-Trościanica group (Beliavets 2004, 256; 2016b, 341) spread here (*e.g.*, Olczak *et al.* 2018; Olczak and Krasnodębski 2022, 89-146; Niedziółka *et al.* 2023). It survived at least until the end of the Early Roman Period and, from the 1st century AD onwards, was part of the post-Zarubintsy horizon, which covered extensive areas in the basins of the Middle Bug, Pripyat, and Middle Dnipro Rivers (Andrzejowski 1999, 42-48; Beliavets 2004, 256 f.; 2016b, fig. 2; Terpilovskiy 2011, 202). The stable settlement developing in the Upper Narew and Middle Bug interfluve under the influence from the forest zone of Eastern Europe may have been one of the reasons for the lack of wider interest in this region in the younger Pre-Roman Period by communities of the Przeworsk culture (Olczak 2009, 263). Although from phase A_2 onwards, a large settlement cluster of this culture existed in the Middle Bug River basin, it probably did not extend beyond the Nurzec River in the north (Godłowski 1984, 114, map 1; Dąbrowska 1988, 73 f., *e.g.*, maps 4, 7, 20; 2008, 83 f., map 3). There is also insufficient evidence for clear influences from the area of the Polesian group of the Zarubintsy culture (Dąbrowska 2004; 2008, 111). At that time, the migration inferred from the written sources of the Germanic Bastarnae and Scirii peoples through these areas from the Jutland Peninsula towards the Black Sea was probably only a short-lived episode for the Upper Narew and Middle Bug River basins (Dąbrowska 2001, 26-28, fig. 2; 2008, 191 f., map 6; Andrzejowski 2005, 112). Archaeological evidence of their presence is provided by artefacts of the Jastorf culture, including a so-called fire dog, found at Site 1C in Haćki, Bielsk Podlaski district (Kobyliński and Szymański 2005, 54 f., fig. III-13; Dąbrowska 2008, 95, 138). In the area of the Białowieża Forest, the only item from the younger Pre-Roman Period that can be connected with the circle of Latčneised cultures is a fibula fragment, probably belonging to the K-M variety according to the typology of Józef Kostrzewski (Kostrzewski 1919), found on the surface or near a settlement of the Suraż group of the Hatched Pottery culture in Leśnictwo Teremiski, Site 3 (Olczak and Krasnodębski 2022, fig. IV.16: 12).

Probably at the beginning of the Common Era, the area in question began to slowly undergo a process of Latčneisation. In the Upper Narew River basin, the oldest finds of the Przeworsk culture can be dated to the developed stage of phase B_2 of the Roman Period (Godłowski 1984, 121; Andrzejowski 1997, 119 f.; 1999, 46 f., fig. 14: B; 2001, fig. 1). The closest to the Białowieża Forest, approximately 11 km to the west of its present boundary, was an alleged cemetery in Lady, Hajnówka district, Site 1. In an accidentally discovered cremation grave, there were, among others, fragments of a vessel typical for this culture (Rajewski 1932, 94 f., fig. 1: 4; Andrzejowski 1999, 47; f. 129). Few artefacts considered to be indicators of the Przeworsk culture were also found at the post-Zarubintsy cemetery in Hryniewicze Duże, Bielsk Podlaski district, Site 2 (Fig. 18), and at the settlement located on the opposite side of the Orlanka River in Zubowo, Bielsk Podlaski district, Site 6 (Andrzejowski 1999, 37 f., 46 f.). Nearly 30 km west of the Białowieża Forest, by the Narew River, there was a Przeworsk culture necropolis in Zawyki, Białystok district, Site 1 (Jas-

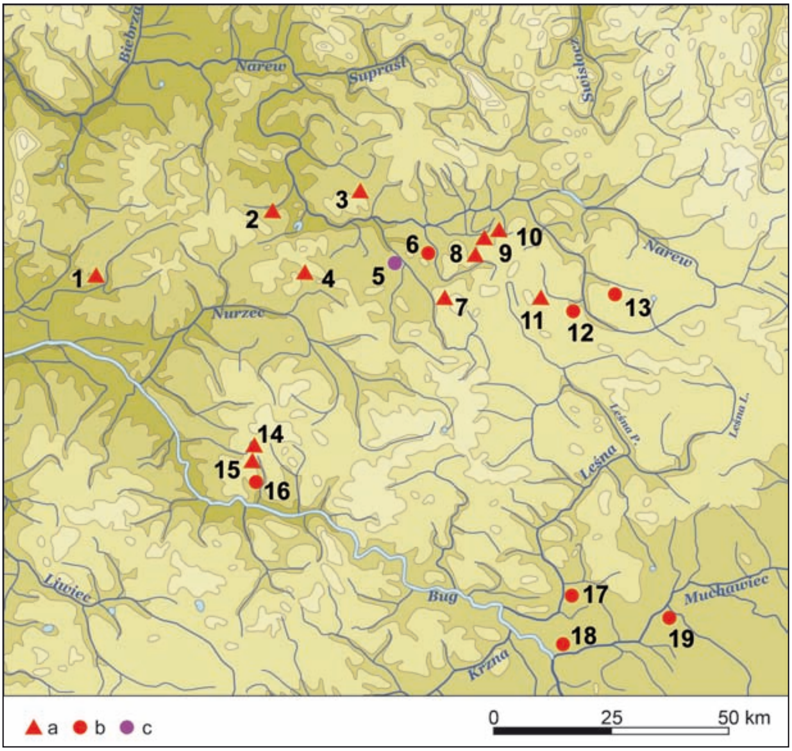

Fig. 18. The most important burial grounds of the Wielbark culture and other cemeteries located in the Upper Narew and Middle Bug interfluve mentioned in the text: 1 – Dmochy-Rodzonki; 2 – Grochy Stare; 3 – Rostołty, 4 – Szpaki; 5 – Hryniewicze Duże; 6 – Pilipki; 7 – Szczyty-Dzięciołowo; 8 – Kuraszewo; 9 – Kotłówka; 10 – Kutowa; 11 – Leśnictwo Wilczy Jar, Site 2; 12 – Leśnictwo Nowe, Site 4; 13 – Białowieski Park Narodowy, Site 33; 14 – Skiwy Małe; 15 – Cecele; 16 – Krupice; 17 – Skorbichy (Druzhba); 18 – Brest-Trishin; 19 – Petrovichi. Explanation: a – Wielbark culture burial grounds with barrows; b – Wielbark culture burial grounds with flat graves; c – other burial grounds. Compiled by H. Olczak (basic map prepared by K. Skrzyńska)

kanis 1962). A similar distance separates the discussed region from the settlement cluster by the Middle Bug River, where in the first centuries AD there were cemeteries in, among other places, Krupice (Jaskanis 2005) and Niemirów, Siemiatycze district, Site 6 (Rusin 2001). However, no clear traces of the Przeworsk culture settlement have been found in the Białowieża Forest so far.

It was not until phase B_2/C_1, with the spread of the Wielbark culture, that the Upper Narew and Middle Bug interfluve entered the range of influence of the Central European *Barbaricum* for good (see *e.g.*, Okulicz 1970; Jaskanis 1976; 2012; Jaskanis and Okulicz 1981; Andrzejowski 2001; 2005; 2007; 2019; Cieśliński 2014). A number of cemeteries are associated with the so-called Cecele phase, the closest of which are located on the edge of the Białowieża Forest, only 17 km north-west to the barrow in question (Fig. 18). These include the already mentioned sites at Kutowa, Kotłówka, and Kuraszewo, forming a complex consisting of 14 barrows and a flat cemetery (Jażdżewski 1939, 16; Jaskanis 1963; 2012, 106-194), dated to phases C_2-D (Jaskanis 1976, 220 f.; 2012, 181, 248). Furthermore, in addition to the aforementioned cemeteries that have been excavated, incidental discoveries from presumed burial grounds in Szczyty-Dzięciołowo, Site 2 (Jaskanis 1970) and Pilipki, Site 6 (Okulicz 1970, 468-477; Beliavets *et al.* 2018; older literature there), both in Bielsk Podlaski district, also originate from this region. Luxurious artefacts comprising the grave goods of a single burial of a woman (who undoubtedly belonged to the local elite) discovered in Pilipki, testify to the connections of this area with Scandinavia in the C_{1b} phase (Beliavets *et al.* 2018, 173, 177-179). Approximately 30 km to the west of the Białowieża Forest are barrows in Rostołty (Jażdżewski 1939, 2-12; Jaskanis 2012, 14-65) and Szpaki (Rusin 2005b; 2008), and a little further away in Grochy Stare (Rusin 1998; 1999; 2005a). The first of these mentioned barrows probably date to phases B_2/C_1-C_1 and are among the oldest graves of this type in the area of the Biebrza and Middle Bug interfluve (Jaskanis 2012, 37, 246 f.). The cemeteries at Szpaki and Grochy Stare are dated to phases C_2 (Rusin 2008, 306; Jaskanis 2012, 247) and C_{1b}-C_2, respectively (Rusin 1998, 196; 1999, 232; 2005a, 225). On the other hand, about 50 km southwest of the Białowieża Forest, there is the largest and best studied flat and barrow necropolis in the Upper Narew and Middle Bug interfluve – Cecele, which was presumably used from the Pre-Roman Period (phases A_2-A_3) to phase C_3-D of the Roman Period and the Migration Period (Jaskanis 1996, 111 f.). A distinctive feature of the burial rite of the Wielbark culture in northeastern Poland is the presence of barrows of the so-called Rostołty type, with elaborate stone constructions and often rich grave goods, which are considered to be burials of the tribal elite (*e.g.*, Jaskanis 1976, 247 f.; Mączyńska 2007, 13; Jaskanis 2012, 196, 209, 245; Cieśliński 2014, 82 f.). Numerous cemeteries and settlements of the Wielbark culture are also known from the southwestern part of Belarus, from the basins of the Middle Bug and Pripyat Rivers. The sites located closest to the Białowieża Forest include those in Skorbichy (now Druzhba, Brest District) and Petrovichi, Zhabinka District, as well as the most important of the excavated cemeteries of this region, Brest-Trishin, used from the last quarter of the 2nd to the beginning of the second half of the 3rd centuries (Fig. 18; *e.g.*, Kuharenko 1980, 60-63; Vyargej 1999, 302 f., fig. 95; Andrzejowski *et al.* 2005, 19 f., 22-29; Beliavets 2007, map 1; 2014; 2016a; further literature there).

Taking into account the results of excavations and stray finds, it can be assumed that the areas of the Upper Narew and Middle Bug River basins were quite densely settled in the Younger and Late Roman Periods. Despite this, the region of the Białowieża Forest, located between the above-described settlement clusters, was until recently placed at the edge of the area occupied by the Wielbark culture population (see *e.g.*, Andrzejowski 1999, figs 14: C, D; 2005, figs 3 and 4). As already mentioned, the discoveries of the last twenty years have clearly changed this picture, shifting its extent visibly to the east. Several settlements and cemeteries of the Wielbark culture are currently known from the Białowieża

Forest, and several more are sites of unknown cultural affiliation, generally dated to the period between the 2nd/3rd and 5th/6th centuries AD (Fig. 17; Olczak and Krasnodębski 2022, 119-163). One of the newly discovered settlements of the Wielbark culture is situated in the southern part of the Białowieża Forest, in Leśnictwo Podcerkiew, Site 4 (forest plot 578B/D) (Olczak and Krasnodębski 2022, 120-122). Another one is probably Białowieża, Site 1, located in the centre of the village (Olczak and Krasnodębski 2022, 123). A trace of some unspecified activity related to the Wielbark culture is also probably a glass bead of the TM 254a type (Tempelmann-Mączyńska 1985), found in the fields north of Białowieża, at Site 2 (Górska 1976, 116, fig. 2d; Olczak and Krasnodębski 2022, fig. IV.34). Analogous ornaments were widespread from phase B_2 or B_2/C_1 until the beginning of the Migration Period (Tempelmann-Mączyńska 1985, 53). As recent research has shown, a presumed settlement of the Wielbark culture was also located in the north-western part of the Białowieża Forest, in forest plot 764B, within the former Ladzka Forest (Pawleta 2017; Zapłata 2019a; Zapłata 2019b). Two coins from the second half of the 2nd century AD, discovered during the penetration of the forest with metal detectors – a denarius of Emperor Commodus and a fourrée of Faustina the Younger – also come from the same region (Zapłata *et al.* 2019, fig. III.31). It is also possible that one of the occupation phases at Leśnictwo Sacharewo, Site 9 (forest plots 412B and 413A) is associated with the Wielbark culture. Although the pottery from this settlement is hardly typical of this culture, such a chronology may be indicated by the results of radiocarbon analyses and a denarius of Marcus Aurelius of 162/163 AD found there (Olczak and Krasnodębski 2022, 111 f., 123; Niedziółka *et al.* 2023). A black opaque glass bead, most probably belonging to the TM 11 type, dated from phase B_2-C_1 to phase D (Tempelmann-Mączyńska 1985, 27, pl. 1: 11), was also found at the site (Niedziółka *et al.* 2023, fig. 10B: 8).

Among the burial grounds, the best excavated is the flat cemetery with cremation graves in Białowieski Park Narodowy, Site 33 (forest plot 345A; Fig. 17), dated to phases C_{1b}-D of the Roman Period and the Migration Period (Krasnodębski *et al.* 2008; Olczak and Krasnodębski 2022, 126-133). A second, possibly similar necropolis is located in forest plot 124 (Kądziela 2019; Zapłata *et al.* 2019, 52). The next presumed burial ground, where a single inhumation grave from the phase C_{1b}-C_2, possibly C_2, has been found to date, is the already mentioned Site 4 in Leśnictwo Nowe (Dzierżykray-Rogalski and Jaskanis 1961; Kokowski 1995, 106; Olczak and Krasnodębski 2022, 134 f.).

So far, however, no barrows of the Wielbark culture have been known from the Białowieża Forest. Although several earthen mounds have been investigated here in recent years, which chronologically seem to fall within the time span from the Younger Roman Period to the Migration Period (Fig. 17), their connection with this culture is poorly documented. Indeed, no stone constructions, which were typical of Cecele phase barrows (Jaskanis 2012, 210; Cieśliński 2014, 66-72; 2020, 66-68), have been discovered in any of them. The first of these sites is Leśnictwo Podcerkiew, Site 11 (forest plot 578B), which is part of a multicultural settlement cluster located by the small Jamienka River, in the southern part of the Białowieża Forest. Its location is very characteristic – on a small 'island' of about 0.5 ha, surrounded by marshes and periodic streams. Eight earthen mounds, each about 10 m in diameter and 0.3 to 0.5 m high, have been found there. At the base of the partially excavated Barrow 5, a layer with burnt planks was discovered, with the bow of an iron fibula, probably of the Almgren 161-162 type (Almgren 1923), and two very small fragments of burnt bones (due to their size, it is uncertain whether they are from a human skeleton). A radiocarbon date of 1905±30 BP was obtained for the burnt wood, which, after calibration, lies within the range between the first half of the 1stcentury AD to the beginning of the 3rd century AD (Olczak and Krasnodębski 2022, 135-140). Another group of barrows, which may date from the Younger or Late Roman Period, is located in the Ladzka Forest, at Leśnictwo Rybaki, Site 3 (forest plot 750A). It consists of six earthen mounds ranging from about 15 to over 20 m in diameter and up to about 0.8 m in height (Oszmiański 1996, no. 71; Jakubczak *et al.* 2021, 70-79; Olczak and Krasnodębski 2022, fig. IV.57). Beneath the mound of the partially researched Barrow 2, in its centre, a presumed burial pit was unearthed, in which, among other things, three bone fragments and small parts of a copper or bronze object, possibly an appliqué, were found. A glass bead was also discovered during the research (Rutyna and Szubski 2018). Two further groups of mounds are also similarly dated, but no human remains were recovered from them, so their sepulchral function is uncertain: Leśnictwo Postołowo, Site 4 and Leśnictwo Sacharewo, Site 3. The first cluster, consisting of six loosely scattered flat barrows, approximately 11-15 m in diameter and quite variable in height, ranging from 0.4 to 1.0 m, is located by the Łutownia River, on the south-eastern edge of the Szczekotowo multicultural settlement cluster, in forest plot 214D (Olczak and Krasnodębski 2022, 147-152). Under the partially excavated Barrow 112, on its edge, a small cobblestone pavement with a vessel set on it was discovered. It has the most analogies among the miniature forms of Wielbark IC-type pots (Wołągiewicz 1993, 12, pl. 3). Fragments of another vessel, probably also of IC type, were found in a small pit covered by a mound, probably a hearth. The results of radiocarbon analyses indicate that the barrow was built between the mid-2nd and mid-6th centuries AD, with the highest probability between the early 3rd and mid-4th centuries AD (Olczak and Krasnodębski 2022, 151 f.). The other cluster (Leśnictwo Sacharewo, Site 3) is located in forest plot 413A, in the forks of the Leśna Prawa River and an unnamed watercourse flowing into it, a short distance southeast of the already mentioned settlement Leśnictwo Sacharewo, Site 9. There are ten earthen mounds here, ranging from 7 to 12 m in diameter and varying in height from 0.3 to 1.1 m (Krasnodębski *et al.* 2019; Olczak and Krasnodębski 2022, 153-159; Niedziółka *et al.* 2023). A very interesting artefact that was found in the upper part of the excavated Barrow 3 is an iron bow-shaped spur of type F3b, which, according to the classification of this category of items in the Przeworsk culture, can be dated to phases C_{1a} and C_{1b} of the Roman Period (Ginalski 1991, 66 f., 74). The results of radiocarbon analyses of charcoal and plant remains taken from the two mounds (Barrows 3 and 5) suggest that they were built between the second half of the 3rdcentury and the beginning of the 7th century AD (Olczak and Krasnodębski 2022, 158, table IV.1; Niedziółka *et al.* 2023, table 2). There are also other groups of earthen mounds for which radiocarbon dates have been obtained that date them to the end of Antiquity or the beginning of the Early Middle Ages (Szubska *et al.* 2020; Olczak and Krasnodębski 2022, 394, 396-398, table VII.1). However, due to the lack or limited size of excavations, their exact chronology, function, and cultural affiliation are unclear for the time being. One of them is Białowieski Park Narodowy, Site 22 (forest plot 257C/D), which contains an interesting group of approximately 100 small mounds with stone constructions, including stelae (Okulicz 1969; Górska 1976, 132; Krasnodębski and Olczak 2012, table 2; Dzik 2015, 126; Olczak and Krasnodębski 2022, 141 f.). Another one is a cluster of earthen mounds at Leśnictwo Podcerkiew, Site 12 (Krasnodębski and Olczak 2012, 159-163). To complete the description of archaeological finds from the Late Roman Period, mention should also be made of a fragmentarily preserved crossbow fibula, probably of the Almgren 161 type, discovered on the surface or in the vicinity of the settlement at Leśnictwo Teremiski, Site 3 (Olczak and Krasnodębski 2022, fig. IV.16: 13).

Other evidence for the relatively well-developed settlement network in the area of today's Białowieża Forest during the Roman Period comes from the results of palynological investigation (Latałowa *et al.* 2015; Latałowa *et al.* 2016; Zimny *et al.* 2017). It is most likely that partial deforestation associated with farming occurred here for the first time in the first centuries AD. Two pollen profiles from the Białowieża National Park area gave radiocarbon dates of 226±131 BC and 24±83 BC, thus coinciding with the settlement of the Suraż group of the Hatched Pottery culture, while another yielded dates of 469±70 AD and 492±73 AD, which may correspond to the late phase of the Wielbark culture or the early phase of the Early Middle Ages (Latałowa *et al.* 2015, 246, table 17.1; 2016, table 2). The earliest evidence of cereal cultivation, including pollen from rye (*Secale cereale*), dates to circa 50 AD (Latałowa *et al.* 2016, 11). In the period between the 1st and 5th centuries AD, in addition to rye, pollen of barley (*Hordeum*) and wheat (*Triticum*), as well as hemp (*Cannabis sativa*), which was also found in seed form, were recorded (Zimny *et al.* 2017, 48). However, the average percentage of anthropogenic pollen indicators from the Białowieża National Park area does not exceed 2-5%, while in the case of cereals it is less than 0.5% (Zimny *et al.* 2017, fig. 11). There is also evidence of animal husbandry and grazing, confirmed by the presence of pollen from meadow and pasture plants, including ribwort plantain (*Plantago lanceolata*) (Latałowa *et al.* 2015, 249; 2016, 33; Zimny *et al.* 2017, 48). Another indicator supporting the deforestation of part of the area is the high proportion of micro-charcoal, suggesting the use of slash-and-burn cultivation (Latałowa *et al.* 2015, 249). Burning of parts of the forest and its thinning are also evidenced by an elevated frequency of fungi spores of the genus *Gelasinospora* and pollen and spores of light-tolerant plants, such as heather (*Calluna vulgaris*), melampyrum (*Melampyrum* sp.), and bracken (*Pteridium aquilinum*), common in fire-affected habitats (Zimny *et al.* 2017, 47). The high magnitude of disturbance to the species composition of forest habitats, with a relatively low proportion of pollens from cultivated plants, may indicate developed metallurgical production, manifested by an increased demand for certain wood species used in smelting iron in bloomeries (Latałowa *et al.* 2015, 257). Evidence of iron production in the Early Roman Period has been confirmed, for example, at the aforementioned settlement of the Suraż group of the Hatched Pottery culture at Leśnictwo Podcerkiew, Site 1 (Olczak *et al.* 2018).

It is not yet clear to what extent the development of settlements in the first centuries AD caused the creation of agricultural field systems in the Białowieża Forest (Olczak and Krasnodębski 2022, 408-430, fig. VII.43; further literature there). As already mentioned, their discovery became possible thanks to the use of airborne laser scanning data in recent years. The relics of the field systems have the form of barely visible low banks that are parallel and perpendicular to each other and are of varying length ranging from several tens to several hundred metres. Their width is about 2-5 m on average, sometimes reaching up to about 8 m, while their relative height generally does not exceed 0.2-0.3 m, rarely reaching about 0.5 m. The banks surround areas that are roughly quadrangular in shape and range in size from a few ares to over 1 hectare. The embanked fieldplots in the Białowieża Forest resemble in many respects the systems of ancient agricultural fields known in North and West Europe as ‘Celtic fields’ or ‘fossil fields’ and usually dated there from the Late Bronze Age to the Roman Period (*e.g.*, Gerritsen 2003, 172-180; Lang 2007, 103-105; Arnberg 2009). In the Białowieża Forest, the banks extend over higher parts of the morainic upland, located at quite varying distances from major watercourses. The area of the smallest clusters is a few hectares, while the most extensive ones are several tens or even hundreds of hectares. The concentration of embanked fields is noticeable in the vicinity of multicultural settlements, which had often been occupied (although not continuously) from the Pre-Roman Period until the Early Middle Ages, like in the Szczekotowo Range (forest plots 213 and 214), the Jelonka Range (forest plots 123 and 124), the Zamczysko and Obołonie Ranges (forest plot 281), in the micro-region by the Jamienka River (forest plots 545 and 578), and the settlement cluster in the Ladzka Forest (forest plots 759 and 760) (Olczak and Krasnodębski 2022, 409-427, figs VII.44, VII.52, VII.56, VII.58-60). The results of radiocarbon analyses of charcoal and other plant remains taken from banks located in several places in the Białowieża Forest indicate that they may have been constructed during the Roman Period, but also, for example, in the Early Middle Ages (Stereńczak *et al.* 2020, fig. 10; Krupski *et al.* 2022, table. 9; Olczak and Krasnodębski 2022, 413; Niedziółka *et al.* 2023, table 2).

This brief overview of archaeological discoveries from the last twenty years proves that during the Younger and Late Roman Period, settlement of the Wielbark culture spread in the area of today’s Białowieża Forest. The sites described above probably represent only a small part of the settlements and cemeteries from this period that could be found here. This area, due to many years of neglect, still requires intensive and multidirectional activities in the field of archaeological research. The same postulate applies to the Belarusian part of the Białowieża Forest, where investigations are even less advanced than in the Polish part. With the exception of a few stray finds (for example, at least two bronze eye brooches of the Prussian series found about 6 km east of the village of Kamyanyuki, Kamyenyets District), no archaeological sites dated to the Roman Period have been known from there so far. However, it is already possible to conclude that the settlement patterns prevailing in today's Białowieża Forest in the Younger and Late Roman Period did not differ in general outlines from the picture we know from the rest of north-eastern Poland. The region became part of the Central European *Barbaricum* in contact with the Roman world at this time, as evidenced, for example, by stray finds of Roman coins from the reigns of Marcus Aurelius and Commodus (Zapłata *et al.* 2019; Olczak and Krasnodębski 2022, 111 f., 123; Niedziółka *et al.* 2023, fig. 11), as well as the presence of imported glass objects in the cemeteries (Dzierżykray-Rogalski and Jaskanis 1961, fig. 5: d, e; Krasnodębski *et al.* 2008, figs 4: 3, 8; 5: 1, 4; 10: 1, 2, 4, 5). As was the case in the whole territory occupied by the Wielbark culture (*e.g.*, Gałęzowska 2007, 166-171; Kokowski 2007, 129-158; Jaskanis 2012, 214-216; Cieśliński 2016, 232-236), a diversity of burial rites was also characteristic for the area of the present-day Białowieża Forest, which on the one hand manifested itself in the practice of both cremation and inhumation, and on the other in the establishment of flat cemeteries and, as shown in the research at the site Leśnictwo Wilczy Jar 2, the erection of barrows with stone constructions.

The discussed mound, located 17 km southeast of the important Wielbark culture settlement cluster in Kotłówka, Kutowa, and Kuraszewo, is the easternmost grave of the Rostołty type (or Rostołty horizon). The Białowieża Forest thus appears to be a transitional area between the western part of the Upper Narew and Middle Bug interfluve, where Wielbark culture barrow cemeteries are quite numerous, and the Belarusian Pobuże region, from where they are not yet known (Vyargej 1999, 302 f.; Beliavets 2016a, 405). However, it should be noted that such a picture may be due to the already mentioned insufficient state of excavation research. At the same time, this is the only barrow with features typical of the Wielbark culture graves researched in the Białowieża Forest so far. Indeed, the other earthen mounds described above cannot, for the time being, be considered unquestionably as graves of this culture, mainly due to the lack of stone constructions in them. Thus, despite the items from the mounds dating to the Roman Period and the results of radiocarbon dating, their cultural affiliation is not entirely clear. The dominance of the Wielbark culture communities in the Younger and Late Roman Periods in the present-day Białowieża Forest does not exclude influences from other cultural zones. Above all, the survival in some enclaves of populations of the Suraż group of the Hatched Pottery culture, which from the 1st century AD onwards belonged to the broader post-Zarubintsy horizon, must be reckoned with. As in the rest of the Upper Narew and Middle Bug River basins, in the Białowieża Forest, Wielbark settlers often occupied areas that had already been inhabited. This phenomenon can be observed, for example, in the Szczekotowo Range and in the micro-region by the Jamienka River, which had been occupied by communities of the

Suraż group in the Early Roman Period (Olczak and Krasnodębski 2022, 90-98, 107-109, 120-122, 147-152). It cannot be ruled out that an acculturation process took place with regard to the communities of the Suraż group, analogous with that that occurred in the case of the population groups of the Wielbark and Przeworsk cultures, whose close contacts are attested, among other things, by the use of the same cemeteries (Wołągiewicz 1981, 86 f.; Andrzejowski 2005, 117; Cieśliński 2016, 226 f.; Andrzejowski 2019; 2020, 21-28). In addition to the Wielbark culture necropolis in Kutowa, where, among other things, a bronze ringed pin of the Zarubintsy culture was found (Jażdżewski 1939, fig. 62), a very good example of permeation of multi-cultural influences is the cemetery in Hryniewicze Duże. This site, located a little further west, was used in phases B_2 and B_2/C_1 of the Roman Period (Szmit 1922; Andrzejowski 1999). In fact, in the grave goods from this necropolis, in addition to the predominant post-Zarubintsy elements, clear influences from the Wielbark culture, Przeworsk culture, and the West Baltic circle are also visible (Andrzejowski 1999, 30-48). It is very likely that in the Białowieża Forest, which is a border region between the Central European *Barbaricum* and the Eastern European forest and forest-steppe zones, a peculiar cultural conglomerate was formed, which, however, it is not possible to characterise in detail at the present stage of research.

Despite these reservations, there is now no longer any doubt that in the Białowieża Forest there are barrows from the Roman Period, and not – as was thought until recently (*e.g.*, Górska 1976, 124-128; Bieńkowska 2005, 242) – exclusively Early Medieval burial mounds. Subsequent research will probably lead to the discovery of more Wielbark culture graves in this area, as in both the Polish and Belarusian parts of this forest complex, there are numerous clusters of mounds with morphological features where such an origin is not ruled out. It should be expected that in the near future the settlement area of this culture, which is currently artificially delimited in this region on the eastern border of Poland (*e.g.*, Cieśliński 2016, fig. 8), may be moved even further east.

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A NEW DEPOSIT OF EARLY MEDIEVAL AXE-LIKE IRON BARS FROM A SETTLEMENT AT BRZESKO, SITE 16-17, LESSER POLAND VOIVODESHIP

ABSTRACT

Szmoniewski B. S., Lasota-Kuś A., Lach A. and Okoński M. 2024. A new deposit of early medieval Axe-like iron bars from a settlement at Brzesko, Site 16-17, Lesser Poland Voivodeship. *Sprawozdania Archeologiczne* 76/2, 341-367.

The article discusses the rare find of a deposit of 38 ax-like iron bars from Brzesko, Site 16-17 (Lesser Poland Voivodedship). Each of them was forged out of iron in the form of an oblong axe with a short blade. Lugs on a part of the items form cups. The characteristic shape of the preserved fragments allows for including them in the type of Lesser Poland bars, also called Vistula's bars. These items differ from the Greater Moravian type known from territories south of the Carpathian Mountains. They were discovered in feature 286. In the fill, only a few pottery fragments have been found.

In light of the analogy of rims and analogous finds from Lesser Poland and Great Moravia, this complex can be dated to the period between the mid-9th century and the beginning of the 10th century, or its first half.

Keywords: iron axe-liked bars, Lesser Poland, Early Middle Ages
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1. INTRODUCTION

Site 16-17 in Brzesko is located on the southern and southwestern slopes of a small elevation of the ground overlooking a minor left tributary of the river Uszwica (Fig. 1: A and B). Rescue excavation was conducted in 2023 in advance of an extension of the local road infrastructure, the work was done by the archaeological companies APB THOR sp. z o.o. together with Archeologiczny Serwis Konsultacyjno-Badawczy Mirosław Kuś. During this research, among other things, 42 features were found that on the basis of the material evidence discovered in their fills, could be dated to the so-called tribal phase of the Early Medieval Period. Apart from the ceramic material mentioned, a dozen iron items were found among which a deposit consisting of 38 axe-like iron bars (so-called grywnas) placed in Feature 286 seems to be the most important find (Fig. 1: B).

2. THE LAYOUT OF THE SETTLEMENT

An attempt to determine the layout and arrangement of features within the settlement, to explain the positioning of Feature 286 containing the deposit of axe-like iron bars is difficult at this stage. Firstly, the settlement has not yet been excavated to its full extent, so the documentation on this subject is still fragmentary. Secondly, there are no observable chronological differences regarding functioning of the particular features, especially within one phase. We must also consider complex denudation processes as well as anthropogenic processes impacting the relocation of archaeological evidence material on the surface (*cf.*, Gruszka 2015, 73). The discussed settlement was located on a slope subjected to strong denudation processes which can be indicated by a relatively deep ravine at the foot of the elevation where a small watercourse, a tributary of the Uszwica river, had its bed. All these factors have influenced the state of preservation of the features and items buried and characterized by small volumes. The layout of features in the settlement seems to suggest its linear arrangement consisting of at least two rows of features running parallel to the watercourse mentioned earlier, now hardly visible. This observed linear arrangement is typical for settlements of the Early Medieval Period (Kobyliński 1988, 122-128; Dulinicz 2001, 169, 170).

However, it is also worth mentioning that Feature 286 was located in the southern part of the settlement, somewhat aside and rather far from the centre where a concentration of dwellings and pits dated in the tribal phase has been documented (Fig. 1: B). It is perhaps connected with the purpose of the feature as a place of iron processing, and this may be the reason for placing it in a part of the settlement reserved for productive activities. Moreover, it must be stated here that since the 9th century, some settlements began to display division into two separate parts: the residential and the production ones (Gruszka 2015, 55).

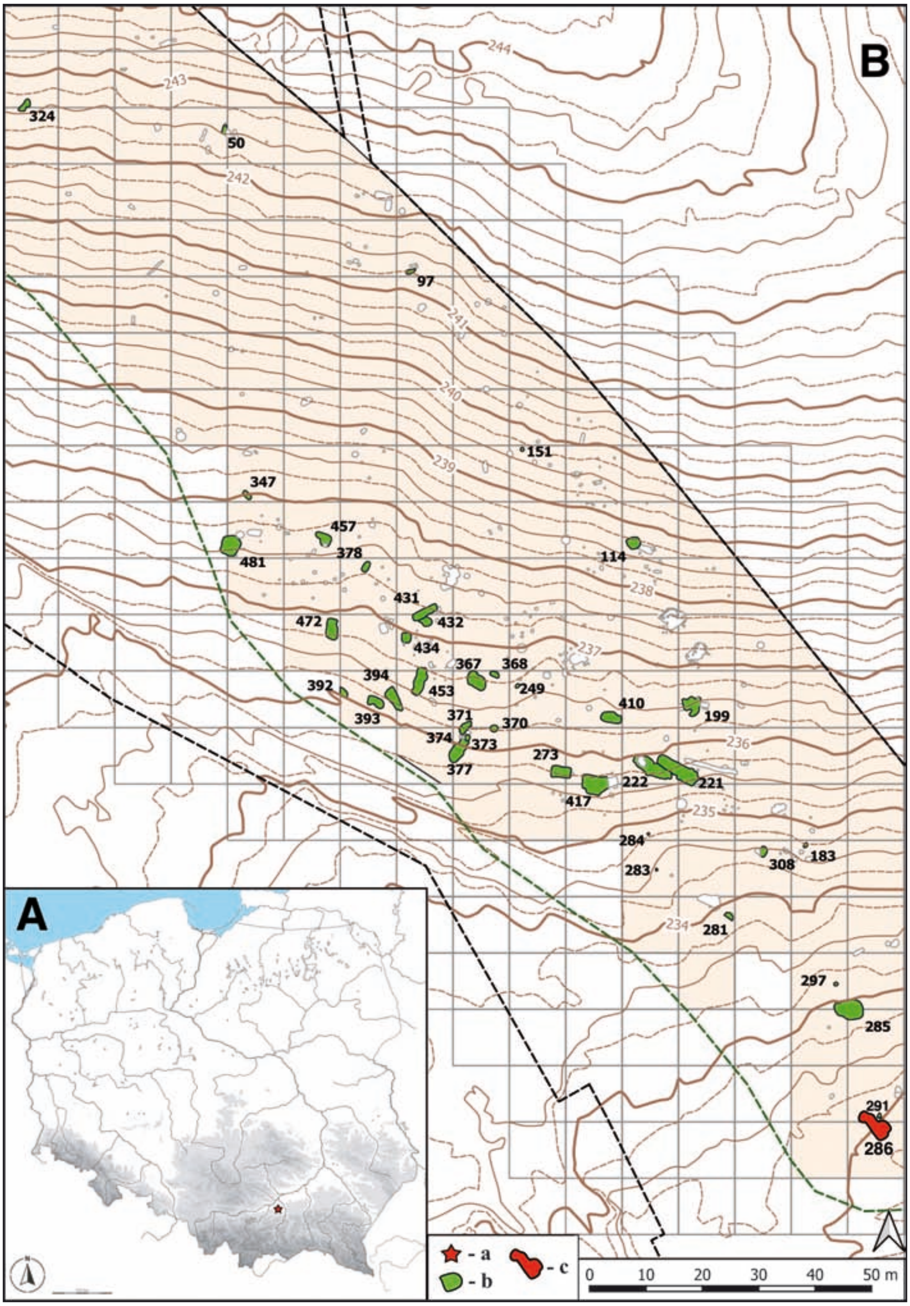

Fig. 1. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship. A – location of the site. B – general horizontal layout of the excavated area (a – site; b – features dated back to Early Medieval horizon; c – feature no 286 with the deposit of iron ax-like bars; drawing B. S. Szmoniewski and A. Lach)

3. DESCRIPTION AND INTERPRETATION OF THE FEATURE 286 (Figs 2-5)

Feature 286 was irregular in plan, of an approximately rectangular shape with a semi-circular annexin its eastern part and with a lesser annex in its northern part. The pit had the parameters of 569 × 325 cm with slightly sloped walls and a depth reaching 22 cm, positioned on the level of 30 cm below the current surface of the ground (Figs 2, 3, 5). The filling was homogeneous, of black colour, and strongly saturated with pug. In its north-eastern part, there was a deposit consisting of 38 axe-like iron bars (Fig. 4). In the pit filling, there were 13 fragments of pottery and one piece of slag.

Feature 286 inside which the deposit of iron bars was found had an atypical shape in its horizontal plan supplemented by a post near the semi-circular annex. A log cabin construction seems to be indicated by a streak left by a burned fragment of a log nested along at the eastern edge, separating the main body of the structure from the semi-circular annex. The unusual shape of the feature could have been caused by its special purpose. Considering the pattern of communication dynamics inside the chamber as well as the presence of such facilities as strip footing (earthen benches), we can assume that such fittings were mounted along the SW edge out of the earth from the centre of the chamber. They could have been used to store tools assuming that some smithing activities may have been conducted inside the feature because apart from the secondary burnt iron bars, pieces of slag were also found. If we agree to Mirosław Ciesielski's proposition that such a strip foot-

Fig. 2. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship. Horizontal layout of feature 286 (Photo A. Lach)

Fig. 3. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship. Cross-section of feature 286 with the iron ax-like bars deposit in the foreground (Photo A. Lach)

Fig. 4. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship. Deposit of the iron ax-like bars (photo A. Lach)

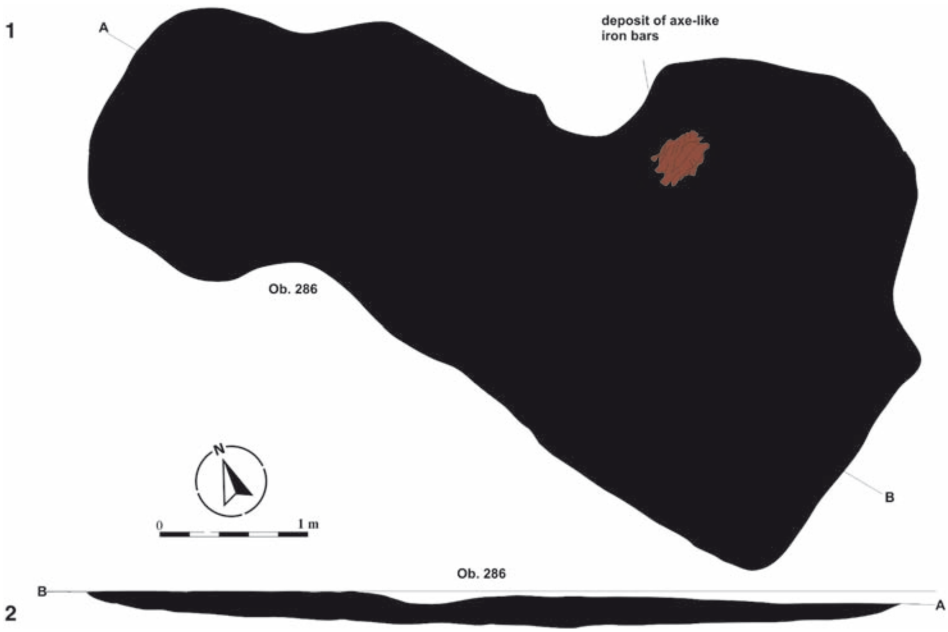

Fig. 5. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship. Horizontal layout of feature 286. 1 – horizontal layout; 2 – cross-section (drawing A. Lach)

ing was about 80 cm wide (Ciesielski 2008, 288, fig. 2), we would have to assume that the feature was as wide as 405 cm. It follows that the floor area of the interior would have been as large as 23 m^2 and consequently, its shape would have to be conceived as more functional than previously thought. Regarding the post hole found near the semi-circular annex (Feature 291), it can be assumed that the post could have been a structural element as well, *i.e.*, a type of pillar or element supporting the corner of a roof. In folk architecture, there are multiple buildings documented as having such corner arcades (Prokopek 1976, phot. 4, phot. 42).

Considering the shape of Feature 286 as well as the characteristics of its filling, we can include it with some probability to the so-called tub-shaped features that occur 14 times within the discussed settlement. They are characterized by a variety of shapes of their floor plans but they are absolutely no isolated phenomena (Parczewski 2003, 204). On many sites where such tub-shaped features were discovered, their fillings were intensely black, saturated with charred wood and tar, and were therefore similar to the analyzed filling from Brzesko. Due to this characteristic, it is not possible to localize potential spots of continual fires or hearths within the features, which is accentuated in the literature on the subject (see Pawlak and Pawlak 2008, 14, 15). Oval tub-shaped pits are found in early medieval settlements, especially in central and northern Poland (Ciesielski 2008). Several

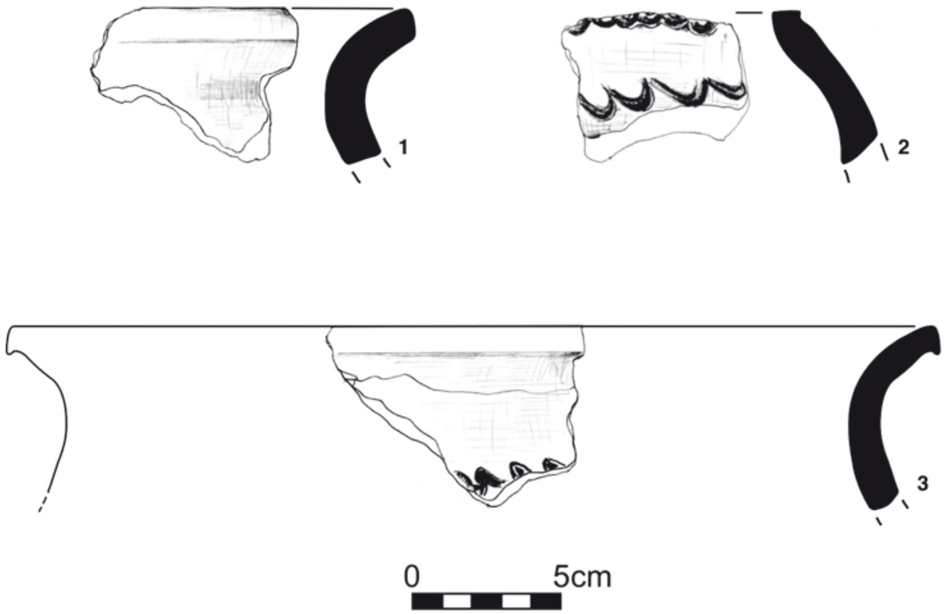

Fig. 6. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship. Fragments of pottery from feature 286 (drawing B. S. Szmoniewski)

such pits were discovered relatively close to the analyzed settlement, in Wojnicz, Site 48, Tarnów county (Wojenka 2010, 151-153, plates. 1-14) as well as in the stronghold of Zawada, Tarnów county (Cetera 1994, 256, 257, pl. 2: 7, 8, 9). There is no consensus in the literature regarding the interpretation of the oval-hollowed features discussed here. Some researchers are inclined to associate them with lightweight architectural structures such as wattle and daub construction with posts, chalet structures with gabled roofs (Chudziak 1996, 110-112), wattlework (Cetera 1994, 256, 257), or wattlework without posts (Foltyn 1998, 42). Others interpret them as trims of log cabin constructions, sometimes also supplied with a kind of strip footing (Foltyn 1998, 42; Ciesielski 2008). One of the arguments in support of this is the fact that wattle structures provide poor protection against the cold during the autumn-winter season in contrast to solid log cabins, which seems quite valid in our opinion (Ciesielski 2008). It cannot be excluded that buildings of wattle construction were used temporarily during some seasons as outbuildings, for example for storing crops or for dwelling during the summer season (see Cetera 1994, 256).

At the moment, it is hardly possible to determine the function of such a feature. It can be assumed that it was used as a place for iron processing while the lack of a hearth can be explained by a possible re-utilization of the building material to construct a new heating facility in another housing feature (Parczewski 1988, 53).

4. THE DEPOSIT OF AXE-LIKE IRON BARS FROM FEATURE 286 (Table 1, Figs 4, 7-13)

The most numerous category of iron products found on the site is represented by the deposit of axe-like bars (commodity currency) that was found inside Feature 286. It was unearthed as an irregular block, strongly bonded and covered with a thick layer of hammer scale indicating the impact of a secondary fire on the iron material. The deposit discussed here consisted of 38 axe-like bars which, after conservation and restoration, present various grades of preservation. Each of them was forged out of iron in the form of an oblong axe with a short blade. Lugs on a part of the items form beards. The preserved length of the bars ranges from 18.2 cm and 38.2 cm, while most of the items are characterized by a length within the intervals from 20 to 30 cm (26 examples) and from 31 to 38 cm (11 examples). Their width ranges from 2.2 cm to 3.3 cm, and their height is from 2.7 cm to 5.5 cm. The weight is quite diversified ranging from 230 g to 780 g (Table 1).

The characteristic shape of the preserved fragments allows them to be classified as Lesser Poland-type bars, also called Vistula bars, variants A and B in E. Zaitz's classification (1988; 1990, 147-153, figs 5-12) and type IB according to D. Bialeková and V. Turčan's classification (2007, 155, fig. 9). They differ from both the Greater Moravian type and from the Piotrawin type (Rozmus *et al.* 2006, 109, fig. 6).

The parameters of the bars found in Brzesko are in part different from those of analogical products found in southern Poland, which are as follows: a) length from 27 to 41 cm, b) weight from 270 to 2200 g (Zaitz 1990, 161, fig. 14) but this difference must be the result of the state of their preservation and, in several cases, caused by the missing of a part of the lugs with the beards. In the light of discoveries of fragments of lugs with beards from the deposit in Szklarka near Kraków, we can see that the operation of cutting the parts off was intentional, and the bars thus prepared were directed to further processing (Szmoniewski and Rozmus 2022).

The distribution of bars of the Lesser Poland or Vistula type was limited to the Upper Vistula basin (Szmoniewski 2010; Szmoniewski and Rozmus 2022). Due to the number of items, the deposit found in the Okół region of Kraków deserves our special interest. It was laid in a rectangular pit of the parameters 108 × 210 cm and of a depth of about 100 cm which was dug in sand showing no additional anthropogenic traces. It was covered with earth obtained from a rampart built by the end of the 9th century. Into such a pit, about 510 bundles of bars were laid, the bundles including 3 to 15 examples, but most of them 7 to 9 examples. The deposit consisted of 4212 bars in total and its total weight was about 3630 kg. Most of the examples were forged out of one piece of metal whilst one-third of the total was made by welding together two pieces of iron different sizes. In some cases, items were made of several or a dozen metal pieces. Singular samples were found on Site 1 in the Nowa Huta-Mogiła district of Kraków and also, most probably, in Zwierzyniec another district of Kraków; this is indirectly suggested by a note about strange iron items discov-

Table. 1. Tabular summary of the iron ax-like bars from Brzesko, Site 16-17, Brzesko District. Lesser Poland Voivodeship

Inventory number	Dimensons (cm)			Weight (g)	Figure
	Length	Width	Height		
BRZ16/286/2/1	26.4	3.3	4.6	580	7: 1
BRZ16/286/2/2	38.2	2.6	5.5	760	7: 2
BRZ16/286/2/3	34.7	2.9	4	550	7: 4
BRZ16/286/2/4	27	2.8	5	510	7: 5
BRZ16/286/2/5	22.5	2.3	3.4	310	7: 3
BRZ16/286/2/6	30	2.9	4.5	640	7: 6
BRZ16/286/2/7	27.6	2.7	3.5	320	8: 1
BRZ16/286/2/8	34.2	2.2	4.5	430	8: 2
BRZ16/286/2/9	25.7	2.2	5	410	8: 4
BRZ16/286/2/10	25.7	2.3	3.5	520	8: 5
BRZ16/286/2/11	32.7	3	4	710	8: 3
BRZ16/286/2/12	25.4	2.3	3.5	350	8: 6
BRZ16/286/2/13	24.1	2.5	3.2	350	9: 1
BRZ16/286/2/14	27.1	2.4	4.7	330	9: 2
BRZ16/286/2/15	31.5	3	3.7	530	9: 4
BRZ16/286/2/16	18.2	2.4	2.7	230	9: 5
BRZ16/286/2/17	33.6	3.1	4	560	9: 3
BRZ16/286/2/18	34	3	4.3	780	9: 6
BRZ16/286/2/19	28.9	3	3.9	690	10: 1
BRZ16/286/2/20	30	2.9	3.4	440	10: 2
BRZ16/286/2/21	26.4	3	3	590	10: 4
BRZ16/286/2/22	26.4	3	3.3	490	10: 5
BRZ16/286/2/23	29	2.7	4	350	10: 3
BRZ16/286/2/24	29.4	3.2	4.5	480	10: 6
BRZ16/286/2/25	28.4	2.8	4	520	11: 1
BRZ16/286/2/26	32	3.1	4.5	590	11: 2
BRZ16/286/2/27	33.5	2.8	3.3	600	11: 4
BRZ16/286/2/28	28.2	2.4	4.1	470	11: 5
BRZ16/286/2/29	28	3.2	3.3	590	11: 3
BRZ16/286/2/30	22.2	2.6	3	410	11: 6
BRZ16/286/2/31	26.6	2.9	3.7	410	12: 1
BRZ16/286/2/32	31.2	3.3	4.4	660	12: 3
BRZ16/286/2/33	27.5	2.3	3	290	12: 4
BRZ16/286/2/34	28.8	3.1	3.7	670	12: 5
BRZ16/286/2/35	31.4	3	3.7	600	12: 2
BRZ16/286/2/36	29.6	2.8	3.6	550	12: 6
BRZ16/286/2/37	27	2.5	3.7	400	13: 1
BRZ16/286/2/38	29.5	3	2.8	586	13: 2

Fig. 7. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship.
1-6 – iron axe-like bars (photo M. Okoński)

Fig. 8. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship.
1-6 – iron axe-like bars (photo M. Okoński)

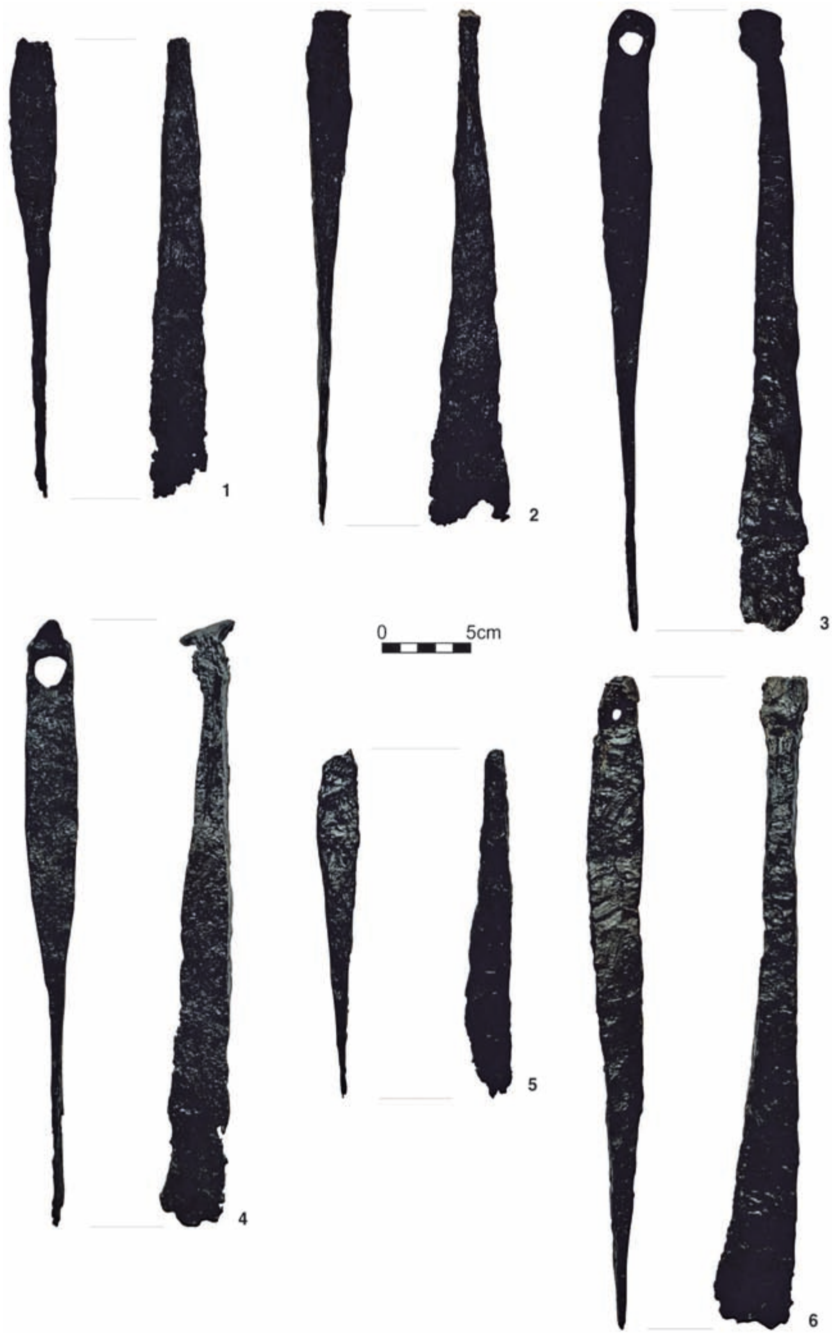

Fig. 9. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship.
1-6 – iron axe-like bars (photo M. Okoński)

Fig. 10. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship.
1-6 – iron axe-like bars (photo M. Okoński)

Fig. 11. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship.
1-6 – iron axe-like bars (photo M. Okoński)

Fig. 12. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship.
1-6 – iron axe-like bars (photo M. Okoński)

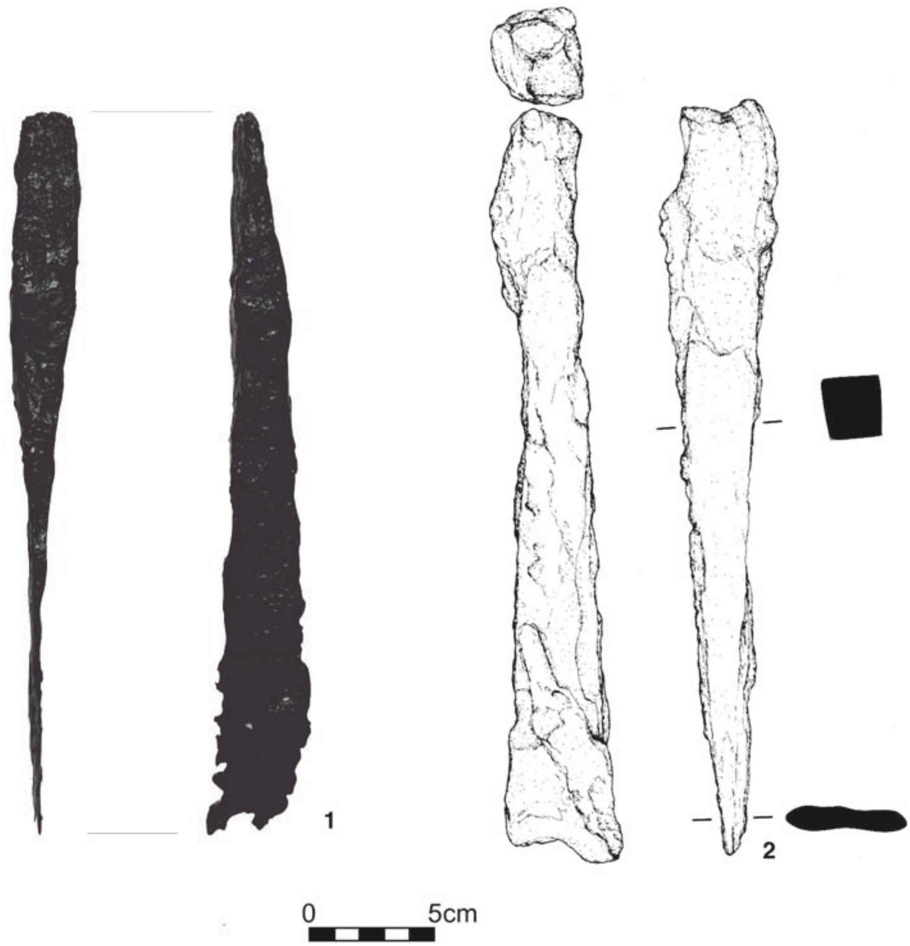

Fig. 13. Brzesko, Site 16-17, Brzesko District, Lesser Poland Voivodeship.
1-2 – iron axe-like bars (photo M. Okoński, drawing A. Lach)

ered in 1845 during construction work of a road leading up St. Bronisława Hill (Szmoniewski and Rozmus 2022, 51)

Regarding the number of fragments found in Brzesko, this is also quite unusual among the material from Lesser Poland because (apart from the deposits in Okół and the Szklarka valley) axe-like bars are mostly found in numbers ranging from 1 to 12 examples (Szmoniewski and Rozmus 2022, figs 1 and 2).

Undoubtedly, the discovery in Brzesko can serve as yet another piece of evidence for a high potential and equally high level of skills in processing iron by the inhabitants of Lesser Poland during the tribal phase of the Early Middle Ages.

5. AN ATTEMPT TO DETERMINE THE CHRONOLOGY OF FEATURE 268

Apart from the deposit of axe-like bars, Feature 268 revealed fragments of 13 pottery sherds of which three were the fragments of two vessels (Fig. 6: 1 and 3) and one fragment was decorated with two bands of multiplied curved lines (Fig. 6: 2). The remaining fragments were not decorated. Traces of top turning were observed in several cases within zones 2 (rim and neck) and 3 (rim-neck-collar) according to U. Maj's classification (1990, fig. 5). For the rest of the fragments, due to their degree of preservation and the lack of any distinguishing features, it is difficult to determine the extent of surface finish. According to the author's categorization (Szmoniewski 2024), mostly the earthenware type of group IV of raw material was used (hard structure, colour approximating to light brick-red, monochrome fractures, a medium temper of sand of grain size ranging from 0.1 cm to 0.2 cm, occasionally to 0.3 cm), a smaller quantity of examples of group II (hard structure, surface coloured dark brown to brick-red, bi-coloured and tricoloured fractures, temper of chamotte, sand and crushed stone of the grain ranging 0.3 to 0.4 cm). The least represented was group I (various grades of hardness, rough surfaces, grey-brown and brown colouring, monochrome and sometimes bicoloured fractures, tempers of crushed stone and thick grained sand reaching the grain size of 0.2-0.3 cm, less frequently grog, and silicates/mica).

Two rims found in the analyzed pit are not good landmarks for dating due to the considerably long timespan of their occurrences among early medieval artefacts from Lesser Poland. Because of this, in the documentation of the pottery evidence from the Brzesko site, they have been included in Type B5 – straight rims with the outer edges cut straight, and in Type D13 – rims indistinctly formed with the lower edge profiled (Szmoniewski 2024). Analogical rims are discovered in Lesser Poland with various frequencies. They display similarities to the rims of the ceramic vessels known from Kraków, especially to Type 4 included in the group of indistinctly profiled examples, and to Type 9 consisting of examples with edges that are not intensely profiled, with outer cuts. They are found in the layers dating from the middle of the 9th to the middle of the 10th century, up to its second half (Radwański 1968, 61, 62, figs 38, 39). In areas closer to the analyzed settlement, similar rims are known from features in the hillfort in Zawada near Tarnów, where such slightly profiled rims resembling those of Type 4 are discovered mainly in the complexes dated to the phase I of the hillfort's existence (2nd half of the 9th-1st half of the 10th century) as well as being sporadically found in phase II (2nd half of the 10th-10/11-1st half of the 11th century) while those analogical to Type 9 are found both in phase 1 and 2 (Okoński 1995, 59, fig. 7). On the other hand, in the settlement of Wojnicz, Site 48, similar rims have been included in Groups A (A4) and B (B4) (Wojenka 2010, fig. 139, 142 fig. 15). The period of functioning of this settlement is assigned to the 8th and maybe also to the beginning of the 9th century (Wojenka 2010, 148).

Summing up, in this complex archaic traits such as the lack of surface decoration, rims of group B5, the ceramic material of groups I and II, and more progressive traits such as the type of the rim belonging to group D13, the ceramic material of Group IV and surface decoration, are both present. Considering the analogy of the rims, this complex can be dated in the time between the middle of the 9th century to the beginning of the 10th century or its first half.

It should be stressed here that in the case of Lesser Poland, there is a lack of documented complexes that would contain axe-like bars along with any independent chronological indicators other than ceramics. Only in one problematic instance, in Pit 61/58 in the Mogiła settlement in the Nowa Huta district of Kraków, was a fragment of an iron item found that is interpreted as a part of an axe-like bar together with a spur similar to Type VB according to Darina Bialeková, so as a consequence of this, Jacek Poleski assumes that any finds of axe-like bars from Lesser Poland should be dated in line with Great Moravian analogies, namely in the time between the beginning of the 9th century and the middle of the 10th century (Poleski 1992, 37; Poleski 2019, 231).

6. EARLY MEDIEVAL SETTLEMENT AROUND SITE 15-16 IN BRZESKO (Fig. 14)

Settlement activities contemporary to the analyzed site where the deposit mentioned above was found had not been very intense. The earliest traces of settlement from the tribal phase of the Early Medieval Period are dated to the time as late as the 9th century. To map the distribution of settlements in the closest area, those contemporary to the analyzed early medieval settlement, a circle was drawn with a diameter of about 12 km, inside which the data from four sheets of the AZP survey maps were taken into account, namely from the sheets 104-62, 104-63, 105-62, 105-63). In the presented cartographic visualization, an aggregation of sites from the tribal phase is visible to be concentrated on the right bank of the Uszwica River and especially on two of its tributaries, the Grodna and the Jastwianka. In Okocim, *i.e.,* between the Uszwica and the Grodna, remnants of two settlements were documented (Sites 10 and 13) where numerous pottery fragments with simple, indistinctly formed rims and with the surface decoration of ornament of a multiplied curved line were found (Cetera and Okoński 1993a, plates 4 and 5). The hamlets together with the rest of the settlements localized around the hill of Bocheniec, Jadowniki Podgórne, Brzesko county (Sites 63, 64, and 65) presumably constituted a microregional settlement complex. Its centre was at the hillfort (Site 1) set atop the hill; the hillfort had the form of two segments on the plan of an elongated oval on the E-W line, with the parameters of 380 × 220 m and a surface area of about 6.8 ha (Jodłowski 1968; Żaki 1969; Leńczyk 1983, 20; Poleski *et al.* 2019). The chronology of the site is based on the analysis of a rather modest collection of pottery discovered during some small-scale excavations made in the last century, it is assigned to the 9th and 10th centuries (Poleski *et al.* 2019, 62).

On the left bank of the Uszwica and in the direct surroundings of the analyzed site, there are significantly fewer remnants of settlements from the later phases of the Early Medieval Period. Such remnants were documented in Jasień, Brzesko county (Sites 2, 3, and 9) as well as in Łazy, Brzesko county (Sites 29 and 54). Considering the finds of ceramic fragments, the functioning of these settlements can be assigned to the tribal phase

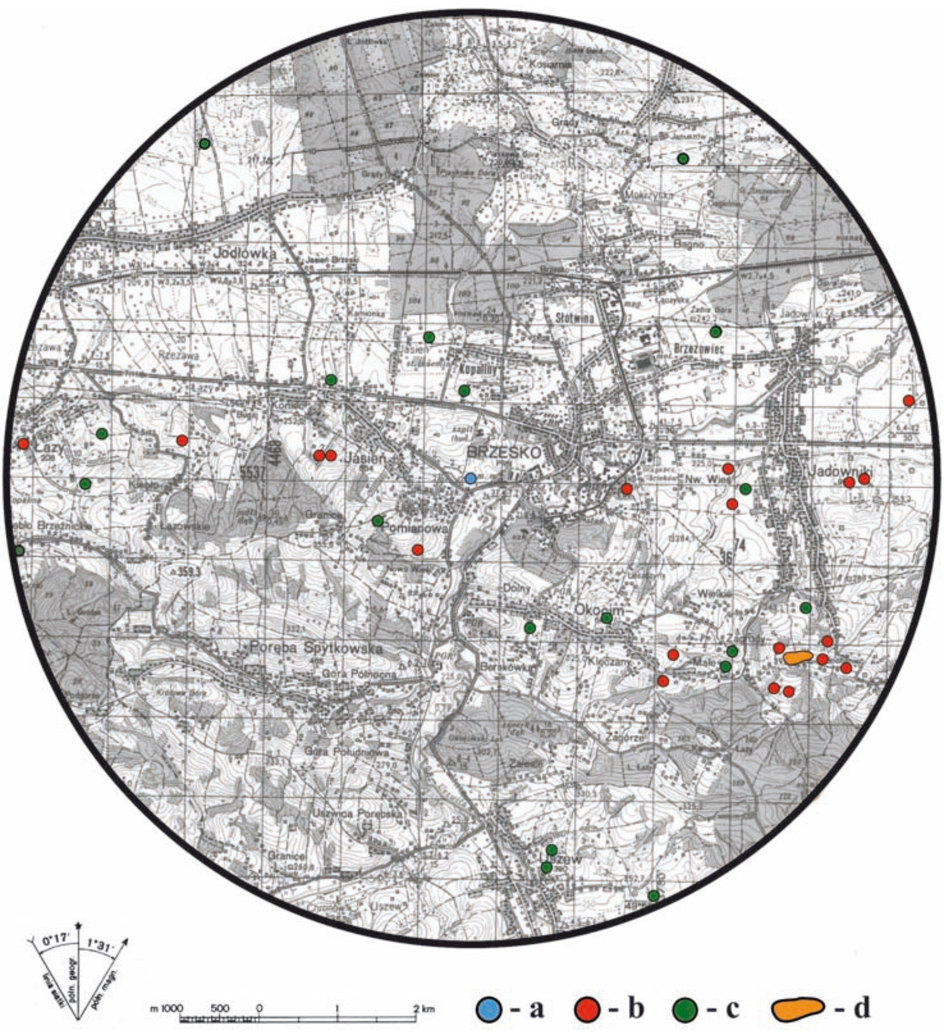

Fig. 14. Settlement pattern in the vicinity of the settlement in Brzesko, Site 16-17 (9th-11th century). A – Brzesko, Site 16-17, Brzesko District; b – the settlement; c – a single trace of the settlement; d – hillfort 'Bocheniec', Jadowniki Podgórne, Site 1. Polish Archaeological Record (AZP) sheets: 104-62, 104-63, 105-62, 105-63 (after Cetera *et al.* 1992; 1994; Cetera and Okoński 1993a and 1993b; drawing B. S. Szmoniewski)

and the early stage of state formation (9^{th}-11^{th} centuries) (Cetera and Okoński 1993a; Cetera *et al*. 1994).

This disproportion between the number of the right bank settlements and the number of the left bank settlements on the Uszwica can probably be explained, leaving the state of research aside, by the presence of a nearby defence structure – the hillfort of Bocheniec. This was the central place with other settlements surrounding it. The population inhabiting the settlements was probably obliged to raise, repair, and above all, to defend the hillfort in times of trouble. The hillfort was a part of the fortification system of the Vistulans' community, a tribal organization known from documents written in the 9th century, by the so-called 'Bavarian Geographer' among others.

7. THE AXE-LIKE BARS IN CENTRAL EUROPE DURING THE EARLY MEDIEVAL PERIOD – AN ISSUE OF POSSIBLE FUNCTIONS

The functions of axe-like iron bars are the subject of continuing discussions leaving the researchers specializing in Central Europe of the Early Medieval Period without any definite solution to date (*cf*., Hájnik 2019). Initially, the bars were ascribed the role of household tools (*e.g*., for splitting clay) (Hrubý 1955, 276-278), however, due to their shape and the poor quality of iron they were made of, this interpretation was later refuted (Pleiner 1963). Some researchers interpreted them also as semi-finished products for further processing to form tools (Piaskowski 1964, 133-140; 1980, 299, 300) or, as intermediate products being also a kind of currency or tokens, *i.e*. a medium of exchange (Sejbal 1960, 73-82; Pleiner 1961, 405-446; Adamczyk 2004). Additionally, they have ascribed some special magic properties (Novotný 1973, 275-280), and even thought to fulfill a similar ritual function as the obol of the deceased (Sejbal 1960, 73-82). More recent interpretations constitute a kind of compromise by which an axe-like bar had the function of part-processed material and at the same time served the function of being a social currency – the axe-like bar (commodity money) originated in the process of transforming an axe into a metal bar (Adamczyk 2004, 220).

In the case of Great Moravian axe-like bars, it is assumed that they were a kind of regional variant of primitive money – pre-coin currency, which could have been in circulation as a medium of exchange as credit tokens. Thus, the intrinsic value of axe-like bars must have been equal to, or higher than, the value of the iron commodity of which they were made (Hlavica and Bárta 2021, 12, 19). According to some, their prototypes can be seen in the pre-Christian ritual behaviour which had suppressed their practical use and replaced it with a symbolic role for the semi-finished axes, which then evolved into massive elongated axe-like bars. During subsequent stages, the increasing need to spare the material due to iron scarcity resulted in the gradual shrinking of their parameters, regarding both their length and their weight, and finally, the stage of miniature bars was reached. Semi-finished axes, apart from their practical functions as tools and weapons, also served ritual functions as votive/consecrate deposits or as grave goods. Along with the evolution of the forms of the bars, their purposes also evolved. Thus, the big and the medium ones functioned within the sphere of social exchange where they could serve in many ways: as a gift, payment of bride-wealth, a bride token, or a wergild (blood money), while the small-sized ones functioned in the sphere of commercial exchange as element trade or payments. In the latter, due to the size reduction and, consequently, the decreasing value of the iron material used, their value was arbitrarily established and guaranteed by the issuing authority; at this stage, they started to be used as substitute tokens of general-purpose money within the Great Moravian economy (Hlavica *et al.* 2022, 327-331, figs 1 and 2).

Regarding their circulation in the territory of Lesser Poland, it must be stated that apart from one small axe-like bar of the Great Moravian type (lost) from Stradów, Kraków, a far-reaching standardization during the whole period of their usage can be observed (Figs. 15 and 16). In consequence, their interpretation must be rather different from the ones applied in the case of examples from Great Moravia. In Lesser Poland, their function should be associated with the sphere of social exchange; according to this, they should be seen as a kind of gift or offering being a semi-product but at the same time having a considerable value, both of the symbolic and of a material nature. Being so, the redistribution of axe-like bars started from a central place which in this case was located in Okół, Kraków, where the largest deposit of such items was placed as was already mentioned. Considering the accumulation of finds of axe-like bars in and around today's Kraków as well as the presence there of areas rich in bog iron and replete with forests supplying wood required for smelting, we can easily point to these areas surrounding Kraków and located in the upper Vistula basin as the most probable region of the production of the standardized axe-like bars. The process of their production was strictly controlled by persons in the ruling position at the central borough. Having been produced, the axe-like bars were subsequently taken away from the workshops where they had been stored. Representatives of smaller centres brought some local products to the central borough as a tribute to the person in charge, most certainly receiving something in exchange – and in this case, it must have been an axe-like bar, or bars (Szmoniewski and Rozmus 2022).

The settlement in Brzesko is located within a circle of a 65 km radius with Kraków's Okół in its centre as it has been determined based on the occurrence of deposits of axe-like bars (Szmoniewski and Rozmus 2022, 63, 64, fig. 2); this circle overlaps with the regions occupied by the Vistula, and according to the new perspective it stretched from the northwest to the southeast (Liwoch and Szmoniewski, in print). Additionally, south of Brzesko, in the hillfort in Zawada Lanckorońska dated in the time between the 8th to 10th centuries, several axe-like bars were found (Poleski 2013, nr kat. 55 CD, 142), therefore it is more than probable that the Brzesko settlement can be regarded as one of the important points in the network of exchange between the northwest and the south, a network including the

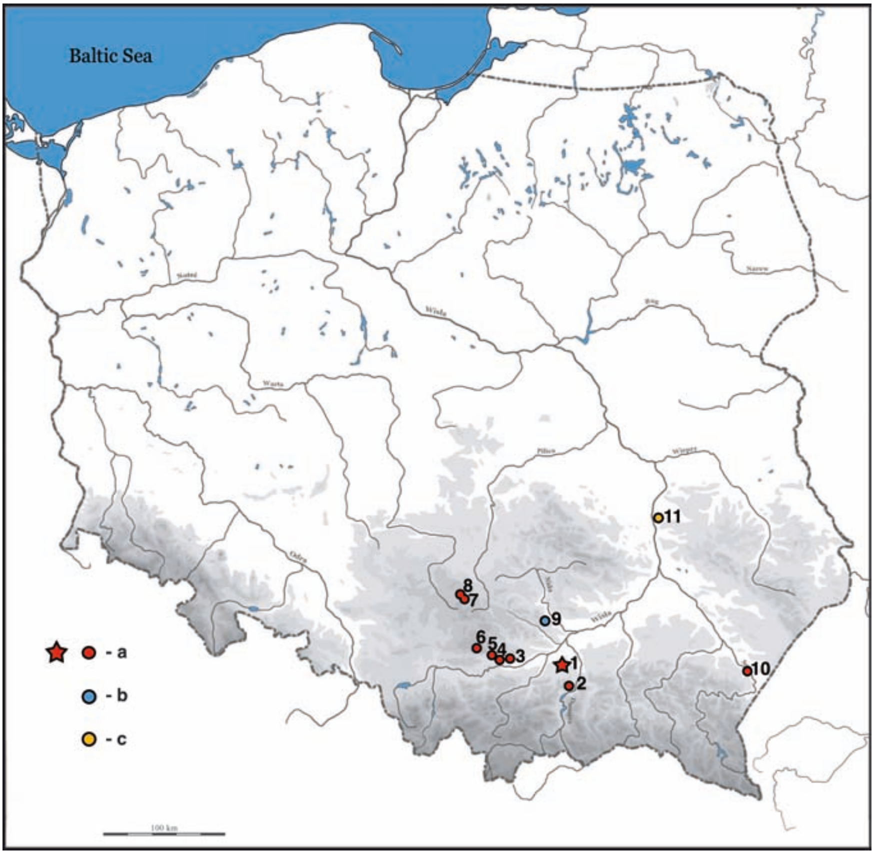

Fig. 15. Distribution of Iron axe-like bars from Poland: 1 – Brzesko, Brzesko District; 2 – Zawada Lanckorońska, Tarnów District; 3 – Cracow-Nowa Huta – Mogiła, Cracow District; 4 – Cracow, suburbium Okół, Cracow District; 5 – Modlnica, Cracow District; 6 – Szklarka Stream valley, Cracow District; 7 – Kroczyce (unpublished); 8 – Kostkowice, Góra Słupsko, Zawiercie District; 9 – Stradów, Kazimierza Wielka District, Poland; 10 – Radymno, Jarosław District; 11 – Piotrawin, Lublin District, a – Lesser Poland/Vistulan type; b – Great Moravian type; c – Piotrawin type (drawing B. S. Szmoniewski)

Vistula and the Dunajec rivers (Szmoniewski and Rozmus 2022, 64). Consequently, we cannot exclude that the axe-like iron bars alongside iron bowls and blades were the traditional form of raw material portions or units in which iron was traded (Urbańczyk 2001, 52).

It is worth mentioning here that the finds of axe-like bars inside any dwelling place or outbuildings are extremely rare. One deposit consisting of 101 such items was discovered above a damaged inhumation grave (3/62) dug into one of the corners of a sunken-floored building (3/62) excavated in Bíňa, southwestern Slovakia (Habovštiak 1966, 454, fig. 17). The deposit is assigned to the time horizon when hillforts in southwestern Slovakia were already disappearing due to the invasion of Hungarians by the end of the 9th century and

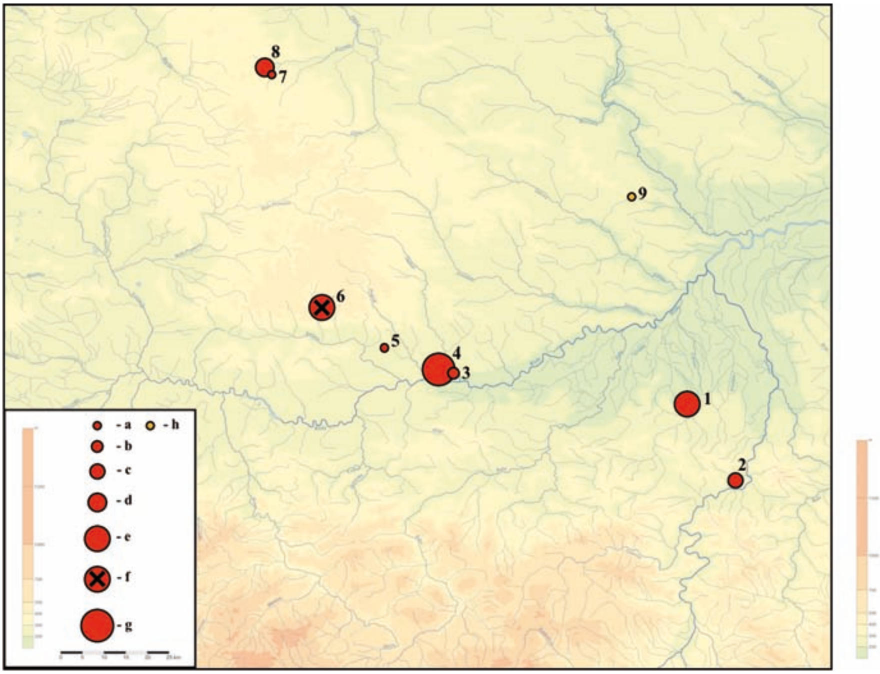

Fig. 16. Distribution of Iron axe-like bars in Lesser Poland (Numbers as Fig. 14): a-e and g – Lesser Poland/Vistulan type; f – the assemblage of intentionally cut axe-shaped bars of Lesser Poland/Vistulian type; h – Great Moravian type; a – 1 pc; b – 2 pcs; c – more than 5 pcs; d – more than 10 pcs; e and f – more than 35 pcs; g – 4212 pcs. (drawing B. S. Szmoniewski)

in the beginning of the 10th century. However, in this case, it was most probably deposited after the sunken-floored building had ceased to function as a dwelling place. In recent times, on the hillfort of Bojná-Valy also located in southwestern Slovakia, a hoard has been found inside a furnace cleaned from ashes in another sunken-floored building (Feature 44); the hoard includes 37 axe-like bars and it is interpreted as 'possessions hidden in times of trouble'. The point of time of its deposition is determined to be after the year 908 which corresponds to the time when the hillfort of Valy was sacked and burnt (Robak 2021, 52, 57, fig. 5; Pieta and Robak 2023, 107, 108, fig. 44: 3-6).

8. CONCLUSIONS

The settlement in Brzesko, which can be dated to a period between the 9th and the first half of the 10th century, constitutes an important point on the map of the early medieval settlement in this part of Lesser Poland. The uncovered features revealed, and especially the tub-like ones, correspond to similar discoveries known from the nearby areas, namely to those in the settlement in Wojnicz of a somewhat earlier but still overlapping chronology, and with those from the Zawada hillfort. Special importance can be given to the discovery of the deposit of axe-like iron bars made at the end of the 1970s in Kraków's Okół. Earlier finds of axe-like bars such as the find from the hillfort of Zawada Lanckorońska located south of Brzesko represented the cluster type of finds or were just stray finds. The second deposit find made after the one from Kraków was discovered in the Dunajec basin in Brzesko, a site to the north of Veľká Lomnica on the Poprad River in Slovakia. These locations can indicate an important communication trail which at the same time could have been the commercial route connecting the Vistulans' community with their southern neighbours. Despite its apparent peripheral character within the tribal region of the Vistula, the settlements in Brzesko, were, therefore, a significant element in the net of contemporary settlement structures.

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

ABSTRACT

Michalak A., Kotowicz P., Garbacz-Klempka A. and Jurecki P. Wind from the South? Mace head from Surowica in the light of formal and metallurgical analysis. *Sprawozdania Archeologiczne* 76/2, 369-381.

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

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

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

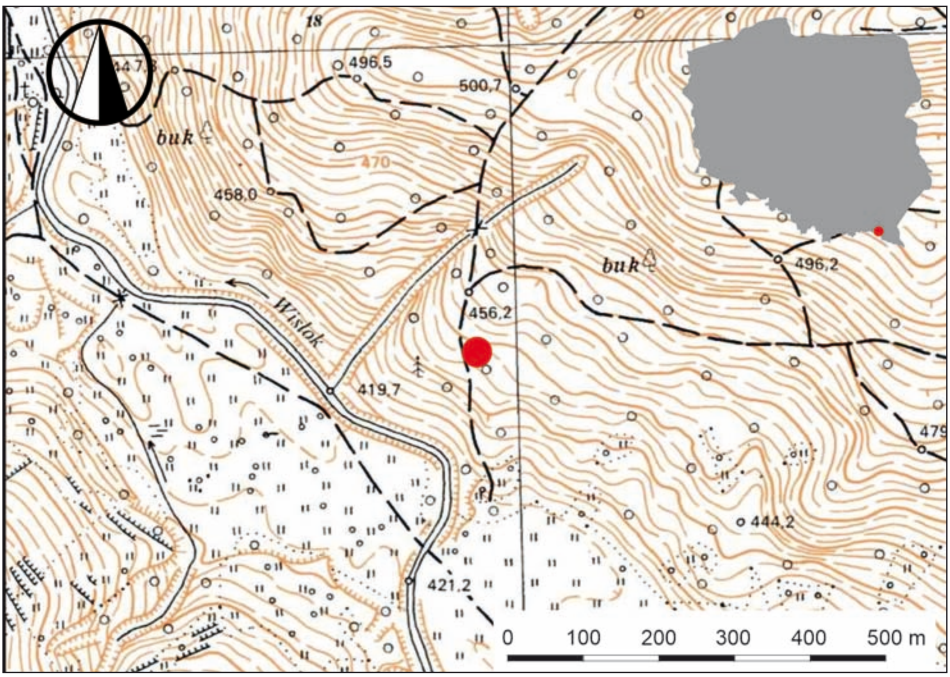

Fig. 1. Surowica, Jaśliska Commune, Krosno District, Podkarpackie Voivodeship – location of find site of mace head (P. Kotowicz)

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

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

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

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

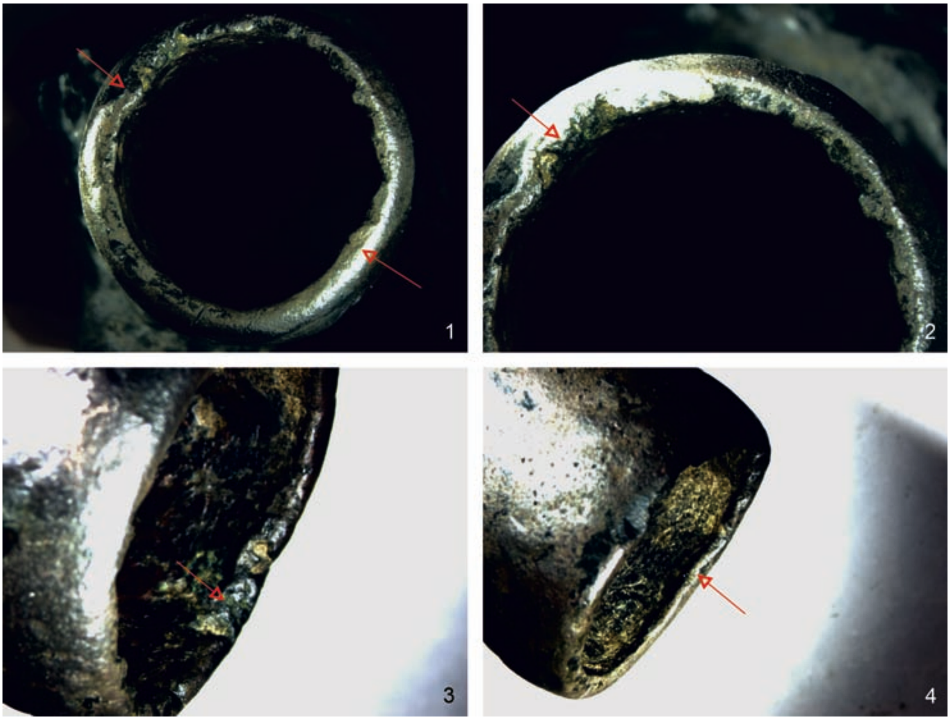

Fig. 3. Mace head from Surowica:
1 – lower flange with remains of gating system; 2-3 – broken-off part of ring (remains of gating system);
4 – rounded part of ring with processed trace of gating system (photos by P. Jurecki)

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

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

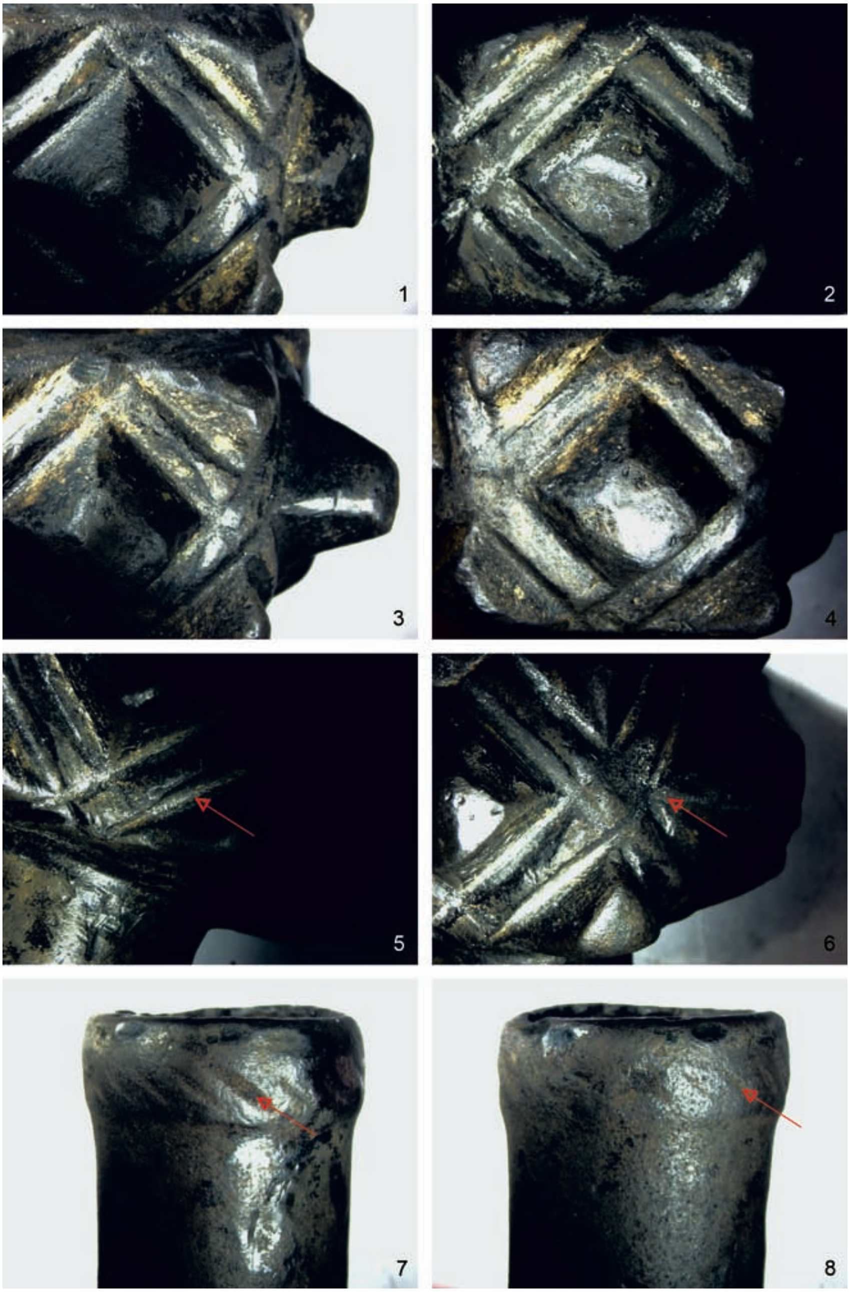

Fig. 4. Mace head from Surowica:
1-4 – quadrilateral spikes modelled in wax; 5-6 – ornaments made on wax model and deepened by grinding; 7, 8 – ornaments made on wax model (photos by P. Jurecki)

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

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

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

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

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

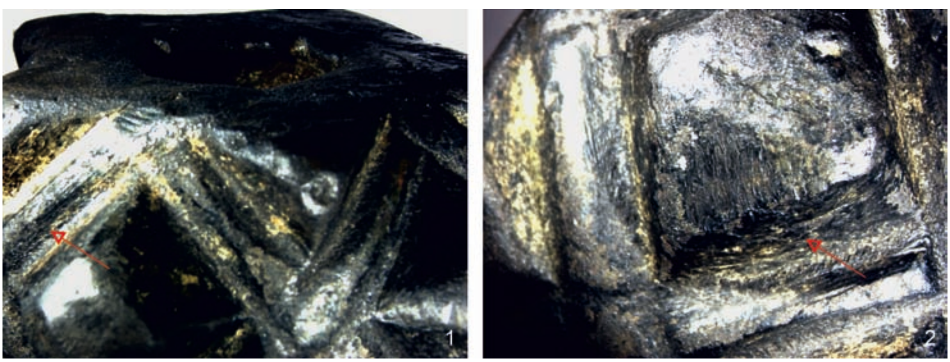

Fig. 5. Mace head from Surowica: 1, 2 – traces of grinding (photos by P. Jurecki)

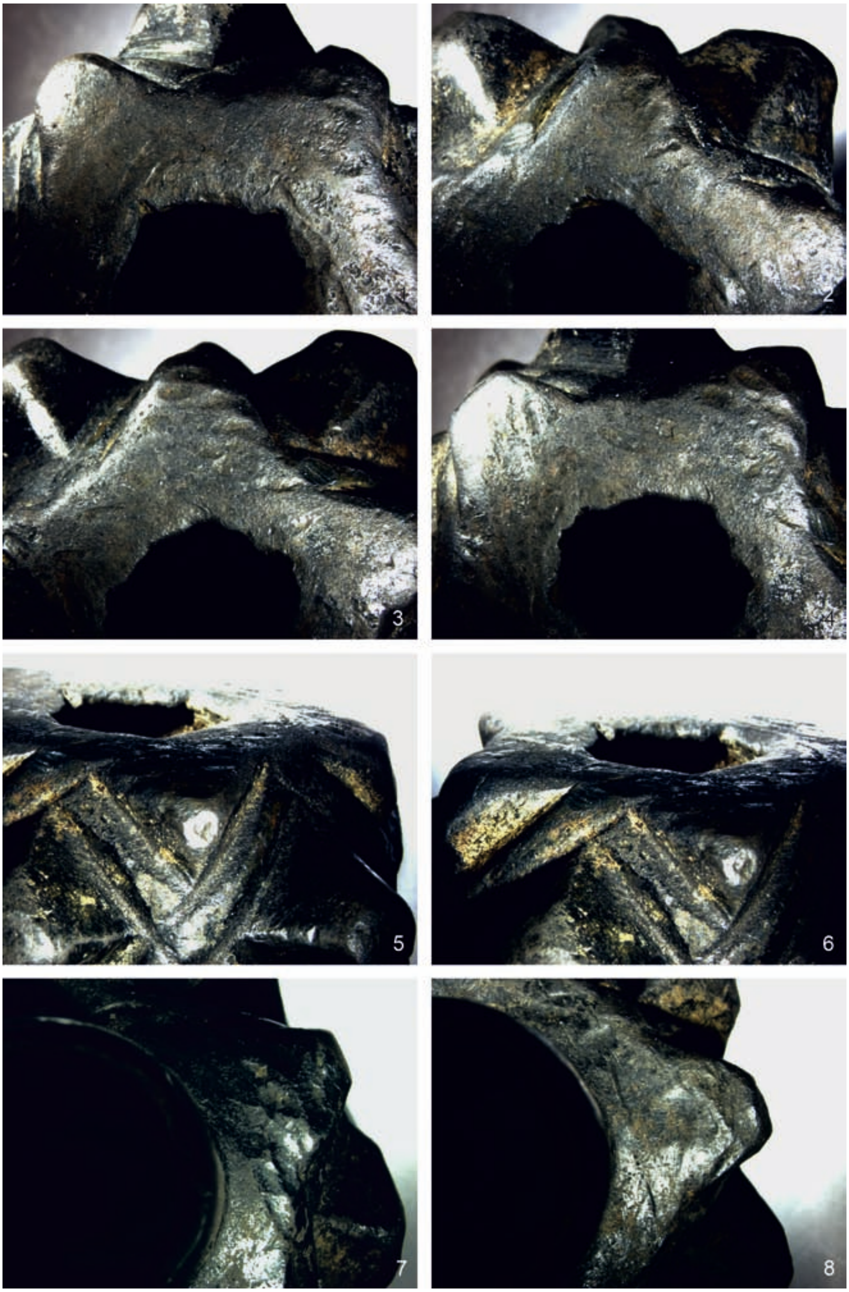

Fig. 6. Mace head from Surowica:
1-6 – upper plane of mace head with traces of mechanical damage; 7, 8 – lower part of mace head with traces of mechanical damage (photos by P. Jurecki)

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

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

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

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

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

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

It would be also recommended to briefly discuss the circumstances in which the mace head found its way to the grounds of the village of Surowica. The general 14th century chronology does not render this discussion easier, as this was a time of dynamic political changes in the area of the artefact's discovery. Until 1340, this area was part of the southwestern part of Halych-Volodymyr Rus' – very close to the borders with Poland and Hungary. In close proximity to the find site of the mace head is the Beskid Pass above Czeremcha, which was certainly used in communication and trade between the lands that were situated to the south and north of the Carpathians after the mid-14th century. A route from the territory of present-day Slovakia via Jaśliska to Rymanów went through this pass (Fastnacht 2007, 59). It cannot be excluded, however, that this route was also in use during the earlier period. Due to the scarcity of sources, we do not know much about any contact between the Duchy of Halych and Volodymyr and the Kingdom of Hungary during the first half of the 14th century It is certain, however, that it was vivid, as this was during the preceding century; this contact would have included trade, military actions, and settlement. Without discussing this issue in too much detail, we can merely mention (as speculated by historians) the military aid from the Hungarian King Charles Robert (Károly Róbert) to the Polish ruler Władysław the Short in order to place Jerzy II Trojdenowicz on the throne of Halych in 1324 (Font 2011, 96, 97). This duke also granted nearby town of Sanok with a Magdeburg law foundation privilege, permitting the town's mayor and his heirs to judge each person (including Hungarians) in the territory of the town (Kiryk 1995, 97; Fastnacht 2007, 205).

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

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

To conclude, it must be said that the mace head from Surowica is yet another find from the area of present-day Poland that demonstrates the close genetic relationships with the territory of medieval Hungary (*cf.*, Michalak 2006). The numerous artefacts of this kind that were discovered in medieval Hungary imply large-scale manufacturing, whose products could be exported to neighbouring lands (Kovács 1971; Kovács 2016). There is no doubt that this was rendered possible by the huge resources of copper from mines that were located in the territory of Upper Hungary (Baitizi 2018, 166-181). Some reservations have been provoked by the low number of sites with confirmed mace head manufacture in the territory of medieval Hungary (although their numbers are scant in general terms).

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

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

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NEW MEDIEVAL SUN COMPASSES? THE PROBLEM OF THE FUNCTION OF STONE DISKS FROM SOUTHERN RUS'

ABSTRACT

Veremeychyk O. and Antowska-Gorączniak O. 2024. New medieval sun compasses? The problem of the function of stone disks from southern Rus'. *Sprawozdania Archeologiczne* 76/2, 383-398.

The article explores stone disks discovered at medieval sites in Rus'. A total of eight pyrophyllite slate objects, sourced from outcrops near Ovruch (Ukraine), were analysed. These disks have been previously interpreted as various items, including calendars, craft tools such as needle sharpeners and polishing stones, as well as components of hand-operated bow drills. Through measurements and surface analysis, three stone disks (Kyiv, Listven, Liubech) exhibit similarities to Vikings' sun compasses, with a limited number of examples found in Greenland and the Baltic Sea region. The analysed objects were dated to the period between the late 12th and mid-13th centuries. The origin of the raw material suggests local manufacturing. At the same time, the form and function may have been influenced by Scandinavian traders and sailors, aligning with the presence of these disks along rivers within the trade route 'from the Varangians to the Greeks.' Further studies and archaeological experiments are necessary to confirm whether these disks had a practical navigational purpose.

Keywords: sun compass, Ovruch pyrophyllite slate, stone disk, Rus', navigation
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INTRODUCTION

One distinctive cultural trait in medieval Central and Eastern Europe is manifested through the prevalence of diverse artefacts crafted from red pyrophyllite slate, exhibiting hues ranging from light pink to purple. This raw material found application in various contexts, including tombstones, sizable decorative elements intricately carved within places of worship in Old Rus', as well as icons, querns, whetstones, weights, casting moulds, spindle whorls, crosses, beads, and other items.

A notable concentration of these artefacts has been identified within the territory of southern Rus'; however, spindle whorls originating from abroad are also documented in this region. Despite an exhaustive exploration encompassing diverse categories of pyrophyllite items, the examination of associated workshops, distribution routes, and chronological aspects (Rozenfeldt 1964, 220-224; Rybakov 1948, 188-195), numerous unresolved questions persist within this domain.

Recently, the investigation into products derived from the pyrophyllite industry has undergone a heightened focus, primarily catalysed by the implementation of a scientific project aimed at the exploration and preservation of a medieval outcrop named Ovrutskoykras. This initiative, spearheaded by A. P. Tomashevskyi (Tomashevskyi 1998, 151-155; 2005, 186-194; Pavlenko 2005), has not only intensified research outcomes related to pyrophyllite deposits, settlements, and workshops in proximity to Ovruch – where pyrophyllite items were processed – but has also extended its purview to encompass diverse categories of pyrophyllite discoveries from other regions within southern Rus' (Pavlenko 2001). This surge in focus has further stimulated a comprehensive investigation of pyrophyllite artefacts within the Chernikhiv Polissia territory (Veremeychyk 2008; 2013; Sytyi and Skorokhod 2012).

The escalating volume of studies and publications dedicated to these materials has facilitated the identification of a collection of stone disks featuring concentric rings and dimensions that significantly deviate from conventional spindle whorls. These distinctive characteristics form the foundation for the research presented in this paper. An effort has been made to establish connections between some of these disks and artefacts previously documented in scientific literature, where they have been denoted as compasses (see Sølver 1953; Thirlsund 1987; 1999; Stanisławski 2000).

THE MATERIALS – DISKS OF PYROPHYLLITE SLATE

Within the diverse array of pyrophyllite artefacts, attention is drawn to objects of an unclear function. Of particular interest are relatively uncommon discoveries of disks adorned with concentric rings on their surfaces, occasionally featuring radial lines or notches.

We have successfully compiled information regarding the sizes and appearances of nine such disks. However, a detailed description was available for only four of them (from Listven, Liubech, Kyiv, and Gubin). As for the remaining disks, their documentation is limited to published photographs, lacking comprehensive descriptions or containing only scant information, which will be elucidated in the subsequent discussion.

1. Malyi Listven, Chernikhiv region

Two such artefacts are known from the Chernikhiv district. The first originates from a settlement adjacent to the Stronghold II near Malyi Listven village. Researchers interpret the archaeological sites near Malyi Listven as correlating with the Listven mentioned in chronicles (so-called letopises), quoted in the year 1024 AD. This settlement is situated along a water trade route on the Bilous River, connecting Chernikhiv and Liubech between the 10th and 13th centuries (Kovalenko and Shekun 1984).

A pyrophyllite slate disk was discovered within the remains of a two-storey dwelling (Trench 1, Structure 1), dated to the end of the 12th and mid-13th centuries (Shekun and Veremeychyk 1986, 328). The find, circular and pink in shape, had a diameter of 6.5 cm, a thickness of 1.3 cm, and a hole diameter of 1.7 cm (Fig. 1). Its surface exhibited a polished, shining, and smoothed texture, with a rounded side edge. An irregular undulating line was carved on the lateral surface, approximately in the middle. The disk's surface was well-preserved, with minimal damage. On one side, four deep concentric rings were present, with irregular spacing between them. The first outermost circle was located 0.5 cm from the edge, the second at the same distance from the first. The third and fourth circles were carved 0.3 cm from each other. The distance between the irregular fourth internal circle and the central hole was 0.7 cm. This side of the disk featured twelve radial lines outlining irregular sectors. Most lines were deeply carved, radiating from the hole towards the outermost circle but not crossing

Fig. 1. The disk of pyrophyllite slate from Listven, Ukraine (Photo by O. Veremeychyk)

Fig. 2. The disk of pyrophyllite slate from Liubech, the Castle Hill, Ukraine (Photo by O. Veremeychyk)

it. On the back side, six concentric rings were observed, with a part showing seven. It is plausible that during the carving of lines near the hole, the distance between the rings was reduced, leading to variations in measurements. The first outer ring on this side was carved 0.5 cm from the edge, with the distances between the first, second, third, and fourth circles being almost identical at 0.3 cm.

Upon further observation, a disrupted arrangement of concentric rings becomes apparent on the disk. The internal ring was carved 0.5 cm from the hole. On this side, the disk is also segmented into irregular sectors with lines radiating from the hole towards the outer circle. Additionally, around the hole, additional diagonal notches are visible. The radial lines on both sides were carved onto the existing concentric rings.

2. Liubech, Chernikhiv region

Another fragment of a pyrophyllite disk was documented in Liubech on Castle Hill (Trench 1) in 2010 (Veremeychyk and Bondar 2010, 185, fig. 209). This artefact originates from a cultural layer dated to the end of the 12^{th}-13^{th} centuries.

Only a quarter of the original object remains intact (Fig. 2). The slate disk has delaminated, leaving only a fragment of one of its surfaces. The estimated diameter of the item was approximately 7.5 cm, with a hole measuring 1.8 cm in diameter. Four concentric rings are still clearly visible on the disk, with the first one situated 0.5 cm from the external edge. The distance between the other circles is roughly the same, around 0.3 cm. Because some circles have nearly vanished, determining the original number or their original spacing is challenging. Additionally, the disk features three irregular, notched radial lines.

3. Kyiv

During excavations in the area of Gonchari and Kozhumiaki in Kyiv, a pink pyrophyllite slate disk was unearthed in a cultural layer dating to the Old Rus period (Kozubovskyi *et al.* 1993, 251-253). The disk had a diameter of 6.5 cm, with a hole diameter of 2 cm. On one side of the disk, the authors of the publication noted four concentric rings, each at an approximately equal distance (0.4-0.5 cm). One of the internal circles featured characteristic diagonal notches. Unfortunately, the photograph provided in the publication is of low quality, preventing an accurate determination of the number of notches.

Furthermore, the clearly visible rings on this side are intersected by radial lines, forming distinct sectors. On the severely damaged reverse side of the disk, an inscription remains: И…ОАNАКІЛО, which, according to S.O. Vysotskyi, may signify ‘the circle of John’.

4. Gubin, Khmelnytskyi region

The disk discovered in Gubin has been dated to the 12^{th}-13^{th} centuries, featuring a diameter of approximately 10 cm and a hole diameter of 2.3 cm. On both sides of the disk, three concentric rings were carved, although no radii were documented (Fig. 3). The author of the publication of the disk interprets the artefact as a polishing stone. In the Cyrillic alphabet, three words are inscribed: Jesus, Amen, Yarilo. This inscription is accompanied by a solar symbol (Yakubovskyi 2020, 120, fig. 103: 3).

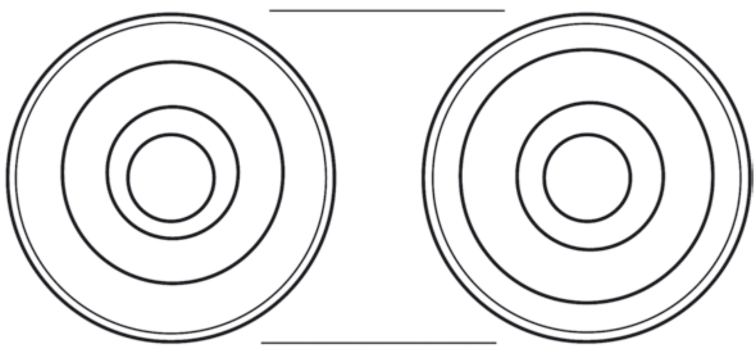

Fig. 3. Drawing of radial lines on the disk in the published photo
(No scale – illustrated by O. Antowska-Gorączniak after Yakubovskyi 2020, fig. 103:3)

5. Others

Similar discoveries have also been documented in Kyiv Podol (four items) and Mstislav' in Belarus, although precise information about them is unavailable (Kozubovskyi *et al.* 1993, 253).

An analysis of photographs depicting fragments of the disks from Kyiv suggests that the disks had external diameters ranging from 6.6 to 10 cm, with central holes varying from 1 to 2.2 cm. In one instance, the hole was square-shaped with a side length of 1.4 cm. However, publications lack detailed descriptions and chronological information regarding these items.

Consequently, concentric circles have been identified on the discussed disks, accompanied by either inscriptions (two items) or radial lines (three items).

FUNCTIONS OF THE DISKS

Various interpretations regarding the function of these disks have been proposed. O.V. Shekun suggested, based on the division of the item into twelve sections, that the disk from Listven might have served as a calendar. The authors of the publication on the disk from

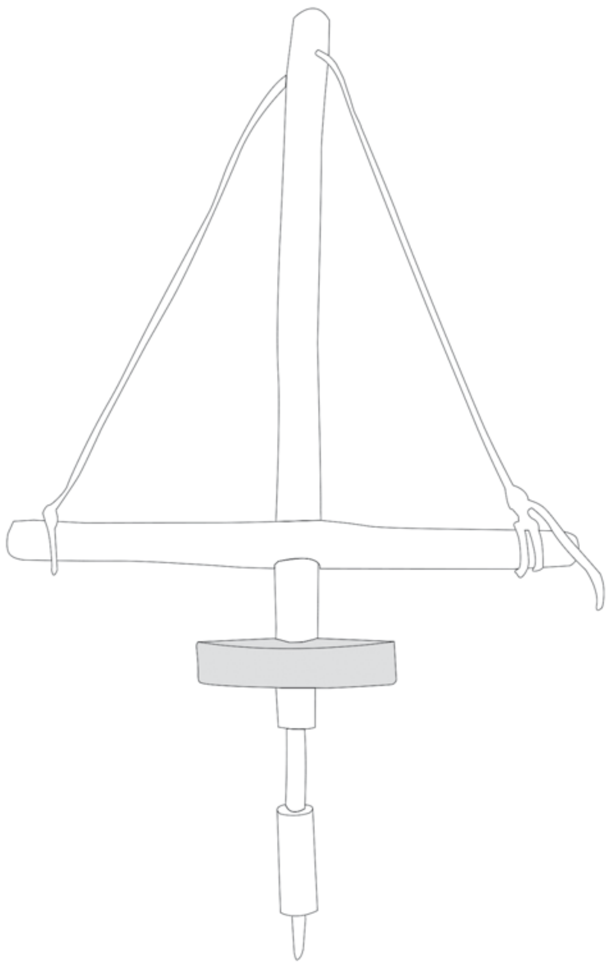

Fig. 4. A bow drill with a stone disk-base
(Illustrated by O. Antowska-Gorączniak after Popkiewicz 2012)

Gonchari and Kozhumiaki also allowed for such an interpretation while additionally suggesting their potential use as needle-sharpening devices (Kozubovskyi *et al.* 1993, 253). In contrast, the discoverers of the artefact from Gubin interpreted the disk as a polishing stone (Yakubovskyi 2020, 120). Being a relatively soft rock, pyrophyllite slate was easy to process. The polished surfaces of the disks, however, lack visible traces of wear that would be expected if they had been used as polishing stones, suggesting a different function.

A. P. Tomashevskyi and A.A. Chekanovskyi have suggested (in personal communication), that these objects might have served as flywheels for manual bow drills used in jewellery production (Fig. 4). In such an interpretation, the main axis of the tool would pass through the central hole and have at its end a sharp drill for boring holes. Similar tools, for instance, might have been utilised to drill holes in amber (Popkiewicz 2012, 565). Thus, one possible function of the pyrophyllite slate disks appears to be connected with crafts, although this does not preclude a secondary use for other purposes.

The division into sectors observed on three of them (Listven, Kyiv – the area of Gonchari and Kozhumiaki, Liubech) allows for the assumption of another potential function. Recent discussions among Polish researchers regarding similar disks found in Greenland and Poland, made from wood, bone, or stone in one case, have led to the hypothesis that these objects could be compasses – navigational instruments used by Vikings (Stanisławski 2000, with further references therein, 2002, Jagodziński 2015, 46-51). Carl S¸lver was the first to propose such an interpretation of the disk from Greenland in 1953. The pros and cons of this hypothesis are presented below.

SUN COMPASSES

The hypothesis of Vikings employing navigational instruments, including sun compasses, is a widely debated idea with both proponents (*e.g.*, Stanisławski 2000; Indruszewski and Godal 2006) and critics (*e.g.*, Roslund *et al.* 2003; Filipowiak 2020, critically assessing data and prior discussions; 2022).

To date, several artefacts from early medieval Europe have been identified and interpreted as navigational instruments:

1. A wooden disk discovered in Greenland – unearthed in 1948 by Danish archaeologist Christen Leif Vebćk near the Uunartoq fjord, in the southern part of the island within the Narsarsuaq settlement (Fig. 5: a). Preserved is half of the object with a diameter of approximately 7 cm, about 1 cm thick, and features a hole around 1.5 cm in diameter. On one side of the dial, around its perimeter, there are 32 triangular notches and two lines – one straight and the other curved – interpreted as gnomonic lines (Sølver 1953, 294). The remnants of the structure where the disk was discovered were initially dated, using the ^{14}C method, to approximately 1000 AD (Thirslund 1987). However, recent verifications of the site have raised concerns about its stratigraphy, and the relics above the layer containing the disk were dated to the 14^{th}-15^{th} centuries (Arneborg *et al.* 2012, 23, 24, fig. 9). Consequently, the dating of this specific object, the wooden disk, remains far from unequivocal.

2. A second disk from Greenland was located in the Uunartoq fjord – detailed information about this object is not available (Thirslund 1987; Stanisławski 2000, 159).

3. A triangular stone from Greenland, situated in the eastern part of the island at Vatnahverfi farm – features a gnomonic line indicating 61°N latitude (Thirslund 1987; Stanisławski 2000, 159).

4. A semicircular stone from Denmark, discovered on the Albuen peninsula by Aase Hansen – likely constitutes half of an artefact with one damaged surface (Fig. 5: b). It ex-

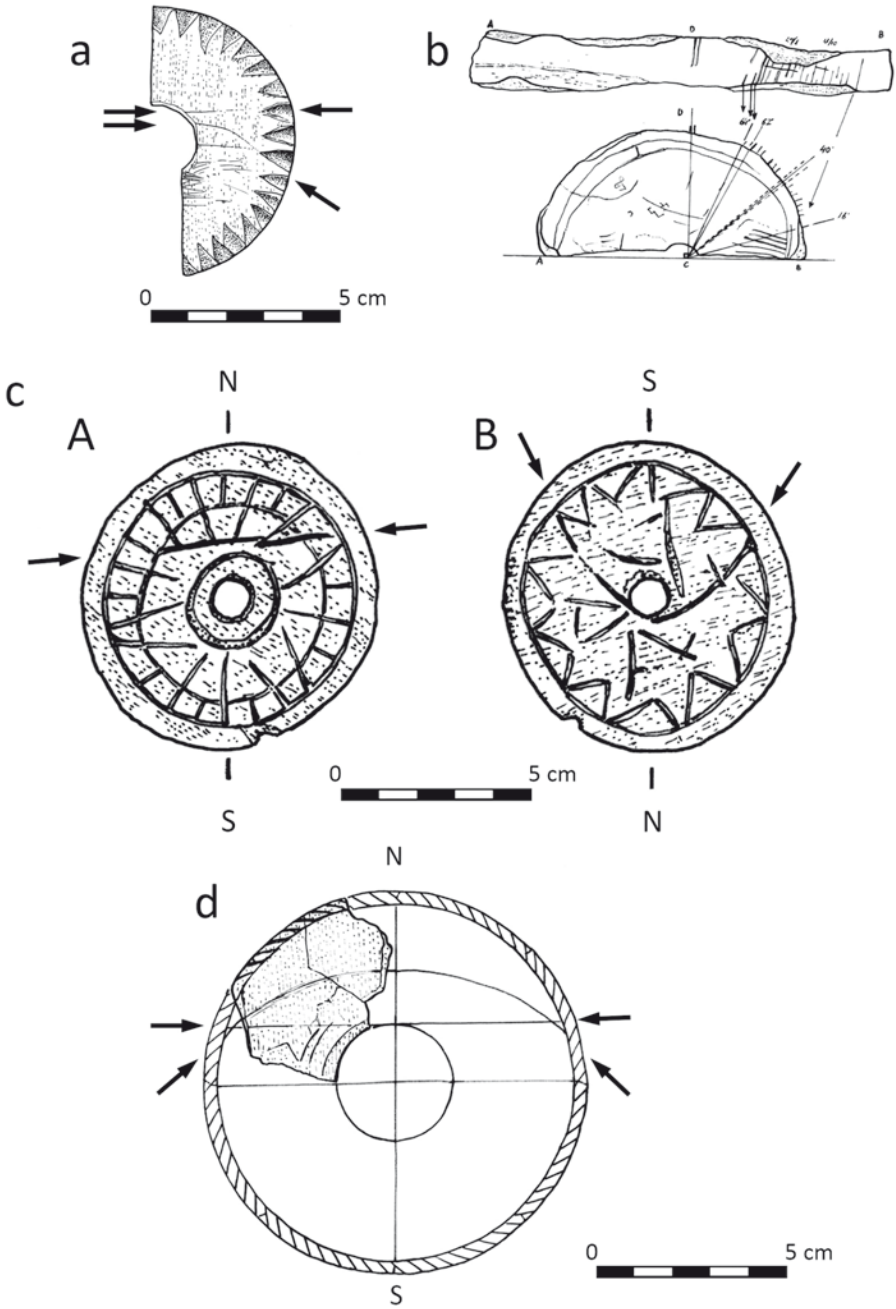

Fig. 5. The disks recognised hitherto: wooden (a, c), stone (b – no scale) and of whale bone (d) (Illustrated by O. Antowska-Gorączniak after: a – Jagodziński 2015, fig. 37; b – Thrislund 1987, 27; c – Stanisławski 2000, fig. 4, 5; d – Jagodziński 2015, fig. 39)

hibits notched lines on its side and radial lines on the surface (four remaining), along with a clearly recognisable fragment of the edge of its hole (Thirslund 1987, 21; Stanisławski 2000, 159).

5. A wooden disk from Wolin was discovered in the year 2000 during excavations led by Władysław Filipowiak at Site 4, specifically in Trench 2, within wooden structures found in Layer IV (Fig. 5: c). Crafted from oak wood, it measures 8.1 cm in diameter when measured along the growth rings but 8.6 cm across them, approximately 0.9 cm thick, with a central hole diameter of around 1 cm. On side A of the disk, the radii on the dial were marked following a 12/24-part system, albeit with some inaccuracies. These markings were incised with a sharp knife to 1-2 mm depth. Side A also featured three concentric rings and 24 incised lines extending from the last circle towards the middle of the dial, more or less perpendicular to the outermost ring. The shorter notches terminated on the second circle, while the longer ones almost reached the third circle. On the opposite side of the artefact, side B, only one circle was incised around its perimeter, along with twelve irregular triangles oriented with their apices facing the centre of the dial and four semicircular incised lines with a side rectangular notch. However, a different interpretation of these ornaments has been proposed by W. Filipowiak, suggesting that there were no semicircular notches, and instead, the lines formed a pattern of eight circular ornaments on the disk and around its hole, five of which were almost L-shaped (Filipowiak 2020, 321, fig. 4: A). The artefact has been dated based on dendrochronological dates obtained from samples taken from the construction of the wharf and a house, along with stratigraphical data, to the first half of the 11th century, likely its final stage (Stanisławski 2000). However, a more recent publication raises some doubts about such a narrow dating, as archaeological data from the layers may have been mixed (Filipowiak 2020, 321).

6. Fragments of a bone disk and a square bone object from Truso (Janów Pomorski) were unearthed by Marek Jagodziński during excavations conducted between 2001 and 2003 within the port settlement area, specifically in Building No. 8 (Fig. 5: d). The discovery included 17 strongly fragmented whale bones. Among them, some originated from a disk adorned with a decorated frame featuring diagonal notches along its perimeter, alongside straight and curved lines – interpreted as gnomonic lines. Additional fragments were identified as part of a tetragonal object, assumed to be a dial base. Considering the find's location, technology, and decoration, both objects were deemed components of the same instrument. According to Páll Bergţórsson, an Icelandic specialist in navigational instruments, this ensemble might have served as an astrolabe, representing a more sophisticated implement. The reconstructed dimensions of the disk were determined to be 10 cm in diameter and 1.7 cm in thickness. The dating of the area where Building No. 8 was recorded corresponds to the second and third phases of the settlement's occupation, commencing at the turn of the 10th century (Jagodziński 2012, 326-328; 2015, 49-51; 2017).

OPERATION MODE OF A SUN COMPASS

Captain Carl Sølver was the pioneer in suggesting, based on the wooden disk from Greenland, that such artefacts might have functioned as sun compasses (Sølver 1953). This proposition gained further support from subsequent archaeological discoveries and insights from various disciplines, notably astronomy and experimental sailing experiences with similar objects as compasses (Thirslund 1987; 1999, 8; Stanisławski 2000, 159). Expertise in criminology also played a crucial role, confirming the deliberate creation of the lines on the dials of the compasses found in Greenland and Wolin (Thirslund 1999, 7; Stanisławski 2000, 174).

All these disks feature a hole, a characteristic utilised in sun compasses where a gnomon was placed to cast a shadow on the dial. However, no such component was discovered alongside any of the disks. This missing part could have been a wooden stick, cut to the appropriate height and sharpened, or a purposefully processed piece of wood. The gnomon facilitated the determination of the time of day based on the Sun's apparent position in the sky (akin to a sundial) or, in the case of a compass, latitude alone. The key elements in the interpretation of the disks as sundial-compasses were the divisions and markings on the dials. These included diverse combinations of radial lines, rings, perimeter notches, and straight and curved lines traversing the dial.

A significant breakthrough occurred when the Swedish astronomer Curt Roslund determined the function of lines on the dial of the disk from Greenland: a straight line corresponding to the declination of the vernal and autumnal equinoxes and a curved one indicating the summer solstice at 61˚N latitude (Thirslund 1987, 14, 15). Similar lines were identified on the bone dial from Truso, assumed to have served a comparable purpose but for 54°N latitude (Jagodziński 2015, 50). The interpretation of notches on the best-preserved disk from Wolin also supported a similar hypothesis: the straight line on side A marked the equinox, while the curved line on side B denoted the end of April or mid-summer at 60˚N latitude (Stanisławski 2000, 171). The gnomonic line's shape resulted from three factors: latitude, the gnomon's height, and the Sun's declination. For extended sea voyages, multiple gnomonic lines were essential to account for latitude changes during the voyage and variations in the Sun's declination throughout the day (Thirslund 1987, 16; Stanisławski 2000, 169). The divisions marked by radial lines or triangular notches probably represented directional indicators.

The wooden disk from Greenland distinguished itself with a notable feature: a series of 32 triangular notches around its perimeter, implying that Scandinavians might have been cognizant of up to 32 directions. This stands in contrast to other known sun compasses, which typically follow the 12/24 system – a division method associated with the Mediterranean region. The employment of the 32-system in Northern Europe is suggested (Stanisławski 2000, 171). In the 12-division system, the distance between incised lines is generally 30°, though deviations and inaccuracies have been observed in compasses.

Extensive discussions on medieval navigation methods, detailed in the literature (Thirslund 1987), and the multifaceted functions and operational modes of these devices, particularly those derived from the disk from Greenland, have been proposed. These interpretations include viewing them as instruments for coordinating latitude and local south (Bernáth *et al*. 2013a), compasses based on the rule of a reversed solar disk (Bernáth *et al.* 2013b), or twilight boards (Bernáth *et al*. 2014).

COMPARATIVE STUDY

The pyrophyllite items under discussion, along with previously published artefacts linked to sun compasses, share the characteristic shape of a flat disk featuring a central hole. This aperture appears to be a pivotal element essential for the device's functionality, designed to house the gnomon – a sharpened stick casting a shadow on sunny days. Additionally, we consider that some form of marking on the dial – be it triangular notches along the edge or engraved rays – is necessary to categorise the disk as a navigational instrument. Consequently, in our further analysis, we exclude the disk from Gubin, characterised by only three circles, irregularly cut in relation to the hole.

The distinctive feature that sets the pyrophyllite disks apart from those identified as sun compasses is the absence of gnomonic lines, both the straight line for an equinox (either vernal or autumnal) and the hyperbolic one. These lines were not engraved on the stone surfaces, although they could have been temporarily applied using erasable dyes, such as charcoal or chalk.

When hypothetically considering the use of a temporally-determined gnomon curve, attention should be directed to the inland location where the stone disks from Rus' were discovered. The utilisation of such a temporal genomic curved line might have been crucial when moving along the N-S axis, where latitude changed relatively rapidly, impacting the angle of incidence of the shadow. In such cases, the ability to easily adjust the curve could have been significant for achieving more precise directional measurements. W. Filipowiak has suggested that the limitation imposed by permanent gnomon shadow lines may hinder the prolonged and widespread use of instruments interpreted as navigational tools (Filipowiak 2020, 318, 319).

Despite the absence of genomic lines, the objects share numerous common features. The wooden disks from Greenland and Wolin are of similar sizes: 7 cm and 8.6 cm in diameter, corresponding to the dimensions of the items from Rus'. Two of them have diameters of 6.5 cm (Kyiv and Listven), while the one from Liubech measures 7.5 cm. The estimated thickness of the disks varies from 0.9 cm (Wolin) to 1 cm (Greenland) and up to 1.3 cm (Listven).

The diameters of the holes in the stone disks from Ukraine (ranging from 1.7 cm to 2 cm) are slightly larger than those known from other sites (from 1 cm in Wolin to about 1.5 cm in Greenland).

Excluding the triangular object from Greenland and the wooden disk without a description, based on the available writings, the authors are aware of four disks, including the well-preserved one from Wolin. If hypothetically considering that the three pyrophyllite slate disks also served as sun compasses, their potential differentiation over time may be suggested, taking into account factors such as size, marking elements, and the shape of the notches.

Thus, the disks from Greenland (although their chronology is still unclear) and from Truso lack concentric rings, which, on the contrary, were incised on the disk from Wolin (three circles) and the objects made of pyrophyllite slate from Kyiv (four), Listven (four and six or seven), and Liubech (four). This suggests that the earlier, older ones (9^{th} to 10^{th} centuries) did not feature concentric rings, which appeared only on the wooden item from Wolin, dated to the end of the first half of the 11^{th} century. Towards the end of the 12^{th} and up to the mid-13^{th} centuries, the rings were confirmed on the disks from the territory of Kyivan Rus.

The older navigational instruments (Greenland, Truso) do not have the division of the dials with radial lines. Such a division was observed on the item dated to the end of the mid-11^{th} century from Wolin – with a 12/24 division system, having only 12 triangles marked on the opposite side of the disk, facing their apices towards the centre of the disk and based on the outermost ring. This division might have referred to the cardinal directions of the world. The marking of the navigational instrument from Wolin and the division into 12 radii of the stone disk from Listven, and possibly that from Kyiv (the fragment of the disk from Liubech is unfortunately too small), refer to the southern marking system from the Mediterranean region. On the reconstructed compass from Greenland, triangular notches were marked around its perimeter in the 32-system, which was used in Northern Europe (Stanisławski 2000, 174).

CONCLUSIONS

The analysis of the disks of pyrophyllite slate from the territory of Ukraine presented here allows for the assumption that the items had a particular utilitarian function. In addition to previously proposed interpretations found in publications, a new hypothesis suggests they could have functioned as sun compasses. This interpretation applies to a subset of items featuring concentric circles and radii, with a central hole intended for a gnomon. Hypothetically, it might have been possible to mark a curved gnomonic line on the surface using erasable dyes. Making such corrections could have been crucial when changing latitude, accompanied by a shift in the angle of incidence. It may be presumed that one supporting element for this interpretation is a dial with radial divisions and a hole suitable for a gnomon, notably found on two disks (Kyiv, Listven). Moreover, the division into 12 parts on these two disks allows us to relate this measuring system to that applied to compasses in the Mediterranean region. The significance of concentric rings on the stone disks, seemingly similar to the wooden sun compass from Wolin, adds weight to this interpretation. Changes in the appearance of known examples of navigational instruments over time have also been observed, particularly in the youngest specimens.

In the early medieval period, the utilisation and advancement of navigational instruments were ascribed to Scandinavians, who were believed to have been able to use such tools not only in coastal sailing but also undertake long voyages across open seas, eliminating the need to constantly observe the shoreline. Both constellations and the Sun played crucial roles in sea navigation during this era. Compasses utilising sunlight have been recognised as a significant technological advancement of the time. Scandinavians, with their vessel construction, navigational skills, and compass usage, successfully reached distant islands in the northern Atlantic, such as Greenland, Newfoundland, and the shores of present-day Canada. The sagas also provide limited information on sea voyages and directional settings, indirectly suggesting the use of navigational instruments. In favourable weather conditions, a navigator 'could then discern the quarters of heaven', indicating the ability to find direction, and the radial lines on the disks might have facilitated such quarter division, aiding in staying on course. In 1984, a reconstruction of the disk from Greenland was conducted, accompanied by a sailing experiment that demonstrated the potential use of such an item as a compass (Stanisławski 2000, 159). However, some researchers criticise this experiment, pointing out that the disk used was not an accurate replica of the original archaeological find. While the experiment confirmed the possibility of sailing using a solar compass, it did not conclusively prove that the Narsarsuaq disk was initially utilised for this purpose (Filipowiak 2020, 323).

Recent critical publications challenging the function of the wooden disks from Greenland and Wolin as navigational instruments propose alternative uses for the Narsarsuaq object. While the exact purpose is not specified, suggested functions include a piece of furniture, a 'butter-stamp', a top for a small keg, a component of a fish trap, or a spindle whorl. The disk from Wolin might have served as a fishing float or a potter's bat, intended for stamping vessel bottoms (Filipowiak 2020, 326). In the case of stone disks from Rus', their use as a fragment of furniture decoration or a float is deemed implausible due to the chosen raw material for their production. Additionally, the shallow incisions of concentric circles and radii make them unsuitable for use as 'butter stamps' or potter's stamps. The presentation of similar stone objects within a different context by the authors sheds light on potential interpretations of future discoveries and contributes to the ongoing discussion about evolving study concepts regarding their purpose.

The pyrophyllite slate disks, as discussed above, likely originated as a local product, manufactured in the territories of southern Rus' given the proximity of the raw material outcrops. However, if their function as compasses is acknowledged (a plausible scenario), it can be speculated that the inhabitants of the region acquired knowledge about such instruments from the Scandinavians, who had a presence in the area from the early 10th century (Duczko 2007). Considering the locations where these stone disks were discovered, particularly Kyiv, Listven, and Liubech situated along the significant communication and trade route 'from the Varangians to the Greeks' (*Povist vremennykh lit – Powieść minionych lat* 1999, 6), it is conceivable that the skill of using navigational instruments, such as sun compasses, in this part of Europe might have been imparted by Scandinavian traders and sailors.

The understanding of how navigational instruments might have been utilized in the Middle Ages has been substantiated through experiments conducted by archaeologists. A faithful replica of the compass from Greenland demonstrated its effectiveness during a voyage from Reykjavik to Nuuk in Greenland (Stanisławski 2000, 159). Consequently, it is proposed that further experiments be conducted with other objects, including those made of pyrophyllite slate.

In general, the pyrophyllite slate disks necessitate further comprehensive investigation, encompassing precise determination of their size and weight, macro- and microscopic analysis of both surfaces (including the measurement of the position and depth of the rings, radial carvings, notches, and potential mechanical wear on the surface), involving macro-scale photographs, and other laboratory analyses aimed at verifying the function and chronology of these artefacts.

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FORTIFIED STRONGPOINT OF THE RUSSIAN ARMY FROM THE 1914 OFFENSIVE ON KRAKÓW AT RACIBOROWICE-PRAWDA, SITE 3, KRAKÓW DISTRICT (S. POLAND)

ABSTRACT

Niebylski J. M. 2024. Fortified strongpoint of the Russian Army from the 1914 offensive on Kraków at Raciborowice-Prawda, Site 3, Kraków District (S. Poland). *Sprawozdania Archeologiczne* 76/2, 399-453.

The paper discusses a previously unknown earthwork of a fortification of the First World War found in the investigation of a barrow at Site 3 in Prawda in Raciborowice (Kraków district). The discovery consisted of a fortified strongpoint for all around defence enclosing the top of the barrow. It was built by the Russian troops during the offensive on Kraków from November to December 1914, after the strategic retreat of the Austro-Hungarian army towards the south, under the cover of the fortress artillery, ending the Battle of Kraków. The paper fills the gap in knowledge about the combat taking place between the Battle of Kraków and the battles on the right bank of the Vistula River, enabling the reconstruction of those events and giving insight into the material culture of the soldiers participating in them.

Keywords: artillery, barrow, Battle of Kraków, Kraków Fortress, field fortifications, First World War
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INTRODUCTION

Site 3 at Prawda is part of the village of Raciborowice, Michałowice commune near Kraków. A mound here had been described in 1935 by Juljan Piwowarski as being related to the Trzciniec culture (Piwowarski 1935, 180, giving the location as Wiktorowice, Luborzyca commune). The multicultural archaeological site was registered by Eligiusz Dworaczyński in 2008 during the field survey (Polish Archaeological Record, Polish name: Archeologiczne Zdjęcie Polski – AZP, region number: 101-57). Due to the need to conduct rescue excavations in advance of the construction of a section of the S7 expressway, the site was investigated by the Polish Atelier for Monuments Conservation (Polish abbrev. PPKZ S.A.), and the firm 'Galty' (Usługi Ziemno-Inżynieryjne Paweł Micyk), at the request of the General Directorate for National Roads and Highways (Polish abbrev. GDDKiA). The archaeological investigations were carried out in 2016-2017 and further in 2020, as a result of which an area of 829 ares was examined and 711 archaeological features were discovered. Among those close to the barrow, 47 features and 50 artefacts were dated to the period of the First World War (Fig. 1B: 1).

OUTLINE OF WRITTEN SOURCES FOR FIRST WORLD WAR EVENTS IN THE VICINITY OF PRAWDA, SITE 3

In 1914, the area of the archaeological site became the theatre of operations for the belligerent armies of the Russian Empire and the Austro-Hungarian Monarchy (Niebylski 2021a, 34). This was related to the activities on the Eastern Front of First World War, which in 1914 were characterised by variable successes for the parties involved in the fight. In the last week of October, a general retreat of the Austro-Hungarian troops began. The Russian offensive following the opponent was so strong that it was called a 'steam roller' (Niebylski 2020a, 557).

The aim of the new Russian offensive was blocking Kraków, threatening Silesia and then opening ways deep into the Austro-Hungarian Monarchy, to Vienna (von Horstenau 1932, 341-516; Bator 2008, 119; Orman and Orman 2008, 39-41; Łukasik 2009, 47). Kraków, similarly to Przemyśl, was a fortress, consisting of numerous objects of a defensive character.

The Austro-Hungarian 4th Army aimed at defeating the Russian troops in the battle that was planned to be fought on the line Słomniki-Proszowice. That operation was scheduled for 16 November (Bator 2008, 126). By that time, the Russian troops had advanced further west and southwest than expected.

The military struggles in the Battle of Kraków were conducted from 16 November with varying intensity and success for the involved parties. Due to the failure of 39th Honvéd Infantry Division on the Proszowice-Koszyce line and the reinforcement of the Russian

Fig. 1. Location of the Raciborowice-Prawda, Site 3. A. Location on the map of Poland; B. Detailed location of the barrow and field fortifications, as well as permanent ones associated with the Kraków Fortress in 1914: 1 – the barrow in Raciborowice-Prawda, Site 3, 2 – burnt village of Zesławice, 3 – burnt village of Grębałów, 4 – infantry sconce IS VI-1, 5 – Fort no. 49a 'Dłubnia', 6 – Fort no. 49 'Krzesławice', 7 – Fort no. 49 1/4 'Grębałów', 8 – wire obstacle, 9 – firing trenches and a communications trench, 10 – artillery batteries. Designed by J. M. Niebylski, drawn by K. Przybysz-Malczewski, adapted from RGVia, Fond 2067

troops with additional forces sent by the 3rd Army, the Austro-Hungarian 4th Army was moved closer to Kraków so that it would be under the cover of the fortress artillery and protect the foreground of the Fortress itself. That strategic retreat began on 26 November and lasted until 28 November, concurrently ending the battle. The Russian side did not undertake an armed pursuit due to the secrecy of the retreat manoeuvre as well as the weakening of its troops.

ARMED ACTIONS AFTER THE END OF THE BATTLE OF KRAKÓW: THE CASE OF PRAWDA BARROW

The area abandoned by the Austro-Hungarian army, about 5 km long, had extensive field fortifications in the northern part, which were occupied by the Russian army. Certainly, at the turn of November and December, both involved parties began to build new field fortifications in places corresponding to the new front line, which at the end of November, in the case of the Russian troops, was based on the village of Brzozówka-Michałowice-Prusy-Wyciąże, Kraków district, bringing it close to the area of Prawda, Site 3 (*Feldzug*… 1917, 44; Veltzé 1919, 513). The barrow was then referred to as Hill 305 (German: Höhe 305/Kote 305; *Viribus*… 1919, 102). The defensive units of the Fortress who were designated to occupy that area, were initially the Austro-Hungarian 1st and 110th Landsturm Infantry Brigade and 106th Landsturm Infantry Division, and then, after moving the 1st Brigade to the terrain of the Fortress and 110th Brigade to the west, it was solely the 106th Division that remained in the area (*Feldzug*… 1917, 90-92; Ehnl and von Sacken 1938, 244, 288, 289, 293, 294). The fighting in the area in question lasted for the first two weeks of December. They took place on the border of the effective range of the artillery of the fortress. The aim of the Russian troops was to blockade the Kraków Fortress from the north, north-east and the east. Already on the afternoon of 30 November, the artillery of Fort no. 49a 'Dłubnia' and Fort no. 49 'Krzesławice' responded with fire, shelling the enemy from a considerable distance, which in combination with the raids of the fortress garrison resulted in keeping it at a distance (Veltzé 1919, 18). At that time, two Russian high-explosive shells hit Fort no. 49 'Krzesławice' (*Österreichisch-Ungarische*… 1915, 4). In response, Fort no. 49a 'Dłubnia' and Fort no. 49 1/4 'Grębałów' responded with artillery fire and in order to reach the enemy, they moved their mobile batteries with the support of infantry. That artillery exchanged fire lasted until 5 December (*Österreichisch-Ungarische*… 1915, 4; *Viribus*… 1919, 101, 102). On the basis of the data of the Russian intelligence, it is known that between Fort no. 49a 'Dłubnia' and Fort no. 49 'Krzesławice', a continuous wire obstacle was set up, as well as two firing trenches. The eastern trench had a zigzag profile communications trench leading from it to the south. An analogous wedge-shaped firing trench was located between Fort no. 49 'Krzesławice' and Fort no. 49 1/4 'Grębałów'. In the background of those three forts, 12 batteries of artillery were located

(Fig. 1B: 4-10; RGVia, Fond 2067). Thus, that section of the fortifications, in addition to the permanent defences, had a well-developed network of field fortifications. In order to bind the opponent by engaging in combat, on 2 December, the Austro-Hungarian 110th Landsturm Infantry Brigade was ordered to carry out an attack towards Hill 305, *i.e.*, the barrow in Prawda, which was occupied by the Russian troops. The attack in question was supported by mobile heavy artillery batteries (*Österreichisch-Ungarische…* 1915, 4; *Viribus…* 1919, 102). On the night of 4 December, from the main post north of Prawda, in a bayonet fight, an Austro-Hungarian Sergeant, Franz Spirk, and his platoon fought off, a powerful enemy patrol that attacked them (*Ehrenhalle…* 1917a, 134). On 5 December, the fighting for the hill in Prawda, on which the barrow is located, was continued. Another attack on the hill was entrusted on that day to the Austro-Hungarian 35th and 110th Landsturm Infantry Brigades, which was supported by the fire of five mobile heavy artillery batteries under the command of Major General Aust. Those brigades were ordered to carry out an assault after dusk, from the area of Kocmyrzów, *i.e.*, from the east (*Österreichisch-Ungarische…* 1915, 4; *Viribus…* 1919, 102). The person who was awarded for skilful and prudent securing of the left flank of troops on that hill was an Austro-Hungarian Captain Johann Lappat, the commander of 36th Landsturm Infantry Battalion (*Ehrenhalle…* 1916c, 79). Already on 7 December, within the range of the fortress artillery, no enemy activity was detected in the northeast and east directions, which was considered to be a redeployment of their troops to the other side of the Vistula River (*Österreichisch-Ungarische…* 1915, 4; Veltzé 1919, 18, 19). In the area of Prusy, the fighting was still ongoing on 11 December (*Ehrenhalle…* 1916b, 43). On that day, the Russian troops carried out a strong night attack, for which Paul Czernysz was awarded due to his brave defence and notifying in time both the main post and the crew of Fort no. 49 1/4 'Grębałów' about that emergency (*Ehrenhalle…* 1917b, 23). As a result of those battles, the area of the village of Raciborowice and the hamlet of Prawda were regained and the Russian troops were repelled.

During this combat, on 2 December, the fighting was shifted to the southern bank of the Vistula River, where the Austro-Hungarian forces attacked the Russian 3rd Army advancing towards the Kraków Fortress (Arz von Straußenburg 1924, 42). The fortress artillery played a significant role in those engagements that continued until 6 December and stopping the Russian troops, avoiding the blockade of Kraków (*Heldenwerk…* 1917, 219; Schäfer 1934, 96; Urbanski von Ostrymiecz 1939, 298, 307). Its consequence was moving the front line away from the city in the southeast direction, and then, the Russian troops were driven out of Galicia (Niebylski 2020b, 263, 264; 2021b, 303, 304).

War losses

As a result of the Battle of Kraków, which took place in that area, there were great material and personal losses of both fighting parties. The Austro-Hungarian army, in order to prepare the foreground for the fortress artillery, completely destroyed the buildings in the village of Grębałów (Łukasik 2009, 162). The built-up area of the village of Zesławice, Kraków district, was also completely damaged (Fig. 1B: 2, 3). In the Austro-Hungarian 1st Army, about 30.000 soldiers were killed, wounded or became ill during the fighting, while in the 4th Army, the number was over 20.000. At that time, 16.000 Russian soldiers were held captive as prisoners of war. During the War, there were 120 hospital outposts in Kraków, including a garrison hospital, ten fortress hospitals consisting of several outposts, three epidemiological hospitals and ten reserve hospitals (Łukasik 2009, 67, 68).

The deceased soldiers were buried in individual and mass graves, and later, their remains were reburied during exhumations of temporary graves; they were laid in war cemeteries and quarters. For example, in Luborzyca, Kraków district, before the exhumations, a grave was located in a local cemetery, 6 km away from the barrow. Forty soldiers were buried there, including 34 Austro-Hungarian ones, some of whom had died in the Field Hospital no. 8/14 in Kocmyrzów (*Verlustliste*… 1915, 11; Pałosz 2012, 343, 357). Based on the documents concerning the news about the wounded and sick soldiers (German name: *Nachrichtenüber Verwundete und Kranke*), it was also possible to establish that men whose surnames we know were present there but, as a result of the sustained wounds and diseases, died and were buried in the same grave, then referred to as Kocmyrzów, Kraków district (*Nachrichten*… 1915; *Ehrenhalle*… 1916a, 41). These data indicate that the prevailing kind of injuries of soldiers fighting in the foreground of Kraków was a gunshot wound, mainly to the stomach, constituting 39.4% of all injuries and ailments. A small number of the hospitalised had received head and neck shots, amounting to only 18.2% of all the injuries and ailments, indicating the nature of the fighting in that area, taking mainly the form of numerous assaults, rather than trench warfare type of combat. After the exhumations of these remains, there are currently three war cemeteries in the area of Prawda – no. 391 in Kocmyrzów (5.5 km away) designed by Lieutenant Hans Mayr and planned at the site of the earlier burials in Baran, no. 399 in Prusy, designed by Lieutenant Karl Korschmann (3 km away) and no. 400 in the same place, also designed by Korschmann (3.5 km away; Schubert 2018, 188, 197, 198).

Features – field fortifications

At the site, 47 features dated to First World War have been discovered (Figs 2 and 3). Six of them have been dated by their artefactual content, while 41 by analogy with the adjacent features, taking into account the shape of the plan and cross-section, orientation and the nature of the fill. The following features have been dated artefactually: Nos 379, 484 (together with its part named Feature 483), 503, 509, 510 and explosion crater located in Feature 534 (the latter itself being of older chronology). The following features have been dated by analogy: Nos 402, 496-499, Feature 501, 502, 505, 506, 544-554, 571-574, 593, 598-611, 613, 614 and 714. In the immediate vicinity of three other features (Features 34, 40 and 41), artefacts dated to First World War were also discovered, but they got there

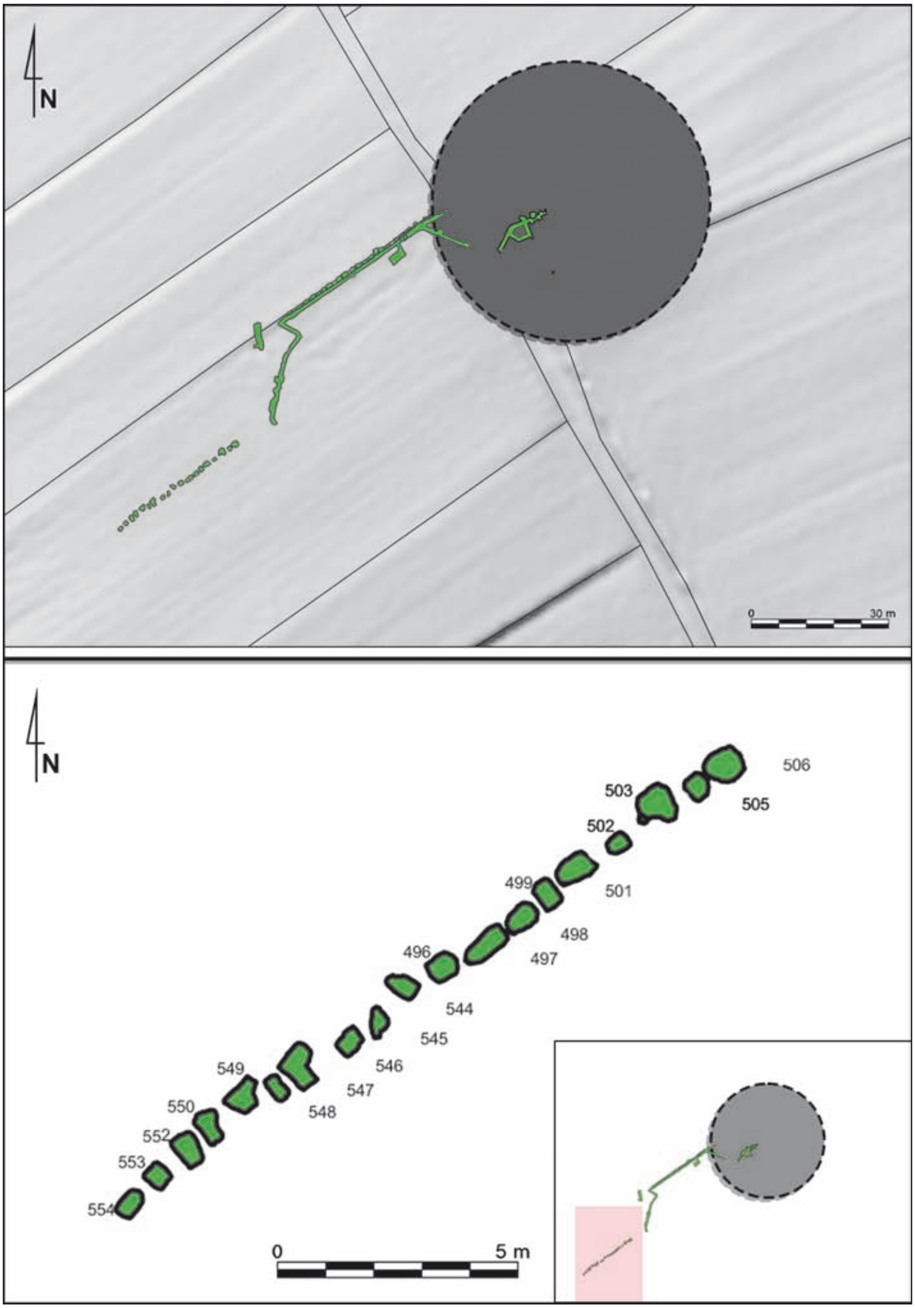

Fig. 2. Raciborowice-Prawda, Site 3: upper panel – location of field fortifications related to First World War and location of the barrow, lower panel – close-up of the western cluster of field fortifications. Graphic created by K. Przybysz-Malczewski

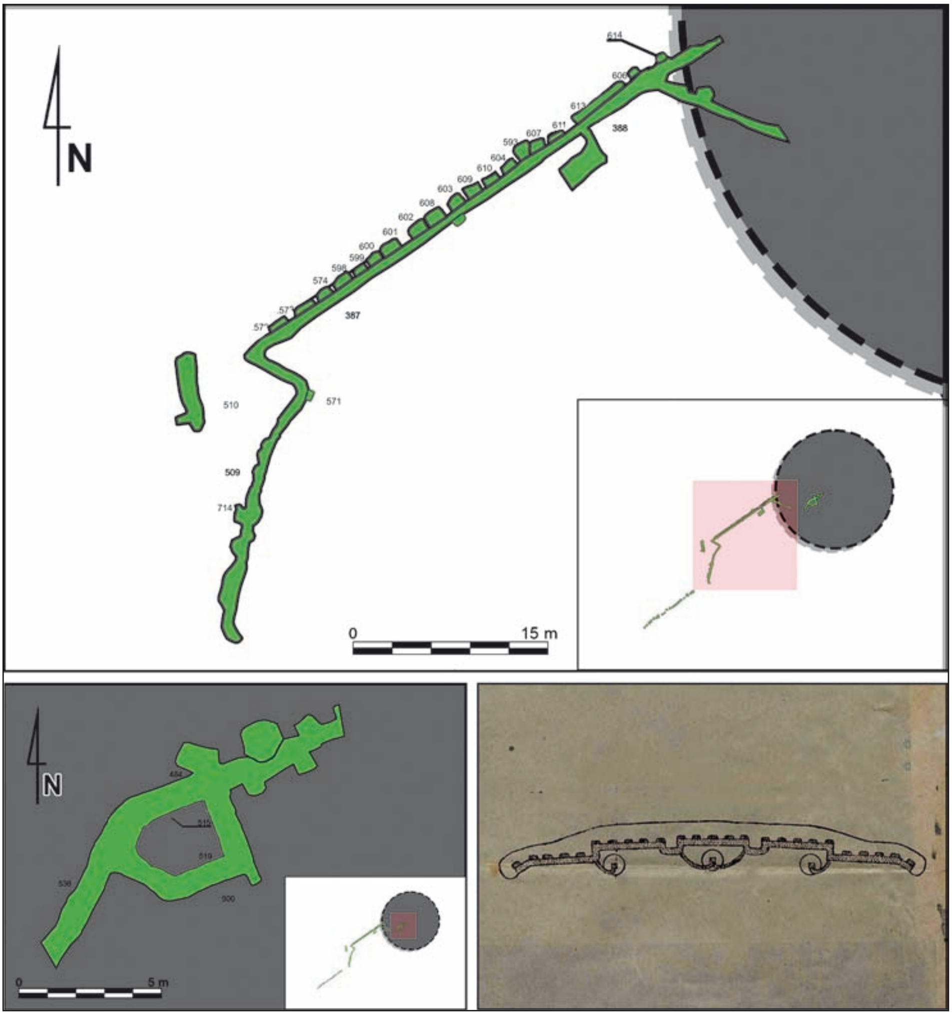

Fig. 3. Raciborowice-Prawda, Site 3: upper panel – close-up of the central cluster of field fortifications, lower-left panel – close-up of the eastern cluster of field fortifications. Lower-right panel – plan of the statutory type of position of the Russian troops for one platoon of soldiers, according to the military manual of 1914. Graphic created by K. Przybysz-Malczewski, adapted from Modrakh 1914

due to post-depositional factors and the chronology of those features should not be referred to that period.

Among the features dated to First World War, the following functions can be distinguished: one fortified position for all around defence; one shooting post; two firing trenches; twenty front trench niches; two rear trench niches, twenty one-man prone foxholes and a shell crater left by a high-explosive shell explosion on the site of a feature of older chro-

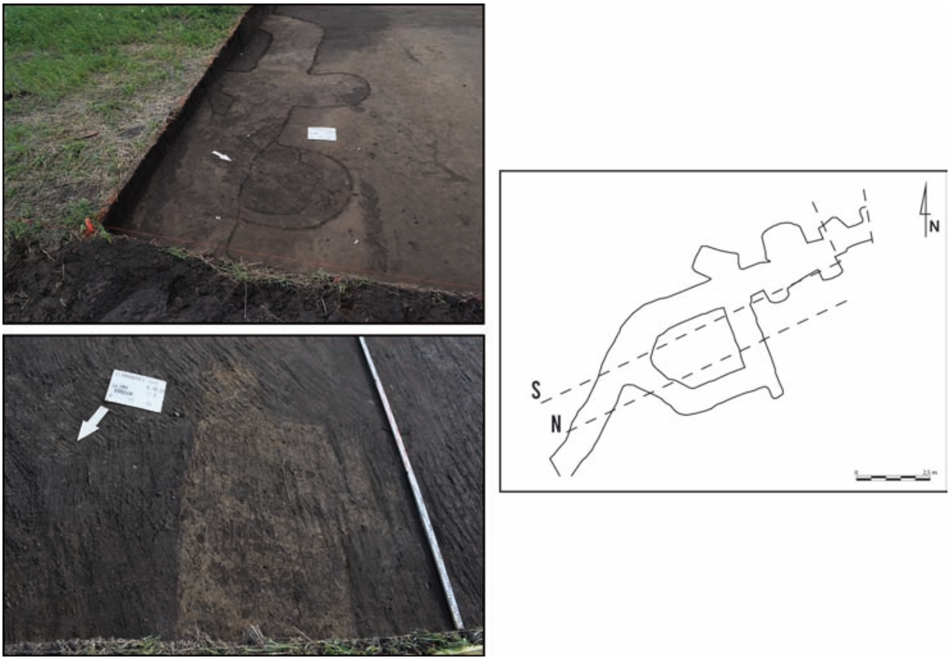

Fig. 4. Raciborowice-Prawda, Site 3. Fortified position for all round defence (Feature 484): upper-left panel – photo of the plan of the northern part, lower-left panel – photo of the plan of the southern part, right panel – drawing of the plan with the N and S cross-sections marked.
Graphic created by K. Przybysz-Malczewski

nology. Intentionally made features also comprised one position of the field fortifications, built simultaneously.

The fortified position for all around defence (Feature 484) is a continuation of Feature 379, which at the central point of the barrow surrounded its top (there is slight divergence on the southern side of the trench), leaving free space in the middle, it has a square-shaped section with dimensions of approximately 2.5 × 2.5 m. The trench has a continuation beyond the research are in the eastern direction and had two trench niches in its front slope. Before the commencement of the archaeological excavations, the barrow had been preserved to the height of 1.5 m and its diameter was 30 m.

The shooting post (Feature 510) had an irregular, elongated shape in plan. It was 5.9 m long. During the archaeological excavations, two cross-sections were made. The first one was located 0.8 m away from the southern edge of the feature. At that point, it was 1.12 m wide and 0.6 m deep. Its shape was four-sided, with a fire step located in the floor part on the eastern side, while in its western part, a provisional stove was built. The filling of the feature was diverse and composed of mixed layers of grey humus and beige loess (Fig. 6).

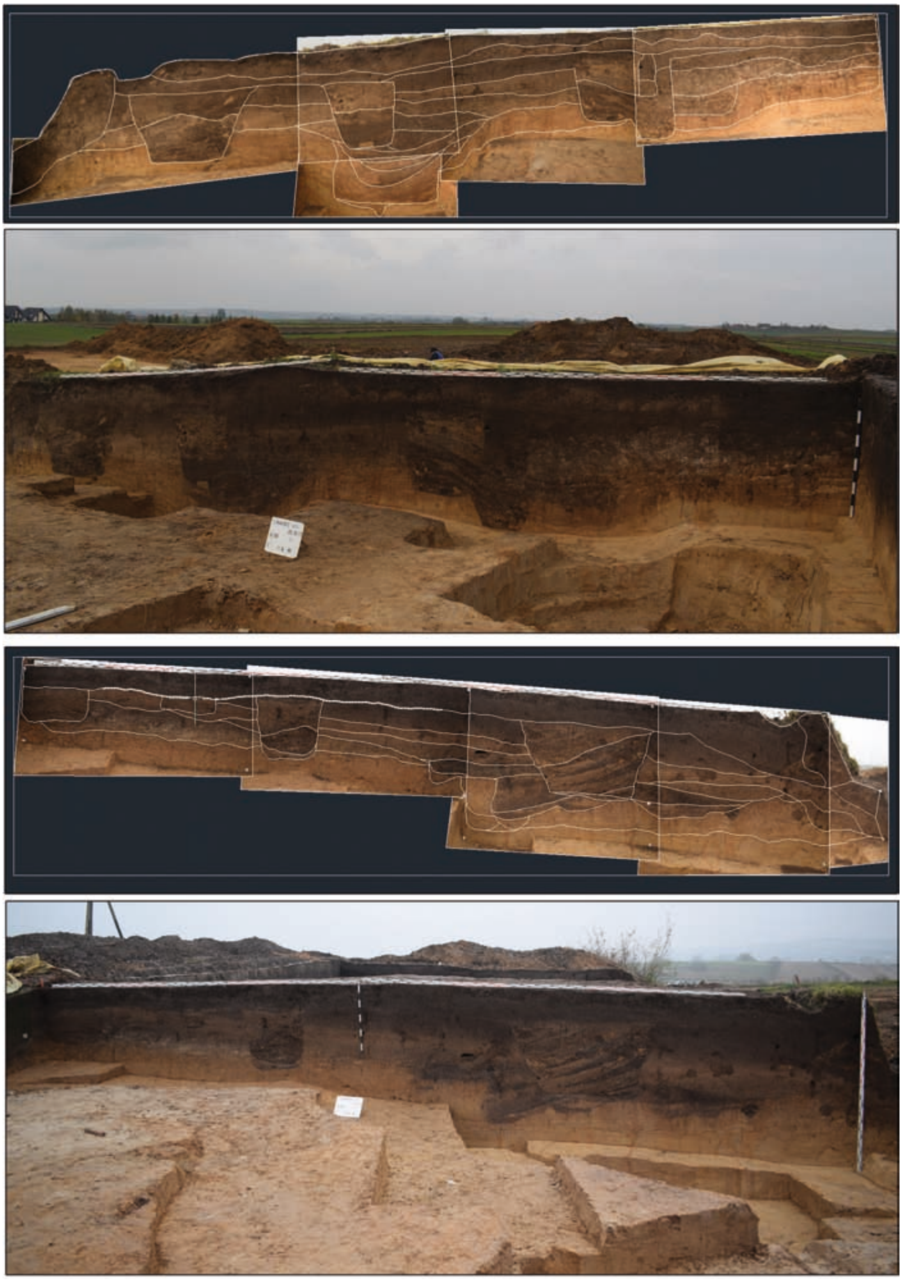

Fig. 5. Raciborowice-Prawda, Site 3. Fortified position for peripheral defence (Feature 484): two upper panels – orthophotomosaic with the outline of features and layers and a photo of the N cross-section, two lower panels – orthophotomosaic with the outline of features and layers and a photo of the S cross-section. Graphic created by K. Przybysz-Malczewski

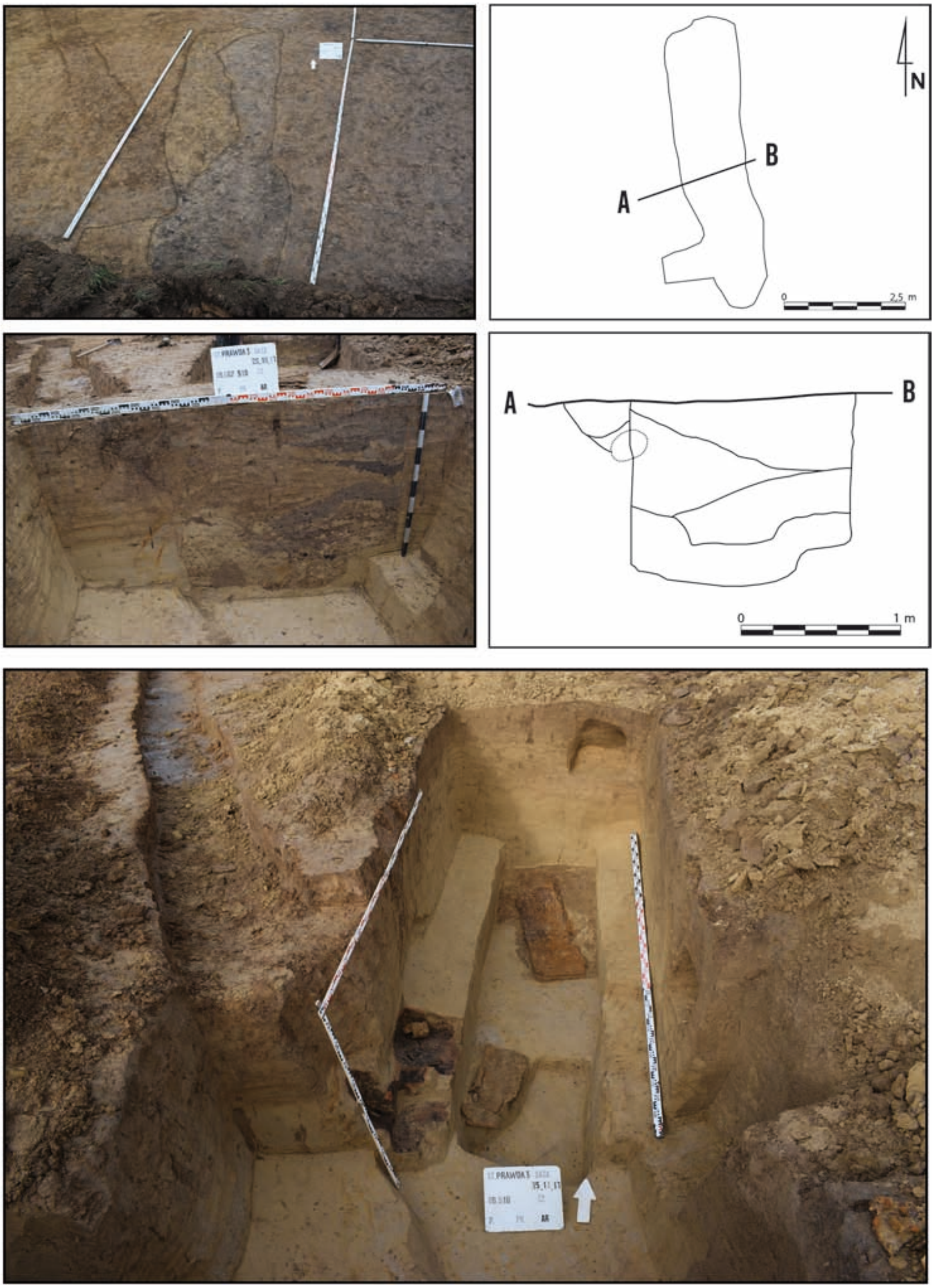

Fig. 6. Raciborowice-Prawda, Site 3. Shooting post (Feature 510): two upper panels – the photo and drawing of the plan, two middle panels – the photo and drawing of the cross-section, lower panel – the photo of the interior of the shooting post with the stove. Graphic created by K. Przybysz-Malczewski

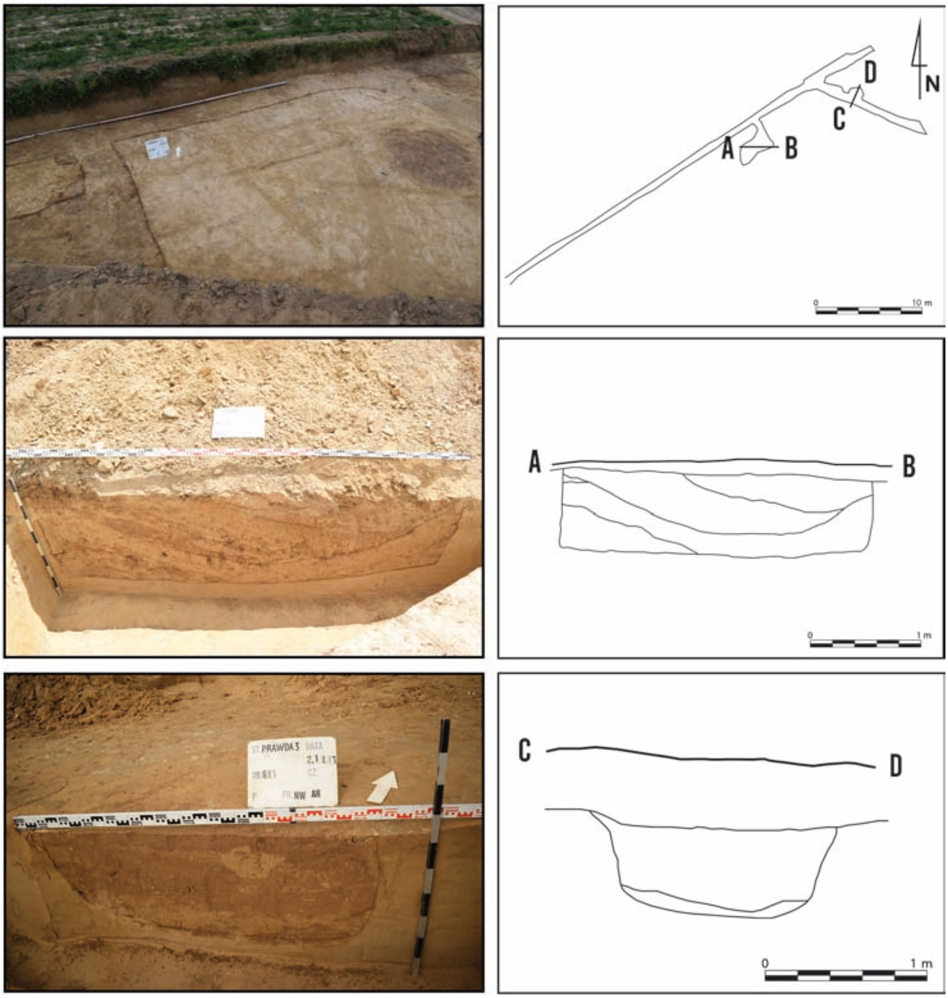

Fig. 7. Raciborowice-Prawda, Site 3. Firing trench (Feature 379): two upper panels – photo and drawing of plan with the cross-section lines A-B and C-D marked, two middle panels –photo and drawing of A-B cross-section, two lower panels – the photo and drawing of C-D cross-section.
Graphic created by K. Przybysz-Malczewski

Two firing trenches (Feature 379 and 509) were connected with each other. The firing trench in the section named Feature 509 was in the form of the interconnected curvilinear trench. A series of other features adjoined it – those were niches. The total length of the feature was 11.09 m. Four cross-sections were made. Profile no. 1 (N) was located 2.8 m away from the southern edge of the feature. The feature at that point seemed to be quadrilateral, expanding towards the top. The width of the top of the feature, located at the depth of 0.24 m below the humus surface, was 1.2 m, and the depth of the layers was 0.74 m.

Profile no. 2 (S) was created 1 m from the southern edge of the feature. At that point, it seemed to be quadrilateral, slightly widening towards the top on the west side, with a depth of 0.42 m. The upper part of the feature was 0.8 m wide. Profile no. 3 (N) was 3.4 m away from the southern edge of the feature. In that cross-section, it was connected at the eastern edge with Feature 571 (the rear niche of the trench), which disturbed the structure of its filling. Thus, the rear trench niches, unlike the front ones, were made after the trench had been built, as the final stage. In addition, the shape of the feature coincided with its form visible in other profiles. The width of the top of the feature was 0.64 m, and the depth of the layers was 0.4 m. At its eastern edge, the outline of Feature 714 (the front trench niche) was visible. The filling of the feature composed of grey and grey-beige humus, as well as beige loess. Feature 379 was characterised by analogous dimensions, indicating that it was the continuation of the same feature. It was extended in the southern direction with a short connecting trench, connected with the dugout. Its eastern wall was the extension of that connecting trench. The dugout had a rectangular shape in plan, with a longer wall oriented in accordance with the course of the firing trench. It was located 1.35 m away from this trench and it had in plan the dimensions of 3.65 × 1.85 m. Its walls were perpendicular to the bottom. Its upper part was at the depth of 0.4 to 0.18 m below the surface of the humus, and its depth from the bottom of the humus was 0.74 m (Fig. 7).

Twenty front-facing niches of the firing trench (Features 379 and 509) – Features 572-574, 593, 598-611, 613, 614 and 714, were very similar in size and shape. In plan, they had a shape similar to a rectangle, with a width ranging from 0.51 m to 1.42 m (with a mean of 0.89 m), length ranging from 0.6 m to 1.54 m (with a mean of 1.21 m) and depth ranging from 0.06 m to 0.62 m (with a mean of 0.43 m; Fig. 8). It should be pointed out that the front slopes of those niches coincides with the boundary of the agricultural fields at the time, so most likely those one-man prone foxholes were made with the use of a natural terrain obstacle, which was a boundary, in order to expand the position later on and implement a firing trench in that place (see Fig. 2).

The two rear niches of the firing trench (Features 402 and 571) are analogous to the front niches, but they were created at the rear slope of the firing trench. In plan, they had a shape similar to a rectangle, with a width ranging from 0.42 m to 0.7 m (with a mean of 0.56 m), and length ranging from 0.8 m to 0.94 m (with a mean of 0.87 m) and depth ranging from 0.44 m to 0.22 m (with a mean of 0.33 m; *cf.*, Fig. 9).

Twenty-one-man prone foxholes (Features 496-499, 501-503, 505, 506, 544-554) are the front-facing trench niches located on one axis without the construction of a firing trench, which was another unrealized stage of the works. In plan, they had a shape similar to a rectangle, with the width ranging from 0.59 m to 1.49 m (with a mean of 0.99 m), length ranging from 0.92 m to 1.57 m (with a mean of 1.28 m) and depth ranging from 0.06 m to 0.72 m (with a mean of 0.29 m; Fig. 10).

Intentionally made features represent the statutory type of field fortifications of the army of the Russian Empire (*cf.*, Niebylski *et al.* 2021, 113, 114, 121, 123). The niches

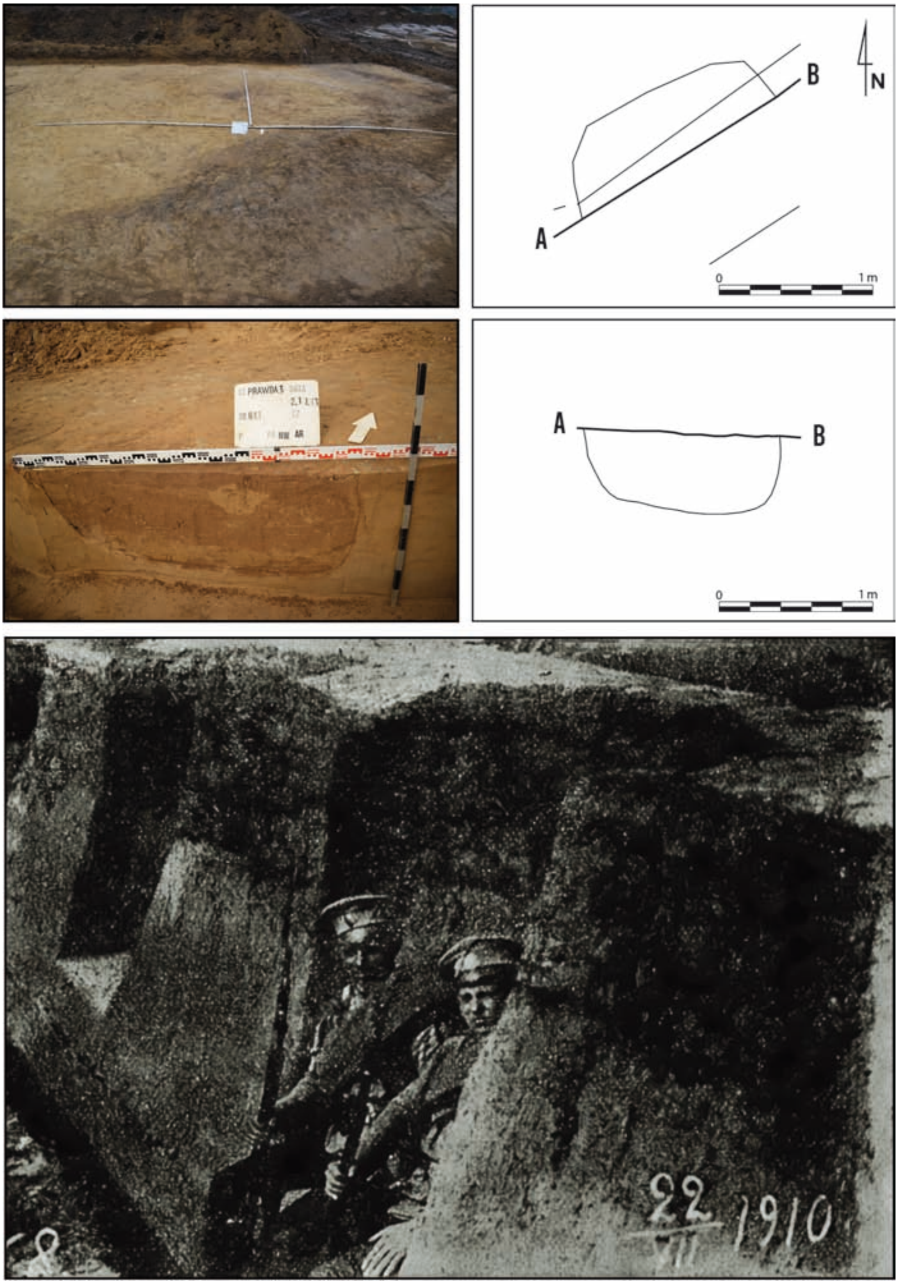

Fig. 8. Raciborowice-Prawda, Site 3. Front trench niche (Feature 611): two upper panels –photo and drawing of the plan, two middle panels – the photo and drawing of the cross section. Lower panel – the photo taken on 04.08.1910, showing the interior of a Russian firing trench with front trench niches. Graphic created by K. Przybysz-Malczewski, adapted from Modrakh 1914

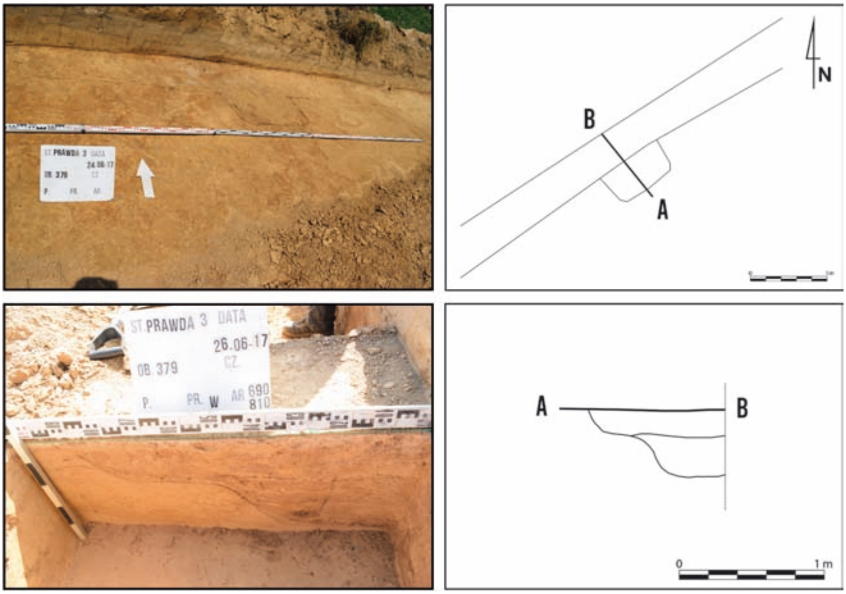

Fig. 9. Raciborowice-Prawda, Site 3. Rear trench niche (part of Feature 379): two upper panels – the photo and drawing of the plan, two lower panels – the photo and drawing of the cross-section. Graphic created by K. Przybysz-Malczewski

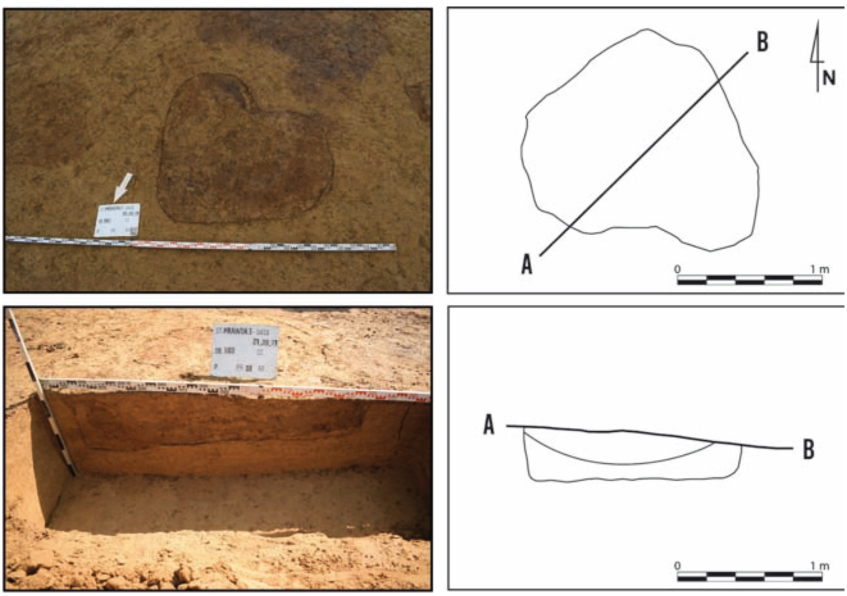

Fig. 10. Raciborowice-Prawda, Site 3. One-man prone foxhole (Feature 503): two upper panels – the photo and drawing of the plan, two lower panels – the photo and drawing of the cross-section. Graphic created by K. Przybysz-Malczewski

discovered at the site increased the horizontal firing angle from 60° (with the straight course of the firing trench) to 120° (Modrakh 1914). In addition, they allowed the soldiers to move freely through the firing trench, behind the soldiers occupying the positions in the niches (*cf.*, Fig. 8). It was a position fortifying the elevated area with a central point on the barrow and firing trench flanking it from the north-west, *i.e.*, protecting it from a possible enemy attack from the village of Prawda (see *Russische*... 1912, 91). It was only the shooting post (Feature 510) and the rear trench niches (Features 402 and 571) that were turned in the opposite direction in order to protect the position from the rear. Particularly noteworthy is the fact that the number of one-man prone foxholes in the unrealised section of the firing trench, is the same as the number of the front niches in the completed section, as well as being of similar size. Therefore, it was the second line, being the extension of the firing trench, that was probably planned for construction after the completion of the first section, which, however, did not happen.

As mentioned above, the discovered field fortifications represent the statutory form of position, which is confirmed in the Russian sapper manual (Modrakh 1914). According to the manual, a position with a length of 100 steps, with three dugouts and 25 front niches, was intended for one platoon of soldiers, *i.e.*, 50 soldiers (see Fig. 3). The analysed position has almost double number of niches and one-man prone foxholes and it is more than one and a half times longer, so it was intended for two platoons of soldiers, *i.e.*, 100 people. The eastern boundary of that position has not been found, so it could have been longer.

Examination of the discovered features

The use of barrows during First World War in order to build field fortifications is also known from other sites. A good example is Barrow 1 at the archaeological site Stryjów, Site 30, Krasnystaw district. The mound is dated to the early Bronze Age. It had a diameter of 10-12 m and a reconstructed height of 1.5-2 m. In the central part, a single-person shooting post with a fire step, associated with the battles of 1914–1915, was dug. What was discovered in it were a steel fitting of a wicker-type container for artillery shells and rifle cases of ammunition 7.92 × 57 mm. In addition, in the vicinity of the shooting post, the balls of shrapnel shells and cases of rifle ammunition were found (Budziszewski *et al.* 2016, 383, 384, ryc. 4, 386, ryc. 7, 400). As another example of the construction of field fortifications near the barrow in the form of trenches from the First World War, the parados of which were covered by the embankment, Feature 1 and 2, located in Guciów, Site 6, Zamość district, can be cited. The first of them has a diameter of 7.2 to 9.6 m, and its height is 0.95 m, and the trench is located on the north and northwest sides. The second barrow has a diameter of 2.8-5.3 m and a height of 0.2 m, and the trench surrounds it from the north and west (Iwański 2018, 41, 42). The relief of the terrain due to the presence of a barrow complex there was utilised in that case (*cf.*, Fig. 11).

Barrows were also used during Second World War to build field fortifications of strategic defence importance. An example of a barrow, around which a trench was built for the

Fig. 11. Examples of passive anti-personnel obstacles: upper panel – Kraków area. The photograph of an Austro-Hungarian anti-personnel obstacles made from barbed wire and plain wire in the foreground of the position from 1914. Note that the picture shows a roll of plain wire, analogous to the item discovered at the Raciborowice-Prawda, Site 3. Österreichische Nationalbibliothek, Wien, ref. no Pk 5090, 42, colourised by K. Przybysz-Malczewski, lower panel – Lytovezh, Volyn Oblast (Ukraine). The photograph of an Austro-Hungarian fortified position from First World War in an elevated area with the foreground secured with wire obstacles, analogous to the position discovered at the Raciborowice-Prawda, Site 3. Private collection of J. M. Niebylski, colourised by K. Przybysz-Malczewski

purpose of all around defence is the ‘Medisova humka’, located upon Tisza in Žabalj, South Bačka district, in Serbia. This barrow has a diameter of 40 m, a height of 3.2 m and dated to 2800-2700 BC. In the northern part of the mound, a single-person brick-formed shooting post was additionally constructed, which constituted a convenient observation point. In its immediate neighbourhood, several other field works connected by a trench were made and they were surrounded by adjacent, currently eroded barrows. Those fortifications were constructed due to the organisation of defence by the Hungarian and German troops against the Red Army invading in October 1944, in order to prevent it from crossing the Tisza. In the vicinity of a single-person one-man foxhole, numerous Russian bullets of 7.62 × 54 mm R M1930 rifle ammunition were discovered, which confirms the active use of those positions in 1944 (Majstorović 2016, 396-398, 401, 402). This barrow, like the mound in Prawda, also has traces of artillery shelling in the form of craters after explosions of artillery high-explosive shells, which are also visible in its surroundings (Jarosz *et al.* 2021, 109, fig. 10, 110, fig. 11, 12, 111, 112, 132). Close to it, a German 8 cm mortar bomb was discovered, proving the firing of that area by the retreating troops.

An analogous line of fortifications, created in the form of one-man prone foxholes partially combined into a firing trench, where the foxholes constituted niches in the front slope of this trench, was discovered at Zalesie, Site 1, Kraków district, related to the Battle of Kraków (Niebylski *et al.* 2021, 114, fig. 7, 122, fig. 12). In this case, the field fortifications were built by the soldiers of the Russian army.

Feature 510, which is a forward shooting post, also has analogies with Zalesie, Site 1. These were two shooting posts with an elongated shape with a step, where in one of them there was also a hearth in the form of a provisional stove (Niebylski *et al.* 2021, 112, ryc. 5, 112, ryc. 6). Moreover, a brick stove was discovered in a feature located at Sadowie-Kielnik, Site 1, Kraków district, which was also part of the battlefield of the Battle of Kraków (Niebylski 2020a, 560, 562-564, 564, fig. 9, 10, 570, fig. 15, 572, 578).

ARTEFACTS

General characteristics

At the site, 50 artefacts in 711 fragments were discovered (Fig. 12, 13, 15-22). The items can be classified into five categories. These are as follows: 1. small arms ammunition (17 artefacts); 2. artillery ammunition (2 artefacts); 3. military equipment (11 artefacts); 4. personal items (4 artefacts), and 5. the equipment of field fortifications (16 artefacts). In some cases, artefacts can be divided into items related to a given party of the conflict, *i.e.*, the Austro-Hungarian Monarchy and Russian Empire, although there is a group of artefacts without such features that would be a basis for a determination of their provenance (Tables 1-3).

Table 1. Raciborowice-Prawda, Site 3.
List of artefacts of the provenance of the Austro-Hungarian Monarchy

Inv. no.	Feature	Item	Category	Figure
1	34	Can of ration	Military equipment	16: 1
2	40	Case of 7×57 mm M1893 ammunition	Small arms ammunition	12: 5
3	41	Case of 7×57 mm M1893 ammunition	Small arms ammunition	12: 6
4	379	Cartridge of 8×50 mm R M1893 ammunition	Small arms ammunition	12: 1
5	379	Cartridge of 7×57 mm R M1893 ammunition	Small arms ammunition	12: 2
6	379	Case of 7×57 mm M1893 ammunition	Small arms ammunition	12: 7
7	379	Cartridge charger clip of 7×57 mm M1893 ammunition	Small arms ammunition	12: 10
8	379	Cartridge charger clip of 7×57 mm M1893 ammunition	Small arms ammunition	12: 11
9	379	Cartridge charger clip of 7×57 mm M1893 ammunition	Small arms ammunition	12: 12
11	484	Can of ration	Military equipment	16: 2
13	484	Case of 7×57 mm M1893 ammunition	Small arms ammunition	12: 8
14	484	Case of 7×57 mm M1893 ammunition	Small arms ammunition	12: 9
16	484	Can of ration	Military equipment	16: 3
17	484	Charger clip with cartridges of 7×57 mm M1893 ammunition	Small arms ammunition	12: 17
18	484	Charger clip with cartridges of 7×57 mm M1893 ammunition	Small arms ammunition	12: 18
25	503	Can of ration	Military equipment	16: 4
27	509	Can of ration	Military equipment	16: 5
29	509	Tent peg of a M1893 tent sheet	Military equipment	17: 2
30	509	M1908 cartridge pouch for a carbine	Military equipment	17: 3
31-33	534 and in the barrow	12 cm M1861 high-explosive shell	Artillery ammunition	15: 1
35	In the barrow	Adjustment pin of the M1887 calfskin knapsack	Military equipment	17: 4
41	510	Can of ration	Military equipment	16: 6

Among these finds are 18 artefacts that testify to the presence of soldiers of the Austro-Hungarian army at the place of their discovery. These are elements of ammunition (charger clips with cartridges, cartridges, cases and charger clips) and equipment (pouch, peg of a tent, adjustment pin of a knapsack and cans) discovered in Features 34, 40, 41, 379, 484, 509, 510, and in the barrow.

The Russian army is associated with six items, confirming the presence of those soldiers at the place of their discovery (all of such provenance in the collection). They were found only in one location, Feature 503 (inv. nos 19-24). The ammunition had not been

Table 2. Raciborowice-Prawda, Site 3.
List of artefacts of the provenance of the Russian Empire

Inv. no.	Feature	Item	Category	Figure
19	503	M1909 cartridge pouch	Military equipment	17: 1
20	503	Cardboard box of charger clips with cartridges of 7.62 × 54 mm R M1908 ammunition	Small arms ammunition	13: 1
21	503	Cardboard box of charger clips with cartridges of 7.62 × 54 mm R M1908 ammunition	Small arms ammunition	13: 2
22	503	Cartridge charge clip of ammunition 7.62 × 54 mm R M1891 ammunition	Small arms ammunition	13: 5
23	503	Case of 7.62 × 54 mm R M1891 ammunition	Small arms ammunition	13: 3
24	503	Case of 7.62 × 54 mm R M1908 ammunition	Small arms ammunition	13: 4

Table 3. Raciborowice-Prawda, Site 3.
List of artefacts of undetermined provenance

Inv. no.	Feature	Item	Category	Figure
10	483	Tree planting bar	Field fortifications equipment	19: 1
12	484	Tablespoon	Personal items	18: 1
15	484	Shrapnel ball	Artillery ammunition	15: 2
26	503	Rim of a tobacco pipe lid	Personal items	18: 2
28	509	Bordeaux wine bootle with stopper	Personal items	18: 3
34	In the barrow	Pipe	Field fortifications equipment	21: 1
36	379	A roll of plain wire	Field fortifications equipment	22: 1
37	510	Scythe	Field fortifications equipment	19: 2
38	510	Barbed wire	Field fortifications equipment	21: 2
39	510	Charred wood	Field fortifications equipment	21: 3
40	510	Charred wood	Field fortifications equipment	21: 4
42	510	Bottle for high percentage alcohol	Field fortifications equipment	18: 4
43	510	Metal sheet	Field fortifications equipment	20: 1
44	510	Metal sheet	Field fortifications equipment	20: 2
45	510	Nail	Field fortifications equipment	21: 5
46	510	Nail	Field fortifications equipment	21: 6
47	510	Nail	Field fortifications equipment	21: 7
48	510	Nail	Field fortifications equipment	21: 8
49	510	Nail	Field fortifications equipment	21: 9
50	510	Nail	Field fortifications equipment	21: 10
51	510	Nail	Field fortifications equipment	21: 11
52	510	Cramp	Field fortifications equipment	21: 12

fired in any case; therefore, it only proves the presence of those soldiers, without getting into the fight or shooting at that place from a distance.

Among the artefacts, two items were made from leather. These are an Austro-Hungarian M1908 cavalry pouch with a steel stud and two brass rivets (inv. no. 30) and a Russian M1909 pouch with a preserved single brass stud (inv. no. 19). Two items were made from glass – a Bordeaux wine bottle with a wooden stopper stuck inside (inv. no. 28) and a bottle for vodka, as well as other high-percentage alcohol (inv. no. 42). Another artefact with preserved wood is a half of the Austro-Hungarian tent peg with steel tip fitting of a M1893 tent sheet (inv. no. 29), as well as two charred fragments of wood from the inside of the stove (inv. nos 39, 40). Cardboard has been preserved on two artefacts – in both cases, it is a package of Russian ammunition (inv. no. 20 and inv. no. 21) containing three charger clips with five cartridges in each of them (in the latter case, one item is missing due to post-depositional factors). Other artefacts in the collection were made solely from metal (brass, lead, lead-antimony alloy, steel, tin and tombac), and they are the following: inv. nos 1-3, 5-18, 22-27, 31, 34-38, 41, 43-52, and 32, 33 – parts of the item inv. no. 31.

The lacquer has been preserved on all discovered Austro-Hungarian cases and cartridges of 7 × 57 mm M1893 ammunition (inv. nos 2, 3, 5-9, 13, 14, 17, 18). Black lacquer filled the gaps around the primers in the heads of the cases to protect them from humidity and covered the cores of the bullets under the steel jackets). Moreover, red lacquer was preserved on the Austro-Hungarian artillery fuse M1901, covering two deepened markings in the form of letter ‘a’ on the upper screw (inv. no. 33, in the barrow).

Factory markings can be found only on the elements of small arms and artillery ammunition, which are all cases in the collection, fuse and bullets of the Austro-Hungarian production (both 8 × 50 mm R M1893 ammunition and 7 × 57 mm M1893 ammunition, an Austro-Hungarian type). On the fuse (inv. no. 33, in the barrow), the letters ‘a’ located on the opposite sides of the screw mean ‘Aufschlag’, that is ‘impact’ (a percussion fuse with direct action, detonating on contact with surface); what it indicates is that it was intended for a high-explosive shell without time delay (*Notes*… 1917, 7).

Dating based on the markings of the discovered artefacts is possible thanks to several items. It enables determining *terminus post quem* on the basis of headstamps of ammunition, the limit dates of which are 1906 (inv. no. 23) and 1914 (inv. nos 3, 6, 18, 21). Thus, on the basis of these signatures, it can be said that the battle took place in 1914 or later.

Small arms ammunition of the provenance of the Austro-Hungarian Monarchy

Twelve items were discovered at the site, which are elements of small arms ammunition of the provenance of the Austro-Hungarian Monarchy. These are charger clips, cases, cartridges, and charger clips with cartridges, which testify to the presence of soldiers of the Austro-Hungarian army in the places of their discovery. They represent 8 × 50 mm R M1893 ammunition and 7 × 57 mm M1893 ammunition (Fig. 12).

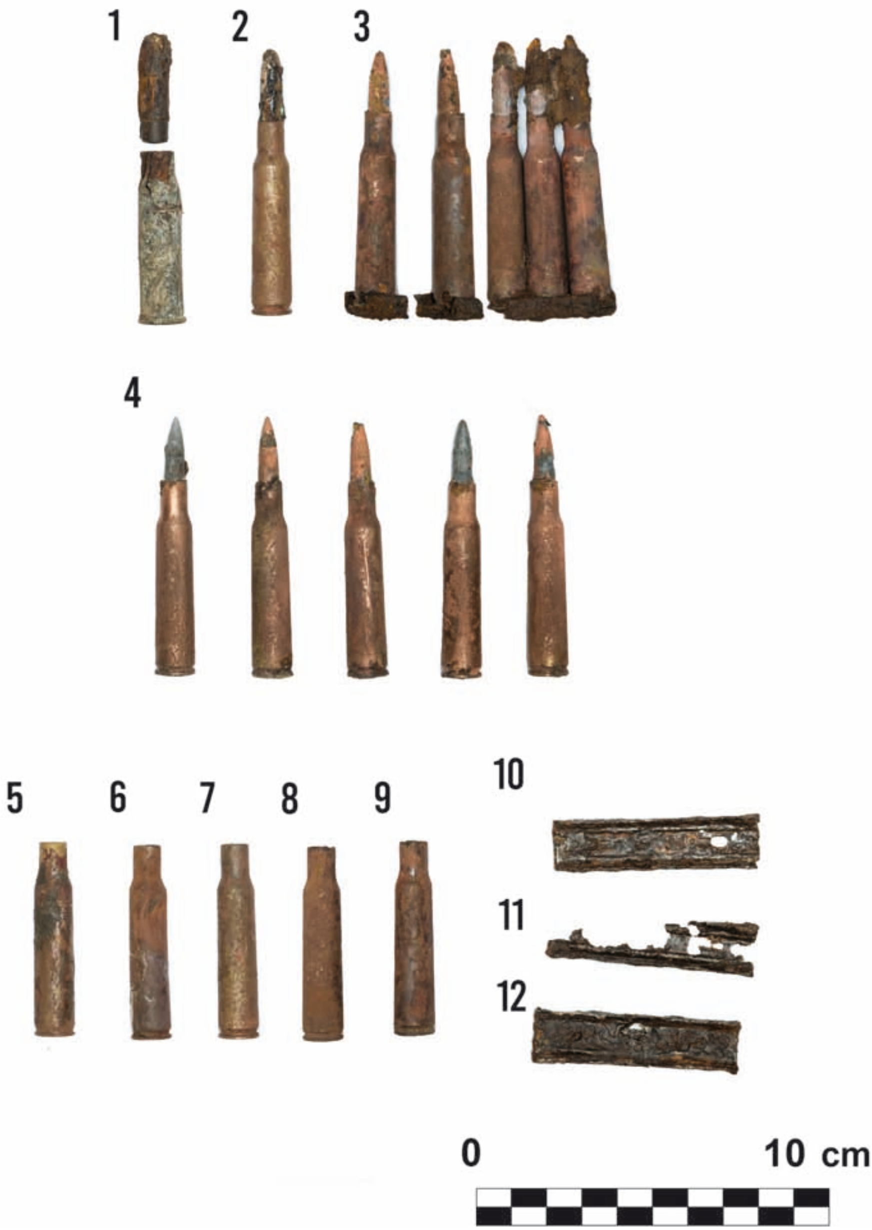

Fig. 12. Raciborowice-Prawda, Site 3. Small arms ammunition of the Austro-Hungarian Monarchy: 1 – cartridge of 8 × 50 mm R M1893 ammunition (inv. no. 4), 2 – cartridge of 7 × 57 mm M1893 ammunition, a German type (inv. no. 5), 3, 4 – charger clips with cartridges of 7 × 57 mm M1893 ammunition, an Austro-Hungarian type (inv. nos 17, 18), 5-9 – cases of 7 × 57 mm M1893 ammunition (inv. nos 2, 3, 6, 13, 14), 10-12 – cartridge charger clips of 7 × 57 mm M1893 ammunition (inv. nos 7-9). Graphic created by K. Przybysz-Malczewski

The 8 × 50 mm R M1893 ammunition is represented by one artefact – a cartridge without traces of rust of the steel en bloc clip (inv. no. 4). It consists of a brass case with a brass primer and a round nose bullet with a core made of lead-antimony alloy in a steel full metal jacket. At the head (base) of the cartridge case, there is a headstamp in 4 × 90° system. These four fields are separated by sector lines, and the signatures are deepened. In the sector at 12 o'clock, there is the digit of the month 'VII', at 3 – the last two digits of the year '13', at 6 – the symbol of a two-head eagle, and at 9 – the first two digits of year '19'. It is also possible to read the markings located at the bottom of the core of the bullet, which is convex. In the upper row, it is a monogram <MF>, while below '8/3'. Thus, the case was produced in July 1913 by K.u.k. Munitionsfabrik in Wöllersdorf, Wiener Neustadt-Land district, whereas the bullet in August 1913, in the same factory (Mötz 1996, 386, 389, 425). Particularly noteworthy is the information about the incompatibility of markings of the bullet with the case headstamp (a discrepancy between the months); therefore, it is the first confirmation of the lack of the possibility of correlating precisely the fired bullets with the cases at archaeological sites (*cf.*, Niebylski *et al.* 2021, 147). This cartridge has no traces of corrosion products of the steel en bloc clip, *i.e.*, it was lost due to carrying a single cartridge in the pocket, or through unnecessary reloading of the loaded weapon, or intentional reloading, in order to unload the weapon, which would enable loading a five-round en bloc clip. That unnecessary reloading of weapon has been defined as the phenomenon of shooting uncertainty and in the case of the ammunition of this pattern at the Zalesie battlefield, it was frequent – it took place in the case of 13.51% of cartridges (Niebylski *et al.* 2021, 138, 142, 150, fig. 35). The cartridge in question has no traces resulting from the malfunctioning of a firearm, or ammunition malfunction, a dud, *i.e.*, the lack of ignition of the primer or propelling charge (no traces of impact-mark of the firing pin on the primer). The discussed ammunition was for a Mannlicher M1895 rifle (Żuk 2016, 58, 59), which was the statutory armament of an Austro-Hungarian army soldier, as well as its variants and belt-fed Schwarzlose M1907 and M1907/12 machine gun (*Instruktion*... 1913). Due to the single discovery, they should be related to a bolt action (repeating) rifle. The Mannlicher M1895 rifle was charged by ammunition made with smokeless powder; therefore, its tangent rear sight was scaled to the distance of 450 to 1800 m (with the minimum position at 375 and the maximum at 1950 m), with a barrel length of 76.5 cm and the initial velocity of V_o = 620 m/s (Karczewski 1934, 162, 165, 174; Hýkel and Malimánek 1998, 253; Krčma *et al.* 2016, 194; Łukaszewski 2016, 109).

The discovered elements of 7 × 57 mm M1893 ammunition are represented by 11 artefacts. These are three steel cartridge five-round charger clips (inv. nos 7-9), five cases (inv. nos 2, 3, 6, 13, 14), one cartridge (inv. no. 5) and two charger clips with five cartridges in each of them (inv. nos 17, 18). Cartridges in charger clips consist of brass cases with brass primers and pointed-nose bullets with cores made of lead-antimony alloy in a steel full metal jacket. The charger clips are steel, with additional steel flat leaf springs. There were no cartridges in the three charger clips during their deposit, and all the cases had been fired. The discovered single cartridge with no traces of the corrosion products of steel charger clip and therefore, it was lost due to carrying a single cartridge in the pocket, or unnecessary reloading of the loaded weapon. In the weapon that was supplied with that cartridge, there was no need to unload it to recharge the magazine. Furthermore, that cartridge has no traces of firearm malfunction, or the lack of ignition of the primer or propelling charge (no trace of impact of the firing-pin tip on the primer). It consists of a brass case with a brass primer and a round-nose bullet with a core made of lead-antimony alloy in a steel full metal jacket. At the gap around the primer in the head, all cases and cartridges were lacquered black to protect the cartridge from humidity, whereas the cartridge, as well as two charger clips with cartridges, has traces of lacquered the core of the bullet under a steel jacket. When comparing the number of three empty charger clips and two full ones with the number of five cases and one cartridge, it is possible to estimate the minimum amount of this type of ammunition originally located at the discovered position. Hence, its amount should be estimated at the minimum of 25 pieces (at least nine cases or cartridges are missing). The headstamp system of that kind of ammunition provided a system of deepened signatures in the system 2 × 180° without sectoral lines. At 12 o'clock, the manufacturer's symbol was placed, and at 6 o'clock, the full year of production was indicated. Among the discovered artefacts, three different variants of headstamps of that type of ammunition can be distinguished. The first of these is letter 'H' at 12 o'clock and date '1913' at 6 o'clock. Two cases have such markings (inv. nos 2, 14) and cartridges in one charger clip (inv. no. 17). In the case of cartridges from that charger clip, it was possible to read the marking at the bottom of the core of one of the bullets – it was a convex, stylised letter 'H'. The second variant of headstamps of this type of ammunition in the collection is letter 'H' at 12 o'clock and date '1914' at 6 o'clock. Such markings can be noted on three cases (inv. nos 3, 6, 13) and cartridges in one charger clip (inv. no. 18). The symbol 'H' indicates that the ammunition was manufactured at the Hirtenberger Patronen-, Zündhütchen- und Metallwarenfabrik A.G. factory in Hirtenberg, Baden district (Mötz 1996, 370, 389). The third variant of headstamps is represented by one cartridge (inv. no. 5). In this case, at 12 o'clock, there is the letter signature 'DWM', while at 6 o'clock, there is the annual date '1913'. The letter signature 'DWM' indicates production in the German Empire at the Deutsche Waffen- und Munitionsfabriken factory in Karlsruhe, Karlsruhe district (Ciemiński 2014, 96). The bottom of the bullet of this cartridge has a cone-shaped cavity and it is not marked. The German Empire exported the weapon supplied with that ammunition and the ammunition itself, but they did not have it in service in their army. It is highly likely that this finding testifies to the purchase of this kind of ammunition by the Austro-Hungarian Monarchy. The German ammunition is distinguished morphometrically from the Austro-Hungarian one by the fact that in the former case, the bullets were round-nosed, and in the latter they were pointed-nosed.

The ammunition in question was developed in 1892 by Paul Mauser, at the request of the Kingdom of Spain (Żuk 2016, 71). That cartridge was structurally based on the 7.92 ×

57 mm cartridge developed in the German Empire, but it had a reduced diameter to 7 mm (Labbett 1982, 30, 31; Woodard 2011, 78; Kisak 2016, 323; Bussard 2017, 657). It was intended for export to such countries as Chile, Colombia, Mexico, Spain and Venezuela (Ciemiński 2014, 109). Other producers of that ammunition in the Austro-Hungarian Monarchy were as follows: Manfred Weiss, Budapest-Csepel, Budapest district (symbol 'W') and Georg Roth Aktiengesellschaft, Vienna III, Vienna district (symbol <GR>; Ciemiński 2014, 112, 113). It was produced in relation to the export of the weapon that it supplied – the Steyr M1912 rifle (Spanish name: Fusil Modelo 1912), produced at the Austro-Hungarian Österreichische Waffenfabriks-Gesellschaft in Steyr, Steyr district (ŚWG). That weapon was based on the construction of the German Mauser M1898 rifle (Gewehr 98) and its recipients were Chile, Colombia and Mexico (Haładaj and Rozdżestwieński 2010, 31; Żuk 2016, 61, 79). Before the outbreak of First World War, the Mexican authorities had a problem with solvency for orders due to the overthrowing of President Portifiro Díaz, followed by the policy of the government of Francisco I Madero (1911–1913) and several changes of the authorities after him (four authorities after him in 1913–1914; Mirosz 2007, 223, 224; Jung 2017, 34, 44). After the outbreak of the War, the discussed weapon and ammunition remained unshipped in the Austro-Hungarian warehouses and at the time of mobilisation, it was included in the armament as Infanterie Repetiergewehr M1914 (*Merkblätter*… 1918, 13). Some of the reserve Austro-Hungarian units were armed with this weapon. In that manner, the weapon and ammunition in question were included in the armament of the Landsturm, constituting the crew of the Kraków Fortress that joined the fight in that section of the front on 23 November 1914, supporting the 39^{th} Honvéd Infantry Division, and then were fighting in the foreground of the Kraków Fortress until December 1914 (*Instruktion*… 1916; Mötz 1996, 265; Niebylski 2020a, 582). That rifle and type of ammunition were discovered at Sadowie-Kielnik, Site 1 and the ammunition again was found at Wola Więcławska, Site 10, Kraków district, which was the battlefield of the Battle of Kraków (Niebylski 2020a, 570, fig. 15, 571, 572, 574, fig. 18, 577, 582; Niebylski and Czarnowicz 2022, 86, 94, 95, ryc. 15, 96, 102-104).

Small arms ammunition of the provenance of the Russian Empire

The Russian ammunition was discovered only in one feature – 503. This collection consists of a steel 7.62 × 54 mm R M1891 charger clip (inv. no. 22), a 7.62 × 54 mm R M1891 case (inv. no. 23), a 7.62 × 54 mm R M1908 case (inv. no. 24) and a package of three charger clips with five 7.62 × 54 mm R M1908 cartridges (inv. no. 20) and a second package with three charger clips with five 7.62 × 54 mm R M1908 cartridges, in one charger clip, one cartridge is missing due to post-depositional factors (inv. no. 21). Those two packages constituted the contents of the Russian M1909 pouch discovered there (Fig. 13). None of the ammunition was fired. The discovered cases were made from brass, with brass primers placed in recesses in the heads. These cartridges have pointed-nosed bullets with lead-

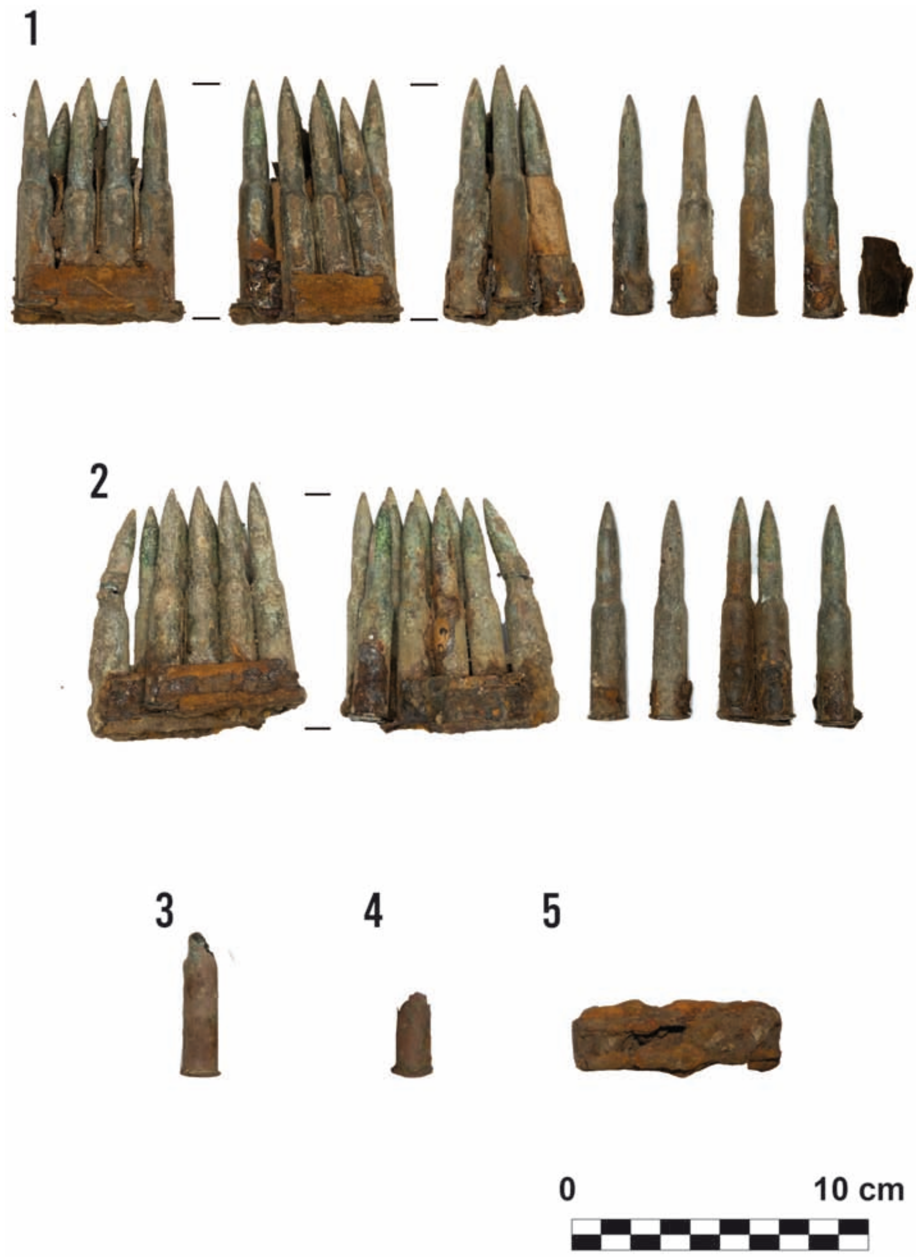

Fig. 13. Raciborowice-Prawda, Site 3. Small arms ammunition of the Russian Empire: 1, 2 – the contents of the M1909 cartridge pouch (inv. no. 19) – cardboard boxes of charger clips with cartridges of 7.62 × 54 mm R M1908 ammunition (inv. nos 20, 21), 3 – case of 7.62 × 54 mm R M1891 ammunition (inv. no. 23), 4 – case of 7.62 × 54 mm R M1908 ammunition (inv. no. 24), 5 – cartridge charge clip of 7.62 × 54 mm R M1891 ammunition (inv. no 22). Graphic created by K. Przybysz-Malczewski

antimony alloy cores and tombac full metal jackets. On one 7.62 × 54 mm R M1891 case (inv. no. 23), which was not fired, there are traces on its neck, indicating the deliberate breaking apart of the bullet before its deposition (*cf.*, Niebylski 2020a, 580, Fig. 21, 581; Niebylski and Czarnowicz 2022, 95, fig. 15, 107, fig. 28). No propellant was found nearby. This had most likely been done in order to obtain the combustible material (propelling charge) inside by a soldier to start a fire. There are no traces of the charger clip's corrosion products on the case. Its neck has been crushed by post-depositional conditions and hence, it is not possible to determine whether the bullet clamp was two- or three-point. The 7.62 × 54 mm R M1908 ammunition in each case has an all around clamp. The second case (inv. no. 24) has no traces of the charger clip's corrosion products either and it has neither a preserved body part nor a neck; therefore, it is impossible to determine whether it had been broken apart as well.

The Russian ammunition, due to the alloy used, has survived in a much worse condition than the Austro-Hungarian items. In the group of these two types of ammunition, all cases have convex headstamps on the heads and they are in 2 × 180° and 4 × 90° systems. The former is represented by three artefacts, including two pieces from a package of cartridges from the pouch (inv. no. 21). At 12 o'clock, they have two digits '10' standing for 1910, and at 6 o'clock, they have digit 'I', for the first trimester of the year (January–April). That ammunition was produced by an undetermined factory, most likely from pre-prepared cases without headstamps. The third cartridge, coming from the same package, at 12 o'clock has the mark 'Л', and at 6 o'clock – '914' (inv. no. 21). What this means is that the cartridge was manufactured in 1914 in the factory Luganskiy Patronnyi Zavod in Luhansk, Luhansk district. The latter system is represented by three variants of marking. The first of these is (12)-'06' (3)-'T' (6)-"'II' (9)-'П' (inv. no. 23) and it means that the cartridge was made in September–December 1906 at the Sankt-Peterburgskiy Patronnyi Zavod plant in Saint Petersburg, Saint Petersburg district, to which the brass sheet for cases was delivered from the Torgovyi Dom F. G. fon Gillenshmidta plant in Tula, Tula district. Another variant is the case (inv. no. 23) with the headstamp (12)-'10' (3)-'T' (6)-'I' (9)-'Л', which means that it was produced in January–April 1910 at the Luganskiy Patronnyi Zavod factory in Luhansk and the brass sheet for the cases was delivered from the aforemetnioned plant in Tula. The third variant, which is represented by three pieces (one with inv. no. 20 and two with inv. no. 21), is a headstamp (12)-'11' (3)-'Ф' (6)-'II' (9)-'П', which means that that ammunition was produced in May–August 1911 at the Sankt-Peterburgskiy Patronnyi Zavod plant in Saint Petersburg, and the supplier of the brass sheet for the cases was the Zavod Obschestva Franko-russkikh Zavodov in Saint Petersburg (Dąbrowski 2009, 18; Niebylski 2020a, 575-577). Thus, a package with three charger clips with cartridges (inv. no. 21) constitutes the confirmation that within one clip, it was feasible to have cartridges with more than one variant of headstamps (see Fig. 14).

That ammunition was used in the bolt action rifle Mosin M1891 (modernised) and its variants, as well as the belt-fed machine gun Maxim M1910 (Ostrowski 2018, 103-105,

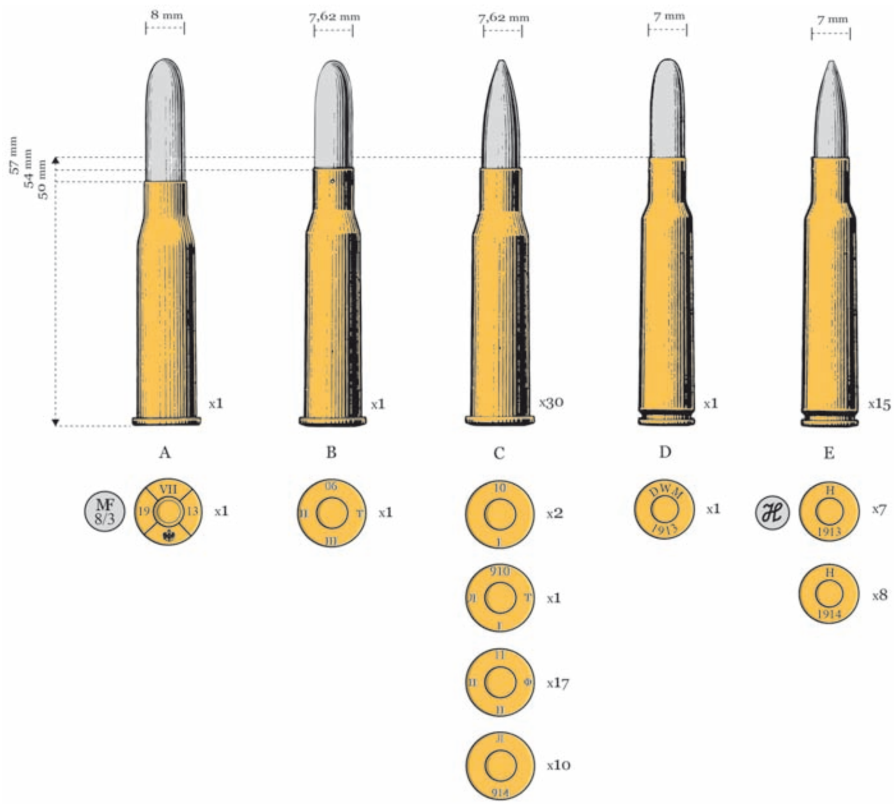

Fig. 14. Raciborowice-Prawda, Site 3.
The variety of types and variants of headstamps of the discovered small arms ammunition: A – 8 × 50 mm R M1893 (Austro-Hungarian Monarchy), B – 7.62 × 54 mm R M1891 (Russian Empire), C – 7.62 × 54 mm R M1908 (Russian Empire), D – 7 × 57 mm M1893 (German Empire), E – 7 × 57 mm M1893 (Austro-Hungarian Monarchy). Designed by J. M. Niebylski, drawn by K. Przybysz-Malczewski

108). The Mosin M1891 rifle (modernised) had an effective firing range over a distance of 420 m, and its tangent rear sight was scaled to the distance of 284.48 to 2275.84 m, with a barrel length of 80.1 cm and the initial velocity of V_o = 880 m/s (Wrobel 1999, 65, 347; Chumak 2007, 19; Żuk 2016, 92).

Artillery ammunition of the provenance of the Austro-Hungarian Monarchy

At the site, 21 fragments of one artillery shell (projectile) – a high-explosive 12 cm M1861 shell were discovered in three clusters: of four fragments (inv. no. 31), four fragments (inv. no. 32) and 13 fragments (inv. no. 33). The body of the projectile is made from steel, and on the surface, there is a lead rotating band, *i.e.*, jacket with bulges (Fig. 15: 1A-E; *Zusam-*

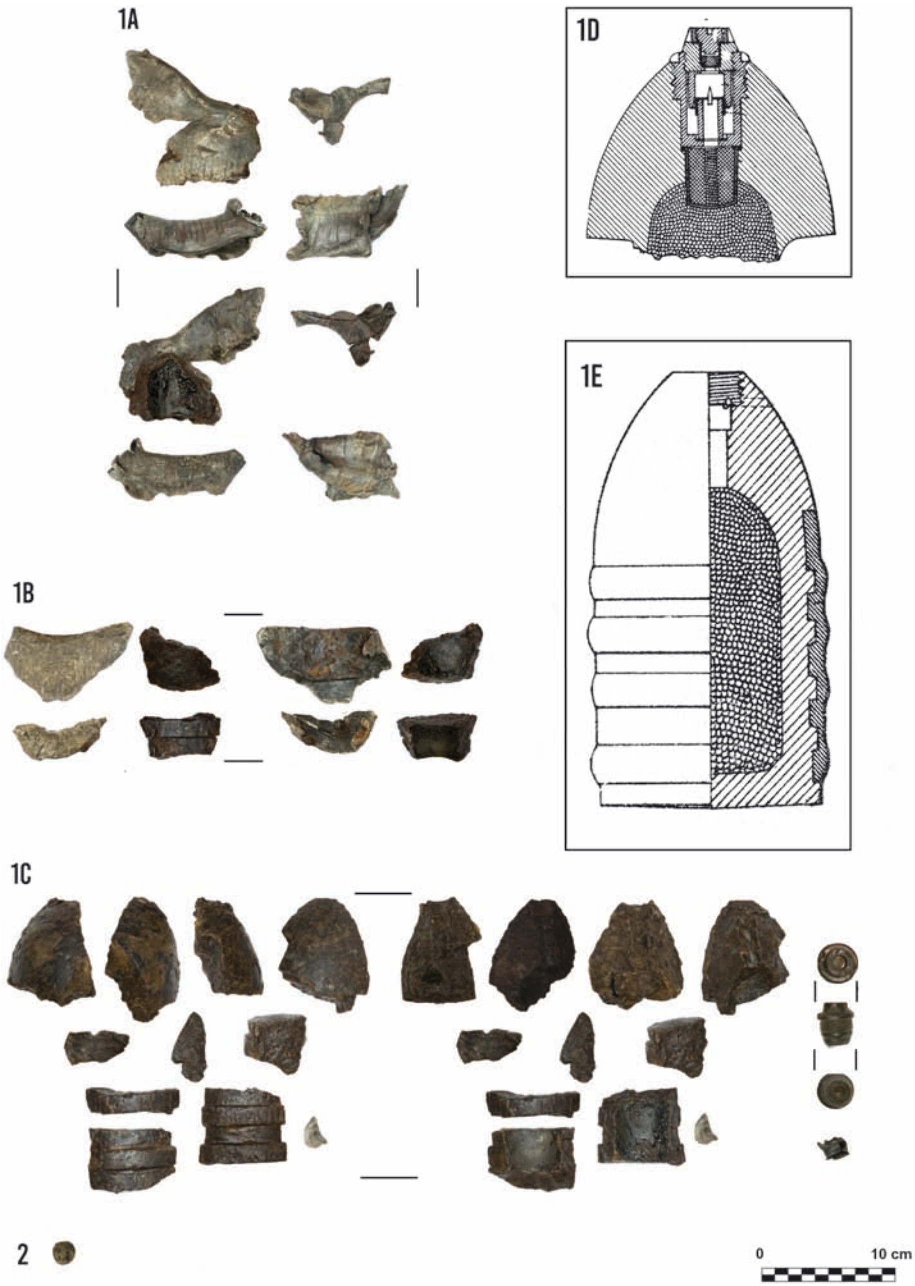

Fig. 15. Raciborowice-Prawda, Site 3. Artillery ammunition: 1A-C – a 12 cm M1861 Austro-Hungarian high-explosive shell (inv. nos 31-33), 1D, E – technical drawings of an 12 cm M1861 high-explosive shell, 2 – shrapnel ball (inv. no. 15). Graphic created by K. Przybysz-Malczewski, adapted from *Zusammenstellung*… 1913 and *Notes*… 1917

menstellung... 1913, 71). In the cluster of 13 fragments (inv. no. 33, found in the barrow), there is a complete ogive part of the projectile (six fragments) with a fuse cavity for a fuse and a side in the ogive slot for its safety pin. This is an indicator of production by the German Empire, at the request of the Austro-Hungarian Monarchy. These fragments have the following specification: length 8 cm and 495 g; 9 cm and 630 g; 9.5 cm and 644 g; 8 cm and 694 g; 5 cm and 172 g and 5 cm and 45 g. What is more, the cluster encompassed four fragments of the body, including three with thickenings (lands) in the shape of a ring for embedding the rotating band, with the following dimensions: 7 cm and 253 g (lower land); 7 cm and 369 g (two lower lands), and 7.5 cm and 131 g. In addition, this group of artefacts in question involves 1 fragment with an upper land and cannelure (groove) for a rotating band above, and one fragment of the rotating band with a length of 2.5 cm and a weight of 7 g. What has also been discovered are a brass M1901 inertial fuse of Austro-Hungarian production, with no preserved central screw, with two 'a' markings ('Aufschlag') lacquered red, located on both sides of the upper screw, weighing 88 g, and a detonator cup of this fuse, weighing 3 g (*Notes*... 1918, 16, 17). Thus, the total weight of the fragments of this cluster is 3.531 kg. The second cluster of fragments, also coming from the barrow (inv. no. 32) consists of four fragments: two pieces of a projectile body (length 7 cm and weight 159 g; 6.5 cm and 166 g), including one with a land; two fragments of a rotating band (7.5 cm and 125 g; 10.5 cm and 371 g, with the upper edge of the rotating band including the groove and the upper land), both with a narrowing for the projectile body land. On the fragments of the rotating band, there is a trace of the rifled bore of the barrel and the width of the land is 1 cm and the width of the groove is 0.6 cm. Thus, the weight of the fragments from this cluster is 0.821 kg. The third cluster of fragments (inv. no. 31) was discovered in Feature 534. This was in fact a niche grave of the burial of two individuals from the population of the Corded Ware culture. The four fragments of shell that were found intrusive in its fill consisted of one fragment of a projectile body with land (length 6.5 cm), combined with a rotating band (length 15 cm); and three fragments of a rotating band with lengths of 11 cm (396 g), 8.5 cm (106 g) and 10.5 cm (427 g). There is a trace of the rifled bore of the barrel, with the same dimensions as in the second cluster – the width of the land is 1 cm, and the width of the groove is 0.6 cm. The weight of the fragments from this cluster is 0.929 kg. The total weight of the fragments of this projectile from the entire site (from the three clusters, located at a short distance from each other) is 5.281 kg. That projectile, without explosive material (0.52 kg), weighed 13.51 kg, so about 39.1% of its fragments have been recovered (*Schießtafeln*... 1908, 22; Chrzanowski 2008, 28).

That shell charged a Wahrendorff M1861 12 cm (twelve-pounder) battery gun with 24 twists of micro-rifled bore of the barrel with a rotation to the right (Benda 1919, 131, 132, 136, 137; Kerchnawe 1935, 113, 114; Ortner 2007, 102-107). That obsolete model was still included in the armament of the forts of the Kraków Fortress. It was a casemate gun with a wooden depression carriage to be placed in scarp caponiers, although it could also be located, for instance, on a counterscarp battery to cover the ditch, or on a rampart. It was

2.77 m long and its weight was 1490 kg. The range of that gun for a canister was 500 m, for a shrapnel shell 2800 m, and for a high-explosive shell 5500 m. That type of a gun was modernised in 1895, obtaining the designation 'M1861/95'. The wooden carriage was adapted to being placed in casemates as their main weapon. The modernisation increased the distance, when firing high-explosive shells, to 5800 m, while the distances of firing canisters and shrapnel shells did not change (*Artillerieunterricht*… 1906, 133, 134; Kurek and Kurek 2002, 55, 56, 79, 87, 89). Close to the site, among the forts taking part in the Battle of Kraków, only Fort no. 49 'Krzesławice' had those guns in its armament, there were four of them. It shelled the Russian positions between 18 and 20 November, as well as on 30 November 1914 (Brzoskwinia 1994, 1). This Fort is located 3.80 km away from the barrow in question, which is located in the north-northwest direction. The projectile was manufactured in the German Empire, then used with a newly designed M1901 Austro-Hungarian fuse (Chrzanowski 2008, 25). The new projectiles of Austro-Hungarian production were devoid of a slot for the safety pin for the German M1861 percussion fuse. That type of gun, on the fortress carriage, was operated by five soldiers. The 12 cm M1861/95 sights had an elevation markings every 100 m and they were calibrated to 3000 m, whereas the maximum distance (range) during the test shots was determined to be 5500 m. The dimensions of the explosion crater ranged from 0.21 m to 0.79 m in depth and the diameter from 0.50 m to 1.42 m, while the tightness of the shot grouping from a distance of 3000 m was 36 m in length, 4.14 in width and 9.03 m in height (taking into account the 50% Circular Error Probable (*Zusammenstellung*… 1913, 24; Chrzanowski 2008, 16, 17, 19, 37). Thus, the site was within the range of Fort no. 49 'Krzesławice', and the projectile was fired from it.

Artillery ammunition of undetermined provenance

The spherical lead shrapnel ball from the explosion of a shrapnel shell discovered in Feature 484 (inv. no. 15) does not have any features that would allow its origins to be determined (Fig. 15: 2). It weighs 14.82 g, and on its surface there are four dents from collisions with other shrapnel balls. Its diameter is within the range of 1.4-1.5 cm. Most likely, it comes from a shrapnel shell with a calibre of more than 10 cm.

Military equipment with the provenance of the Austro-Hungarian Monarchy

At the site, six steel, statutory food rations of the Austro-Hungarian army were discovered, being cans of rations, including two completely preserved (inv. nos 1, 41), the first of which with a separately preserved, half-bent end of the can, opened with a can opener (Fig. 16; Birnstein 1911, 97; Schmid 1914, 392; *cf.*, Mroczkowski and Kawa 2020, 111-113). It was 11 cm high and it had a diameter of 10.5 cm. The second one, discovered in the chamber of a provisional stove, had an end opened with a can opener and bent upwards as well, leaving

Fig. 16. Raciborowice-Prawda, Site 3. Military equipment of the Austro-Hungarian Monarchy: 1-6 – cans of rations (inv. nos 1, 11, 16, 25, 27, 41). Graphic created by K. Przybysz-Malczewski

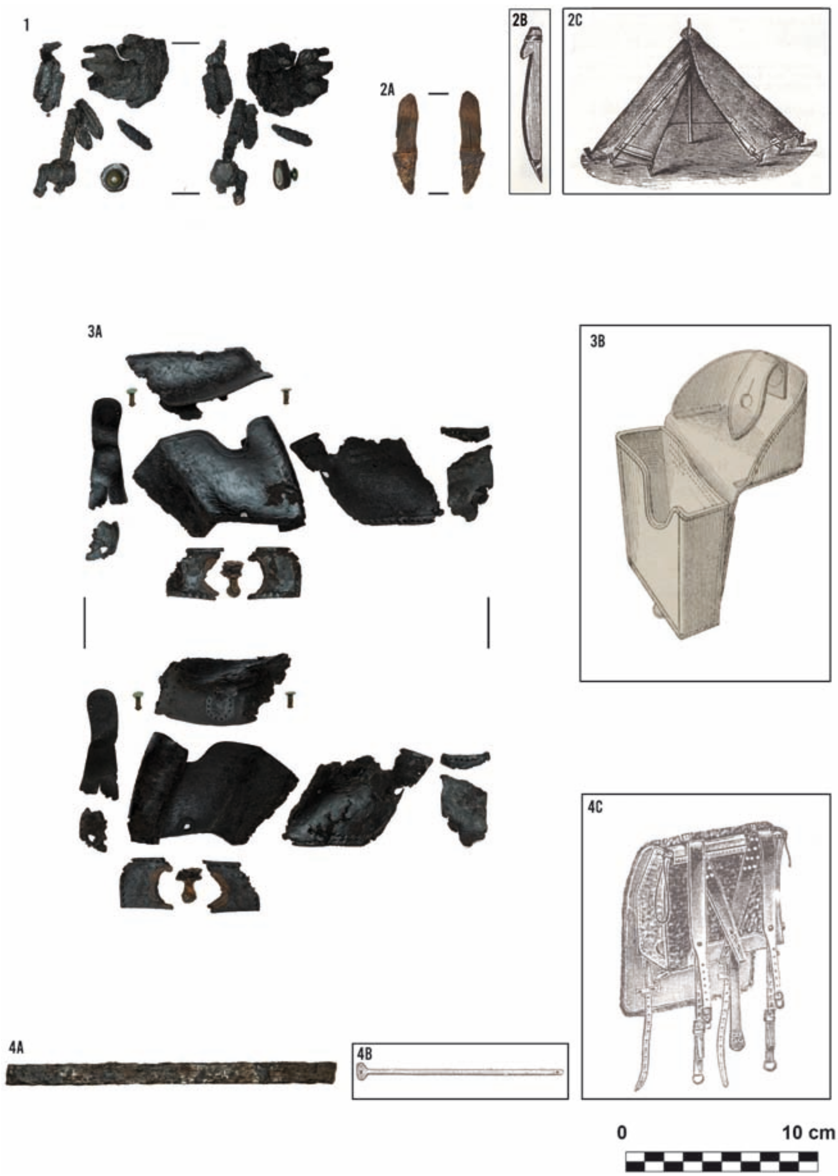

Fig. 17. Raciborowice-Prawda, Site 3. Military equipment of the Russian Empire and the Austro-Hungarian Monarchy: 1 – a Russian M1909 cartridge pouch (inv. no. 19), 2A – an Austro-Hungarian tent peg of a M1893 tent sheet (inv. no. 29), 2B, C – the technical drawings of the tent peg and the M1893 tent sheet, 3A – an Austro-Hungarian M1908 cartridge pouch for the carbine (inv. no. 30), 3B – technical drawing of the M1908 cartridge pouch for the carbine, 4A – an Austro-Hungarian adjustment pin of the M1887 calfskin knapsack for the infantry (inv. no. 35), 4B, C – technical drawings of the adjustment pin and the M1887 calfskin knapsack for the infantry. Graphic created by K. Przybysz-Malczewski, adapted from *Adjustierungsvorschrift*… 1911 and Schall 1915

the uncut section of the length 3.5 cm. It has a height of 7.8 cm and a diameter of 7.7 cm. It is burnt and it has a bottom warped outside from cooking, protruding beyond its rim by 0.5 cm, making it now impossible place it flat. The third example consisted of 35 fragments of one can (inv. no. 11), which included a completely preserved bottom with a connection to the wall; five fragments of the upper rim with traces of opening the end with a can opener; seven fragments of the end and 22 fragments of the wall. The fourth find (inv. no. 16) is a fragment of the base of a can with a length of 2.4 cm and a width of 2 cm. The fifth example contained 25 fragments of a can (inv. no. 27), with seven fragments of the bottom, including one fragment of the base with a connection to the wall, and six others with lengths not exceeding 2 cm; 13 fragments of the wall, including one with the sheet connection; five fragments of the upper rim with traces of opening the end with a knife, including one fragment with the end bent outwards. The sixth example consisted of two small fragments of wall with the length of 3.5 cm and 5.3 cm.

Another artefact that constitutes the equipment of an Austro-Hungarian soldier is a fragment of the tent peg of a M1893 tent sheet (inv. no. 29; Schall 1915, 270; Ortner and Hinterstoisser 2013, 143). It was made from wood (the preserved length is 4 cm outside the fitting) and steel (the preserved complete lower, tip fitting). The tip fitting has a length of 2.8 cm, the width of 1.5 cm and a thickness of 1 cm. Its upper fitting has not been preserved (Fig. 17: 2A-C).

Moreover, the Austro-Hungarian M1908 cartridge pouch for a carbine (inv. no. 30) was discovered (*Adjustierungsvorschrift*... 1910, 88; *Adjustierungsvorschrift*... 1911, 91; Schall 1915, 305). It is a completely preserved leather pouch without a preserved buckle with no prong for attaching the carrying straps of the knapsack. What has been preserved are two rear brass rivets and a steel stud for fastening the lid strap. Among the preserved fragments of leather, one can distinguish a complete lid, a lid strap in two fragments, the bottom in two fragments, the rear wall and the front with the sides of the pouch, as well as a carrying strap in two fragments for attaching to the belt in two fragments (Fig. 17: 3A, B). That (single-compartment) pouch was sufficient to contain a cardboard box for two *en bloc* clips of five cartridges of 8 × 50 mm R M1893 ammunition in each of them. The fact that it was not two-chambered was justified by its designation for the cavalry and gendarmerie units armed with Mannlicher M1895 carbines. After the leather had been formed and before it was handed over to a soldier, a block of wood, profiled in the shape of two en bloc clips with cartridges, was placed inside (Ortner and Hinterstoisser 2013, 52, 58).

The last artefact of Austro-Hungarian provenance is the adjustment pin of the M1887 calfskin knapsack found in the barrow (inv. no. 35; Schall 1915, 304; Ortner and Hinterstoisser 2013, 92, 93). It was damaged before its deposition. It is a flat bar with both ends broken and a preserved partial length of 17 cm, with a width of 1 cm and a thickness of 0.3 cm. It was inserted from the side into the upper part of the knapsack and into the carrying straps and fastened at the ends with straps, in order to limit its deformation and allow adjustment of the length of the carrying straps (Fig. 17: 4A-C).

Military equipment of the provenance of the Russian Empire

Among the discovered artefacts, there were parts of a leather Russian M1909 pouch (inv. no. 19), inside which there were 30 cartridges of 7.62 × 54 mm R M1908 ammunition, one piece is missing due to post-deposition factors (inv. nos 20 and 21). In each of the two compartments, there were three charger clips with five cartridges (*Sbornik*… 1915, 396; Bushmakov 2017, 502; Niebylski *et al*. 2021, 127, 129, fig. 18). The pouch was discovered in six fragments and it is not complete. It consists of five leather fragments with the following lengths: 6 cm; 6 cm; 5 cm; 3.5 cm and 3 cm, as well as one fragment with the preserved brass rivet-back stud, 0.8 cm in diameter, 0.8 cm in length and 1.1 cm in the diameter of the brass washer, located on the other side of the wall of the pouch (Fig. 17: 1). The second stud has not been preserved – it was originally placed on the opposite, side wall. Both compartments of the pouch were closed with a lid that extends over both compartments, from which two leather straps along the side walls with holes for studs were led. Russian soldiers of this period were equipped with two such pouches fastened to the main belt, slid onto the belt either side of the buckle.

Personal items

A tin tablespoon with steel core (inv. no. 12) was discovered in Feature 484. It does not have a manufacturer's mark. Its full length has not been preserved, the fragment is 15 cm long, and only the complete handle and neck, with the transition to a bowl has been preserved. The handle with a neck is 13.5 cm long, its width at the widest point is 2.1 cm, and it is narrowed to 0.6 cm at the bowl and bent in the major part. At the end of the handle, there is a short, 1 cm rib in the middle, slightly marked, at which the end of the handle is rounded (Fig. 18: 1). It is very similar to the spoons that were included in the sets of Austro-Hungarian field kitchens. The only difference is the lack of markings (see *Beschreibung*… 1917, Fig. 30).

In Feature 503, the rim of a tobacco pipe lid (inv. no. 26) was discovered, placed on the bowl, in order to assemble a lid. It was made of brass and it is bent. The preserved length is 3 cm, but due to the distortion, it is impossible to determine the original diameter of the pipe bowl (Fig. 18: 2).

A Bordeaux type glass wine bottle with a wooden stopper stuck inside (inv. no. 28) was found in the fill of Feature 509. It was made of transparent, dark green glass and has been fully preserved. Its height is 23.5 cm, and its base is slightly deepened. The diameter of the regular, cylindrical body is 14 cm. Above it, there is a 3 cm long shoulder. The neck and finish are 6.5 cm long. Slightly below the lip of the finish, there is a collar of the finish with a width of 0.8 cm and a diameter of 2.8 cm, whereas the diameter of the bore (orifice) is 2.5 cm (Fig. 18: 3). It has a capacity of 375 ml, referred to as 'demie', which is a half of the standard capacity referred to as 'bouteille' or 'fillette', holding the equivalent of 3 glasses.

Fig. 18. Raciborowice-Prawda, Site 3. Personal items: 1 – tablespoon (inv. no. 12), 2 – rim of the tobacco pipe lid (inv. no. 26), 3 – Bordeaux wine bottle with stopper (inv. no. 28), 4 – bottle for high percentage alcohol (inv. no. 42). Graphic created by K. Przybysz-Malczewski

It was made from industrial green glass by pressing on a mechanical press, by placing the gob of molten glass in a profiled, durable cast-iron mould. The molten glass used for its production was devoid of gas bubbles (mainly CO_2) at the production stage by its clarification. The colour of the glass resulted from the addition at the production stage of an auxiliary raw material – iron oxide (Fe_2O_3), constituting approximately 1.5% of the molten glass, or chromium oxide (Cr_2O_3; Kielski 1969, 12, 135, 142, 149; Maćkiewicz and Świderska-Bróż 1983, 38; Kunicki-Goldfinger 2020, 81). Most likely, that bottle was prepared for a red wine. The method used for its production was introduced in the second decade of the 19th century and became popular in the second half of the 19th century. Until the mid-20th century, those bottles were utilised, after the original product had been consumed, for storing other liquids, for instance medicines, disinfectants, or, as it can be assumed, high-proof liquors produced outside a registered distilleries, as proven by the stopper inside (Bis 2017, 389; Lipiec 2017, 180-183).

A second bottle was discovered in Feature 510 (inv. no. 42). It was in 19 fragments and was not complete due to breaking it before its deposition. It was made from transparent glass with a slightly light green tint. It was made with the use of the same technology as the first bottle. It has a cylindrical body with the diameter of 8.8 cm. The body is connected with a round, 1.9 cm wide heel, in the middle of which there is a flat base, deepened at 0.7 cm. Its distinguished, 5.2 cm long neck and finish have a cylindrical collar. The collar is placed below the 0.3 cm long lip of finish and it has a height of 1.0 cm and a diameter of 3.0 cm. The lip outside the collar has a diameter of 2.7 cm, whereas the inside of the finish, the bore has a diameter of 1.6 cm (Fig. 18: 4). It is not possible to determine its full height. Bottles of this type were intended for vodka and other high-proof liquors, *e.g.*, spirit. They have also been discovered at other sites related to First World War. One of the instances is Zalesie, Site 1, where one complete, colourless glass bottle sealed with a stopper and a fragment of another green, transparent glass bottle were found (Niebylski *et al.* 2021, 126, fig. 16, 127, 128).

Equipment of field fortifications

In Feature 483, the iron head of a tree planting bar (inv. no. 10) of undetermined provenance was discovered (Fig. 19: 1). It was hand forged, and its form and decorated reinforcements, as well as the two horseshoe nails used for fastening the handle indicate a farm (forestry) tool. Perhaps, it was taken from a farm by soldiers as a useful tool for building field fortifications. A tree planting bar could be helpful in digging in hard loess ground, which is the undisturbed subsoil at this site. Its length is 39 cm, while the working part is 19 cm long, the length of the widening winged type socket of the wooden cylindrical handle (not preserved) is 14 cm. Above the socket, there is reinforcement in the form of a 6 cm long and 2.6 cm wide spindle shaped extension, with a nail hole with a horseshoe nail inside, with a rectangular head measuring 0.5 × 0.8 cm. The width of the working part is 7.5 cm.

Fig. 19. Raciborowice-Prawda, Site 3. Field fortification equipment – tools: 1 – tree planting bar (inv. no. 10), 2 – scythe (inv. no. 37). Graphic created by K. Przybysz-Malczewski

The maximum external width of the socket is 4.9 cm. The working part at the rear is flat and led in one line to the end of the reinforcement. Nonetheless, on the front, it is thickened to 1.5 cm. On the left side of the socket, 3 cm from its upper edge, there is a nail hole with a horseshoe nail stuck in it, of the same size as the second one and it is moved by 120° in relation to it. A part with the next, symmetrical nail hole (moved by 240 degrees) has not been preserved due to the breaking apart of the fragment of the socket – a 9.5 × 3 cm fragment is missing; therefore, the socket did not protect from the side the handle against its falling out. This tool is of a type used to make holes in the ground for tree seedlings. The method of planting with this tool consisted of driving the blade full length into soil and vigorously pulling bar back and pushing forward, in order to push the ground away, creating a hole at that point into which the seedling would be inserted.

Another iron head of an agricultural tool is the blade of a scythe (inv. no. 37) discovered in Feature 510 (Fig. 19: 2). That tool could have been taken by a soldier from one of the nearby farms as well. The blade has not been completely preserved, because there is no tang (the part used to attach it to the handle). Despite this, the body of the tool has been preserved to its full length of 73 cm. The width of the blade in the widest place is 7.5 cm, while in the narrowest preserved one 3.5 cm. The blade is arched-bent, with a topside carved to the left side, so that scythe was designed for a right-handed person. The rib has a rectangular cross-section, which is 0.8 cm wide and 0.5 cm high. From the bottom, on the left, it is 0.4 cm wide and separated in this part from the blade by a 0.4 cm wide groove.

In Feature 510, near the stove, two rectangular sheets of steel plate with traces of burning were found (Fig. 20). The first of them was discovered at the bottom of the feature, below the stove (inv. no. 43). It had the dimensions of 66 × 25 cm. Among the discovered fragments, four were diagnostic ones. They show that one of the edges of the sheet had a 1.2 cm wide overlap and that sheet was secondarily bent along that edge by 4 cm to form a semi-circular roller.

The second sheet of the plate was located at a greater distance from the stove (inv. no. 44). That sheet had the dimensions of 111 × 32.5 cm. Two of its fragments were diagnostic ones. What they indicate is that the sheet in question also had a 1.2 cm wide overlap along one of the edges, and nails were hammered into it. One of the fragments has a straight nail hammered into it, without bends, with a square shank in the cross-section, measuring 0.3 × 0.3 cm and with the length of 8.2 cm. Its head is flat and round in the cross-section, with the diameter of 0.8 cm. The diagnostic fragments of the discussed sheet of plate indicate that it comes from the same source as the first aforementioned sheet, for instance they may originally have been roofing sheets from the same building. Those sheets could have been used as a stove plate, as indicated by the burning.

Two irregular fragments of charred wood serving as fuel were recovered from the stove filling in Feature 510 (inv. nos 39, 40). The former has a length of 8 cm, a width of 3.5 cm and a thickness of 2.0 cm, while the latter has a length of 6.5 cm, a width of 2.5 cm and a thickness of 1.5 cm (Fig. 21: 3, 4). It is not possible to determine from examining the

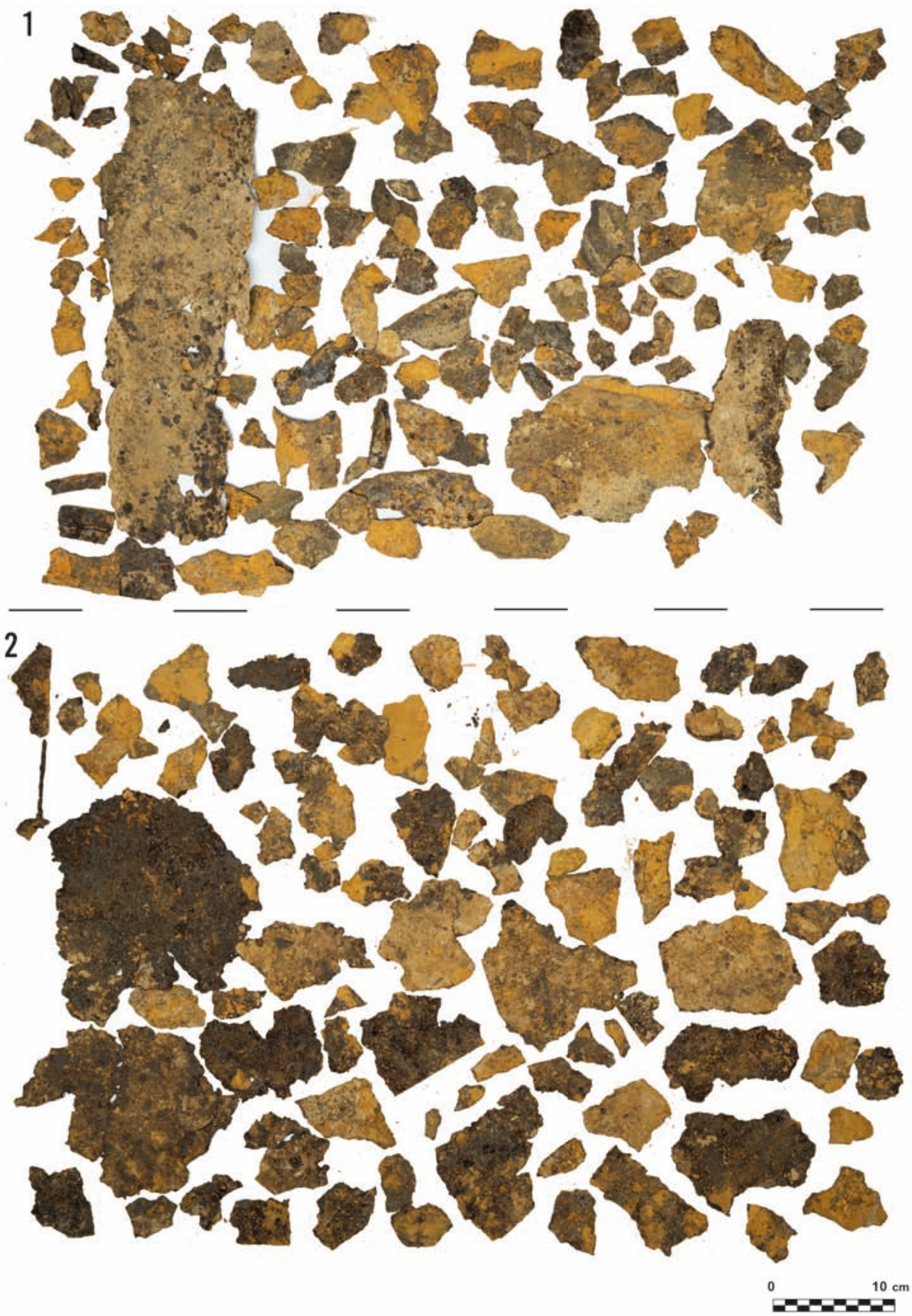

Fig. 20. Raciborowice-Prawda, Site 3. Field fortification equipment – stove elements: 1, 2 – metal sheets (inv. nos 43, 44). Graphic created by K. Przybysz-Malczewski

wood itself whether these were derived from wooden objects with a different primary function, but used as fuel, or whether they were purpose-cut firewood.

In the same feature, in the stove chamber, a burnt steel cramp and seven burnt steel nails were discovered as well (Fig. 21: 5-12). They were machine made. Six of the nails are bent, one even twice, while the other one is straight. The cramp (inv. no. 52) was made from wire round in the cross-section, with the diameter of 0.4 cm. The wire used to make it was 12 cm long. It was made by folding it in half back at the factory, in one plane, with parallel ends, thanks to which it formed a space with the inner width of 3.0 cm and a length of 4.8 cm. The chronology of that type of cramp with a shank made by cutting off steel wire round in the cross-section should be related in Europe to the period from about 1850 to the present (Nelson 1968, 7, 9; Wells 1998, 92, fig. 8, 96; Green 2014, 20, 21). The first of the nails (inv. no. 45) is straight, fully preserved. It has a length of 9.2 cm and a shank that is square in cross-section with a width of 0.4 cm. The second nail (inv. no. 46) has been fully preserved too and it has a length of 8.2 cm. Its shank has a square cross-section with the width of 0.3 cm, and its head is round in cross-section and has a diameter of 0.7 cm. It is bent at a right angle, at a distance of 3.0 cm from the head. The third nail (inv. no. 47) has the fully preserved length of 8.2 cm, a head round in the cross-section with the diameter of 0.8 cm, and a shank, 0.3 cm wide square in the cross-section. It is bent at an angle close to a right angle, at a distance of 4.5 cm from the head. Moreover, the fourth nail (inv. no. 48) has been fully preserved as well and it has a length of 6.8 cm. It has a 0.3 cm wide shank with a square cross-section and a head circular in the cross-section, with a diameter of 0.7 cm. It is bent at right angle, at a distance of 2.5 cm from the head. The fifth nail (inv. no. 49) has a fully preserved length of 8.2 cm. Its shank is square in cross-section, 0.3 cm wide and its head round in cross-section has a diameter of 0.9 cm. It is bent in two places. One of the bends is located at the distance of 2.5 cm from the head, at right angle, while the other at the distance of 6 cm from the head, also at a right angle, in the same plane, so that the end of the pin faces the head. The sixth nail (inv. no. 50) does not have the full length preserved, only 4.8 cm, without a fragment of the shank and the tip. Its shank is square in the cross-section, with a width of 0.3 cm and the head is circular in cross-section with the diameter of 0.7 cm. It has a slight bend 3.0 cm from the head. The last of the nails (inv. no. 51) has not been completely preserved either. The fragment has a length of 5.1 cm, without a fragment with the head. It has a shank with a square cross-section, a width of 0.3 cm and a bend at a right angle, 4.0 cm from the tip. It is noteworthy that the three discussed nails (inv. nos 46, 47, 49) with the length of 8.2 cm and the shank width of 0.3 cm and the head diameter of 0.7-0.9 cm are analogous to the nail hammered into the discovered metal sheet (inv. no. 44). They probably come from the same source. Perhaps, the nails and cramp come from the wooden structures of the nearby farm buildings that served as fuel, as evidenced by their discovery in the stove chamber, and the sheet that was secondarily used was attached to the stove structure with a nail obtained in that manner, or the nail was originally utilised to fix the sheet as the roofing material, and the wooden structure of

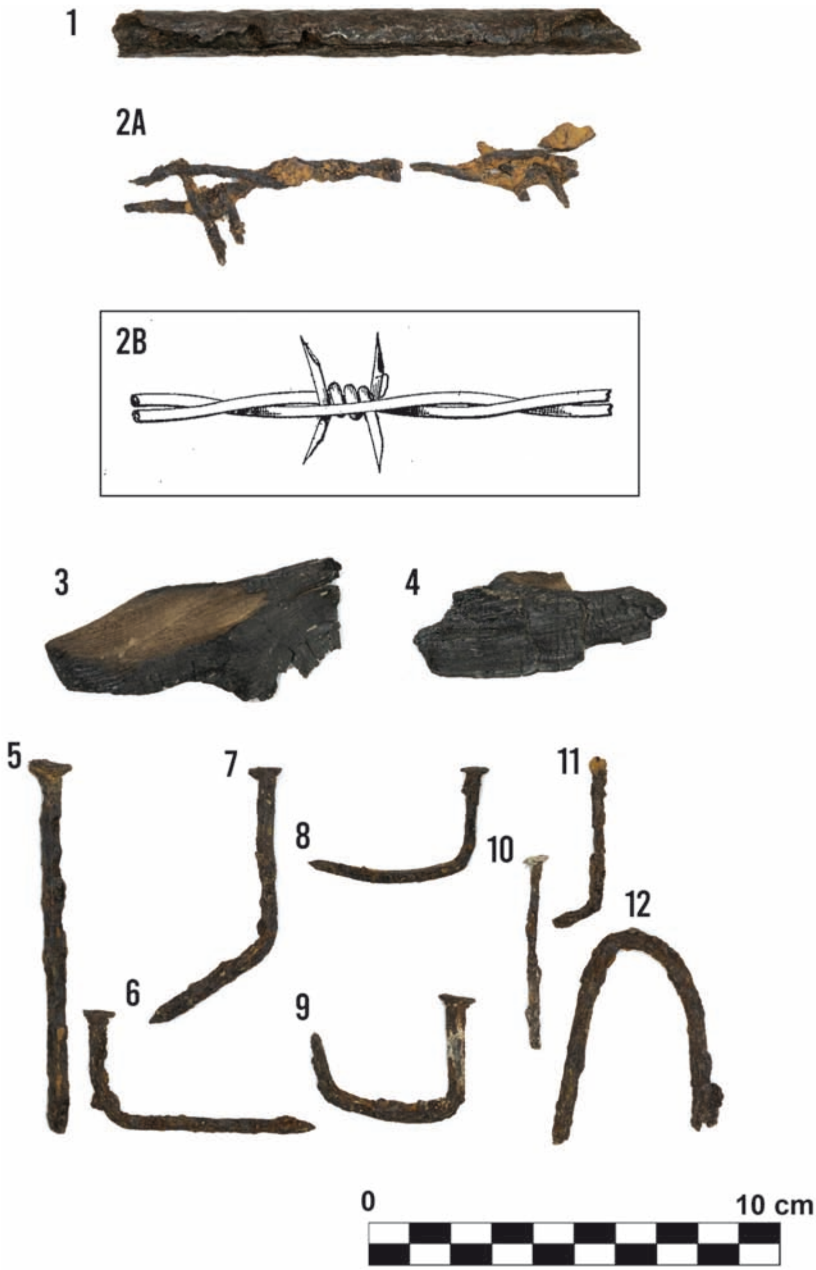

Fig. 21. Raciborowice-Prawda, Site 3. Field fortification equipment: 1 – a fragment a pipe (inv. no. 34), 2A – barbed wire (inv. no. 38), 2B – technical drawing of analogous barbed wire, 3, 4 – fragments of charred wood (inv. nos 39, 40), 5-11 – nails (inv. nos 45-51), 12 – cramp (inv. no. 52).
Graphic created by K. Przybysz-Malczewski, adapted from Clifton 1970

the roof served as fuel. Another interpretation may be the army's possession of nails used to fix the formwork of field fortifications, which were dismantled in the face of low temperatures for heating purposes, and the metal sheet was attached to the stove also with the use of the same nails.

Those nails were made from steel sheet with a thickness consistent with the obtained width of the shank. The semi-finished products of the future nails were cut at intervals consistent with the thickness of the metal sheet to form strips on which the heads were later formed by forging. That type of nail, with the tip of the shank formed through the coinciding walls and its square cross-section are dated to the first half of the 19th century to the 20th century (Nelson 1968, 7, 8). In today's Poland, they were gradually being replaced since the beginning of the first half of the 20th century with the nails obtained by mechanical cutting from steel wire, with a shank that is characteristically circular in cross-section, but their quantities were still significant (*cf.*, Nelson 1968, 10; Green 2014, 20, 21; Niebylski 2020a; Niebylski *et al.* 2021). Nails of that type, machine made with a flat, circular head and a shank square in the cross-section, have also been discovered at other positions from the Battle of Kraków, such as Sadowie-Kielnik, Site 1 and Zalesie, Site 1 (Niebylski 2020a, 578, 579, fig. 20, 582; Niebylski *et al.* 2021, 125, 146, fig. 29, 154, 156, 157, 161). Those artefacts should be interpreted as used for fixing wooden formwork of field fortifications, or they could have come from wooden elements from the nearby farm buildings, brought to the field fortifications for heating purposes.

At the bottom of the firing trench, Feature 379, a roll of plain steel wire was discovered (inv. no. 36). It is made from one piece of wire, round in cross-section with a diameter of 0.2 cm, with the length of approximately 117 m. It was rolled 117 times, creating a 8 cm wide and 5 cm thick roll. This roll has an external diameter of 38 cm, and each of the coils contains about 1 m of wire (Fig. 22). That type of wire was used to construct passive anti-personnel barriers in the foreground of field fortifications (*Russische*... 1912, 95; Perzyk 2000, 165, 170). In the Austro-Hungarian army, that type of wire with a length of 1000 m was given to each company (Mikulski 2011, 4). It was transported in rolls measuring 300 m (Zellner 1935, 351). The plain wire of that type was most often used to build tanglefoot wire obstacle, *i.e.*, linear structures made from wire stretched at the height of 15-25 cm above the ground, anchored in the ground on wooden posts (*Feldbefestigungsvorschrift*... 1908, 55, 96; *Anhaltspunkte*... 1916, 40; Mikulski 2011, 19). Tanglefoot wire obstacles secured the foregrounds of field fortifications against the enemy infantry, causing a fall. It could also be used instead of barbed wire for the same purpose, in case of its unavailability, or it could be spliced with barbed wire (*Anhaltspunkte*... 1915, 40). In addition to the construction of the tanglefoot wire obstacles, 0.2 cm thick plain wire could have been utilised to build more complex anti-personnel barriers, supplemented with 0.4 cm thick plain wire. In that manner, obstacles consisting of several lines were made, with wires stretched between posts at different heights and additionally connected with each other by posts from the adjacent lines. For instance, three lines could be 2 m apart and consist of posts spaced

Fig. 22. Raciborowice-Prawda, Site 3. Field fortification equipment: 1 – a roll of plain wire (inv. no. 36). Graphic created by K. Przybysz-Malczewski

at intervals of 2 m, which were connected with each other by 0.4 cm thick wire at the height of 25 cm and 100 cm, both in one line and between the lines, as well as crosswise. In such an obstacle, the free spaces were additionally supplemented with 0.2 cm thick plain wire attached to the thicker strands (*Mitteilungen*... 1899, 176). The high demand for wire during the fighting in First World War is most clearly evidenced by the fact that 2000 tons of wire per week were delivered to the front for the needs of the army of the German Empire in July 1915 (von Wrisberg 1922, 107).

Furthermore, in Feature 510, a short section (12 cm long) of barbed wire (inv. no. 38) was found (Fig. 21: 2A). This consists of a strand, twisted from two strand of wire round in cross-section with a diameter of 0.25 cm. The strand is twisted counterclockwise in such way that the wires cross each other every 1.5 cm. Two barbs have been preserved, with an undetermined distance from each other. That distance was certainly no denser than 5 cm. The barbs are wound on only one of the strands. Each barb is made of two sections of wire with a diameter of 0.25 cm, twisted together clockwise (double barb). Each point of the barbs is turned in the opposite direction, after two full rolls around the strand, forming two loops. Thus, the barb consists of a total of 4 visible loops (4-point barb). The width of the barb is 1 cm, and its diameter is 0.7 cm. The length of the ends of the wires (points) coming from the barb and forming the spines is 1.2 cm. The distance between the ends of two points of the barb, oriented in the opposite directions, in one line, is 3 cm. That type of barbed wire was patented in the United States, by Thomas H. Dodge and Charles G. Washburn from Worcester (Massachusetts) on 24 January 1882, under number 252746 and it is referred to as Dodge-Washburn's Barb (Fig. 21: 2B; Clifton 1970, 146). At the turn of 1914 and 1915, the Russian Empire purchased ten sets of equipment for barbed wire production from the United States (Perzyk 2000, 170). With the use of barbed wire, it was possible to make various passive obstacles (see *Anhaltspunkte…* 1915, 48-59).

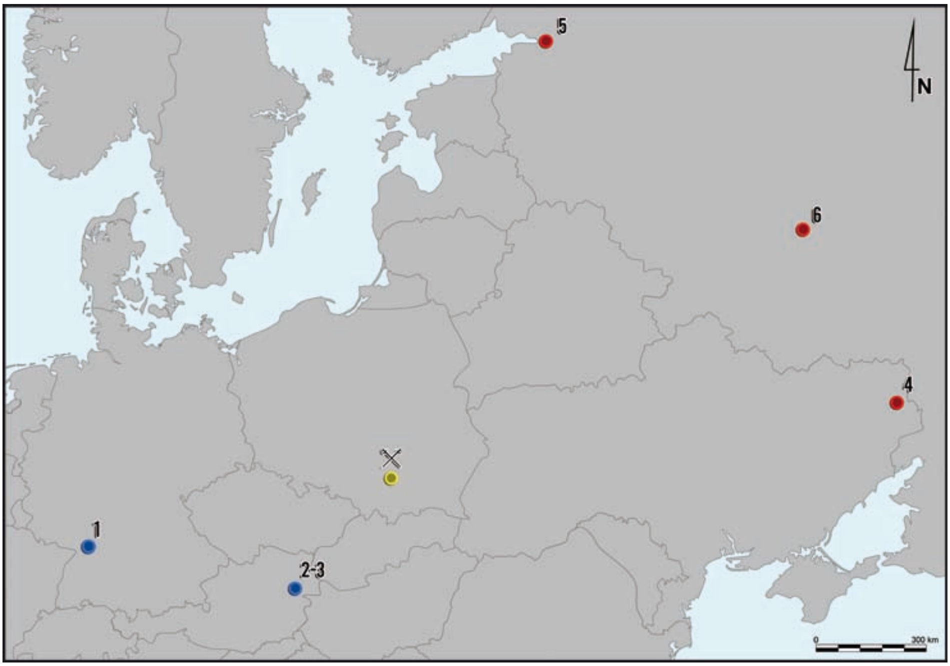

Fig. 23. The places of production of the artefacts discovered at the Raciborowice-Prawda, Site 3: 1 – Karls-ruhe, Karlsruhe district (German Empire), Deutsche Waffen- und Munitionsfabriken (inv. no. 5), 2, 3 – Hirtenberg, Baden district (Austro-Hungarian Monarchy), Hirtenberger Patronen-, Zündhütchen- und Metallwarenfabrik A.G. (inv. nos 2, 3, 6, 13, 14, 17, 18) and Wöllersdorf-Steinabrückl, Wiener Neustadt-Land district (Austro-Hungarian Monarchy), K.u.k. Munitionsfabrik (inv. no. 4), 4 – Luhansk, Luhansk district (Russian Empire), Luganskiy Patronnyi Zavod Tsvetnykh Metallov (inv. nos 21, 24), 5 – Saint Petersburg, Saint Petersburg district (Russian Empire), Sankt-Peterburgskiy Patronnyi Zavod (inv. nos 20, 21, 23) and Zavod Obschestva Franko-russkikh Zavodov (inv. nos 20, 21), 6 – Tula, Tula district (Russian Empire), Torgovyi Dom G. fonGillenshmidta (inv. nos 23, 24).
Designed by J. M. Niebylski, drawn by K. Przybysz-Malczewski

The fact that the barbed wire has solely been discovered in Feature 510 allows reconstructing the image of the foreground of a fortified position of that type. That feature (shooting post) was the only element of the fortifications extended in the northern direction beyond the line, the front of which was facing that side, as evidenced by the front trench niches. Perhaps only in the vicinity of that feature was an obstacle made from wire placed so close to the field fortifications. Most probably, the discovered position was secured by an obstacles made of wire on the north, in a longer section. This position is for all around defence, and the discovered fragment of its course is located on the north-western side. Possibly, in the remaining, unexcavated parts, there are also similar fortifications, in the foreground of which (that is on the outside), there were also obstacles made from barbed wire. This position is the only battlefield discovered so far related to the Russian offensive on Kraków in 1914, where both barbed wire and plain wire with a military purpose were discovered.

What is more, an unspecified steel pipe has been discovered at the site, which was located in the barrow (inv. no. 34). It is made from a thin, rolled metal sheet bent along the longer edge, with no preserved ends on either side. The preserved length is 13.5 cm, and its diameter is 1.2 cm (Fig. 21: 1).

The discovered items bearing the manufacturer's markings testify to their production in the plants located then in the following areas:

German Empire – Karlsruhe, Karlsruhe district, Deutsche Waffen- und Munitionsfabriken (inv. no. 5);

Austro-Hungarian Monarchy – Hirtenberg, Baden district, Hirtenberger Patronen-, Zündhütchen- und Metallwarenfabrik A.G. (inv. nos 2, 3, 6, 13, 14, 17, 18), Wöllersdorf-Steinabrückl, Wiener Neustadt-Land district, K.u.k. Munitionsfabrik (inv. no. 4);

Russian Empire – Luhansk, Luhansk district, Luganskiy Patronnyi Zavod Tsvetnykh Metallov (inv. nos 21, 24), Saint Petersburg, Saint Petersburg district, Sankt-Peterburgskiy Patronnyi Zavod (inv. nos 20, 21, 23) and Zavod Obschestva Franko-russkikh Zavodov (inv. nos 20, 21) and Tula, Tula district, Torgovyi Dom F. G. fonGillenshmidta (inv. nos 23, 24; Fig. 23).

INTERPRETATION AND SUMMARY

The defensive position discovered at the site using the barrow for the purpose of fortification, represents the statutory type of field fortifications of the Russian army utilised during First World War (Modrakh 1914). It consists of a position for all around defence, surrounding the top of the barrow, leaving a space at the centre. There were two trench niches on the north. From the ring-trench, a firing trench was extended in the western direction, with a connecting trench developed in the southern direction, leading to a dugout. That firing trench had twenty trench niches on the north side. From the south, there were two trench niches. In the extension of the trench in the western direction, there were twenty one-man prone foxholes, not connected by the trench, which testifies to the unfinished work on that fortification. If they had been combined, they would have become front-facing trench niches. To the north of the trench, a shooting post with a stove built inside was constructed.

The discovery of barbed wire in that feature proves the presence of a passive anti-personnel obstacles made in the foreground of the position. What is more, in the trench, a roll of plain wire with a length of about 117 m was discovered that could have been used for building or repairing such obstacles. This firing position is the only portion of battlefield landscape from First World War discovered so far, related to the Battle of Kraków, where such obstacles made from barbed wire have been confirmed by artefacts.

Most likely, agricultural and forestry tools, which were not included in the military equipment, were used to create that fortified position. These include the tree planting bar and the scythe. For the construction of the stove, two metal sheets discovered in its vicinity were used, probably coming from the farm buildings nearby.

Several artefacts recovered by the excavation confirm that these are Russian fortifications. These were: an M1909 cartridge pouch with six charger clips including 7.62 × 54 mm R M1908 cartridges; one M1891 cartridge charger clip; a case of unfired 7.62 × 54 mm R M1891 ammunition with traces of bullet break apart; and a case of unfired 7.62 × 54 mm R M1908 ammunition. Those artefacts indicate that the soldiers in that position had not engaged in combat.

The position in question was probably extended in the eastern direction, beyond the area of the investigations and the unexcavated element may have had a form analogous to the discovered one, constituting its mirror image. Therefore, it was an autonomous position, fortifying a hill with a barrow, with a good view of the surrounding area. The number of trench niches created on the north (20), combined with their number of trench niches on the south (two) indicates that the foreground of the position was located in the north, while the rear was to the south. Hence, the niches located on the north side were the front trench niches, whereas in the south, the rear ones. That has additionally been confirmed by the location of the dugout, which has been found in the rear. Thus, most likely, similar fortifications were also located on the south side of the barrow, securing the position from there. The view from the trench in the direction of the foreground is horizontally 60°, while from the niche, in the same direction, 120°. Combining the data on the length of the discovered position, the number of front trench niches and the number of one-man prone foxholes in the unfinished fragment of the position, indicates that the position was prepared for two platoons of soldiers, *i.e.*, 100 people.

Historical sources point out that the Russian troops reached the area of the village of Raciborowice, that is the area of the barrow from the north, after the end of the Battle of Kraków. That took place after the strategic retreat of the Austro-Hungarian troops into the area of the range of fortress artillery, which was completed on 28 November 1914. During

First World War, that elevation was called 'Hill 305'. The Russian troops raised that position in order to block the Kraków Fortress. Against them were operating the 106th Landsturm Infantry Division and the 1st and 110th Landsturm Infantry Brigade, located south of the Russian positions. On the afternoon of 30 November, the Russian artillery fired on the Fort no. 49a 'Dłubnia' and Fort no. 49 'Krzesławice', hitting it twice with a high-explosive shells. Those forts responded with artillery shelling of the Russian positions. Until 5 December, Fort no. 49a 'Dłubnia' and Fort no. 49 1/4 'Grębałów' continued artillery shelling of the Russian positions, sending their mobile batteries under the cover of the infantry. It is from that stage of the fighting comes the 12 cm M1861 high-explosive shell discovered at the site, which hit Feature 534, located on the southern slope of the barrow. At that time, only Fort no. 49 'Krzesławice' was armed with Wahrendorff's 12 cm M1861 guns, the number of which was four. The barrow was within the range of those cannons; hence, it can be concluded that the position was hit by a shell from that fort. Therefore, that fortified position was built too close to the defensive ring III (outer) complex of forts of the Kraków Fortress, being exposed to shelling.

On 2 December, the 110th Landsturm Infantry Brigade was ordered to carry out an attack on Hill 305, *i.e.*, the barrow in Prawda, which was conducted with the support of mobile heavy artillery batteries. That order was issued in relation to the presence of the Russian troops on that hill. on the night of 4 December and on 5 December, the fighting for the hill in Prawda continued, in relation to the order to attack it by the 35th and 110th Landsturm Infantry Brigade, which was conducted with the support of 5 mobile heavy artillery batteries, under the command of Major General Aust. It was carried out after dusk, from the east, from the area of Kocmyrzów. On 7 December, the enemy's activity in the range of fortress artillery in the northeast and east direction, *i.e.*, in the area of the barrow in Prawda, was no longer identified. At that time, the Russian troops withdrew from their positions.

Therefore, it should be concluded that the discovered position was created by the Russian troops between 28 November and 6 December 1914. The high-explosive artillery shell discovered at the site was fired from Fort no. 49 'Krzesławice' most likely on 30 November or later, although there is no confirmation in historical sources of the use of that fort's artillery in the following days. Direct battles for the barrow in Prawda lasted from 2 December certainly until 5 December, although there are no data in historical sources concerning the events of 6 December. Surely, on 7 December , there were no Russian soldiers in the area of the site.

The fact that the Austro-Hungarian troops captured the discovered position and carried out actions against the Russian troops has been confirmed by the discovery of items of Austro-Hungarian provenance, testifying to the presence of soldiers of that army. These are the following items: five cans of rations, adjustment pin of the M1887 calfskin knapsack, M1908 cartridge pouch for a carbine, tent peg of a M1893 tent sheet, unfired cartridge of 8 × 50 mm R M1893 ammunition, two charger clips with cartridges of 7 × 57 mm

M1893 ammunition, unfired cartridge of 7 × 57 mm M1893 ammunition, three fired cases of 7 × 57 mm M1893 ammunition, and three charger clips of ammunition 7 × 57 mm M1893 ammunition. Two other fired 7 × 57 mm M1893 ammunition cases, were discovered as single stray finds, from fills of other features located in the north and west of the analysed position. What this means is that after capturing that position, the Austro-Hungarian soldiers conducted firing on the Russian troops from the firing trench and the fortified position for all around defence, located at the centre of the barrow. They fired at least several shots. They were armed with Mannlicher M1895 rifles or carbines (8 × 50 mm R M1893 ammunition cartridge has been found, as well as an M1908 cartridge pouch for the carbine) and Steyr M1912 rifles (two charger clips with cartridges of 7 × 57 mm M1893 ammunition, unfired cartridge of 7 × 57 mm M1893 ammunition, five fired cases of 7 × 57 mm M1893 ammunition and three cartridges of 7 × 57 mm M1893 ammunition have been found). The discovery of ammunition for charging the Steyr M1912 rifle is the confirmation of historical sources regarding the units fighting for Hill 305 with the barrow in Prawda, as those were the soldiers of the reserve units – Landsturm, that were armed with that model of rifle.

Moreover, what has been discovered at that position includes items that were privately owned by soldiers. These are the following personal items: a tin tablespoon, a rim of the tobacco pipe lid, a Bordeaux wine bottle, made from dark green glass with stopper and a bottle of vodka or other high-proof liquors, made from light green glass. These items give an insight into the material culture of the soldiers taking part in First World War (*cf.*, Niebylski and Tunia 2018, 932, 933; 2019, 47). They also indicate that the soldiers spent their time consuming alcohol and smoking. On the other hand, they demonstrate shortages in equipment, indicated by a discovered civilian tablespoon. The army supplies did not provide cutlery for the soldiers of the Russian army, which may indicate the provenance of that utensil.

The discovered Russian position was the largest territorial gain of that army in that area, north of Kraków and east of Kończyce, Kraków district, towards the Fortress. The conclusions drawn fill a gap in the knowledge of military operations taking place after the end of the Battle of Kraków, *i.e.*, after 16–28 November 1914, before the combat on the right bank of the Vistula River. They constitute a testimony to the combat readiness of the Kraków Fortress and the success of the strategic plan of the Chief of the General Staff of the Austro-Hungarian Army, Field Marshal Franz Conrad von Hötzendorf. The plan assumed slowing down the Russian offensive in an engagement north of Kraków, engaging the enemy in combat and redeploying troops to the southern bank of the Vistula River, in order to attack the Russian 3rd Army advancing in that place. The combat of Hill 305 with the barrow in Prawda consisted of simultaneously preventing the enemy from entering the Fortress and engaging Russian troops in combat, in order to protect the redeployment of troops to a new area of military operations. That plan was successfully implemented and the operation was successful. That led to withdrawing the front to the south-east, conducting the victorious Operation Limanowa-Łapanów, and then shifting the fighting to the Carpathians, and, consequently, repelling the Russian troops from the entire territory of Galicia, which ended military operations of First World War in that area.

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REVIEWS AND SHORT REVIEW NOTES

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(Review) Alexandra Staniewska and Ewa Domańska (eds), *Ekshumacje polityczne: teoria i praktyka*. Lubin 2023: Muzeum Historyczne w Lubinie, Wydawnictwo Słowo/Obraz Terytoria, 728 pages, ISBN: 978-83-7453-521-2.

Exhumations, understood as the act of retrieving human remains from the ground, are of interest to fields such as law, medicine, and archaeology. They are commonly perceived as individual acts, often performed at the request of the family or due to investigative needs in criminal cases. However, there are instances where exhumations become mass events, particularly in historical contexts involving human rights violations.

On occasion, exhumations take on a political nature. Politics – that is, matters of the state, public affairs. It is not without reason that Francisco Ferrándiz, one of the book's contributors, refers to the concept of the 'political life of dead bodies', a kind of life after life. In this context, the protection of individual rights seems to gain deeper significance, raising justified concerns among many researchers. Alexandra Staniewska and Ewa Domańska have tackled this very subject, creating a monumental work. 'Ekshumacje polityczne' is a compilation of texts by various authors: anthropologists, literary historians, archaeologists, and geographers. Such a broad approach to the issue undoubtedly allows for examining political exhumations from various perspectives.

The starting point for creating 'Ekshumacje polityczne' was the concept of the so-called forensic turn: a methodology whereby human remains, as witnesses to past events, can be analyzed within a broad social, cultural, and historical perspective. This approach, where 'bones don't lie' assigns a new kind of subjectivity to remains, compelling researchers to go beyond the confines of their own disciplines and adopt a comprehensive view on the issues related to exhumations.

It is not without reason that Ewa Domańska, in the 'Final Remarks' of the publication, advocates for the creation of a new, hybrid research method, treating 'bones as method'

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(p. 581). The author emphasizes the necessity for new research: innovative and transdisciplinary, proposing a sort of marriage between the humanities and the sciences. This hybridity in the context of research on human remains gains new significance here, and the nature of 'Ekshumacje polityczne' undoubtedly proves the validity of such an approach.

The publication is divided into three parts: 'Theories, Methods, Research Approaches,' 'Global Perspective,' and 'Local Perspective.'

The theoretical section opens with Élisabeth Anstett's text on the concept of the mass grave. Anstett highlights a linguistic problem: the word 'burial' implies a certain voluntariness in the interment of bodies, which is problematic in the context of mass crimes. In response, Anstett proposes creating a new term that emphasises intentionality rather than voluntariness. Erin Jessee and Mark Skinner also suggest new definitions, noting that 'mass graves' are understood differently by archaeologists, humanitarian workers, and lawyers. To help readers understand these proposed changes, the authors introduce clear graphical distinctions in their article. This methodological section is particularly important for 'Ekshumacje polityczne' because it is difficult to advocate for a new research method without standardising the terminology.

Other interesting articles in this context include studies on the necrosols of selected cemeteries in the Land of the Great Masurian Lakes (L. Majgier and O. Rahmonov) and an overview of global research on the impact of cemeteries on groundwater chemistry (J. Żychowski). Although seemingly unrelated to the overall theme, these articles introduce another perspective, emphasising the necessity of considering human remains as a subject of study in themselves.

The theoretical section concludes with articles on the cultural conditions of handling human remains from excavations (Z. Kobyliński) and the ethics of archaeology (A. González-Ruibal), which appropriately correspond with each other. Zbigniew Kobyliński points out that in Poland, the issue of handling human remains from excavations has not been adequately addressed. He also notes that while archaeological excavations can significantly contribute to scientific knowledge, they often conflict with the rights of various minorities, particularly regarding their beliefs.

A potential barrier to presenting 'Ekshumacje polityczne' to a broader audience is the specialized language of the publication. However, Staniewska and Domańska have organized the anthology in an orderly manner. After thoroughly introducing readers to the theoretical issues, the second part of the book addresses the global perspective of political exhumations. It is unclear why the chapter opens with a preface to the book 'Forensic Archaeology: A Global Perspective' (C. C. Snow), as this article might have been better suited for the theoretical section.

Francisco Ferrándiz's text is particularly moving, discussing the 'social autopsy of the exhumation of mass graves in Spain.' It addresses the handling of bodies of civil war victims, depending on whether they fought on the winning or losing side. Ferrándiz highlights the associated violence, noting that 'in the case of mass burials resulting from war, the deliberate mingling of anonymous bodies in unmarked graves has the potential to seep disorder, fear, and division into the social fabric' (p. 273). He also asserts that contemporary exhumations are crucial for recovering historical memory.

Sarah Wagner's article offers an intriguing perspective, questioning how the saying 'bones don't lie, and graves tell stories' applies to incomplete remains that cannot fully convey a narrative. Wagner analyzes two cases: remains from a mass grave in Srebrenica and remains of American soldiers killed during the Korean War. Élisabeth Anstett's subsequent article focuses on the victims of Soviet Gulags. In this case, remains are rarely incomplete, but families often have no knowledge of the burial sites due to the Soviet state's systematic confiscation of bodies. Anstett explores the practices of erasing traces and their effects, highlighting the state of deferred mourning (p. 330) experienced by the victims' relatives.

Małgorzata Wosińska's article on commemorating human remains as an emancipatory strategy compares the Rwandan genocide and the Holocaust. Wosińska, an anthropologist, writes from her own experiences and fieldwork. She refers to a "turning point" in her research when the Rwandan government, despite comparing the Tutsi genocide to the Holocaust, rejected assistance from the Auschwitz-Birkenau Museum (p. 337). She analyses the presentation of exhibits at the Kigali Genocide Memorial Centre and the controversial display in Murambi, which treats human remains as museum objects. Although the title suggests a comparison with the Holocaust, the author focuses primarily on Rwanda, leaving its contextualisation to future authors.

Dorothée Delacroix's article, 'Etnografia uciszanej przemocy. Ku antropologii życia pośmiertnego zamordowanych i zaginionych w Peru', discusses the discrepancy between officially accepted local memory, in line with political and legal norms, and the cultural element of widespread 'ghost sightings' of conflict victims. Delacroix also examines the impact of mass deaths on people's imaginations, questioning whether this phenomenon results from trauma or serves as an interpretative category for experiencing violence. Her conclusions are supported by an extensive bibliography and interviews with those experiencing the phenomenon.

Anne Yvonne Guillou's article on the status of bodies after the Khmer Rouge genocide closes the global perspective section. Guillou attempts to understand Cambodian society post-genocide, emphasizing the importance of interpreting the remaining traces of war, including the status of the victims. She highlights that until the 1991 peace agreements, human remains were treated not only as evidence but also as a symbolic foundation for the new order. The signing of the peace agreements halted exhumation efforts until 2007, with official documents making no mention of the recent genocide. This article underscores the need for local perspective research.

The local perspective section opens with Caroline Sturdy Colls' text on Holocaust archaeology and the study of Nazi persecution sites. This article deserves special attention not only for its subject matter but also because it serves as a kind of manual for researchers.

Colls analyzes various approaches used in Holocaust landscape studies and proposes a new methodology incorporating contemporary archaeological and forensic advances, with an emphasis on non-invasive methods. This article provides practical guidance for archaeologists, aiding in the selection of appropriate research methods.

Andrzej Kola's work, 'Zbrodnia katyńska w świecie prac archeologiczno-ekshumacyjnych' reports on exploratory work in the Kharkiv and Bykivnia areas. A similar structure characterizes Krzysztof Persak's article on the Jedwabne exhumations in Poland. Both exhumations share common points, such as significant limitations on the scope of work and attempts to draw conclusions from incomplete evidence. In the case of the Katyń massacre, this resulted from the USSR's (and later Russia's) reluctance to conduct extensive extraction-archaeological operations. This situation is somewhat analogous to that described in Élisabeth Anstett's text on Gulag victims. The Jedwabne exhumations were limited due to restrictions imposed by Halacha, Jewish religious law. Nevertheless, Persak's article seems crucial, especially given the ongoing public controversy surrounding the events in Jedwabne.

Milena Bykowska's work, 'Zdjęcia lotnicze i materiał DNA w procesie identyfikacji skazanych na karę śmierci i rozstrzelanych w Polsce w latach 1944-1956. Zarys problematyki' leaves the reader somewhat unsatisfied. Bykowska discusses the individual approach to identifying the fallen, describing her experience with the first large-scale DNA comparison studies of the missing and their families, conducted during work at the 'Łączka' ('Meadow') site under the modern graves of the Powązki Cemetery in Warsaw. However, she only briefly touches on a controversial topic related to this case: a 2016 amendment to the IPN Act, which allows exhumation work in cemeteries without first obtaining the consent of families of those later buried on top of the sites where victims of repressions in the Stalinist period lie. Although this does not detract from Bykowska's work, it would have enriched both her article and the entire publication.

An interesting editorial choice is the inclusion of information on the results of the exhumation of remains of victims of the 2010 Smolensk airplane crash , released by the National Prosecutor's Office on April 10, 2020. This seems like an almost readable prelude to Marcin Napiórkowski's article on mourning ceremonies as tools of legitimization and delegitimization of power This information was published exactly 10 years after the accident, when Tupolev Tu-154 aircraft operating Polish Air Force Flight 101 crashed in Russia, killing all 96 people on board, including the Polish presidential couple. Napiórkowski's text also opens the final (though informal) literary section of 'Ekshumacje polityczne'. Napiórkowski, a literary historian, emphasizes his interest in 'not only what is remembered but also how it is remembered' (p. 535). Referring to national mourning, he analyzes past events in Poland, such as the collective memory in Poland following the deaths of Pope John Paul II, the Smolensk disaster, the funeral of Józef Piłsudski, and even Stanisław Staszic.

Just as Napiórkowski's text discusses the creation of narratives, Paweł Tomczok's article on Przemysław Dakowicz's 'necropatriotism' analyzes the work of the Nowy Sącz poet, whose writings largely concern the 'cursed soldiers', that is people who attempted to oppose the rise of communist power in Poland through underground military action. Although Dakowicz's poems are about the deceased, Tomczok notes that it is death that makes their lives significant, and the fate of the bodies themselves creates a narrative. This 'necropatriotism' becomes a pretext for telling stories about a lost world, meant to be remembered by the victims of the communist regime.

'Past events are of interest only when they matter for the present or future' (p. 245), writes Alfredo González-Ruibal in his article on the ethics of archaeology. In the case of exhumations, both the historical context and the contemporary fate of the remains are crucial. 'Ekshumacje polityczne' challenges the Polish legal principle that grants personhood only until death. By questioning the fate of the bodies, the book highlights their narrative agency, demonstrating that remains are often used to create new layers of history.

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