SPRAWOZDANIA ARCHEOLOGICZNE

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SPRAWOZDANIA ARCHEOLOGICZNE

Archäologische Berichte
Archaeological Reports

75

2

KRAKÓW 2023

Cover: Sword scabbard chape from Poszyna, gm. Kłaj. Photo A. Janowski

Editor's Address
CENTRE FOR MOUNTAINS AND UPLANDS ARCHAEOLOGY, INSTITUTE OF ARCHAEOLOGY AND ETHNOLOGY, POLISH ACADEMY OF SCIENCES, 31-016 KRAKÓW, UL. SŁAWKOWSKA 17

PL ISSN 0081-3834 (PRINT), 2719-647X (ONLINE), DOI: 10.23858/SA/75.2023.2

Edition: 300 pcs.

Sprawozdania Archeologiczne is regulary listed in the: SCOPUS, CEJSH, ERIH Plus

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Sprawozdania Archeologiczne is regulary listed in the International Current Awareness Service: Anthropology. Selected material is indexed in the International Bibliography of Social and Cultural Anthropology.
Indexed in:
IBZ – International Bibliography of Periodical Literature
IBZ – CD-ROM

SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3723

PREFACE

JAN MACHNIK

(20 September 1930 – 7 October 2023)

On October 7, 2023, we were saddened to learn of the death of Professor Jan Machnik – an outstanding Polish prehistorian, long-time head of the Department of the Archaeology of Małopolska [Lesser Poland] of the Institute of the History of Material Culture (currently: Institute of Archaeology and Ethnology) of the Polish Academy of Sciences, editor of "Sprawozdania Archelogiczne" in the years 1967-2003 (volumes 19-55). Thanks to his work this journal has become one of the most important Polish archaeological periodicals. Polish science has suffered an immeasurable loss. Above all, however, his death means the passing of a person with whom the lives of several generations of Polish archaeologists were closely linked. For many of them, he was a scientific mentor, promoter, project partner and friend. He was an exceptional personality whose legacy also includes unforgettable memories, emotions and anecdotes.

We would like to dedicate issue 75/2 of this journal to Professor Jan Machnik. The short memoire presented below is the first of many that will probably be published on various occasions in the coming years. I belong to the generation that has had contact with him for many years. The Professor was also the supervisor of my doctoral thesis. But, when I first met him in the early 1990s, he seemed like a person from another world. It was though he was always immersed in the vanished past of his Podkarpacie [Subcarpathian region], and faithful to time-honoured patriotic and religious principles. The roots of this are unclear, but he was an uncritical admirer of Marshal Piłsudski and a "militarist" admiring cavalry traditions, showing a weakness for bladed weapons (Fig. 1). During the times of the People's Republic of Poland, he was an anti-communist. I heard that at archaeological conferences in Western Europe, he gave out badges of the banned trade union "Solidarity" to his colleagues. While in Georgia, I heard a story about Professor Machnik who, during an evening meeting while on a study trip there in the early 1980s, took a sabre from the

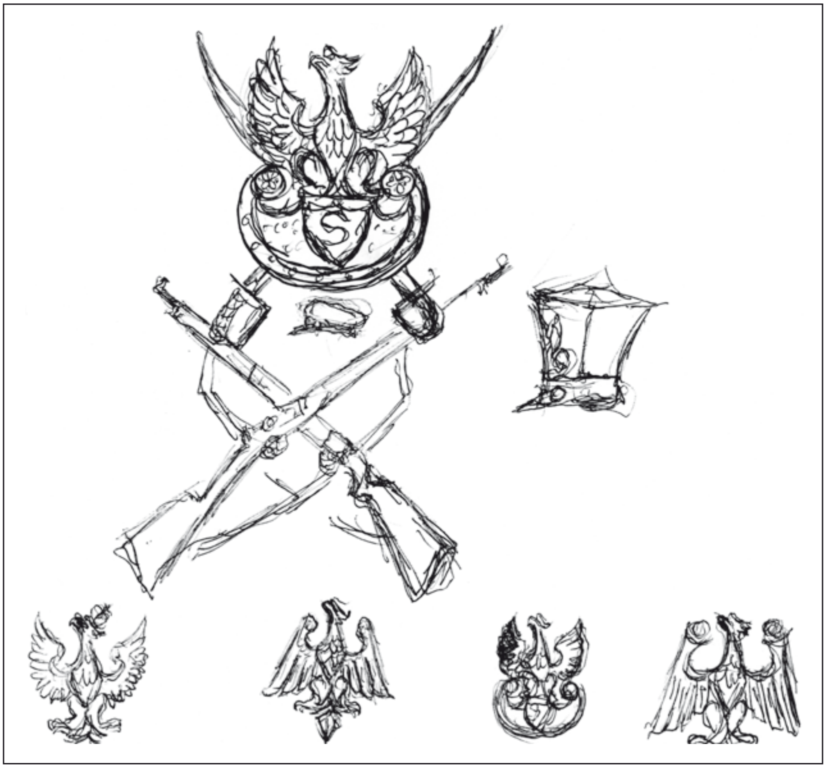

Fig. 1. "Machnik's eagles". Part of a page of notes from the conference in Niepołomice (2007), collected by Barbara Burchard. While listening to the lectures, Jan Machnik often doodled – either eagles, or beakers and battle-axes of the Corded Ware culture

wall and brandished it, shouting and singing anti-Soviet slogans. In the 21st century, times have changed, but despite the passage of the years, the Professor remained as characteristic and expressive as ever. Both in Poland and abroad you can hear many colourful stories in which he was the main character.

Since the 1950s, Jan Machnik was deeply engaged in dealing with the issues of the Corded Ware culture. In 1966, he wrote a classic work on this subject: "Studies on the Corded Ware Culture in Lesser Poland." This book can be compared with the works of, among others: P. V. Glob, K. H. Struve, M. Malmer and M. Buchvaldek. It focused research on the Final Eneolithic of Lesser Poland for the next several dozen years. Until the end of his life, the Professor continued to reflect on the problems presented in this book. Since the late 1960s, he was also strongly involved in research on the Early Bronze Age in south-eastern Poland. As one of his collaborators, Józef Ścibior, used to say humourously, "Machnik invented the Early Bronze Age in Lesser Poland for the good of his own career and material profits". The Professor developed his own concept of the chronology, taxonomy and spatial development of the Mierzanowice culture, absolutely believing in and constantly persuasive about the truthfulness of these findings. To this day, most researchers believe Professor Machnik on this matter. In the 1970s, the Professor led large-scale research on the Mierzanowice culture settlement in Iwanowice, carried out as part of a Polish-American project. He entrusted Sławomir Kadrow with the processing, analysis and publication of the materials coming from these excavations. The resultant publications of the results of this fieldwork have become of fundamental importance for studies on the Early Bronze Age in Lesser Poland. In several joint works, both researchers have in addition used the results of the research in Iwanowice for exploring and discussing several more general aspects of prehistoric phenomena.

Field research has always been Jan Machnik's favorite professional activity. In the 1980s, he returned to his native Podkarpacie to discover traces of the little-known prehistory of the end of the Stone Age in the region. At the beginning, in collaboration with Jan Gancarski, He examined two burial mounds in Bierówka near Jasło. Later – in the 1990s – together with Ewa Sosnowska, he conducted research on several burial mounds in the Dynów Foothills. At the same time, he was the mentor of the project of excavation of burial mounds in Grzęda Sokalska [Sokal Ridge], carried out by Jolanta Bagińska and Wiesław

Fig. 2. Jan Machnik during field research on the Tanew in 1956
(Lubaczów expedition in the Polish-Ukrainian borderlands). Photo J. Potocki

Jan Machnik during the 70th birthday celebration
(hall of the Polish Academy of Arts and Sciences in Kraków).
Photo P. Włodarczak

Koman. He thus returned to the years of his youth, when he participated in research projects on burial mounds in the Roztocze region. These are only some of the most important archaeological sites related to the Professor's field activities.

Professor Jan Machnik made enormous contributions to the implementation of research projects that transcend state and national barriers. In the 20th century, the areas of scientific research projects in the eastern part of Central Europe were, for many reasons, usually limited by state borders. Political changes in the 1990s, however, and consequent more frequent international collaboration opened up new opportunities for organizing joint ventures with researchers from Slovakia and Ukraine. The Professor was able to take advantage of these circumstances to organize such projects. Moreover, he made numerous friends there. Today, many successors from several Polish research centres continue this international adventure.

For most of his professional life, Jan Machnik was associated with the Department of Archaeology of Małopolska at the Institute of the History of Material Culture of the Polish Academy of Sciences – being its head for many years. Starting from the 1980s, famous seminars were held in the palace at Igołomia under his aegis. The discussions held there shaped generations of archaeologists from all over Poland. Many current professors emphasize how much they owe to these meetings. Later, Professor Jan Machnik became a lecturer at the University of Rzeszów. He played a key role in establishing the Institute of Archaeology there.

Once, following a slight altercation about something or other, Professor Jan Machnik brought me a photo, claiming that he would show me a picture of myself as I am now. What he showed me was a photo of himself taken by Jan Potocki in the 1950s during research in Roztocze (Fig. 2). "Look...", he said, "an angry young man. He thinks he knows and understands everything!" He then ordered me to confirm that this was how it looked. This was the essence of Professor Jan Machnik.

Piotr Włodarczak

SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3517

ARTICLES

Dagmara Chylińska[1]

CURRENT PALAEOANTHROPOLOGY AND PALAEOARCHAEOLOGY IN THE MUSEUMS OF POLAND IN THE TOURISM CONTEXT. INVISIBLE HERITAGE?

ABSTRACT

Chylińska D. 2023. Current palaeoanthropology and palaeoarchaeology in the museums of Poland in the tourism context. Invisible heritage? *Sprawozdania Archeologiczne* 75/2, 13-36.

The heritage of prehistory, in the fields of both palaeoanthropology and palaeoarchaeology, constitutes a huge physical and interpretative resource, even though the majority of artefacts have never left museum storage rooms. The current significant development in research into human fossils does lead to considerations about the current ways of exhibiting museum collections regarding this kind of heritage. In Poland, artefacts of prehistory, including human fossils, are distributed between different kinds of museums – historical, archaeological, natural history, and geological ones, as well as museums belonging to universities and scientific institutes. None of them builds their brand based on palaeoanthropological artefacts. Moreover, since the excavations have stopped, the sites of discoveries of that kind remain illegible to the general public due to the lack of on-site markers and appropriate educational tourist facilities. All these facts together underline the problem of limited visibility of the recent discoveries and palaeoanthropological and palaeoarchaeological heritage in the Polish museum and tourist market.

Keywords: palaeoanthropology, palaeoarchaeology/Palaeolithic archaeology, museum studies, tourism, Poland
Received: 15.07.2023; Revised: 20.09.2023; Accepted: 15.12.2023

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INTRODUCTION

In the 21st century, research into the history of humankind is experiencing its true "golden years". This is due to the development of modern laboratory research techniques and breakthroughs in genetics, such as the sequencing of fossil DNA of the protohumans (Meyer *et al.* 2016). The obtained information about our direct ancestors and extinct human species not only enriches the existing knowledge, but forces us to revise many established views (*e.g.*, on Neanderthal life and culture) about human evolution, migration and the contribution of protohuman species (or populations) to the genetic heritage of modern humans.

The heritage of prehistory in archaeology, palaeontology and palaeoanthropology (the latter deals with the morphological analysis of fossil bone remains, Ławecka 2003, 182) is an enormous resource, both physical and interpretative, even though most artefacts have never left the drawers of museum storage rooms. Others, such as dinosaur fossils, have enjoyed not only scientific but also pop-cultural success, inspiring many – from authors of literature or film to toy manufacturers. Among this wealth, the heritage of palaeoanthropology and palaeoarchaeology (also called 'Palaeolithic archaeology'; Clark 2009) are increasingly taking the lead, also in the context of tourism, although not everywhere and not to the same extent.

The aim of this article is to analyse the tourism potential of the heritage of palaeoanthropology (mainly fossil bone remains of protohumans) and palaeoarchaeology (*e.g.*, stone tools of protohumans, and the remains of the first representatives of *Homo sapiens* and other extinct human species) in Poland against the background of contemporary trends in museology and in the context of commonly used modes of interpretation. The presented paper was based on desk study (analysis of secondary sources, literature) and observation (selected museum collections, *in situ* sites related to the prehistory in Poland).

THE HERITAGE OF PALAEOANTHROPOLOGY AND PALAEOARCHAEOLOGY IN TOURISM

The objects of interest in archaeotourism are legible or "legibilised" archaeological sites in the landscape as well as artefacts collected in museums and available to the general public. Archaeological heritage includes "all remains, objects and any other traces of mankind from past eras" (European Convention on the Protection of the Archaeological Heritage (Revised)..., Valletta 1992), relics of past worlds acquired through both purposeful research and accidental discovery. Palaeoarchaeology deals with the earliest material heritage of humans (*e.g.*, stone tools, traces of encampment, and other activities of protohumans), while palaeontology also provides us with knowledge of the evolution of the animal world (with humans as a part of it) and the plant world on Earth. The preserved traces from the sometimes very distant past allow scholars to understand processes that shaped the Earth in its geographical and cultural layers, as well as the cyclical nature of certain phenomena on a macro scale and their consequences for the modern world (*e.g.*, great extinctions).

Palaeoanthropological heritage occurs in the form of fossils of the most ancient forms of humans and is exhibited mostly in museums. It originates in the discoveries made in the geographical environment. The archaeotourism attraction of Palaeolithic human discovery sites often overlaps with the geotourism attraction (*e.g.*, caves, see Antić *et al.* 2022), hence archaeotourism may co-occur with geotourism. This occurs primarily when prehistoric artefacts remain at the site of their discovery simply because they cannot be taken anywhere else without being harmed. Such a situation occurs, for example, in the famous caves of El Castillo (Ripoll *et al.* 2021) or Altamira in Spain (Parga Dans and González 2019), where tourists are able to admire spectacular works of both nature (extensive cave chambers, speleothems) and human beings (prehistoric cave art). Another *in situ* attraction that the visitors can admire is the famous palaeoanthropological site at Laetoli showing the footprints of representatives of the bipedal species *Australopithecus afarensis* dating back to 3.6 Ma BP, imprinted in hardened pyroclastic sediments in eastern Tanzania (International Union of Geological Sciences 2021, 114, 115). The frequency of significant palaeoanthropological discoveries in the past has turned some regions into palaeontological eldorados, while becoming their tourist brand: Awash Plains in Ethiopia, the caves of the Swabian Jura in Germany, or the Sierra de Atapuerca of the Dolina Trench in northern Spain (with the famous Sima de los Huesos/Pit of Bones, Carbonell *et al.* 1999). At the same time, the "success" of these locations in the context of the science of the evolution of humankind and the scale of scientific, not always ethical, exploitation of the fossils made many people realise that "bones" are a non-renewable resource, requiring particular protection (see White 2014, 342).

At times, sites of famous palaeontological finds are visited in this context, even when the artefacts unearthed there have long since gone to museums. This is the case at places such as Olduvai Gorge in Tanzania, the La Chapelle caves in France, or Sterkfontein and Blombos – both in South Africa (Table 1). The geographical features and location of these destinations also make them the focus of various forms of cognitive, qualified or adventure tourism (see Antić *et al.* 2022).

The mere fact of the discovery of Palaeolithic artefacts (Table 1), including the remains of protohumans, may be subject to practices of commemoration and celebration. The 1908 discovery of a Neanderthal skeleton called "The Old Man" from La Chapelle (LCS1), which (partly) falsely shaped the public image of representatives of this species for nearly a century, is celebrated at the Musée de l'Homme de Neandertal located between Brive-la-Gaillarde and Rocamadour, not far from the site of the original discovery (in la Bouffia Bonneval, Rendua *et al.* 2014).

Table 1. Sites of selected famous finds in the field of human prehistory.
Source: author's own research

Location	Meaning
The Olduvai Gorge, Tanzania	Discovery of the remains of *Zinjanthropus boisei* (1.848 Ma), *Homo habilis* (1.848-1.832 Ma), *Homo erectus*, *Homo sapiens*, and numerous stone tools (International Union of Geological Sciences 2021, 114-115)
Laetoli, Tanzania	Footprints of the march (27 m trail) of the *Australopithecus afarensis,* dated to be 3.6 Ma BP. (International Union of Geological Sciences 2021, 114-115)
Trachilos, Crete, Greece	Traces of the march of bipedal humans from 5.7 Ma BP (Gierlinski *et al.* 2017)
Sterkfontein Cave, SA	*Australopithecus africanus* remains (2.8-2.4 Ma), *Homo habilis* skull (1.5 Ma), fossil fauna (Kuman 1994)
Blombos Cave, SA	Snail shell beads and a silkrette flake with a pattern drawn in ochre-colored crayon found in an approximately 73,000-year-old Middle Stone Age level (Henshilwood *et al.* 2018).
Hadar, Etiopia	"Lucy", a largely preserved skeleton of an *Australopithecus afarensis* individual, 3.25 Ma BP (Johanson 2017)
Hadar, Etiopia	"First Family," 13 individuals of the *Australopithecus afarensis* species living in one group, or members of one family, 3.2 Ma BP (Johanson 2017)
Buxton-Norlim Limeworks quarry near Taung, SA	The "Taung child," a skull of an *Australopithecus africanus* individual 2.8 Ma BP (Berger and Clarke 1995)
Liang Bua Cave, Flores, Indonesia	"Hobbits," members of the species *Homo floresiensis*, dating back to 74-17 ka BP (Aiello 2013)
Cave system called Rising Star Cave, Dinaledi Chamber, SA	Discovery of remains of at least 15 *Homo naledi* individuals (dating back to 335-236 ka BP). This is one of the largest bone collections obtained from a single hominin species in Africa (Berger *et al.* 2015)
La Chapelle cave, France	Discovery of an intentional burial of a representative of *Homo neanderthalensis* with a preserved complete skeleton, the so-called "Old Man" from La Chapelle, 60 ka BP (Trinkhaus 1985).

In the case of several locations famous for their finds, the nature of the artefacts particularly susceptible to destruction, led cave managers to decide to close them to the public. The spectacular Palaeolithic hunter paintings and other related finds of the Lascaux and Chauvet caves in France (Geneste 2017) can be admired today only through virtual tours or by visiting exact replicas of the caves and their painted decorations (Lascaux II, III and IV and Cave Chauvet 2, Ardèche) (Hammer 2015).

Some fossil remains of protohumans are extremely valuable, but also extremely fragile, hence they are rarely made available to visitors in their original form. They are kept in the collections of high-ranking museums (*e.g.*, the bones of the Neanderthal "Old Man" from La Chapelle (LCS1) at the Muséum National d'Histoire Naturelle in Paris, France, or the remains of the *Australopithecus afarensis* "Lucy" (AL 288-1) at the National Museum of Ethiopia in Addis Ababa) or in the research units involved in their discovery (*e.g.*, the skull of the "Taung Child", a representative of the *Australopithecus africanus* species, kept at the University of the Witwatersrand in Johannesburg). The original bones are made available to scientists for study. A certain rarity in the context of making authentic artefacts available to visitors is the repeated lending of “Lucy” bones by the National Museum in Addis Ababa for a kind of “tour” to other museums, including those abroad.

The most famous finds documenting the history of humankind are in museums, usually natural history museums, constituting an important part, less frequently the core, of the collection. There are exhibitions devoted to the evolution of the human species at the Natural History Museum in London, the Muséum National d’Histoire Naturelle in Paris, the Museum für Naturkunde in Berlin, the Naturhistorische Museum in Vienna (the collection includes figures of the so-called Venus of Willendorf and “Fanny” of Stratzing, dated at 29.5 and 36 ka BP, respectively), the American Museum of Natural History in New York, the Smithsonian National Museum of Natural History in Washington, the Harvard Museum of Natural History, and many others. Due to the dynamic development of knowledge about extinct species of protohumans, including Neanderthals, involving a change in the perception of their physicality, adaptive skills, ability to think in abstract terms and even create culture, museums dedicated to specific species (populations?) of humans have been recently established. An example is the Neanderthal Museum in Mettmann, Germany, where Neanderthals are shown as outright members of the human family, close relatives whose DNA is still present in the genome of modern humans (non-Africans) (Reilly *et al.* 2022), thus breaking with the damaging stereotype of uncultured and primitive troglodytes. The art of prehistoric humans, preserved not only on cave walls but also in the form of movable objects of often symbolic significance, tens of thousands of years old, is a trademark adornment of the collections of museums such as the Israel Museum in Jerusalem (Venus of Berekhat Ram), the Urgeschichtliches Museum Blaubeuren (Venus of Hohle Fels) and the Museum Ulm (Lion Man of Hohlenstein-Stadel Cave).

In terms of presenting the history of human evolution, modern museology is characterized by a kind of conglomerate of traditional 19th-century display-case exhibition and modern reconstructions or visualizations, also using virtual reality. The opportunity for visitors to see authentic, sometimes millions of years old fossil skeletal remains of protohumans is, in this case, a great advantage of the traditional “behind glass” exhibition, enriching the experience of visitors to a degree incomparable to any, even the fanciest, modern visualisation. The latter serve mainly to expand the knowledge of the issues presented in a way that engages all the senses of the viewers, so that the cognitive effect is as durable as possible. In accordance with Tilde’s (1957) rules of museum interpretation, palaeoanthropological expositions often turn to so-called “windows of the past”, dioramas, where genre scenes are shown in a specially arranged space, in which protohumans and the conditions of their lives were recorded at key moments in the evolution of the species or at individual moments of life or death. Commenting on the Mettmann museum’s exhibition on Neanderthals in light of the latest scientific knowledge about them, Drell (2000) pointed to the then novel museum trend of depicting protohumans in a more “human” way, with greater empathy, exposing features previously reserved mainly for *Homo sapiens* (ability to think abstractly, social behaviour). Visitors were thus able to see the "home/family" life of the Neanderthals (not just hunting scenes), rich in emotions (which, however, we can only guess) that modern people could easily identify with. The fossilised skeletal remains of the protohumans are usually presented in the form of replicas, casts (see Nowacki 2012 for the rules of modern heritage interpretation described broadly). Huge interpretative possibilities have emerged in modern times with the development of 3D scanning techniques, thanks to which it is possible to make prehistoric artefacts available to visitors without the risk of their destruction and with the possibility of their extremely insightful observation. Collaboration with artists and being based on the data that was obtained from the analysis of fossil DNA provided the opportunity to reconstruct the potential appearance of protohumans (eye and hair colour, complexion), granting them individual human characteristics.

Instead, special reconstructions, "genre scenes" showing various aspects of the life of early humans at these sites (*e.g.*, Einhornhöhle cave in Germany) are frequently placed at the discovery sites, often caves, rock shelters, from which artefacts related to ancient people have been removed (remains, traces of residence, tools, *etc.*).

PALAEOANTHROPOLOGICAL AND PALAEOARCHAEOLOGICAL COLLECTIONS IN POLAND

Museums

In Poland, palaeoanthropological collections are usually part of broader palaeontological collections, mainly maintained by universities or research institutes (Table 2). Due to modest local discoveries of the oldest protohuman remains, the collections mostly consist of replicas of the most famous finds, crucial to the history of the evolution of the mankind, increasingly enriched with artistic reconstructions of the hominins, according to the latest knowledge about them and the palaeoenvironments in which they lived. The museums rely mainly on traditional, display-case exhibitions, not deviating significantly from the display practices used in most museums of this type. This seems to be due partly to the size of the collections associated with protohumans. Apart from the Human Museum at the University of Wrocław (which, however, will soon become part of the UWr Natural History Museum), none of the university museums presenting human evolution expose this fact in the name of the institution.

The material remains related to protohumans as such (their biology) are often presented in conjunction with material creations of Palaeolithic cultures (usually, however, the latter are much younger than the oldest known human remains, their age counted not in millions, but tens of thousands of years). They also appear on the margins of collections in some regional museum and are also found in the collections of archaeological or ar-

Table 2. Museums of universities and scientific institutes with palaeoanthropological collections in Poland. Source: author's own research based on sources such as https://muzeauczelniane.pl/muzea/ and https://muzeumewolucji.pl/?p=967 (20.01.2023)

Museum	Exhibits	Offer
Museum of Evolution at the Institute of Palaeobiology at the Polish Academy of Sciences in Warsaw	The collection of fossil human skulls illustrates the most important evolutionary trends leading to the emergence of humans; An artistic reconstruction of the australopithecus "Lucy" made by a sculptor Marta Szubert under the supervision of Charles Sabath.	Traditional visit Virtual visit Museum classes Young Palaeontologist Club
Museum of Earth Sciences of the University of Silesia in Sosnowiec	An exhibition on human evolution; Reconstructions: *Sahelanthropus tchadensis* reconstructed on the basis of a skull dated by the discoverers to 6-7 Ma BP. Figure against the backdrop of the natural environment in which the species occurred – a grassy savanna; *Homo neanderthalensis* is shown against a Pleistocene environment.	Traditional visit Museum classes Field workshops
Museum of Earth at Adam Mickiewicz University in Poznań	A replica of the most complete skull of the first adult australopithecus (*Australopithecus africanus*) discovered by Robert Broom at Sterkfontein Caves (South Africa) in 1936. A copy was made at the Sterkfontein Museum and, together with a cast of the *Homo habilis* skull, was given to Prof. Jerzy Fedorowski, Rector of the Adam Mickiewicz University (1990-1996).	Traditional visit
Natural History Museum of the University of Łódź in Łódź, Poland	In the room dedicated to the history of life on Earth, there is a life-size model of Neanderthal man *Homo neanderthalensis*. The head of the model was made based on the skull of the so-called Old Man of La Chapelle-aux Saints; a replica of the Old Man's skull.	A visit with an audioguide
Human Museum at the Department of Human Biology of the University of Wrocław (after reorganization part of the Natural History Museum of UWr)	Bone material and replicas of fossil hominid remains	Traditional visit (currently unavailable due to organisational and location changes)

chaeological-historical museums. An approximately 15,000-year-old Palaeolithic Venus figurine from Wilczyce (one of many acquired at this archaeological site, Kuczyńska-Zonik 2014, 135-139) is exhibited at the Archaeological and Ethnographic Museum in Łódź. Other figures of Palaeolithic Venus (made of hematite), discovered in Poland, come from sites such as the Dzierżysko site in Opole region (Ginter and Połtowicz 2006; Kuczyńska-Zonik 2014, 113) and represent the Magdalenian cultures. Rich Palaeolithic collections from the Ciemna, Nietoperzowa, Jama and Okiennik caves, as well as Palaeolithic and Mesolithic assemblages of flint artefacts from the Rydno site near Skarżysko-Kamienna, from the area around Warsaw, as well as from eastern and northeastern Poland have been deposited at the State Archaeological Museum in Warsaw (closed to visitors since 2018 due to renovation of the museum building). These collections, despite their considerable value, are usually made available in the form of thematic temporary exhibitions. The Archaeological Museum in Kraków presents a permanent exhibition called "Prehistory and Early Middle Ages of Małopolska" in the form of a classic diorama with models of prehistoric and indigenous inhabitants of the region complemented with multimedia narratives (the scenes staged in the diorama are rather static). As part of the museum's virtual offer, visitors can see animations and 3D visualisations related to the oldest and most valuable relics in the institution's collection, including the Prądnik Knife from the Ciemna Cave and a Shouldered Point from Kraków (Spadzista Street). Palaeolithic artefacts from the Mamutowa Cave and the Maszycka Cave are in the collection of the Archaeological Museum in Kraków, but are not part of permanent exhibition. At the Jura Natural and Cultural Heritage Centre in Podlesice (a small regional educational centre) tourists might visit a modern exhibition with a multimedia presentation devoted to the research under the cave deposits of the Jura. The museum collection was prepared on the basis of knowledge and selected materials collected during research carried out in the nearby Stajnia Cave.

Given the fact that collections related to protohumans do not constitute separate museum exhibitions and usually form a minority in aggregated collections (except Krasiejów, mainly as a result of its specificity: it is closer to an entertainment centre than a traditional museum), they are not able to conduct comprehensive narrative of the evolution of humankind, focusing more on selected episodes than on the whole story in all its complexity (complexity not only in the historical sense, but rather in relation to the changing environment and other elements of nature). Dioramas/history windows try to reflect the (usually) environmental and situational context of the presented artefacts, but it is necessarily limited. However, museums whose collections include palaeoanthropological or, more broadly, prehistoric collections usually conduct educational and popularising activities aimed at young people at various stages of education, including early primary schools.

Sites of discoveries related to protohumans and their cultures

So far in Poland, there have been few bone finds associated with known protohuman species. In fact, discoveries of material culture artefacts documenting various Palaeolithic cultures remain much richer. Fragments of Late Pleistocene human bones have been found during excavations at the Stajnia Cave and the Ciemna Cave, both in the Silesian-Częstochowa Upland.

The Stajnia Cave is located in the northern slope of Grzęda Mirowska within a limestone outcrop called the Rock with Grotto, on private land. The cave has two entrances and consists of basically one spacious 23 m-long corridor, 2.5 m wide, 8 m high (Zygmunt 2013). In the cave, artefacts dating back to 110-115 ka BP have been found (Zygmunt 2013), as well as three teeth from representatives of the *Homo neanderthalensis* species (Urbanowski *et al.* 2010; Żarski *et al.* 2017; Picin *et al.* 2020), located in a layer dated by various methods to 49-52.9 ka BP (Dąbrowski *et al.* 2013). The obtained material culture relics included an ornamented mammoth bone pendant, believed to be the oldest ornament made by *Homo sapiens* 41.5 ka BP (Talamo *et al.* 2021), and a horse bone awl. A single tourist information board, located near the entrance to the site, informs visitors about the palaeoanthropological discoveries in the Stajnia Cave.

The Ciemna Cave, also known as the Królewska Cave, is located in Ojców, in the Prądnik Valley within the Ojców National Park. The so-called "Prądnik knives", *i.e.*, a specific type of flint knife characteristic of Neanderthal man's culture made using a specific formation method (Prądnik technique), were discovered and distinguished here for the first time. The presence of Neanderthal man is documented in the cave by numerous flint and stone artefacts. The cave, formed in Jurassic rocky limestone, has a slightly more complex plan than the Stajnia Cave, with three entrance holes leading to it. The main hall is 88 m long, a maximum of 23 m wide, and is 8-10 m high (Gradziński and Michalska 2020). An undisturbed sequence of seven cultural levels dating to the Middle Palaeolithic period was discovered inside. The oldest human remains in Poland were found in the cave: the phalanges of a Neanderthal child dating to about 115 ka BP, and a tooth dated to 50 ka BP (Willman *et al.* 2019). The Ciemna Cave has been one of the tourist attractions easily accessible for centuries. Today, however, it is open to the public under supervision, visits are possible only with a guide. The prehistoric context has been visualised to tourists in a rather modest form: a replica of a Neanderthal encampment and an observation platform with a panoramic view of the Prądnik Valley have been located in front of the cave entrance.

The Obłazowa Cave located near Nowa Biała was inhabited as early as the Palaeolithic 100-40 ka BP, first by Neanderthals and later also by *Homo sapiens*. Stone tools were found there, as well as an object made from a mammoth tusk in the shape of a boomerang attributed to *Homo sapiens*. Other discoveries included Conus shells with traces of incisions (Valde-Nowak 2015) and peculiarly made perforations, two horn wedges, one of them with a curvilinear sculpted ornament, pendants made from polar fox tusks and other stone artefacts. From later times comes a stone tile shaped into a typical Venus female figure, representing the Western European Lalinde-Gönnersdorf style – https://archeo.uj.edu.pl/jaskinia-oblazowa, accessed 14.02.2023; Valde-Nowak and Nadachowski 2014). A hunting camp with a campfire, dating to the first half of the Allerød interstadial, has been recognized in the cave (Valde-Nowak 2008; Valde-Nowak *et al.* 2019).The architectural project of a modern exhibition centre within the archaeological reserve aimed at protection and popularization of the Obłazowa Cave is still at an early stage of realization (looking for funds).

Fig. 1. Educational panels of the educational path in the former brickyard on the slopes of Wine Mountain in Trzebnica dedicated to the prehistory of humans, photo by the author (2021).
The panels' diagrams and content allow viewers to locate the layers where prehistoric relics were found in the sedimentary exposures they are looking at

Some of the oldest Palaeolithic artefacts discovered in Poland come from the Mamutowa Cave (Wierzchowska Lower Cave). They include a small, quadrangular plate made of mammoth bone, with two hanging holes, decorated with rows of punctures, dated to around 30,000 years, and elements of a necklace made of pendants made of mammoth tusk and drilled animal teeth; as well as an object made of a bone of a reindeer toe segment, presumably serving as a whistle (*Archeologiczny Atlas Małopolski. Jaskinia Mamutowa, Jaskinia Wierzchowska Dolna* n.d.).

A collection of Palaeolithic art of the Magdalenian culture has been obtained from the Maszycka Cave (in the Prądnik Valley), consisting, among other things, of a collection of skids (arrowheads) made of reindeer horn decorated with engraved symbolic representations, bone handles with split ends, and an object made of reindeer antler with a hole in the

Fig. 2. Educational panels of the educational path in the former brickyard on the slopes of Wine Mountain in Trzebnica dedicated to the prehistory of humans, photo by the author (2021).
The panels' diagrams and content allow viewers to locate the layers where prehistoric relics were found in the sedimentary exposures they are looking at

centre and phallic decoration on the ends of the appendages, presumably an attribute of shamanic power. The age of the artefacts is estimated to be around 15 ka BP (Kozłowski *et al.* 2012).

The lack or limited use of information about valuable palaeoanthropological and palaeoarchaeological finds and their interpretation, both concerning on-site markers (in geographical space, in specific locations) and various types of popular off-site markers (on their role in creating tourist attractions – MacCannell 1999), does not allow us to take advantage of this heritage in the effective marketing of the place and building local identity (see Mikos von Rohrscheidt 2020).

Sites associated with traces of life of protohumans in present-day Poland also include a clay quarry site in Pleistocene sediments of a former brickyard on the slopes of Wine

Mountain (Winna Góra) in Trzebnica, Lower Silesia. The Trzebnica 2 site has revealed traces of a human encampment of *Homo heidelbergensis* from the Małopolska interglacial period 500 ka BP. Approximately 1,500 stone artefacts and remains of hunted fauna prove that the site served Palaeolithic hunters as a place to quarter game (Burdukiewicz 2006). The second level associated with prehistoric settlement was dated at about 300-350 ka BP. After years of unsupervised tourist or recreational exploration of the former brickyard, the area has lived to see professional tourist development. As part of the so-called Trzebnica Wine Mountain Park, entailing the so-called documentation site "Loess of Wine Mountain" ("Lessy Winnej Góry"; Uchwała... 2016), it included a nature trail (Figs 1-2) dedicated to both geotourism (loess, Pleistocene sediments, fossil valley) and palaeoarchaeological attractions of the site (Palaeolithic hunter encampments). A disadvantage of the otherwise interesting and substantive presentation of the content is the fact that the boards are placed with their backs to the geostationary site (loess outcrop) viewed by visitors, which makes it difficult to compare the description with the reality.

Science and Human Evolution Park in Krasiejów

The Science and Human Evolution Park is part of the Jura Park in Krasiejów. One of Poland's largest "dinoparks" (next to Bałtów and Solec Kujawski), it was created on the site of a cemetery of Mesozoic reptiles and amphibians discovered in 1993 on the site of an open pit clay mine. In the siltstone layer, remains of animals living 225 million years ago were discovered (Dzik 2003). Krasiejów is the richest skeletal excavation area of its kind available for research in Europe, research work has been done here for more than 20 years.

The development of Krasiejów, involving the careful visualisation of Mesozoic life in the landscape of the open pit, has contributed to the popularization of knowledge about the history of the Earth in the age of dinosaurs and its tourist use. The park pursues scientific and educational purposes (palaeontological pavilion, models of prehistoric animals), but is primarily a family amusement park with a 5D cinema, an oceanarium, a time tunnel, and a food and souvenir complex. All that is maintained in the style following pop-culture products such as films about dinosaurs or "fun" prehistory, popular in the late 20th century, *e.g.* "Jurassic Park" (1993, directed by Steven Spielberg) or "The Flintstones" (1994, directed by Brian Levant). The Science and Human Evolution Park, located in the immediate vicinity but outside the dinopark's boundaries complements the complex. It is a joint or individual tourist product, depending on visitors' preferences. The facility does not have the status of a museum, it is more of a knowledge and science centre, similar to such facilities as Wrocław's Hydropolis or the Copernicus Science Centre in Warsaw. In terms of the display tools used, it does not deviate from the latest trends in museology. Dr. Andrzej Boczarowski, among others, was responsible for the substantive layer of the exhibition. Using a "space shuttle," visitors leave behind the present and take a journey to the begin-

Fig. 3. One of the dioramas – "windows of prehistory" of the Science and Human Evolution Park in Krasiejów, photo by the author with permission of the Science and Human Evolution Park in Krasiejów (2022)

nings of the history of mankind. Guided by a virtual tutor (3D glasses, augmented reality) and by a remotely played narration (audioguide), visitors follow subsequent "windows of prehistory". These are professionally prepared dioramas referring to the most important palaeoanthropological discoveries, documenting the evolution of the hominidae. They are a reminiscence of traditional forms of museum display of natural history collections, and those related to man, alluding to the famous 19th century natural history museums. The depicted scenes, usually dynamic and full of emotion, captivate not only with realism, but also reflect the current state of knowledge about specific types of hominidae and about the lives and circumstances of death of specific individuals. This is the case, for example, with the scene showing a pair of adult australopithecines witnessing the abduction of their child by a bird of prey (Fig. 3). According to research, the remains of the Taung Child (*Australopithecus africanus*) bear the marks of attack and feeding by such an animal (Berger 2006).

The scenes selected in this visual time travel include one that "de-emphasizes" the image of Neanderthals as incapable of social behaviour characteristic of *Homo sapiens*. The diorama (Fig. 4) depicts a group of individuals burying and mourning the deceased (Neanderthal floral burial from Shanidar Cave; Leroi-Gourhan 1975; Pomeroy *et al.* 2020). The portrayed scene is deeply emotional. However, it is noteworthy that the intentional laying flowers on a Neanderthal grave is contested in the light of current studies (Hunt *et al.* 2023).

Fig. 4. "First funeral" diorama. Science and Human Evolution Park in Krasiejów, photo by the author with permission of the Science and Human Evolution Park in Krasiejów (2022)

Fig. 5. The Ancestors Gallery, Park of Science and Human Evolution in Krasiejów, photo by the author with permission of the Park of Science and Human Evolution in Krasiejów (2022)

The Krasiejów exhibition is extended with the Ancestors Gallery with a collection of casts of skulls of ancestors and cousins of modern humans (Fig. 5), complete with interactive multimedia to supplement knowledge, replicas of the oldest products of human culture like the famous Palaeolithic Venus, as well as painted and sculpted representations of prehistoric animals, and the history of selected tools such as flint knives. Some parts of the Krasiejów exhibition focus on the more recent (and commonly more recognizable) history of modern humans. Extraordinary visual and factual precision was shown by the creators of dioramas depicting the so-called Oetzi mummy, a man found in an Alpine glacier from over 5,000 years ago (Kutschera and Rom 2000). Visitors learn about the dramatic circumstances surrounding the death of this prehistoric man and the purpose of the objects he was carrying. The choice of this particular artefact for the Krasiejów exhibition (and others, devoted to protohumans) does not seem to be accidental from the point of view of effective, "hot" interpretation – the dramatic moments that the hunter experienced before his death make him the hero of a downright criminal, therefore intriguing, mystery.

The narrative of the remotest past of mankind is complemented by information about the migrations of human ancestors over millions of years and their impact on modern human populations, as well as reports of sensational new discoveries in the field of palaeontology, to which Polish scientists have also contributed (*e.g.*, the discovery of traces of the march of bipedal hominidae from 5.7 Ma BP, at Trachilos in Crete, Gierliński *et al.* 2017).

DISCUSSION

Although the potential of palaeoanthropology and palaeoarchaeology in Poland, both in museums and *in situ* sites (places of discoveries), seems if not high (especially regarding the former type of heritage), then certainly significant, the question arises whether it is sufficiently visible against the background of other types of heritage used in various ways for educational as well as tourist purposes. This is certainly not helped by the considerable dispersion of collections presented in different types of museums. These are Earth museums, natural history museums, and historical and archaeological museums. This is due to the fact that the protohumans are usually set in two strong contexts, namely as parts of nature (subject to its laws) and producers of culture (changing the world for their needs). Although these contexts are strongly linked, they are often displayed separately in the museum space.

As stated earlier, no museum's name emphasises the heritage of human evolution or the oldest Palaeolithic cultures. The most valuable museum collections related to these two categories are never or rarely the subject of permanent exhibitions, just occasionally leaving museum storage rooms. Full catalogues of the antiquities (not only those presented in exhibitions) are not made available in easily accessible, open channels of communication with the viewer/visitor. Therefore, it is difficult to know the whereabouts of the remains related to the prehistory of humans and their most ancient cultures found in Poland. If this information is available, visitors often do not know whether they will be interacting with the original artefacts in the exhibitions or with their replicas. In terms of recognising the palaeoanthropological context, the Science and Evolution Park in Krasiejów is certainly in the avant-garde, but despite its great educational potential, it is not able to provide the power of the original (often very old) artefact.

From the point of view of achieving marketing goals, the dispersal of palaeoanthropology and palaeoarchaeology monuments is not beneficial for this heritage. Ideologically, however, it is justified. Małczyński (2022), for example, points out that natural history museums can be regarded today as museums of the Anthropocene, emphasizing man's place in nature and the impact he has on the world (in all its complexity) in which he lives. The author (2022, 93) writes: "Dioramas have become a 'natural' habitat for many extinct species which can now only be seen in museum display cases" and "the collected (...) artefacts conceal narratives about complex relationships between species."A similar way of presenting the remains of extinct human species surrounded by extinct or endangered fauna can therefore give visitors food for thought in the context of man's destructive impact on the environment and the future of the human race in a world which is now changing drastically as a result of human activity. Małczyński (2022, 93) claims that natural history museums also create, scary as it sounds, "retrospective predictions" on the basis of their collections. According to Stobiecka (2020, 16), on the other hand, an archaeological museum, especially one that develops the concept of a critical museum, negotiates meanings and promotes interpretive polyphony. In the case of such a thriving science as palaeoanthropology today, this can be of colossal importance not only for the dissemination of currently acquired or modified knowledge, but also for shaping the image of an extremely vital science, looking to the past through the use of innovative methods and high-tech tools. In both cases – a natural history museum or an archaeological museum – even modest palaeoanthropological or palaeoarchaeological exhibits can constitute the basis for "hot" interpretation, referring directly to the most pressing problems of the present day. In her reflections, Stobnicka (2020) emphasises the importance of original artefacts, even when they do not seem exciting in terms of form. According to the author, it is the animation of artefacts, rather than so-called "digital escapism", that is the best path forward for archaeological exhibitions (and thus also those presenting palaeoanthropological or palaeoarchaeological collections). The author best sums up her view of the role of artefacts in contemporary museology with the words:

> An exhibit, therefore, is a material, given to us element of museum reality which, as a result of scientific framing, becomes a foundation in the process of presenting knowledge. As such, it has the potential to stimulate the imagination. I believe that the exhibit, understood in such a way, is the most important museum tool in the process of showing the current state of research, scientific developments, and prevailing theories (Stobiecka 2020, 108).

Thus, it seems that museums presenting fossilised human remains and cultural heritage of the oldest human history should reconcile the goals of aesthetic exhibitions, which emphasise the qualities of the artefact itself (in this case, the fossilized bone material of protohumans and the products of their culture), and contextual exhibitions, where the essence of a visit to the museum is additional information placed on boards, walls, labels, or transmitted to visitors in a multimedia version. In both types of exhibitions, where original artefacts are presented, the support (but not the core of the exhibition) can be modern multimedia display tools used in different ways and for different purposes.

In the case of palaeoanthropological collections, most artefacts need to be "clothed in flesh" in order to be legible yet attractive to visitors. Traditional dioramas use figural representations made by artists based on existing scientific knowledge of various species of protohumans. However, realistic figures are not only bones and muscles, they are also poses, gestures, emotional facial expressions, but also the contexts in which these reconstructions are presented. Visualizations of representatives of specific species of protohumans in museums are not repetitive templates. Although they reflect the main typological features, they vary in detail. In this context, questions arise about the boundaries between the truth confirmed by facts and the images of the past, and the desire to see in the ancestors a reflection of ourselves – modern people. The problem of authenticity and credibility arises also from multimedia visualizations. Stobiecka (2020, 249) writes: "(...) a digitally generated image may seem, on the one hand, too real and thus be uncritically accepted as objective 'truth'".

Preparing substantively credible yet visually appealing models is an arduous, costly process, requiring extensive consultations, both scientific and technical. As Boczarowski, the author of numerous scenarios for paleontological exhibitions, emphasizes, it also requires creativity and, in a way, sense and intuition (Rożko 2008). The quality of the resulting visualisations is responsible not only for the nature of the viewer's tourist experience and emotions, but also ultimately for the image (true or false) and knowledge (reliable or not) they will take away from the exhibition.

The role of modern means of virtual exhibition seems particularly important for virtual museums. They are complementary to visits to traditional museums and, at the same time, indispensable when the visitor does not have the opportunity to interact with the original exhibit. This is usually the case for two reasons: when a valuable artefact is too fragile, sensitive to be the subject of regular display, or when most collections for practical reasons rarely or never leave museum storage rooms. Small, fragmentary artefacts tend to be overlooked in grand narratives (Pearce 1990). Most Polish museums whose collections contain palaeoartefacts related to the biology of the protohumans or the products of their culture have an online offer of a virtual walk-through, during which the viewer has the opportunity to familiarise themself with the spatial organization of the exhibitions and, to some extent, the exhibits presented. To a small degree, they can use such advanced virtual exhibition tools as narrated 3D animations of major artefacts, which is, for example, a frequent practice of such museums as the Smithsonian National Museum of Natural History. A Polish archaeological museum which stands out in this regard is the Archaeological Museum in Kraków, implementing the COME-IN! project, which includes the visualisation of selected (very few) artefacts (including a 50,000 year old Prądnik knife and a 35,000 year old shouldered point) with audio-description and commentary in sign language (https://ma.krakow.pl/aplikacja-comein/ – accessed 07.02.2023). Improving the visibility of the heritage of paleoanthropology and paleoarchaeology against other categories of heritage would certainly be helped by digitizing, classifying and making the artefacts available virtually, given the vastness of the collection, probably including the most valuable exhibits first. This process is taking place in Polish archaeological museums, but it is progressing slowly and so far in a selective rather than comprehensive manner. Virtual access to artefacts serves both to conduct research on them (*cf.*, Pyne 2019, 270) and to make them available for a wider audience, especially among people who are looking for non-academic ways to develop their scientific passions.

In her discussion of the shape of the modern archaeological museum, Stobiecka (2020) points out that the multimedia tools of the exhibition make it a dynamic, inclusive and participatory creation. She writes (2020, 238): "multimedia exhibitions provide visitors not only with an image of the past, but also with the means to 'feel' it with their senses". In a museum treated as an institution of living culture, as a space for dialogue, emotion and experience rather than a simple depository of the past, this is an undoubted advantage. On the other hand, however, an excess of multimedia of various types and quality may trivialize exhibitions, obscuring the value of original museum artefacts, reducing a visit to the museum to playing with gadgets. Given the nature of the museums described and the degree of saturation with modern means of museum display, there is still a long way to go to such a situation. In the Science and Human Evolution Park in Krasiejów, the described problem does not seem to be primary, as the exhibitions are based on multimedia and replicas.

Given the nature of the bone material acquired in Poland from the most ancient people, one may ask whether an interesting museum narrative can be built on a single human phalanx or tooth? While opinions are probably divided, it seems that in this case the strength of this humble heritage is the knowledge it reveals about the past through modern research methods and tools. Their use may come as a surprise to visitors. These additional touches to the museum narrative help build the image of sciences perceived statically (archaeology, palaeology, palaeontology, anthropology), happening in serious lecture halls, locked in glass (dusty) display cases, as vital, creative and dynamic. It is increasingly a world of sterile laboratories, and in the field the researcher's intuition is supported by GPR (Ground Penetrating Radar), lidar scanning and other modern research tools.

As for the sites from which have been obtained both bone material and material culture relics related to the most protohuman history, only the Ciemna Cave is equipped with infrastructural elements that emphasise this context of their tourist attractiveness. The remaining sites are spaces of free exploration, mainly in various forms of qualified tourism (*e.g.*, hiking, climbing, caving tourism, *etc.*), devoid of any tools of tourist interpretation. In the case of caves whose palaeoanthropological and palaeoarchaeological context is not directly recorded in the form of a site, and where the objects found have been deposited in museums, it is necessary to authenticate the distant past in the landscape using display tools similar to the geotourism that is thriving today. In geotourism, special emphasis is placed on the illustrative (demonstrative), cognitive qualities of unique, rare landscape forms, representative of specific geological, geomorphological (and other) processes (Welc and Miśkiewicz 2020). Presented in a broader context, the final goal is to increase visitors' awareness of the complexity and beauty of the Earth's heritage, the human impact on the environment, and vice versa. Geotourism also aims to effectively communicate science: to reach a wider audience with highly factual scientific knowledge in an accessible way.

Tourism infrastructure for geotourism emphasizes the direct relationship of the information presented to the object observed. Thus, it is not enough to provide visitors with "dry facts," they must be properly linked to both the site/object with its specific features, and the observer's experiences/emotions. In interpreting the most ancient ancestors/cousins of humans, not only their physical skills that guarantee survival in a hostile environment are increasingly emphasized, but those characteristics and behaviours which distinguish humans in the animal world and at the same time bridge the gap between the past and present. Equally important are the palaeoenvironments they inhabit, which are more than just a backdrop for evolution.

Most caves mentioned in this paper – places of palaeoanthropological and palaeoarchaeological discoveries – are easily accessible locations that do not require the use of speleological techniques in tourist exploration. The physical remains (fossilised remains of protohumans, artefacts and other material items) obtained during scientific research there are not available on-site. Thus, regarding prehistorical context visitors have to rely on their imagination, admiring instead the beauty of extensive rock shelters and rock labyrinths. In this particular case, the availability of high-quality and substantive prepared multimedia on-site (*e.g.*, via QR codes) becomes a necessary condition to show visitors how caves functioned as human shelters, hunting camps, or places of worships several dozen thousand years ago. According to Nowacki (2020), both virtual reality (VR) and augmented reality (AR) are of great potential to intensify immersive experiences, they can be included in the process of heritage interpretation *in situ* (while travelling, on-site) and *ex situ* ('armchair archaeology') as well.

CONCLUSIONS

The media interest generated by the latest discoveries in palaeoanthropology and their importance for understanding the history of humankind, and in light of the current changes related to global warming revealing the future of humans on Earth to be fragile and uncertain, it is time for the legacy of this science to find a more prominent place in the museum mainstream. Although artefacts related to early humans and their culture have been present in Polish museology for a long time, they do not stand out significantly from the collections. Among the possible recommendations for achieving change in this regard would be actions aimed at:

– Giving prominence of this type of heritage in museums by focusing on both: “physicality” of specific representatives of humankind and the network of interconnections between humans, other species, the whole of nature and environment (a challenge might be in maintaining balance in this whole narrative); This approach is known and partially practiced in Polish museums with palaeoanthropological and palaeoarchaeological collections (as previously described – usage of dioramas, history windows, replicas, and staged authenticity), but due to the size of the exhibitions, it still leaves room for museum creativity and further development. The author’s proposal is in line with Mikos v. Rohrscheidt (2020), who underlines the necessity of diversity of interpretative messages that results from knowledge about the use of stimuli in learning processes, as well as knowledge of the expectations of modern tourists who prefer a variety of experiences;

– Making fuller use of the tourist potential of *in situ* sites (places of palaeoanthropological and palaeoarchaeological discoveries) through the implementation in archaeotourism of the rich experience of geotourism in the creation of a tourist infrastructure that allows full and optimal use of the wide-ranging tourist values of the sites. Since the tourist experience is usually complex and the tourist exploration is motivated by different needs, in the places of palaeoanthropological discoveries one should reach for their different contexts – related to human biology, culture, the environment in which protohumans lived, and the transformations that took place in this environment under the influence of the presence of our ancestors. Different kinds of tourist attractiveness of the site should not be separated;

– Expansion of the offer and fuller use in school education of museum lessons in museums and open-air museums offering palaeoanthropological and palaeoarchaeological collections, as well as field education in sciences such as biology, geography and selected humanities subjects (history, cultural science, art) for better communication of science in the social dimension. This proposal seems to be a natural consequence of the postulate of presenting palaeoanthropological and palaeoarchaeological collections in extensive spatial, environmental, socio-cultural and scientific/technological contexts. Museums with palaeoanthropological and palaeoarechaeological collections in Poland, as shown, have the regular educational offer, but not always equally broad and targeted at different groups of recipients (mainly early school children, less for special interest groups).

Regarding the small number and rather not spectacular nature of the fossilised remains of protohumans obtained in Poland, it seems that contextual exhibitions will be a more appropriate form of organizing exhibitions. However, where original exhibits can also be shown, a “turn towards objects” is postulated by which is meant, according to

Stobiecka (2017), a turn towards materiality, physical sense, and sensory cognition, allowing for fuller involvement of visitors which encourages reflection on the presented museum artefacts.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3374

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ATTEMPTS AT SPATIAL ANALYSES OF DATA FROM THE POLISH ARCHAEOLOGICAL RECORD

ABSTRACT

Solecki R. and Smereczyńska P. 2023. Attempts at spatial analyses of data from the Polish Archaeological Record. *Sprawozdania Archeologiczne* 75/2, 37-50.

Since the mid-1970s, the Polish Archaeological Record has been a national program in Poland with the primary objective of cataloguing archaeological sites, providing detailed descriptions and exact geographical locations. It is in operation to this day. So far, approximately 90% of the area of Poland has been prospected and almost 470,000 archaeological sites catalogued. Currently, work is underway to digitise the entire database. This paper presents our attempts to use the digitised data from this database to study the intensity of settlement processes in the past as well as how to visualise these data on a map. For the purpose of this research, archaeological data from an area in the northeast of Poland were digitised in a GIS environment. Examples of similar spatial analyses were taken from Scottish and Czech research and adapted to this case. The results, a series of maps showing the intensity of traces of human habitation in different time periods, demonstrate the strengths and weaknesses of such visualisations.

Keywords: GIS, Polish Archaeological Record, archaeological prospection, spatial data, spatial analysis
Received: 01.02.2023; Revised: 22.05.2023; Accepted: 15.07.2023

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INTRODUCTION

As David Unwin noted back in 1996, the importance and availability of spatial analyses will grow, especially those based on data that can be easily imported into a GIS (Geographic Information System) environment – GISable (Unwin 1996, 548-549; Openshaw and Clarke 1996, 21-30). Now, over 20 years after this statement, spatial analyses performed in a GIS environment are ubiquitous in almost every area of life and the economy. The ease of preparing this type of analysis results from the relative ease of collecting spatial data on the basis of currently available instruments and methods. A problem arises, though, when we want to use for spatial analysis data that were not collected with the intention of being used in a GIS environment. The Polish Archaeological Record is a large archive of such spatial data.

The first attempt at making a systematic catalogue of archaeological sites in today's Poland can be dated back to the mid-19th century. The field prospection carried out at that time, however, did not have a standardised methodology and was rather local in scope. The methodology of this type of research was significantly developed in 1965-1974, when Stefan Woyda (then conservator of the Warsaw Voivodeship) conducted a large-scale survey of the area around Warsaw, inventorying dozens of previously unknown archaeological sites (Woyda 1981, 11-20; Kozioł *et al.* 2012, 133-135). Based on these experiences, efforts were made to extend the research to the entire territory of Poland. The year 1978 can be regarded as the official start date of the national program "Polish Archaeological Record" (pol. Archeologiczne Zdjęcie Polski – AZP). It was then that the methodology for conducting surface archaeological prospection was formulated for this project, a manual for the preparation of documentation was created, and the "Form of Archaeological Site" (pol. Karta Ewidencji Stanowiska Archeologicznego – KESA) was developed (Grabowski 2012, 73, 74). In following years, the name of the form was changed to Archaeological Monument Record Sheet (pol. Karta Ewidencji Zabytku Archeologicznego – KEZA), and its current name is Land Archaeological Monument Record Sheet (pol. Karta Ewidencyjna Zabytku Archeologicznego Lądowego – KEZAL).

For the Polish Archaeological Record project the entire area of Poland was divided into rectangular polygons. In the assumptions made in the 1970s, such a polygon should have a size that fits an A4 sheet of paper when scaled to 1:25,000 on a map. According to this, in reality, the size of a polygon is approximately 5 km North-South and 7.5 km East-West, with an area of 37.5 km^2 (Kozioł *et al.* 2012, 134; National 2012). Every such polygon has a unique number. A grid of these polygons is available to download as a WMS (Web Map Service) and free to use in a GIS environment.

The Polish Archaeological Record project continues to the present day and over the years has been periodically modernised, including the use of GPS (Global Positioning System) devices and GIS applications (Bryk and Chyla 2013, 19-27), DEMs (Digital Elevation Model) obtained with the use of LiDAR (Light Detection and Ranging) technology (Zapłata *et al.* 2018, 95-103), and the inclusion of archaeological sites located within cities (Florek 2018, 59-67) and underwater (Kaźmierczak 2018, 83-89). Recently it has been focusing on acquiring information about archaeological sites with the use of non-intrusive prospection (Oniszczuk and Makowska 2021). So far, approximately 90% of the area of Poland (the area of Poland is 312.696 km^2) has been surveyed, and almost 470,000 archaeological sites have been catalogued (Siemaszko 2018, 7, 8; Niedziółka 2016, 122). Over the past few years, work has been underway to digitise the entire database. Part of it is already included on the website of the Polish National Institute of Cultural Heritage, which is currently managing this database (Oniszczuk and Makowska 2017).

According to David Ebert's hierarchy, which consists of three levels of GIS application in archaeology (Ebert 2004, 320, 321), the Polish Archaeological Record database pertains to the first two levels: "visualisation" – it shows the location and size of archaeological sites, and "management" – it organises and generally classifies information about archaeological sites. Combined data from these two levels enable us to perform the procedure from Ebert's third level: "analysis".

This paper presents our attempts to use the digitised data from the Polish Archaeological Record to study the intensity of settlement processes in the past and how to visualise the results of spatial analysis on a map. Similar efforts were performed recently on the basis of the same data, but these have tended to focus on changing the parameters of visualisation (Kołodziej 2011, 85-91) or on statistical analysis (Niedziółka 2018, 115-134), rather than typical spatial analysis. Here, spatial analysis will be carried out using GIS. The results, a series of maps presenting the intensity of traces of human habitation in different time periods, will show the strengths and weaknesses of such visualisation.

METHODS AND RESULTS

In the Polish Archaeological Record project, every archaeological site has its own record sheet. A set of information about each archaeological site is described therein, including precise administrative information (town, municipality, county) and details specifying the type of archaeological site, its chronology, type of acquired archaeological sources and also specifying who conducted the research and when. The area and location of an archaeological site is shown on the attached map at a scale of 1:10,000. A geoportal with the location of already digitised archaeological sites is available at https://zabytek.pl. This enables archaeologists to display and categorise the locations of archaeological sites (defensive architecture <fortifications, shafts, castles>, sacral architecture <places of worship, temples>, manor houses and palaces, mounds, battlefields, sites with an economic function, settlement sites <hillforts, caves, settlements>, sepulchral sites and others) and chronology (the main periods being Palaeolithic, Mesolithic, Neolithic, Bronze Age, Iron Age, 600 AD, 1000 AD, 1500 AD, 1700 AD, 1900 AD).

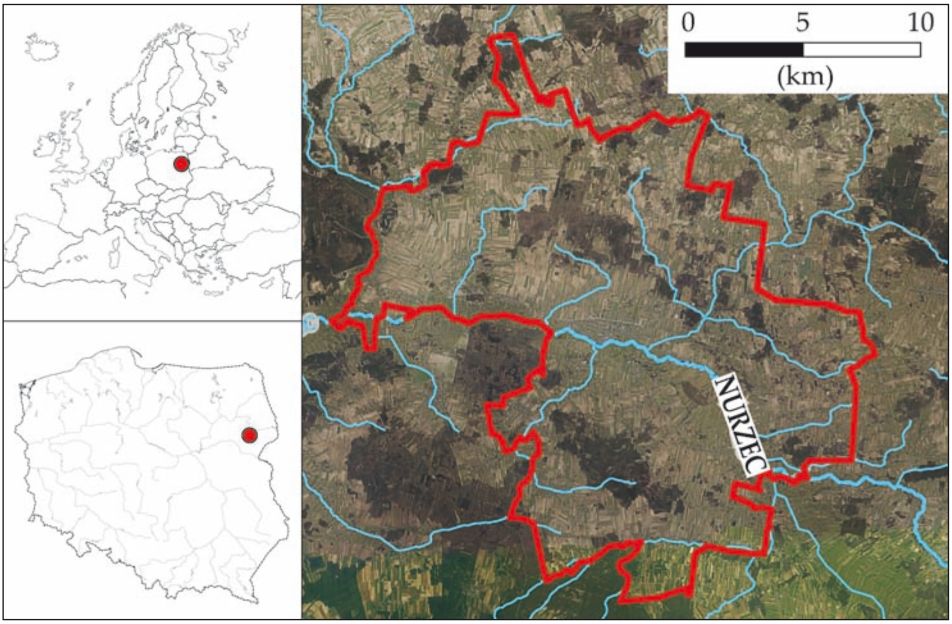

Fig. 1. Location of Brańsk Commune, an administrative area the Archaeological Record of which is the subject of spatial analysis (source: www.geoportal.gov.pl; processing by R. Solecki)

For the purpose of this research, archaeological data from one administrative region in Poland was scanned from the original paper documents, then digitised, vectorised and optimised for GIS. Brańsk Commune in northeast Poland was chosen as the geographical area of interest (Fig. 1). It has an area of 259 km^2. It is located on a plain, which is crossed by the Nurzec River, flowing from east to west. Two significant tributary rivers, the Siennica and the Czarna, also run through the area. This area is of interest because of the presence of 1208 catalogued archaeological sites with traces of human habitation (Table 1). The oldest confirmed archaeological finds can be dated back to the Palaeolithic era, with many sites from the Mesolithic, Neolithic and Bronze ages also present (Romaniuk 1994, 4-13), but there are also traces of human habitation from the Early Iron Age linked with the pre-Roman period and then from Early Mediaeval to Early Modern times. For the purpose of preparing the GIS database, when traces of two or more phases of habitation were found in one location, each phase was counted as a separate archaeological site

Brańsk Commune is covered by 15 AZP polygons. All archaeological records within these polygons were digitised in the GIS and described with five characteristics:

• AZP ID – the unique number attributed to every catalogued archaeological site.

• Type – the type of archaeological site. They were classified as traces of habitation (513 sites), small temporary camps (228 sites), settlements (444 sites), cemeteries (19 sites), hillforts (3 sites) and a manor (1 site).

Table 1. Information about the chronology and types of archaeological sites within the borders of Brańsk Community (processing, R. Solecki)

	Palaeolithic	Mesolithic	Neolithic	Bronze Age	Early Iron Age	Early Medieval	Medieval	Late Medieval	Early Modern	Sum
Traces of habitation	78 15.2% 84.8%	62 12.1% 81.6%	18 3.5% 69.2%	93 18.1% 58.5%	47 9.2% 51.6%	49 9.6% 24.6%	37 7.2% 40.2%	47 9.2% 30.7%	82 15.9% 25.6%	513 100% 42.5%
Small temporary camps	14 6.1% 15.2%	13 5.7% 17.1%	6 2.6% 23.1%	24 10.6% 15.1%	3 1.3% 3.3%	44 19.3% 22.1%	19 8.3% 20.7%	25 11.0% 16.3%	80 35.1% 25.0%	228 100% 18.9%
Settlements		1 0.2% 1.3%	2 0.4% 7.7%	39 8.8% 24.5%	37 8.3% 40.7%	94 21.2% 47.2%	35 7.9% 38.0%	81 18.3% 53.0%	155 34.9% 48.5%	444 100% 36.7%
Cemeteries				3 15.8% 1.9%	4 21.1% 4.4%	10 52.6% 5.1%			2 10.5% 0.6%	19 100% 1.6%
Hillforts						2 66.7% 1.0%	1 33.3% 1.1%			3 100% 0.2%
Manors									1 100% 0.3%	1 100% 0.1%
Sum	92 7.6% 100%	76 6.3% 100%	26 2.2% 100%	159 13.2% 100%	91 7.5% 100%	199 16.5% 100%	92 7.6% 100%	153 12.7% 100%	320 26.4% 100%	1208 100% 100%
Entry: quantity % in row % in column										

• Chronology – assigned to predetermined periods – Palaeolithic (92 sites), Mesolithic (76 sites), Neolithic (26 sites), Bronze Age (159 sites), Early Iron Age (91 sites), Early Mediaeval (199 sites), Medieval (92 sites), Late Medieval (153 sites), Early Modern times (320 sites). This division was necessary to identify the distinct categories that would apply to every type of archaeological site chronology recorded on the record sheets. The original descriptions varied – sometimes they referred to an archaeological culture (*e.g.*, Corded Ware culture), sometimes to an archaeological epoch (*e.g.*, Stone Age) and sometimes to a specific century or even decade. Without systematisation it would not be possible to use this data in further analyses.

• Artefacts – amount of artefacts – mostly ceramic sherds of different vessels – collected during field prospection.

• Size – determined upon gaining information on the archaeological site during field prospection. Here, there were six categories:

$\mathbf{1} \leq 100\ m^2 < \mathbf{2} \leq 5000\ m^2 < \mathbf{3} \leq 10000\ m^2 < \mathbf{4} \leq 50000\ m^2 < \mathbf{5} \leq 150000\ m^2 < \mathbf{6}$

The size categories presented above, which correspond to the amount of ceramic sherds found during field prospection, served as the basis for assigning a value to each archaeological site.

The intensity of occurrence of archaeological sites in given area, which may be linked with density of habitation, can be visualised as a choropleth map, in a grid of squares. Similar attempts to visualise the intensity of occurrence of archaeological sites in a specific area were undertaken in Scotland. From the mid-1980s, field prospections were carried out by the former Royal Commission on the Ancient and Historical Monuments of

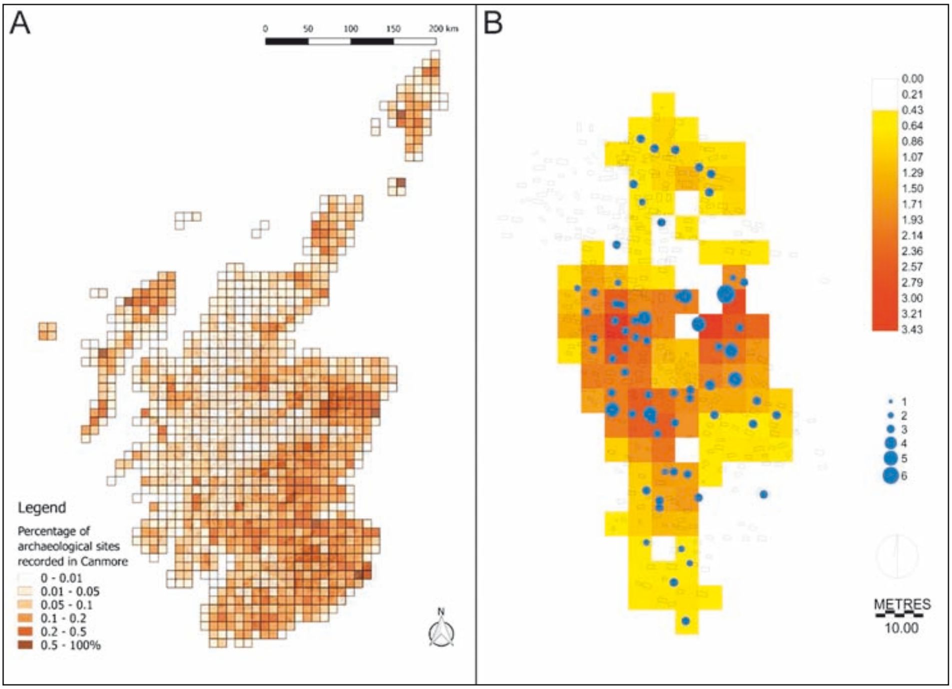

Fig. 2. A – density of archaeological records in Scotland (Banaszek *et al.* 2018, fig. 2), B – distribution of artefacts among the cemetery visualised in the square grid (Šmejda 2004, fig. 10)

Scotland (abbrev. – RCAHMS) and recently by Historic Environment Scotland (abbrev. – HES). The results were catalogued in the National Record of the Historic Environment (abbrev. – NRHE). Because of the uneven coverage of prospection across the country, the data cannot be used for spatial analyses on a national or regional scale. For the purposes of presenting the current state of the archaeological database, an interesting map was prepared (Fig. 2: A) which shows the density of archaeological records in Scotland organised in 10 km grid of squares (Banaszek *et al.* 2018). Such maps with a grid of squares are constructed in such a way that the intensity of colour in each cell represents the density of archaeological sites. A regular pattern enables spatial analysis in a GIS environment, which is characteristic of raster data (Herbei *et al.* 2018, 151-156).

Another similar example of presenting spatial data, but of micro-scale, was that from a prehistoric cemetery at Holešov in the Czech Republic. The method of presenting spatial analyses results in regular 5 m grid squares was used there to show the distribution of artefacts within the cemetery. It is important to note that the value shown in each cell was not the result of counting of artefacts within its borders but was instead recalculated using a mean filter with a kernel made up of a 3 × 3 grid of cells (Fig. 2: B). This procedure was used to reduce the errors that can be visible while visualising the “raw” values; these errors

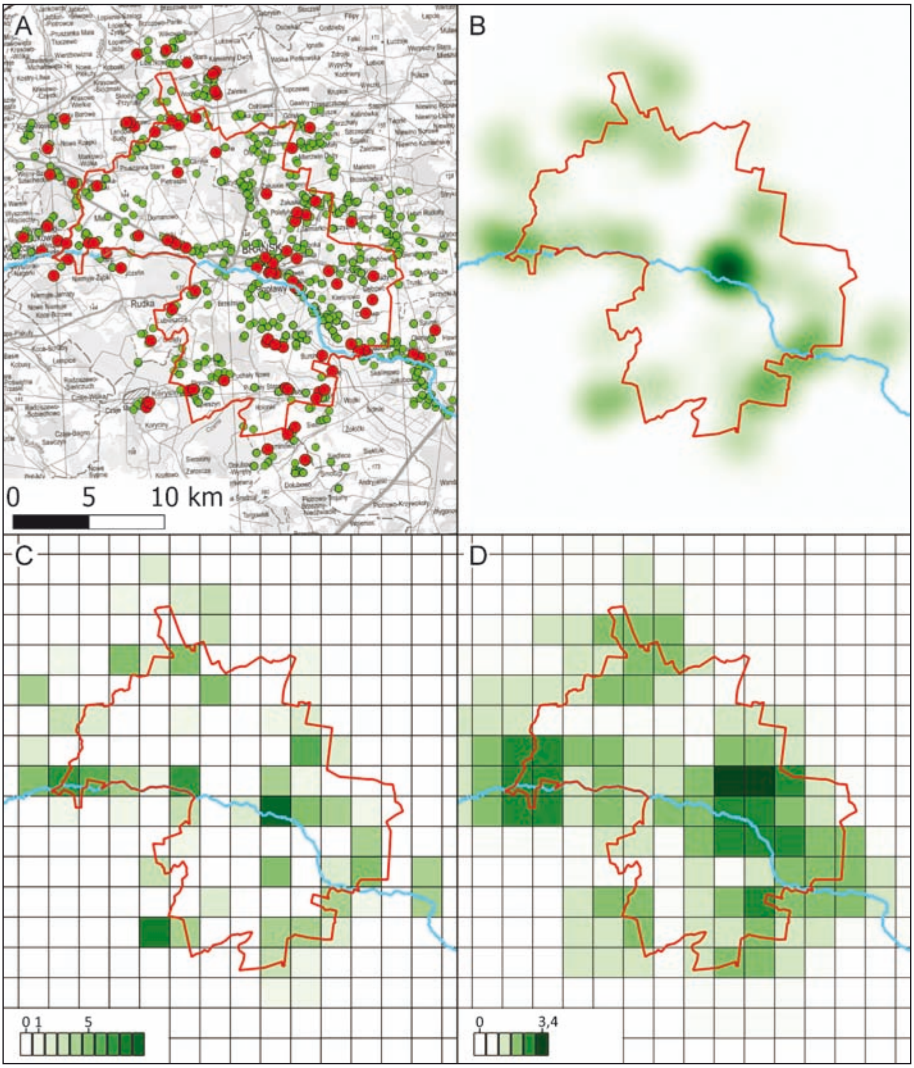

Fig. 3. Examples of visualisation of the density of Palaeolithic sites within the borders of Brańsk Community: A – on the background of a topographic map (green points – all archaeological sites; red points – Palaeolithic sites), B – the cluster map, C – grid of squares colourised on the basis of the quantity and size of the sites, D – grid of squares colourised on the basis of the quantity and size of the sites and then recalculated with a mean filter with a specified kernel size (processing R. Solecki, P. Smereczyńska)

can appear when the input point of the grid is changed and the grid is moved (Šmejda 2004, 59-63).

The simplified method – without using a mean filter with a specified kernel size – had already been used in Poland to analyse the distribution of flint material at the Neolithic

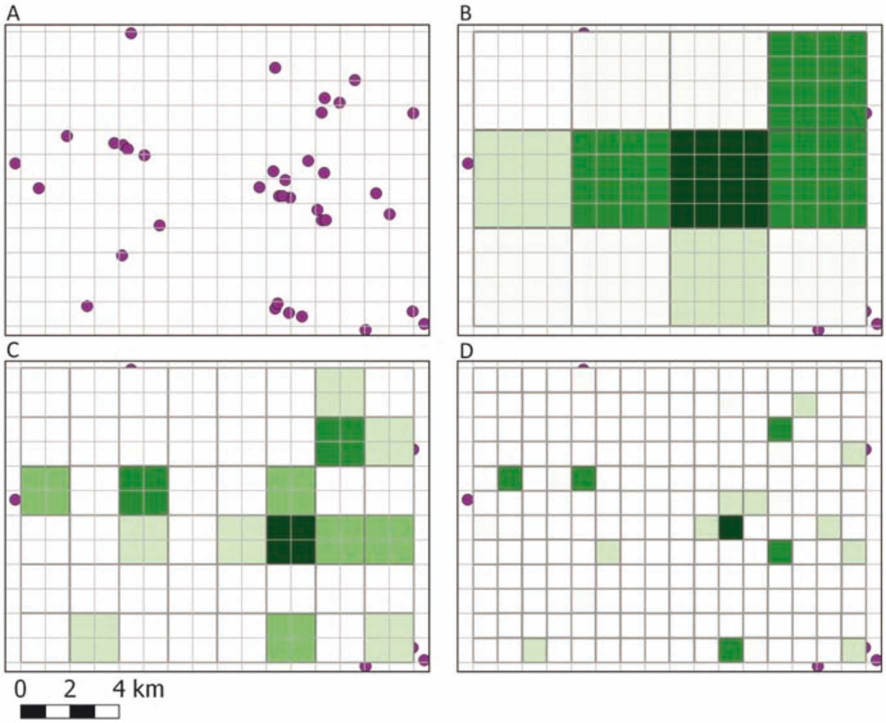

Fig. 4. Different variants of visualisation of archaeological sites located in the same area: A – location of sites in relation to a grid of squares, each with side length of 1 km, B – visualisation of the density of sites in relation to a grid of squares, each with a side length of 4 km, C – visualisation of the density of sites in relation to a grid of squares, each with a side length of 2 km, D – visualisation of the density of sites in relation to a grid of squares, each with side length of 1 km (processing, P. Smereczyńska)

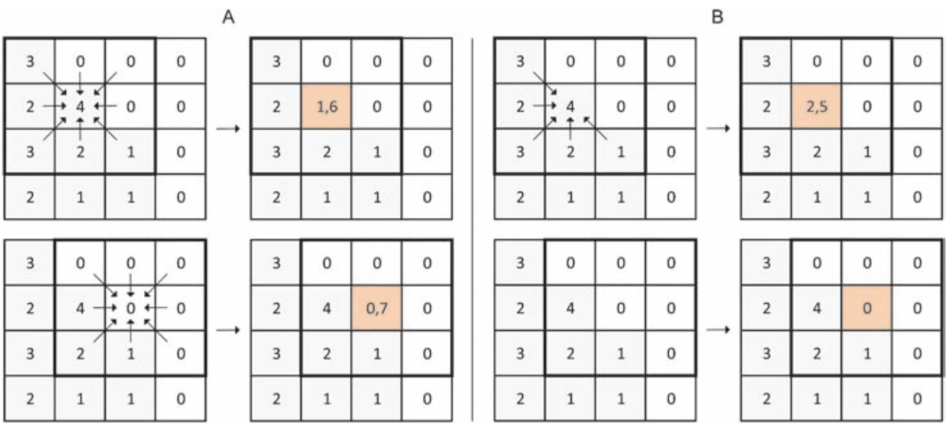

Fig. 5. Methods of recalculation of values: A) mean filter with a kernel in a 3 × 3 grid, B) a mean filter with a kernel in a 3 × 3 grid, ignoring cells where the value is "0" (processing R. Solecki)

flint mine "Oszybka" in Pakosław. Apart from this analysis, there was a cluster map that showed the concentration of artefacts. This kind of visualisation of spatial data was easy to perform and refine (Szubski *et al*. 2017, 116-119).

Here it is worth to mention the presentation of spatial data in the form of choropleth map needs a proper source data (absolute or relative, unprocessed or processed), carefully chosen aggregation area and a proper graphic scale (Pieniążek and Zych 2017, 122-130; Pieniążek *et al*. 2015, 50-59; Nowacki 2019). It is also important to choose a proper classification method to show analysed spatial data with the most higher accuracy (Całka 2018). Without a proper alignment of these variables the choropleth map will show an invalid presentation.

In order to visualise the data from the Polish Archaeological Record, tools and plugins provided by QGIS were used (version 3.22 Białowieża). The results of spatial analyses performed are in the form of maps showing the intensity of occurrence of archaeological sites. As an example, Figure 3 shows visualisations of Palaeolithic sites, with the intensity of occurrence displayed as a green gradient.

The easiest way to visualise the data was by using a "Heatmap renderer". This allows one to set the radius of the occurrence and to define the weight of the points based on a specific characteristic – here it was based on the size of the archaeological site (Fig. 3: B). This kind of visualisation does not require any additional actions and can be prepared straight after the database is properly completed.

The second example of visualisation requires a regular grid of squares, each with a side length of 2 km, to be laid over the region of interest. The grid was set parallel to the axis of the flat rectangular coordinate systems PL-1992 (EPSG 2180). The input location of the grid was chosen randomly in order to potentially cover the digitised locations of archaeological sites evenly. The 2 km grid seemed to show the optimal precision of analysed data – the 4 km grid was too generalised, and the 1 km grid was too itemised (Fig. 4).

To visualise the data in a prepared grid of squares, it is necessary to count the cumulative value of the archaeological sites in every cell and classify it in equal intervals (Całka 2018, 23). The maximum of that range is the highest summation value (Fig. 3: C). This kind of visualisation is closest to the original data recorded in the Polish Archaeological Record archive, but it is not robust when the input point of the analytical grid is changed – shifted along the X or Y axis. To make the visualisation more robust, a mean filter with a 3x3 kernel was applied to the recalculation in a square grid (Fig. 3: D). Such recalculation gives a more stable visualisation, but the precision is significantly lower. This is because during recalculation with this method, cells where there were no archaeological sites and which had a value of "0" gained a new mean value (Fig. 5: A).

To reduce the blur effect, cells with a value of "0" were ignored during the recalculations. A mean filter with a 3 × 3 kernel was applied to cells with a value greater than "0" (Fig. 5: B). This procedure has made the visualisation of data more resistant to changes of location of the grid, and only cells containing archaeological sites were colourised. It also

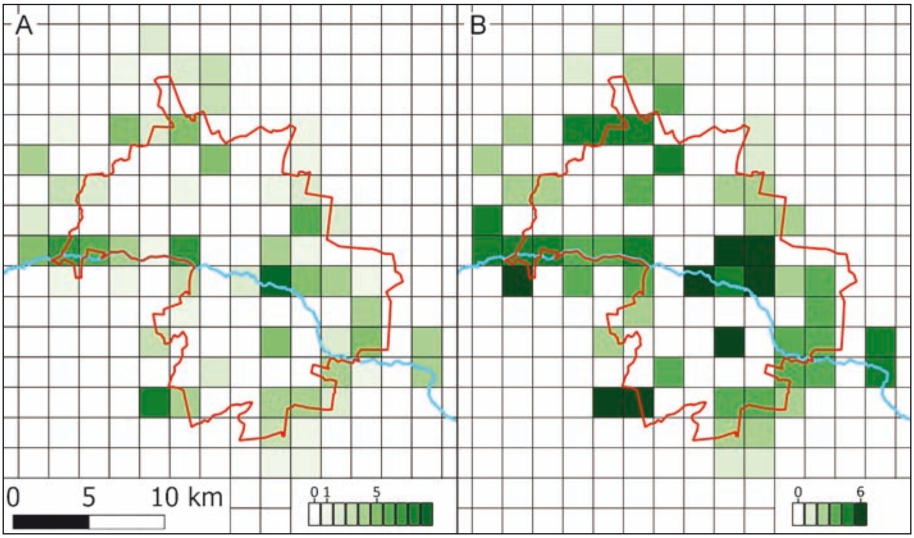

Fig. 6. Examples of visualisation of the density of Palaeolithic sites within the borders of Brańsk Community: A – a grid of squares colourised on the basis of the quantity and size of the sites, B – a grid of squares colourised on the basis of the quantity and size of the sites, recalculated with a mean filter with a kernel in a 3 × 3 grid, ignoring cells where the value is "0" (processing, R. Solecki, P. Smereczyńska)

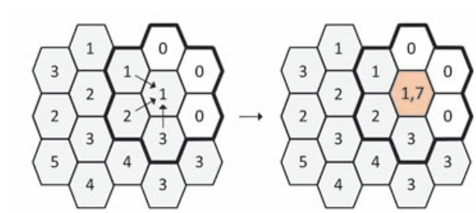

Fig. 7. Method of recalculation of values by mean filter with a kernel in a super-hexagon built with seven hexagons and ignoring cells where the value is "0" (processing, R. Solecki)

presents the density of archaeological sites at a similar level to the one where there was only counting and visualising of sites in the grid (Fig. 6).

The third example of visualisation is similar to the second one but with a difference in the shape of the cells in the grid – they are no longer squares but hexagons inscribed in circles with a radius of 2 km. Hexagonal grid cells are better suited for the purpose of spatial analyses as the distances between the centres of neighbouring cells are the same, while in a square grid there are two different values (Sousa *et al.* 2006, 191-194). Moreover, despite the hexagonal shape, they can still be processed and analysed like raster graphics (Sousa and Leitão 2018). This means that the modified mean filter with a kernel – in a grid of super-hexagons composed of seven hexagons – can be calculated to reduce the blur effect

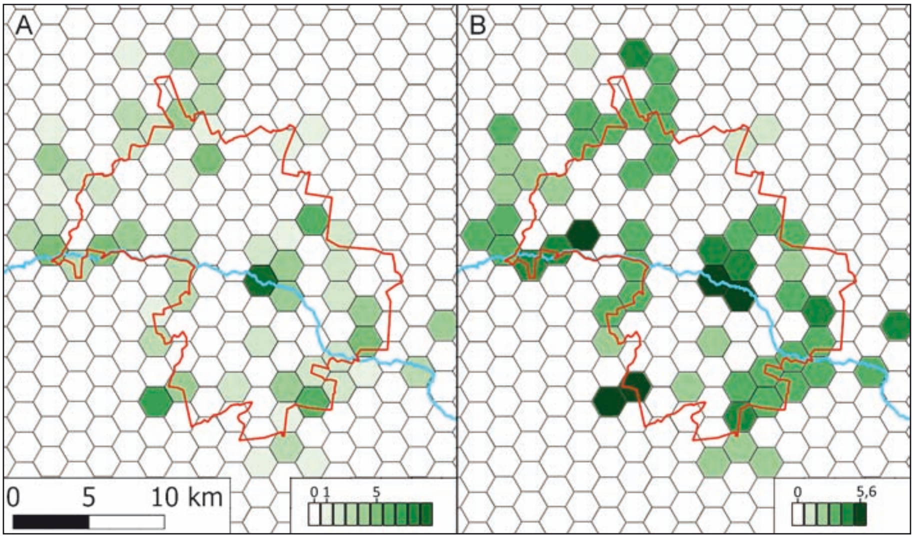

Fig. 8. Examples of visualisation of the density of Palaeolithic sites within the borders of Brańsk: A – a grid of hexagons colourised on the basis of the quantity and size of the sites, B – a grid of hexagons colourised on the basis of the quantity and size of the sites and then recalculated with a mean filter with a specified kernel size (processing, R. Solecki)

in cells where there is no archaeological site (Fig. 7). The simple counting and visualising of sites in the grid of hexagons (Fig. 8: A) looks clear and is readable, but with the addition of a mean filter with a specified kernel size (Fig. 8: B) it has both previous advantages and additionally it is more resistant to changes in the input point of the analytical grid.

DISCUSSION

When it comes to the Polish Archaeological Record project, the raw information gathered during field prospection and archived on the archaeological sites record sheets, are difficult to use automatically within a GIS environment. The problem is not only in digitising this information. The main issue is that the records are unsystematised. The way the record sheets were filled in was arbitrary because for many years, basically, every researcher did this in his or her own way. In many cases some parts of the record sheets were left blank. Now, after the Polish National Institute of Cultural Heritage has published more and more complete instructions for filling in the record sheet, recently filled in forms are usually correct. However, the older documents are still waiting to be standardised.

The problem with visualisation of data from the Polish Archaeological Record project is also that it covers the area of Poland in uneven way. This is because the archaeological data gathered in the 20th and the beginning of 21st centuries were mostly acquired from open, agricultural fields. The forested areas were left without prospection. This changed when LiDAR technology allowed the localisation of archaeological sites also beneath the tree canopies, which had a big impact on Polish archaeology (Stereńczak *et al*. 2020). The result of omitting of forested areas during field prospection is the Polish Archaeological Record is incomplete. That means the results of spatial analyses will always be subject to error.

To visualise the spatial data other methods can be used as well, for example contour line method. Such attempts have been already made in archaeology (Ahlrichs *et al*. 2016). The visualisation methods presented here, as stated in title of the article, are just our attempts to use the data from the Polish Archaeological Record archive as a basis for spatial analyses of the intensity of the occurrence of archaeological sites. When developed, this may be used to analyse past habitation processes. However, even at this stage, it shows how relatively quickly and effectively we can assess the development of settlement in a given area.

The squares used to build the grid had sides with a length of 2 km and the hexagons were inscribed in circles with a radius of 2 km because this size was the most useful to analyse the discussed area. The size of the cells can be easily modified if it is necessary to analyse a larger or smaller area and to obtain the best research results.

The area in which this study took place was somewhat out of context because it was not the territory of any particular archaeological culture but rather an artificially created administrative unit. Selecting, for example, an area occupied by a specific archaeological culture for analysis could bring much more interesting results.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3481

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RADIOCARBON CHRONOLOGY OF THE POST-LBK MALICE CULTURE IN LESSER POLAND

ABSTRACT

Kadrow S. 2023. Radiocarbon Chronology of the post-LBK Malice Culture in Lesser Poland. *Sprawozdania Archeologiczne* 75/2, 51-64.

A series of new radiocarbon dates from Neolithic Malice Culture (MC) sites in Lesser Poland allow for making significant corrections in the absolute chronology of this culture. Bayesian modelling of a series of MC dates made it possible also to specify the absolute chronology of individual phases of the development of this culture. The early classic phase (MC1a) is around 4800-4700 BC, the classic phase (MC1b) between 4700 and 4450 BC, and the late phase (MC2) between 4450 and 4200 BC. In addition, the review of the definitions of the MC phases and their new absolute chronology allow for the synchronization of their development with the cultural units in the Tisza basin. Phase MC1b developed parallel to phase III of the Herpály culture, phase MC1c to Proto-Tiszapolgár (layer 5 on the Herpály tell), and phase MC2 with the Tiszapolgár culture.

Keywords: MC, Lesser Poland, Neolithic, bayesian modelling, radiocarbon chronology
Received: 07.05.2023; Revised: 22.05.2023; Accepted: 25.09.2023

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INTRODUCTION

In recent years, several works have been published presenting quite numerous series of radiocarbon dates from Neolithic sites in south-eastern Poland (Czekaj-Zastawny *et al.* 2020; Kadrow *et al.* 2021; Kadrow *et al.* 2022; Golański and Kadrow 2022; Oberc *et al.* 2022; Zastawny 2022). They have already influenced the new picture of the absolute chronology of the end of the *Linienbandkeramik* (hereafter: LBK) and the whole duration of the Malice culture (hereafter; MC). This is confirmed by studies on the chronology of other regions of Poland (*e.g.*, Marciniak *et al.* 2022) or Carpathian Basin (*cf.,* Staniuk *et al.* 2020).

The aim of this article is to achieve a more precise absolute chronology of the Malice culture, including chronology of the house at Targowisko Site 14-15 (Kadrow *et al.* 2021, 162-164; table 1, figs 8, 9) against the background of the absolute dating of this culture in south-eastern Poland (Włodarczak 2017; Zastawny 2022, 168-169, figs 9, 10).

THE STATE OF RESEARCH ON THE ABSOLUTE CHRONOLOGY OF THE POST-LBK MALICE CULTURE

We may begin with a few remarks about the chronology of the LBK, the culture that preceded the development of MC. Until recently, it was believed that the LBK population reached the areas of south-eastern Poland as early as around 5500/5400 BC in its pre-music-note phase (Czekaj-Zastawny *et al.* 2020). The appearance of the oldest farmers in the Polish Lowland was similarly dated, *i.e.*, in the period 5500-5400 BC (Czerniak 1990), and this period was later moved to the years 5400-5300 BC (Czerniak 2012). The youngest phase of the LBK was dated to the period 5000-4900/4800 BC (Czekaj-Zastawny 2017, 27), similarly in the Lowlands (5000-4900/4800 BC; Grygiel 2004, 523).

Bayesian modelling of a series of dates related to the LBK, mainly from Lesser Poland, showed that the emergence of this culture occurred much later than previously thought, *i.e.*, around 5280 BC. Also its end is now dated earlier, *i.e.*, around 5080 BC (Oberc *et al.* 2022, 208). Moreover, the duration of phase I overlapped significantly with phase II, and Phase III with Phase II (Oberc *et al.* 2022, 204). Similar results were obtained from the analyzes of LBK dates from the area of the Polish Lowlands, mainly from Kuyavia. This culture appeared there around 5265 and lasted until 5015 BC (Marciniak *et al.* 2022, 398). It was a common phenomenon to overlap the development phases of the LBK while maintaining their traditionally understood sequence in its development (Marciniak *et al.* 2022, fig. 12).

The beginning of the classical phase of MC1b was dated to 4800 BC and its end to 4100 BC (Kadrow 1996, 68). Later, it was proposed to date the beginning of this culture (phase MC1a) to 5000 and the end (MC1c) to 4200 BC (Kadrow and Zakościelna 2000, 244-247, fig. 44). The Rzeszów phase of MC (2a-2b) was dated to the period 4200-3800 BC (Kadrow and Zakościelna 2000, 245-249, figs 44, 45). Calibration of over thirty radiocarbon dates of MC, collected recently, made it possible to define the framework of this culture in Lesser Poland between 4850 and 4330 BC (Zastawny 2022, 169).

Bayesian modelling of the series of dates of the late phase of MC (MC2) from the site Wzgórze Zawichojskie in Sandomierz allowed its chronology to be shifted to the period 4400-4200 BC (Włodarczak 2017).

BAYESIAN MODELLING OF THE RECENTLY PUBLISHED SERIES OF RADIOCARBON DATES FROM LESSER POLAND

Albert Zastawny recently published 36 radiocarbon dates of MC assemblages from Lesser Poland (Fig. 1; Zastawny 2022). He described the dated pottery sets in detail. However, in presenting radiocarbon dates, he limited himself only to their calibration. This creates the need for their Bayesian modelling, at least on a basic level, to obtain a more realistic absolute and inner MC chronology.

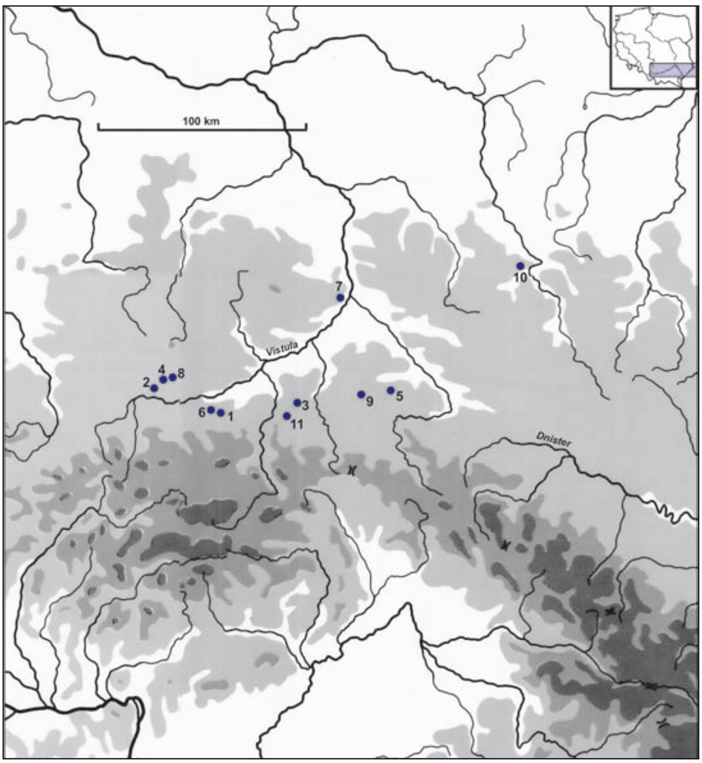

Fig. 1. Map of the locations from which the radiocarbon dates come (see Table 1)

Table 1. List of radiocarbon dates from MC sites in Lesser Poland. 1-3 – MC1a phase; 4-15 – MC1b phase; 16-34 – MC2 phase. Calibration after OxCal v4.4.4 Bronk Ramsey 2021. Acc. to Zastawny 2022 with some changes

	Site	Lab.	BP	BC 1 sigma	BC 2 sigma
1	Targowisko TRG core	MKL-4183	5960±80	4940(86,3%)4776 4759(0,13%)4726	5198(0,01%)5189 5049(95,3%)4672
2	Aleksandrowice 2	Poz-121003	5890±35	4792(68.2%)4718	4844(95.5%)4687
3	Targowisko 10-11	Poz-71637	5800±35	4709(68,2%)4611	4774(1.3%)4762 4726(94.2%)4544
4	Łoniowa 18	Poz-15978	5880±40	4794(68,3%)4710	4846(93,4%)4657 4636(2,0%)4616
5	Kraków-Olszanica 2	Poz-77984	5830±40	4776(8.1 %)4758 4726(47.5%)4654 4638(12.7%)4614	4792(92.7%)4585 4569(2.7%)4552
6	Targowisko 14-15	MKL-A5167	5821±23	4686 (65.0%) 4602 4562 (3.3%) 4556	4674 (7.6%) 4636 4616 (85.9%) 4492 4472 (1.9%) 4461
7	Rozbórz 42	MKL-799	5820±90	4784 (2.4%) 4740 4735 (50.2%) 4582 4572 (5.7%) 4551	4898 (2.2%) 4866 4851 (93.2%) 4456
8	Targowisko 14-15	MKL-A5166	5779±24	4686 (65.0%) 4602 4562 (3.3%) 4556	4703 (95.4%) 4549
9	Zakrzowiec 8	Poz-45435	5760±40	4677(26,2%)4632 4620(42,1%)4548	4712(95,4%)4502
10	Targowisko 14-15	MKL-A5165	5755±23	4658 (15.0%) 4636 4616 (53.3%) 4548	4703 (95.4%) 4549
11	Targowisko 14-15	MKL-A5162	5741±23	4652 (6.5%) 4640 4613 (61.8%) 4542	4681 (90.2%) 4531 4526 (5.2%) 4502
12	Targowisko 14-15	MKL-A5163	5737±23	4650 (4.7%) 4641 4613 (63.6%) 4540	4678 (18.0%) 4631 4621 (77.5%) 4501
13	Targowisko 14-15	MKL-A5168	5737±23	4650 (4.7%) 4641 4613 (63.6%) 4540	4678 (18.0%) 4631 4621 (77.5%) 4501
14	Targowisko 14-15	MKL-A5164	5705±24	4585 (8.9%) 4569 4553 (56.6%) 4493 4469 (2.7%) 4464	4611 (95.4%) 4456
15	Zakrzowiec 8	Ki-13694	5690±90	4674 (9.7%) 4634 46 71 (58.6%) 4446	4721 (95.4%) 4351
16	Sandomierz 6/6	Poz-57913	5590±40	4451(68.3%) 4362	4498 (95.4%) 4347
17	Sandomierz 6/6	Poz-57916	5590±40	4451(68.3%) 4362	4498 (95.4%) 4347
18	Sandomierz 6/6	Poz-60513	5580±35	4446 (9.0%) 4436 4428 (59.3%) 4363	4490 (4,1 %) 4474 4460 (91.4%) 4347
19	Sandomierz 6/6	Poz-57917	5565±35	4444 (25.0%) 4418 4402 (43.3%) 4356	4484 (0.6%) 4480 4456 (94.8%) 4342
20	Sandomierz 6/6	Poz-60512	5545±35	4443 (25.2%) 4420 4399 (15.9%) 4381 4372 (27. %) 4348	4450 (95.4%) 4340
21	Sandomierz 6/6	Poz-62480	5525±35	4442 (20.9%) 4421 4396 (7.4%) 4385 4370 (39.9%) 4338	4448 (95.4%) 4330

22	Kraków-Witkowice II	Poz-43316	5525±35	4442 (20.9%) 4421 4396 (7.4%) 4385 4370 (39.9%) 4338	4448 (95.4%) 4330
23	Sandomierz 6/6	Poz-505596	5520±40	4442 (9.6%) 4421 4396 (7.3%) 4385 4370 (41.4%) 4335	4450 (91 .0%) 4326 4286 (4.4%) 4266
24	Sandomierz 6/6	Poz-505595	5490±40	4361 (50. %) 4326 4287 (18.1 %) 4266	4445 (10.6%) 4416 4406 (59.9%) 4315 4300 (24.9%) 4252
25	Rzeszów 31	Poz-16473	5480±40	4358 (43.0%) 4324 4290 (25.3%) 4262	4443 (6.3%) 4420 4400 (2.5%) 4382 4372 (86.7%) 4249
26	Sandomierz 6/6	Poz-63725	5452±35	4344 (28.0%) 4322 4292 (40.3%) 4260	4356 (95.4%) 4244
27	Rzeszów 31	Poz-16474	5450±40	4346 (27.7%) 4319 4295 (40.6%) 4256	4361 (93.6%) 4237 4189 (1.8%) 4174
28	Sandomierz 6/6	Gd-2910	5450±100	4442 (4.8%) 4420 4398 (2.9%) 4382 4371(49. %) 4227 4196 (7.0%) 4167 4094 (4.5%) 4071	4493 (1.4%) 4471 4461(93.9%) 4044 4007 (0.2%) 4004
29	Świerszczów Kolonia 28	Ki-4193	5430±60	4347 (67.0%) 4240 4183 (1.3%) 4180	4440 (1.3%) 4424 4366 (73.5%) 4216 4206 (9.9%) 4158 4136 (0.7%) 4054
30	Sandomierz 6/6	Poz-62494	5420±35	4334 (19.3%) 4313 4301 (49.0%) 4251	4349 (90.2%) 4231 4194 (5.2%) 4169
31	Sandomierz 6/6	Poz-57821	5360±35	4320 (14.3%) 4294 4258 (18.6%) 4226 4198 (18.8%) 4166 4124 (3.6%) 4151 4096 (13. %) 4068	4328 (8.6%) 4283 4270 (47.7%) 4158 4137 (29.2%) 4054
32	Świerszczów Kolonia 28	Ki-4189	5350±50	4318 (8.5%) 4296 4256 (14.6%) 4222 4201 (17.0%) 4163 4131 (28. %) 4060	4330 (14.7%) 4282 4273 (80.8%) 4048
33	Sandomierz 6/6	Poz-62493	5300±35	4230 (19.2%) 4194 4168 (7.0%) 4154 4143 (28.0%) 4092 4078 (14. %) 4050	4246 (92.0%) 4042 4016 (3.5%) 3995
34	Tworkowa 20	Poz-47533	5200±40	4044 (68.3%) 3968	4224 (2.8%) 4199 4165 (7.4%) 4128 4101 (0.6%) 4100 4066 (84.8%) 3948

In order to more precisely determine the beginning and end of the phase in question, it was therefore decided to perform Bayesian modelling of the recently published series of radiocarbon dates from Lesser Poland (Zastawny 2022).

Several small changes have been made to the list of MC radiocarbon dates prepared by Zastawny (Table 1). From the list of 36 dates, 3 dates from the Las Stocki were removed

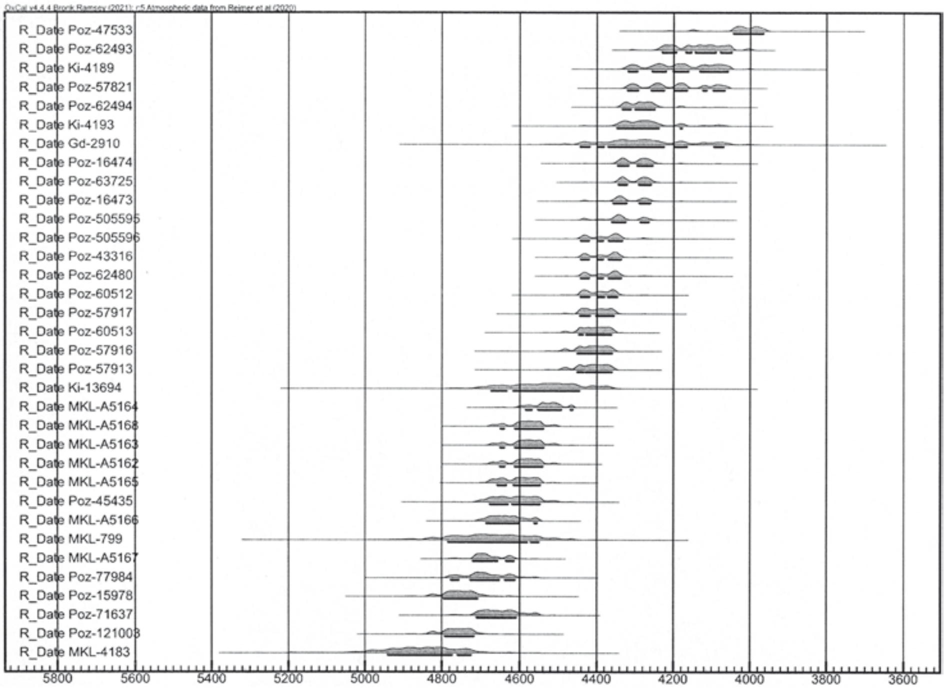

Fig. 2. Calibration of MC radiocarbon dates from Lesser Poland by the OxCal 4.4 package (Bronk Ramsey 2021)

due to their unclear relationship with the MC (Zastawny 2022, fig. 9). However, one date from the TRG core of biogenic sediments in Targowisko (MKL-4183 5960±80 BP) was added, which is clearly related to the functioning of the nearby MC settlement in its older phase (MC1a) at the Targowisko 11 site (Forysiak *et al.* 2021, tab. 1; fig. 4; Kadrow *et al.* 2022, tab. 1; fig. 11). In a few cases, the affiliation to a specific MC phase was also changed.

The indefinite complex from Aleksandrowice 2 was assigned (with hesitation) to phase Ia. The complex from Łoniowa 18, unspecified in terms of phase, was assigned to phase Ib. The assemblage assigned to the turn of phases (MC1a/1b) from Kraków-Olszanica 2 was qualified for phase MC1b. Two assemblages from Zakrzowiec 8, identified as phase MC1c, were qualified for phase MC1b. The unspecified complex from Kraków-Witkowice was qualified for the Rzeszów phase (MC2).

Therefore, 34 dates classified under three phases were sent for further analysis: early classic (MC1a) – 3 dates; classic (MC1b) – 12 dates, and late (Rzeszów–MC2) – 19 dates. Unfortunately, there are no radiocarbon-dated late classic (MC1c) assemblages (Fig. 2).

As a result of *Phase* modelling, time intervals of MC evolution within three phases were obtained (Fig. 3). The beginning of the MC and the beginning of the early classic phase

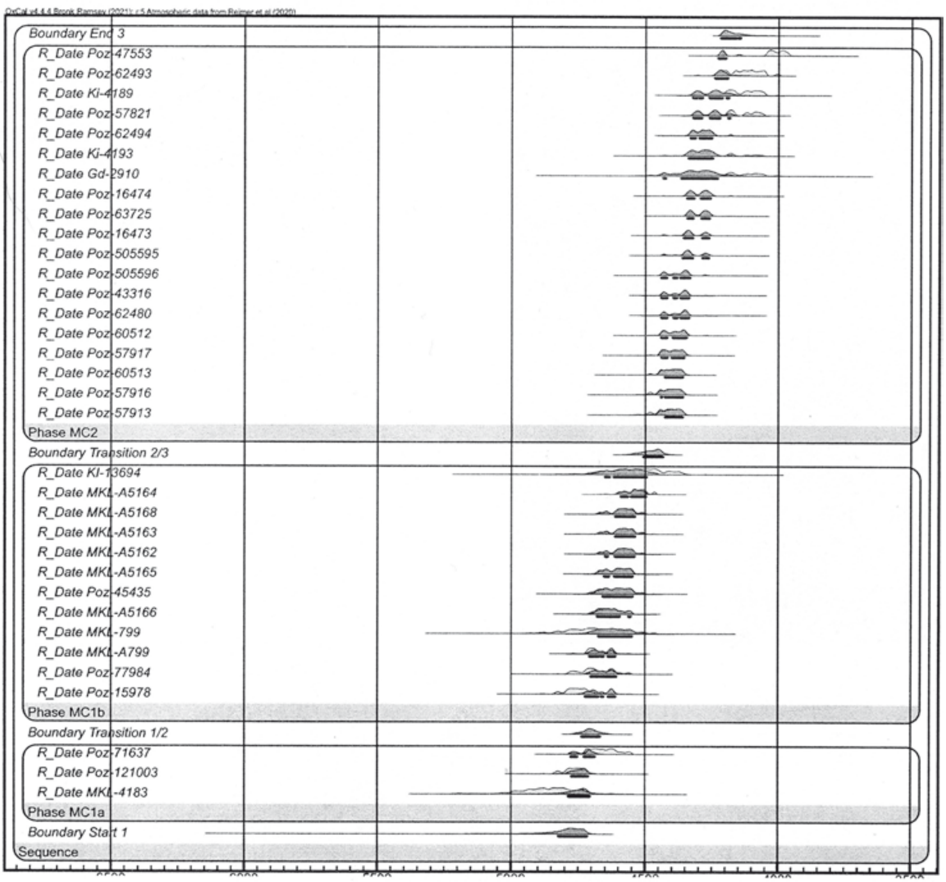

Fig. 3. Bayesian modelling of radiocarbon dates of MC phases in Lesser Poland by the OxCal 4.4 package (Bronk Ramsey 2021)

(MC1a) is marked by the *Boundary start* 4822-4717 BC or its median 4785 BC. The end of phase MC1a, and at the same time the beginning of phase MC1b, is marked by *Boundary Transition* 1/2, *i.e.*, the period 4736-4669 BC or its median 4703 BC. The end of phase MC1b and at the same time the beginning of phase MC2 is marked by *Boundary Transition* 2/3, *i.e.,* the period 4508-4435 BC or its median 4474 BC. The end of phase MC2 (late) and at the same time the end of MC is marked by the *Boundary end*, *i.e.*, the period 4220-4146 BC or its median 4184 BC. The obtained results are reliable due to the values of the compatibility parameters A_{model}=60.4 and $A_{overall}$=66.5 for the whole model. However, two single dates from the list demonstrate poor agreement (Poz-15978 A = 40,1% and Poz-47553 A=17,6%).

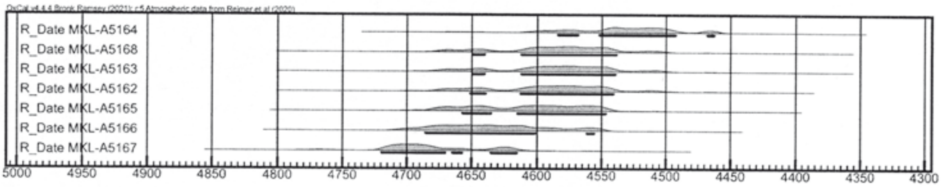

Fig. 4. Calibration of radiocarbon dates from MC house at Targowisko Site 14-15 by the OxCal 4.4 package (Bronk Ramsey 2021)

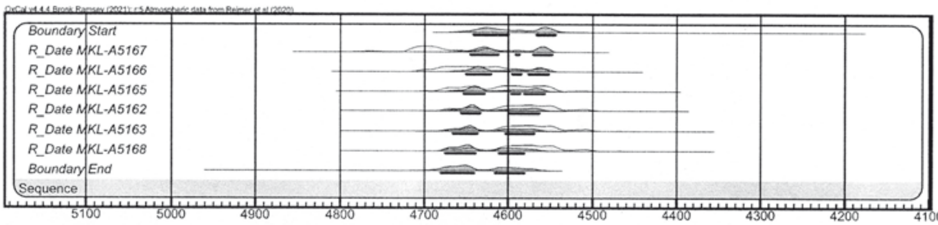

Fig. 5. Bayesian modelling of radiocarbon dates from the MC house at Targowisko Site 14-15 by the OxCal 4.4 package (Bronk Ramsey 2021)

The logic and dynamics of the succession of the development phases of the MC indicate that the late classic (MC1c) phase, which is not yet chronologically defined, should be included in the period 4550-4450 BC.

An unusual opportunity to precisely assess the chronology of the duration (use) of one house is provided by the analysis of seven dates from the MC house from Targowisko 14-15 (Fig. 4; Table 1). The samples for dating, in the form of charred grains, were taken from the fillings of pits which are relics of this house. It was located on the outskirts of the settlement. Only there could one expect to obtain material from one settlement phase, without the remains of older and younger phases, according to the observations of Ryszard Grygiel (1986, 273, fig. 3).

A series of seven dates of the MC house from Targowisko 14-15 (Fig. 5) was subjected to modeling a *Sequence* of events (Bronk Ramsey 2023). In this model, I assume, that charred grains, as samples for radiocarbon dating, represent selected events from the time of construction and use of the house. As a result of this modelling (Fig. 5), the period of residence of this house was estimated to have lasted from 4642-4545 BC (from *Boundary start*) to 4681- 4581 BC (*Boundary end* of the 1 sigma range). The medians of these parameters significantly narrow the duration of this period from 4643 to 4597 BC. The credibility of the quoted values is reduced by the compatibility parameter A_{model}=51.2, which is slightly lower than required, while the other parameter $A_{overall}$=64.8 is sufficiently high.

ABSOLUTE AND RELATIVE MC CHRONOLOGY

For the first time, the reason for distinguishing the early classic phase (MC1a – Fig. 6) of MC was the presence of pottery with a bulging neck in the pottery complex from Rzeszów Site 20 (Kadrow 1990b, 102; fig. 2: h, j; 3: g, h). The second reason was the registration of

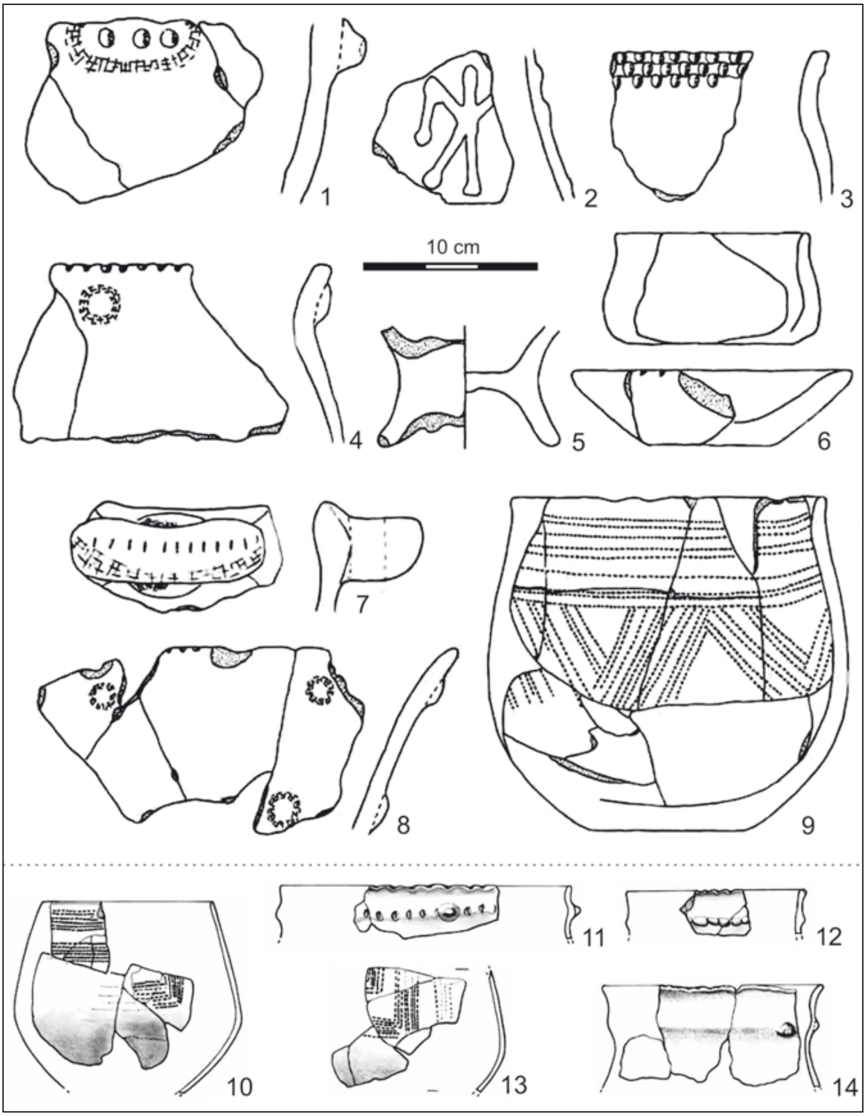

Fig. 6. Pottery characteristic for the MC1a (10-14) and MC1b (1-9) phases of MC; 1-9 – Targowisko Sites 14-15; 1-9 – Targowisko Sites 10, 11 (after Kadrow *et al.* 2022; Zastawny 2022)

a stroked ornament in the shape of a meander in the MC assemblages (Czekaj-Zastawny *et al.* 2002, 28-34; fig. 9). They were considered to be characteristic indicators of the Samborzec-Opatów group, which was considered older than MC, and synchronized with phase IVa of the *Strichbandkeramik* (hereafter: STK; Kaczanowska *et al.* 1986, 100-101). A good representative of the early classic phase of MC (MC1a) is the set of pottery from the feature 2271

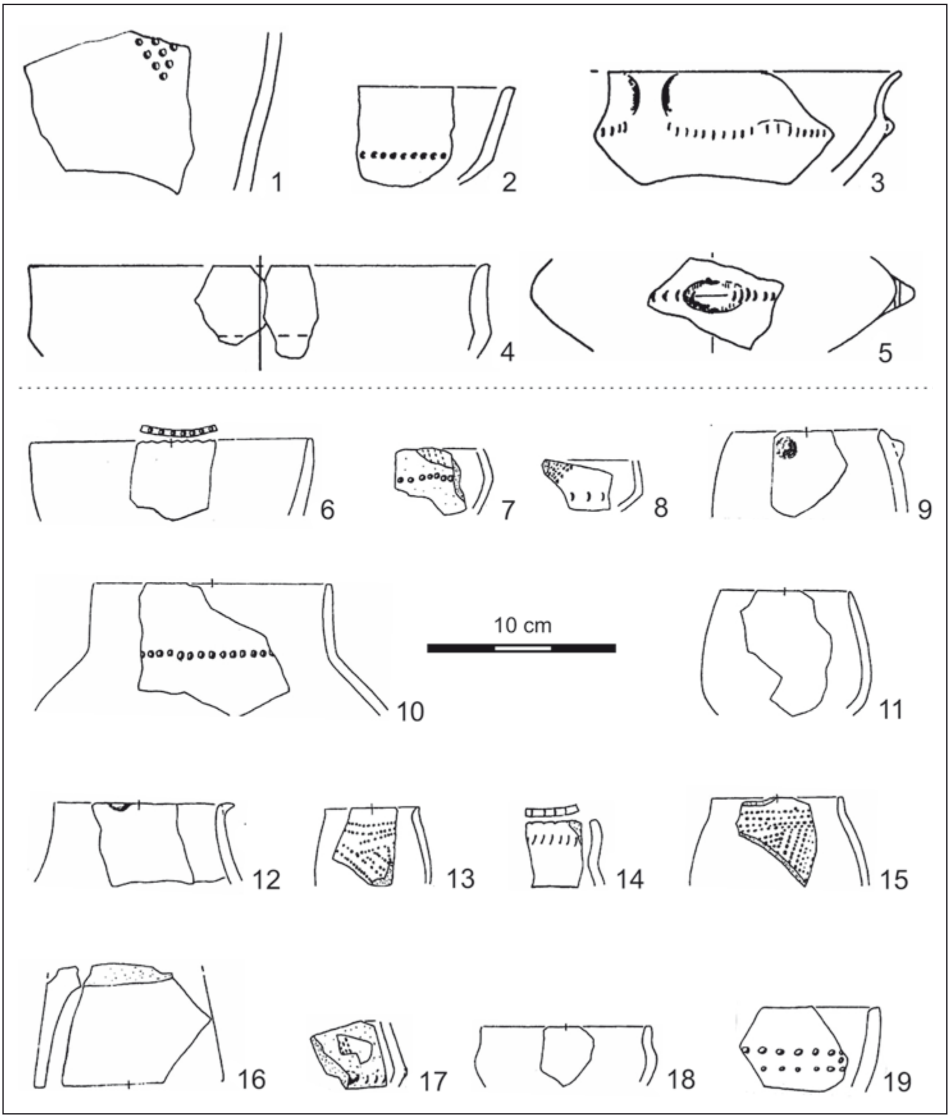

Fig. 7. Pottery characteristic for the MC1c (6-19) and MC2 (1-5) phases of MC; 1-5 – Rzeszów Site 24; 6-19 – Rzeszów Site 16 (after Kadrow 1996)

from Targowisko 10-11, which includes pots with a bulging neck and a meander ornament (Zastawny 2022, fig. 5: 11, 12, 15, 20). The set is dated Poz-71637 5800±35 BP. The early classical phase MC1a understood and dated in this way is an adequate context for the amphora with an anthropomorphic image from Targowisko 10-11, stylistically connected even with the older STK phase in Bohemia (Grabowska and Zastawny 2007, 128-132, figs 3, 8).

The classic phase of the MC (MC1b – Fig. 6) was defined half a century ago (Kamieńska 1973). It is represented by a fairly rich collection of pottery from the house at Targowisko 14-15 (Golański *et al.* 2021, fig. 19, 20) with seven ^{14}C dates (Table 1). The absolute chronology of this phase (4703-4474 BC) corresponds to phase II and, above all, phase III of the Herpály group, in which ceramics were decorated with white and red paint (Csőshalom stage) and white paint (Oborin I stage) applied after firing the vessel (Kalicz and Raczky 1987a, 30; Kalicz and Raczky 1987b, 124, 125, fig. 35). This is an adequate context for a pear-shaped cup decorated with white and red oil paint from Targowisko 12-13 (Golański and Kadrow 2022, fig. 11).

The specificity of the pottery assemblages from the cluster of features (No. 108) in Rzeszów Site 16 became the basis for defining the late classic phase (MC1c – Fig. 7) of MC (Kadrow 1990a, 70; fig. 11). Stroked ornament – very simplified – was then made only with a tool with spike with a round cross-section. In addition, ornamental threads consisting of round, shallow pits appeared, which has analogies in the pottery assemblages of the Proto-Tiszapolgár phase (Kalicz and Raczky 1987a, 27).

The definition of the late phase of MC (MC2 – Fig. 7) was completed only slightly later than the classic phase (*cf.*, Kamieńska 1973; Kadrow 1988; Kadrow and Zakościelna 2000, 204-208). The pottery of this phase is distinguished by a tendency to clearly profile the vessels, mainly bowls, and decorate them with deep punctures or round pits, similar to the Tiszapolgár culture. The absolute chronology of this phase of MC (4474-4184 BC) is very close to that of the Tiszapolgár culture (4420-4240 BC; Brummack and Diaconescu 2014, 254, 255, figs 4-9).

CONCLUSIONS

Thanks to the analyses performed above, we have come much closer to determining the sequence of MC development phases (Figs 6 and 7) and their exact framework in absolute chronology. The typological and stylistic relationships of the pottery confirm the synchronicity of the development of MC with the cultures of the Tisza basin. This will make it easier to understand the dynamics of changes at the turn of the Neolithic and Eneolithic in Lesser Poland.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3409

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EARLY NEOLITHIC SETTLERS ON THE BORDER OF THE LOESS OF EASTERN POLAND: NEW DATA FROM THE NAŁĘCZÓW PLATEAU

ABSTRACT

Szeliga M. and Gawryjołek-Szeliga K. 2023. Early Neolithic settlers on the border of the loess of Eastern Poland: new data from the Nałęczów Plateau. *Sprawozdania Archeologiczne* 75/2, 65-113.

This article is an interim presentation of the colonisation of the loess upland border of the western Lublin Region by LBK societies. The main point of reference are materials discovered in Bogucin (Nałęczów Plateau) in 2011, which are currently the only homogenous Early Neolithic collection from this region. The results of the research indicate that the LBK settlement on the loess borderland started at least at the end of the 6th millennium BC, in the classical stage of the Music-Note phase (NII). It clearly intensified during its latest part (NIII), which was linked with the adaptation of the early-Želiezovce ornamentation style. The obtained data confirms the existence of at least two settlement micro-regions in the discussed period. They dynamically developed through intense and far-reaching interregional contacts and exchange of goods (especially flints and flint artefacts). The initial territories of the LBK societies inhabiting the analysed loess borderland were most probably the areas of the northern foreland of the Sandomierz Upland.

Keywords: Neolithic settlement, LBK, loess border, Nałęczów Plateau, Želiezovce style
Received: 05.03.2023; Revised: 26.06.2023; Accepted: 21.12.2023

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INTRODUCTION

The early phase of the Neolithic associated with the development of the Linear Pottery culture (LBK) remains one of the most enigmatic periods of the Neolithic settlement on the upland territories of the interfluve between the Vistula and Bug Rivers despite a great number of known sites (*cf.,* Brzozowski 1988; Szeliga 2021, tab. 1). On the one hand, this state of affairs results from the very slow pace of obtaining new evidence – together with the fact that surface-collected materials are predominant. On the other, it is a consequence of the fact that previous discoveries have not been sufficiently researched and published – this observation especially refers to the most abundant inventories found during excavations. These limitations mainly affect not only comprehensive considerations on the development of the LBK within the entire loess interfluvial zone of the Vistula and Bug Rivers, but also micro-regional studies. In this context, especially important are clearly geographical disproportions in the distribution and representativeness of diagnostic finds. The vast majority of sites associated with the culture in question are clustered within the south-eastern part of the discussed zone – more precisely in territories located between the Huczwa and Bug Rivers, which are part of the Western Volhynian Upland (Szeliga 2021, fig. 1: 2). The great majority of the excavated inventories which were found in feature context – representing nearly the entire scope of the stylistic development of the LBK – also come from this territory (*cf.*, Kempisty 1962; Kącki 1982; Zakościelna 1988a; 1988b; Niedźwiedź and Panasiewicz 1994; Gawryjołek-Szeliga 2009; Szeliga and Gawryjołek-Szeliga 2021, fig. 11). This material admittedly provides us with the basis to very generally reconstruct the development of the culture in question across the discussed territory, but the fact that individual inventories – especially from the earliest and particularly the latest stages of the LBK – have not been completely researched still remains the main limitation (Szeliga 2021, 64-69). The state of research of the remaining loess territories located in the interfluve of the Vistula and Bug Rivers is much poorer. In the light of the current state of knowledge, LBK sites distributed across the central, western and northern parts of this area are much more scattered. Most of them are grouped in clusters of different sizes – counting from several to even more than ten settlement points – arranged along the local watercourses. With a few exceptions, they are solely surface discoveries or were excavated without feature context (Szeliga 2021, fig. 1; tab. 1). This fact considerably reduces their cognitive value, both for local analyses and supra-regional research, which include all the loess uplands located between the Vistula and Bug Rivers.

In the context of the indicated problems and interpretative limitations, discoveries made during recent years at Site 6 in Bogucin, Nałęczów Plateau, appear to be especially pertinent. At this moment, it is the largest excavated LBK settlement located in the interfluvial zone of the Vistula and Bug Rivers. At the same time, the material discovered at this site is one of the most sizeable Early Neolithic inventories found in this territory and the only inventory from its entire western zone found in feature context (*cf.*, Szeliga 2021, tab. 1).

This gives us previously unknown interpretation possibilities by presenting new and important data on the history and intensity of settling the edge zone of the loess uplands located in eastern Poland by the LBK society as well as information concerning the range of the chronological and stylistic development of the discussed culture in this territory. The

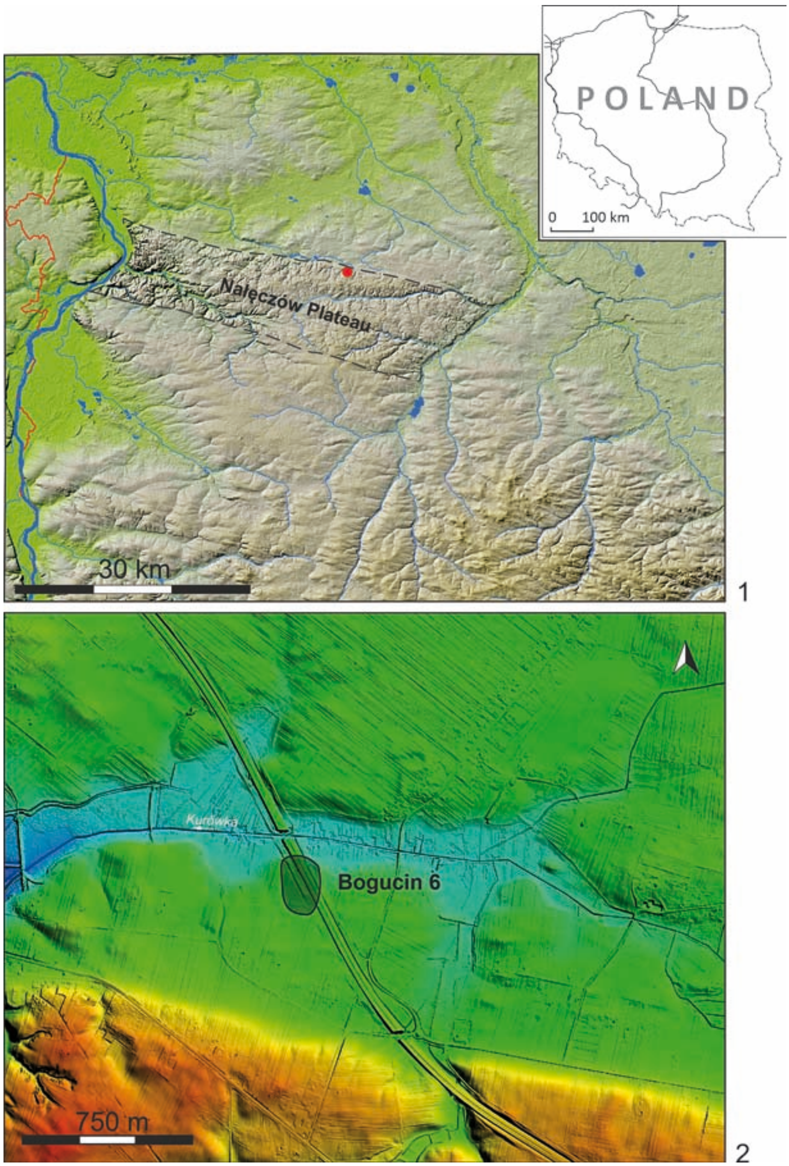


Fig. 1. Location of the analysed area and Site 6 in Bogucin
(1 – map based on Gawrysiak 2004, modified by M. Szeliga)

indicated issues, together with the complex presentation and multi-faceted analysis of the extremely important collection of finds from Bogucin are the main subject of considerations presented in this paper.

LBK SITE IN BOGUCIN

Site Bogucin 6 (AZP 75-79/14) is located on the north-eastern edge of the Nałęczów Plateau, which is at the same time the north-western extremity of the loess upland occupying the interfluve of the Vistula and Bug Rivers (Fig. 1: 1) and the northernmost part of the Polish loess cover (*cf.*, Maruszczak 1991; Marks *et al.* 2006). It covers part of the top and a slightly convex slope of a vast flattening descending to the north, to the valley of the Kurówka River (Fig. 1: 2). Its modern soil cover is composed of Luvisols formed on the loess and loess-like dusty deposits, which are the latest lithofacies component of the local quaternary sediments (Reder and Stępniewski 2012, 14). The site was discovered in 2007 during verification surface research conducted along the rute of the planned S17 express road. It was estimated that the site covered *c.* 2.5 ha. The discovery was immediately followed by a preliminary survey research, which made it possible to classify the site as a multicultural settlement, intensely occupied at least from the Neolithic to the Early Middle Ages (Sadowski 2006). The excavation proper – which was a rescue intervention – was carried out in 2011 and led by Mariusz Matyaszewski from the Archaeological Research and Supervision in Workshop of Lublin (Pracownia Badań i Nadzorów Archeologicznych w Lublinie) The research covered jointly 230 ares and resulted in discovering abundant relics of the multicultural settlement from the Neolithic, Bronze Age, Iron Age, Early Middle Ages and Modern Period (Matyaszewski 2011). The earliest phase of the site was linked with the early stage of the Neolithic and the LBK settlement that existed within its limits (Gawryjołek-Szeliga and Szeliga 2012).

FEATURES

The Early Neolithic phase of settling the discussed site is represented by a total number of 51 features. They were recorded only in the central part of the researched area, forming several minor, more or less distinct clusters (Fig. 2). The analysis of the dimensions and morphological properties of particular features made it possible to classify them in two basic formal categories – postholes and pits. The former is represented by only four features (Nos. 4, 30, 123, 310, Fig. 3: 1-4) that were small in size, with a regular, oval outline in plan view (maximum diameter of 60 cm), trough-shaped or irregular in the cross-section and a rather shallow depth (up to 22 cm). The fills of each of them were of homogeneous character and consistency, and their colour was light grey-brown. Postholes Nos. 4 and 310 were

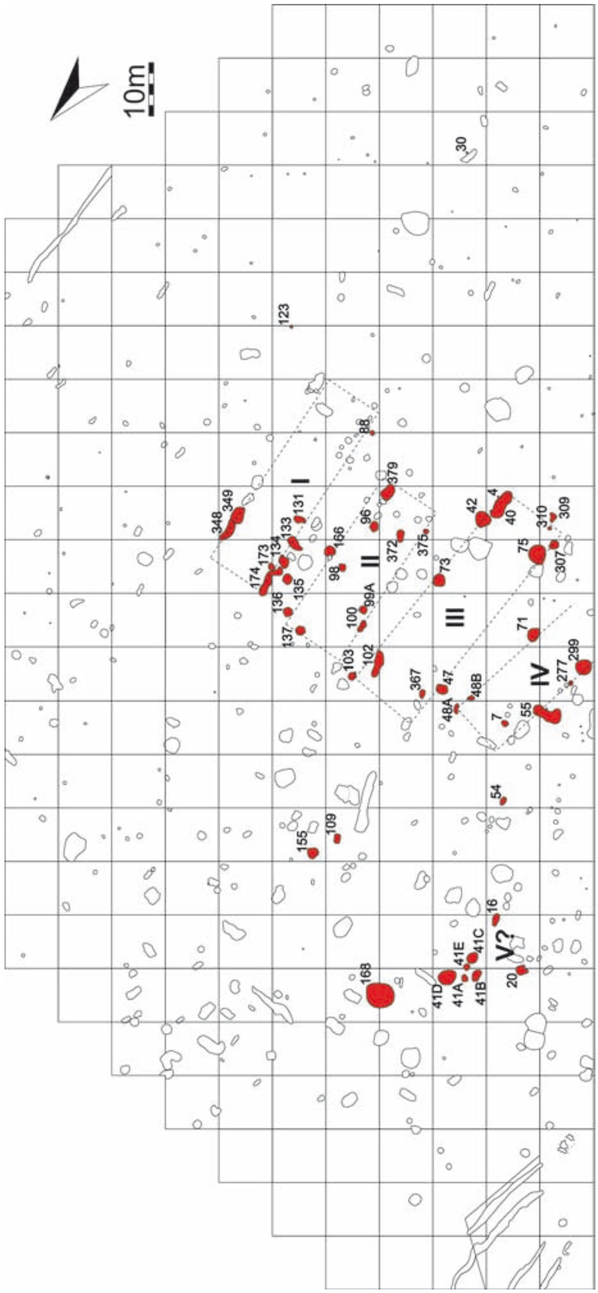


Fig. 2. Bogucin, Site 6: Arrangement of the LBK features in the researched area with supposed locations of longhouses (according to Gawryjołek-Szeliga and Szeliga 2012, modified by M. Szeliga)

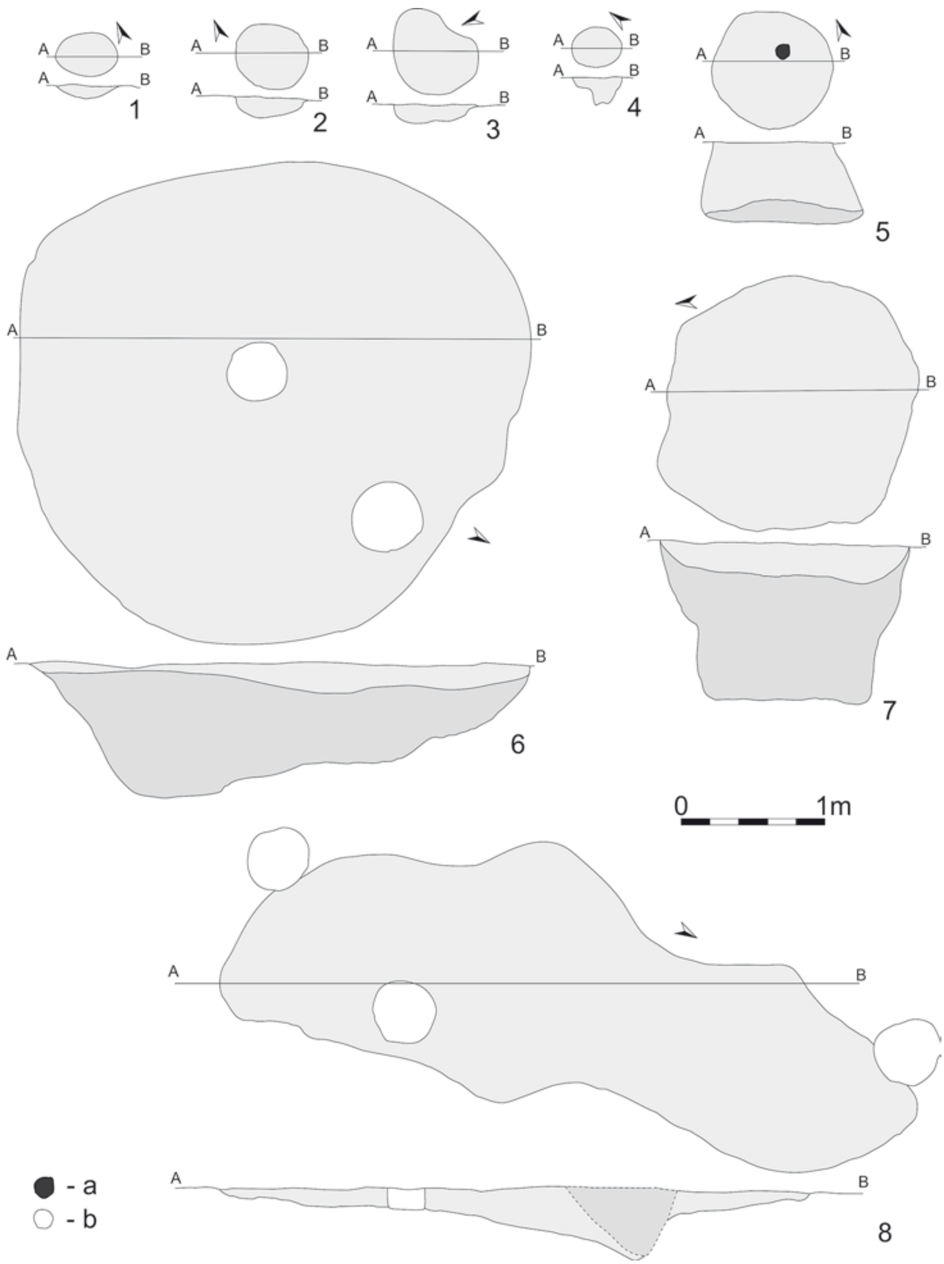


Fig. 3. Bogucin, Site 6: Plan views and cross-sections of selected LBK features:
1 – Feature 30; 2 – Feature 123; 3 – Feature 310; 4 – Feature 4; 5 – Feature 88; 6 – Feature 75;
7 –Feature 135; 8 – Feature 102; a – modern hop pits; b – stone
(according to Gawryjołek-Szeliga and Szeliga 2012, modified by M. Szeliga)

located in the zone of the greatest concentration of the LBK relics, in the direct vicinity of the pits (Fig. 2). This may indicate that they were functionally and structurally related, which might have been linked with creating and using above-ground structures of farm and/or residential buildings. On the other hand, postholes Nos. 30 and 123 were discovered at a clear distance (several dozens of metres) to the south-east from the cluster of the LBK features (Fig. 2). This fact allows us to rule out their functional relation to other features dated to the same time. This means that their association with the LBK is not certain, although single characteristic pottery sherds were discovered in their fills.

The second category of features – more numerous and considerably more diverse – were pits, a total number of 47 features. Over half of them (30 features) had regular (circular or slightly oval) outlines in plan view and, usually, a trough-shaped profile (Fig. 3: 6), whereas flat-bottomed features with trapezoidal or nearly rectangular profiles were much less numerous (Fig. 3: 5, 7). The sizes of the pits were considerably diverse, usually with diameters ranging from one to three metres at the level of their discovery (sporadically even 5 metres: feature 168). Their depths varied from 12 to even 122 centimetres. Their fills were usually homogeneous in character and consistency, although their dark grey-brown colour had different hues. Only several of the fills were visibly stratified (Fig. 3: 5-6), which indicates that the features were gradually filled in stages and over a prolonged period of time after being used. The precise identification and functional classification of the discussed features is made impossible by the limited number of the archaeological data and, in many cases, by the poor state of their preservation. Still, it is highly probable that some of them (Fig. 3: 5, 7) were used as storage pits. We cannot rule out the possibility that other such features – especially the largest, trough-shaped hollows – were construction pits, left after building and using habitation structures of the longhouse type. Most probably, the same role was played by 17 other pits having decidedly greater dimensions at the level of their discovery, ranging from 80 × 200 cm (Feature 48A) to even 170 × 640 cm (Feature 174) and diverse maximum depths (19-82 cm), with considerable variations within particular structures. The outlines of these pits were elongated, less frequently oval or irregular and usually had trough-shaped or irregular profiles, whereas their fills were homogenous in structure and colour (Fig. 3: 8). The individual morphological properties of the discussed features, as well as their distribution and orientation within the researched area (Fig. 2), justify the interpretation that they are the remains of construction pits linked with building and the use of residential constructions of the longhouse type, as they find numerous and close analogies across the entire range of the LBK.

The location of the LBK features within the excavated area of the site allows us to suspect that they determine the northern limit of the settlement, which occupied an unspecified total area on the gentle slope and top of the local terrain flattening. The poor state of preservation of the features – especially lack of row arrangements of the preserved postholes – makes it impossible to precisely determine the number and arrangement of the residential buildings within the researched area. The analysis of the dispersion of the LBK features, supported by data obtained from other, better examined settlements attributed to the discussed culture from the drainage basin of the Upper Vistula (*e.g.*, Milisauskas 1986; Czekaj-Zastawny 2008; 2014; Kulczycka-Leciejewiczowa 2008; Dębiec 2014), allows us to suspect that what was discovered in the excavated area were the remains of at least four LBK longhouses having a width of *c.* 10 m and length of several dozens of metres, oriented roughly N-S (Fig. 2). It appears that this assumption can be partially verified by expanding the excavation to the south-western part of the site.

ARTEFACTS

All the excavated LBK features yielded 634 artefacts, the great majority of which are vessel fragments (501) and flint artefacts (117). Daub fragments (12) and stone items (4) were decidedly less numerous (Table 1). Particular features contained very small quantities of artefacts. In most of them, only single or a few artefacts were discovered. Greater amounts of such materials – including the total number of a dozen or so artefacts representing different categories – were yielded much less frequently. Only 10 features contained more numerous inventories, ranging from 21 to 59 artefacts (Table 1). The numbers of the discovered artefacts did not directly correspond to the forms or dimensions of the features in which they were found.

The analysis of the quantitative distribution of flint artefacts and pottery within the features that were the most abundant in archaeological material indicated that most of them contained artefacts that were especially concentrated at the top level and, sporadically, in the middle part, whereas in the deeper strata and near the bottom they were much more sparse or even absent (Fig. 4: 1-4). This fact closely corresponds to data obtained from, for example, the uppermost strata of damaged LBK features from Site 6 in Tominy, Opatów District (Szeliga and Zakościelna 2007, figs 13 and 14) as well as the middle and bottom levels of pits from Site 16 in Rzeszów (Kadrow 1990, figs 5b; 6b; 7b; 8b; 9b; 12b; 13b), indirectly indicating a somewhat considerable degree of destruction of certain features linked with this culture and recorded in the excavated part of the site.

Considering the general range of the relics of the LBK settlement within the researched area of the site – as well as the sizes and depths of particular features – their overall abundance in material should be considered modest and untypical in regard to other, previously researched settlements of this culture. The most notable disproportions mainly concern the number of pottery remains, which usually are a category of mass artefacts (*cf.*, for example, Kadrow 1990, 22; 1997, 8, fig. 3; Gruszczyńska 1992, 123; Michalak-Ścibior and Taras 1995, tab. II; Dębiec 2006, 47; Szeliga 2008, tab. 1). The main reasons of this fact – besides the original functional diversity of farm buildings built within the limits of the settlement and factors linked with the creation of their fills – should be attributed to the incomplete state of preservation of the great majority of these features (as a result of slope

Table 1. Bogucin, Site 6: qualitative and quantitative comparison of artefacts originating from the LBK features

Feature No.	Pottery	Flint	Stone	Daub	Total
4	30	5	-	-	**35**
7	3	4	-	-	**7**
16	5	-	-	-	**5**
20	11	1	1	-	**13**
30	1	-	-	-	**1**
40	12	9	-	-	**21**
41A	12	-	-	-	**12**
41B	43	5	-	-	**48**
41C	2	-	-	-	**2**
41D	1	-	-	-	**1**
41E	2	-	-	-	**2**
42	9	5	-	-	**14**
47	31	7	-	3	**41**
48A	5	1	-	-	**6**
48B	11	2	-	-	**13**
54	2	-	-	-	**2**
55	43	14	1	-	**58**
71	5	-	-	-	**5**
73	1	2	-	-	**3**
75	1	4	-	-	**5**
88	2	2	-	-	**4**
96	1	1	-	-	**2**
98	5	4	-	-	**9**
99A	12	-	-	-	**12**
100	3	-	-	-	**3**
102	9	4	-	-	**13**
103	4	1	-	-	**5**
109	2	-	-	-	**2**
123	1	-	-	-	**1**
131	26	7	1	2	**36**
133	33	-	-	2	**35**
134	3	-	-	1	**4**
135	2	-	-	-	**2**
136	9	4	-	-	**13**
137	1	2	-	-	**3**
155	1	-	-	-	**1**
166	5	1	-	-	**6**

Feature No.	Pottery	Flint	Stone	Daub	Total
168	14	1	-	-	**15**
173	4	-	-	-	**4**
174	9	3	-	-	**12**
277	16	2	-	-	**18**
299	26	-	-	-	**26**
307	34	6	1	-	**41**
309	3	-	-	-	**3**
310	3	-	-	-	**3**
348	4	-	-	4	**8**
349	14	-	-	-	**14**
367	7	1	-	-	**8**
372	1	-	-	-	**1**
375	2	1	-	-	**3**
379	15	18	-	-	**33**
TOTAL	**501**	**117**	**4**	**12**	**634**

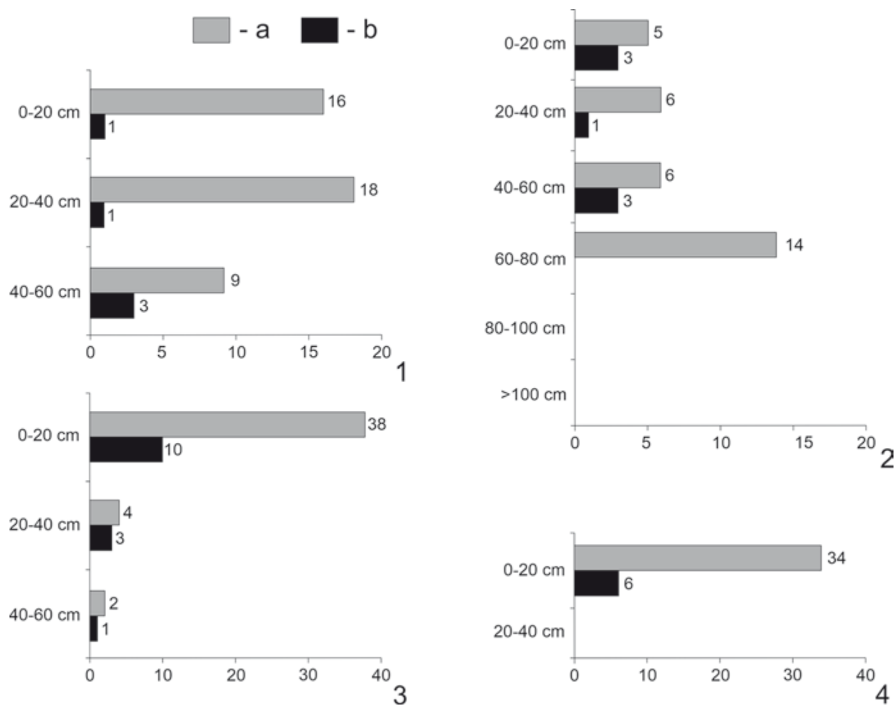


Fig. 4. Bogucin, Site 6: Quantitative distribution of pottery (a) and flint materials (b) in regard of the depths of the most abundant LBK features: 1 – feature 41B; 2 – feature 47; 3 – feature 55; 4 – feature 307. Prepared by M. Szeliga

Table 2. Bogucin, Site 6: condition of the ceramics in the LBK features: O – ornamented fragments; NO – non-ornamented fragments

Rims		**Bodies**		**Bases**		**Unspecified shards**	**Total**	
O	NO	O	NO	O	NO	NO	O	NO
55	24	111	265	10	27	9	176	325
79		**376**		**37**		**9**	**501**	

erosion and intense, multi-phase settlement process in the later phase of using the site) as well as the methodical procedures used during their exploration.

POTTERY

The pottery inventory discovered in the LBK features encompasses 501 specimens (Table 1) represented entirely by vessel sherds. This collection is composed of very fragmented material, which makes it difficult to reconstruct the vessels. None of the vessels was entirely preserved, and only several were reconstructed to a degree that allows us to learn about their whole forms and ornamentation sequences. The attempts to reconstruct the vessels were also considerably hindered by fresh breaks, which indicated that sometimes pottery inventories found in particular features were considerably incomplete. In the entire collection, the most numerous type of sherds are fragments of bodies (75.05%), as opposed to very small numbers of parts of rims and bases (15.77% and 7.39%). About 1.80% of the sherds could not be identified due to their small size and poor state of preservation. They were generally classified as unidentified sherds (Table 2). The present state of preservation of the collection makes it difficult to determine the original number of vessels. However, the obtained refits of sherds (*c.* 25% of the whole collection) and the number of diagnostic fragments (*e.g.*, rims, bases and ornamented sherds) allow us to estimate that the whole collection represents the remains of at least 40 vessels.

Morphometric and technological properties

The examination of the production features of the pottery included 437 sherds (87.22% of the entire collection). Based on the analysis of the wall thickness, properties of the clay fabric, ornamentation techniques as well as the methods of vessel surface finishing, it was observed that there is a distinct division between delicate (so-called tableware) and coarse (so-called kitchenware) vessels, which is typical of the LBK pottery (*e.g.*, Kulczycka-Leciejewiczowa 1979, 82-83; Kadrow 1990, 33; 1997, 8-12; Gruszczyńska 1992, 123; Michalak-Ścibior and Taras 1995, 86-93).

The forms included in the former category have thin walls – whose thickness ranges from 2.5 mm to 8 mm, but fragments with 5-8 mm-thick walls are predominant. They were made of greasy clay, thinned mainly with fine and very fine sand, grog (chamotte) of various degrees of granulation and organic addition, which have various composition and volumes in particular specimens, although it appears that sand was added on a usual basis. Sporadically, the clay fabric did not contain intentionally added temper. In some cases, it contained very finely crushed stone and ochre. The characteristic feature of the pottery included in this category is the presence of incised ornaments and the small size of the vessels, which are mainly represented by spherical bowls, both hemispherical, and in the shape of three-fourths of a sphere (Figs 5: 1, 2; 7: 1-6; 8: 1-4, 7), and – considerably less often – by open bowls (Fig. 9: 1, 3) and more complex forms (Fig. 9: 4, 10). The surfaces of these vessels – especially those of specimens decorated with incised ornaments – are much more carefully formed in comparison with the rest of the collection. Their walls are usually even, smoothened (in several cases they are even slightly polished). In most cases, they are lustreless and – depending on the amount of temper and state of preservation – smooth or coarse. Both their external and internal surfaces usually have solid colours, ranging from grey through brown to black, which indicates that they were evenly fired in a reductive atmosphere. Some of the vessels were slipped, as evidenced by exfoliated external surfaces of several sherds. The thin-walled pottery of somewhat inferior production quality is usually unornamented or has plastic ornament, and the clay fabric used in its production contains greater amounts of crushed grog and organic temper. The wall surfaces of such vessels are often uneven, wavy, both smooth and grainy, and their colours are often diverse, blotched, mainly of grey, yellow-grey or – less frequently – orange colour.

The kitchenware pottery comprised decidedly larger vessels with thicker walls – ranging from 9 to 18 mm. The clay fabric contains considerable amounts of crushed grog, organic temper, gravel and sand. Sporadically, it also includes crushed stone, limestone and ochre. The granulation of the temper is widely diverse: from fine (0.5-1 mm – mainly sand), through medium (1.1-3 mm – grog and organic temper, sand), coarse-grained (3-5 mm – grog and organic temper, gravel, sporadically crushed stone) to very coarse-grained (5-11 mm – mainly grog temper and gravel). The prevailing decorative patterns are plastic ornament represented by nodules, finger and fingernail imprints (Figs 10: 1-4; 11: 2-9; 12: 1, 2, 5-9), and – only in several cases – applied strips (Fig. 12: 3). Incised ornament was rather exceptional (Fig. 6: 1). Just like in the case of thin-walled forms, the most numerous group are spherical bowl fragments (Figs 10: 1-3; 11: 9). The materials also included fragments of a squat wide-open vessel with a massive, everted rim (Fig. 8: 16). Because the clay fabric used in the production of the vessels contains considerable amounts of coarse-grained temper, the preserved surfaces are usually rough, porous or even coarse. Both the external and internal surfaces of the vessel walls were finished in a much less careful way than the walls of the tableware vessels. In most cases, they were only initially smoothed or rubbed. The upper and middle parts of the vessels are usually particolored, and the predominant

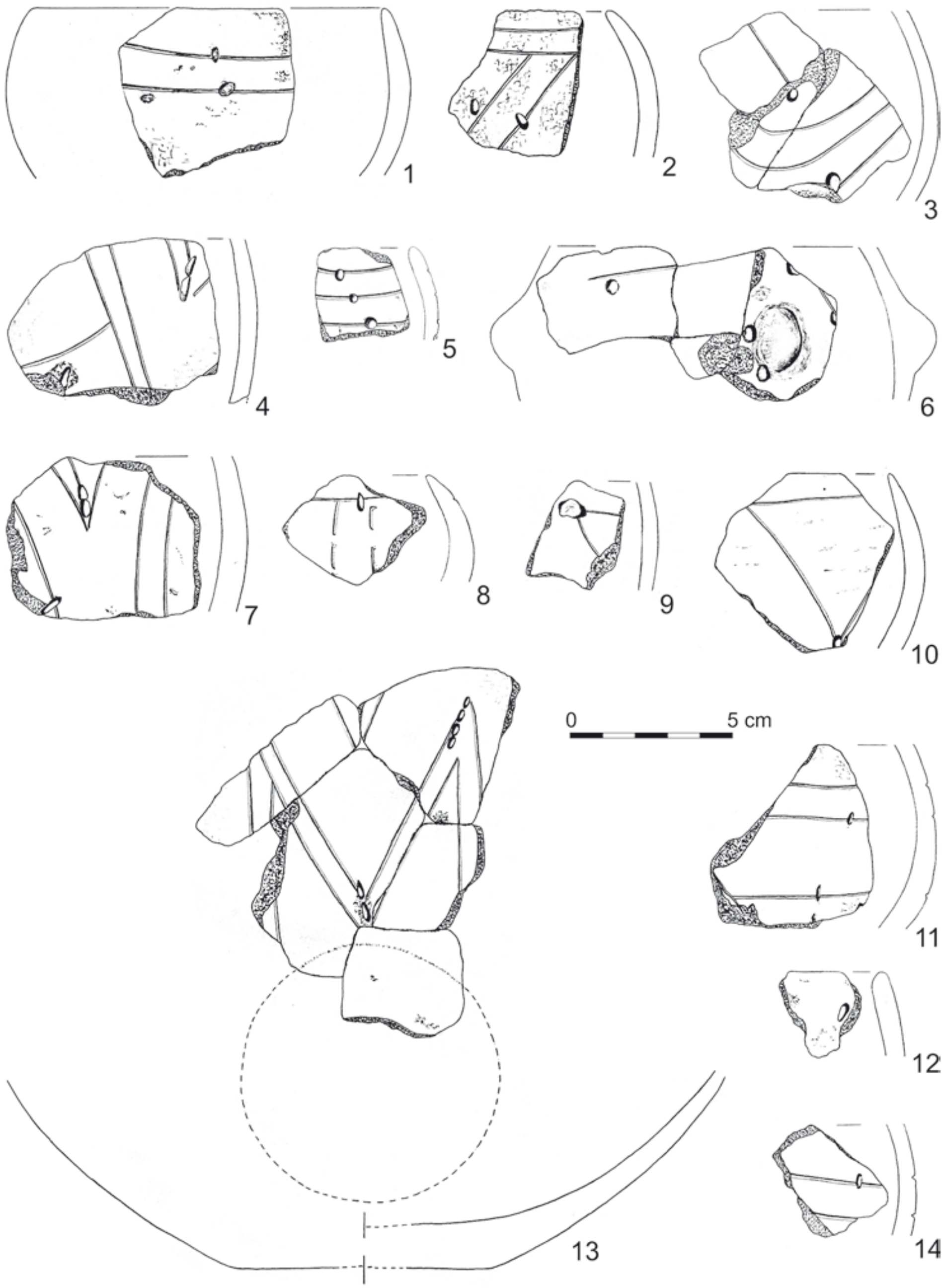


Fig. 5. Bogucin, Site 6: Selection of vessel pottery from the LBK features: 1 – Feature 173; 2 – Feature 16; 3, 6 – Feature 349; 4, 7, 13 – Feature 307; 5 – Feature 137; 8, 11 – Feature 47; 9 – Feature 135; 10 – Feature 133; 12 – Feature 42; 14 – Feature 41. Drawn by K. Gawryjołek-Szeliga

colours are bright hues of yellow/orange/grey. They are darker near the base. Most of the vessels included in this group were poorly fired in an oxidising atmosphere, which was caused by their size and method of production, but also probably by functional reasons and the intended use of such pottery.

The above-presented technological categorisation of the pottery material was not strictly followed by the potters who produced it. For example, some of the thick-walled vessels – probably bigger and having walls whose thickness exceeds 9 mm – were made of clay fabric generally used in the production of thin-walled pottery. The collection also includes delicate forms, made of clay thinned with the use of mineral temper, often having considerable granulation.

Vessel forms

As mentioned before, the morphologies of the analysed pottery collection are generally not very diverse. Based on partial reconstructions (including drawings) that allow us detect the basic features and parameters of the vessels, we can state that a relatively large proportion were spherical bowls. It seems that this category includes all the basic variants known from LBK inventories discovered across the drainage basin of the Upper Vistula. Among them, the least numerous are forms with completely everted rims and those whose rims are slightly inclined inwards (Figs 5: 1; 8: 10, 13, 17; 12: 1, 3), which correspond to types I and II according to the classification by M. Godłowska (1991, fig. 3), but the most numerous are forms in the shape of the segment of a sphere (both ½ and ¾), with rims strongly bent inwards (Fig. 5: 2, 8). Their sizes and macro-morphological features are very diverse. They have different wall thicknesses and gradients, and their edges are profiled in various ways. The bases of the vessels are most often flat (Figs 5: 13; 6: 13; 7: 1-2), and only sometimes do they have a slightly concave shape (Fig. 7: 11), with the diameters ranging from 30 to 120 mm. Forms with a distinguished base are extremely rare (Fig. 11: 9). The rim diameters of the spherical bowls range from 6 to 22 cm, but in most cases they do not exceed 10 cm. Determining their heights was made impossible by the virtual lack of completely reconstructed forms and the considerable fragmentation and incompleteness of the assemblage.

Other forms are definitely less numerous. They are mainly open bowl-shaped vessels – including unornamented forms with rim diameters of 18 and 19 cm and unspecified heights (Figs 8: 11, 17; 9: 1, 3) and somewhat untypical, very small forms having only nodules under the rims (Figs 9: 4; 12: 4). Another group of extremely rare forms are small amphora-shaped vessels (Fig. 9: 10) and large, thick-walled, squat vessels with strongly everted rims and large diameters (Fig. 8: 16). Such forms sometimes have horizontally pierced, semi-circular handles. One vessel is decorated with an incised ornament inlaid with dark/black substance resembling wood tar (Fig. 6: 1).

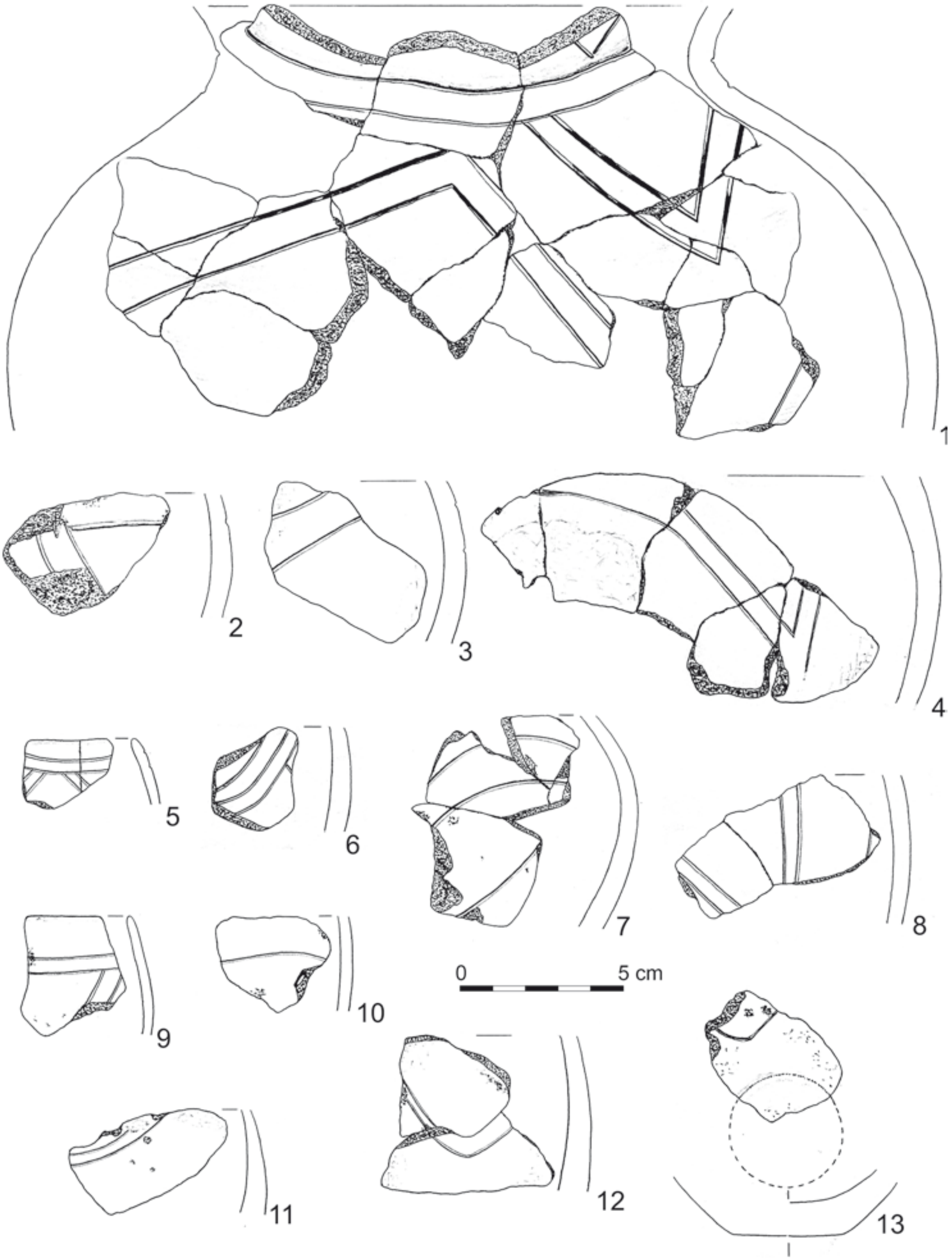


Fig. 6. Bogucin, Site 6: Selection of vessel pottery from the LBK features: 1 – Feature 4; 2 – Feature 47; 3 – Feature 41; 4, 6 – Feature 48B; 5 – Feature 100; 7 – Feature 349; 8 – Feature 307; 9, 12 – Feature 133; 10-11 – Feature 367; 13 – Feature 16. Drawn by K. Gawryjołek-Szeliga

Ornamentation

The overall share of ornamented sherds in the collection was determined to be *c.* 35.13% (176 specimens). The most numerous group are body fragments of different sizes. They outnumber ornamented rims and, especially, base parts (Table 2). Among the ornamented sherds, the most frequent are pottery fragments decorated with incised patterns, which occur almost exclusively on thin-walled vessels and represents the most common decorative element recorded below the rim as well as in the middle parts of certain vessels. In the former case, the incised ornament nearly always takes the form of rectilinear patterns composed of single (Figs 5: 8; 7: 8; 8: 3), double (Figs 5: 1, 2; 6: 5, 9; 7: 1, 2, 4; 8: 1, 2, 8, 9), or even triple (Figs 5: 5; 7: 3, 5, 6) horizontal lines – that go around the perimeter of a vessel, but not always form a full circle (Fig. 7: 3, 5) – usually located directly below the rim. Much more diverse decorative compositions can be found on the middle parts of the vessels, forming rectilinear or curvilinear patterns (*cf.*, Pyzel 2010, 20, 21) – oriented horizontally or diagonally to the vertical symmetry axis of vessels – most often composed of evenly distributed double (Figs 5: 3, 7, 13; 6: 1, 4, 7, 9, 11, 12; 7: 1, 2, 4, 6-8, 10, 11) or, less frequently, triple (Figs 6: 6; 7: 5) incised lines. Their widths are diverse, varying from *c.* 0.5 mm (Fig. 7: 3, 5) to 2 mm (Figs 6: 2; 8: 12), but lines whose width is more or less 1 mm are clearly the most numerous. Most of them were made with pointed tools and have V-shaped profiles in cross section.

The incised ornaments are most often accompanied by music-note holes or Želiezovce-type notches of diverse sizes and shapes. The music-note holes are usually more or less elongated and tear-shaped (Figs 5: 8, 11, 12, 14; 7: 7). Only sporadically are their outlines regular, round or oval (Fig. 5: 2, 3, 5, 6). They are usually arranged separately within incised lines (Fig. 5: 1, 2, 5), next to them (Fig. 5: 2, 6), at their ends (Fig. 5: 3) as well as in the places where they meet or bend (Fig. 5: 9, 10). Only in few cases, do the music-note holes form various small groups usually arranged in rows (Fig. 5: 4, 7, 13), or they even overlap, creating single elongated grooves joining parallel incised lines (Fig. 8: 1). This decorative element refers to the Želiezovce ornamentation style (Pavúk 1969, Abb. 5: 9; Kadrow 1990, fig. 8: g, q, z; Dębiec 2015, 41, 47), represented in the analysed collection by numerous diagnostic notches. Each time, they are accompanied by incised ornaments within the main decorative compositions and in patterns located below the rim. Most often, the notches cross single incised lines (Figs 7: 7, 9; 8: 3, 12, 18) or join two parallel incised lines (Figs 7: 1, 2, 4, 8, 10-11; 8: 2, 5, 6, 15). In one case, a small, tear-shaped music-note hole was impressed next to regularly arranged notches (Fig. 7: 2).

Plastic elements are slightly more scarce in the analysed assemblage. They occur most frequently (or, in some case, exclusively) – and in their greatest diversity – on the surfaces of the thick-walled vessels. This group is most often represented by nodules of different shapes and sizes – although the most numerous are circular (Figs 9: 8; 10: 3; 11: 1, 6, 9; 12: 10) and oval elements (Figs 10: 4; 11: 4), which often have hollows on the tops of their usually

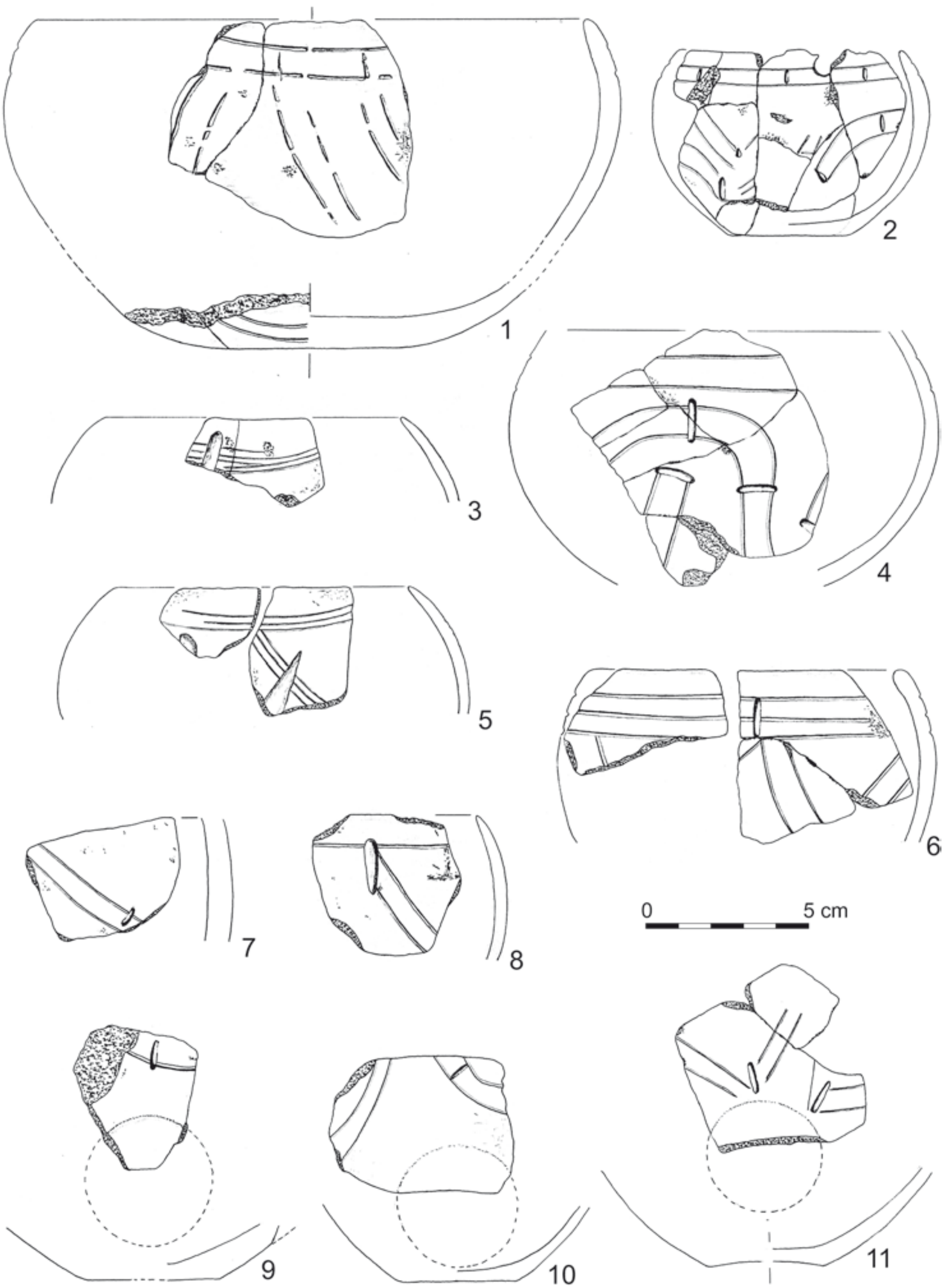


Fig. 7. Bogucin, Site 6: Selection of vessel pottery from the LBK features: 1 – Feature 131; 2, 10 – Feature 379; 3, 5 – Feature 103; 4 – Feature 136; 6 – Feature 133; 7 – Feature 7; 8 – Feature 48A; 9 – Feature 100; 11 – Feature 98. Drawn by K. Gawryjołek-Szeliga

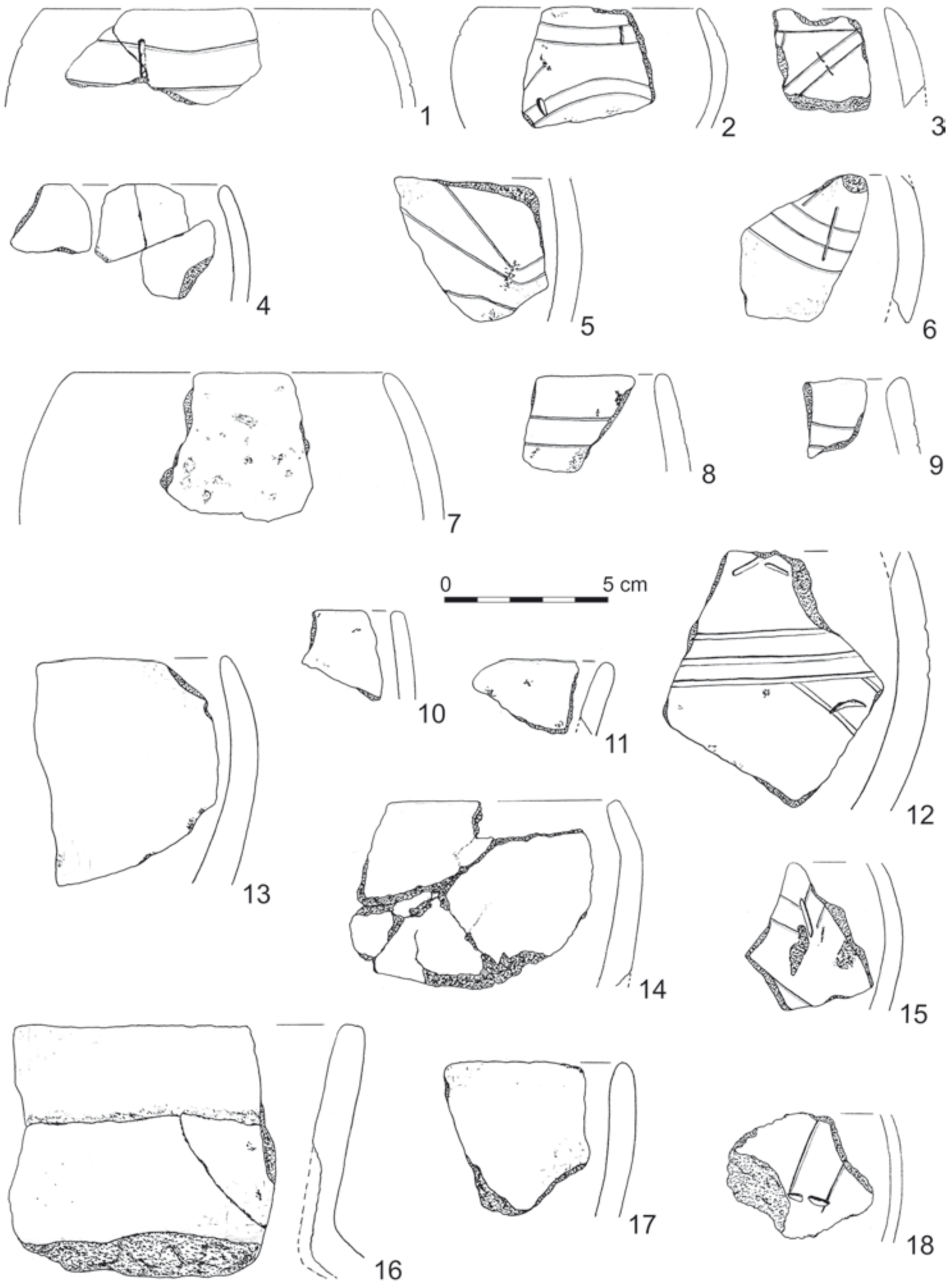


Fig. 8. Bogucin, Site 6: Selection of vessel pottery from the LBK features: 1 – Feature 136; 2, 5 – Feature 379; 3 – Feature 47; 4, 12-13, 15 – Feature 133; 6 – Feature 134; 7-9 – Feature 307; 10-11 – Feature 229; 14 – Feature 99; 16 – Feature 40; 17-18 – Feature 55. Drawn by K. Gawryjołek-Szeliga

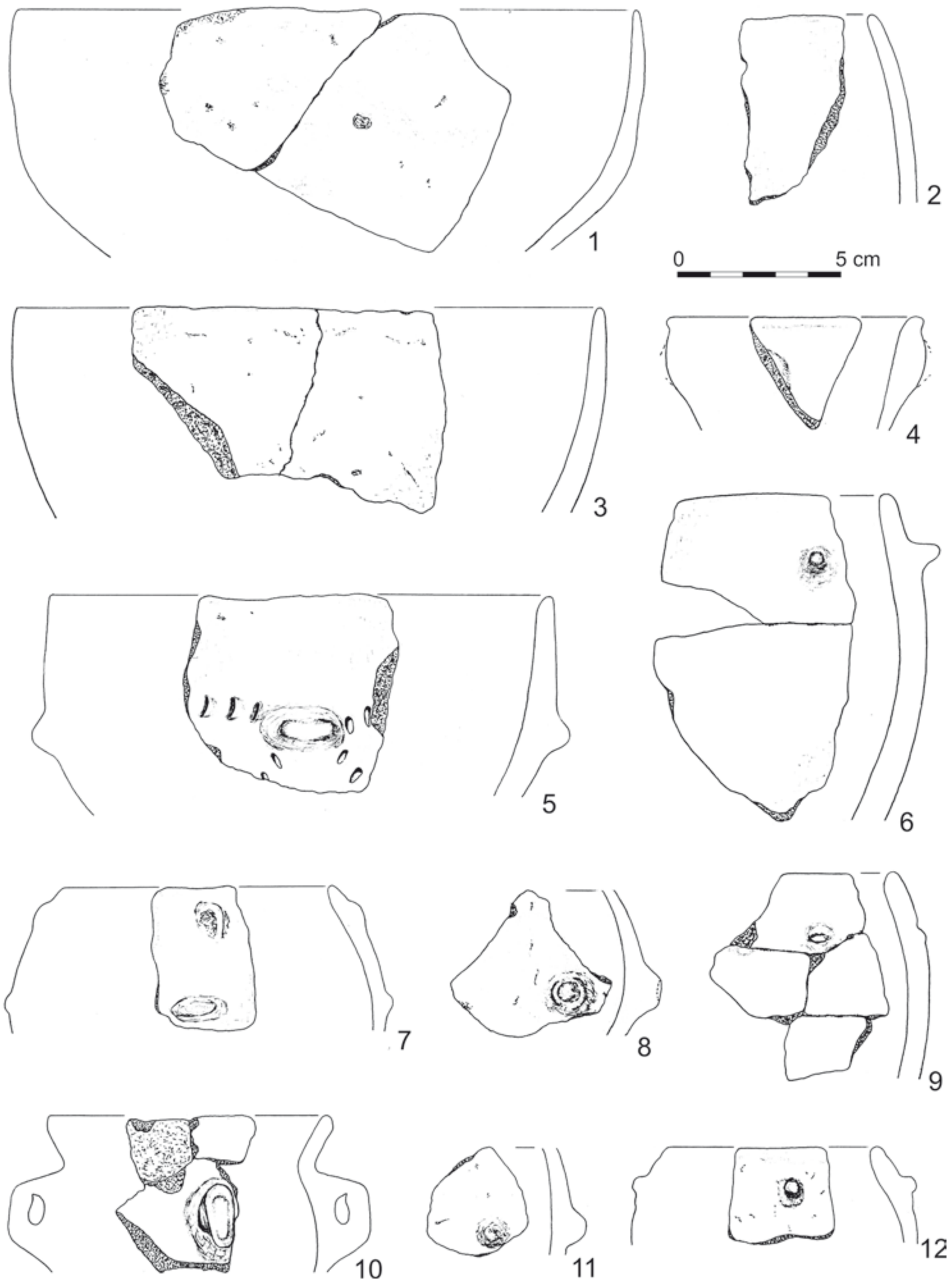


Fig. 9. Bogucin, Site 6: Selection of vessel pottery from the LBK features: 1 – Feature 131; 2 – Feature 41; 3 – Feature 55; 4, 6, 9 – Feature 133; 5, 12 – Feature 307; 7 – Feature 310; 8, 11 – Feature 4; 10 – Feature 102. Drawn by K. Gawryjołek-Szeliga

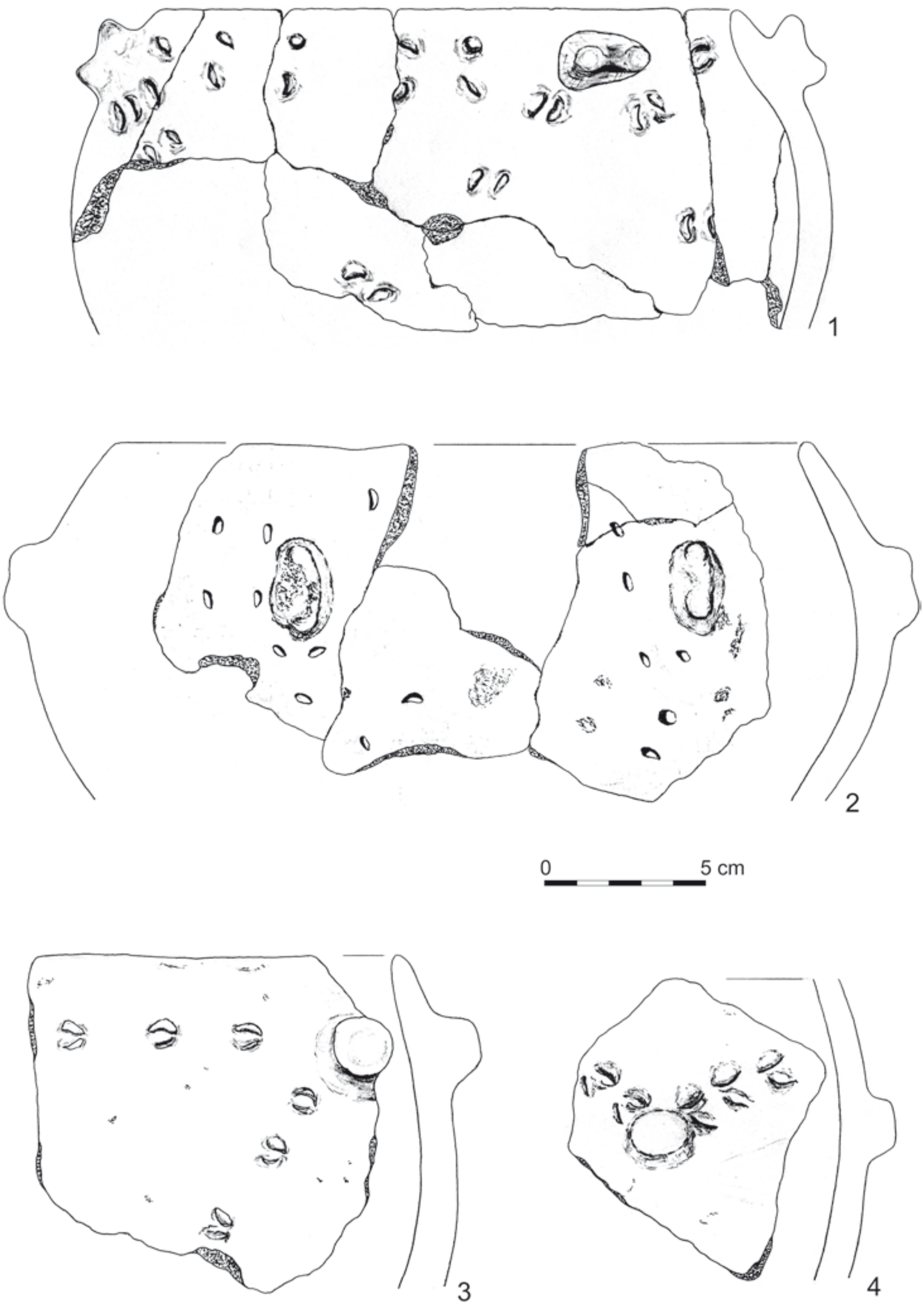


Fig. 10. Bogucin, Site 6: Selection of vessel pottery from the LBK features:
1 – Feature 277; 2 – Feature 41; 3 – Feature 55; 4 – Feature 307. Drawn by K. Gawryjołek-Szeliga

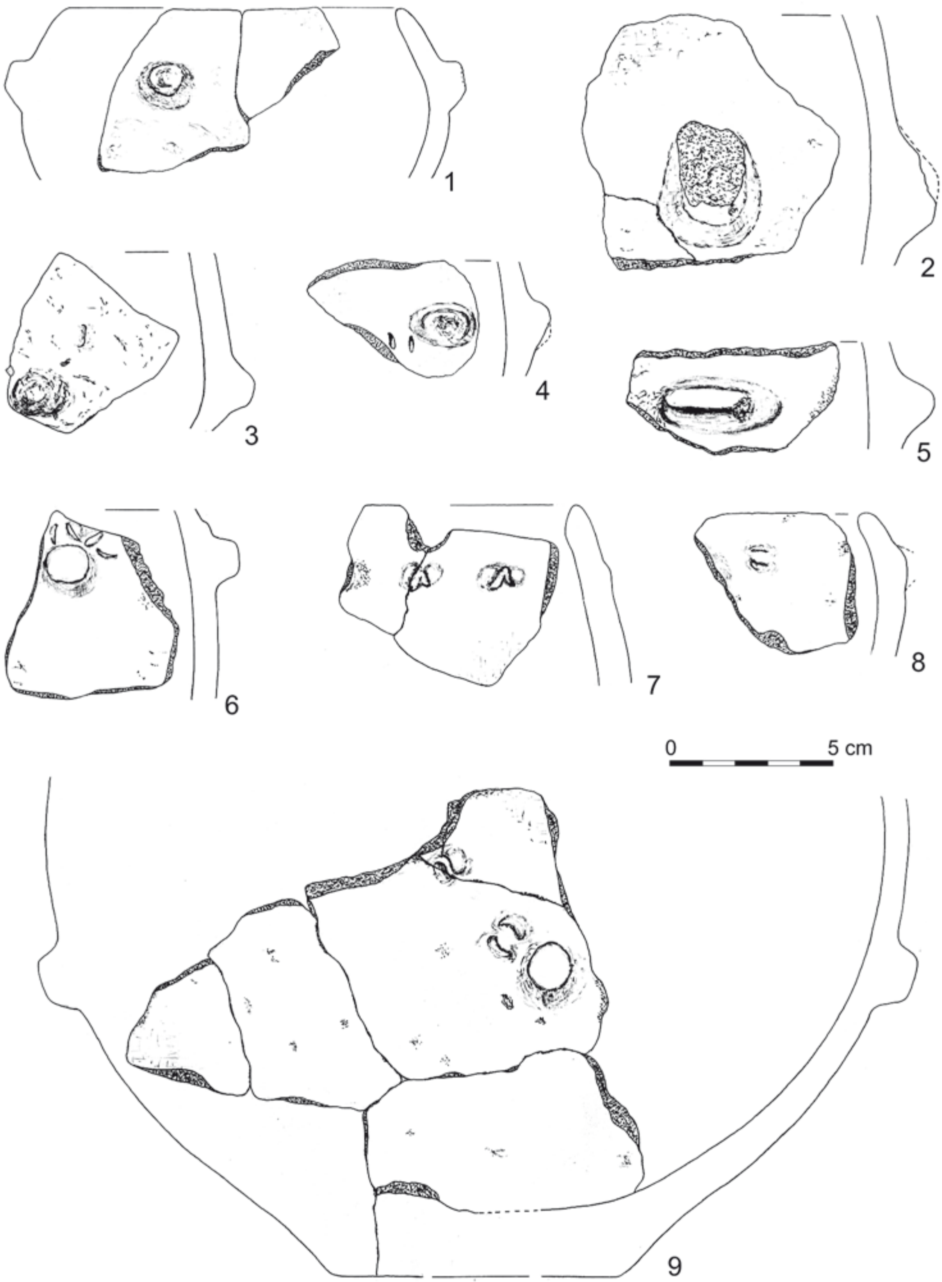


Fig. 11. Bogucin, Site 6: Selection of vessel pottery from the LBK features:
1 – Feature 131; 2 – Feature 4; 3 – Feature 47; 4, 6-7, 9 – Feature 307; 5 – Feature 55; 8 – Feature 133.
Drawn by K. Gawryjołek–Szeliga

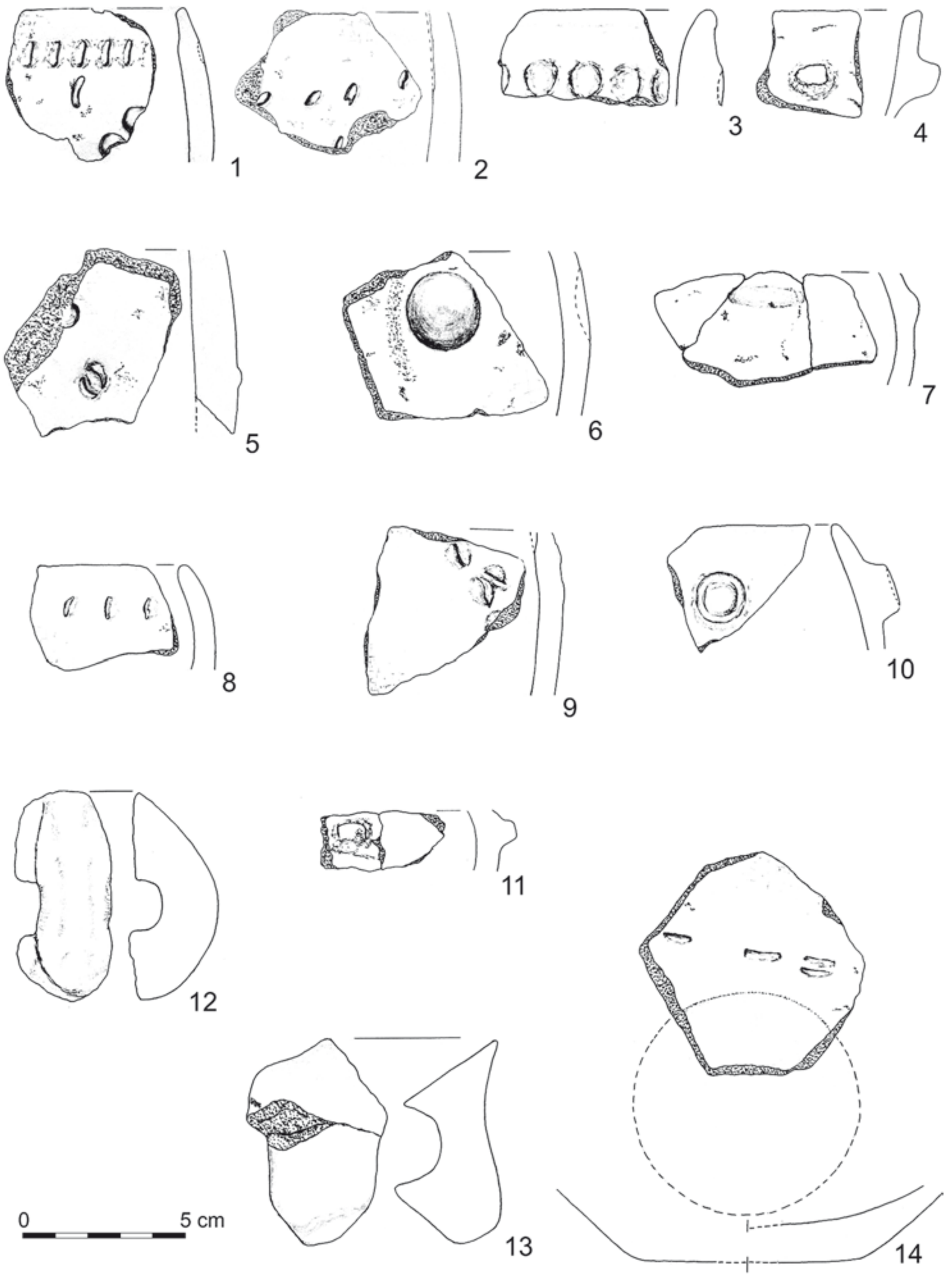


Fig. 12. Bogucin, Site 6: Selection of vessel pottery from the LBK features:
1 – Feature 173; 2 – Feature 131; 3 – Feature 55; 4 – Feature 40; 5 – Feature 75; 6 – Feature 136; 7 – Feature 41; 8 – Feature 102; 9-10 – Feature 307; 11 – Feature 4; 12 – Feature 229; 13 – Feature 168; 14 – Feature 367. Drawn by K. Gawryjołek-Szeliga

flattened surfaces. Oval – horizontal or vertical – nodules with a conical cross-section are somewhat less numerous (Figs 9: 5-7; 11: 5). In at least two cases, forms having rectangular outlines were recorded (Fig. 12: 4, 11). A considerable majority of the nodules are single forms. Double nodules – alleged or confirmed – occur only sporadically (Fig. 10: 2). Among them, the most noteworthy are four small double nodules – having a conical shape and asymmetrically arranged in alternating horizontal and vertical patterns directly below the rim of a spherical bowl discovered in Feature 277 (Fig. 10: 1).

Handles – which, besides their functional meaning, have an undisputed decorative value – are definitely less numerous in the analysed materials. Altogether, the collection yielded five handles – the great majority of which are massive, horizontally pierced forms having a semi-circular cross-section (Fig. 12: 12), but sometimes their shape is difficult to reproduce (Fig. 12: 13). These were part of large, thick-walled vessels (probably storage containers). An exceptional case was the discovery of a somewhat untypical, horizontally pierced handle having an angular shape, situated in the upper part of the body of a thin-walled amphora-shaped vessel, whose rim was slightly bent outwards (Fig. 9: 10).

Another example of plastic ornament is a strip decorated with a row of somewhat regular, oval and shallow finger imprints found on a single rim fragment (Fig. 12: 3). Finger and fingernail imprints alone were recorded on a relatively small number of sherds, mainly of thick-walled vessels. Most often, they formed simple linear compositions in the upper parts of vessel bodies, which were adorned with nodules or equipped with handles, as well as directly below the rims of vessels (Figs 10: 1, 3; 11: 6, 7; 12: 5, 9). Based on a completely reconstructed rim part of a spherical bowl discovered in Feature 277 (Fig. 10: 1), we can suspect that this type of ornament might have covered larger parts or even entire surfaces of the vessels, taking the shape of single rows encircling their rims and spreading radially from particular nodules and handles located at different heights of bodies.

Fingernail or finger imprints – most often arranged in horizontal rows below the rims – are definitely less common (Fig. 12: 1, 2, 8). In one case, the discussed type of decorative elements occurred together with music-note ornaments (Fig. 9: 5). One sherd had a large, circular hollow with a very regular outline and the diameter of c. 24 mm (Fig. 12: 6).

FLINT ARTEFACTS

The collection of flint items encompasses altogether 117 artefacts. They were discovered in 28 features – that is in slightly more than half of them – usually as single specimens or rather small assemblages counting up to 18 items (Table 1). Despite this small number, the analysed material is diverse in respect of the raw materials used in their production (Table 3; Fig. 13: 1). The predominant group are flints genetically linked with Mesozoic sediments located on the north-eastern edge of the Holy Cross Mountains (Świętokrzyskie Mountains), specifically with Turonian deposits situated by the right bank

Table 3. Bogucin, Site 6: quantitative comparison of flint artefacts originating from the LBK features: 1 – Świeciechów flint; 2 – chocolate flint; 3 – Volhynian flint; 4 – erratic flint; 5 – Jurassic-Cracow flint; 6 – burned flint; 7 – unspecified flint

Feature No.	1	2	3	4	5	6	7	Total
4	5	-	-	-	-	-	-	**5**
7	2	1	-	-	1	-	-	**4**
20	-	1	-	-	-	-	-	**1**
40	6	1	1	1	-	-	-	**9**
41B	-	2	2	1	-	-	-	**5**
42	3	2	-	-	-	-	-	**5**
47	3	3	-	-	-	-	1	**7**
48A	1	-	-	-	-	-	-	**1**
48B	1	1	-	-	-	-	-	**2**
55	10	2	-	1	-	1	-	**14**
73	1	1	-	-	-	-	-	**2**
75	1	3	-	-	-	-	-	**4**
88	1	-	-	1	-	-	-	**2**
96	1	-	-	-	-	-	-	**1**
98	3	1	-	-	-	-	-	**4**
102	2	1	-	-	1	-	-	**4**
103	1	-	-	-	-	-	-	**1**
131	5	-	-	-	-	2	-	**7**
136	2	2	-	-	-	-	-	**4**
137	1	1	-	-	-	-	-	**2**
166	-	-	-	-	-	-	1	**1**
168	-	1	-	-	-	-	-	**1**
174	3	-	-	-	-	-	-	**3**
277	2	-	-	-	-	-	-	**2**
307	5	-	1	-	-	-	-	**6**
367	1	-	-	-	-	-	-	**1**
375	-	-	-	-	1	-	-	**1**
379	17	1	-	-	-	-	-	**18**
Razem	**77**	**24**	**4**	**4**	**3**	**3**	**2**	**117**

of the Middle Vistula (Świeciechów flint) and – to a lesser degree – Upper Jurassic sediments located on the opposite bank of the river (chocolate flint). The linear distance between the outcrops of both raw materials and the researched settlement is *c.* 60-80 kilometres. Undoubtedly, Świeciechów flint was of the greatest importance. Artefacts made of this raw material were the most numerous in the majority of the features containing flint artefacts. It is definitely predominant in the entire raw material structure (*c.* 65.82%; Table

3; Fig. 13: 1). Artefacts made of chocolate flint are the second most numerous – although a definitely smaller – group, constituting collectively *c.* 20.51% of the entire assemblage. This clear disproportion between the numbers of products made of both materials is confirmed by the materials found at other LBK sites from central-eastern Poland, especially those located in the direct vicinities of their outcrops (*e.g.*, Sandomierz-Kruków, Site 20, Tominy, Site 6; *cf.*, Michalak-Ścibior and Taras 1995, tab. V; Szeliga and Zakościelna 2007, 14; Szeliga 2008, fig. 12).

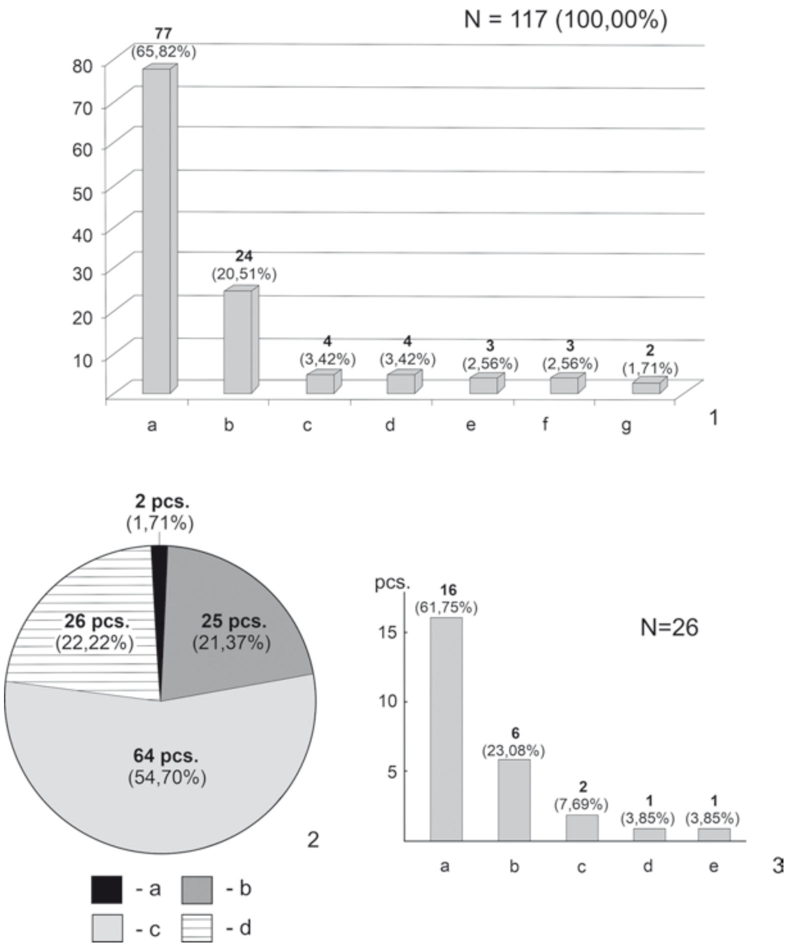


Fig. 13. Bogucin, Site 6: Flint inventory from the LBK features:
1 – raw material structure (a – Świeciechów flint; b – chocolate flint; c – Volhynian flint; d – erratic flint; e – Jurassic-Cracow flint; f – burnt flint; g – unspecified flint); 2 – morphological structure (a – core forms; b – blades and their fragments; c – flakes; d – retouched tools); 3 – typological structure of the retouched tools (a – end-scrapers; b – retouched blades; c – retouched flakes; d – truncation; e – end-scraper+truncation).
Prepared by M. Szeliga

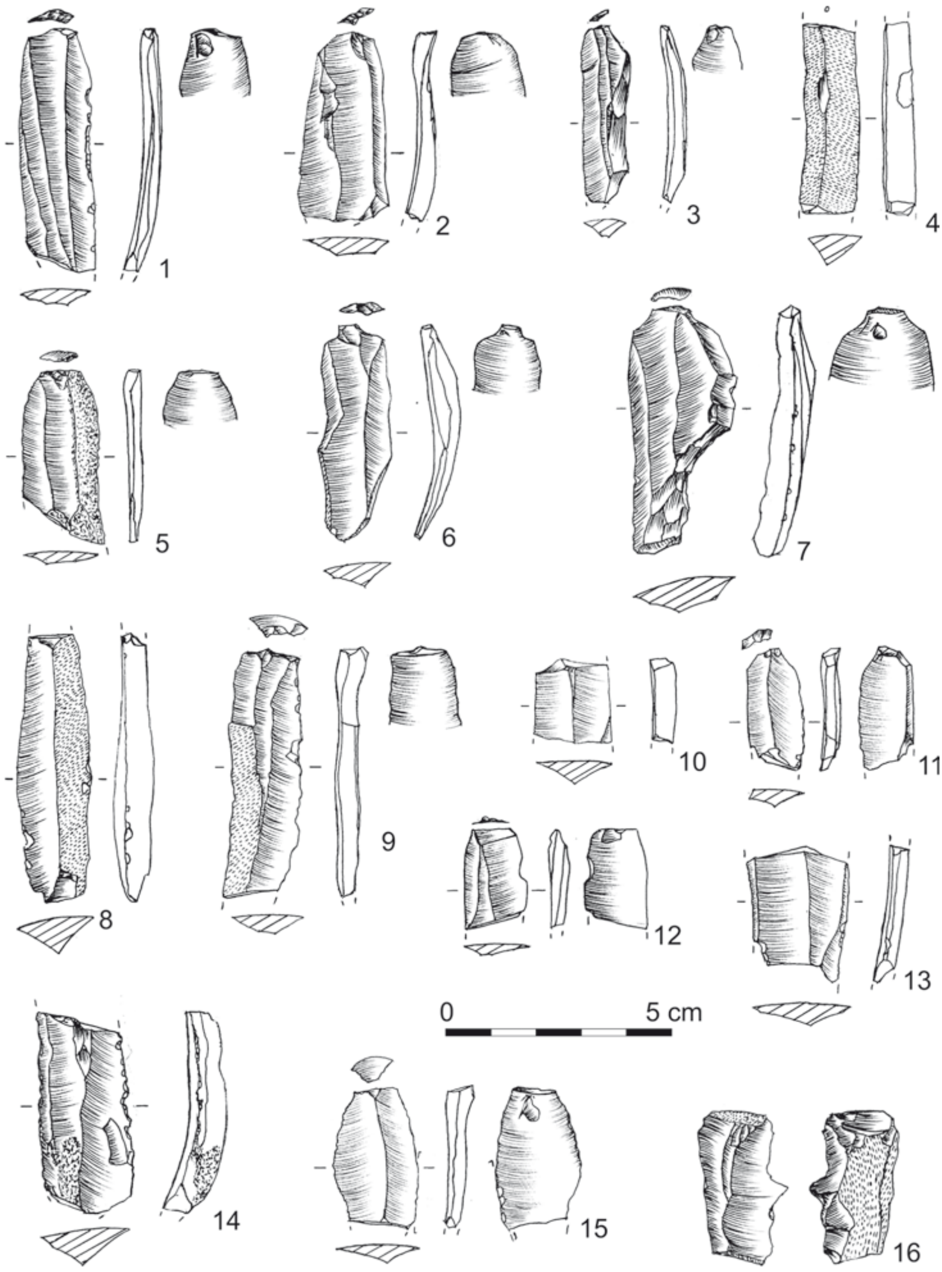


Fig. 14. Bogucin, Site 6: Selection of flint materials from the LBK features: 1, 12 – Feature 379; 2 – Feature 136; 3 – Feature 98; 4 – Feature 307; 5, 10 – Feature 131; 6 – Feature 42; 7-9, 14 – Feature 55; 11 – Feature 20; 13 – Feature 168; 15 – Feature 47; 16 – Feature 88. Raw materials: 1-3, 7, 11, 13-14 – chocolate flint; 4, 6, 8-10, 12, 15 – Świeciechów flint; 5 – burnt flint; 16 – erratic flint. Drawn by M. Szeliga

The remaining identified flint varieties are represented only by small groups (Fig. 13: 1), composed of artefacts that were usually found individually in particular features. Four specimens (3.42%) were made of Cretaceous flints, whose outcrops are located across the vast areas of the central-eastern part of the Volhynian-Podolian Upland. The same number applies to erratic flints from glacigenic sediments – which were probably located at a short distance from the settlement. Three artefacts (2.56%) were made of Jurassic-Cracow flint (Table 3; Fig. 13: 1). They were all made of brown flint that macroscopically corresponds to variant A according to M. Kaczanowska and J. K. Kozłowski (1976, 206). It was impossible to definitely determine the raw material used in the production of five specimens (*c.* 4.27%), which was caused, among other factors, by the fact that they were heavily burnt.

The morphologies of the discussed flint inventory are not very diverse. Flakes are definitively the most numerous, jointly constituting 54.70% of the whole collection (Fig. 13: 2). Intentionally retouched tools are the second most abundant group, only slightly outnumbering the total number of blades. The remaining specimens of the inventory can be included – although tentatively – in the group of core-forms. They constitute only 1.71% of all the finds discovered within the discussed LBK features (Fig. 13: 2) and are represented by a single unipolar splinter made of erratic flint (Fig. 14: 16) and a fragment of a hammerstone formed on a Świeciechów flint core.

The most abundant collection of flakes and their fragments encompasses specimens having different metric values as well as morphological profiles and representing different stages of the production process. Flakes of unspecified technological origin – specimens having their dorsal surfaces entirely covered with negative scars or flakes with only partially natural dorsal surfaces – are definitely the most numerous group of this category. The material also included several massive, completely cortical specimens formed during the initial exploitation phase – specifically at the stage of forming the main exploitation surfaces of the core (especially striking platforms). The analysed collection does not contain diagnostic remains left by such technological procedures as repairing striking platforms (rejuvenation flakes, core tablets) or changing the orientation of blade cores, which were known and used by the societies of the LBK, as indicated by materials from many other settlement sites (*e.g.*, Kozłowski 1970; Lech 1979; 1997; 2008, Kaczanowska 1985; Kaczanowska *et al.* 1987; Kabaciński 2010; Pelisiak 2014; Wilczyński 2014a; 2014b). The complete absence of such remains in the collection may indicate that the community inhabiting the discussed settlement processed raw materials to a somewhat limited degree. However, this is contradicted by the presence of few refits of flint products (Figs 17: 4; 18). They indirectly indicate that the original quantity and quality structures of inventories discovered in particular features are relatively incomplete.

The great majority of the blades are represented by different fragments (Fig. 14: 1-5, 8-15), whereas complete specimens are extremely rare (Fig. 14: 6, 7). All of them were obtained from single-platform cores. The predominant group are blades with completely scarred dorsal faces formed during advanced stages of core exploitation (Fig. 14: 1, 2, 6, 7,

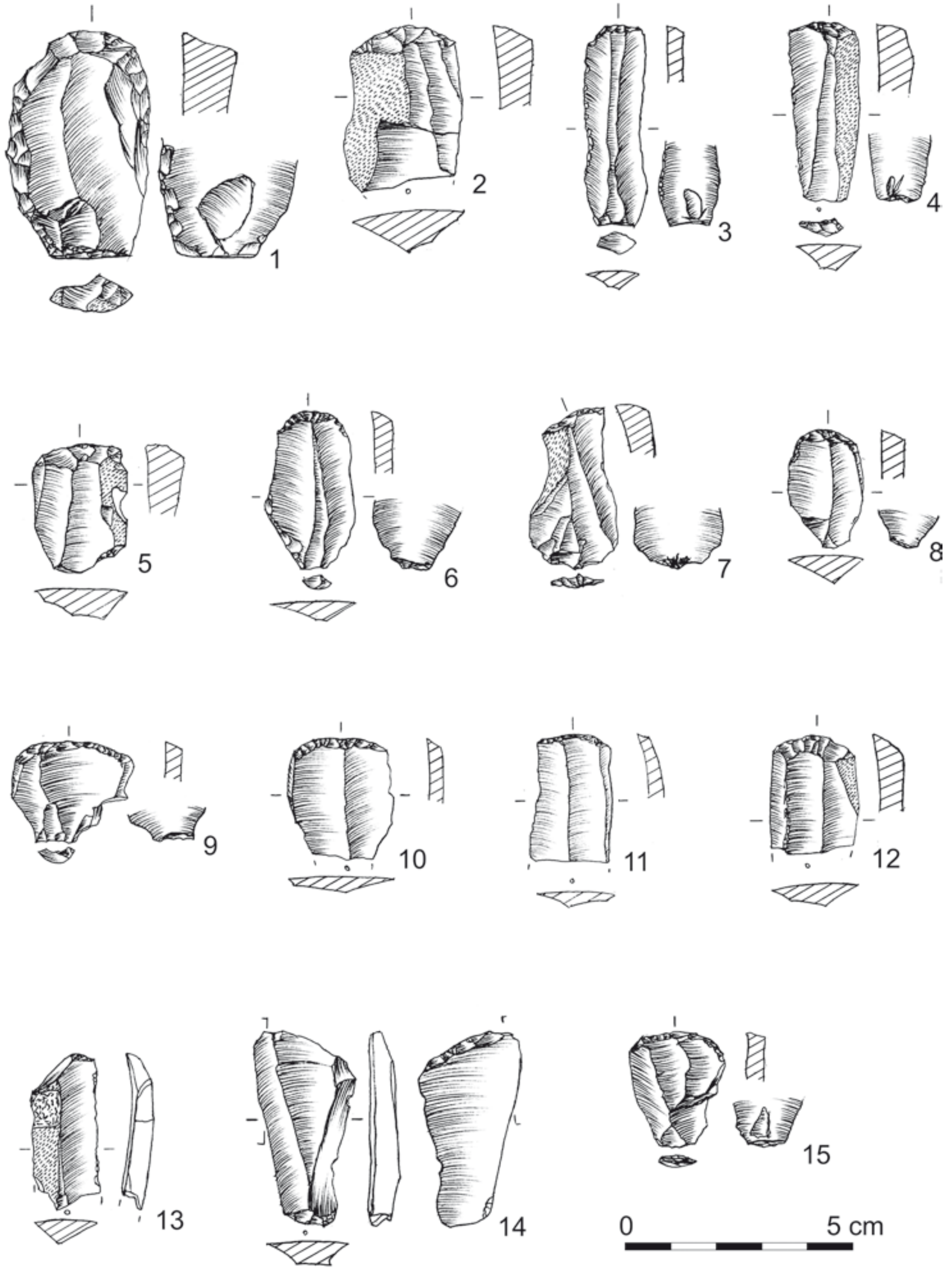


Fig. 15. Bogucin, Site 6: Selection of flint materials from the LBK features: 1, 9, 15 – Feature 55; 2 – Feature 88; 3, 10 – Feature 379; 4 – Feature 47; 5 – Feature 4; 6-7 – Feature 40; 8 – Feature 7; 11 – Feature 375; 12 – Feature 42; 13 – Feature 131; 14 – Feature 73. Raw materials: 1-10, 12-15 – Świeciechów flint; 11 – Jurassic-Cracow flint. Drawn by M. Szeliga

10-15), as well as longitudinally cortical blades formed during the expansion of the flaking faces into the natural sides of the cores (Fig. 14: 5, 8, 9). They are usually somewhat regular specimens having parallel or converging lateral edges and triangular or trapezoidal cross-sections. A high share of faceted butts and frequent marks of platform edge trimming indicate that the core angle was carefully adjusted directly before removing the blades. The lateral edges of one specimen were polished on both sides, obliquely to its long axis, which suggests that it was originally used as one of insets forming a segmented blade of a harvesting tool (Fig. 14: 15).

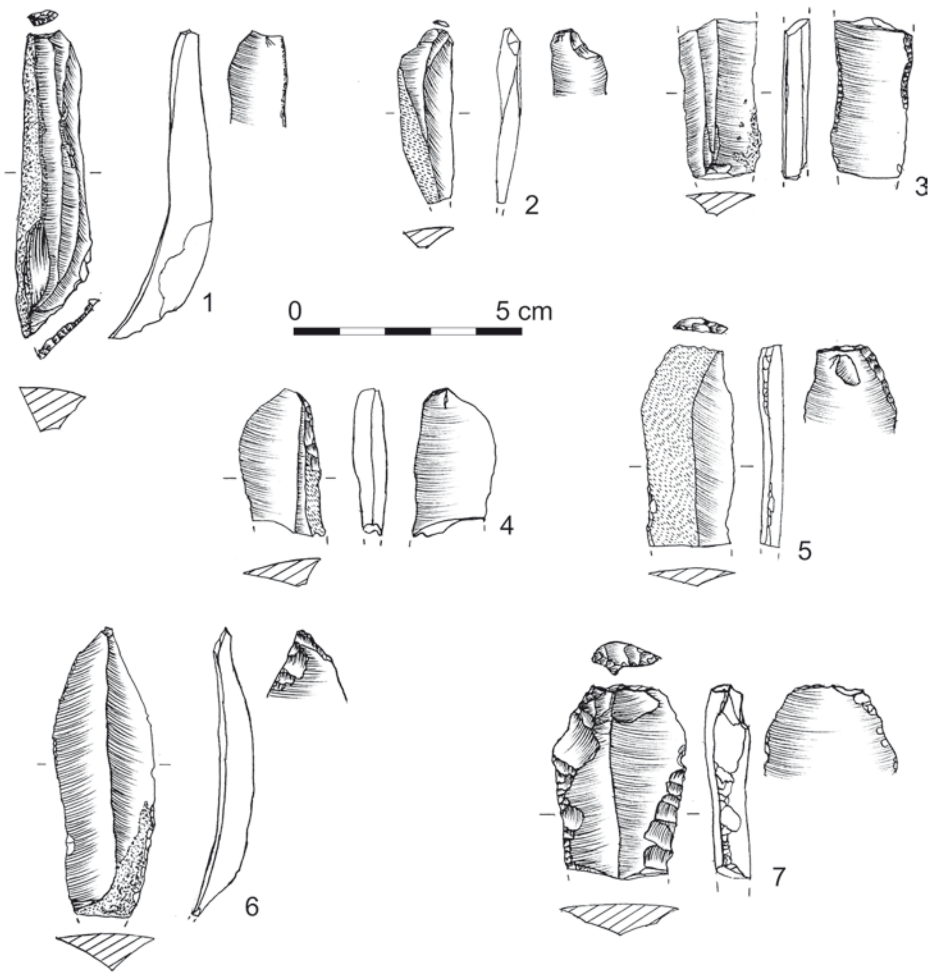


Fig. 16. Bogucin, Site 6: Selection of flint materials from the LBK features: 1, 4 – Feature 136; 2-3 – Feature 40; 5 – Feature 307; 6 – Feature 55; 7 – Feature 41B. Raw materials: 1, 3 – chocolate flint; 2, 4-5 –Świeciechów flint; 6 – erratic or Volhynian flint; 7 – Volhynian flint. Drawn by M. Szeliga

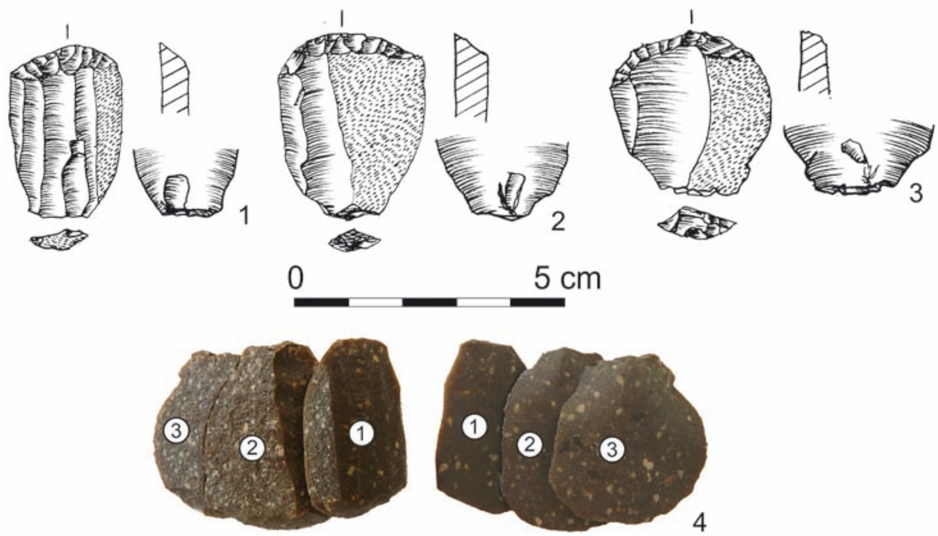
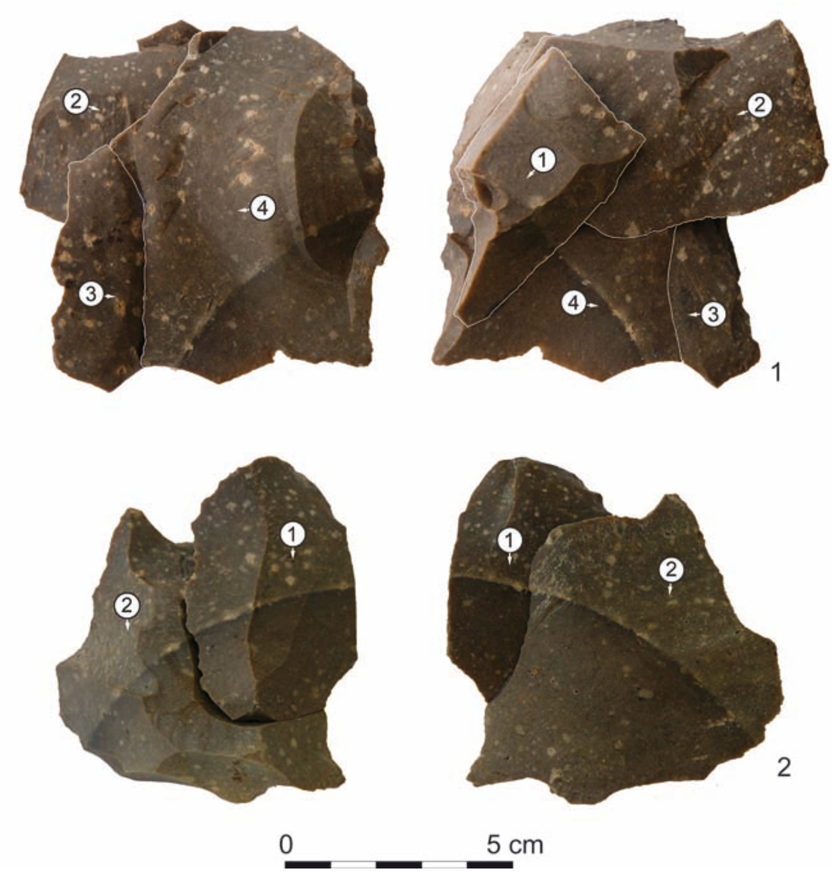


Fig. 17. Bogucin, Site 6: Three end-scrapers from the Feature 379 (1-3) and their refit (4). The numeration in the photographs corresponds to the numbers in the figure and it reflects the order of the strikes. Raw material: Świeciechów flint. Prepared by M. Szeliga

The materials include 26 intentionally retouched forms, which comprise 22.22% of the total number of the discovered flint artefacts of the LBK (Fig. 13: 2). Their typological structure demonstrates a clear predominance of end-scrapers, whose overall share in the group of tools was as much as 61.53% (Fig. 13: 3). With a single exception of a specimen made of Jurassic-Cracow flint (Fig. 15: 11), Świeciechów flint was used in the production of all the end-scrapers. It is worth mentioning that three of them, discovered in Feature 379, could be refitted together (Fig. 17: 1-4). The discussed category of tools is a somewhat morphologically uniform group of artefacts. They were formed both on blades (Fig. 15: 2-4, 6, 8, 11-14) and flakes (Figs 15: 1, 5, 7, 9, 15; 17: 1-3). Their working edges are usually arched, slightly or moderately curved, mostly symmetrically to the longer axes of the half-products on which they are formed (Figs 15: 1, 2, 5, 6, 8-10, 12, 15; 17: 1-3). Specimens with straight working edges – perpendicular (Fig. 15: 11) or oblique to the longer axis (Fig. 15: 13) – are decidedly less numerous. A single combined tool (end scraper + truncation) was also discovered. The fact that its surface was polished on both sides indicates that it was used as an inset of a harvesting tool (Fig. 15: 14). The second most numerous group of typological tools are entire or fragmentarily preserved retouched blades and flakes. Eight such tools were found, comprising 30.77% of the total number of the discovered tools. Each of them was intentionally retouched only on a fragment of one or two edges, on one side (Fig. 16: 2-7). It appears that the locations of the retouch – in respect of their parts and surfaces – were not the result of following any rules. The last, least numerous category of tools are truncations, represented – besides the above-mentioned combined form – by only one



Ryc. 18. Bogucin, Site 6: Refitted flakes made of Świeciechów flint found in Feature 379 (1) and features Nos. 103 and 174 (2). The order and directions of the strikes were marked in the photographs. Prepared by M. Szeliga

specimen made of chocolate flint with the truncated edge perpendicular to the longer axis of the blade (Fig. 16: 1). It was formed on a longitudinally cortical plunging blade removing the apex of a core.

The flint inventory – despite the fact that it seems that it is incomplete as regards its original quantity and quality structure – demonstrates very close similarities with other LBK assemblages discovered across the drainage basin of the Upper Vistula. Clear analogies concern not only the general morphological diversity of the collection and the shares of particular inventory groups within it, but also general production tendencies manifested by the structure of tool types, which is similar to patterns known from many other sites – especially by the clear predominance of end-scrapers (*e.g.*, Lech 1979, 128; Balcer 1983, tab. 8; Kaczanowska *et al.* 1987, 95, 98, 103; Kadrow 1990, fig. 25: a-f; Wilczyński 2014a, fig. 2; 2014b, 504, 505). The general diversity of the inventory demonstrates proportions characteristic of so-called 'user settlements' and is decidedly different from structures typical of settlements where flint materials were extensively processed (*e.g.*, Olszanica, Vedrovice, Tominy; *cf.*, Lech 2008, fig. 26: B, H; Szeliga 2014, fig. 3: F-H). The closest analogies to the character of the discussed collection can be found in the structures of inventories discovered at the sites of Tarnoszyn and Strachów, which demonstrate – besides the predominance of flake half-products and a small number of specimens included in morphological group I – fairly similar, high quantities of blades and prepared tools (respectively: 19.1% and 29.8% in Tarnoszyn, 22.6% and 25.2% in Strachów; *cf.*, Lech 1997, tab. 2; 2008, fig. 26: C, E).

The high percentage of blades and retouched tools may suggest that at least some of them were brought to the settlement in the final form. Still, we must remember that this suggestion may regard only some specimens included in the whole category, especially those made of materials other than Świeciechów flint. Processing Świeciechów flint within the limits of the settlement is indirectly confirmed by a single fragment of a hammer-stone discovered in Feature 307 and a small number of Świeciechów flint artefacts that can be refitted. They are remains left after initial procedures conducted during the preparation of the main exploitation surfaces of cores (Fig. 18: 1, 2) and actions aiming at tool production (Fig. 17: 4).

STONE ARTEFACTS

The least numerous and diverse group of the mobile finds are stone artefacts, of which only four specimens were found (Table 1). There were one entire and fragments of two other abrasive plates – made of fine-grained and medium-grained sandstone – and a small (72,7 × 54.8 × 21 mm) axe – asymmetric in the longitudinal and cross section, made of light rock (of bright beige colour), whose macroscopic properties resemble those of marl (Fig. 19). It is the first LBK axe made of this type of material discovered in the Lublin Region that has macroscopic features analogous to the properties of similar Early Neolithic finds from south-eastern Poland (Pelisiak 2018, fig. 1: G).

RELATIVE CHRONOLOGY OF MATERIALS AND SETTLEMENT IN BOGUCIN

The analyses of ornamentation techniques and decorative patterns indicate that the stylistically earliest group of pottery finds are materials ornamented in the music-note style. Among them, there is a distinctive but small group of thin-walled sherds decorated with double or triple incised lines, which are straight or S-shaped. A small number of tiny

Fig. 19. Bogucin, Site 6: Stone axe found in Feature 55. Photo by M. Szeliga

music-note imprints, having round, somewhat regular shapes, are arranged on them (or along them) (Fig. 5: 3, 5, 6, 9). These specimens clearly correspond to pottery decorated in the early music-note style, but their small number makes it impossible to rule out the possibility that they are also linked with the later phase of the LBK stylistic development, that is with phase NIII. The early music-note ornamentation is represented much more often by the analysed materials, showing a decidedly greater stylistic variety. Its main indicator are small music-note holes having oblong or tear-shaped outlines and individually arranged on or next to incised lines (Fig. 5: 1, 2, 8, 11, 12, 14), but sometimes they are closely spaced or overlapping pits forming vertical rows within rectilinear or angular motifs of double incised lines (Figs 5: 4, 7, 13; 8: 1).

The most numerous group of pottery finds – representing the latest ornamentation type – are sherds decorated in the early-Želiezovce style (phase ŽI; *cf.*, Pavúk 1969, 321-325). Its diagnostic indicator is the presence of impressed notches – having different sizes and intersecting one or more incised lines (Figs 7: 3, 7, 9; 8: 12, 18) or joining two adjacent parallel lines that form varied rectilinear and curvilinear compositions near the rim, in the middle part and – less frequently – near the base (Fig. 7: 1, 2, 4, 6, 8, 10, 11; 8: 2, 5, 15). Sometimes, impressed ornaments are represented by tiny dashes individually arranged within particular incised lines (Fig. 8: 3, 6). An occurrence of small, tear-shaped music-note holes was recorded on a partially reconstructed small spherical bowl found in Feature 379, next to regularly arranged notches joining double incised, straight and arched lines (Fig. 7: 2). The presence of both ornamentation motifs on the same vessel is also a very characteristic element of the early-Želiezovce style (Pavúk 1969, Abb. 13-16; Kadrow 1990, 62, fig. 8).

To sum up, the relative chronology of the settlement in Bogucin – analysed in the context of the stylistic variation of the ornaments present on the examined vessels – is limited to a relatively short period, which probably lasted from the late stage of the Music-Note phase (NIII) to the beginning of the Želiezovce phase (ŽI) of the LBK. The somewhat small range of the stylistic variation of the sherds found in the excavated features may indicate their similar chronologies, which suggest a single-phase character of the local LBK settlement. This assumption is indirectly corroborated by lack of clear stratigraphic relations between thus classified features. Unfortunately, the fact that we have no absolute dates makes it impossible to verify this thesis. Certain, but rather general, hints concerning the chronology of the settlement in Bogucin were provided by a single radiocarbon date from charcoal (Gawryjołek-Szeliga and Szeliga 2012, 72; Szeliga 2021, 70). The sample probably constituted a secondary deposit in a feature of the Lublin-Volhynian culture. The date it produced was 6220 ± 40 BP, which gives a timeframe ranging from 5170 to 5075 BC (68.2%). Keeping in mind this date and radiocarbon determinations from other LBK sites located in the drainage basin of the Vistula (*cf.*, Dębiec and Dzbyński 2007, 56-58; Kulczycka-Leciejewiczowa 2008, fig. 55; Czekaj-Zastawny 2008, 116, tab. I; 2014, tab. XI; Valde-Nowak 2009, tab. 1; Szeliga 2017, tab. 1, fig. 6; Czekaj-Zastawny and Oberc 2021, tab. 45; Kadrow *et al.* 2021, tab. 1), it appears that the period of using the settlement in Bogucin may be most probably dated to the period between *c.* 5150/5100 and 5000/4900 BC. This range partly overlaps with the developed and late phase of the LBK in Central Europe, which corresponds to the chronological framework of its Music-note and Želiezovce phases in the drainage basin of the Upper Vistula (*e.g.*, Kulczycka-Leciejewiczowa 2008, 106-108; Czekaj-Zastawny 2008, 116; 2014, 94, 104).

THE FIRST FARMERS ON THE EDGE OF THE LOESS OF WESTERN LUBLIN REGION

For the time being, we know of over 60 LBK sites – represented mainly by surface finds – from the entire area of the western Lublin Region (identified with the territories comprised between the Wieprz and Vistula Rivers). They are quite widely dispersed, but the majority are grouped in several settlement clusters of different sizes (Szeliga 2021, fig. 1: 2). The greatest number of such sites were documented at the north-western edge of the discussed area, which encompasses the Nałęczów Plateau and the neighbouring territories located outside the compact range of the loess cover (Fig. 20: 1). There are two main settlement clusters within this zone: (1) a larger group covering its western part (lower and middle course of the Bystra River) with the adjacent section of the valley of the Middle Vistula; (2) a smaller cluster located in its eastern area, by the Middle Ciemięga and Upper Kurówka Rivers (Fig. 20: 2, 3). The two most abundant inventories come from these clusters. They are represented by the collection from Bogucin, Site 6, which is the main subject of this paper,

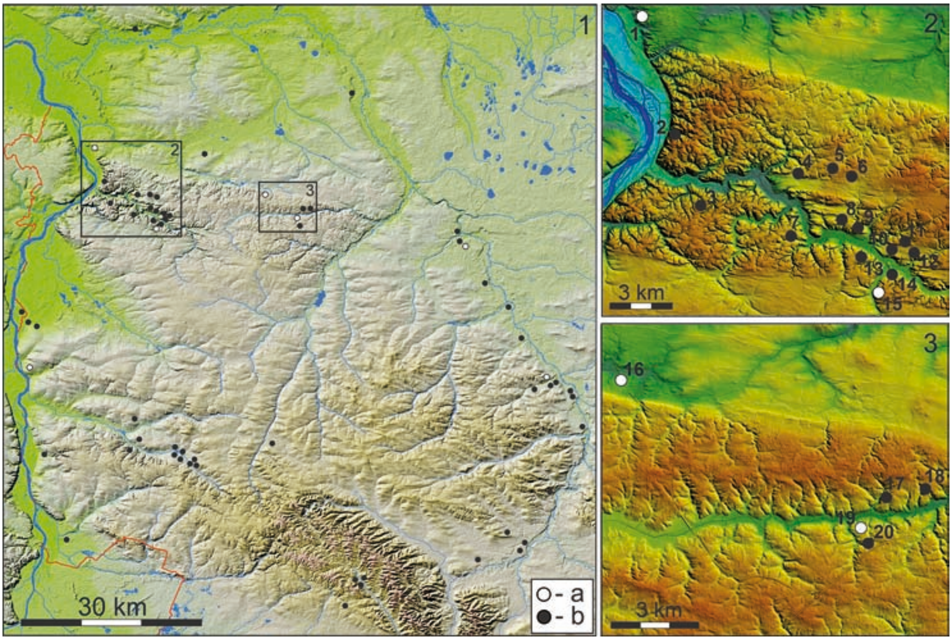


Fig. 20. LBK sites in the interfluve of the Vistula and Wieprz Rivers: 1 – general dispersion of the diagnostic surface finds (a) and excavated sites (b); 2-3 – locations of the sites in the analysed settlement microregions within the Nałęczów Plateau and the adjacent non-loess areas. Sites: 1 – Puławy-Włostowice, Site 3; 2 – Parchatka, Site 26; 3 – Góry Rzeczyckie, Site 1; 4 – Celejów, Site 10; 5 – Łopatki Kolonia, Site 1; 6 – Łopatki, Site 3; 7– Rąblów Kolonia, Site 10; 8 – Zgórzyńskie, Site 5; 9 - Zgórzyńskie, Site 8; 10– Zarzeka, Site 6; 11 – Zarzeka, Site 8; 12 – Zarzeka, Site 17; 13 – Mareczki, Site 12; 14 - Wąwolnica, Site 7; 15 – Wąwolnica, Site 1; 16 – Bogucin, Site 6; 17 – Snopków, Site 5; 18 – Snopków, Site 12; 19 – Panieńszczyzna, Site 1; 20 – Dąbrowica, Site 12 (according to Szeliga 2021, fig. 1: 2, modified)

and a group of finds (found outside features) discovered in Puławy-Włostowice, Site 3 (*cf*., Szeliga 2018b, 179-182). Presently, they are the most important corpus of sources and practically the only point of reference in the discussion on settling both the edge zone of the local loess cover and the entire upland zone of the western Lublin Region by the LBK societies.

In light of the current state of research, the entire discussed area lacks finds that can be linked with the earliest stage of the LBK and stylistically homogenous collections from the Music-Note phase. This situation, mainly reflects the incomplete state of research and, to much a lesser degree, the actual intensity of the cultural and settlement processes, considerably limits the possibility of definitely determining the time of including the discussed territories in the essential ecumene of the LBK. Based on data from other settlement clusters of this culture – including other upland territories located in the interfluve of the Vistula and Bug Rivers – we can assume that the colonisation of the western and north-western parts of the Lublin Region by the societies of the LBK commenced at least in the classical stage of the Music-Note phase (NII), and was clearly (and possibly most intensely) continued in its latest part (NIII), which was linked with the adaptation of the early-Želiezovce decorative style in the local vessel ornamentation (Szeliga 2021, 66). This fact appears to be corroborated by the overall stylistic diversity of the pottery from Bogucin and Puławy-Włostowice. In both cases, the classical music-note ornamentation was represented by a small number of pottery materials, although the late music-note/early-Želiezovce style was quantitatively predominant (*cf.*, Szeliga 2018b, 186-189). This allows us to suspect a relatively close relation between the two inventories – in regard to their styles and chronologies – and, as a result, link the establishment and development of the two settlements (and micro-regions) with the same phase of settling the marginal part of the Nałęczów Plateau and the adjacent non-loess territories by the early agricultural societies. The still outstanding question is whether this was the first or a subsequent stage of the colonisation of these territories by the LBK societies. Independently from this issue, the accessible source data indicates a particular intensity and durability of the settlement processes in the discussed territories, mainly during the period linked with the adaptation of the early-Želiezovce ornamentation patterns by the local late music-note community. This process most probably occurred at the end of the 6th millennium BC.

The Želiezovce ornamentation motifs recorded in the assemblages from Bogucin and Puławy-Włostowice do not differ greatly from the decorative style characteristic of the early stage of the youngest phase of the LBK, finding numerous and very close analogies within all the greatest settlement clusters of this culture located in the drainage basin of the Upper and Middle Vistula. This observation concerns both the loess regions of western (*cf.*, *e.g.*, Godłowska 1991; Czekaj-Zastawny 2014) and northern Lesser Poland (*cf.*, Rauhut 1970; Michalak-Ścibior and Taras 1995; Szeliga 2008; Kulczycka-Leciejewiczowa 2008) as well as the Subcarpathian loess regions (*cf.*, Kadrow 1990; 1997; Dębiec 2014; 2015). A completely different situation can be observed in the interfluvial zone of the Vistula and Bug Rivers, where pottery decorated in the Želiezovce style was previously represented only by a small collection from Site 42 in Podhorce, Werbkowice Commune (Kącki 1982, 4, fig. 1). The lack of such motifs at other sites – especially in the most numerous and richest music-note inventories from the interfluve of the Bug and Huczwa Rivers indicates a territorially limited adaptation of early-Želiezovce ornamentation patterns and, at the same time, a different scope of the stylistic development of the LBK in the western and eastern Lublin Region. This fact also allows us to assume that different ornamentation traditions in these territories – the classical and late-music note style in its eastern part and the early-Želiezovce tradition in the western and north-western areas – stagnated until the end of the development of the discussed culture (Szeliga 2021, 68, 69). The mentioned processes are part of a much broader territorial context and well correspond to the dynamics and sequence of analogous cultural phenomena that are suspected to have occurred across the vast territories of the northern and north-eastern forefield of the Carpathian Mountains – starting with the Music-Note phase of the LBK (Kadrow and Zakościelna 2000, 193, 194, figs 2 and 3).

As mentioned before, the main settlement activity of the first early agricultural societies in the north-western part of the Lublin Region – independently from the actual moment of their arrival to this area – can be now mainly linked with the period of the adaptation of the early-Želiezovce ornamentation traditions by the local environment of the late-music note LBK. At that time, the main settlement network – composed of at least two geographically isolated micro-regions that occupied the higher and middle parts of the river valleys and encompassed from several to even more than ten settlement points – developed within the marginal zone of the local loess cover and in territories located outside its compact range (Fig. 20: 2, 3). Similar preferences for clustering settlement points within micro-regional settlement structures were probably also prevalent across other territories of the western Lublin Region. This assumption is clearly corroborated by the dispersion of the previously recorded sites (Fig. 20: 1), which evidently corresponds to the structure of the LBK settlement network documented for the vast territories of the Vistula River drainage basin (*cf.,* Kruk 1973, 45-48; Czekaj-Zastawny 2008, 111, 112). At least some of the settlements operating in particular micro-regions had residential buildings in the form of longhouses. This fact is mainly confirmed by the results of the research conducted in Bogucin (Fig. 2), although we cannot rule out the possibility that analogous relics were found in Puławy-Włostowice. Unfortunately, the small number of the LBK features at this site and the fact that they were only partly researched make it impossible do conclusively determine their function (*cf.,* Szeliga 2018b, 179-182).

LOCAL COMMUNITIES AND THEIR NON-LOCAL RELATIONSHIPS

The complete lack of radiocarbon dates prevents us from deciding whether both mentioned settlements and micro-regions were settled for a long time or only episodically. Independently from this fact, the gathered data indicates their dynamic development within the entire settlement network, which was induced, for example, by intense interregional contacts and, as a result, exchange of goods – especially raw materials and flint products. The raw material structure of the inventory discovered in Bogucin reflects the character of the local economy, which was based on flint deposits from the north-eastern margin of the Holy Cross Mountains, especially on Świeciechów flint – imported from territories located 60 km from the site. This raw material was supplemented – to a considerable, but much lesser degree – by the supplies of somewhat more distant (70-80 km) chocolate flints. Other raw materials practically did not play any important role in the local processing and tool production, which is clearly confirmed by their smaller quantities (Fig. 13: 1). This statement evidently corresponds to the data obtained from Puławy-Włostowice (Zakościelna 1981, tab. 1; 2002, fig. 1; Balcer 1983, tab. 4), although the fact that the majority of the finds made at this site come from outside the features considerably limits the possibility of determining their chronology and cultural attribution (*cf.*, Szeliga 2018b, 189). A hoard of pre-core forms made of Świeciechów flint found at this site – and certainly linked with the Early Neolithic horizon of the settlement – is especially important (Zakościelna 2002, 112-116; Szeliga 2018b, 179). Its presence – just as the raw material structure of the inventory from Bogucin – indicates the leading role of the local LBK communities in the redistribution of the flints from the Holy Cross Mountains across much more distant territories – undoubtedly to settlement clusters located east and south-east of the Nałęczów Plateau, occupying both the drainage basin of the Middle Wieprz River (Zakościelna and Gurba 1991, 13) and the much more remote interfluve of the Bug and Huczwa Rivers, which is indicated by single artefacts made of chocolate and Świeciechów flints included in the local inventories (*e.g.*, Uzarowiczowa 1964; Zakościelna 1981, tab. 1; Gawryjołek-Szeliga 2009, 64). The contacts with the LBK societies inhabiting the Western Volhynian Upland were mutual, which is indicated by a small number of artefacts made of Volhynian flint recorded both in Bogucin (Fig. 13: 1), and Puławy-Włostowice (Zakościelna 2002, fig. 1; Szeliga 2018b, 193). Most probably some of the Volhynian flint blades, flakes and tools imported to both settlements were subsequently redistributed – along with other artefacts, *e.g.*, items made of Świeciechów flint – to the north, *i.e.*, to LBK settlement clusters located across the lowland areas. This assumption is based on incidental finds of these raw materials in the inventories of the classical and late phases of the LBK in Kuyavia and Chełmno Land (*e.g.*, Domańska 1988, 83; 2002: 147, 148; Grygiel 2004, tab. 11; Kabaciński 2010, 106, 107, tab. 3, 12; Małecka-Kukawka 2008, tab. 1). The above-presented observation also concerns artefacts made of materials from more distant sources, *i.e.*, obsidian and Jurassic-Cracow flint, whose influx into the lowland areas during phases II and III of the LBK is documented by finds from several dozens of local settlement sites (*cf.*, Grygiel 2004; Małecka-Kukawka 2008; Szeliga 2009; Domańska and Kabaciński 2010; Kabaciński 2010; Pyzel and Wąs 2018; Budziszewski and Pyzel 2022, 127). Although obsidian artefacts have not been discovered in Bogucin and Puławy, the possibility that the local LBK societies redistributed them to the north is indirectly indicated by their sporadic finds at other sites of the western Lublin Region (*e.g.*, Rąblów Kolonia, Wąwolnica Commune; Góry Rzeczyckie, Kazimierz Dolny Commune; *cf.*, Brzozowski 1988; Szeliga 2021, tab. 1). It appears that the question of how the LBK societies from the lowland areas were supplied with chocolate flint – which represented the predominant raw material in the collective inventory structures of many local sites – is a completely separate issue (*e.g.*, Grygiel 2004; Małecka-Kukawka 2008; 2012; Kabaciński 2010; Budziszewski and Pyzel 2022, 127). The high frequencies of this raw material and the morphological structures of inventories that reflect the entire range of its processing at some settlement sites (Kabaciński 2018) allow us to suspect that it was imported to the settlement clusters located in this area as a result of expeditions to the outcrops of the flint organised by the inhabitants of such settlements, without the intermediation of the societies from the western Lublin Region.

The sporadic finds of obsidian artefacts in the interfluve of the Vistula and Wieprz Rivers and the presence of items made of Jurassic-Cracow flint in the inventories from Bogucin (Fig. 13: 1) and Puławy-Włostowice (Zakościelna 2002, fig. 1; Szeliga 2018b, 192) suggest that the local communities also maintained contacts with the LBK settlement clusters from the upland loess areas of the Vistula River drainage basin. Most probably, the initial territories of both mentioned raw materials were the settlement clusters from the Sandomierz Upland and its northern forefield. This assumption is corroborated by their relative proximity and location in the direct vicinity of the Vistula River valley as well as the nearly identical raw material preferences of the local LBK societies, oriented mainly at processing Świeciechów flint (Szeliga 2014, fig. 4; 2018a, 378-380). This interpretation also allows us to assume that the population of the western Lublin Region (including the inhabitants of the Nałęczów Plateau) participated in supplying the Sandomierz cluster with the Volhynian flint artefacts that were part of the inventories found in Tominy, Ożarów Commune (Szeliga 2018a, fig. 2) as well as – possibly – in Samborzec, Samborzec Commune (*cf.*, Lech 2008, 180, 181). On the other hand, contacts with the Rzeszów cluster are indicated by an axe from Bogucin - made of beige rock similar to marl – whose macroscopic features suggest its affinity to local finds of this type (Pelisiak and Dębiec 2022, fig. 2). Explaining this issue undoubtedly requires further, detailed research and specialist analyses. Another, relatively poorly represented category of finds, represented by pottery decorated in a style which refers to ornamentation used by the cultures of the Transcarpathian Eastern Linear circle, namely the Kapušany-Tiszadob group and the Bükk culture, should be associated with contacts and cultural exchange between the discussed sites and southern territories. Presently, only three vessel sherds of this type – discovered in Puławy-Włostowice and represented by base parts of thin-walled spherical bowls – are know from the entire area of the western Lublin Region (Szeliga 2018b, tabl. I: 8; IX: 4, 5). The fact that one of them is decorated with a music-note ornament allows us to state that it was locally produced and, at the same time, rule out the possibility that all of such finds were imports from Transcarpathian territories (Szeliga 2021, 75). This observation clearly corresponds to findings concerning analogous discoveries from other upland areas, including the northern forefield of the Sandomierz Upland (*cf.*, Szeliga and Zakościelna 2019, fig. 4: 2, 4; Szeliga and Gawryjołek-Szeliga 2022). Apart from the actual character of these finds (elements of interregional exchange or rather relics of more complex social and migration processes?; *cf.*, *e.g.*, Furmanek 2010, 192; Szeliga and Zakościelna 2019, 188, 189; Szeliga and Gawryjołek-Szeliga 2022, 105, 106), their presence in the western Lublin Region indicates clear links between the local societies and communities inhabiting the drainage basin of the Upper Vistula, especially the Sandomierz and – possibly – Rzeszów settlement clusters of the LBK.

The presented data expressly indicate that a dynamic settlement centre – maintaining intense and extensive contacts with all the neighbouring LBK settlements located both in the upland and lowland parts of this culture ecumene – functioned at the end of the 6th millennium BC in the marginal zone of the area of the loess cover of the western Lublin

Region. The remains of such contacts are visibly reflected by the raw material structures of both most abundant inventories from Bogucin and Puławy-Włostowice. They indicate the leading role of the local societies in the entire process of the raw material redistribution – through controlling and coordinating the directions and scale of the influx of locally processed items made of Świeciechów flint as well as half-products and tools whose production required imported raw materials, brought to the local settlements through indirect interregional exchange. At the same time, this fact indicates the crucial role of both settlement micro-regions in the entire system of the circulation and exchange of raw materials across vast territories on both sides of the Carpathians, which was especially dynamic since the Music-Note phase of the LBK (*e.g.*, Kaczanowska 1985, Karte 3; Lech 1979, fig. 1, 130, 131; 2003, fig. 1; Mateiciucová 2008, maps 7 and 8). The distribution of raw materials and items made of them allowed the local societies to initiate new and maintain existing interregional contacts. Most probably, it was accompanied by various social and cultural phenomena and events – having a ceremonial character and fundamentally shaping as well as strengthening permanent contacts with the inhabitants of other LBK settlement clusters. At the same time, it had a decidedly non-economic base, and met needs that were entirely non-utilitarian. This observation is clearly indicated by data from all the destination areas of the deliveries, from the Sandomierz Upland as well as the Western Volhynian Upland and lowland areas, especially Masovia and Kuyavia. The local river system was undoubtedly of pivotal importance for the effectiveness and durability of these processes. The most important role was played by the Wieprz – which connected the settlement clusters occupying the edge of the western Lublin Region loess with territories located east and south-east of them – and, especially, by the Vistula River – which was the fundamental communication artery with the southern (Sandomierz Upland) and northern (Masovia, Kuyavia) settlement clusters of the LBK. This fact corresponds to previous findings, according to which this river played an important role both in the process of the early agricultural colonisation of the lowland territories, and in the distribution of the flint raw materials, especially chocolate flint and Jurassic-Cracow flint (Kabaciński 2010, 107; Pyzel 2021, 213).

SUMMARY

The above-presented data indicates that the margin of the loess covering the western Lublin Region was most probably colonised by the LBK societies at the end of the 6^{th} millennium BC. It also suggests a dynamic development of at least two settlement micro-regions in the loess area – maintaining extensive and multidirectional contacts of interregional character, which were based, *e.g.*, on the distribution and exchange of artefacts made of various flint types. The diversity of the ornamentation styles used in decorating the vessels from Bogucin and Puławy-Włostowice allows us to suspect that the colonisation

took place at least at the classical stage of the Music-Note phase, although the main intensity of the local settlement processes should be associated with the development of the late music-note style, strictly connected with the adaptation of the early-Želiezovce tradition. For the time being, the finds from both mentioned sites may be seen as representing the latest stage of the LBK stylistic development. At the same time, they designate the only 'compact' area where such a late ornamentation style was concentrated – not only in the western Lublin Region, but also across the entire upland zone of the Vistula-Bug interfluve (Kadrow 2020, fig. 8). It seems that the presence of pottery decorated in this style across the eastern part of this area (Podhorce; *cf.*, Kącki 1982, fig. 1), and even near Lutsk in Volhynia (Rovantsi; *cf.*, Bardeckiy 2012, fig. 5: 2, 3, 5, 6, 8, 9, 16) reflects only an ephemeral, much weaker and transient influence of the Želiezovce style on the local music-note complex. These issues undoubtedly require further specialist research, especially an intensification of excavations carried out at LBK settlements in the Volhynian Upland. Presently, the range of the accessible source data clearly indicates that the essential zone where the Želiezovce style was adapted are the territories of the western Lublin Region, especially settlement clusters occupying its northern edge, both on its loess cover (Bogucin) and outside its compact range (Puławy-Włostowice). The diversities of the ornamentation decorating pottery inventories from both sites indicate that their styles are very similar. This fact allows us to suspect that the chronologies of both settlements are most probably similar, thus they must have been established during simultaneous colonisation activities of the LBK societies in these territories. Unfortunately, the complete lack of radiocarbon dates makes it impossible to determine whether this activity was transient or long-term and spaced in time. The dynamic development and leading role of the local societies in the system of distribution and exchange of raw materials rather confirm the latter possibility. Nevertheless, the obtained data allow us to assume the permanent colonisation of both settlement clusters by the LBK communities, which is also corroborated by the remains of permanent residential buildings (longhouses) recorded in Bogucin (Fig. 2) and, possibly, Puławy-Włostowice (Szeliga 2018b, 182).

In the context of the discussed issues, one of the most important research questions is the origin of the societies initiating the settlement processes in the reviewed microregions. It appears that their original areas can be identified mainly with the Sandomierz settlement cluster of the LBK, and – perhaps – even with its northern enclave occupying the borderland between the loess Sandomierz Upland and the sandy-loam area of the Iłża Piedmont (Szeliga *et al.* 2019, fig. 1). This assumption appears to be corroborated by rather numerous and close analogies between these territories and both clusters from the western Lublin Region. They include identical raw material preferences of the local LBK societies – expressed by the crucial role of Świeciechów flint – and local imitations of pottery representing early linear ornamentation traditions, which refer to finds from the northern forefield of the Sandomierz Upland and possibly reflect analogous sociocultural phenomena and processes associated with those areas (Szeliga and Zakościelna 2019, 189; Szeliga and

Gawryjołek-Szeliga 2022, 105, 106). The relationships between both territories are also indicated by signs of mutual contacts, which include, on the one hand, the influx of artefacts – made mainly of Jurassic-Cracow flint and obsidian – to the north. On the other, they are represented by a highly probable redistribution of Volhynian flint items to the south. The similar locations of the discussed territories is also somewhat remarkable. In both cases, they include territories occupying borderlands between loess and non-loess areas. Having this in mind, we need to answer the following questions: Did the LBK societies reach the Nałęczów Plateau directly from the northern forefield of the Sandomierz Upland – and the colonisation of the local fringe of the loess uplands was a kind of repeating the original settlement pattern from their indigenous areas (Szeliga *et al.* 2020; 2023)? Was it the only target destination of the settlers, or maybe colonising it was an intermediate stage (and initial territory) for further, gradual migrations of the LBK societies, *e.g.*, to the lowland areas? What – in this context – was the character of the actual links between the local clusters and the LBK societies from Masovia and Kuyavia? Certainly, they were not limited only to importing single artefacts made of various flint varieties and obsidian. This fact is directly indicated by scarce discoveries of pottery ornamented in the Šárka style from the eastern Lublin Region (Bronicki 2016, fig. 5: 8) and even Volhynia (Saile *et al.* 2018, abb. 5), which suggest a considerably greater range and scale, as well as a mutual character of these contacts. What actual role was played in this process by the communities inhabiting the analysed clusters from the western Lublin Region, by the Vistula River? The above-listed questions are undoubtedly ones of the most important issues in the context of further research on the origins, history and character of the neolithisation of the western Lublin Region and other territories located in the upland part of the Vistula and Bug interfluve.

Acknowledgements

The authors would like to thank Edmund Mitrus for allowing them to examine and present in this article the materials from Site 6 in Bogucin. Thanks also to Piotr Moskała for translating the text into English.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3222

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FROM POTS TO POTTERS: RECONSTRUCTING GROUP AND INDIVIDUAL VARIABILITY IN POTTERY PRODUCTION. A CASE STUDY OF THE LBK SITE CZĄSTKÓW POLSKI XII, CZOSNÓW COMMUNE

ABSTRACT

Pyzel J. and Gomart L. 2023. From pots to potters: reconstructing group and individual variability in pottery production. A case study of the LBK site Cząstków Polski XII, Czosnów Commune. *Sprawozdania Archeologiczne* 75/2, 115-135.

This article presents the results of the analysis of the manufacturing macrotraces on the LBK pottery from Cząstków Polski, Site XII, Czosnów commune. It is a small, highly fragmented, and eroded assemblage and the usefulness of such material for the study of pottery production was tested. Different lines of evidence could be combined and led to the recognition of various vessel forming methods and to the reconstruction of distinct *chaînes opératoires* and even individual traits within them, indicating the occupation of the site by one community of practice with multiple manufacturers. Pottery production at Cząstków Polski followed general LBK potting standards but also shows some peculiarities indicating some degree of idiosyncrasy within this community of practice.

Keywords: pottery production, pottery technology, vessel forming techniques, chaîne opératoire, LBK
Received: 07.01.2023; Revised: 20.02.2023; Accepted: 24.05.2023

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INTRODUCTION

Techniques of production, especially of pottery production, have been regarded in common archaeological practice as representing highly pragmatic, rational, and somehow passive decisions determined by the availability and properties of raw material. This approach is visible in the processual archaeology, which stressed the dichotomy of style and function, as well as in post-processual archaeologies which were mainly interested in reading the symbolic meaning of the material culture (see Gosselain 2002, 10, further references therein). Archaeology of the new millennium is influenced by the materiality turn stressing the affordance of things, their networks or entanglements with humans (*e.g.*, Harris and Cipolla 2017), but even these directions focus much more on finished items and their agency than on their production. However, this topic has been addressed by the early French archaeology, always strongly connected with the French school of anthropology of techniques. This school refers to M. Mauss's seminal achievements (Mauss 1935; 1947), where he noticed that even the most "natural" techniques depended on culture and could be expressions of identities (Lemonnier 1986). This led to the development of studies on operational sequences – *chaînes opératoires* (see Burdukiewicz 2012, further references therein). This concept, describing the series of operations involved in the transformation of matter from the raw material to the finished product (Creswell 1976), is broadly applied in research on flaked stone artefacts (Tixier 1967) but also, increasingly, in pottery studies (Roux 1994). This growing interest in pottery technology correlates with the third scientific revolution in archaeology of recent decades, which brought the development and spread of many new analytical methods, especially connected with the determination of raw materials. The term *chaîne opératoire* can be found in many pottery publications not only of the French school, although sometimes it is limited to the determination of fabric groups. However, apart from the collection and processing of raw materials, the following stages of pottery production, *i.e.*, fashioning, finishing, surface treatments, decoration, firing and post-firing treatments, are also determinant to grasp ancient pottery production structures and can be reconstructed by archaeologists though an array of analytical methods (Roux 2019). During each of these stages, a wide range of techniques have been recognised by ethnographic research (*e.g.*, Livingstone Smith 2001; Gosselain 2002; Gelbert 2003) and experimental research work, enabling the interpretation of the traces identified on the archaeological material in terms of technical gestures (*e.g.*, Martineau 2000; Roux 2019). Reconstructing the stages of pottery fashioning or forming is crucial for developing social interpretations in archaeological context (Roux 2020), as those stages involve techniques and methods acquired through long-term apprenticeship requiring close contact between a tutor and an apprentice. Non discursive knowledge in the form of embodied skills and routines connected to pottery fashioning is conservative and less prone to superficial trends and changes than, for example, the raw material choices (Gelbert 2003) or the decoration of pots (Dietler and Herbich 1994). It is precisely the process of apprenticeship that ensures the continuity of technical traditions: forming techniques and methods are transmitted from one generation to another within a given community of practice (see Wenger 1999), whose social structure can correspond to, for example, an ethno-linguistic group, a caste, a gender *etc.* (Roux 2011), although the rules of these correlations are complex (Gosselain 2002). The determination of production techniques thus enables archaeo-logists to identify and distinguish groups of producers in archaeological context, to follow their spatial trajectories over time and can thus be regarded as a crucial step of the *chaîne opératoire*; sometimes, indeed, the analysis focuses mainly on this stage, as in the case of this paper.

Research on the production techniques of the pottery of the Linear Pottery culture (LBK) has so far been conducted only for a dozen sites (less than a tenth of a percentage of all LBK sites; Cámara Manzaneda *et al.* 2021, fig. 1). The literature on the LBK from Poland contains only general remarks that the vessels were produced by the coiling technique (Kulczycka-Leciejewiczowa 1979, 83; Czekaj-Zastawny 2017, 44); different types of coil joints were observed on some fresh breaks from Strzelce, Site 2 (Wiślański 1959) and a similar but singular case of a good, visible example of a coil junction was noted for the material from Strzelin, Site 16 (Wojciechowski and Cholewa 1995, 77), though both descriptions were solely qualitative, not quantitative, and no systematic analysis was ever conducted. Research on the production techniques does not belong to a standard procedure applied for this culture in any of the regions of its vast territory. Most of this research was conducted in francophone countries: France and Belgium. After the first general papers indicating the necessity of such an analysis (Constantin 1994) and preliminary small case studies (Bosquet *et al.* 2005), more complex methods of quantitative analysis of macrotraces were established (inspired by Livingstone Smith 2001, see: Gomart 2006; 2011; 2014; Gomart *et al.* 2017; Van Doosselaere *et al.* 2013; 2016), combined with radiography (Van Doosselaere *et al.* 2016) and computer microtomography (*e.g.*, Neumannová *et al.* 2017). Similar studies were also conducted for a few sites from Hungary (Gomart *et al.* 2020; Kreiter *et al.* 2017, ongoing project: Marton *et al.* 2020), and the Czech Republic (Neumannová *et al.* 2016; 2017; Thér *et al.* 2019), although in the latter case they had a preliminary character and have not yet yielded quantitative results (*e.g.*, Thér 2020).

Apart from these studies, selected LBK pottery from two sites from Moldova and Ukraine were analysed according to the quite similar Russian tradition of technological studies (*e.g.*, Bobrinsky 1978). Coiling with the paddle and anvil technique was identified as a dominating technique characteristic for the LBK pottery irrespective of the raw material and vessel type (Kozhin and Palaguta 2016; Palaguta and Starkova 2021). This conclusion corresponds to some extent to the above mentioned results obtained for other LBK regions, where beating is registered but is not the only prevailing technique of shaping among the assemblages. In the eastern part of the LBK oecumene, the slab technique, also registered in the preceding Starčevo culture (Burke 2022), could be identified as well (Thér *et al.* 2019; Gomart *et al.* 2020).

There has not been, and probably never will be, established one universal methodology of pottery analysis according to the *chaîne opératoire* approach and the description of traces of forming techniques.

Studies of pottery forming techniques are mainly conducted as comparative analyses, as technological and spatial variability can reveal different social networks of prehistoric communities (Roux 2020). The research presented in this paper focuses on a single pottery assemblage from one, small site. Its goal is to test the variability of the pottery assemblage in order to apprehend the social structure of the Cząstków Polski XII community: was this settlement inhabited by one single group of people sharing one technical tradition or by different groups with distinct technical repertoires? The pottery is badly preserved and highly fragmented, no single complete vessel profile could be identified, and well preserved vessels are regarded as best suited for preliminary definition of *chaînes opératoires* (Gomart 2006; 2011). The additional goal is thus to test how much information can be obtained from such fragmentary data. It is the first such analysis of forming techniques of the LBK pottery from Poland.

MATERIALS AND METHODS

LBK pottery from Cząstków Polski, site XII

The pottery assemblage under study comes from Cząstków Polski, Site XII. Czosnów commune. The site is located in a peripheral and not well-known region of the Polish Lowlands LBK oecumene: the Vistula Basin in Mazovia where a small cluster of a dozen LBK sites was detected (Fig. 1: 1). They are located on the Weichselian terrace of the Vistula River where small elevations of sandy formations existed close to wet depressions, presumably oxbow lakes in the Atlantic period, as well as large fertile silty areas which attracted the first farmers (Budziszewski and Pyzel 2022). The site Cząstków Polski XII was excavated in 2008 to a small extent (850 sqm; Fig. 1: 2) by M. Czarnecki due to the construction of a storage facility. He recorded altogether five pits with a depth of 0.6-0.9 m. Features 3, 4 and 5 formed a small cluster; Features 1 and 2, excavated only partially, were located 10 and 20 m to the east. Four pits (Features 1, 2, 3 and 4) contained artefacts dated only to the LBK: 547 pottery fragments (very few also from the cleaning of the trench, without a precise assignment to a feature), 77 flint and seven stone artefacts, small fragments of daub and animal bones. The pottery assemblage is quite homogeneous, leading to the hypothesis that is tested in this paper that all features are more or less contemporary and represent an occupation of a single group of people. The temper and decoration date the site to the early Music Note Phase (LBK IIA; Budziszewski and Pyzel 2022).

The material is highly fragmented: the average weight of a sherd was 15 g. Many sherds were so eroded that they resembled pebbles; it was difficult to analyse ornament which

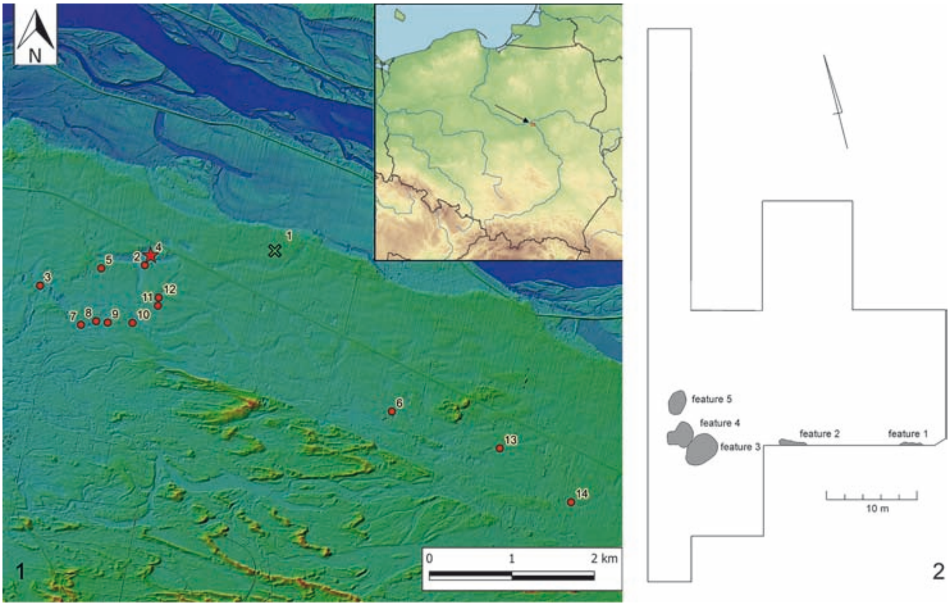

Fig. 1. 1 – Location of Cząstków Polski Site XII (marked with asterisk) within the LBK Vistula Basin microregion (other LBK sites are marked with red dots). After Budziszewski and Pyzel 2022; 2 – Plan of the excavated area

was badly preserved. Based on refitting and characteristic traits such as temper, colour, wall thickness, decoration and surface treatment, some sherds could be assigned to vessels and the total number could be reduced to 251 sherd families (Orton *et al.* 1993) representing both distinctive pots, but also small undiagnostic pieces. Most of them are body sherds, only 32 rims and 18 bases could be identified. For 32 vessels the basic form could be estimated: the majority (23 vessels) are globular pots typical for the LBK; others could be classified as bowls, collared jars and miniature vessels. The complete profile could not be reconstructed in any case.

The pottery can be divided into fine (63% of sherd families) and coarse ware (37%). Most of the fine ware was produced using a pure clay, but in some cases fine organic and sand temper was visible. For the coarse ware, organic temper was the most common, but sand could be identified macroscopically as well.

44% of the fine and 25% of the coarse ware was decorated; the identification of ornament was sometimes difficult due to the bad state of preservation of the material.

Traces of production on archaeological pottery

Traces indicating various production methods applied at different stages of pottery production are difficult to identify (*e.g.*, Gucsi 2022), as they are often erased by subsequent gestures and only a combination of various scales of observation and different analytical tools can yield valuable information on forming (*e.g.*, Roux 2017). This approach was also applied in our study, combining mainly macroscopic observations (with the naked eye and a magnifying lamp with 5 dioptres magnification) of various traces: breakage pattern and fractures, traces on the inner and outer surface as well as vessel sections: old and fresh breaks, polished sections as well as thin sections. On a total of 70 sherds or sherd families – 25 rims, 20 bases and 25 body fragments – various macrotraces could be observed.

Breakage pattern and fractures

The breakage pattern of a vessel can indicate its forming technique, as a clay pot breaks most easily on joints of various parts which were formed in different steps, such as the base, body and collar or even separate coils or slabs. In the case of the assemblage from Cząstków Polski, an average sherd family consisted of only 2.2 sherds, which means that in most cases it was too fragmented to recognise any clear breakage pattern. Fractures were also heavily eroded in most cases but for ten sherd families it was possible to identify clear horizontal breakages (rounded fractures); in one case the break on the collar-body joint was oblique to the exterior and a similar bevelled fracture joint was noted for one lower base fragment.

Surface traces

Traces of continuous and discontinuous pressure indicate gestures connected with the forming of a vessel. The bad state of preservation limited their detection but, in some cases, it was possible to observe both types of pressure. Traces of continuous movements were detected only twice, on the interior part of vessels, one on the lower part of the body and one on the bottom. Discontinuous traces were registered on the outer surface of a miniature vessel and in 13 cases on the inner surface of vessels: once on the lower part and nine times under the rim. In five cases such imprints were associated with traces of beating on the external surface.

Traces of beating were visible on external surfaces as overlapping flat circular areas (Fig. 2: 4); in these places wall thickness was also lower than in their surroundings (*e.g.*, Fig. 3: 2 – difference between the wall thickness of the rim and the part underneath). Such traces were registered 11 times: five in the upper part of a vessel, five in the lower part and one in an undefined body part.

Wall thickness

Apart from the differences in wall thickness caused by beating, in one case roughness of walls in the form of horizontal depressions and bulges could be observed on the inner side (Fig. 2: 3).

Sections

Radial sections of pottery, combined with surface features, are one of the best sources of information on the shaping techniques (*e.g.*, Thér 2020), as the alignment and orientation of inclusions and voids depend on forces applied while performing certain gestures

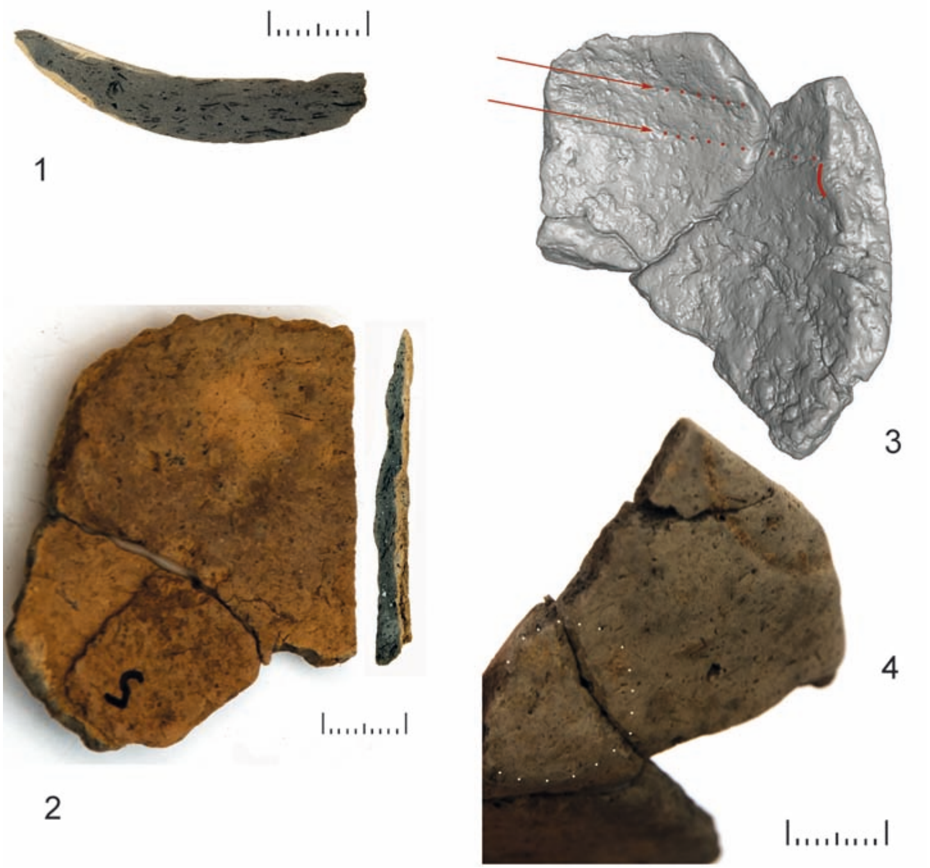

Fig. 2. Selected macrotraces on the LBK pottery from Cząstków Polski Site XII. 1 – polished radial section of a miniature vessel, *chaîne opératoire* CzP4, 2 – vessel with undulations on the inner surface and the radial section, *chaîne opératoire* CzP1, 3 – Lower part of a vessel with a beating trace on the outer surface, *chaîne opératoire* CzP3, 4 – Radial section and outer surface of a vessel with some traces of a hypothetical slab technique. Photos Joanna Pyzel

(Livingstone Smith 2001, Pl. V-26). In our study we used different types of radial sections: old (Fig. 2: 3) and new breaks (Fig. 3: 1, 2, 4, 5, 6), freshly polished sections (Fig. 2: 1; 3: 7), freshly polished sections of pottery hardened by adding a resin (Fig. 3: 3) and thin sections of such hardened pottery. Old breaks were observed first on the whole body of material; however, they were not always informative due to the high state of erosion. In 26 cases some observations were possible, and no other treatment was applied there mainly in order not to damage small and diagnostic pieces. In other cases, the pottery was broken, and such fresh breaks were the main source of information in 24 cases. Some sherds were also selected for sections to verify observations made on breaks or to cut pieces which were too thick to be broken with pincers. Thirteen sherds (nine with fresh, two with old breaks and

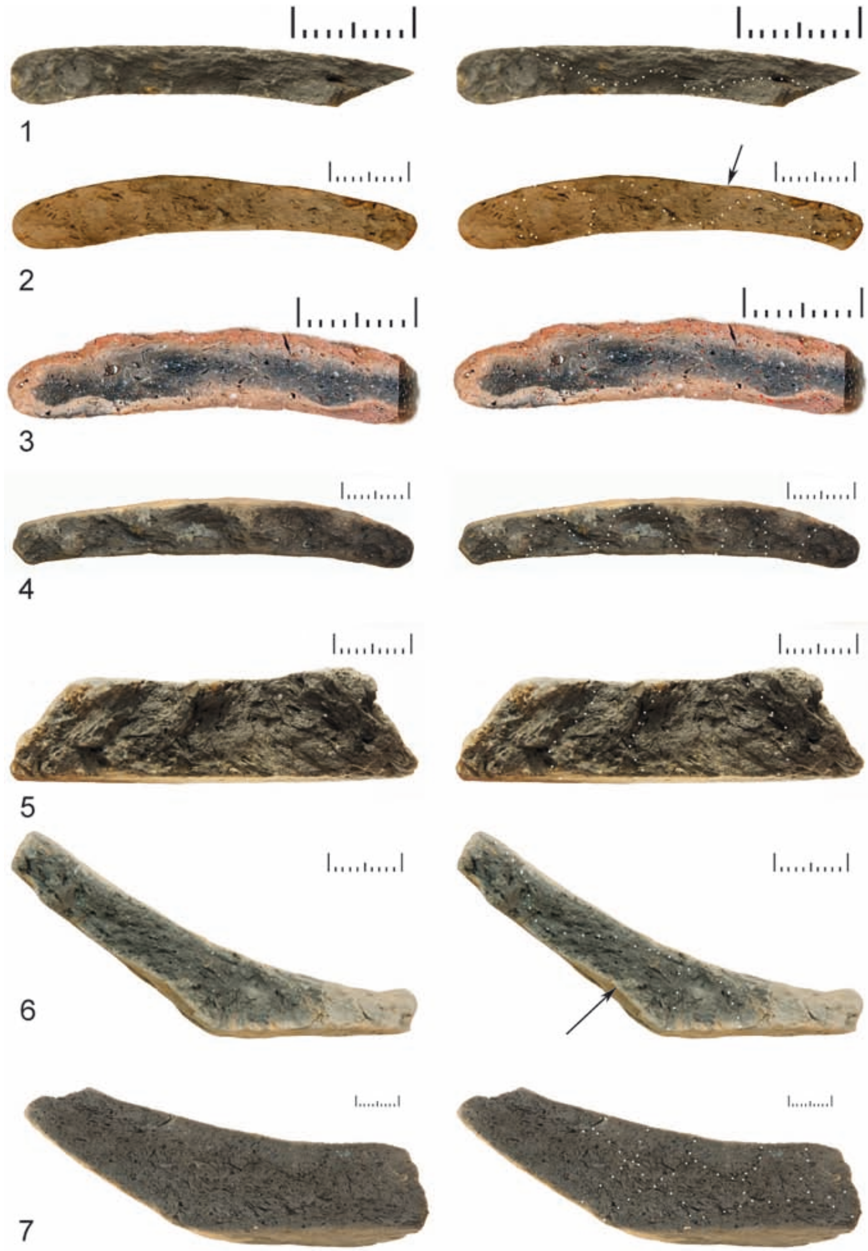

Fig. 3. Radial sections of selected vessels from Cząstków Polski Site XII. 1, 2, 4, 5, 6 – fresh breaks, 3 – polished section of a resin-hardened sample, 7 – polished section without resin; 3, 4 – *chaîne opeìratoire* CzP1, 1 – *chaîne opératoire* CzP2, 2, 6 – *chaîne opeìratoire* CzP3, 5 – fragment of a base with coils in a C/O configuration, 7 – fragment of a base made of double coil spirals. Photos 1-2, 4-7 Joanna Pyzel, photo 3 Anna Rauba-Bukowska

two too thick to break them) were selected for polished sections. Ten pieces were hardened with a resin; on eight of them simple polished sections and on two thin sections were performed. As the results of thin sections, microphotographs made in plane-polarised light and crossed-polarised light could be analysed enabling an analysis of the microfabrics (Courty and Roux 1995). In the case of one vessel, four methods could be used and compared: an old and fresh break as well as a polished section with and without resin.

In general, fresh breaks turned out to be most informative as not only the alignment and orientation of inclusions and voids, but also the roughness of the wall relief could be observed, which indicated different building units (Fig. 3: 4, 5). All kind of sections which made the wall surface flat could only sometimes confirm the results obtained in this way but were seldom precise enough to yield any new substantial information. Cutting of very soft and silty material closed the voids in many cases, which made the observation difficult.

For fresh breaks, the dimensions (length and width) of well visible building units (coils) were measured. This was possible for 29 bodies, nine rims and four bases.

Tangential sections were in most cases highly abraded and were not broken or cut in order not to fragment the sherd family additionally to radial sections. Thus, no observation was possible for them.

RESULTS

A combination of various macrotraces could be detected in certain configurations.

C/O configuration

Not so strongly deformed coils were the best visible and thus the most common feature in the assemblage from Cząstków Polski. They were registered on a total of 26 sherd families in the form of various macrotraces. They could be traced in joints as flat sectioned fractures and even as roughness on the inner side of one vessel where the remains of coils did not become totally smoothed while finishing (Fig. 2: 3). They could be quite well observed in the old breaks in the form of small circular bulbs and depressions (Fig. 2: 3). These relief undulations became even more clear in fresh breaks (Fig. 3: 4) – in these cases the radial arrangement of voids and temper was clearly visible. This was also the case for polished sections with and without a resin (Fig. 3: 3). Some coils are more circular, and they have a zig-zag or C arrangement (Fig. 3: 4), while others are slightly more rounded or elongated in the form of a chain of Os (Fig. 3: 3). This C/O configuration (Bosquet *et al.* 2005) was registered more often on the coarse (19 vessels) than on the fine pottery (seven vessels). These are mainly upper fragments with rims as well as indistinctive body parts and lower pieces with bases. In all cases the coil arrangement does not change between vessel parts, and it is uniform for bodies and rims as well as bodies and bases. All identified vessels of this group belong to the globular vessel type.

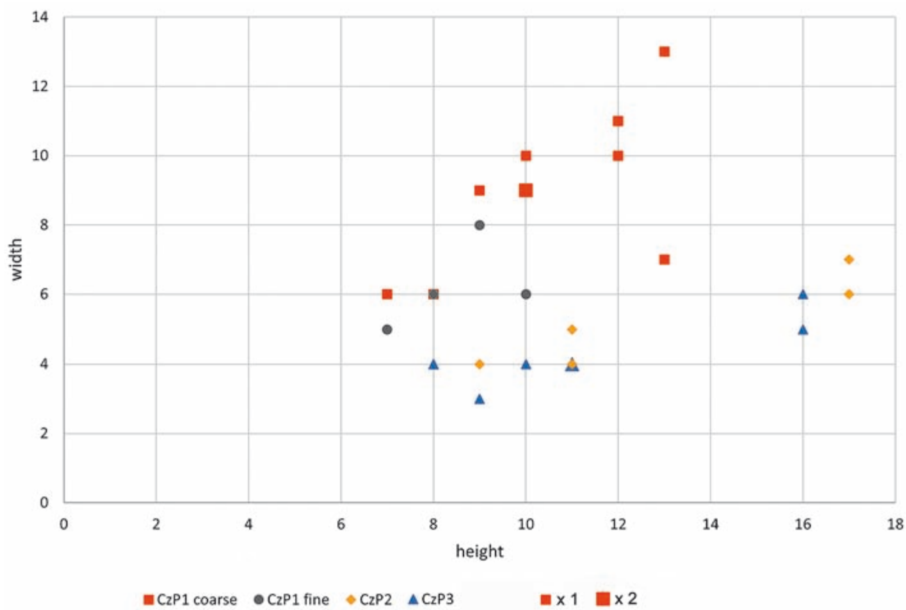

Fig. 4. Height-width relationship of coils forming vessel bodies from Cząstków Polski Site XII

Most of the C/O shaped coils forming vessel bodies have a similar size: the height lies between 7 and 13 mm for the coarse and 7 and 10 mm for the fine pottery and the width between 6 and 13 mm for the coarse and 5 and 8 mm for the fine pottery with an average size of 10 × 9 mm for the coarse and 8 × 6 mm for the fine pottery (Fig. 4). The size of coils forming rims and bases is similar.

Traces of discontinuous pressure inside were registered in seven cases: five upper parts under the rim and two body fragments.

S configuration

On other sherd families, a different type of configuration was visible in sections. For old breaks it looks like an elongated semi-circular bulb. In the case of fresh breaks, the orientation of voids and temper follows that pattern as well, forming a wavy, S-shaped line in a radial section (Fig. 3: 1). This S configuration (Bosquet *et al.* 2005) was registered only on bodies of fine pottery vessels. In the case of four vessels, it co-occurs with bases where traces of not so strongly transformed coils (C/O configuration) could be identified.

In ten cases, beating traces could be observed on the upper and lower parts of vessels (Fig. 2: 4; 3: 2, 6) in the form of circular flat areas of *c.* 1.5 cm diameter, repeating at different density. For one lower body part such traces occur every 3 cm. For this and four upper body fragments, traces of discontinuous pressure were registered on the inner surface opposite to the beating traces. Beating traces were also visible as a flattening of the vessel wall: the thickness is slightly lower than that of the other parts (Fig. 3: 2, 6). In general, the wall thickness of sherds showing an S configuration in the radial plan without beating traces on the surface is between 3 and 7 mm with a mean of 5 mm, while for sherds with beating traces it is slightly lower: between 2 and 6 mm with a mean of 4 mm. In the case of one body sherd, which had clear beating traces on the outer surface and a thickness of only 2 mm, no traces of coil junctions could be observed, while voids are elongated and oriented parallel to the radial profile. In other cases when beating was registered, the vessels body was characterized by S-shaped coils, while the vessel rim/neck showed a combination of 2-3 small non deformed coils (Fig. 3: 2). This type of configuration was observed for globular vessels and collared jars where O-shaped coils formed the neck and S-shaped coils the body. In the case of five sherd families, a combination of a lower body part with visible S configuration with beating traces and bases with C/O configuration could be identified.

S-shaped coils have a similar size irrespective of the presence or absence of beating traces. Coils without beating are 9-17 mm high and 4-7 mm wide with an average of 13 × 5 mm; for sherds with beating traces these values are 8-16 mm and 3-6 mm with an average of 11 × 4 mm. Slightly higher values for coils without beating traces may be influenced by fragments of lower body parts, where coils are extremely elongated: sherds with and without beating form a clear cluster on the right side of the diagram (Fig. 4). O-shaped coils forming the rim are smaller: 4-7 mm high and 4-7 mm wide, with a mean of 4 × 5 mm.

S-shaped coils without beating traces could be registered for 18 sherd families and with beating for 11 sherd families altogether.

Other configurations

Apart from these coiling procedures registered for all vessel parts, there were also some small fragments where the classification is equivocal. There were three small rim fragments representing the fine ware only with O-shaped coils visible in the radial sections. It is not clear if they represent the C/O group of vessels or just fragments of S-shaped profiles with beating where the lower part was not preserved. The same applies to six bases where a single row of singular coils in C/O configuration is visible (Fig. 3: 5), especially for five of them representing the fine ware. There were also two very thick and heavily eroded coarse ware bases that had to be cut because it was not possible to break them. Unfortunately, the polished section perturbed the voids so the observation was difficult, but traces of two layers of coils can be suggested here due to some circulating arrangements of organic temper whose sizes are regular and correspond to typical coil size at the site (Fig. 3: 7). The body part, however, is too disturbed to conclude the form of coils in the walls. The shape of fracture, which can indicate a coil joint, is in one case oblique and in the other flat.

One miniature fine vessel (a 2.8 cm high deep bowl) was also cut, and the polished section revealed elongated voids oriented along the radial section and running uninterrupted through the whole profile (Fig. 2: 1), which is unique for the analysed assemblage. A trace of discontinuous pressure could be registered on its outer surface.

Another unique case is represented by a rim fragment of a strongly eroded coarse globular vessel. Its outer surface is very irregular but so damaged that it is not possible to interpret the irregularities. On the inner surface, lines of tensions are visible as well as foliation of the surface (Fig. 2: 2). This is also visible in the polished section – the sherd was also cut because this method seemed gentler than breaking such a sensitive piece. In the section some oblique oriented voids are visible as well (Fig. 2: 2), which is unique for the assemblage.

DISCUSSION

Reconstruction of forming techniques

Most of the vessels from Cząstków Polski were made with the coiling technique.

Different forming methods can be reconstructed from the identified macrotraces. The C/O configuration visible in sections in the form of rhythmic undulations, radial arrangement of voids and temper, bumpy walls with differences in thickness as well as flat or rounded fractions indicate vessel building by placing coils on top of each other without strong transformation. In this procedure, coils were joined through pinching (Livingstone Smith 2001, 122; Roux 2019, 161) and traces of discontinuous pressure are indeed quite common on sherd families of the C/O group despite their bad preservation.

The S configuration echoes a variant of the same method (Livingstone Smith 2001, 121). Subcircular, elongated orientation of voids and temper and similar rhythmic undulations in radial sections represent coils placed along an alternating external/internal bevel and subsequently thinned and stretched (Roux 2019, 163).

The miniature vessel was formed from one piece of clay (Fig. 2: 1). The alignment and orientation of voids and temper running parallel to the vessel's walls (without any discontinuities that could indicate coil joints) refer to the vertical compression of a single clay mass caused by drawing and pinching (Roux 2019, 170). Traces of discontinuous pressure are an additional argument for pinching.

Another unique piece (Fig. 2: 2) is difficult to interpret due to its bad state of preservation, which erased many traces. That is why conclusions must be treated with caution. The section is unclear: diagonal orientation of some voids can indicate coil joints, but as they are quite irregular, they can also represent slab joints (*e.g.*, Vandiver 1987, Pl. V: 4). A clear foliation of the inner surface is visible in the section, which can indicate an overlapping of clay pieces (*e.g.*, Vandiver 1987, Pl. I: 1). The laminar fissuring is also visible on the inner side of the sherd. The interpretation of these traces is equivocal, but they can indeed indicate the sequential slab technique (Vandiver 1987; Roux 2019, 167).

Apart from these fashioning techniques, finishing in the form of beating/paddling could be identified on some sherd families. Traces in the form of alternating flattened and curved external surfaces are a strong indication of beating (Roux 2019, 177). The elongated and, in some cases even vertical configuration in radial sections, is an additional characteristic trait caused by a compression of clay (Livingstone Smith 2001, 121). On the inner surface, traces of discontinuous pressure suggest the use of a counter-paddle during beating (Roux 2019, 178).

Definition of *chaînes opératoires*

On the basis of the results of the technological analysis of the assemblage from Cząstków Polski we are able to distinguish the following *chaînes opératoires*:

CzP1. simple coiling with pinching

The vessel bases were formed using a singular spiralled coil. The coils forming the body were then added on top of each other until the vessel's rim. Coils of similar diameter were used for all vessel parts. They were not strongly transformed during forming nor finishing. This *chaîne opératoire* includes both fine (seven sherd families) and coarse pottery (nineteen sherd families; Table 1).

CzP2. coiling with pinching and subsequent thinning and stretching

The vessel bases were formed using a single spiralled coil. The coils forming the body were placed on top of each other with an alternate overlapping: every other coil is stretched once on the inner surface of the previous coil, and again on the outer surface of the previous coil. The coils became thinned and stretched during forming and finishing of the vessel. It is not clear how the vessel's neck was built here. This *chaîne opératoire* was applied only for the fine pottery (eighteen sherd families; Table 1).

CzP3. coiling with beating (paddle and anvil technique)

Vessels were formed following the same gestures as for the CzP2. The rims were formed from two or three smaller coils of clay placed on top of each other and slightly elongated through pinching but not as thinned and stretched as those of the body. The body was then shaped using the beating technique, especially in the upper and lower part. This *chaîne opératoire* was applied only for the fine pottery (eleven sherd families; Table 1).

CzP4. drawing from one piece of clay

Miniature vessels were formed from one piece of clay which was pulled and stretched out by drawing and pinching. Only one fine vessel representing this procedure could be identified in the assemblage.

Other chaînes opératoires

Additionally, a *chaîne opératoire* connected with the sequential slab technique can be assumed on one vessel, as described in Kreiter *et al.* (2017). The presence of vessel bases made of double coil spirals indicate also that other *chaînes opératoires* were used as well; however, they cannot be fully reconstructed due to the high fragmentation of the assemblage.

Table 1. Distribution of most common *chaînes opératoires* identified for the LBK pottery assemblage from Cząstków Polski Site XII. F – fine pottery, C – coarse pottery

	Feature 1			**Feature 3**			**Feature 4**			**Layer**			**Total**		
	CzP1	CzP2	CzP3	CzP1	CzP2	CzP3	CzP1	CzP2	CzP3	CzP1	CzP2	CzP3	CzP1	CzP2	CzP3
rim&body	1F, 1C	0F, 0C	2F, 0C	3F, 7C	0F, 0C	3F, 0C	1F, 1C	0F, 0C	0F, 0C	0F, 0C	0F, 0C	0F, 0C	5F, 9C	0F, 0C	5F, 0C
body&base	0F,1C	2F, 0C	3F, 0C	1F, 0C	2F, 0C	1F, 0C	0F, 0C	0F, 0C	0F, 0C	0F, 0C	0F, 0C	1F, 0C	1F, 1C	4F, 0C	5F, 0C
body	0F, 4C	3F, 0C	1F, 0C	1F, 5C	11F, 0C	0F, 0C	0F, 0C	0F, 0C	0F, 0C	0F, 0C	0F, 0C	0F, 0C	1F, 9C	14F, 0C	1F, 0C
total	1F, 6C	5F, 0C	6F, 0C	5F, 12C	13F, 0C	4F, 0C	1F, 1C	0F, 0C	0F, 0C	0F, 0C	0F, 0C	1F, 0C	7F, 19C	18F, 0C	11F, 0C

The traces observed in sections indicate that they could have been combined with bodies shaped using both the simple coiling technique with pinching (as the CzP1) and the coiling with thinning and stretching (as the CzP2).

Variability within *chaînes opératoires*: tracking "potters' hands"

Chaînes opératoires CzP1-3 are the most common in the analysed assemblage (Table 1). They could be identified in the two features that are the richest in pottery: Pits 1 and 3, located c. 10 m from each other. In both features some very characteristic vessels were found. Lower fragments of four small fine pots made using CzP3 have strong traces of beating above the base which caused a slight deformation of the profile (Figs 2: 3; 3: 6). The base-body junction was always built in the same way and, in all cases, coils of similar size were used: for two of these vessels, the lowest ones were measured, and these are extremely elongated (16 × 5 mm and 16 × 6 mm; Fig. 4); for two other vessels, the upper coils are smaller, but also similar (10 × 4 mm and 8 × 4 mm; Fig. 4). Almost identical coil sizes could also be observed for the vessels made using CzP1, which also share very similar traits: a slightly alternating alignment of sub-circular coils (C configuration: 10 × 9 mm and 10 × 10 mm as well as 12/10 mm and two 12/11 mm; Fig. 4) or overlapping alignment of circular coils (O configuration: 9 × 9 mm and 10 × 9 mm; Fig. 4). Although these are different vessels, such similarities in technical gestures and coil sizes are so striking that these vessel groups seem to have been built by one person for each group respectively. Such motor habits connected with rolling coils seem indeed very individual (Manem 2008; Gomart 2011; 2014). Pottery manufactured by these hypothetical manufacturers was spread in both Features 1 and 3, which is a strong additional indication for their contemporaneity. The small number of *chaînes opératoires* at Cząstków Polski Site XII, as well the low variability within them, is an argument that the site represents a LBK settlement inhabited by one group of people sharing the same technical tradition (*e.g.*, Roux 2019, 6), and including different manufacturers. This is not at all obvious as interpretations of the Vistula Basin microregion as only temporary stops on the "motorway" connecting the loess uplands with the Polish lowlands have been discussed for many years (*e.g.*, Kulczycka-Leciejewiczowa 1968; Budziszewski and Pyzel 2022, further references therein). On larger LBK settlements, such as Cuiry-lès-Chaudardes in Picardy (France), a higher number of co-existing technical traditions could be identified (Gomart 2014).

Comparison with other sites

Forming and fashioning techniques and methods reconstructed at Cząstków Polski are all known for the European Neolithic and the LBK. However, their combination in certain *chaînes opératoires* has some degree of idiosyncrasy.

Coiling with pinching without strong coil deformation was registered in the Hungarian (Kreiter *et al.* 2017), Bohemian (Neumannová *et al.* 2017; here as an S configuration), as well as French and Belgian LBK (Gomart 2014). However, nowhere can a direct analogy to the CzP1 be found. In Hungary, bases were made of superimposed coiled spirals (Method 2: Kreiter *et al.* 2017; which may correspond to one of the hypothetical *chaînes opératoires* of Cząstków Polski). In the western LBK, bases are rounded, and rims were made of smaller coils (*e.g.*, CCF2: Gomart 2014, 79). CzP2 has similarities in France (*e.g.*, CCF8: Gomart 2014, 79), but the bases are again different. CzP3 resembles the Method 1 from Hungary (Kreiter *at al.* 2017), but no traces of shaping the bases against a support could be detected at Cząstków Polski. The rims were also made in a different way, which looks like the practices known from France and Belgium (*e.g.*, CCF10 and FHC10: Gomart 2014, 79, 174). However, this method was not restricted to fine pottery there as is the case at Cząstków Polski. Also, in Ukraine and Moldova, the paddle and anvil technique was used on all types of vessels. This technique prevailed there, even if examples of not so strongly transformed coils (similar to CzP1) were also registered (Palaguta and Starkova 2021).

The sequential slab technique was suggested for Hungary (Method 3: Kreiter *et al.* 2017), which makes our hypothesis on its occurrence at Cząstków Polski more probable. The definition of slabs is not unequivocal among pottery specialists (*e.g.*, Vandiver 1987; Commenge 2009; Thér *et al.* 2019; Gucsi 2022): early Neolithic slabs in the Balkans and the Carpathian basin seem to correspond to flattened short coils (Kreiter *et al.* 2017), different from the small patches of clay described by P. Vandiver in the Levant (1987), or from the possibly larger slabs of clay documented by C. Commenge in Macedonia (2009).

The identified *chaînes opératoires*, with notably different coiling procedures, beating and sequential slab building, characterizes LBK pottery assemblages in different quantities from the emergence of the culture in Transdanubia to its final expansion in central Western Europe (Gomart *et al.* 2020). In that sense, the assemblage from Cząstków Polski fully integrates the LBK common ceramic tradition. At the individual scale, the limited size of the pottery assemblage allowed for the identification of specific "hands" within this common LBK tradition and to differentiate several individuals in charge of the production.

CONCLUSIONS

A variety of forming techniques could be identified for the pottery assemblage from Cząstków Polski and four *chaînes opératoires* could be reconstructed. This technical repertoire echoes the intrinsic variability of LBK pottery assemblages as described in other LBK contexts (Gomart *et al.* 2020). Our results demonstrate that even quite poor, highly fragmented, and badly preserved material can be used to study pottery production. We could not reconstruct the exact number and proportions of *chaînes opératoires,* but we could recognise some unique traits that distinguish the social group (community of practice) from Cząstków Polski and even certain producers within it. Thus, even if the LBK manufacturers followed quite consistent general potting rules, some variability can be observed between (and even within) sites and regions. Our results demonstrate the very high potential of research on pottery production techniques: when so much information can be gained from such a site, we could obtain tremendous knowledge on various social groups and their interactions when analysing systematically better preserved settlements, microregions and whole regions. This offers valuable avenues for future research, and we hope that analysis of production techniques will become a standard in pottery studies.

Acknowledgements

This collaborative research resulted from the NCN MINIATURA 4 Project 2020/04/X/HS3/00201 "Linear pottery beyond typology: multi-proxy studies of Early Neolithic ceramics". Thin sections of pottery were performed as part of petrographic analysis conducted by A. Rauba-Bukowska and financed by the Faculty of History, University of Gdańsk. We would like to thank M. Krystek and D.K. Płaza for providing us free use of the facilities of the Museum of Archaeology and Ethnography in Łódź for polished sections.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3500

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BALTIC AMBER IN THE HUNGARIAN BRONZE AGE. NEW DATA AND CURRENT STAGE OF RESEARCH

ABSTRACT

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Amber was one of the key raw materials distributed in Bronze Age Europe. One of its varieties – succinite – was exchanged over a vast area stretching from its sources on the southern shores of the Baltic Sea to the shores of the Mediterranean Sea. The chemical identification of Baltic amber significantly expands our knowledge of the dynamics and nature of the relationships connecting different regions of Europe in the first half of the second millennium BC. One of the most significant cultural-geographical areas reached by this amber was the Carpathian Basin. This text presents a summary of the current state of knowledge about the context, chronology, and the extent of amber occurrence in the Hungarian Bronze Age. At the same time, it supplements the catalogue of finds with artefacts acquired in recent years, providing new information regarding radiocarbon dating and spectral analysis of selected amber artifacts.

Keywords: Baltic amber, Carpathian Basin, Hungarian Bronze Age, prehistoric exchange, spectral analysis, absolute chronology

Received: 07.06.2023; Revised: 20.09.2023; Accepted: 26.11.2023

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1. INTRODUCTION

The distribution of amber and products made of it is a significant element of discussion within European Bronze Age archaeology (Czebreszuk 2003; 2011 with further references). From the very beginning of interest in this subject, the southern coast of the Baltic Sea was indicated as the most likely source of the origin of this raw material discovered in more and less distant parts of the continent, both in the Neolithic and in the Bronze and Iron Ages. Currently, the discussion on the provenance of particular fossil resins is developing in the direction of distinguishing its chemical varieties (*e.g.*, succinite, simetite or rumenite; Czebreszuk 2009, Plate I), and thus a more precise indication of the presence of Baltic amber – succinite, in archaeological contexts.

Succinite is a fossil resin that was formed in the Eocene (about 55-33 million years ago; Sawkiewicz 1970). During this period, in a vast area stretching from southern Scandinavia, through the territory of today's Poland, to central Ukraine, there was a shallow and warm sea surrounded by coniferous forests. It was there that large amounts of resin were produced, which, as part of long-term diagenetic processes and movement between the land and sea environment, transformed into amber (Kosmowska-Ceranowicz 2001). Geological deposits containing Baltic amber arose within river deltas that formed in the Eocene seas. The ones currently known are: the Sambia-Chłapowo delta (also known as Gdańsk Palaeogene delta), the Klesowska delta (in today's Ukraine) and the Parczewska delta in south-eastern Poland. These areas are among the richest deposits of Baltic amber.

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Contemporary analytical possibilities, based on the method of infrared spectral analysis, proposed in the 1960s by C. W. Beck (Beck *et al.* 1964; Beck 1970), enable the identification of particular types of fossil resins. However, despite the development of chemical methods, it is still not possible to separate succinite into individual varieties that could in turn be linked to a specific source of origin. Due to the process of creating Baltic amber described briefly above, the origin of each piece of raw material discovered in archaeological context can potentially be associated with any region of the vast area of Northern and Eastern-Central Europe: from the southern coast of the North Sea in the west, through Jutland and the southern coast of the Baltic, until western Ukraine in the east (Czebreszuk 2009, Plate I). Consequently, in archaeological research on the origin of Baltic amber, apart from the indications from chemical analyses, it seems to be important to have contextual knowledge about the mechanisms of contact and exchange prevailing in certain areas of Bronze Age Europe.

2. AMBER IN THE CARPATHIAN BASIN – GENERAL REMARKS

According to the prevailing view on the dynamics of the spread of Baltic amber in Europe in the first half of the 2nd millennium BC, this process developed in two stages. In the older stage, amber is perceived as a key raw material controlled by the communities of the Únětice culture in Central Europe and a raw material known in the British Isles and in today's France and Spain. M. Ernée dates this phase to the classical phase of the Únětice culture (between 2050/2000 and 1750 BC), while H. Meller considers this period until 1600/1550 BC (Ernée 2016; Meller 2017). In the later stage, the presence of amber is recorded in a wider area, including – apart from the above-mentioned – also the Apennine and Aegean Peninsulas and, of key importance from our point of view, the Carpathian Basin (Meller 2019). The wider distribution area of amber is linked with the collapse of the classical Únětice culture in Bohemia, caused by the transformation of trade routes and the emergence of the Maďarovce-Věteřov cultural complex (Ernée 2012; 2016), or with the crisis and the disappearance of the Únětice culture, which formerly could have possibly created a complex system of military and political control of its region and of goods obtained from the north, including Baltic amber (Meller 2017, fig. 6; 2019, fig. 21). As a consequence, in the studied area of Hungary and in the neighbouring regions, today's Slovakia and Romania, amber finds should dominate after *i.e.*, 1750 or 1600 BC.

In the above context, the area of today's Hungary is most often discussed as an element of a larger cultural and geographical area, *i.e.*, the Carpathian Basin. In the frames of grand narratives concerning Bronze Age Europe, the Carpathian Basin is seen as a kind of transit area that connected two cultural zones – the Central European Bronze Age communities and the civilizations of the Mediterranean basin, especially the Mycenaean culture. Amber plays a significant role in this discussion. In the collection of nearly 300 amber finds from the area of Mycenaean Greece, the vast majority (87%) were identified as succinite (Beck 1966; 1970; 1974). This fact has opened a wide discussion on the relations between the distant ends of the continent and the exchange mechanisms within which Baltic amber reached mainland Greece (Beck and Sprincz 1981; Sprincz 2003; Czebreszuk 2011; Kneisel and Müller 2011).

This discussion has long framed perceptions of the Carpathian Basin in this period and resulted in the attribution of a key role to local communities in the development of a complex network of far-reaching connections, implemented above all by warrior elites modelled on those known from Aegean sources (Kovács 1977; Sherratt 1982; Kristiansen 1999, 177; Kristiansen and Larsson 2005; Kristiansen and Suchowska-Ducke 2016). However, these statements are often based on sources (including Baltic amber), which are used selectively, without the necessary local contextualization and precise chronological considerations (Vulpe 2011; Jaeger 2014; Kienlin 2015; Jaeger *et al.* 2020).

Recent analytical results have raised a question concerning the origin of amber finds from the Carpathian Basin. Based on differences in the spectra of beads from Hungary the prehistoric use of not only succinite, but other fossil resin variants: ajkaite from the Balaton uplands or rumenite from the Romanian extra-Carpathian region has been hypothesized (Horváth 1999; Horváth *et al.* 2016).

3. MATERIALS AND RELATIVE CHRONOLOGY

According to the Bronze Age chronology in Hungary (Fischl *et al.* 2013; Kiss *et al.* 2019), the Early Bronze Age (EBA) can be dated to the period between 2600/2500 and 2000/1900 BC. The Middle Bronze Age (MBA) began around 2000/1900 BC and ends with the so-called Koszider period (MBA 3) dated to around 1500/1450 BC (Jaeger and Kulcsár 2013; Fischl *et al.* 2013, fig. 6; 2015, fig. 1b). From the last phase of the EBA (EBA 3, 2200/2100-2000/1900 BC) to the classical phase of the Middle Bronze Age in Hungary (MBA 1-2, 2000/1900-1700/1600 BC), the central part of the Carpathian Basin is characterized by a continuous development, best exemplified by the emergence of tell settlements. Therefore the sites, which cannot be dated more precisely within this period, are categorized as Middle Bronze Age. The Late Bronze Age (LBA), in turn, can be dated between 1500/1450 and 900/850 BC and includes both the period of the development of the Tumulus (*Hügelgräber*) and the Urnfield cultures, and contemporaneous Piliny and Kyjatice cultures (Kovács 1977, 18-20; Visy 2003, 476; V. Szabó 2019).

A total of 659 amber beads known from 22 Middle and Late Bronze Age sites from Hungary were classified into 17 formal groups by the first typological studies (Sprincz and Beck 1981). Later, further sites were added (Horváth 1999; 2013; Kiss 2012b); some of these, however, do not fall within the territory of today's Hungary. The latest summary contains altogether 28 Bronze Age sites (Stahl 2006). The Hungarian pieces examined

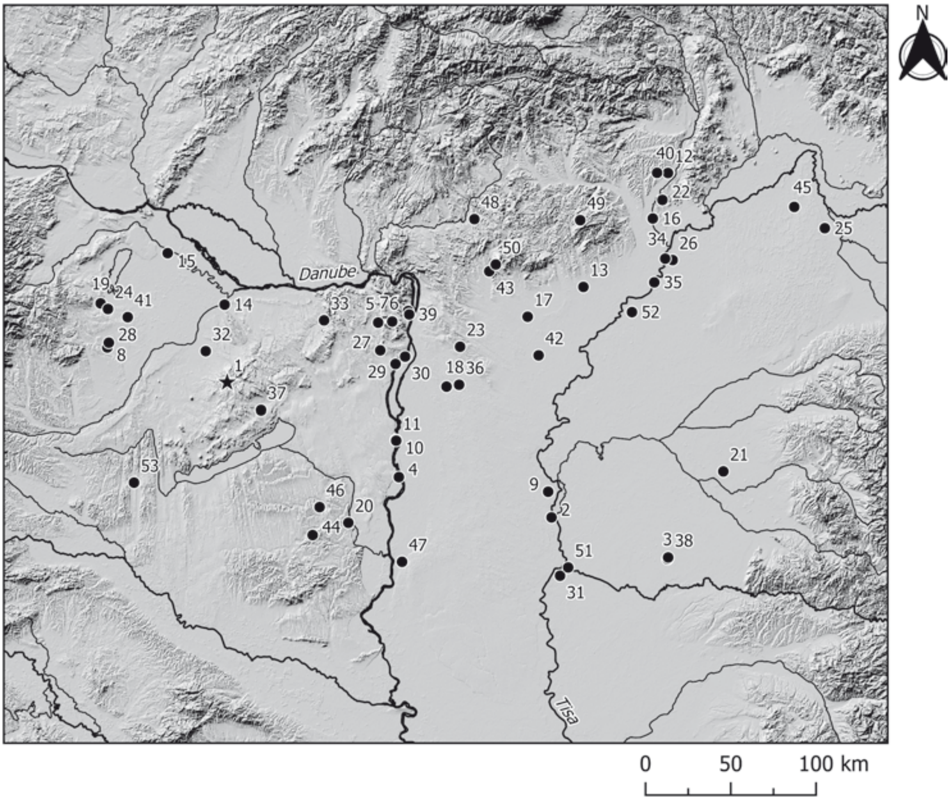

Fig. 1. Distribution of Bronze Age amber finds and ajkaite sample (paleontological site) in Hungary (key after Appendix 1)

from Móra Ferenc Museum in Szeged in the 1980s (nine beads from the Baks-Levelény hoard, Szőreg Grave 114, Tápé Graves 184 and 215; mentioning also the unpublished result of a sample taken from Battonya-Vörös Október Tsz, Grave 68) all proved to be succinite of Baltic origin (Beck and Sprincz 1981). Later analysis included further pieces from Százhalombatta (Horváth 1999), as well as Budakalász, Füzesabony, Hernádkak, Kötegyán, and Megyaszó (Horváth *et al.* 2016); from these, the pieces from Százhalombatta, Budakalász, Füzesabony and Kötegyán were interpreted as not originating from Baltic sources (Horváth 1999; 2017, fig. 13; Horváth *et al.* 2015, fig. 12).

Amber, mainly as an element of ornaments, was certainly used in greater quantities than is known today, as in many cases extremely small and fragile beads are only obtained through very meticulous excavation techniques (*e.g.*, sieving and flotation; see the case of the Kakucs-Turján settlement – Jaeger *et al.* 2018). Cremation also effects the presence of amber beads, as was demonstrated by the analysis of MBA finds from Hungary: in the case

Fig. 2. Szigetszentmiklós-Felső Ürgehegyi-dűlő, Grave 532, find no. 2 (Type IB amber bead)

of the vast cremation cemetery of Dunaújváros-Duna-dűlő (Vatya culture) 0.2% of the burials contained amber beads, while in the much smaller inhumation cemetery of Hernádkak (Füzesabony culture), 8.5% of the burials were equipped by amber ornaments (Jaeger 2016b, 208).

Currently, complimenting the former data of 28 sites, 52 Bronze Age Hungarian archaeological sites are now known, where altogether at least 1915 amber finds have been discovered from the Early Bronze Age until the Late Bronze Age (Fig. 1; Appendix 1). The minimal number of (complete) beads can be added because of the fragmentary condition of several amber find assemblages. It should be also noted that in the course of the work on the presented study, a hoard was discovered in Szécsény-Benczúrfalva. This deposit, in addition to bronze and gold objects, contained 770 amber beads (Guba and Tankó 2023). A full analysis of the hoard has not yet been completed so in this study the amber beads from Szécsény-Benczúrfalva are not included in the analytical sections on typology and absolute chronology.

In the text presented here, the available contextual and chronological information on the known amber finds was collected and their form (where possible to determine due to their state of preservation) was determined according to the typochronological scheme by E. Sprincz and C. W. Beck (Sprincz and Beck 1981; Stahl 2006) (see below). Within the framework of relative chronology, the presence of amber in the study area can be dated to the long period from the end of the 3rd millennium BC to the 2nd/1st millennium BC, Urnfields development period.

4. ABSOLUTE CHRONOLOGY

The chronology of the Hungarian Bronze Age, like that of the neighbouring areas of Slovakia and Romania, is still largely based on relatively few radiocarbon dates from well-recognized and described stratigraphic contexts. This observation applies to dating from settlements as well as cemeteries (Kiss *et al.* 2019; Staniuk 2021). The chronology of sites, including tells and multi-layered settlements, is determined primarily in terms of relative chronology, which is derived from typological studies most often referring to finds from cemeteries (Jaeger *et al.* 2018; Staniuk *et al.* 2020). In this context, it was difficult to determine the dynamics of the emergence and use of amber by local Bronze Age communities.

In this paper, next to new spectral analyses of amber finds, we publish radiocarbon dates from six archaeological sites, from different well-defined stratigraphic contexts, in general categories dated to Early, Middle and Late Bronze Age (Table 1; Appendix 1). The dataset collected in this study is supplemented by spectral analyses of amber pieces from Iharkút, a Late Cretaceous site in the Bakony Mountains, where palaeontological excavations were conducted. The amber from this particular study served as a reference point for identifying potential examples of a local variety of amber (ajkaite) among Bronze Age artefacts. In light of the new radiocarbon dates presented below, three distinct stages of amber use (deposition) in Bronze Age contexts can be identified.

The earliest dates for assemblages associated with the presence of amber products are from the burials of Bell Beaker culture at Szigetszentmiklós-Felső Ürgehegyi-dűlő (Grave nos 84, 162, 176, 532, 539 and 609; fig. 2) and at Budakalász-Csajerszke (Grave 1025). These are dated to the late 3rd millennium BC Early Bronze Age (EBA). Also dated to the end of the 3rd millennium BC is Grave no. 3 from the Csepreg site, the amber from which unfortunately could not be analysed in the presented study. Represented by the above-mentioned sites, the earliest stage of amber use can be dated to the period around 2560-2040 BC (Fig. 3; Table 1).

Within the Middle Bronze Age (MBA), we have a small collection of radiocarbon dating amber finds from the Nagycenk cemetery (Grave 61; Table 1; Fig. 4: 11) (Gömöri *et al.* 2018) and the Kakucs-Turján settlement, where five bead fragments were discovered within layers associated with the Vatya culture settlement. In the last mentioned case, soil samples 122 and 125 were dated from two stratigraphic layers, where amber fragments were identified. These fragments were associated with Kakucs phases 9-11 (MBA 2-3). In light of the available absolute dates, this phase of habitation belongs to the period around 1750/1700-1650 BC. Soil sample no. 102 was taken from the 5th mechanical level. This part of the site's stratigraphy is associated with Kakucs Phase 8 (MBA 2), as are the other two samples, as manifested by the presence of the remains of a younger Vatya culture house (Jaeger *et al.* 2018). Available radiocarbon dating allows a preliminary determination of the framework for the formation, functioning and decline of the household during

Table 1. Radiocarbon dated archaeological contexts of amber finds. The dates were calibrated using the OxCalv4.4 software and the IntCal20 calibration curve (Reimer *et al.* 2020; https://c14.arch.ox.ac.uk/oxcal/OxCal.html)

Site	Context	Relative Chronology	Laboratory no.	BP date	cal BC (95.4%)	References
EBA (Bell Beaker)						
Szigetszentmiklós-Felső Ürgehegyi-dűlő	Grave No. 162	EBA 2 Bell Beaker c.	Poz-145195	3815 ± 30	2434-2142	unpubl.
Szigetszentmiklós-Felső Ürgehegyi-dűlő	Grave No. 176	EBA 2 Bell Beaker c.	DeA-8228	3837 ± 21	2451-2201	unpubl.
Szigetszentmiklós-Felső Ürgehegyi-dűlő	Grave No. 532	EBA 2 Bell Beaker c.	Poz-145120	3900 ± 35	2471-2236	unpubl.
Szigetszentmiklós-Felső Ürgehegyi-dűlő	Grave No. 539	EBA 2 Bell Beaker c.	DeA-7313	3967 ± 26	2573-2351	unpubl.
Szigetszentmiklós-Felső Ürgehegyi-dűlő	Grave No. 609	EBA 2 Bell Beaker c.	Poz-145121	3855 ± 35	2459-2204	unpubl.
MBA						
Nagycenk-Lapos-rét	Grave No. 61	MBA 1–2 Gáta–Wieselburg c.	DeA-10114	3489 ± 31	1894-1697	Gömöri *et al.* 2018, fig. 41.
Kakucs-Turján	KEX13-15: 70038 – floor, phase 8	MBA 2 Vatya c.	Poz-88387	3435 ± 35	1878-1626	Jaeger *et al.* 2018, Table 2, fig. 26.
Kakucs-Turján	KEX14-16: 50015 – oven, phase 8	MBA 2 Vatya c.	Poz-88392	3490 ± 30	1892-1699	Jaeger *et al.* 2018, Table 2, fig. 26.
Kakucs-Turján	KEX13-15: 50024 – debris, phase 9	MBA 2 Vatya c.	Poz-61647	3425 ± 30	1873-1625	Jaeger *et al.* 2018, Table 2, fig. 26.

Kakucs-Turján	KEX14-16: 60033 – collapsed wall, phase 9	MBA 2 Vatya c.	Poz-88382	3455 ± 30	1882-1687	Jaeger *et al.* 2018, Table 2, fig. 26.
Kakucs-Turján	KEX14-16: 60033 – collapsed wall, phase 9	MBA 2 Vatya c.	Poz-88383	3475 ± 35	1892-1690	Jaeger *et al.* 2018, Table 2, fig. 26
Kakucs-Turján	KEX13-15: 40008B – pit with debris concentration, phase 10	MBA 3 Vatya III–Koszider	Poz-61645	3425 ± 30	1873-1625	Jaeger *et al.* 2018, Table 2, fig. 26.
Kakucs-Turján	KEX14-16: 60016A – seed deposit, phase 10	MBA 3 Vatya III–Koszider	Poz-88389	3435 ± 35	1878-1626	Jaeger *et al.* 2018, Table 2, fig. 26.
Kakucs-Turján	KEX13-15: 50030 – hearth, phase 11	MBA 3 Vatya III–Koszider	Poz-61649	3365 ± 30	1741-1541	Jaeger *et al.* 2018, Table 2, fig. 26.
LBA (Tumulus culture)						
Jánoshida-Berek	Grave No. 113	LBA 1 Tumulus c.	DeA-7941	3167 ± 24	1500-1406	Csányi 2019, Table 1, fig. 4.
Jánoshida-Berek	Grave No. 140	LBA 1 Tumulus c.	DeA-7942	3157 ± 25	1499-1326	Csányi 2019, Table 1, fig. 4.
Sükösd-Árpás-dűlő V.	Grave No. 1	LBA 1 Tumulus c.	DeA-33514	3234 ± 26	1538-1434	Pásztor *et al.* 2022, 100.
Szurdokpüspöki-Hosszú-dűlő	Grave No. 1	LBA 1 Tumulus c.	Poz-145122	3225 ± 35	1601-1418	unpubl.

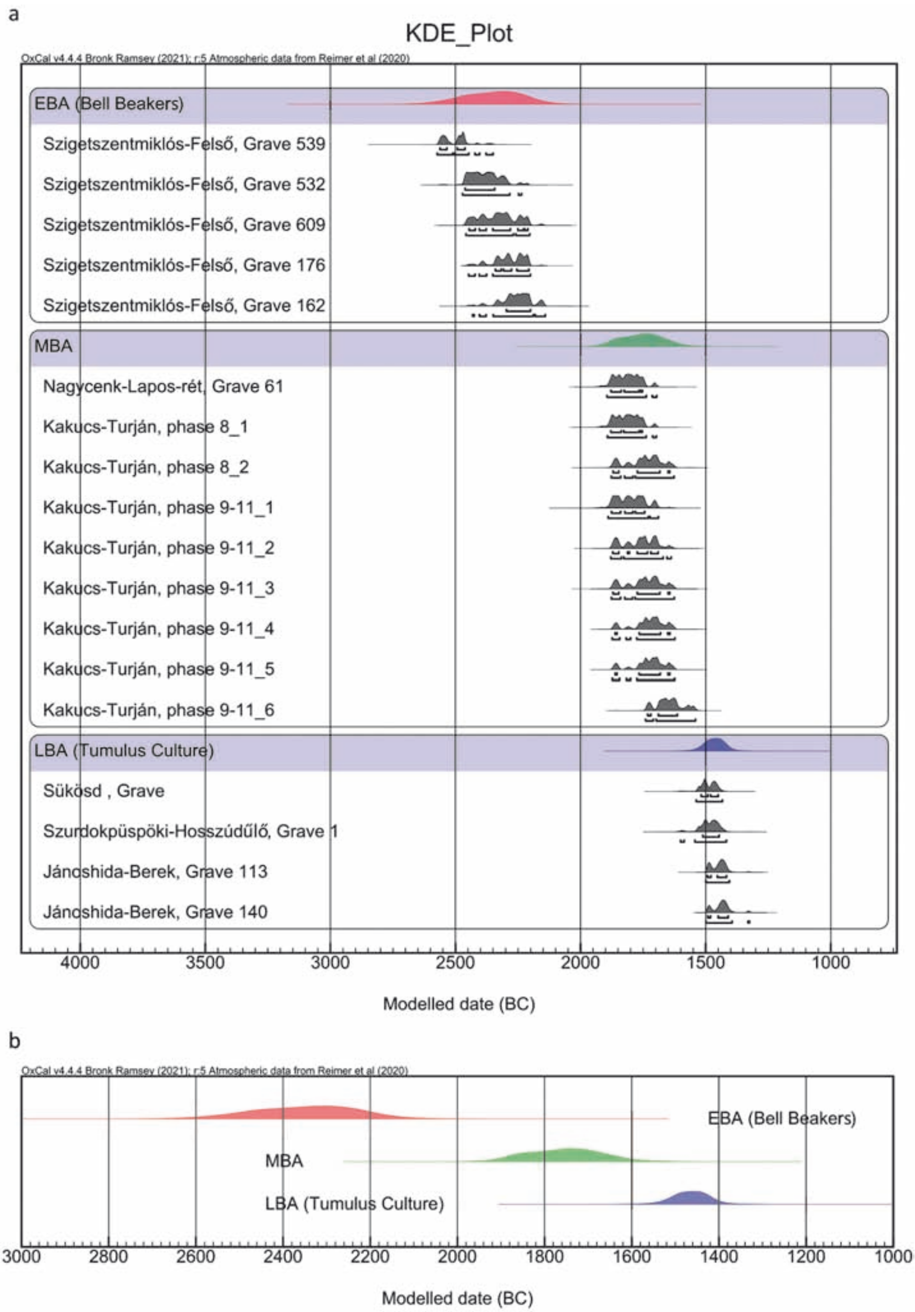

Fig. 3. KDE plot visualization of radiocarbon dated Bronze Age amber finds' contexts (a); KDE plot visualization of the overall distribution of particular Bronze Age phases (b)

Fig. 4. Amber beads from 1. Füzesabony-Öregdomb, 2. Hegyeshalom-Újlakótelep, Grave 5, 3. Hernádkak-Temető, 4-8. Jánoshida-Berek, Grave 113, 9. Kötegyán-Sarkadi út (Gyepespart), 10. Megyaszó, Grave 121, 11. Nagycenk-Lapos-rét, Grave 61, 12. Szurdokpüspöki-Hosszú-dűlő, Grave 1, 13. Jászdózsa-Kápolnahalom, Hoard no. 2

Fig. 5. Amber beads from Sükösd-Árpás-dűlő V.; hemispherical bead with a cross-shaped borehole (Type IB, V, XI, XII)

this period around 1800-1700 BC. The dates associated with the stage of amber use at the MBA sites mentioned above are in the 1900-1650 BC (Fig. 3; Table 1) period.

From the Late Bronze Age (LBA) period, radiocarbon datings of Tumulus culture burials from Jánoshida-Berek (Graves 113 and 140; Fig. 4. 4-8) (Csányi 2017; 2019, 1. táblázat), from Szurdokpüspöki (Grave 1; Fig. 4: 12) (Guba and Bácsmegi 2009) and from Sükösd (Grave 1; Fig. 5) (Pásztor *et al.* 2022, 100) are available. They allow dating the stage of amber use before the Urnfield development period to around 1540-1420 BC (Fig. 3; Table 1).

At this stage of research, it seems crucial to obtain more radiocarbon-dated contexts of the amber finds, especially in relation to the MBA. A relatively large number of these would make it possible to address the views put forward in the literature indicating that there was no influx of significant quantities of raw material into the area in question before 1750 BC or before 1600 BC (before the end of the Classical phase of the Únětice culture) (Ernée 2016; Meller 2017). The dating of the finds associated with the Gáta-Wieselburg style, as well as from the Vatya culture settlement from Kakucs-Turján and the information presented in other studies from the Maros/Mureş culture sites from Szőreg and Battonya (burials furnished with amber are not radiocarbon dated, but their chronology was determined to the Szőreg 2-3 phase, *i.e.,* to the period 2100-1800 BC) (Beck and Sprincz 1981; O'Shea *et al.* 2019, table 1-2, fig. 2), as well as the presence of Baltic amber in the earliest radiocarbon-dated graves at the Nižna Myšla cemetery in neighbouring eastern Slovakia (Jaeger *et al.* 2023), allow a cautious hypothesis about the availability of succinite before the crisis of the distribution system developed by the Únětice culture community.

5. FORM

The area of Hungary is distinguished from other regions of the Carpathian Basin by the availability of a typochronological scheme. The results show that during Middle Bronze Age flattened globular and disc beads were common, while during the Late Bronze Age more sophisticated types spread, like cylinder beads with sharp edges and truncated biconical beads (Fig. 6) (Sprincz and Beck 1981, fig. 6, fig. 9).

During the Late Bronze Age, however, other types can be observed based on recent evidence. From the burials of the Tumulus culture (from Jánoshida and Sükösd; fig. 7-8) triangular beads are also known (Csányi 2017; 2019; Pásztor *et al.* 2022, fig. 3.5). This new type, following the mentioned typological system (Sprincz and Beck 1981) can be ranked in Type XI (Fig. 6). Similar triangular beads were found in Tumulus culture burials in Hundersingen, Germany (Type 30 after Woltermann 2016, 168, Abb. 124.).

Another new type, a hemispherical bead (which can be ranked in Type XII) was found in Grave 1 of the Tumulus culture cemetery recently discovered at Sükösd (Fig. 5) (Pásztor *et al.* 2022, fig. 3.3), and in the Szilvásvárad-Kelemenszéke depot 1 (V. Szabó 2019, fig. 168), beside a truncated biconical bead (the last mentioned one is Type IXE; Sprincz and Beck 1981). The hemispherical bead from Sükösd is very interesting because of the cross-shaped borehole in it. A similar amber bead with a cross-shaped borehole is known from the mentioned Tumulus culture grave assemblage from Hundersingen, and from the sun symbol with bronze handle, discovered in an unknown site in Jutland (Denmark) (Kaul 2004, 66, 67; Pásztor *et al.* 2022)

Completing the typochronological scheme by Sprincz and Beck for Bronze Age amber beads in Hungary with new types (Fig. 6) we can demonstrate the diachronic transformation of amber bead fashion. During the early phase, before 1600 BC (sporadic finds from the Early Bronze Age and Middle Bronze Age 1-2 phases) cylinder, flattened globular and flat disc forms (typological Groups I, III, VII) are the most common (Appendix 1; Fig. 9).

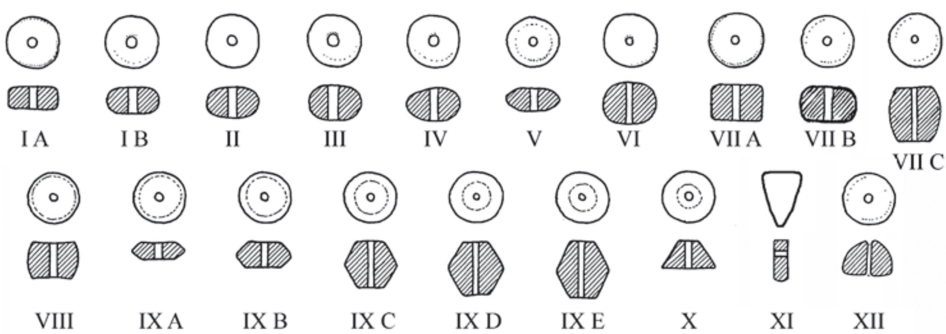

Fig. 6. Typochronological scheme of Bronze Age amber beads in Hungary (redrawn after Sprincz and Beck 1981, Fig. 6; supplemented by the authors)

Fig. 7. Jánoshida-Berek, Grave 113, amber beads (Type IA amber bead, Inv. no DJM 80.2.51)

Fig. 8. Triangular bead from Jánoshida-Berek, Grave 140 (Type XI; Inv. no DJM 80.2.76)

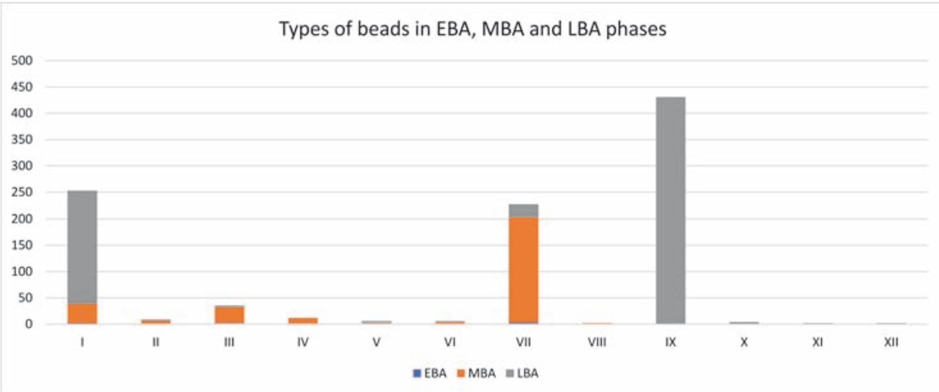

Fig. 9. Number of bead types in particular phases of the Bronze Age in Hungary

In the Koszider period (MBA 3) the same forms are still the most popular with a growing scale of flat disc and irregular round beads (typological Groups I, III, IV, VII). In the Late Bronze Age truncated biconical and flat disc beads (typological Groups I and IX) spread in the largest scale, beside the appearance of new types (Groups X-XII).

Table 2. Number of identified bead types in particular phases of the Bronze Age in Hungary

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
EBA	2	0	2	1	0	0	3	0	0	0	0	0
MBA	37	7	31	11	2	4	201	2	1	0	0	0
LBA	214	2	2	0	4	2	23	0	430	4	2	2

6. PROVENANCE OF RAW MATERIAL

Many analytical techniques are used in amber research, such as Fourier-transform infrared spectroscopy (FTIR), nuclear magnetic resonance (NMR) or gas chromatography-mass spectrometry (GC-MS). These methods are used individually or in various combinations, depending on the specificity of the analysed material and the analytical problem under consideration.

FTIR infrared spectroscopy has been repeatedly demonstrated by numerous research teams as the leading method of amber identification and classification. The specificity of the analysis, usually for small archaeological amber finds, imposes limitations that usually exclude the use of analytical techniques such as NMR (required amount 30-100 mg, destructive technique), GC-MS (required amount 1-3 g, destructive technique).

Among the various configurations of the apparatus in IR spectroscopy, the attenuated total reflection (ATR) technique deserves attention as the most popular and non-destructive method of examining amber in infrared. ATR requires exposure to infrared radiation of the cleaned amber surface, moreover, it is recommended to repeat the measurement several times for different exposures in order to identify possible changes in the spectrum resulting from a chemically differentiated surface. Unfortunately, for very small lump the surface degradation is difficult to avoid and covers a significant fraction of the sample volume. Despite its obvious advantages when analyzing large amber objects, the ATR method does not work for archaeological objects of a few and sub-millimeters in size.

In the reported research, the previous analyses of artefacts were carried out using the FTIR method. This was due to, on the one hand, the conservation aspects (less invasiveness of historic material) and the fact that this method was widely used by other researchers of prehistoric amber, which made it possible to compare the obtained results between individual regional studies. FTIR infrared spectroscopy in the transmission mode requires only 1-2 mg of sample, which is why it is sometimes referred to as a low-invasive method (Angelini and Bellintani 2017). For measurements using the FTIR transmission method, the sample is prepared by grinding a small amount of amber, mixing it with potassium bromide (KBr) and pressing it into a tablet. The disadvantage of this method is the destruction of practically the entire sample. From it, we obtain a spectrum showing vibrations in the molecules of chemical compounds constituting amber, and not its surface changed due to the influence of the environment.

In all cases published here, it was decided to use the infrared spectroscopy (FTIR) method conducted in the Laboratory of Department of Materials Chemistry Faculty of Chemistry AMU, Poznań. The amber samples were crushed by hand using an agate mortar and pestle. 1.8 milligrams of powdered sample was dispersed into 200 mg of KBr and finally pressed into a pellet in a hydraulic press with a force of 10 tons. FTIR spectra were obtained with a resolution of 2 cm^{-1}, in the measuring range of 4000-400 cm^{-1}, using a Bruker IFS 66v/S FTIR spectrometer.

The spectra of all 22 analysed amber samples – with the exception of an amber lump from Iharkút (palaeontological site) show agreement with the succinite spectra known from the literature and with the standard spectra made for Baltic amber. This consistency is very high in the characteristic area of 1260-1100 cm^{-1} constituting a "fingerprint" of succinite, containing an almost horizontal area from ~ 1260 to 1200 cm^{-1}, resulting from the partial overlap of bands of almost equal intensity, followed by a maximum absorption at ~ 1156 cm^{-1}. This region called the "Baltic shoulder" is particularly useful in identifying succinite. In addition to the spectra features typical of succinite, changes were also noted in the literature spectra of archaeological amber related to the change in the content of carboxylic acids and the presence of salt (Angelini and Bellintani 2017), which, however, did not affect the possibility of identifying all the examined amber lumps as succinite. To sum up, in the light of the spectral analyses provided as part of the described research and the

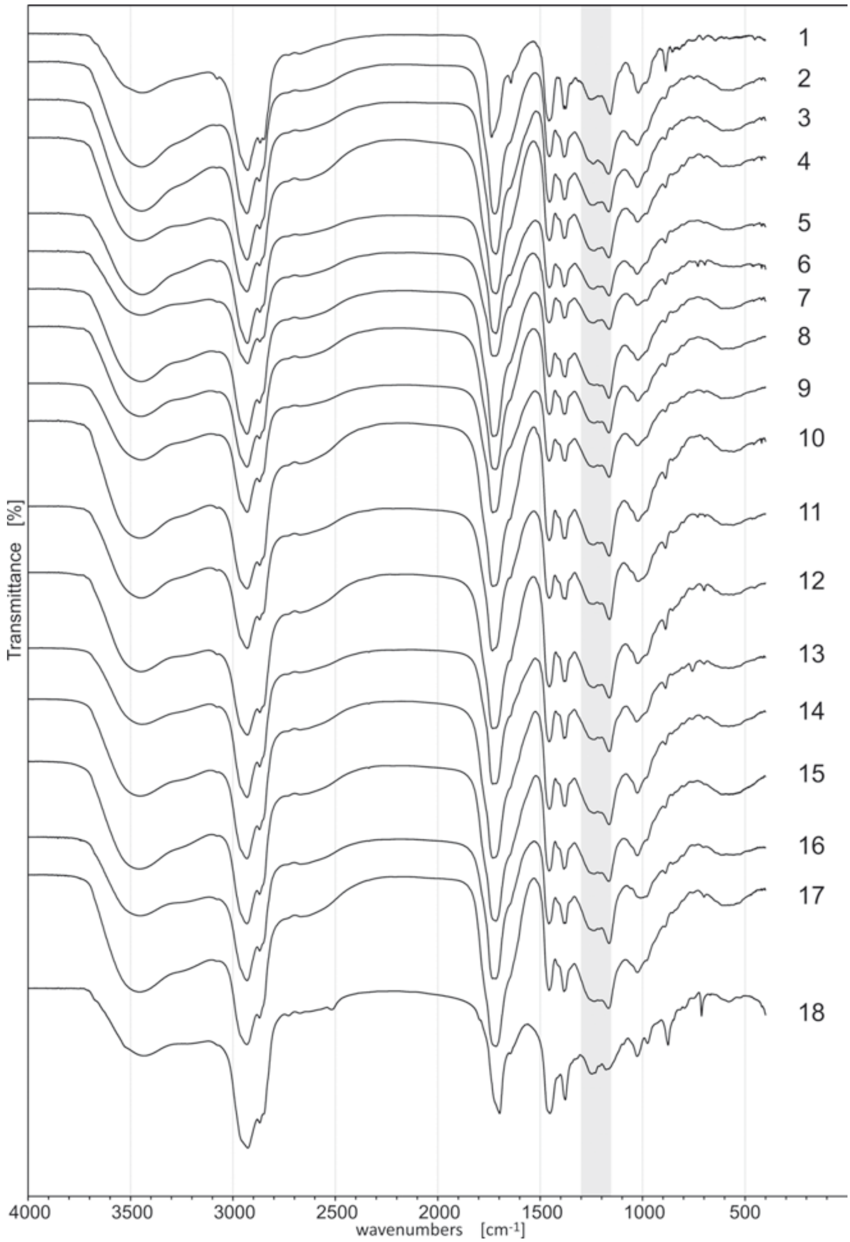

Fig. 10. Results of the FTIR analysis of amber samples: 1 – Baltic amber master sample; 2 – Hegyeshalom-Újlakótelep; 3 – Nagycenk-Lapos-rét; 4 – Hernádkak-Temető; 5 – Jászdózsa-Kápolnahalom; 6 – Jánoshida-Berek (dagger pendant); 7-9 – Megyaszó; 10-12 – Jánoshida-Berek; 13 – Budapest-II. Máriaremete (Nagykovácsi)-Remete Cave; 14-15 – Szurdokpüspöki-Hosszú-dűlő; 16 – Tiszakeszi-Szódadomb; 17 – Detek; 18 – Iharkút ajkaite master sample

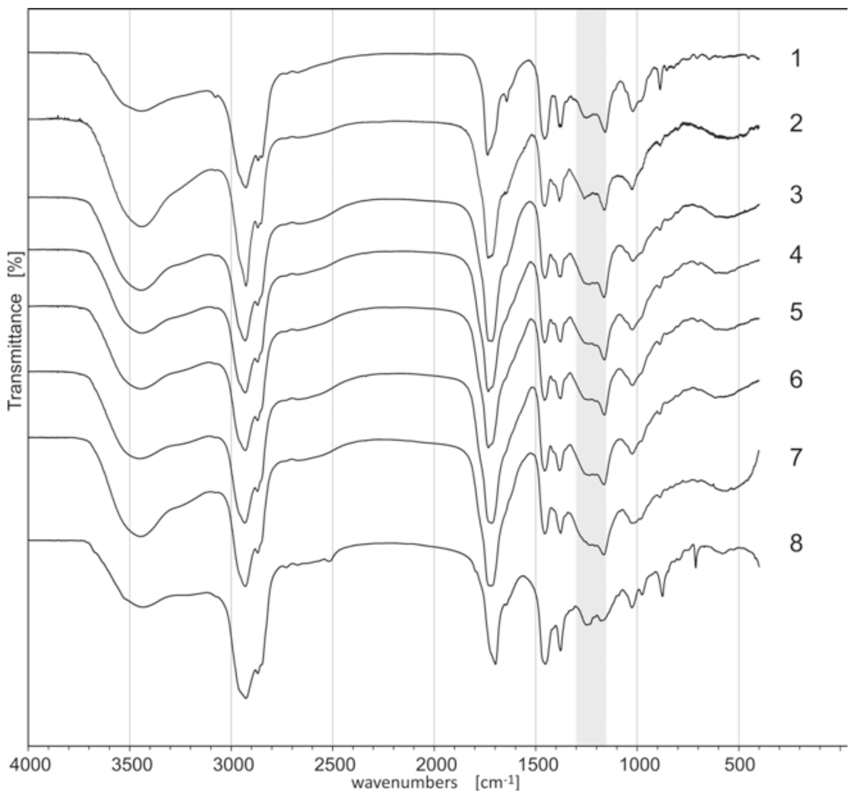

Fig. 11. Results of the FTIR analysis of amber fragments from: 1- Baltic amber master sample; 2-3 – Sükösd-Árpás-dűlő V.; 4-7 – Szigetszentmiklós-Felső Ürgehegyi-dűlő; 8 – Iharkút ajkaite master sample

analysis carried out earlier by the team of C. W. Beck, the vast majority of amber beads in the context of the Hungarian Bronze Age were identified as made of succinite.

7. CONTEXT

In the territory of today's Hungary, Bronze Age amber finds were most often deposited as grave goods and elements of (metal) hoards. The underestimation of settlement finds may result from the imperfection of excavation techniques that are not conducive to the identification of amber and its low resistance to post-depositional processes (Jaeger 2016b, 208).

As has been mentioned above, in total 52 Bronze Age sites are currently known from the research area, which provided amber finds. The collection includes 31 cemeteries (53 graves; the available publications in some cases lack accurate information about the number of graves furnished with amber objects), 15 hoards from 14 sites, and 7 (only MBA) settlements (Appendix 1; Fig. 1). The reconstructed number of amber objects (basically only beads of various forms or their fragments) was estimated at 1915. However it must be noted, that the number of finds could not be clearly determined. In the literature on the subject, in a few cases only numerical ranges were given, *e.g.*, 15-20 beads. In the presented study, it was decided to use the minimum number of items mentioned in the literature each

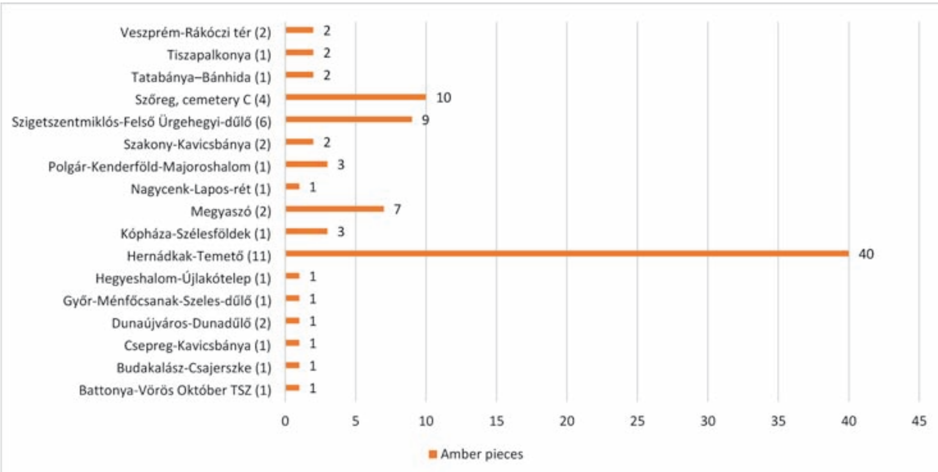

Fig. 12. Number of beads in EBA and MBA burials in Hungary. Number of burials furnished with amber in a particular cemetery given in brackets next to the site name

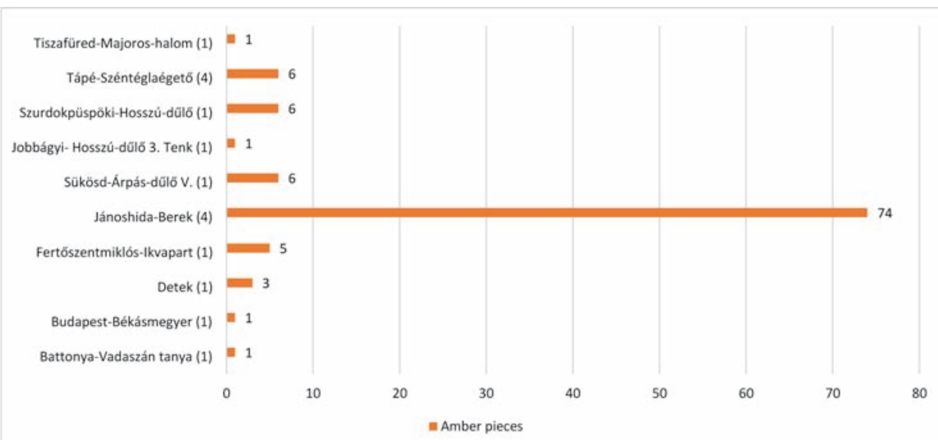

Fig. 13. Number of beads in LBA burials in Hungary. Number of burials furnished with amber in a particular cemetery given in brackets next to the site name

Fig. 14. Hoard no. 2 from Jászdózsa-Kápolnahalom tell settlement (photo: Péter Makrai)

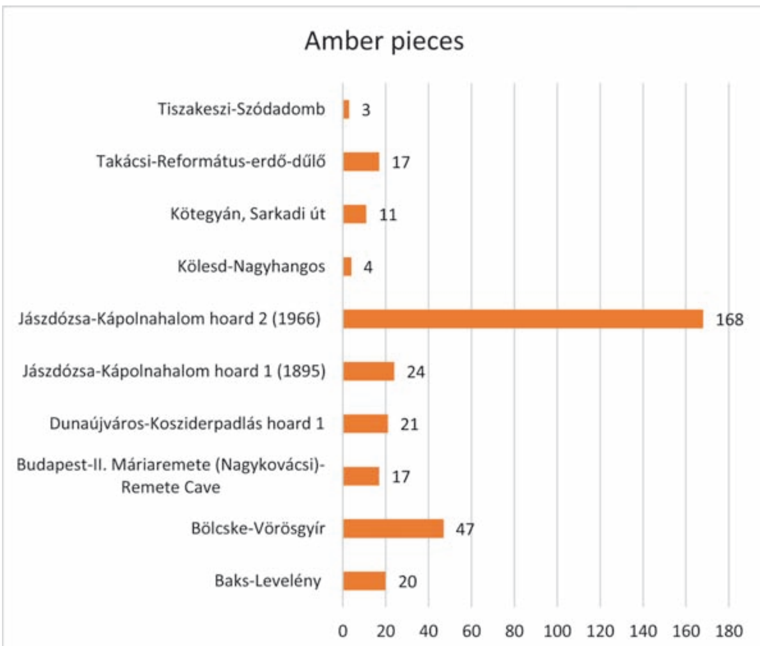

Fig. 15. Number of amber beads in MBA hoards in Hungary

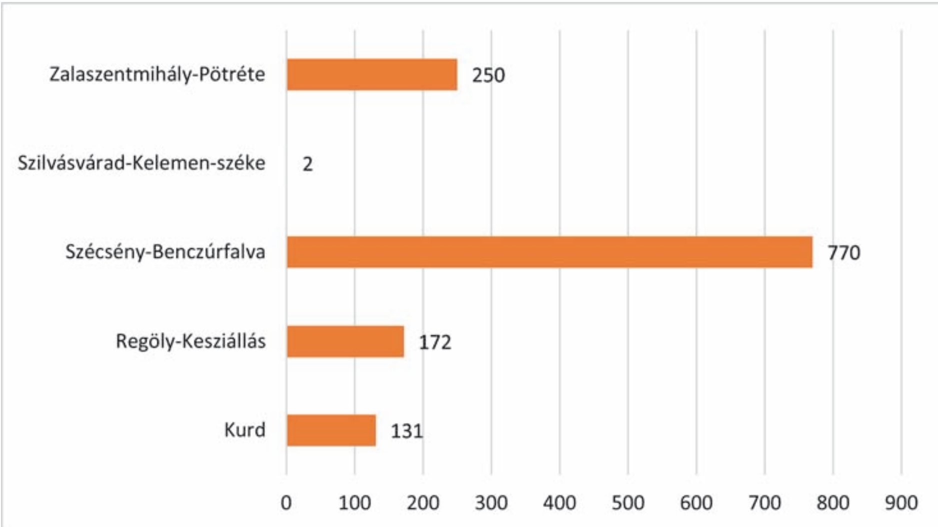

Fig. 16. Number of amber beads in LBA (Urnfield period) hoards in Hungary

time. Only those graves for which the number of amber finds was given in any number were taken into account.

On the basis of the available information, it can be concluded that amber was more often a part of female (11 cases) than male burials (6 cases). It should be emphasized that the number of anthropologically examined burials is relatively small. However, the trend of more frequent deposition of amber in female graves is also noticeable in the case of larger data collections, such as the cemeteries in Slovakia of Jelšovce and Nižna Myšľa (Bátora 2000; Jaeger *et al.* 2023). In general, the number of beads furnishing individual burials is relatively low, and only in exceptional cases (in all phases of the Bronze Age) were ornaments consisting of dozens of pieces discovered (Figs 12 and 13).

Amber beads appear in hoards during the MBA in Hungary, in the hoard no. 2 at Jászdózsa in outstandingly high number (Fig. 14), which can be dated to the MBA 1-2 period based on the stratigraphy of the tell settlement (Stanczik and Tárnoki 1992, 124, 125, Abb. 368. 2-10; Csányi *et al.* 2000, 154, Abb. 5.2).

At the end of the Middle Bronze Age, amber beads are a common element of the hoards (Fig. 15). At the same time, it should be noted that no hoard containing amber beads is known from the study area, which could be associated with the Tumulus culture. Another peak is represented by later hoards related to the Urnfield period. Although they represent a small group of finds, the vast majority contained several hundred amber beads (Fig. 16).

8. CONCLUSIONS

The new information presented above about Bronze Age amber finds in Hungary concerns the following aspects: 1) spatial distribution, 2) absolute chronology, 3) context of deposition of amber objects, 4) form of amber objects and 5) Baltic origin of the raw material.

The context of deposition of the earliest finds associated with the Early Bronze Age cannot be defined very precisely within the framework of absolute chronology. Although it should be noted that radiocarbon dating is known from some of the sites where amber finds have been discovered, which makes it possible to determine the chronological framework of their development: three sites can be dated to EBA 2: Budakalász, Csepreg, Szigetszentmiklós and four sites can be dated between EBA 3 – MBA 1-2: Hegyeshalom, Kópháza, Százhalombatta, Szőreg (see Appendix 1).

The distribution of amber artefacts in the area of present-day Hungary shows a certain dynamics over a long period from the Early Bronze Age (Bell Beaker), through the Middle Bronze Age, *i.e.*, the period of development of the so-called classical tell cultures, to the Late Bronze Age and slightly later period of the development of the Urnfield communities (Fig. 1).

Among them, however, the presence of radiocarbon-dated amber finds from the Bell Beaker cemetery at Szigetszentmiklós-Felső Ürgehegyi-dűlő should be highlighted. Indeed, the collection of discovered ornaments dating to the late 3rd millennium BC included both finds made of Baltic amber and simetite (Jaeger *et al.* forthcoming), a raw material present in the Chalcolithic of the Iberian Peninsula (Murillo-Barroso *et al.* 2018). Simetite may be connected to the mobility of Bell Beaker groups (Olalde *et al.* 2018; Dani and Kulcsár 2021, fig. 8). A much larger number of sites and amber finds in the analysed collection are dated to the first half of the 2nd millennium BC (2000/1900-1500/1450 BC; 29 sites from the Middle Bronze Age in Hungarian terminology, from which nine can be certainly dated to MBA 3; Appendix 1). However, it should be emphasized that their number and spatial distribution probably do not reflect the original knowledge and scale of amber use by local communities. Two important factors contribute to the incomplete picture of the phenomenon under study. The first is the cremation burial rite prevalent in most of the study area during this period. The second factor, on the other hand, is the imperfectness of the excavation techniques used in the study of settlements, especially those with complex stratigraphy (tells and multi-layered settlements). Sensitive to post-depositional factors and high temperature, amber, on the one hand, is rarely preserved in cremation graves, while, on the other hand, it is not easy to identify in sedimentary layers without special techniques, such as flotation.

In the Late Bronze Age (in Hungarian terminology; after 1500/1450 BC), the presence of amber finds in both burial furnishings and hoards (15 sites; Appendix 1) testifies to the availability of the raw material at a time when changes in the distribution of amber are evident across Central Europe. Thus, communities in the study area acquired amber regardless of the observed transformations in the system of exchange routes for this raw material. The Late Bronze Age is notable for the relatively small number of hoards with amber, which, however, contained large quantities of amber beads. A similar situation can be seen in the period of development of Urnfields. After 1200 BC, only four hoards with amber are known from the study area, but they contained a very large number of beads.

The information on absolute chronology presented in this study, while still scarce, allows us to draw two basic and important conclusions. The first of these points unequivocally to the access and presence of amber in the study area over a long period reaching from the end of the 3rd millennium BC to the Urnfield period. The earliest finds (from EBA and MBA 1-2 phases according to Hungarian Bronze Age terminology) can be connected to the main trade routes along the Danube and the Tisza, as well as to the close relationship of the Únětice population with the Gáta-Wieselburg communities (living in the vicinity of the northwestern gateway of the Carpathian Basin; Krenn-Leeb 2011, 23, 24, fig. 21). We can assume that amber reached the area of present-day Hungary from regions located north of the Carpathians and the Alps, along with the steady development of complex exchange networks of the 2nd and late 2nd millennium BC centred around the acquisition of raw materials for metallurgical production (copper, tin, finished bronze and gold products). The Únětice and Maďarovce related pottery and metal finds in the northern part of western Hungary, and also the vessels and characteristic metal ornaments of the Transdanubian Encrusted Pottery culture in southwestern Slovakia, and also the strong connections of the Otomani/Füzesabony cultural complex with Únětice metallurgical zone prove these contacts (Kiss 2002; Czebreszuk 2009, pl. II. 1; Kiss 2011, fig. 3; Fischl and Kiss 2015, fig. 4). The direction of these connections can be clearly associated with the Slovakian copper ore sources, where Bronze Age mining in the Špania Dolina area is documented during the period of the Únětice culture (Žebrák 1995; Czajlik 2012; Modarressi-Tehrani *et al.* 2016; earlier use of this mine can be dated to the period of the Copper Age Ludanice culture; see also Siklósi *et al.* 2023) (Fig. 17).

The second conclusion relates to the relatively numerous group of amber sites and finds that date to the period before 1700/1600 BC. Based on the relative dating of the Early and Middle Bronze Age find assemblages and available radiocarbon dates, we can state that at least around 17 of the 50 Hungarian Bronze Age sites with amber finds (more than half of the amber related sites from the EBA-MBA period) can be dated before 1700/1600 BC. Based on the number of finds (280 pieces) these are more than 50% of the Early and Middle Bronze Age beads (486 pieces). This reflects the significant stages of using this raw material in the first half of the 2nd millennium BC before and during the apogee of dispersion of amber artefacts in Central Europe. The finds from Nagycenk, Hegyeshalom, Kópháza and Szakony are related to the Gáta-Wieselburg style, which can be treated to some extent as a peripheral phenomenon, culturally related to the tradition of Central European Únětice style. Transdanubian Encrusted Pottery, Vatya, Füzesabony

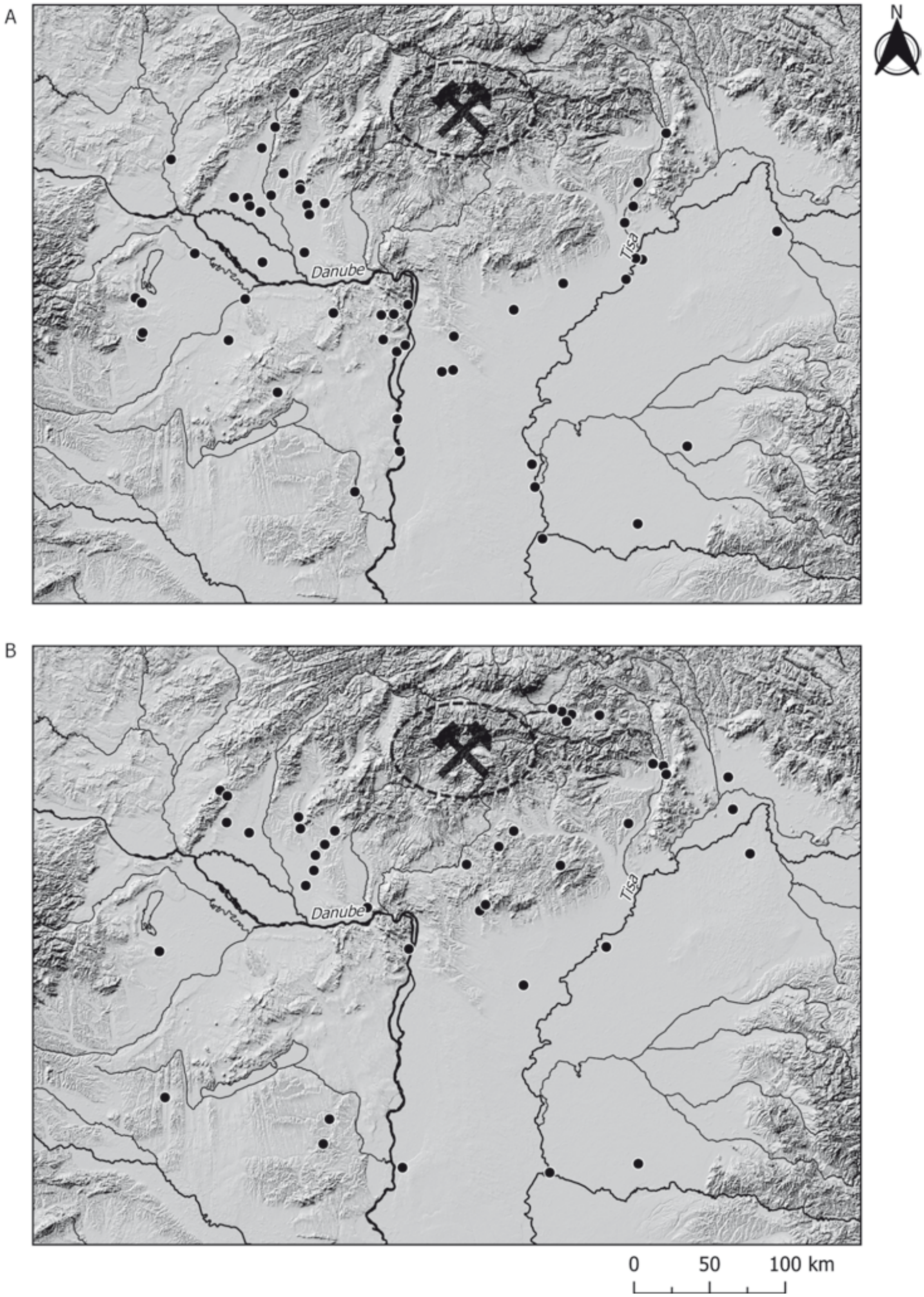

Fig. 17. Distribution of amber finds from the EBA and MBA (map A) and from the LBA (map B) in relation to the copper-bearing areas of today's Slovakia

and Maros culture amber finds, however, can be connected to a wider trade activity. The accumulated information seems to cast doubt on the proposed model of a kind of monopoly of the Únětice culture, which, thanks to its complex political and military structure, would have had the ability to fully control the flow of Baltic amber and block its penetration into the Carpathian Basin (Meller 2017). On the one hand, this is contradicted by finds from both Hungary and Slovakia, which can be dated to the period of the Classical Únětice culture (Jaeger *et al.* 2023). On the other hand, what draws attention is a very numerous group of finds in the form of imports of bronze objects, and stylistic inspirations in ceramics testifying to the bidirectional relations of the areas of the Únětice culture and the Carpathian Basin. A special case in this context appears to be the Vatya culture's multilayered site at Kakucs-Turján in Central Hungary, where pottery forms representing imitations and imports of neighbouring styles were discovered within one of the huts, including a cup alluding to the stylistics of the classic Únětice cup (Jaeger 2018; Staniuk *et al.* 2022, 8, fig. 4, 30). Significantly, bronze, copper, gold and Baltic amber objects were also discovered at the same site. These provide strong evidence of very extensive (in terms of cultural and geographic distance) relationships being built by local Bronze Age communities in the territory of present-day Hungary (Sherratt 1993; Kiss 2011, fig. 6; Czebreszuk 2013, fig. 5; Fischl and Kiss 2015, fig. 4).

As in other areas of Central Europe, amber was most often discovered in burial equipment (Jaeger *et al.* 2023). Less frequently, the raw material was part of hoards of metal

Fig. 18. Finds from Tiszakeszi-Szódadomb hoard (after Fischl 2014)

objects. It should be noted, however, that in the latter, amber is relatively often present in the form of necklaces consisting of a very large number of beads. On the other hand, single beads dominated in the equipment of burials, being elements of ornaments combined with beads/pendants made of other raw materials. In this context, the area of present-day Hungary does not differ from that of neighbouring Slovakia, where amber was most often combined with pendants made of animal teeth or boar tusks, faience and small metal elements such as bronze spirals. Such examples are known from hoards in Jászdózsa (Fig. 14) and Tiszakeszi (Fig. 18) (Csányi *et al.* 2000; Fischl 2014; Jaeger *et al.* 2023). In both Slovakia and Hungary, amber was primarily used to furnish female burials, although in the case of the latter area it should be noted the very small number of anthropological analyses available. There is also insufficient information to conclusively determine the relationship linking the presence of amber to a specific age group of the deceased or their status during life. In Battonya, Hegyeshalom, Polgár, Sükösd, Szakony, Szőreg and Tiszafüred amber beads were discovered beside female individuals, however, in Budakalász, Csepreg and Nagycenk burials with amber grave goods belong to male individuals (see Appendix 1).

In the collection of amber finds from present-day Hungary, we are dealing primarily with beads. The vast majority of Middle Bronze Age beads were flattened globular and disc beads known from other areas of Central Europe (Czebreszuk 2011; Jaeger *et al.* 2023). However, it is important to note the change that occurred in the Late Bronze Age. In the later finds of the analysed collection there appeared not only examples of unique shapes (Jánoshida and Sükösd), but also new types of beads (truncated biconical and flat disc beads), which were not produced in earlier periods (Fig. 6). There are only two cases with irregular pieces of amber lumps among the finds (in burials from Csepreg and Tiszafüred) that could be considered as raw material prepared for processing (semi-finished product). From the study area we do not have information on a site within which remains of amber bead production were discovered. Such finds are still rare and for the time being allow us to assume that amber reached most areas of Central Europe in the form of finished products (beads). Ernée (2016, 94) mentions pieces of amber raw material for bead processing from Hosty (South-Bohemia), from where a typical cup of the Transdanubian Encrusted Pottery is also known (Kiss 2012b, fig. 42, fig. 43.7), as signal of contacts between South Bohemian Únětice groups and the western part of the Carpathian Basin.

Formerly known and the spectral analyses published here from 12 sites performed for some of the finds allow us to unequivocally state that the basic raw material in the research area was Baltic amber. Thus, the information presented confirms the results of research already performed earlier (Beck and Sprincz 1981). As mentioned in the introduction, the precise origin of succinite known from many different natural sources cannot be clearly indicated on the map using spectral methods. However, it seems most likely that the amber used by local Bronze Age communities came from areas of Western Pomerania and/or the Scandinavian coast. In the collection of finds from present-day Hungary from the Middle Bronze Age, the relatively large number of beads discovered as elements of metal hoards draws special attention. Amber was found in deposits of the types characteristic for the area and the Middle Bronze Age: Tolnanémedi, Hajdúsámson-Apa and Koszider. The latter may be one of the additional arguments in the discussion on the northern (Baltic) provenance of amber. Hoards of the Koszider type, with a specific composition, containing both Carpathian and Nordic imports, are known from Western Pomerania in Poland. They should be interpreted as clear evidence of interactions taking place within the communities inhabiting the area between southern Scandinavia and the Carpathian Basin (Vandkilde 2014).

Acknowledgements

The authors would like to thank Tamás Czuppon, János Gömöri and Attila Mrenka for their help providing amber and radiocarbon samples for analyses. We are grateful for Attila Ősi for the ajkaite sample from Iharkút, and Bálint Savanyú for the information about amber beads excavated in Fertőszentmiklós. We owe special thanks for the photos made by Péter Hámori (HUN-REN Research Centre for the Humanities), as well as Károly Kozma and Péter Makrai (Damjanich János Museum, Szolnok).

This article was prepared under grant no. 2015/17/D/HS3/00704, funded by the National Science Centre (Poland), supported by the Momentum Mobility research project (LP 2015-3) hosted by the Institute of Archaeology, HUN-REN Research Centre for the Humanities, granted by the Hungarian Academy of Sciences and by the Immortal Oak grant (2020/33) of the Wacław Felczak Foundation and supported also by the Fritz Thyssen Foundation in the frames of the project "Paneuropäische Phänomene in der Vorgeschichte: Bronzezeitliche Metalldeponierungen in der östlichen Ostseeregion im Licht der interregionalen Fernbeziehungen" (no Az. 20.18.0.011AA).

Appendix 1. Catalogue of Bronze Age amber finds from Hungary and paleontological site with master sample of ajkaite
1 n.d. – no available data; cca.: without AMS radiocarbon data from the site, the estimated absolute dates based on the relative archaeological chronology;
2 D= diameter, L = Length, W = width, We = weight; S = small, less than 10 mm; M = medium, 10 mm to less than 20 mm; L = large, 20 mm or more (according to Sprincz and Beck 1981); 3 If the inventory number is available

No.	Site	Context	Relative chronology	Absolute chronology[1]	Number of amber finds	Type and Size of amber finds (Fig. 6)[2]	Analysis	Place of deposit; Inv. No[3]	References
1	Iharkút	Dinosaur locality	Late Cretaceous	n.d.	1	piece of an amber (ajkait master sample)	Botfalvai *et al.* 2021; this study	n.d.	Botfalvai *et al.* 2021
Early and Middle Bronze Age Finds in Hungary									
2	Baks-Levelény	hoard	MBA 3 Koszider period, Vatya c.	cca. 1600-1500/1450 BC	20	Group III and V D=25 mm, 22 mm	Beck and Sprincz 1981, Table 1 and Fig. 1	Móra Ferenc Musem (Szeged) Inv. No 66.2.19, 19a, 20. 3 beads remained in Museum	Trogmayer 1967, Abb. 3. 1-2, 4; Sprincz and Beck 1981, 206-207; Mozsolics 1988, 51.
3	Battonya-Vörös Október TSZ	Grave No 68; inhumation burial of a maturus woman	MBA 1-2 Maros/Mureş c.	site dated to 2000-1700 BC based on 16 radiocarbon dates after Allentoft *et al.* 2015; O'Shea *et al.* 2019	1	Group IXA D= cca. 20 mm	Beck and Sprincz 1981, 208 (unbpublished)	Munkácsy Mihály Museum (Békéscsaba); Inv. No (see Szabó 1999, 26)	Sprincz and Beck 1981, 208; Szabó 1999, 38-39, Abb. 22. 68/2; O'Shea *et al.* 2019, Table 2, Fig. 4.
4	Bölcske-Vörösgyír	hoard	MBA 3 Koszider phase, Vatya c.	cca. 1600-1500/1450 BC	47	Group IB, III, IV, VIIB D=11-32 mm	-	Hungarian National Museum (Budapest) Inv. No 1883.52.1-9.	Wosinsky 1896, 395-396; Mozsolics 1967, 131, Taf. 34, 7-43; Sprincz and Beck 1981; Kovács 1994; Kiss 2012b, 100, 102
5	Budajenő-Hegyi-szántók	settlement	MBA 2-3 Vatya III-Koszider phase	cca. 1800/1700-1500/1450 BC	1	fragment	-	Ferenczy Museum Centre (Gödöllő)	Repiszky 2004, 184; Gucsi and Szabó 2018

6	Budakalász-Csajerszke	Grave No 1025; urn burial of a 23-30 year-old male	EBA 2 Bell Beaker c.	site dated between 2580-1780 cal BC; based on 10 radiocarbon dates: Czene 2017, Fig. 17; Olalde *et al.* 2018	1	probably Group I D=9 mm	Horváth 2017, Fig. 12.46	Ferenczy Museum Centre (Gödöllő); Inv. No 2005.14.1025.	Horváth 2017; Czene 2017; Olalde *et al.* 2018
7	Budapest-II. Máriaremete (Nagykovácsi)-Remete Cave	hoard	MBA 3 Koszider phase, Vatya c.	cca. 1600-1500/1450 BC	17	Group IB, III, IV, VIIB D=10-20 mm	this study	Budapest Historical Museum Inv. No 73.2.1-17.	Gáboriné Csánk 1984; Mozsolics 1988, 28, Abb. 4
8	Csepreg-Kavicsbánya	Grave No 3 inhumation burial of a genetically identified male child aged 4-5	EBA 2 Somogyvár-Vinkovci or Leitha-prodersdorf c.	2270-2040 cal BC; (Szécsényi-Nagy *et al.* forthcoming)	1	irregular piece of an amber	-	Savaria Museum (Szombathely) Inv. No 69.20.	Károlyi 1975, 173-174; Ilon 1996, 19-20, Fig. 7, Pl. III. 12; Szécsényi-Nagy *et al.* forthcoming
9	Csongrád-Felgyő	settlement pit	MBA 2-3 Vatya III-Koszider c.	cca. 1800/1700-1500/1450 BC	1	Group VIII D=16 mm	-	Katona József Museum (Kecskemét) Inv. No 66.6.45.	Sprincz and Beck 1981, 481, Fig. 4. 16; Fischl and Guba 2010, 47. kép 6.
10	Dunaújváros-Dunadűlő	Grave Nrs 251, 948	MBA 1 Vatya I c.	cca. 2000/1900-1800/1700 BC	47	Group II and III D=10, 12 mm	-	Intercisa Museum (Dunaújváros)	Bóna 1975, 56; Sprincz and Beck 1981, 478, 484, Fig. 2.5, Table 2; Stahl 2006, 108; Vicze 2011, 108, Pl. 37. 9, Pl. 99. 12
11	Dunaújváros-Kosziderpadlás	Hoard No 1	MBA 3 Koszider phase, Vatya c.	cca. 1600-1500/1450 BC	21	Group IB, IIA, III, V, VI, VIIB D=9-33 mm	-	Intercisa Museum (Dunaújváros)	Mozsolics 1967, 134, Taf. 48, 1-20; Sprincz and Beck 1981, 484, Table 2; Stahl 2006, 108
12	Encs-Mérnöki-teleptől délre	Cemetery with 1093 graves	MBA 1-3 Füzesabony c.	cca 2000/1900-1600/1500 BC	2	n.d.	-	Herman Ottó Museum (Miskolc)	Mengyán and Dávid 2018; Mengyán and Dávid 2019

No.	Site	Context	Relative chronology	Absolute chronology[1]	Number of amber finds	Type and Size of amber finds (Fig. 6)[2]	Analysis	Place of deposit; Inv. No[3]	References
13	Füzesabony-Öregdomb	settlement	MBA 2-3 Füzesabony B-C period, Koszider	site dated between 1800-1500 cal BC; based on dates Szathmári *et al*. 2019	1	Group VIIB, D=12 mm	Horváth *et al.* 2017	Hungarian National Museum (Budapest) Inv. No 1948.46.68.	Sprincz and Beck 1981, 476, Fig. 4.2, Table 2; Horváth 2013; 2016; Szathmári *et al*. 2019
14	Győr-Ménfőcsanak-Szeles-dűlő	Grave No 33 cremation burial with 35 ceramic vessels	MBA 2-3 Transdanubian Encrusted Pottery c.	cca. 1800-1500/1450 BC	1	probably Group III	-	Rómer Flóris Art and Historical Museum (Győr)	Figler 1996; Melis 2023, 62. ábra a
15	Hegyeshalom-Újlakótelep	Grave No. 5 inhumation burial of an adult woman	EBA 3-MBA 1-2 Gáta-Wieselburg c.	cca. 2100/2000-1700 BC	1	probably Group VI D=11 mm	this study	Hansági Museum (Moson-magyaróvár) Inv. No 65. 4.3.1.	Szathmári 1988, Fig. 8.1-15; Nagy and Figler 2009, 257-258, Fig. 1; Melis 2020a, Fig. 2.13
16	Hernádkak-Temető	Grave Nos 16, 67, 74, 81, 94, 95, 96, 103, 105, 110, 123 (Bóna 1975: Grave Nos 67, 74, 81, 110)	MBA 1-2 Füzesabony A-B period, Füzesabony c.	cca. 2000/1900-1700 BC	40	Group IB D= 9 mm	Horváth 2017; and this study	Hungarian National Museum (Budapest) Inv. No 1952.3.32.	Bóna 1975, 148, 159-160, Taf. 164. 5-6, 22, 27; – Sprincz and Beck 1981, 478, 484, Fig. 2. 5, Table 2; Schalk 1992, 139, 183-188, Abb. 54; Stahl 2006, 108-109; Horváth 2017
17	Jászdózsa-Kápolnahalom	Hoard No 1 (from the settlement, 1895)	MBA 1-2 Hatvan c.	cca. 2000/1900-1700 BC	24	Group VIIB	-	Hungarian National Museum (Budapest) Inv. No 125.1895.191.	Hampel 1896; Mozsolics 1967, 142; Sprincz and Beck 1981, Fig. 4. 2, Fig. 7; Stahl 2006, 109; Tárnoki 2015, 17

17	Jászdózsa-Kápolnahalom	Hoard No. 2 (from the settlement, 1966, Level 11, upmost Hatvan layer)	MBA 1-2 Hatvan c.	site dated between 2450 and 1750 cal BC (based on 8 dates for early and late Hatvan period, excluding Koszider phase)	168	probably Group II, III, VI D= 4-16 mm	this study	Damjanich János Museum (Szolnok) Inv. No 76.1.40.	Stanczik and Tárnoki 1992, 124-125, Abb. 368. 2-10; Csányi *et al.* 2000, 154, Abb. 4-6, Abb. 5. 2; Stahl 2006, 109 erroneously mentions 10 amber beads; Tárnoki 2015
18	Kakucs-Turján	settlement from 8, and 9-11 phases	MBA 2-3 Vatya III-Koszider, Vatya c.	site dated between 1800-1650 cal BC	5	Group IB or II D=7 mm	Jaeger 2016; Jaeger *et al.* 2018; Jaeger *et al.* 2020	Ferenczy Museum Centre (Gödöllő)	Jaeger 2016; Jaeger *et al.* 2018
19	Kópháza-Szélesföldek	Grave No S-1625 inhumation burial	EBA 3-MBA 1-2 Gáta-Wieselburg c.	cca. 2100/2000-1700 BC	3	different types, but not identifiable based on the excavation report	-	Rómer Flóris Art and Historical Museum (Győr)	Ujvári 2019, 20-21. 7-9
20	Kölesd-Nagyhangos	hoard	MBA 3 Koszider phase, Transdanubian Encrusted Pottery c.	cca. 1600-1500/1450 BC	4	probably Group VIIB, IXC, X	-	Hungarian National Museum (Budapest) Inv. No 1903.11, 1903.13.	Hampel 1903, Abb. 427, 430. 3-6; Mozsolics 1967, 151-152; Stahl 2006, 227.
21	Kötegyán-Sarkadi út (Gyepespart)	hoard	MBA 2-3 Gyulavarsánd c.	cca. 1800-1500/1450 BC	11	Group IB, II, III, IV, VIIC	Horváth *et al.* 2017	Hungarian National Museum (Budapest) Inv. No 1965.32.11.	Kovács 1968, 210, Abb. 2.9; Mozsolics 1967:145-146; Sprincz and Beck 1981, 480, 483, Table 2; Stahl 2006, 109; Horváth 2017, Fig. 13, A.
22	Megyaszó	Grave Nos 95 and 121	MBA 2-3 Füzesabony B-C, Füzesabony c.	cca. 1800-1500/1450 BC	7	Group IB, VIIB	Horváth 2017, and this study	Hungarian National Museum (Budapest) Inv. No 1952.1.152, 188.	Bóna 1975, 148, 160, Taf. 189.9; Schalk 1992, 139, note 322; Schalk 1994; Horváth 2017, Fig. 13, E

No.	Site	Context	Relative chronology	Absolute chronology[1]	Number of amber finds	Type and Size of amber finds (Fig. 6)[2]	Analysis	Place of deposit; Inv. No[3]	References
23	Mende-Leányvár	settlement	MBA 3 Koszider phase, Vatya c.	cca. 1600-1500/1450 BC	1	Group VIII	-	Hungarian National Museum (Budapest)	Kovács 1975; Sprincz and Beck 1981, 481, Fig. 4.17, Fig. 7, Tab. 2; Horváth 1999, Table 1; Stahl 2006, 227.
24	Nagycenk-Lapos-rét	Grave No. 61 inhumation burial of a male, aged 48-54	MBA 1-2, Gáta-Wieselburg c.	1894-1697 cal BC		probably Group VI D=18 mm	this study	Museum of Sopron Inv. No 2006.1.61.3	Gömöri *et al*. 2018, 24, Fig. 14.61/3
25	Ópályi-Tangazdaság	Grave inhumation burial of a male with vessels, necklace (bronze spirals and amber beads), axe and dagger	MBA 3, Koszider phase, Füzesabony c.	cca. 1600-1500/1450 BC	n.d.	n.d.	-	Jósa András Museum (Nyíregyháza)	Németh 1966, 85-88, Abb. 1.1, 2. 5a-b; Mozsolics 1973, 165; Sprincz and Beck 1981, Fig. 8; Horváth 1999
26	Polgár-Kenderföld-Majoroshalom	Grave No. 301 inhumation burial of a senilis woman	MBA 3, Koszider phase, Füzesabony c.	cca. 1600-1500/1450 BC	3	Group II-VII?	-	Déri Museum (Debrecen)	Dani *et al.* 2004, 95, Abb. 14. 1.
27	Sóskút-Barátház (26/4)	settlement from mixed mass finds	MBA 1-3, Vatya I-III, Koszider phase, Vatya c.	site dated between 1900-1600 cal BC	1	fragment	-	Ferenczy Museum Centre (Gödöllő)	Earle *et al.* 2012; Kulcsár *et al.* 2022

28	Szakony-Kavicsbánya	Grave Nos 2 and 6 inhumation burial No. 2 belongs to a 22-25 year-old female; burial No. 6 and 7 was a consecutive burial of a female (Individual I) aged 45-60 and an unidentified Individual II aged 8-30, with only a couple of bone fragments and an amber bead	MBA 1-2 Gáta-Wieselburg c.	1924-1743 cal BC (one radicarbon date from Grave No. 1)	2	Grave No. 2: probably Group VI, D=10 mm Grave No. 6: probably Group I or VII, D=10 mm	-	Museum of Sopron Inv. No 60.66.2, 60.70.1.	Ilon 1996, 25, Fig. 5, Table 4, Table 5; Melis 2019, Fig. 5, Fig. 9, 3.
29	Százhalom-batta-Földvár	settlement several layers	EBA 3-MBA 1-2 Nagyrév and Vatya c.	cca. 2100/2000-1700 BC	3	n.d.	Horváth 1999	Matrica Museum (Százhalombatta)	Horváth 1999; Vicze 2002, 137
30	Sziget-szentmiklós-Felső Ürgehegyi-dűlő	Grave Nos 84, 162, 176, 532, 539, 609	EBA 2 Bell Beaker c.	Grave 539: 2560-2470 cal BC, Grave 176: 2340-2210 BC	9	Group I, IB, and discoid beads without perforation, and unique lozenge-shaped beads	this study	Ferenczy Museum Centre (Gödöllő) Inv. No. 2009.11.84.4. 2009.11.162.23. 2009.11.176.2-3. 2009.11.532.1-3. 2009.11.539.9. 2009.11.609.4.	Patay 2013

No.	Site	Context	Relative chronology	Absolute chronology[1]	Number of amber finds	Type and Size of amber finds (Fig. 6)[2]	Analysis	Place of deposit; Inv. No[3]	References
31	Szőreg-C	Grave Nos 2 and 114 , 181, 211 inhumation burial Nos 2 and 114 are adultus woman	EBA 3-MBA 1-2 Maros/Mureş c., Szőreg phase 2-3	early phase dated between 2100-1800 cal BC the whole site dated between 2100-1700 cal BC based on 16 dates in Allentoft *et al.* 2015; O'Shea *et al.* 2019	10	Group IB, III, IV, VIIB D=15, 13.8, 11 mm	Beck and Sprincz 1981, 207, Table 1	Móra Ferenc Museum (Szeged) Inv. No 53.115.599 (1), 599(2), 581, 625.	Bóna 1975, Taf. 94-127, Taf. 128. 5-10, Taf. 129. 1-3, 5-7, Taf. 130. 1, 3, 5; Sprincz and Beck 1981, 476, Fig. 2. 8; Fig. 3. 9, 13; Fig. 4. 1, 5, 7; Fischl 2000, 80; Allentoft *et al.* 2015; O'Shea *et al.* 2019, Fig. 2.
32	Takácsi-Református-erdő-dűlő	hoard	MBA 1-2, Transdanubian Encrusted Pottery c.	cca. 2000/1900-1700 BC	17	n.d.	-	Esterházy Károly Museum (Pápa)	https://papa-ma.papaesvideke.hu
33	Tatabánya-Bánhida (Dinnyeföldek)	Grave No. 18	MBA 1-2 Transdanubian Encrusted Pottery c.	cca. 2000/1900-1700 BC	2	n.d.	-	Kuny Domokos Museum (Tatabánya)	Cseh 1996, 28; Cseh 1999, 32, Pl. 1. 1, Pl. 2. 1, Pl. 5. 5; Kiss 2012b, 183, 260
34	Tiszapalkonya-Erőmű	Grave No. 7 or 8	MBA 3, Koszider phase, Füzesabony c.	cca. 1600-1500/1450 BC	2	Group IX or X?	-	Herman Ottó Museum (Miskolc) Inv. No. 60.4.1-41.	Kovács 1979, 60-62, Abb. 4. 5; Horváth 1999
35	Tiszakeszi-Szódadomb	hoard	MBA 3, Koszider phase, Füzesabony c	cca. 1600-1500/1450 BC	3	Group IB, II, III D=15-20 mm	this study	Herman Ottó Museum (Miskolc) Inv. No 53.432.2-4.	Bóna 1957, 214, 216, 233, Taf. 4; Mozsolics 1967, 87, 170; Sprincz and Beck 1981; Fischl 2014

36	Újhartyán-Vatya	cemetery (no grave number known)	MBA 2-3, Vatya II-III.,Vatya c.	cca. 1800/1700-1500/1450 BC	6	n.d.	-	Katona József Museum (Kecskemét)	Bóna 1975 Taf. 33, 12-13; Sprincz and Beck 1981, 476, Fig. 7-8; Horváth 1999, Table 1
37	Veszprém-Rákóczi tér	Grave Nos II and XII (creamation burials)	MBA 2-3, Transdanubian Encrusted Pottery c.	cca. 1800-1500/1450 BC	2	Group II or III?	-	Laczkó Dezső Museum (Veszprém) Inv. No 53.5.111.	Éri *et al.* 1969, 243, Site 51/40; Kiss 2012b , 183, Pl. 50.9.
EBA-MBA					**486 pieces**				
Late Bronze Age finds in Hungary									
38	Battonya-Vadaszán tanya	Grave No 1 (inhumation burial)	LBA 1, Tumulus c.	cca. 1500-1400/1300 BC	1	Group IXA D= 20 mm	-	Munkácsy Mihály Museum (Békéscsaba)	Sprincz and Beck 1981, 476, Fig. 5.48; Kállay 1983, 45-47, Fig. 5. 12; Horváth 1999, Table 1; Stahl 2006, 108
39	Budapest-Békásmegyer	Grave No 51 (cremation burial)	LBA Urnfield c.	cca. 1200-1000 BC	1	a large amber disc, Group 1B? D=cca. 20 mm	-	Budapest Historical Museum Inv. No 64.46.192.	Kalicz-Schreiber *et al*. 2010, Abb. 84, Taf. 28. 4
40	Detek	Grave No 6 (cremation)	LBA 1 Piliny c.	cca. 1500-1400/1300 BC	3	Group I A, D=7 mm Group X, D=7 mm and 9 mm	this study	Herman Ottó Museum (Miskolc) Inv. No 63.12. 1-3.	Kemenczei 1968, 170, 174, Fig. 6. 25, Fig. 9-11; Sprincz and Beck 1981, 477-478, Fig. 8, Table 2; Horváth 1999; Stahl 2006, 108
41	Fertőszent-miklós-Ikvapart	Grave No. S340 (inhumation burial)	LBA 1 Tumulus c.	cca. 1500-1400/1300 BC	5	more types, before restoration Group VI, V, III?	-	Rómer Flóris Art and Historical Museum (Győr)	Savanyú 2020; B. Savanyú pers. comm.

No.	Site	Context	Relative chronology	Absolute chronology[1]	Number of amber finds	Type and Size of amber finds (Fig. 6)[2]	Analysis	Place of deposit; Inv. No[3]	References
42	Jánoshida-Berek	Graves Nos 113, 134, 140, 273	LBA 1 Tumulus c.	Grave No. 113: 1500-1406cal BC, Grave No. 140: 1499-1326 cal BC	74	probably Group IA, D=5-8 mm; Group IB, V, VI, D=13-22 mm; a big semi-spherical disc: new type: Group XII, D=54 mm; a triangular, new type: Group XI, L=28 mm, W=21 mm	this study	Damjanich János Museum (Szolnok) Grave No. 113: Inv. No 80.2.48-51, Grave No. 140: Inv. No 81.2.76.	Csányi 1980; Sprincz and Beck 1981, Fig. 8; Horváth 1999, Table 1 (mentions 71 beads); Csányi 2013; 2017, Fig. 5, Fig. 10; Csányi 2019, 50-51.
43	Jobbágyi-Hosszú-dűlő 3. Tenk	Grave No. 158 (Str. No 187) (cremation burial)	LBA 1 Tumulus c.	cca. 1500-1400/1300 BC	1	Group IB D=18.6 mm	-	Dornyay Béla Museum (Salgótarján)	Fülöp and Váczi 2014; Fülöp and Váczi 2016
44	Kurd	hoard	LBA Urnfield c.	cca. 1200-1000 BC	131	Group IA (9 pieces), IB (1),VIIA (4), IXA (S: 7), IXB (76), IXC (27), IXD (4), IXE 2), X (1)	-	Wosinsky Mór County Museum (Szekszárd) Hungarian National Museum Inv. No B25.1933.1-65, 22.18951-278.	Müller 1972 mentions 226 amber beads; Mozsolics 1985, Taf. 26. 3-4; Sprincz and Beck 1981, Fig. 5, Fig, 8, Table 2.
45	Nyírkarász-Gyulaháza	burial mound, excavated in 1901	LBA Felsőszőcs/Suciu de Sus c.	cca. 1500-1400/1300 BC	n.d.	n.d.	-	Jósa András Museum (Nyíregyháza)	Mozsolics 1973, Taf. 67.
46	Regöly-Kesziállás	hoard with bronze, gold and amber finds	LBA Urnfield c. (Ha A1)	cca. 1200-1000 BC	172	Group IA (4 pieces), VIIA (1),VIIB (1), VIIC (3), VIII (1), IXA (S: 7, L: 1), IXB (S: 73, M: 12, L: 1), IXC (S: 38, M: 6), IXD (S: 1, M: 1), IXE (9), (1)	-	Wosinsky Mór County Museum (Szekszárd)	Mészáros 1977, 71, VII. t.; Sprincz and Beck 1981, Fig. 5, Fig, 8, Table 2; Stahl 2006, 110.

47	Sükösd-Árpás-dűlő V.	Grave No.1, inhumation burial of a female aged 20-25;	LBA 1 Tumulus c.	1540-1430 cal BC (95.4%) (Pásztor *et al.* 2022)	6	Group IB, V, D=12 mm new type: Group XI, L=28 mm new type: Group XII, D=35-37 mm	this study	Türr István Museum (Baja) Inv. No 2021.1.42, 45, 97, 150.	Pásztor *et al*. 2022.
48	Szécsény-Benczúrfalva-Majorhegy	Hoard no. 2	LBA Late Piliny-early Kyjatice c. (RBD-Ha A1)	*cca.* 1350-1100 BC	770	Group IA, IB, II, III, IV, V, VI, VIIA, VIIB, VIIC, IXA, IXB, IXC, IXD, IXE D=3 mm-31 mm	-	Hungarian National Museum Forgách-Lipthay Castle Museum (Szécsény) uninv.	Guba and Tankó 2023
49	Szilvásvárad-Kelemen-széke	hoard with bronze ornaments, 2 big amber beads	LBA Kyjatice c.	cca. 1200-1000 BCE	2	Group IXE new type: Group XII; D=?	-	Dobó István Castle Museum (Eger)	V. Szabó 2019, Fig. 168.
50	Szurdokpüspöki-Hosszú-dűlő	Grave No 1 Inf. II child inhumation burial	LBA 1 Tumulus c.	1600-1420 cal BC	6	Group IA, IB, D= 6-8 mm; Group variant of X?, D=24 mm	this study	Hungarian National Museum Forgách-Lipthay Castle Museum (Szécsény) Inv. No 2008.4.3.15, 16.	Guba and Bácsmegi 2009, Taf. 2. 4-5.
51	Tápé-Széntéglaégető C	Grave Nos 184, 215, 412, 666	LBA Tumulus c.	cca. 1500-1200 BC	6	W=17 mm, amber cube, Size: 16×15×15 mm, We=0.8 g (Group V, and one unique cubic ornament	Beck and Sprincz 1981	Móra Ferenc Musem (Szeged) Inv. No 65.1.209, 249	Trogmayer 1975, 46, 52-53, 92, 141, Taf. 16. 2, Taf. 19.7; Taf. 217,7; Sprincz and Beck 1981, Table 2: 184. 2; Csányi 2017, 210; O'Shea *et al.* 2019.

No.	Site	Context	Relative chronology	Absolute chronology[1]	Number of amber finds	Type and Size of amber finds (Fig. 6)[2]	Analysis	Place of deposit; Inv. No[3]	References
52	Tiszafüred-Majoros-halom	Grave No. 342 D 342 inhumation burial belongs to a 22-25 year-old female	LBA 1 Tumulus c.	site dated between 1530-1270 cal BC (Dani *et al.* forthcoming)	1	amber nugget L= 35 mm	-	Hungarian National Museum (Budapest)	Kovács 1975a, 35-36, 55, Fig. 25a-b, Pl. 31.17; Sprincz and Beck 1981, Fig. 5.45, Table 2; Hajdu 2012, 2. táblázat; Csányi 2017, 210; Dani *et al.* forthcoming
53	Zalaszent-mihály-Pötréte	hoard hoard found in 1967 during peat-bog mining: 250 amber beads and 247 bronze artifacts, textile remains: ceremonial dress (pontificals)	LBA Urnfield c. (Reinecke BD-Ha A1)	cca. 1200-1000 BC	250	Group IA (67 pieces), IB (1),VIIA (10), VIIC (4), IXA (S: 10, M: 6, L: 1), IXB (S=81, M= 42, L=2), IXC (S=13, M= 6), IXD (1), IXE (2), X (1); largest: 43×37×19 mm, W=3 mm, D=4 mm	-	Göcseji Museum (Zalaegerszeg) Inv. No 69.11.1.	Müller 1972, Fig. 5; Sprincz and Beck 1981, Fig. 5, Fig. 8, Table 2; V. Szabó 2019, 32, Fig. 18.
LBA					**1429 pieces**				

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3432

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A MULTIDISCIPLINARY ASSESSMENT OF DISABILITY IN EARLY MEDIAEVAL CULMEN, POLAND

ABSTRACT

Matczak M. D., Kozłowski T. and Chudziak W. 2023. A multidisciplinary assessment of disability in early mediaeval Culmen, Poland. *Sprawozdania Archeologiczne* 75/2, 187-223.

This study bridges a gap between palaeopathology and the textual analysis, with the aim of investigating which diseases and pathological lesions could have been associated with disability in Early Mediaeval Culmen in Poland. We used palaeopathological methods to examine 661 skeletons, as well as reviewed Early Mediaeval hagiographies and chronicles. The textual analysis revealed three types of disability: mobility difficulties, an abnormal posture, and blindness, which were also identified in the osteological materials from Culmen. Eight skeletons display lesions corresponding to Pott's disease, poliomyelitis, leprosy, osteomyelitis, multiple myeloma, and amputation, which were identified as disabilities. The prevalence of disability depended on the age, with adults affected more frequently. This interdisciplinary study is the first to analyse people with disabilities on a population level, using textual sources and osteological materials from mediaeval Central Europe. The protocol for research on disability in archaeology presented by us may be applied to other archaeological contexts, also from sites outside Poland, from historical periods of time.

Keywords: disability studies, bioarchaeology, biohistory, palaeopathology, Middle Ages
Received: 18.03.2023; Revised: 26.06.2023; Accepted: 21.12.2023

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1. INTRODUCTION

All societies acknowledge the existence of physical and behavioural differences, but their attitude towards them varies across cultures (Hubert 2000a). In Western culture, three main models of disability were developed (Barnes and Mercer 2010; see also Byrnes and Muller 2017a). The first of them, the medical model, focuses on disability as a biological impairment and handicap, limiting the proper (*normal*) functioning of a person, and thus resulting in their inability to work, social exclusion and stigmatisation.

The second one, the social model, was developed in the 1960s, when people with disabilities started highlighting the lack of adjustment of the able-bodied society to the needs of those with different (*dis*-abled) bodies (Cross 1999). In 1976, the Union of the Physically Impaired Against Segregation defined impairment as the lack of 'part or all of a limb, or having a defective limb, organ or mechanism of the body', and disability as 'the disadvantage or restriction of activity caused by a contemporary social organisation which takes no or little account of people who have physical impairments and thus excludes them from participation in the mainstream of social activities' (Barnes and Mercer 2010, 30). This was an important step in changing society's attitudes towards people with disabilities.

The mixed (multifactorial) model is a response to medical and social models of disability (Beaudry 2020). It indicates that disability results from many factors (individual and environmental), and includes different dimensions of disability within one definition. A well-known example of the multifactorial model is the WHO's 'biopsychosocial model' (2002, 10), in which 'disability and functioning are viewed as outcomes of interactions between health conditions (diseases, disorders and injuries) and contextual factors' (environmental and personal factors). We argue that it is impossible to ignore the biological factor of disability, especially in bioarchaeology, which focuses on the physical dimension of impairment. On the other hand, the archaeological context and the mentality of the epoch must be taken into account in the (re)construction of the disability experience. Therefore, the multifactorial model seems to be the most adequate approach in bioarchaeological studies.

Disability studies emerged as an academic response to the recognition of the rights of people with disabilities, and represent an interdisciplinary field merging sociology, history, and anthropology, including bioarchaeology and palaeopathology (Goffman 1986; Finlay 1999; Kudlick 2003; Barnes and Mercer 2010; Ginsburg and Rapp 2013). Bioarchaeological studies on disability developed with research conducted on Shanidar Neanderthals, a male called Romito 2 from the Italian Late Upper Palaeolithic, and a male from Early Archaic Florida, from the perspective of compassion and care (Solecki 1971; Trinkaus 1983; Frayer *et al.* 1987; Dickel and Doran 1989). Dettwyler (1991) criticised these studies and argued that health-challenged individuals survived not because of compassion and care, but because they could contribute to their societies. Since this seminal paper, the interest in disability has decreased, except for a few studies (*e.g.*, Finlay 1999; Hubert

2000b). The interest in disability rose again with the emergence of bioarchaeology of care (Tilley and Oxenham 2012; Tilley and Cameron 2014; Tilley 2015), which resulted in numerous new studies (*e.g.*, Byrnes and Muller 2017b; Tilley and Schrenk 2017; Micarelli *et al.* 2022; see also Matczak *et al.* 2019; Matczak *et al.* 2020).

Bioarchaeologists (*e.g.*, Cross 1999; Finlay 1999; Roberts 2000; Zakrzewski 2014) agree that the perception of disability depends on the cultural context and is related to social norms observed in a given society. Disability is defined on the basis of physical impairments that limit the daily life and functioning of an individual in a significant way, and as a sociobiological status that results from the society's attitude toward a person with disability (Cross 1999; Knüsel 1999; Roberts 2000; Zakrzewski 2014, 2015; Tilley 2015; Boutin 2016). In other cases, disability is inferred when an individual had a significant physical impairment that limited their ability to meet social requirements, and that made them dependant on the care of other people to survive (Tilley and Oxenham 2012; Tilley and Schrenk 2017). Other researchers identify disability when a person was marked as different in the mortuary context (*e.g.*, by being buried in an atypical grave; Palkovich 2012; Lovell 2016). Other scholars emphasise that it is difficult to conclude whether someone was disabled solely on the basis of pathological lesions and the mortuary context (Cormier and Buikstra 2017).

Thus far, the aforementioned ground-breaking studies presented cases of disabled individuals using methods of palaeopathology and mortuary archaeology. Health and diseases in a population were investigated in the socio-cultural context from the perspective of care (*e.g.*, Tremblay Critcher 2017), and the socioeconomic status (*e.g.*, Powell 1988; Robb *et al.* 2001; Peck 2013). Some attempts were made to quantify a physical impairment and investigate disability on a population level (Byrnes 2017; Stodder 2017; Young and Lemaire 2017), and to combine palaeopathology with archival research (Phillips 2017), as well as a review of textual sources from the mediaeval period (Dittmar *et al.* 2023). Archaeological research on disability is characterised by a broad temporal-geographical range, covering *e.g.*, Neolithic France and Vietnam, Bronze Age Bahrain, ancient Egypt and Italy, medieval Europe, and the Americas (Dettwyler 1991; Buquet-Marcon *et al.* 2007; Tilley 2015; Zakrzewski 2015; Boutin 2016; Lovell 2016; Cormier and Buikstra 2017; Micarelli *et al.* 2022).

Studies on disability in mediaeval Poland were also conducted and they addressed this problem on the individual (Matczak and Kozłowski 2017; Matczak *et al.* 2022), and on the population level (Matczak *et al.* 2021). The analysis of disability in textual sources is crucial for the assessment of disability in the archaeological records from the mediaeval period. To date, only an initial assessment of disability in Polish mediaeval sources had been conducted (Matczak *et al.* 2022).

The present study presents a more extensive review, using textual sources and osteological materials on disability on the population level. Our paper presents a study focused on a group of individuals with potential disabilities in Early Mediaeval Poland. This study had the following objectives: (i) to investigate which afflictions could have been perceived as disabilities, using textual sources, together with palaeopathological, ethnomedical and modern clinical studies; (ii) to identify various types of disability, and (iii) to verify if there is a relation between sex and age and disabilities in terms of their prevalence. Therefore, this study not only contributes to the bioarchaeology of disability, but also to biohistory, understood as a field of research that focuses on the biological roots of human social behaviour to explain social processes. Biohistory is the study of the interrelationships between social groups, a health status, and a physical condition. Only when we understand all aspects of life, we can assemble the complete picture of the past, because biological aspects influenced social factors and vice versa. Therefore, biohistory combines the methods from various disciplines, especially history, archaeology, anthropology, and medicine, which, together with bioarchaeology, put it in the context of broadly understood biohumanities.

2. DAILY LIFE IN EARLY MEDIAEVAL POLAND

Disability, disease and various health conditions may impact the functioning of an individual, and their ability to perform various tasks and fulfil social obligations. Disability could be related to sex, age, and a social role. To better understand the impact of disability on the human life, a social role of a given individual in the mediaeval society must be considered. Polish mediaeval society was divided into three main parts: the first included craftsmen, peasants and warriors, the second one consisted of clergy, and the third was formed by nobility, with dukes or a king at the top. Men from the upper classes were knights and dukes. Royals handled political affairs and arranged marriages for their sisters and daughters, to maintain or establish good relations between noble families. For people from the upper classes, an alternative to marriage was to become a nun, a monk, or a priest (Miśkiewicz 2010).

People in cities, strongholds, and settlements surrounding them were responsible for ensuring the comfortable living of the upper classes. Some men in cities were merchants (Miśkiewicz 2010), while others were craftsmen, *e.g.*, saddlers, tinsmiths, blacksmiths, and potters. They tanned animal skins and wove cloth. Men felled trees and built houses and other buildings. Peasants constituted a significant part of the mediaeval society, and cultivated cereals (wheat, barley, rye, and oat), vegetables and fruit. They also got food by fishing, hunting, collecting honey, and breeding animals (*e.g.*, cattle, pigs, and sheep). They were obliged to deliver a part of their crops to landowners as the tithe. A special group among the men were warriors responsible for defending settlements and fighting in wars.

Women married early and their lifespan was short due to high mortality rates at childbirth (Kozłowski 2012). They were supposed to take care of the household (*e.g.*, cook meals) and raise children. Women were responsible for cultivating vegetables, breeding animals, weaving fabrics, and making ceramics (Miśkiewicz 2010).

Children from the upper classes in cities received schooling, while those in villages learned occupational and domestic skills from their parents, and worked and helped them to earn a living from their earliest years (Penny-Mason and Gowland 2014). In their free time, children played games (Miśkiewicz 2010). The hair-cutting ritual at the age of seven was a time of the transition from childhood to youth for boys (Delimata 2004a). For girls, the transition from childhood to youth might have happened at the same age; however, we do not have any evidence for that. The transition to adulthood occurred at the age of 12-15 years (Delimata 2004b).

3. MATERIALS AND METHODS

3.1. Materials

Chronicles and hagiographies are some of the best sources for assessing disabilities and diseases in mediaeval times. Two chronicles were selected for the textual analysis. The first (Anonim tzw. Gall 2008), is from the 12th century and it was written by an anonymous and probably non-Polish author, traditionally referred to as 'Gallus' (a person from Gaul, or France). The second is from the 13th century, and was written by Master Vincentius called Kadłubek from Cracow (Mistrz Wincenty 2008). The hagiography of Saint Hedwig, a Duchess of Silesia, was written shortly after her death before the end of the 13th century. The original source was not preserved; however, its copy was included in *Vita beate Hedwigis* (*Legenda świętej Jadwigi* 1993) from the 14th century. These sources are dated to the same period as the archaeological and osteological materials used in this study.

Archaeological and osteological materials were excavated in 1957 and 1997-2011 in the village of Kałdus, situated on the east bank of the Vistula River, in northern Poland (Fig. 1). The Early Mediaeval (10th-13th century) settlement complex uncovered at the foot of Mount Saint Lawrence was named Culmen (or Chełmno in Polish). Culmen was initially located outside the borders of the Gniezno state (the first Polish state), but later was one of its main centres, to eventually become a castellany in the 12th century. It was strategically located on the border between the Polish state and the Prussian lands, and at the crossroads of two main routes linking Rus' with the Baltic Sea and Scandinavia (Chudziak 2003, 2006, 2010).

The settlement complex consisted of a stronghold with the remains of a stone basilica (Site 3) and a cemetery (Sites 1, 2, and 4) with up to 1,500 graves – one of the largest in Early Mediaeval Central Europe (*e.g.*, Chudziak 2006, 2010; Kozłowski 2012; Bojarski 2020). A significant number of burials contained grave goods, with temple rings, knives and rings being the most common. Other grave goods included beads, coins, chains, pendants,

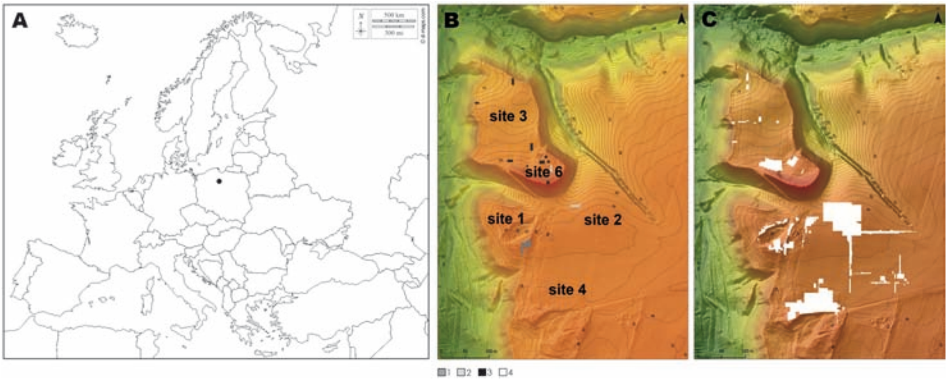

Fig. 1. A: The location of Kałdus in Poland (www.d-maps.com). B: The location of remains of the Early Mediaeval settlement complex of Culmen at archaeological sites in Kałdus, Poland. The site and height guidelines plan of the settlement complex, with trenches explored in 1958-1973. C: The site and height guidelines plan of the settlement complex, with trenches explored in 1996-2015 (by M. Skrzatek, M. Weinkauf, W. Ochotny; Chudziak, Noryśkiewicz 2016).
1 – excavations conducted in 1958 (E. Kaszewska, MAIEŁ); 2 – excavations conducted in 1958 (H. Wiklak, KA UŁ); 3 – excavations conducted in 1967-1973 (A. Kola, KA UMK); 4 – excavations conducted in 1996-2015 (W. Chudziak, IA Nicolaus Copernicus University)

rattles, a sword, whetstones, iron fire strikers and flintstones, ceramic whorls, and bowls (Chudziak 2006, 2010). The majority of individuals were buried in simple earth graves, but some were buried in graves containing structures such as coffins, frames, or chamber graves. Eight chamber graves, dating back to the end of the 10th century or the first half of the 11th century, were linked to the local elite (Chudziak *et al.* 2010a, b; Stawska *et al.* 2010; Bojarski *et al.* 2016). A chamber grave is a burial in an external 'non-portable wooden structure, shaped like a small building/chamber, erected over the deceased's body at a burial site' (Janowski 2011, 257; 2015, 25). The design of the chamber graves from Culmen and the goods found within (a bronze bowl, a plate with gilded fittings, glass beads) indicate that all or at least some of the individuals buried in them were of Scandinavian origin (Chudziak 2001, 2010, 2012; Bojarski 2021). The Scandinavian elite could have significantly influenced the development of the settlement in Culmen, as is evidenced by items with runic inscriptions (a game piece and a lead cross pendant). However, the latest stable isotope analysis of strontium showed that five out of nine individuals buried in the discussed chamber graves probably came from the Polish lands (Błaszczyk 2017), indicating that they could be Slavs.

In total, we selected 661 skeletons from 653 burials (some of them being multiple burials) for the analysis of disability and diseases in Culmen. The palaeopathological analysis indicated a number of pathological lesions, diseases and health conditions that were present in the population in Culmen (Kozłowski 2012). They included degenerative joint disease, injuries, specific infections (tuberculosis, leprosy), periosteal reactions, and osteomyelitis, as well as metabolic diseases (anaemia, rickets, and scurvy). Furthermore, tumour-like lesions, paralysis, endocrine disorders, developmental defects, dental caries, and stress markers were also observed.

3.2. Methods

3.2.1. Disability and palaeopathology

In our study, we use the above-mentioned multifactorial definition of disability (WHO 2002). In this interdisciplinary analysis, we developed and used the following protocol for studying disability in historical periods of time. First, we reviewed the textual sources, to learn which physical conditions might be perceived as disabilities. Second, we identified pathological conditions that were observed in skeletons of the individuals from Culmen; and, on the basis of ethnomedical, modern clinical, and palaeopathological studies (*e.g.*, Ibingira 2003; Goodwin *et al.* 2013; Baliga *et al.* 2015), we assessed their impact on the daily life. At this stage, disability was perceived as physical conditions associated with diseases that were likely to negatively affect the individual's functioning, and significantly impacted their daily lives for a considerably long period of time (Matczak and Kozłowski 2017). Next, we analysed which pathological lesions found in the skeletons could be linked with disabilities described in the textual sources. This way, we identified those skeletons that belonged to people with disabilities. These analyses resulted in a synthesis of information on how disability was defined and which afflictions present in the textual and osteological materials were regarded as disabilities.

In our work aiming at determining which diseases were considered disabilities, we used historical source criticism (information evaluation) to evaluate the qualities of information (validity, reliability, and relevance) available in historical sources (Topolski 1976). The palaeopathological analysis of the skeletons was performed by Tomasz Kozłowski, mostly as part of the European Module of the Global History of Health Project using the *Data Collection Codebook* (Steckel *et al.* 2006) and associated software. The results of this analysis were also published (Kozłowski 2012).

3.2.2. Age and sex

Sex was determined by interpretation of skull and pelvis morphology (Acsádi and Nemeskéri 1970; White and Folkens 2005), while the age at death in adults was estimated by morphology of pubic symphyseal surfaces (Brooks and Suchey 1990) and pelvic auricular surfaces (Buikstra and Ubelaker 1994), the fusion of cranial sutures (Steckel *et al.* 2006), dental attrition (Lovejoy 1985), and assessment of the sternal rib end (Krogman and Ýţcan 1986; Bass 1987). The age of subadults was additionally estimated on the basis of ossification of long bones, pelvis and vertebrae (Buikstra and Ubelaker 1994). For children, the age at death was estimated on the basis of the dental development stage of deciduous and permanent teeth and tooth buds (Ubelaker 1989), diaphyseal lengths, and the size of a pelvis and a scapula (Florkowski and Kozłowski 1994). The individuals were assigned to six age categories: young children (0-7), older children (8-15), adolescents (16-18), young adults (19-29), mature adults (30-49), and old adults (50+).

4. RESULTS

4.1. Perception of people with disabilities in mediaeval Poland

The *Vita beatae Hedwigis*, a hagiography of Saint Hedwig, the duchess of Silesia, provides numerous descriptions of people with various ailments. The source mentions 'thirteen particularly handicapped poor men'; however, it does not say which diseases were regarded as 'handicaps' (*Legenda świętej Jadwigi* 1993, 99). A man, 18 years old, with all his limbs stiff, was regarded as a 'cripple'. He could not feed himself unassisted and was completely bedridden. Siostromił, Racław and Więcymił were paralysed, and the last two were called 'cripples' (*Legenda świętej Jadwigi* 1993, 99-101). A woman bent almost in half, whose chest was touching her legs, was called an 'invalid' (*Legenda świętej Jadwigi* 1993, 101). A man called Wawrzyniec had an ulcerated wound in his chest that oozed pus and stank, and a swollen leg, and was unable to walk. His wife was so disgusted with his condition that she abandoned him. Some of the spouses of health-challenged people claimed that they were useless in the household and forced them to beg. For example, Racław, who suffered from cramps, was called 'a cripple' and was a beggar in Wroclaw (*Legenda świętej Jadwigi* 1993, 101). The cataract that caused blindness was perceived as 'an eye impairment' (*Legenda świętej Jadwigi* 1993, 66). Mutilations, such as cut-off body parts (*e.g.*, a hand) or a lost eye, inflicted during battles or resulting from a punishment, like cutting off the tongue or the nose of a slanderer or blinding of a criminal (Anonim tzw. Gall 2008; Mistrz Wincenty 2008), contributed to the number of people with impairments.

People of a high social status, who were mutilated in a battle, were perceived in a positive manner and could maintain their social roles and good living. On the other hand, some people of a lower social status, suffering from health conditions that prevented them from working, received care while others were forced to beg or were abandoned. This indicates that both physical and social factors played a role in perception of disability associated with the listed health conditions (WHO 2002; compared with Barnes and Mercer 2010). These conditions impaired the functioning of an individual and as a result, some people created social barriers for certain individuals with the above-mentioned afflictions. Taking the discussed sources into account, we assumed that disabilities in mediaeval Poland included paralysis and other health conditions causing problems with movement, or inability to move, an abnormal posture of the body, and blindness. Disabilities involving a loss of a body part resulted from punishments, battles, and possibly also from accidents, although this third cause is not mentioned in textual sources (*Legenda świętej Jadwigi* 1993; Anonim tzw. Gall 2008; Mistrz Wincenty 2008). We divided disabilities into mobility difficulties (*e.g.*, paralysis, amputation), an abnormal body posture (*e.g.*, postural kyphosis), and blindness. We use them as the basis and as indicators for investigating which pathological lesions might have been perceived as disability in Culmen. On the basis of textual sources, it can be noticed that it was adults, of all age groups, who were perceived as disabled in mediaeval Poland.

4.2. Disability, disease and health conditions found in Culmen

4.2.1. Disability in Culmen

As mentioned above, the analysis determined numerous diseases and health conditions present in the population in Culmen. On the basis of medical, palaeopathological and ethnomedical studies, we assessed the impact of diseases and health conditions on the daily life of relevant individuals, to see if they were disabled. Our research shows that out of 661 skeletons from Culmen, eight skeletons display pathological lesions indicating disability, 313 skeletons have lesions indicating diseases and other health conditions that had an impact on the functioning of individuals, and 340 skeletons do not have such lesions (Fig. 2). Table 1 presents diseases and health conditions classified as disabilities. Osteomyelitis (N=3) was the most prevalent disability (Fig. 3). The remaining disabilities, associated

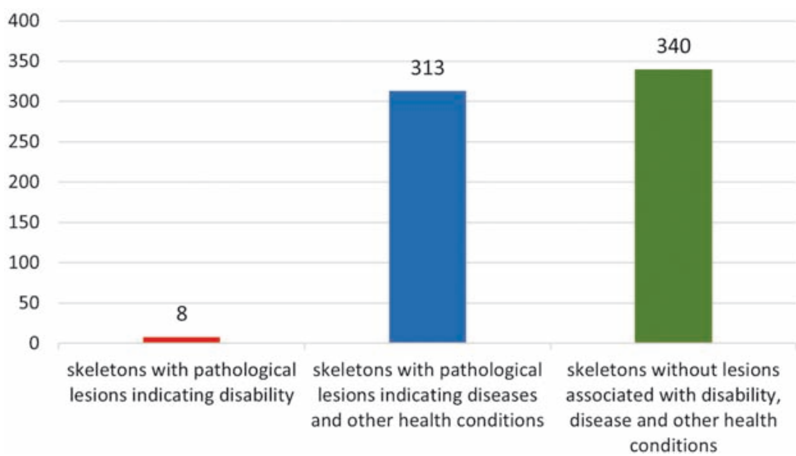

Fig. 2. The number of skeletons with pathological lesions indicating disability, pathological lesions associated with disease and other health conditions, and without lesions associated with disease, health conditions or disability, found in Culmen (by M. D. Matczak)

Table 1. Diseases and health conditions identified as disability and grave numbers in Culmen

Diseases and health conditions identified as disability	Grave numbers		
	Site 1	Site 2	Site 4
Spinal tuberculosis (Pott's disease)			42/00
Leprosy	101/98		
Lower limb paralysis (post poliomyelitis)		5/03	
Osteomyelitis	56/98	31/04	52/00
Neoplasm (multiple myeloma)	122/99		
Amputation			41/00

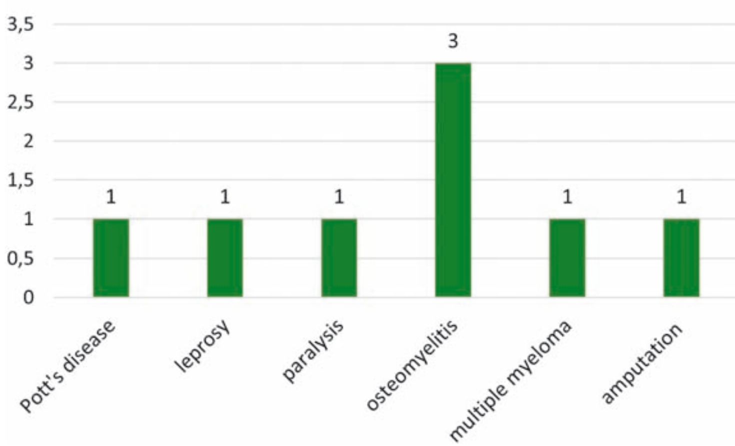

Fig. 3. The prevalence of afflictions associated with disability in Culmen (by M. D. Matczak)

with Pott's disease, leprosy, paralysis, multiple myeloma, and amputation, were identified only once. Below we present the description of those diseases and health conditions that had the greatest impact on the functioning of individuals, leading to their disability. Table 2 contains a detailed palaeopathological description of each individual with identified disability.

An individual from Grave 42/00, who was seven years old at the time of his/her death, displays signs of spinal tuberculosis known as Pott's disease (Fig. 4). Tuberculosis was confirmed by molecular analysis (Kozłowski 2012). The most common symptoms of Pott's disease include back pain (84%), followed by fever (40%) and pain elsewhere (28%), local tenderness, stiffness, and muscle spasms. Neurological complications, if untreated, may lead to paraplegia (Garg and Somvanshi 2011; Kamara *et al*. 2012; Rasouli *et al*. 2012). At the onset of Pott's disease, the child could experience weakness, fever, and coughing. Active disease in a child could cause malaise, loss of weight and appetite, night sweats, an

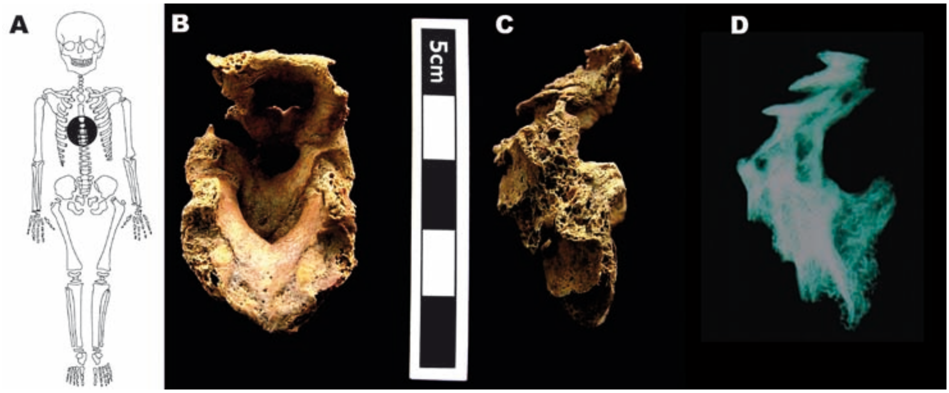

Fig. 4. A: Location of the lesions in the skeleton diagram of an individual with Pott's disease from Grave 42/00. B: Anterior view of the spine fragment. C: Right lateral view of the spine fragment. Note a block of four, probably lower mid and/or lower thoracic vertebrae (only arches preserved), suggesting formation of a hump. D: An X-ray image of thoracic vertebrae, the lateral projection: a significant arching of the block and the irregular arrangement of osseous tissue with destruction centres (round, small bone defects) and minor sclerotic changes visible (photos by T. Kozłowski; Kozłowski 2012)

evening rise in the temperature, generalised body aches, and fatigue (Garg and Somvanshi 2011). The intensity of pain in Pott's disease varies from a chronic mild and dull ache to severely disabling pain, and it is localised to the site of involvement and most common in the thoracic region. The thoracic region was involved in the case of the child from Culmen, so it is probable that she/he experienced pain in that area (Fig. 4). Spinal motions, coughing and weight-bearing could aggravate the pain. The incidence of neurological complications varies from 10% to 43% of the cases, and they are common in the thoracic and cervical regions. If the thoracic or lumbar spine is involved, the function of upper extremities is maintained, while the symptoms in the lower extremities progress, leading to paraplegia (Garg and Somvanshi 2011; Kamara *et al.* 2012; Rasouli *et al.* 2012), which has a devastating effect and the incidence rate ranging from 23% to 76% of the cases. In the past, when multi-drug therapy and surgical treatments were unavailable, severe cases could lead to permanent neurological disability (*e.g.*, paraplegia) and spinal deformity such as severe kyphosis, which affects the biomechanics of the spine and body and contributes to motor deficits, respiratory deficiencies, and degenerative spinal stenosis (Kamara *et al.* 2012; Rasouli *et al.* 2012). As the disease progressed in the thoracic part of the spine of the child from Culmen, it would have led to paraplegia of the lower limbs. The child would not have been able to fully help her/his parents in the household and/or play with other children. When the child was free of fever, she/he could perform easy daily tasks with the hands that required sitting, but she/he could not move unassisted. It is possible that the child did not work at all, and was just lying in bed at the advanced stage of the disease, when back pain, fatigue, weakness, paraplegia, and the respiratory deficiency (caused by the gibbous spine) could be severe. The child's contribution to the household was minimal and she/he mostly required a lot of care. The child was probably provided with food, fed and his/her hygiene was maintained. Somebody had to carry the child during her/his paraplegia episodes. The child could probably not play and interact with other children unless she/he had siblings and could interact with them in a household.

An adult female from Grave 101/98 was infected with leprosy (Fig. 5a, b, c), which was identified using the macroscopic analysis of skeleton morphology (mostly the facial skull), and the molecular analysis at the Department of Molecular Biology, the Medical University of Łódź (Kozłowski 2012; Matczak and Kozłowski 2017). At the advanced stage, leprosy causes loss of sensation in hands, feet and other areas, and causes various eye problems, including blindness. This leads to a limited ability to work, as well as to social and psychological problems (Matczak and Kozłowski 2017). Nowadays, this condition is perceived as disability, and multi-drug therapy helps people to recover from it. In the past, when such therapy was not available, leprosy caused significant impairment. It is possible that the female from Culmen experienced such problems. As a result, she was probably unable to perform many or all of her daily tasks: cultivating vegetables, breeding animals, weaving fabrics, and producing ceramics. She could have had a problem with finding a husband and, if unmarried, would depend on her relatives for housing and support. Her need for assistance would increase as her condition worsened. She would require help in acquiring and preparing food and feeding herself, and would need a guide outside the known territory.

Atrophy of bones in lower limbs, associated with paralysis-induced changes (probably poliomyelitis), was identified in the skeleton of a female, 30-40 years old at death, from Grave 5/03 (Fig. 5d, e, f; Kozłowski 2012). Her shorter and more fragile left lower limb indicates that poliomyelitis was contracted in childhood (Waldron 2009). This acute viral infection is characterised by fever, hypersensitivity, irritation of the gastrointestinal tract, headaches and muscle aches, paralysis of single muscles or muscle groups, muscle weakness, or permanent paralysis (Aufderheide and Rodríguez-Martín 2006; Roberts and Manchester 2010; Baliga *et al.* 2015). This condition leads to complications such as instability and contracture of the joints, limb growth disorders, muscle balance disorders, and muscle cramps and distortions (Gaździk 2008). Poliomyelitis also causes a decrease in muscle tone, abolition of reflexes in the affected limb, muscle fasciculations, or atrophy of denervated muscles (Spodaryk 2002). Therefore, the person is unable to move without support and assistance, or without special equipment (*e.g.*, crutches). Nowadays, it leads to disability (Baliga *et al.* 2015) and in the past, it could also have a significant impact on someone's life. The female from Culmen probably experienced the above-mentioned symptoms of poliomyelitis. Her shorter limb prevented her from walking and restricted her mobility. If she contracted poliomyelitis in childhood (which is probable), she would have experienced difficulties in performing various tasks from an early age. She needed assistance of others to move due to possible paralysis. It could be difficult or even impos-

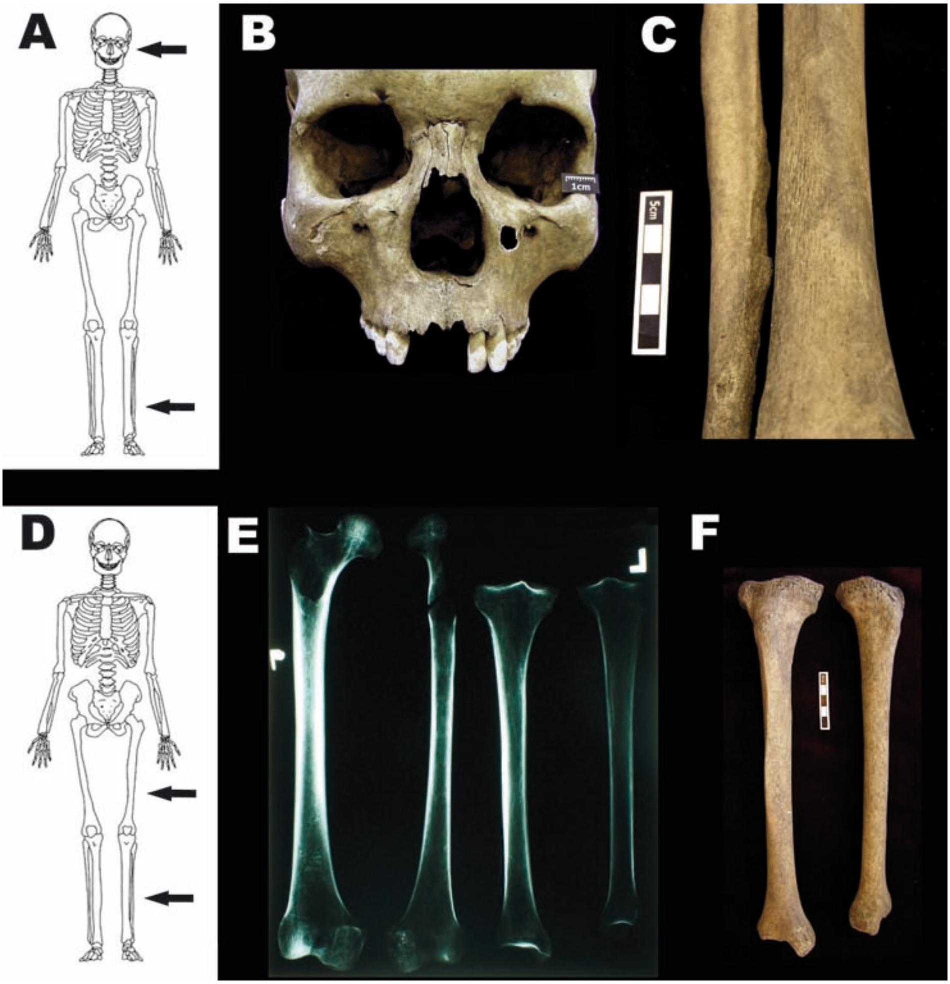

Fig. 5. A: Location of the lesions in the skeleton diagram of the individual with leprosy from Grave 101/98. B: Anterior view of the skull. Note clear cylindrical edges of the anterior nasal aperture, atrophy/destruction of the nasal spine, and atrophy of the frontal surface at the base of the nasal cavity, with the receding edge of the anterior nasal aperture, where all these characteristics are specific for *facies leprosa*. C: Signs of periostitis on the surface of right tibial and fibular shafts. D: Location of the lesions in the skeleton diagram of the individual with poliomyelitis (Heine-Medin disease) from Grave 5/03. E: An X-ray image of the right and left femora and tibiae, the anterior projection. The left femur and tibia display atrophic features: general osteoporosis of epiphyses and significant thinning of shaft walls, when compared to the right femur and tibia. Epiphyses of atrophic bones, of a reduced size, are covered with a very thin layer of the compact substance (almost invisible). Cross sections of the shafts are reduced. F: Anterior view of the right tibia and the left tibia with symptoms of atrophy. The left tibia is shorter, with barely developed shaft edges and surfaces, as well as attachments of muscles and ligaments. A pronounced lateral twist of the distal epiphysis suggests an external (lateral) foot position (photos by T. Kozłowski; Kozłowski 2012)

sible for her to perform duties such as collecting honey, plants, and fungi, or ploughing and working in the fields. She could sit and help with cooking, craftwork, and looking after small children. She lived until she was in her 30s-40s, so she required help and care for a considerably long time.

Three individuals present pathological lesions associated with osteomyelitis (Kozłowski 2012). Osteomyelitis is a nonspecific infectious disease of the bone and bone marrow caused by bacteria, viruses, fungi, and multicellular parasites (Roberts 2019). It is a debilitating condition that has three forms: acute, subacute, and chronic. It starts with an acute or subacute form that lasts for a couple of weeks, and when left untreated, develops into a chronic bone infection. Chronic osteomyelitis is associated with a vascular necrosis of the bone and the formation of sequestra (fragments of dead bone) (Lew and Waldvogel 2004). Symptoms of acute osteomyelitis include fever, chills, and swelling (Lazzarini *et al.* 2004). Subacute osteomyelitis is manifested as mild pain and slight functional impairment (Ibingira 2003). Symptoms of chronic osteomyelitis include pus discharge, swelling, deformity, chronic pain, muscle spasm, fever, limping when lower limbs are affected, restricted mobility, the inability to use the infected body part, and functional impairment (Lazzarini *et al.* 2004; Biruk and Wubshet 2007; Roberts and Manchester 2010; Mundada and Patil 2022). Osteomyelitis is also considered a disability. In the past, when no antibiotics, surgical treatment (*e.g.*, debridement, or amputation) and physiotherapy were available, it could easily develop into a chronic form that significantly impacted the life of an individual. If the infection spreads through the body, it can be fatal (Lew and Waldvogel 2004). In an adult female from Grave 56/98 on Site 1 (Fig. 6a, b, c), chronic osteomyelitis is manifested as shaft deformation and broadening, and a sequestrum with cloacae in the left femur (Kozłowski 2012). This could have caused severe pain in the left femur, and difficulty with using the left lower limb and walking. She could have done light daily peasant and craftwork tasks, *e.g.*, make pots, so she would still contribute to earning income and looking after the household. This person could cook, as well as take care of small children. However, her abilities in those areas were limited, and she needed assistance, *e.g.*, she had to be provided with food ingredients, etc. In the case of an adult male from Grave 52/00 at Site 4, osteomyelitis was chronic as indicated by a broad cloaca, and significant thickening and deformation of the tibial shaft (Fig. 6d, e, f, g; Table 2). It caused severe pain in the tibia and difficulty with using the affected lower limb and walking. Thus, it was impossible for him to perform certain tasks such as tree felling, building huts, or ploughing. Somebody had to help him to walk to places where he could work as a peasant or craftsman, and provide him with the necessary materials to perform his work. He could contribute to sustaining the family and household, although to a limited extent, due to his sickness and the care that he needed. Osteomyelitis was also identified in the form of osseous tissue layers on the tibia of a male, 50-60 years old at death, from Grave 31/04 on Site 2 in Culmen (Fig. 6h, i, j; Table 2; Kozłowski 2012). Osteomyelitis could have had a significant impact on the life of that male because it could have caused pain, deformity, and functional limitation of

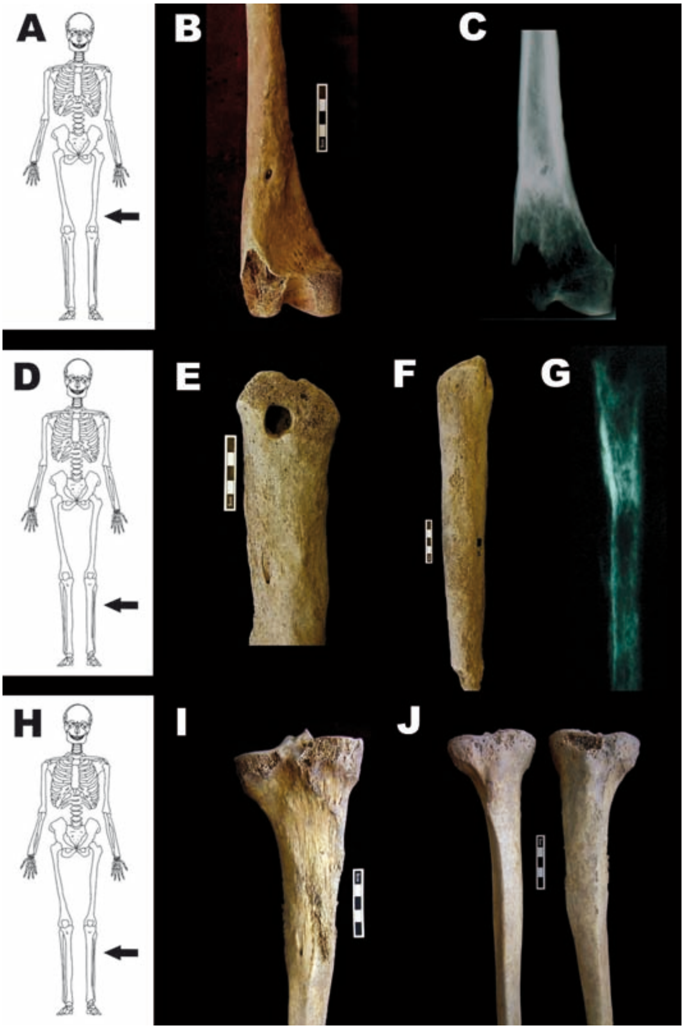

Fig. 6. A: Location of the lesions in the skeleton diagram of the individual with osteomyelitis from Grave 56/98. B: The left femoral shaft near the distal metaphysis is deformed and broadened. Note the cloaca with bone fragments (so-called sequestra) adhering. C: An X-ray image of the part of the left femur showing deformation of the bone contour, irregular sclerotization of internal structures, and a sequestrum. D: Location of the lesions in the skeleton diagram of the individual with osteomyelitis from Grave 52/00. E: The left tibia with a round, broad cloaca penetrating into the bone near the proximal epiphysis, and a significant widening of the nutrient foramen. F: A significant thickening and deformation of the left tibial shaft and epiphysis, as a result of the inflammation process. G: An anterior-posterior X-ray image of the tibia shows substantial bone damage caused by the disease process involving all its segments, together with irregular sclerotic areas and cavernous defects in the internal structure and the original cortical bone. H: Location of the lesions in the skeleton diagram of the individual with osteomyelitis from Grave 31/04. I: Posterior view of the left tibia. Note obliterated signs of massive *periostitis* and widening of the nutrient foramen. J: Anterior view of the tibiae. The left tibia displays deformation of the proximal part (widening) and signs of *osteitis*. The right tibia is free of pathological lesions (photos by T. Kozłowski; Kozłowski 2012)

Table 2. A catalogue of skeletons with pathological lesions associated with disability in Culmen (Chudziak *et al.* 2006, Kozłowski 2012, this study). DJD – degenerative joint disease

Item	Grave no.	Date	Sex and age	Pathology	Figures
1	56/98	the 12th c. – 1st half of the 13th c.	Female 35-45	In the left femur, osteomyelitis involved most of the diaphysis with cloacae. The shaft near the distal metaphysis is deformed and broadened. Small bone fragments (so-called sequestra) are well visible in the cloaca. Periosteal reactions are visible as markedly accentuated longitudinal striations. Other identified pathological lesions included: DJD manifested as slight marginal lipping observed in both shoulder joints, dental caries in eight teeth, an antemortem loss of five teeth, and two hypoplastic lines on a mandibular canine, an incisor, and a maxillary canine.	6 a-c
2	101/98	the 12th c. – 1st half of the 13th c.	Female 25-30	Leprosy manifests as a rounded and receding edge characterising the anterior nasal aperture, with the atrophy of the anterior nasal spine. A porous palate and chronic inflammation in the nasal cavity were also identified. Markedly accentuated longitudinal striations are visible in the shaft of the humerus and the metatarsal bones. Periosteal inflammation, manifested as slight, discrete patches of reactive bone, involves less than one quarter of the surface of the long bones in the lower limbs. The morphological deformation of the left tibia shaft is probably caused by a healed fracture. Signs of a massive periosteal reaction and remodelling are present. A massive deposit of osseous tissue is visible on the left tibia and fibula, leading to deformation of the shaft shape. Systemic osteoperiostitis is present in both tibias and fibulas. Schmorl's nodes on thoracic vertebrae and a congenital fusion of the C2 and C3 vertebrae were identified. *Cribra orbitalia* as a cluster of mostly fine foramina covering a small area ($\leq$1 cm^2), and porotic hyperostosis visible as slight pitting or severe parietal porosity may suggest anaemia.	5 a-c
3	122/99	the 12th c. – 1st half of the 13th c.	Female 25-30	A neoplasm, probably multiple myeloma, was identified on the basis of circular lytic defects on the vertebrae, the pelvis and the long bones. Circular osteolytic lesions with irregular edges spread on the external (*clunis*) surface of the ala of ilium, and in the posterior part and on the epiphysis and proximal metaphysis of the humerus. Signs of periostitis were present, manifesting as numerous holes for tiny blood vessels, typically located on the shaft of the humerus. Osteolytic lesions can be found on the epiphysis and proximal metaphysis of the right humerus in the form of numerous, round defects in the external compact bone layer. Periostitis, active at the moment of death, involved the shaft in the area of the nutrient foramen of the right ulna. Vessel holes are broadened on the posterior surface of the vertebral bodies of the lumbar spine (from the side of the vertebral canal), and there are signs of osteolysis on the external plate of the bone. Osteolytic lesions are visible within the epiphysis and the area of the proximal metaphysis of the right femur, manifesting as numerous round defects in the plate layer, holes made by tiny blood vessels and periostitis. Other identified pathological lesions included: a healed fracture of the distal part of the right ulna, DJD – slight marginal lipping in the right elbow, an antemortem loss of six teeth, and one root abscess.	7 a-f

Item	Grave no.	Date	Sex and age	Pathology	Figures
4	5/03	2nd half of the 11th c. – 2nd half of the 12th c.	Female 30-40	The left lower limb is shorter and more fragile than the right one. The left tibia is shorter than the right one, with barely developed shaft edges and surfaces, as well as muscle and ligament attachments. A pronounced lateral twist of the right distal epiphysis suggests external (lateral) foot position – post-paralytic lesions that could be connected with poliomyelitis (Heine-Medin disease). In comparison to the right femur and tibia, a radiograph showed general osteoporosis in the epiphysis and significant thinning of the shaft walls in the left femur and tibia. A very thin layer of the compact substance (almost invisible) covers the epiphysis of the bones, which are reduced in size (atrophied). Cross-sections of the shafts are reduced. A radiograph showed atrophy of the left patella and talus, which were reduced in size and displayed signs of reduced bone density (osteoporosis). The left first proximal phalanx is reduced in size when compared to the right one. DJD, manifesting as slight marginal osteophytic lipping, is visible in both temporo-mandibular joints, the left shoulder, and the right wrist and hand. Osteophytic formations are present in the thoracic and lumbar vertebral bodies. The lateral surface of the proximal end and the shaft of the atrophic side of the tibia displays signs of periosteal reactions, which are partially healed and probably not directly associated with the atrophy. Periosteal reactions manifest as markedly accentuated longitudinal striations, with moderate involvement of the periosteum, but affecting less than one-half of the long bone surface, and as slight, discrete patches of reactive bone affecting less than one quarter of the long bone surface. Mandibular and maxillary canines and a mandibular incisor have one hypoplastic line, while a maxillary incisor has two hypoplastic lines. An antemortem loss of six teeth was also observed.	5 d-f
5	31/04	2nd half of the 11th c. – 2nd half of the 12th c.	Male 50-60	DJD manifests as slight marginal lipping in the temporo-mandibular joints, shoulders, elbows, hips, left knee, wrists and hands, and the left ankle and foot. Cervical and lumbar vertebrae are characterised by osteophytic formations. The thoracic vertebrae display extensive osteophytic formations. Signs of a massive lesion caused by healed *periostitis* on the posterior aspect, widening of the nutrient foramen, and deformation of the proximal part of the bone are visible in the left tibia, indicating osteomyelitis. Periosteal reactions are present in the form of markedly accentuated longitudinal striations, and slight, discrete patches of reactive bone affecting less than one quarter of the long bone surface. Layers of osseous tissue are visible on the pleural surface of the rib. A radiograph of the rib, at the vertical projection angle, towards the shaft surface, showed limited irregular areas of sclerotic lesions in the shaft. The identified pathological changes included: osteoma on the right parietal bone (8 mm), complete sacralization of L5, dental caries in seven teeth, and an antemortem loss of 10 teeth.	6 h-j

Item	Grave no.	Date	Sex and age	Pathology	Figures
6	41/00	40s of the 11th c. – 11th/12th c.	Male 40-50	DJD in the form of slight marginal lipping was identified in shoulders, elbows, the right knee, wrists and hands. Osteophytic formations are visible in the cervical vertebrae. An extensive osteophytic formation is visible in the thoracic and lumbar vertebrae. Distal parts of the left tibia and fibula were amputated, which resulted in their shortening by about 7 cm, when compared to the right tibia and fibula. Observed periosteal reactions are probably associated with amputation. Proliferation and remodelling (healing) processes in the tibia and fibula suggest that the male survived amputation and lived with this condition. Porotic hyperostosis, indicated by the presence of slight pitting or severe parietal porosity, possibly indicating anaemia, was identified. Furthermore, an antemortem fracture of the crown was observed in the upper right medial incisor.	8 a-d
7	42/00	2nd half of the 12th c. – 12th/13th c.	Unknown 7	Thoracic vertebrae form an arch, resembling a gibbus deformity. A radiograph shows a significant arching of the block and an irregular arrangement of osseous tissue with destruction centres (round, small defects). The thoracic vertebrae display lytic lesions, and are obliterated and fused. These pathological lesions correspond to Pott's disease (spinal tuberculosis). *Cribra orbitalia* are present as a cluster of mostly fine openings covering a small area, indicating possible anaemia.	4 a-c
8	52/00	10th/11th – 1st half of the 11th c.	Male 30-40	Osteomyelitis was identified on the basis of a round, broad cloaca penetrating into the bone near the proximal epiphysis and a significant widening of the nutrient foramen of the tibia. The shaft and the epiphysis are significantly thickened and deformed as a result of the inflammation process. An anterior-posterior radiograph of the tibia showed substantial bone damage caused by the disease process affecting all its segments. Furthermore, irregular sclerotic areas and cavernous defects in the internal structure and original cortical bone are also visible. One hypoplastic line on a mandibular canine and two or more hypoplastic lines on a maxillary canine were identified.	6 d-g

the infected limb. The assessment of disability in that male is difficult; however, it cannot be excluded that he had functional impairment in his advanced age.

A neoplasm, probably multiple myeloma, was identified in the skeleton of a female, 30-40 years old at death, from Grave 122/99 (Fig. 7, Table 2; Kozłowski 2012). Multiple myeloma causes bone pain, anaemia, kidney failure, infections and neurological problems, and in its advanced stages, results in severe pain and an inability to move, which nowadays leads to disability (Goodwin *et al.* 2013). The female from Culmen probably experienced pain, anaemia, kidney failure, infections and neurological problems. At the advanced stage, multiple myeloma causes weakness and severe pain (Goodwin *et al.* 2013). The female could not work and was lying down all the time. The family had to provide assistance to ensure that her domestic, basic, and economic needs were satisfied. For some months or years before her death, while multiple myeloma was progressing, she was probably fully

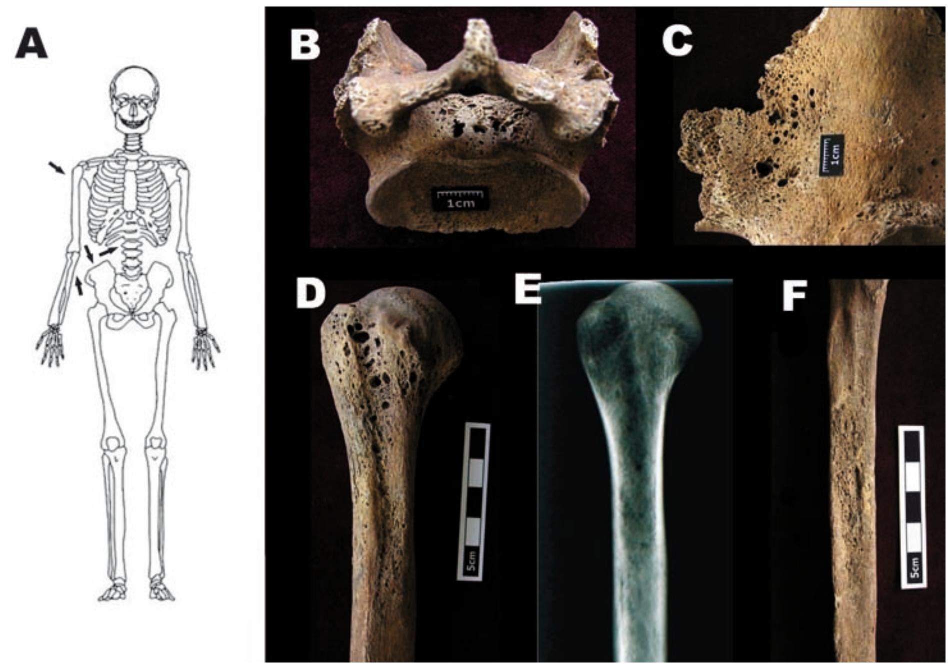

Fig. 7. A: Location of the lesions in the skeleton diagram of the individual with suspected multiple myeloma from Grave 122/99. B: Broadened vessel holes on the posterior surface of the second lumbar vertebral body (from the vertebral canal side) and osteolysis affecting its external surface. C: Circular osteolytic lesions with irregular edges spread to the external (*clunis*) surface of the posterior aspect of the right ala of the ilium. D: Osteolytic lesions are visible on the epiphysis and the proximal metaphysis of the right humerus as numerous round defects in the external compact bone layer. E: An X-ray image of the right humerus, the anterior projection. Note areas of significantly reduced density (osteoporosis) and numerous round cavities. The greater tubercle does not have a normal internal spongy structure and the contour of its shaft surface is blurred. F: Signs of active periostitis near the nutrient foramen of the right ulna (photos by T. Kozłowski; Kozłowski 2012)

Fig 8. A: Location of the lesions in the skeleton diagram of the individual with amputation of the left tibia and fibula from Grave 41/00. B: Anterior view of the right tibia and fibula and amputated distal parts of the left tibia and fibula. C: An X-ray image of the tibia and fibula, the anterior projection, showing signs of proliferation and remodelling processes. D: Anterior view of significant rebuilding and consolidation/fusion (bridging bone fusion) between tibial and fibular shafts (post-mortem damage to the bridging bone) (photos by T. Kozłowski; Kozłowski 2012)

disabled. Nowadays, multiple myeloma leads to death within 7-60 months of the diagnosis (Piotrowski 2003). It could probably be the reason of the death of the female from Culmen.

An amputation, which was identified in the skeleton of a male, 40-50 years old at death, from Grave 41/00, could have a long-term impact on that individual's life (Kozłowski 2012). As a result of amputation, the distal parts of the left tibia and fibula were shorter by about 7 cm than the corresponding bones in the right lower limb (Fig. 8). Proliferation and remodelling (healing) processes in the tibia and fibula (Fig. 8d) suggest that the male survived amputation and lived with this condition. In his advanced age, he could have had considerable problems with obtaining food and earning an income as a consequence of amputation and walking difficulties. He might have been unable to actively perform all his duties at work and in the household. It is possible that someone had to support him to satisfy his economic needs. Amputation of one lower extremity at or above the ankle is nowadays considered a disability in Poland and elsewhere, *e.g.*, in the USA (*Disability Evaluation Under Social Security*). Being a condition that restricts mobility, it could have also been perceived as such in the past. Therefore, the individual from Grave 41/00 might have been considered as a disabled member of the community.

4.2.2. Types of disability

On the basis of mediaeval texts, we have distinguished disability due to mobility difficulties, an abnormal posture, and blindness, and linked those types with the specific diseases and health conditions identified in osteological materials from Culmen. A bone neoplasm (probably multiple myeloma), osteomyelitis and Pott's disease could have caused severe pain, which could have affected the individual's ability to move. Additionally, paralysis (caused by poliomyelitis), amputation, and leprosy could also be associated with disability due to mobility difficulties. For this reason, those afflictions can be considered as a disability due to mobility difficulties (Table 3). Disability due to an abnormal posture could result from Pott's disease (spinal tuberculosis), limb paralysis (due to poliomyelitis), and amputation. Disability due to blindness could be associated with leprosy. In some cases, one affliction can be assigned to two categories of disability, *e.g.*, paralysis and amputation can be considered as a disability due to mobility difficulties, as well as due to an abnormal posture.

Of the discussed types of disability, disability due to mobility difficulties was the most frequent (N=8; Table 3). Only one individual with amputation (Grave 41/00) was disabled as a consequence of a specific human activity such as surgery, punishment or fighting, and the remaining ones (N=7) were disabled due to development of disease. Some individuals could be fully or partially disabled, depending on the severity and the number of afflictions a particular person suffered from. However, the qualitative analysis of disability is out of the scope of this article.

Table 3. The prevalence of disability types in Culmen

Diseases and health conditions identified as disability	Disability due to mobility difficulties		Disability due to an abnormal posture		Disability due to blindness	
	N	%	N	%	N	%
Spinal tuberculosis (Pott's disease)	1	12.5%	1	33.3%	0	–
Leprosy	1	12.5%	0	–	1	100%
Lower limb paralysis (post poliomyelitis)	1	12.5%	1	33.3%	0	–
Osteomyelitis	3	37.5%	0	–	0	–
Neoplasm (multiple myeloma)	1	12.5%	0	–	0	–
Amputation	1	12.5%	1	33.3%	0	–
Total	8	100%	3	100%	1	100%

4.2.3. Age and sex of people with disabilities

Table 4 presents the age and sex of the people with disabilities from Culmen. The values are too low to perform a statistical analysis; however, it is visible that the majority of people with disabilities were adults (N=7), with only one child found. The prevalence of disability is almost equal in males (N=3) and females (N=4).

Table 4. Distribution of age and sex per group of skeletons of individuals with disabilities in Culmen

Age	Sex						Total	
	Female		Male		Unknown			
	N	%	N	%	N	%	N	%
Young child (0-7)	0	–	0	–	1	100.0%	1	12.5%
Older child (8-15)	0	–	0	–	0	–	0	–
Adolescent (16-18)	0	–	0	–	0	–	0	–
Young adult (19-29)	2	50%	0	–	0	–	2	25%
Mature adult (30-49)	2	50%	2	66.7%	0	–	4	50%
Old adult (50+)	0	–	1	33.3%	0	–	1	12.5%
Total	4	100.0%	3	100.0%	1	100.0%	8	100.0%

4.2.4. Diseases and health conditions in Culmen

We treated the remaining afflictions from Culmen as diseases and health conditions that impacted the functioning of individuals. They included anaemia, scurvy, rickets, degenerative joint disease, thoracic disc herniation, periosteal reactions, tuberculosis (excluding Pott's disease), meningitis, hyperostosis frontalis interna (HFI), trauma (excluding amputation), osteochondritis dissecans, osteochondrosis, spondylolysis, spondylolisthesis, enthesopathy, hip dysplasia, developmental foot defect, deep dental caries, dental abscesses and tooth fracture.

139 individuals were identified as having anaemia, manifesting as *cribra orbitalia*, porotic hyperostosis, and other lesions (Kozłowski 2012) (Fig. 9). The most common symptoms of anaemia include pale skin, mucous membranes and conjunctiva, weakness, fatigue, tenderness, reduced exercise tolerance, headaches, sleep disorders, worsening of memory, apathy, depression, feeling cold, and constipation (Aufderheide and Rodríguez-Martín 2006; Kotschy 2009; Zahorska-Markiewicz and Małecka-Tendera 2009; Roberts and Machester 2010). Other symptoms involve arrhythmias, functional systolic murmur, cardiac hypertrophy, and congestive heart failure, which can be fatal if left untreated (Pegelow *et al.* 1977). Advanced forms of anaemia lead to the inability to work (Brittemham 2000). In the present and in the past, anaemia could cause fatigue and weakness when performing various duties. Headaches and sleeping disorders associated with anaemia could affect the individual's ability to rest sufficiently during the day or at night.

Skeletal signs of scurvy were identified in 24 individuals (Fig. 9). This condition is characterised by swelling of the gums, bleeding, blood spots on the skin, epidermal keratosis, impaired wound healing, periodontal diseases, weakness, pain in muscles and joints of the lower limbs, and irritability (Wojtecka-Łukasik 2009; Roberts and Manchester 2010). It is probable that 24 individuals from Culmen experienced such symptoms; however, it is hard to estimate how they affected their performance of daily tasks.

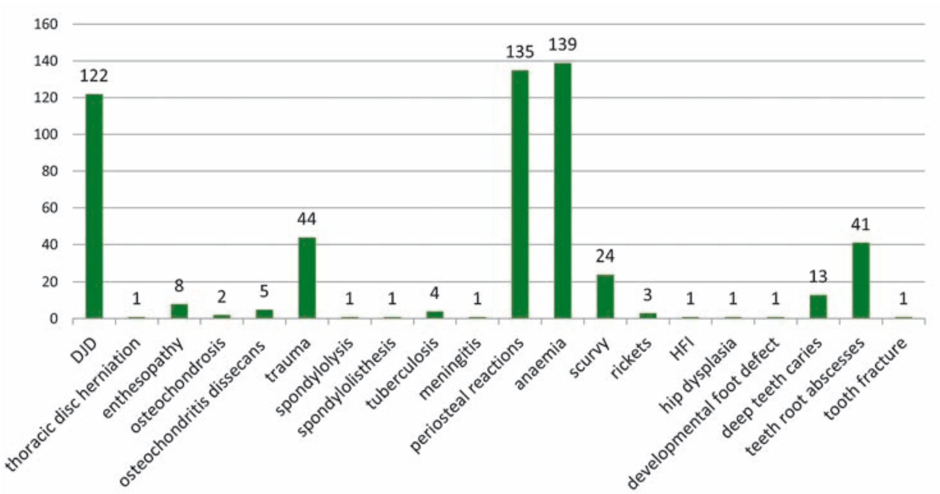

Fig. 9. Numbers of cases of diseases and health conditions identified in the skeletons in Early Mediaeval Culmen. DJD – degenerative joint disease, HFI – hyperostosis frontalis interna (by M. D. Matczak)

Rickets was identified in three skeletons (Fig. 9). It causes bone deformation, a delay in serration, thickening of the bones of the forearm and lower leg, malocclusion, tendency to develop caries, a high palate, scoliosis, bone pain in the limbs, pelvis and spine, and muscle weakness (Henning and Schmidt 1973; Sahay and Sahay 2012). It also leads to malaise, bone pain, and rapid fatigue with muscular weakness, which may manifest as a waddling gait (Spodaryk 2002; Kozłowski and Witas 2012). Bone deformities (mostly on the *femora*) caused by rickets in early life were identified in one adult individual. Rickets also affected two children in Culmen.

Periosteal reactions at different stages of development could cause pain, and are one of the components of the human body's reaction to pathogens (of septic origin), non-infectious diseases (of non-septic origin), and injuries (Brothwell and Sandison 1967; Steckel *et al.* 2006; Roberts and Manchester 2010; Weston 2012). In Culmen, 135 skeletons display signs of periosteal reactions (Fig. 9), which could be connected with scurvy, leprosy, tuberculosis, and tumours or traumas to the skull, ribs, vertebrae, long bones, and the 3rd metatarsal.

Four individuals from Culmen show pathological lesions that could be associated with tuberculosis (Fig. 9). Symptoms of tuberculosis could include chest pain, a draining sinus in the chest wall, and abscesses (Chang *et al.* 1999). The skeleton from Grave 347/02 (male, adult) has signs of possible active tuberculosis of the ankle, and in the skeleton from Grave 82/01 (female, older adult), the talocrural joint is destroyed by tuberculosis to a great extent. In an individual from Grave 82/01, tuberculosis was confirmed by a molecular analysis (Kozłowski 2012).

Signs of nonactive endocranial meningeal reactions (probably post meningitis) were observed in the skeleton of a female, 45 years old at death, from Grave 455/04, and on the inner surface of several infant calvarial bones. In the latter case, aetiology of lesions is not clear, and they could also indicate metabolic disorders, for example, scurvy or infection. Meningitis causes headache, photophobia, nausea, drowsiness, unconsciousness, coma, epilepsy, nuchal rigidity, irritability, an increase in the body temperature, and arthritis. Today, if left untreated, meningitis can be fatal, with a mortality rate of 70-100% (Longmore *et al.* 2004).

Hyperostosis frontalis interna (HFI; continuous overgrowth of the frontal bone) manifests as chronic headaches (Torrealba-Acosta and Mandel 2020). Therefore, HFI found in a female from Culmen, 45-55 years old at death, should be considered a disease in terms of human life and functioning.

Degenerative joint disease (DJD) was identified in 122 individuals in total (Fig. 9). In the joints of the limbs, slight marginal lipping (osteophytes <3 mm) and slight degenerative changes do not cause pain intense enough to be felt constantly. Severe marginal lipping (osteophytes of >3 mm) and severe degenerative changes may cause frequent episodes of moderate pain (Neogi *et al.* 2009; Matczak 2015). Advanced DJD, such as complete or near-complete (>80%) destruction of the articular surface in the knee joint, can cause chronic pain (*e.g.*, Neogi *et al.* 2009). Two individuals from Culmen had complete or near-complete (>80%) destruction of the articular surface in the right glenohumeral joint (Grave 82/98) and the right hip joint (Grave 367/03). Several different scales are used to evaluate osteoarthritis in the glenohumeral joint, *e.g.*, the Kellgren and Lawrence scale, but there are no studies on their association with disability. Results of research on the relationship between hip pain and the DJD grading system are ambiguous. Some studies show that there is no relationship between the degree of pain and the degree of osteoarthritis according to the Kellgren and Lawrence grading system (Kim *et al.* 2015; Hattori *et al.* 2021). On the other hand, other researchers have demonstrated a relationship between pain and the grading system (Assogba *et al.* 2020). Hip osteoarthritis leads to pain, stiffness, and limitations in activities (Rydevik *et al.* 2010). On the basis of osteological studies, it is very difficult to determine whether a person with advanced DJD in the glenohumeral or hip joint was disabled. Thus, advanced DJD in the glenohumeral and hip joints, identified in Culmen, cannot be considered as disability.

Osteophyte formation on at least one vertebral body is associated with the reduction of the disc size, and causes back pain (Fujiwara *et al.* 1999; Pye *et al.* 2004; Hart *et al.* 2015). Extensive osteophyte formation on the lumbar vertebral body can cause chronic pain (lasting for over 3 months to up to one year) (de Schepper *et al.* 2010; Matczak *et al.* 2022). DJD decreases the quality of life; however, it is difficult to observe a correlation between osteophytes and pain and disability, because some DJD changes in the spine might be asymptomatic, while even small changes may cause pain. Therefore, it is difficult to conclude if DJD in the spine and back pain could lead to disability, and for this reason we consider DJD as a disease rather than disability. We are aware that Schmorl's nodes are not as good an indicator for pain assessment, because they cause pain in some individuals, whereas in others, they do not (Williams *et al.* 2007). However, clinical research shows that ≥1 Schmorl's nodes on lumbar vertebrae and ≥2 Schmorl's nodes on thoracic vertebrae can cause pain and stiffness in a relevant joint (Williams *et al.* 2007; Faccia and Williams 2008). Plomp (2017) discussed studies providing evidence that Schmorl's nodes cause pain. For this reason, we consider the presence of ≥1 Schmorl's nodes on lumbar vertebrae and ≥2 Schmorl's nodes on thoracic vertebrae as indicators of pain that has an impact on the quality of life of an individual. Considering the above, only joint fusions in the spine and limbs are easier to interpret as disability, because they lead to an inability to move the affected body parts. However, we did not identify any joint fusions in the osteological material from Culmen.

A hole in the anterior surface of the thoracic vertebral body, resulting from a forward shift (outside the vertebrae body outline) and herniation of the nucleus pulposus, was identified in a skeleton of a male, 50-60 years old at death, from Grave 444/04 (Kozłowski 2012).

Osteochondrosis (N=2), osteochondritis (N=5) and enthesopathy (N=8) can cause pain (Spodaryk 2002; Saseen *et al.* 2012). Sacralization is the fusion of the L5 vertebra with the sacrum, which is asymptomatic (Spodaryk 2002). Spondylolisthesis (N=1) and trauma cause pain, and at more severe stages, an inability to move (Roberts and Manchester 2010). Traumas were identified in 44 skeletons in total (Fig. 9) and included neurocranium trauma (N=20), facial trauma (N=1), trephination (N=4), long limb bones trauma (mostly, healed fractures, N=16), weapon trauma (N=2), and other cases of post-cranial trauma (N=9). They affected the life of individuals temporarily by causing pain and mobility difficulties in a relevant body part.

The presence of DJD in the left hip and the age of a male (adult) with a possible hip dysplasia from Grave 319/02 indicates that he could walk, but almost certainly with a waddling gait (Waldron 2009). A developmental defect of metatarsal bones (joints deformation and 'compression', N=1) could affect mobility (Kozłowski 2012; Jung *et al.* 2013).

Osteoma is a benign tumour that is located mainly in the bones of the skull and does not cause any symptoms (Spodaryk 2002; Mazurkiewicz 2008).

Deep caries (N=13) causes acute or chronic (in the case of pulp and nerve inflammation) pain in response to cold or heat (Winiarska-Majczyno 1983). Dental abscesses (N=41) could cause severe pain, difficulty in swallowing, fever, and facial swelling (Górski 1983; Roberts and Manchester 2010; Arslan *et al.* 2016). Antemortem crown fracture of the upper right medial incisor could cause temporal pain and sensitivity (Patnana and Kanchan 2023). The antemortem loss of permanent teeth in adults results in articulation disorders of speech sounds and chewing disorders (Włoch 1983). However, only a small number of individuals experience total loss of teeth. Some individuals experience the loss of one tooth or several teeth, which does not have a significant impact on the individual's functioning.

A thorough assessment of the impact of antemortem loss of teeth on the individual's life should be the subject of further investigation. The degree to which some pathological lesions such as, *e.g.*, enamel hypoplasia (Roberts and Manchester 2010) could affect the ability of an individual to 'function', and their association with other diseases is unclear. Figure 9 presents the number of cases of each disease, health condition, and pathological lesion that had an impact on the life of individuals from Culmen, but which are not considered disability.

5. DISCUSSION

5.1. Disability, age, and sex

Although disability is a modern concept that has developed in the Western culture (Barnes and Mercer 2010; Horstmanshoff 2012), textual sources show that there was a concept of 'otherness' associated with a physical impairment in mediaeval Poland. The textual analysis reveals that some people with disabilities were perceived in a positive way while others experienced social marginalisation, and did not receive the necessary care from their spouses and partners (*Legenda świętej Jadwigi* 1993; Anonim tzw. Gall 2008; Mistrz Wincenty 2008). However, such individuals could seek healing at holy places, *e.g.*, at tombs of saints, as well as seek help and protection from dukes and royals (*Legenda świętej Jadwigi* 1993). On the basis of textual sources, we have distinguished three types of disability, due to mobility difficulties, an abnormal posture, and blindness, which can be associated with disabilities observed in skeletons of the individuals from Culmen. The hagiography of Saint Hedwig describes three males who were paralysed and called 'cripple' (*Legenda świętej Jadwigi* 1993). In Culmen, we identified an individual from Grave 5/03 with paralysis, who could have been considered disabled. This supports the approach according to which interdisciplinary research, combining the textual analysis with osteological examinations, is crucial for identification of disabled people in archaeological records.

Textual sources indicate that in mediaeval Poland some adults were disabled. The analysis of osteological materials from Culmen confirms this observation. At Culmen, adults were more often disabled than children. This may be related to the fact that adults lived longer, so diseases could leave pathological lesions in their bones, whereas children died earlier. The occurrence of disability in males (N=3) and females (N=4) was almost equal. Research on individuals with disabilities from various periods and locations show that these problems affected males and females alike (*e.g.*, Dettwyler 1991; Pany and Tescher-Nicola 2007; Buquet-Marcon *et al.* 2007; Palkovich 2012; Tilley and Oxenham 2012; Boutin 2016; Lovell 2016; Roberts 2017; Schrenk and Martin 2017; Willett and Harrod 2017). However, we do not know the sex, age and prevalence of disability and pathological lesions in their respective populations.

5.2. Covenants and constraints

The fact that disability due to mobility difficulties was the one most frequently observed in the osteological materials from Culmen may result from the situation that we can only study the skeleton, which is a part of the locomotor system. Out of 661 skeletons, only eight displayed lesions connected to disabilities. This is due to the fact that disability is very often assessed on the basis of the most apparent symptoms, such as blindness or lameness (Ginsburg and Rapp 2013). Many diseases and disabilities do not leave traces on the bones, and thus, it is impossible to identify them (Roberts 2002). This mostly concerns diseases affecting soft tissues, acute infections, blindness, and lameness. We also have to bear in mind that infectious diseases could kill people at a young age without leaving any pathological lesions in their skeletons. While those who had stronger immune system and survived to a more advanced age could have other diseases, *e.g.*, DJD, that left lesions in their bones (Wood *et al.* 1992).

Even when we have bones with pathological lesions, we have to be careful with an assessment of disability and disease because diseases like advanced DJD might be asymptomatic (Roberts and Manchester 2010), whereas an individual may complain of severe pain despite the fact that they have no degenerative changes (Rogers and Waldron 1995; Bedson and Croft 2008; Waldron 2012). Early-mediaeval people performed many activities related to physical work; for example, they worked in the fields, or were craftsmen or warriors. Pain associated with DJD could be very nagging with hard physical work. On the other hand, these people could be more accustomed to pain and thus, they could accept it and live with it, contrary to people of the 21st century. For this reason, we should not rely solely on biological definitions of disability, and we need textual sources to guide us in defining what disability was at that time.

6. CONCLUSIONS

This interdisciplinary study is the first that analyses in such detail people with disabilities on a population level in the mediaeval period in Central Europe. It presents a detailed and in-depth analysis of 661 individuals in Culmen, including eight individuals with disabilities whose skeletal remains were discovered at a cemetery at the foot of Mount Saint Lawrence in Kałdus. The textual sources suggest three groups of disabilities, which we identified in osteological materials from Culmen. They include disability due to mobility difficulties, an abnormal posture, and blindness. The number of adults with disabilities was higher than that of children, because they lived longer than children. Thus, they were exposed to diseases for a longer time and this led to the development of more advanced diseases and health conditions, resulting in disability and leaving pathological lesions in their skeletons. This study contributes to the growing body of literature about disability in archaeology and in the Slavic world, and reveals a hitherto overlooked aspect of the life of mediaeval populations. It should help to better understand the daily life of individuals in the Middle Ages. Only interdisciplinary research, combining palaeopathology with textual analysis, could provide more evidence on who was perceived as disabled at that period. While our study remains preliminary, its findings would definitely benefit from analyses of the social status of people in Culmen with disabilities, enabling better understanding of their position in this society. The protocol for studies on disability in archaeology presented by us can be applied to other archaeological contexts, also to sites outside Poland, from historical periods of time. The analysis of disability using more populations and textual sources from the mediaeval period and other parts of Europe can provide a bigger picture of who was perceived as a disabled member of a community in that period.

Acknowledgements

We would like to thank Marcin Weinkauf for providing the map of the archaeological sites and Jane Buikstra and anonymous reviewers whose comments contributed to the improvement of this article. The article was prepared under grant No. UMO-2014/13/N/HS3/04602 of the National Science Centre, realised in the former Department of Anthropology of the Faculty of Biology and Environmental Protection (currently the Faculty of Biological and Veterinary Sciences) of Nicolaus Copernicus University in Toruń, entitled 'The Ill and the Impaired in Early Medieval (10th-13th century) Poland. A case study of the sites from Kałdus (Kuyavian-Pomeranian voivodship)'.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3488

FIELD SURVEY AND MATERIALS

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FLAKED LITHIC ARTEFACTS FROM PARADIMI AND KROVILI (THRACE, NORTHERN GREECE). REMARKS FROM THE 2020 SURFACE INVESTIGATIONS

ABSTRACT

Pelisiak A., Urem-Kotsou D., Dębiec M., Matsas D. and Chrysafakoglou P. 2023. Flaked lithic artefacts from Paradimi and Krovili (Thrace, Northern Greece). Remarks from the 2020 surface investigations. *Sprawozdania Archeologiczne* 75/2, 225-250.

The paper presents flaked lithic materials from two tell-type Neolithic sites Paradimi and Krovili located in Eastern Thrace. They were obtained during systematic and detailed surface surveys. All the collected lithic materials were examined and described. Some conclusions about processing and sources of raw materials were presented along with comparisons to other Neolithic sites in northern Greece.

Keywords: Greece, Aegean Thrace, Neolithic, Paradimi culture, flaked lithic artefacts, raw material
Received: 20.05.2023; Revised: 14.08.2023; Accepted: 02.09.2023

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INTRODUCTION

This paper presents the results of the analysis of lithic finds discovered during the archaeological surface surveys at the Neolithic settlements of Paradimi and Krovili in Aegean Thrace, province of Rhodope (Fig. 1). The sites are located southwest (Paradimi) and southeast (Krovili) of Komotini, the capital of the province. Both settlements are tell-type sites.

The settlement at Paradimi was initially investigated by S. Kyriakidi and E. Pelekidi with a trial trench in 1929-1930, and it was dated by pottery to the end of the Middle Neolithic and the Late Neolithic. In 1965, G. Bakalakis undertook stratigraphic excavations with a single trench uncovering 4.5 m-thick deposits that confirmed the habitation of the settlement during the Late Neolithic and the Early Bronze Age (Bakalakis and Sakellariou 1981). These early excavations made Paradimi an eponym for the Neolithic in Aegean Thrace, characterising what became known as the "Paradimi culture" (Matsas 2017). A new trench was opened in 1997 by D. Matsas and K. Gallis, but its excavationmade no significant progress (Matsas 2003). In spite of the importance of Paradimi for investigations of the Neolithic period in Aegean Thrace, apart from pottery and other forms of portable materials (*e.g.*, lithic tools, figurines), the excavations have provided little evidence for the architecture and intra-site organisation of the settlement.

The Neolithic settlement at Krovili is situated in Papa-Ampelia, close to the modern village of Krovili. Excavations have yet to be conducted here, but the site was investigated in 2004 with six borehole cores by A. Ammerman and N. Efstratiou. According to the surface pottery, they dated the site to the Middle Neolithic. Borehole cores revealed up to 4m-thick archaeological deposits. The samples of charcoal found in drilling cores date the earliest habitation of the settlement to *c.* 6000 BC and the later to 5400 BC (Ammerman *et al.* 2008), that is from the late phase of the Early Neolithic to the beginning of the Late Neolithic in Greece (Andreou *et al.* 2000: 260, table 1). A Systematic surface survey undertaken by the team of the MapFarm project confirmed later habitation of the settlement in the early phase of the Late Neolithic (5400-4900 BC).

Systematic and detailed surface surveys on both sites were carried out in 2020, within an ongoing project entitled "Mapping the early farmers in Aegean Thrace" (MapFarm, see https://mapfarm.he.duth.gr) (Urem-Kotsou *et al.* 2022) (Fig. 2).

MATERIAL

Detailed surface surveys carried out in 2020 resulted in the discovery of 407 lithic artefacts, 40 in Paradimi and 367 in Krovili. Several kinds of flakeable raw materials were recognized among the materials. Moreover, each type of them contains variants which differ from one another in colour, transparency, cleaveage, presence or absence of intrusions, and varying usefulness for flaking (Table 1).

Fig. 1. Location of the two investigated sites

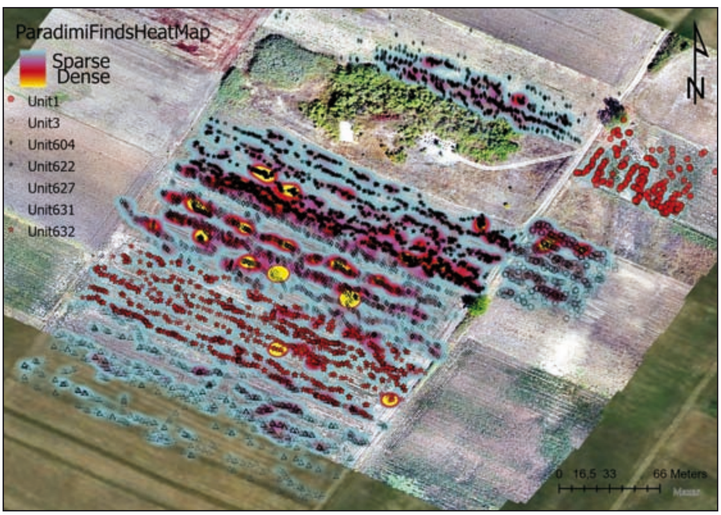

Fig. 2. Distribution and density of archaeological finds per field at Paradimi site (Sgouropoulos *et al.* 2022, fig. 6)

Table 1. Cumulated raw material composition of artefacts from survace surveys in Paradimi and Krovili

No	Raw material	Paradimi	Krovili	=
1	green stone		4	**4**
2	green jasper		2	**2**
3	white quartz	11	12	**23**
4	greenish quartz		1	**1**
5	light-pink quartz	1		**1**
6	grey translucent chalcedony		6	**6**
7	light grey, translucent chalcedony	4	51	**55**
8	light yellowish translucent chalcedony	1	97	**98**
9	dark grey, translucent chalcedony		1	**1**
10	blue-grey translucent chalcedony		1	**1**
11	black non translucent chert		1	**1**
12	black translucent chert	1	15	**16**
13	dark brow translucent chert,	4	41	**45**
14	brown translucent chert	2	24	**26**
15	brown stripped chert		1	**1**
16	grey and greenish stripped non translucent chert		1	**1**
17	yellow chert	1	1	**2**
18	dark grey non translucent chert		2	**2**
19	red non translucent chert	1	1	**2**
20	red-brown non translucent chert		3	**3**
21	green-grey non translucent chert	1	3	**4**
22	light grey, non translucent chert	4	69	**73**
23	light grey stripped non translucent chert	1	2	**3**
24	grey non translucent chert		7	**7**
25	green slightly translucent chert		3	**3**
26	green non translucent chert		2	**2**
27	overheated undefined	8	9	**17**
28	lithic undefined		7	**7**
	Sum	**40**	**367**	**407**

Paradimi 2020

Natural pieces of raw material

Two pieces were found: one of white quartz and one of brown translucent chert.

Chunks with traces of flaking

Three specimens were recorded: one of light grey translucent chalcedony (diameter 34 mm), one of red non-translucent chert (diameter 36 mm) and one of light grey non-translucent chert (diameter 112 mm).

Single platform blade cores

One single platform blade core made of black translucent chert has a prepared striking platform, sides and a back, and changed orientation of flaking. In the last stage it was used for making of flakes.

Single platform microblade cores

One microlithic single platform blade core with repeatedly changed orientation of flaking, made from light grey, non-translucent chert (Fig. 3: 1).

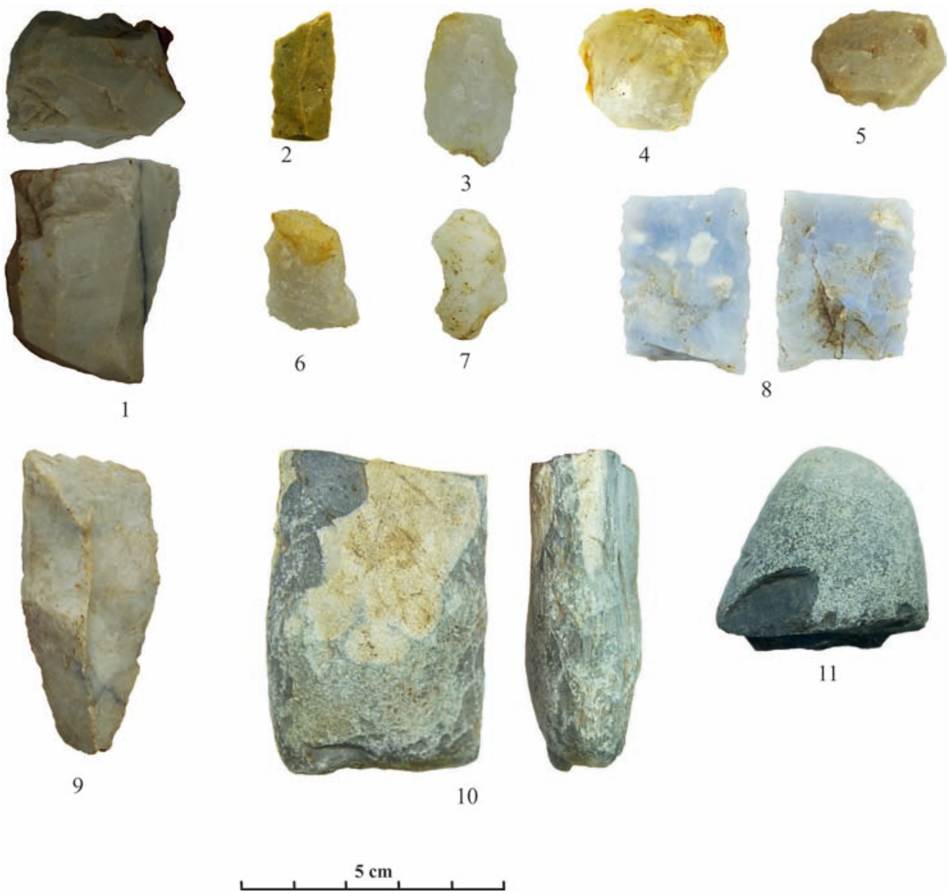

Fig. 3. Paradimi. 1 – microlithic single platform blade core light grey, non translucent chert; 2 – fragment of blade, light grey creamy chert; 3 – double front bifacial splintered piece, quartz; 4 – fragment of overheated splintered piece; 5 – round end-scraper on, quartz; 6 – truncated blade, quartz; 7 – fragment of irregular retouched flake, quartz; 8 – fragment of retouched blade; quartz; 9 – truncated blade+burin from blade, light grey chert; 10 – fragment of bifacial axe, green chert; 11 – fragment of axe or shaft-hole axe (Photo M. Dębiec, prepared by A. Pelisiak)

+50% cortical flakes

One flake of this category (dimensions: 42 × 36 × 13 mm) was made from light grey non-translucent chert; it is straight in profile and has a distinct bulb and a linear butt.

-50% cortical flakes

One flake (dimensions: 61 × 42 × 12 mm) made from brown translucent chert, curved in profile with a distinct bulb and a flat butt.

Unidirectional flakes

Three unidirectional flakes were discovered: one of light yellow translucent chalcedony (dimensions: 22 × 32 × 7 mm; straight in profile, with a diffuse bulb and flat butt), one of dark brown translucent chert (dimensions: 25 × 14 × 6 mm, straight in profile with distinct bulb and linear butt), and one of undefined lithic raw material (dimensions: 21 × 27 × 8 mm, curved in profile with a diffuse bulb and a linear butt).

Multidirectional flakes

In this group one specimen was made from light grey translucent chalcedony, and four from undefined lithic raw material. Their length varied from 24 to 39 mm (average 29.2 mm), width from 27 to 45 mm (average 33.8 mm) and thickness from 7 to 12 mm (average 8.2 mm). One flake is curved, four specimens are straight in profile. They have a distinct bulb and a linear (4) or flat (1) butt.

Fragments of flakes

Flakes preserved in small fragments were made from white quartz (1), light pink quartz (1), dark brown translucent chert (2), light grey striped non-translucent chert (1), and an undefined lithic raw material (1).

Blades

Only two specimens were found: one proximal and mesial part of an irregular blade with a partly natural surface, a flat butt and a distinct bulb, dimensions 43 × 20 × 10 mm, made from dark brown chert, and the mesial part of a regular, small blade, dimensions 24 × 12 × 4 mm, made from light grey creamy chert (Fig. 3: 2).

Splintered pieces

Two splintered pieces were made from white quartz: a double-front bifacial splintered piece with sharp fronts, dimensions 29 × 18 × 9 mm (Fig. 3: 3), and a fragment of flake or splintered piece, dimensions 28 × 19 × 7 mm. There was also one fragment of an overheated splintered piece of undefined lithic raw material (Fig. 3: 4).

Lithic tools

Seven specimens are of white quartz. Two end-scrapers: one round end-scraper made of splinter with a steep front, dimensions 23 × 30 × 12 mm, and a round end-scraper on flake, dimensions 25 × 19 × 5 mm (Fig. 3: 5); one truncated blade with convex truncation made from an irregular blade, dimensions: 23 × 13 × 5 mm (Fig. 3: 6); three fragments of retouched flakes: one fragment of crushed retouched flake, diameter 18 mm; one fragment of irregular flake with one edge retouched on the dorsal side (Fig. 3: 7); one fragment of a multidirectional flake, one edge retouched on the dorsal face, dimensions 27 × 33 × 9 mm;

one irregular blade, one edge partly irregularly retouched on the dorsal side, straight in profile, faceted butt, dimensions 42 × 18 × 6 mm.

Two tools were formed from light grey, translucent chalcedony: one fragment of retouched flake; one mesial part of a regular retouched blade, both edges with bifacial retouch and slightly glossy polishing, dimensions 34 × 25 × 11 mm (Fig. 3: 8).

One tool is of light grey, non-translucent chert, a truncated blade+burin formed from a regular curved blade from a single platform blade core with a flat prepared butt, one edge retouched on the dorsal side, dimensions 60 × 28 × 14 mm (Fig. 3: 9).

One tool is of green-grey non translucent chert. It is mesial and close to cutting edge fragment of a bifacial axe retouched on the whole surface, dimensions 62 × 44 × 22 mm (Fig. 3: 10).

Other tools

This group contains:

Seven polished axes and their fragments made from green stone: a fragment of a polished axe; a quadrilateral axe completely polished, cutting edge destroyed, butt broken off, dimensions of preserved part 74 × 42 × 17 mm; a crushed fragment of the butt and one edge of a polished axe; a small fragment of polished axe; a fragment of a side of a polished axe.

Dimensions of preserved part 38 × 50 × 16 mm; fragment of axe or shaft-hole axe, butt is rounded, polishing on all preserved surfaces, dimensions of preserved part 38 × 43 × 33 mm (Fig. 3: 11); fragment of the cutting edge of an axe.

Also found were: one probable fragment of a stone polished chisel; one spherical, regular grinding stone, dimensions 68 mm; one fragment of a spherical grinding stone; one natural stone pebble without traces of use; one fragment of a longitudinal hammerstone with polished sides and butt, working part broken off, dimensions 134 × 54 × 46 mm; one fragment of a probably longitudinal pestle with polished sides and crushed working part, dimensions 98 × 50 × 44 mm; one fragment of a polished pebble, dimensions 57 × 40 × 32 mm; one fragment of a stone pebble with traces of polishing, dimensions 58 × 30 × 26 mm; two fragments of polished stone plates.

Krovili 2020

Natural pieces of lithic raw material

This group contains the following pieces of raw material: two of white quartz (33 and 47 mm in diameter), one of greenish quartz (55 mm in diameter), one of grey translucent chalcedony (55 mm in diameter), one of light grey translucent chalcedony (42 mm in diameter), six of light yellowish translucent chalcedony (from 20 to 38 mm in diameter), three of black translucent chert (from 35 to 46 mm in diameter), eight of dark brown translucent chert (from 29 to 49 mm in diameter), five of light grey non-translucent chert (from 18 to 86 mm in diameter), and one of green translucent chert (43 mm in diameter).

Chunks with traces of flaking

Chunks with traces of flaking constitute one of the largest group of lithic artefacts. It contains: one chunk of green stone (diameter 47 mm), four of white quartz (dimensions from 28 to 33 mm, average 30 mm), one of grey translucent chalcedony (diameter 48 mm), five of light grey translucent chalcedony (dimensions from 28 to 50 mm, average 38.4 mm), eleven of light yellowish translucent chalcedony (dimensions from 32 to 48 mm, average 39 mm), one of dark grey translucent chalcedony (43 mm in diameter), three from black translucent chert (dimensions from 34 to 36 mm, average 35 mm), three from dark brown translucent chert (dimensions from 38 to 41 mm, average 39.5 mm), seven from brown translucent chert (diameter from 17 to 46 mm, average 34.3 mm), one of red non-translucent chert (diameter 55 mm), one of green-grey non-translucent chert (diameter 32 mm), four of light grey non-translucent chert (dimensions from 20 to 70 mm, average 44.25 mm), and two of an unidentified lithic raw material.

Single platform blade cores

Four specimens were discovered: two small fragments of cores; one irregular single platform blade core with a prepared striking platform, a flaking surface covers partly both sides of the core, from grey non-translucent chert (Fig. 4: 1); one fragment of probably a blade core, raw material undefined.

Single platform microcores

This group contains: one crushed used up flake microcore made from light yellowish translucent chalcedony; one single platform flake core, striking platform prepared from light yellowish translucent chalcedony; one fragment of flake microcore made from light yellowish translucent chalcedony; one worn up single platform microcore made from black translucent chert (Fig. 4: 2); one worn up microcore, light grey, from non-translucent chert with red patina.

Microcores with changed orientation of flaking

Seven specimens were found: one blade microcore with changed orientation of chipping, from translucent chalcedony; one microcore with changed orientation of chipping made from light grey, translucent chalcedony; one Microlithic blade/flake core with changed orientation of flaking, from light yellowish translucent chalcedony; one worn up microcore with changed orientation of chipping, striking platform prepared, from black translucent chert; one crushed and worn up core, from black translucent chert; one crushed worn up core with changed orientation of chipping in a last stage of use for flake removal, from black translucent chert (Fig. 4: 3); oneused up flake core with changed orientation of flaking, from dark brown translucent chert.

Flake cores and their fragments (6 specimens)

This category contains six artefacts: one flake core or chunk with traces of flaking with natural striking platform, sides and back, dimensions: 42 × 39 × 23 mm, from light grey translucent chalcedony; one flake core with natural striking platform made from light grey translucent chalcedony; one worn out single platform flake core with prepared striking

Fig. 4. Krovili. 1 – single platform blade core, grey non translucent chert; 2 – single platform microcore, black translucent chert; 3 – changed orientation core, black translucent chert; 4 – flake core, dark brow translucent chert or chalcedony; 5 – flake core, light grey, translucent chalcedony; 6 – flake core, dark brow translucent chert; 7 – flake core, dark brown translucent chert (Photo M. Dębiec, prepared by A. Pelisiak)

platform, from dark brown translucent chert or chalcedony (Fig. 4: 4); one crushed fragment of probably flake core (?), from dark grey non-translucent chert; one fragment of flake core, light grey, from non-translucent chert; one fragment of crushed core, of light grey non-translucent chert.

Fig. 5. Krovili. Discoidal flake core or Palaeolithic tool, size: 105 × 112 × 49 mm, made of light grey, translucent chalcedony (Photo M. Dębiec, prepared by A. Pelisiak)

Discoidal flake cores

Only one probably large discoidal flake core with a linear irregular striking platform (or a Palaeolithic tool), was discovered, dimensions 105 × 112 × 49 mm, of light grey translucent chalcedony (Fig. 5).

Flake cores with changes in orientation of flaking

This is a relatively large group of artefacts: one irregular flake core with changed orientation of flaking, from grey translucent chalcedony; one irregular flake core with changed orientation, linear striking platforms, of light grey translucent chalcedony (Fig. 4: 5); one crushed and worn up core, of black translucent chert; one crushed worn up core with changed orientation of chipping in a last stage of used for flake removal of black translucent chert; one used up flake core with changed orientation of flaking of dark brown translucent chert; one irregular flake core of dark brown translucent chert (Fig. 4: 6); one irregular flake core with changed orientation of flaking of dark brown translucent chert (Fig. 4: 7); one irregular flake core with changed orientation of flaking, from dark brown translucent chert; one fragment of irregular crushed core, from dark brown translucent chert; one fragment of crushed core, from dark brown translucent chert; one fragment of crushed core, from dark brown translucent chert or chalcedony; one (K64) irregular flake core with changed orientation and linear striking platforms, from a partly cortical chunk of dark brown translucent chert; one irregular changed orientation flake core of light grey non-translucent chert (Fig. 6: 1); one worn up core with changed orientation of flaking, from light grey non-translucent chert.

Flakes with +50% cortical or natural surface

Five specimens were discovered: two are of dark brown translucent chert (dimensions 40 × 38 × 24 and 42 × 13 × 11 mm), one straight and one curved in profile, both have a distinct bulb, one with a with natural butt, and the other with a linear butt; three are from light grey non-translucent chert (dimensions: 92 × 41 × 12 mm; 45 × 25 × 11 mm; 45 × 33 × 13 mm), one is straight in profile, two are curved in profile, one has a distinct bulb with a bulbar scar, two have diffuse bulbs, one with bulbar scar, they have a natural (2 specimens) or a linear butt.

Flakes with -50% cortical or natural surface

Two flakes are made from light yellowish chalcedony, dimensions: 28 × 35 × 10 (curved in profile) and 28 × 37 × 10 mm (straight), they have diffuse bulbs, one has a facetted butt and the other has a natural butt.

Unidirectional flakes (20 specimens)

This category consists of 20 artefacts: one crushed flake of white quartz, dimensions 24 × 23 × 5 mm; one of grey translucent chalcedony (dimensions 56 × 43 × 8 mm) is curved in profile and has distinct bulb with a bulbar scar and flat butt; two of light grey translucent chalcedony (dimensions: 28 × 39 × 8 mm and 34 × 28 × 7 mm) are straight in profile, have a distinct bulb and a linear and natural butt; four are of light yellowish translucent chalcedony, their length varied from 27 to 41 mm (average 34.25 mm), width from 18 to 32 mm (average 27.3 mm), thickness from 7 to 18 mm (average 11 mm), they are straight (2) or curved (2) in profile, all with a distinct bulb (one with bulbar scar) and a linear (1) or facetted (3) butt; two of dark brown translucent chert (dimensions: 21 × 38 × 7 mm; 22 × 27 × 8 mm), both straight in profile with a distinct bulb and linear or facetted butt; two from brown translucent chert (dimensions: 25 × 23 × 2; 14 × 20 × 12 mm), straight or curved in profile with a distinct bulb and a natural and facetted butt; five flakes are from light grey non-translucent chert, with lengths ranging from 24 to 36 mm (average 31.8 mm) widths from 24 to 45 mm (average 32 mm), and thicknesses from 7 to 10 mm (average 7.8 mm), straight (4) or curved (1) in profile, and four have a diffuse bulb (1 bulb is distinct), with a natural (2), linear (2) or facetted (1) butt; one specimen made from green non-translucent chert (dimensions: 33 × 24 × 9 mm) is curved in profile, with a distinct bulb and facetted butt; two specimens are partly crushes, and are overheated and made from undefined raw material.

Multidirectional flakes

This group contains 25 flakes: three specimens are made from light grey translucent chalcedony, their lengths are from 23 to 37 mm (average 29.67 mm), widths from 27 to 31 mm (average 29.3 mm), thicknesses from 5 to 13 mm (average 8 mm), they are straight (2) or curved (1) in profile, have a distinct (1) or diffuse (2) bulb and a flat (2, one natural) or facetted butt; nine multidirectional flakes are made from light yellowish translucent chalcedony, with lengths varying between 19 and 35 mm (average 28.89 mm), widths between 20 and 40 mm (average 31.1 mm), and thicknesses between 4 and 15 mm (average 8.33 mm), straight (5) or curved in profile (4), with a distinct bulb (4, 2 with bulbar scars) or a diffuse bulb, and a linear (7), facetted (1) or natural (1) butt; one specimen of dark brown translucent chert (dimensions 54 × 37 × 8 mm) is curved in profile with a distinct bulb and a facetted butt; five flakes are from brown translucent chert, with lengths varying between 23 and 39 mm (average 29.4 mm), widths between 16 and 37 mm (average 27 mm), and thicknesses between 3 and 11 mm (average 7.4 mm), straight (2) or curved (3) in profile, with a distinct (2) or diffuse (3) bulb, and a linear (3) or facetted (4) butt.

Six from light grey translucent chert are from 31 to 80 mm in length (average 49.7 mm), from 30 to 68 in width (average 41.7 mm), and from 7 to 25 in thickness (average 12.33 mm), straight (5) or curved (1) in profile, with a distinct (2) or diffuse (4) bulb, and a flat (1), linear (1) or facetted (4) butt; one from green slightly translucent chert (dimensions 21 × 37 × 8 mm) is curved in profile and has a diffuse bulb and a facetted butt.

Fragments of flakes (143 specimens)

These constitute the largest group of lithic artefacts from Krovili. It contains one specimen made of green stone, four of white quartz, one of grey translucent chalcedony, 23 of light grey translucent chalcedony, 53 of light yellowish translucent chalcedony, three of black translucent chert, nine of dark brown translucent chert, eight of brown translucent chert, one of brown striped chert, one of yellow chert, two of red-brown non-translucent chert, 21 of light grey non-translucent chert, four of grey translucent chert, two of green slightly translucent chert, and 10 made from undefined raw materials including seven overheated specimens.

Irregular blades

There are six artefacts: one straight blade with a destroyed butt and convex bulb, dimensions 41 × 18 × 17 mm, made from light yellowish translucent chalcedony (Fig. 6: 2); one specimen curved in profile with a partly natural surface from a single platform blade core with a punctated butt and a small distinct bulb, dimensions 53 × 25 × 11 mm, from dark brown translucent chert or chalcedony; one irregular bladelet from a single platform blade core with a linear butt and small convex bulb, dimensions 40 × 20 × 5 mm, from light yellowish translucent chalcedony, and three fragments of irregular blades, from light grey translucent chalcedony, light yellowish translucent chalcedony, and light grey non-translucent chert.

Blades and bladelets from single platform blade cores (3 specimens)

Only three such items were found: one proximal and mesial part of a regular bladelet from a single platform blade core with a linear butt and flat bulb, dimensions 35 × 18 × 5 mm, light yellowish translucent chalcedony (Fig. 6: 3); one straight in profile irregular blade with a linear butt and diffuse bulb, dimensions 42 × 17 × 5 mm, from light grey non-translucent chert (Fig. 6: 4); one distal part of a regular blade, dimensions 44 × 24 × 8 mm, from light grey non-translucent chert (Fig. 6: 5).

Crest blades of second series (1 specimen)

One crest blade of second series, dimensions 55 × 20 × 8 mm is from light grey non-translucent chert.

Splintered pieces

These constitute a distinctive group of lithic artefacts: one splintered piece with sharp edges, dimensions 31 × 16 × 9 mm, of white quartz (Fig. 6: 6); one splintered piece with one

Fig. 6. Krovili. 1 – changed orientation flake core, light grey non translucent chert; 2 – blade, light yellowish translucent chalcedony; 3 – bladelet fragment, light yellowish translucent chalcedony; 4 – blade, light grey, non translucent chert; 5 – fragment of blade, light grey, non translucent chert; 6 – splintered piece, quartz; 7 – splintered piece, light grey, translucent chalcedony; 8 – splintered piece, light grey, translucent chalcedony; 9 – splintered piece, light yellowish translucent chalcedony; 10 – splintered piece, light yellowish translucent chalcedony; 11 – splintered piece, black non translucent chert; 12 – splintered piece, brown translucent chert; 13 – end-scraper, light-grey stripped non translucent chert; 14 – splintered, brown translucent chert; 15 – end-scraper, light grey non translucent chert; 16 – end-scraper, light, translucent chalcedony (Photo M. Dębiec, prepared by A. Pelisiak)

Fig. 7. Krovili. 1 – quadrilateral axe, green stone; 2 – miniature, quadrilateral axe, green stone; 3 – fragment of axe cutting edge, green stone; 4 – fragment of axe, greenish stripped non translucent chert; 5 – end-scraper, light yellowish translucent chalcedony; 6 – end-scraper, light grey non translucent chert; 7 – blade end-scraper, green-grey non translucent chert; 8 – end-scraper or perforator, light grey non translucent chert (Photo M. Dębiec, prepared by A. Pelisiak)

working edge sharp opposite one blunt, dimensions 38 × 28 × 21 mm, of light grey translucent chalcedony (Fig. 6: 7); one specimen with one front sharp and the other blunt and rounded, dimensions 28 × 16 × 13 mm, of light grey translucent chalcedony (Fig. 6: 8); one fragment of a splintered flake, of light grey translucent chalcedony;one splintered piece made of crushed microcore, dimensions 28 × 28 × 14 mm, of light yellowish translucent chalcedony (Fig. 6: 9); one almost flat splintered piece with two sharp opposite striking edges, dimensions 23 × 24 × 6 mm, of light yellowish translucent chalcedony (Fig. 6: 10); one fragment of a splintered piece with retouched edges, of light-yellowish translucent chalcedony; one splintered piece with one front sharp and the other blunt and round, dimensions 36 × 27 × 20 mm, of black non-translucent chert (Fig. 6: 11); one irregular splintered piece, made of chunk, dimensions 42 × 28 × 15 mm, of dark brown translucent chert; one fragment of crushed splintered piece of dark brown translucent chert; one double platform splintered piece with sharp opposite fronts, dimensions 22 × 24 × 7 mm, of brown translucent chert (Fig. 6: 12); one double platform splintered piece with sharp opposite fronts, dimensions 31 × 23 × 8 mm, of brown translucent chert (Fig. 6: 14); one splintered piece made from unidirectional flake, sharp fronts, dimensions 30 × 22 × 11 mm, from light grey non-translucent chert.

Chips (3 specimens)

Chips represent light-yellowish translucent chalcedony (1 item), and dark-brown translucent chert or chalcedony (2).

Lithic tools

Tools in the lithic assemblage from Krovili are relatively numerous. There are nine categories of artefacts.

Axes

Seven axes were discovered: one flat quadrilateral axe wholly polished, with a rounded butt and destroyed cutting edge, dimensions 66 × 47 × 15 mm, of green stone (Fig. 7: 1); one miniature, quadrilateral axe, wholly polished with a rounded butt, dimensions 58 × 23 × 13 mm, of green stone (Fig. 7: 2); one fragment of a cutting edge of an axe made probably of green jasper, dimensions of preserved fragment 44 × 46 × 16 mm, probably of green jasper (Fig. 7: 3); one thinned and rounded butt of a bifacial axe probably of green jasper, dimensions of preserved fragment 44 × 45 × 14 mm; one mesial part of a bifacial wholly polished axe, dimensions of preserved part 54 × 41 × 18 mm of grey and greenish striped non-translucent chert (Fig. 7: 4); one crushed butt of a polished axe of green-grey non-translucent chert; one fragment of a polished axe, of light grey non-translucent chert.

Flake end-scrapers

Four specimens were found: one flake end-scraper with a semi-steep front, dimensions 33 × 41 × 11 mm, from light translucent chalcedony (Fig. 6: 16); one end-scraper made from irregular flake, with an irregular front, dimensions 64 × 49 × 18 mm, from light-grey striped non-translucent chert (Fig. 6: 13); one end-scraper made from irregular partly cortical flake, semi-steep irregular front, one edge with irregular retouch, dimensions 66 × 37 × 12 mm, of light-grey non-translucent chert; one rounded end-scraper made of large flake, regular front steep and semi-steep, dimensions 57 × 62 × 15 mm, of light grey non-translucent chert (Fig. 6: 15).

Blade end-scrapers

This group comprises one blade end-scraper with irregular semi-steep front, dimensions 27 × 18 × 5 mm, from light-yellowish translucent chalcedony (Fig. 7: 5); one blade end-scraper with irregular front, dimensions 28 × 18 × 8 mm, from light yellowish translucent chalcedony; one end-scraper made from an irregular blade with steep irregular front, one edge with irregular retouch on the dorsal side, dimensions 79 × 34 × 14 mm, from green-grey non-translucent chert (Fig. 7: 7); one end-scraper made from regular blade, irregular front, retouched one edge, dimensions 44 × 27 × 13 mm, from light grey non-translucent chert; one end-scraper made from a regular blade from a single platform blade core, front is regular semi-steep, one edge of the blade is irregularly retouched on the dorsal side, from light grey non-translucent chert (Fig. 7: 6); one fragment of end-scraper or perforator made of regular blade, the front of the tool is prepared with semi-steep irregular retouch, dimensions 38 × 33 × 11 mm, from light grey non-translucent chert (Fig. 7: 8).

Truncated pieces

One truncated piece made from an irregular blade, dimensions 42 × 30 × 18 mm, of light grey translucent chalcedony (Fig. 8: 4).

Perforators

There is one fragment of a perforator with a broken-off sting made from irregular flake, dimensions 48 × 36 × 20 mm, from light translucent chalcedony (Fig. 8: 3), and one irregular perforator made from flake, dimensions 62 × 32 × 11 mm, from light grey non-translucent chert (Fig. 8: 1).

Retouched flakes

This is the largest group of tools. It contains one irregular flake with retouched notch, on edge irregular retouch, dimensions 37 × 23 × 9 mm, of light translucent chalcedony (Fig. 8: 5); one fragment of flake partly with natural surface, one edge with irregular retouch on dorsal side, of light translucent chalcedony; one irregular flake with one retouched edge on dorsal side, dimensions 30 × 24 × 15 mm, of light grey translucent chalcedony; one fragment of irregular flake with one edge retouched on dorsal side, dimensions 25 × 47 × 15 mm, of light grey translucent chalcedony; one unidirectional retouched flake, dimensions 36 × 26 × 8 mm, of light grey non-translucent chert; one fragment of flake with one edge retouched on dorsal side, of light-grey non-translucent chert; one fragment of flake with one edge retouched on dorsal side, of light grey non-translucent chert; one multidirectional flake with alternate irregular retouch, dimensions 57 × 61 × 13 mm, of light grey non-translucent chert (Fig. 8: 2); one fragment of partly cortical flake with one edge (base) partly retouched, dimensions 36 × 40 × 11 mm, of light grey non-translucent chert (Fig. 8: 6); one multidirectional flake, flat butt, two edges partly retouched on dorsal side, dimensions 42 × 40 × 8 mm, of light grey striped non-translucent chert (Fig. 8: 7); one fragment of

Fig. 8. Krovili. 1 – perforator, light grey, non translucent chert; 2 – retouched flake, light grey, non translucent chert; 3 – fragment of perforator, light, translucent chalcedony; 4 – truncated piece, light grey, translucent chalcedony; 5 – retouched flake, light, translucent chalcedony; 6 – retouched flake, light grey non translucent chert; 7 – retouched flake, light-grey striped non translucent chert; 8 – retouched blade, grey non translucent chert (Photo M. Dębiec, prepared by A. Pelisiak)

flake with partly natural surface with irregular retouch of two edges, dimensions 60 × 48 × 10 mm, of light grey non-translucent chert.

Retouched blades (2 specimens)

There is one fragment of a curved irregular blade from a single platform blade core with one edge retouched, a facetted butt and a distinct bulb, of light grey translucent chalcedony, and also one overheated fragment of a crushed blade with one edge crushed with steep retouch on dorsal side, dimensions 35 × 30 × 12 mm, raw material overheated and undefined.

Backed bladelets

One backed bladelet, dimensions 23 × 11 × 3 mm, of red-brown non-translucent chert.

Retouched chunks (2 specimens)

Two specimens were found: one chunk with one edge retouched on one side, dimensions 42 × 28 × 19 mm, of light yellowish translucent chalcedony; and one chunk with irregular retouch of one edge, dimensions 33 × 30 × 18 mm, of light grey nontranslucent chert.

Jagged blade

One slightly curved irregular blade with partly natural surface, with jagged edges, butt is flat and prepared, dimensions 63 × 34 × 16 mm, of light grey striped non-translucent chert.

Blade with use retouch (1 specimen)

One mesial and distal part of a blade from a single platform blade core with use retouch of grey non-translucent chert was discovered, dimensions 28 × 18 × 6 mm (Fig. 8: 8).

DISCUSSION

The Neolithic lithic industry in northern Greece is known on the basis of material from benchmark sites in the knowledge of the Neolithic of south-eastern Europe, *e.g.*, Dikili Tash (Darcque *et al.* 2011, fig. 2; Kourtessi-Philippakis 2009, 306; Lespez *et al.* 2013, fig. 4), Makri (Efstratiou *et al.* 1998; Skourtopoulou 1998), Makriyalos (Pappa and Besios 1999; Pappa *et al.* 2013), Movropigi (Karamitrou-Mentassidi *et al.* 2015), Sitagroi (Dimitriadis and Skourtopoulou 2003; Dixon 2003; Kakavakis 2015; Tringham 2003), Anarghiri (Papadopoulou 2018; 2020). The materials from these sites provide good typological raw material, and chronological contexts for the materials from the surface research in Paradimi and Krovili. This applies in particular to those sites where large and diverse lithic inventories (*e.g.*, Sitagroi, Makri, Anaghiri) with numerous pieces of débitage (flakes, blades and their fragments, cores in various stages of their preparation or exploitation, lumps) and tools were discovered. Stone axes are common at the Neolithic sites (*e.g.*, Elster 2003a; 2003b; Ridley *et al.* 2000; Biskowski 2003). All items from Paradimi and Krovili (Tables 1, 2, 3) find their counterparts in the lithic inventories from the Neolithic and the Early Bronze Age sites listed above (*e.g.*, Karageorgiou 2016). Conversely, the materials from the excavations in Paradimi offer limited comparative possibilities in terms of typology, chronology and the lithic raw materials used. Unfortunately, in the excavations conducted in the first half of the 20th century the lithic materials were sometimes not treated with due attention, and their importance to the study of the prehistory of Greece was underesti-

Table 2. Paradimi. Composition of lithic artefacts

	Category of artefacts	**3**	**5**	**7**	**8**	**12**	**13**	**14**	**17**	**19**	**21**	**22**	**23**	**29**	**=**
Chipped artefacts	Natural pieces of raw material	1						1							2
	Chunks with traces of flaking			1						1		1			3
	Single platform blade core					1									1
	Single platform microblade core											1			1
	+50% cortical flakes											1			1
	-50% cortical flakes							1							1
	Unidirectional flakes				1		1							1	3
	Multidirectional flakes			1										4	5
	Fragments of flakes	1	1				2						1	2	7
	Fragments of blades						1		1						2
	Splintered pieces	2												1	3
	Lithic Tools	7		2							1	1			11
	SUM	**11**	**1**	**4**	**1**	**1**	**4**	**2**	**1**	**1**	**1**	**4**	**1**	**8**	**40**

mated. Only selected, "attractive" lithic artefacts were published, and sometimes little or no information about this group of artefacts was published (Kourtessi-Philippakis 2009, 32; Archibald *et al.* 2010-2011). Unfortunately, Paradimi is one of these Neolithic sites (Bakalakis and Sakellariou 1981). The small number of artefacts leads to the assumption that some of the lithic artefacts from this site were already "lost" during the excavations. In particular, this concerns debitage, which in the publication of this site is represented by only several items, and these are only blades and their fragments, tools and artefacts made of silex and obsidian (*e.g.*, Bakalakis and Sakellariou 1981, table 4b: 1, 3, table 5b: 4, 6, table 6a: 1, 2, 6-8, 10, table 18b:11-15, table 73a: 17-23).

In the Late Neolithic of northern Greece, a variety of lithic raw materials were used. Unfortunately, raw materials are sometimes not clearly identified. Sometimes the same raw material is noted under different names (*e.g.*, flint, chert, chalcedony) in different publications.

This creates some difficulties when comparing materials from different sites. These disadvantages are offset, to some extent, by descriptions of macroscopic features (colour, transparency, presence or absence of intrusions) and the fact that most of them are local raw materials. It should be noted, however, that this remark does not apply to obsidian and Balkan honey flints, which are raw materials with distinct macroscopic features.

The obsidian is rare or very rare, and as petrographic analysis suggests, the raw material for flaking was mostly of regional or local provenience (Dimitriadis and Skourtopoulou

Table 3. Krovili. Lithic chipped assemblage

Category of artefacts	Raw material																										
	1	2	3	4	6	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	28	29	30	=
Natural pieces of raw material			2	1	1	1	6			3	8									5				1				28
Chunks with traces of flaking	1		4		1	5	11	1		3	3	7					1		1	4						2		44
Single platform blade core																1						2				1		4
Single platform microcore							3			1										1								5
Microcores with changed orientation of flaking					1	2				3	1																	7
Flake cores and their fragments						1					**2**					1				2								6
Discoidal flake core						1																						1
Flake cores with changed orientation of flaking					1	1				2	8									2								14
Flakes with +50% cortical or natural surface											2									3								5

Category of artefacts	Raw material																											
	1	2	3	4	6	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	28	29	30	=
Flakes with - 50% cortical or natural surface							2																					2
Unidirectional flakes			1		1	2	4				2	2								5				1	2			20
Multidirectional flakes						3	9				1	5								6			1					25
Fragments of flakes	1		4		1	23	53			3	9	8	1		1			2		21		4	2		7	3		143
Irregular blades and bladelets						1	3				1									1								6
Blades and bladelets from single platform blade cores						1														2								3
Crest blade of second series																				1								1
Splintered pieces			1			3	3		1		2	2								1								13
Chips							1				2																	3
Lithic tools	2	2				7	3							1				1	2	15	2	1				1		37
Lithic sum	**4**	**2**	**12**	**1**	**6**	**51**	**98**	**1**	**1**	**15**	**41**	**24**	**1**	**1**	**1**	**2**	**1**	**3**	**3**	**69**	**2**	**7**	**3**	**2**	**9**	**7**		**367**

Table 4. Krovili. Lithic tools

Category of artefacts	Raw material											=
	1	2	7	8	16	20	21	22	23	24	28	
Axes	2	2			1		1	1				7
Flake end-scrapers			1					2	1			4
Blade end-scrapers				2			1	3				6
Truncated pieces								1				1
Perforators			1					1				2
Retouched flakes			4					6	1			11
Retouched blades			1								1	2
Backed bladelet						1						1
Retouched chunks				1				1				2
Jagged blade										1		1
Sum	**2**	**2**	**7**	**3**	**1**	**1**	**2**	**15**	**2**	**1**	**1**	**37**

2001; 2003; Kakavakis 2014; 2015, fig. 1, 37; Perlès and Vitelli 1999, 97; Sørensen 2010, 160, 164). Flaked assemblages from Sitagroi consist of artefacts made from chert, chalcedony quartz, honey Balkan flint, and so-called pebble flint (Dimitriadis and Skourtopoulou 2003; Dixon 2003; Tringham 2003). In Dikili Tash, chalcedony, quartz, rock crystal, jasper, and a variety of flints (Balkan flint) were used (Kourtessi-Philippakis 2009, 306).

The Neolithic lithic assemblage from Makri contains artefacts made from translucent or semitranslucent flints: milky-grey, yellowish, honey, black, and orange flints, and also opaque flints varying in colour from light blue-grey to grey and black. Their sources are located up to 30 km from this site, except for honey flint, whose natural deposits are located at greater distances (Efstratiou *et al.* 1998; Skourtopoulou 1998, 44). Moreover, local lithic production is confirmed by the presence of technical flakes, for example cores and rejuvenation flakes and blades in this assemblage (Efstratiou *et al.* 1998; Skourtopoulou 1998, 44).

In the lithic assemblages from Makriyalos, artefacts made from raw materials from various regional and non-regional sources were discovered, *e.g.*, from quartz, chert, jasper and flint (Pappa and Besios1999, 191; Pappa *et al.* 2013, 82). In Turkish Thrace, Edirne Region, mainly flint and quartz were used. Other flakeable raw materials are recorded in lesser quantities, with virtually no obsidian. Milky-brown flint, black flint of inferior quality, honey flint from Bulgaria, and dark brown flint were used (Burcin 2001).

It should be added that lithic assemblages from the sites dated to the Early Bronze Age from northern Greece are also characterized by a large variety of raw materials used: chalcedony of various colours; the share of honey flint decreases, and there are quartz and jasper (Kourtessi-Philippakis 2010, 173, 174; Karageorgiou 2016, Table 1). In the Early Bronze Age at Toumba, Thessaloniki, many variants of chert of different colours, chert, quartz, jasper, and chalcedony were used. Chert came from the vicinity of Vasilika and Galatista in Chalkidiki (Karageorgiou *et al.* 2016) At least part of the lithic raw materials in both the Neolithic and Early Bronze Age could have been obtained from the immediate vicinity of the sites in Paradimi and Krovili. Numerous blocks of quartz and chert of various dimensions (up to several dozen centimetres in diameter) are present on the surface of the ground. Easily accessible outcrops of various lithic raw material are located in the vicinity of Petrota, several kilometres from Krovili (Ammerman *et al.* 2008; Efstratiou and Ammerman 2004; Foltiadis *et al.* 2003; Kakavakis 2015, 38, 39; Kilias *et al.* 2006; Michailidou *et al.* 2020; Papadopoulou 2020). These sources of lithic raw material have been used since the Palaeolithic. It should be assumed that the Neolithic and Early Bronze Age communities, including those inhabiting the Paradimi and Krovili sites, obtained raw material there as well. Detailed physicochemical analysis of raw material used on both sites should be considered an important element of future research.

The analyzed lithic artefacts from Paradimi and Krovili came from systematic and detailed surface surveys. This has negative consequences for their chronological classification. It can be assumed with high probability that they are chronologically heterogeneous, and that these materials come from different periods of occupation of these locations. However, some observations are important for the knowledge of flint-making in these areas.

As already mentioned, all categories of artefacts have counterparts at Neolithic and Early Bronze Age sites in northern Greece, but it should also be noted that the material discovered on the surfaces of these sites also has its typological specificity. No items made of Balkan flints or obsidian were recorded in these collections. Regular blade cores are also absent. Moreover, a small number of regular blades from single platform blade cores were found there. Instead, a large number of highly exploited cores, including cores with changed orientation, were found. Splintered pieces are numerous. Most of half of the lithic assemblages from the surface survey at Krovili site constitutes different flakes and their fragments. Various flakes build clear evidence of *in situ* activities connected with the elaboration of flakeable lithic raw materials and the manufacturing of lithic tools. Moreover, numerous chunks with traces of flaking offers confirmation of testing of pieces of raw material for their suitability for processing. On the other hand, a large amount of material on the surfaces of both sites may be the result of the fact that in both cases they were covered by arable fields, and ploughing always has a destructive effect on archaeological sites.

Acknowledgements

We would like to warmly thank Chrysa Karadima, the Director of the Ephorate of Antiquities of Rhodope and Anna Mousioni, for their support in the study of lithic assemblages presented in this work. Also Mrs Konstantina Krioneridou for her help in solving practical issues. The study of lithic assemblages from Paradimi and Krovili has been undertaken as part of the MapFarm Research Project, which was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I.) under the '1st Call for H.F.R.I. Research

Projects to support Faculty Members & Researchers and the Procurement of high-cost research equipment grant' (Project Number: HFRIFM17-2187). We would like also to thank Keith Horechka for language corrections.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3674

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EARLY NEOLITHIC RED-PAINTED POTTERY FROM THE PRANDOCIN SITE, SOUTHERN POLAND. INDIRECT TRANSFER IN A TECHNOLOGICAL CONTEXT

ABSTRACT

Rauba-Bukowska A., Nowak M., Juźwińska G. and Moskal-del Hoyo M. 2023. Early Neolithic red-painted pottery from the Prandocin site, southern Poland. Indirect transfer in a technological context. *Sprawozdania Archeologiczne* 75/2, 251-283.

The paper presents the results of specialized research on a small collection of artefacts of the Linear Pottery Culture in southern Poland. Among the 27 pottery fragments discovered at the Prandocin Site 1, a few painted fragments were identified. Such kind of painting style directly relates to the Želiezovce group of this culture in western Slovakia. Painted vessels are rarely found in the context of the Linear Pottery Culture in Lesser Poland (Małopolska), which is why special attention was given to raw material and technological studies of the ceramics. The study aimed to answer the question of whether the painted vessel was produced locally or if it represents evidence of direct migration of people, objects, or ideas from the areas of present-day western Slovakia at the turn of the 6th and 5th millennium BC.

Keywords: Early Neolithic, red-painted ceramic, south-eastern Poland, Linear Pottery Culture, Transcarpathian contacts

Received: 11.12.2023; Revised: 11.12.2023; Accepted: 28.12.2023

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1. INTRODUCTION

The Linear Pottery Culture (LBK) in Poland is estimated to have emerged around 5350-5000 BC (Czekaj-Zastawny *et al.* 2020). This cultural unit is divided into three principal phases: early phase (phase I or Pre-Music-Note) spanning approximately 5300-5250 BC; a subsequent classic phase (phase II or Music-Note) lasting approximately from 5250-5100 BC, and a later phase (phase III or Želiezovce phase), occurring between 5100-5000 BC (Czekaj-Zastawny and Oberc 2021, 328, 329; Oberc *et al.* 2022; Moskal-del Hoyo *et al.* 2024, fig. 5, 6; Fig. 1). Generally, the cultural changes in the Lesser Poland (Małopolska) region during the evolution of the LBK followed a similar pattern to that in southwestern Slovakia (Czekaj-Zastawny 2017; Kadrow and Rauba-Bukowska 2017a).

Numerous objects made from obsidian and vessels with ornamentation reminiscent of Alföld Linear Pottery Culture (ALPC) discovered in southeastern Poland suggest direct interactions between communities on both sides of the Carpathian Mountains (Kaczanowska and Godłowska 2009; Czekaj-Zastawny and Rauba-Bukowska 2014; Kozłowski *et al.* 2014; Rauba-Bukowska 2014a; Czekaj-Zastawny 2017; Czekaj-Zastawny *et al.* 2017; Kadrow and Rauba-Bukowska 2017a; Rauba-Bukowska and Czekaj-Zastawny 2020). Around the transition between phases II and III, there was a significant influx of obsidian

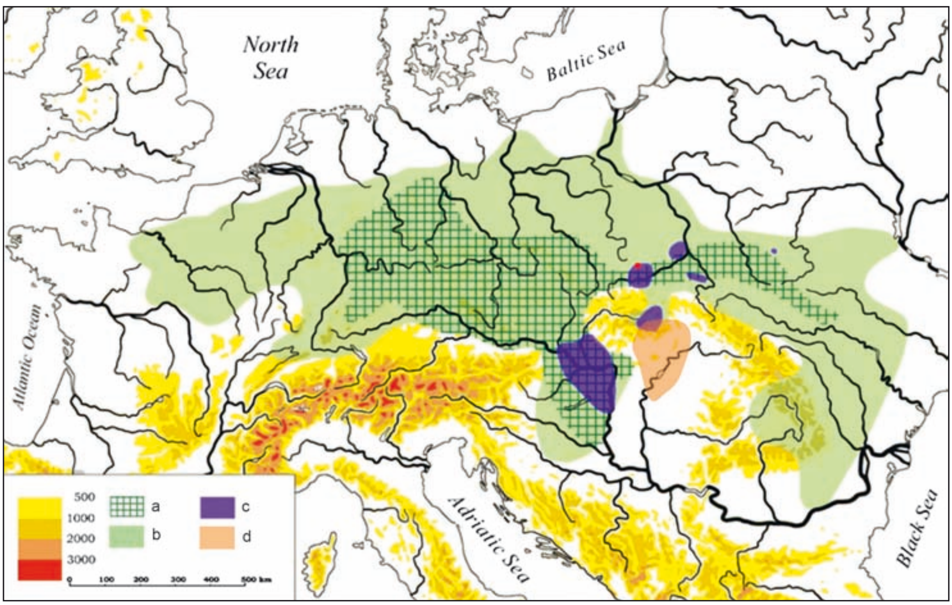

Fig. 1. Extent of the linear pottery culture (LBK) in Europe during the earliest phase (a); maximum extent (b); the Želiezovce group (in Slovakia and Pannonia), and clusters with pottery decorated in the Želiezovce style in south-eastern Poland and Volyn' (c); Bükk culture (d); location of the Prandocin site (red dot); (after Rauba-Bukowska and Czekaj-Zastawny 2020; Kadrow 2020). Drawing K. Juszczyk and A. Rauba-Bukowska

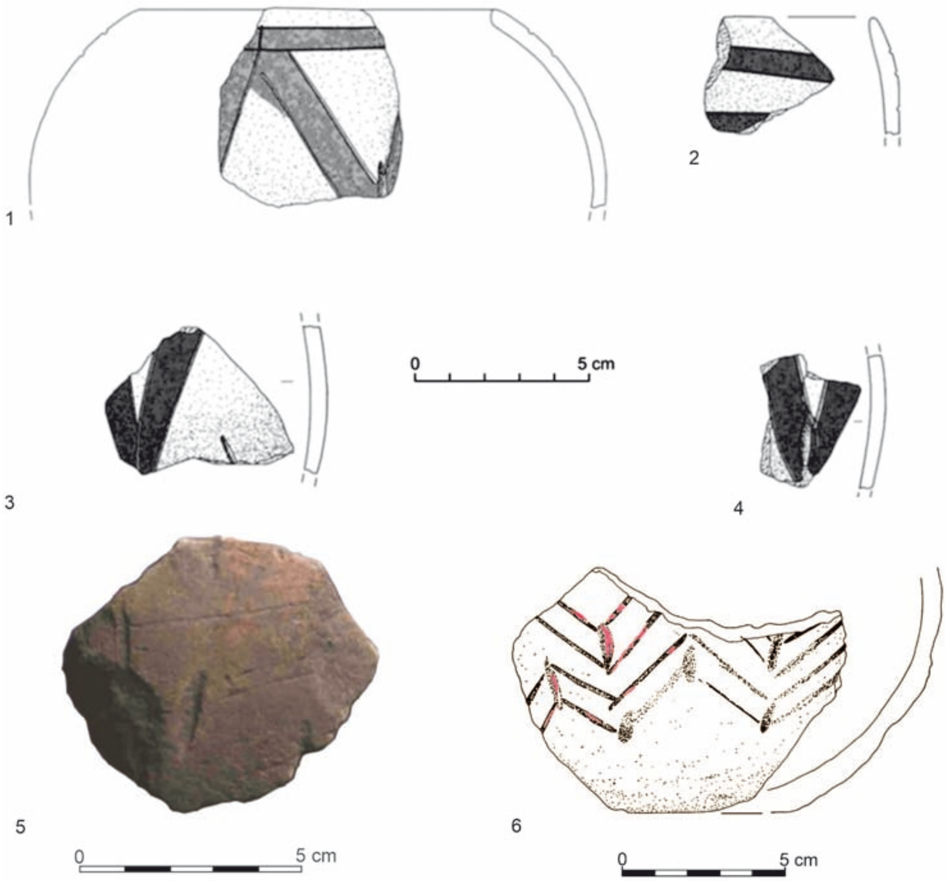

Fig. 2. Examples of Polish finds with red-painted pottery of the Linear Pottery Culture.
1-4 – Zwięczyca 3 (Dębiec 2014); 5 – Targowisko (Czerniak *et al.* 2006); 6 – Żerków (Valde-Nowak 2022).
Prepared by M. Nowak

that was imported from the Carpathian Basin. This surge in new raw materials was especially noticeable in the southeastern Poland, particularly in the vicinity of Rzeszów (Kadrow 1990a, fig. 14 and 17c; 1990b, fig. 26c; Szeliga 2007, 295-297, fig. 1). Concurrently, there was a notable uptick in the importation of ceramic vessels or local replication of the patterns associated with the ALPC, primarily originating from the upper Tisza area and linked to the Bükk culture (Kadrow 1990a, 59-63, fig. 14; Kaczanowska and Godłowska 2009). This influx of ALPC ceramics brought about changes in the technology employed for locally manufactured pottery during the late (III) phase of the Linear Pottery Culture (Kozłowski *et al.* 2014, 70; Czekaj-Zastawny *et al.* 2017; Szeliga and Zakościelna 2019; Dębiec *et al.* 2021; Rauba-Bukowska and Czekaj-Zastawny 2020).

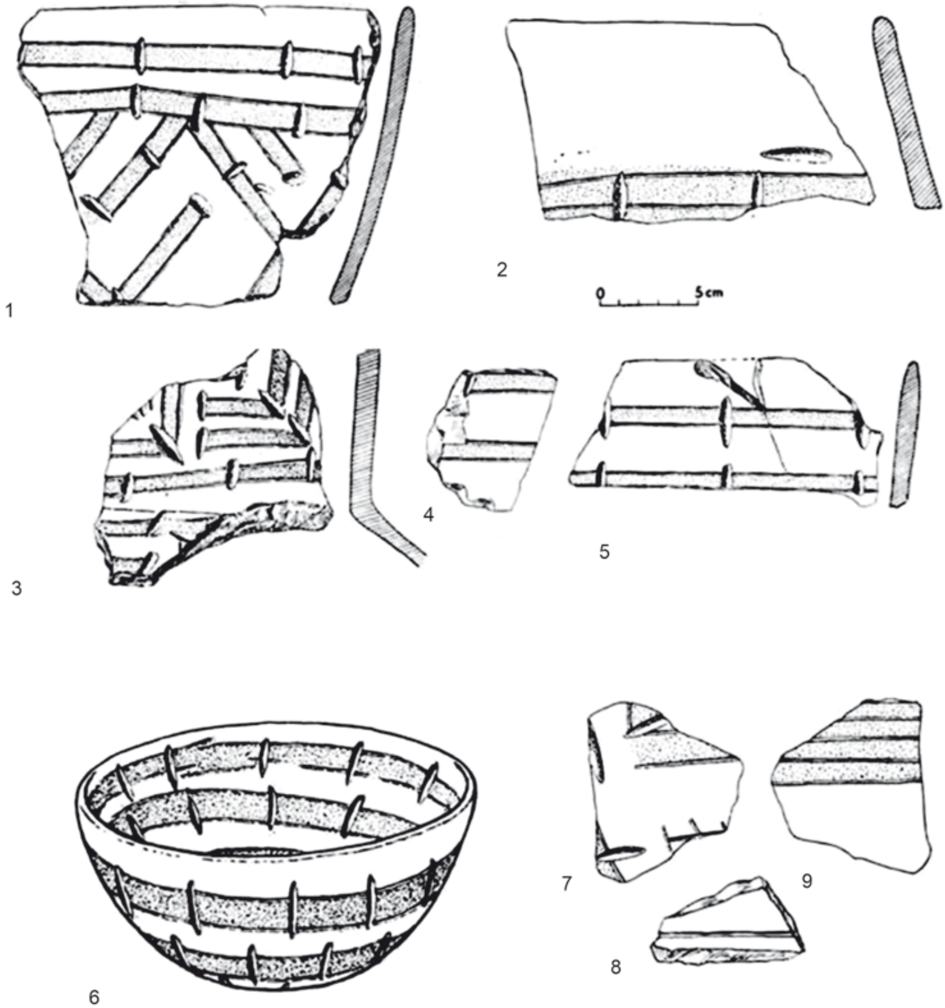

Fig. 3. Examples of finds with red-painted pottery of the Linear Pottery Culture from western Slovakia 1-9 (Štúrovo after Pavúk 1994). Prepared by M. Nowak

From the area north of the Carpathians in Poland, finds of Linear Pottery Culture (late phase/Želiezovce style) red-painted pottery fragments are known only from a few sites *i.e.*, Targowisko (Czerniak *et al.* 2006), Zwięczyca (Dębiec 2014), Kraków-Nowa Huta – Pleszów (Godłowska 1976), Żerków (Valde-Nowak 2022) and now from Prandocin (Fig. 2). In contrast, from the areas of southwestern Slovakia, this type of decoration is common on the sites of the contemporary Neolithic Želiezovce group (Pavúk 1969; 2009; Cheben 2000) (Fig. 3). Therefore, it can be assumed we are dealing with imports of ceramics or technology. In order to verify this issue, petrographic studies were carried out on the pottery samples from Prandocin. Raw material and technological analyses were conducted on pottery, and the results were compared with similar analyses of the pottery from the Želiezovce phase from Małopolska. Detailed analyses allowed for the determination of the mineral composition of ceramic fabrics. The arrangement of components, degree of clay processing, and approximate firing temperature were established. These data were correlated with geological information and the availability of suitable raw materials in the Prandocin site area. An approximate composition of the paint, which covered the surface of the vessel with a thin layer, was also determined.

These are the first microscopic studies for the painted pottery of the LBK from Poland. Determining the technological and raw material characteristics of this pottery is of great importance for further considerations regarding the transfer of objects, people, or ideas in the Early Neolithic in southeastern Poland.

Additionally, archaeobotanical analyses were performed for the soil samples taken from the filling of the LBK feature. Archaeobotanical research was carried out as part of a larger research program dedicated to the study of Early Neolithic agriculture in southern Poland and long-term effects of human activities on the landscape (Moskal-del Hoyo 2021; Moskal-del Hoyo *et al.* 2017a). New excavations, such as in Prandocin, offer opportunities to gain new plant remains that may lead to better documentation of the interactions between human communities and their environment.

2. CHRONOLOGY

Radiocarbon dating was not conducted on the materials from Prandocin. Stylistic characteristics of the ceramics suggest a cautious dating to a later phase of ŽII according to J. Pavúk's system (1969), and for the Polish territory, according to Kadrow (1990a; 1990b; 2022). This is indicated by the presence of painted decorations as well as ornamentation in the form of double lines and notches in angular arrangement, along with a repetitive line motif (Fig. 4: 1, 2, 3, 5, 6, 8). The diversity of ceramic vessel forms from Prandocin aligns with the general development trends of the Linear Pottery Culture in southern Poland. Fragments of typical spherical bowls dominate.

Table. 1. Relative chronology of red-painted pottery assemblages from southeastern Poland

Site	Chronology	References
Pleszów	ŽIIb	Godłowska 1976; Godłowska *et al*. 1985
Targowisko	ŽIIb	Czerniak *et al*. 2006
Zwięczyca	ŽIIb/ŽIII	Dębiec 2014
Żerków	ŽIIb	Valde -Nowak 2022
Prandocin	ŽIIb	

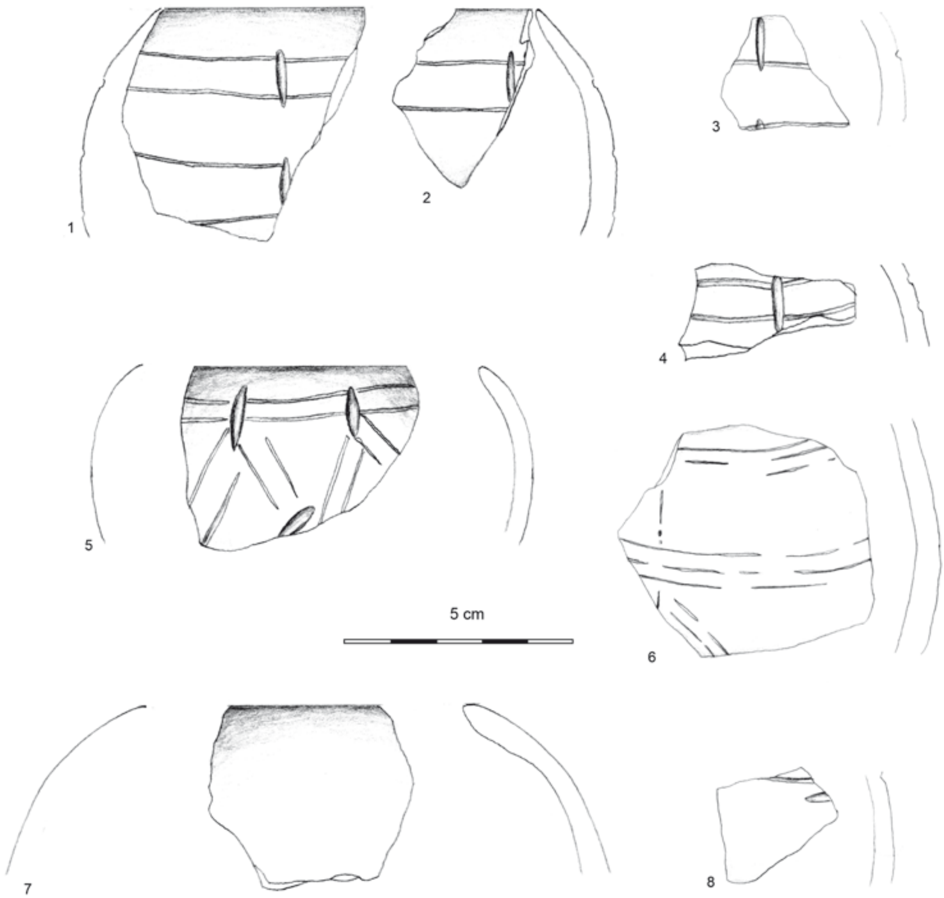

Fig. 4. Prandocin Site 1, Słomniki commune. Ceramic selection from Feature 54.
1, 2, 4, 5, 6 – thin sectioned fragments; 3, 8 – fragments of ornamented vessels; 7 – fragment of thin-walled vessels without ornamentation. Drawing W. Rumian and M. Nowak

As mentioned above, findings of ceramics with red painted decorations north of the Carpathians are only known from a few sites (Table 1). In Zwięczyca (Feature 661), fragments of vessels decorated with red paint, dated by the researcher (Dębiec 2014, 91) to the end of phase ŽIIb or even as a transitional phase between ŽIIb/ŽIII have been identified. However, it should be noted that, as of now, no material has been found in the Upper Vistula River basin that can be dated to phase ŽIII (Czekaj-Zastawny 2008a, 116; 2008b). Similarly, artefacts from Targowisko 3 (Czerniak *et al.* 2006), Kraków Nowa Huta – Pleszów (Godłowska 1976; Godłowska *et al.* 1985), and a vessel from Żerków are dated to phase ŽIIb, although the entire assemblage from which it comes is described as early Želiezovce phase (Valde-Nowak 2022).

For chronological assemblages in the Małopolska region, we have 21 radiocarbon dates from six sites. These sites include Biskupice 18 (Moskal-del Hoyo *et al.* 2024), Gwoździec 2 (Czekaj-Zastawny *et al.* 2020; Czekaj-Zastawny and Oberc 2021), Kraków Nowa Huta – Pleszów 17-20 (Oberc *et al.* 2022, 194), Łoniowa 18 (Valde-Nowak 2009, table 1, p. 23), Samborzec 1 (Kulczycka-Leciejewiczowa 2008, fig. 55, 104), and Żerków 1 (Valde-Nowak 2009, table 1, 23). Based on these data, sites in Małopolska with pottery decorated in the Želiezovce style are dated absolutely to a period beginning in the range of 5286-5216 BC (68.3%; 5339-5111 BC at 95.4%) and ending in the range of 5128-5022 BC (68.3%; 5175-4975 BC at 95.4%) (Oberc *et al.* 2022, 202). Similarly dated findings are from the Vráble site in western Slovakia (Furholt *et al.* 2020, 246). This confirms the contemporaneity of the development of the Linear Pottery Culture in Poland and western Slovakia.

3. THE SITE PRANDOCIN 1

The site was discovered in 1970 and later verified in 1997 during the survey within the Polish Archaeological Record (AZP) (Kruk 1970). The rescue excavations at site took place in spring 2021. In a trench 200 m long and 1.4 width, 74 features were revealed. Just one of them – Feature no. 54, is related to the LBK.

Prandocin Site 1 is situated in the Miechów Upland (Kondracki 2002, 264-265) within the drainage basin of a left bank tributary of the Szreniawa River (Fig. 5). The Miechów Upland is composed of hills with elevations ranging from 280 to 360 metres above sea level (50-100 metres in relative height), separated by basins and river valleys. The geological composition of the site's surroundings is dominated by Cretaceous and Quaternary formations. The prevailing features of the recent landforms are loess covers, sometimes forming loess plains. They are widespread in the discussed area, overlaying pre-existing landforms. Loesses represent the entire period of the North Polish glaciations, extending up to the Holocene, with a thickness reaching 20 metres (Boratyn and Brud 2001). In the immediate vicinity of the site, there are Holocene sediments of lower river valleys and peaty sediments, Pleistocene loesses, and Cretaceous marls, sometimes containing phosphorites, marls, sandy marls, glauconite-bearing sands, limestones, and glauconite-bearing limestones (Fig. 5).

The site is located in the temperate climate zone. In the Miechów Upland the mean temperature in January is between -4°C and -2°C, whereas in July the mean temperature is 17-18°C. The region is characterised by a relatively low average annual precipitation, which usually does not exceed 600 mm (Latałowa 1976; Pająk ed. 2012). The area of the archaeological site is deforested and urbanised, therefore, the current natural vegetation is strongly influenced by human presence. The maps of potential natural vegetation (Matuszkiewicz 2008) indicate that the main woodlands in this zone are oak-hornbeam forests (*Tilio-Carpinetum*) accompanied by patches of open oak forest (*Potentillo albae-Quercetum typicum*).

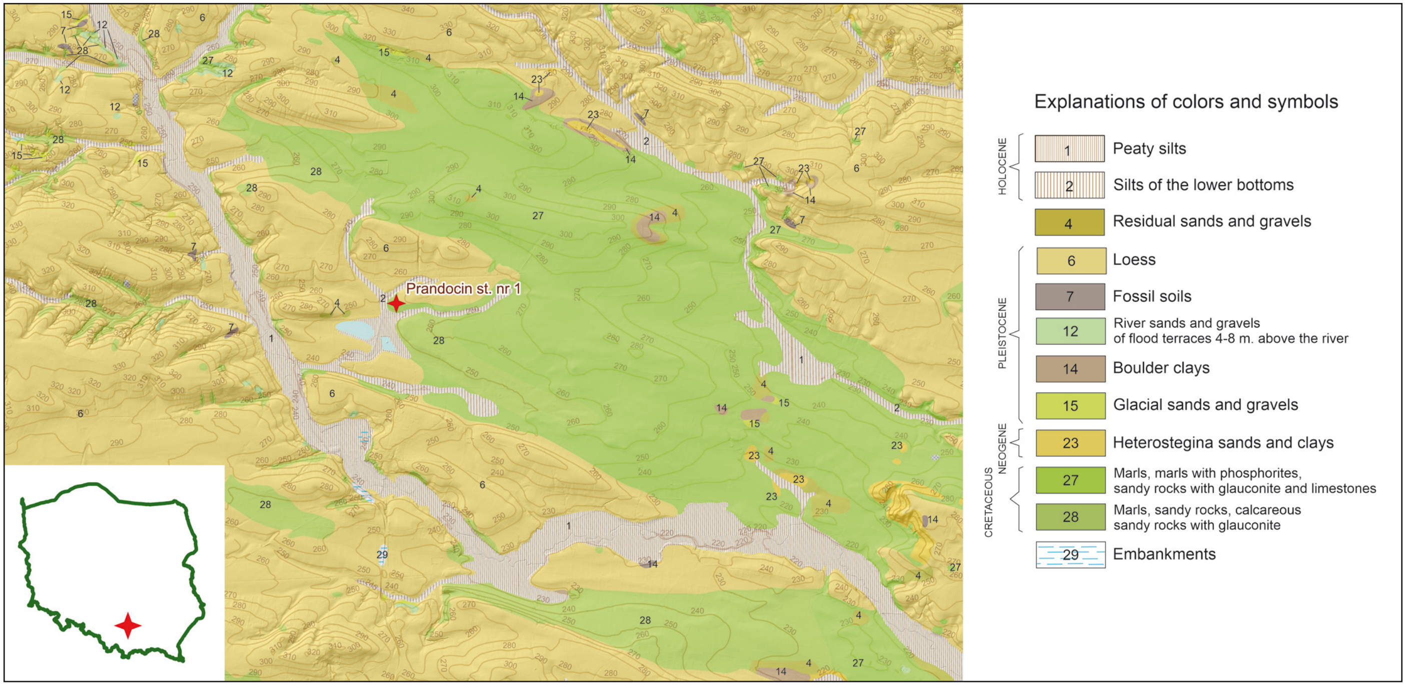

Fig. 5. Prandocin Site 1. Location against the geological background. Drawing K. Juszczyk, A. Rauba-Bukowska

4. METHODS AND MATERIALS

4.1. Archaeology

The characterization of the pottery was conducted based on numerous publications, including synthetic works (*e.g.*, Kulczycka-Leciejowiczowa 1979; 1983; Kadrow 2020a; 2020b; 2020c) and site monographs (*e.g.*, Godłowska 1991; 1992; Kadrow 1991; Pavúk 1994; Czekaj-Zastawny *et al.* eds 2021). In its description, the state of preservation of the artefacts (size of fragments) was determined, vessel forms were reconstructed, and the dimensions of the diameter of the rims and bases were estimated. Regarding ornamentation, the decorative motifs and their execution were specified. Macroscopic observations were made, taking into account the surface colour, its character, fractures, visible impurities, and the thickness of the outer crust of the pottery. The artefacts were assigned to the technological groups distinguished in Małopolska.

The outline of Feature no 54 had been identified after removing the topsoil approximately 50 cm thick. At this level, the pit was shaped like a rectangle with rounded corners. The preserved dimensions were 1.3 × 1.3 m, and its profile resembled a shallow basin (Fig. 6). In the feature's upper part, a concave layer was distinguished, associated with a younger,

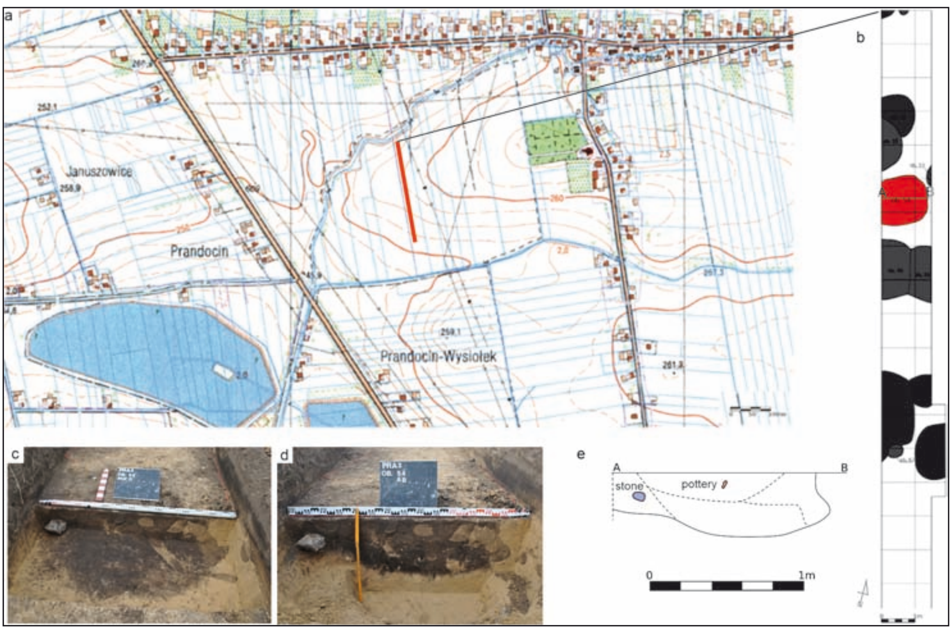

Fig. 6. Prandocin Site 1, Słomniki commune. Localization of the excavation site (a); excavation plan (b); photographs of the feature during excavation (c); cross section photographs (d) and drawing (e) of Feature 54. Drawing K. Spytkowska, prepared by A. Rauba-Bukowska and M. Nowak

Table 2. Prandocin 1. List of the samples and mineral composition; value in percentages

Symbol of the sample	**Pran01**	**Pran02**	**Pran03**	**Pran04**	**Pran05**	**Pran06**	**Pran08**
Site	Prandocin 1	Prandocin 1	Prandocin 1	Prandocin 1	Prandocin 1	Prandocin 1	Prandocin 1
Locality	Feature 54	Feature 55	Feature 56	Feature 57	Feature 58	Feature 59	Feature 61
Cultural afiliation	LBK III	LBK III	LBK III	LBK III	LBK III	LBK III	LBK III
Clay minerals	45.2	46.0	39.8	39.6	45.9	41.00	0.00
Carbonate mud	0.00	0.00	0.00	0.00	0.00	0.00	54.3
Glauconite	0	1.2	1.2	1.2	0.6	0	5.1
Grains of silt fractions	20.7	10.0	8.2	9.2	22.9	22.2	0.6
Quartz	27.9	32.2	34.7	38.0	21.7	24.6	4.8
Potassium feldspars	0.7	0.9	0.7	0.8	0.6	1.0	0.0
Flint / chalcedony	0.0	0.3	0.0	0.8	0.3	0.0	0.0
Fragments of sedimentary rocks	0.0	0.0	0.0	0.0	0.0	0.7	28.4
Fragments of igneous rocks	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fragments of metamorphic rocks	0.0	0.0	0.2	0.0	0.6	1.0	0.0
Muscovite	1.4	0.6	1.2	1.6	1.9	1.7	0.0
Opaque minerals	0.0	0.3	0.7	0.4	0.0	0.0	0.0
Iron oxides and hydroxides	0.0	0.0	0.0	0.4	0.0	0.0	2.7
Grog	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Clay pellet	0.0	0.0	0.0	0.0	0.3	0.0	1.2
Isotropic clasts	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Organic fragments	0.7	0.3	0.2	0.0	0.0	0.0	0.0
Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Voids	3.4	8.0	12.6	8.0	5.1	7.5	2.7

settlement of the Lengyel culture. In total, 27 pottery fragments, 2 flint scales, an unmodified stone, and a bone awl were extracted from the feature. The homogeneous assemblage of the LBK materials comes from a depth of 70-90 cm and included 19 fragments of ceramic vessels.

4.2. Petrography

Thin sections were prepared from fragments of pottery for microscopic examination in transmitted polarized light. Through point-counting quantitative microscopic analysis, the percentage composition of various components, such as clay minerals, quartz, potassium feldspars, plagioclase, muscovite, biotite, carbonates, grains of sedimentary, igneous, and metamorphic rocks, fragments of secondarily used ceramics, as well as organic material, was determined. Petrographic descriptions of the ceramic sections were also carried out, considering the degree of consolidation of the fabrics, as well as firing atmosphere and temperature (Whitbread 2016; Reedy 2008, 109-210). The collected data were used for comparative studies and to determine petrographic and fabric groups. The approximate firing temperature was determined based on the thermal alteration of clay minerals – observing the degree of transformation into amorphous, isotropic substance, as well as the observation of minerals such as biotite, hornblende, and glauconite (Stoch 1974, 484; Bolewski and Żabiński 1988; Quinn 2013, 190-203). Grain size measurements were conducted using a micrometric scale under a polarizing microscope. The grain size classification followed the guidelines of the Polish Soil Science Society (Polskie Towarzystwo Gleboznawcze 2009).

Seven samples of the LBK ceramics were selected for petrographic studies, guided by technological characteristics of the ceramic mass, form, and decoration (Table 2). The investigations were carried out using a Nikon Eclipse LV100N POL polarizing microscope for transmitted light.

4.3. Archaeobotany

Archaeobotanical samples (13 litres) were floated with a mesh size of 1 mm and 0.5 mm at the W. Szafer Institute of Botany of the Polish Academy of Sciences (IB PAS). Only charred plant remains were taken into consideration as in dry archaeological sites uncharred material can be considered modern contamination (Lityńska-Zając and Wasylikowa 2005). Fruits and seeds were identified based on morphological features visible under a stereoscopic microscope at 10× and 16× magnifications, following keys, atlases, other publications (*e.g.*, Kulpa 1974; Cappers *et al.* 2009; Lityńska-Zając and Wasylikowa 2005) and the reference collection of the National Biodiversity Collection of Recent and Fossil Organisms at IB PAS. Charcoal fragments were studied with the help of a reflected light microscope with magnifications of up to 500×. They were analysed based on wood anatomy (*e.g.*, Schweingruber 2021). In Central Europe charcoal fragments are mostly identified to the genus level and species, *Pinus sylvestris*, has been indicated as it is the only possible pine species among native plants in the region. A Hitachi S-4700 scanning electron microscope (SEM) was used for micrographs at the Laboratory of Field Emission Scanning Electron Microscopy and Microanalysis at the Institute of Geological Sciences of the Jagiellonian University (Kraków, Poland).

5. RESULTS

5.1. Pottery

Most ceramic fragments have their maximum size falling within the range of 1.7 to 6 cm. Only four are larger, falling within the range of 6 to 9.3 cm. The edges of breaks on the pottery are rounded, and their surfaces are relatively well-preserved. Distinctive features include fragments with black glossy surfaces indicating traces of paint, most likely originating from a single vessel (see below), as well as fragments with grey, greyish-white, and powdery-touch surfaces. The fractures in the pottery are uniform and monochromatic. In some fragments, a mineral admixture in the form of individual grains of coarse sand can be observed in the ceramic mass. The thickness of the pottery crust ranges from 5 to 11 mm. Most of them can be classified as tableware ceramics. They represent a typical for LBK vessel form, that is a spherical bowl.

The fragments probably originate from 3 to 4 vessels. The estimated diameter of the rims falls within the range of 6 to 7 cm. Decoration on the vessels was identified on six fragments. In terms of ornamentation, in addition to painting (see below), there are sets of double lines, including bands arranged horizontally with notches, in an angular arrangement, and a motif of decoration with multiple lines (Fig. 4: 1, 2, 3, 5, 6, 8). The presence of vessel fragments (with rims) without the customary engraved ornamentation, typical for LBK, is also noteworthy (one vessel; Fig. 4: 7).

5.2. Technology of the ceramics

Mineral composition

The primary components of the groundmass of the pottery fabrics are clay minerals (from approximately 40% to 47%), grains of the silty fraction (0.002-0.05 mm), fine mica flakes, concentrations and streaks of iron oxides and hydroxides, opaque minerals, and heavy minerals (*e.g.*, zircon, rutile, amphiboles; Table 2). Additionally, grains of thermally altered glauconite were identified. Inclusions are 0.05-1 mm composed of quartz grains (up to 38% in the Pran04 sample), feldspars, less commonly chalcedony, and fragments of sedimentary (*e.g.*, mudstones) and metamorphic rocks (*e.g.*, quartz-muscovite schists). The clastic material is well-rounded.

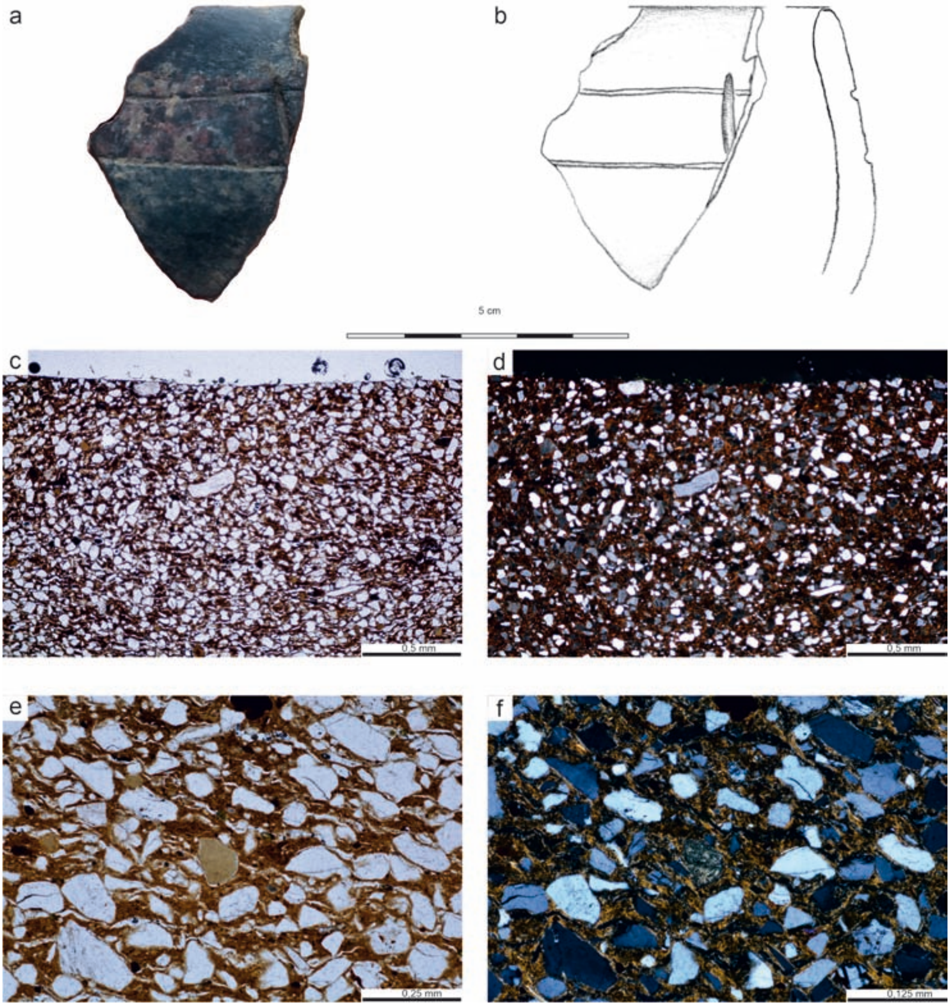

Fig. 7. Prandocin Site 1, sample Pran02; technological type II; photography (a) and drawing (b) of the fragment; microphotography of thin section (c-f); numerous grains of silt fraction (c, d); grain of thermal altered glauconite (e, f); plane polarized light (c, e); crossed polarized light (d, f).
Photo A. Rauba-Bukowska, drawing W. Rumian

One sample (Pran08) contain numerous carbonate components. The primary component is carbonate mud (approximately 54%), in which there are numerous fragments of micrite-sparite limestone and thermally altered glauconite.

The above composition of the samples corresponds to the local geological structure of the site of Prandocin (Fig. 5). It can be concluded that the vessels were made from raw materials readily available in the close vicinity.

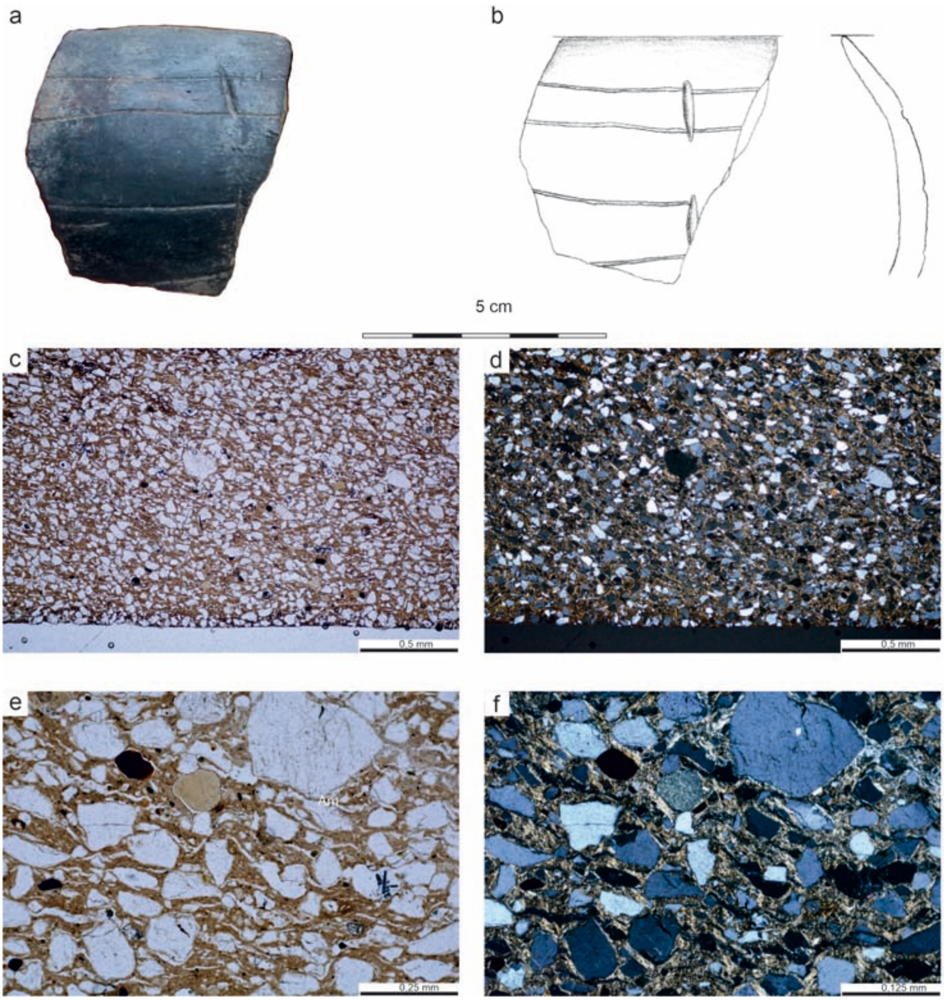

Fig. 8. Prandocin Site 1, sample Pran03; technological type II; photography (a) and drawing (b) of the fragment; microphotography of thin section (c-f); numerous grains of silt fraction (c, d); grain of thermal altered glauconite (e, f); plane polarized light (c, e); crossed polarized light (d, f).
Photo A. Rauba-Bukowska, drawing W. Rumian

Microstructure – granulation and sorting

The arrangement of mineral components and their quantitative relationships differ among the samples. Three basic ceramic fabrics can be distinguished.

The first type consists of fine-grained, well-sorted fabrics, represented by samples Pran02, Pran03, and Pran04. These are homogeneous fabrics that are well-mixed. Ceramic fabrics contain up to 10% of fine silt sized grains and between 32.2 to 38% very fine

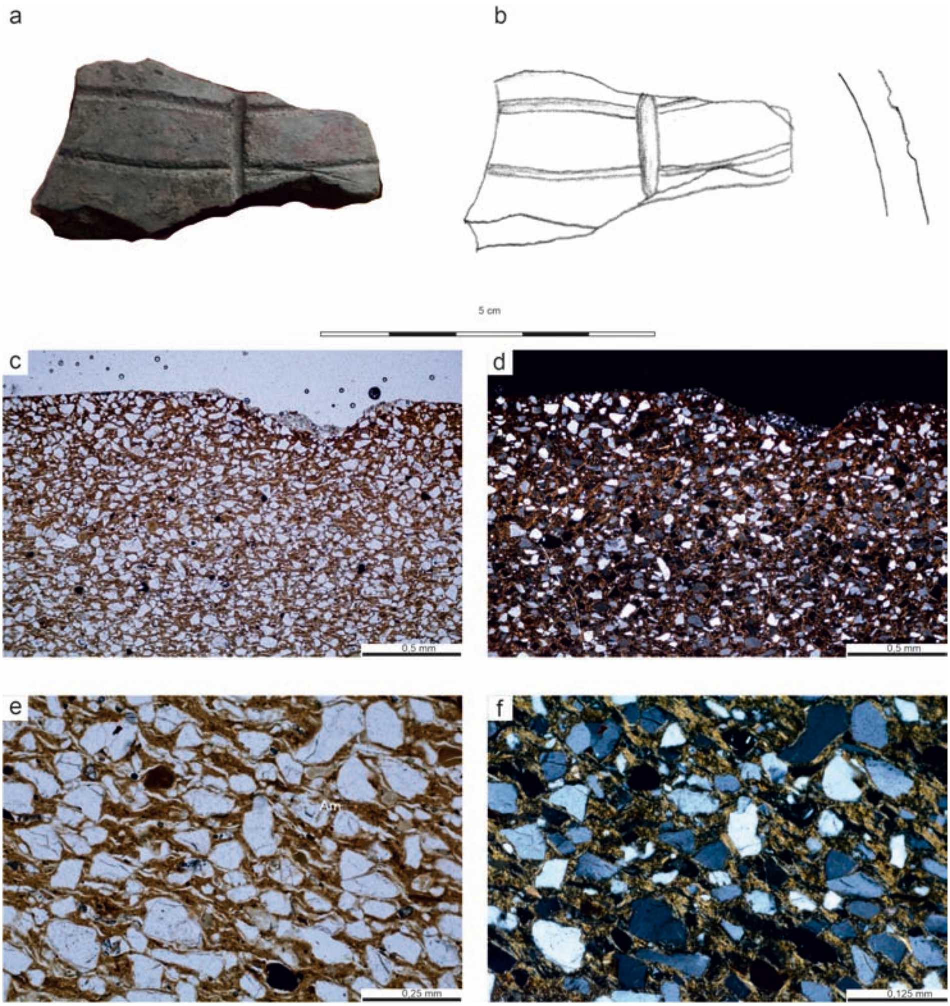

Fig. 9. Prandocin Site 1, sample Pran04; technological type II; photography (a) and drawing (b) of the fragment; microphotography of thin section (c-f); numerous grains of silt fraction, homogenous ceramic fabric (c-f); plane polarized light (c, e); crossed polarized light (d, f).
Photo A. Rauba-Bukowska, drawing W. Rumian

sand (Fig. 7; 8; 9). The components are evenly distributed in the mass, indicating good preparation of the pottery fabric. It can be inferred that these three fragments are made from the same ceramic mass and originate from the same vessel.

The second type consists of medium to coarse-grained fabrics, moderately sorted and well-mixed, represented by samples Pran01, Pran05, and Pran06 (Fig. 10; 11; 12). They are dominated by rounded grains of varying sizes, with a silty fraction ranging from 20 to 30%,

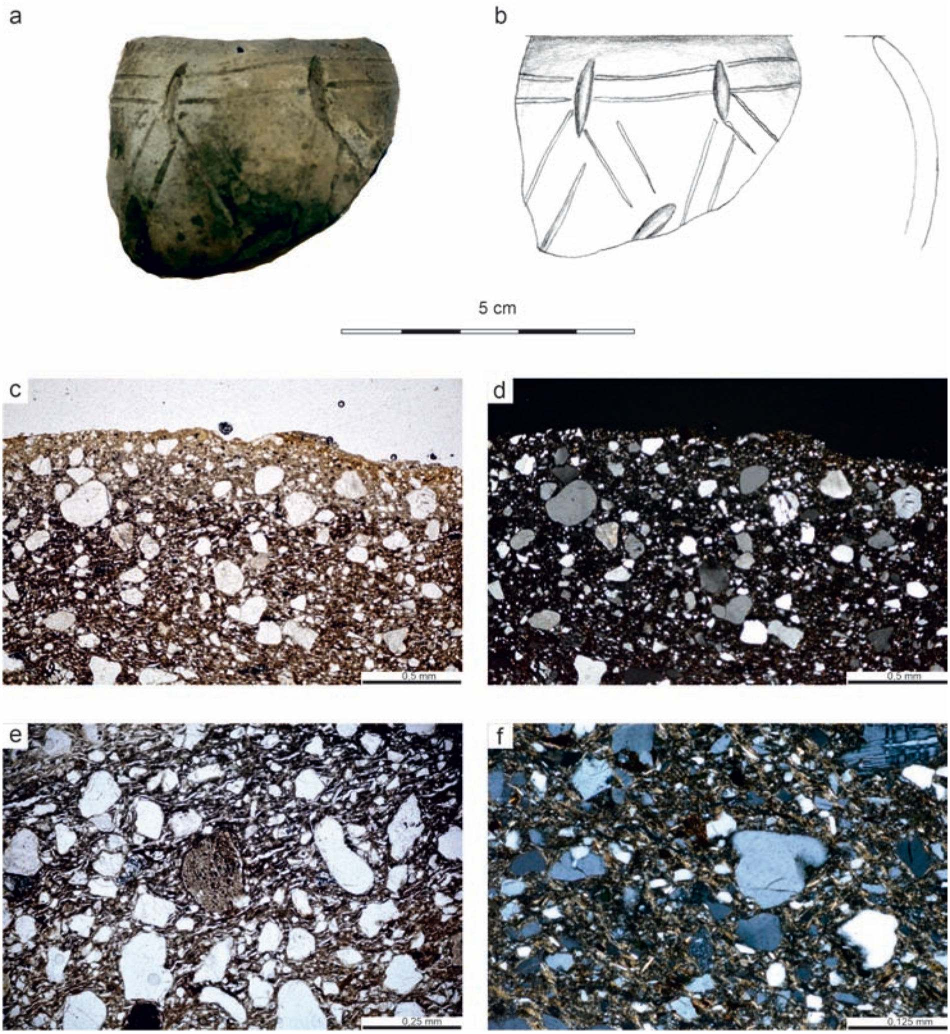

Fig. 10. Prandocin site 1, sample Pran01; technological type III; photography (a) and drawing (b) of the fragment; microphotography of thin section (c-f); numerous sand grains (c-f); plane polarized light (c, e); crossed polarized light (d, f). Photo A. Rauba-Bukowska, drawing W. Rumian

and a sand fraction from 20 to 28%. Grains and rock fragments are evenly distributed in the clay mass, indicating good preparation of pottery fabrics.

The third type is medium-grained, lumpy with numerous clasts of micrite and sparite limestones, represented by sample Pran08 (Fig. 13). The mass is heterogeneous, fine to medium-grained. The components are evenly distributed in the mass, indicating good preparation of the pottery fabric.

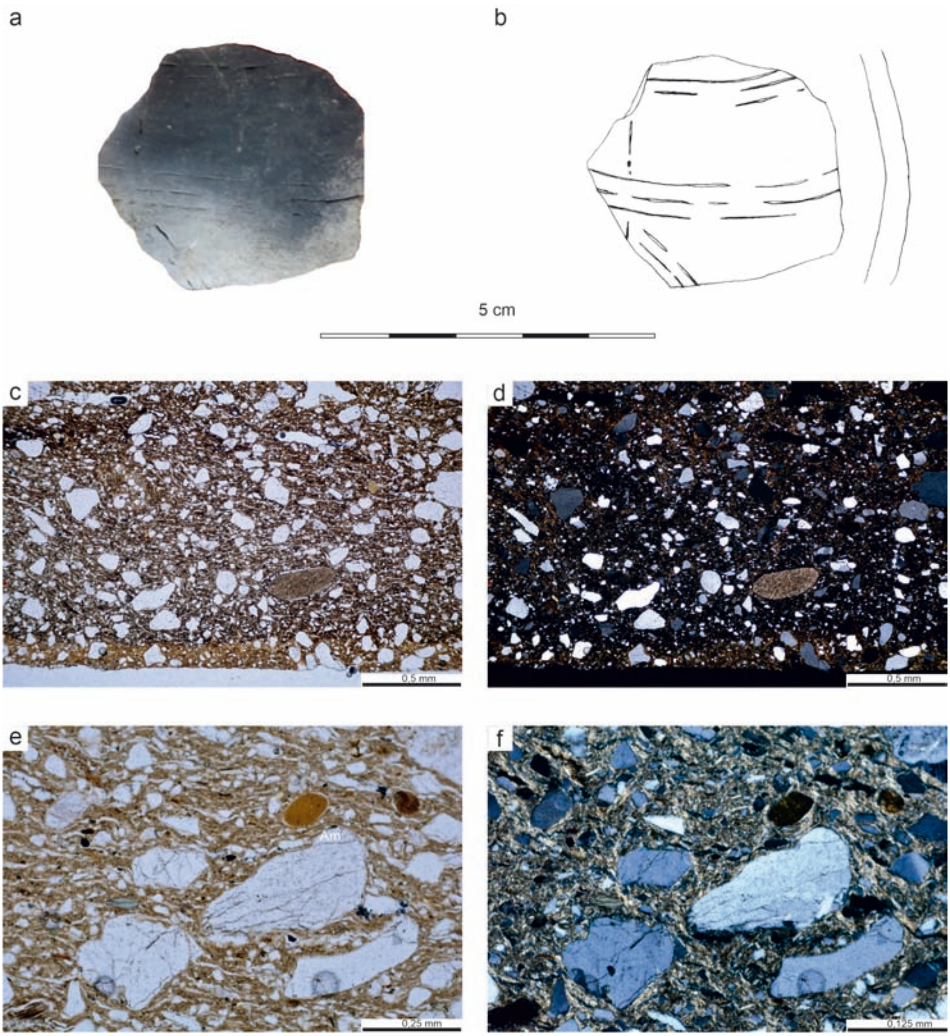

Fig. 11. Prandocin Site 1, sample Pran05; technological type III; photography (a) and drawing (b) of the fragment; microphotography of thin section (c-f); numerous grains of silt and sand fraction (c, d); grain of thermal altered glauconite (e, f); plane polarized light (c, e); crossed polarized light (d, f).
Photo A. Rauba-Bukowska, drawing W. Rumian

Temperature and atmosphere of firings

All examined fragments show traces of firing under a mixed reducing-oxidizing atmosphere. Within the clay minerals, no glassy phase was observed, which starts forming above 800-850 Celsius degrees. The observation of thermally induced changes and the microstructure of the clay bodies indicate firing temperatures at approximately 700-750°C

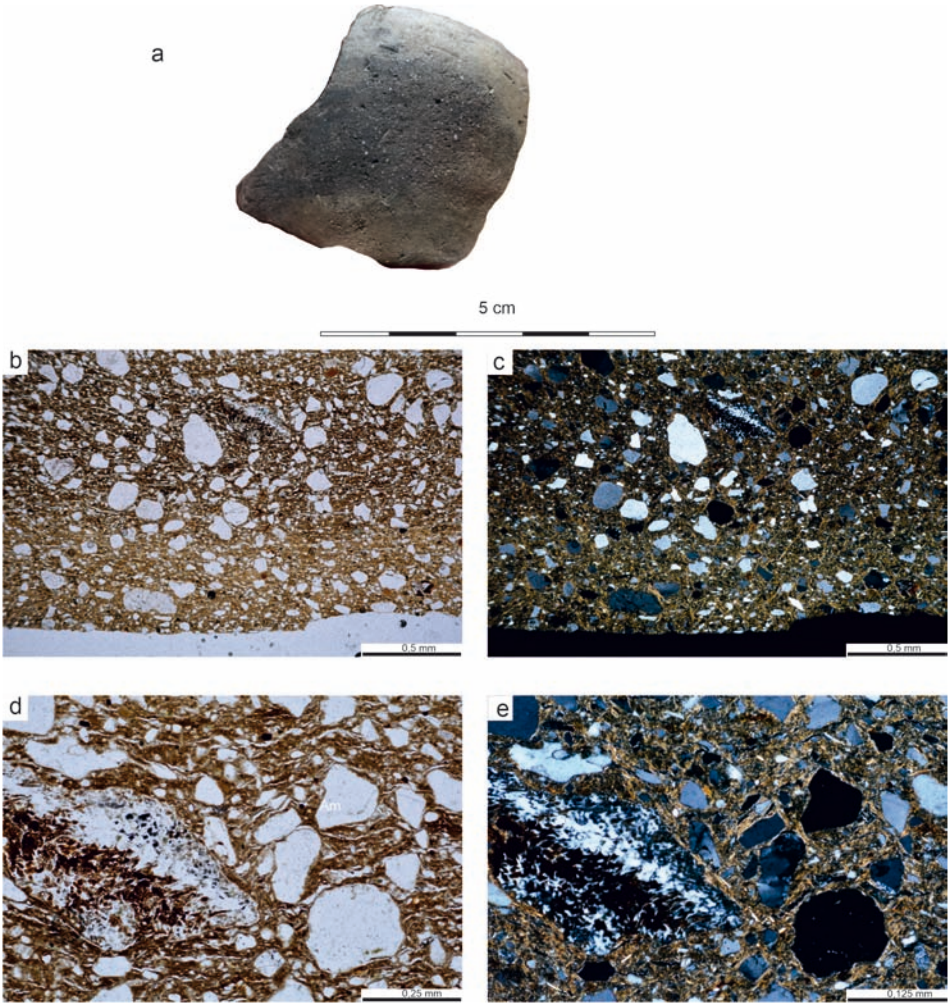

Fig. 12. Prandocin Site sample Pran06; technological type III; photography (a) of the fragment; microphotography of thin section (b-e); numerous grains of silt and sand fraction (b, c); grain of chalcedony (d, e); plane polarized light (b, d); crossed polarized light (c, e).
Photo A. Rauba-Bukowska, drawing W. Rumian

(Stoch 1974, 484; Quinn 2013, 190-200; Whitbread 2016; Daszkiewicz and Maritan 2016; Czekaj-Zastawny *et al.* 2021, 109).

Observations of the painted area

Macroscopically, the painting is visible on fragments in the form of a horizontal band running along two incised lines. On the cross-section of the vessel wall, a thin layer (approximately 0.03 mm) of dye is visible. It is likely composed mainly of iron oxides and

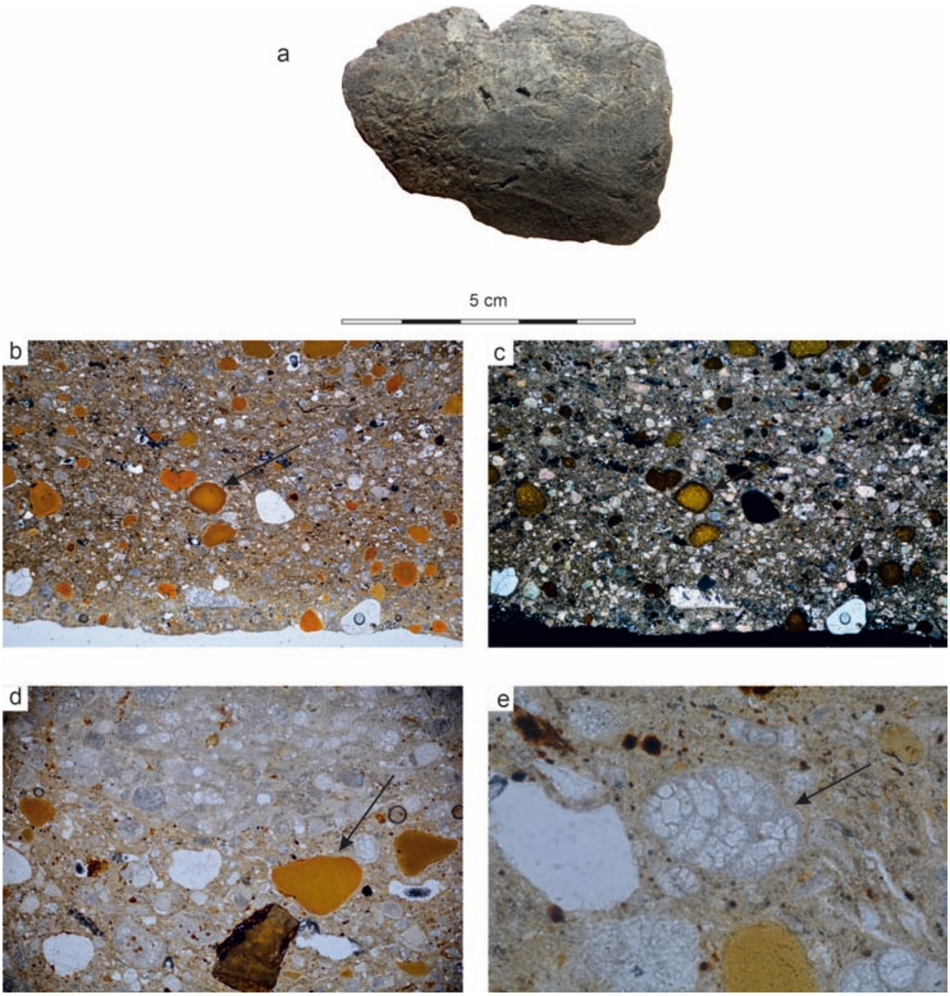

Fig. 13. Prandocin Site 1, sample Pran08; technological type IV; photography (a) of the fragment; microphotography of thin section (b-e); numerous grains of thermal altered glauconite (b, c, d, arrows); grains of carbonate rock (d) and microfossils (e, arrow); plane polarized light (b, d, e); crossed polarized light (c). Photo A. Rauba-Bukowska, drawing W. Rumian

hydroxides, no other clastic components, such as silty grains, were observed in this pigment.

The paint adheres to the smoothed surface of the vessel. The same treatment of the vessel wall is observed on the remaining surface that is not covered by red dye. There are no visible signs of intentional roughening or preparation of the surface covered by pigment. On one fragment, the red colour extends beyond the area delimited by two lines.

Intentional roughening of the surface, which was painted after the firing of the vessel is a common and standard practice in the ceramics of the Želiezovce group in western Slovakia (Pavúk 1994; Cheben 2000). This characteristic distinguishes the ceramics from Prandocin, as well as from other Polish sites, from the ceramics in Slovakia.

Interpretation on the background of state of research

The basic types of ceramic fabrics of the LBK in Małopolska have been established during extensive studies of this pottery. The research indicated that specific structural and physical characteristics of ceramic fabrics were employed to create vessels for various purposes. Based on the analysis of over 300 ceramic thin sections, it was also determined that the methods of preparing ceramic fabrics varied for each stylistic phase (*e.g.*, Rauba-Bukowska *et al.* 2007; Czekaj-Zastawny and Rauba-Bukowska 2013; Rauba-Bukowska 2014a; 2014b; 2014c; 2014d; Rauba-Bukowska 2016; Kadrow and Rauba-Bukowska 2017a; 2017b; Czekaj-Zastawny *et al.* 2017; Czekaj-Zastawny *et al.* 2021; Rauba-Bukowska and Czekaj-Zastawny 2020; Rauba-Bukowska 2021).

In summary, fine-grained, compact fabrics (types I and II) were used for forming thin-walled vessels. On the other hand, thick-walled vessels were crafted from fabrics with a higher sand content (type III) or fragments of sedimentary rocks (type IV). All mentioned types of ceramic fabrics contained a varying amount of plant admixture (Moskal-del Hoyo *et al.* 2017b; Czekaj-Zastawny *et al.* 2017; Rauba-Bukowska and Czekaj-Zastawny 2020).

Differences in technology have been observed between vessels from the Music-Note and Želiezovce phases. These changes involve the use of intentional additives, such as plant material and grog. In the early and classical phases (Music-Note phase), plant additives were commonly used, and no evidence of ceramic grog was found. However, vessels decorated in the Želiezovce style were made from ceramic fabrics with the addition of grog. At the same time, the proportion of organic additives decreased (Kozłowski *et al.* 2014; Czekaj-Zastawny *et al.* 2017; Rauba-Bukowska and Czekaj-Zastawny 2020; Rauba-Bukowska 2021). Grog is a new type of additive in the LBK pottery tradition. It was particularly abundantly mixed into clays used for crafting thick-walled vessels. This technological innovation was likely adopted in the LBK tradition through Transcarpathian contacts, possibly from the Bükk culture (Czekaj-Zastawny and Rauba-Bukowska 2014; Kadrow and Rauba-Bukowska 2016; Kadrow and Rauba-Bukowska 2017b; Kadrow 2020; Rauba-Bukowska and Czekaj-Zastawny 2020).

The analyzed assemblage of ceramics from Prandocin includes ceramic fabrics with a significant sand content and lacks additives typical for LBK in Małopolska, such as organic (plant) material and grog. The sand grains mainly consist of quartz and feldspar, occasionally chalcedony, corresponding to local deposits. Various granulations were observed; the fabrics of vessels Pran02, Pran03, Pran04, and Pran08 are fine-grained and well-sorted, while the fabrics of vessels Pran01, Pran05, and Pran06 are poorly sorted and contain grains of different sizes. Based on mineral composition and granulation, the fabrics can be assigned to several technological types distinguished for the LBK. Samples Pran02, Pran03, Pran04 (fragments with painting) correspond to Type II, characterized by fine-grained, very well-sorted, homogeneous, and compact fabrics. These three samples show significant similarity, suggesting they originate from the same vessel. Samples Pran01, Pran05, and Pran06 correspond to Type III with a high sand content. The fabric of vessel Pran08 is challenging to classify within the existing division due to its atypical carbonate composition and the presence of fragments of micritic limestones. However, because of the content of sedimentary rock fragments and its lumpy structure, it can be assigned to Type IV ceramic fabrics (*e.g.*, Rauba-Bukowska 2021, table 5).

A unique feature of the examined vessels is the absence of additives typical for LBK pottery, such as organic material and grog additives.

5.3. Archaeobotanical analysis

The results of the archaeobotanical analysis are presented in Table 3. Among fruits and seeds, there were six taxa identified to species (*Anthemis arvensis* – Fig. 14: c and *Chenopodium album* type – Fig. 14: a), genus (*Galium* sp. and *Stipa* sp. – Fig. 14: d) and family (Caryophyllaceae – Fig. 14b – and Chenopodiaceae). Also, two fragments of caryopsis were documented, which represented badly preserved cereal grains (Cerealia indet.). The carpological material was very scarce. Fruits of *Anthemis arvensis* (field chamomile) and awns of *Stipa* sp. (feather grass) were the most abundant, while other diaspores appeared

Table 3. Archaeobotanical analysis

Name of a taxon	Kind of remains	Number of specimens/fragments
Carpological material		
Anthemis arvensis	fruit	7
Chenopodium album type	seed	2
Galium sp.	fruit	1
Stipa sp.	awn	4
Caryophyllaceae	seed	1
Chenopodiaceae	seed	1
Cerealia indet.	caryopsis	2
Undetermined		7
Anthracological material		
Pinus sylvestris	charcoal	2
Alnus sp.	charcoal	2
Quercus sp.	charcoal	26
Broad-leaved	charcoal	1

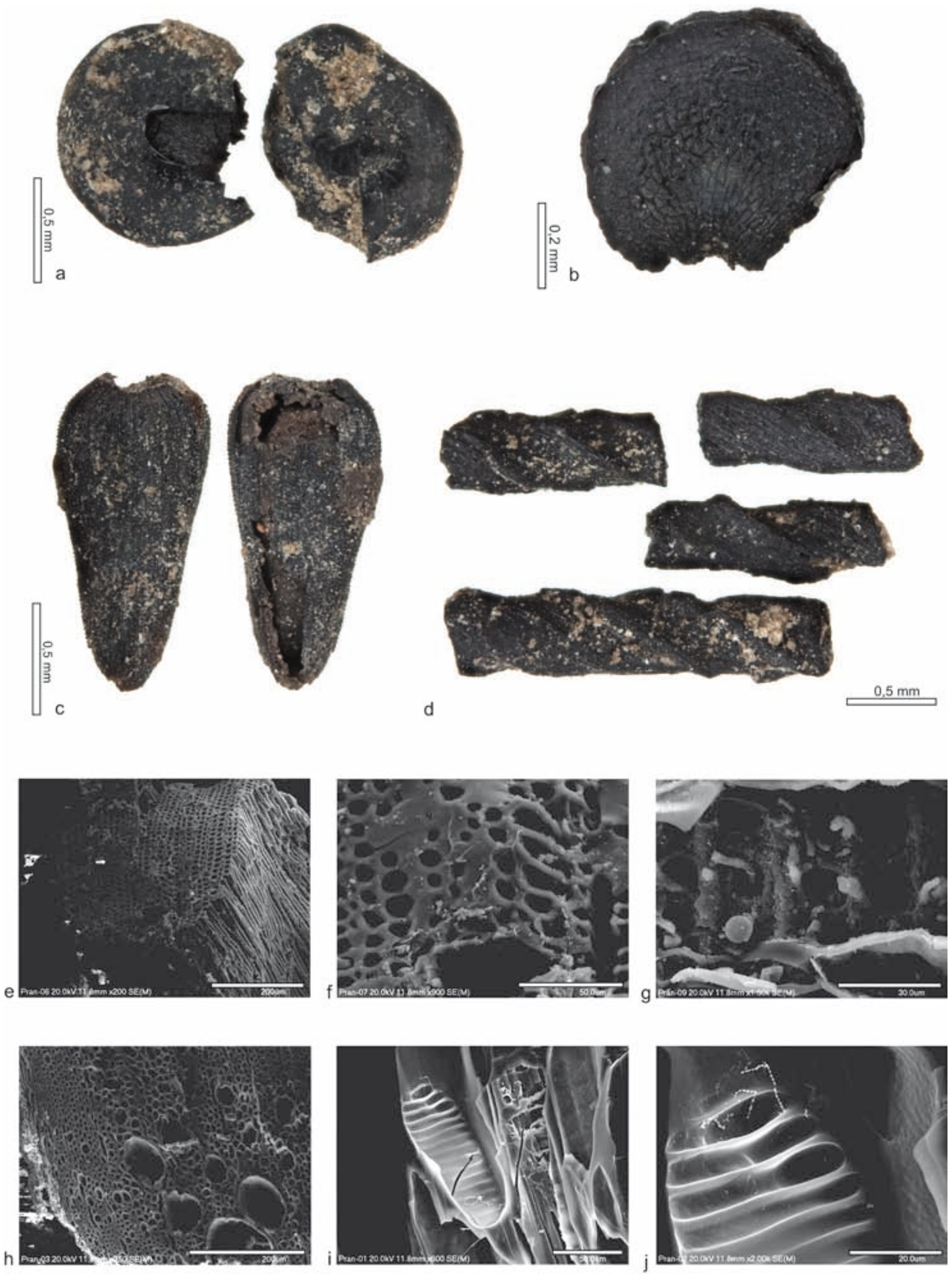

Fig. 14. Charred plant remains from Prandocin site 1: taxa of wild herbaceous (a-d) and woody plants (e-j); a. *Chenopodium album* type; b. Caryophyllaceae; c. *Anthemis arvensis*; d. *Stipa* sp.; e-g. *Pinus sylvestris*; h. *Quercus* sp.; i-j. *Alnus* sp. Scale-bar: 0.5 mm (a, c-d); b. 200 µm (b, e, h); 50 µm (f, i); 30 µm (g); 20 µm (j). Photos K. Stachowicz, Micrographs M. Moskal-del Hoyo

Fig. 15. Photographs of the red-painted vessels from Prandocin (a, b, c) (Poland) and Štúrovo (d, e) and Bajč (f) (Slovakia). Photo A. Rauba-Bukowska

as one or two specimens. Among cultivated plants, only two fragments of cereal caryopses (Cerealia indet.) were found.

In the group of wood charcoal remains, there were three taxa identified to species (*Pinus sylvestris* – Fig. 14: e-g) and genus (*Alnus* sp. – Fig. 14: i-j – and *Quercus* sp. – Fig. 14: h). They were preserved as very small fragments (<2 mm, Fig. 14: e, h), were vitrified (Fig. 14: f, i-j) and were characterised by a presence of microorganisms and fungi (Fig. 14: f, g, j), which suggests that they might have come from deadwood (Moskal-del Hoyo *et al.* 2010). Remains of *Quercus* sp. (oak) clearly predominated, whereas *Pinus sylvestris* (Scots pine) and *Alnus* sp. (alder) were less frequent.

6. DISCUSSION

The presence of finds of ceramics with red painting in areas north of the Carpathians fits into the discussion about the penetration of patterns and influences from Transcarpathia into the Upper Vistula River basin. Studies in this area have primarily addressed the issue of the presence of "imports" (both ceramics and mineral resources) from the East Linear Pottery circle (*e.g.*, Kaczanowska and Godłowska 2009; Czekaj-Zastawny and Rauba-Bukowska 2014; Kozłowski *et al.* 2014; Rauba-Bukowska 2014a; Czekaj-Zastawny 2017; Czekaj-Zastawny *et al.* 2017; Kadrow and Rauba-Bukowska 2017a; Rauba-Bukowska and Czekaj-Zastawny 2020; Szeliga and Zakościelna 2019; Dębiec *et al.* 2021). Studies are also focused on the dissemination of new patterns from a southern origin, manifested in changes in the ornamentation of vessels referred to as the Želiezovce style or phase (Kadrow 2020).

The Slovak Želiezovce group (phase), according to J. Pavúk (1969; 2009), originates from the local substrate of the LBK in the late Music-Note phase, influenced by the Eastern Linear Pottery circle (Alföld Linear Pottery Culture). In terms of ornamental motifs, it is characterized by the presence of oval impression located on two or three parallel engraved lines or long incisions cutting of transversely through multiple engraved lines. Technique of finishing vessels consists of placing appropriate motifs made up of engraved lines and smoothing the surface. However, the surface between the lines was specially roughened. After firing, these rough surfaces between the lines were covered with red or yellow dye (Fig. 15: d, e, f). In some cases, the red color is visible only inside the engraved lines. This is probably related to the state of preservation of the ceramics. Painting was present in this group from its very beginning, and it shares several analogies with the Szakalhat group of the Eastern Linear Pottery circle (Pavúk 1969, 295-297).

The Małopolska assemblages with ceramics decorated in the Želiezovce style are considered the result of interactions with the territory of Slovakia, involving the rapid absorption of new ideas and patterns (Kulczycka-Leciejowiczowa 1979, 60). The spread of this new ornamentation could have occurred through contacts associated with the exchange of goods and ideas (*e.g.*, Kadrow 2020a; 2020b; 2020c; Kozłowski *et al.* 2014; Czekaj-

Table. 4. Prandocin Site 1. Technological features of the LBK pottery – Želiezovce phase Poland (Rauba-Bukowska 2021) in comparison to Želiezovce group material from western Slovakia (Pavúk 1969; 1994; 2009; Cheben 2000); (+) – present; (-) – lack

Technological features of the pottery	Dominant admixture			Paint	Correlation of ceramic fabric to vessel type
	Plant	Grog	Sand		
Music-Note phase LBK	++		+	-	+
Želiezovce phase LBK	+	+	++	very rare	+
Ceramics from Prandocin site	-	-	++	+	-
Želiezovce group from western Slovakia (Pavúk 1969; 2009; Cheben 2000)	-	-	?	very often	?

Zastawny 2014; 2017; Rauba-Bukowska 2014a; Czekaj-Zastawny and Rauba-Bukowska 2014; Czekaj-Zastawny *et al.* 2017). Typical Želiezovce assemblages in Poland (*e.g.*, sites like Rzeszów 16 – Kadrow 1990a; Nowa Huta – Godłowska 1991; 1992) are primarily characterized by the presence and high frequency of basic decorative elements such as groups of notches and engraved lines, often accompanied by imports of obsidian artefacts and pottery of the Eastern Linear circle. The inspirations from the areas south of the Carpathians continue until the period associated with phase ŽIIb. To date, there is no evidence of interaction with the youngest stylistic phase of the Želiezovce group from Slovakia, namely ŽIII (Godłowska 1982, 152, 153; Kadrow 1990a; Czekaj-Zastawny 2008a; Pavúk 2009).

The results of the presented research are particularly interesting in the above context. In Prandocin, ceramics with ornamentation characteristic for the Želiezovce phase in Małopolska were discovered. Petrographic studies indicate that the vessels were made from locally available raw materials. The forms do not deviate from typical assemblages from southeastern Poland. However, the manufacturing technology clearly differs from the technology of Małopolska pottery (Table 4). This is evidenced, among other things, by the absence of typical additives, such as organic material and grog. In these aspects, it is similar to the ceramics of the Želiezovce group in Slovakia, where no organic additives or grog were noted (Pavúk 1994; Furholt *et al.* 2020). The technology used in crafting the vessels from Prandocin also does not precisely replicate patterns from Slovakia. This is indicated, for instance, by the method of preparing the surface to be painted. In the case of vessels from sites such as Štúrovo or Bajč, they have a specially prepared surface intended to be covered with pigment (Pavúk 1994; Cheben 2000; I. Cheben personal communication). This preparation was not observed in the examined assemblage from Prandocin. A unique blend of technological features in the ceramics was observed, which cannot be explained solely by the migration of the creator or the idea. According to Olivier Gosselain (2000), features such as surface ornamentation can easily transfer to other areas or to another human group. However, the choice of raw material or the preparation of ceramic fabric requires a more in-depth knowledge of the production process. The vessels found in

Prandocin could have been made by someone familiar with the Želiezovce ceramic-making techniques. However, their knowledge was not precise enough to replicate the method of painting ornamentation (Fig. 15). It is possible that the creator had not acquired knowledge about pottery production methods directly from the Želiezovce group. The Bükk culture environment can also be excluded as a transmitter. In Bükk culture ceramic materials, grog additives are often present, as well as organic (plant) fragments (Czekaj-Zastawny *et al.* 2018, 354-358).

To sum up, technologically the assemblage from Prandocin is closer to the Želiezovce group. It should be noted that the small collection from Prandocin certainly does not reflect the entire range of diversity in ceramic fabrics at this site. It is only a limited glimpse into the working methods of the pottery workshop. Nevertheless, due to the rarity of findings of painted ceramics from the LBK, it deserves special attention and in-depth analysis.

The plant assemblage from Prandocin is very scant, partly because it comes only from one archaeological feature. However, a scarcity of plant remains at Early Neolithic sites is typically observed in Linear Pottery Culture sites (*e.g.*, Lityńska-Zając*et al.* 2017; Mueller-Bieniek *et al.* 2019; Moskal-del Hoyo *et al.* 2023). Only two fragments of cereals represent cultivated species, which probably belonged to wheat species (emmer *T. dicoccum* and einkorn *Triticum monococcum*) or barley (*Hordeum vulgare*), crops typically found in LBK sites in southern Poland (Lityńska-Zając *et al.* 2017). Among wild herbaceous plants, taxa indicating segetal and ruderal communities appeared (Lityńska-Zając 2005), while a presence of feather grass indicates steppe-like vegetation or open canopy forests (Ceynowa-Giełdon 2001). This kind of woodland might be suggested by a dominance of oak followed by pine in the charcoal assemblage, which is in accordance with the results obtained in other LBK sites in loess areas of southern Poland (Moskal-del Hoyo 2021).

7. CONCLUSION

The vessels were made from clay, whose characteristics correspond to the local geological structure of the area. Microscopic examinations were used to determine the quantitative relationships of mineral components in the ceramic fabrics. Comparisons with other studies conducted in the same way revealed that the ceramics were produced using a technology different from that of the LBK vessels in Małopolska. Primarily, no organic additives and grog were identified in the pottery fabrics (*e.g.*, Rauba-Bukowska *et al.* 2007; Rauba-Bukowska and Czekaj-Zastawny 2020; Rauba-Bukowska 2014b; Rauba-Bukowska 2021). Especially, the presence of organic additives is a distinctive feature of LBK ceramics in general (Moskal del-Hoyo *et al.* 2017b). Thus, its absence is an atypical characteristic for the LBK. Additionally, the presence of ceramics with a high content of sand is also atypical.

Previous detailed studies of LBK ceramics have shown a significant change in the composition of ceramic fabrics between vessels with Music-Note and Želiezovce ornamentation

(Czekaj-Zastawny *et al.* 2017; Rauba-Bukowska and Czekaj-Zastawny 2020; Czekaj-Zastawny *et al.* 2021). Primarily, the addition of grog began to be used in the production of vessels with thicker walls. Meanwhile, the use of organic additives, which dominated in the pre-Music-Note and Music-Note phases, became less frequent in the Želiezovce phase (Moskal del-Hoyo *et al.* 2017b). However, these changes in the technology of LBK vessel production between pots with Music-Note and Želiezovce ornamentation styles are less radical than those observed in Prandocin. The materials from Prandocin exhibit a unique blend of characteristics from the Želiezovce group ceramics from Slovakia and the ceramics of the Želiezovce style and phase from Małopolska.

Finally, it is worth noting that even if the plant material is not very abundant, it contains plants that have been documented from the Early Neolithic sites in Poland, showing a high match with other LBK sites, documenting the presence plants of segetal and ruderal communities, open oak-pine woodland, and likely steppe-like grasslands.

Aknowledgements

We would like to express our gratitude to Professor Agnieszka Czekaj-Zastawny for her valuable insights during the writing of this article. Our thanks also go to Dr. Ivan Cheben for his expert consultation on painting techniques specific to the Želiezovce pottery. Special appreciation is extended to Professor Juraj Pavúk for facilitating access to ceramic materials within the resources of the Academy of Sciences in Nitra. I would also like to thank my father – Jacek Nowak for his support and help during the research in Prandocin. The studies were made possible with financial support from the Institute of Archaeology and Ethnology PAS, Departments of Mountain and Highland Archaeology. Archaeobotanical analysis was funded by the statutory research fund of the Institute of Botany, Polish Academy of Sciences.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3150

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RESULTS OF A PALYNOLOGICAL STUDY OF THE CONTENTS OF SMALL GLASS BOTTLES FROM LATE ANTIQUITY FROM THE KANCHAANI CEMETERY (SOUTHEASTERN GEORGIA)

ABSTRACT

Kvavadze E., Martkoplishvili I., Kakhiani K. and Rezesidze N. 2023. Results of a palynological study of the contents of small glass bottles from Late Antiquity from the Kanchaani Cemetery (Southeastern Georgia). *Sprawozdania Archeologiczne* 73/2, 285-309.

Eight small glass bottles (vials) have been obtained from five graves of the Kanchaani cemetery, dating to the 1st-3rd centuries AD. The objects came to the laboratory almost intact, and their contents have also survived. Analysis of the plant pollen and the study of non-pollen palynomorphs (NPP) of these contents showed that there was a set of various medicinal plants in seven bottles, and one bottle contained an infusion made from insects, which also had medicinal properties. The pollen of 23 medicinal plants has been determined to genus and species levels in the contents of the bottles. The paper describes in detail the characteristics of all found medicinal plants and their use in folk medicine. It turns out, that the ethnopharmacology of the Late Antiquity Period in the region under consideration was rather well developed.

Keywords: Late Antiquity Period cemetery, medicinal plants, small glass bottles, Georgia
Received: 13.01.2023; Revised: 07.01.2023; Accepted: 18.01.2023

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1. INTRODUCTION

Palynological examination of the content of the vessels from the Late Antiquity Period of Georgia have never been conducted before, although such analysis has been done of analogous material from the Early Antiquity Period. The evidence studied came from two graves (Nos 22 and 24) of the Vani site located in Western Georgia (Chichinadze *et al.* 2012, 2017, 2019), where organic remains of amphorae and oenochoe were examined. These materials were dated to the 5^{th}-4^{th} centuries BC. Grave 339 of the Pichvnari cemetery, in which the contents of a tumbler were analyzed also dates to the 5^{th} century (Kvavadze and Davadze 2014). From eastern Georgian sites, only the vessel found in Grave 5 of the Khovle necropolis, dated to the 3^{rd}-2^{nd}centuries BC, was studied (Kvavadze and Shatberashvili 2010). It should also be noted, that the vessels from all above mentioned sites are made of clay, with the exception of the oenochoe. The contents of glass vessels of either the Early Antiquity Period or the later period have hardly been studied palynologically either in Georgia or abroad. To this day, it has not been completely clarified what the purpose of this ritual of deposition of these vessels was, namely, what these rather beautiful vials that accompanied the dead into the graves had contained. Most scholars call them scent bottles, which were supposed to have contained the fragrant perfume oil (Lucas and Harris 1962; Colombini *et al.* 2009), but some studies claim that they contained plant infusion or oil for medical purposes (Bardinet 1995; Mortensen 2014).

The Kanchani cemetery is located on the left bank of the river Mashavera on the territory of the village Boslebi, Dmanisi municipality, Kvemo Kartli region, South Georgia. The cemetery consists of two parts - the first (GPS: X 442005.992; Y4576010.687; 980 M.) and

Fig. 1. Map of Georgia and location of the Kanchaani cemetery

Fig. 2. Bottles and vials from the burials of the Kanchaani cemetery: 1 – Grave 2, vial No. 76; 2-5 – Grave 3, bottles No. 84-87; 6 – Grave 4, bottle No. 98; 7 – Grave 12, vial No. 199; 8 – Grave 3, pot No. 82; 9 – Grave 3, pot No. 83

the second (GPS: X 442462.927; Y 4576054.721; 980 M.), (Fig. 1). During the excavation at the cemetery, twenty-five graves were investigated, eight in the first part, seventeen in the second part. All of them are inhumation graves, skeletons were buried in flexed position, on the left or right side, mostly facing west. Among the grave goods were ceramic and glass vessels of various sizes, iron, bronze and gold items, silver coins, beads, *etc*. Based on these material the cemetery in general is dated to the 1st-3rd centuries AD.

Among the grave goods should be distingushed small size glass bottles (Fig. 2). They are almost intact, and their contents have also survived. Six bottles were found in the first part, and two in the second part. They are made of transparent glass. The shape, colour, size as well as the technique of production of each of these bottle varies. One of them was mould-blown, the others were made by the free blowing method. The moulded vessel is light brown and thin-walled, with a high neck, a flat open mouth, a spherical,slightly elongated body, a ring-based bottom, and two ears. Embossed rays extend across the sides of the body. In the free blown vessels, several types are distinguished in shape: jug-like, amphora-like and flask-like (Fig. 2). Such glass vessels were quite often found in the territory of Georgia in Early Antiquity Period graves (Saginashvili 1970; Maisurashvili *et al.* 2018). It should be noted that especially many glass bottles were found at the Urbnisi cemetery. Interestengly here bottles in the burials were placed around the head and in the chest area of the skeletons (Saginashvili 1970).

2. MATERIAL AND METHOD

18 samples of the contents were extracted and palynologically examined from eight small glass bottles and two ceramic pots obtained in the graves of the Kanchaani cemetery. Two samples were taken from each bottle – one from the neck and the other from the bottom. Four small glass vials (Nos 84-87) and two pots (Nos 82 and 83) were found only in Grave 3. In the other four graves, single glass bottles were documented: Bottle No. 76 – Grave 2; Bottle No. 98 – Grave 4; Bottle No. 199 – Grave 12; Bottle No. 203 – Grave 14 (Figs 2-4). Because of the small number of soil samples collected from the neck of the bottles, palynological material almost was not detected in this part of the bottle. The exceptions are the vials No. 84 and No. 98, found in the third and fourth graves (Table 1). In general, the contents are dark organic remains with friable earth. The only exception is the sample from vial No. 199 (Grave 12), the contents of which is of whitish colour.

For the comparative analysis of the palynological spectra, samples were collected from two ceramic vessels within Grave 3. These vessels were selected because they were found next to the glass bottles, together forming a single group for examination.

Material extracted from the contents of vials was processed in a palynological laboratory using the standard chemical method adopted today (Erdtman 1969; Moore *et al.* 1991). At the first stage, the contents were boiled a long time in 10% potassium alkali. At the second stage, the material was centrifuged in a heavy liquid and, finally, acetolysis, that is, colouring, of the material was performed. After washing, the material was placed in glycerol. Palynological study was carried out by means of a new generation light microscope Olympus BX-43. Palynomorphs were photographedusing the same microscope.

The results of the palynological research and the analysis of non-pollen palynomorphs are shown on the diagrams (Fig. 3 and 4). The spectra differ from each other by the complexes of plant pollen. Let us discuss peculiarities of each of them.

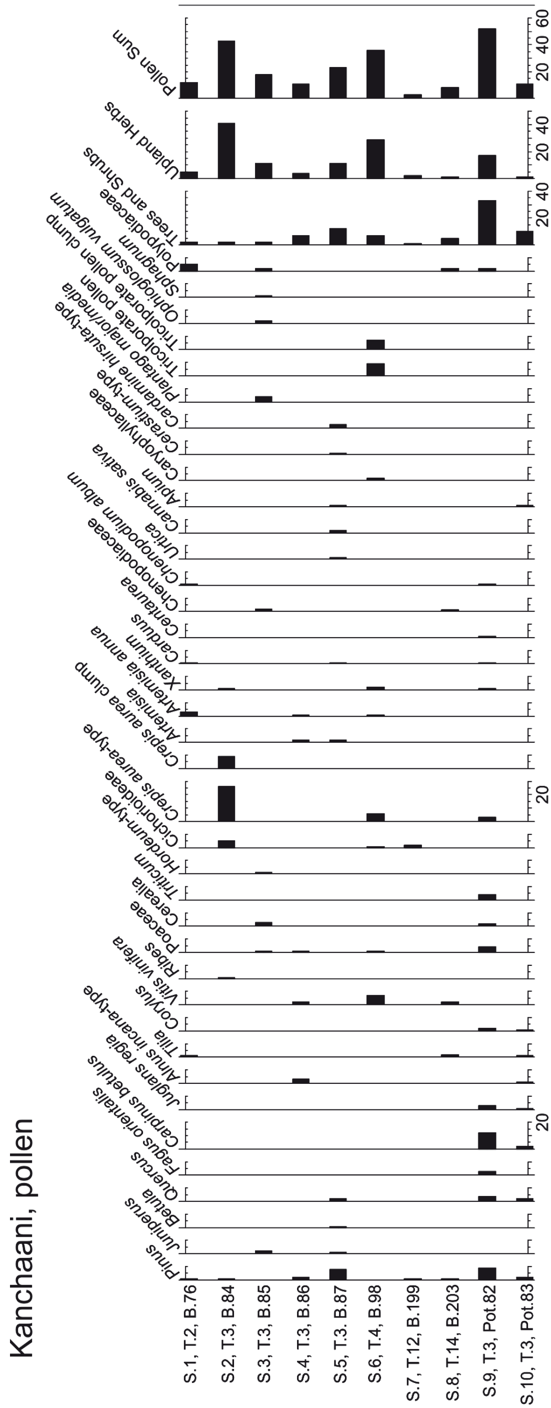

Fig. 3. Pollen diagram of organic remains of bottles and vials from Kanchaani cemetery.
Explanation: S – sample, T – tomb, B – bottle

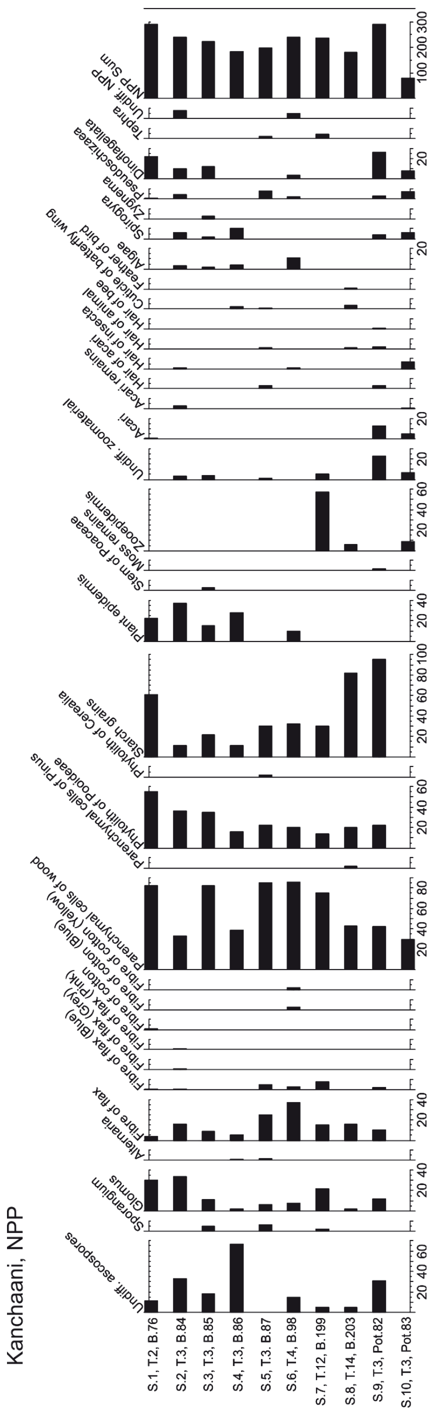

Fig. 4. Non pollen palynomorphs diagram of organic remains of bottles and vials from Kanchaani cemetery.
Explanation: S-sample T – tomb, B – bottle

Table 1. List of samples taken from Kanchaani Cemetery with archaeological and palynological description

Sample No.	Sample No. on Diagram	Grave No.	Bottle No.	Archaeological context	Palynological context
1	1	Grave 2	Neck of Bottle No. 76	Inhumation burial, crouched on the left side, its head facing north. The grave contained a glass bottle in front of the chest of the skeleton with other goods.	Empty
2			Bottom of bottle No. 76		Pollen of 6 plants taxon, 11 types of NPP type
3	2	Grave 3	Neck of bottle No. 84	Inhumation burial, crouched on the left side, its head facing south-west. The grave contained four glass bottles in front of the chest of the skeleton with other goods.	Pollen of 2 plants taxon, 4 NPP type
4			Bottom of bottle No. 84		Pollen of 6 plants taxon, 14 types of NPP
5	3	Grave 3	Neck of bottle No. 85		Empty
6			Bottom of bottle No. 85		Pollen of 9 plants taxon, 14 types of NPP
7	4	Grave 3	Neck of bottle No. 86		Empty
8			Bottom of bottle No. 86		Pollen of 6 plants taxon, 11 types of NPP
9	5	Grave 3	Neck of bottle No. 87		Empty
10			Bottom of bottle No. 87		Pollen of 11 plants taxon, 14 types of NPP
11	9	Grave 3	Pot No. 82		Pollen of 15 plants taxon, 15 types of NPP
12	10	Grave 3	Pot No. 83		Pollen of 8 plants taxon, 9 types of NPP
13	6	Grave 4	Neck of bottle No. 98	Inhumation burial, the grave was damaged, and the position of the skeleton is unclear. The glass bottle was found in the southern part of the grave	Pollen of 2 plants taxon, 3 types of NPP
14			Bottom of bottle No. 98		Pollen of 9 plants taxon, 13 types of NPP

Sample No.	Sample No. on Diagram	Grave No.	Bottle No.	Archaeological context	Palynological context
15	7	Grave 12	Neck of bottle No. 199	Inhumation burial, crouched on the right side, its head facing south. The grave contained a glass bottle in front of the stomach of the skeleton with other goods	Empty
16			Bottom of bottle 199		Pollen of 2 plants taxon, 10 types of NPP
17	8		Neck of bottle No 203	The Inhumation burial, Only a fragment of a young person's cranium and a glass bottle were found in the grave.	Empty
18		Grave 14	Bottom of bottle No. 203		Pollen of 5 plants taxon, 11 types of NPP

3. RESULTS

Sample 1, Grave 2, bottle No. 76.

Of woody plants: pollen grains of lime tree (*Tilia*), and pine (*Pinus*) were found in the sample of the contents of this vial. Of herbaceous plants: wormwood (*Artemisia annua*), thistle (*Carduus*), goosefoot (*Chenopodium album*) and forest ferns (*Polypodiaceae*) were detected. Among non-pollen palynomorphs, parenchymal cells of wood predominate (Fig. 4). There were a lot of starch and phytoliths of herbaceous plants. Plant epidermis and fungal spores were well represented as well. There were also spores of fungus *Glomus* in considerable numbers. This fungus grows only on friable soil, and it turned up in this vial from earth, which must have fallen into the bottle after decaying of the cork. There were remains of freshwater algae, ticks and tissue fibres among non-pollen palynomorphs in the examined sample. There were a small quantity of flax fibres, among them also were ones that were light blue in colour. Additionally, cotton fibres were discovered, but they were fewer in number when compared to flax.

Sample 2, Grave 3, bottle No. 84

Four small vials (Nos 84-87) and two pots (Pot Nos 82 and 83) were found here (Fig. 5). From woody plants: pollen of pine (*Pinus*) and currant (*Ribes*) were found in the contents of the bottle. Herbaceous plants were represented by only one species of hawk's-beard (*Crepis aurea*- type). More than 20 pollen grains and 7 pollen clumps of hawk's-beard were counted, which were found only on the pistil (Fig. 6). Non-pollen palynomorphs were more diverse. Plant epidermis, parenchymal cells of wood and phytoliths of herbaceous plants prevail. Fungal spores, hairs of insects, starch and linen fibres were also found. Remains of freshwater algae were rather well represented.

Pollen grains and clumps of hawk's-beard were also found in the sample taken from the neck of the same bottle. As was already noted, these should be the remains of a hawk's-beard flower. Pollen of common cocklebur was also found in the sample taken from the neck of the bottle. The composition of the non- pollen palynomorphs was nearly the same as in the sample taken from the bottom of the vial. Plant epidermis, phytoliths and wood cells predominate. But fungal spores and linen fibres were more frequent in the sample taken from the neck. Linen fibres of pink, light blue and grey colours were found here.

Sample 3, Grave 3, bottle No. 85

Among woody plants, only pollen of juniper (*Juniperus*) was found in the palynological spectrum of the sample under discussion. In the group of herbaceous plants, the number of pollen grains of plantain (*Plantago major/media*) prevails (Fig. 3). Pollen of cereals, including barley (*Hordeum* type.), was identified. There were also Poaceae. Of sporous plants, spores of adder's-tongue fern (*Opioglossum vulgatum*) and mosses (*Sphagnum*) were found (Fig. 7). Burnt parenchymal cells of wood were abundantly present among the non-pollen palynomorphs. There were a lot of phytoliths of cereals and their starch. Plant epidermis, remains of stalks of cereals, zoo-epidermis and fungal spores were also observed. The following freshwater algae were detected: *Spirogyra*, *Dinoflagellata*, and *Zygnema*. Other algae were also found, the genera of which were not determined at this stage of the study.

Fig. 5. Grave 3, location of bottles Nos 84-87 and pots Nos 82 and 83

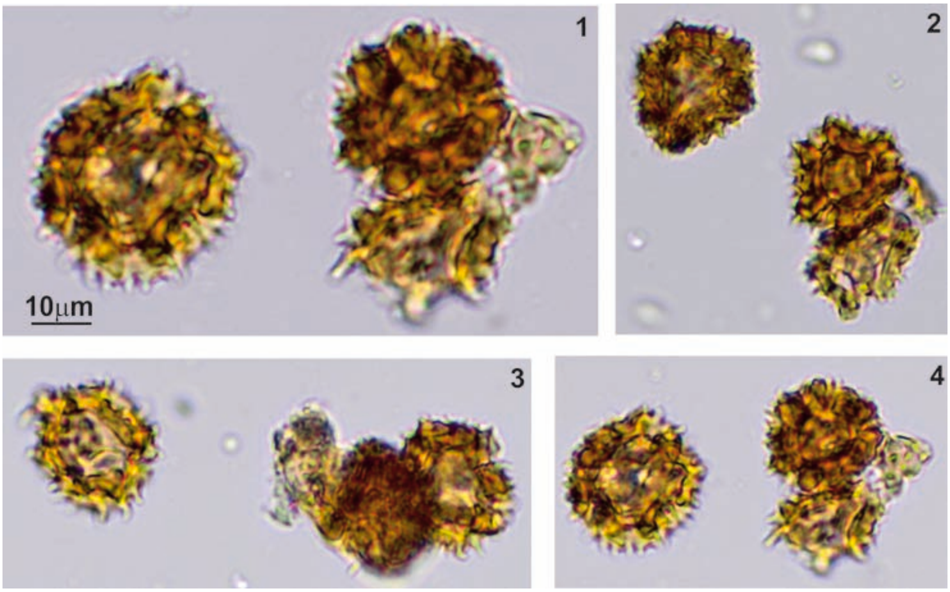

Fig. 6. Grave 3, bottle No. 84: 1-4 – *Crepis* and clumps of *Crepis* pollen

Sample 4, Grave 3, bottle No. 86.

This is a small bottle with a very narrow neck (Fig. 2). Of woody plants: pollen grains of pine (*Pinus*), spruce (*Picea*), alder (*Alnus incana*-type) and vine (*Vitis vinifera*) were found. It should also be said that plant pollen grains were well preserved (Fig. 8). From the herbaceous plants: there were only wormwood (*Artemisia, Artemisia annua*- type) and grasses (Poaceae). Fungal spores and tracheal cells of wood predominate among non-pollen palynomorphs. There was a lot of plant epidermis, phytoliths and starch. Remains of freshwater algae (*Spirogyra*) were also well represented. Fibres of flax textile were observed as well.

Sample 5, Grave 3, bottle No. 87

Of woody plants: pollen grains of juniper (*Juniperus*), pine (*Pinus*), birch (*Betula*) and oak (*Quercus*) were found in the contents of this vial, and of herbaceous plants: those of apium (*Apium*), wormwood (*Artemisia*), hairy bittercress (*Cardamine hirsuta*), thistle (*Carduus*), common mouse-ear chickweed (*Cerastium*), stinging nettle (*Urtica*), and cannabis (*Cannabis sativa*). In non-pollen palynomorphs, parenchymal cells of burnt wood prevail here as well. There were a lot of grains of cereal starch and their phytoliths. Wheat phytoliths were also observed. Fungal spores, remains of ticks and insects were represented in a small quantity. Hairs of animal was also found, as well as algae *Pseudoschizaea*. There was a rather large amount of linen textile fibres. Among them fibres dyed blue and light blue were detected.

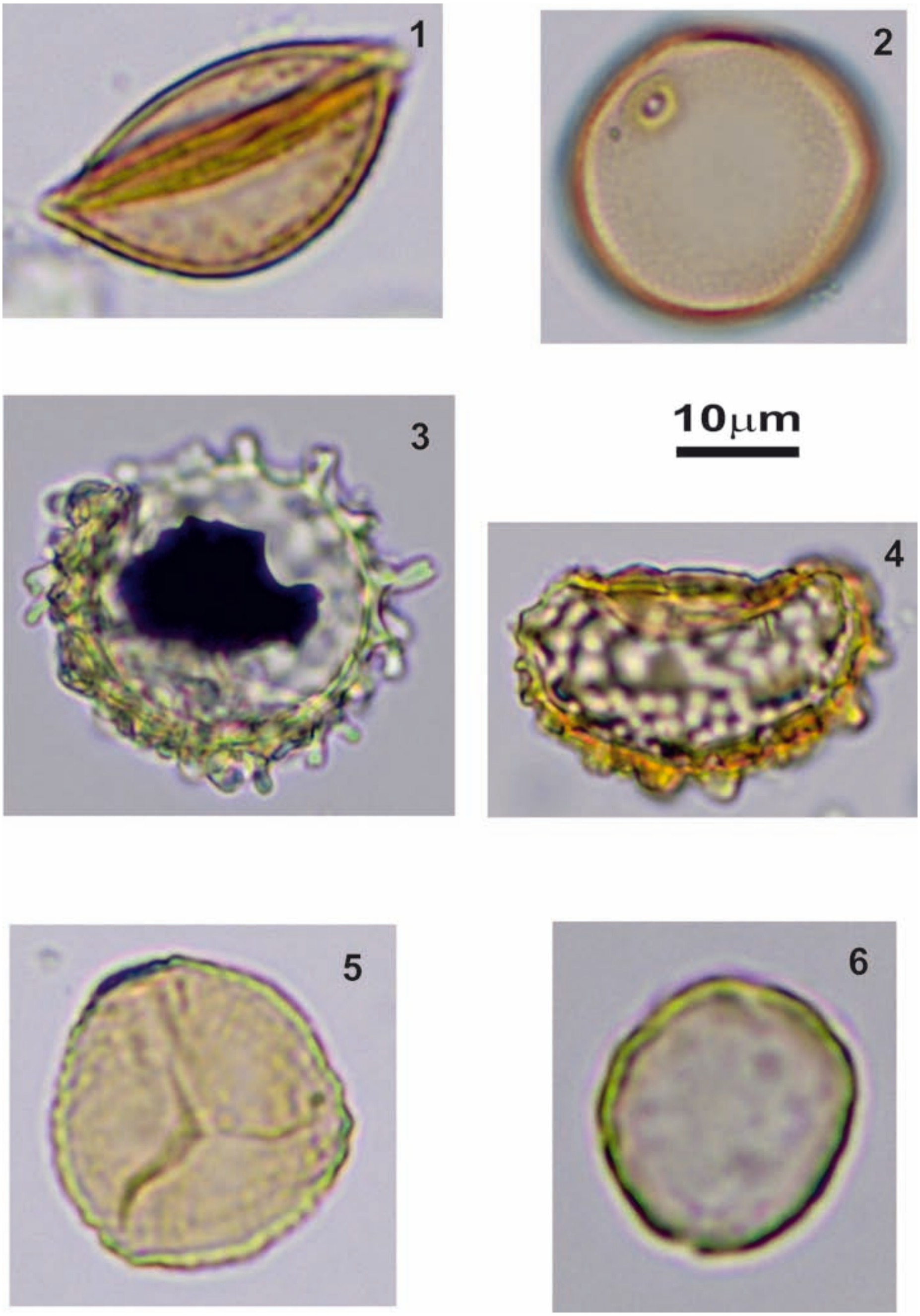

Fig. 7. Grave 3, bottle No. 85: 1 – *Juniperus*; 2 – *Hordeum* type; 3,4 – *Ophioglossum vulgatum*; 5 – *Sphagnum*; 6 – *Cannabis sativa*

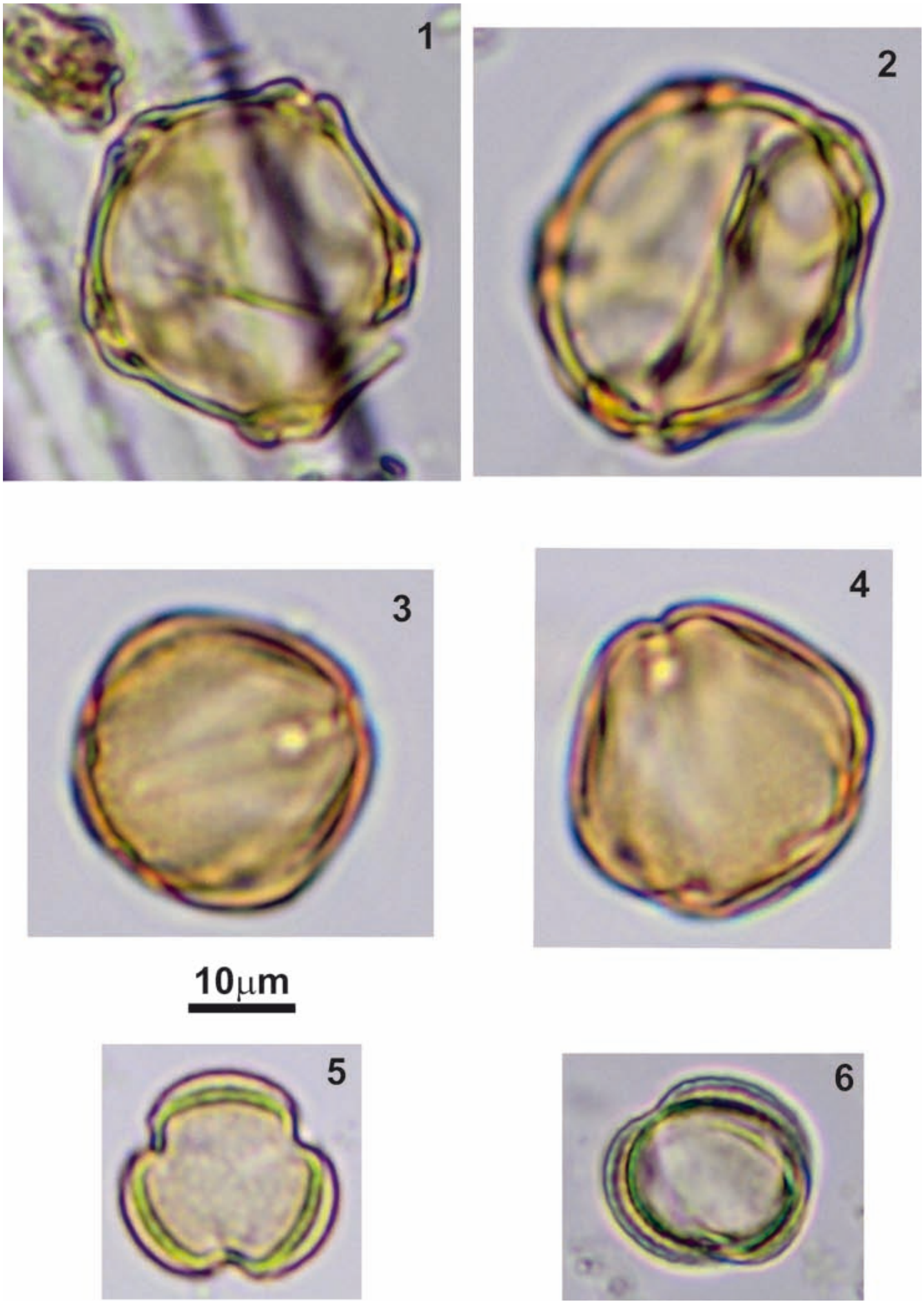

Fig. 8. Grave 3, bottle No. 86: 1, 2 – *Alnus*; 3, 4 – *Vitis vinifera*; 5, 6 – *Artemisia*

Sample 6, Grave 4, bottle No. 98

In the contents of the bottle only vine pollen grains (*Vitis vinifera*) were found in the group of woody plants and bushes. There were more herbaceous plants here, among them pollen grain clumps of hawk's-beard (*Crepis aurea*type), common cocklebur (*Xanthium*), plants of the pink family (Caryophyllaceae), grasses (*Poaceae*) and other undetermined tricollporate pollen. Parenchymal cells of wood and vine starch prevail among the non-pollen palynomorphs. Among textile fibres, linen predominated, which was well represented. Linen and cotton fibres, were dyed light blue. Some yellow cotton fibres were also found. Besides, fungal spores, phytoliths of cereals and freshwater algae were identified.

Plant pollen was almost absent in the sample taken from the neck of the same bottle, but there were a lot of parenchymal cells of wood and linen fibres. Plant epidermis, fungal spores, starch, phytoliths and remains of freshwater algae were present in a small amount. Therefore, we can suppose that we have the remains of a wooden cork in the neck of the vial. Linen was wrapped around the cork, as there were a lot of wood cells and textile fibres in this sample.

Sample 7, Grave 12, bottle No. 199

The contents were left only in the big and elongated neck of the vial under discussion, as it was found in an almost horizontal position and placed by the abdomen of the deceased. This bottle resembles more a chemical measuring glass. It is of big size and greenish in colour. The palynological spectrum contains only one pollen grain of pine and two pollen grains of representatives of the genus *Cichorium*. Cells of wood and epidermis of insects and their microscopic remains of other types prevail among the non-pollen palynomorphs. About 60 insect remains have been counted, that was not recorded in any other vials. That's why we assume that some kind of infusion made of insects was kept in this bottle. It should also be noted that remains of volcanic ashes were found only in the contents in question. Fungal spores, starch and phytoliths were also found in the contents of the vial neck. Linen fibres and among them those dyed light blue were well represented. There were freshwater algae *Spirogyra* and *Pseudoschizeae* in small numbers.

Sample 8, Grave 14, bottle No. 203

This is a small vessel with a narrow neck. Its contents were dark and dense (non friable). Of woody plants, pollen grains of pine (*Pinus*), lime tree (*Tilia*) and vine (*Vitis vinifera*) were found in the palynological spectrum. Of herbaceous plants, only pollen grains of goosefoot and spores of forest ferns were detected. Starch, including that of vine, predominates in the non-pollen palynomorphs. There were a lot of parenchymal cells of charred wood and among them cells of pine (*Pinus*) (Fig. 9). Phytoliths were well represented. Small amounts of fungal spores, bird feathers, animal hair and scales of butterfly wings were found. It should also be noted that dark cells of wood were found in the content of the vial, which were microscopic traces of ashes or smoke, as well as light ones that should be the remains of a cork. Only pine cells were of light colour here, so we might assume that the cork was made of pine tree. The cork must have been wrapped in a piece of linen here as well, as there were a lot of linen fibres in the neck (Fig. 3).

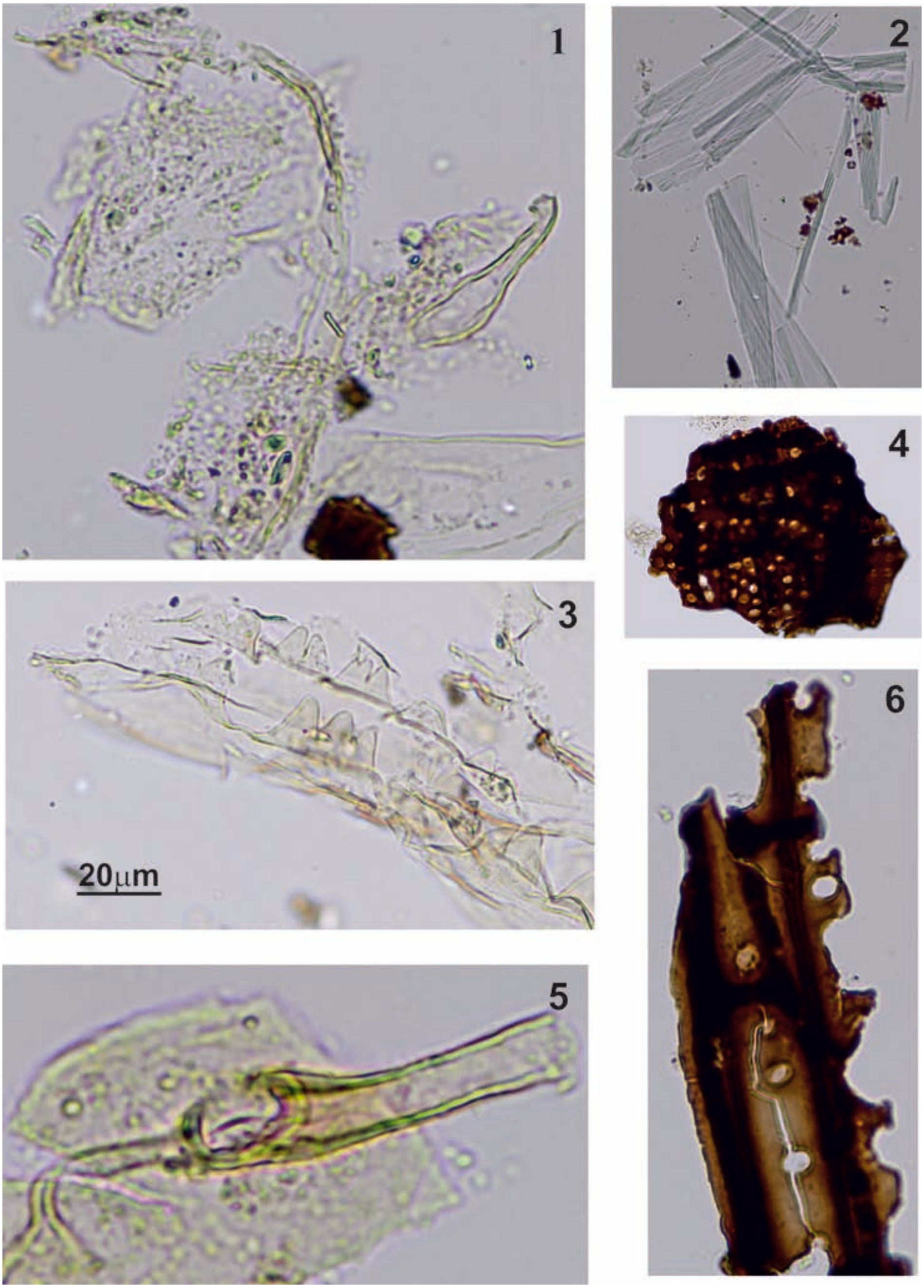

Fig. 9. Grave 12, vial No. 199: 1, 3, 4 – insects epidermis; 2 – flax textile fibres; 4 – tracheal cells of undiff. wood; 5 – Grave 14, viol 203: insect epidermis; 6 – parenchymal cells of *Pinus* (pine) from cork

Sample 9-10, Grave 3, pots Nos 82 and 83

As has been already noted, the contents of two clay vessels from the Grave 3 were also examined. They were both small jugs, approximately, about one litre in volume (Fig. 2). The palynological spectrum of the content of the vessel with a broken handle (Pot No. 82) was rather rich in the composition of pollen grains (Fig. 3). Among woody plants: pollen grains of hornbeam (*Carpinus betulus*) and pine (*Pinus*) prevail. The pollen of oak (*Quercus*), beech (*Fagus orientalis*), walnut (*Juglans regia*) and hazel (*Corylus*) was observed. The quantity of herbaceous plants in the spectrum was less than the above mentioned trees. This group also contains pollen of some cereals. These were wheat, absinth, thistle, Iranian knapweed, goosefoot, and spores of forest ferns. Starch prevails in non-pollen palynomorphs. There were a lot of wood cells, fungal spores, phytoliths. Remains of insects and other invertebrates, as well as algae, were well represented. There was a small amount of linen fibres, moss residues and spores of the fungus *Glomus*, indicating contamination from the soil. Pot No. 83 from Grave 3 is characterized by a completely different palynological spectrum. There was almost no pollen of herbaceous plants. From tree plants, separate pollen grains of pine, oak, hornbeam, walnut, alder, birch, lime tree and hazel were present in a small amount (Fig. 3). From non-pollen palynomorphs, only cells of wood, insect remains and freshwater algae were found (Fig. 4).

4. DISCUSSION

The palynological spectra of the material under discussion differbothin the complexes of plant pollen grain and in the quantity of non-pollen palynomorphs. This picture is well seen on the palynological diagram (Figs 3 and 4). It is also noticable that the spectra of the big-sized vials with a wide mouth (Nos 76, 84 and 199) are distinguished by a large number of spores of the fungus *Glomus*. This indicates a greater contamination of its contents with grave soil. As has already been mentioned, this microscopic fungus grows only in the loose soil (Van Geel 1998; Geel *et al.* 2003; Geel and Aptroot 2006). The least amount of the spores of this fungus was detected in the small and narrow necked vessel (Nos 86-88 and 203), where the soil of the grave walls could not penetrate so easilyinto the vessel. The same situation is found with the number of phytoliths. There are more of them in large and wide-mouthed vials than in the ones with narrow necks. Phytoliths consist of silica, so they also are well preserved in the soil (Piperno 2006).

The study and analysis of the plant composition of those palynological spectra that are less contaminated, showed that they consisted completely of plants with medicinal uses. Table 2 provides a detailed breakdown of the diseases for which these plants have been used. It's worth noting that only the members of the pink family (Caryophyllaceae) are odorous within the spectrum, and nearly all of them possess medicinal properties (Chandra and Rawat 2015). Among trees and shrubs, nine medicinal plants are evident. Notably, pollen grains of pine were discovered in five of the bottles under consideration. In traditional medicine, pine flowers, cones, needles, and at times its resin are used to create remedies for respiratory diseases such as asthma, pneumonia, and tuberculosis. (Khare 2007; Alarcon *et al.* 2015; Bussmann *et al.* 2016). The pollen of juniper (which also belongs to the coniferous plants) was found in two bottles (Nos 85 and 97). Juniper can be used as a remedy for epilepsy (Adams *et al.* 2012; Alarcon *et al.* 2015), as well as an antiseptic (Alarcon *et al.* 2015) in ethnopharmacology. It is also used as an antibacterial agent, a remedy for hepatitis, diabetes, helminthiasis and other diseases (Swanston-Flatt *et al.* 1990; Tilford 1997; Al-Snafi 2018). The medicine is made from almost any part of the juniper, namely from the fruits, cones, needles, wood. Healing oil is also made from it, as its wood contains oil (Al-Snafi 2018). It should also be noted that juniper pollen grains are poorly preserved in the soil, as it has a very thin exine (Kurmann 1994). It can be assumed that both vials in which juniper pollen was found in better condition (Fig. 7), were used to keep juniper oil. Another argument is that it was in these bottles that the largest amount of pollen of medicinal plants was found (Table 1). The oil preserved pollen of other eight plants in bottle No. 85 and that of nine plants in bottle No. 87. The diagram shows that in other bottles, except for No. 89, there are much fewer taxa. Therefore, we can suppose that the bottles would have contained oil, which preserved not only grains of juniper pollen but that of other plants as well. The vials are of a small size, which is another argument in favour of the fact that they would have contained oil, each drop of which had healing properties.

Oil must have been kept in the bottle No. 98, where vine pollen is also presented. Like juniper pollen grains,vine pollen is hardly ever preserved in the soil (Kvavadze *et al.* 2010; McGovern *et al.* 2017). Therefore it should be proposed that oil in the bottle No. 98 was pressed from grapeseeds, which are always followed by pollen grains (Tvalchrelidze and Kvavadze 2016). The number of plant taxa (nine) is also large in the palynological spectrum in question. It should also be noted that all of them are of medicinal plants (Table 2).

The palynological spectrum of the bottle No. 84 is of great interest. It contains a large number of pollen of hawk's-beard (*Crepis*), including numerous clumps of pollen (Fig. 6). This suggests that there would have been an infusion of the flower of this plant. Its pollen, like other Cichorioideae, is preserved well and possibnly here we are dealing with traces of an infusion of flowers boiled in water. There are also many algal residues in the spectrum (Fig. 4). Hawk's-beard (*Crepis*) treats hepatitis. It is used as an anti-inflammatory and antioxidant agent (Fleurentin et al. 1986; Quattrocchi 2012; Pedreiro *et al.* 2021). Hawk's-beard (*Crepis*) was also found in the bottle No. 98, which would have contained vine oil. It was also identified in the content of the jug No. 82. Several species of hawk's-beard (*Crepis*) still grow in the territory of Georgia, and 38 of its species are widespread throughout the Caucasus (Grosgeim 1949).

As was already noted, in the vessel No. 199 from Grave 12, only remains of insects were found, that means that their infusion or decoction would have been in it (Fig. 9). Insect remains were also found in both clay jugs from the third grave. In the traditional medicine

Table 2. List of medicinal plants of the Late Antiquity Period found in the small glass bottles from Kanchaani cemetery and their pharmacological properties

Plant	Family	Pharmacological Properties	References
Pinus (pine)	Pinaceae	Asthma, rheumatism, antiseptic, pneumonia, cystitis, painkiller, wounds	Lim 2012b; Kizirarslan and Sevg 2013; Alarcün *et al*. 2015
Juniperus (juniper)	Cupressaceae	Epilepsy, gastrointestinal diseases, antiseptic, diarrhea, diuretic, earache	Swanston-Flatt *et al*. 1990; Tilford 1997; Al-Snafi 2018
Betula (birch)	Betulaceae	Antipyretic, epilepsy, painkiller, cystitis, rheumatism	Adams *et al*. 2012; Papp *et al*. 2014; Al-Snafi 2015
Quercus (oak)	Fagaceae	Wounds, hypertension, preventing a cold, diabetes, antimicrobial	Keskin and Alpýnar 2002; Mikaili *et al*. 2012; Taib *et al*. 2020
Alnus (alder)	Betulaceae	Antihelminthic, diarrhoea, dysentery, gastritis, hemorrhage	Quattrocchi 2012; Menale and Mouio 2014; Dahija *et al*. 2016
Tilia (lime)	Tiliaceae	Preventing a cold, cough, high temperature, antiseptic, hemorrhage, cystitis	Demiray 2009; Güler *et al*. 2015; Poljšak and Glavač 2021
Vitis vinifera (common grape vine)	Vitaceae	Epilepsy, anemia, painkiller, antiallergic, preventing a cold, cancer, toothache, antibacterial	Adams *et al*. 2012; Kanagarla *et al*. 2013; Hayta *et al*. 2014
Ribes (currants)	Grossulariaceae	Diabetes disease, kidney stones; analgesic; antiseptic	Duke 2002; Hayta *et al*. 2014; Cao *et al*. 2021
Hordeum (barley)	Poaceae	Hepatitis, abdominal pains, cough, diarrhoea, painkiller, toothache	Chevallier 1996; Marwat *et al*. 2012; Lim 2013
Crepis (hawksbeard)	Asteraceae	Anti-inflammatory, antioxidant	Fleurentin *et al*. 1986; Quattrocchi 2012; Pedreiro *et al*. 2021
Artemisia (fragrant wormwood)	Asteraceae	Malaria, fever, antiseptic, rheumatism, antihelminthic, diarrhoea, diabetes, anti-bug	Hayta *et al*. 2014; Bussmann *et al*. 2016; Koul *et al*. 2017
Artemisia annua (wormwood)	Asteraceae	Malaria, antiseptic, fever, anti-bug	Liu *et al*. 1992; Ferreira 2004; Mueller *et al*. 2004; de Ridder *et al*. 2008;
Xanthium (cocklebur)	Asteraceae	Antimicrobial, gastrointestinal diseases, antibacterial, preventing a cold, rhinitis, toothache	Eissa *et al*. 2013; Li and Xing 2016; Khan *et al*. 2020
Carduus (thistle)	Asteraceae	Gastrointestinal diseases, snakebite, antipyretic, causing vomiting	Dold and Cocks 2000; Zheleva-Dimitrova *et al*. 2011; Hayta *et al*. 2014
Chenopodium album (goosefoot)	Chenopodiaceae	Antihelminthic, diuretic, arthritis, rheumatism, scurvy, talc	Meuninck 2013; Bibi *et al*. 2014; Trivedi and Singhh 2018
Urtica (stinging nettle)	Urticaceae	Rheumatism, asthma, hemorrhage, high temperature, mumps, rhinitis, anemia, fungal diseases	Kültür *et al*. 2007; Dyubeni and Buwa 2012; Kregiel *et al*. 2018
Cannabis sativa (ordinary hemp)	Cannabaceae	Sensation of dizziness, diarrhoea, fracture, swelling, painkiller, antihelminthic	Kalant 2001; Bibi *et al*. 2014; Jamila and Mostafa 2014
Apium (celery)	Apiaceae	Antispasmodic, diuretic, rheumatism, gout, painkiller, diarrhoea, dysentery	Leto *et al*. 2013; Kooti *et al*. 2014; Alarcün *et al*. 2015

Plant	Family	Pharmacological Properties	References
Cerastium (chickweed)	Caryophyllaceae	Headache, renal colic, body ache, decoction, cough	Angmo *et al.* 2012; Chandra and Rawati 2015;
Cardamine (toothworts)	Brassicaceae	Dysentery, epilepsy; diuretic, depurative, antispasmodic	Wiart 2006; Hatfield 2004; Quatrocchi 2012
Plantago (great plantain)	Plantaginaceae	Antiseptic, skin diseases, arthritis, diseases of respiratory ways, gastrointestinal diseases, burning, hemorrhage	Kültür *et al.* 2007; Tetik *et al.* 2013; Najafian *et al.* 2018
Ophioglossum vulgatum (adder's tongue)	Ophioglossaceae	Antiseptical, hemorrhage, angina, hematoma, vomiting, wounds, antiviral, treating frostbite, burning	Mannan *et al.* 2008; Quattrocchi 2012; Lim 2016a; 2016b.
Sphagnum (sphagnum moss)	Sphagnaceae	Hot compress, abscess characteristic of diseases of urogenital systems, eye lotion	Souter 1995; Allen and Hatfield 2004; Meuninck 2013

of many countries around the world, the treatment of several diseases using insect extracts or decoctions is a well-established practice. For example, in China there are more than hundred such kind of insects (Feng *et al.* 2009). Today there is a special branch of medicine called "entomotherapy", that is entomological therapy "Insect-derived compounds for therapeutic use have huge promise as they have remedial, analgesic, antibacterial, diuretic, sedative, anticancer and anti-rheumatic properties" (Kaur *et al.* 2023). Insect infusions possess antibacterial, antianalgesic properties, treats diarrhea, rheumatism and other diseases (Yamakawa 1998; Costa-Neto 2002, 2005; Bairagi 2019; Mozhui *et al.* 2021).

The fact that the vessel with insect infusion in Grave 12 was placed near the abdomen of the deceased might suggest that he suffered from diarrhoea, and that is why the vessel full of remedy was placed near the abdomen (Fig. 10).

Palynological examination of the content of eight vials has shown that each each vessel contained an infusion or decoction of various medicinal plants. The pollen of 23 medicinal herbs have been determined to genus and species, which indicates that the population inhabiting the territory of Georgia in the Late Antiquity Period very well knew the properties of numerous plants. At that time, the medicinal properties of insects were also well known, that is why three vessels with medicines made of insects accompanied the dead in the graves.

It is interesting to note that all the bottles had a wooden cork.These corks would have been made of pine wood (Richter *et al.* 2004) and wrapped in a piece of linen for greater safety, or probabaly corks were only made of textile. This is evidenced by the presence of wood parenchymal cells and large amounts of flax fibres in a spectrum of non-pollen palynomorphs. Among the wooden cells there are light cells that did not burn out in the fire, but rotted naturally. The cells that were burnt in fire are of much darker in colour, than the parenchymal cells of a decayed tree (Kvavadze and Kakhiani 2010). Based on this difference, it is possible to determine the presence of decoction and tincture of medicinal plants. In the case if there is a healing tincture, in the spectrum of non-pollen palynomorphs, light-

Fig. 10. Grave 12, location of vial No. 199

coloured, decomposed wood parenchymal cells predominate, which are the remains of the cork. In the case of the decoction, the spectrum is dominated by the burnt wood parenchymal cells.

5. CONCLUSION

The palynological study and, in particular, the existence of non-pollen palynomorphs have shown that small glass bottles placed in graves were tightly closed from the very beginning with corks that were wrapped with a piece of cloth. This circumstance has preserved all the components of the contents in the bottles. These are pollen of medicinal plants, remains of freshwater algae, which had existed in the water in which plants were boiled. During boiling, sterilization also took place, which subsequently contributed to the preservation of pollen grains and microscopic remains of other organisms. In addition, in four bottles, where the preservation was particularly good, traces of vine seed oil and juniper fruit or wood oil were found. It is well known that oil is an excellent conservation agent (as fungi, microbes or bacteria that destroy the organic remains do not thrive in it).

Palynological analysis has revealed the presence of infusion and decoction of various medicinal plants in eight bottles. The pollen of 23 medicinal plants was detected. This suggests that during the Late Antiquity Period, the population living near the Kanchaani cemetery knew the medicinal properties of several plants. Moreover, during the 1st-3rd centuries AD, the population was also aware of the medical properties of insects, which were placed in the graves of two individuals as part of the funerary rites.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3402

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CEMETERY AT LUZINO – THE EASTERNMOST LOCATED SITE OF THE DĘBCZYNO GROUP IN POLAND (POMERANIA)

ABSTRACT

Piotrowska M. and Żychliński D. 2023. Cemetery at Luzino – the easternmost located site of the Dębczyno Group in Poland (Pomerania). *Sprawozdania Archeologiczne* 75/2, 311-344.

The Luzino burial ground is the easternmost site of the Dębczyno group, located in Wejherowo county, in the northern Polish province of Pomerania. The cemetery occupied the summit of a slightly elevated terrain ridge. The remains of 20 graves, most probably only skeletal burials, were recorded, in which, apart from one case, no bone material survived. Grave goods were recorded in five of them. In four graves, small-sized hand-made vessels were recorded whose state of preservation allowed their reconstruction, while in one burial an elaborate necklace of beads (glass and amber), a brooch and probably a belt buckle were discovered.

The materials found at the Luzino site should be associated with the late stages of the Migration Period. The burials with grave goods, however, show mainly links to the Elbe circle, while Scandinavian influences are lacking in the mobile materials.

Keywords: Dębczyno group, Pomerania, Cemetery, Migration Period
Received: 28.02.2023; Revised: 24.05.2023; Accepted: 19.09.2023

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INTRODUCTION

The village of Luzino, Wejherowo county, is located in the northern part of the Kashubian Lake District, right on the border with the Łeba and Reda Proglacial Valley (Fig. 1). Site 93 is located on the western, rather steep slope of the large valley of the Bolszewka River, approximately 400 m west of its bed. The cemetery occupied the summit of a slightly elevated terrain ridge located between the steeply sloping valley slope to the east and the gently sloping westward slope between the hills situated on the upland. The burial ground was arranged along an approximate northwest-southeast axis (Figs 2 and 3).

The recent publication of Henryk Machajewski's book on the Dębczyno group (2021) comprises a study of the eponymous settlement at Dębczyno, in the county of Białogard, northern Poland. Although this subject has been covered by the above-mentioned archaeologist's publications on previous occasions, his latest work supplements earlier findings with an analysis of materials from Site 6 (see Machajewski 1992; 1993; 2021, 13). The material that is the subject of this article perfectly extend the knowledge contained in the

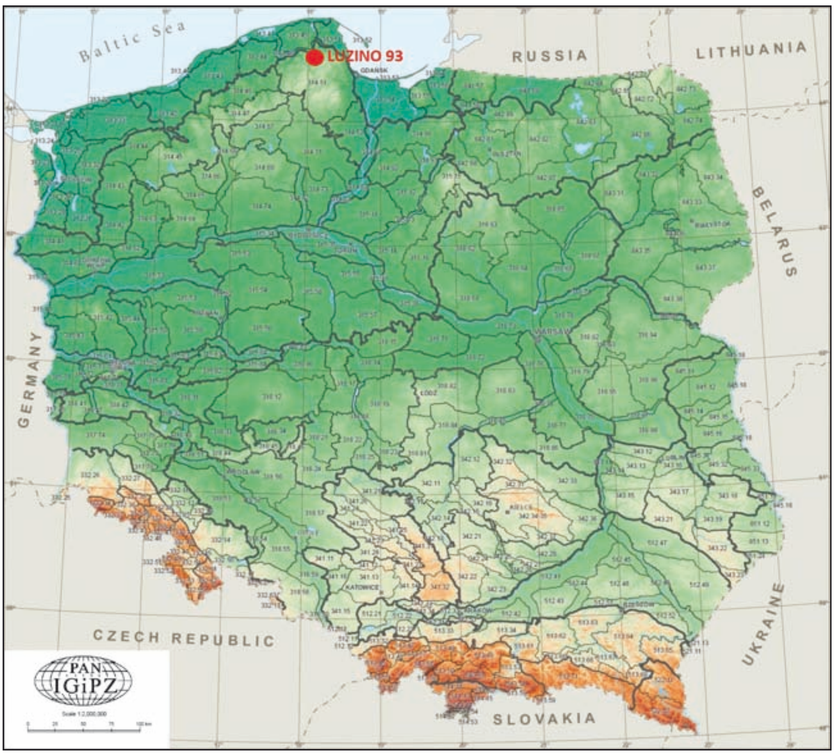

Fig. 1. Luzino, Site 93. Location of the site (after: Solon *et al.* 2018; by M. Piotrowska)

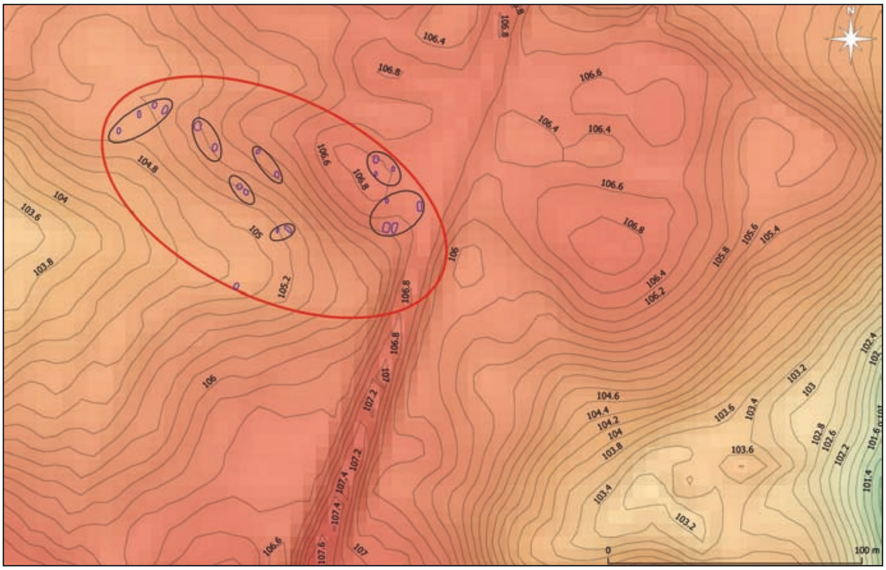

Fig. 2. Luzino, Site 93. Contour map of the site. Legend: blue – burial, black – clusters of graves, red – range of cemetery (prepared by K. Waszczuk and D. Żychliński)

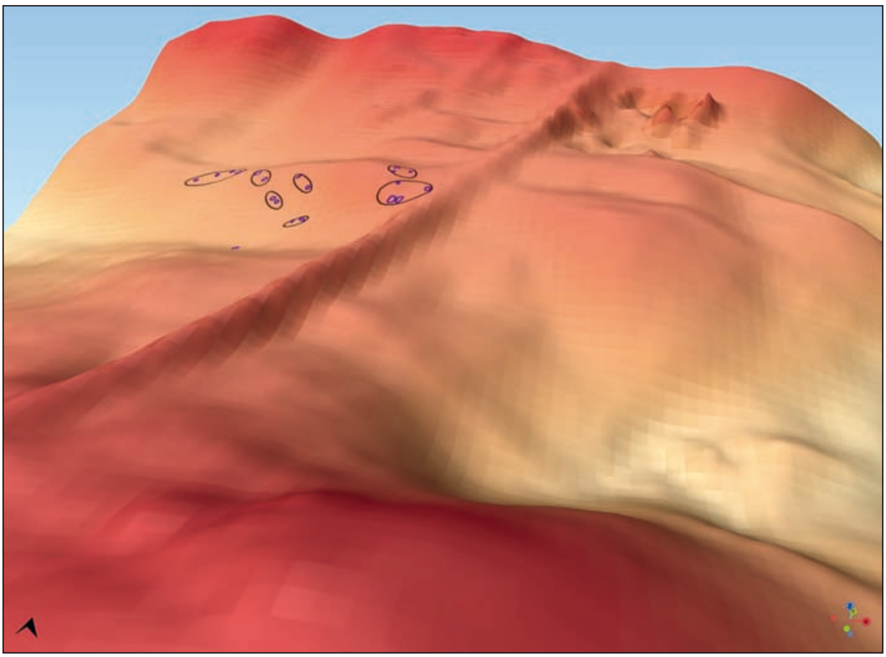

Fig. 3. Luzino, Site 93. Digital elevation model showing the location of the cemetery (prepared by K. Waszczuk and D. Żychliński)

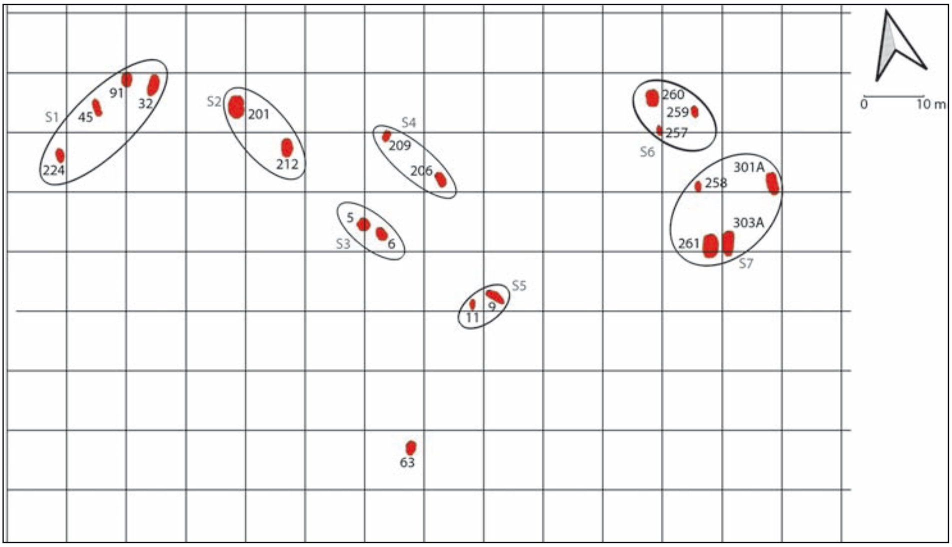

Fig. 4. Luzino, Site 93. Location of the burials and clusters of graves within the cemetery. Legend: red – burial, black – clusters of graves, violet – number of clusters (prepared by M. Wołoszyńska-Far and D. Żychliński)

above-mentioned publication, with the Luzino burial ground being the easternmost site of the Dębczyno group.

Rescue excavations at Site 93 in Luzino (AZP 7-39/160), in the northern Polish province of Pomerania, were undertaken in connection with the construction of the S6 expressway between Gdańsk and Lębork. The research was carried out in several stages from 2020. As a result, evidence connected with the Bronze Age, the Iron Age, the Migration Period, the Middle Ages, as well as the modern and contemporaneous periods, were recorded. The remains of the burial ground which is the subject of this article were discovered in 2021, when nine graves, most probably inhumation graves, were recorded. A total of 337 pottery sherds were recovered from five vessels, a bronze fibula, a buckle and a necklace consisting of 174 beads, as well as an undetermined bronze object in a very poor state of preservation (although an attempt was made to preserve the artefact, unfortunately the object disintegrated). After a careful analysis of the features, both securely dated (nine) and containing no finds, but characterized by analogous dimensions, shapes, orientation, and construction of the fills, a further 11 graves were identified (Fig. 4). Eventually, 20 graves were recorded that should be linked to the population of the Dębczyno group (Features 5, 6, 9, 11, 32, 45, 63, 91, 201, 206, 209, 212, 224, 257, 258, 259, 260, 261, 301A and 303A). It should be mentioned, however, that the authors believe that there must have been more graves, but that they have not survived to the present day. This is indicated by their distribution in the burial space. Features which are presumed to be potential burials, as well as their dating, are marked in the text and the catalogue table with a question mark (?).

All of the graves are inhumation graves in which, apart from one case, no bone material survives. Grave goods were recorded in five of them, while the others produced none. In four graves (Features 5, 45, 257, 303A), small handmade vessels were recorded whose state of preservation allowed their reconstruction, while in one burial (No. 206), an elaborate necklace of beads (glass and amber, see below), a brooch and probably a belt buckle were discovered. A brief characterization of the graves is included in the table, hence only the grave equipment will be discussed in detail and the internal structure of the sepulchral space with grave clusters will be presented below the finds.

GRAVE GOODS

Pottery

In discussing the pottery from the Luzino burial ground, the scheme proposed by Henryk Machajewski was applied (see 1992, 75-77; 2021, 24, 25). In Luzino, two types of such vessels were distinguished – namely, vases and a single pot (Machajewski 1992, 78-101).

1. A low vase-like vessel (from Feature 5) characterised by good-quality firing and a smooth surface of a light brown colour (Figs 5 and 6). The diameter of the rim is 18 cm, while its height is 12 cm. The largest diameter of the body is located at the mid-height point

Fig. 5. Luzino, Site 93. Vessel from Grave 5 (photo by B. Pachulski)

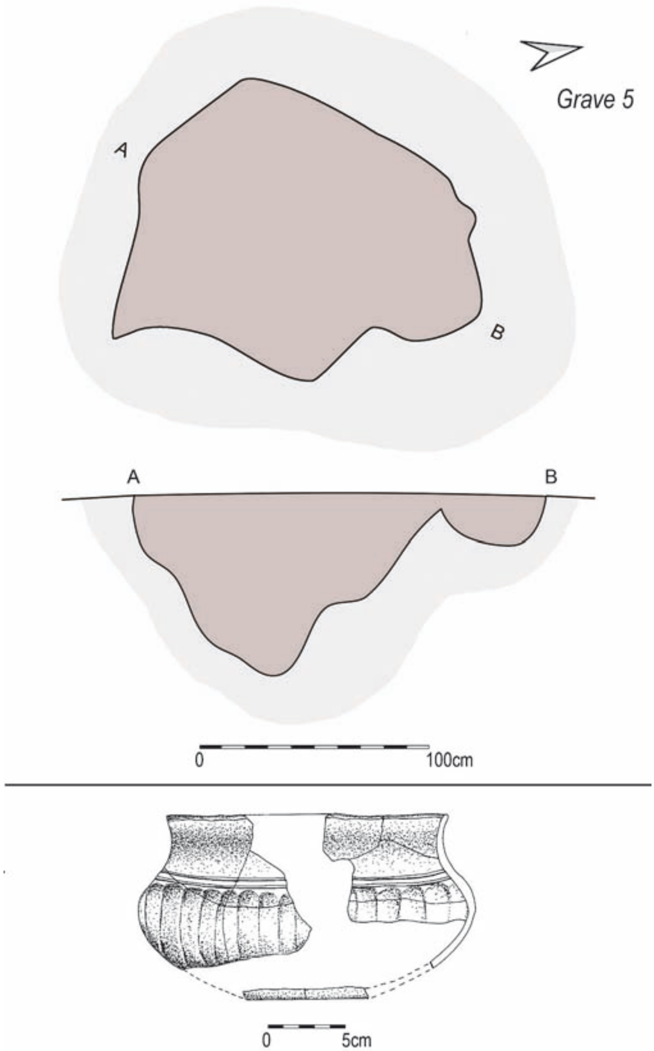

Fig. 6. Luzino, Site. 93. Burial no. 5 – plan, section and grave goods (prepared by M. Piotrowska and M. Wołoszyńska-Far)

of the vessel. The rim is gently everted with a rounded edge. The neck is clearly marked and smoothed. At the transition of the neck to the belly there is a circumferential decoration in the form of two parallel engraved lines emphasising the structural features of the vessel. Below, around the belly, are densely placed rather wide vertical grooves, extending to the base. The vessel should be included in group A, *i.e.*, type II vases with a bulbous body, variety 3 – squat forms according to Machajewski (1992, 194, pl. 6: i). Similar forms were recorded in graves at a site in Kowalki, Białogard county and at the settlement in

Dębczyno, with their occurrence being linked to the later phase of the Late Roman Iron Age (Machajewski 1992, 79, 80, 218, pl. 30: 7, 219, pl. 31: 7).

2. A vase-like vessel (from Feature 45) characterised by careful workmanship, good-quality firing, and a smooth surface with a brown outer colour (Figs 7 and 8). Its rim is 17 cm in diameter and it is 12 cm in height. The largest swell of the belly is placed slightly above the mid-height point. The rim is slightly everted with a rounded edge. Above the largest swelling of the body there is a circumferential decoration in the form of an engraved line, from which short, diagonal, fairly densely spaced incisions diverge. The form is most similar to a type II, variety 4 vessel from Grave 17 in Dębczyno dated to the later phase of the Late Roman Iron Age (Machajewski 1992, 80, pl. 6: j). Similar forms are known from the Late Roman Iron Age and the Migration Period from Mecklenburg (Schuldt 1974, plates 64: 5 and 66: 2).

3. A vessel (from Feature 257) with a rim diameter of 10 cm, characterised by careful workmanship and good-quality firing and a brown surface colour (Figs 9 and 10). The largest swell of the belly was probably at its mid-height point. The rim was everted outwards with a rounded edge and the neck was quite high. The vessel displays ornament in the form of a circular rhythmic line at the bottom of the neck and another line at the transition of the neck to the belly. Between these lines is engraved ornament in the form of double triangles. Below, in the upper part of the belly, there is stamped ornament composed of pairs of circular and rectangular impressions bordered from below by another line of engraving. The vessel from feature 257, although fragmentarily preserved, is most likely a Group D

Fig. 7. Luzino, Site 93. Vessel from Grave 45 (photo by B. Pachulski)

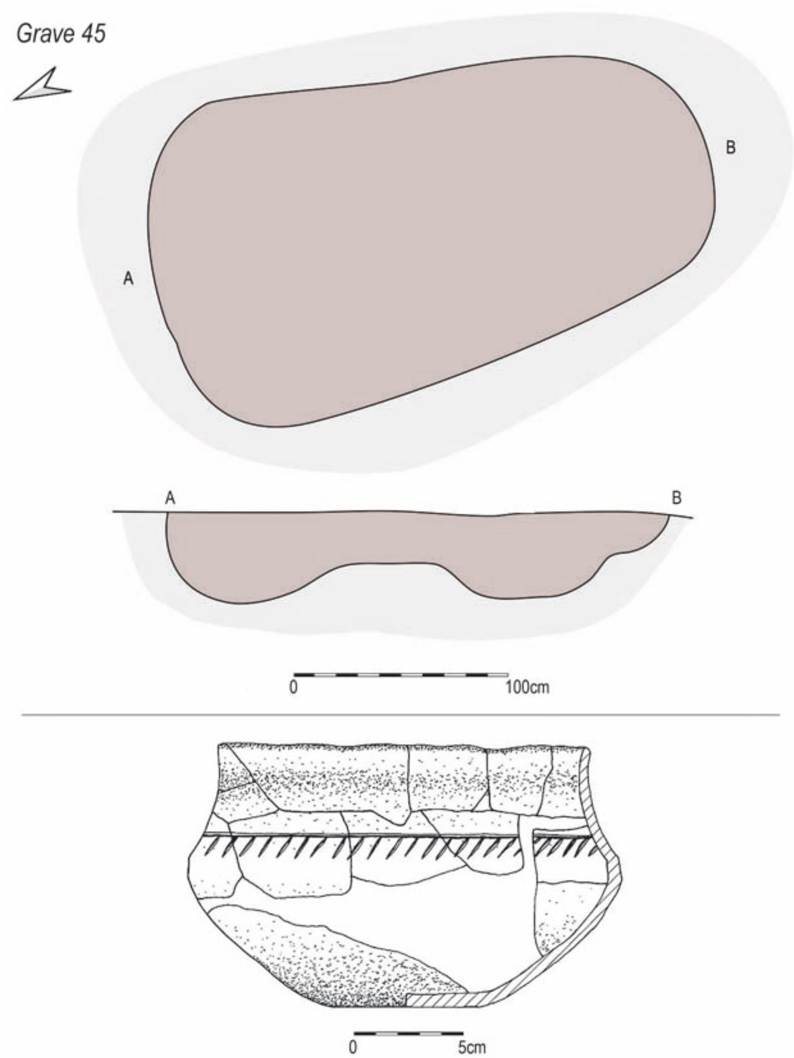

Fig. 8. Luzino, Site 93. Burial no. 45 – plan, section and grave goods (prepared by M. Piotrowska and M. Wołoszyńska-Far)

pot (Machajewski 1992, 90). This partially preserved form is most similar to pots of type III, variety 1 (see Machajewski 1992, 92, 195, pl. 7: v). A vessel of this type and variety comes from the cemetery in Kowalki and, like the specimen from Luzino, was decorated in the same place with stamped and linear ornament. Such pots have also been recorded at the cemetery in Dzierżęcin, Sławno county (Machajewski 1992, 93). The appearance of such forms in the Parsęta valley is linked to phase D according to Ryszard Wołągiewicz

(Machajewski 1992, 93). A grave with a similar vessel from the burial ground in Kowalki is linked to phase IIa of the Dębczyno group and dated to phase D (Machajewski 1993, 135, fig. 6, 162, pl. 24: 7, Grave 6; Machajewski 2001, 371). These vessels are rare in the Dębczyno group, come from the northern Polish Lake District and should be dated to the beginning of the Migration Period (Machajewski 1993, 94, 95). They are also encountered in Lower Saxony (Machajewski 2001, 364). The vessel from Feature 257, due to its bulbous body, cylindrical neck and the presence of complex ornamentation, can be referred to the Kuhbier style, which falls into subphases Ib and IIa of the Dębczyno group (Machajewski 1985, 197, 198).

4. A low vase-like vessel (from Feature 303A; vessel no. 1 – Figs 11 and 12: 1) was characterised by a rim diameter of 11 cm and a height of 10 cm. The largest swelling of the belly is located above its mid-height point. The neck is very short, while the rim with rounded edge is vertical. The ceramic vessel presented above is a small, undecorated vase of group B, type I, variety 1 according to Machajewski (1992, 195, pl. 7: a). Such vessels are rare and their chronology is not specified (Machajewski 1992, 87).

5. A low biconical vase-like vessel (from Feature 303A; vessel no. 2 – Figs 12: 2 and 13), 11 cm in height with a rim diameter of 18 cm. The rim is strongly everted with a rounded top. At the transition of the short neck into the belly, decoration is visible in the form of a circumferential engraved line, from which groups of three diagonal engraved lines diverge. From below, the decoration is bordered by a double, circumferential engraved line. The ornamentation is located above the largest swelling of the body. The surface is dark brown. This form can be assigned to group A, type II, variety 5 according to Machajewski (1992, pl. 6: k). In the Dębczyno group, two similar vessels are dated on the basis of a multiform

Fig. 9. Luzino, Site 93. Vessel from Grave 257 (photo by B. Pachulski)

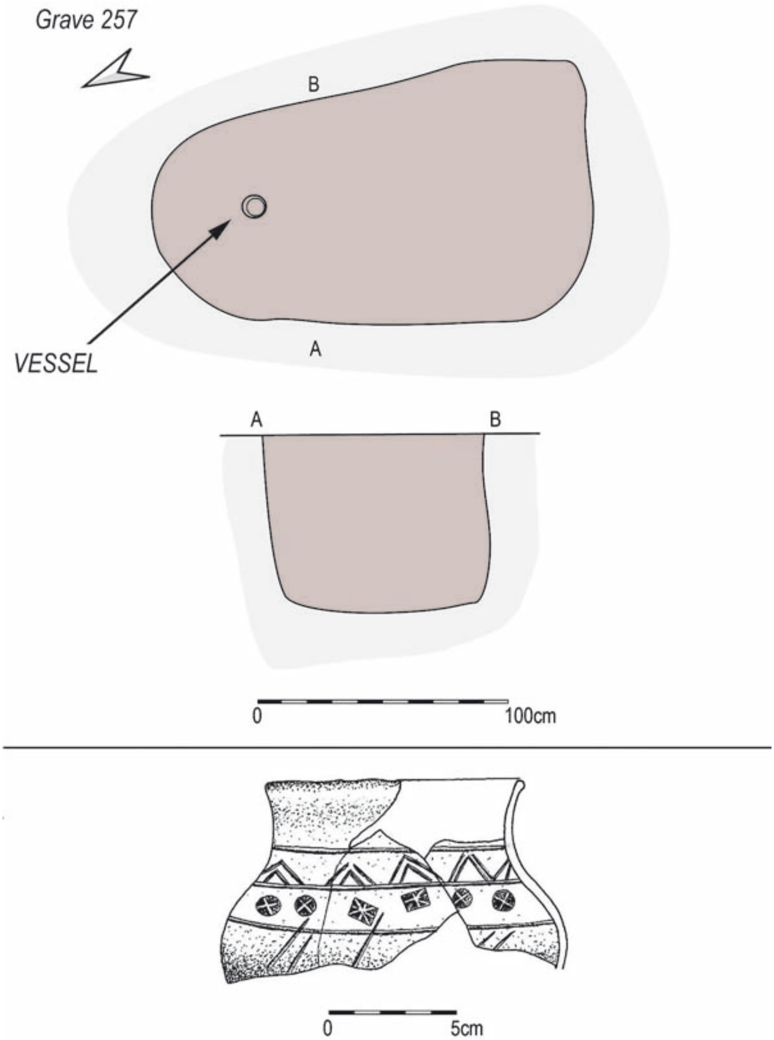

Fig. 10. Luzino, Site 93. Burial no. 257 – plan, section and grave goods (prepared by M. Piotrowska and M. Wołoszyńska-Far)

ornamental thread, which differs from the ornament on the vessel from Luzino – with only the form of these vessels being similar (Machajewski 1992, 80). In the case of the vessel in question, although its rim is strongly tilted outwards, it is not as horizontally aligned as in some specimens known from Dębczyno and several other sites (Machajewski 1992, 215, pl. 27: 10; 2021, 188, pl. 43: 10). At its most swollen point, the belly is vertically truncated, which emphasises the structure of the vessel and allows reference to be made to biconical forms (see Machajewski 1993, 93; 2021, 28). Specimens with a horizontally aligned rim and a biconical body in the eponymous deposits are linked to the C3/D and D phases. Similar vessels are known from the Cecelska phase of the Wielbark culture and from the Elbe Circle (Machajewski 1993, 93; 2021, 28). The presented vessel differs morphologically from the specimens with biconical bellies and horizontal rims, also in terms of its decorative thread, which is poor in relation to the rich, multifaceted decorations in the form of, for example, stamps or decorative bands found on this type of vessel (Machajewski 2021, 28, 29). The artefact from the necropolis in question may constitute a reference to the vessels cited above. A very similar form, only with a slightly less outwardly everted rim, but with analogous decoration, comes from Mecklenburg, from a site in Perdöhl, in the north-eastern German district of Ludwigslust (Schuldt 1974, pl. 53: 1). A vase-like vessel similar to the form from Grave 303A occurred in the cemetery at Kowalki in a grave linked to phase Ib of the Dębczyno group (Machajewski 1993, 135, fig. 6, 165, pl. 27: 22, grave 11).

The vessels from the cemetery presented here are characterised by thin walls, well-prepared pottery fabric and a smooth surface finish. In the upper parts – the necks – the vessels are usually smoothed. Their colour comprises various shades of brown. Fine-grained crushed stone and sand were added to the pottery fabric as an admixture. Fractures were monochrome in colour, indicating good-quality firing and the craftsmanship of the potters. The technical features of the pottery indicate that it belongs to the Dębczyno group. The similarity is evident in their colour, admixture, fractures and surface treatment (Machajewski 2021, 39).

Fig. 11. Luzino, Site 93. Vessel no. 1 *in situ* from Grave 303A (photo by K. Zbróg)

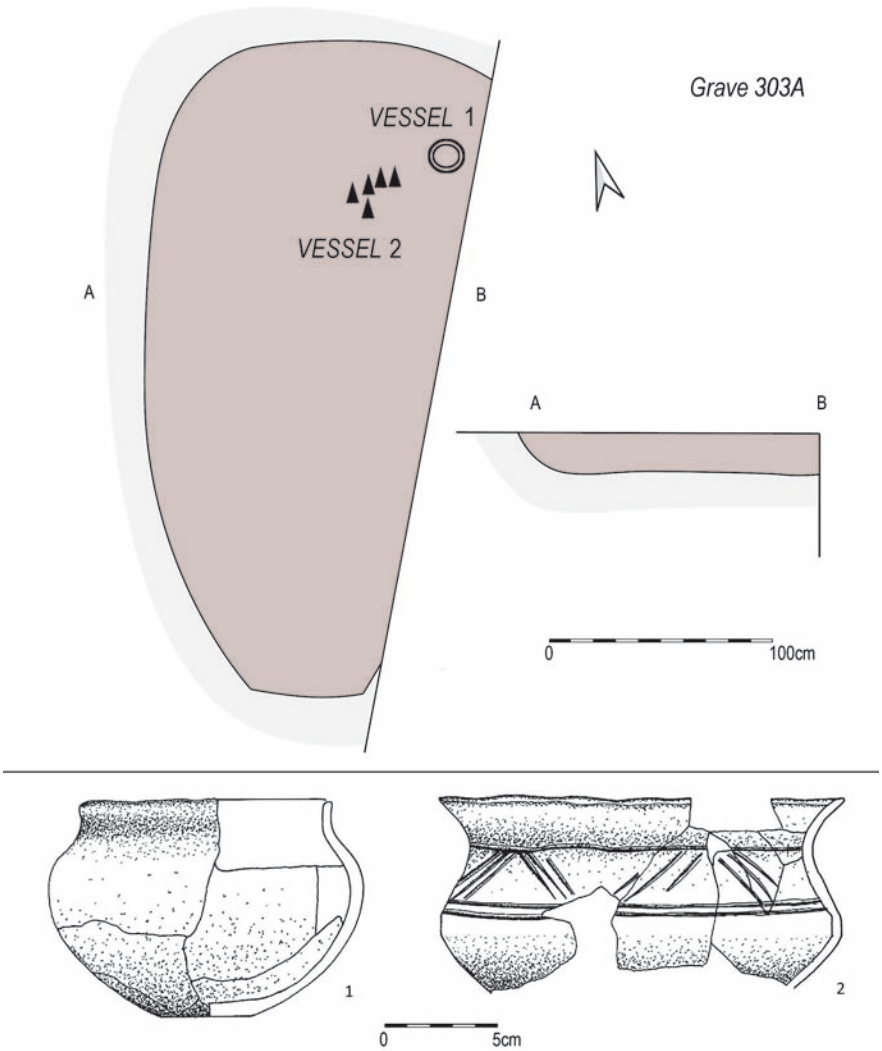

Fig. 12. Luzino, Site 93. Burial no. 303A – plan, section and grave goods (prepared by M. Piotrowska and M. Wołoszyńska-Far)

Their micromorphological features are also worth noting. Indeed, the high arched mouth of the vessel from Feature 257 and rounded bottoms are features that can be associated with the late stages of the Migration Period (Machajewski 2021, 39).

Most vessels from Luzino were decorated. The dominant ornament was engraved, which also occurred in the company of decorative forms – on a vase with wide grooves and on the only pot discovered with stamped ornament.

Fig. 13. Luzino, Site 93. Vessel no 2 from Grave 303A (photo by B. Pachulski)

A multi-line zigzag in combination with a horizontal line was recorded in Luzino on two vessels, namely a vase from Grave 303A and a pot from Grave 257, on which it occurred in combination with another form of decoration. At Site 6 in Dębczyno, such a decorative motif was most common on vase-like vessels in all phases of settlement, this decoration possessing a broad chronological framework in Pomerania (Machajewski 2021, 34). It is ornament frequently found in the Dębczyno group, and similar motifs are recorded in materials from the Elbe River area, the Danish Islands and in the Wielbark culture (Machajewski 1993, 53; 2021, 34). It was also recorded on vessels from a burial ground in Dahlhausen, Ostprignitz district (Matthes 1931, pl. 6: b). An ornament of short, diagonal incisions was also recorded at the same site, which can be compared with the decoration found on a vessel from Grave 45 in Luzino (see Matthes 1931, pl. 6: c). The vessel form from this burial also meets its analogues in the cemetery at Kuhbier, Ostprignitz district (see Matthes 1931, pl. 7: a, b). In the area between the lower Elbe and the Oder, such ornament in the form of a multi-line zigzag and horizontal lines is frequently recorded (see, among others, Schach-Dörges 1970, 181, fig. 32, 202, fig. 48).

On a single vessel, as mentioned above, there was stamp decoration in the form of a simple cross within a circle and a double cross – one multi-armed, enclosed in a rectangle, for which no direct analogues have been found in Pomerania, with the only similar ornament described as a rosette (see Machajewski 2001, 362, fig. 2). Similar ornamentation framed within a circle occurred on a fragmentary vessel from a site at Barzowice, Sławno county, dated to phases C2-D (Machajewski 2001, 365, fig. 4: 3, 371 – Catalogue: 1). Stamps in the form of crosses are found in the Elbe circle (Machajewski 2001, 362). The ornament made with a stamp in the Debczyno group is combined with the C2-D phase (Machajewski 2001, 371). The vessel from Luzino displays multi-faceted ornament – in addition to the stamped ornamentation described above, there was also a circumferential multi-line zigzag, as well as single and double diagonal lines engraved on the body.

Grooves are often found on vase-like vessels in the Dębczyno group. In the case of the sort of ornament in the form of wide grooves that is visible on the vessel from Grave 5 in Luzino, Machajewski (1985, 196), suggested that perhaps it is related to the ornamentation of bronze cauldrons found in large numbers on the Danish Isles and in Polish Eastern Pomerania. Such ornamentation in the Dębczyno group has been dated to phases C_2 and D (Machajewski 1993, 95). Kowalki is a cemetery where similarly decorated vessels were discovered in graves associated with phases Ib and IIa according to Machajewski (1993, 166, pl. 27a: 1, 167, Grave 10, pl. 28: 1, 2, grave 13, 169, pl. 30: 2, Grave 17). Such decoration is also found in the Elbe circle on vessels associated with the Dahlhausen style, as well as on Jutland and Bornholm (Machajewski 2021, 33 and further literature there).

Brooch

1. A brooch (from Feature 206) made of bronze is a fibula of the second series of group VI in the classification of Oskar Almgren (1923). This artefact is undecorated on the bow, which may indicate its local production, as imported specimens were richly decorated. There is a knob on the bow as are two more on the ends of the spring axis (Figs 14 and 15: 1). The brooch is 6 cm long. The knob on the bow of the fibula discussed here is riveted, in a similar manner to the brooch discovered at the site in Janów Pomorski, Elbląg county (see Jurkiewicz and Machajewski 2012, 222, fig. 21, 223). The aforementioned fibula found near the eastern bank of the Vistula delta, as well as the specimen discussed here, resemble Bügelknopffibeln-type brooches, which are associated with the Elbe circle, Scandinavia, Polish Western Pomerania, Bohemia and the Rhine and Danube basins (Meyer 1960, 216-349; Schulze-Dörlamm 1986, 593-720; Cieśliński and Rau 2019, 47-60). There is also known an Eastern European variant of this fibula (Schuster 2017, 215-221). These artefacts are rarely found in the Wielbark, West Baltic and Chernyakhiv cultures (Machajewski 1992, 29).

Fig. 14. Luzino, Site 93. Fibula from Grave 206 (photo by B. Pachulski)

The way of fixing the knob is alluding to Zwiebelknopffibeln. Usually in the case of Bügelknopffibeln-

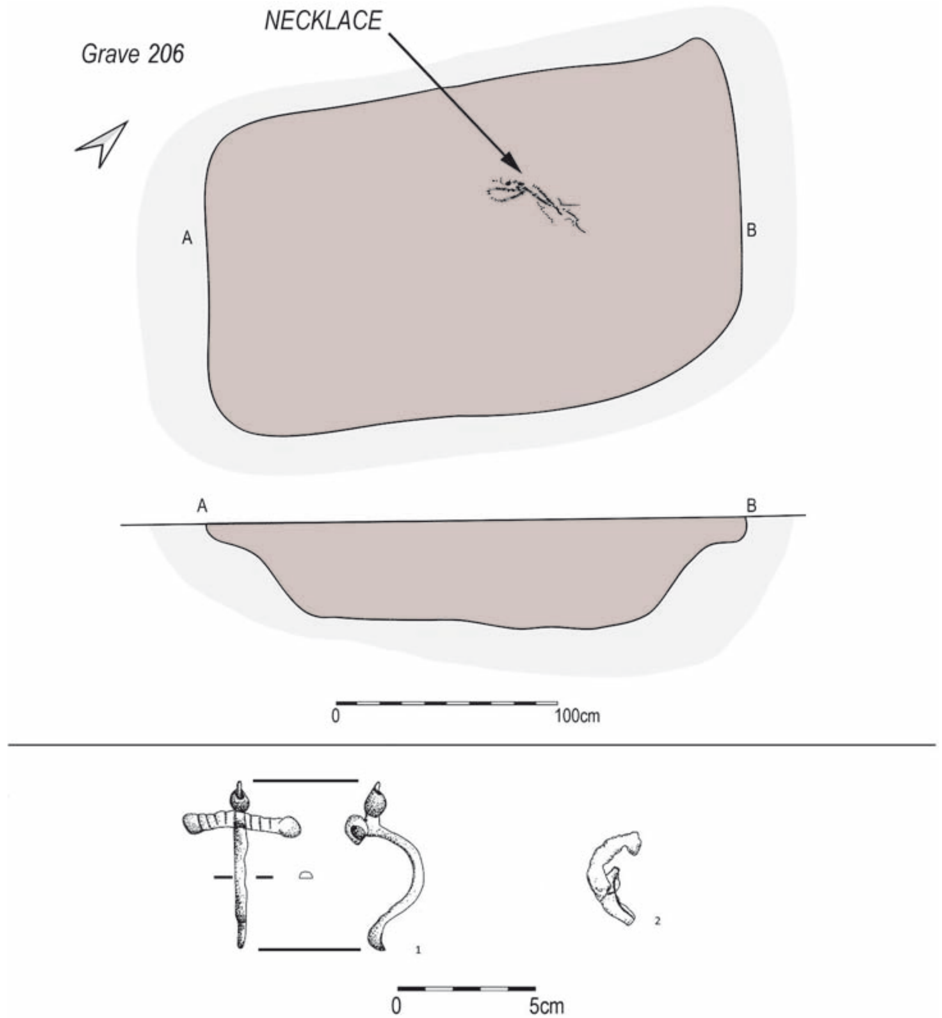

Fig. 15. Luzino, Site 93. Burial no. 206 – plan, section and grave goods (prepared by M. Piotrowska and M. Wołoszyńska-Far)

type brooches the knobs are cast together with the bow, while Zwiebelknopffibeln-type fibulae bear traces of riveting knobs, as in the case of the brooch in question (Prötter 1988, 347-372, fig. 2: 4, 4a: 2, 4, 5, 7). A knob, different from that of the Luzino brooch, but coming from a fibula described as a Bügelknopffibel-type brooch, was found in a hearth at Site 6 at the settlement in Dębczyno (Machajewski 2021, 41). Brooches with knob at the ends of the bow are quite common in the Dębczyno group (Machajewski 2021, 42). A bronze fibula with knobs on the bow and spring ends (Bügelknopffibel) occurred in one of the graves in the cemetery at Dzierżęcin (Hahuła and Machajewski 2006, 176, 179, 191, fig. 3: 26). These ornaments are associated with phase D of the Migration Period (Jurkiewicz and Machajewski 2012, 224). The brooch from Luzino presented here should also be dated similarly.

Belt buckles

1. This belt buckle (Feature 206) is characterised by a significant degree of deterioration (Fig. 15: 2). It was made of iron and its state of preservation does not allow assigning it to a specific type according to Renata Madyda-Legutko (1987). Buckles are among the artefacts recorded at sites of the Dębczyno group, almost exclusively in cemeteries (Machajewski 1992, 36).

A necklace of glass and amber beads

1. A necklace of 174 beads (from Feature 206), which included amber, glass and a single, bone specimen (Figs 16, 17 and 18). The beads recorded 'in their original' arrangement were numbered from 1 to 141 (labelled P1-P141, including P55a in addition to P55). The

Fig. 16. Luzino, Site 93. Necklace *in situ* from Grave 206 (photo by K. Zbróg)

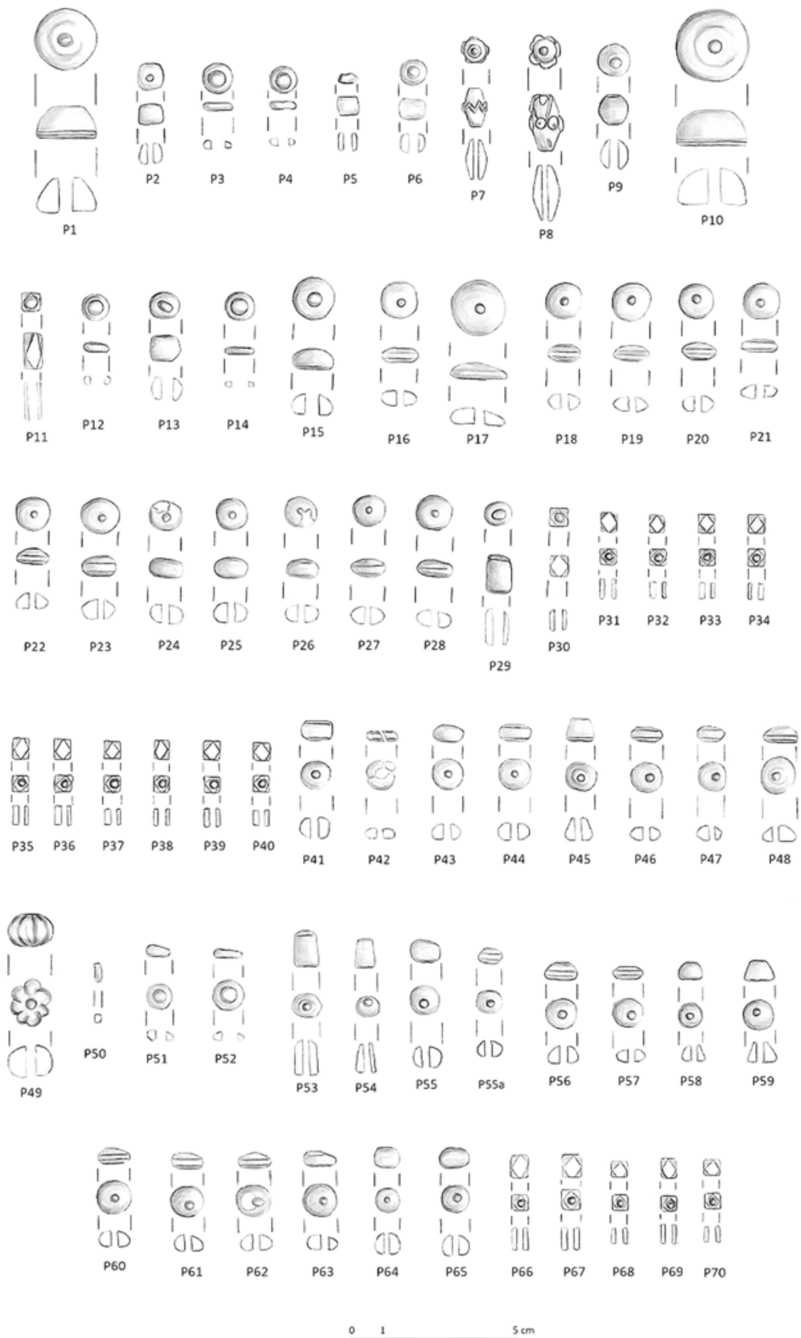

Fig. 17. Luzino, Site 93. Beads from Grave 206 (prepared by M. Piotrowska and M. Wołoszyńska-Far)

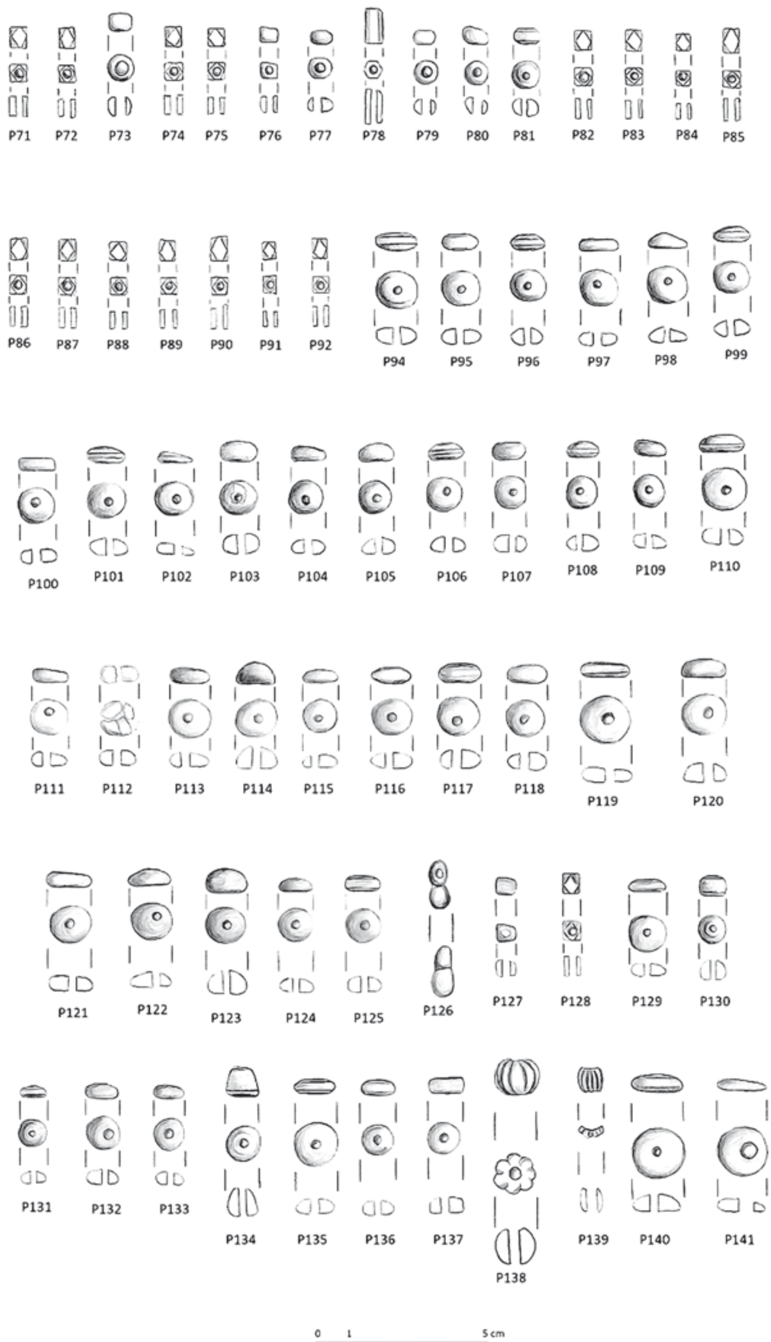

Fig. 18. Luzino, Site 93. Beads from Grave 206 (prepared by M. Piotrowska and M. Wołoszyńska-Far)

remaining 32 specimens were recorded 'loose' in the vicinity of the necklace and it was not possible to reconstruct their place in the 'string' of these ornaments. Almost all the beads find their analogues in the classification by Magdalena Tempelmann-Mączyńska (1985). However, bead P8 and bead P139 proved difficult to classify.

Amber beads: TM388 (P16, P18-P28, P41-P44, P46-P48, P55 and P55a-P57, P60-P64, P94-P113, P115-P118, P120-P122, P124, P125, P129, P131-P133, P135-P137), TM389 (P17, P81, P119, P140, P141), TM392 (P123), TM394 (P58, P65, P130, P134), TM400 (P1, P9, P59, P114), TM402a (P45), TM406 (P53, P54), TM465 (P126).

Glass beads: TM6 (P5), TM10 (P73, P79), similar to TM12 or TM10? (P2), TM12 (P6, P9, P13, P80), TM28 (P77), TM30a (P3, P4, P12, P14, P15, P51, P52), TM75 (P29), similar to TM106 (P76), similar to TM107 (P127), TM115 (P78), TM126 (P11, P30-P40, P66-P72, P74, P75, P82-P92, P128), TM158b (P49), TM158b (P138), TM165? (P139 damaged), TM335 (P7), similar in shape to type TM335 (?) and ornamentation to type TM279? (P8), TM? (P50 damaged).

The beads that were recorded as "loose" were mainly glass beads of type TM126 (P161-P173), small red and orange coloured glass beads of opaque glass similar to type TM106 (P142-P145), TM107 (P155-P157), TM30a (P146), TM58 (P155), TM88 (P156), TM12 (P160) and amber beads of type TM388 (P149, 150, P153), TM389 (P51), TM407 (P152) and TM393 (P154). Two damaged amber beads were undefined.

There was also one bone bead characterised by its poor state of preservation, which perhaps corresponds to type TM516 (P174). Bone beads have been found in Pomerania since the early phase of the Roman Iron Age but are not among the specimens frequently encountered (Tempelmann-Mączyńska 1985, 90, 91).

In summary, the most numerous groups of beads forming the necklace are amber specimens. Beads of group XXX, *i.e.,* disc-shaped specimens of types TM388 and TM389, dominate. These specimens became widespread in Pomerania during the Roman Iron Age and can be found after the Migration Period (Tempelmann-Mączyńska 1985, 24, 65-67, tables 5 and 15, 58-59). Amber disc beads are known from sites of the Dębczyno group and are among those specimens considered widely distributed (Machajewski 1992, 57, 58).

Regarding the necklace under discussion, TM392 and TM394 beads are modestly represented here. Only one specimen (P123) has been assigned to the former type. Barrel beads of type TM392 are found in grave assemblages with beads of group XXX mainly in Pomerania from the B1 phase to the Migration Period – they have a wide chronological framework (Tempelmann-Mączyńska 1985, 24, 67, 68, plates 15 and 60; Machajewski 1992, 58). Among the beads forming the necklace was one TM402a specimen. Small beads made of blue glass of type TM126 were also numerous. Beads of the last type, referred to as cuboctahedral beads, were found in the burial ground of the Dębczyno group population in Dzierżęcin and are among the specimens frequently found in Pomerania from the B2/C1 phase until the Migration Period (Machajewski 1992, 50; Hahuła and Machajewski 2006, 180). A bead necklace was discovered in a cemetery from the Migration Period in

Brzyno, Puck county (Strobin and Machajewski 2017, 552, fig. 3, 568; Strobin 2021). Among the beads were blue glass specimens similar to type TM126 (Strobin and Machajewski 2016, 553, 554, fig. 5).

The collection of beads forming the necklace also included two specimens referring to melon beads of type TM158b made of clear glass – P49 and P138 – which are also found in the Dębczyno group (Machajewski 1992, 51; Hahuła and Machajewski 2006, 181). A bead characterised by bands made of glass threads and knobs made of dark glass and decorated with yellow, red and white elements was also recorded. One of these specimens refers to type TM335.

Human bone

The only human bone found in the analysed cemetery was obtained from Feature 303A. A closer assessment of its anatomical affiliation is not possible due to its small size and significant degree of deterioration. It comprised a few extremely thin and fragile flakes of a few millimetres each. The residually preserved structure of the spongy substance characteristic of human bone helped in assessing the species affiliation. The examined fragment was highly weathered, decalcified and brittle. The structure of the compact substance had a tendency to fracture and delaminate. As a result of sub-depositional taphonomic factors, the bone had acquired a white colouration. With a high degree of caution, this specimen can be classified as a long-bone shaft fragment.

INTERNAL STRUCTURE OF THE SEPULCHRAL SPACE

In the burial ground in question, most of the graves were oriented on a north-south axis with some deviation to the west. Seven clusters were identified here, which appear to form closed structures (Fig. 4). Starting from the west, they are:

– Cluster No. 1, located in the western part of the study area, oriented on a northeast-southwest axis, comprising four graves numbered as follows: 32 (Fig. 19), 45, 91 (Fig. 20) and 224. The distances between the individual burials did not exceed 10 m;

– Cluster No. 2, located in the western part of the necropolis, east of the one described above at a distance of just over 10 m, oriented on a northwest-southeast axis, consisting of two graves numbered 212 (Fig. 21) and 213, respectively. The distances between the burials were approximately 7 m;

– Cluster No. 3, located in the central part of the cemetery, to the southeast of cluster No. 2 at a distance of less than 20 m, oriented on a northwest-southeast axis, consisted of two graves, Nos. 5 and 6 (Fig. 22). The distance between these graves was approximately 5 m;

Fig. 19. Luzino, Site 93. Plan of Grave 32 (photo by K. Zbróg)

Fig. 20. Luzino, Site 93. Plan of Grave 91 (photo by K. Zbróg)

Fig. 21. Luzino, Site 93. Plan of Grave 212 (photo by K. Zbróg)

Fig. 22. Luzino, Site 93. Plan of Grave 6 (photo by K. Zbróg)

– Cluster No. 4, located in the central part of the necropolis, to the northeast of cluster No. 3 at a distance of approximately 12 m, oriented on a northwest-southeast axis, consisted of two graves, Nos. 206 and 209. The distance between them was approximately 10 m;

– Cluster No. 5, located in the central part of the cemetery, to the southeast of cluster No. 3 at a distance of almost 20 m, oriented on a northeast-southwest axis, consisted of two graves, Nos. 9 and 11. The distance between the graves was approximately 3 m;

– Cluster No. 6, located in the eastern part of the necropolis, to the northeast of cluster No. 4, at a distance of approximately 40 m, oriented on a northwest-southeast axis, consisted of three graves with the following numbers: 257, 259 and 260. The distances between them were from 3 to 5 m;

– Cluster No. 7, located in the eastern part of the cemetery, to the southeast of cluster No. 6, at a distance of approximately 10 m, consisted of four graves numbered: 258, 261, 301A and 303A, respectively.

DISCUSSION

As can be surmised, the depicted clusters of graves may be an expression of the social connections of a 'living community', the quality of which is difficult to discuss at the moment. However, it is possible to assume the simplest solution indicating emotional-familial links, which have already been pointed out in the literature (Kokowski 1999, 105, 109; 2007, 135, 136; Leather 2014, 66), and which were extremely important in shaping the cemetery space and funerary rituals in honour of one's ancestors (Żychliński 2018, 199).

In addition, a single grave, Feature 63, located far south of the above-described clusters (*c*. 30 m), was also recorded (see Fig. 4). It was located in a small hollow in the ground, as can be assumed, on the southern edge of the necropolis and marked its southern boundary (Fig. 3). With some caution, it can be assumed that a person of somehow socially excluded status or even foreign origin was deposited there. Such a hypothesis is supported by its location below the other graves, on the slope of the hollow, and thus by its inferior or even negligible visibility, which, as already indicated in the literature, may be very important in the funerary sphere (Cieśliński 2016, 88; Smaruj and Żychliński 2023). Moreover, the 'unusual nature' of the person buried in this grave is indicated by the presence of two very large stones originally placed on the body of the deceased (Figs 23 and 24). A very similar feature interpreted as a potential grave was recorded in Czarnówko, Lębork county (see Schuster 2015, 38, pl. 2: feature R156). No human bones were preserved and the only grave goods comprised an uncharacteristic, thick-walled, barrel-shaped vessel (Schuster 2015, 15, 16). On the basis of indirect indications, the site has been linked to a small necropolis from the Migration Period dating from the second half of the fifth century, where newcomers from Scandinavia were buried (Schuster 2015, 17, 29). This burial, analogously to the site at Luzino, was characterised by the presence of two

Fig. 23. Luzino, Site 93. Plan of Grave 63 (photo by K. Frątczak)

Fig. 24. Luzino, Site 93. Section of Grave 63 (photo by K. Frątczak)

large stones and additionally one small one next to the burial pit. It was oriented on a north-south axis with a slight deviation to the west. It differed from the other burials, similarly to the presumed Grave 63 (see Table 1), by its smaller dimensions, namely 1.1 × 0.4 m (Schuster 2015, 16, 18, fig. 1).

One issue of great importance for determining the structure of the burial space of the Luzino necropolis, is the correlation of the location of the graves and their clusters with the form of terrain they occupy. An analysis of the contour map (Fig. 2) and the 3D model of the necropolis area and its surroundings (Fig. 3) allows one to conclude that the vast majority of the graves were placed on the summit and the south-western slope of a small elevation within the upland, at a considerable distance from local watercourses. The only deviation from this rule is the above-mentioned Feature 63, situated on the opposite slope of another terrain elevation with northern exposure, as if facing the other graves included in the clusters. It seems that such a situation can be interpreted as being in opposition to the 'centre' of the burial ground, with the hollow between the two arrangements of graves representing a clear obstacle/boundary separating the zone used by fully-fledged members of the community founded on the larger of the terrain elevations and the area of the cemetery intended for other people, perhaps those not fully accepted.

Furthermore, based on an analysis of the terrain of the necropolis and its vicinity, it can be assumed with a high degree of probability that graves may also have been located further east. However, this area was completely destroyed during the construction of the road to Luzino (Figs 2 and 3). It can be assumed that this was at a distance of about 15 m, where, given the distribution of the discovered grave assemblages, there may have been at least one or even two further clusters.

The structure of clusters described above appears to be quite distinctly scattered. This is an unprecedented situation for the Dębczyno group, as other known, albeit few, investigated cemeteries such as Dębczyno, Site 2 and Kowalki, Site 1 (Machajewski 1993) do not represent such diluted internal structures, and the individual graves are located much closer together. While it is also difficult to find clear clusters of graves at Dębczyno (Machajewski 1993, pl. 1), six such examples can be distinguished with some caution at Kowalki (Machajewski 1993, pl. 22). Thus, this is an analogous situation to that recorded at Luzino and further confirms the affiliation of the studied necropolis to the Dębczyno group.

The burial ground in nearby Brzyno, which also dates to the Migration Period but is not directly linked to the grouping discussed here, contained seven inhumation graves with a north-south orientation with a westward tilt. Stone constructions in the graves in the form of cobblestones were recorded. Human bones were recorded in only one feature. The situation is analogous at the already mentioned cemetery in Czarnówko, where out of six graves, bones were preserved in only two (see Schuster 2015, 15-17). It seems, therefore, that the situation observed at the eponymous necropolis is encountered quite commonly at sites from the Migration Period in Pomerania (Strobin and Machajewski 2017, 566). In Brzyno, only four vessels were discovered in burial pits (Strobin and Machajewski 2017, 569). Furthermore, the graves at this necropolis, like those at Luzino, form two clusters that are quite far apart (Strobin and Machajewski 2017, 566).

This raises the question of cremation burials, which, however, also occurred in the Dębczyno necropolis, albeit rarely (Machajewski 1993, 57, 58, 100, 101). In Dębczyno an interesting phenomenon of locating two cremation burial complexes on the periphery of grave clusters was observed (Machajewski 1993, 57, 58; pl. 21), in the extreme western

Table 1. Luzino, Site 93. Catalogue of the graves

Burial no/ Fig.	Location	Dimensions			Shape		Fill	Burial type/ bones	Finds/other	Chronology
		length [m]	width [m]	depth* [m]	plan	profile				
5/ 5, 6	Central part of cemetery–cluster 3	2.40	1.50	**0.80**	irregularly rectangular	irregular	clayey sand	inhumation/ no bones preserved	1 clay vessel	phase D
6/ 22	Central part of cemetery–cluster 3	2.30	1.40	**0.36**	oval elongated	trapezoidal	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)
9	Central part of cemetery–cluster 5	2.66	1.40	**0.88**	irregularly elongated	irregular	clayey sand	inhumation/ no bones preserved	none/ 3 stones in the upper fill	phase D(?)
11	Central part of cemetery–cluster 5	2.00	0.72	**0.32**	irregularly elongated	irregular	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)
32/ 19	Western part of cemetery-cluster 1	2.60	1.50	**0.20**	irregularly elongated	irregular	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)
45/ 7, 8	Western part of cemetery-cluster 1	2.20	1.50	**0.42**	irregularly rectangular	irregular	clayey sand	inhumation/ no bones preserved	1 clay vessel	phase D
63/ 23, 24	Southern part of cemetery–isolated burial	1.60	0.88	**0.36**	irregularly rectangular	trapezoidal	clayey sand	inhumation (?)/ no bones preserved	none/ 2 big stones in the fill	phase D(?)
91/ 20	Western part of cemetery-cluster 1	1.78	0.90	**0.40**	irregularly elongated	concave	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)
201	West-central part of cemetery-cluster 2	2.44	1.60	**0.82**	irregularly oval	trapezoidal	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)

206/ 14-18	Central part of cemetery-cluster 4	2.48	1.54	**0.50**	irregularly rectangular	trapezoidal	clayey sand	inhumation/ no bones preserved	Bronze fibulae, iron buckle, necklace of 174 beads made of glass and amber, undefined iron object	phase D
209	Central part of cemetery-cluster 4	2.20	1.14	**0.26**	oval elongated	trapezoidal	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)
212/ 21	West-central part of cemetery-cluster 2	2.20	1.98	**0.34**	oval elongated	trapezoidal	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)
224	Western part of cemetery-cluster 1	2.28	1.28	**0.60**	oval elongated	trapezoidal	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)
257/ 9, 10	Eastern part of cemetery-cluster 6	1.60	0.94	**0.60**	irregularly rectangular	trapezoidal	clayey sand	inhumation/ no bones preserved	1 clay vessel	phase D_2
258	Eastern part of cemetery-cluster 7	1.80	0.80	**0.28**	irregularly rectangular	trapezoidal	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)
259	Eastern part of cemetery-cluster 6	1.76	0.98	**0.32**	irregularly rectangular	trapezoidal	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)
260	Eastern part of cemetery-cluster 6	2.40	1.80	**0.56**	irregularly rectangular	trapezoidal	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)
261	Eastern part of cemetery-cluster 7	1.94	1.41	**0.32**	irregularly elongated	trapezoidal	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)
301A	Eastern part of cemetery-cluster 7	1.68	0.77	**0.28**	irregularly rectangular	trapezoidal	clayey sand	inhumation (?)/ no bones preserved	none	phase D(?)
303A/ 11-13	Eastern part of cemetery-cluster 7	2.93	1.27	**0.15**	irregularly rectangular	concave	clayey sand	inhumation/ part of the long bone	2 clay vessels	phase D

*The depths of the graves are marked in bold font to emphasize the very poor preservation of the burials part of the necropolis. No cremation burials at all were recorded at Luzino. With some caution, however, it can be assumed that there were also complexes of this type here, but as they were deposited at much shallower level than skeletal burials, they have been completely destroyed, both by natural processes and during the modern period by intensive farming.

To conclude our considerations concerning the internal structure of the Luzino cemetery, it should be stated that due to the lack of preservation of skeletons in the graves and the damage done in the course of modern ploughing, as well as a significant number of chronologically undetermined features that do not contain any archaeological materials, it can be assumed that the number of graves of the Dębczyno group may have been higher than the recorded 20 assemblages. This is due to the fact that it is possible that a certain group of features was not recognised as comprising burials, and a certain number of them, including the hypothetical above-mentioned cremation burial complexes lying at shallower levels than skeletal burials, have been completely destroyed. Despite these disruptions, the characterisation of the burial space presented above appears to have been reconstructed in accordance with past reality.

The issue of the absence of human bones in graves

Although the arrangement of the bead necklaces in burial 206 clearly indicates that they were deposited in the grave together with the body of the deceased, no bones have survived. This is a clear indication that we are dealing with inhumation burials, originally containing human corpses, and not cenotaphs. Following this line of thought, it is important to consider the reasons for the complete decomposition of the bodies deposited in the graves in the Luzino cemetery. The soil substrate here was clayey sand, which is characterised by considerable water permeability. And at the same time, its pH level, *i.e.,* acidic, was unfavourable for the preservation of human bone over longer time intervals (White and Hannus 1983, 319; Jerszyńska 2004, 10). In addition, what seems to be the most significant factor destructively affecting human bones already after the bodies had been skeletonised was low ground frost resistance - the penetration of ground frost was high. All the burials described above reached a depth (range between 0.08 and 0.88 m – see Table 1) above the minimum ground frost depth in Poland, which is 0.8 m (Gontaszewska 2010, 46, fig. 5.1). Although only features 5 and 9 reached this limit, combined with the unfavourable reaction of the soil environment, here too human bone was not preserved until the site was exposed during the rescue survey. To summarise these considerations, the absence of human bone or the presence of only negligible traces of it (see Feature 303A) can be explained by a combination of two unfavourable factors, namely the acidic soil environment and the shallow deposition of skeletons in the context of ground frost.

Furthermore, it is worth mentioning that, in addition to the unfavourable soil conditions and low ground frost resistance mentioned above, one can also take into account the custom of extracting human bones from graves, commonly encountered during the period of Roman influence within the environment of the Wielbark culture (Schuster 2018, 28; Skóra 2017; Żychliński 2015; 2018), and traces of which were also discovered during the Migration Period precisely in the cemeteries of the people of the Dębczyno group (Żychliński 2021). Leaving aside the purpose for which the human bones were obtained, it can be assumed that those that remained in a grave may have decomposed far more quickly due to their structure and characteristics (Knüssel 2014, 32, 33, fig. 3). As a result, not the slightest trace would have remained of the skeleton for archaeologists to record. Furthermore, accepting such a hypothesis, it should be noted that disturbed burial pits are much more quickly affected by external factors such as seepage/water flow or freezing than graves with undisturbed original fills (see *e.g.*, Skóra 2014; 2017; 2018; 2019).

Although no traces of burials having been opened were observed in the burial ground presented here, their insignificant preserved ground depth and sub-depositional processes may have influenced the lack of evidence for such funerary behaviour.

Chronology of the cemetery

Pottery and, in the case of one grave, a beaded necklace and a brooch, form the basis for determining the functional period of the cemetery. The assemblages devoid of grave goods were associated with the Dębczyno group due to their location, the orientation of the grave pits and their similarity to securely dated features. The sparse ceramic assemblage recovered from the Luzino graves finds links with the Dahlhausen and Kuhbier stylistics dated from the late C_1 phase to the D phase (Machajewski 1985, 188). Despite the modest assemblage of artefacts, cultural links can be seen here, namely with the Elbe circle and areas of northern and central Germany, with which the aforementioned styles evident in the ceramics are linked (Machajewski 1985, 202).

The burial ground at Luzino is situated between areas where elements from the west and north flowed in, and the lower Vistula, where the Wielbark culture continued to develop (Machajewski 1985, 188; 2006). The eastern boundary of this area as well as the extent of the Dębczyno group in this direction is defined by the Łeba basin (Machajewski 2006). As the boundary of this area is in the vicinity of the site located at Luzino, it seems that the findings of Machajewski concerning the phases of settlement can also be applied to the presented site (see 2006, 35). For the area of central Pomerania, Machajewski distinguishes several phases – stages of settlement and seven chronological phases – the most important of which, in the context of the materials presented here, is phase VI.

Phase VI is an earlier stage of the early phase of the Migration Period and is associated with destabilisation of settlement and a paucity of grave goods (Machajewski 2006, 41). During this phase, *Bügelknopfibeln*-type fibulae appear and, in addition to the pottery of the older style of the Dębczyno group, vessels of the younger stylistic stage are recorded (Machajewski 2006, 42). In this phase, stamp motifs are visible in the decoration, cylindrical-necked vessels and vase-like vessels occur (Machajewski 2001, 359-371; 2006, 42). Moreover, it is characterised by a certain destabilisation of settlement and is associated with Phase D of the Migration Period. During this period, references to the Scandinavian circle are evident, and then, at the end of the early phase of the Migration Period, allochthonous tribes – namely, Scandinavian tribes – appear in the area (Wołągiewicz 1981, 151-153; Machajewski 1992, 83-91; Schuster 2015). However, Scandinavian influences are not visible in the materials presented.

The settlement of the Dębczyno group in the eastern part of central Pomerania does not appear until the end of the C_2 or even the beginning of the D phase, as in this area we are still dealing with the Cecelska phase of the Wielbark culture, as exemplified by the necropolis in Głuszyno, Słupsk county used from the C_1b to D phase (Machajewski 2006, 46 and further literature there). It can therefore be inferred that further east, the Dębczyno group appears even later.

The materials found at the Luzino site, on the basis of analogies from other Dębczyno sites, should be linked to phase IIa of the Dębczyno group, *i.e.*, stages C_3 and D (see Machajewski 2021a, 83, Table 1). In conclusion, the grave goods presented above are culturally homogeneous – dated from the D_1-D_2 phase of the Migration Period.

In the case of the necropolis presented here, its peripheral location should be taken into account – it is, as already written in the title of this paper, the easternmost cemetery of this grouping. Therefore, it should be associated with the Migration Period – seemingly rather with the late stages of this period.

FINAL CONCLUSIONS

The burial ground at Luzino was used by a small community of the Dębczyno group, as indicated by the number of graves discovered. We are dealing here with a small inhumation burial ground and a probable lack of cremation burials. We find a parallel with the grave featuring two large stones in the fill in the necropolis at Czarnówko, where such a burial has been tentatively linked to a Scandinavian element. The burials with grave goods, however, show mainly links to the Elbe circle, while Scandinavian influences are lacking in the finds.

The Dębczyno group formed in areas previously occupied by the Gustowska group and the Wielbark culture (zone B, abandoned by the Wielbark culture community during the B_2/C_1-C_{1a} phase), excluding, among others, areas of the Kashubian-Krajeńskie Lake District (Machajewski 1985, 188). The discovery of the burial ground at Luzino shows that the formative settlement of the Dębczyno group, which then occupied areas to the east, did not completely bypass the Kashubian-Krajeńskie Lake District and reached further east beyond the Łeba basin (see Machajewski 2006, 46). Thus, the necropolis discussed here 'shifts' the range of the eponymous cultural grouping further eastwards.

Acknowledgments

The authors would like to thank Prof. Henryk Machajewski for his consultation and assistance in writing this article.

Thanks, are also due to Dr Kamilla Waszczuk to Dr Artur Rewekant for their analysis of the only bone fragment discovered at the Luzino site and for their consultations indicating unequivocally that the fact that human skeletons' lack of preservation was caused by post-depositional conditions, *i.e.*, the reaction of the soil environment and its low ground frost resistance. The authors would also like to thank Dr Marta Krzyżanowska for her consultations in our analysis of the beads.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3472

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EARLY MEDIEVAL BURIAL FROM THE CULMINATION OF THE OLD TOWN HILL IN SANDOMIERZ

ABSTRACT

Florek M. and Szczepanek A. 2023. Early medieval burial from the culmination of the Old Town Hill in Sandomierz. *Sprawozdania Archeologiczne* 75/2, 345-370.

The subject of this article is a grave dated to the end of the 10th century AD discovered in 2016 at the culmination of the so-called Old Town Hill in Sandomierz (Sandomierz Site no 45). The grave, just like a burial found in 2006 – located a dozen or so metres from the discussed feature – was unusually oriented – approximately along the N-S axis. Specialist analyses and examination of the burial goods found in the grave – a knife, a firesteel, a flint strike-a-light and a vessel fragment – indicate that the buried man probably lived in Sandomierz or its surroundings. The graves discovered in 2006 and 2016 are not part of a vast cemetery that occupied the middle and upper part of the Old Town Hill in the 11th century, but they are separate burials. It is possible that they attest to an abandoned attempt to establish a cemetery by an unspecified group inhabiting Sandomierz at the end of the 11th century, desiring to stress their distinctiveness from the rest of the population not only by having their own necropolis, but also by digging graves that were oriented in a different direction.

Keywords: Sandomierz, Early Middle Ages, grave, cemetery
Received: 19.04.2023; Revised: 24.05.2023; Accepted: 28.09.2023

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INTRODUCTION

The term 'Old Town Hill' refers to a vast hummock in Sandomierz, located at a certain distance from the chartered town – within the marginal zone of the Sandomierz Upland – gently descending to the Vistula valley (Fig. 1). The name derives from the Old Town – *civitas antiqua*, a designation used already in the Middle Ages, as opposed to the city located on the Town Hill by prince Leszek the Black in 1286 (*cf.*, Buko 1993, 43-47; Kiryk 1994, 120; Florek 2019, 37). The elevation is also called St Jacob's or St Paul's Hill. Both names derive from the dedications of the medieval churches standing there. Today, the Old Town Hill is split by a deep loess gully called Queen Jadwiga's Ravine, which starts near St Paul's Church and ends at the foot of the hill, in the Vistula valley.

In 1928, a vast inhumation cemetery from the 11^{th} century and remains of an early medieval settlement from a somewhat later time were discovered in the central part of the Old Town Hill during earthworks related to the construction of the so-called House of Retired Priests at Staromiejska Street and the building of the Catholic School located on the opposite side of the Queen Jadwiga's Ravine. The rescue research then commenced under the supervision of Józef Żurowski – which continued the next year – encompassed only part of the cemetery, near the building complexes of St Jacob's Church and the monastery of the Dominican Order, between the Staromiejska Street and Queen Jadwiga's Ravine. The area of the cemetery located on the other side of the ravine was not researched and its greater part was destroyed (*cf.,* Gardawski 1955, 96). The excavations led by Żurowski led to the discovery of about 200 (from 177 to 228) graves considered to be early medieval. Three funerary features were dated to the Neolithic, and another two graves – to late medieval times or even the Modern Period (*cf.*, Żurowski 1929, 26-38; 1930, 15-17; Sarama 1957, 444-457; Gąssowski 1969, 399-434; Rysiewscy 1991, 193-231; Florek 2012, 49; 2019, 40).

In later years, building work and earthworks resulted several times in finding early and late medieval graves in different parts of the Old Town Hill. Nevertheless, archaeological excavations in the places of their discoveries – which led to unearthing new burials (Fig. 2) – were conducted only at a few occasions (*cf.*, for example, Bajka 2011, 60, 61; 2016, 62-64; Bajka and Florek 2011, 169-180; Florek 2006a, 65, 66; 2006b, 410-412; 2011, 24-32; 2012, 49, 50; 2019, 43, 44; Florek and Zakościelna 2005, 132, 133; Grabowska and Grabowski 2017, 50-53). It is not certain whether all these graves were part of one vast necropolis, which covered the greater part of the Old Town Hill, or they attest to the existence of two or more medieval cemeteries that were located one near the other and coexisted at least for some time (*cf.*, Florek 2012, 51, 52). We will tackle this question at the end of the article.

Besides the cemetery – or cemeteries – located on the Old Town Hill, similar non-churchyard cemeteries from early medieval Sandomierz were located on the Town Hill and Reformackie Hill (Florek 2011, 24-32; 2012, 46, 47; 2021a, 22-27; 2021b, 79, 80; 2023).

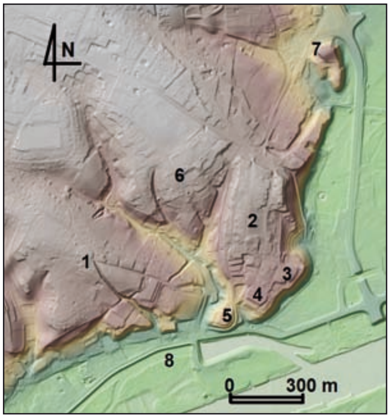

Fig. 1. Topography of medieval Sandomierz.
Key: 1–Town Hill; 2 –Gostomianum Hill; 3 – Collegiate Hill; 4 – Castle Hill; 5 – Old Town Hill; 6 – Reformackie Hill; 7 – Żmigród Hill; 8 – Vistula Valley. Prepared by M. Florek

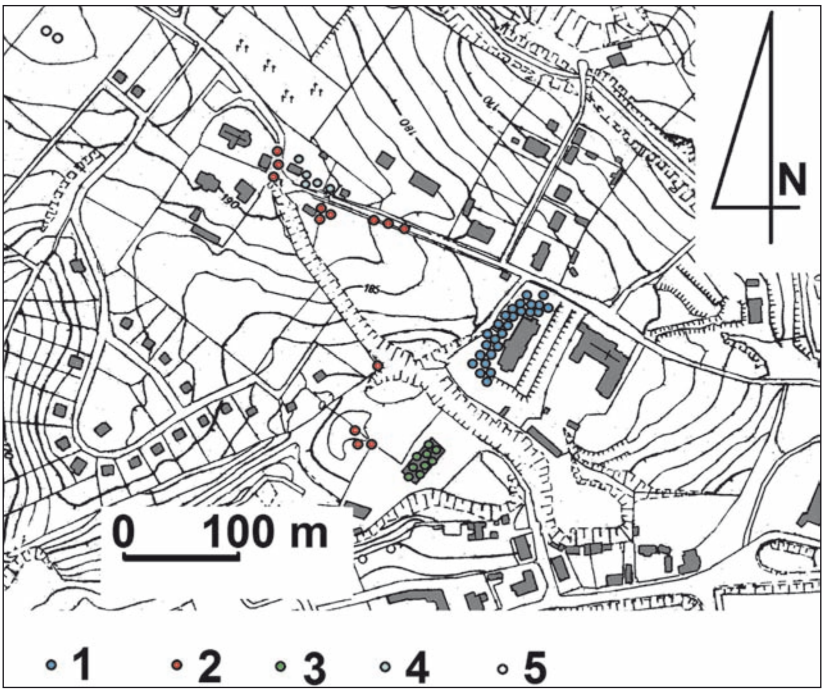

Fig. 2. Sandomierz – Old Town Hill. Early medieval cemetery and graves known from archaeological research and serendipitous discoveries. Key: 1 – part of the cemetery researched by J. Żurowski in 1928-1929; 2 – part of the cemetery destroyed during the construction of the Catholic School at the end of the 1920s; 3 –part of the cemetery destroyed at the end of the 19th and beginning of the 20th century; 4 – graves discovered in 2006 and 2016; 5 – other graves known from archaeological research and serendipitous discoveries after 1945. Prepared by M. Florek

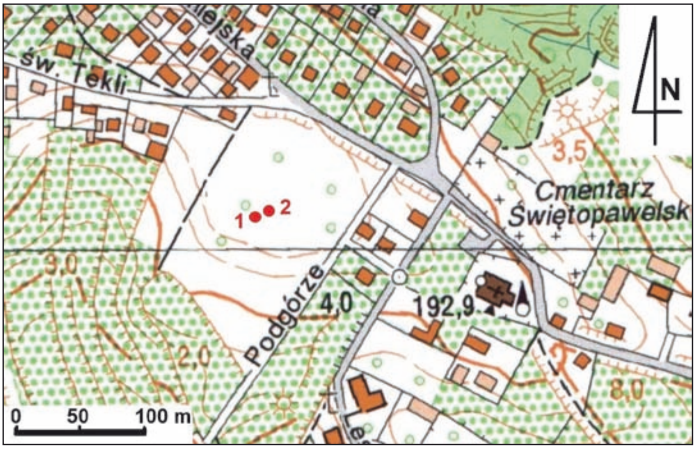

Fig. 3. Sandomierz, Site 45. Locations of the graves discovered in 2006 and 2016. Prepared by M. Florek

We will focus on an early medieval grave (Fig. 3) discovered on the culmination of the Old Town Hill – to the west of St Paul's Church – during a rescue research conducted in 2016 by Monika Bajka (Bajka 2016, 62-64). Earlier, in 2006, a considerably damaged early medieval burial was found a dozen or so metres from this funerary feature. Only the bones of the lower limbs and burial goods (a knife and iron hoops of a small wooden bucket) preserved in this grave (Florek 2006a; 2006b). Monument preservation records refer to the area of both discoveries as Site 45 (*cf*., Florek 1995, 171, 172; 2018, 79).

GRAVE DESCRIPTION AND BURIAL GOODS

Grave

The outline of the burial pit discovered in 2016 was recorded c. 40 cm below the present ground level, at the depth of the top of the loess subsoil. The depth of the pit bottom was *c*. 70 cm. In its upper part, the pit was nearly rectangular, with the dimensions of *c*. 250 × 70-100 cm. Its long axis was oriented NNE-SSW. At the level of the bottom, its layout (plan) was irregular and its dimensions were more modest (*c*. 200 × 40-60 cm). The fill of the pit was composed of grey, mixed soil. At the bottom, there was the skeleton of a male – who had died at the age of 35-45 – buried in the supine position, with arms oriented along the body and head pointing S (Figs 4 and 5). The skull was located at some distance from the rest of the skeleton and turned by 180 degrees from its natural position. There were no remains of a coffin or wooden box, in which the man might have been buried. Nevertheless, the darker colour of the pit bottom under the skeleton may suggest that he was placed

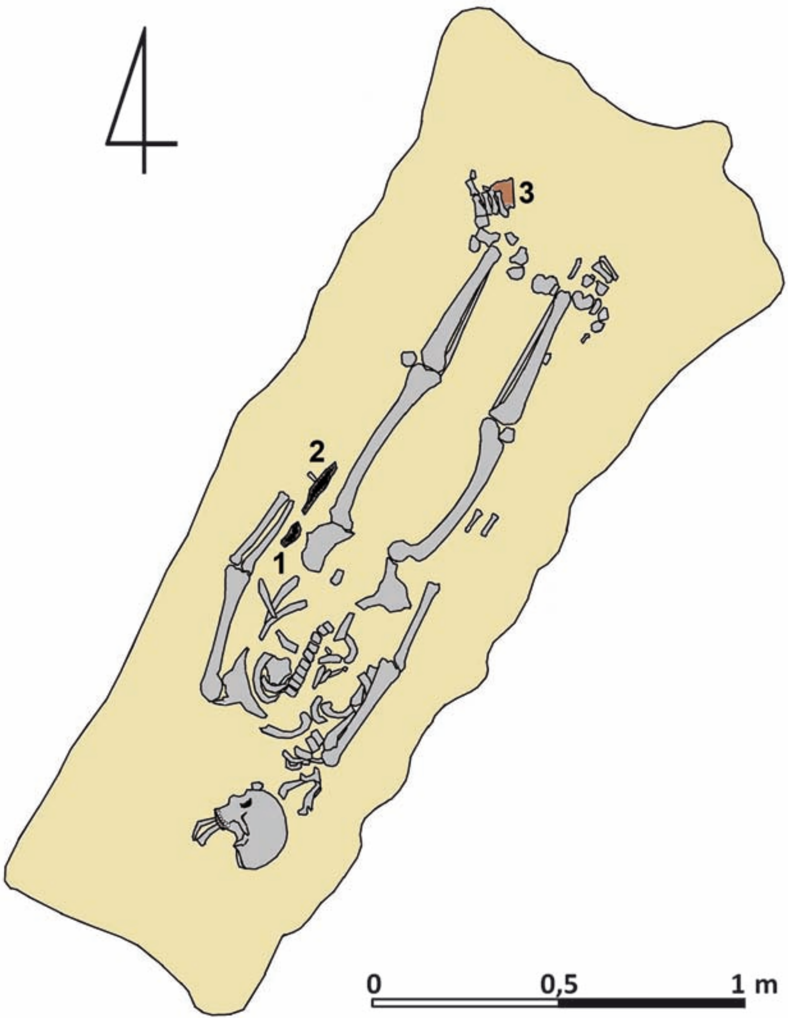

Fig. 4. Sandomierz, Site 45. Layout of the grave discovered in 2016 at the depth of 70 cm. Markings: 1 – fire-striking set; 2 – knife; 3 – vessel fragments. Prepared by M. Bajka

on wooden boards, or that his body was wrapped in a shroud. An iron knife, two fragments of a flint strike-a-light and a bow-shaped firesteel were discovered next to the left hand, which was not preserved except a single phalanx. The strike-a-light and the firesteel were found in a single lump (Fig. 6), which indicates that they had been deposited together in some small container, possibly in a pouch. By the left foot of the man, there were fragments of a small clay vessel. Four small fragments of early medieval pottery and tiny chunks of limestone were discovered in the fill of the burial pit. They come from later times.

Fig. 5. Sandomierz, Site 45. Grave discovered in 2016. Photograph by M. Bajka

Fig. 6. Sandomierz, Site 45. Grave discovered in 2016– firesteel and strike-a-light directly after discovery. Photograph by M. Bajka

Burial goods

1. Set for starting a fire, composed of the iron firesteel and the flint strike-a-light.

1.1. The firesteel (Fig. 7: 1) represents the so-called double-bow type. The frame was made of a narrow, flat iron bar – profiled in the middle part and having the form of two joined bows with sides bent upwards. The ends of the sides – coiled to form eyelets – meet at the symmetry axis of the tool, although one of them is located slightly higher than the other. Dimensions: length – 5 cm; height – 4.2 cm; maximum thickness – 0.5 cm.

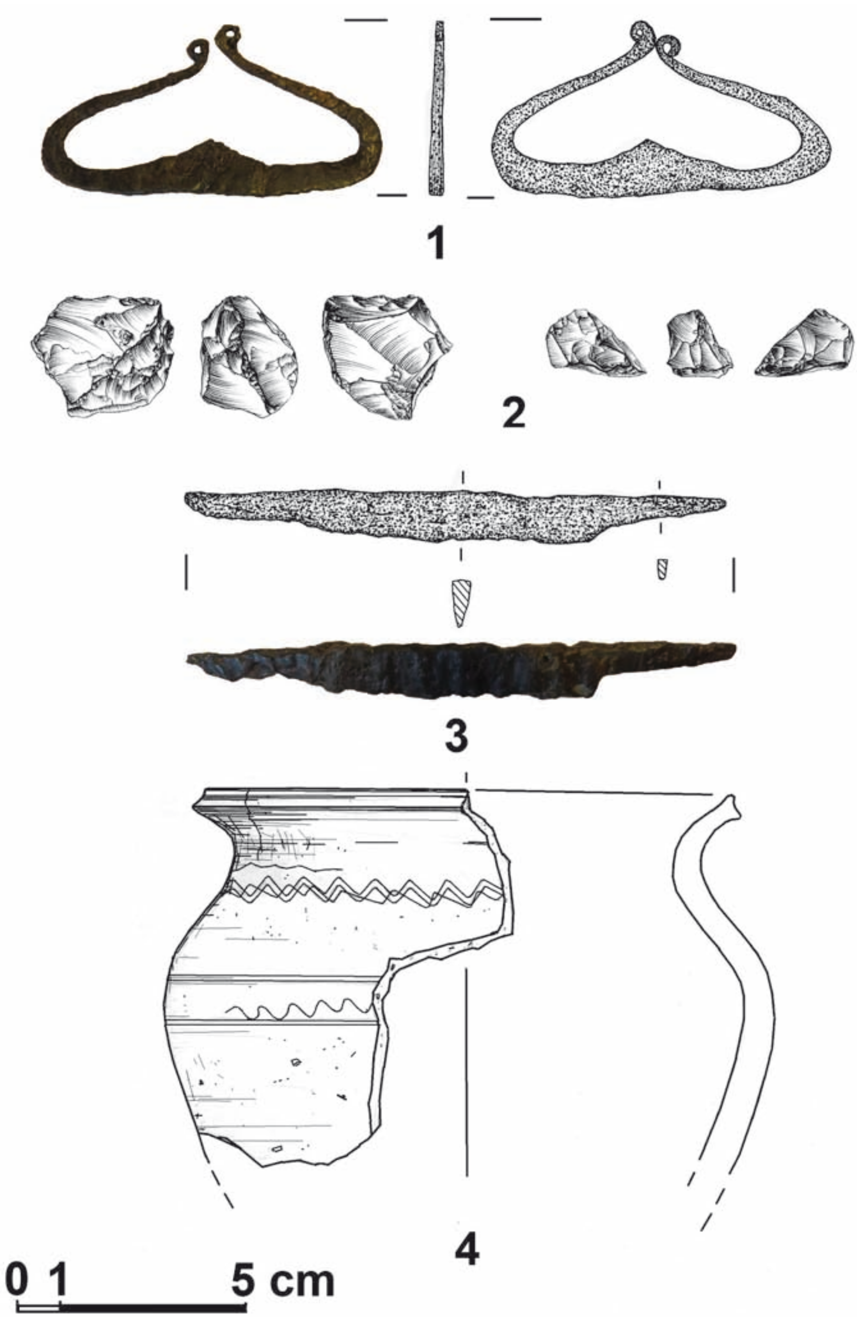

Fig. 7. Sandomierz, Site 45. Burial goods from the grave discovered in 2016. Key: 1 – iron firesteel; 2 – flint strike-a-light; 3 – iron knife; 4 – vessel fragment. Prepared by M. Bajka and M. Florek

1.2. Strike-a-light (Fig. 7: 2), preserved in two pieces, made of a large fragment of so-called Świeciechów flint. Dimensions: 4.4 × 2.0 × 2.0 cm. It is impossible to determine whether the strike-a-light was already broken into two parts when deposited or it was damaged as a result of post-deposition processes. Still, the latter option appears to be more probable.

2. Knife (Fig. 7: 3). A small knife made of iron, with a narrow blade (triangular in cross section) and a relatively short, visibly distinct tang (rectangular in cross section) for mounting the handle. Dimensions: total length – 13.5 cm; length of the blade – 10.3 cm; maximum width of the blade – 1.2 cm; maximum thickness of the blade – 0.4 cm; dimensions of the tang cross section in the widest place – 0.65 × 0.4 × cm.

3. Pottery sherds (Fig. 7: 4) comprising about a quarter of a small vessel. They are made of clay, having a grey-cream colour after firing and having an admixture of quartz grains (less than 1 mm in diameter, only sporadically larger). The vessel was made of clay bands moulded on a potter's wheel and wheel-thrown. Its profile is nearly S-shaped. It has no distinguished neck, and its rim is bent to the outside. The rim edge is diagonally truncated and only slightly profiled. On the belly, there is a shallow, irregular ornament (made with a stylus) in the form of single wavy lines that partially overlap. Dimensions: reconstructed rim diameter – 12 cm; reconstructed maximum belly diameter – 15 cm; wall thickness – 0.7-0.9 cm.

ANALYSIS

Form of the grave

Because of its form – a nearly rectangular burial pit without any additional construction elements, containing the body placed at the bottom of the pit, in the supine position, with arms arranged along the body – the discussed burial does not differ from the vast majority of graves discovered at flat non-churchyard cemeteries from the territory of Poland and dated to the Early Middle Ages. What distinguishes this funerary feature is its orientation along the NNE-SSW axis, whereas most of burials found at this type of necropolises are oriented E-W, usually with slight deviations (*cf.*, Miśkiewicz 1969, 247; Zoll-Adamikowa 1971, 49).

From among more than 200 graves of the three early medieval cemeteries discovered in Sandomierz (on the Old Town Hill, Town Hill and Reformackie Hill), only two funerary features were oriented N-S or close to it – both are located on the Old Town Hill. One of them is the previously-mentioned burial discovered on the same plot of land in 2006 (*cf.*, Florek 2006a; 2006b) and Grave No. 90 from the part of the cemetery researched in 1928-1929 by J. Żurowski. Another distinguishing feature of the latter is the fact that the body was inhumed in a prone position (Gąssowski 1969, 415). As to the rest of the graves, they were mainly oriented E-W, with certain deviations. Still, the deviations of the graves from the oldest part of the cemetery on the Town Hill are the most considerable – although they never exceed 45 degrees (*cf.*, Bajka and Florek 2015; Florek 2022). On the other hand, among six researched cemeteries from the nearest vicinities of Sandomierz – in Gnieszowice, Sandomierz-Kamień Plebański, Samborzec, Trześnia, Turbia and Złota (*cf.*, Florek 2004; 2021a; 2021b; further literature there), only three graves discovered in Samborzec were oriented N-S (Nos 15b, 59, 62 – *cf.*, Bartys 1936, 173, 174). Graves oriented N-S or close to it are virtually absent from other cemeteries of the historical Sandomierz Region. The only exception is Burial 13 from Złota near Pińczów that was thus oriented (Zoll-Adamikowa 1966, 133-135). The same can be said about the entire Lesser Poland region. The relatively most numerous group of graves oriented N-S or close to it were found at the cemetery in Grodowice, Kazimierza Wielka District. Three out of 35 graves were oriented this way (Kubica-Grygiel 2014, fig. 5).

Burials in grave pits oriented N-S, NE-SW, NW-SE or close to them occur more often in Greater Poland, Central Poland, Masovia and Pomerania. At certain cemeteries, such orientations are even predominant, *e.g.*, in. Bodzia, Włocławek District (*cf.*, Kara 2015, 343-369) or Stare Łączyno, Mława District (Rauhut 1971, 547-563).

Several remarks on grave goods

The term 'grave goods' should be interpreted as items intentionally deposited in funerary features together with the buried people. We can distinguish direct equipment – adornments and elements of garments in which they were buried – and grave goods proper, often referred to as funerary offerings (*cf.*, Miśkiewicz 1969, 249). The latter category encompasses items – often also animals or even people – deliberately placed in a grave together with the buried body – no matter what the aim of these actions was (this remains unclear anyway). They might have been personal belongings of the buried people or things linked with them – so, according to the mourners, they had to be taken with them – or things that could not be used by the living. Such items, including food, and sometimes also humans and animals, were supposed to serve the buried in the netherworld or at least help them get there. This category encompasses devotional articles and amulets. Burial goods also include items deposited in graves during funeral services – supposed to remind people taking part in the ceremony about who the buried persons were and what their social position was – and gifts given to the deceased and signifying that they were respected and remembered by the mourners.

The knife discovered in the grave located on the Old Town Hill in 2016 has a modest size (the length of the blade is 10.3 cm), with a tang for mounting the (probably wooden) handle. It represents the most common form of small knives found both at settlement sites and cemeteries. Taking into consideration its location in the grave, we can suspect that it might have been originally attached to the belt of the buried man, on his left (in the preliminary information on the discovery of the grave, it was suggested that the knife was an element of a double fire-striking set – *cf.*, Bajka 2016, 62 – but this interpretation does not appear to be plausible). In the typology of the knives from the Castle Hill in Szczecin, similar specimens were included in the most common type Ia (Rogosz 1983, 264, 265).

Knives are the most numerous group of items used as funerary goods in early medieval burials. They are found both in male and female graves. In Lesser Poland, they were discovered in every third male grave and in every fifth female burial (Zoll-Adamikowa 1971, 67). Among the 200 graves of the non-churchyard cemeteries from Sandomierz, knives occurred in 30 funerary features, which comprises 15% of the total number. A knife, along with a wooden stave bucket with iron hoops, was found in the grave discovered in 2006, near the described burial (*cf.*, Florek 2006a, 65, 66; 2006b, 410-412). In one case, in Grave No. 9 from the Town Hill, dated to the turn of the 10th and 11th centuries, or the beginning of the 11th century, a knife – together with two firesteels, an iron key and strike-a-lights – was part of a fire striking set deposited on the lid of the coffin. On the other hand, at six excavated cemeteries from the vicinities of Sandomierz, knives were discovered in 51 graves, that is in nearly 40% of all the found burial features. In one of the graves, at the necropolis in Złota, a knife was accompanied by a firesteel and a flint strike-a-light, so it was probably an element of a fire striking set. We also know that knives were deposited as burial goods at the cemeteries in Ruszcza-Płaszczyzna, Dwikozy and Garbów Stary, Sandomierz District (Florek 2021a, 24).

Firesteels, including bow-shaped specimens, are not frequent burial goods found in early medieval graves, at least in Lesser Poland. Except for the grave discussed in this paper, they were not found in any of the burial features of the cemetery on the Old Town Hill. On the other hand, as many as two firesteels of this type were discovered in the abovementioned Grave No. 9, in the northern, oldest part of the cemetery on the Town Hill (Bajka and Florek 2015, 70-74). By contrast, from among over 130 graves grouped in eleven early medieval necropoli from the nearest vicinities of Sandomierz, a firesteel was discovered only in one burial feature – Grave No. 17 at the cemetery in Złota, Sandomierz District (Gąssowski 1953, 80-92). They were also found at two other necropoli representing the historical Sandomierz Region: in Gorysławice, Busko District – in one out of 54 researched burial features (Grave No. 31) – and in Złota, Pińczów District – also in a single burial feature (No. 7), out of 130 discovered (Miśkiewicz 1969, 276, 285). Firesteels are also seldom discovered at other cemeteries located across Lesser Poland: one specimen was discovered only at the necropolises in Kraków-Zakrzówek (Morawski and Zaitz 1977, 136) and Modlnica, Kraków District (Sztyber 2015, 343). An iron firesteel, together with an axe, a knife and a clay vessel, were burial goods found in a grave dated to the turn of the 10th and 11th centuries discovered near Św. Tomasza Street in Kraków. Nevertheless, it appears that it did not belong to any of the contemporary cemeteries in Kraków, but was a single, isolated burial (Myszka and Myszka 2000, 363, 364).

A relatively great number of firesteels were found at a cemetery in Końskie, Końskie District – located at the borderland between the Sandomierz Region and Masovia. Firesteels were found in eight graves, out of 171 discovered burial features. Five of them were double-bow firesteels, two others were lens-shaped. The type represented by one specimen remains unknown (Gąssowski 1952, 99-157). A rather considerable number of such artefacts – four specimens – was recorded at the cemetery in Strzemieszyce – previously in Będzin District, presently part of Dąbrowa Górnicza – located at the borderland between Silesia and Lesser Poland (Marciniak 1960, 168). More often than in Lesser Poland, firesteels deposited as burial goods were discovered at cemeteries located across Greater Poland, Pomerania, Central Poland and Masovia (*cf.*, Miśkiewicz 1969, 275-285). Nevertheless, we should pay attention to the fact that there are considerable differences in the quantities of such artefacts discovered at particular cemeteries. For example, in Lutomiersk, Pabianice District, firesteels were discovered in six out of 135 researched graves (Nadolski *et al.* 1959, 93). In Kałdus, Chełmno District, they were found only in three out of the total number of 466 graves discovered to this day (Chudziak *et al.* 2010, 85). At most of such cemeteries, no artefacts of this type were discovered.

Besides the firesteel, the fire striking set deposited in the grave discovered at the Old Town Hill in 2016 included a strike-a-light – preserved in two pieces and made of a large chunk of spotted siliceous material, so called Świeciechów flint. As mentioned above, it is impossible to determine whether the strike-a-light was deposited in the grave in two pieces, or it split as a result of post-deposition processes. Strike-a-lights made of siliceous rocks and used for striking fire – found individually or in sets together with firesteels or with other iron items that could have substituted firesteels (*e.g.*, knives, keys *etc.*) are known from many early medieval cemeteries (*cf.*, Libera and Florek 2018, 243-245). In the case of the firesteel found on the Old Town Hill, it is worth mentioning that it was made of Świeciechów flint, whose physicochemical properties made it difficult to strike a spark. Thus, the artefact might have been a symbol rather than a tool destined for being used by the buried man in the afterlife.

A large fragment (about a quarter) of a clay vessel – composed of several sherds discovered near the feet of the buried man – should also be considered as a burial good. Although finding a whole vessel clearly indicates that it was intentionally deposited in a grave – either as a container for food supplied to the buried people for their journey to the afterlife or simply as gifts – pottery sherds are more difficult to interpret. It is often not easy to determine whether vessel fragments got to a burial pit by accident – *e.g.*, with soil during filling it, or as a result of using cemetery sites in later times – or maybe such sherds were intentionally deposited as grave goods. If the latter interpretation is valid, it is necessary to answer whether only the pottery sherd (or sherds) was deposited in the grave – maybe as a substitute for the whole vessel (which would indicate that it was a gift in itself and not only a container for beverages and food), or the whole vessel was placed in the grave, but it was later partially damaged – *e.g.*, as a result of digging into the ground, ploughing, or natural factors *etc.* – which resulted in the preservation of sherds only. The pottery fragments found in the discussed grave certainly did not get there by accident. They were located near the feet of the buried man, and it is the most common place of depositing vessels in early medieval graves (another popular spot is located near the head – *cf.*, Miśkiewicz 1969, 249). As to the stylistic and technological properties of the sherds, they are clearly different from those of vessels discovered in the cultural layer above the grave and archaeological features linked with a settlement dated to a later time. Still, it is difficult to establish whether it was only a single fragment of a large vessel deposited in the grave together with the buried man – and later it broke into several smaller sherds as a result of post-deposition processes – or it was the whole vessel, which was later partially destroyed. Still, the latter possibility – that the whole vessel was placed by the feet of the body during the funeral, and only fragment of it preserved until this day – appears to be more plausible. The vessel might have been partially destroyed as a result of the intense agricultural exploitation of the culmination of the Old Town Hill, which took place between the Late Middle Ages and the end of the 20th century Ploughing might have not only partially destroyed the vessel deposited in the grave, but also dislocated the skull and damaged the bones of the hands.

In Sandomierz, entire vessels were discovered in three graves linked with the earliest phase of the cemetery on the Town Hill (Bajka and Florek 2015, 70-74) and in three burial features located in the part of the cemetery on the Old Town Hill researched by Żurowski (Gąssowski 1969, 430). As to the excavated cemeteries located in the vicinities of Sandomierz, whole vessels were found in five funerary features (*c.* 3.8% of the entire number of the researched graves), with as many as four discovered at the cemetery in Złota and one in a grave from the cemetery in Samborzec. Three clay vessels discovered – as we may suspect – in three different graves, were also found at the serendipitously discovered cemetery in Garbów Stary (Florek 2021a, 25, 26, further literature there). Certain vessels were probably grave goods deposited in graves (destroyed in the first half of the 19th century) from the cemetery in Ruszcza-Płaszczyzna, Sandomierz District (Lelewel 1855, 77, 78).

Pottery sherds were discovered somewhat more often in graves from Sandomierz and at cemeteries located in its nearest vicinities, although it is not certain whether they had been deliberately deposited as grave goods or they got to the burial pits by accident, together with soil, during the process of filling them or somewhat later. At other cemeteries from Lesser Poland, clay vessels – as well as stave buckets – are even less frequent. The only example is the above-mentioned cemetery in Strzemieszyce. Entire clay vessels were discovered in 13 graves (in one of them, two vessels were found), whereas pottery sherds were discovered in five other graves – from among over 100 excavated burial features (Marciniak 1960, 160). Vessels – as well as other types of burial pits – are found much more often in graves at early medieval cemeteries from Central Poland, Greater Poland and Masovia (Zoll-Adamikowa 1971, 109-114; Kufel-Dzierzgowska 1975, 379).

The vessel, a fragment of which constituted the grave equipment was made of clay having a grey-cream colour after baking, corresponding to type II of raw materials used in the production of Sandomierz pottery dwfined by Andrzej Buko (1981, 72). This material was obtained by adding different tempers to boulder clay, which can be also found in the vicinity of Sandomierz (Buko 1981, 78). In this case – if the macroscopic observation is a reliable source here – the temper is composed of powdered (ground) limestone, which gave the sherd its floury texture. The vessel was modelled on a potter's wheel from bands of clay and wheel-thrown, with the use of the ring-band kneading technique according to Buko's (1981, 87) terminology. Traces of wheel-throwing are visible only on the external surface. From the inside, they are present only near the rim. The vessel is covered with an indistinct ornament composed of shallow, irregular wavy lines that partly overlap. They were made with a stylus. This ornament corresponds to group VI of decorative motifs present on Sandomierz pottery according to Buko's classification (1981, 113) and group "f" of ornamental patterns defined by U. Maj for the pottery from Stradów (1990, fig. 7). Because of its form, the vessel can be classified as representing Family I of Vessel Forms of Sandomierz pottery as defined by A. Buko (1981, 145-147).

ANTHROPOLOGICAL ANALYSIS AND RESULTS OF SPECIALISED EXAMINATIONS

Anthropological analysis

The anthropological analysis of the skeleton was conducted in accordance with the classical research methodology. The age at death was determined based on anatomical and morphological criteria that are commonly accepted in anthropology (Ubelaker 1989; White and Folkens 2005). Mainly, the degrees of cranial suture obliteration and teeth attrition were taken into consideration. The sex was determined by analysing the degrees of development of diagnostic skeletal elements, especially those of the skull and pelvis (Phenice 1969; White and Folkens 2005). The body height in life was determined based on measuring the long bones, with the use of regression equations according to V. Formicolla and M. Franceschi (1996).

The skeleton is virtually complete. The skull is partially damaged in the facial part. Above the right orbit, on the squamous part of the frontal bone, there is a trauma (35 × 7 mm) caused by a blow with a sharp-edged object (Fig. 9). The calotte is long (cephalic index: 70.5; Table 1) and moderately massive; the forehead is of medium width; wide nose; low orbits; development of dimorphic features typical of the male sex. The preserved sections of the sutures are in the process of obliteration. Section S2-S3 of the sagittal suture is fused. The right lateral part of the occipital bone is damaged. The mandibular and maxillary permanent teeth are severely attrited:

M3	M2	ob	P2	P1	C	I2	I1		I2	C	P1	P2	M1	M2	ob
M3	M2	M1	P2	P1	C	I2	I1	I1	I2	C	P1	P2	M1	M2	M3

Fig. 8. Sandomierz, Site 45, Grave 5, skull and cervical vertebrae: a – skull, *norma frontalis*, b – right and left maxilla, c – mandible, d-i – cervical vertebrae, j – skull, *norma lateralis*, left side, k – skull, *norma lateralis*, right side, l – damage on the squama of the frontal bone. Prepared by A. Szczepanek

Fig. 9. Sandomierz, Site 45, Grave 5: a, b – proximal epiphyses of the femurs; c, d – schematic figures illustrating Poirier's Facet (c) and plaque formation on the anterior femoral head-neck junction (d) according to Zurmühle *et al.* (2017). Prepared by A. Szczepanek

The maxillary left medial incisor (I1) was lost *post mortem*, whereas the maxillary left lateral incisor (I2) is reduced (peg shaped). Between I2 and C of the left maxilla, there is a tooth socket, probably of the milk canine (c). On the right head of the mandible, there are degenerative changes. The mandibular and maxillary teeth are covered with plaque. The tooth necks were partially exposed due to paradontosis. The maxillary right M1 and left M3 were lost in life and the tooth sockets were in the process of obliteration. The mandibular right M1 and M3 were taken for the analysis of strontium isotopes.

Table 1. Sandomierz, site 45, grave 5, skull measurements and indices

Measurement	**[mm]**		**indices**	
g-op	200		*eu-eu/g-op* x 100	70.5
eu-eu	141		*ft-ft/eu-eu* x 100	68.8
ft-ft	97		*apt-apt*/n-ns x 100	63
mf-ek	37		*sbk-spa/mf-ek* x 100	72.9
sbk-spa	27			
apt-apt	29			
n-ns	46			
n-pr	62			

Postcranial skeleton: cervical vertebrae (C1-C6), with damaged right arches and transverse processes. The grave also contained fragments of 10 thoracic vertebrae, the manubrium and part of the body of the sternum as well as fragments of left and right ribs. The right and left clavicle and muscle attachments are preserved. Especially the impression of the costoclavicular ligament is more distinctly articulated on the right side. The subspinal parts of the right and left scapula are damaged. The right (349 mm) and left humerus (347 mm) are completely preserved. The right and left radius have damaged distal epiphyses; complete right ulna (280 mm) and left ulna with the damaged distal epiphysis. The burial contained the pisiform, two metacarpal bones and five proximal phalanges. The deltoid tuberosity is better developed on the right humerus. Muscle attachments on the proximal epiphyses of both ulnae are strongly developed. The preserved bones of the lower limb are the right and left pelvis with damaged pubic bones, right (484 mm) and left femur (485 mm), right and left patella, right (377 mm) and left tibia (380 mm), fibular bones with damaged proximal epiphyses, bones of the left and right foot (complete set of tarsal and metatarsal bones, proximal and middle phalanges of the foot and the distal phalanx of the big toe). On the anterior surface of the right femur neck, there is plaque formation on the anterior femoral head-neck junction (Fig. 9). Morphological features of this region like Poirier's facet, cervical fossa of Allen and plaque have been considered in relation to some behaviours and specific activities (*e.g.*, squatting, horseback riding, *etc.*). These ideas were verified by analyses applied to a sample of 225 adult individuals of both sexes coming from an identified modern skeletal collection. The variability of the femoral neck region show that plaque, almost always bilateral, appears to be a normal condition of the femur, being present in approximately 90% of the individuals. Therefore these results suggest caution in considering these features as markers related to specific activities but only non-metric variations of the femur's neck (Radi *et al.* 2013). Degenerative changes were observed on the posterior surface of the right patella, calcaneal tuberosities and distal phalanx of the hallux.

Based on the preserved skeletal elements, it was established that the remains belonged to a male in the *Maturus* age category (*c.* 35-45 years old), who was *c.* 175 cm tall in life.

The trauma above the right orbit – caused by a blow with a sharp-edged object (weapon) occurred *perimortem*. It might have been the cause of the man's death or damage inflicted to the body short after placing it in the grave, *e.g.*, by robbers plundering the burial feature. The possibility that the skull was damaged during the exploration of the grave should be ruled out, because it was lying on the right side. It is difficult to interpret the damage of the right side of the skull base and right parts of the cervical vertebrae – the position of the skull in the grave, reverse in regard to the skeleton – suggests that the head might have been chopped off, although the dislocation might have been caused by digging into the grave soon after the burial. This possibility is indicated by the natural, anatomical position of the mandible and the dislocation of bones in the rib cage.

Analysis of strontium isotope composition ($^{87}Sr/^{86}Sr$) in tooth enamel

Currently, strontium isotope composition analyses ($^{87}Sr/^{86}Sr$) are ones of the most popular methods used to determine the origin and mobility of individuals belonging to a given society (Price *et al.* 2002; Montgomery 2010). Samples from the enamel of molars M1 and M3 were taken in order to determine the mobility of the person buried in the grave. Also three samples were taken from the enamel of animals representing different species: ovicaprid, cattle and pig. The analytical research and measurements of the strontium isotope composition were conducted with the use of a Finnigan MAT 261 mass spectrometer at the Isotope Laboratory of the Adam Mickiewicz University in Poznań. The procedure included chemical separation of Sr and measurements of Sr isotope ratios according to methods developed in this laboratory (Belka *et al.* 2018). The obtained isotopic signatures are presented in Table 2.

Comparative analyses (Fig. 11) used previous results of strontium isotope composition examinations obtained from Sandomierz burials dated to the Early Middle Ages (Błaszczyk *et al.* 2018). This research presented a somewhat wide range of bioavailable strontium, which encompassed signatures $^{87}Sr/^{86}Sr$ obtained from the tooth enamel of a female buried in Grave 8 (0.7104) and a male from Grave 9 (0.7135). This range also includes signatures obtained from the tooth enamel of the above-mentioned animals (Table 2). This fact made it possible to state that the male buried in Grave 5 might have spent his childhood in the

Table 2. Strontium isotope composition ($^{87}Sr/^{86}Sr$) in samples taken from tooth enamel in Sandomierz

Site	feature	$^{87}Sr/^{86}Sr$	age	sex	sample
Sandomierz 45	5	0.710561± 0.000010	35-45	M	right mandibular M1
Sandomierz 45	5	0.709133± 0.000010			right mandibular M3
Sandomierz 7-2	7	0.712156± 0.000011	adult	?	ovicaprid
Sandomierz 7-2	2	0.712694± 0.000012	adult	?	cattle
Sandomierz 7-2	6	0.712700± 0.000010	adult	?	pig

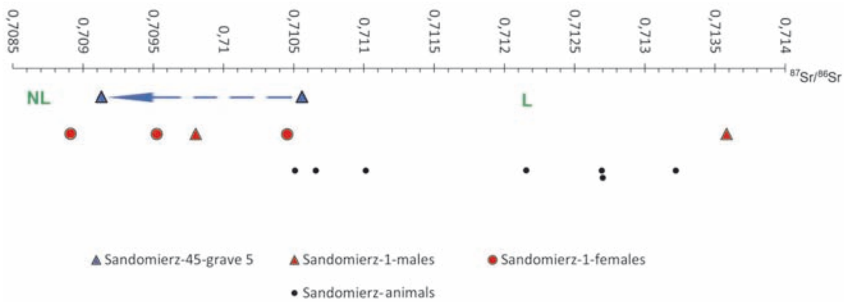

Fig. 10. Strontium isotope composition ($^{87}Sr/^{86}Sr$) in samples taken from enamel of human and animal teeth from Sandomierz: L – local, NL – non-local. Prepared by A. Szczepanek

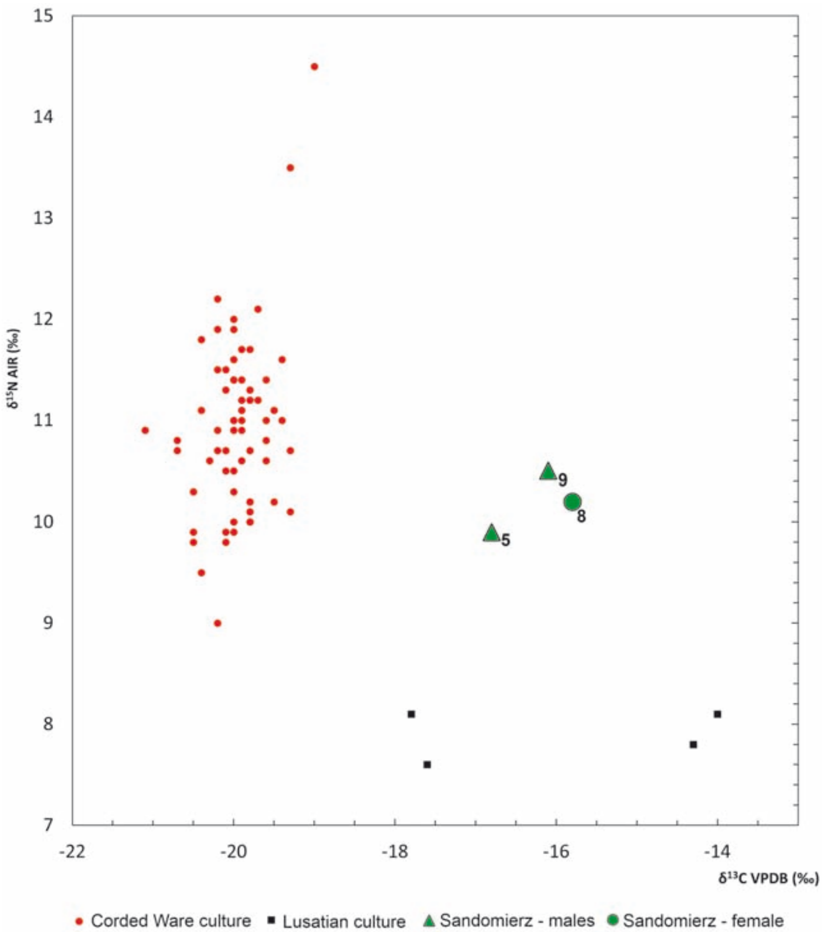

Fig. 11. Sandomierz, Site 45. Isotope values $\delta^{13}C$ and $\delta^{15}N$ in collagen samples taken from human bones. Prepared by A. Szczepanek

vicinity of Sandomierz (value obtained for M1), and next migrated to territories where strontium is less radiogenic (value obtained for M3). The nearest areas having such geological properties are the vicinities of Busko and Pińczów as well as the closest neighbourhood of Kraków (Belka *et al.* 2022). To the east of Sandomierz, such rocks are distributed in Roztocze and by the Dnister River in Ukraine, but to a much lesser extent, so it is rather not possible that they caused such low content of $^{87}Sr/^{86}Sr$ in human tissues. Analogous territories are widely distributed, *e.g.*, across northern Denmark, southern Germany, many regions of France and Spain as well as in the Hungarian Plain. In the later period of his life, the man came back to the vicinities of Sandomierz and was buried there.

Analysis of stable carbon and nitrogen isotopes

Analyses of stable carbon isotopes ($\delta^{13}C$) and nitrogen isotopes ($\delta^{15}N$) were included in the main canon of bioarchaeological research that makes it possible to reconstruct life strategies of prehistoric societies (Loftus *et al.* 2016). It allows scholars to learn about the diets of buried people, because it is believed that $\delta^{13}C$ refers to the total amount of consumed calories, whereas $\delta^{15}N$ denotes mainly the consumption of animal products (Ambrose 1993). The analyses of stable carbon and nitrogen isotopes were conducted on three samples, from which collagen was previously obtained for AMS ^{14}C dating in the Poznań Radiocarbon Laboratory (Table 3). The stable isotopic composition of collagens ($\delta^{15}N$ and $\delta^{13}C$) was analysed with IRMS, at the Goethe University in Frankfurt (Longin 1971; Piotrowska and Goslar 2002). Isotope ratios were reported as delta (δ) values and expressed relative to VPDB for $\delta^{13}C_{coll}$ and to atmospheric nitrogen for $\delta^{15}N_{coll}$. Delta values were normalized to a calibration curve based on international standards USGS 40, USGS 41, IAEA 600. All human and animal bone collagen samples had C/N_{at} values within the accepted ranges of 2.9-3.6 (DeNiro 1985) and 3.1-3.5 (van Klinken 1999), indicating good collagen preservation.

The obtained $\delta^{13}C$results clearly indicate that millet (plant C_4) was included in the diets of the examined individuals, because they are higher than the limit value – 18‰ (Wang *et al.* 2019). Addition or prevalence of millet in consumed food results in elevating the isotopic levels of carbon above the established limit. The presence of millet in the diets of individuals from the Early Middle Ages is clearly visible compared to the societies of different subsistence strategies *e.g.*, the Corded Ware and Lusatian cultures, who consumed a different type of

Table 3. Results of the analyses of stable carbon and nitrogen isotopes for human remains from Sandomierz

grave	ä^{13}C$_{coll}$ [‰]	ä^{15}N$_{coll}$ [‰]	age [in years]	%C	%N	C/N_{at}	sex
Sandomierz 1-grave 8	-15.8	10.2	40-50	53.1	19.3	3,2	F
Sandomierz 1-grave 9	-16.1	10.5	40-50	49.7	18.1	3,2	M
Sandomierz 45-grave 5	-16.8	9.9	35-45	51.6	18,9	3,18	M

food (Fig. 11). This difference also concerns the values of $\delta^{15}N$, which are visibly higher than those obtained for the inhabitants of the Lusatian culture, but they fall within the lower limit of the variation scope obtained for the population of the Corded Ware culture. To sum up, it should be stated that the analysed individuals used local environmental resources with a somewhat considerable participation of C_4 plants – specifically millet – in their diets, which were also supplemented with animal proteins. The acquired data are consistent with other results obtained for medieval series from Poland (Reitsema 2012).

Dating of the grave

The funeral rite and form of the grave discovered in 2016 on the top of the Old Town Hill – as well as grave goods found in it – do not provide us with sufficient basis for dating it with precision.

Taking into consideration the fact that it was a non-churchyard burial, we can broadly date it from the second half of the 10^{th} century – when first inhumation burials started being used in Poland – to (at least) the end of the 12^{th} century – when, together with building new churches accompanied by churchyards, non-churchyard cemeteries ceased to be used (*cf.*, Florek 2015; Sikora 2015; further literature there). The earlier phase of this time frame is suggested by the orientation of the grave, because burials oriented differently than W-E are linked with the earliest periods of using non-churchyard cemeteries (Miśkiewicz 1969, 264).

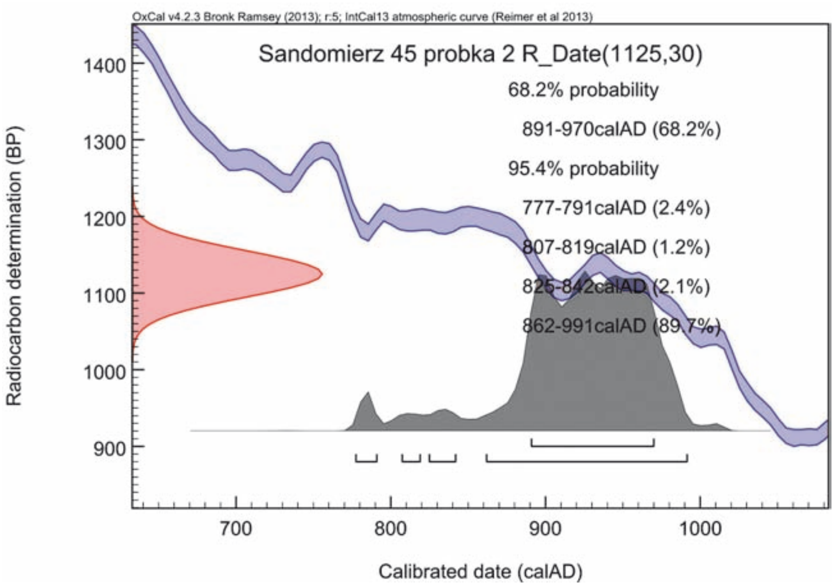

Fig. 12. Sandomierz, Site 45. ^{14}C dating – calibration of the radiocarbon date

Polish double-bow firesteels – and together with them flint strike-a-lights – are dated from the middle of the 10th to the first half of the 13th century AD (*cf*., Bronicka-Rauhut 1998, 38, 108-114; Piotrowski and Dąbrowski 2007, 231; further literature there), although we need to remember that rural populations used them at least until the second half of the 19th century, when matches became widespread (Moszyński 1967, 254-256). The knife – because of its uncharacteristic form – can be dated only very generally to the Early Middle Ages. The partially preserved clay vessel discovered near the feet of the buried man is a more precise chronological indicator. Taking into account the raw material and the technique of its production as well as the shape of the vessel, method of forming the edge of its rim and the character of the ornament covering it, the sherds should be associated with the second stage of the development of pottery production in Sandomierz, dated from the middle of the 10th to the end of the 11th century AD (Buko 1981, 189).

The ^{14}C dating of the sample taken from the upper limb of the buried man – carried out in the Poznań Radiocarbon Laboratory – gave an age of 1125 ±30 BP (Poz-104418). After being calibrated using the Intcall 13 curve (Reimer *et al*. 2013), the following result was obtained: 2.4% probability for 772-791 AD; 1.2% probability for 807-819 AD; 2.1% probability for 825-842 AD; 68.2% probability for 891-970 AD; 89.7% probability for 862-991 AD (Fig. 12). Together with dating of the grave based on the analysis of its form, funeral rite and burial goods, we may suspect that the most probable date of the burial is the second half of the 10th century AD, most probably the 980s, but possibly even several years earlier.

CONCLUSIONS

The grave discovered at the culmination of the Old Town Hill in 2016 is presently the oldest preserved early medieval burial from Sandomierz. It is very probable that the fragmentarily preserved burial documented in 2006 – located a dozen or so metres from the discussed feature, having a similar orientation and containing a stave bucket with iron hoops and a knife – comes from a similar time period. No other early medieval greaves were discovered in their vicinity as well as in the area between them and St Paul's Church despite the fact that several pieces of archaeological research were undertaken there. The nearest graves are located *c*. 300 metres from the burials discovered in 2006 and 2016. They should be probably linked with the 11th century cemetery occupying the middle and top parts of the Old Town Hill that was researched by J. Żurowski. This means that both funerary features are not part of this burial ground, but they represent remains of another cemetery from a similar period or – which appears to be more probable – they are two isolated graves. They may attest to an abandoned attempt to establish a new cemetery by an unspecified community inhabiting Sandomierz at the end of the 10th century and intending to stress their distinctiveness not only by a desire to have their own necropolis, but also by the orientation of the graves.

Contrary to the people buried at the cemetery on the Town Hill – or at least some of them, whose non-local origin (from outside the vicinities of Sandomierz in a broad sense) is indicated by grave goods found in certain graves and the results of the analyses of the strontium isotope composition (*cf.*, Błaszczyk *et al.* 2018; Florek 2023) – as well as to part of the people inhumed at the cemetery on the Old Town Hill (*cf.*, Rysiewscy 1991), it appears that the remains buried in the analysed grave belonged to a man of local origin. This means that he was born and spent his early years in the vicinities of Sandomierz, and although he left this area – which is indicated by the strontium isotope analyses – he returned to Sandomierz, where he died and was buried. The local origin of this individual is also indirectly indicated by the burial goods, because they lack elements that could be considered as having foreign origin.

Translated by Piotr Moskała

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3598

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IN THE MIDDLE OF NOWHERE. UNIQUE SWORD SCABBARD CHAPE FROM NIEPOŁOMICE FOREST

ABSTRACT

Janowski A., Sojka K. and Włodarczak E. 2023. In the middle of nowhere. Unique sword scabbard chape from Niepołomice Forest. *Sprawozdania Archeologiczne* 75/2, 371-382.

Detector recognition carried out in Lesser Poland in last few years deliver a wealth of movable historical artefacts. One of them is a sword scabbard chape made of a copper alloy discovered in the middle of Niepołomice Forest. The paper subjected this artefact to typological classifications, comparative analysis, dating and ethnocultural characterization. Sword scabbard chapes in this type are very rare finds and most of them were discovered in southern and eastern Europe in Bulgaria, Ungarn and Ukraine, and are dated to the second half of the 10th and the 11th century. Specimen from Niepołomice Forest was presumably created in one of these areas and ended up here via one of the trade routes that intersected in Cracow.

Keywords: Lesser Poland, Niepołomice Forest, Early Middle Ages, trade routes, sword scabbard chapes, palmette
Received: 27.10.2023; Revised: 27.10.2023; Accepted: 19.11.2023

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Niepołomice Forest, located in the western part of Sandomierz Basin in Lesser Poland between the River Vistula and the Raba, is today a densely forested area about 30 km east of Kraków covering an area of almost 110 km^2. However, originally the forest was much bigger and it was first mentioned in a document issued by Konrad, Duke of Kraków and Łęczyca, in 1242, in which he confirmed the borders of the village of Mszczęcin owned by a monastery and had renewed old boundary markings on the border with *Kłaj*, the duke's forest (Kodeks 1886, no. 421). In 1393 the forest is mentioned in sources as *Las Niepołomicki* (Niepołomice Wood) and in 1441 the name *Puszcza Niepołomicka* (Niepołomice Forest) is mentioned for the first time. Between the 13th and the 17th centuries the forest was the property of Polish kings and its location close to Kraków, which was the capital city at that time, made it their favourite hunting ground (*cf*., Sadzewicz 1952; Smólski 1981, 12-15). A dense forest does not favour archaeological survey or excavations hence archaeological digs, if any, are located in its buffer zone (Fig. 1). Hence random finds, which enrich our knowledge about the exploitation of this area, are even more worthwhile. This article discusses such a discovery, made almost in the heart of the Niepołomice Forest, in the village of Poszyna. The find was uncovered on 26 March 2023 during an archaeological field survey using a handheld metal detector subject to a permission issued by the Voivodeship Cultural Heritage Conservator (No. ZA.I.5163.17.21 in Forest District Niepołomice, forest area No. 116 – forestry Chysne, commune Kłaj, district Wieliczka).

The chape, namely a protective fitting at the bottom of a scabbard for a sword, was made of an copper alloy. The analysis of chemical composition carried out in the Bio- and Archaeometric Laboratory of the Institute of Archaeology and Ethnology of the Polish Academy of Sciences in Warsaw (analysis No. CL 28751), in two different parts of the object showed that the alloy is composed of copper (Cu – 79.60-79.99%), lead (Pb – 12.01-12.88%), zinc (Zn – 4.77-5.65%) and tin (Sn – 1.61-1.75%). The total share of other elements in the alloy is no higher than 1% (Fe – 0.35%, Sb – 0.01-0.04%, S – 0.33-0.60%, Ag – 0.04%) (Gan 2023). The artefact is slightly damaged – the upper part of one of the sides is missing. In its present state, the artefact measures 91.38 mm in height, it is no wider than 43.55 mm and 15.66 mm thick. The fitting is solid and the cast itself is massive: the thickness of the walls ranges from 1.0 to 1.4 mm. The chape weighs 61.05 g. The surface shows marks of use, but the decoration is deep enough to be seen. The upper edge of the chape is marked with a flat rim 3-4 mm wide, clearly rising in its central part and topped with a decorative thickening marked with three strands arranged in a herringbone pattern (a stylised animal head?). Below, a trefoil pointing downwards is to be seen, of which the central lobe is lengthened, and the two other ones at each side are shorter, volute-like. The mirror reflexion of the motif rising from a bigger, flat trefoil can be seen in the lower part of the fitting, with a clear spur at the bottom (Fig. 2).

A few attempts have been made in the archaeological literature to provide a classification of sword scabbard chapes; they were developed on the basis of source materials which varied both in terms of quantity and quality, and on the basis of criteria of typological divi-

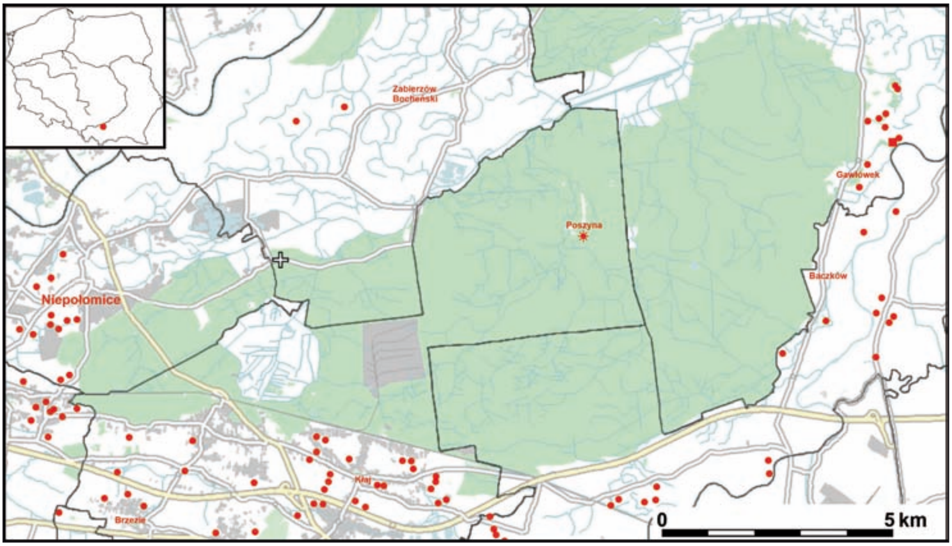

Fig. 1. Location of find in the context of medieval archaeological sites inside and bordering Niepołomice Forest. Prepared by A. Janowski

sion which were often at variance (*cf.*, Janowski 2006, 23, tab. 1). As a matter of fact, it is only the classification developed by Peter Paulsen (1953) that provides an overarching European outlook on this category of finds while the remaining ones, such as the ones developed by Gala Fiodorovna Korzukhina (1950), Vytutas Kazakevičius (1998) or Przemysław Sikora (2001; 2003) are more or less territorially restricted and as such they include fewer formal and decorative solutions. Considering the shape and the decoration, the Poszyna chape can be classified as Paulsen's (1953, 59-96) type III, in which the underlying principle is an oriental style palmetta motif (German *Ortbänder mit orientalischer Palmette*). Differences in the way fittings were made, construction details and decoration and the way the major decoration motif was cast inclined the scholar to make further divisions into four sub-types. The find would be classified as type III.1 (the so-called Varangian Group – German 'eine warägische Gruppe' – Paulsen 1953, 59-67) (Fig. 3). According to the classification by G. F. Korzukhina (1950) such fittings can be classified as type V; in the typology by P. Sikora (2001, 112; 2003, 24-25) they fall into type IV.a.2.; they were not included in the classification by V. Kazakevičius as they did not occur in the area which he studied. The group, even despite a few newly published finds (Shpilev 2021), including from the territory of Poland (Chudziak *et al.* 2009, 102, fig. 5: j), is relatively scarce: seven finds were uncovered in Bulgaria, a further three in Ukraine and Poland each, two in Russia and one in Hungary and Belarus each (*cf.*, Janowski 2006, 30, 31, fig. 8, with corrections and additions). Hence the finds come mainly from southern and south-eastern Europe (Fig. 4).

Fig. 2. Sword scabbard chape from Poszyna, gm. Kłaj. Photo A. Janowski

The find in the group that shows closest analogy to the Poszyna chape is a fitting uncovered in a closely undefined circumstances in Bilär, today the Republic of Tatarstan, Russian Federation (Fig. 5). The object is a part of the collection of Vasiliy Zausaylov (1845-1913), a banker, collector of ancient artefacts and an honoured resident of Kazan. After the outbreak of the Japanese-Russian war in 1904 and the bankruptcy of the trade house of which he was the president, the rich collection was sold to the State Historical Museum in Helsinki (today the National Museum of Finland – from 1809 to 1917 Finland was part of the Russian Empire), where it has been a part of the collection of Vasiliy Zausaylov until today (catalogue number KM5385:Z 4664; *cf.*, Tallgren 1910, av. 3; 1918, 30, pl. IV: 29; and https://rt-online.ru/kupets-bankir-kollektsioner-metsenat/, accessed 27.04.2023). The fitting is slightly damaged in its lower part and a bit bigger: it is 100 mm long (100 mm – according to Paulsen 1953, 63; 101 mm – according Izmaylov 1997, 199; 103 mm – according to Khuzin 1985, 174), 50 mm wide and about 20 mm thick. The decoration on the surface of the chape is composed in an identical way and there are slight

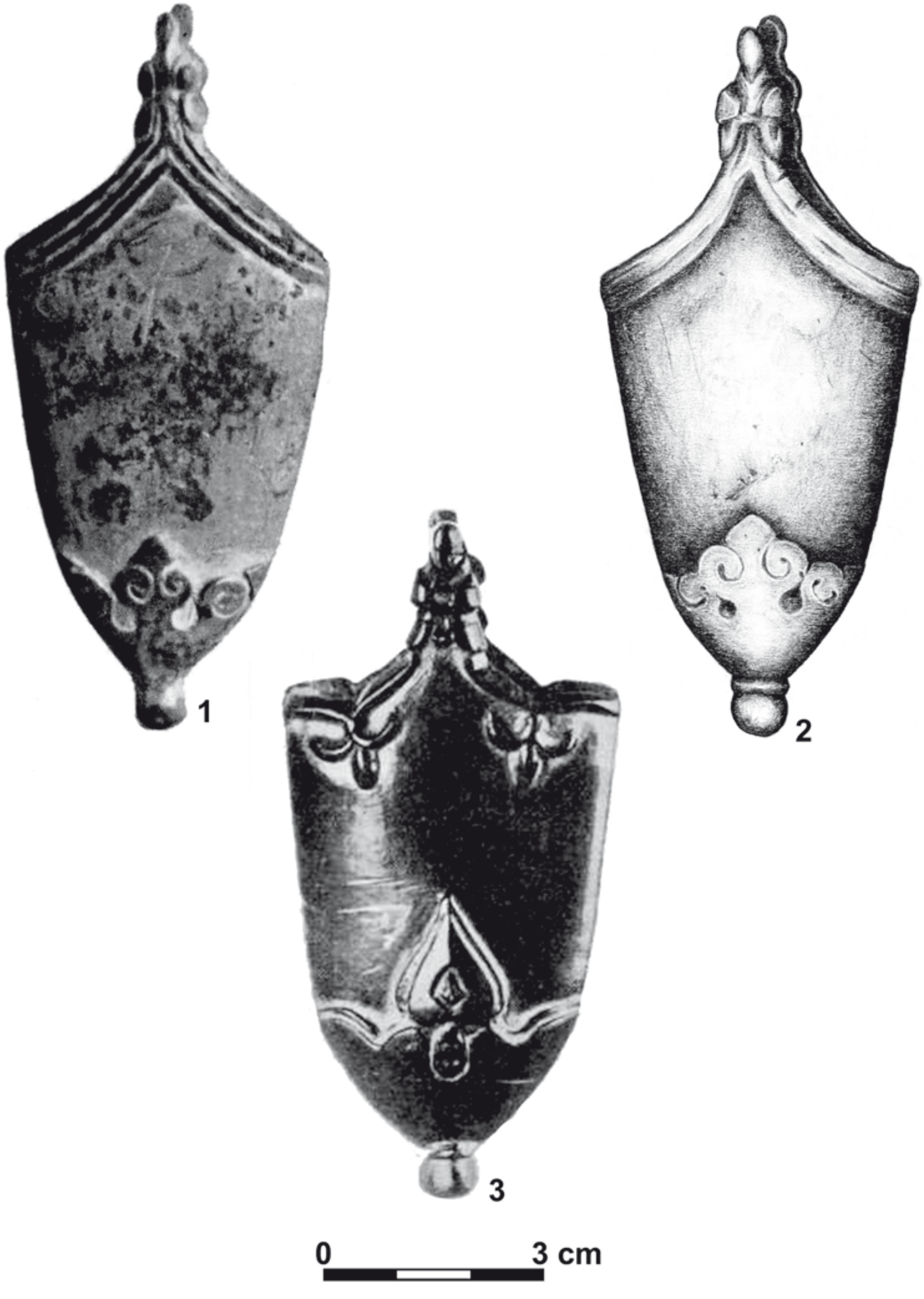

Fig. 3. Some examples of sword scabbard chapes of Paulsen type III. a: 1 – Madara; 2 – Bobięcino, 3 – Plovdiv (1, 3 – after Paulsen 1953, Abb. 67, 69; 2 – after Chudziak *et al.* 2009, 102, fig. 5: j)

Fig. 4. Map showing the distribution of sword scabbard chapes of Paulsen type III.1. According to Janowski 2006, with supplement

differences only in its top part (*cf.*, Paulsen 1953, 63, Abb. 70; Khuzin 1985, 174, pl. 57: 2; Izmaylov 1997, 199, fig. 25: 1).

Another analogous find was unearthed in 1984 during archaeological excavations in the north-eastern part of quarter VI in Chersonesos (today Sevastopol in Crimea, Ukraine). Preserved only in part and reassembled from a few pieces, the artefact is 70 mm high, 46 mm wide and 17 mm thick (Fig. 6). In this case the composition of the decoration is also identical, but the band on the edges creates a circular lining (Vizantiyskiy 1991, 102)

The find from Bilär is a random one, without any archaeological context, hence it is difficult to point out the date when it was made; however, the Chersonesos chape is dated to the period between the end of the 10th and the beginning of the 11th century. The remaining fittings of type III.1 are of quite a similar chronology. Three out of seven Bulgarian finds have a context which allows them to be dated to the 10th-11th centuries (Yotov 2004, 54, catalogue). The Székesfehérvar chape (Hungary) was unearthed in Grave 33 in a burial ground together with a type S sword (according to Jan Petersen) and a set of weaponry

Fig. 5. Sword scabbard chape from *Bilär* (Finnish Heritage Agency, Resource ID 3033324, CC by 44, after https://museovirasto.finna.fi/arkeologia/Search/Results?lookfor=4664&type=AllFields&limit=50; access 15.09.2023)

Fig. 6. Sword scabbard chape from Chersonesos. After Vizantiyskiy 1991, 102

(stirrups and a bit) dated to the period between the 10th and the beginning of the 11th century (*cf*., Bakay 1966, 51, 52, 73, 74). When it comes to finds in Poland, then, according to Jerzy Antoniewicz (1955, 260), the fitting from the "Castle" in Zawada Lanckorońska needs to be dated to the 10th century. The find has no stratigraphic context, however, we know, on the basis of more recent research, that it was already in the 11th century that the fort in Zawada Lanckorońska ceased to exist (Poleski 2004, 372). The Bobięcino fitting was uncovered in 2007 in the remains of a bridge (Site 3) which connected the stronghold and the ancillary settlement on the island with the mainland. Dendrochronological analyses indicate that the crossing must have been used from at least the 1020s until the 1180s, however, the fort was built as early as in the middle of the 10th century and ceased to be used at the beginning of the 12th century (Chudziak *et al.* 2009, 102, fig. 5: j; Chudziak *et al.* 2020, 91-95). Here it needs to be mentioned that also chapes of other sub-types of type III according to Paulsen are dated mostly to the period between the middle of the 10th until the beginning of the 12th century (*cf.*, for example Paulsen 1956; Janowski 2006; 2011). In view of the above considerations, it does not seem unjustified to establish the chronology of the Poszyna fitting to the period between the second half of the 10th and the 11th century.

The location of finds of chapes of the type discussed in this paper including their concentration in southern and south-eastern Europe suggests it was that particular region in which they were made. Peter Paulsen (1953, 65) was of the opinion that they were made in Rus' and he considered their presence in southern Europe to have been the result of an expedition of the Rus' duke, Sviatoslav to Bulgaria in 969, which was inspired by the Byzantine Empire. According to Iskander Lerunovich Izmaylov (1997, 46), the Bilär chape was made in a local workshop but copying Rus' patterns. Jerzy Antoniewicz (1955, 260) also advocated the Rus' origin of the chape while Jan Żak (1954, 728) considered it was of Hungarian origin. This was due to the fact that according to G. F. Korzukhina (1950, 68), whose work he used, Hungary and Bulgaria were the places in which a whole collection of chapes decorated with the palmette motif were produced. In the most recent study on the weaponry from the territory of Bulgaria, the hypothesis that chapes of this type were produced in the regions on the lower and middle course of the Danube was upheld (Yotov 2004, 51; Yotov *et al.* 2016, 110-113).

Unfortunately, metal analyses of the Poszyna chape do not offer much support in establishing of its provenience. The number of samples for this category of finds keeps growing, however, it is still limited and among them there are no finds of the type of interest to us (*cf.*, Janowski *et al.* 2019). On the other hand, however, considering the observations to date it can be concluded that the producers did have knowledge about the properties of alloys and made attempts at producing mixtures of certain properties to give the finds desired features. They could also use the raw material available at that time, even if it did not meet fully the required characteristics.

The features of the decorations which can be seen on the group of chapes discussed here support the hypothesis of an origin on the Danube. The decoration has been described as an oriental style palmette. The motif resembles symmetrical, fan-shaped leaves of a palm tree. Its origins in decorative art reach ancient Egypt but then it was subsequently developed through the art in the whole Mediterranean region, in ancient Greek and Roman and later also in Byzantine and Islamic art (*cf.*, Zahra and Sharif 2022). In period between the 9th to the 11th centuries the palmette was one of the major motifs in Hungarian art, where it developed into a characteristic form which was even called 'the Hungarian palmette' in which the multiplied plant motif created a net-like pattern. According to some scholars, the mutation occurred due to the influence of Islamic art in which leaves in the palmette do not spread out separately; instead the leaves are interwoven in an intricate pattern of spiralling tendrils. The motif is ubiquitous and appears *inter alia* on fittings of exclusive weapons: swords and sabretaches (flat bags or pouches used for carrying small objects which were worn suspended from the belt together with the sabre) and belt fittings (*cf.*, for example, Bérczi 1987; Fodor 1996; Mesterházy 1997; Minaeva and Holmquist 2012; Virágos ed. 2022). The palmette is also to be seen on belt fittings in Bulgarian art (*cf.*, for example, Stanilov 2006, 90-189; Pletniov and Pavlova 2000; Minaeva and Holmquist 2012). This statement definitely does not exhaust the discussion on the provenience of chapes decorated with the palmette motif, however, considering the limited number of finds and lack of new arguments they need to be considered conclusive. Finally, their production in Byzantium cannot be ruled out, considering the use of the palmette motif in this area and the strength of the empire's influence.

It therefore needs to be considered with a high degree of probability that the Poszyna chape is not of local origin. It is difficult to decide whether it came from eastern or southern Europe, but it was in Kraków that major trade routes from both regions crossed. One of them ran from as far away as from Regensburg via Prague and from Kraków it ran east via Volodymyr to Kyiv and from there further to Volga Bulgaria where Bilär was located (*cf.*, Khalikov 1992; Morawiec 2009, 89-97). Ibrahim ibn Yaqub, a Sephardi Jew, who travelled to Central Europe in 965-966, gave a clear account while describing Prague (Kowalski 1946, 49) of the Rus' and Slavs carrying goods who came from the town of Karākō (=Kraków/Cracow). The precise route between Kraków and Volodymyr and Kyiv is subject to supposition only; however, it could have run towards Przemyśl bypassing Niepołomice Forest in the south or ran along its northern edge along the River Vistula to Sandomierz. The third solution is the route led through Niepołomice Forest. The place where the Poszyna chape was found is located along the so-called Royal Route which, since at least the second half of the 14th century, had led from the castle in Niepołomice to a small royal hunting palace in Poszyna and further east to Baczków and Gawłówek (Sadzewicz 1952, 31, 32; Smólski 1981, 15). However, it cannot be excluded that the route, though narrower and less comfortable, existed earlier. Literature on the subject mentions that a majority of early medieval chapes were uncovered away from settlements which existed at that time, which can be explained as a loss while travelling and hence it cannot be ruled out that the places in which they were uncovered mark trade routes or the paths of marching armies (*cf.*, Janowski 2006). In Kraków the route from Kyiv crossed the route which ran south to Wieliczka and Košice to Hungary and further to the Danube. Although sources confirm the route no earlier than in the 13th century, however, its earlier origin can be assumed (Kutrzeba 1902, 58-72; Weyman 1938, 109-111; *cf.*, also Naprawca 2014).

The sword scabbard chape uncovered in the Niepołomice Forest is but one of several such artefacts in Europe. As luck would have it, the find which was probably made on the River Danube or Volga or Byzantium between at the end of the 10th and the end of the 11th century, reached Kraków to be found one thousand years later in the middle of nowhere.

Acknowlegements

The authors wish to express their thanks to staff of the National Museum of Finland for all information about the artefact and collection of Vasiliy Zausaylov.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3638

REVIEWS AND SHORT REVIEW NOTES

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(Review) Agnieszka Czekaj-Zastawny, Anna Rauba-Bukowska, Agnieszka Kukułka (eds), *Najstarsza osada kultury ceramiki wstęgowej rytej z terenu Polski. Gwoździec stan. 2, gm. Zakliczyn/ The earliest settlement of the Linear Pottery Culture from the territory of Poland Gwoździec Site 2, com. Zakliczyn*. Kraków 2021: Instytut Archeologii i Etnologii PAN, Muzeum Okręgowe w Tarnowie. ISBN 978-83-66463-50-9. 436 pages with colour figures and CD with the catalogue of features, colour tables and plan of the site; DOI: 10.23858/Krk/k/001

One of the most thrilling discoveries concerning the Early Neolithic in the drainage basin of the Upper Vistula made in the last 25 years are the results of a research conducted in 1996-2006 by Agnieszka Kukułka in Gwoździec (in the Wiśnicz Foothills). These works resulted in discovering a previously unknown fact that the Carpathian Foothills had been exploited by a population of the Linear Pottery culture (LBK) as early as in the first phase of its stylistic development. They also brought to light numerous, immensely important archaeological finds, including probably the most spectacular clay model of a human foot (Kukułka 2000; 2001). These results were the main inspiration for further wide-area field research conducted by A. Czekaj-Zastawny in 2016-2018 within the framework of the project of the National Science Centre entitled '*The oldest phase of the Linear Pottery Culture in the Lesser Poland (5600/5500-5300 BC) – genesis, dating, settlement, economy*'. The District Museum in Tarnów participated in the research, lasting several years, which was enriched with numerous and diverse specialist examinations and analyses conducted by experts in archaeology, traceology, archaeobotany, archaeozoology and organic chemistry. The reviewed monograph that is the result of this cooperation is, it is important to note, an extensive interdisciplinary study of all the data and finds obtained at the site in Gwoździec. It should be stressed that it includes results of all earlier research conducted at

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this site – the earliest (1996-2006) as well as later work carried out in 2018 within the framework of archaeological supervision after finishing the wide-area research in 2016-2018.

The monograph is composed of eight main sections preceded by a short note ‘From the Editors’. The first part, ‘Introduction’ (authors: Agnieszka Czekaj-Zastawny, Agnieszka Kukułka and Maria Lityńska-Zając) contains preliminary data concerning the site in Gwoździec, including a description of its location, environmental conditions and outline of the research history. It also includes information on the corpus of sources used in the discussed paper, which encompasses 172 features and 10 187 artefacts, almost all of which are linked with the period of settling the discussed territory by LBK communities.

Part two, entitled ‘Prehistoric materials’ is the longest section of the monograph. It presents analyses of all the mobile and immobile archaeological finds and environmental data obtained during the excavations. In this section, comprehensive information on the methodology of archaeological research (authors: Agnieszka Czekaj-Zastawny and Tomasz Oberc) as well as the question of the poor state of preservation of the archaeological remains discovered at the site – caused mainly by intense erosion processes were discussed in the first place (authors: Robert Kenig, Tomasz Oberc and Andreas Kotula). The subsequent chapters present preliminary information concerning the settlement chronology (author: Agnieszka Czekaj-Zastawny) and the functional identification of the features discovered at the site – it is accompanied by their classification within the framework of the internal periodisation of the LBK (authors: Agnieszka Czekaj-Zastawny and Tomasz Oberc). The research resulted in linking 128 features with the LBK. The great majority of them were remains of four households (I-IV) representing two main chronological-stylistic stages; the pre-music note phase (Ib, the so-called Zofipole phase) and the early music-note phase (IIa). What is more, 21 pits concentrated in the eastern part of the site allowed researchers to distinguish the latest stage of settling the site in the Early Neolithic, which stylistically corresponds to the early Želiezovce phase of the LBK (IIIa). Individual households as well as the concentration of the early Želiezovce phase pits were discussed in chronological order. The functional identification of the features from this concentration employed the entire number of the collected information – concerning their sizes, morphologies, character of their fills, the number and diversity of the artefacts discovered inside as well as archaeobotanical and archaeozoological data and results of other specialist analyses (*e.g.*, chemical and traceological examinations).

The following chapters discuss analyses conducted on different categories of archaeological materials. Each time, their results were presented in chronological-stylistic order, which corresponds to the subsequent phases of settling the discussed site. First, the most numerous ceramic materials (8789 specimens) were discussed (authors: Agnieszka Czekaj-Zastawny, Anna Rauba-Bukowska, Agnieszka Kukułka and Magdalena Bochnia). The great majority of them are pottery sherds. This collection was discussed in detail with regard to the ornamentation stylistics, diversity of vessel forms and technological properties of the ceramic compounds used in their production. The study of the technology focused on observation of macroscopic properties, but it also included a microscopic mineralogical-petrographic analysis of 38 sherds representing particular LBK phases, as well as six clay samples taken in the vicinities of the sites. The results of these analyses made it possible to state that the vessels used by the inhabitants of the settlements were made of local raw materials. The following subchapter (authors: Agnieszka Czekaj-Zastawny, Anna Rauba-Bukowska and Agnieszka Kukułka) was dedicated to imported ceramics, represented in Gwoździec by three fragments of ornamented bodies, linked with the environment of the Eastern Linear Tiszadob-Kapušany group from eastern Slovakia. The fact that one of them was discovered in a set linked with the Zofipole phase of the LBK is especially noteworthy. Previously, the earliest discoveries of Eastern Linear ceramics in the drainage basin of the Upper Vistula were recorded in the context of the music-note pottery (*e.g.*, Kadrow 1990; Kaczanowska, Godłowska 2009; Czekaj-Zastawny 2014, 68-72, 123-125; 2017, 52-55; Kozłowski *et al.* 2014). The next subchapter (authors: Agnieszka Czekaj-Zastawny and Agnieszka Kukułka) discusses all non-pottery ceramics finds from Gwoździec, represented by a collection of a dozen or so spindle-whorls and weaving weights, fragments of two bracelets, a piece of a clay spoon as well as a unique model of a human foot and several pieces of unspecified artefacts. The section of the monograph dedicated to ceramics is concluded with a chapter (authors: Harry K. Robson, Fiona England, Alexandre Lucquin and Oliver E. Craig) entitled 'Analysis of ceramic residues preserved within the pottery (ORA – Organic Residue Analysis)', which presents results of analyses conducted on 20 samples of ceramics with the use of gas chromatography-mass spectrometry (GC-MS) and gas chromatography combustion isotope ratio mass spectrometry (GC-C-IRMS). They confirmed that the inhabitants of the settlement processed ruminant adipose fats as well as non-ruminant adipose fats, most probably including fats of freshwater organisms. Some of the vessels contained, leafy plant lipids and remains of products made by insects (honey and wax).

Another category of the analysed finds are 'Lithic artefacts' (authors: Jarosław Wilczyński and BernadetaKufel-Diakowska) represented by a collection of 1599 items, including 55 macrolithic stone tools. The authors associated the great majority of them with LBK colonisation and attributed them to the subsequent chronological-stylistic phases of this culture at the site in Gwoździec. The finds were analysed to determine their morphological-typological and functional aspects as well as the raw materials used in their production. The raw material structure of the discovered siliceous materials indicates that Jurassic-Cracow flint played a strategic role in artefact production throughout the entire period of the development of the discussed LBK settlement. The percentage of other raw materials (e.g., erratic and chocolate flint, radiolarite, limnoquartzite and obsidian) was incidental. The analysis of artefacts made of obsidian indicated that its percentage in the collective raw material structure had grown during the latest phase of the settlement. This observation clearly corresponds to data obtained from other sites dated to the Želiezovce phase discovered in the drainage basin of the Upper Vistula (Szeliga *et al.* 2021). The morphological-typological analysis did not indicate any substantial differences between the collection from Gwoździec and other inventories of this culture discovered in this region, although the considerable percentage of retouched tools (*c.* 20%) in materials dated to phase IIa is conspicuous. The results of a use-wear analysis indicated a considerable number of tools used in processing animal materials (*e.g.*, carcasses, hide) and production of artefacts made of bone and antler. At the same time, tools used in harvesting and processing vegetal raw materials were much less frequent. This fact visibly corresponds to results of very scarce traceological analyses conducted on siliceous materials discovered at other LBK sites in the drainage basin of the Upper Vistula (*cf.*, Małecka-Kukawka 2008; Szeliga and Pyżewicz 2018). In this context, it should be stressed that the range of the conducted analyses is incomparably more comprehensive than any other study of LBK inventories from the loess uplands spreading north of the Carpathian and Sudeten mountains.

The three final chapters of a section entitled 'Prehistoric materials' were dedicated to analysing various bioarchaeological remains discovered during the exploration of the LBK features as well as from samples taken from their fills. An analysis of 'Plant remains' (authors: Maria Lityńska-Zając and Magdalena Moskal-del Hoyo) confirmed the most important role of emmer wheat (*Triticum dicoccon*), with a considerably lesser significance of einkorn (*T. monococcum*) and, since phase IIa, barley (*Hordeum vulgare*). The obtained data indicate that the inhabitants of the settlement probably cultivated pea and flax, but also harvested such wild growing plants as apple trees, hazel, goose-foot, brome and knotgrass. The cultivation of emmer wheat appears to be confirmed by the results of an analysis conducted on modest palynological data taken from a profile of one of the discovered LBK features. Nevertheless, the taxonomic structure of pollens present in this material clearly indicates that its character was not homogeneous (the chapter 'Analysis of palynological profile' by Agnieszka Wacnik). Very scarce 'Faunal remains' (author: JarosławWilczyński), represented by only 33 fragments of charred bones discovered in five LBK features, were separately discussed. It was possible to identify farmed species typical for the LBK (*i.e.*, cattle, ovicaprid and pig), despite the fact that the osteological materials were charred and considerably fragmented. On some bones, there were traces formed during processing animal carcasses.

The subsequent, third section of the monograph (authors: Andreas Kotula, Joanna Jędrysik, Robert Kenig and Tomasz Oberc) discusses a multi-faceted spatial analysis of different finds made within the settlement – including ceramic materials as well as siliceous, lithic and obsidian artefacts – conducted with the use of GIS tools. The analysis includes the results of traceological examinations, which makes it possible to suggest that in the vicinities of particular households there were zones where different materials were processed. Spatial distribution of various palaeobotanical materials was also examined, which made it possible to determine the greatest concentration zones of preserved remains of cultivated plants (including crops) and wild vegetal species within the settlement.

The monograph's fourth part (authors: Tomasz Oberc and Joanna Jędrysik) focuses on analyses of the area exploited by the inhabitants of the settlement. First, the basic and maximum productive area were determined – together with indicating the places of exploiting resources and performing various farming activities. These analyses took into account the morphology of the discussed area and the local river network. A visual field analysis made it possible to reconstruct the maximum field of view from the settlement. What is more, examining the degree of insolation – which was determined for the area of the main exploitation around the settlement – indicated that the most insolated territories were located east of the site. This makes it possible to assume that the inhabitants of the settlement most intensely exploited the local slopes (especially their higher parts) when cultivating crops. Next, the entire local network of LBK settlements within the Wiśnicz Foothills was examined. The obtained results confirm the assumption that settlements were established in the zones of brown earth formed on loess, at a short distance from the watercourses. This fact clearly corresponds to settlement preferences attributed to the LBK population within the drainage basin of the Upper Vistula (*cf.,* Czekaj-Zastawny 2008). Visual fields from all the LBK settlements in the region were also analysed, which made it possible to reconstruct the network of mutual visibility between them, which indicates the existence of a centralised settlement system.

The subsequent part of the monograph discusses the chronology of the colonisation of the site in Gwoździec (authors: Agnieszka Czekaj-Zastawny and Tomasz Oberc). First, it presents considerations on the relative chronology of the settlement, based on an analysis of the styles of vessel ornamentation. Next, data concerning the absolute chronology were discussed based on 30 radiocarbon dates. Bayesian modelling allowed the authors to reach the conclusion that the site in Gwoździec should be considered as a generally one-phase settlement – which means that it was developed continuously (without hiatuses between particular stylistic phases), and vessels representing new styles replaced directly older pottery, or even vessels made in different styles were used at the same time. The overall chronological framework of the settlement was determined to last from *c.* 5300 BC and *c.* 5160 BC.

The subsequent part (by Agnieszka Czekaj-Zastawny, Magdalena Bochnia, Oliver E. Craig, Fiona England, Joanna Jędrysik, Robert Kenig, Andreas Kotula, Bernadeta Kufel-Diakowska, Agnieszka Kukułka, Maria Lityńska-Zając, Alexandre Lucquin, Magdalena Moskal-del Hoyo, Tomasz Oberc, Anna Rauba-Bukowska, Harry Robson and Jarosław Wilczyński) presents a reconstruction of the functioning and spatial development of the LBK settlement based on the totality of the data obtained during the research (the results of the detailed analyses conducted on them were presented in the previous parts of the book). The radiocarbon data and the stylistics of vessel ornamentation made it possible to distinguish four subsequent phases of the settlement, represented by four separate households (phases 1-3) and the concentration of farming pits (phase 4). Based on their distribution, it was established that there had been different settlement zones during the development of the settlement: the eastern (phases 1 and 4) and the western part of the site (phases 2-3). An analysis of the dispersion of the archaeological finds, supported by specialist examinations, made it possible to reconstruct the system of using house surroundings during the development of the settlement by the identification of zones linked with different economic activities performed near the households in different phases. The most complete data in this regard (and, at the same time, certain differences) were obtained for phases 1 and 3. As to the earliest phase (House I), the traces of backyard farming were concentrated in the eastern part of the household, and phase 3 (House III) is indicated by remains that were evenly distributed around the house. Next, the authors focused on questions concerning the economy of the settlement. The basis of these considerations – taking into account the entire period of the development of the discussed settlement – were all the collected archaeological and environmental data together with the results of specialist analyses performed with their use (*e.g.*, use-wear analysis and organic residue analysis). These pieces of information clearly confirm the conjecture that the economy of the settlement was always multi-faceted and based on growing cereals (wheat, barley) and animal husbandry (cattle, ovicaprids, pigs). At the same time, the inhabitants of the settlement were focused on intense exploitation of various natural resources (gathering wild-growing plants and hunting). This fact probably means that the diet of this population was varied – based on plant and meat products – and rich in nutrients, which was probably enriched with such products as honey. This fact is clearly indicated by the organic residue analysis. In this context, we should stress that the analysed vessels from Gwoździec were the first artefacts of this type in which lipids of unspecified freshwater animals were detected, which indicates that they were processed as food. These findings considerably complement very modest data obtained at other sites in the drainage basin of the Upper Vistula, which prove that LBK societies hunted fish, terrapins and beavers as well as collected mussels (*cf*., for example, Nadachowski and Wolsan 1999, 238; Makowicz-Poliszot 2008, 256-257; Szeliga *et al*. 2023, fig. 10, Tab. 3-4).

The next chapter (by Marta Korczyńska and Joanna Jędrysik) discusses the latest archaeological discoveries dated to the Early Bronze Age. These materials, associated with the Pleszów group of the Mierzanowice culture, are represented by only three pottery sherds having no archaeological context. Despite the somewhat modest number of these artefacts and the fact that they are loose finds, they triggered an extended discussion on the character and potential scale of the colonisation of the Wiśnicz Foothills by the the communities of the Mierzanowice culture at the beginning of the 2nd millenium BC. This is the final chapter of the monograph, which is followed by brief 'Conclusions', a bibliography, a summary in English and an alphabetic list of all the authors. The book is complemented with a CD containing a digital catalogue listing the discussed features, figures with photographs and colour illustrations presenting the features as well as an abundant group of illustrations presenting the archaeological materials and the overall plan of the site.

The discussed publication is another monograph presenting LBK materials discovered during archaeological excavations in the drainage basin of the Upper Vistula published in recent years – after Samborzec, Modlniczka, Brzezie, Targowisko and Zwięczyca (Kulczycka-Leciejewiczowa 2008; Czekaj-Zastawny and Przybyła 2012; Czekaj-Zastawny 2014; Dębiec 2014; Zastawny ed. 2014). What makes it stand out from previous, enormously important and valuable works is the incomparably greater scale of the conducted specialist analyses and, as a result, a great number and variety of the obtained data. They are the base of a complex reconstruction allowing us learn about the history of the settlement in Gwoździec, methods of its internal management, and the scale of the exploitation of its surroundings at the end of the 6th millennium BC. They also made it possible to determine the economic principles of the existence of its inhabitants, including obtaining, processing and using various raw materials. Still, the results of the interdisciplinary research are of greater than just a local or even regional importance. They provide us with many new and immensely important pieces of information on the origin, spread, chronology, development and geographical distribution of the earliest LBK settlements, not only in south-eastern Poland, but also across other territories of Central and Central-Eastern Europe. The presented monograph opens a completely new chapter in the discussion of these topics, undoubtedly playing a role of the most important reference point for further research on the Early Neolithic and the neolithisation of old upland loess territories – in the drainage basin of the Upper Vistula as well as across the entire northern foreland of the Carpathians.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3623

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(Review) Martin Furholt, Ivan Cheben, Johannes Müller, Alena Bistáková, Maria Wunderlich and Nils Müller-Scheeßel (eds), *Archaeology in the Žitava valley I: The LBK and Želiezovce settlement site of Vráble* (= *Scales of Transformation in Prehistoric and Archaic Societies* 9). Leiden 2020: Sidestone Press, 546 pp.

In 2012, an important international research project called The Collaborative Research Centre, 'Scales of Transformation: Human-Environmental Interaction in Prehistoric and Archaic Societies' (CRC 1266) was started at Kiel University. The main assumption of this multidisciplinary project is research of socio-environmental transformations in ancient societies. The volume: "The LBK and Želiezovce settlement site of Vráble" is the first part presenting the results of this project. The book was created under the editorship of Martin Furholt, Ivan Cheben, Johannes Müller, Alena Bistáková, Maria Wunderlich and Nils Müller-Scheeßel. It presents LBK (Linearbandkeramik) and Želiezovce settlement materials fromVráble (southwest Slovakia) – being one of the largest LBK-sites in Europe.

The book is divided into six sections. The first, by Ivan Cheben and Martin Furholt, presents the history of research project at the LBK and Želiezovce settlement site of Vráble. The LBK settlement Vráble was discovered accidentally in 2009 because of investigations of the extensive geophysical prospection of the Bronze Age settlement Vráble 'Fidvár'. The investigation of the Neolithic site began in 2012. Subsequently, a joint research project was established by the University of Kiel and the Archaeological Institute of the Academy of Sciences in Nitra, which was soon embedded into the newly formed CRC 1266 'Scales of Transformation' project in 2016. Thanks to its inclusion in the project, it was possible to conduct interdisciplinary research, the results of which could be used to clarify the history and character of the settlement.

The second section of the work is divided into three parts that are devoted to the scientific analyses. The first on magnetic prospection by Kay Winkelmann, Jozef Bátora, Isabel

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Hohle, Johannes Kalmbach, Nils Müller-Scheeßel and Knut Rassmann presents the results of the large-scale research in 2008-2012. The magnetic prospection was conducted near Vráble on the sites of 'Fidvár' and Velky Lehmby and covered an area of around 150 ha, thanks to the results of the prospection revealed to the multiperiod site of Vráble 'Fidvár'/ 'Veľké Lehemby'/'Farské'.

The next chapter in this section by Natalie Pickartz, Erica Corradini, Raphael Kahn, Diana Panning, Knut Rassmann, Nils Müller-Scheeßel, Martin Furholt, Dennis Wilken, Tina Wunderlich and Wolfgang Rabbel presents the benefits of geophysical on-site measurements in excavations. The authors prove that excavations supported by geophysical in-situ measurements (ground-penetrating radar (GPR), electromagnetic induction (EMI) and magnetic susceptibility (MS)) on an excavation planum enable us to extend the documentation of the excavated area from 2D to 3D model subsurface structures before being destroyed through excavation. Methods used in the study the – long pits accompanying houses and postholes at the LBK and Želiezovce settlement site at Vráble. The result showed that long pits have an irregular bottom, which may be due to the authors' opinion of discontinuous construction over time. Interestingly, a comparison of archaeological documentation with EMI and GPR measurements in some cases showed that that the bottom of the long pits were deeper than excavated. The remains classified as postholes had no distinct anomalies of geophysical parameters that could be detected, which the authors explain by the excessively high level of erosion. Only a minimal volume of the posthole fill had remained on the planum.

The authors (Stefan Dreibrodt and Hans-Rudolf Bork) of the last article in this part presents the results of geomorphological and geoarchaeological research. The study of the Holocene erosion history of the slopes adjacent to the LBK site of Vráble, revealed that Holocene soil erosion started after the phases of LBK land use (Lengyel, Baden). The pit fills were analyzed by laboratory methods (magnetic susceptibility, portable energy dispersive X-ray fluorescence (ped-xrf), colour-spectrometry, loss on ignitron) which show similar geochemical properties (probably local origin of the infilled material). Additionally, they were rich in organic waste, which is probably the remains of everyday waste.

The third section entitled "Settlement features and Human burials" consists of two chapters. The first, by Robert Staniuk, Martin Furholt, Nils Müller-Scheeßel and Ivan Cheben, presents the information on archaeological features excavated between 2012-2017 from the sites of Vráble 'Veľké Lehemby'/'Farské'. The data were collated and presented clearly in descriptive, table recordings and drawing form. The number of artefacts within features is included, information on relative chronological dating (based on pottery decoration) and ^{14}C (Bayesian modeling) is provided.

The second part of this section is devoted to the burials and human remains from the site of Vráble. Nils Müller-Scheeßel and Zuzana Hukeľová present a catalogue of burials and human remains with information about varieties of the modes of skeletons positions (burial practices), burial goods, sex, age, pathology, results of the analyses of stable carbon

($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope ratios and ^{14}C. Then the anthropological evaluation of the skeletal remains is assessed, including pathology. The analysis of the stature of adult individuals indicates that this corresponds with the values recorded for other Neolithic populations in the region. The authors also describe pathological lesions and developmental anomalies and their impact on burial practices.

The work's fourth section presents the chronological analyses. The text by Ivan Cheben, Alena Bistáková, Bastian Wolthoff, Wiebke Mainusch, Nils Müller-Scheeßel, and Martin Furholt is devoted to chronological analyses of the ceramic material from the LBK and Želiezovce settlement site of Vráble. The typochronological analysis of the pottery material was based on qualitative comparison with existing chronologies (qualitative analysis) and research on the motifs and decorative techniques. Based on Juraj Pavúk's (1994) recording system, they were catalogued with motifs and decorative techniques on sherds. Then, the decorative elements were quantitatively analyzed using correspondence analysis (CA). The CA of decorative techniques showed a chronologically significant pattern of changes. Interestingly, the CA of decorative motifs showed their diversity on a smaller scale: to the yard or region of the site.

In the article entitled "Radiocarbon dating at the LBK and Želiezovce settlement site of Vráble" (by Robert Staniuk, Maria Wunderlich, John Meadows, Nils Müller-Scheeßel, Martin Furholt and Ivan Cheben) the dating programme and Bayesian modelling developed for the 'Veľké Lehemby'/'Farské' settlement complex at Vráble is presented. The authors described the method of sampling of archaeological features, their selection of ^{14}C, and methodology behind the dating programme as an outline of the developed models.

The fifth section is entitled "Material culture, plants and animal data". In the first part, Ivan Cheben and Alena Bistáková present a description of the technological and typological features of the pottery materials excavated from the Vráble 'Veľké Lehemby'/'Farské' site. They note that the inventory represents the younger LBK style, the Želiezovce style, and some objects also contain Bükk and Lengyel style pottery, which is typical for southwestern Slovakia. The settlement areas in Vráble are marked by common technology, and a uniform set of vessel shapes, but as noted above, the decorative motifs are more specific to different areas on the site.

The second chapter by Michal Cheben, Pavla Hršelová, Maria Wunderlich and Kata Szilágyi present the lithic material from Vráble, consisting of chipped and ground stone tools and debitage. The analysis shows that different varieties of raw materials and types of tools were used within the settlement. The distribution patterns of stone artefacts at the site and the causes that may be responsible for them are also discussed.

The next chapter (by Rebekka Eckelmann) presents the analysis results of bone tools discovered at Vráble. Rebecca Eckelmann shows the assemblage of bone tools from this site is comparable to those found in other LBK contexts. She sees the need for further research on this category of archaeological sources, among other things, to better understand the function of bone objects.

The chapter by Rebekka Eckelmann, Ulrich Schmölcke and Cheryl A. Makarewicz is devoted zooarchaeological analyses of fauna recovered from Vráble 'Veľké Lehemby'/ 'Farské'. The authors describe the modes and types of animal husbandry. The analysis result show a predominance of remains of domestic animals with a small share of remains of wild ungulate animals. It seems interesting to note that animal husbandry systems at Vráble focused on the exploitation of pigs differently than at other LBK sites in Europe.

In the article entitled "Archaeobotanical remains from the LBK and Želiezovce settlement site of Vráble" (by Dragana Filipović, Helmut Kroll and Wiebke Kirleis) archaeobotanical data was presented for Vráble. The collated data were used by the authors for reconstruction of the plant-growing and consumption habits and how the surrounding landscape had been used. The typical LBK crop spectrum (einkorn and emmer as the most prominent components) and typical model of the nature and scale of farming at LBK was documented at Vráble.

Tim M. Schroedter presents in his article the anthracological data (wood charcoal) to get insight into the wood vegetation in the vicinity of the site. In his opinion, the small number of taxa at this site indicates a high degree of selection in firewood economy.

The next chapter by Frank Schlütz, is devoted to the analysis of snail shells. The research results help in the reconstruction of former environmental conditions. They point towards a landscape of open grasslands around Vráble.

The last article by Rosalind E. Gillis and Cheryl A. Makarewicz, is devoted the stable isotopic analyses of samples of human and animal bones and of cereal grains from the LBK site of Vráble. They provide important information about the human or animal diet in prehistoric times. Analyses showed that animal products played a minor role in the diet of LBK farmers at Vráble.

The last part of the monograph is entitled "Synthesis". Here, Johannes Müller, Nils Müller-Scheeßel, Ivan Cheben, Maria Wunderlich and Martin Furholt deal with the reconstruction of the demographic development of the Vráble site. The magnetic plans of the entire site and the data from the excavations and extensive coring programs were developed into a chronological model. Additionally, based on ^{14}C dates and the orientation of houses showed a gradual change in their orientation towards the left of 13° per 100 years. Using statistical, archaeological, and anthropological data, they estimated the average number of inhabitants of the settlement and change in this number over time. The data obtained became the basis for the reconstruction of social and economic processes and strategies in the history of the Vráble settlement.

The second chapter by Martin Furholt, Rebekka Eckelmann, Dragana Filipovic, Rosalind E. Gillis and Johannes Müller devoted to reconstructing the subsistence strategies at Vráble and discuss their social implications. For this purpose, they use data from the results of zooarchaeological, archaeobotanical, and stable isotope analyses together with demographic patterns. The authors also describe possible reasons for the settlement's decline. They look for them in exclusionary strategies (enclosure construction activities).

The last part of the discussed book (by Maria Wunderlich, Johannes Müller, Ivan Cheben, Alena Bistáková, Martin Furholt and Nils Müller-Scheeßel), presents a synthesis of the socio-political developments of the communities at the Neolithic site of Vráble 'Veľké Lehemby'. Using available data, they reconstructed a model of the political economy of the LBK and Želiezovce settlement site. They point to the simultaneous existence of an exclusionary and communal strategy as an important element of this system. In their opinion, this could indicate the existence of social tensions, conflicts and social inequalities (*e.g.*, diverse burial rites). Ultimately, the intensification of these processes contributed to the abandonment of the settlement.

In conclusion, this book is a valuable resource for anyone interested in archaeology, going beyond basic research on archaeological material (*e.g.*, specialist analyses, use of interdisciplinary research methods, attempt to synthesize data) can be a model for researchers of various periods. This case study of a settlement at Vráble provides important information to the studies upon the LBK and socio-environmental changes in this society.

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SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3712

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(Review) Andrzej Buko, *Świt państwa polskiego*, Warszawa 2021: Wydawnictwo Instytutu Archeologii i Etnologii PAN, Muzeum Historii Polski, ISBN: 978-83-66463-42-4. 332 pp. (in Polish with English summary)

This book attempts to explore the first stages of the rise of the Polish state specifically focussing on exploring the processes operating during the reign of its first historical ruler, duke Mieszko of the Piast dynasty (ruled c. 960-992). Unlike previous accounts that tend to treat this area (in fact, more or less that occupied by post-1945 Poland) as a single unit, the writer produces a more nuanced picture by looking at the disparate processes taking place in several discrete region within that larger unit between the end of the eighth century and the last decade of the tenth century. Much of the new work and insights discussed have come from archaeological projects with which the writer has himself been involved, many of which were in southern and eastern regions of the country, formerly somewhat neglected.

The monograph bases the narrative on the interpretation of the archaeological evidence as a key source of information on this subject; the written sources from the period are few, laconic and difficult to use. In the author's words, the book: "shows not only a colourful picture of the past a thousand years ago, but also the contribution of archaeology to understanding the roots of our state, and thus Poland and Poles". Both aims seem to have been met. Medievalists have often tended to use excavated remains as illustrations to a text-based history rather than as sources in their own right, but Polish archaeology broke away from this in the complex interdisciplinary research into Polish origins carried out under the 1949-1970 "Millennium Project". The study of the nation's early medieval past was given a new boost after 1990 with the rise of a new generation of scholars. This coincided with the use of new techniques for fieldwork (better understanding of excavation and field survey techniques, geophysics), and the analysis of the products (more sophisticated pottery analyses, increasing use of absolute dating – in particular the development of reliable

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dendro-dating, the use of isotopic and genetic analyses). This book is the result of considering the work of this "new wave" of scholarship.

The author has crammed a surprisingly large amount of information into the 329 pages of this compact (16.5 × 23.5 cm) volume that is explicitly addressed to both specialists and a wider circle of interested readers. The writing style is engaging and the material is skilfully organized (with a sizeable index of geographical, local and ethnic names that helps navigate it).

The narration has been organized into eight chapters each focussing on a group of selected issues from the region of modern Poland in the period concerned. There are two underlying themes, the first is the processes of centralization of power under the first Piast rulers that culminated in the creation in just a few years (probably between 962 and 966) of what we regard as the first Polish state. The second is the massive ideological shift that accompanied the process from native pagan beliefs to the acceptance (at least by the elite) of Christianity from more powerful neighbours process of culminating in the so-called "Baptism of Poland" in 966, which from today's perspective has been seen as a watershed event in the creation of Polish culture and identity.

The first chapter (pp. 13-38) sets the background presenting a panorama of the transformations taking place in central and eastern Europe between the second half of the 8th century and the beginning of the 10th century. This period is marked in Poland by the crystallization of discrete territorial communities that can be detected through the distribution of settlements found by fieldwalking, often clustering around central places consisting of earth and timber strongholds, which in turn coalesce to form archaeologically legible larger regional groupings. The author uses the ethnographic literature to discuss (pp. 27-31) the nature of the social links these archaeological groupings may represent. This precedes four chapters presenting the changing archaeological characteristics and principle sites of various regions of Poland in the pre-state period (9th and first half of the 10th centuries).

The book's second chapter (pp. 39-83) considers the broad zone in the southern part of Poland, along the rivers flowing from the mountains. Silesia in the SW (pp. 39-45) has a number of specific features, such as a distinctive construction of stronghold ramparts with stone facing and the presence of upland cult centres such as on Ślęża mountain. Despite the rather dense clustering of strongholds in the area, there seems to be a lack of evidence for the crystallisation in the pre-state period of larger-scale tribal unions. It is suggested that the area came under the cultural influence of the Moravian and then later the Přemyslid Czech state, reflected perhaps by the earlier appearance (9th century?) here of inhumation burials as well as the 'southern' pottery styles and finds of Moravian riders' equipment.

The Kraków centre in the SE (pp. 68-76) likewise has a number of characteristic features not found in other regions. Above all are about a dozen massive areas, upwards of 10 ha, on hilltops and hill slopes in the Carpathian foothills enclosed by box-ramparts of wood and earth. There is a lack of evidence that these 'Great Strongholds', built from the mid 8th century and lasting in use until the 10th and 11th centuries, were involved in conflict between each other (p. 83). In the region also are monumental earthen mounds (presumed funerary) not found elsewhere. The material culture also differentiates the region, apart from the rich metalwork assemblages (again including riders' equipment); from the end of the 8th century the pottery assemblages are dominated by vessels with a whitish or buff fabric (from the use of calcareous clays) of 'southern' style – this pottery abruptly disappears when the Krakow region is joined to the Polish state. It is unclear what the relationship was between this region and the Moravian state (in fact, Buko discusses whether or not there really was such a thing on pp. 77-79). The author explores the concept that the characteristics of the region reflect the chances of early statehood that in the end were unfulfilled.

In this chapter, too the author then discusses (pp. 45-68) his own work in the lesser-known regions on the northern edges of Kraków zone (Sandomierz, Lublin and Chełm) within which are traces of similar phenomena to those described above. It is demonstrated that each of them followed their own path in the period leading up to the establishment of Piast rule over them.

The third chapter (pp. 85-116) defines the characteristics and settlement changes in so-called Greater Poland, which is the core territory from which it seems the early state had its beginnings. This has a very dense network of well-investigated strongholds. One of the main topics is the appearance in the second half of the ninth century of a mysterious network of ringwork strongholds (pp. 91-96) of Tornov type which abruptly finish functioning in the period 920-40. Their appearance seems part of a wider phenomenon, their decline however seems related to the rise of Piast power. As an appendix to this the region of Mazovia with its much sparser settlement network is presented here (pp. 96-116) as a "great region in the shadow of Greater Poland". Settlement here is more discontinuous, strongholds are relatively speaking few and far between and knowledge of both is depicted as still rather sketchy.

The fourth chapter (pp. 117-139) discusses Pomerania, the broad zone in the furthest northwest of the country that forms the hinterland of the south coast of the Baltic Sea. Like Greater Poland, the area has a dense settlement network centred on the many strongholds. A particular focus is the emporia, such as Wolin, that functioned in the circum-Baltic economic zone and developed a proto-urban character from the eighth century. Regional differentiation is seen here too, in the west there is a specific funerary rite (Alt Kabelich) and zones of the interaction between local populations and settlers using Scandinavian style objects (pp. 127, 128). In the east, Scandinavian accents are also present, attention is drawn by the exceptional remains from the trading emporium of Truso at the Vistula estuary (pp. 131-135) and the presence of graves with Scandinavian material in the Elbląg area.

The picture that this overview of the various regions of the country in the pre-state period is one of a growing social complexity but also tensions, reflected by the functioning and construction of strongholds in the late 800s and early 900s, possibly as prestige sites as well as defensive measures against threats from neighbouring groups. The proliferation and subsequent decline of large religious centres in some parts of ninth-century Poland may have represented early attempts at organizing into larger regional polities of some kind. The fate of both, however, suggests the inability to effectively maintain a status quo, the social, economic and organizational systems thet represent proved vulnerable and unstable.

The fifth chapter, the longest in the book (pp. 141-188), presents the formation of the Polish state in the light of archaeological data. This is depicted as involving profound structural transformations (while previous chapters had illustrations depicting sites discussed in the text, this crucial part of the narrative is heavily accompanied by diagrams depicting processes). In the author's view, the emergence of the Polish state was due to a complex interplay of factors involving the needs of communities to organize defence, the contribution of population movements, shifts in settlement patterns, and foreign influences. The book somewhat brutally contrasts the archaeological evidence with the long-cherished dynastic legends reflected in later texts and traditions concerning the centres (Gniezno, Poznań, Kruszwica) in Greater Poland, and while these turn out to have had little explanatory merit, they prompt some thinking about the original ancestral seats and power base of the Piast family (Giecz? Kalisz?).

The origins of the medieval Polish state are attributed to a sort of 'revolution' originating in Great Poland, which witnessed significant transformations at the end of the tribal era. While this is not in itself a novel idea, the book shows how this process is particularly legible in shifts in fortified settlement locations that are now datable by more refined pottery studies, but above all the dendrochronological dates. Many old tribal strongholds did not escape destruction in this region and new sites were constructed by the Piasts. These new main centres of the state consisted of strongly fortified strongholds and their adjacent settlements (podgrodzia – singular: podgrodzie), representing the beginnings of early urbanization. This construction work involved a huge investment/consumption of resources (such as an unbelievably large amount of lumber which must have led to large scale deforestation and other environmental changes changes in the natural landscape already before the end of 10th century). The author argues for the process being accompanied by profound demographical changes, examples of which are migrations and the deliberate relocation of the populace that seem to be archeologically detectable in many regions.

The second part of this chapter discusses the beginnings of the territorial expansion of from this core area (pp. 157-188). At Sandomierz there is good evidence (p. 160) for population replacement (including the abrupt intrusion of a foreign pottery style brought from the areas to the west). This may be interpreted as migration/resettlement of populations from centres that were crushed in the expansion of Piast rule – possibly coming there as prisoners that had been driven out. The author then discusses the evidence for Piast expansion into Mazovia in the 970s, again apparently involving population replacement and the destruction of old and construction of new central places (pp. 160-167).

Another direction of expansion was to the Baltic coast. This seems to have begun in the 970s with military action in eastern Pomerania. In this context, the book describes the ongoing debates about the location of the first port of Gdansk, or whether there was one there at all until a bit later (pp. 135-139 and 167-169). The extension of Piast power to western Pomerania in the 980s seems not to have disrupted the functioning of the emporia such as at Wolin, Szczecin and Kołobrzeg, indeed they flourished in this period and provided the Piasts with economic benefits. Inland from the Pomeranian coast, however, there were far-reaching social/cultural changes that included a clear development of the settlement network with the settling of previously empty areas. Not many of the old pre-state strongholds survived, and a number of new ones were founded to replace them (p. 174).

It seems that some time in the tenth century the Czech Přemyslids had laid claim to the territory in the regions to the south in the forelands of the mountains (p. 43), but while a tributary relationship may have existed, there were few physical traces of this in for example the creation of any strongholds. There may be traces of an earlier Czech phase under the main centre of the region, Wrocław. The latter site was remodelled on the establishment of Piast control in Silesia (dendrodated to the 980s). It seems that Kraków Land which the Piast state absorbed (*c.* 989) may also have previously had some kind of relationship with the Czech state. A contrast here with the evidence elsewhere was that after the extension of the Piasts into the area (the process still being somewhat unclear) was that the Great Strongholds of the region not only were not destroyed, but continued to function into the eleventh century. There is even the example of Wiślica (pp. 177-180), where it seems the Piast stronghold with ecclesiastical buildings was built less than half a kilometre from the existing site that continued in use.

The final section of this long chapter starts off as a brief but masterly discussion of where Mieszko got the funds necessary to build the state, and discusses the various factors involved, plunder from warfare, tribute/gifting, controlling trade routes in various directions, as well as the slave trade (hitherto a somewhat neglected theme in Polish historiography). Tucked away inconspicuously at the end (pp. 186-188) is a key passage referring to the definition of a state and a brief mention (with an exciting map) of the mysterious and ultra-laconic copy of an (apparently) tenth century document known as “Dagome Iudex” without which it seems Polish authors unanimously agree that no discussion of early medieval Poland can be without.

Chapter six (pp. 189-211) has as its subject the beginnings of Christianity in Poland but in fact incorporates a fascinating and instructive discussion of the interpretation and misinterpretation of archaeological features on Polish sites linked with this process. The remains of the architecture relatable to that baptism were eagerly sought by archaeologists under today’s baroque churches and this chapter introduces some of what was found, including the remarkable complex of churches on the Wawel rock rising up over the town of Kraków (pp. 190-193). Also discussed are the mysterious complex of structures on Ostrów Lednicki island (pp. 198-203). The author raises the question whether instead of the “Baptism of Poland” of the history textbooks, the physical remains instead suggest the demonstrative baptism of a small part of the state’s elite.

The final part of the chapter (pp. 203-209) discusses the issues of the first graves of the new burial rite, the foundation of new cemeteries, not only by churches but also in the countryside of cemeteries with their E-W supine inhumations in rows. Although some are tenth century, it seems most date from the eleventh century, but even then there were accompanying grave goods (pp. 208, 209). Tellingly, the final section of this chapter is called "more questions than answers".

Chapter seven (pp. 213-252) leads on from the preceding discussion of cemeteries and here in it Buko heeds the maxim that archaeology is about people. The pages of the history books are populated by the elite, those who were mentioned in the written sources (and about whose lives we sometimes know quite a lot and whose motives we can infer). Society was actually made up of countless thousands of people whose lives can only be discussed on the basis of the physical traces they left behind, the objects and structures they used, the changes effected on the sites where they lived their lives, as well as their corporeal remains.

The several different types of cemeteries are discussed (pp. 219-224) and what they reveal about the social structure of the deceased. Discussion then shifts to the issue of evidence from human remains, material culture and isotope evidence (pp. 238-240), for regional and interregional migrations and other means to determine kin and interpopulation relationships within cemetery populations (pp. 240-243). There is also a substantive presentation of the health of communities as revealed by anthropological evidence, about the diet of the inhabitants of Polish lands a thousand years ago, what they were sick with and how long they lived (pp. 246-252).

The eighth part of the book's text summarises and helpfully brings together the various threads of the regional sections into a single chronological narrative (pp. 253-256), characterising the processes operating in the whole region decade by decade. At the end of the book is an extensive (pp. 291-303) and useful English summary that is almost something of a standalone essay that expands the book's final text and refers to the figures (which have English captions) that will enable its reader to follow the author's arguments in some detail. Between the two is a substantial 32 page bibliography (pp. 257-289).

Though a relatively compact book, the reader is presented with a substantial portion of attractively packaged material and introduced to a lot of the current cutting-edge thinking on the topic. The material presented shows not only how our understanding of the formation and expansion of the early medieval Polish state has been significantly refined, but also how it is revealed as a much more complex multifaceted narrative than the traditional portrayals. The skilful use of the results of the use of new methods and recent archaeological investigations is a valuable contribution to the literature on the subject, not only of interest for Polish researchers but also those of adjacent regions, and from this point of view, the way the basic ideas have been made accessible to foreign readers is exemplary.

Of particular interest is the way that, although it deals with the west-facing aspects of the early state (in particular its relationship with the Ottonians), unlike the majority of its predecessors, this is not the main focus. The book draws also attention to the significance of the eastern territories (Lublin, Chełm, eastern Mazovia) as borderlands with Rus', topics that have tended to be relatively neglected in previous syntheses.

While the book focuses on the information from archaeology, the written sources and traditions are not ignored. This narrative asserts the need for dialogue between documentary and other sources and identifies a number of conceptual and methodological problem areas. The book adroitly deals with topics where there has in the past been over-interpretation of unclear information and, where opposing interpretations of the same sources have arisen, presenting both sides, indicating where there is a conflict but often resisting the temptation for the author to impose his own preferred explanation, preferring to leave the issue for later resolution. In this sense the book serves more as a stepping stone for future research than a presentation of research as a *fait accompli*.

The reviewer has a few quibbles. It would have been very helpful to have had a map of the country showing the location of the main places (and boundaries of the regions) discussed in the work rather than assuming all readers will be aware of where they lie in relation to each other. The illustrations are well-chosen and integrate well with the text, but some with multiple images overlain on each other have the appearance of powerpoint presentations for a lecture that would look good on a screen or wall, but lose a lot of their legibility on a page this size. Since the book's 93 illustrations come from a variety of sources, there is some variation in their style, which is acceptable, but this leads to problems when they are incompatible with each other in terms of the information they present (the position of strongholds in figs 9, 19, 31 *etc*.), or in situations where a map (fig. 8) shows an ethnonym in an area, while the text (pp. 79-83) questions whether these 'Polanie' inhabited the region in question in pre-state times. It is also puzzling why the book does not make any substantial use of the results of the massive landmark project of monographic publications (in the ongoing series *Origines Polonorum*, 2013-present) of the backlog of final results from the major excavation projects conducted in the 1949-1970 "Millennium Project".

As noted above, the formal definition of a state is provided in a brief passage in the text. One is struck by the degree to which the process of state-building is shown as relying on violence and repression to create a centralized political authority that would exercise firm control over a defined territory. A prevalent theme is the widespread destruction, often by fire, and abandonment of tribal centres across regions like Great Poland, Little Poland, and Mazovia. This was then followed by the establishment of new central settlements under Piast control. By changing the locations of these strongholds, a deliberate shift away from earlier tribal centres emphasises the imposition of a new way of organizing the landscape on the ashes of the preceding one. One might ask whether the author considers that there was an ideological basis for this, an economic one, or (given the emphasis on the effects on the environment of these centres) perhaps simply the practical aspects of moving the construction sites closer to where there were still stands of trees?

The motif of coercion reappears in the evidence for the (apparently abrupt) changes in population densities, as populations surged in some areas while dwindling in others. The author presents evidence for large-scale population relocations during state formation. As yet, the mechanisms are not firmly determined, but there is a disturbing possibility that these were the result of coercive acts akin to ethnic cleansing and or repression, driving populations out, enslaving or annihilating them. Such migrations would have resulted in various forms of interactions and intermingling of different cultural and social groups that would contribute to the emergence of new hybridized socio-cultural, if not ethnic (and linguistic?), identities. oreign influences played a crucial role in the success of the state's expansion and integration, with the recruiting of warriors, including those equipped with equipment of 'Scandinavian' aspect. The retinue of the ruler of the state seems to have contained foreigners who may have acted as some kind of 'siloviki' imposing the will of their leaders and maintaining the state's monopoly on the legitimate use of force within their territory. The author does not explore the topic of to what degree Mieszko's Poland was purely a tribute-gathering militocracy organized around warlords or something more akin to a mafia-state. There is very little evidence from the archaeology (or indeed written sources from the late 10th century) on any kind of more sophisticated bureaucratic structure to administer governance and maintain administrative records or a anything like a state-imposed developed legal system codifying governance. These things certainly existed in the later phases of the Early Medieval Polish state and were important to its cohesion and functioning, and a detailed discussion of any evidence on when and how they started would have been welcome, though may have been beyond the scope of this book.

There is also a certain amount of ambiguity about the religious aspects of the processes operating at the dawn of the Polish state. In general, religious beliefs, practices and institutions often play a significant role in ethnogenesis, be a key element of identity and a source of cultural and social cohesion and development. Adopting the same Christianity that was practiced by the state's immediate neighbours (Moravia, Czechs, Ottonians etc.) may also have been seen as having a political and protective function. It is not known to what degree coercion was used to convert Mieszko's subjects to Christianity (if at all, it really does seem to have been an elite phenomenon). Traces of destruction of the pre-tribal cult centres often cannot be accurately dated and could have been done in later periods.

Most previous accounts of the beginning of the Polish state have tended to treat as a whole block a period that ends perhaps in the eleventh, or even twelfth centuries. This makes the task easier because it increases the amount of evidence from written sources, on the elite and ecclesiastical affairs, a charter or two and the beginnings of the Medieval chronicles. The author however has deliberately chosen to focus on the narrow period equivalent to the time of the operation of Mieszko. This then removes the temptation to speculatively/hopefully extrapolate backwards information that applies to a later period to fill in gaps, and isolates what we know from that which is merely assumed. This makes this an important and much-needed book that sets the stage for more detailed discussions and hypothesis-testing.

Information for Contributors

Manuscripts are accepted for review with the understanding that the same work has not been published, that it is not under consideration for publication elsewhere, and that its submission has been approved by all of the authors and by the institution where the work was carried out. Articles and any other material published in ***Sprawozdania Archeologiczne*** represent the opinions of the author(s) and should not be construed to reflect the opinions of the Editor and the Publisher.

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