# EXPLORING PREHISTORIC POLAND

# EXPLORING PREHISTORIC POLAND
## FROM PALAEOLITHIC TO NEOLITHIC

EDITED BY:
IWONA SOBKOWIAK-TABAKA, ALDONA KURZAWSKA



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**Distinguished Colleagues, Dear Guests,**



It is with great pleasure and honour that I welcome you to the XXI World Congress of the International Union of Prehistoric and Protohistoric Sciences (UISPP), held from August 31st to September 4th, 2026, at the Faculty of Archaeology at Adam Mickiewicz University in Poznań.

This year's Congress is of particular significance to us. Since the establishment of the Union more than ninety years ago, no World Congress has been held in Poland. The decision of the UISPP leadership to entrust the organisation of this prestigious gathering to Adam Mickiewicz University in Poznań and to the Polish archaeological community constitutes a great distinction and a mark of confidence. We accept this responsibility with profound gratitude and strong commitment.

Poznań – the first historical capital of Poland – is a city distinguished by its rich cultural and scholarly heritage. It was here that archaeology evolved from pioneering investigations conducted by dedicated enthusiasts into a modern academic discipline. A particularly prominent figure in this development was Professor Józef Kostrzewski, founder of the Poznań School of Archaeology and archaeological studies at the University of Poznań in 1919. His scholarly achievements and intellectual vision continue to inspire successive generations of researchers, and the Faculty of Archaeology at Adam Mickiewicz University remains today one of the leading centres of archaeological research and education in Poland.

I trust that this Congress will provide an exceptional forum for the exchange of knowledge and experience among scholars from across the world. It also offers an opportunity to reflect on the challenges facing contemporary archaeology, including the protection of cultural heritage, legal dimensions of archaeological research, and the role of archaeology in fostering public awareness and engagement with the past.

We are particularly pleased to welcome early-career researchers, doctoral candidates, and students, who will have the opportunity to participate in international scholarly dialogue and engage with best practices in interdisciplinary collaboration.

On the occasion of the XXI World Congress of the UISPP, we are pleased to present a unique scholarly publication: the two-volume work

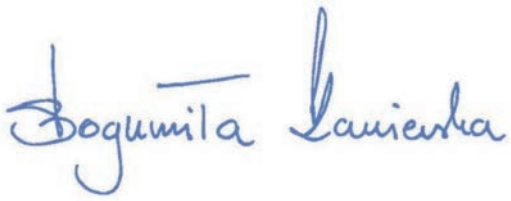
*Exploring Prehistoric Poland*, prepared specifically for this event by several dozen researchers representing the leading Polish academic and research institutions. Volume I – *Exploring Prehistoric Poland from Palaeolithic to Neolithic*, edited by Iwona Sobkowiak-Tabaka and Aldona Kurzawska, and Volume II – *Exploring Prehistoric Poland from the Early Bronze Age Pastoralists to the Roman Period*, edited by Andrzej Michałowski, Maciej Kaczmarek, and Mateusz Jaeger, provide a contemporary and accessible introduction to the current state of research on the pre- and protohistory of the land comprising modern-day Poland.

The publication combines concise syntheses of successive prehistoric periods with numerous case studies highlighting some of the most significant archaeological sites. Richly illustrated and authored by leading specialists, the two volumes not only offer a comprehensive overview of the latest achievements in prehistoric archaeology but also identify current research directions and emerging perspectives on Poland's earliest past. I am confident that this publication will serve as a valuable source of knowledge for Congress participants and for all those interested in the archaeology of Central Europe.

I wish you an inspiring and productive Congress, stimulating discussions, fruitful scholarly exchanges, and many new academic connections. May your stay in Poznań be both enjoyable and memorable. Let the XXI World Congress of the UISPP serve as a celebration of knowledge, international collaboration, and our shared passion for exploring and understanding the human past.

It is my great pleasure to welcome you to Adam Mickiewicz University in Poznań.

Bogumiła Kaniewska
/Rector of Adam Mickiewicz University/



# PREFACE

It is our pleasure to present this two-volume publication prepared for the XXI World Congress of the International Union of Prehistoric and Protohistoric Sciences (UISPP), to be held in 2026 in Poznań, Poland, with the theme *Archaeology in Motion: Past Lessons, Future Responsibilities*. The Congress will bring together scholars from across the globe, creating a unique forum for the exchange of ideas, methods, and research results, while also encouraging reflection on archaeology's role in contemporary society and its responsibilities toward future generations.

The publication you hold in your hands was conceived as a contribution to this international dialogue. Its primary objective is to introduce readers from different countries and continents to the prehistoric past of the lands that constitute present-day Poland, whose archaeological record reflects a remarkable diversity of cultural traditions, environmental settings, and historical trajectories. At the same time, we highlight a selection of archaeological sites that can be regarded as representative landmarks in the study of the prehistory of this part of Europe.

It should be emphasised that the present work is not intended as a comprehensive or exhaustive account of prehistoric archaeology in Poland. Such an undertaking would require a far more extensive treatment than could be accommodated within the framework of this publication. Instead, our aim is to provide an informed and accessible overview of key periods, phenomena, and discoveries, offering international readers a broad outline of current knowledge and directing their attention to sites that have played a particularly important role in archaeological research. The chapters collected here, therefore, represent selected perspectives and examples rather than an all-encompassing synthesis.

The publication is divided into two complementary volumes.

Volume I, *Exploring Prehistoric Poland from Palaeolithic to Neolithic*, opens with a series of introductory chapters devoted to the history of archaeology in Poland, Polish archaeological research conducted worldwide, contemporary methodological reflections, environmental transformations during the Pleistocene and Early Holocene, and the distribution and significance of silica lithic resources. These contributions provide the broader historical, intellectual, and environmental context necessary for understanding prehistoric developments in the region.

The remainder of the first volume is organised chronologically and presents the Palaeolithic, Mesolithic, and Neolithic periods. Each section combines a synthetic overview of the current state of research with a series of detailed case studies devoted to selected archaeological sites. The sites discussed – including caves, open-air settlements, cemeteries, ritual landscapes, and other key localities – illustrate the diversity of human adaptation, technological innovation, social organisation, and cultural change from the earliest traces of human presence through the emergence of farming communities.

Volume II, *Exploring Prehistoric Poland: from Early Bronze Age Pastoralists to the Roman Period*, continues this narrative by examining the profound transformations that shaped societies from the Early Bronze Age through the Roman Iron Age. The volume begins with chapters devoted to the Early and Middle Bronze Age, emphasising the interplay between tradition and innovation, the development of metallurgy, and the emergence of increasingly complex social structures. Subsequent sections explore the Late Bronze Age and the beginnings of the Iron Age, followed by broader discussions of

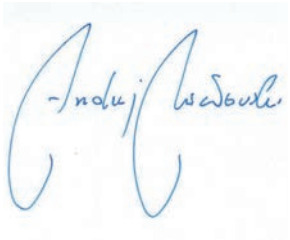
iron production and the cultural landscape of the Roman Iron Age in the Polish territories.

As in the first volume, synthesis chapters are complemented by numerous case studies presenting some of the most significant archaeological sites in the region. These include settlements, fortified sites, cemeteries, ritual deposits, metallurgical centres, and other locations that have fundamentally contributed to our understanding of prehistoric communities and their interactions within wider European networks. Together, they demonstrate the richness and diversity of archaeological heritage preserved within the lands of present-day Poland.

By bringing together contributions from specialists representing numerous Polish academic institutions and research centres, this publication reflects both the achievements of Polish archaeology and the vitality of contemporary research. We hope that it will serve as a useful introduction for participants of the XXI UISPP World Congress and for all readers interested in the prehistoric past of Central Europe.

Above all, we hope that the overview presented in these volumes will encourage further exploration of the archaeological record of Poland, stimulate new international collaborations, and contribute to the ongoing discussion about how the study of the past can inform our responsibilities toward the future.

Andrzej Michałowski
/Chairman of the Congress/



Iwona Sobkowiak-Tabaka
/General Secretary
of the Organising Committee/



# HISTORY OF ARCHAEOLOGY IN POLAND

Marzena Woźny

The beginnings of interest in the distant past, unknown from written sources, date back to medieval times in Poland. In 1416, cremation graves from the Bronze Age or the early Iron Age were discovered in Nochów in Greater Poland. They were considered to be natural formations. The information about clay pots emerging from the ground was reported at the time by the chronicler Jan Długosz, and was repeated by many other scholars in Poland and Europe. This issue has been of interest to researchers for centuries, especially as further discoveries were reported in various places. Similar problems with identification and proper understanding also arose in the case of other archaeological finds. For example, it was believed that prehistoric tools or weapons, and even belemnites, found in the ground were created at the sites of lightning strikes (Kostrzewski 1949a, 2–5; Abramowicz 1983). At the same time, activities resembling archaeological excavations were already being undertaken in the Middle Ages. These were searches for the relics of saints, which involved opening graves. For example, in 1390, at the behest of Prince Ludwik I Brzeski, such a search was conducted at the stronghold in Ryczyn in Silesia (Abramowicz 1983, 24). At the end of the Middle Ages, contact with the customs of pagan neighbours – Lithuanians, Samogitians, Prussians – certainly influenced the change in perceptions of the pre-Christian past.

During the Renaissance in Poland, numismatics developed. Coins, including ancient ones, were discovered and collections began to be formed. In the 16th century, attempts were made to scientifically explain how Roman coins reached what would later become Polish territory. During this period too, numerous discoveries of cremation cemeteries were also recorded. At that time, people were becoming increasingly aware of what they actually were. Scholars interested in prehistory appeared, no longer only interested in coin finds, but also in the distribution of burial mounds, cemeteries and fortified settlements (Abramowicz 1983; 1992).

The eighteenth century brought events that caused an increase in interest in antiquity. The discovery of Herculaneum, followed by excavations there and in Pompeii, visits to Paestum and other places associated with antiquity, led to a fashion for collecting ancient artefacts. Ancient sculptures and ceramics were collected, as well as coins and gems. The fascination with antiquity did not bypass Poland. The most valuable collection of ancient artefacts in the second half of the 18th century belonged to King Stanisław August Poniatowski (1732–1798). Another well-known collector of gems was the king's nephew, Stanisław Poniatowski (1754–1833). Not only original antique gems were collected, but also their casts, which were treated as sources for learning about ancient history. Antique ceramics were also very popular (see, for example, Mikocki 1990; Mikocka-Rachubowa 2014).

At the end of the 18th century, a different view of antiquities began to emerge, heralding a new era. For Poland, this was a time of tragic events – at the end of the 18th century, as a result of three partitions, its territory was entirely annexed by Russia, Austria and Prussia. The collapse of the state contributed to a rise in patriotism, which in turn drew attention to the pre-Christian history of the Slavs. Researchers such as Jan Potocki (1761–1815), Hugo Kołłątaj (1750–1812), Stanisław Staszic (1755–1826) and Julian Ursyn Niemcewicz (1758–1841) – turned their attention with increasing interest to learning about Proto-Slavic customs and religion, as well as ancient art. Considered the first Polish archaeologist, writer and traveller Jan Potocki (see Abramowicz 1970, 12–17; Lech 2008) was interested in both ancient and Egyptian

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ARCHAEOLOGICAL MUSEUM IN KRAKÓW

antiquity, as well as the earliest history of Central and Eastern Europe. During his numerous travels (not only in Europe, but also in Egypt, Turkey, the Caucasus and the steppes of Astrakhan), he paid attention to historical monuments. He was the author of maps on which he included information about antiquity, as well as works on chronology. He recorded his discoveries and thoughts on Slavic culture in, among other works, the five volumes of *Suite des Recherches sur la Sarmatie* (Potocki 1789–1792). The publication in Warsaw at the beginning of the 19th century of Johann Joachim Winckelmann's (1717–1768) *Geschichte der Kunst des Alterthums* (1764), creatively translated by politician and collector Stanisław Kostka Potocki (1755–1821), contributed to the revival of interest in antiquity among Polish researchers. In Polish, the work was titled *O sztuce u dawnych czyli Winkelman polski* [On the Art of the Ancients, or Polish Winkelmann] (1815). Ethnographic observations also influenced the development of archaeology. Julian Ursyn Niemcewicz, like many travellers and scholars of his era, first encountered antiquities while travelling through Europe. However, he began to reflect more deeply on the customs and life of prehistoric peoples during his stay in the United States of America, where he travelled with Tadeusz Kościuszko (1746–1817) in 1796. He was prompted to reflect on what life might have been like in prehistoric times by the similarities he saw between the way of life of the native Americans and the peoples described by Tacitus in *Germania* (Abramowicz 1987, 250–261).

At the turn of the 18th and 19th centuries, the first institutions were established that could support the developing interest in antiquity and, later, archaeology. At the end of the 18th century, Tadeusz Czacki (1765–1813), an educational and political activist and later co-founder of the Warsaw Society of Friends of Science, planned (unsuccessfully) to establish a chair of antiquities at the secondary school he founded in Krzemieniec in Volhynia. He kept antiquties at this Lyceum, including the numismatic collections of King Stanisław August (Abramowicz 1987, 202–203; Danowska 2006, 279–325). In 1800, the Warsaw Society of Friends of Science was established in the Russian partition, which, among other scientific tasks, also undertook research into prehistory. Members of the Society drew attention to the need for research into the religion and art of the Slavs (see, for example, Surowiecki 1808). The Płock Scientific Society was also active from 1820. On its initiative, excavations were carried out in Płock Cathedral in search of the graves of the Piast dynasty rulers Władysław Herman and BolesławKrzywousty (Abramowicz 1967, 38–40; Szczerba 2012, 97–98). Both societies collected artefacts, including archaeological ones. They also took care to record information about the circumstances of their discovery. And although during this period, finds from local prehistoric cultures aroused less interest than ancient artefacts, small collections of prehistoric artefacts had been gathered by various institutions and associations in Poland since the beginning of the 19th century. In addition to the aforementioned scientific societies in Warsaw and Płock and the Lyceum in Krzemieniec, they were also in the possession of, among others, the Cabinet of Antiquities at the University of Warsaw and the Society of Collectors of National Antiquities in Szamotuły in Greater Poland. Initially, in the first half of the 19th century, however, they constituted a rather random part of the collections, consisting mainly of historical artefacts, works of art, various souvenirs and natural specimens (Abramowicz 1967, 31–38; Szczerba 2017a, 177–179; Woźny 2024a, 34).

Scientific literature began to feature dissertations that took archaeological sources into account. A new way of looking at archaeology can be seen in the work of historian and political activist Joachim Lelewel (1786–1861), who, in his work entitled *Historyka* (1815), listed monuments of material culture among the sources of interest to historians. Lelewel dealt with archaeology in a theoretical way, but while working with the Warsaw Society of Friends of Science, he came into contact with prehistoric objects (Lelewel 1830). Later, while in exile, he was in contact with prominent European archaeologists such as Jacques Boucher de Perthes (1788–1868) (Abramowicz 1991, 29).

One of the pioneers of Polish archaeology was Zoryan Dołęga Chodakowski (real name Adam Czarnocki; 1784–1825). He wanted to define the boundaries of the Slavic world and, to this end, he studied the location of hillforts, including during his trip to Russia in 1820–1821. He drew up a map of hillforts, conducted excavations and documented his research. He was also the author of the treatise *O Sławiańszczyźnie przed chrześcijaństwem* [About Slavic culture before Christianity] (Chodakowski 1818). It had a great influence on those interested

in the earliest history of the Polish lands (Blombergowa 1993, 11–37; Szczerba 2012, 93–94).

Politics had a huge impact on the development of science in Poland in the 19th century. Periods of development were interrupted by historical catastrophes. As a result of successive armed uprisings aimed at regaining Poland's independence, severe repressions followed, which also affected science. After the fall of the November Uprising (1830–1831), the Russian authorities dissolved the Warsaw Society of Friends of Science, the University of Warsaw, the Płock Scientific Society and the Lyceum in Krzemieniec. This was a huge blow to the development of archaeology. Nevertheless, interest in antiquity in the territories incorporated into the Russian Empire, especially in the Lithuanian-Ruthenian lands of the former Polish-Lithuanian Commonwealth, did not disappear. The partitioning authorities did not oppose research into the history of the Slavs in the pre-state period. In Lithuanian and Belarusian lands, research, including excavations, was conducted by the Polish historian and researcher of Lithuanian history, Teodor Narbutt (1784–1864). He was the author of the treatise *Dzieje starożytne narodu litewskiego* [Ancient History of the Lithuanian Nation], in which he referred, among other things, to archaeological sources (Narbutt 1835–1841). The Polish-Lithuanian archaeologist (born in present-day Belarus) Eustachy Tyszkiewicz (1814–1873), author of the work *Rzut oka na źrzódła Archeologii krajowej...* [*A Glance at the Sources of National Archaeology...*], published in 1842, became famous for his significant scientific and organisational achievements (Tyszkiewicz 1842). He researched burial mounds and published the results of his work. In 1843, he travelled to Scandinavia, where, among other things, he visited the collections of the Royal Society of Northern Antiquaries in Copenhagen [Det Kongelige Nordiske Oldskriftselskab], familiarised himself with the system of three epochs and became a member of this association (Tyszkiewicz 1846, 5–17). In later years, he was the founder of the Vilnius Archaeological Commission and the Vilnius Museum of Antiquities (more on this later). His older brother Konstanty also made a significant contribution to archaeology (Szczerba 2017b, 184–194). Other researchers interested in learning about prehistory were also active in the areas discussed, such as Adam Plater (1790–1862) and the famous writer Józef IgnacyKraszewski (1812–1887), publisher of the *Athenaeum* yearbook, which appeared in Vilnius between 1841 and 1851.

In the 1840s, an inventory of monuments was carried out in the so-called Kingdom of Poland (a state united with Russia by a personal union, created in 1815 at the Congress of Vienna from parts of the former Duchy of Warsaw). On the orders of the Commission for Internal and Spiritual Affairs, the task of cataloguing historical objects was entrusted to Kazimierz Stronczyński (1809–1896). Stronczyński was to collect information about architectural and artistic monuments. He set to work equipped with one of the earliest instructions for inventorying monuments in Europe. The inventory, originally planned to take six months, took 10 years (1844–1853). Stronczyński was not obliged to register prehistoric objects and sites, but he included them in his list (Walicki 1931; Szczerba 2012, 101–104).

In the 1830s and 1840s, interest in antiquity also developed in Greater Poland, in the Prussian partition. The magazine *Przyjaciel Ludu* published articles devoted to archaeology. Over time, authors from outside Greater Poland also began to publish articles there (see Abramowicz 1991, 16–17; Linetty 2020, 105–111). In Greater Poland, between 1841 and 1846, the Society of Collectors of National Antiquities operated in Szamotuły, headed by lawyer Jędrzej Moraczewski (1802–1855). The Society's task was to collect information on monuments, record and study hillforts and burial mounds. It was modelled on the work of the aforementioned Zoryan Dołęga-Chodakowski. Archaeology was also pursued by members of the Literary Department of the Casino in Gostyń, established in 1838 and headed by Józef Morawski (1872–1853). They were also involved in, among other things, cataloguing hillforts and mounds. Activities related to archaeology were also carried out outside these societies. In 1842, in Gniezno, politician and patron of the arts Edward Raczyński (1876–1845) conducted excavations aimed at discovering pagan deities allegedly sunk in the lake near St. George's Church. During these investigations, wooden structures were found. With the consent of the Gniezno chapter, Edward Raczyński also examined the interior of the alleged tomb of Dąbrówka (c. 930–977), a Czech princess and wife of Mieszko I (died in 992), the first ruler of Poland. This researcher also conducted other fieldwork (Abramowicz 1991, 18–22; Kaczmarek 1996, 33; Linetty 2020, 123–134). The 1846 independence

uprising against the Prussian state in Greater Poland, followed by arrests and repressions, put an end to the conditions conducive to the development of Polish science in Greater Poland.

In Galicia (the southern lands of the former Polish-Lithuanian Commonwealth annexed by Austria at the end of the 18th century), interest in antiquity developed most slowly in the first half of the 19th century compared to the other partitions. However, works on antiquity and archaeology were still published here. In 1835, Chodakowski's dissertation on Slavic culture (1835) was published in Krakow. In Lviv (formerly Polish Lwów and Lemberg), historian Żegota Pauli (1814–1895) published a dissertation entitled *Starożytności Galicyjskie* [Galician Antiquities] (1840). A significant change in favour of archaeology did not occur here until around the middle of the 19th century (Abramowicz 1991, 22–24; Lech 2006, 11–13; Bulyk 2014, 46–48; Woźny 2025, 21–35).

The mid-19th century saw a real boom in Polish archaeology. Within a few years, institutions were established that accumulated collections, conducted archaeological research, organised exhibitions and published works devoted to prehistory. In 1850, the Committee (later the Department) of Archaeology was established, together with the Museum of Antiquities at the Krakow Scientific Society (Nosek 1967, 19; Woźny 2025, 37–69). In 1855, thanks to the efforts of the aforementioned Eustachy Tyszkiewicz, the Archaeological Commission was established in Vilnius, and a year later, the Museum of Antiquities was established under its auspices (Abramowicz 1991, 35–37; Blombergowa 1993, 39–42; Ilgiewicz 2005, 105–146). In 1857, the Society of Friends of Science was established in Poznań, alongside which the Museum of Polish and Slavic Antiquities was created (Abramowicz 1991, 38–39; Kaczmarek 1996, 56–60; Linetty 2020, 222–223). A little later, in 1875, the Toruń Scientific Society began its activity, and a museum was established in 1876. In this museum, the archaeological department was a separate, rapidly developing part (Abramowicz 1991, 72; Lech 2002; Wawrzykowska 2002, 38–41; Małecka-Kukawka and Wawrzykowska 2004, 110–112). Two Polish museums established on private initiative in Lviv were also public. These were the Lubomirski Princes Museum at the Ossoliński Institute (opened to the public in 1870) and the Dzieduszycki Natural History Museum (opened in 1880). In both museums, archaeological artefacts also constituted only a part of the collections – mainly natural history in the case of the Dzieduszycki Museum (Dzieduszycki 1895) and historical artefacts and works of art in the case of the Lubomirski Museum (Zawadzki 1874; Catalogue 1877; Bulyk 2014, 49–59; Gruk ed. 2023).

There were no favourable conditions for establishing a museum in Warsaw in this period. The former collections of the university's Archaeological Cabinet were stored in the Government Library (later the Main Library). Archaeological collections were also gathered by the Society for the Encouragement of Fine Arts, established in 1860, and the Museum of Industry and Agriculture, established in 1875. A public archaeological museum was not established in Warsaw until the 20th century (Piotrowska 2003, 13–15; Szczerba 2012, 153–159; Woźny 2024a, 34–36). At the same time, it was in Warsaw in 1856 that the famous Exhibition of Antiquities and Art Objects was organised in the palace of August Potocki (Fig. 1). Following its example, a similar exhibition was also organised in Krakow in 1858/9. Scientific societies issued proclamations appealing to the public to donate archaeological and historical artefacts. The two most famous were issued by the Krakow Scientific Society (Odezwa 1851; 1857). Thanks to this, a year after its establishment, the Museum of the Krakow Scientific Society received its most famous artefact – a statue of the pagan deity Światowid, recovered from the Zbrucz River (in eastern Galicia, now western Ukraine), which later became its symbol (Woźny 2025, 40–43, 93–95).

Prehistoric archaeology emerged in the early second half of the 19th century. It differed significantly from Romantic archaeology. It was based on three groundbreaking discoveries: the three-era system of Danish scholar Christian Jürgensen Thomsen (1788–1865), Darwin's theory of evolution, and the recognition of a longer human past than that described in the Bible. These findings enabled the further development of prehistoric archaeology, among other things through the use of the typological method to systematise finds – arranging artefacts in chronological and developmental sequences. From the very beginning, the emergence of prehistoric archaeology was closely linked to advances in the natural sciences – geology and anthropology.

The development of prehistoric archaeology in the second half of the 19th century was




FIGURE 1. Karol Beyer, *Album de l'exposition des objets d'art et d'antiquité*, Warszawa 1856

accompanied by a real revolution in the way people thought about the past. This science was shaped in opposition to the biblical view of history, which was still prevalent in science at that time. First among researchers, and later in society, the thesis began to slowly gain ground that the world was not, as literally stated in the Bible, only six thousand years old. In France and England, the first proper interpretations of archaeological discoveries and publications indicating a much longer existence of humanity and the world than presented in the Bible were initially met with great resistance and violent protests. It was not until 1859, after discussions in English scientific societies, that scholars accepted the claim of French researcher Jacques Boucher de Perthes that humans had lived in much earlier times than previously thought. The groundbreaking works of Charles Darwin published at that time, especially his treatise *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (Darwin 1859), were also of great importance here. Evolutionism sought to look at the history of humanity in relation to social and natural issues. Representatives of the natural sciences who shared this approach began to make a significant contribution to the development of archaeology from around the 1860s. Using methods applied in the disciplines they were mainly involved in, they searched for the oldest traces of humans at sites unrelated to the history

known from written sources. Archaeology – also in Poland – thus ceased to be a general reflection on the past and began to become a field based on carefully conducted excavations and scientific analysis of discovered artefacts (Lech 1992; Trigger 2006, 121–176; Díaz-Andreu 2007, 338–397; Lech, Werra 2018; Manikowska et al. 2023, 60–64).

The ideological debate concerning prehistory and the biblical view of history also swept across Polish lands. It was provoked by the publication of a book by political and social activist Karol Libelt (1807–1875; Linetty 2015) on archaeological discoveries from the mid-1860s on the coast of Lake Czeszewskie in Czeszewo (Wągrowiec district) in Greater Poland. Wooden structures, probably from the Bronze Age, were discovered there (cf. Linetty and Linetty 2016). In Poland, the debate on evolution, Darwin's theory and the new chronology of history, although lively and emotional, took place on a smaller scale than in Western Europe (Abramowicz 1991, 53–57; Lech 1992; Linetty 2020, 174–184). At that time, Poles were overwhelmed by the struggle to preserve their national identity and regain independence.

International anthropological and archaeological congresses played a major role in the development of prehistoric archaeology (Kaeser 2008; 2009; Manikowska et al. 2023, 123–127; Sommer 2025). The contacts established during these congresses, the exchange of ideas between participants and the presentation of new discoveries cannot be overestimated. Polish researchers also took part in the congresses, officially representing Russia, Prussia and Austria-Hungary. They gave presentations, among which those by Jan Nepomucen Sadowski (1814–1897) on trade routes in prehistory (Sadowski 1877) as well as Jan Zawisza (1822–1887) on cave research in the Kraków-Częstochowa Upland and Aleksander Przezdziecki (1814–1871), who presented archaeological discoveries in Polish lands (Zawisza 1873; 1877; Przezdziecki 1873; 1875). Several congresses also discussed a project developed by the Krakow Scientific Society for international symbols to be used on maps to indicate archaeological sites and monuments, including their chronology (Cartes 1873; Woźny 2018b). The 1876 congress in Budapest was particularly important for researchers from Central Europe, including Poland. It mainly dealt with issues related to the prehistory of this part of the continent. Fourteen Poles took part in the congress. The congress was accompanied by a large exhibition, at which archaeological finds from Hungary were displayed, as well as, separately, those from other countries. Polish archaeologists prepared an exhibition presenting finds from the area between the Baltic Sea and the Carpathians (Congrès 1877). They also took part in all-Russian archaeological congresses organised by the Moscow Archaeological Society in the Russian Empire (Szczerba 2013; see Blombergowa 1988).

Numerous archaeological studies were conducted in the 19th century. Some of them were sponsored by scientific societies. For example, in Poznań, members of the Commission, then the Section, and finally the Archaeological Department of the Poznań Society of Friends of Science conducted a series of excavations in Greater Poland (Abramowicz 1967, 117–120; Kaczmarek 1996, 56–58; Linetty 2020, 197–222). On behalf of the Toruń Scientific Society and in order to enrich its collections, archaeological research in Pomerania was conducted by one of the most important Polish archaeologists of the 19th century, geologist and archaeologist Gotfryd Ossowski (1835–1897). He later published the results of his work in a series published in Krakow entitled *Zabytki Przedhistoryczne Ziem Polskich, Seria I, Prusy Królewskie* (Ossowski 1879–1888; Fig. 2). Ossowski was also the author of an archaeological map of West Prussia (1880; 1881). At the end of the 1870s, the researcher came to Krakow and began working at the Academy of Arts and Sciences, the most important Polish scientific institution at the time. On behalf of this institution, he explored caves and conducted research in eastern Galicia (now western Ukraine). In the 1880s, Ossowski conducted excavations of burial mounds in Ryżanówka (Ossowski 1888; see Lech 2002, 19–26; Wawrzykowska 2002, 38–40; Chochorowski 2016a; Woźny 2025, 197–214). Under the auspices of the Academy of Arts and Sciences in Krakow, other archaeologists also conducted large-scale research projects. Apart from Ossowski, these included Adam Honory Kirkor (1818?–1886), Teodor Nieczuja Ziemięcki (1845–1916) and Włodzimierz Demetrykiewicz (1859–1937) went on expeditions aimed at archaeological exploration of the Dnistr and Vistula river basins (Nosek 1967, 45–63; Woźny 2025, 203–211, 290–310). Some archaeologists also conducted research on their own initiative, such as Zygmunt Gloger (1845–1910), an archaeologist and

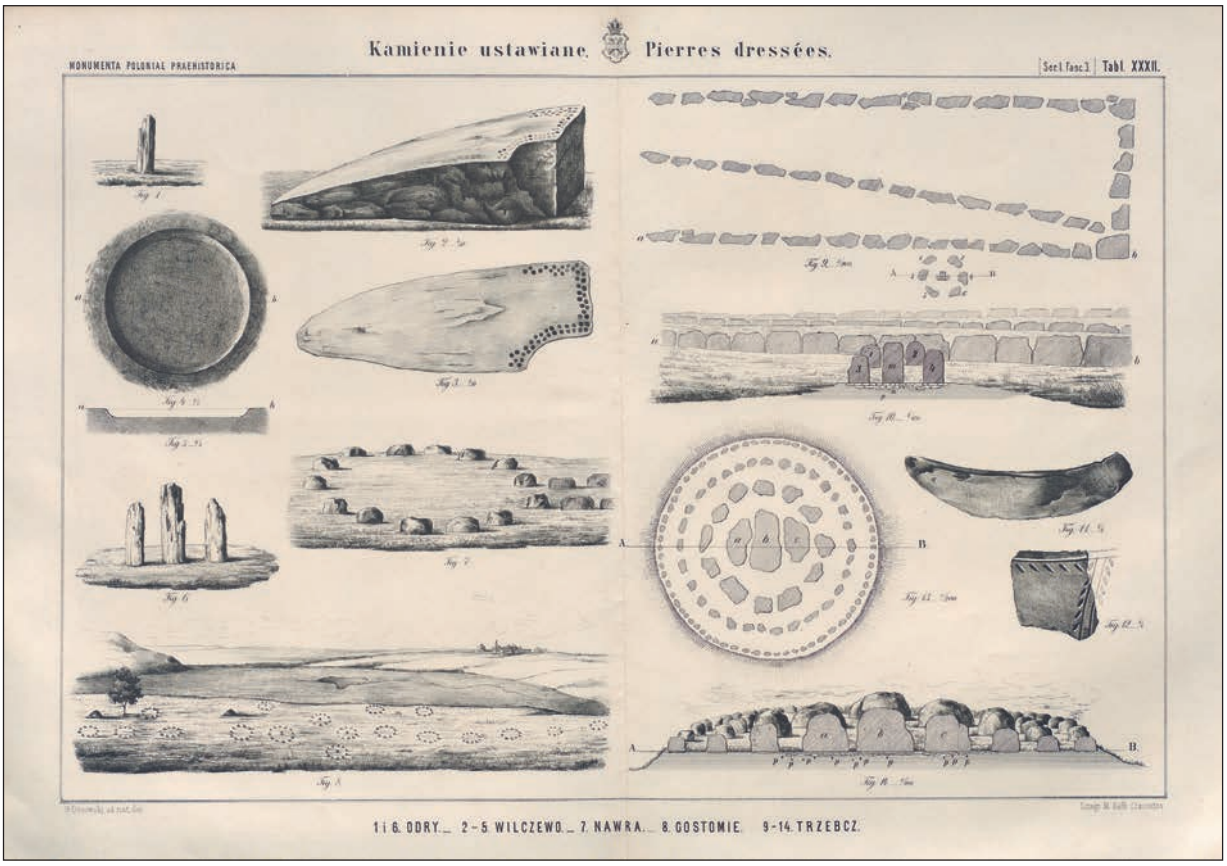



FIGURE 2. Godfryd Ossowski, plate from the volume *Zabytki Przedhistoryczne Ziem Polskich [Prehistoric Monuments of the Polish Lands], Series I, Royal Prussia*

ethnographer who, during his expeditions mainly to the eastern lands of the former Polish-Lithuanian Commonwealth, collected a huge collection of archaeological finds, mainly flint artefacts (Gloger 1903; Blombergowa 2016). One of the most important Polish archaeologists of the second half of the 19th century, Jan Zawisza (1822–1886), was also an independent researcher. He conducted research in the Ojców caves in the Kraków-Częstochowa Upland (Fig. 3). As already mentioned, he presented his findings at international anthropological and archaeological congresses. Operating in Warsaw, which was deprived of scientific institutions after the January Uprising (1863–1864), he became the creator and publisher of *Wiadomości Archeologiczne*, the first Polish scientific journal devoted entirely to archaeology.

In the second half of the 19th century, archaeology became a university discipline. The first Polish chair of this discipline was established at the Jagiellonian University in Krakow in 1866. It was headed by Józef Łepkowski. He had been lecturing on archaeology for several years prior to that, after obtaining his habilitation in 1863 (Woźny 2024b). In his lectures, he presented issues related not only to prehistory, but also to art history, protection of historical monuments and auxiliary sciences of history. In 1867, Łepkowski established the Archaeological Cabinet at the department, which collected archaeological artefacts. It officially operated until Łepkowski's death in 1894, but the Cabinet's collections remain the property of the Jagiellonian University to this day (Gałczyńska 1964; Woźny, Dzięgielewski 2018). The Jagiellonian University is also associated with the beginnings of Polish classical archaeology. In 1893, Piotr Łada Bieńkowski (1865–1925) obtained his habilitation in Krakow. After four years of lecturing, a chair of classical archaeology was created for him at the University in 1897. This event is considered to be

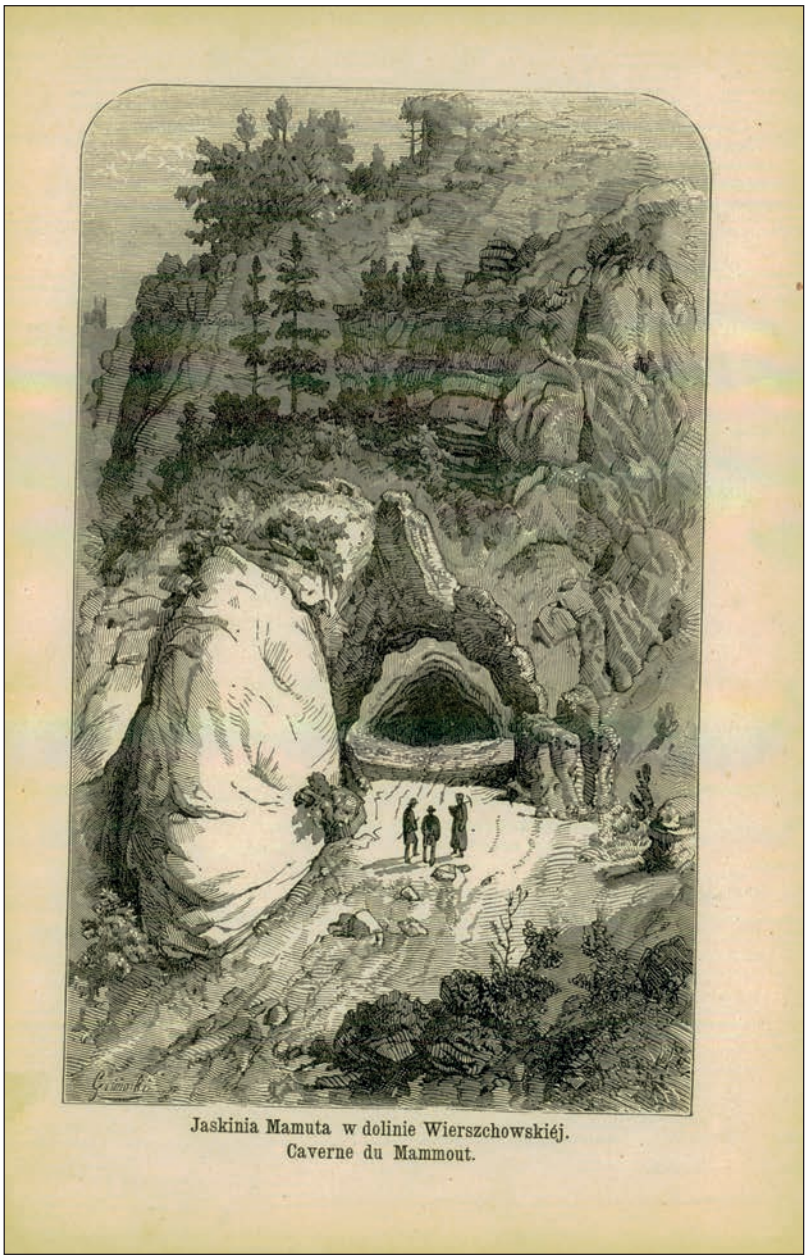



FIGURE 3. Jan Zawisza, entrance to the Mamutowa Cave in the Kraków-Częstochowa Upland. Engraving from the dissertation *Poszukiwania archeologiczne w Polsce (Archaeological Research in Poland)*, Warszawa 1874

the beginning of Mediterranean archaeology in Poland (Śliwa 1998; 2000; Woźny 2025, 267–281).

At the turn of the 19th and 20th centuries, a new generation of researchers entered the scene. They were already fully representative of prehistoric archaeology, based on the achievements of natural sciences. During this period, the most important Polish prehistorian was Włodzimierz Demetrykiewicz (1859–1937; Fig. 4). He was first a conservator of sites and monuments, co-founder of the Group of Conservators of Western Galicia [Grono Konserwatorów Galicji Zachodniej], curator of the Archaeological Museum of the Academy of Arts and Sciences in Krakow, and later also a professor of prehistoric archaeology at the Jagiellonian University. He conducted numerous excavations at



FIGURE 4. Włodzimierz Demetrykiewicz at the Archaeological Museum of the Polish Academy of Arts and Sciences. 1930s. From the collection of the National Digital Archives, ref. no. SM0_1-N-702-6

sites from various periods and was the author of significant scientific publications. He was the first in Poland to use the term „archaeological culture" (Woźny 2009; 2018a). Before the Great War, Demetrykiewicz's lectures were attended by future eminent prehistorians such as Józef Kostrzewski (1885–1969), who became a professor at the University in Poznań in 1920, Roman Jakimowicz (1889–1951), curator of the State Archaeological Museum in Warsaw, Leon Kozłowski (1892–1944), a professor at the University in Lviv, Józef Żurowski (1892–1936), later a successor of Demetrykiewicz at the Jagiellonian University and Włodzimierz Antoniewicz (1893–1973), a professor at the University in Warsaw (Gedl 1971, 191; Sklenář 1983, 137; Woźny 2018a, 213–218). In Warsaw, Erazm Majewski (1858–1922), founder of the archaeological museum in Warsaw, publisher and editor of the archaeological magazine *Światowit,* was active. He was an entrepreneur and, in the field of science, not only an archaeologist but also a naturalist. Majewski was a researcher of the Stone Age and studied the typology of flint tools. He also gathered students around him. They were young researchers who later became prominent Polish archaeologists – the aforementioned Leon Kozłowski, Marian Himner (1887–1916), Stefan Krukowski (1890–1982) and Ludwik Sawicki (1893–1972). They conducted a series of field studies financed mainly by Majewski, primarily at sites on sand dunes in the Vistula river basin (Majewski 1901; 1902; 1904; 1906; see Kozłowski, Lech eds 1996). Karol Hadaczek (1873–1914) worked at the University of Lviv, dealing with both classical archaeology and prehistory. From 1905, he headed the Chair of Classical Archaeology and Prehistory there (Bulyk, Lech 2009). The first Ukrainian archaeologists were also active in Lviv during this period (see Bulyk 2014).

Cultural-historical archaeology and the theories of its creator, the German archaeologist Gustaf Kossinna (1858–1931), had a major influence on archaeology in this part of Europe at the time. Kossinna was the creator of the ethnic interpretation of archaeological finds (Trigger 2006, 235–241). Archaeology began to be used for political purposes – to prove the rights of contemporary states to occupy territories considered to be Proto-Germanic or Proto-Slavic. Kossinna's ethnic views in archaeology were contested by Erazm Majewski, supported by Demetrykiewicz. Karol Hadaczek, on the other hand, held views similar to those of Kossinna on this issue (Twardecka 1977; Lech 1996, 53–57; 2004, 29–30; Leligdowicz 1999, 173–197). In Poznań, in the Prussian sector, at the turn of the 19th and 20th centuries, Polish archaeology developed to a lesser extent than in the Austrian and Russian partitions. German archaeology was much more prominent in these lands at that time (Kaczmarek 1996, 36–82). It was not until 1914 that a change took place, with the return to Poznań from Berlin of the then young Józef Kostrzewski, a student of Gustaf Kossinna. He later became the founder of the Poznań school of archaeology and one of the most important Polish archaeologists of the 20th century, as well as an opponent of Kossinna on the issue of the Germanic past of the Polish lands. However, he used the same approach to prove the Slavic nature of these lands (Lech 1997–1998, 35; Kaczmarek and Prinke 2023).

In 1918, after the First World War, Poland regained its independence (Fig. 5). Despite the very difficult economic and political situation, the restoration of statehood gave hope for an improvement in the situation of science, whose development had previously been limited (for political or financial reasons) by the partitioning powers. Archaeology focused on several key issues. It was a period of organising prehistory as a scientific discipline, museology and archaeological conservation (see, for example, Antoniewicz 1919; Demetrykiewicz 1920; Kostrzewski 1920). After the organisational structures were created, a phase of intensified field research began. Efforts were also made to develop a synthesis of the prehistory of the Polish lands (Stopiak 1984; see Abramowicz 1991, 105).

At that time, the training of new researchers was an extremely important issue. In Krakow, students continued to be taught by two departments – Piotr Bieńkowski's Department of Classical Archaeology and Włodzimierz Demetrykiewicz's Department of Prehistoric Archaeology. Demetrykiewicz was succeeded by Józef Żurowski in 1933–1936, and then by Tadeusz Sulimirski (1898–1983) from 1936. In Lviv, after the death of Karol Hadaczek, the Chair of Classical and Prehistoric Archaeology was divided into two units – the Department of Classical Archaeology (in 1916, it was taken over by Edmund Bulanda [1882–1951]) and the Department of Prehistory together with the Department of Prehistory (in 1921, it was taken over by Leon Kozłowski). In Poznań, at the newly established university, the Department of Prehistory began operating in 1919,

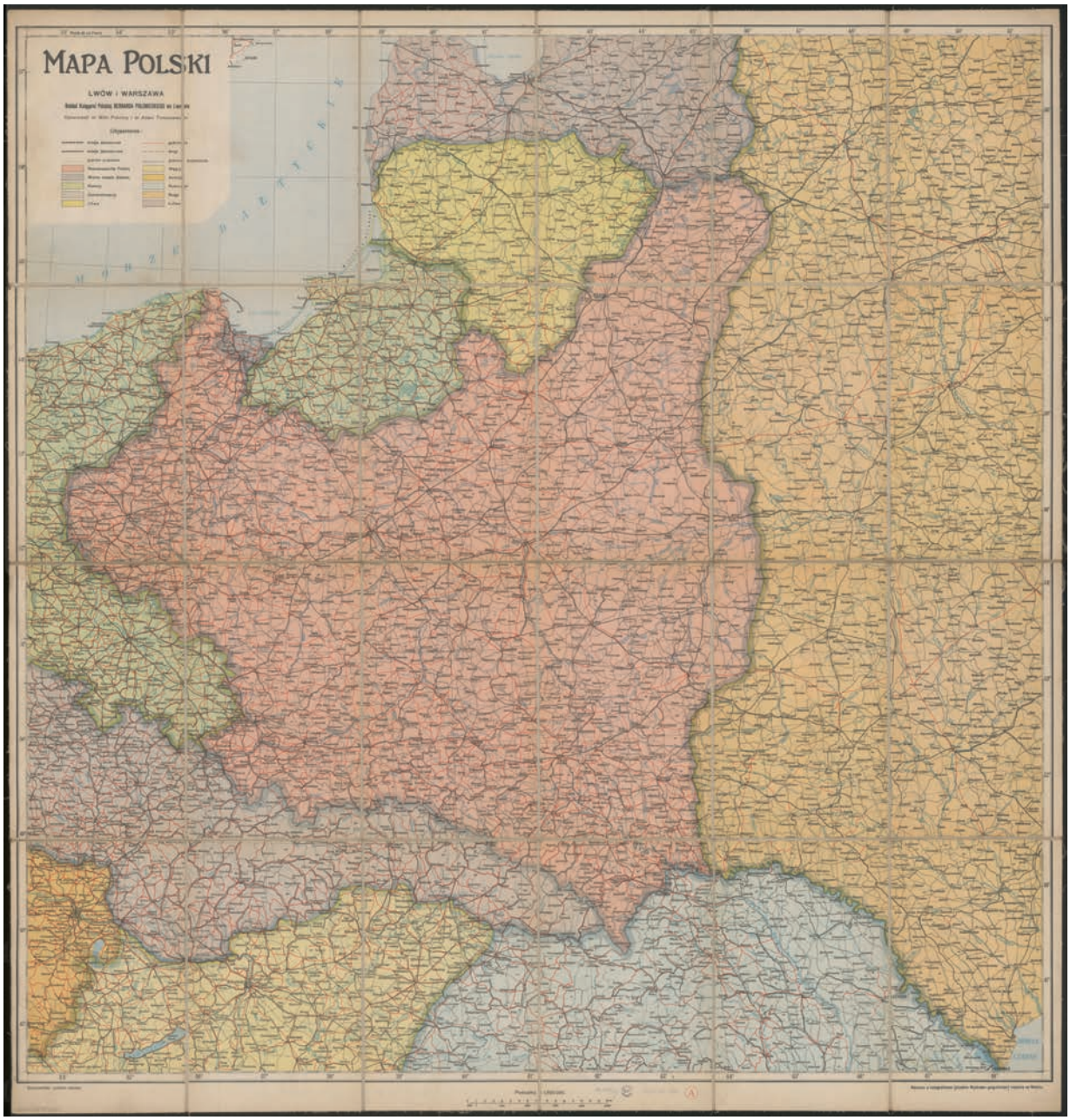



FIGURE 5. Map of Poland from the interwar period. Elaborated by W. Pokorny and A. Tomaszewski. Circa 1923. Lwów-Warszawa. From the collections of the National Library, ref. no. ZZK 52 384 A

headed by Józef Kostrzewski. Poznań also hosted lectures and classes in numismatics conducted by Zygmunt Zakrzewski (1867–1951), as well as lectures in classical archaeology conducted by Mieczysława Ruxer (1891–1957). In Warsaw, too, the university was re-established after independence. The Department of Prehistoric and Early Archaeology, created within its structure, was headed by Erazm Majewski in 1919, and after his death in 1922, by Włodzimierz Antoniewicz (1893–1973). The University of Warsaw also had a Department of Christian Archaeology and Ecclesiastical Art, headed by Swiss priest Paweł Styger (1886–1937). The University of Vilnius did not have a department of

archaeology. Włodzimierz Antoniewicz commuted from Warsaw to Vilnius to give lectures. For some time, the Vilnius chair was looked after by classical philologist and Mediterranean archaeologist Rajmund Gostkowski (1885–1966) (Stolpiak 1984, 44–53; Kozłowski, Kolendo eds 1993; Kozłowski 2009, 45–61; Chochorowski 2015, 14–22; Bilas 2018; Woźny 2018a, 208–221). From the early 1920s, there were discussions about reforming the curriculum at universities in Poland. A new type of study programme gradually took shape between 1926 and 1930. At that time, a partially joint master's programme was introduced for students of anthropology, ethnography and prehistory (Stolpiak 1984, 51–52, 127–129; Abramowicz 1991, 113; Woźny 2018a, 348–353).

A conservation system was organised from scratch. The legal organisation of monument protection in independent Poland was based on a decree of the Austro-Hungarian Regency Council on the protection of monuments of art and culture from 1918, which had been prepared during the First World War. Monument protection became the responsibility of the Ministry of Art and Culture. However, archaeology was treated in a special way – the care of archaeological monuments was left to the Ministry of Religious Affairs and Public Education. In 1920, this Ministry established the State Council of Prehistoric Monument Conservators (Państwowe Grono Konserwatorów Zabytków Przedhistorycznych, abbreviated PGKZP). It consisted of a Presidium, nine honorary conservators, seven district conservators and several correspondents. Its activity, which lasted only a few years (until 1928), was of fundamental importance for archaeological conservation in Poland (Jażdżewski 1966, 86–87; Stolpiak 1984, 53–61; Abramowicz 1991, 114–115; Lech 1997–1998, 38–39; Blombergowa 1999, 125–127; Wysocki 1999, 134–136; Woźny 2018a, 408–410). In 1928, the President of the Republic of Poland issued a decree on the protection of monuments. The State Council of Prehistoric Monument Conservators was dissolved, and the protection of historical monuments, including archaeological ones, was entrusted to provincial conservators, mainly art historians. This proved to be detrimental to the protection of archaeological heritage. The situation was only improved to a certain extent by the granting of powers to protect prehistoric monuments to the State Archaeological Museum in Warsaw, established in 1928 (see Piotrowska 2003). However, the State Archaeological Museum was not able to carry out conservation work on the same scale as the PGKZP had previously done (Blombergowa 1999, 128–131; Wysocki 1999, 139–140, 144; 2021, 27–57).

During the interwar period, a series of excavations were conducted at sites from various eras. Stefan Krukowski (but also other researchers) explored Palaeolithic sites in the Kraków-Częstochowa Upland. The discovery of Neolithic flint mines in Krzemionki Opatowskie in the 1920s was an event of great scientific significance. Krukowski also conducted research there at the time. Leon Kozłowski, head of the Department of Prehistory at the University of Lviv, studied, among other things, the settlement in Koszyłowce, in what is now western Ukraine (then eastern Lesser Poland). In 1923, Vere Gordon Childe (1892–1957) participated in this research. Between 1926 and 1930, Józef Żurowski conducted excavations at Neolithic sites in Złota, Kielce Province. Konrad Jażdżewski (1908–1985) also studied Neolithic sites between 1933 and 1936 in Brześć Kujawski. Research on the Roman period was conducted in Tropiszów and Igołomia, Kraków district. Pottery kilns for firing so-called grey ware were discovered there. Excavations were also carried out at medieval sites, including in Poznań and Gniezno (Lech 1997–1998, 44–48). However, the most famous research from this period was probably the research in Biskupin, where in 1933 the well-preserved remains of a fortified settlement of the Lusatian Culture were discovered. Until the outbreak of the Second World War, excavations were conducted there by Józef Kostrzewski and Zdzisław Rajewski (1907–1974) from the University of Poznań. The research in Biskupin was conducted on a large scale, using interdisciplinary methods. They were also important because the site in Biskupin was considered as associated with the proto-Slavic ancestors of contemporary Poles (Piotrowska 1997–1998; Fig. 6, 7). It was a time of heated discussions between Polish and German archaeologists on the ethnogenesis of the Slavs (Lech 2004, 30–41; Piotrowska 1997–1998, 259–266; Rohrer 2004).

The first syntheses of the prehistory of Polish lands were created in the interwar period. First, studies of individual prehistoric eras were published (Kozłowski 1922; 1924; 1925), followed in the late 1920s by the first comprehensive synthesis of the archaeology of Polish lands, entitled *Archeologia Polski* [Archaeology of Poland]. Its author was

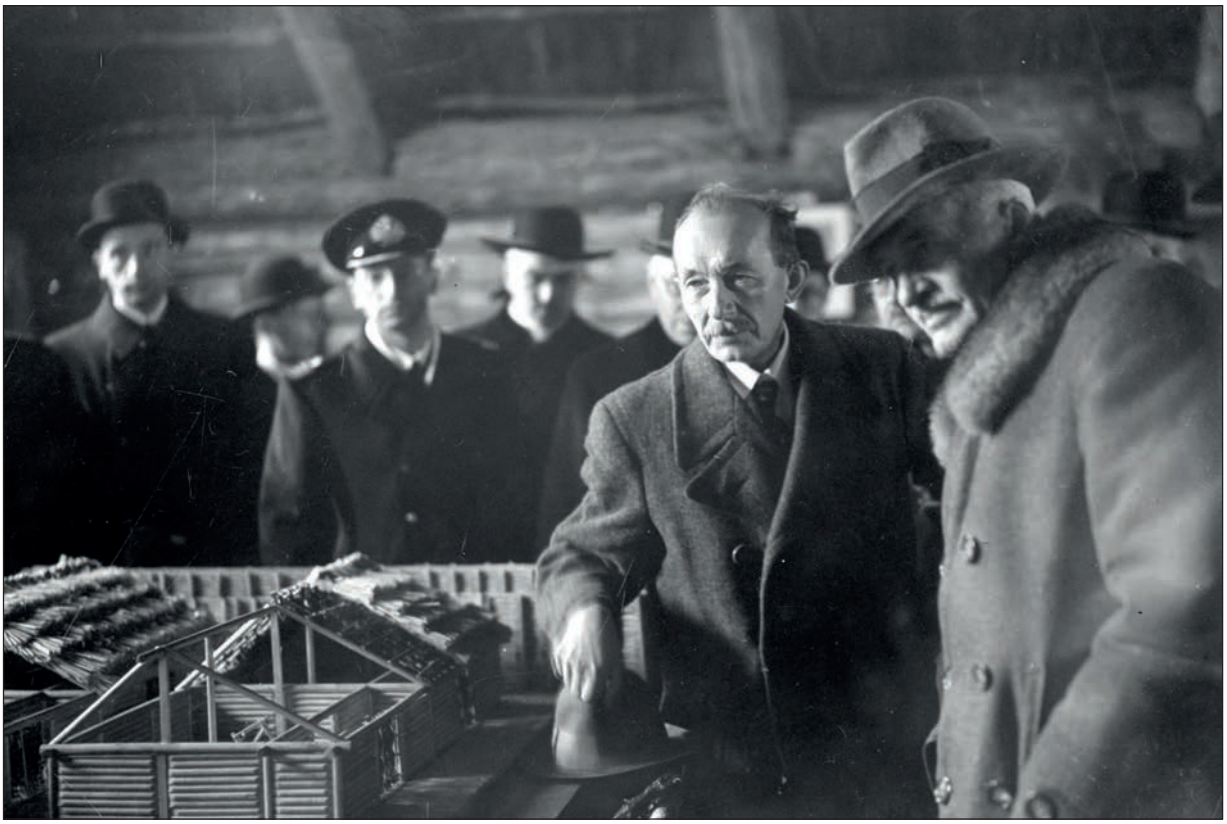


FIGURE 6. Józef Kostrzewski (second from the right) shows Polish President Ignacy Mościcki the results of research in Biskupin. 1936. From the collections of the National Digital Archives, ref. no. 1-A-1606-3

Włodzimierz Antoniewicz (1928). Just before the outbreak of World War II, a second, more comprehensive synthesis was published by the Polish Academy of Arts and Sciences. It consisted of two parts – the first (Palaeolithic) was written by Stefan Krukowski, and the second (from the Mesolithic to the Migration Period) by Józef Kostrzewski (Krukowski, Kostrzewski 1939). This synthesis, supplemented with later periods described by Roman Jakimowicz, was also published after World War II (Krukowski, Kostrzewski, Jakimowicz 1948). Professional periodicals were also published. Most articles in the field of archaeology were published at that time in the journals *Wiadomości Archeologiczne, Światowit* and *Przegląd Archeologiczny*, published in Warsaw and Poznań. *Prace i Materiały Antropologiczno-Archeologiczne i Etnograficzne* continued to be published in Krakow. The magazine Z *otchłani wieków*, published in Poznań and which has appeared since 1926, was more popular in nature.

In September 1939, World War II broke out. On 1 September, Poland was invaded by the Third Reich, and on 17 September by the Soviet Union. After more than a month of fighting, the country was occupied and its territory was divided between the Third Reich and the Soviet Union as a result of the Ribbentrop-Molotov Pact. This division lasted until June 1941, when Germany started a war with Soviet Russia, pushing its borders far to the east. The period of occupation (1939–1945) was the most tragic time in Polish history. This also applied to science. Secondary schools, colleges and universities were closed, and Polish scientific activity was completely banned. Higher education was only available underground. Archaeological interpretation was weaponised by the Nazi occupant, among other things using it as a propaganda tool to justify the German ownership of Polish lands. Museums were taken over by the occupying authorities. Archaeology suffered enormous losses.



FIGURE 7. View of the Lusatian culture site in Biskupin during excavations. Aerial photograph. 1936. From the collections of the National Digital Archives, ref. no. 1-N-995-1




FIGURE 8. Map of Poland from 1952. Wrocław. Elaborated by: E. Romer. From the collections of the National Library, ref. no. ZZK 3 398 A

A significant part of the collections of archaeological museums in Warsaw and Poznań was destroyed. Of the large institutions, only the archaeological museum in Krakow was spared destruction or major losses (Kaczmarek 1996, 156; Piotrowska 2004; Lech 2004, 47; Woźny 2019). A quarter of Polish archaeologists died in combat or in German and Soviet camps. Some, such as Józef Kostrzewski, had to go into hiding because he was actively pursued by the Gestapo due to his pre-war scientific work, which directly undermined the narratives of the Germans. In the areas under Soviet occupation, scientific institutions were able to operate to a limited extent, but had to adopt Marxist ideology in their research (Lech 1997–1998, 56–57; see Abramowicz 1991, 139–140; Florjanowicz 2023, 87–176).

The war brought about enormous changes. After its conclusion, as a result of the agreements reached at the conferences in Tehran (1943), Yalta and Potsdam (1945), Poland's borders were redrawn. Its former eastern territories were incorporated into the Soviet Union, while its new borders included the so-called Western Territories, which had belonged to Germany before the War. Poland also became dependent on the Soviet Union (Fig. 8). After the adoption of a new constitution in 1952 (Lech 1997–1998, 57–59), it was renamed the Polish People's Republic (abbreviated PRL). New challenges arose in the field of science. It was necessary to rebuild the scientific staff and destroyed institutions. Polish archaeologists from Lviv and Vilnius, cities that found themselves within the borders of

the USSR after the War, moved to scientific centres in Warsaw, Wrocław, Toruń and elsewhere.

Shortly after the end of the War, university lectures resumed in Poznań, where Józef Kostrzewski continued to lecture, and in Kraków, where guest lecturers taught for several years, because Tadeusz Sulimirski, the head of the department before the War, was then in Great Britain (see Chochorowski 2016b). In Warsaw, the Department of Archaeology (after World War II, the Department of Polish Archaeology) continued to operate with Włodzimierz Antoniewicz at its head. Kazimierz Majewski, who had previously worked at the University of Lviv, joined the University's Section of Classical Archaeology. Later, in 1958, the Chair of Slavic Archaeology headed by Witold Hensel was also established at the University of Warsaw (Sochacki 1993a; Sztetyłło 1993). After the War, new universities were also established. In Lublin, which had been liberated earliest, the Maria Curie-Skłodowska University was established in 1944. At the end of 1945, the Department of Prehistoric Archaeology was established there, headed by Stefan Nosek (1909–1966; Kokowski, Łuczkiewicz 2016). A new university was also established in Łódź, and in 1945, Konrad Jażdżewski became a professor of prehistory there; at the same time, he was also the director of the Municipal Prehistoric Museum. A classical archaeologist from Vilnius, Rajmund Gostkowski, also came to Łódź and began his scientific work (Abramowicz 1991, 143; Domańska, Szczerba 2016). The universities in Vilnius and Lviv were now relocated outside the new borders of Poland and many of their former employees had moved west. The Nicolaus Copernicus University in Toruń continued the tradition of the University of Vilnius; in 1946, the Department of Prehistory was established there, headed by Roman Jakimowicz (Małecka-Kukawka, Przewoźna-Armon 2007, 126–131). Two archaeologists who had previously worked in Lviv and Vilnius collaborated with him there – Helena Cehak-Hołubowiczowa from Lviv (1902–1979) and her husband Włodzimierz Hołubowicz (1908–1962). Włodzimierz Hołubowicz was a Marxist and also author of a pioneering work in the field of ethnoarchaeology, *Garncarstwo wiejskie zachodnich terenów Białorusi* [The rural pottery production of western Byelorussia] (Hołubowicz 1950; see Żmudziński 2022; Florjanowicz 2023, 217–221). After the War, a Polish archaeological centre was established in Wrocław (German Breslau before the war). Its origins were linked to a campaign initiated in Kraków to save the cultural heritage of this city, which had been severely damaged by the War. The protection of archaeological monuments throughout Silesia was then taken over by the Kraków archaeologist Rudolf Jamka. In 1946, Jamka organised the Department of Prehistoric Archaeology at the University of Wrocław. However, after a few years, he returned to Kraków, and the chair was taken over by the aforementioned Włodzimierz Hołubowicz (Burdukiewicz 2020, 12–16). The University of Wrocław became the successor to the Polish Jan Kazimierz University in Lviv and took on many of its former staff, so when the Department of Classical Archaeology was established in Wrocław in 1946, it was headed by Edmund Bulanda, who had arrived from Lviv.

The acquisition of the so-called Western Territories presented Polish archaeology with new challenges. It was expected that archaeology would prove the Slavic origins of these lands. Shortly after the War, research began in these areas – in 1946 on Ostrów Tumski in Wrocław, and in 1948 in Opole. Research was also undertaken in Szczecin and Wolin (Abramowicz 1991, 155). In the northeast of the country, research into the heritage of the Balts was also undertaken, as Poland also gained formerly German territories here after the War. In the early post-War years, studies written before 1939 that had not been published earlier, or those written during the war, were published. These included *Prasłowiańszczyzna* [Pre- Slavic culture] (1946) and *Pradzieje Polski* [Prehistory of Poland] (1949b) by J. Kostrzewski. Archaeological journals also began to be published again. The publication of *Przegląd Archeologiczny* and *Wiadomości Archeologiczne* continued. The popular publication *Z Otchłani Wieków* also continued to be published (initially under a changed title, *Dawna Kultura*). In Poznań, a new journal, *Slavia Antiqua,* was established in 1948.

Science was influenced by Marxist ideology. However, this influence was not equally strong throughout the entire period of socialism in Poland. In the early post-War years, until 1948, the influence of ideology was still weak. It was only in the following years, 1949–1955, that Stalinism and very strong pressure from the state to implement Marxism-Leninism in science, including archaeology, took hold (Lech 1997–1998, 84–91; see Boguszewski 2018; Lozny 2025). In the 1950s,

a reform of archaeological studies was carried out. Under the influence of Marxist ideology, archaeology, classical archaeology and ethnography were combined to create a field of study called material culture history. However, this new type of study only lasted a few years. In 1956, the concept of separate studies for each discipline was reinstated (Abramowicz 1991, 151; Lech 1997–1998, 62). A significant change in the organisation of science took place in the 1970s and early 1980s. At that time, the chairs of archaeology at universities were replaced by institutes of archaeology – in 1971 at the Jagiellonian University in Krakow, and in 1976 at the University of Warsaw. Similar institutes were established in Toruń and Poznań (Sochacki 1993b, 194; Lech 1997–1998, 61–64; Małecka-Kukawka, Przewoźna-Armon 2007, 134–141; Chochorowski 2015, 26–27).

About ten years after the end of the War, in 1956, a few years after Stalin's death, the so-called Thaw took place. It became possible again to conduct research outside Poland and establish international cooperation, which had been impossible during the Stalinist period. Since then, a gradual departure from dogmatic Marxism-Leninism has been observed (Abramowicz 1991, 176–177; Lech 1997–1998, 91). As Jacek Lech noted, in the following years, alongside the Marxist methodology prevailing in scientific studies and archaeological research, the influence of other trends was also visible – "the neoautochtonic school of Kostrzewski, Moszyński's critical evolutionism, the functionalism of Bronisław Malinowski, Anglo-American neo-evolutionism, the French *Annales* school, and, later, also the American and British 'New Archaeology'" (Lech 1997–1998, 92). It is worth noting that although most researchers moved away from Marxism, the subject of their research continued to be prehistoric society and economy.

In the second half of the 20th century, Polish archaeology placed great emphasis on researching the Middle Ages (cf. Kajzer 1996; Kobyliński 2007). Shortly after World War II, the idea arose to undertake a large-scale, collaborative research project aimed at investigating the origins of the Polish state. The idea of commemorating the 1000th anniversary (the "Millennium") of the founding of the state in this way was presented in 1946 by Witold Hensel (1917–2008), later professor of archaeology at the Universities of Poznań and Warsaw and longtime director of the Institute of Material Culture History of the Polish Academy of Sciences in Warsaw. Aleksander Gieysztor (1916–1999), a medieval historian, wrote that researchers were also encouraged to undertake the "Millennium" campaign by the discoveries of early architectural relics in places like Poznań, Trzemeszno and Strzelno, made in 1945–1947 in part as a result of repairing war damage to medieval ecclesiastical buildings here, as well as due to the proposals presented at the 7th General Congress of Polish Historians in Wrocław in 1948 (Gieysztor 1953, 2). However, political and ideological issues were of great importance. Scientific literature has repeatedly emphasised that an important issue in post-War research on the early Middle Ages – focusing not only on the origins of the Polish state, but also on the ethnogenesis of the Slavs – was the need to prove Poland's right to the so-called Western Territories, felt by a society traumatised by the War. The celebrations of the Millennium of the state were also intended by the authorities of socialist Poland to compete with the Church's celebrations of the 1000th anniversary of the baptism of Poland. In fact, however, archaeologists did not get involved in the conflict between the Church and the state. Organisational needs led to the creation of the Directorate for Research on the Origins of the Polish State at the then Ministry of Culture and Art in 1949. As part of the Directorate's work, excavations were undertaken at many important sites (Abramowicz 1991, 155–158; Lech 1997–1998, 65–78; Woźny 2016, 774; Szczerba 2021, 87–269).

In the post-War period, there were also lively discussions in Polish archaeology about the ethnogenesis of the Slavs (see Lech 1997–1998, 97–105). This trend of dynamic development in medieval and modern archaeology continued over the following decades. Journals devoted to these issues were published, such as *Slavia Antiqua* and *Fasciculi Archaeologiae Historicae.* Between 1961 and 1996, with the support of the Polish Academy of Sciences, *The Dictionary of Slavic Antiquities: an encyclopaedic outline of Slavic culture from the earliest times* was published.

The early 1950s brought enormous changes to the organisation of Polish science. Under pressure from the political authorities of the Polish People's Republic, at the end of 1952, the Polish Academy of Sciences was established to replace the Polish Academy of Arts and Sciences, the Warsaw Scientific Society and other scientific societies.

As part of the newly established Academy, in the autumn of 1953, the Institute of Material Culture History (abbreviation: IHKM) PAS was established. This was an adaptation of the Russian system of scientific organisation at the time. The IHKM was established on the basis of the creation of the Directorate for Research on the Origins of the Polish State. This became the main centre for archaeological, ethnographic and material culture history research in the People's Republic of Poland. Several branches of the Institute were established in various cities across Poland. Kazimierz Majewski became the first director of the Institute, but due to his health, he was replaced in 1954 by Witold Hensel, who later became its long-time director. The Institute published (and continues to publish) a number of journals devoted to archaeology, including *Kwartalnik Historii Kultury Materialnej, Archeologia Polski*, *Przegląd Archeologiczny*, and *Archaeologia Polona* (published in congress languages and addressed to foreign readers). *Sprawozdania Archeologiczne* was also published, with the main aim of publishing the results of excavations as quickly as possible (Abramowicz 1991, 158; Lech 1997–1998, 78–82; 2009; Klonder 2023). The scale of the work undertaken at the Institute is evidenced by its publications. Between 1975 and 1986, the Institute of Material Culture History of the Polish Academy of Sciences developed and published several syntheses, e.g.: *Prahistoria ziem polskich* [*Prehistory of the Polish lands*] (6 vol., Hensel ed. 1975–1986), *Historia kultury materialnej Polski w zarysie* [An overview of the history of Poland's material culture] (6 vols., Historia kultury 1978–1979), *Kultura materialna starożytnej Grecji. Zarys* [The Material Culture of Ancient Greece: An Overview] (3 vols., Majewski ed. 1975–1978). Other syntheses of particular eras or regions were also published.

Important research was conducted on the Palaeolithic period. Among the successors of Stefan Krukowski, the aforementioned researcher of this epoch, were such distinguished archaeologists (working in various centres in Poland) as Waldemar Chmielewski, Bolesław Ginter, Janusz Krzysztof Kozłowski, Stefan Karol Kozłowski, Romuald Schild and Michał Kobusiewicz. As early as the 1960s, they began to publish works on the Palaeolithic and Mesolithic periods. Syntheses of these periods appeared, e.g. Kozłowski and Kozłowski (1975; 1977). Some researchers (Schild, Kobusiewicz) also conducted research on the Stone Ages in North Africa (Lech 1997–1998, 112–115; Chmielewski 2000; Cyrek 2007; Schild 2020; Schild et al. ed. 2025). A number of studies and excavations were also conducted on other prehistoric periods. For example, research on flint mining, flint technology and distribution developed. The influence of Anglo-American processual archaeology was evident in these studies (Lech 2022). Studies of burial customs in different eras were also conducted. An interesting topic was, for example, research on megalithic burials on the eastern flank of the megalithic world (Lech 1997–1998, 115–123; Libera, Tunia eds 2006).

In another important phenomenon, the archaeology of historical (later medieval and post-medieval) times also developed. Alongside the investigation of medieval sites as a consequence of the Millennium project, from the late 1960s, many excavations, often interdisciplinary, archaeological and architectural, were conducted by the State Company for Conservation of Monuments (PP PKZ) (Kajzer 1996, 49–54; Lech 1997–1998, 123). Research into battlefields from various eras and studies of military matters also developed. Contemporary archaeology, which dealt with, among other things, research in concentration camps and at war crime sites such as Katyn in the former Soviet Union, constituted a separate branch (see volume 61 of the journal *Archaeologia Polona* from 2023).

In the second half of the 20th century, archaeological excavations were conducted on a much larger scale than in the pre-War period. They were carried out at thousands of archaeological sites. The larger ones, of great scientific importance, include the aforementioned research conducted as part of the study of the Millennium of the Polish state, as well as – to mention just a few others – research on the Neolithic settlement in Ćmielów, near the striped flint mine in Krzemionki Opatowskie (Fig. 9); settlements in Brześć Kujawski; the burial grounds of Kuyavian-type megalithic tombs in Sarnowo and Wietrzychowice, Włocławek province; and extensive research conducted by researchers from Poznań at sites from various periods in the Kuyavia region. In the 1960s and 1970s, Polish-American research on the Neolithic and Early Bronze Age was conducted in south-eastern Poland. Sites such as Kraków-Olszanica, Bronocice and Iwanowice in the Kielce province were studied at that time. Many years of important research were also conducted at a multicultural Bronze Age cemetery in




FIGURE 9. Krzemionki Opatowskie, Ostrowiec Świętokrzyski district. Area around Shaft No. 2. A pillar bearing a Neolithic drawing made with charcoal. Neolithic mining site inscribed on the World Heritage List as the main site of the Krzemionki Prehistoric Striped Flint Mining Region. Photograph from the 1990s (photo by J. Lech)



FIGURE 10. Kazimierz Michałowski. 1967. From the collection of the National Digital Archives, ref. no. 40-X-16-2

Kietrz, Opole province (Institute of Archaeology of the Jagiellonian University). The Jagiellonian University also conducted a series of studies at Palaeolithic sites, primarily, but not exclusively, in caves. Long-term research was conducted on behalf of the Archaeological Museum in Krakow on the history of the city of Krakow, as well as (in cooperation with the AGH University of Science and Technology) on ancient iron metallurgy in the Świętokrzyskie Mountains. Researchers from the University of Warsaw conducted excavations at medieval and prehistoric sites in Wiślica, Kielce province and its surroundings for many years. Archaeologists from the State Archaeological Museum conducted research on the culture of the Balts in the north-eastern part of post-War Poland (before 1945, German East Prussia). It is worth noting the initiation of research in the specific terrain of the mountains of southern Poland, mainly the Carpathians, by Andrzej Żaki (1923–2017) and the

launch of the journal *Acta Archaeologica Carpathica.* Numerous studies were also conducted outside the country (Lech 1997–1998, 128–141; Kobusiewicz, Kurnatowski eds 2000; Lech ed. 2007 – see also M. Krueger's text in this book). The results of most of the research were summarily presented in the annually published *Informator Archeologiczny.*

Mediterranean archaeology developed primarily at the University of Warsaw, the Department of Ancient Art in the National Museum, and the Section of Mediterranean Archaeology in the Polish Academy of Sciences. The development of this discipline, associated primarily with the work of the eminent researcher Kazimierz Michałowski, was made possible by the political changes of 1956. As already mentioned, the so-called Thaw made it possible to re-establish international cooperation. Thanks to favourable political circumstances, the Centre of Mediterranean Archaeology of Warsaw University was established in Cairo in 1959. This marked the beginning of a period of important research that made Michałowski famous in the international scientific community (Fig. 10). He and his team conducted research in Egypt, the Middle East, and off the coast of the Black Sea (Sztetyłło 1993; Gawlikowski 1993; Daszewski 1993; Lech 1997–1998, 83–84, 126–128).

Archaeological museology also developed in the second half of the 20th century. In 1945, the State Archaeological Museum resumed its activities in devastated Warsaw under the direction of Ludwik Sawicki. Shortly after the War, work also resumed in Poznań at the Wielkopolska Museum, under the direction of Józef Kostrzewski. Tadeusz Reyman (1899–1955) returned to his position as director of the Archaeological Museum of the Polish Academy of Arts and Sciences in Krakow. Archaeological museums also began operating in Wrocław and Łódź. In Szczecin, a prehistory department was established at the Museum of Western Pomerania. Staff shortages meant that many people worked both at universities and in museums. Museums played an important role in popularising archaeology. They hosted exhibitions, but were also involved in scientific activities – conducting research (including excavations) and publishing their results. Museums also pursued their scientific ambitions by establishing their own journals, such as *Sprawozdania PMA* in Warsaw, *Fontes Praehistorici* and *Fontes Archaeologici Posnaniensis* in Poznań, *Materiały Archeologiczne* in Kraków, *Prace i Materiały Muzeum Archeologicznego i Etnograficznego w Łodzi* in Łódź, and others.

Protection of historical monuments played an important role in post-War Poland. In 1951, the Department of Archaeological Conservation was established within the Ministry of Culture and Art, as part of the General Directorate of Museums and Monument Protection (Wysocki 2021, 59–66). This department supervised the Provincial Conservators of Monuments. A number of studies were conducted in connection with various construction projects. Urban archaeology developed, influenced, among other things, by the reconstruction of many cities damaged during the War. A major rescue operation was undertaken near Krakow, on the site of the emerging metallurgical complex and urban development of Nowa Huta. Numerous archaeological sites were threatened there, and rescue research was undertaken in this area in 1950. Due to the enormous scale of the work, its financing was taken over by the Ministry of Culture and Art. In 1950, the Excavation Management in Nowa Huta was established, headed by Stanisław Buratyński (1908–1994). In 1953, in order to create an institutional framework and facilities for the research, a branch of the State Archaeological Museum in Warsaw was established in Nowa Huta, which in 1955 was incorporated into the structures of the Archaeological Museum in Krakow. Research was conducted there for decades (Nosek 1967, 119–120; Górski 2010, 179–180).

A special project was the so-called "The Polish Archaeological Record" (Archeologiczne Zdjęcie Polski – abbreviated AZP). Implemented since the 1970s, the project aimed to conduct archaeological surveys of the entire country in order to protect all archaeological sites. In 1979, the entire territory of Poland was divided into approximately 8,000 search areas with an area of approximately 30 $km^2$, which were then surveyed using surface research methods, taking into account the analysis of archival sources and scientific literature, as well as collections of artefacts stored in various institutions (Jaskanis 2000).

In the early 1980s, the declaration by the Communist regime of martial law in Poland and the extremely difficult political and economic situation in the country caused stagnation in science. In the 1980s, the country was in a deep crisis, which also affected the state of science. International cooperation and publishing were significantly reduced.

Favourable changes only came with the fall of socialism in Central European countries in 1989 and the change of political system. Major political and systemic changes enabled the further development of archaeology on a much larger scale. The new situation opened up new opportunities. Universities developed. Archaeology appeared as a subject of study at most universities, and several former institutes were transformed into Departments of Archaeology (Warsaw, Poznań). Each year, a significant number of graduates of the discipline received their professional qualifications. Research developed. The favourable economic situation, the introduction of free market principles, led to a huge increase in construction and road investment. On a scale unprecedented in Poland, preliminary excavations were carried out for many years in connection with large linear investments – the construction of gas pipelines and road and motorway networks. This research has yielded a wealth of new archaeological sources and has significantly changed our knowledge of the prehistory of Poland. The sources obtained during this research are being gradually processed and published. To this end, new publishing series have been created, e.g. *Via Archaeologica,* and a number of studies have appeared. However, a significant part of the sites and sources are still awaiting processing. At the same time, in accordance with accepted international interpretations of conservation law in the field of archaeological heritage protection, great emphasis has been placed on non-invasive research in archaeological studies. New methods, such as LiDAR, have been used extensively, and emphasis has been placed on interdisciplinary cooperation with representatives of other sciences. There has also been a development in aerial and underwater archaeology. A number of international excavation projects have been undertaken, and joint international excavation campaigns have been conducted outside the country (including in Slovakia, Ukraine, and South and Central America). New syntheses and studies have been produced on all periods of prehistory, as well as the Middle Ages, modern times, and contemporary archaeology. In 2017, a new five-volume study of the prehistory of Poland was published – *The Past Societies* (Urbańczyk ed. 2017). Research in the field of the history of archaeology also developed. Archaeology in Poland continues to develop within the structures of universities, the Polish Academy of Sciences (in 1992, the Institute of Material Culture of the Polish Academy of Sciences was renamed the Institute of Archaeology and Ethnology of the Polish Academy of Sciences) and museum institutions. In addition, the state conservation service oversees the protection of archaeological heritage. The most important archaeological centres in Poland are currently located in Warsaw, Krakow, Poznań, Wrocław, Toruń, Łódź, Lublin and Rzeszów.

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# HISTORY OF POLISH ARCHAEOLOGICAL FIELD RESEARCH WORLDWIDE

Michał Krueger

Polish archaeology conducted outside the country has gained significant renown over the last hundred years, becoming synonymous with high-quality scientific research. In the public consciousness, this reputation has been shaped primarily by the presence of Polish excavation missions in the eastern Mediterranean basin. The aim of this article is to familiarize readers with Polish team[1] initiatives in the field of archaeology abroad, particularly those of a fieldwork nature, such as excavations and surface surveys. The research described here has been carried out by scholars employed at Polish academic institutions.[2] The chronological scope of this presentation spans from the 19th century to the present day. The article is based on studies concerning the history of Polish archaeology, press reports, and information from the websites of Polish archaeological institutions. Due to limitations of space, many facts and figures important to Polish research teams working abroad have inevitably been omitted. The most recent history, covering the last four decades, has been summarized in a timeline format, allowing for the presentation of key details about fieldwork projects, such as their duration, a brief description, significant discoveries, and project leaders. Interested readers will find an extensive bibliography listing works that substantially supplement the condensed information presented in this chapter.

## Fieldwork in Archaeology Before the Outbreak of World War II

Polish archaeology, which developed dynamically after 1918, had its roots in scholarly initiatives undertaken much earlier, as far back as the 18th century (Abramowicz 1992, 33). While activities in the 18th century were sporadic, the following century saw a growing interest in the archaeology of the Mediterranean basin. It is worth mentioning a few representative examples of such endeavours to illustrate the goals, methods, and results of the work conducted at that time.

Among the earliest researchers of the past – though without formal training in archaeology – were Jan Potocki, Aleksander Sapieha, Edward Raczyński, and Wacław Rzewuski. Their primary contribution lay in fieldwork carried out in the eastern and central Mediterranean, focusing on material remains that they described, often sketched, but only rarely excavated (Abramowicz 1970, 8–41). Of course, their work had little in common with archaeology as understood today. The same applies to the activities of Jan Działyński, who, in addition to conducting excavations in Nola (Głuszek and Krueger 2017, 294), spent the 1860s in Italy collecting ancient vases, primarily through antiquarian purchases (Mężyński 1987, 151; Marek 1994, 13). Other notable collectors of Mediterranean antiquities included Michał Tyszkiewicz, Władysław Czartoryski, and Izabela Działyńska (née Czartoryska), Jan Działyński's wife. Fieldwork was also undertaken, as exemplified by Karol Lanckoroński's

[1] There are numerous examples of Polish researchers participating individually in foreign archaeological expeditions; however, these will only be discussed in exceptional cases, primarily in reference to the 19th and early 20th centuries.

[2] The exception is initiatives from the 19th century, when Poland was absent from the map of Europe.

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archaeological expedition to southern Anatolia, the results of which were published in Polish, French, and German (Abramowicz 1991, 77–78). Even more distant parts of the world became sites of Polish archaeological excavations. In South America, Władysław Kluger conducted research at the Ancón cemetery in Peru, with some of the artefacts he acquired being donated to the Academy of Arts and Sciences in Kraków between 1876 and 1878 (Iwaniszewski 2007, 195–196). The aforementioned initiatives were undertaken under the difficult conditions of Poland's lack of statehood[3] and were financed with private funds.

Significant changes in the development of Polish Mediterranean archaeology occurred at the turn of the 20th century with the establishment of the Chair of Classical Archaeology at the Jagiellonian University in Kraków and the habilitation of its head, Piotr Bieńkowski, in 1893 (Abramowicz 1991, 80). Another milestone was the employment at the University of Lviv of Karol Hadaczek – a scholar trained in classical archaeology who (in 1912–1913) participated in excavations in the mastaba cemeteries from the Old Kingdom period in Giza[4] (Śliwa 2017, 45–48). After Hadaczek's premature death in 1914, his legacy was continued by Edmund Bulanda, who assumed leadership of the Chair of Classical Archaeology in 1916 (Abramowicz 1991, 106). This period marked the institutional consolidation of archaeology in Poland, enabling the development of research and academic training. The culmination of these trends came after Poland regained independence, with the establishment of new classical archaeology departments at universities across the country.

In Lviv, Kazimierz Majewski (Press 1993) and Stefan Przeworski (Taracha 1993) conducted research, while in Kraków, Stanisław Jan Gąsiorowski and Kazimierz Bulas (Śliwa 2007) were active. Meanwhile, Mieczysława Ruxer, educated in Kraków, was employed at the newly established University of Poznań (Bugaj 2013). The work of these scholars was primarily desk-based, as no Polish excavations were conducted in the Mediterranean basin at the time.

A turning point came in the early 1930s, when Kazimierz Michałowski assumed leadership of the Chair of Classical Archaeology at the University of Warsaw, marking the beginning of international recognition for Polish Mediterranean archaeology abroad (Abramowicz 1991, 123–125). This was largely due to Michałowski's appointment as deputy director of the Polish-French archaeological mission at Edfu in Egypt (Bruyère et al. 1937, VI). Prior to this, he had participated in French excavations in Greece, on Delos and Thasos. As early as 1934, Michałowski travelled through Egypt to select a suitable archaeological site for excavation. The choice of Egypt was motivated by the opportunity to enrich Polish museum collections with archaeological artefacts – something that was not possible in Greece. As a result of the work at Edfu, by the eve of World War II, the National Museum in Warsaw had become the custodian of a significant Egyptological collection (Sztetyłło 1993, 290; Gawlikowski 1993, 301). The excavations also yielded important scholarly findings, including the identification of three burial types from the First Intermediate Period, the discovery of numerous terracotta figurines deposited in graves from this period which were typologically analyzed, the uncovering of fortifications and baths associated with houses inhabited by Roman commanders, the dating of architectural structures, the discovery of a local sculptor's workshop and a room used by a physician-pharmacist containing a large number of glass vials and a wax model of a human skeleton, as well as the recovery of a substantial collection of *ostraca* and the remains of a Coptic-era monastery where, among other finds, texts of prayers were unearthed (Michałowski 1983, 25–26). These excavations had not only scholarly but also organizational and educational significance: they served as a training ground for gaining fieldwork experience and implementing modern methodologies, including interdisciplinary research. It is also worth noting that the results of these archaeological initiatives were promptly published. For example, the report on the 1937 excavation campaign in Edfu appeared that same year (cf. Bruyère et al. 1937).

[3] Poland vanished from the map of Europe following the Third Partition in 1795, only to reemerge as an independent state in 1918.

[4] During this period, excavations in Egypt also involved the participation of Piotr Bieńkowski and Tadeusz Smoliński (Abramowicz 1991, 89).

## Postwar Period until 1989

The years immediately following World War II were a difficult period for Polish archaeology. They were characterized by limited scholarly exchange, including restrictions on foreign travel, international contacts, and access to foreign literature (Marciniak 2011, 182). It was only the second half of the 1950s that brought radical changes, enabling archaeological research initiatives to be undertaken beyond the country's borders. Following an invitation, Polish archaeologists conducted a field survey in Crimea and selected the site of Myrmekion, an ancient Greek colony, as the location for Polish excavations beginning in 1956. A Soviet mission worked independently nearby (Michałowski 1983, 35). The excavations at Myrmekion primarily led to the discovery of a remarkably well-preserved Hellenistic wine press along with its associated equipment. Fragments of residential buildings were also uncovered, with their state of preservation allowing researchers to determine roofing techniques and the extent of subsequent renovations. Animal bones found in various stratigraphic layers provided insights into changes in the diet of Myrmekion's inhabitants over several centuries. Additionally, in accordance with the terms of the excavation permit, a selection of the movable artefacts, mainly terracottas and pottery, were transported to Warsaw, enriching Polish archaeological collections (Michałowski 1983, 37–44).

A year later, Polish archaeologists returned to Egypt, specifically to Tell Atrib (Fig. 1), the ancient Athribis in the Nile Delta (Sztetyłło 1993, 296). They examined Roman baths with a water supply system, as well as villas with remnants of wall paintings. The foundations of two Late Period temples, a surrounding sacred enclosure wall, a pottery kiln, and numerous lime kilns were also discovered (Ruszczyc 1986, 29–33). Initially, these excavations were directed by Kazimierz Michałowski, but from the late 1960s, leadership was taken over by Barbara Ruszczyc, who shifted the fieldwork to Kom Sidi Yussuf, where baths, cisterns, and the remains of an early church were uncovered, along with numerous small artefacts (Ruszczyc 1986, 33). Some of the finds from this site were added to the antiquities collection of the National Museum in Warsaw (Michałowski 1983, 61). The work continued until 1999.[5]

In 1958, Kazimierz Michałowski and Tadeusz Andrzejewski were invited by Egyptian authorities to conduct an archaeological reconnaissance of ancient Nubia. They accepted the proposal and, after fieldwork, prepared an extensive report that later served UNESCO in developing a plan to rescue monuments threatened by the flooding of the Nile due to construction of the Aswan High Dam (Daszewski 1993, 304).

In the same year, research was initiated in Alexandria. Initially, exploratory probes were conducted in search of the burial place of Alexander the Great, but these did not yield the expected results (Michałowski 1983, 121). In 1960, the Egyptian authorities approached Kazimierz Michałowski with a proposal to conduct preliminary surveys on the artificial hill known as Kom el-Dikka, which was slated for development with public utility buildings. Remarkably well-preserved remains of Roman baths were quickly discovered at the site. Soon after, fragments of mosaics were uncovered, and most significantly, a theatre structure was found (Fig. 2) (Michałowski 1983, 122–126). In subsequent years, a complex of late Roman auditoria and Roman houses was identified at Kom el-Dikka.[6] Currently, archaeological work at this site is being conducted under the direction of Grzegorz Majcherek. Research is also being conducted on a Muslim necropolis at the site.

Another site of exceptional value where excavations began in 1959 was Palmyra in Syria (Fig. 3). The initial focus was on Diocletian's Camp, particularly its main military axes. In later years, the religious and administrative centre of the Roman garrison was investigated, followed by the temple district and a structure adjacent to the walls of Diocletian's Camp that housed grain mills. The second research area was the western necropolis known as the Valley of the Tombs (Gawlikowski 1986, 121–126). The excavation reports and monographic studies were published in congress languages, significantly raising the international profile of the Polish archaeological mission. The work at this site led to the creation of a specialized journal dedicated to Palmyrene studies, titled "Studia

[5] https://pcma.uw.edu.pl/2017/10/19/tell-atrib/ [16.01.25].
[6] https://pcma.uw.edu.pl/2018/01/22/aleksandria-kom-el-dikka/ [16.01.25].



FIGURE 1. Excavations at Tell Atrib (photo by H. Romanowski)

Palmyreńskie", which in 2014 was transformed into a monograph series.[7]

In the late 1950s, reconnaissance work was also carried out to assess the potential for excavations at the Greek site of Tanais (Scholl 2005), then located within the borders of the Soviet Union.[8] On the Crimean peninsula, at Kalos Limen, Maria Ludwika Bernhard conducted an excavation campaign in 1959. Her team uncovered the remains of two houses and a section of a street, revealing continuous settlement from the 4th century BCE to the 3rd century CE (Sztetyłło 1986, 111).

In 1959, the Research Centre for Mediterranean Archaeology of the University of Warsaw was established in Cairo. This facility was designed to support Polish missions working in the eastern Mediterranean basin, particularly in Egypt (Daszewski 1993, 304–305). Today, it operates as a dynamic research institute with its own library and accommodation base, providing the foundation for long-term archaeological projects in the Mediterranean region for over six decades.

In 1960, Polish archaeologists began working in Bulgaria. The first site explored was the legionary camp and city of Novae on the Danube shore, the excavations were directed by Kazimierz Majewski, and his deputy was Stefan Parnicki-Pudełko from the Adam Mickiewicz University in Poznań (Sztetyłło 1993, 296). The Polish team focused on the western part of the camp, while Bulgarian archaeologists investigated the eastern section. From 1970 onward, Novae was studied independently by the Warsaw team and a separate Archaeological Expedition from the Adam Mickiewicz University (Biernacki, Klenina 2020, 9–15). Research targets included Novae's defensive system and an early

[7] https://pcma.uw.edu.pl/publikacje/studia-palmyrenskie/ [16.01.25].

[8] Research at this site was resumed in the 21st century, with excavations conducted under the direction of Tomasz Scholl and later Marcin Matera https://projekty.ncn.gov.pl/index.php?projekt_id=169335, https://www.archeologia.uw.edu.pl/tanais-badania-miasta-antycznego-nad-morzem-azowskim-w-rosji/ [16.01.25].



FIGURE 2. Theater in Kom el-Dikka, Alexandria (photo by W. Jerke)

Christian episcopal basilica (Parnicki-Pudełko 1990, 1995). Notably, these ongoing excavations[9] have been characterized by their interdisciplinary approach. Alongside archaeologists, expedition participants have included historians, art historians, philologists, geologists, architects, chemists, and specialists from other fields.

The second half of the 1950s proved exceptionally fruitful in terms of initiated research, with many projects culminating in spectacular successes. The organizational and scientific achievements of missions operating in this period are particularly remarkable, considering they were conducted during Poland's difficult period of post-War reconstruction, with limited financial resources and under political constraints. It should be noted, however, that Poland's position within the socialist bloc facilitated cooperation with Egypt under Gamal Abdel Nasser's socialist-oriented government, as well as with Syria. Domestically, the term "classical archaeology" was replaced with the more neutral "Mediterranean archaeology", which expanded Polish researchers' geographic and chronological scope of study (Gawlikowski 1993, 301–302).

In 1961, Polish archaeological excavations were initiated in Italy. The Italian archaeologists invited the Poles to work on the Venetian lagoon at Torcello. This was a consequence of the archaeological achievements obtained during the excavations carried out on the occasion of the millennium of the Polish State. The research was directed by Witold Hensel, and the direct executors of the work were Lech Leciejewicz, Stanisław Tabaczyński, and Eleonora Tabaczyńska (Hensel 1981, 4–5). The work lasted two seasons, focused on medieval layers, and resulted in a monograph published in 1977. Cooperation between Italian and Polish archaeologists continued for subsequent decades under an agreement between the Consiglio Nazionale delle Ricerche and the Polish Academy of Sciences; on the Polish side, research on the Venetian lagoon was sustained in the 1990s by Iwona Modrzewska

[9] https://www.archeologia.uw.edu.pl/novae-oboz-legionowy-i-miasto-poznoantyczne/, https://www.archeologia.uw.edu.pl/novae-statuaryczno-epigraficzny-pejzaz-centralnej-czesci-rzymskiego-obozu/ [16.01.25]



FIGURE 3. General view of Palmyra (photo by M. Krueger)

Pianetti.[10] Italian-Polish research was conducted in 1962–1963, with a similar personnel composition as at Torcello, at the site of Castelseprio, located north of Milan. The results of the work were published both in Poland and in Italy. Slightly later, in the 70', the Poles, together with Italian archaeologists, also conducted research at the medieval site of Capaccio Vecchia (Leciejewicz 2006).

The 1960s decade was fruitful for Polish archaeology also in Egypt. In 1961, Egypt's Ministry of Culture invited Kazimierz Michałowski's team to participate in the partial reconstruction of Hatshepsut's Temple (Fig. 4) at Deir el-Bahari (Michałowski 1983, 137). The inventory of stone blocks for reconstruction necessitated excavations near the Temple, where a rock debris field was located. While searching for loose blocks from Hatshepsut's temple, researchers unexpectedly discovered remnants of Thutmose III's lost mortuary temple, including a portrait monument of the pharaoh seated on his throne (Michałowski 1983, 140–143). These findings were published in numerous articles and monographs about Deir el-Bahari, and conservation, reconstruction, and epigraphic work continues at the site to this day.[11]

Equally spectacular results came from excavations at Faras in Sudan (Fig. 5), directed by Kazimierz Michałowski. These rescue excavations preceded the construction of the Aswan High Dam and the subsequent flooding of numerous archaeological sites. The Polish team was one of many participating in the Nubian Campaign to document and rescue these sites. Limited financial and technical resources, combined with the desire for

[10] https://www.archeologia.uw.edu.pl/wp-content/uploads/2018/12/CV-Iwona-Modrzewska-Pianetti-2021.pdf [17.04.26].

[11] A full list of project directors, collaborating institutions and subprojects is available at https://pcma.uw.edu.pl/2018/01/05/deir-el-bahari/ [24.01.25].



FIGURE 4. Temple of Hatshepsut, Deir el-Bahari (photo: PCMA UW)

significant discoveries, influenced their methodology. Instead of excavating from the top of the settlement mound (kom), they worked from the side to avoid documenting later Arab citadel ruins and private dwellings. This approach led them through windblown sand directly to walls that turned out to be part of a cathedral, where two exceptionally well-preserved frescoes were discovered. Subsequent seasons revealed the cathedral walls, graves, stelae, a palace, epigraphic artefacts, a provisional church, and most notably over one hundred medieval wall paintings (Michałowski 1983, 160–165). Many of these were transported to the National Museum in Warsaw, where they form a collection unique in Europe of Nubian Christian art from the 8th-14th centuries.[12]

During the 1960s, discussions were held on how to preserve the rock temples of Ramses II at Abu Simbel (Fig. 6). Kazimierz Michałowski was appointed to a UNESCO committee tasked with saving these temples from being submerged by the Nile. After evaluating cost estimates, the Swedish proposal – which involved cutting the sculptures into blocks and reconstructing the temple on higher ground – was selected. The project was successfully completed, and the foundation act of the reconstructed temple was signed by the President of the UNESCO General Assembly, the Egyptian Minister of Culture, and Kazimierz Michałowski, highlighting the Polish archaeologist's contribution to this international effort (Michałowski 1983, 195–201; Żurawski 2007, 152–154).

In 1962, Polish archaeologists from the Institute of Archaeology and Ethnology of the Polish Academy of Sciences, together with the Southern Methodist University in Dallas and the Geological Survey of Egypt, established the Combined Prehistoric Expedition. Its scientific objectives focused on Quaternary geomorphology and the Stone Age prehistory of the north of Africa. The research area was very broad and included Sudan, Ethiopia, the Lower Nile Valley, the Eastern Sahara, Sinai, and Yemen (Schild et al. 2013: 12). As a consequence of its work, it was proven that

[12] https://pcma.uw.edu.pl/2017/12/19/faras/ [24.01.25].



FIGURE 5. Detachment of a wall painting in Faras, Professor Michałowski on the right (photo by G. Gerster)

Eastern Africa was one of the oldest centres of ceramic vessel production and also one of the earliest places where cattle domestication began.[13] The results of the Expedition's interdisciplinary research have been published in many scientific publications. For several decades, its work was directed by Romuald Schild (Fig. 7), and later also by Michał Kobusiewicz, Jacek Kabaciński and Przemysław Bobrowski.

At the end of 1964, Kazimierz Michałowski arrived in Old Dongola with a Sudanese antiquities inspector to select a site for future excavations. Following the significant discoveries at Faras, further research on medieval Nubia was imperative. Just a few weeks of work were enough to uncover the main nave of a church with granite columns. Subsequent campaigns fully exposed the structure, which was dated to the 8th century based on architectural parallels with Faras. Additionally, a baptistery, decorated terracotta window grilles, a bronze baptismal font, and the remains of a southern church were discovered (Michałowski 1983, 183–191). Work at this vast site, covering over 200 hectares, has continued into modern times. In recent years, numerous research grants have been secured, including a prestigious ERC grant for Artur Obłuski.[14]

In 1964, French-Polish archaeological excavations were conducted on the site of the abandoned village of Montaigut in France. The research was preceded by earlier field prospection. The director of the work on the Polish side was Witold Hensel (Hensel et al. 1965, 303–304). In the second half of the 1960s, Polish archaeologists, together with French colleagues, carried out excavations on several other abandoned settlements, including Saint-Jean-le-Froid and Condorcet (Gayraud 1975, 307). The research project, carried out by

[13] https://naukawpolsce.pl/aktualnosci/news%2C361266%2Csesja-poswiecona-45-leciu-combined-prehistoric-expedition.html [01.09.25].

[14] The list of project directors and research projects related to Dongola is available on the website of the Polish Centre of Mediterranean Archaeology: https://pcma.uw.edu.pl/2017/12/27/13493/ [24.01.25].



FIGURE 6. Facade of the temple in Abu Simbel (photo: PCMA)

the Polish Academy of Sciences together with the École Pratique des Hautes Études in Paris, aimed to investigate the phenomenon of abandoned medieval villages (Rębkowski 2012, 45).

Since 1965, Polish excavations have also been ongoing in Cyprus, focusing on the ancient city of Nea Paphos. During the first season alone, a collection of well-preserved Hellenistic sculptures was discovered. Subsequent finds included numerous high-value silver coins depicting Alexander the Great, Roman mosaics, additional sculptures, and the identification of a Roman proconsul's palace, to name just a few of the most significant discoveries (Michałowski 1983, 211–214). The work initiated by Kazimierz Michałowski was continued by Wiktor Andrzej Daszewski and later Henryk Meyza. In recent years,[15] excavations on the agora have been directed by Ewdoksia Papuci-Władyka, which will be discussed in more detail in the following section of this work.

Polish archaeologists also made their mark on the Iberian Peninsula. Particularly significant were the joint Polish-Spanish excavations conducted in the late 1970s at the medieval Mozarabic site of Marmuyas (1978–1982), initiated by Spain's National Research Council (Consejo Superior de

[15] Key information about the site, including a list of excavation directors, can be found on the Polish Centre of Mediterranean Archaeology website: https://pcma.uw.edu.pl/2017/11/17/nea-pafos [24.01.25].

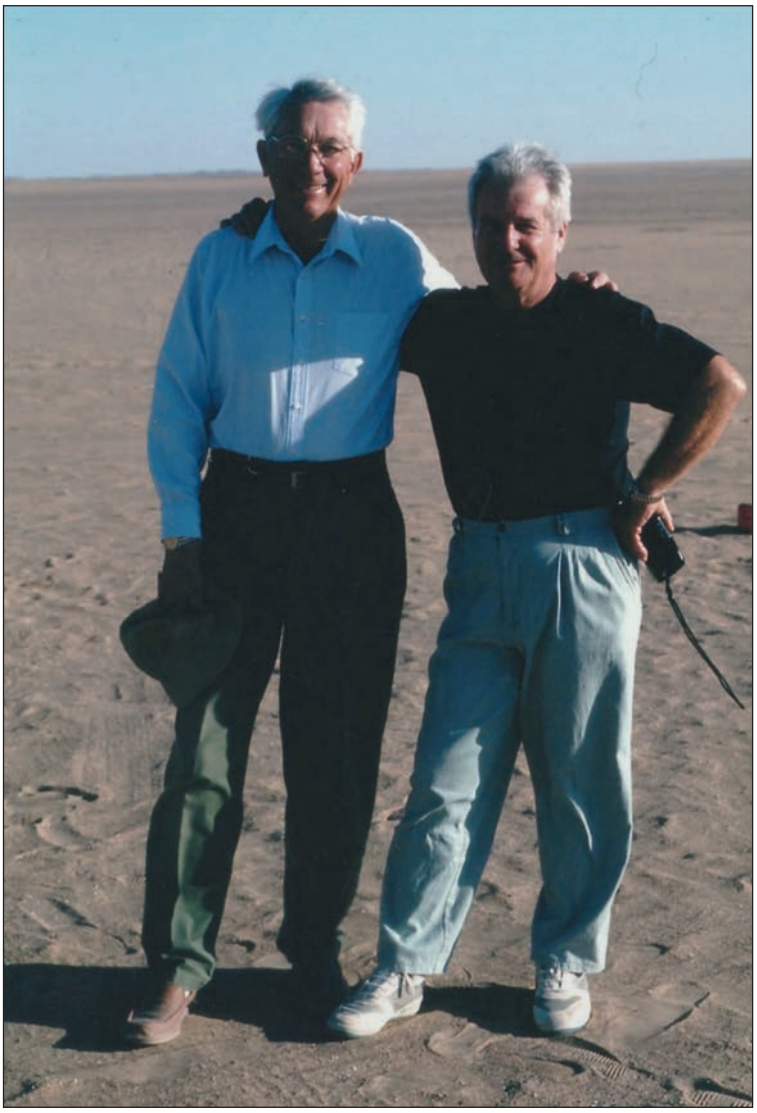


FIGURE 7. Fred Wendorf and Romuald Schild in Nabta Playa – first directors of CPE (courtesy of Jacek Kabaciński)

Investigaciones Científicas) in Madrid. The Spanish team invited Polish archaeologists who had gained considerable fieldwork experience through Poland's Millennium Research Program. The Polish team was led by Professor Lech Leciejewicz, and the collaboration resulted in a joint publication of research findings in the journal *Przegląd Archeologiczny* (Leciejewicz et al. 1985). This wasn't Professor Leciejewicz's only research activity on the Iberian Peninsula. In 1988, he was invited as a consultant for excavations at San Salvador de Valdediós in Asturias, and in 1994 he served in the same capacity during excavations at Purchena in Almería province (Krueger 2021, 422).

Between 1972 and 2003, a Polish archaeological mission directed by Lech Krzyżaniak conducted excavations at Kadero in Sudan (Fig. 8). These interdisciplinary investigations covered settlement remains and burial grounds,[16] yielding valuable information about daily life, economy and social structure of Neolithic populations.

Mesopotamia became another new research area for Polish archaeologists in the 1970s. Excavations were initiated at Nimrud in Iraq by

[16] https://pcma.uw.edu.pl/2017/12/04/kadero/ [24.01.25].



FIGURE 8. Kadero, Sudan, 1991, Neolithic cemetery, Lech Krzyżaniak documenting a grave (photo from the Archaeological Museum in Poznań, archival photo no. inv. 44 000, author: Karla Kroeper (?))

Kazimierz Michałowski, with Janusz Meuszyński (Fig. 9) from Warsaw leading three excavation seasons from 1974 to 1976 (Michałowski 1977, 332–333).

In the mid-1970s, archaeological research was initiated jointly with Algerian scholars at the site of Tlemcen in Algeria. The work had a research and training character. The director of these works on the Polish side was Witold Hensel (Konopka 1974, 310).

Another area of Polish archaeological research were the Balkans. In the mid-1970s, excavations began at the old town in Prilep. The work was directed by Witold Hensel (Konopka 1974, 308).

In 1978, archaeological investigations were conducted in Peru's Cordillera Huayhuash region, exploring previously unstudied areas which led to the discovery of new archaeological sites under Andrzej Krzanowski's direction.[17] These were the first Polish team-based archaeological investigations in South America.

From 1979 to 1985, Polish archaeologists led by Joachim Śliwa collaborated with researchers from the German Archaeological Institute in Cairo to study Middle Kingdom architectural remains at Qasr el-Sagha in the northern part of Egypt's Faiyum Oasis. Later, geophysical surveys were conducted at the site under Tomasz Herbich's direction (Herbich 1999).

In the late 1970s, Polish archaeologists were invited to conduct research in Iraq in connection with planned reservoir construction on the Tigris,

[17] https://theexplorersclubpolska.pl/pl/component/content/article/mariusz-ziokowski?catid=35&Itemid=101&format=html [30.01.25].

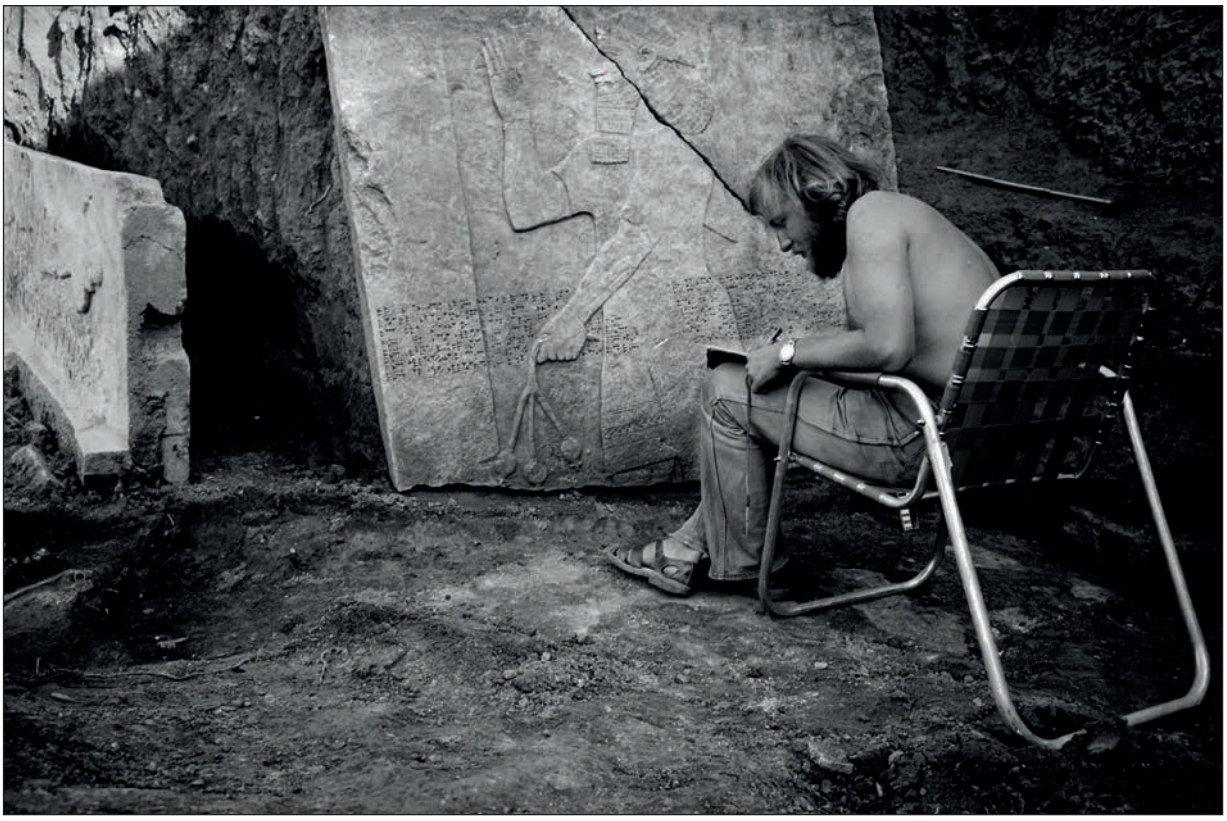


FIGURE 9. Janusz Meuszyński, director of the mission in Nimrud (photo by A. Bodytko)

Euphrates and Diyala rivers. Following preliminary surveys, excavation sites were selected at Bijan on the Euphrates and Tell al-Saadiya on the Diyala (Kozłowski et al. 1986, 135).

The first site was investigated by Maria Krogulska's team from 1979 to 1983. Located on an island in the Euphrates, the site revealed settlement structures dating to the first millennium BCE, including a multi-phase mudbrick fortress – one of many Neo-Assyrian border strongholds. Parthian structures and artefacts (including graves), Roman remains (connected with a Roman military presence in the mid-3rd century CE), and early Islamic finds were also uncovered (Kozłowski et al. 1986, 135–140).

Tell al-Saadiya, investigated by Stefan K. Kozłowski's team between 1979–1980, contained settlement and burial structures dating to the Ubaid period. Among the movable artefacts, numerous pottery fragments and flint tools were particularly noteworthy. The team also discovered 26 infant burials, with bodies placed in jars (often with necks removed), cups, bowls, and other vessels (Kozłowski et al. 1986, 135–138).

The same scholar researched the Masnaa site complex in the Middle Euphrates region from 1981–1983, focusing primarily on Palaeolithic sites. Discoveries included hand axes, pebble tools (among Iraq's oldest artefacts), as well as Levallois-Mousterian type artefacts and Upper Palaeolithic materials (Kozłowski et al. 1986, 135–138).

The Nemrik site in Iraq has been investigated since 1985 under Stefan K. Kozłowski's direction through surface surveys and excavations, revealing flint materials, animal bones, and pottery (Kozłowski et al. 1986, 142).

Since the same year, Tell Raffaan and Tell Rijim sites have been researched under Piotr Bieliński's direction. Tell Raffaan, located on the Tigris and dating to the Uruk culture, yielded flint and obsidian tools and flakes, along with numerous pottery fragments and a stone-lined grave. Just 1 km from Raffaan, the multicultural settlement of Rijim contained layers dating to the first half of the 3rd



FIGURE 10. Documentation of petroglyphs, Dakhleh Oasis Project (photo by E. Kuciewicz)

millennium BCE, Khabur ware pottery, a 2nd millennium BCE stone structure, and Neo-Assyrian period materials including pottery, a cylinder seal, and stone architectural remains (Kozłowski et al. 1986, 143, Koliński 2000b).

Since 1983, field research on Crete has been conducted under Krzysztof Nowicki's direction, involving landscape surveys to identify individual sites and settlement complexes, investigations of mountain peak sanctuaries, and joint excavations with archaeologists from the British School at Athens at the Karfi site. These investigations are currently carried out under the auspices of the Polish Institute of Archaeology in Athens.[18]

Between 1983 and 1985, Polish archaeologists under the general direction of Witold Hensel conducted excavations in cooperation with Italian partners on the island of Murano. The main goal of the research was to learn about the origins of Venice (Konopka 1987, 256). The results include a number of publications, including a recently published extensive, bilingual Polish-Italian monographic work on the archaeology of the island of Murano.[19]

From 1985, through Mariusz Ziółkowski's collaboration with an Italian mission working in the Andes, numerous Polish researchers gained opportunities to conduct fieldwork in Peru. This led to the establishment of the Andean Archaeological Mission.[20]

Since the mid-1980s, a significant increase in Polish research initiatives has been observed, primarily in Mediterranean countries but not exclusively. Since 1985, work in Egypt's Dakhla Oasis has focused on discovering and documenting rock art (Fig. 10). Initially directed by Lech Krzyżaniak

[18] https://iaepan.edu.pl/instytut/struktura/osrodki/osrodek-archeologii-starozytnej-grecji-i-rzymu/pracownicy/prof-dr-hab-krzysztof-nowicki/ [30.01.25].

[19] https://iaepan.edu.pl/ammuriana-wyspa-murano-w-swietle-wykopalisk/ [17.04.26].

[20] https://archeowiesci.pl/polscy-archeolodzy-za-oceanem-katedra-archeologii-ameryk-uw/ [06.02.25].



FIGURE 11. Michał Kobusiewicz at work (courtesy of Jacek Kabaciński)

and Michał Kobusiewicz (Fig. 11), the project is now led by Paweł Polkowski, having documented over 1,300 petroglyph sites spanning from prehistory to modern times.[21]

Polish archaeologists have also made significant contributions in the Americas. While individual researchers conducted scientific work in Mexico and Cuba as early as the 1970s (Iwaniszewski 2007, 200–203), more substantial scholarly impact came from the comprehensive, comparative and team-based Polish-American research (1985–1992) on cultural development of Stone Age hunter-gatherer communities in the Midwest prairies. Parallel comparative studies were conducted in Poland through excavations at Wojnowo. Polish archaeologists participated in archaeological investigations in Iowa and Illinois (Iwaniszewski 2007, 199).

Successes in the Middle East and America didn't diminish archaeological activities elsewhere. In 1986, Professor Jerzy Kmieciński initiated collaboration between the University of Łódź and the University of Santiago de Compostela in Spain (Grabarczyk 1995, 91). From 1987 to 1993, a Polish team led by Professor Kmieciński participated in excavations at Castro A Graña and the Roman villa Agro de Nogueira in Galicia's Furelos river valley, along with field surveys and test excavations at three other castro-type sites: San Xiao do Monte, Piñero and Vilamor (Grabarczyk 1995, 94–95). These investigations were summarized in several scholarly articles and fostered intensive academic exchange between Polish and Spanish archaeologists (Krueger 2021, 423).

Since 1986, the Polish Archaeological Expedition at Naqlun in Egypt has been active (Fig. 12).

[21] https://pcma.uw.edu.pl/2017/11/14/oaza-dachla/ [06.02.25].



FIGURE 12. Monastery of the Archangel Gabriel (photo by J. Kucy)

Directed by Włodzimierz Godlewski until 2020, then by Robert Mahler, the research focused on monastic hermitages and cemeteries, yielding significant discoveries including 11th-century wall paintings, archives, a 1100 AD Coptic codex of the Gospel of St. John, well-preserved textiles and glass vessels[22].

From 1987–1990, the Polish-Egyptian Archaeological and Conservation Mission at el-Ashmunein, led by Marek Barański, conducted archaeological and conservation work on Hellenistic and Roman remains, particularly focusing on preserving a 5th century AD basilica.[23]

Since 1987, the Polish-Egyptian Archaeological Mission at Marina el-Alamein, initially directed by Wiktor Andrzej Daszewski and later by Krzysztof Jakubiak, has excavated and conserved the ancient port city on Egypt's northern coast, investigating Hellenistic and Roman residential and funerary architecture.[24]

Also beginning in 1987, excavations and conservation work at the cemetery near Djoser's Step Pyramid in Saqqara, Egypt, directed first by Karol Myśliwiec then Kamil Kuraszkiewicz, have revealed numerous tombs and burials primarily from the Old Kingdom period.[25]

## Archaeological Fieldwork Initiated After 1989

The systemic transformation in Poland after the collapse of Communist rule in 1989, affecting many aspects of social life, also significantly influenced archaeological field projects conducted abroad. The fall of the Iron Curtain allowed for much greater freedom in implementing projects in distant

22 https://pcma.uw.edu.pl/2017/11/18/naklun/ [06.02.25].
23 https://pcma.uw.edu.pl/2018/01/19/ashmunein/ [06.02.25].
24 https://pcma.uw.edu.pl/2017/11/26/marina-el-alamein/ [06.02.25].
25 https://pcma.uw.edu.pl/2017/11/05/sakkara/ [06.02.25].

regions of the world. Changes in research funding systems positively impacted the ability to carry out field research projects. Poles conducted research not only in Europe but also in Asia, Africa, and the Americas.

## Asia

Between 1989 and 1990, a Polish archaeological mission led by Stefan Karol Kozłowski conducted rescue excavations at the Epipaleolithic settlement of M'lefaat near Mosul, Iraq, as part of the "Eski Mosul Dam Salvage Project". Discoveries included round houses dating back to the 9th millennium BCE.[26]

The program of rescue archaeological research in Syria and Iraq continued until the 1990s. Excavations were carried out at sites such as Tell Djassa el-Gharbi, Tell Rad Shaqrad, and Tell Abu Hafur (Koliński, Ławecka 1992: 177; Koliński 1996; Koliński 2000a). This period of rescue research served as an excellent training ground for Polish archaeologists before transitioning to long-term projects.

In 1990, a Polish mission led by Michał Gawlikowski conducted excavations in the ancient city of Hatra in northern Iraq, focusing on urban fortifications,[27] among other features. Starting in 1996, excavations began at Tell Arbid[28] in northeastern Syria (Fig. 13) under the direction of Piotr Bieliński.[29] Between 2007 and 2010, a Poznań-based mission led by Rafał Koliński worked on the western slope of the tell, uncovering numerous graves from the Khabur culture period and a post-Akkadian structure (Koliński 2013). Both missions continued their work until the outbreak of the Syrian civil war in 2011.

As a result of the war, archaeological activity in Syria nearly ceased, and archaeologists, including Poles, shifted their focus to Iraqi Kurdistan (Fig. 14). Since 2012, Rafał Koliński, along with archaeologists from Poznań and Warsaw, has been conducting extensive surface surveys aimed at identifying prehistoric, protohistoric, and medieval settlements. These efforts have led to the discovery of hundreds of new archaeological sites, documented in monographs published by Harrassowitz Verlag. One of the most spectacular finds was fragments of reliefs, depicting a mythological scene of the god Enki and the goddess Ninmah creating humans from clay (Koliński 2021).

Since 1992 to the present, Andrzej Rozwadowski has been conducting field research in various regions of the world (Uzbekistan, Kazakhstan, Russia, South Africa, USA, Sudan, Egypt, Kyrgyzstan, Peru, Canada), focusing on rock art studies (Fig. 15), including contemporary reception of this art form.[30]

Since 1995, excavations at the Ayakagytma site in Uzbekistan have been conducted by a Polish-Uzbek expedition led by Karol Szymczak, investigating an Early Neolithic campsite. The discoveries include rich flint, stone and ceramic materials, remains of domesticated animals, and the identification of two settlement phases.[31]

From 1996 to 2016, with interruptions, archaeological research was carried out at the Chhîm site in Lebanon (Fig. 16) under the direction of Tomasz Waliszewski. The work concentrated mainly on a Hellenistic-Roman sanctuary, residential buildings and Early Byzantine period olive presses.[32]

The following year, the same scholar's team began research at Jiyeh (Fig. 17) on the Lebanese Mediterranean coast, a multicultural site identified with the Greco-Roman city of Porphyreon. Fieldwork continued intermittently until 2014.[33]

In 1997, Barbara Kaim initiated excavations at the Zoroastrian fire temple in Mele Hairam, conducted in cooperation with Turkmenistan's Ministry of Culture. This Sasanian-period temple complex consisted of six chambers.[34]

[26] https://pcma.uw.edu.pl/2017/11/19/mlefaat/ [06.02.25].
[27] https://pcma.uw.edu.pl/2017/12/10/hatra/ [06.02.25].
[28] The bibliography on Tell Arbid is available at: http://www.tellarbid.uw.edu.pl/ [06.02.25]
[29] In 2021, there was a change in the leadership of the Tell Arbid excavations; Anna Smogorzewska replaced Piotr Bieliński: https://pcma.uw.edu.pl/2021/07/08/zmiana-kierownictwa-ekspedycji-tell-arbid-i-tell-qaramel/ [06.02.25]
[30] https://archeo.amu.edu.pl/Pracownicy/pracownicy-wydzialu/Pracownicy-naukowo-dydaktyczni/andrzej-rozwadowski [06.02.25].
[31] https://www.archeologia.uw.edu.pl/ayakagytma-obozowisko-wczesnoneolityczne-w-uzbekistanie/ [06.02.25].
[32] https://pcma.uw.edu.pl/2018/01/10/chhim/, https://www.archeologia.uw.edu.pl/chhim-swiatynia-rzymska-w-libanie/ [15.02.25].
[33] https://pcma.uw.edu.pl/2017/12/07/jiyeh/ [15.02.25].
[34] https://www.archeologia.uw.edu.pl/mele-hairam-zoroastryjska-swiatynia-ognia-w-iranie/ [15.02.25].



FIGURE 13. View of the site of Tell Arbid from the east (photo by A. Reiche)



FIGURE 14. The oldest rock relief in Mesopotamia (2150 BCE) documented in northern Iraq in 2016. The Ugzar Project, led by Rafał Koliński from the Department of Archaeology at Adam Mickiewicz University in Poznań (photo by D. Piasecki)



FIGURE 15. Rock paintings in the Stormberg Mountains, South Africa (photo by A. Rozwadowski)

From 1998 to 2009, excavations beneath a church ruin in the Syrian village of Hawarte revealed an underground Mithraeum, directed by Michał Gawlikowski.[35]

From 1999 to 2013, with interruptions, surveys in Lebanon's Iqlim el-Kharroub province under Mahmoud El-Tayeb's direction discovered dozens of new archaeological sites.[36]

Between 1999–2011, the Polish-Syrian Mission at Qaramel in Syria led by Ryszard Mazurowski uncovered dozens of Early Neolithic architectural features, ornamented stone artefacts and skeletal burials.[37]

The year 2001 marked the beginning of Polish archaeological research at Çatalhöyük in Turkey, a site inscribed on the World Heritage List (Filipowicz et al. 2021, 12). Polish researchers working under the direction of Arkadiusz Marciniak in a designated area called Team Poznań (2001–2008) formed part of an international team led by Ian Hodder. Excavations focused primarily on Neolithic and post-Neolithic structures, and the findings regarding the transformations that changed the character of the settlement (Marciniak 2019, 17) had a significant impact in both academic circles and international media. The research at this archaeological site continues to this day (Fig. 18) (Filipowicz et al. 2025).

Between 2004 and 2008, surface surveys were conducted in the microregion forming the economic hinterland of Sidon under the direction of Michał Neska and Krzysztof Jakubiak. The work uncovered flint workshops, settlements, and burial grounds.[38]

From 2007 to 2012, a Polish-Kuwaiti archaeological project was carried out in the Al-Subiyah region of Kuwait for rescue research purposes. Work focused primarily on a tumulus cemetery,

[35] https://pcma.uw.edu.pl/2017/12/09/hawarte/ [15.02.25].
[36] https://pcma.uw.edu.pl/2017/12/08/iqlim-el-kharoub/ [15.02.25].
[37] https://pcma.uw.edu.pl/2017/10/11/tell-qaramel/ [15.02.25].
[38] https://pcma.uw.edu.pl/2017/12/30/dolina-eszmun/ [15.02.25].



FIGURE 16. Roman temple at Chhim (photo by A. Oleksiak)

establishing the chronology of the site and its main phases of occupation. The research was initially directed by Piotr Bieliński and later by Łukasz Rutkowski.[39]

In 2007 and 2017, surface surveys were conducted at the Khalde site in Lebanon under the direction of Tomasz Waliszewski and Mariusz Gwiazda. The work revealed, among other things, remains of a Roman and Early Byzantine settlement.[40]

Between 2008 and 2010, Barbara Kaim and her team conducted excavations at Khune-ye Div in Iran. The research uncovered a Late Sasanian architectural complex, probably a fire temple.[41]

Since 2008, under the direction of Piotr Bieliński and later Agnieszka Pieńkowska, work has been carried out at the Bahra site in Kuwait as part of the Kuwaiti-Polish Archaeological Mission. The research has focussed on a large settlement dating to the Ubaid period.[42] Among the discoveries at the site is the first anthropomorphic figurine found in the Persian Gulf region.

Since 2011, a mission from Kraków has been operating in Nea Paphos, Cyprus, where work has been ongoing since 1960, merging with the Warsaw mission. Ewdoksia Papuci-Władyka took over its leadership. The site has yielded numerous spectacular artefacts, primarily from the Hellenistic and Roman periods, including high-quality mosaics. Fieldwork was complemented by laboratory analyses of archaeological finds.[43] In 2025, the Polish Centre of Mediterranean Archaeology, University of Warsaw, established its research

39 https://pcma.uw.edu.pl/2018/01/20/al-subiyah/ [15.02.25].
40 https://pcma.uw.edu.pl/2017/12/02/khalde/ [15.02.25].
41 https://pcma.uw.edu.pl/2017/11/30/khune-ye-div/ [15.02.25].
42 https://pcma.uw.edu.pl/2018/01/17/bahra-1/ [15.02.25].
43 https://naukawpolsce.pl/aktualnosci/news%2C106054%2Cpolscy-archeolodzy-juz-60-lat-odkrywaja-historie-cypryjskiego-miasta-nea [15.02.25].



FIGURE 17. Domestic architecture in Jiyeh (photo by M. Bogacki)

station in Nea Paphos, serving as a logistical base for Polish archaeologists working in Cyprus henceforth.[44]

In 2012, surface surveys were conducted on Failaka Island, Kuwait, to identify and determine the extent of traditional fishing settlements.[45] Since 2013, excavations have been carried out at the late Islamic period site of Kharaib al-Desht[46] on the island, along with research aimed at discovering archaeological sites located in the tidal zone around the island.[47] These investigations were directed by Piotr Bieliński.

Between 2012–2019, excavations took place in Siberia in collaboration with Russian archaeologists. Both settlements and burial grounds from the Scythian period were examined. Łukasz Oleszczak led the Polish team.[48]

From 2012 to 2022, a Polish-Georgian archaeological expedition co-directed by Radosław Karasiewicz-Szczypiorski and Natalia Lockley (Polish side) conducted geophysical surveys followed by surface and excavation work at the Roman fort of Gonio-Apsaros in Georgia. Among the most significant discoveries were floor mosaics from the garrison commander's house.[49]

Since 2013, the Armenian-Polish Archaeological Mission in Metsamor, led by Krzysztof Jakubiak (Polish side), has been conducting excavations and surface surveys at the Metsamor settlement complex in Armenia. The discovered artefacts

44 https://naukawpolsce.pl/aktualnosci/news%2C108332%2Ccypr-uniwersytet-warszawski-otworzyl-archeologiczna-stacje-badawcza-w-pafos [15.02.25].
45 https://pcma.uw.edu.pl/2017/12/22/fajlaka-badania-powierzchniowe/ [15.02.25].
46 https://pcma.uw.edu.pl/2017/12/21/kharaib-el-desht/ [15.02.25].
47 https://www.archeologia.uw.edu.pl/failaka-badania-strefy-przybrzeznej-wokol-wyspy/ [15.02.25].
48 https://siberia-scythica.pl/ [15.02.25].
49 https://pcma.uw.edu.pl/2017/12/13/gonio-apsaros/ [15.02.25].



FIGURE 18. Çatalhöyük, East Area (photo by M. Dembowiak)

and settlement structures mainly date to the Late Bronze and Iron Ages.[50]

During the same period (2013–2018), research was carried out at the Katta Sai 1 and 2 sites by a Polish-Russian-Uzbek archaeological expedition under Karol Szymczak's direction. These are settlements of Palaeolithic hunters from approximately 40,000 years ago, where discoveries included a stone tool production workshop.[51]

Since 2014, field surveys and excavations have been conducted in southern Jordan (Fig. 19). The main objective of this research is to determine the role of southern Jordan (including the At-Tafila region) during the Early Bronze Age through analyses of settlement patterns, contacts with Egypt and the Levant, and artefact studies. The project is directed by Piotr Kołodziejczyk (Kołodziejczyk 2019).

Between 2014 and 2015, a field survey led by Karol Juchniewicz in Lebanon identified over thirty historic architectural structures, primarily Muslim funerary chapels.[52]

During a similar period (2014–2016), the Beit Ras (Capitolias) Archaeological Project was carried out under the direction of Jolanta Młynarczyk, focusing on elements of the ancient city, particularly its defensive wall and a winery.[53]

Michał Gawlikowski co-directed surface surveys and excavations from 2014 to 2019 as part of the Saudi-Polish Archaeological Mission in Aynuna, Saudi Arabia. Discoveries included a complex of buildings from the Roman, Late Roman, and Early Islamic periods associated with a trading post.[54]

Since 2015, the Omani-Polish Archaeological Mission in the Qumayrah Valley, led by Piotr

[50] https://pcma.uw.edu.pl/2017/11/21/metsamor/ [15.02.25].
[51] https://www.archeologia.uw.edu.pl/katta-sai/ [17.02.25].
[52] https://pcma.uw.edu.pl/2018/01/18/35168/ [17.02.25].
[53] https://pcma.uw.edu.pl/2018/01/13/beit-ras/ [17.02.25].
[54] https://pcma.uw.edu.pl/2018/01/18/aynuna/ [17.02.25].



FIGURE 19. Excavations in Wadi Feynan, site WF731 (Jordan) (photo by P. Kołodziejczyk)

Bieliński, has conducted surface surveys leading to the discovery of dozens of archaeological sites dating from the Stone Age to modern times. Excavations and test surveys have also been carried out.[55]

Also since 2015, fieldwork has been conducted in southern Mongolia in collaboration with Mongolian researchers (Fig. 20), aimed at identifying Stone Age settlements. The project is coordinated by Mirosław Masojć.[56]

Between 2016 and 2017, archaeological investigations took place at the Qumayrah Ain 2 site in northern Oman as part of the Omani-Polish archaeological project directed by Marcin Białowarczuk within Piotr Bieliński's team. The discoveries included remains of Neolithic residential and economic structures, hearths, and numerous stone and flint artefacts. Radiocarbon dating indicates the settlement was active in the second half of the 5th and the 4th millennium BCE.[57]

From 2016 to 2018, research was conducted at the metallurgical centre of Saruq al-Hadid in the United Arab Emirates under the direction of Piotr Bieliński and Iwona Zych. Among the finds were several thousand well-preserved metal artefacts dating to the Early Iron Age.[58]

In 2018, the Akkar Survey Project, led by Zuzanna Wygnańska, uncovered residential structures and Early Bronze Age dolmens, along with accompanying rock carvings.[59]

Since 2018, an archaeological mission led by Jolanta Młynarczyk and Mariusz Burdajewicz has been conducting non-invasive research at Khirbat es-Sar on the western outskirts of Amman, Jordan. A monumental architectural complex was identified

[55] https://pcma.uw.edu.pl/2017/12/28/qumayrah-ayn/ [17.02.25].
[56] https://archeo.mongolia.uwr.edu.pl/o-projekcie/ [17.02.25].
[57] https://www.archeologia.uw.edu.pl/qumayrah/ [17.02.25].
[58] https://pcma.uw.edu.pl/2017/11/04/saruq-al-hadid/ [19.02.25].
[59] https://pcma.uw.edu.pl/2019/02/19/akkar/ [19.02.25].

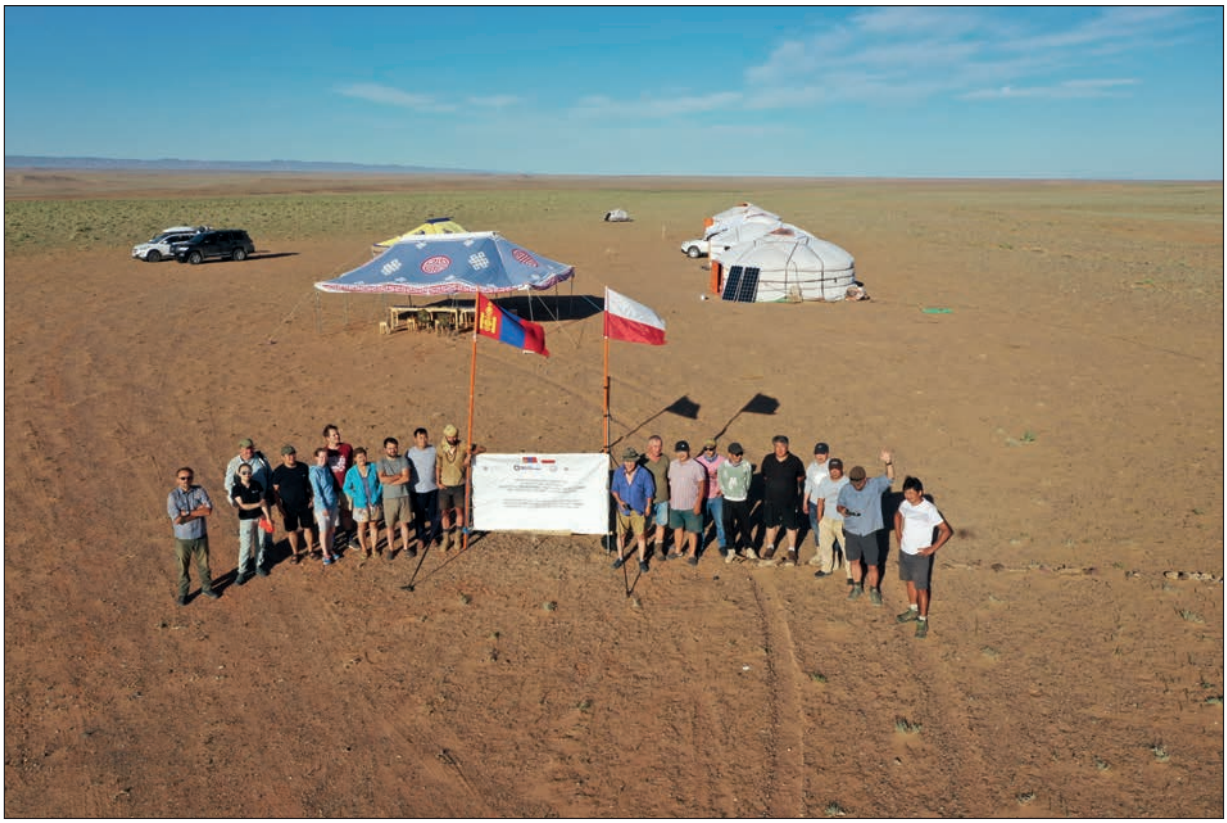


FIGURE 20. Camp of Polish-Mongolian expedition. Gobi desert, year 2023 (photo by M. Szmit)

at the site,[60] which served as a strategically located trading post from the 8th century BCE to the 14th–15th centuries CE.[61]

In the same year, research began at the Ertash Sai 1 site in Uzbekistan. This is a Palaeolithic hunter's camp dating back over 35,000 years, with preserved stratigraphic layers and stone tools. The expedition is led by Karol Szymczak.[62]

In 2020, a group of Polish researchers joined a Spanish-Lebanese team working in Tyre, Lebanon. Several research projects are currently being carried out on the material culture of Tyre, funded in part by Polish institutions. The Polish side of the research is coordinated by Francisco Núñez.[63]

In 2023, a new field research project was launched in Iraqi Kurdistan. The project aims to study two poorly understood settlement phenomena in northeastern Iraq: the use of caves as shelters during the Stone Age and the continuity of Christian settlement in the Nahla Valley into modern times. The research is led by Rafał Koliński.[64]

Since 2024, excavations have been conducted as part of the Armenian-Polish Archaeological Expedition in Argishtihinili, with Mateusz Iskra leading the Polish team.[65] The same researcher is collaborating with local archaeologists at the Davti Blur site in Armenia, where work also began in 2024.[66]

60 https://www.archeologia.uw.edu.pl/od-biblijnych-ammonitow-do-mamelukow-badania-archeologiczne-w-khirbat-sarah-khirbat-as-sar/ [21.02.25]
61 https://pcma.uw.edu.pl/2017/12/01/khirbet-sarah/ [21.02.25].
62 https://www.archeologia.uw.edu.pl/ertash-sai/ [21.02.25].
63 https://pcma.uw.edu.pl/2017/10/03/tyr/ [21.02.25].
64 https://projekty.ncn.gov.pl/opisy/559008-pl.pdf [21.02.25].
65 https://pcma.uw.edu.pl/2018/01/19/argishtikhinili/ [21.02.25].
66 https://wszystkoconajwazniejsze.pl/pepites/archeolodzy-z-polski-odkrywaja-tajemnice-davti-blur/ [03.03.25].



FIGURE 21. Research in the Kiik Kamar Cave in Uzbekistan (photo by Hermano)

In 2024, Małgorzata Kot received an ERC Consolidator Grant for a five-year research project in Central Asia (Fig. 21). The project aims to trace technological innovations in stone tool production and study the relationships between hominins through genetic analysis. Previous work by the researcher has led to the discovery of Pleistocene-era layers containing stone artefacts, hearths, and animal bones, raising the possibility of finding human remains suitable for genetic studies.[67]

## Africa

Since the first half of the 1990s, field archaeological work as part of various scientific projects has been conducted in Sudan under the direction of Henryk Paner. These activities included not only

[67] https://www.uw.edu.pl/erc-consolidator-grant-dla-prof-malgorzaty-kot/ [03.03.25].

surface surveys but also excavations in various parts of the country.[68] Recently, the aforementioned researcher has completed a project titled "Prehistoric communities in the Bayuda Desert in Sudan – new borders of the Kerma Kingdom".[69]

From 1998 to 2020, archaeological excavations and conservation work were carried out at the fortified settlement of Banganarti on the right bank of the Nile in Sudan under the direction of Bogdan Żurawski. The discoveries included medieval inscriptions, wall paintings, remains of sacred architecture, and smaller artefacts.[70] The same researcher also led surface surveys on the right bank of the Nile (Żurawski 2003). Work in this area was later continued in the context of Stone Age research by Marta Osypińska's team (Osypińska, Osypiński 2015), as well as in broader sub-Saharan Africa (Osypińska et al. 2019). In spring 2023, all archaeological work in Sudan was suspended due to the outbreak of civil war[71].

In 1998, surface surveys were conducted near the village of Selib in Sudan, followed by excavations and conservation work a decade later. The discoveries included new archaeological sites, religious structures, and public utility buildings. The project, led by Bogdan Żurawski, was completed in 2020.

Since 1998, excavations at Tell el-Farcha have uncovered structures and artefacts dating from the 6th to the 3rd millennium BCE. Under the direction of Marek Chłodnicki and Krzysztof Ciałowicz, discoveries included a brewing centre, gold figurines, an Early Dynastic administrative and cult centre, and the oldest mastaba in the Delta[72] (Chłodnicki 2011).

Research has often been conducted through international collaborations. For example, from 1999 to 2002, a Polish-French archaeological mission led by Adam Łukaszewicz (Polish side) carried out excavations at Dendera, Egypt. The work focused on Hellenistic and Roman urban remains east of the Temple of Hathor, revealing architectural relics primarily from the First Intermediate Period[73].

Since 2000, a Polish mission directed by Hanna Szymańska, Krzysztof Babraj, and Tomasz Derda has been excavating the ancient city of Marea in Egypt, located on Lake Mariut, 45 km from Alexandria. Discoveries include an Early Byzantine basilica, 6th-century CE baths, a funerary chapel, and one of Egypt's largest collections of ostraca.[74]

In 2001, at the initiative of Tomasz Mikocki, research began in ancient Ptolemais, Libya, focusing on residential structures. Discoveries included a 3rd-century CE house decorated with mosaics, frescoes, and an inscription bearing the owner's name, as well as a residential-economic complex with cisterns, storage areas, and fragments of marble sculptures.[75] The work continued until 2010 and was recently resumed in 2023 under Piotr Jaworski's direction, with current research focusing on port infrastructure, acropolis structures, and settlement studies.[76]

From 2003 to 2004, rescue excavations were conducted in Sudan on the islands of Saffi and Uli in the Nile (Fourth Cataract region) and on the left bank of the Nile between Khor Umm Ghizlan and Shemkhiya. This area was threatened by flooding due to the construction of the Merowe Dam. The project, led by Lech Krzyżaniak, Bogdan Żurawski, Włodzimierz Godlewski, and Marek Chłodnicki, resulted in the discovery and documentation of numerous artefacts at newly identified sites (Merowe Dam 2005, 321–323). The left bank of the Nile was also investigated in later years (Chłodnicki 2007; Chłodnicki, Stępnik 2013).

From 2003 to 2009, the Polish-Egyptian Archaeological Mission worked at Tell el-Farama (ancient Pelusium) in Egypt, initially directed by Michał Gawlikowski and later by Krzysztof Jakubiak. The team conducted excavations and geophysical surveys, including investigations of a large Roman theatre and residential buildings.[77]

Since 2003, with interruptions, the Polish-Egyptian Archaeological Mission has been operating at

[68] https://pcma.uw.edu.pl/o-nas/pracownicy/henryk-paner/ [01.09.25].
[69] https://projekty.ncn.gov.pl/opisy/358112-pl.pdf [01.09.25].
[70] https://pcma.uw.edu.pl/2018/01/16/banganarti/ [03.03.25].
[71] https://archeosudan.org/ostatnie-dwa-sezony-w-sudanie/ [03.03.25].
[72] https://pcma.uw.edu.pl/2017/10/15/tell-el-farcha/ [03.03.25].
[73] https://pcma.uw.edu.pl/2017/12/31/dendera/ [03.03.25].
[74] https://pcma.uw.edu.pl/2017/11/27/marea/, https://www.archeologia.uw.edu.pl/marea/ [03.03.25].
[75] http://ptolemais.uw.edu.pl/badania/wykopaliska/ [03.03.25].
[76] https://serwisnaukowy.uw.edu.pl/przerwana-lekcja-archeologii-niedostepne-miasto-znow-otwarte-dla-polskich-naukowcow/ [03.03.25].
[77] https://pcma.uw.edu.pl/2017/11/12/peluzjum/ [03.03.25].

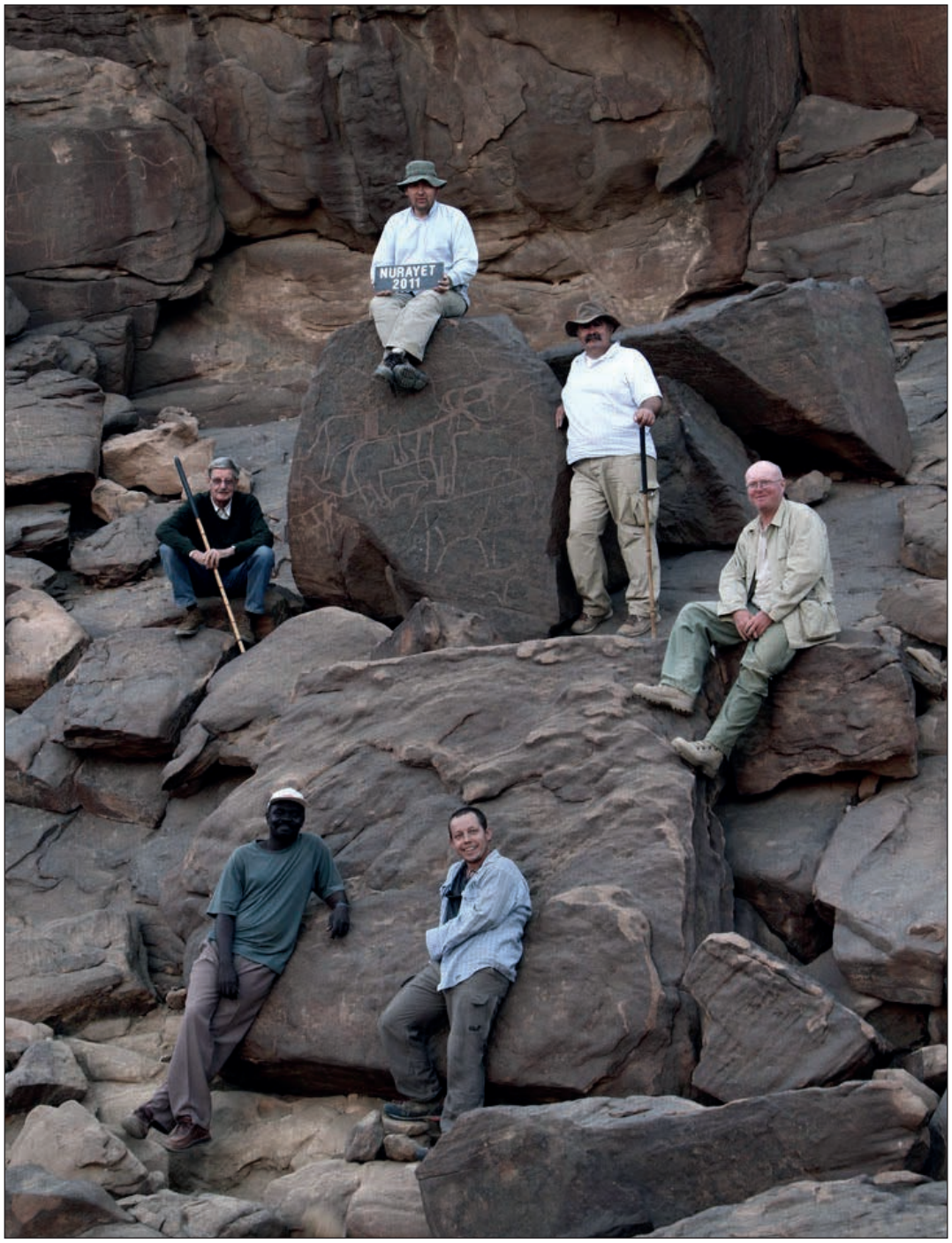



FIGURE 22. Members of the Bir Nurayet Mission (photo by M. Jórdeczka)

Sheikh Abd el-Qurna in Egypt under successive directors: Tomasz Górecki, Andrzej Ćwiek, and Aleksandra Pawlikowska-Gwiazda. Their research has focused on storage structures, craft workshops, and Middle Kingdom tombs later adapted into Coptic monastic hermitages[78] (Ćwiek, Kaczanowicz 2019, 65–69).

[78] https://pcma.uw.edu.pl/2017/11/02/sheikh-abd-el-gurna/ [03.03.25].

Between 2004–2017, with breaks, excavations were conducted at El-Zuma in Sudan, primarily under Mahmoud El-Tayeb's direction. The project investigated nearly thirty tumuli, yielding artefacts including jewellery, bone objects, and pottery.[79]

Since 2007, the Polish-Slovak Archaeological Mission has been working at Tell el-Retaba in Egypt, employing various methods including field surveys, geophysical prospection, and excavations of settlements dating from the Second Intermediate Period (17th-16th centuries BCE) to the Late Period (7th-4th centuries BCE). The Polish team is led by Sławomir Rzepka.[80]

Also since 2008, the Polish-American archaeological mission at Berenike in Egypt has been active under the direction of Iwona Zych and Mateusz Gwiazda, primarily uncovering Hellenistic period remains.[81]

In the same year (2008), work began at Tell el-Murra in Egypt under the direction of Mariusz Jucha and Grzegorz Bąk-Pryca. Discoveries included bread-baking installations, ceramic coffin burials, and remnants of residential structures.[82]

The year 2009 marked the beginning of Polish archaeological activities in the Gebel Ramlah area, near the Egypt-Sudan border.[83] Research has focused on settlements, burial grounds, and ceremonial structures of Neolithic pastoral communities. The project is directed by Jacek Kabaciński.[84]

Between 2010 and 2012, fieldwork was conducted at Bir Nurayet in northeastern Sudan (Fig. 22). The primary objective was to study rock carvings and associated settlements. Thousands of petroglyphs and 120 settlement sites were documented. The project was led by Przemysław Bobrowski.[85]

From 2010 to 2015, excavations took place in Wadi Khashab, Egypt. The research was directed by Piotr Osypiński. Discoveries included Neolithic human and animal burials, stone stelae, and tumuli.[86]

From 2012 to 2018, the Polish-Sudanese archaeological mission directed by Artur Obłuski conducted excavations at the Ghazali site in Sudan, primarily focusing on a well-preserved medieval monastery. Numerous inscriptions were discovered among the findings.[87]

The Polish Archaeological Expedition to Northern Asasif (Egypt) has been conducting fieldwork since 2013. Initially led by Patryk Chudzik and currently by Anastasia Stupko-Lubczyńska, the project primarily documents Middle Kingdom tomb complexes and analyses their reuse in later periods.[88]

Also from 2013 until 2020, comprehensive archaeological research was carried out in the Gebelain microregion of Egypt, including excavations, surface surveys, epigraphic studies, and conservation work. The project was directed by Wojciech Ejsmond.[89]

Since 2015, excavations have been conducted at the El-Detti site in Sudan under the direction of Mahmoud El-Tayeb. The work focused on a tumulus cemetery where over 50 burial mounds were uncovered.[90]

In 2015, research began at the Monastery of the Syrians (Deir al-Surian, Egypt), led by Dobrochna Zielińska. The project aims to reconstruct the developmental phases of the structure, which has been in use since the 7th century. The study examines architectural modifications, stratigraphy of wall paintings and inscriptions, and the iconography of the wall decorations.[91]

79 https://pcma.uw.edu.pl/2017/12/23/el-zuma/ [04.03.25].
80 https://pcma.uw.edu.pl/2017/10/14/tell-el-retaba/, https://www.archeologia.uw.edu.pl/tell-el-retaba-egipska-twierdza-w-wadi-toumilat/ [04.03.25].
81 https://pcma.uw.edu.pl/2018/01/12/berenike/ [06.03.25].
82 https://pcma.uw.edu.pl/2017/10/15/tell-el-murra [06.03.25].
83 https://naukawpolsce.pl/aktualnosci/news%2C410437%2Cpolscy-archeolodzy-badaja-pierwszych-pasterzy-afryki.html [06.03.25].
84 https://iaepan.edu.pl/instytut/struktura/osrodki/osrodek-studiow-pradziejowych-i-sredniowiecznych/pracownicy/dr-hab-jacek-kabacinski-prof-pan/ [03.02.25].
85 https://iaepan.edu.pl/instytut/struktura/osrodki/osrodek-studiow-pradziejowych-i-sredniowiecznych/pracownicy/dr-przemyslaw-bobrowski/ [03.02.25].
86 https://pcma.uw.edu.pl/2017/10/03/wadi-khashab-2/ [06.03.25].
87 https://pcma.uw.edu.pl/2017/12/15/ghazali/ [07.03.25].
88 https://www.templeofhatshepsut.uw.edu.pl/pl/projekt_asasif.html [17.04.25].
89 https://pcma.uw.edu.pl/2017/12/17/gebelein/ [03.03.25].
90 https://pcma.uw.edu.pl/2017/12/23/el-detti/ [10.04.25].
91 https://www.archeologia.uw.edu.pl/deir-al-surian-badania-kosciola-klasztornego/ [10.04.25].



FIGURE 23. View of the Khor Shambat 1 site (2012), with the Nile River in the background, Omdurman, Sudan (photo by M. Jórdeczka)

Between 2016 and 2019, a research project directed by Maciej Jórdeczka conducted three excavation seasons at the Shambat 1 site in central Sudan (Fig. 23), dating from the early 7th to the second half of the 4th millennium BCE.[92] The excavations yielded rich material for analyzing settlement patterns and daily life of hunter-gatherers and pastoral communities.

Since 2016, field research in Sudan has led to the discovery of settlement remains associated with Acheulean tradition toolmakers and new routes used by the African variant of Homo erectus.[93] The 2016–2019 project was directed by Mirosław Masojć. In 2022, this researcher secured funding for a new grant focusing on excavations and studies of Acheulean settlement and its development in the Eastern Sahara region.[94]

Between 2016 and 2020, field research was conducted at Bargat el Sheb (Fig. 24) and sites at the foot of the Eocene Escarpment in Egypt. The aim was to investigate Neolithic settlement in the area and its influence on the emergence of ancient Egyptian civilization. Material obtained during excavations was analyzed using specialized methods. The project was directed by Michał Kobusiewicz.[95]

Beginning in 2016, the Tunisian-Polish Archaeological Mission in Musti has been operating under the direction (Polish side) of Tomasz Waliszewski. In the ancient city of Musti, Tunisia, excavations and non-invasive research have been carried out. The work has included studies of sacred architecture remains and the discovery of over 500 Latin inscriptions.[96]

In 2019, research began in Soba, Sudan. Excavations, geophysical surveys, and ethnological studies have been conducted under the direction of Mariusz Drzewiecki. Among the discoveries were two differently planned urban districts.[97]

[92] https://iaepan.edu.pl/instytut/struktura/osrodki/osrodek-studiow-pradziejowych-i-sredniowiecznych/pracownicy/dr-maciej-jordeczka/ [10.04.25].

[93] https://naukawpolsce.pl/aktualnosci/news%2C33804%2Cpolscy-archeolodzy-odkryli-nieznana-droge-migracji-homo-erectus-z-afryki [10.04.25].

[94] https://projekty.ncn.gov.pl/opisy/559153-pl.pdf [10.04.25].

[95] https://iaepan.edu.pl/w-oczekiwaniu-na-deszcz/ [10.04.25].

[96] https://pcma.uw.edu.pl/2017/11/18/mustis/ [10.04.25].

[97] https://pcma.uw.edu.pl/2017/11/02/soba/, https://soba.uw.edu.pl/ [10.04.25].

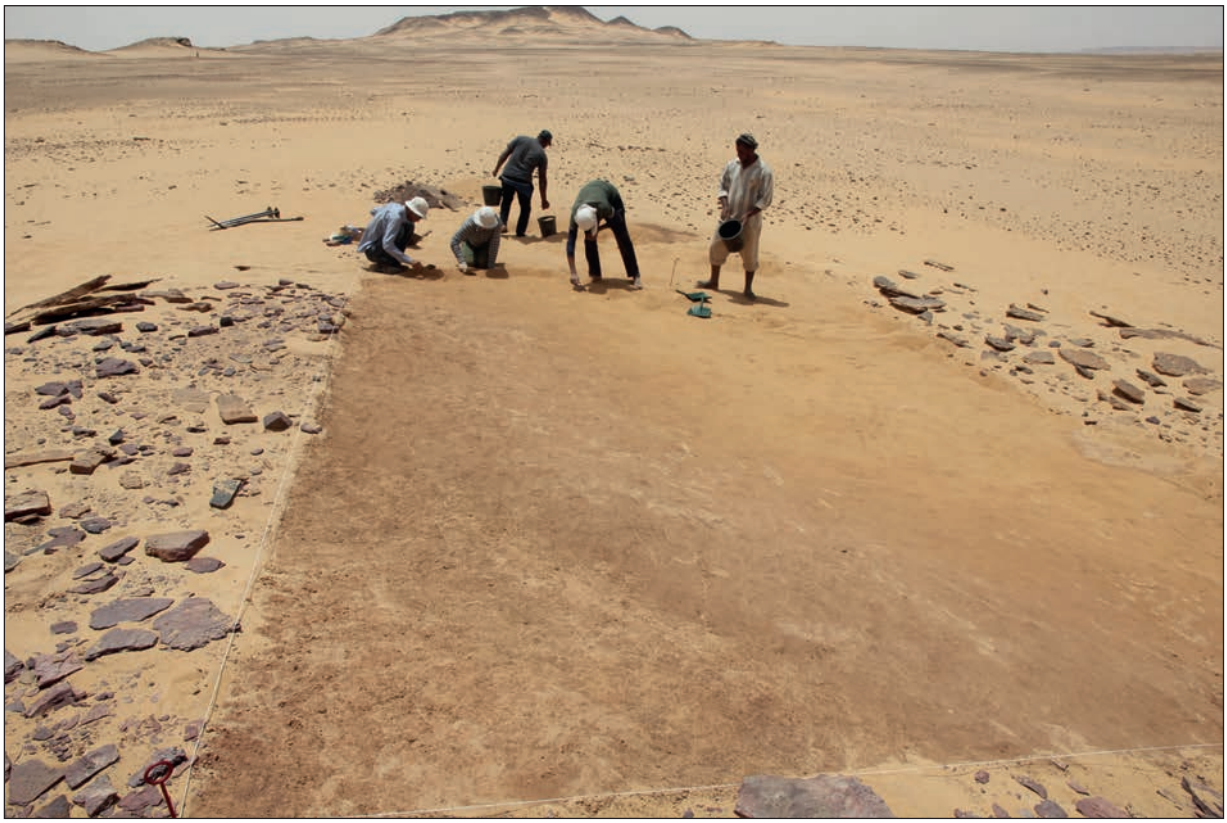


FIGURE 24. Bargat El-Shab (Western Desert of Egypt): Excavations at a Neolithic settlement (photo by P. Bobrowski)

Also in 2019, research started at Misejda (Mahas region, Sudan) under Dobrochna Zielińska's direction. The project examined the ruins of a church built around a Kushite-period rock carving, as well as surrounding archaeological sites. The "Good Shepherd"-like carving predates the region's Christianisation by at least 300 years and represents a unique phenomenon in Nubia.[98]

In 2020, work was carried out at Debre Gergis, Ethiopia, under Michela Gaudiello's direction. The team studied ruins of a church preliminarily dated to the 6th-8th centuries AD. The project was interrupted by measures related to the Covid pandemic (Gaudiello and Mackiewicz 2021, 477).

Since 2023, excavations have been conducted in Morocco as part of the Tingitana Frontier Project. The research focuses on a 1st-2nd centuries AD Roman watchtower controlling access to the Roman city of Volubilis. The project is directed by Radosław Karasiewicz-Szczypiorski and Maciej Czapski.[99]

There are more examples of Polish archaeological activity in Northwest Africa: in 2024, the Moroccan-Polish Archaeological Project in Sijilmassa, Morocco was initiated. The Polish side is led by Lorenzo de Lellis. Research concentrates on a fortified settlement that existed from the 8th to the 16th centuries.[100]

A new focus for Polish archaeologists is Tanzania. Since 2024, a multi-year research project has been underway in this country. The research concentrates on the Serengeti Plain in Tanzania, within the Great Rift Valley area – a crucial region for human evolution due to optimal environmental conditions and annual animal migrations. Dozens of new archaeological sites have already been

98 https://www.archeologia.uw.edu.pl/misejda/ [10.04.25].
99 https://pcma.uw.edu.pl/2017/10/02/zegota/ [10.04.25].
100 https://pcma.uw.edu.pl/2017/11/03/sijilmassa-pl/ [11.04.25].

discovered,[101] and excavation work has been initiated at the Loiyangalani site. The project is directed by Marta Osypińska.[102]

Recently, a team of Polish archaeologists led by Grzegorz Bąk-Pryc, Mariusz Jucha, and Lawrence Owens has been conducting international collaborative research in Egypt's Wadi Tumilat valley. The main objectives include discovering new Predynastic and Early Dynastic period sites, investigating the cemetery at Kafr Hassan Dawood, and locating remains of settlements.[103]

## Europe

Since 1995, research has been conducted on the ancient Greek city of Nikonion, now located in Ukraine. The work was carried out in collaboration with the Archaeological Museum in Odesa, with the Polish team led by Mariusz Mielczarek. The investigations continued until 2012.[104]

In 1997, archaeological research began at the Greek colony of Chersonesus Taurica in Crimea, in cooperation with the Chersonesus Taurica Museum in Sevastopol. The work focused on the rural areas of the Greek colony, as well as Roman guard posts and watchtowers. Directed by Tadeusz Sarnowski, the research continued until 2013.[105]

Between 1998 and 2008, Polish-Ukrainian investigations took place near Koszary, close to Odesa. These provided crucial data about Greek colonial settlement on the northern Black Sea coast, particularly regarding settlement structures and interactions with local tribes.[106] The Polish team was led by Ewdoksia Papuci-Władyka and Jan Chochorowski (Papuci-Władyka 2004).

In 2001, joint Polish-Montenegran research commenced at Rhizon on the Adriatic coast. The work, under the direction of Piotr Dyczek, has concentrated on ancient structures, including a Hellenistic palace complex.[107]

From 2008 to 2013, Alfred Twardecki led the Polish Archaeological Mission "Tyritake"[108] at the Greek city of Tyritake on the Kerch Peninsula in Ukraine. In addition to excavations, the mission aimed to establish an archaeological park and local museum dedicated to Tyritake, though these plans were abandoned following Russia's annexation of Crimea.

Since 2009, several seasons of surface surveys followed by excavations were conducted at Akrai in Sicily, in collaboration with Italian colleagues. Roksana Chowaniec directed the work, which focused on uncovering remains of Hellenistic-Roman residential structures and Late Antique workshops.[109]

From 2009 until Russia's invasion of Ukraine, the international Upper Dnister Expedition carried out various fieldwork projects in western Ukraine, including surface surveys, non-invasive investigations, and excavations (Fig. 25). The research particularly examined kurgan burial grounds from the 3rd and 2nd millennia BCE (Makarowicz et al. 2021, 177–179), under the direction of Przemysław Makarowicz.

Between 2009 and 2010, research was conducted at Akra near Kerch in Crimea. The investigations focused on the Late Antique period of Greek settlement, providing valuable insights into socio-economic transformations. The Polish team within the Ukrainian-Russian-Polish expedition was led by Ewdoksia Papuci-Władyka.[110]

In 2010, the Polish-Greek field project called the Anthemous Valley Archaeological Project was initiated in the Anthemous River valley in northern Greece. The research aims to study prehistoric settlement history in the area, primarily through surface surveys (Andreou et al. 2021, 147–152). Dozens of archaeological sites have been identified (Fig. 26), with many investigated using geoarchaeological methods. The Polish team is directed by Janusz Czebreszuk,

[101] https://www.national-geographic.pl/historia/pierwsze-polskie-badania-archeologiczne-w-tanzanii-jest-sukces/ [11.04.25].
[102] https://projekty.ncn.gov.pl/opisy/583901-pl.pdf [11.04.25].
[103] https://archeo.uj.edu.pl/wiadomosci/-/journal_content/56_INSTANCE_2L5WG5b8Bc2D/11321345/158456000 [11.04.25].
[104] See also Mielczarek, Sekerskaja 2001.
[105] https://vienna.pan.pl/index.php?option=com_content&view=article&id=930&catid=250&lang=pl&Itemid=1023 [11.04.25].
[106] https://archeo.uj.edu.pl/pl_PL/zak [11.04.25].
[107] https://www.uw.edu.pl/odkrycie-w-iliryjskim-rhizon/ [22.04.25].
[108] https://blackseaproject.iaepan.edu.pl/pl/tyritake [21.04.25].
[109] https://www.archeologia.uw.edu.pl/akrai-sycylia/ [21.04.25].
[110] https://archeo.uj.edu.pl/pl_PL/zak [11.04.25].

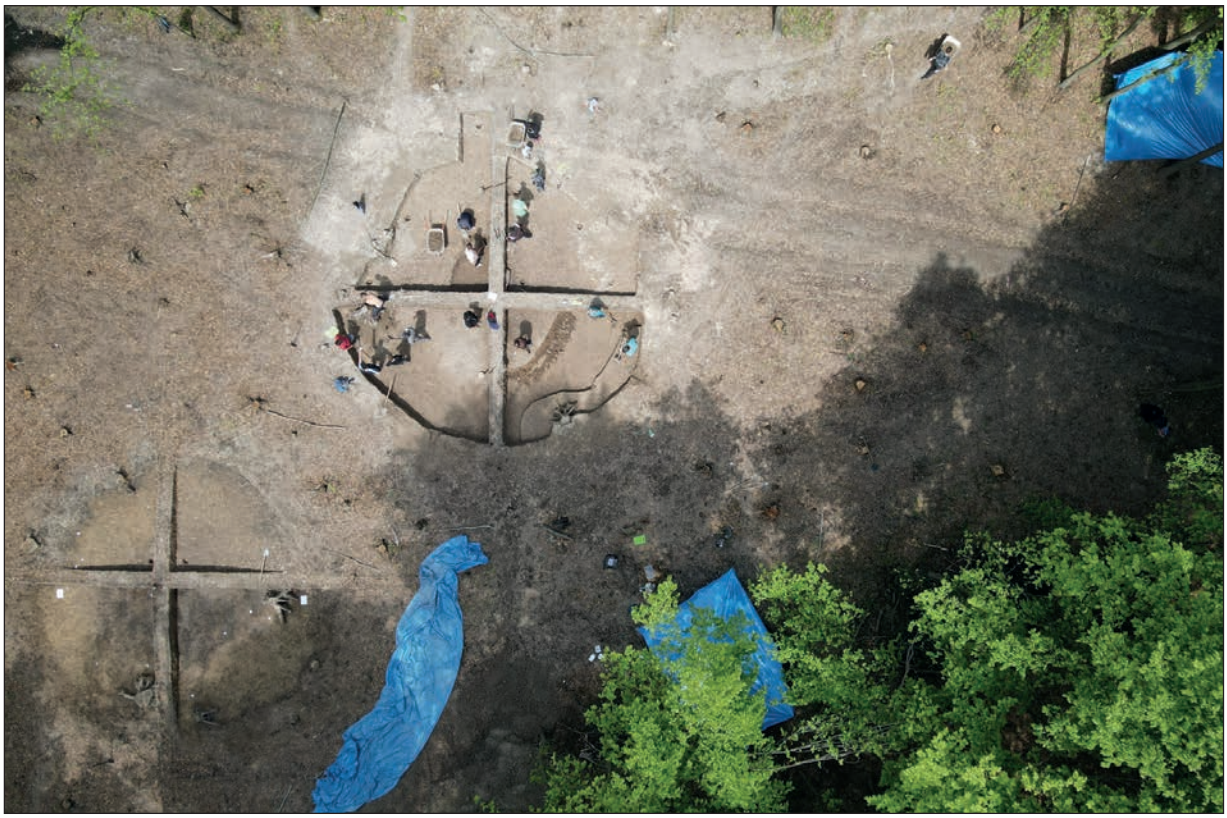


FIGURE 25. Volytsia, Ternopil Oblast, western Ukraine. Barrows of the Corded Ware Culture (2500–2200 BCE) (photo by J. Romaniszyn)

one of the founders and current director of the Polish Institute of Archaeology in Athens, established in 2019.[111]

Between 2010 and 2014, a Polish-Ukrainian archaeological expedition excavated seven burial mounds at four sites in the Yampil region of Ukraine. The excavations and specialist analyses provided new information about connections between the Yamna and Corded Ware cultures (Kośko et al. 2021). The Polish team was led by Aleksander Kośko. It should be noted that joint Polish-Ukrainian fieldwork had been conducted since 2000, though initially in a reconnaissance capacity (Kośko 2011, 483).

From 2011 to 2027, an Albanian-Polish team investigated the remains of the ancient and medieval city of Scodra in northern Albania. Nearly 30 test trenches were excavated in the hilltop fortress, revealing mass burials from the 15th century. The team also studied the Late Antique defensive walls of Scodra.[112] The Polish team was directed by Piotr Dyczek.

Between 2013 and 2017, surface surveys and excavations were conducted at the Kakucs-Turján settlement in Hungary by archaeologists from Polish, Hungarian, and German institutions. The work identified Bronze Age layers containing numerous imported artefacts and included extensive specialist analyses. The Polish team was led by Mateusz Jaeger (Jaeger et al. 2018).

Between 2014 and 2020, Spanish-Polish research was conducted at the early medieval site of Madinat Ilbira in Andalusia (Krueger 2021, 424). The investigations focused on urban structures, utilizing both ground-penetrating radar and excavation methods. Samples were also collected for

[111] https://paia.amu.edu.pl/ [11.04.25].
[112] https://novae.uw.edu.pl/scodra-bushat/ [11.04.25].



FIGURE 26. Survey in Amalara site (photo: AVAP archive)

specialized analyses. The Polish team was led by Marian Rębkowski.[113]

The year 2015 also marked the beginning of Polish-Herzegovinian research on Roman rural settlement in the Ljubuški region (Bosnia and Herzegovina). Directed by Tomasz Dziurdzik, the project primarily aimed to examine settlement structures, with particular focus on the role of Roman military units and veterans. Geophysical surveys confirmed that one of the local sites was a Roman fort.[114]

Since 2016, research in Pojejena, Romania has been conducted by a team led by Emil Jęczmieniowski in collaboration with the Banat Museum. The project investigated a Roman auxiliary fort and its associated settlement. The fort was active during the Dacian Wars and remained in use until Late Antiquity. Current findings indicate at least two construction phases of the fortification.[115]

Also in 2016, investigations began at the Greek colony of Histria under Inga Głuszek's direction. Focused primarily on ceramic material, the ongoing research is conducted in partnership with the Vasile Pârvan Institute of Archaeology of the Romanian Academy.

Between 2016 and 2018, Alfred Twardecki conducted research at the site of the Greek colony of Olbia. The excavations were continued from 2019 under an agreement between the Polish Academy of Sciences and the Institute of Archaeology of the National Academy of Sciences of Ukraine until the time of the Russian invasion of Ukraine. The results of the field research are currently being analysed.[116]

[113] https://iaepan.edu.pl/madinat-llbira-poprzednik-granady-sredniowieczne-miasto-umajjadow-i-mozarabow-na-polwyspie-iberyjskim/, https://iaepan.edu.pl/instytut/struktura/osrodki/osrodek-archeologii-sredniowiecza-krajow-nadbaltyckich/archeologia-szczecin-pracownicy/prof-dr-hab-marian-rebkowski/ [08.04.25].

[114] https://www.archeologia.uw.edu.pl/ljubuski-rzymski-fort-oddzialow-pomocniczych/ [08.04.25].

[115] https://www.archeologia.uw.edu.pl/pojejena-rzymski-fort-oddzialow-pomocniczych/ [09.04.25].

[116] https://blackseaproject.iaepan.edu.pl/pl/misja-olbia/ [08.04.25].

Since 2017, land and underwater surveys have been carried out along Romania's Black Sea coast. The non-invasive work centred around the ancient city of Argamum, directed by Martin Lemke and Karolina Trusz. Underwater exploration has confirmed the presence here of several shipwrecks, among other findings.[117]

In 2018, research commenced at the Bushat site in Albania to locate ancient settlements and fortifications that formed the economic and military hinterland of ancient Scodra, located approximately 15 km northwest of Bushat. Discoveries included a section of Hellenistic defensive walls.[118] The project was directed by Piotr Dyczek.

Since 2018, excavations have been conducted under the direction of Sławomir Moździoch in the Altavilla Milicia region of Sicily. The research aims to investigate the history of a local religious centre established during the early period of Norman conquest of Sicily. The project is carried out under a scientific cooperation agreement with the Soprintendenza per i Beni Culturali ed Ambientali di Palermo and has so far revealed architectural remains, coins, and other artefacts that have helped establish the chronology of the masonry church.[119]

In recent years, excavations have been carried out at the early medieval kurgan cemetery of Shestovitsa in Ukraine. The main objectives included determining the site's chronology, reconstructing burial practices, and identifying the cultural affiliation of the interred individuals. The research was directed by Dariusz Błaszczyk and Viacheslav Skorokhod.[120]

2019 also marked the beginning of underwater investigations in Lake Hammersø on the island of Bornholm, Denmark, conducted by Bartosz Kontny in collaboration with researchers from the Bornholm Museum in Rønne. The study identified several phases of the lake's use from the Middle Ages to modern times, uncovering numerous artefacts.[121]

In 2019, Polish-Ukrainian research began at a Trypillian culture site in Kamianets-Podilskyi, Ukraine (Diachenko, Sobkowiak-Tabaka 2021, 89). Discoveries included remains of residential structures and pottery kilns. The Polish team was led by Iwona Sobkowiak-Tabaka.

In 2021, research was initiated on the Late Bronze Age in the Volos Bay region of Thessaly.[122] The project involved geophysical surveys and core drilling at the Pefkakia site near the city of Volos.[123] The work is conducted in collaboration with Greek archaeologists, with the Polish team directed by Bartłomiej Lis.

Between 2021 and 2025, Fabian Welc directed a project aimed at investigating whether climate and environmental changes influenced settlement transformations in Late Antiquity in the northeastern Adriatic region. Diverse methodologies were employed, including: excavation and surface surveys, geophysical and paleoclimatic studies, laboratory sample analyses, and GIS modelling.[124]

In 2023, a collaborative excavation project with archaeologists from Mainz began at the Schwarzenacker site in Germany. The primary goals include verifying previous geophysical results and conducting surveys in areas not covered by earlier research. The project is co-directed by Peter Haupt and Agnieszka Tomas.[125]

Also in 2024, research began on Bronze Age burial mounds in Romania to investigate the spread of mound-building practices and the transfer of cultural patterns from the Black Sea steppes. Two projects are being conducted in this regard, one

117 https://www.archeologia.uw.edu.pl/argamum-i-okolice-polnocna-dobrudza-i-delta-dunaju/ [08.04.25].
118 https://novae.uw.edu.pl/scodra-bushat/ [08.04.25].
119 http://www.santamariadicampogrosso.com/pl/projekt/opis-projektu [09.04.25].
120 https://www.archeologia.uw.edu.pl/szestowica-cmentarzysko-kurhanowe-z-okresu-wikinskiego/ [03.04.25].
121 https://www.archeologia.uw.edu.pl/hammerso-stanowisko-jeziorne/ [03.04.25].
122 https://iaepan.edu.pl/od-pierwszych-do-ostatnich-mykenczykow-w-rejonie-zatoki-wolos-tesalia/ [04.04.25].
123 https://naukawpolsce.pl/aktualnosci/news%2C93125%2Cgrecja-trwaja-grecko-polskie-badania-archeologiczne-kolomiasta-volos.html [04.04.25].
124 https://archeologia.wnhs.uksw.edu.pl/upadek-kryzys-czy-transformacja-korelacja-przemian-poznoantycznego-osadnictwa-ze-zmianami-srodowiska-i-klimatu-w-rejonie-polnocno-wschodniego-adriatyku-na-podstawie-wynikow-badan-geoarcheo/, https://projekty.ncn.gov.pl/opisy/478202-pl.pdf [28.07.25].
125 https://www.archeologia.uw.edu.pl/schwarzenacker-saarland-niemcy/, https://www.saarpfalz-kreis.de/pressearchiv/deutsch-polnisches-grabungscamp [04.04.25].

led by Przemysław Makarowicz,[126] and another by Jan Romaniszyn.[127]

## America

Under new political conditions, Polish archaeologists have continued their work in South America. Since 1996, the Condesuyos archaeological project has been conducted in collaboration between the University of Warsaw and the Catholic University of Santa María in Arequipa, Peru. The main objective is to study archaeologically unexplored high-altitude areas of southern Peru. The project is directed by Mariusz Ziółkowski.[128]

Since 2001, cave research has been conducted on Easter Island (Rapa Nui, Chile). Hundreds of caves serving various functions – from residential and ceremonial to defensive and funerary – have been documented. Exploration of cave interiors has revealed obsidian, bone and stone tools, as well as cult objects, demonstrating the complexity of the culture and use of these spaces by native Rapa Nui inhabitants since at least the 11th-13th centuries.[129] The research is led by Maciej Sobczyk.[130]

Since 2006, investigations have been carried out under the Nakum Archaeological Project at the Maya culture site of Nakum in northern Guatemala. Polish researchers have studied this site since the late 20th century. In recent years, archaeological work has expanded to include the Poza Maya site south of Nakum and other nearby archaeological sites. The excavations have yielded many spectacular discoveries that have gained international media attention, under the direction of Jarosław Źrałka and Wiesław Koszkul.[131]

Since 2008, Polish-Peruvian team research has been conducted in the Río Tambo basin, one of the least explored areas of southern Peru. The work has documented settlements from the Stone Age through the Inca expansion (Szykulski 2009, 8–9). The project was led by Józef Szykulski, who brought extensive field experience in Peruvian research when he took over the mission. It should be noted that research on southern Peru under this scholar's direction continues to this day as an interdisciplinary project.[132]

Since 2010, an international team led by Miłosz Giersz has been conducting archaeological research at Castillo de Huarmey (Peru) in collaboration with Peruvian partners. The team has identified a settlement, cult site, and necropolis dating to the Wari Empire (600–1050 CE). The researchers discovered the first intact royal tomb of the Wari civilization, containing the remains of 58 noblewomen, six ritual sacrifice victims, two guards, and over 1,300 artefacts made of gold, silver, bronze, ceramics and other materials. This discovery has been recognized as one of the most important archaeological finds worldwide.[133]

In 2011, archaeological investigations began in the Southwestern United States with the participation of Polish scholars under the direction of Radosław Palonka (Palonka 2019, 2). The research continues as part of the Sand Canyon-Castle Rock Community Archaeological Project conducted in cooperation with American institutions and Indigenous communities focusing on remains of Ancestral Pueblo culture settlements and historic Ute rock art in Colorado canyons (Fig. 27).[134]

Between 2015–2016, fieldwork was carried out at the Toro Muerto site in Peru, covering an area of nearly 4 square kilometres. The team documented approximately 1,650 petroglyph-bearing rock blocks and created an orthophoto map of part of the site under the direction of Janusz Wołoszyn, Karolina Juszczyk, and Abraham Imbertis Herrera.[135] Research at this site continued by Janusz Wołoszyn's

[126] https://projekty.ncn.gov.pl/opisy/591081-pl.pdf [04.04.25].
[127] https://projekty.ncn.gov.pl/opisy/589670-pl.pdf [08.04.25].
[128] https://theexplorersclubpolska.pl/pl/component/content/article/mariusz-ziokowski?catid=35&Itemid=101&format=html [08.04.25].
[129] https://naukawpolsce.pl/aktualnosci/news%2C27561%2Cpolacy-badaja-jaskinie-wyspy-wielkanocnej.html [03.03.25].
[130] https://www.archeologia.uw.edu.pl/rapa-nui-jaskinie-i-konstrukcje-nadbrzezne/ [03.03.25].
[131] https://archeo.uj.edu.pl/dr-hab.-jaroslaw-zralka [09.03.25].
[132] https://uni-wroc.academia.edu/J%C3%B3zefSzykulski/CurriculumVitae, https://projekty.ncn.gov.pl/opisy/522910-pl.pdf [09.03.25].
[133] https://www.archeologia.uw.edu.pl/castillo-de-huarmey-osrodek-imperium-wari-na-polnocnym-wybrzezu-peru/ [09.03.25].
[134] https://e-sandcanyon.org/ [09.03.25].
[135] https://pl.toromuerto.org/antecedentes [09.03.25].



FIGURE 27. Archaeological investigations at Ancestral Pueblo cliff dwelling, Two Story House (5MT1805), Graveyard Canyon, Colorado (photo by R. Słaboński)

team until 2023, primarily involving comprehensive analysis of previously collected data.[136]

In 2018, Polish archaeologists initiated surface surveys followed by excavations at the San Isidro site in El Salvador. The work revealed remains of monumental architecture, pottery preliminarily dated to the first millennium BCE, and a group of large ceramic figurines. The project is directed by Jan Szymański.[137]

That same year, research began under Jarosław Źrałka's direction on unique Ixil Maya wall paintings at a site in Chajul, a town in Guatemala's mountainous region.[138] The project concluded in 2023, resulting not only in academic publications but also museum exhibitions.

## Conclusions

Polish archaeology emerged and developed under challenging conditions of national subjugation. In the interwar period, thanks to Kazimierz Michałowski's initiative, joint Polish-French excavation campaigns were successfully conducted in Egypt. This period saw the development of a pragmatic approach that included rapid publication of research results, direct and friendly relations with excavation workers, and interdisciplinary investigations (Michałowski 1983, 27–30). In the post-War years, this strategy was consistently implemented, with excavations primarily focused on ancient major sites, leading to significant discoveries that captured media and public attention. Warsaw became the dominant academic centre for such initiatives. During the 1980s, and especially after the post-1989 political

[136] https://projekty.ncn.gov.pl/opisy/356095-pl.pdf [09.03.25].
[137] https://www.archeologia.uw.edu.pl/san_isidro/ [08.04.25].
[138] https://projekty.ncn.gov.pl/index.php?projekt_id=393101 [08.04.25].

transformation, there was rapid growth in excavations and archaeological surveys conducted by Poles across nearly all continents. This work built upon the achievements of previous generations of Polish archaeologists and was characterized by addressing specific research problems. Investigations covered all historical periods, with many projects carried out through international collaboration, mainly with institutions from countries where fieldwork took place.

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# ARCHAEOLOGY IN THE MIRROR OF AGES: REFLECTIONS ON THE METHODOLOGY OF ARCHAEOLOGY AT THE ADAM MICKIEWICZ UNIVERSITY, POZNAŃ

Danuta Minta-Tworzowska, Michał Pawleta

This paper attempts to define the current position of archaeological methodology as developed by the academic community at the Adam Mickiewicz University (AMU) in Poznań, Poland. The methodology of archaeology is understood in a broad sense, as a reflection on the theoretical and practical foundations of studying the ancient past. This encompasses epistemological assumptions, the selection and application of research methods, and critically analysing ways of interpreting empirical data (Topolski 1984, 13). Viewed in this way, it emerges as a complex cognitive system whose components are closely linked not only to dominant scientific paradigms, but also to institutional conditions and the socio-cultural expectations of science. The relationship between theory and research practice is of particular importance here, i.e. how theoretical assumptions influence the formulation of research questions, the selection of sources, and their analysis and interpretation.

This article begins with the idea that archaeology is a field of negotiation between different cognitive approaches. These reflections concern, on the one hand, the extent to which the modernist assumptions that have historically shaped the methodological approach of AMU archaeologists have been realised, and, on the other hand, the degree to which contemporary methodological practice aligns with postmodern thinking. The article analyses selected aspects of the development of archaeological theory and methodology, focusing particularly on the evolution of the views of the so-called Poznań School, from Jan Żak to his students and successors, and then on to subsequent generations of researchers.

Formulating this kind of idea within one's own research environment poses a challenge (Minta-Tworzowska and Pawleta 2013). This stems from the need to maintain a balance between involvement and necessary distance, as well as the risk of unconscious bias or excessive identification with the researched environment. While a self-reflective attitude is valuable, it can also blur the boundaries between analysis and justification, making the process of internal diagnosis particularly challenging. This is why the external perspective proposed by Henryk Mamzer in his article 'An Apologia of the Methodology of Archaeology at Adam Mickiewicz University in Poznań' (2020) was important in this context. Mamzer proposed an approach that enables us to examine the methodological and epistemological foundations of the activities of the AMU archaeological community from a more distant perspective. Using the metaphor of 'apologia' in the sense of presenting and justifying a particular methodological approach rather than in the colloquial sense of defence, he conducted an in-depth analysis of their research attitudes, modes of argumentation, and epistemological assumptions. Rooted in deep philosophical and anthropological reflection, his approach synthesises distinctly polyphonic views, encompassing both traditional and innovative methodological approaches. Mamzer's aim was not to unify or normatively evaluate these views, but rather to demonstrate their internal logic and the interrelationships between the various orientations and approaches. This allows methodological diversity to be presented as a valuable feature rather than a barrier to research coherence. This approach renders the

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Poznań methodology of archaeology not as a monolith, but as a space for dialogue, negotiation, and creative tension between different paradigms.

This article outlines the key elements of the methodology and theory developed by the AMU archaeological community. It combines a presentation of the main assumptions with elements of critical reflection, primarily relying on literature from this milieu to accentuate its characteristic features, consistency, and internal coherence. This facilitates an understanding of the dynamics of local methodological reflection and enables the contextual conditions of theory development within a specific academic centre to be reconstructed. This approach also enables us to analyse how local methodological approaches contribute to the global archaeological debate while maintaining intellectual autonomy and making significant original contributions to the development of archaeological theory and methodology. The wider socio-cultural, and sometimes political, context is also significant.

Recognising the multifarious nature of the issues addressed, the article organises them into the following main thematic areas: (1) reflections on the theory and methodology of archaeology, its sources of inspiration and proposed solutions, including the relationship between theory, methods and research practice; (2) classification in archaeology; (3) archaeological sources analysed in the context of methodological discussions from a diachronic perspective; and (4) the study of the past and cultural heritage in relation to the present and new fields of research, including social archaeology, landscape studies, memory studies, identity, and the social role of archaeology. This critical reinterpretation of selected ideas from earlier publications (Minta-Tworzowska and Pawleta 2013; Minta-Tworzowska, Pawleta 2025) permits a fresh reading in light of the current theoretical and methodological contexts of Polish archaeology.

## Theory and Methodology of Archaeology: Have We Achieved Our Goals?

Although the research carried out by Poznań archaeological methodologists is characterised by great diversity, their central focus remains reflection on the theory and methodology of archaeology. This tradition was initiated by Jan Żak in the 1960s and 1970s (Fig. 1).

The AMU archaeology centre was one of the few in Poland that actively developed research on the theoretical and methodological foundations of archaeology, which was clearly influenced by the Poznań methodological school, founded by Jerzy Kmita and Leszek Nowak, and, in the context of historiography, Jerzy Topolski. Representatives of this school developed an original research programme on the epistemology of the humanities. This included the social-regulatory theory of culture, humanistic interpretation and functional-genetic explanation, as well as the reinterpretation of Marxist thought (Marciniak, Pawleta and Rączkowski 2025). Jan Żak played a special role in adapting these assumptions to archaeology, formulating new methodological approaches adapted to the specificities of archaeological research. He also sought to disseminate these approaches within the academic community, among both colleagues and students, establishing AMU archaeology as a leading centre for theoretical reflection in this field. Notably, in 1982, Jan Żak established the first and only university department dedicated to the history and methodology of prehistory within the Institute of Prehistory at the time. Similar ideas were also being developed in Warsaw by Stanisław Tabaczyński (Pałubicka and Tabaczyński 1986; Tabaczyński 1987).

The Poznań academic community's understanding of archaeological methodology generally corresponds with the concepts of Jerzy Kmita. According to Kmita (1977, 112), methodology is a set of principles and procedures that define how research activities should be carried out to produce the most valuable cognitive results. In this context, methodology is considered a humanistic discipline that aims to analyse and explain how science – in this case, archaeology, as well as prehistory and protohistory – works. This view is shared by representatives of the Polish philosophy of science, including Kazimierz Ajdukiewicz (1985a, 334 ff.; 1985b), Jan Woleński (1996, 242) and Stefan Amsterdamski (1983). According to these philosophers, methodology is not limited to describing technical research procedures; it has a much broader cognitive and interpretative function. It provides tools for analysing the structure and rationality of scientific knowledge, enables critical evaluation of underlying theoretical assumptions, and fosters reflection on the nature of science, its aims, limitations, and historical variability.

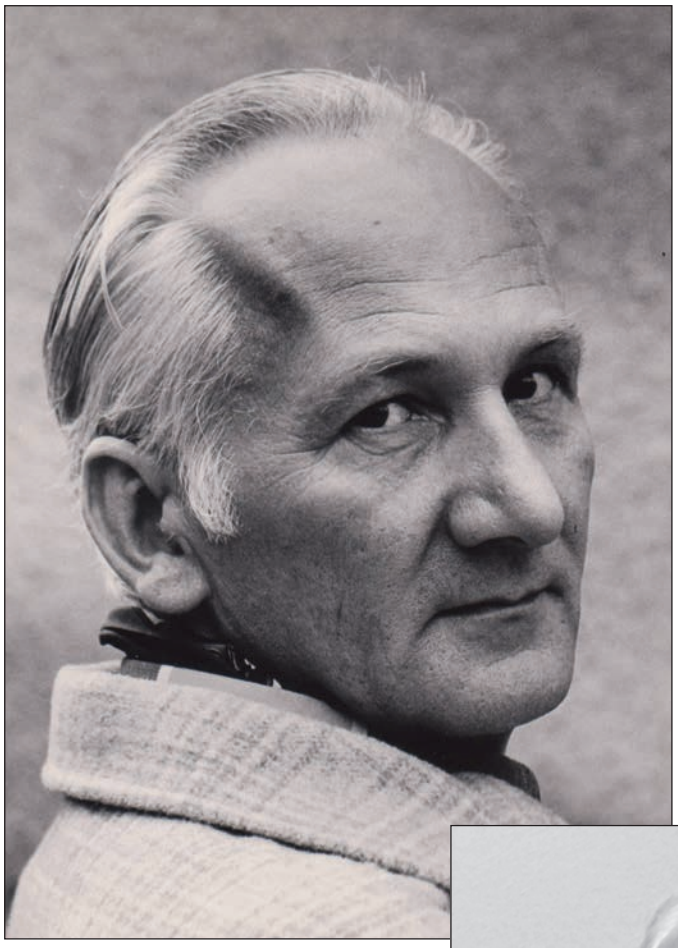


FIGURE 1. Jan Żak

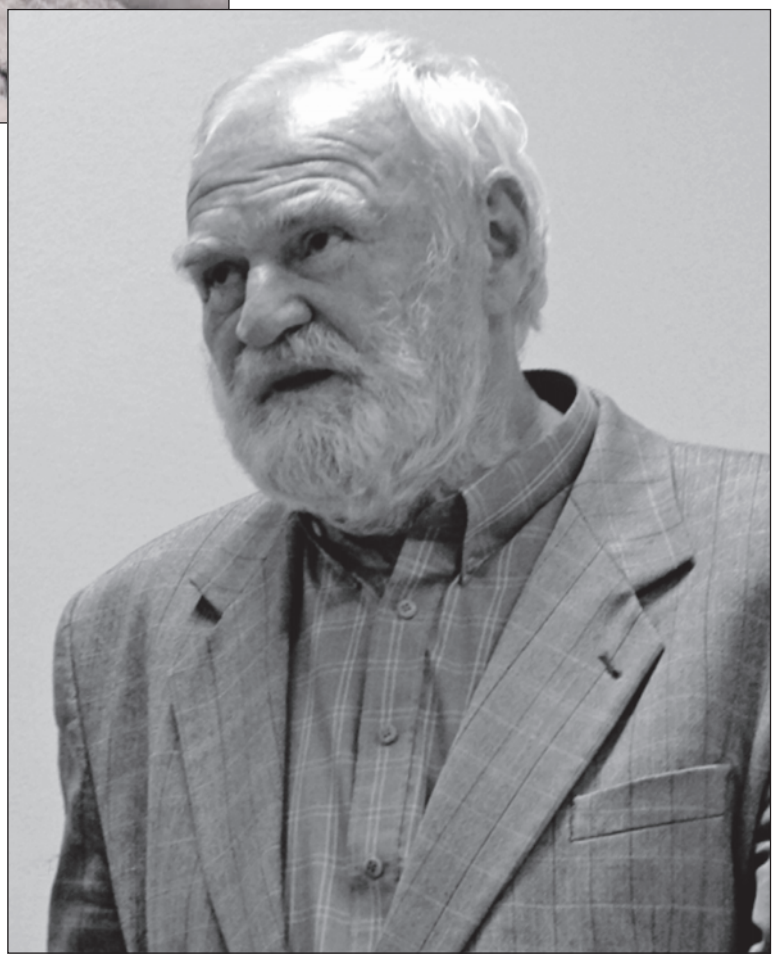


FIGURE 2. Henryk Mamzer

Henryk Mamzer (2020, 123) provides an apt reflection of such a broad understanding of methodology, stating that "methodology is not just ordering, it is bringing out of chaos (Fig. 2). It is the uniformisation of something that was never uniform", with 'chaos' being used metaphorically to refer to a state of cognitive disorder. This understanding of methodology is clearly evident in the work of the Poznań archaeologists.

Jan Żak attempted to transcend the positivist paradigm in archaeology, which is based on inductionism, objectivism, empiricism, and data collection. Although the article by J. Żak and D. Minta-Tworzowska (1991) was published a year after his death, it fully reflects his critical stance towards the dominant positivist orientation in Polish archaeology at the time. He consistently emphasised the importance of the theoretical and methodological basis of archaeological research.

Not only did Żak and Minta-Tworzowska point out the necessity of rejecting positivist reductionism, they also actively participated in designing a modern approach to archaeology that aims to integrate different levels of analysis and explanation. This aspiration is evident in their search for a theoretical framework to explain past phenomena in both synchronic and diachronic dimensions. They postulated the need for an interpretative model that would take into account the complexity and multidimensionality of archaeological data beyond the simple description and classification characteristic of the positivist approach, encouraging deeper reflection on the mechanisms of cultural change.

In his research, J. Żak addressed topics that aligned with the prevailing trends in Polish and, more broadly, Central European archaeology of the 1970s and 1980s. He paid particular attention to the question of the ethnogenesis of the Slavs and also settlement issues, focusing primarily on whether settlement continued or not, a question that, in his view, replaced earlier considerations of continuity or discontinuity of settlement (Żak 1980; 1985). The identity of archaeology, and its position and relationship within the humanities, were also important areas of his reflection (Żak 1966). Additionally, he attempted to study the consciousness of prehistoric humans, addressing issues that went beyond the research trends of the time. In an article from 1974/1975, embedded in a humanist approach, he emphasised the significant differences in the way prehistoric and modern people thought and perceived the world (Żak 1974/1975). He attempted to demonstrate how internal contradictions within these cognitive systems led to socio-cultural evolution. He viewed consciousness as a reflection of the material conditions of life, as well as a mechanism that regulated the behaviour and functioning of communities. According to Żak, consciousness encompasses elements of knowledge, magic, religion, and ancestral-tribal ideology. Based on this, he developed a model of prehistoric consciousness, although he only realised part of it, focusing on Palaeolithic Mediterranean societies, which he described as 'naïve-naturalistic'. His works exemplify a different approach to archaeological practice by integrating a humanistic perspective with the study of the consciousness of prehistoric societies.

Following Jan Żak's death in 1990, the tradition of the Poznań School of Methodology was continued by his alumni at Adam Mickiewicz University: Danuta Minta-Tworzowska (Pawleta 2025), Włodzimierz Rączkowski and Arkadiusz Marciniak, as well as subsequent generations of researchers (Fig. 3).

From the outset, a division into two distinct methodological currents became evident in the activities of the Poznań archaeological community: the dominant humanistic one and the more pronounced naturalistic one. Despite their differences, both approaches grew out of the Poznań School of Methodology's foundations, largely retaining the basic tenets of Jerzy Kmita, Jerzy Topolski, and Leszek Nowak's ideas. Both currents ascribed particular importance to the role of theory in archaeological research practice.

There have been consistent attempts within the Poznań methodologist community to answer the question posed by Henryk Mamzer (2020, 110): 'Why do we need methodology?' This builds on the approach initiated by J. Żak of systematically reflecting on the methodological and theoretical foundations of archaeology. A key aspect of this tradition has been the consistent implementation of interdisciplinarity, reflected not only in declarations, but also in research practice. This manifested itself in the integration of perspectives derived from the methodology of the humanities, the philosophy of science, the theory of history and cultural anthropology. It also manifested itself in the use of scientific achievements at both the level of research procedures and the development of the empirical basis for analysis.

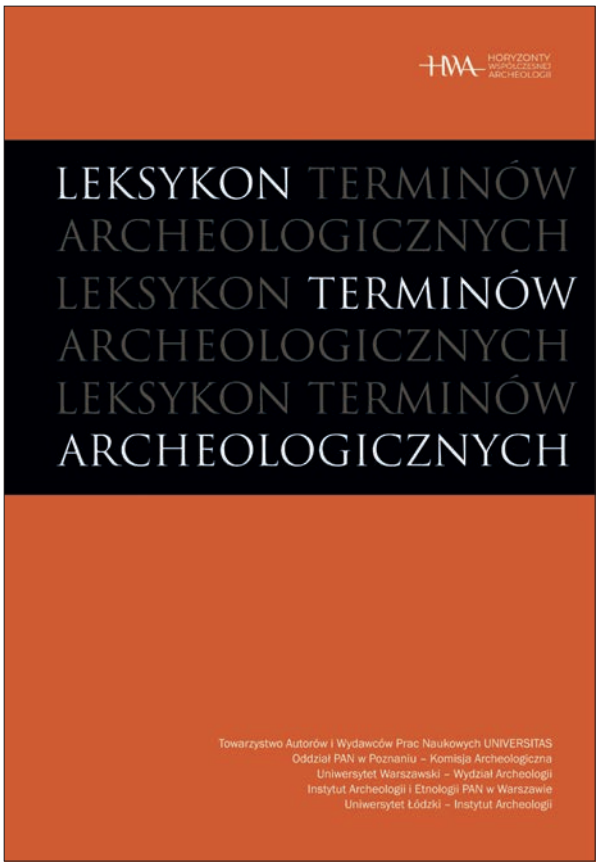



FIGURE 3. The cover of the book *A Glossary of Archaeological Terms* (2024)

AMU methodologists of archaeology have also actively participated in debates within the contemporary humanities. This has fostered deeper theoretical reflection and developed conceptualisations of the research process and archaeological practice. This participation is evident in publishing initiatives, in which researchers from the Poznań centre have made a significant contribution. Of particular note are two publications: *Przeszłość społeczna. Próba conceptualizacji* (*The Social Past: An Attempt at Conceptualisation*) (Tabaczyński, Marciniak, Cyngot and Zalewska eds 2012), and *Leksykon terminów archeologicznych* (*A Glossary of Archaeological Terms*) (Marciniak et al. eds 2024) (Fig. 4). The former attempts to diagnose the current state of archaeology and related disciplines in the context of research into the social past. It contains an analysis of the theoretical and methodological status of key archaeological issues and discusses their links with other fields of knowledge, emphasising the interdisciplinary nature of reflection on the social dimension of the past. The latter publication is a compendium of fundamental terms, concepts and research categories that constitute the conceptual framework of contemporary Polish archaeology. It is the first work of its kind in the Polish archaeological community, demonstrating its maturity, originality, and intellectual potential. The publication systematises the key stages of archaeological research, covering issues such as the conceptualisation of the past, thematic scopes, methodological procedures and the presence of archaeology in the contemporary world.

The post-War critique of the approach of cultural-historical archaeology not only led to the rejection of its fundamental principles, but also initiated further methodological explorations. These were united by the belief in the importance of theory in research procedures. While methodological reflection in Polish archaeology was mainly based on Polish concepts, especially the achievements of the Poznań School of Methodology, which viewed archaeology primarily as a historical discipline, inspiration from international science was increasingly drawn upon from the early 1990s, especially after 2000. Theory and methodology began to embrace diverse influences from Western archaeology, particularly from Britain and the United States. This shift contributed to the emergence of new research fields and directed research towards previously marginalised areas of study (Minta-Tworzowska 2017).

Inspiration from foreign research traditions, which were often adapted creatively to local conditions, naturally led to confrontation with diverse theoretical currents. The Poznań archaeological methodologists' theoretical interests can be broadly categorised into several main research paradigms. The first of these is processual archaeology. The adoption of this was accompanied by an awareness of its limitations, such as ecological and geographical determinism, and the rationalist assumptions typical of neo-positivist models (Weber 1988). The second paradigm synthesises elements of both processualism and post-processualism, combining methodological rigour with an openness to multiple perspectives, meanings and interpretations. It also postulates the need to consider the socio-cultural context of research alongside analytical precision (e.g. Marciniak 1996). A third paradigm

is to adopt certain approaches more directly from post-processual archaeology, also known as interpretative archaeology. This approach focuses on applying social theory to interpret archaeological data and analyse material culture relics, while reflecting on the subjective nature of the research process (Rączkowski 2012). Symbolic archaeology, inspired by the achievements of structuralism and post-structuralism, occupies a separate place. It aims to reconstruct the symbolic aspects of material culture, the structures of thought, and the modes of representation that were characteristic of past societies (Minta-Tworzowska 2017). This strand of research has been particularly concerned with issues of prehistoric and early medieval art. It was developed and systematically discussed during a series of recurring academic conferences organized at the Biskupin Archaeological Museum and in Gdańsk by Danuta Minta-Tworzowska and the scholarly circle gathered around her (Figs. 5–6). These meetings brought together researchers interested in the symbolic and interpretative dimensions of material culture, with a particular emphasis on how visual forms, ornamentation, and spatial organization in prehistoric and early medieval contexts can be understood as carriers of meaning rather than merely functional or aesthetic elements. The conferences played an important role in consolidating methodological approaches that integrate archaeology with insights from anthropology, semiotics, and art history, fostering a more nuanced understanding of symbolic communication in past societies.

However, all these approaches were underpinned by the belief that it was impossible to maintain complete incommensurability between theories in archaeology. Instead, it was assumed that new theoretical approaches would absorb previous paradigms, reinterpreting and expanding their scope in explaining past phenomena rather than completely displacing them. This perspective aligns with the neo-pragmatist stance, which asserts that the value of theory in archaeology is determined by its capacity to offer coherent and multifaceted interpretations of specific fragments of the past (Minta-Tworzowska 2000b).

The methodological premises are typically associated with a particular research theory, which then directs the entire cognitive process, including the selection of research procedures and tools (Topolski 1978, 39–40). In archaeology, theory is often seen as a means of conceptualising the past, as well as a method of constructing images of it. The development of theory and proposals for new approaches have mainly been dominated by British and American archaeology. Matthew Johnson (2013, 25) argues that 'we are all theorists', meaning there is no need to discuss the necessity of theory since every researcher – consciously or not – uses theory. However, the problem is that some archaeologists ‚push' this obviousness out of their consciousness. In extreme cases, this takes the form of an anti-theoretical stance; in milder cases, it takes the form of an aversion to theoretical standards.

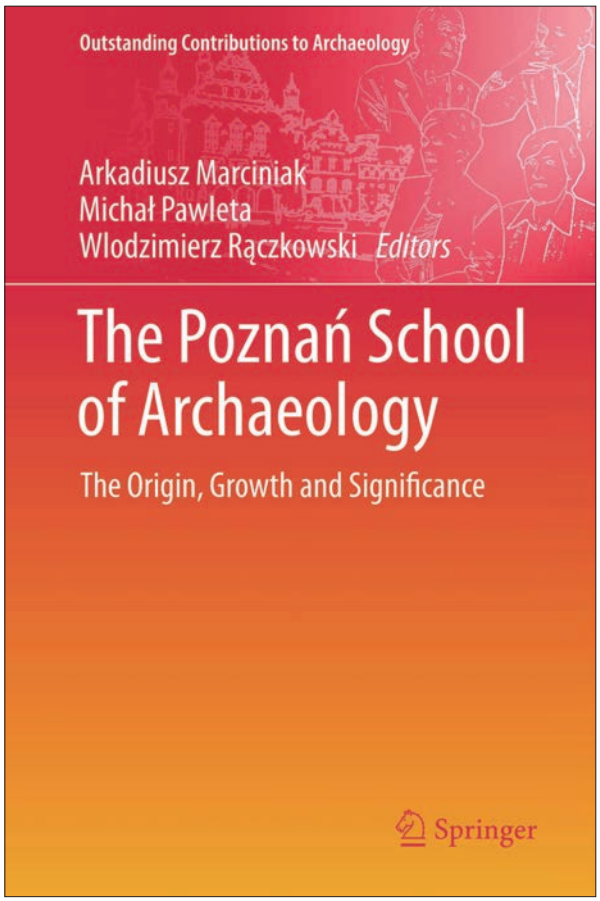



FIGURE 4. Cover of the recent book *The Poznań School of Archaeology: The Origin, Growth and Significance, presenting one of the most prominent schools of archaeological thought in Eastern Europe*, published by Springer in 2025

Among the Poznań archaeological methodologists, the issue of theoretical standards has received

considerable attention (Minta-Tworzowska and Rączkowski 1996; 2007). Following Jerzy Kmita (1971) and Jerzy Topolski (1996) in particular, the concept of the primordiality of theoretical knowledge in relation to empirical knowledge has been adopted. This is reflected most clearly by recent works by Włodzimierz Rączkowski (2002), Arkadiusz Marciniak and Michał Pawleta (2016).

Danuta Minta-Tworzowska has written extensively on the importance of theory in archaeological research, particularly in relation to classification and typology (1994; 1998b). She has also debated whether contemporary archaeology still 'needs' theory (2015a). As a social science, archaeology cannot function without a solid theoretical basis, and its development is closely linked to the formation of new theories or the modification of existing ones to suit changing research areas. Implementing this poses a significant challenge, particularly given the blurring of disciplinary boundaries and the emergence of new sub-disciplines within archaeology. This situation requires critical reflection on the theory and methodology of contemporary archaeology, as well as the formulation of original theories instead of merely adapting Western models.

The relationship between theory, method and research practice is an important topic that has been addressed in different ways, depending on the methodological orientation. In this context, the works of Włodzimierz Rączkowski, which focus on the role of theory in archaeological practice, particularly with regard to non-invasive methods and aerial archaeology, are of particular importance. Both his own publications and those of his students focus primarily on interpretative issues (e.g. Banaszek and Rączkowski 2019). Rączkowski emphasises the fundamental significance of methodological principles in interdisciplinary research, highlighting the pivotal role of interpreting aerial photographs. He notes that, despite Polish archaeology opening up to the achievements of Western science, the dominant approach remains essentially unchanged. At the same time, he indicates that "without knowledge of the fundamentals of aerial archaeology, these methods do not provide information relevant to our understanding of the past. Observing the widespread use of drones, one gets the impression that patterns developed back in the 1930s remain dominant. The issue of the absence of critical reflection continues to be pertinent" (Rączkowski 2017a, 330).

Rączkowski's subsequent publications focus on applying aerial photography to studying different types of landscapes, including historical city spaces. He engages in critical discussions about visualisations created from remotely sensed data, considering the metaphorical relationship between research theory, method, and practice (Rączkowski 2017b; 2020b). He employs metaphors such as 'the anatomy of emptiness' (Kolenda and Rączkowski 2018), 'the river and the quagmire' (Rączkowski 2018), and 'the power and/or penury of visualisations' of remote sensing data (Rączkowski 2020a). These metaphors facilitate reflection on the complexities of interpreting archaeological remote sensing results, enabling us to grasp their multilayered nature and revealing the tensions between theory, methodology, and practice. At the same time, they provide a tool for critically analysing the possibilities and limitations of visualisation, revealing their function as both cognitive instruments and constructs that influence how we perceive and understand the past.

In archaeology, theory is closely linked to the broader issue of how the past is represented, as well as the cognitive and interpretative dilemmas these processes generate (Marciniak 2012c). In this context, the possibility of integrating humanistic perspectives with naturalistic approaches is of particular importance. This is reflected in Arkadiusz Marciniak's research at the Neolithic site of Çatalhöyük (Düring and Marciniak 2005; Marciniak 2013; 2015b; Marciniak et al. 2015). Marciniak's work, which focuses on Neolithic society in the context of this unique archaeological site, is set within an in-depth theoretical and methodological framework. This enabled Marciniak to formulate his research model, 'social zooarchaeology', which constitutes a significant scientific achievement (Marciniak 2005; 2006; 2011; 2015a; Marciniak and Pollard 2015; Marciniak and Tabaczyński 2017). This model involves analysing animal skeletal remains from archaeological sites to reconstruct the social and cultural behaviour of ancient communities. The model places particular emphasis on the study of human–animal relationships beyond nutritional aspects and on the analysis of human relationships shaped by interactions with animals. This includes the perception of animals as a form of wealth and as a symbol, the use of animals in rituals such as sacrifice, and taboos associated with animals. It also relates to the role of meat in



FIGURE 5. Participants of the conference in Biskupin, "Inspirations and Functions of Prehistoric and Early Medieval Art," held in Biskupin in September 2016 (photo: S. Tabaczyński archive)

social transactions and status activities, as well as in building social bonds through sharing food and participating in feasts.

Today, archaeology is clearly moving towards the natural sciences, as reflected by the growing interest in laboratory methods, data modelling, environmental analysis and palaeogenetic research. Many researchers view this trend as a step towards a more ‚scientific' foundation for archaeology, based on objective, measurable data. However, given the significant difficulties they face, we believe that archaeologists' expectations of being able to build ‚universal', interdisciplinary knowledge at the intersection of different fields, such as archaeology and the natural sciences, should be tempered. Firstly, universal terminology remains unattainable due to the logical incomparability of the concepts used in different disciplines. Secondly, the relative incomparability of the stages of development of the various disciplines poses a problem. For instance, the positivist and anti-positivist stages employ distinct languages and paradigms. Furthermore, there is a clear distinction between statements made by archaeologists about the past in the language of the subject and reflection on the nature of these statements, which requires distancing oneself from that language and using a metalanguage. Pierre Teilhard de Chardin's historiosophical conception exemplifies this (Minta-Tworzowska 1986; 1991, 234; 2014). This conception shaped his perception of archaeology and simultaneously inspired him to develop new, 'universal' concepts intended to unify all knowledge. However, achieving such universality and universally valid terminology within any scientific discipline is impossible in practice, although it remains an extremely tempting vision from today's perspective.

## Classification in Archaeology

The transformations taking place within archaeological theory and methodology are clearly reflected in an issue of particular relevance



FIGURE 6. An open-air archaeological museum in Biskupin (photo by K. Grzelczyk)

to Poznań-based archaeological methodologists: the problem of classification in archaeology. Danuta Minta-Tworzowska developed the concept of classification procedures most extensively in her monograph *Klasyfikacja w archeologii jako sposób wyrażania wyników badań, hipotez, oraz teorii archeologicznych* (*Classification in Archaeology as a Way of Formulating Research Findings, Hypotheses, and Archaeological Theories*) (1994; see also 2000a).

Minta-Tworzowska's approach is clearly influenced by the Poznań school's methodological principles and, to some extent, by the study of P. Teilhard de Chardin's historiography and related fields. This is evident in her belief that every research procedure involves certain theoretical assumptions, often unconscious, which emphasise the subjective and constructivist nature of scientific knowledge. Minta-Tworzowska's approach also remains consistent with the idea of humanistic interpretation developed by Jerzy Kmita (1971, 18). In Kmita's approach, humanistic interpretation takes the form of subjective-rational explanation, aiming to answer the question: "Why did X undertake the indicated action, and what were the results?" At its core is the idealising or methodological assumption of the rationality of human action. Another feature of humanistic interpretation is the use of deduction; the conclusion must logically follow from the premises. For this reason, humanistic interpretation excludes the question 'Why?' (Kmita 1971, 18). Consequently, Kmita did not include forms of inference such as incomplete numerical induction (which is actually deduction), reductive inference, inference by analogy or statistical inference in humanistic interpretation, even though these are commonly used in archaeology.

A humanistic interpretation is one that is exclusively oriented towards interpretation. Both human activities and people themselves operate within a framework of recognised rules and norms (Kmita 1973, 28). Kmita's reflections on meaningful activities form the basis for considerations of culture. He moves from the activity level to a higher level of analysis: the norms and rules that govern culture. Consequently, he moves on to the concept of culture itself. A key assumption of his approach is that the interpretative practice of humanists concerning verbal actions is based on cultural competence – the knowledge and rules possessed and shared by members of a given community (Kmita 1995, 265).

Moreover, Minta-Tworzowska's proposed approach to classification is in line with the demand for interdisciplinarity, as it aims to establish a broad foundation for research and reflection in archaeology. This includes archaeology, cultural anthropology, methodology, the philosophy of science, history, and elements of logic and statistics. This makes the proposal an important contribution to methodological reflection in contemporary archaeology.

Danuta Minta-Tworzowska discusses issues of classification, seriation, and typology in Polish and global archaeology from a historical perspective, tracing their development over the past 150 years. She analyses their significance for archaeology and their role in learning about prehistoric reality. She distinguishes two main streams of thought: continental (European) and British and American, which overlap in certain respects. Finally, she demonstrates that classification methods are and have been shaped by research questions, formulated hypotheses, theoretical assumptions, and adopted research methodologies.

Danuta Minta-Tworzowska considers classification to be a fundamental procedure in archaeology. Although its meaning has evolved, it has consistently served to present research outcomes, define concepts, and develop archaeological hypotheses and theories. However, classification does not have a universal function; its form and nature are always determined by the specific research problem it is intended to address. Furthermore, shifts in dominant archaeological paradigms – such as cultural-historical archaeology, processualism, and contextual archaeology – have impacted how classification is conceptualised and its intended objectives. Theoretical changes have led to a redefinition of archaeological sources and a rethinking of the role of classification in the research process. Therefore, classification is not just a tool, but also an indicator of changes in archaeological thinking. It influences the interpretation of the past and the direction of future research. Interpretations and conclusions about the past are formulated 'here and now', based on current conceptual frameworks. Consequently, they are constructs rather than generalisations of the results of inductive inferences, which undermines the belief in their epistemological neutrality (Minta-Tworzowska

and Pawleta 2013). Consequently, it is challenging to assert that archaeological knowledge directly stems from the sources.

In archaeology, classification, as well as seriation and typology, serves to organise data, enabling information to be described and systematised. Based on this organisation of data, researchers can formulate specific hypotheses and theories. Danuta Minta-Tworzowska notes that archaeological classifications can adopt different perspectives: internal (emic) and external (etic). The internal approach focuses on reconstructing patterns and models of human behaviour that were characteristic of a given past community. In contrast, the external approach focuses on analysing the external features of artefacts, such as manufacturing techniques, as well as the uses and manifestations of wider cultural patterns. These approaches form a continuum, meaning they can complement and overlap in archaeological research.

Danuta Minta-Tworzowska has advocated a systems approach to classification, most fully developed within American New Archaeology, albeit not uncritically. This approach enables us to view the world as an ordered system and provides a more accurate description of it. Classification thus serves as both a tool for learning about and representing and interpreting the past. In archaeology, the purpose of classification is not merely to distinguish between artefacts, phenomena, or processes, but also to construct images of the past and underpin arguments based on the results of classification. Classification is therefore a key element of the theory and methodology of archaeology.

## Conceptualising Archaeological Sources

Although the nature of archaeological sources has been studied since the inception of the discipline, they remain a fundamental issue. Sources play a central role in archaeology because conclusions and interpretations about prehistory are based on the analysis of material culture. The way these conclusions and interpretations are formulated depends on the research methodology or theory adopted. Consequently, understanding of sources varies. Sources can be viewed as fundamental tools for reconstructing the past (the traditional approach), as a means of creating models, explanations and interpretations of the past (the modernist approach), or as elements that inform interpretation (the postmodern approach). Thus, the understanding of sources depends on archaeology's changing historical goals.

The nature of archaeological sources and the ways in which they can be conceptualised is also one of the central areas of methodological reflection among Poznań methodologists. Two main approaches to archaeological sources can be distinguished: the constructivist approach and the naturalistic approach.

The treatment of the source as a cultural construct is particularly evident in the approaches developed by those with a humanist methodological orientation in archaeology. The terminology used, including concepts such as 'source', 'archaeological source', 'archaeological record' and 'archaeological fact', is more axiological than objective. This is contrary to the beliefs of some practitioners influenced by the tradition of cultural-historical archaeology and its positivist assumptions. According to the latter view, sources are treated as ‚hard' empirical data and their inductive generalisations are said to lead to objective, ‚true' knowledge of the past. This assumes the existence of facts that are independent of interpretation and of the cultural factors that shape the researcher. Such an understanding should be considered anachronistic today. As Matthew Johnson (2013, 21) aptly points out, 'common sense is not enough'; the interpretation of sources requires a theoretical background. Although archaeological sources are constructed by the researcher and anchored in their theoretical perspective (Rączkowski 2002, 13), they remain the fundamental basis for archaeological reflection.

Danuta Minta-Tworzowska (1998a; 2011) addressed the issue of the archaeological source. She unequivocally highlights the 'entanglement' of material cultural products in human perception and value systems, emphasising that cultural products do not exist in isolation from the norms and meanings shaped by and assigned to them by culture. As carriers of meaning, cultural products are closely linked to the socio-cultural context in which they are created and interpreted.

Minta-Tworzowska's approach to archaeological sources was significantly influenced by Jerzy Topolski's concept of historical sources. In particular, she was influenced by his dynamic understanding of sources embedded in narrativism and postmodernism (Minta-Tworzowska 1998a). Topolski defined a historical source as anything that can be used

to construct images of the past and argue a particular vision of it. According to him, an object only becomes a source when it is analysed in the context of a specific research problem. A key element of this concept is the process of 'extracting' information from objects, which is a fundamental part of the narrativisation of sources and the interpretative process as a whole. Topolski emphasised that both the source and the historical narrative function on the same interpretive plane. Therefore, the transition from source to narrative does not consist of simply discovering the truth hidden in the source and interpreting it; rather, it involves moving within a common interpretative space in which sources and narratives complement each other and coexist.

Danuta Minta-Tworzowska (1998a) argues that the content of an archaeological source should be understood in the context of its narrativisation. This requires consideration of the source's narrative structure and its three coexisting and complementary substructures: informational, persuasive and ideological-theoretical. However, she emphasises that the archaeological record only preserves fragmentary traces of the past, and therefore not every archaeological source has a complete narrative structure (Minta-Tworzowska 2021a; 2021b; 2021c ).

When considering the nature of archaeological sources, Danuta Minta-Tworzowska refers to Ian Hodder's (1995) concept of material culture as text. According to this approach, the archaeologist's task is to ‚read' the past through material remains that function as carriers of meaning. The semiotic nature of material culture is of key importance here, requiring researchers to consider not only the content of objects, but also their structure and the cultural and social context in which they were used. Following Linda E. Patrik's proposal (1985), Minta-Tworzowska distinguishes two basic models for understanding the archaeological source: the physical model and the textual model. The physical model treats the source as a kind of natural 'fossil' to be described typologically and placed in time and space. In contrast, the textual model gives sources a humanistic dimension by regarding them as a kind of 'text' full of explicit and potential meanings that can be extracted during interpretation (Minta-Tworzowska 1998a).

According to this view, archaeological sources are not objective entities, but cultural constructs created through the decisions of archaeologists. Through the selection and interpretation of material, it is the researcher who gives certain objects the status of a source, deciding what will be considered an artefact, an ecofact, or a source of information about the past (Minta-Tworzowska 2011, 46). This understanding of the source undermines the traditional view of it as a neutral basis for reconstructing history. Images of the past are the result of interpretative research and are not cognitively neutral. They are based on sources with a potentially infinite number of meanings, from which only information that answers the research questions is selected. Objects therefore acquire source status only insofar as they are embedded in a specific problematic and analytical context.

In her evolving reflections on the nature of archaeological sources, Danuta Minta-Tworzowska refers to new theoretical currents such as 'new materialism', 'the cultural biography of things', and 'symmetrical archaeology'. These emerged in the humanities in the late 1990s as an alternative to constructivist and textual approaches (Minta-Tworzowska 2021). She analyses the ideas of Björnar Olsen (2013), who attributes causality to material objects and suggests shifting the focus from how humans use objects to how objects – through their properties and what they enable us to do – influence our actions. While this perspective aligns with Minta-Tworzowska's interests, she remains critical of the notion that it constitutes a radical innovation in archaeology. She questions whether the proclaimed ‚new materialism' and ‚return to things' does not, in practice, represent a regression to the positivist foundations of the discipline in an updated, non-anthropocentric form. She notes that archaeology has always engaged with the material products of culture and that the consideration of ‚things' is therefore not a novel concept within the discipline. Nevertheless, she emphasises that contemporary reflection on artefacts goes beyond traditional practices of recording, describing and classifying them. The key lies in shifting the focus from the instrumental treatment of objects to recognising their active role in cultural and social processes. Minta-Tworzowska also suggests that 'things' encompass not only human-made artefacts, but also elements of the natural environment, which traditional archaeology, with its focus on culture and society, often marginalises. She argues that a 'return to things' should not be viewed as a return to the typological and classificatory

foundations of the discipline, but rather as an attempt to redefine how we think about materiality and its relationship to human experience. This perspective not only aims to expand the interpretative field, but also to prevent archaeology from monopolising its vision of the past.

To return to the issue of the conceptualisation of the use of aerial photography as exemplified in Włodzimierz Rączkowski's research, the constructivist approach to sources also involves critically reflecting on aerial photographs as an important source of data on archaeological objects, as well as considering the role of this type of evidence in archaeological practice. Rączkowski (2011, 30) develops this idea, arguing that "the archaeological source has ceased to be the starting point of the research procedure and has started to serve the verification/testing of hypotheses [...] It is the result of a decision made by the archaeologist, who gives meaning to the object It is the archaeologist who brings the source to life". The manner in which aerial photographs are employed as sources in archaeology hinges on the adopted theory or theoretical reflection. This highlights the socio-cultural positioning of aerial photographs as sources (Rączkowski 2002) and how researchers are entangled with their own culture, which influences the images of the past they construct (Rączkowski 2012, 382). This cultural entanglement in the categorisation process implies a re-evaluation of aerial photographs, shifting the focus from their perceived objectivity in cultural-historical terms to their role as researcher-constructed sources in post-processual archaeology.

Rączkowski (2012, 387–388) adopts a similar stance towards remote sensing data, acknowledging that it is not objective due to the necessity of categorisation. He emphasises that, without reflection on the cultural entanglement of the methods used in archaeology and the nature of the sources and data they generate, the cultural context determines their use and interpretation. The results of such analyses are the product of interpretation and influence further interpretations of the past. This does not contradict the general tendency in archaeology to formalise and objectify data analysis, including spatial analysis. Rączkowski explicitly links this approach to methods and sources to the dominant paradigm of the time, which also influences research practice. As he writes, "(...) there is a process of interpreting, constructing data and placing them in a narrative structure" (Rączkowski 2012, 405), in which interpretation plays a vital role.

The approach proposed by Danuta Minta-Tworzowska and Włodzimierz Rączkowski recognises the cultural nature of the source and remains consistent with the concepts developed by Jerzy Kmita and Anna Pałubicka (1992; see also Mamzer 2020). Both positions emphasise the need to move away from the belief that archaeological sources are neutral, to an approach that recognises their relational and constructive nature. An archaeological source is not treated as an objective account of the past, but rather as the product of an interpretative process embedded within a specific cognitive framework and heavily influenced by methodological assumptions. In this context, a methodological perspective is important, as it enables the analysis of sources and their critical problematisation. This involves grasping what is not directly present in the sources, but which can be extracted through theoretical reflection on their nature, scope, and cognitive limitations.

Of the archaeological methodologists associated with Adam Mickiewicz University in Poznań, Arkadiusz Marciniak is the one who clearly adopts a natural science approach to archaeological sources (1996; 2005; 2006; 2011). His views are most fully expressed in *Archeologia i jej źródła. Materiały faunistyczne w praktyce badawczej archeologii* (*Archaeology and Its Sources: Faunistic Materials in Archaeological Research Practice* 1996). Marciniak aims to develop a coherent research model that integrates archaeology as a cultural science with methods and assumptions derived from the natural and exact sciences. As he himself stresses, he attempts to bring archaeology closer to the archaeological sciences while maintaining sensitivity to the cultural dimension of sources (Marciniak 1996, 33). This involves reconciling the assumptions of post-processual archaeology with elements of the processual approach, particularly within the evolving field of archaeological sciences. Marciniak attempts to limit the excessive formalism characteristic of processualism and mitigate the relativism typical of the post-processual approach. In this approach, archaeological sources are treated as 'data' with a considerable degree of objectivity, though they are not entirely divorced from the cultural context in which they are interpreted (Marciniak 2013; 2020). A key element of this concept is the introduction of the

idea of 'guarded objectivity', which establishes the boundaries of interpretation that are characteristic of the humanities and, to an extent, safeguards objectivity. Archaeological data are not purely objective; they are produced through a process of dialectical interaction between observation and interpretation. While full objectivity in the humanities is unattainable, it is possible – and necessary – to limit interpretation by using consistent and transparent research procedures. In this approach, ‚guarded objectivity' performs an epistemological function, enabling the verification of empirical data in relation to theoretical models and limiting the influence of the researcher's subjective assumptions. Arkadiusz Marciniak therefore suggests an approach based on methodological reflexivity and self-monitoring to foster a more balanced relationship between source data and interpretive frameworks, thereby strengthening the cognitive value of archaeological sources.

However, this approach raises an important question: Is this inclination primarily concerned with the level of research methods employed, or does it involve redefining the subject of archaeology itself? It can be assumed that the aim of this approach is for humanistic analyses to reach a level comparable to that of the natural sciences. Nevertheless, it echoes the Enlightenment 'dream' of combining cognitive realism with cultural offerings. This idea has a contemporary continuation in the 'return to things' trend, also known as new materialism or new positivism (Olsen 2013), and in references to Charles S. Peirce's semiotics in archaeological analyses (Filipowicz 2017; Baron 2021). It is worth noting that signs and symbols can be used to move beyond the natural science orientation of processual archaeology, which is based on natural science realism. Moreover, this realism can obscure the symbolic and non-utilitarian content that is crucial for understanding culture (Mamzer 2010; 2011; 2020). From this perspective, realism offers a limited and therefore distorted ('false') view of the world, neglecting its cultural dimension.

Despite their differences, the approaches to archaeological sources presented above are united by the belief that sources do not 'speak for themselves', but are always interpreted through the lens of contemporary conceptual categories. Both approaches that emphasise the 'cultural entanglement' of meanings and those that seek 'objectifying planes' form part of a broader reflection on the relationship between empirical data and their conceptualisation. Understanding an archaeological source is therefore conditioned not only by the adopted epistemological perspective, but also by the current cultural and historical contexts (Mamzer 2000). In this way, Richard Rorty's (1996, 22) remark that "the world does not speak. Only we do" can be interpreted as meaning that ‚facts' do not themselves carry meanings; they are given as part of statements about the past. "Only we do", can be interpreted as meaning that 'facts' do not carry meaning themselves; rather, they are given as part of statements about the past. Consequently, it becomes justifiable to adopt a constructivist perspective, according to which archaeological sources have a material and a symbolic dimension that is interpretatively dependent on the cultural and cognitive context (Minta-Tworzowska 2011; see also Marciniak 2013).

## Constructing Connections Between the Past and the Present through Archaeology

From a contemporary research perspective, it seems that we have long operated within the postmodern paradigm. However, it would be more accurate to refer to the category of postmodernity. Topics once considered controversial, such as the fluidity of meaning, the agency of material culture, the critique of essentialism and the deconstruction of binary oppositions, are now widely accepted and internalised in archaeological reflection. This is due to researchers' growing awareness of their positioning within a global, heterogeneous world embedded in the realities of a capitalist economy and multiculturalism. This inevitably affects how the past is perceived, interpreted, and represented (Harris and Cipolla 2017; Cipolla, Crellin and Harris 2024). This is particularly evident in discourses that critically address the mechanisms by which certain social groups are exposed and privileged while others are marginalised (Casella and Fowler 2005). However, this kind of heterogeneity and polyvocality are not exclusively a product of postmodernism. They had previously been present in archaeological thought, albeit often implicitly. For example, in the processualist tradition, it was often implicitly assumed that this complexity might not apply to premodern communities,

particularly prehistoric ones (Flannery and Marcus 1993, 260).

We have also widely accepted the premise that the present makes sense of the past, because it is in the context of current needs, ideas and discourses that this sense is constructed. This means that interpretations of the past are inevitably shaped by contemporary cognitive and axiological frameworks, meaning that every reading of source material is a reinterpretation to some extent. Consequently, the past becomes a dynamic field in which the meanings are negotiated, with science, politics, identity and contemporary culture playing an active role in shaping narratives about the past.

This approach is grounded in the so-called 'linguistic turn', with which the AMU researchers also identify. This reorientation is evident in the works of Włodzimierz Rączkowski (e.g. 2002), who analyses the significance of post-processualism as a new research perspective in archaeology. Danuta Minta-Tworzowska also expresses a similar view in her article (2000b) *Kwestia przełomu metodologicznego w prahistorii i archeologii polskiej* (*The Question of the Methodological Breakthrough in Prehistory and Polish Archaeology*). In this text, she highlights the significant epistemological implications of adopting a constructivist model of archaeological knowledge. However, she argues that this does not necessitate radical changes in archaeological knowledge on the scale of the Copernican Revolution, as a scientific revolution defined by Thomas Kuhn or Paul Feyerabend. Minta-Tworzowska sees a fundamental difference in whether archaeologists assume the possibility of 'reconstructing' or 'interpreting' the past, the latter being understood as producing images of the past. Thus, an objectivist or constructivist attitude becomes a criterion for change in the way science is practised. Since the mid-1990s, polyvocality has become increasingly evident in archaeology, with the aim of overcoming the opposition between subjectivism and objectivism, subject and object, or nature and culture. In this context, the emergence of ideas such as 'new materialism', Bruno Latour's 'actor-network theory', 'return to things', and 'agency of things' can be seen as part of a 'breakthrough' – or revolution – in the sense of breaking with the earlier scientific tradition.

However, the question arises as to whether the introduction of these concepts has truly broadened the cognitive scope of archaeology, or if it merely responds to the contemporary expectation that knowledge should primarily be effective. Such an instrumental approach seems detrimental to the humanities and is difficult to identify as a genuine ‚theoretical breakthrough'. Conversely, a focus on new areas of knowledge, and a fresh interpretation of concepts such as materiality, causality, archaeological heritage, and the social function of archaeology, bears the hallmarks of a theoretical breakthrough.

Arkadiusz Marciniak's works (2012a; 2012b; 2012c) also exhibit constructivist tendencies, developing the concept of the archaeological past as socially constructed and emphasising that interpretations of the past are always embedded in the contemporary context of the society that produces them, including its needs, values and cognitive structures. We believe that the essence of this position is the recognition that the veracity of an utterance (in the semantic sense) is not solely determined by the cognitive intentionality of the subject, but also – and perhaps above all – by the cultural conceptual apparatus through which we interpret reality ('spectacles of culture'). Henryk Mamzer (2020, 134) conveys this idea particularly aptly when he observes that "[...] a sentence spoken as true in one language may be false in another. This is because they are evaluative in nature and therefore dependent on the cultural context of the phenomenon under study". Mamzer's observation underscores the importance of linguistic and cultural relativism in contemporary reflections on the nature of knowledge in the social sciences, including archaeology.

The AMU archaeological methodologists focus primarily on interpreting the past as studied by archaeologists. This stems from the deeply rooted conviction that, since the objective truth of ancient history cannot be 'discovered' and past reality is no longer available through direct experience, it must be constructed. According to this perspective, the past is not so much unveiled as reconstructed through a contemporary conceptual framework, specific research procedures, and adopted narrative languages. Therefore, experiencing the prehistoric world occurs not only through material remains discovered 'here and now', but also through the deliberate creation of interpretative tools. This requires a solid methodological basis on which to reflect the relationship between

the past and contemporary ways of knowing, representing and experiencing it.

For the younger generation of archaeologists associated with the AMU community, the world of post-processual archaeology and the concept of post-post-processualism are already familiar. This includes Adriana Ciesielska (2002), Rafał Zapłata (2024), Michał Pawleta (2016) and Lidia Żuk (2019), among others. Their doctoral and postdoctoral dissertations reflect their interest in the theory and methodology of archaeology, representing different streams and traditions. They argue that theoretical reflection encompasses more than evolving views on the role of theory and methods in archaeological research; it also involves a deeper recognition of context as a kind of 'framework' for all cognitive activities. This external context not only conditions our cognitive capacities, but also the way we formulate the aims and objectives of archaeology as a scientific discipline. Nevertheless, our perception of reality is inevitably subjective and shaped by the 'spectacles of culture' – cognitive and symbolic frameworks resulting from specific historical, ideological, and mental conditions. However, the interpretative apparatus we use is not arbitrary; it can only be used within the limits set by the dominant cultural and social framework. If we assume that the Poznań methodologists' thinking was shaped by modernism, then modernism itself would function as these ‚spectacles' by providing a conceptual structure including the idea of objective truth. However, the modernity in which we currently operate creates a different set of cognitive frameworks, rooted in the relationship between humans and the material world. On the one hand, this framework limits modernist cognitive ambitions, but on the other, it opens up new interpretative spaces and research fields. It is within this framework that the aims and potential of contemporary archaeology are reinterpreted in light of the epistemological, ontological, and cultural complexity of the contemporary world.

The premises of processual archaeology, which aimed to discover the 'truth' about the past, seem much easier to accept than the post-processual perspective, which is characterised by polyvocality, diversity, and a lack of unified, coherent research programmes. Post-processual archaeology does not offer ready-made, universal analytical tools that researchers can routinely apply; on the contrary, it requires individuals to commit to constructing their own interpretive methods through creative effort and a critical approach. However, this does not mean that processual archaeology offered simplistic or 'easy' solutions. Lewis Binford (1978) and David Clarke (1968), for example, emphasise the complexity of the models and research tools employed, which aimed to describe and explain archaeological issues systematically rather than forcefully simplifying them. In the 1980s and 1990s, there was an intense debate about processualism in archaeology, particularly in response to its limitations. A key aspect of this was the demand for epistemological relativism, which was perceived as threatening the objectivity and scientific legitimacy of archaeology. The postmodern theoretical currents associated with the development of post-processual archaeology (Bintliff 1991; Hodder 1991a; 1991b; 1995; Shanks and Tilley 1992; Urban and Schortman 2012; and in Poland Minta-Tworzowska 2000c; Rączkowski 2011; Marciniak 2012b) raised hopes of expanding interpretive possibilities, but also fears – even among proponents of change – that a shift towards relativism could blur the boundaries of scientific reflection on the past.

The postmodern reorientation, as described by Anna Pałubicka (2018), focuses on five core thematic areas in contemporary archaeology: a) the relativisation of truth, knowledge and meaning; b) the deconstruction of grand narratives; c) the exploration of the relationship between agency and discourse; d) pluralism, polyvocality and heterogeneity; e) the diversity of rhetoric and writing styles. Above all, this reorientation broadens the field of research, incorporating new topics and those that were previously marginalised. This allows for fresh research perspectives and more nuanced, multidimensional analyses of archaeological phenomena to be introduced.

One of the research streams developed by archaeological methodologists in Poznań is the study of the concept of childhood, which was initiated under the influence of post-processual approaches to archaeology (see Pawleta 2004; 2009; 2013). Although this topic is still relatively new to Polish archaeological discourse, it has considerable heuristic potential and opens up new interpretative perspectives for analysing past social structures. This research critically reflects on the reasons for the marginalisation of children and childhood in archaeology to date, from both empirical and

epistemological perspectives. It has been suggested that dominant interpretive models of the past were based on contemporary, ideologised and often naturalised images of childhood that were uncritically transferred to the past. This resulted in anachronistic visions of children as passive members of past societies, excluding the possibility of recognising their agency and participation in social activities, as well as the cultural diversity of forms of childhood in different historical and cultural contexts. Consequently, there has been a call to revise these assumptions and consider children as active participants in social life whose presence and actions leave identifiable and interpretable traces in the archaeological record.

Another important research area that has emerged alongside the adoption of post-processual approaches in archaeology is the discourse of memory. This is one of the primary interpretative frameworks employed in contemporary analyses of the cultural landscape. This area of study encompasses Lidia Żuk's (2015; 2019) reflections, which focus on the relationship between the archaeological landscape – understood as a dynamic cultural palimpsest – and social memory. In her research, Żuk builds upon the concept of cultural memory developed by Jan Assmann, as well as the earlier work of Maurice Halbwachs (1969), who coined the term 'collective memory'. According to Assmann, cultural memory is a mechanism of intergenerational transmission that maintains cultural continuity by reproducing specific content, meanings, and identity patterns (Assmann 2008; see also Ingold 2003). The actualising role of memory and its importance as a social practice rooted in the materiality of the landscape are at the centre of Lidia Żuk's interests. She pays particular attention to sites of memory and processes of commemoration, highlighting their role in shaping community identity and giving permanence to specific narratives about the past. Assuming that prehistoric communities sought to permanently transform space through monumental architectural forms and anchor in it meanings important to a given group leads her to interpret these objects as tools of memory that transmit meanings to subsequent generations in a space-based manner.

The relationship between memory and materiality has also been discussed in the context of cemeteries (including prehistoric ones) as 'sediments' of identity. These are seen as permanent 'records' of collective identity and a manifestation of the social construction of the past. The permanent elements of these cemeteries are regarded as peculiar 'prostheses of memory' (Minta-Tworzowska 2013; 2015b). Similarly, Michał Pawleta (2015) wrote about a specific type of object, stone circles from Pomerania from the Roman Age period, interpreting them as 'sites of memory' and emphasising their contemporary role in constructing community awareness of the past through permanent traces of presence in space.

A work that addresses the key issues of contemporary reflection on the role of the past in the modern world is Michał Pawleta's *Przeszłość we współczesności. Studium metodologiczne archeologicznie kreowanej przeszłości w przestrzeni społecznej* (*The Past in the Present: A Methodological Study of the Archaeologically Created Past in Social Space*) (2016). Pawleta unequivocally advocates the idea that the past belongs to the present, observing that the archaeological past is not merely an object of cognition, but an active part of contemporary social experience. This publication redefines the contemporary role of archaeology, presenting it as a discipline that contributes to the construction of images of the past for both the academic community and a wider social audience. Today, the past – including the prehistoric past – is not confined to scientific research or conservation, but is increasingly invoked, reinterpreted, and experienced in public spaces. The concept of historical culture (Szpociński 2010) best explains its social functioning, allowing us to capture diverse forms of representing the past, such as archaeological reconstructions, museum exhibitions and popular archaeological festivals.

Reflecting critically on the management of archaeological heritage, particularly in terms of its dissemination, is considered a crucial aspect of contemporary research into the role of archaeology in society. This is clearly inspired by public and community archaeology, in which Pawleta (2020; 2022) attempts to define the areas in which archaeology can be visible in the contemporary world. This is particularly evident in its role in shaping social identities, promoting the protection of archaeological heritage and raising awareness of the importance of involving local communities in archaeological conservation and interpretation processes. Assuming the fundamental importance of how heritage sites are presented and interpreted,

Pawleta analyses archaeological reconstructions in situ, archaeology popularisation events (e.g. archaeological festivals and outdoor events), archaeological museum activities, historical re-enactments, archaeological tourism and the commercialisation of archaeological knowledge (Pawleta 2019). Provided a balance is struck between accessibility and the protection of heritage resources, these activities can be carried out in a spirit of sustainable development. In this context, archaeology emerges as a socially significant discipline, capable of addressing contemporary socio-cultural needs related to perceptions of the past and actively participating in social dialogue and responding to contemporary challenges (Pawleta 2017; 2019; 2020).

As a continuation of the reflection on the role of archaeology and heritage in the contemporary world, the publication *Dziedzictwo we współczesnym świecie: kultura, natura, człowiek* (*Heritage in the Contemporary World: Culture, Nature, Man*) (Marciniak, Pawleta and Kajda 2018) offers significant insights into the understanding, management and dissemination of heritage in the context of contemporary social, cultural and environmental challenges. The publication stresses a multidimensional conceptualisation of heritage as a dynamic and complex phenomenon resulting from continuous dialogue between the past and the present, rather than as a static resource. The authors propose a conceptualisation of heritage that is aligned with sustainable development and takes into account not only the preservation of resources, but also social participation, education, integration and intergenerational responsibility. The publication seeks to overcome dichotomies in heritage thinking, such as the division between cultural and natural heritage, tangible and intangible heritage, and heritage from the distant and recent past. It also addresses the distinction between heritage as an object of scientific research and as a field of social action. The authors emphasise the need to develop a common theoretical basis to enable an integrated approach to heritage, encompassing the symbolic and identity dimensions, as well as the practical aspects related to space management, education, social reconstruction, and building social capital. Thus, this book contributes to the broader trend of seeking a new epistemological and operational framework for engaged humanities, where heritage is no longer solely the domain of experts, but rather an area of social co-responsibility and active participation.

In recent years, Poznań archaeologists have developed the issue of the relationship between the past and the present through systematic research into two complementary perspectives: the archaeology of contemporaneity (Marciniak 2019; Pawleta, Kobiałka and Marciniak 2023) and community archaeology. The archaeology of contemporaneity encompasses not only the material remains of the recent past, particularly the 20$^{th}$ century, but also provides tools for critically analysing contemporary socio-cultural, political, and ideological processes. According to this perspective, the past is not considered a distinct chronological category, but rather a phenomenon that is continually being redefined and reinterpreted. Consequently, the role of the archaeologist extends beyond traditional research to encompass the analysis of contemporary cultural practices, including the use of space, the politics of memory, and the formation of local and regional identities.

A related strand is community archaeology (Kajda, Kobiałka and Marciniak 2022; Pawleta 2022), which combines the study of material traces of the past with consideration of contemporary communities' needs and expectations. Community archaeology treats archaeological heritage as a resource that should be used responsibly for the benefit of present and future generations. The idea of socialising archaeology underpins this approach, involving local communities in the research, conservation and interpretation of cultural heritage. In this way, community archaeology disseminates knowledge and enriches education, presenting the present as the perspective through which we interpret and understand the past.

Both contemporary and community archaeology recognise that the past is not a closed and objective category, but a dynamic social construct influenced by current needs and narratives. These ideas were implemented in the project 'Community Archaeology in Rural Environments - Meeting Social Challenges' (Filipowicz 2022; Kobiałka *et* al. 2022), as well as in the interdisciplinary study of the remains of German prisoner-of-war camps in Łambinowice (Lamsdorf) (Kobiałka et al. 2023; Pawleta, Kobiałka and Karski 2024). In both projects, archaeological research was conducted in close collaboration with local communities, volunteers, and non-academics. This approach enabled

the public perception of the sites' heritage and archaeological practices to be considered. This approach emphasises the need to treat relics of the past as living landscapes of memory requiring multi-layered interpretation, not just as objects of archaeological exploration. This encompasses the relationship between the past and the present, as well as the dialogue between local narratives and institutional forms of commemoration. This enables a fuller understanding of the socio-cultural functions of the heritage of the past. Consequently, community archaeology and the archaeology of contemporaneity serve as tools for education and for fostering social connections and dialogue among various stakeholder groups. However, a certain threat to these approaches is posed by the aforementioned principle of knowledge effectiveness. The question arises as to how far the symmetry between society and archaeologists can actually be realised so that, ultimately, archaeology is not subordinated to *ad hoc* social goals – something that has happened before with undesirable results.

## Concluding Remarks

The development and specificity of the archaeological methodology at the Adam Mickiewicz University in Poznań appears to be a dynamic, multifaceted space of negotiation between research theory and practice. The methodological reflections developed by the Poznań School, which evolved from modernist foundations towards postmodernist and post-postmodernist reorientations, have played an important role in shaping the theory and methodology of archaeology in Poland. This reflection covers a broad spectrum of issues, ranging from fundamental questions about the relationship between theory, method, and research practice to the problem of classification as a means of organising sources, formulating hypotheses, and creating concepts, and the analysis and interpretation of archaeological sources. This reflection has led to the exploration of new research fields such as social archaeology, landscape studies, memory, identity, and cultural heritage in the context of contemporary challenges. A notable achievement of the Poznań archaeological community in recent decades has been the significant expansion of the scope of research and the adoption of interdisciplinary, critical, and diverse cognitive perspectives.

At the same time, it is important to acknowledge the challenges that Polish archaeology faces in terms of achieving scientific legitimacy based on Western models. Without providing a detailed analysis of the causes of this phenomenon, Jerzy Kmita's (2011, 101) observation is worth recalling: "The blocking of thinking is conditioned by the permanent association of what is modern with what is 'foreign". Unfortunately, this tendency has now been perpetuated. Polish scientific thought has limited capacity for self-legitimisation, while 'point chasing', i.e. over-prioritising publications in foreign languages in foreign journals, has perpetuated this state of affairs.

In this context, there has been a partial blurring of local methodological reflection, and original concepts developed in Poland have become marginalised. Nevertheless, the Poznań archaeological methodologists' achievements have made a distinctive and lasting contribution to the global debate on archaeological theory and method. They have participated in this debate as an autonomous entity, rather than passively receiving external models. This milieu has developed its own methodological tradition, demonstrating its capacity for creative adaptation and the formulation of independent theoretical approaches. In this light, the Poznań School's achievements should be recognised as a significant voice in contemporary archaeology, demonstrating the potential of Polish science to generate original, critical, and inspiring debates and research concepts.

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# GEOGRAPHICAL SETTINGS, CHANGES IN THE NATURAL ENVIRONMENT IN POLISH TERRITORY IN THE PLEISTOCENE AND HOLOCENE UP TO 4200 CAL BP

Krystyna Milecka

Environment is of fundamental meaning for people both in the past and at present. Nowadays, the development of civilization and technology have enabled people to live in many environmental conditions even very severe. In the past however, such possibilities were significantly lower. People were dependent on a source of food and the possibilities to obtain tools and shelters. Changing climatic conditions in the Pleistocene limited such possibilities, especially during glacial periods. The development of a rich vegetation cover during the interglacials increased chances for successful life and survival. So, reconstruction of environmental conditions and especially plant communities are of great importance in archaeological research to connect them with recognized traces of humans and the material artefacts they could use.

Climate, and especially temperature changes were of fundamental importance, dictating all environmental changes in the Pleistocene and Holocene. A decrease in temperature caused successive glaciations and, as a consequence long-term changes in the geographical environment in terms of both biotic and abiotic nature. Intensive geomorphological processes took place, especially during the retreat phases of the ice sheet. These had a decisive impact on the formation of surface land-forms and the development of the hydrological network (Starkel 2021). As the ice sheet advanced, biotic elements died out and plants and animals species migrated south to find suitable habitats (Iversen 1958; Tobolski 1976). The retreat of the ice sheet allowed a reverse of these processes and species migrated north. This cycle repeated several times in accordance with temperature fluctuations that marked subsequent glacial and interglacial periods (Marks 2023).

Along with the migration of species, plant communities and ecosystems were formed. The changes in vegetation development after the ice sheet retreat are called progressive succession. This eventually resulted in a phase of the functioning of climax communities. Reverse changes during temperature decrease and leading to the next glaciation are called regressive succession (Tobolski 1997). At the same time, the process of soil development was progressing. Iversen (1964) and Tobolski (2003) have presented and described the pattern of climate and vegetation changes during the glacial-interglacial cycle.

## Geological and geomorphological processes during the Quaternary

Climatic changes influenced geological and geomorphological processes in the Pleistocene and Holocene, shaping contemporary landforms in Poland. As a result, the relief of the country today

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exhibits a zonal (belt-like) pattern, generally aligned latitudinally, and is conditioned by long-lasting geological processes (Starkel 2021). Past endogenic and exogenic geological processes led to the formation of geological structures that had originally been reshaped during the Alpine orogeny. Since the end of the Neogene, orographic features have undergone intensive changes due to climatic fluctuations, with exogenic processes remaining active. During the Middle and Upper Pleistocene, the transgressions of Scandinavian ice sheets and periglacial environmental changes in their forelands reinforced the zonal pattern of Poland's geomorphological structure (Starkel 2021) (Fig. 1). In the Sudeten mountains and upland areas, earlier geological processes were followed by phases of erosional incision, glacial advances, and cryoplanation (Starkel 2021). Due to the progressively decreasing extent of successive glaciations from the north to south (Fig. 1), three main geomorphological zones can be distinguished: a young-glacial zone within the extent of the Vistulian (Weichselian) glaciation, a degraded postglacial zone within the range of the Wartanian (Saalian) glaciation (tab. 2), and an old-glacial zone in the area of the Sanian and Odranian glaciations, where glacial and glaciofluvial sedimentary covers were modified by periglacial processes. Development of permafrost is possible, if mean annual ground temperature is lower than $0^0$C. It existed during the cold stages of Pleistocene, when winters were 3–4 times longer than summers (Marks et al. 2019). Multiphase changes occurred in river valleys throughout the Quaternary, resulting in their incision and infill with sedimentary layers (Starkel 2021). In the Odra and San glaciation zones, repeated cycle of periglacial and temperate conditions led to the formation of denudation valleys and extensive alluvial, diluvial and colluvial plains. Postglacial relief within the Wartian glaciation zone developed unevenly, depending on lithology. Marginal zones and kame hills remain visible, although many of these forms have been transformed into denudation outliers or cryopediments. In river valleys, extensive depositional terraces developed, older ones are often covered with loess, while younger ones are frequently overlaid by dune systems (Nowaczyk 1986; Starkel 2021).

The Vistulian glaciation left numerous landforms of glacigenic and glacifluvial accumulation, subglacial and meltout erosion kettles, outwash plains and ice-marginal valleys (Kozarski 1995). In northern Poland, traces of periglacial activity, such as frost structures, solifluction, eolian covers and deflation hollows, gradually diminish in intensity.

The final stage of the Vistulian glaciation, the Younger Dryas, marked the last treeless phase and was a key period for geomorphological processes influencing both Holocene and contemporary relief in areas affected directly by the ice sheet and in surrounding periglacial regions. In general, the landforms created during the last glaciation have been preserved throughout the Holocene (Starkel 2005). In mountain areas, slope morphology developed in accordance with lithological conditions, while in lowland regions, eluviation processes were dominant. Organic accumulation occurred in land depressions.

Local geomorphological and hydrological changes induced by men were found as early as in the Neolithic (Starkel 2021). Human impact changed hydrological conditions. Deforestation led to an increasing of water level, due to which wetlands formed. Removal of plant cover caused an exposition to wind activity and led to winnowing or depositional processes on areas covered by dunes.

## Methods of palaeoecological research, pollen analysis

Detailed analyses of organic sediments are general methods of research into palaeoenvironment especially during the Quaternary (Latałowa 2003). They use the ability of anoxic conditions of peats and lake gyttjas to conservation of plant and animal remnants in. Any piece of fossil organic remains found in organic sediments can give information about past environment. However, some additional conditions must be fulfilled: (1) it must be possible to recognize the organism (species), from which the part of body cames, (2) the ecological demands of this taxon must be known (3) it should be possible to find the time of accumulation of the sediment layer, where the remnant was found, i.e. chronology (absolute or relative) is necessary. There are quite a lot of methods of palaeoenvironmental research, in fact as many as groups of living organisms we can recognize, if parts of their bodies are found in organic sediments.

Why peats and gyttjas? Gyttja is sediment which is accumulated at the bottom of lakes. Peatland accumulates organic matter in terrestrial conditions. The rate of accumulation and components of

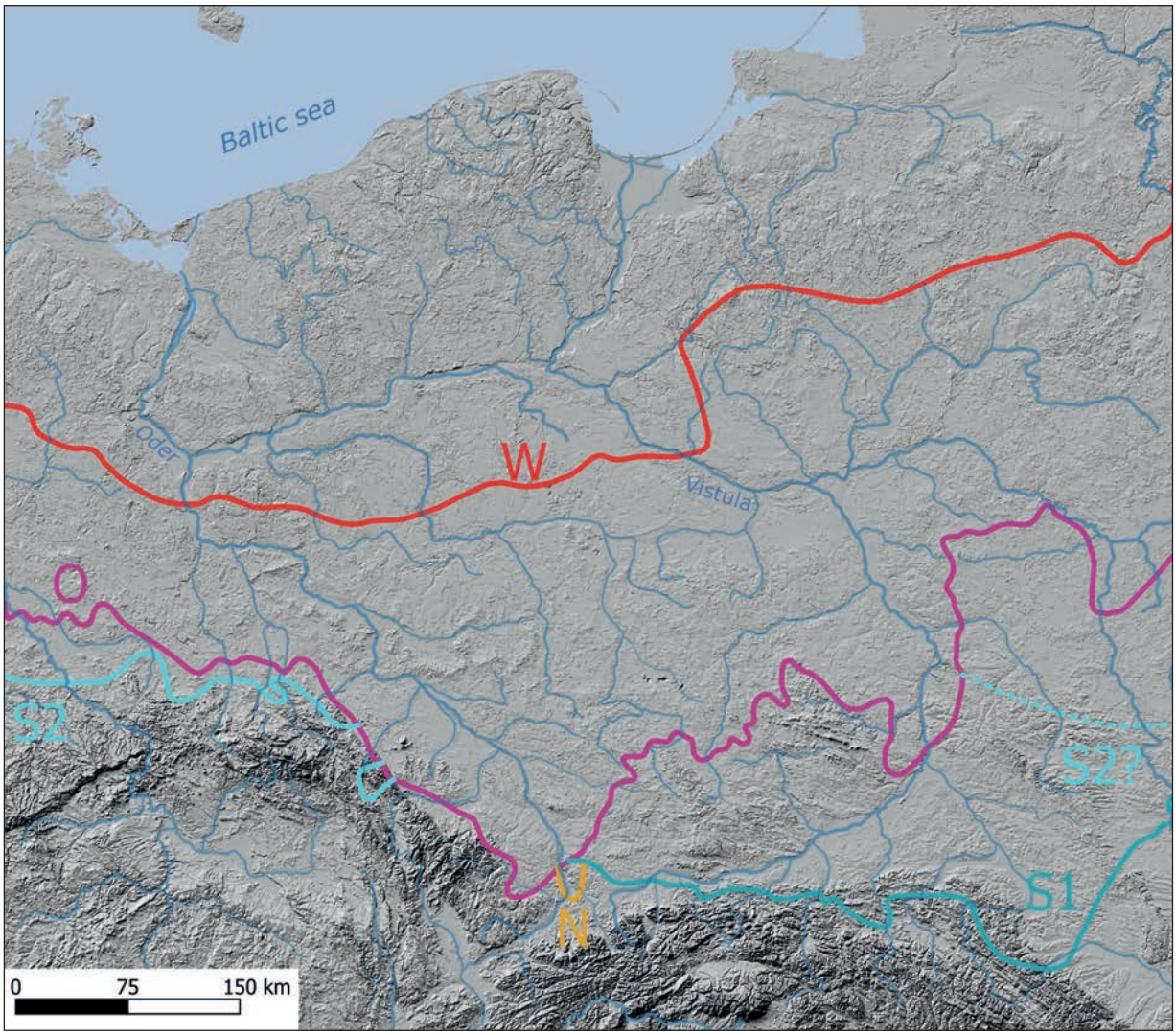



FIGURE 1. Extent of Scandinavian glaciations in Poland: N – Nidanian; O – Odranian; S1 – Sanian1; S2 – Sanian2; W – Vistulian (after Marks 2023)

sediments depend on organic matter productivity in the lake or peatland and the quantity of supply of organic and mineral particles to the water or peatland (Tobolski 2000). Gyttja is a sediment of allochtonic origin: it consists of all the particles both from water of a lake and from the its surroundings settling down to the bottom: pollen, seeds and fruits, bud and fruit scales, tree bark, algae, diatoms, Cladocera, Ostracoda, insects, fish scales and so on (Tobolski 2000). Peat is a sediment of autochthonic origin, consists mainly of remnants of plants growing at the place where the deposit forms. Apart from organic remnants, sediments give information about abiotic conditions, such as climate, based on the content of elements, chemical compounds or isotopes. These are another group of methods, but they are not discussed here.

Most of the methods based on content of organic remnants in sediments have the same procedure of research. The technical stages (scheme) which must be employed in each of them are similar to each other and the procedure goes as follows.

- Choice of the research site, mire or lake; the exact choice depends on the purpose of the research; during an archaeological excavation a lake located close to the settlement is usually the best, because sediments layers probably recorded the traces of human presence and details of their economy.

- Taking cores needs coring equipment, the type of which depends on the site: mire or lake, big or small, deep or shallow and so on. Organic sediments, usually in 0.5 or 1 m tubes of 5 to 10 cm in diameter, carefully, tightly packed and described are carried to a cold store with a temperature of 2–4$^0$C. It is necessary to protect them from drying and mildewing of sediments.
- Description of sediments, their organic and inorganic components, colour, wetness. Instructions for such a description was given by Troels-Smith (1955) and Tobolski (2000).
- Sampling is usually taking a small volume of sediments (e.g., 1 cm$^3$ for pollen or diatom analysis or a slice of 1 cm thick for macrofossil analysis). Such a sample must be large enough for having statistically reliable results.
- Laboratory preparation depends on the method, however generally it consists of removing of the sediment components which are not necessary and/or undesirable during the next stages, and could disturb the possibilities of recognition of the organic remnants during the microscopic analysis.
- Microscopic analysis consists of overview of the sample under a magnification proper for the recognition of all the fossil remnants of the given method. This stage is the most time-consuming part and takes weeks or months before the results are gained.
- All the numerical results must be presented as a master table and then in a graphic style, usually as a percentage or absolute frequency diagram: list of species with all the changes through time. This stage is the last technical one.
- Interpretation can be done based on the results of all the stages because all of them give us some, special information. The indicative value of a species is the most important basis for interpretation.

## Pollen analysis

The official beginning of palynology as a palaeoenvironmental research method started in 1916, when Lennart von Post published the results of his research of fossil pollen and spores in Holocene peat (Sadowska and Chłopek 2003). His method enabled the interpretation of palaeoenvironmental factors. In Poland pollen analytical research has a long tradition (over a hundred of years) and dozens of diagrams have been published concerning different periods of the Pleistocene and Holocene. Professor Władysław Szafer was a pioneer scientist, who introduced this method into research at the Jagiellonian University in Kraków. Then other universities also introduced such analyses. The first results were published in the period between the two World Wars (e.g., Szafran 1925; Paszewski 1930 and many others). Sediments of Holocene and interglacial times were analyzed, however microflora of earlier geological periods was also the subject of interest (e.g., Bitner 1954; Niklewski 1968). In the second half of the 20th century and later, up to date palynological research has been conducted at the Universities in Kraków, Warszawa, Poznań, Wrocław, Gdańsk, Białystok and some others, also in the Polish Academy of Sciences. The above-mentioned botanist, Władysław Szafer, was also the originator of the isopolls method and in the 1930s presented migration maps for two tree species in the area of Poland (Szafer 1935). Isopoll maps were subsequently published for nine species of Polish flora by Ralska-Jasiewiczowa (1983). A big project was conducted at the beginning of the 21$^{st}$ century and migration maps based on isopoll data of 39 trees, shrubs, herbs or pollen types were presented (Ralska-Jasiewiczowa et al. 2004). They show their migration pattern during the late glacial and Holocene in Poland. The last collective and summing up maps of migration during the Eemian interglacial were prepared for 27 taxa (Kupryjanowicz et al. 2018). As a result, the potential availability of plant, and directly animal sources for past societies in different regions of Poland, at least since the Eemian is available.

For better understanding, how reconstruction of palaeoenvironmental conditions is possible, some details of interpretation must be explained. The example is one of the fundamental methods of palaeoecological research – pollen analysis. Pollen analysis (palynology) use pollen grains, a part of the generative system of reproduction of seed plants (Gymnosperme and Magnoliopsida). Additionally, but of less meaning, spores of selected spore plants (Pteridophyta) are recognized and taken into consideration. Seed plants produce differentiated quantities of pollen depend on the way of pollination. The wind-pollinated plants produce a lot of pollen because the probability of pollination by the one pollen grain is scarce. Animal-pollinated

plants produce a lot or little pollen depending on the ecology of a given species. Very low production of pollen is a feature of autogamic plants. Their pollen is hardly found during palaeoecological analyses. Nonetheless every pollen grain found in the sample of sediments provides information about the palaeoenvironment. The list of identified taxa gives information about plants growing in the past. So, we know what kind of plant communities developed. Then we can conclude about the faunal species living in these communities. Finally, the indicative values of some species allow for reconstruction of all the parameters of the geographical environment. Taxa of narrow tolerance to environmental factors are of the greatest importance because they indicate limited, specific values occurring during the analyzed time period. For example, *Typha latyfolia* (bulrush) is considered to be the indicator of minimum July temperature of +14°C (Iversen 1954; Wasylikowa 1964) or +13°C (Isarin and Bohncke 1999). Minimum July temperature for *Nymphaea* (water lilies) is 12°C, and for a species of very wet sites *Solanum dulcamara* (bittersweet) minimum July temperature is 13°C (Isarin and Bohncke 1999). Calciphilic (e.g., *Dryas octopetala,* mountain avens) or nitriphilic (e.g., *Urtica dioica*, common nettle) plants indicate the features of a given soil. Spores of *Isoëtes* (quillworts) indicate lake water poor in nutrients. Plants of mires or reed-beds indicate wet habitats and so on. Thus, identification of plants living in the analyzed area make possible reconstruction of environmental conditions in details.

Human activity indicators are a special group related to the presence and economy of men. Cultivated plants are the most obvious taxa of this group. In Poland almost all of them belong to synanthropic plants, which means that they are introduced species, not occurring in Central Europe before the onset of cultivation. Weeds, such as *Centaurea cyanus* (cornflower), *Agrostemma githago* (common corn-cockle) or *Papaver rhoeas* (common poppy) were introduced together with cereals, *Fagopyrum* (buckwheat), or *Cannabis* (hemp). However, cultivation was introduced in the Neolithic. Traces of human presence are much less clear in the Palaeolithic and Mesolithic periods and generally we can only describe the possibilities of behaviour with respect to the prevailing environmental conditions as a result of paleoecological research. Next to pollen and spores, identification of charred particles is possible during microscopic analysis. They prove the occurrence of fires which could have been caused by men. Traces of controlled fires in the forest understorey are seen in increased presence of *Pteridium aquilinum* (bracken) spores. This species grows on habitats rich in minerals, and soil enriched in ash favoured its abundant spread. Forest fires usually result also in the development of heliophytic species, the presence of which is recorded in pollen diagrams.

## Pollen and macrofossil analyses

Pollen analysis allows for the reconstruction of regional vegetation mainly because of the long-distance transport of many pollen grains. So, another method, macrofossil analysis is complementary. This involves the recognition of plant remnants (bigger in size than pollen), such as: seeds and fruits, macrospores, bud and fruit scales, tree bark, leaves, pieces of wood and others.

TABLE 1. Similarities (S) and differences (D) between pollen and macrofossil analyses

| Pollen analysis | Macrofossil analysis | |
|---|---|---|
| Record of vegetation history | | S |
| Interpretation based on bioindicative value of plants | | S |
| Record of regional vegetation | Record of local vegetation | D |
| Most often the possibility of determination of plant to the genus level | Frequent possibility of determination of plant to the species level | D |
| Universal method because of hugh production of pollen and their good dispersion | Selected data, only some plants are represented, often randomly | D |
| Record of all the plants and plant communities next to research sites | Record of selected plant and plant communities (usually wetlands and lakes) | D |

The results of these studies supply similar knowledge about vegetation but mainly of local plant communities. They also have some special features and great value especially in archaeological research (Tab. 1). So the best way to reconstruct plant communities and environmental conditions of the past is through the connected use of both pollen and macrofossil analyses. Additionally, macrofossil analysis makes possible reconstruction of species history, which is very valuable in archaeological research. It is possible to discover the time of occurring and spreading in the analyzed region of wild and cultivated plants. The latter group allow for reconstruction of the timing and directions of Neolithic evolution and the history of the cultivated plants that are now in common use (Lityńska-Zając and Wasylikowa 2005). However also earlier records are common (e.g., Hardy and Kubiak-Martens 2016; Sobkowiak-Tabaka et al. 2022). Lityńska-Zając and Wasylikowa (2005) in their textbook gave full overview of possibilities and methods related to both earlier and later times from the Palaeolithic to the Neolithic and historical times. Lityńska-Zając (2005) paid attention to difficulties in interpretation especially related to the gathering of wild plants. Usually, we have no proof of their use, however it is possible to make inferences based on their use nowadays and in the traditions of research regions. Some plants or their parts needed special treatment or processing to keep them edible after longer time of storage. This could involve drying, salting, pickling or thermal treatment, which could leave specific traces (e.g., Hardy and Kubiak-Martens 2016). Coprolites are also source of information (Kubiak-Martens 2016). Nowadays, modern technological equipment is very helpful in advanced research methods.

## Environmental changes in Poland during the Pleistocene and the Holocene up to 4200 yrs BP

The Pleistocene is the first part of the Quaternary. The stratigraphy of the Quaternary is often updated because of significance of its deposits and geological mapping (Marks 2023) (Tab. 2). It is also important because of its meaning for human societies. Milankovic's cycles are considered to be the driving force of the climatic cycles of these periods. The global division of stratigraphic stages is supported by geochronologic and magnetostratigraphic dating and correlated with marine isotope stages (MIS) (Marks et al. 2016, 2019; Marks 2023). Subdivisions of the Quaternary have been prepared for continents, countries or regions. According to Marks (2023), the subdivision of the Quaternary relevant for Europe is mainly based on the results from the Netherlands, Germany and United Kingdom (Zagwijn 1985; Gibbard et al. 2005; Litt et al. 2007).

Quaternary deposits in Poland are mostly of terrestrial origin and they are connected with the landforms in which they occur. They are of fluvial and glaciofluvial origin (Marks 2023). Quaternary climatostratigraphy mostly refers to isotope stratigraphy based on the record of variations in the oxygen isotope ratio $^{18}O/^{16}O$ in ice cores or deep-sea sediments (Rasmussen et al. 2014; Cohen and Gibbard 2019; Marks 2023).

In the context of investigating the natural environment as a background for the development of human civilization during the Pleistocene, biostratigraphy is of fundamental importance. It depends primarily on the temperature changes that occurred with successive glacials and interglacials. Central Europe, including Poland, was subject to strong thermal fluctuations, and these regions were also covered by ice sheets, in whole or in part, depending on the period of the Ice Age (Fig. 1). The succession of vegetation that took place in successive interglacial periods was not exactly the same each time, and the characteristic sequence of species is a criterion that allows the correlation of the sediments with a specific interglacial. Pollen diagrams are the most detailed and reliable record of vegetation succession during the Pleistocene and the Holocene. The area of Central Europe is rich in fossil and still-extant sedimentary basins as a result of glacial landform activities, thus the possibilities are particularly favorable for palaeoecological research. The vegetation succession of all the interglacials during the Pleistocen are of interest because of: (1) the need to compare the interglacials between each other, they differ in some courses (2) the possibilities of explaining some climatic problems; pollen analysis based on the indicative value of many taxa supply a lot of palaeoenvironmental information (3) it provides data concerning historical plant geography. The Eemian, the last but one Interglacial is of special interest because of its similarity to the Holocene (Granoszewski 2003). Additionally, it gives the

possibility to predict the direction of the next stages of vegetation succession and environmental processes changed during the Holocene under the impact of men.

TABLE 2. Chronostratigraphic division of the Quaternary (after Marks et al. 2016, Marks 2023, modified). MIS – Marine Isotope Stages

| MIS | Stratigraphy | | Poland | Western Europe |
|---|---|---|---|---|
| 1 | Holocene | 11.7 ka | Holocene | |
| | | | Late Glacial | |
| 2–5d | Pleistocene | Upper 129 ka | Vistulian Glaciation | Weichselian |
| 5e | | | Eemian Interglacial | Eemian |
| 6 | | Middle 774 ka | Wartanian and Odranian Glaciation | Saalian |
| 7 | | | Lublinian Interglacial | |
| 8 | | | Krznanian Glaciation | |
| 9 | | | Zbójnian Interglacial | |
| 10 | | | Liwecian Glaciation | |
| 11 | | | Mazovian Interglacial | Holsteinian |
| 12 | | | Sanian 2 Glaciation | Elsterian |
| 13–15 | | | Ferdynandovian Interglacial | Cromerian III |
| 16 | | | Sanian 1 Glaciation | Glacial B |
| 17–21 | | Lower 2,58 Ma | Podlasian Interglacial | Cromerian II<br>Glacial A<br>Cromerian I |
| 22 | | | Nidanian Glaciation | Dorst Substage |

According to Lindner et al. (2013) the older Interglacials in the Lower and at the beginning of the Middle Pleistocene (Podlasian and Ferdynandovian) (Tab. 2) were longer and more complicated because of more than one climatic optimum (Janczyk-Kopikowa and Żarski 1995; Stuchlik and Wójcik 2001; Pidek 2013). The younger ones (Mazovian, Eemian and Holocene) were shorter and have one climatic optimum (Tobolski 1991; Kupryjanowicz and Żarski 1995; Malkiewicz 2002; Granoszewski 2003; Kupryjanowicz 2008; Kołaczek et al. 2012). According to Maslin and Ridgwell (2005), this is the result of the transformation of the Earth's climatic system during the so-called Mid-Pleistocene revolution.

Below, the records of environmental changes during the selected periods are given to exemplify cyclic changes during the early and later Pleistocene, and the Late Glacial time after the Vistulian glaciation (Tab. 3) which is of special influence on the environmental conditions of the Holocene and at the same time of special interest to many researchers of various disciplines. The Early and Middle Holocene, up to 4200 yrs BP, are the last described periods. It is recorded with a higher specificity both because of the greater possibilities of detailed scientific research and dating and wider interest related to increasing human activity and development of Neolithic settlement in Central Europe.

TABLE 3. Climatostratigraphy (after Marks 2023, modified) and event stratigraphy of the Late Glacial and Early and Middle Holocene in Poland

| Age | | | Climate | Vegetation |
|---|---|---|---|---|
| 4.2 | Holocene | middle | climatic optimum | Rich deciduous forest<br>*Quercus, Ulmus, Tilia, Fraxinus, Corylus* |
| 8.2 | | early | warming | Pine-birch forest, *Ulmus, Corylus*<br>Birch-pine forest |
| 11.7 | Late Glacial | Younger Dryas | cold dry | Cold steppe: *Artemisia*, Chenopodiaceae<br>Tundra: *Dryas octopetala, Betula nana*<br>*Juniperus* – N Poland |
| 12.68 | | Allerød | warming | Birch-pine and pine-birch forest<br>Steppe plants – E Poland |
| 13.35 | | Older Dryas | cooling | Cold steppe: *Artemisia*, Chenopodiaceae<br>Tundra: *Betula nana*, dwarf willows, *Dryas octopetala* |
| 13.54 | | Bølling | warming wetting | Tree-birch forest with willows and poplars;<br>*Hippophaë*; steppe with *Artemisia* |
| 13.67 | | Oldest Dryas | cold | *Hippophaë*; Cold steppe: *Artemisia*, Chenopodiaceae<br>Tundra: *Dryas octopetala*, *Betula nana* |
| 14.90 | | | | |

## The Succession of the Ferdynandovian Interglacial MIS 13–15 (an example of vegetation development in one of older interglacials) (Janczyk-Kopikowa 1991; Janczyk-Kopikowa and Żarski 1995)

The Ferdynandów Interglacial is preceded by the San 1 glaciation, which ends with relatively high proportion of plant communities more typical of open habitats. The treeless vegetation during these glaciations gradually changed into tundra with *Pinus* (pine) and *Betula* (birch) patches. *Larix* (larch) was an admixture. Severe climatic condition obtained; tundra-type elements dominated such as Poaceae (grasses), Cyperaceae (sedge family), Chenopodiaceae (goosefoot family), *Selaginella selaginoides* (lesser clubmoss) and steppe elements: *Artemisia* (mugwort), *Helianthemum* (rock-rose). Light-demanding species *Hippophaë* (sea-buckthorn) and *Juniperus* (juniper) confirm the treeless vegetation with only some thickets of *Betula* and *Salix* (willow).

The development of forest communities started during the Ferdynandów Interglacial time (FI). Vegetation was dominated by *Betula* and then by *Pinus*, so this was a type of boreal forest with changing proportion of *Betula* and *Pinus*. Then more thermophilic species appeared, such as *Ulmus* (elm) and *Quercus* (oak). Herbs diminished to below 5% in most cases. During the next stage (FII – climatic optimum), the share of pine and birch decreased clearly. Good climatic condition and growing temperature allowed for the domination of thermophilic species: continued development of *Ulmus* and *Quercus*, then *Alnus* (alder) appeared in areas with better hydrological conditions. *Corylus* (hazel) was the last frequent element. Vegetation

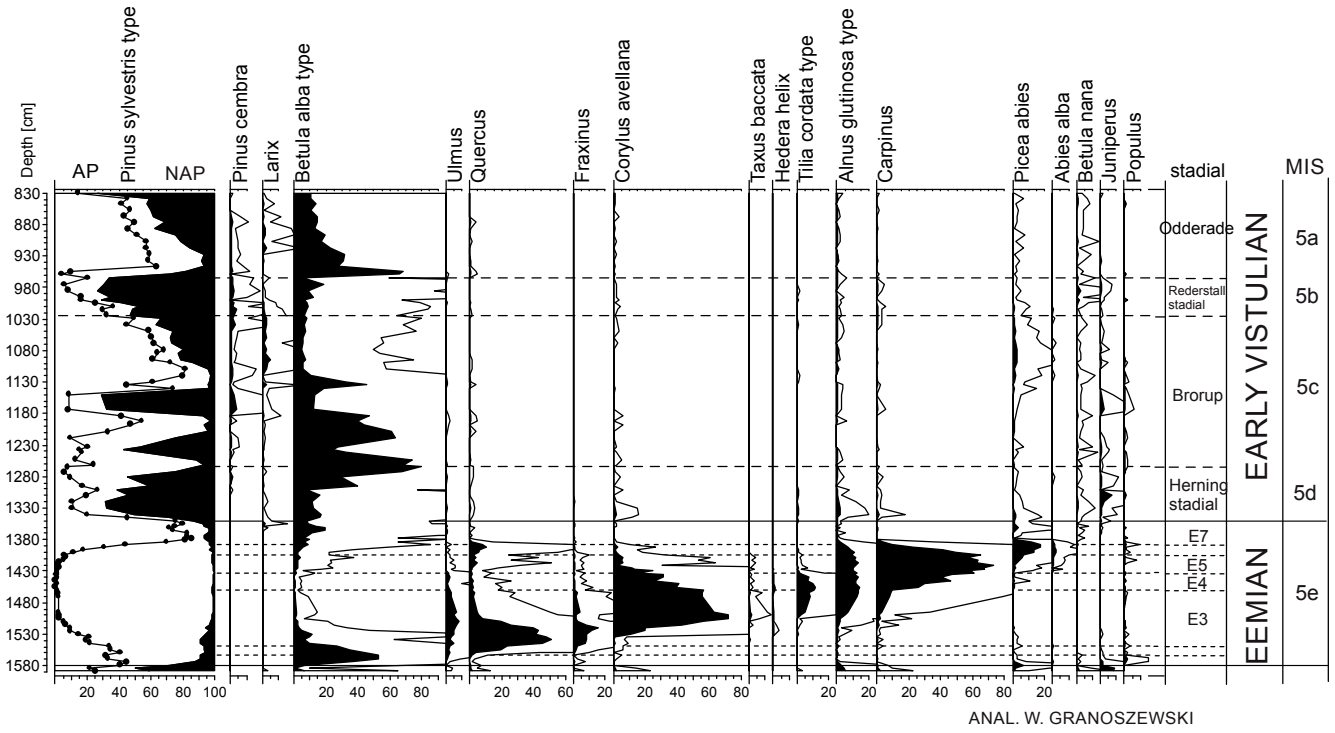



FIGURE 2. Pollen diagram of vegetation development at Horoszki Duże during the Eemian Interglacial, selected curves (after Granoszewski 2003). MIS – Marine Isotope Stages; AP – arboreal pollen (sum of percentages of pollen grains of all the trees and shrubs; NAP – non-arboreal pollen (sum of percentages of pollen grains of all the terrestrial, herbal plants); percentages in black; exaggeration 10x (percentiles) in white

of this stage was rich and full of tree and shrub admixtures, e.g., *Tilia* (lime), *Fraxinus* (ash), *Acer* (maple), *Sambucus* (elder), *Viburnum* (viburnum), *Rhamnus* (buckthorn) and *Cornus* (dogwood). Then deciduous species were gradually overtaken by the dynamic but relatively short development of *Picea* (spruce) and *Abies* (fir) and much less frequent but clearly seen record of *Taxus* (yew). These episodes (in a geological sense) allowed for differentiation of the next stage of the Ferdynandów Interglacial (FIII). Pollen spectra show better hydrological conditions, because the species that had the culmination of their presence at the same time (*Picea*, *Abies*, *Taxus* and Cyperaceae, ferns and *Typha latyfolia*) are characteristics of wet habitats. The last stage of the Ferdynandów Interglacial is distinguished by the domination of pine forest with spruce and birch. Thermophilic species decreased quickly and disappeared except for *Alnus*, which remained on a few sites in wet habitats (FIV). The interglacial succession is closed by the return of pine-birch forest and in the youngest part an increasing proportion of herbal plants.

Typical features of Ferdynandów Interglacial:

1. Occurrence of *Ulmus* and *Quercus* in similar quantities during the climatic optimum
2. Following it, a high culmination of *Corylus*
3. Small proportion of *Tilia*
4. Development of *Abies*, *Picea* and *Taxus* after the climatic optimum
5. The lack of *Carpinus* in the first warming.

## The Eemian Interglacial vegetation succession (MIS 5e) (Fig. 2)

The Eemian is the last interglacial preceding the present time – the Holocene. The late glacial of the Odranian (Wartanian) glaciations was characterized by unstable conditions seen as a lot of redeposited pollen and the presence of Dinoflagellate cysts. They indicated intensive erosional processes due to discontinuous plant cover (Mamakowa 1989;

Granoszewski 2003). Plant communities more typical of open habitats of tundra type dominated, with "cold" plants such as dwarf shrub birch (*Betula nana* type, dwarf birch) and willows (*Salix polaris* type, polar willow). Moist habitats were occupied by reedbed species: *Phragmites* (reed grass), *Typha* and Cyperaceae. *Sphagnum* (bog moss) was also present. Depending on the site and its location in Poland, there is also possibility of rare tree stands (Granoszewski 2003).

The landscapes of the Eemian interglacial resembled those at the early Holocene especially in the young glacial areas. The central and northern part of Poland was characterized as "Lakeland" and the southern part as a "denuded area" (Pidek et al. 2018). The coast was located north of today's line, but the Eemian (Tychnowy) Sea covered the area of the lower Vistula valley and Elbląg Upland (Mojski 2005; Makowska 2009). Sea level was about 3–8 m higher than today (Bruggemann et al. 2004). The enlarged extent of the Eemian Sea resulted in strong influences of oceanic climate as suggested by rapid increase of extent of warm-demanding trees in the vegetation (Pidek et al. 2018). The beginning of the interglacial time is marked by the occurrence of more organic matter in the deposits and content of carbonates, this means also better frequency of pollen grains. The stabilization and development of soil is also indicated (Iversen 1958; Tobolski 1976, Dzięciołowski and Tobolski 1982). The development of soils was very intense. In central and southern Poland, soils were formed on loess (Pidek et al. 2018).

Eemian vegetation development covers seven periods (E1 – E7). The tree *Betula* was the pioneer species beginning forest succession, the presence of *Pinus* however was also significant (E1 – E2). Plant communities more typical of open habitats were of little importance (NAP below 10%). After a decreasing proportion of birch (earlier) and (a little bit later) pine, deciduous trees appeared due to improvement of climatic conditions, mainly growing temperature and development of soil. *Quercus*, *Ulmus* and *Fraxinus* developed forest communities of different composition related to the available habitat conditions (E3). The first – oak, was of the greatest importance reaching over 50% of pollen (Granoszewski 2003; Kupryjanowicz et al. 2003; Kupryjanowicz et al. 2018). Oak-pine forest and riverine communities with elm and ash developed. The record of *Taxus* and *Hedera* (ivy) pollen confirms the amelioration of climate and higher annual temperature. An increasing proportion of *Corylus avellana* in plant communities and the decreasing value of *Quercus* and *Fraxinus* marks the next stage of vegetation succession (E4). *Corylus* is an absolute dominant species of this period (over 70% of pollen Granoszewski 2003; Kupryjanowicz et al. 2003). *Tilia cordata*, *T. platyphyllos*, *T. tomentosa*, *Alnus glutinosa* and *Carpinus* (hornbeam) were also present. Deciduous forest with hazel and lime developed; *Hedera helix*, *Viscum* (mistletoe) and *Trapa natans* (water caltrop) appeared due to very good warm conditions. Changing proportion in forest communities and *Corylus* overtaken by *Carpinus* and *Tilia cordata* were visible in the next successional stage E5. Hornbeam was the dominant species in the forest communities. Together with *Tilia*, *Acer*, *Quercus*, *Ulmus*, *Fraxinus* and *Taxus* it constituted the rich broadleaved forest which can be compared to the modern *Tilio-Carpinetum* lime-hornbeam forest (Granoszewski 2003) typical for the temperate zone of Central Europe (Matuszkiewicz 2001). Hazel was still growing in the understorey. Indicators of temperature conditions that were still good were present: *Viscum*, *Hedera* and *Ilex aquifolium* (common holly). The oceanic climate demands of the last two species suggest a less continental climate than today, also in the eastern areas of central Europe (Granoszewski et al. 2018; B. Noryśkiewicz et al. 2018). Phase E6 is marked with clear changes in vegetation due to increasing wetness and cooling. Wet habitats allowed for development of mixed forest and increasing proportions of such species as *Picea* and *Abies*. Deciduous trees *Alnus*, *Ulmus* and *Fraxinus* retreated from riverine habitats. Some plant communities more typical of open habitats developed, resulting in better conditions for light-demanding species and leaching of soils (Granoszewski 2003). E6 is the beginning of regressive and closing phase of the glacial-interglacial cycle. *Carpinus betulus* and *Picea abies* decreased significantly, instead the proportion of *Pinus* started growing clearly. E7 is the last phase of the Eemian interglacial and reflects the deterioration (cooling) of climate and increasing precipitation. Forest communities were occupied by pine forest with admixture of birch. Spruce developed in wet habitats, locally on peatlands as indicated by presence of *Sphagnum* spores (Granoszewski 2003). Dry habitats in pine forest were occupied by *Calluna* (heather). The

proportion of plant communities more typical of open habitats increased.

The upper boundary between interglacial succession and the beginning of the Vistulian glaciation is related to the end of forest domination and start of plant communities more typical of open habitats. There is also a change in deposits: organic sediments (gyttja or peat) gradually change into more minerogenic ones. This phenomenon is due to the openness of the landscape and increasing erosional processes (Kupryjanowicz et al. 2003). Organic productivity was also limited.

## The Early Vistulian vegetation succession (Fig. 2)

Continued cooling of the climate resulted in the retreat of the forest and the spread of the plant communities more typical of open habitats. Increased amount of herbal (NAP) pollen grains creates the border between the Eemian and Vistulian, however, as is indicated by macrofossils of birch, pine and larch, some tree stands were still present (Granoszewski 2003). The Early Vistulian had four stages. Herning and Rederstall Stadials had a colder climate. Vegetation was dominated by plant communities more typical of open habitats. Pollen of trees and shrubs, mainly *Betula* and a minor proportion of *Pinus* are still present, however their concentration decreased significantly. Tree pollen derives from long-distance transport over the open landscape (Granoszewski 2003). Herbal plants were dominated by Poaceae, Cyperaceae, *Artemisia* and Chenopodiaceae. Pollen of *Betula nana* and spores of *Sphagnum* suggest the development of peat bogs favoured by permafrost.

During the Brörup and Odderade interstadials, improvement of climate resulted in the spread of *Betula* forest, which is indicated by a high increase of pollen grains and macroscopic remains of tree-birch (Tobolski 1991; Granoszewski 2003; Kupryjanowicz 2008). Some stands of other trees, such as *Pinus*, *Larix*, *Populus* (poplar) and *Picea* were also confirmed by macrofossils.

There is some variety of opinion among authors on the division of the Plenivistulian into cold stadials and warmer interstadials (e.g., the views of Granoszewski 2003; Wachecka-Kotkowska et al. 2018) or into Lower, Pleni and Upper Plenivistulian (Marks 2023). To a high degree, the vegetation remained relatively similar and related to cold climatic conditions within which oscillations were relatively slight and did not much influence the plant communities. Changes in diagnostic elements of flora were therefore very small (Granoszewski 2003). As suggested by pollen and macrofossils of species of different ecological demands related to wetness, soil and trophy, during the Plenivistulian the range of plant communities more typical of open habitats expanded and dominated in various habitats. Rare stands of boreal trees, namely *Pinus sylvestris*, *P. cembra*, *Sorbus aucuparia* (rowan), tree *Betula* and *Alnus* were found (Granoszewski 2003; Tobolski 1991). However open landscape dominated. Shrub and dwarf-shrub tundra is evidenced by dwarf birch (*Betula nana*) and shrub willows (*Salix polaris* type). *Artemisia*, Chenopodiaceae, Poaceae pollen document the spread of cold steppe. Mossy tundra species were also present (Tobolski 1991).

## Late Vistulian vegetation succession (Fig. 3)

The late glacial period after the Vistulian glaciation was associated with periods of cooling and warming of the climate. The classical division distinguish the Oldest Dryas, the Bølling-Allerød stage, and the last cooling of the Younger Dryas. In some pollen sequences, a short-term cooling – Older Dryas - is also visible separating two warmer periods of Bølling and Allerød (Tab. 3). Chronology is given after Marks 2023.

The Oldest Dryas (14,900- 13,670 cal BP) was a cold period when tundra-like vegetation developed. Herb species dominated such as Poaceae, Cyperaceae and Chenopodiaceae. *Artemisia* and *Helianthemum* indicate steppe plant communities. Dwarf willows were an important component of vegetation, as indicated in pollen diagrams by the presence of *Salix polaris* type (polar willow) and *S. herbacea* type (dwarf willow) grains (Latałowa 2004). *Betula nana* dominated in wetlands, *Dryas octopetala* in habitats rich in calcium carbonate. Shrub elements were represented by *Hippophaë rhamnoides* and *Juniperus*. *Hippophaë* was the most important during the earlier stages, the Oldest Dryas and Bølling. Sea-buckthorn as a light demanding species occurs always in treeless vegetation and disappeared almost completely when forest communities developed (Krupiński et al. 2004). Juniper increased in later time during the Late Glacial, especially during the Younger Dryas. Tree refuges were located in Carpathian regions and

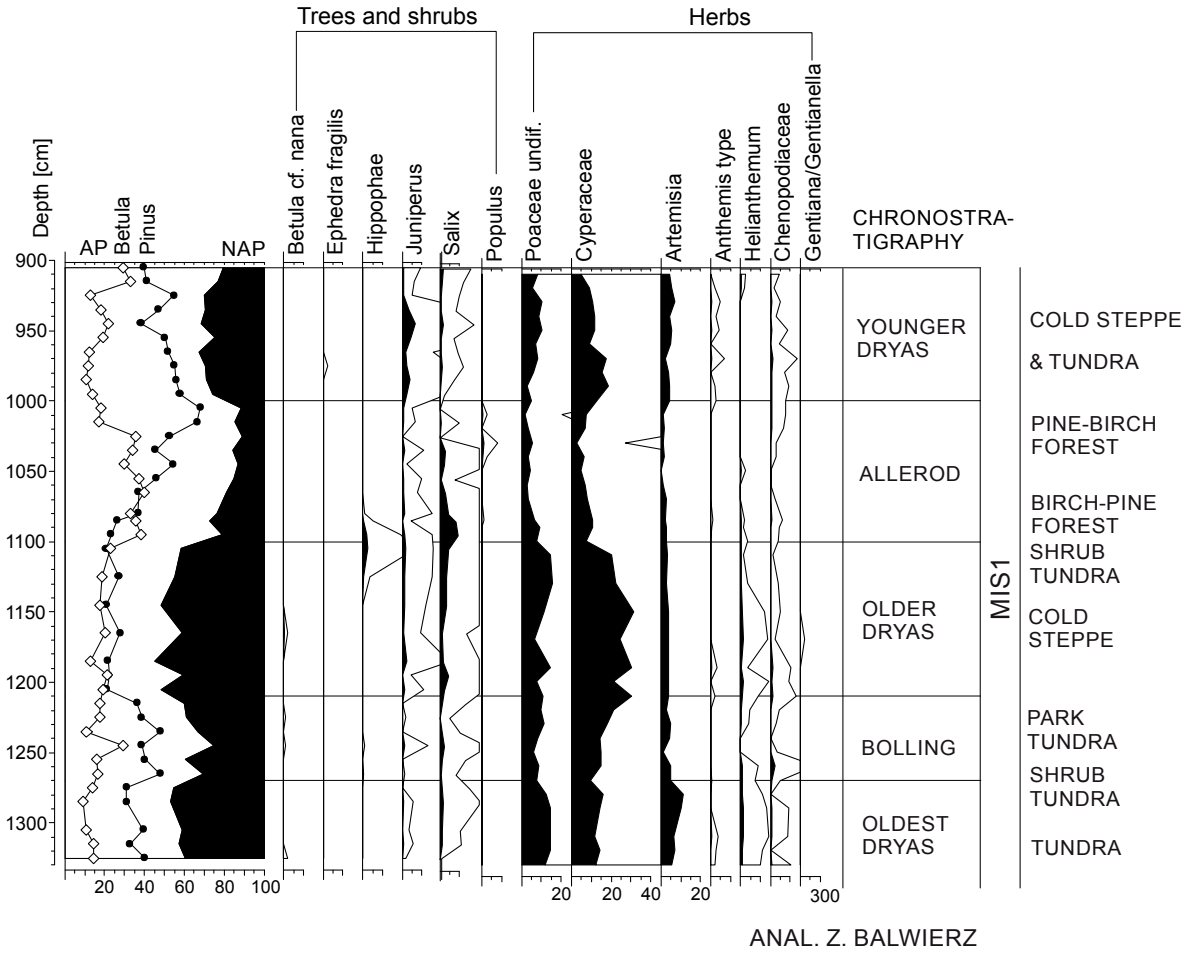



FIGURE 3. Pollen diagram of vegetation development at Żabieniec during the Late Glacial after Vistulian Glaciation, selected curves (after Balwierz 2010). AP – arboreal pollen (sum of percentages of pollen grains of all the trees and shrubs; NAP – non-arboreal pollen (sum of percentages of pollen grains of all the terrestrial, herbal plants); percentages in black; exaggeration 10x (percentiles) in white

probably were absent in the Polish Lowland (Tobolski et al. 1998; Ralska-Jasiewiczowa et al. 1998; Balwierz 2010).

Warming of the climate during the Bølling (13,670- 13,540 cal BP) caused the development of sparse forest communities with domination of *Betula*. Pine, aspen and willows could be the admixtures dependent on habitats. However during this time a certain differentiation between regions was marked. The presence of *Juniperus* is significant in northern areas, *Larix* appeared in the Masurian Lake District and *Hippophaë* still occurred abundantly in Wielkopolska (Tobolski 2003). Steppe, herb elements: *Artemisia*, *Helianthemum* and *Selaginella* still dominated in the east.

The Older Dryas is a 200 years period of cool and continental climate (13,540–13,350 cal BP). It was often absent (not distinguishable) or questionable (e.g., Kubiak 1998; Tobolski et al. 1998; Bałaga et al. 2003) in the plant succession record, especially in older pollen diagrams. The records of some sites however documented this event between others due to higher resolution of sampling. The record of pollen diagrams indicate a decrease of pollen concentration and the presence of tundra plant communities with *Betula nana*, *Dryas octopetala*, dwarf shrub willows and Cyperaceae (Kulesza et al. 2011). Cold steppe communities dominated in dry habitats occupied by heliophytes such as *Artemisia*, Chenopodiaceae, *Thalictrum* (meadow-rue). There

were still *Hippophaë* present, indicating openness of the landscape (Bałaga et al. 1998; Balwierz 2010). Scarce vegetation cover and strong winds favoured aeolian processes and forming of dunes (Fajer 2012).

The Allerød (13,350–12,680 cal BP) is a period of amelioration of the climate again. It is often divided into two parts, an older one dominated by birch forest and the younger dominated by pine forest (Latałowa 2003). The reduction of *Betula* overtaken by *Pinus* is observed at many sites in central and northern Poland (Bałaga 2004; Noryśkiewicz A. M. 2012; Sobkowiak-Tabaka et al. 2022). However, it is not a rule and pollen record of many sites did not show this event (e. g., Tobolski et al. 1998; Ralska-Jasiewiczowa et al. 1998). Generally, pine-birch or birch-pine forest was the dominant type of vegetation; in the Carpathian region, *Picea* and *Pinus cembra* increased. Due to more continentality, steppe plants, *Artemisia* and Chenopodiaceae appeared mainly in the east (Bałaga 2004; Balwierz 2010), however they were also present in the young glacial northern territory (e.g., Tobolski et al. 1998; Noryśkiewicz 2012; Fiłoc et al. 2014; Mirosław-Grabowska et al. 2015).

At the very end of the Vistulian glaciations, the Younger Dryas (12,680–11,700 cal BP) is the last cold event registered in the Greenland ice cores (Rasmussen 2014). It is also apparent in all the records of organic sediments from this time in Poland. The intensity of denudation and onset of aeolian processes enforced then due to discontinuous plant cover and wind activity (Petera-Zganiacz et al. 2022, 2025). The recession of the forest also enhanced erosion during the Younger Dryas (Mirosław-Grabowska et al. 2015). Vegetation changed quickly after the rapid cooling. Birch and pine forest declined except a few possible refugees in favourable local conditions (e.g., Dzieduszyńska et al. 2014). Tundra and steppe tundra plant communities developed; *Betula nana*, dwarf shrub willows (*Salix polaris* type, *S. herbacea* type), Cyperaceae and *Sphagnum* dominated in wetlands and peatbogs. *Selaginella selaginoides* spread all over the territory of central Europe. This arctic-Alpine species spread across the lowland beyond the present-day occurrence in Poland restricted to Carpathian and Sudeten Mountains (Granoszewski et al. 2004). Steppe communities spread once more all over the country, but with more significant meaning in the eastern part of Poland, where influence of continental climate was stronger (Latałowa et al. 2004; Makohonienko et al. 2004). Juniper bushes developed, especially in the young glacial areas of northern Poland (Tobolski 2003; Lauterbach et al. 2011; A. M. Noryśkiewicz 2012; Mirosław-Grabowska et al. 2015);

Warming of the climate at the end of Younger Dryas, is suggested by the presence of *Typha latyfolia* and *Cladium*, the fen-sedge (Ralska-Jasiewiczowa et al. 2004; A. M. Noryśkiewicz 2006; Mirosław-Grabowska et al. 2020; Petera-Zganiacz et al. 2022). *Typha latyfolia* is considered to indicate the mean July temperature of at least +14°C (Iversen 1954; Wasylikowa 1964) or+13°C (Isarin and Bohncke (1999). *Cladium mariscus* usually developed since Boreal time during the Holocene (Milecka et al. 2021). It should be stressed however that both the species belong to azonal, high reed-bed plants and their occurrence depend partly on habitat and local condition.

The succession of the Late Glacial period indicates slight but clear differentiation of vegetation in particular regions of Poland. The eastern part of the country was more abundant in steppe elements (*Artemisia*, Chenopodiaceae) reflecting the influence of a more continental climate. The proportion of pine to birch was higher in the south and lower in the north. The Carpathian region differed by the significant presence of *Pinus cembra*, *Picea* and then *Larix*.

## Holocene vegetation succession (Fig. 4)

### Early Holocene 11,700– 8,200 cal BP

The Holocene vegetation succession is related to the abrupt warming of the climate and development of the domination of forest communities in the temporal zone of central Europe. At the turn of the late glacial/Holocene, the proportion of AP/NAP (arboreal to non-arboreal pollen) increased clearly (e.g., Ralska-Jasiewiczowa et al. 1998; Milecka 2005; Balwierz 2010; Mirosław-Grabowska et al. 2015). Plant elements characteristic of tundra and cold steppe communities decreased and quickly disappeared, to be overtaken by birch-pine forest. This change caused a deterioration of light conditions and many heliophytes diminished or disappeared. Forest development limited also input of detrital material to the lake sediments (e.g., Ralska-Jasiewiczowa et al. 1998; Mirosław-Grabowska et al. 2015). The general content of pollen of herbal plants up to the mid-Holocene and the record of

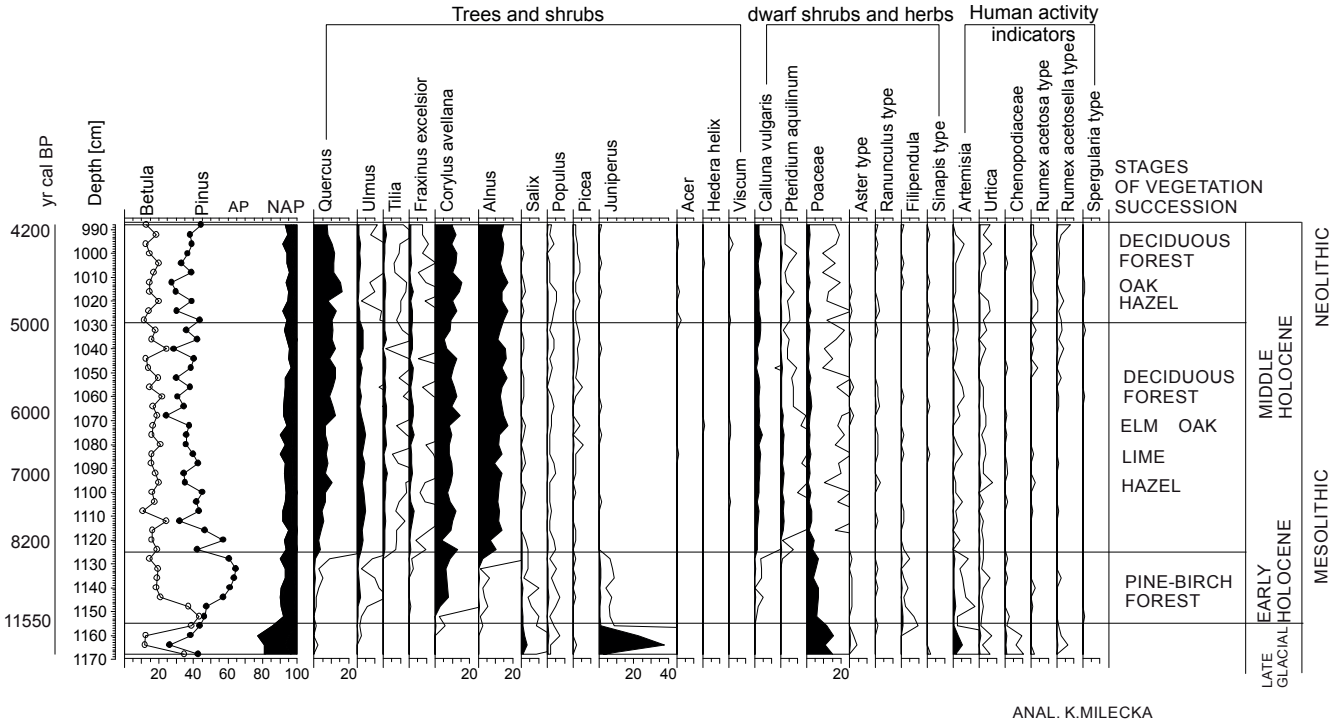



FIGURE 4. Pollen diagram of vegetation development at Ostrowite during the Early and Middle Holocene, selected curves (after Milecka et al. 2021). AP – arboreal pollen (sum of percentages of pollen grains of all the trees and shrubs; NAP – non-arboreal pollen (sum of percentages of pollen grains of all the terrestrial, herbal plants); percentages in black; exaggeration 10x (percentiles) in white

human influences does not exceed 10%. Gradually, the proportion of *Betula* decreased and pine-birch forest developed, occupying the whole territory of Poland. Due to the amelioration of the climate and transformation of soils, deciduous trees and shrubs successively appeared. *Ulmus* arrived from the south-east in the Carpathians and probably via Orava (Zachowicz et al. 2004). A little later, elm migrated also from the north-east from Russia (Huntley and Birks 1983). *Corylus avellana* probably spread from the north-west and from the south through the Moravia Gate (Miotk-Szpiganowicz et al. 2004). It was a significant element of the flora during the Early Holocene, especially in the mountains before the expansion of *Abies* and *Fagus* at the end of the Mid-Holocene. *Quercus* was the next immigrant. As indicated by isopollen maps (Milecka et al. 2004), oak approached Polish territory from the south and north-west. It is mentioned also that it was of minor importance along the eastern margins of the country and more abundant in the north-western part throughout the Holocene.

## Mid-Holocene 8200–4200 cal BP

The climatic optimum is marked with the increasing proportion of warm-demanding species of higher soil requirements (Tobolski 2004). It was the time of the intensive development and relative stabilization of deciduous forest. Deciduous elements, mainly *Corylus avellana*, *Quercus* and *Ulmus* increased their proportions, overtaking *Pinus*. Next *Tilia* and *Fraxinus* developed. The migration route of *Tilia cordata* led from the south through the lower parts of Carpathians (Kupryjanowicz et al. 2004). It was an element of mixed deciduous forest with *Fraxinus* and the earlier immigrants *Quercus*, *Ulmus* and *Corylus*. They occupied fertile soils in all the country, but especially in the young glacial areas of northern Poland and Wielkopolska (Ralska-Jasiewiczowa 1983). *Fraxinus excelsior* is a typical species of the temperate zone in Europe, but it prefers sub-oceanic areas (Ellenberg et al. 1991). It was a significant component of a few mesotrophic and eutrophic forest communities that started migration

at the beginning of mid-Holocene, penetrating existing deciduous forest (Tobolski and Nalepka 2004). *Acer* expanded during the mid-Holocene being an admixture of deciduous forests. Despite low pollen representation, it is considered to be an important constituent of forest communities (Tobolski 2004). The type of forest and proportions of components depended on soil and water conditions. Tobolski (2004) divided all the dominating forest tree species into three groups: (1) the greatest dominance is recorded at the turn of Early and Middle Holocene, *Corylus* is the main species of this group (2) *Ulmus*, *Fraxinus excelsior*, *Tilia*, *Hedera helix* and *Viscum*, they are species exhibiting greatest expansion during the older part of the Middle Holocene, but not at the very beginning. *Ulmus* and *Fraxinus* belonged to the most important forest-forming species of the vegetation at that time. (3) *Quercus*, *Acer* and *Alnus* dominated in the latest part of the Mid-Holocene. *Alnus* was the most frequently represented component of the forest in waterlogged areas and is suggested to have created their own communities (Tobolski 2004).

The younger part of the Mid-Holocene is a period of the increasing influence of human activity due to Neolithic settlement in central Europe. As a result, some changes in vegetation were recorded. The changing proportions of forest components and development of some plant communities more typical of open habitats were the most important. An episode of elm declines about 5900–6000 cal BP discussed intensively in the 20$^{th}$ century was regarded by some authors as a result of human presence and penetration of forests (Troels-Smith 1960; Berglund 1966; Sturludottir and Turner 1985, Latałowa 1992). In the younger part of the mid-Holocene, *Corylus avellana* and *Quercus* formed shrubby and well-lit forest communities as a result of human influences of Neolithic settlement (Milecka et al. 2004; Miotk-Szpiganowicz et al. 2004). In some areas, plant communities more typical of open habitats developed next to settlement sites. The taxa of plants suggesting human activities are recorded in sediments of that time: *Artemisia*, Chenopodiaceae and *Urtica* indicates the living area of man. *Artemisia* is a heliophytic, steppe plant spreading due to human protection at open areas. *Urtica* and Chenopodiaceae expanded as a result of the enrichment of soil in nitrogen and other elements and compounds.

In the end of the mid-Holocene, the range and meaning of *Tilia* was reduced due to cooling and increasing human influences (Kupryjanowicz et al. 2004). At that time, *Carpinus betulus* expanded and partly overtook elm, regressing then especially in the Carpathians. In the lowlands it penetrated unstable oak-hazel forest influenced by human activity and from the fifth millennium BP in Wielkopolska formed dense oak-hornbeam forests which have not an analogue in present-day forest communities (Tobolski1990; Litt and Tobolski 1991).

The end of the mid-Holocene, 4200 yrs BP, is related to vegetation succession due to changing climatic conditions and the growing influence of human activity.

## Traces of human activity recorded in pollen diagrams

Tracing people and their way of life many thousand years ago is difficult, because of shortage of artefacts, remains of food, tools, clothes and other utilities. The areas of the routes taken by wandering human groups were covered by glaciations that destroyed evidence of earlier presence and activity of men. Based on modern knowledge, we can only guess what kind of raw materials were used in the past by nomadic human groups. A number of palaeoecological and archaeological studies suggest possible directions for the use of individual species and parts of plants (Lityńska-Zając and Wasylikowa 2005, Makohonienko et al. 2006; Kabaciński and Sobkowiak-Tabaka 2011, 2013). The forest was very rich source of food during the interglacial periods, when many coniferous and deciduous species were present. Nuts would have been collected from hazel (*Corylus avellana*), fruits from apple-tree, raspberry or blackberry. There are also many species that could be used during the shortage of food, such as nettle (*Urtica dioica*) or sorrel (*Rumex*). The green parts of plants (such as *Chenopodium*, *Polygonum*, *Pteridium aquilinum*) can be used for preparing a kind of soup. The use of the sap of trees like the beech *Fagus*, maple *Acer* and birch *Betula* was probably also known. Many such examples can be given. Butler (1995) made such an attempt concerning possibility of usage of small-seeded legumes (Fabaceae). She analyses the palaeoecological and archaeological results from many sites and speculated that species of this family could have been a resource of food and fodder, as well as medicine, honey, paints and some other applications. These are only suggestions that show

the potential. Generally, however, we can describe the meaning of forests and wetlands communities for wandering human communities and suggest how they could use plants and animal's resources to live.

The forest mitigates weather factors by giving shelter to people. It protects against strong winds and allows the building of a shelter in the form of a hut or dugout. In this way, it also protects against rain and snow. The real but also perceived temperature inside dense forest is more favourable, i.e. higher in winter and lower in summer.

The forest is a source of wood that can be used in many ways. It is an energetic fuel and gives heat and the possibility to prepare food. Wood is a raw material for building many constructions: houses, bridges, causeways, fences, defences, and many others. There are many fine tools and other objects that may be prepared from wood. Next to rocks and stones, wood was the most important material for everyday life.

The forest contains a lot of plant and animal food. Hunting possibilities were dependent on tools, however many herbivorous animals were relatively easy to trap. Hunting in a larger group increased the possibilities and effectiveness of obtaining meat. Animals also provided skins used as clothing, shelter covers, straps, belts etc.

Forest plants (apart from the wood listed above) and species of plant communities more typical of open habitats had fundamental meaning as food and fodder, or for medicinal, cosmetic and other purposes. Many species, such as e.g., Ericaceae were used to weatherproof walls.

From the Neolithic, the more frequent occurrence of long-term settlements increased the possibilities of detecting and investigating human activity. Longer existence in a place left many artefacts: lost utensils, remains of clothes, food waste, but also traces on the environment: pathways with a changed vegetation, micro- and macrofossils of cultivated plants and weeds, and so on. Settlements were most often settled next to lakes or rivers which correlates well with the possibility of preservation of organic fossilised materials in anoxic conditions (Tobolski 2003).

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# LITHIC RAW MATERIALS IN POLAND

Dagmara H. Werra

In the Vistula and Odra basins, there are a number of deposits of flint resources that were widely used by prehistoric communities. These are striped flint, Świeciechów (grey white-spotted) flint, Jurassic-Cracow flint, Cretaceous flints, 'chocolate' flint, and Ożarów flint. In southern Poland, outcrops of radiolarite occur, and in the southeast, Cretaceous flints are found, i.e., in the glacigenic sediments of the Chełm Hills. Among siliceous rocks attested on archaeological sites, obsidian also occurs, with outcrops located in southeast Slovakia and northeast Hungary (Fig. 1).

A brief explanation of terminology: for decades, petrographers and archaeologists have debated clarifying the nomenclature. Unfortunately, even within the same discipline, researchers interpret the terms differently. In Polish geological and archaeological literature, two terms are commonly used: flint (*krzemień*) and chert (*czert*). Flints (*krzemienie*) are always characterised by a hard, compact siliceous rock usually occurring in concretions of spherical or irregular shape, with well-defined contours in relation to limestones, often outlined in the form of a white cortex. The flints are most often grey, ranging from dark brown to brown and black, and differ from the surrounding rock. The fracture of flint is shiny to dull, conchoidal or sharp. While cherts (*czerty*) are hard, siliceous rocks of the concretionary type, without a cortex and distinct contours, characterised by a gradual transition into the surrounding rock; they are generally light grey in colour, often changing to the colour of the surrounding rock, with a dull, jagged fracture. Sometimes, it is slightly porous. Cherts interpenetrate with the surrounding rock, but their central parts sometimes have silica, like in flints (Lech 1980, 169–170; Ryka and Maliszewska 1991; Król and Migaszewski 2009, 16–17).

This nomenclature had been adopted into the Polish literature by the geologist Zbigniew Sujkowski (1898–1954), based on the works of the French geologist Lucien Cayeux (1929), who borrowed the word chert from English literature (Buckland 1817) and gave it a different meaning (Sujkowski 1931, 494; see Miecznik 2014). As a result, there was a discrepancy in the understanding of this concept by British researchers (chert – a siliceous rock with a blurred organic structure) and French researchers (*chert* – a light, shapeless siliceous nodule without precise contours; Lech 1980, 170; Michniak 1989).

In the British literature, the word *flint* is reserved for the dark nodules occurring in Cretaceous formations (Maastrichtian), while chert is used for the lighter rocks that occur as nodules and as layers within limestones and shales of various ages. Meanwhile, in American literature, both terms are treated as synonyms (Budziszewski and Grużdź 2020, 11).

While writing in Polish does not pose problems, publishing in foreign languages does. To clarify the nomenclature, researchers, petrographers, and archaeologists have introduced new terminology into national scientific traditions, such as silicites (Přichystal 2013) or siliceous rocks (Biró 1998; see Brandl 2010; Krajcarz and Krajcarz 2009; Budziszewski and Grużdź 2020; Krajcarz 2023).

To facilitate navigation through Polish-language literature and account for over a hundred years of tradition, the names of siliceous raw materials used by prehistoric communities in this text are presented in their original form.

## Jurassic flints

### 'Chocolate' flint

This raw material is found on the north-eastern margin of the Holy Cross (Świętokrzyskie)

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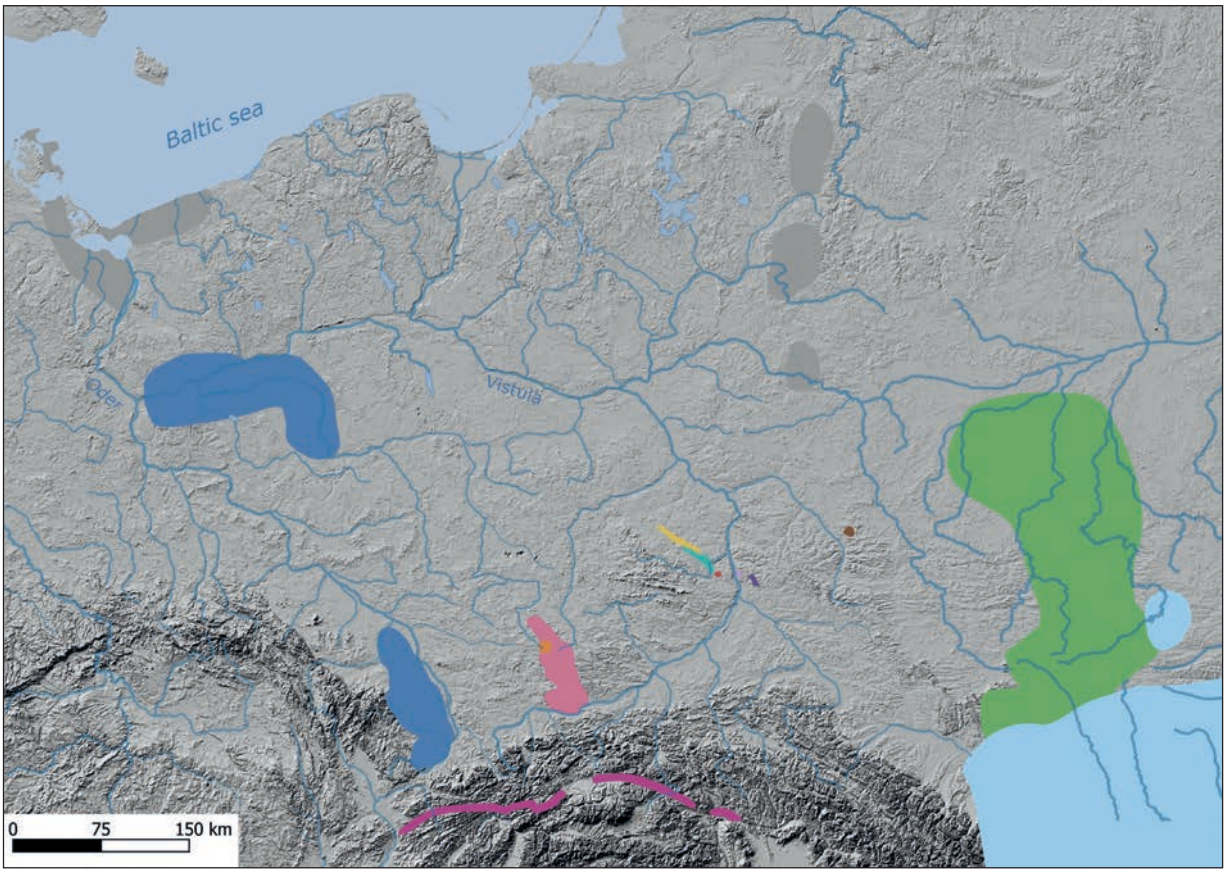



FIGURE 1. Map showing the occurrence of flints mentioned in the text. Grey colour: concentrations of glacial rafts with Cretaceous flint; blue colour: rich occurences of erratic flint; pink colour: Jurassic-Cracow flint; yellow colour: 'chocolate' flint; orange colour: 'chocolate' flint in the Udorka valley; turquoise colour: striped flint; red colour: Ożarów flint; light purple colour: Świeciechów (grey white-spotted flint); dark purple colour: Gościeradów flint; green colour: Volhynian flint; light blue colour: cherts and flints from the Dniester-Prut region; magenta colour: radiolarite; brown colour: Rejowiec flint (after Lech 1981, fig. 2; Sobkowiak-Tabak 2016, fig 8; Budziszewski and Grużdź 2020, fig. 1. Werra and Siuda 2022, fig. 1. Graphic design: D. H. Werra)

Mountains in southeastern Poland and has been discussed in the Polish archaeological literature for over 100 years. It was first characterised by Stefan Krukowski in 1920, and in subsequent years, researcher and geologist Jan Samsonowicz located the first outcrops of this material. Currently, 26 points of exploitation of this flint are known (Fig. 2). 'Chocolate' flint was widely used by prehistoric Palaeolithic, Neolithic, and Bronze Age communities (Budziszewski 2008). Finds of 'chocolate' flint are recorded in flint assemblages at considerable distances from the outcrop area: up to 700 km (Salaspils Laukskola, Latvia) in the Palaeolithic, 500 km (Łubień, Belarus) in the Mesolithic, and over 400 km (Bylany, Czechia) in the Neolithic. During the Bronze Age, its distribution was more local, reaching up to 100–150 km (Szarbia, Kazimierza Wielka district, Poland; Sulgostowska 2005; Lech et al. 2011).

## Localisation

'Chocolate' flint occurs on the north-eastern margin of the Holy Cross Mountains. The flint occurs in a belt about 90 km long. The outcrops begin in the northwest, near Chronów-Kolonia Górna, and

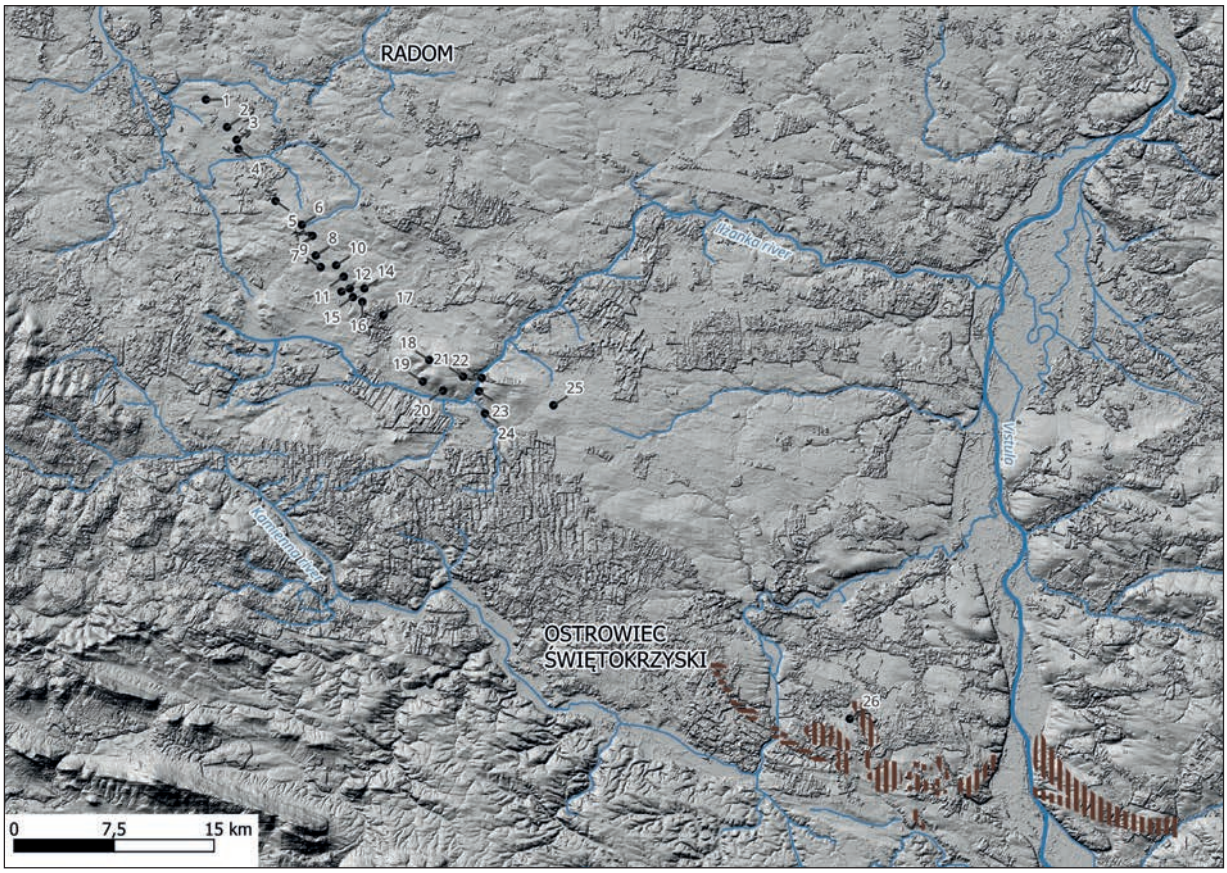



FIGURE 2. Occurrence of 'chocolate' flint on the north-eastern margin of the Świętokrzyskie (Holy Cross) Mountains: 1 - Chronów-Kolonia; 2 - Guzów; 3 - Orońsko 'Mały Orońsk'; 4 - Orońsko (Orońsk II); 5 - Tomaszów Site I; 6 - Rzeczków; 7 - Wierzbica quarry; 8 - Wierzbica 'Zele'; 9 - Wierzbica 'Krzemienica'; 10 - Polany Kolonie Site IV; 11 - Polany Kolonie Site I; 12 - Polany Kolonie Site II; 13 - Polany Kolonie Sites IIa; 14 - Polany Site III; 15 - Polany Kolonie Site III; 16 - Polany Site I; 17 - Polany Site II; 18 - Pakosław; 19 - Seredzice; 20 - Seredzice 'Kolonia'; 21 - Iłża 'Wąwóz Żuchowiec'; 22 - Iłża 'Krzemieniec' II; 23 - Iłża 'Krzemieniec' I; 24 - Błaziny Górne; 25 - Prędocin; 26 - Gliniany 'Wzgórze Kruk' (after Schild 1971, 1976; Balcer 1976; Budziszewski 2008 with changes. Graphic design: D. H. Werra)

then the belt passes through the vicinity of Wierzbica, Polany, and Iłża in the central part, ending near Zawichost in the southeast (Budziszewski 2008, 49, fig. 1).

Several years ago, the sources of a 'new chocolate flint' became known (see below). The outcrops have been localised in southern Poland, on the the Ryczowska Upland, in the valley of a small temporary stream (the Udorka), near the village of Poręba Dzierżna, Olkusz district, approximately 200 km from those previously known (Krajcarz and Krajcarz 2009; Krajcarz et al. 2012; Sudoł-Procyk et al. 2021).

## Geology

From the geological point of view, the Holy Cross Mountains 'chocolate' flint remains enigmatic. Jan Samsonowicz, the first geologist to work with this raw material, described 'chocolate' flint as occurring in a stable stratigraphic position at a single, thin level (Samsonowicz 1934). Researchers still debate whether the deposits are disturbed and whether they occur in a thin or thick layer, in one or several layers (Pożaryski 1948; Dembowska 1953; Wyrwicka 1969). As for today, archaeological research indicates that 'chocolate' flint prehistoric

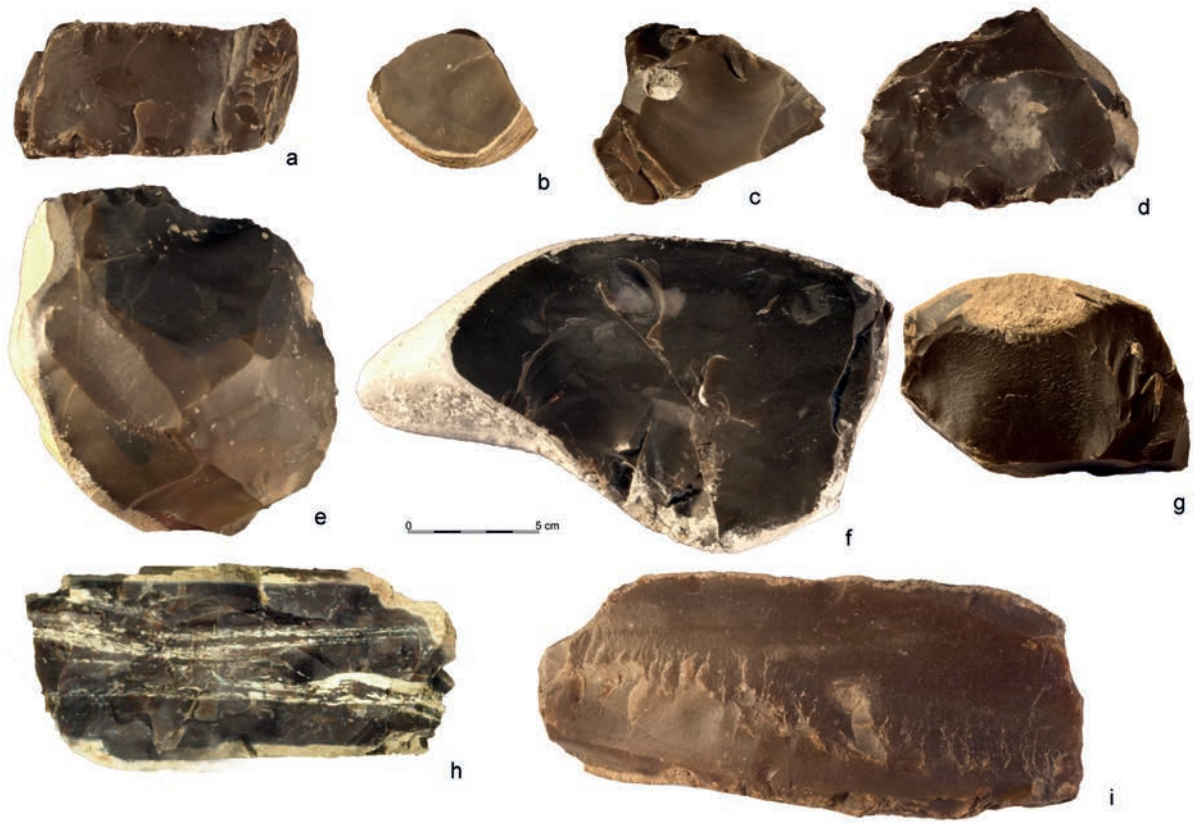



FIGURE 3. 'Chocolate' flint: a – Chronów-Kolonia, Szydłowiec distr.; b – Orońsko, Szydłowiec distr.; c – Tomaszów, Szydłowiec distr.; d – Polany Site II, Radom distr.; e – Wierzbica „Zele", Radom distr.; f – Wierzbica quarry, Radom distr.; g – Prędocin, Radom distr.; h – Śniadków, Szydłowiec distr.; "Kraków-Częstochowa chocolate flint": i – Poręba Dzierżna, Olkusz distr. (photo by D. H. Werra)

outcrops are registered in a single line, approximately 6 m thick. It remains unclear whether 'chocolate' flints are present in one, discrete level or if there are several stratigraphic horizons (Budziszewski 2008, 45; Hughes et al. 2016; Werra and Siuda 2022).

There is also an argument concerning the placement of 'chocolate' flint in the Jurassic stratigraphical sequence. Some geologists assign it to the upper part of the Upper Oxfordian (Malinowska and Dembowska 1973; Dąbrowska 1983), while others place it in the lower Kimmeridgian (*e.g.*, Kutek 1983; Gutowski 2004), and some indicate that this raw material should be assigned to both of these levels (Wyrwicka 1969; Migaszewski et al. 2006). Due to the lack of a clear boundary between those two formations in various parts of Europe, it is not yet possible to determine the stratigraphic position of the 'chocolate' flint accurately. This requires more detailed geological and archaeological study.

## Characterisation of the raw material

'Chocolate' flint is available in several varieties of brown colour, ranging from black through dark brown and dark grey to dark yellow-brown (Fig. 3). Transparency is usually good to medium, and the gloss is either greasy or dull. It occurs in the form of flat and oval concretions and in the form of irregular slabs. The size of the nodules is from a few to a dozen centimetres in length, and the diameter of the slabs is up to over half a metre. The cortex may be rough or smooth; its thickness varies greatly, from less than 1 mm to more than

5 mm. In 1971, Schild identified eleven groups of this flint through his examinations. By 1976, he emphasised that among these, 'three groups are of importance, being the most common and possibly also the most popular in prehistory' (Schild 1976, 149). The first group occurs in the central and eastern portions of the 'chocolate' flint outcrop line. The flints here are dark brown (10 YR 2/2) in colour, waxy, usually not banded, occasionally microbanded, and rarely with a black central part (10 YR 2/1). In the western portion of the outcrop line, the second group occurs, which is dark greyish brown (10 YR 2/1) and brown (10 YR 4/3) in colour. The nodules are waxy and transparent, not usually banded, and rarely irregularly laminated. The third group is black in the central portion of the nodules (10 YR 2/1), and the remaining mass is very dark grey to dark brown (10 YR 3/1–10 YR 3/3), rarely dark greyish brown (10 YR 4/2). The flints are not banded but dull to dull, waxy, and weakly transparent. This group is located in the central part of the line (Schild 1971, 7–17; 1976, 149; Hughes et al. 2016, 100–101).

The 'new chocolate flint' from Udórz can be associated with the Upper Oxfordian and Lower Kimmeridgian, as well as the deposits in the Holy Cross Mountains. This raw material occurs as flat nodules with thicknesses of 2–10 cm. It is fine-crystalline, dull, and slightly transparent, with a fatty or pearly lustre. The observed cortex is thin, white, and smooth, and fossils and grains occur. A white, dull, non-transparent zone can be present between the cortex and the mass. The central portion of the nodule is dark in colour, from dark brown to yellowish-brown, greyish-brown, and milky-white (see Fig. 3: i; Sudoł-Procyk et al. 2018, 93; Werra and Siuda 2022) distribution and role of siliceous rocks in the economies of the prehistoric communities who lived in the territories of Poland have been frequently addressed by archaeologists since the previous century (e.g. Krukowski 1923; Samsonowicz 1923; Schild 1971; Balcer 1975; Balcer and Kowalski 1978; Kaczanowska and Kozłowski 1976; Lech 1981; Cyrek 1983; Budziszewski and Michniak 1983; 1989). The discovery of this new source has contributed to the intensification of research on the characteristics, use, and distribution of 'chocolate' flint (Sudoł-Procyk et al. 2021; Sudoł-Procyk 2022).

## Exploitation, use and distribution

'Chocolate' flint in the northeastern margin of the Holy Cross Mountains was intensively used and exploited by prehistoric communities from the Palaeolithic to the early Bronze Age, and possibly even into the early Iron Age (Werra and Kerneder-Gubała 2019). The most numerous group of prehistoric mining fields in Poland was formed in the areas where it outcropped. Currently, we are aware of 26 points of exploitation of this raw material. The oldest 'chocolate' flint mine was recorded in Orońsko, Site II. This is the only mine of this raw material with radiocarbon dating confirming its use by communities of the Final Palaeolithic. This mining field was also used by Mesolithic and Early Bronze Age communities (Krukowski 1939–1948; Kerneder-Gubała 2019). The mine in Tomaszów, Site I, can be associated with the activity of Mesolithic communities. Additionally, this mine was utilised by communities of the Danubian and Funnel Beaker cultures (Schild et al. 1985; Schild 1995a). The mines in Polany Kolonia II can be associated with the mining activity of Neolithic communities. The obtained radiocarbon dates allow association with the Corded Ware culture community (Schild et al. 1977; Schild 1995b). The activity of Early Bronze Age communities has been confirmed at nearly every recorded 'chocolate' flint exploitation site. The most significant include the Polany mine Site II and the Wierzbica 'Zele' mine (Lech 1984; Lech and Werra 2023), as well as the previously mentioned Polany-Kolonie II site.

This raw material has been registered in the Middle Palaeolithic layers of the cultural sequence from the Biśnik Cave (Cyrek and Sudoł 2008) and the Ciemna Cave (Sobczyk and Valde-Nowak 2013). A series of siliceous artefacts, which can be dated to the early phase of the Upper Palaeolithic, was recorded during the organisation of the collection from the Zwierzyniec 1 site. 'Chocolate' flint was found in Gravettian inventories discovered at the Kraków-Spadzista site and the Jaksice II site. 'Chocolate' flint from the late glacial period was identified, among others, in Magdalenian workshop sites near Brzoskwinia in the southern part of the Kraków-Częstochowa Upland. Its presence was confirmed at the Epigravettian Targowisko Site 10 (Sobczyk 1993, 1996; Wilczyński 2009).

The presence of 'chocolate' flint used by Final Palaeolithic communities is clearly documented

in the inventories of the Świderian culture. Two main outcrops where Tanged Point communities extracted 'chocolate' flint are located near Orońsko and between Polany and Wierzbica. Evidence of mining activities appears at Orońsko II and on the surface at Chronów-Kolonia in the western part of the region, as well as at Polany Kolonie I in the eastern area. At Orońsko II, flint spreads across almost 14 hectares, with Świderian finds including numerous pre-cores and double-platform cores intended for blades (Budziszewski 2008, 83–84, 91–92; Sobkowiak-Tabaka 2016, 218; Osipowicz et al. 2019). The distribution range of 'chocolate' flint in the Final Palaeolithic is approximately 700 km. The farthest localised site, with the presence of 'chocolate' flint, is Salaspils-Laukskola (Riga, Latvia; Sulgostowska 2016, 232).

With the onset of the Mesolithic, the use of mined high-quality 'chocolate' flint disappears. The presence of 'chocolate' flint in irregular forms was found at only four sites of the Early Mesolithic Komornice/Narwian culture. This may suggest a population change during the Early Mesolithic, leading to the collapse of the exchange network and the loss of knowledge of the locations of these outcrops. 'Chocolate' flint became more widespread in the Late Mesolithic, extending to eastern Poland, Lithuania, Belarus, and western Ukraine. The furthest site reported is Łubień, Belarus, approximately 600 km from the outcrop. Both imported 'chocolate' flint and local raw materials were used to create the same types of tools, which served similar functions. It can be inferred that across this large area, shared raw materials, similar products, and technology most likely indicated social affiliation. The popularity and extensive use of 'chocolate' flint during the Late Mesolithic could be attributed to the central location of outcrops in the region, as well as the proximity of the mine of this raw material to the hematite deposits (e.g., an ochre quarry in the Rydno complex; Schild et al. 2011; Masojć 2016, 286; Sulgostowska 2016, 240, 242, 244; Johanson et al. 2025).

Among Early Neolithic communities, 'chocolate' flint, together with Jurassic-Cracow flint, played a vital, not infrequently dominant, role. In the younger Danubian cultures (Samborzec-Opatów group, Pleszów group, Malice culture), 'chocolate' flint predominated in the Sandomierz-Opatów Upland. Jurassic flint strongly predominated in the western Lesser Poland Upland. The material in those forms was transported to the settlements at a distance of approximately 450 km (Kaczanowska and Lech 1977; Czerniak 1980, 1988; Domańska 1982, 1988, 1996; Lech 1982/1983, 1988, 1989, 1990, 2003; Balcer 1983; Kaczanowska 1985; Domańska 1988; Wojciechowski 1988; Małecka-Kukawka 1997, 2001; Kabaciński 2010; Czekaj-Zastwany 2017, 47–49; Kadrow 2017, 82–83; Burgert 2018; Pyzel and Wąs 2018; Whittle et al. 2022, 4).

In the older phase of Funnel Beaker culture communities, 'chocolate' flint still played a significant role, as evidenced by its dominance among the group of implements and blades (Balcer 1983, 123; Domańska 1995; Płaza and Papiernik 2018). Similarly, the production of some roughouts of tetrahedral axes cannot be excluded. Nevertheless, flint axes made of 'chocolate' flint are very rare, and the tetrahedral ones are mostly connected with the Globular Amphora culture (Bobrowski and Sobkowiak-Tabaka 2008). In this period, 'chocolate' flint can be found in the assemblages at a distance of over 200–250 km from the outcrops. In the younger phases of Funnel Beaker culture, this raw material lost its significance (Balcer 1983, 177; Domańska 1995; Prinke and Rachmajda 1988; Libera and Zakościelna 2006, 160; see Małecka-Kukawka et al. 2022).

This raw material also played a special role for the Lublin-Volhynian culture communities. The important and specific role of 'chocolate' flint among those communities is confirmed by the presence of caches of large precores and cores of 'chocolate' flint. Those communities were responsible for the long-distance distribution of this raw material south of the Carpathians. The activity of the Lublin-Volhynian culture has recently been connected to outcrops of 'chocolate' flint in Rzeczków, Radom district (Zakościelna 1996, 2006, 2010; Florek and Zakościelna 2003; Budziszewski et al. 2015; Zakościelna 2018).

The use of 'chocolate' flint to produce small flint assemblages (blades, blade tools) was continued by communities of the Globular Amphora and Corded Ware cultures. The use of 'chocolate' flint became more specific. It was mostly used to produce blade tools – sickle inserts, retouched long blades and arrowheads (*e.g.*, the burial gifts of the Corded Ware culture; Uzarowiczowa 1970; Włodarczak 2008; 2022, 221). Different varieties of 'chocolate' flint can be found in the inventories connected with Corded Ware culture communities;

they therefore probably used different deposits of this raw material (Kempisty and Włodarczak 2000, 123; Włodarczak 2008, 295–296). The large number of products made of 'chocolate' flint within the assemblages of Corded Ware culture communities has two dimensions. On the one hand, the economic significance of the raw material for those communities is unquestionable. The second is symbolic, which involves a non-utilitarian attachment to a selected type of flint and the production of certain items from it (Kowalewska-Marszałek 2008, 255; Włodarczak 2008, 298). The range of distribution of 'chocolate' flint in the Late Neolithic is much smaller, approximately 150–200 km.

In the Early Bronze Age, it appears that 'chocolate' flint lost its significance, retaining only a local meaning, and its distribution range was significantly smaller. The general characteristics of the Bronze Age flint industry are challenging to describe. During that period, isolated developments within particular groups led to local changes in the flint industry. The distinction between the flint industry of communities of the Early Bronze Age (Mierzanowice culture), Middle Bronze Age (Trzciniec Culture) and Late Bronze Age/ Early Iron Age cultures is generally focused on the main characteristic tools that can be distinguished (Kośko and Czebreszuk 1998; Budziszewski 2006; Lech et al. 2011). It is worth noting that in the Bronze Age, the old tradition of including flint artefacts among grave furnishings was continued. 'Chocolate' flint dominated among flint finds at sepulchral sites from the Early Bronze Age in the Sandomierz Upland (38.48% - 608 artefacts from 1567 finds; Bąbel 2013a, 119–121; 2013b). The distribution range of 'chocolate flint by prehistoric communities in the Bronze Age was around 100 km.

Communities in the Late Bronze Age used 'chocolate' flint to produce large knives with long, sharp cutting edges and blunt backs. The knives have a naturally blunt back, preferably with a cortex, or a back shaped by a series of careful retouches. From the Wierzbica 'Zele' mining site, massive backed blades (knives) are known, occurring in several variants, and these are a characteristic product of the Lusatian culture industry from this site. In the Later Bronze Age and even the Early Iron Age, assemblages of arrowheads and crescent-shaped or straight sickle inserts are also present. No examples of the latter made of 'chocolate' flint are currently known (Lech et al. 2011; Lech and Werra 2023).

It has been noted that the presence of new deposits of this raw material in the Kraków-Częstochowa Upland and the difficulty in clearly distinguishing various types of 'chocolate' flint make it problematic to determine the directions of conveyance.

## Jurassic-Cracow flint

The earliest recorded observation of this flint dates to the early 19th century. The initial characteristics of this raw material were identified by Małgorzata Kaczanowska and Janusz K. Kozłowski in 1976, and Jacek Lech summarised the history of the research in 1980.

## Localisation

This siliceous rock is commonly found in the southern part of the Polish Jura formation (Wyżyna Krakowsko-Częstochowska) and its surrounding areas. The outcrops are located near Kraków, in the central region around the Krztynia River, and to the north along the upper part of the Warta River.

## Geology

These rocks occur in primary limestone deposits, secondary deposits within their weathering zone, and in eluvial clays, conglomerates, and gravels. Often, they are found outside the Jurassic limestone area (Upper Jurassic: Lower Oxfordian-Lower Kimmeridgian). In the southwestern part of the Kraków Upland and in the Silesian Upland, there are geologically older flints (found in Devonian, Carboniferous, and Triassic limestones). Conversely, flints of younger geological age (Upper Cretaceous, Campanian) are found in some areas of the southern and eastern parts of the Kraków Upland (Kacznowska and Kozłowski 1976, 202–203; Lech 1980, 165; Prichystal 2013, 102; see Krajcarz 2023).

## Characterisation of the raw material

Małgorzata Kaczanowska and Janusz K. Kozłowski (1976) have identified seven varieties (types A-E, G, and K) of this flint, based on the cortex (its thickness and surface), the transition between cortex and




FIGURE 4. Jurassic-Cracow flint. A – example of a raw material from Neolithic mining site at Sąspów, Kraków district; B – Zelków, Kraków district, gunflint mining site (photo by D. H. Werra)

silica matrix, and the features of the silica matrix (colour, transparency, petrosilex precipitates, size, shape, and distribution of flint nodules).

Type A has a thick, medium cortex, which is rough and contains limestone in a yellowish colour. The change between cortex and silica is sharp. The colour of silica is warm light and dark brown. The silica groundmass is translucent, even if not completely transparent, because it is cloudy due to the very fine pigmentation of orange, red, and red-brown colours. The silica mass also contains bigger, whitish inclusions with many cavities. Most of them represent relics after fossil shells, and there are petrosilex precipitates (Fig. 4). Type B has a similar

cortex as type A, but the change between cortex and silica is not sharp, and sometimes there is a bright rim. The silica groundmass is faintly transparent, and the colours are cold – dark blue and grey, with beige precipitates. In type C, the rim under the cortex is wider and can be bright and dark in colour. The silica groundmass is blue and blue-grey, with numerous beige petrosilex precipitates that are rounded or banded. The accumulation of orange pigment is well visible in the silica groundmass. The D-type has a medium-thick cortex, and the flints are grey-white. The E-type cortex is thick, fine-grained, smooth, and fairly even. The transition between the cortex and the mass is sharp. The flint mass is uniform, black, navy blue, slightly transparent, without visible precipitates. This variety is quite rare and seems to occur rather in small concretions. Type G has a thick, smooth cortex that is sometimes rough, with small fossils on its surface. A clearly visible whitish band is usually quite wide under the cortex. The flint mass is smooth, without petrosilex precipitates, with a very good fracture, opaque, and milky beige in colour with slightly darker small spots. This variety probably occurs – judging by the size of the blades and the axe heads that were made from it – in large concretions. Unfortunately, it has not been possible to identify a deposit of this type of flint so far. It is possible that it does not come from the southern part of the Kraków-Częstochowa Upland. The last type (K) refers to Cretaceous flint. The cortex is thin, smooth, and fine-grained. The flint groundmass is opaque, ranging from ash-grey to whitish, smooth, matte, and uniform. Inside, there may appear concentric streaking (Kaczanowska and Kozłowski 1976, 206–208; Kopacz et al. 2023; Stefański et al. 2023; see Sudoł-Procyk and Cyrek 2023). The research carried out over recent years has enabled scientists to identify new varieties of flint in Ryczów Upland (a microregion in the central part of Kraków-Częstochowa Upland; Krajcarz 2023; Mandera et al. 2024).

Jurassic-Cracow flint appears as nodular concretions, usually with a diameter of 10 to 20 cm, and rarely exceeding 30 cm. The shape of these concretions is irregular, spherical, or oval, with variously shaped outgrowths. Additionally, this raw material can be found in a flat, plate-like form. The thickness of the cortex ranges from fractions of a millimetre to 10 millimetres, and its colour is white, slightly yellowish, or slightly greyish. It is porous, uneven, often rough, and its surface frequently bears imprints of marine organisms. A thin white stripe often runs directly beneath the cortex, parallel to the outer layer.

The colour of the silica mass varies widely, ranging from yellowish to light grey, bluish, blue-grey, grey, and ash-grey, as well as various shades of brown, including chocolate and dark brown, almost reaching black. Transparency also varies considerably, from specimens with significant clarity to those that are nearly opaque. The suspension is always extremely finely divided, giving the silica mass a turbid appearance. Within the silica mass, numerous spots of varying sizes, most often oval-shaped, are present. A distinctive feature of this raw material is the presence of carbonate organic remains, which are elements of fauna filled with quartz. These most commonly include sponge spicules, less frequently foraminifera linings, and radiolarian shells.

The fracture of the Jurassic-Cracow flints is conchoidal, characterised by a smooth surface that is sometimes slightly porous in certain areas. The lustre ranges from dull through waxy to shiny. The texture is compact, sometimes concentrically banded, agate-like, and less often layered (Lech 1980, 208–211; Prichystal 2013, 102).

## Exploitation, use and distribution

In the Lower and Middle Palaeolithic, prehistoric communities used local sources of Jurassic-Cracow flint, found in the vicinity of the sites, mostly from alluvial secondary sources (i.e., Wylotne Cave; Wiśniewski 2016: 67). Single items are known from the Zwoleń open-air Neanderthal site (Schild 2005). The oldest known flint mining site is located in Wołowice. The outcrop was probably also used by Magdalenian and Final Palaeolithic communities (Bańdo et al. 1992). From that period, Jurassic-Cracow flint is known from site inventories in Moravia (Pavlov) and Slovakia (Cejkov). The Final Palaeolithic communities in the southern Kraków–Częstochowa Upland, near Kraków, predominantly used Jurassic-Cracow flint for their stone tools, which was the main material on many sites (Kraków–Kurdwanów; Kraków-Bieżanów; see Sobkowiak-Tabaka 2016, 218). In the Final Palaeolithic, the Jurassic flint was distributed over a radius of approximately 200 km. The farthest known site with this raw material is

Noski, some 500 km from the source region (Sulgostowska 2016).

In the lithic assemblages of the Mesolithic, the absence of Jurassic flint at sites more than 200 km from the outcrops is confirmed (Sulgostowska 2016, 232). The use of this material was local, and its extent essentially matches the range of its deposits. This material has been identified in inventories at Mesolithic community sites in the southern part of the Vistula River basin, with significant occurrences around Kraków (Cyrek 1983, 111–112).

This raw material played a crucial role in the Danubian and Lengyel-Polgar Complex communities. During that period, the distribution was widespread, reaching up to 400 km. Through community activities, the flint mining sites in Sąspów and Bębło can be connected (Trela-Kieferling 2021; Lech 2023). In the Middle Neolithic, Jurassic-Cracow flint remained crucial for Funnel Beaker communities (especially Type G). However, it was not transported over as long distances as previously (Kruk et al. 2023). Nevertheless, a smaller amount has been registered in lithic inventories in the Kujavia region, Greater Poland, Chełmno Land, and Silesia (Małecka-Kukawka 2001; Kabaciński 2010). In Late Neolithic Corded Ware communities, Jurassic-Cracow flint was mainly used locally to make axe heads, flake and blade tools, and arrowheads (Włodarczak 2006).

In the Early Bronze Age, Mierzanowice culture communities primarily used flint from the northeastern Polish Jura. Raw materials in this region are of poor quality and were not used by Neolithic communities. Again, it was primarily used locally in Lesser Poland, but there are known sites where Jurassic-Cracow flint is dominant (see Szarbia, Kazimierz district; Kaczanowska and Kozłowski 1976, 209–214; Borkowski and Kowalewski 2023).

## Striped flint

Striped flint is characterised by its striking and unique stripes, hardness, and density, which, combined with its ability to attain a mirror-like polish, make it highly valued and distinctive. Due to its qualities, it played a vital role in the economy of prehistoric communities from the Palaeolithic to the Early Bronze Age.

The first mention of striped flint in Upper Jurassic limestones from the Iłża and Prędocin areas is attributed to the works of Jan Samsonowicz and Stefan Krukowski (Krukowski 1922; Samsonowicz 1923). The first prehistoric striped flint mine was discovered on July 19, 1922, by the eminent geologist Jan Samsonowicz in Krzemionki, near the village of Magonie, northeast of Ostrowiec Świętokrzyski. He reported this discovery to archaeologist and prehistorian Stefan Krukowski, who began research in the area in 1923 with Zygmunt Szmit (Król and Migaszewski 2009; Bąbel 2014, 2015).

### Localisation

Striped flint occurs in Upper Jurassic sediments of the Holy Cross Mountains. The most important outcrops are located on their northeastern Permo-Mesozoic margin, in a belt extending from Iłża to Zawichost. It also occurs in the western and southern parts of the region – in the quarries of Bukowa, Maćkowa Góra, Małogoszcz, Głuchowiec, Morawica, and Wola Morawicka. Redeposited flint is also found locally in many areas within the discussed region, including fields near Włoszczowice, Tokarnia, and Bocheniec (Krol and Migaszewski 2009; Krajcarz et al. 2015; Sudoł-Procyk et al. 2022).

### Geology

Striped flint formed in the Upper Jurassic, from 159.4 to 154.1 million years ago. The exploitation points on the northeastern rim of the Holy Cross Mountains, lie at the northwest end of the Jurassic basin of Margonie-Folwarczysko, which was formed by younger Kimmeridgian orogenic movements. The striped flint exploited by prehistoric communities occurs in layers of Upper Oxfordian limestone. The striped flint is found in the pelitic limestone layer at varying depths, depending on the dip of the limestone layers (Budziszewski and Michniak 1983/1989; Michniak and Budziszewski 1995; Bąbel 2014).

### Characterisation of the raw material

This flint occurs in the form of nodules ranging in size from a pigeon's egg to flat "cakes" to bulbous "loaves" and irregular flat concretions several meters in length. These flints are characterised by predominantly light, grey, and dark grey bands




FIGURE 5. Striped flint. A – example of a raw material from Krzemionki mining site; B – Krzemionki mining site. A pillar-chamber mine with a drawing on pillar (now the logo of the Archaeological Museum and Krzemionki Reserve) (photo by D. H. Werra)

that are irregular and alternating, resembling onion skin (Fig. 5). A white, porous, and relatively soft, siliceous-calcareous crust appears on the surface. Its thickness ranges from tenths of a millimetre to several centimetres. The striping is a purely macroscopic feature; it is not visible under microscopic observation. Flint nodules consist of a mineral, structurally and texturally uniform mass of rock, without any preferred zones or defined directions of crystallisation (Bąbel 2014).

Flint typically occurs as concretions or parallel layers in carbonate rocks. Concretions form as a result of primary or secondary accumulation of silica around crystallisation centres, while flint

layers form in sedimentary basins alongside carbonate rocks.

The origin of the striping has been, and continues to be, the subject of numerous geochemical and petrographic studies. A team led by Z. Migaszewski demonstrated that the striped texture is associated with varying degrees of impregnation (cementation) of pores by secondary silica, leading to varying light reflection. Stripes containing a small number of micropores are dark grey or brown, while those containing significant amounts are light grey or grey. No correlation has been found between flint colour and the content of organic matter, clay minerals, or hydrated iron oxides and hydroxides (Migaszewski et al. 2006).

## Exploitation, use and distribution

Research into the distribution and utilisation of striped flint has been ongoing for more than 100 years (Piotrowska 2018). Currently, ten prehistoric exploitation sites are recognised along deposits of oolitic limestones from the upper part of the Upper Oxfordian and the Upper Jurassic (Budziszewski et al. 2021; see Fig. 6). Most archaeological excavations and research were carried out in the area of the striped flint mines at Krzemionki, beginning in 1923.

The mines at Krzemionki are extensively developed. The mine complex has a parabolic layout and is located on a syncline dipping between 3° and 20°. The limestone outcrops form a linear feature extending 11 km. Above the limestone are complex deposits made up of glacial sands, weathered clay, pelitic, oolitic, and shelly limestones. Within the limestone, there are three stripped flint seams that, due to tectonic movements, are unevenly distributed, vary in size, and are often cracked. The upper two seams consist of good-quality, small to large nodules with a thin, milky cortex and alternating bands that range in colour from white to grey to black. The bottom seam is of low quality and was not exploited (Budziszewski 1990, 218; Borkowski 1995; Borkowski and Budziszewski 1995, 72–73; Bąbel 2015, 86; Barga-Więcławska 2016; *Krzemionki* 2018, 112–117).

At the Krzemionki mining complex, four main types of mines occur: pit, niche, pillar-chamber, and chamber mines (Fig. 7). Pit-mines, on the complex edge where weathered flint is near the surface, are less than 3 m deep, up to 5 m wide, and were worked with wooden, antler, and flint picks. Niche-mines, where flint quality improves with depth, reach 2.5–4.5 m deep, with short niches and galleries up to 1 m high and 2.5 m long, excavated with stone wedges and flint tools. Pillar-chamber mines, deeper due to synclinal seams, include shafts up to 6 m deep, narrow galleries 0.55–1 m high, and 9 m long, with in-situ bedrock pillars. These mines were accessed using flint tools, wedges, and chisels. Cave-in risk was minimised by storing spoil in exhausted galleries. Chamber mines are the deepest, up to 9 m, and 3 m wide, with galleries radiating up to 7 m, where flint was extracted from the walls. Mining involved flint and antler tools. These mines, covering up to 600 $m^2$, produced enough flint for roughly 7,000 axe heads (Borkowski et al. 1991; Bąbel 2008; 2015; *Krzemionki* 2018; Jedynak and Wroniecki 2022; Przychodni and Jedynak 2022).

Palaeolithic communities used striped flint occasionally (Borkowski and Budziszewski 1995; Krajcarz et al. 2015, 233–239; Sudoł-Procyk et al. 2022, 172). The idea that Mesolithic hunters were aware of deposits of striped flint remains unproven (Bąbel et al. 2005).

In the Early Neolithic, striped flint is rarely present in the lithic assemblages. In Funnel Beaker communities, in the older phase, it played a secondary role in lithic inventories and was of local significance. In contrast, lithic inventories from the younger phase in regions such as Lesser Poland, Sandomierz Upland, and Nałęczów Plateau demonstrate a marked increase in the presence of striped flint. This is directly related to the localisation of striped flint outcrops near the target areas. The main product of striped flint during the Funnel Beaker communities period was axeheads, tetrahedral, square, or wedge-shaped, and polished either across entire surfaces or just at their cutting edges. It is argued that these axeheads were mass-produced, as they were necessary for tree felling by Funnel Beaker communities engaged in woodland clearance. Other Funnel Beaker communities' lithics included chisel blades and dihedral forms, manufactured at the mine complex workshops and at settlements throughout the broader region (Balcer 1983, 142–145; Bąbel 2014; Sałacińska and Sałaciński 2022). During the period of Funnel Beaker communities, striped flint was distributed over a radius of approximately 330 km from the mine (Bąbel 1981, 592).

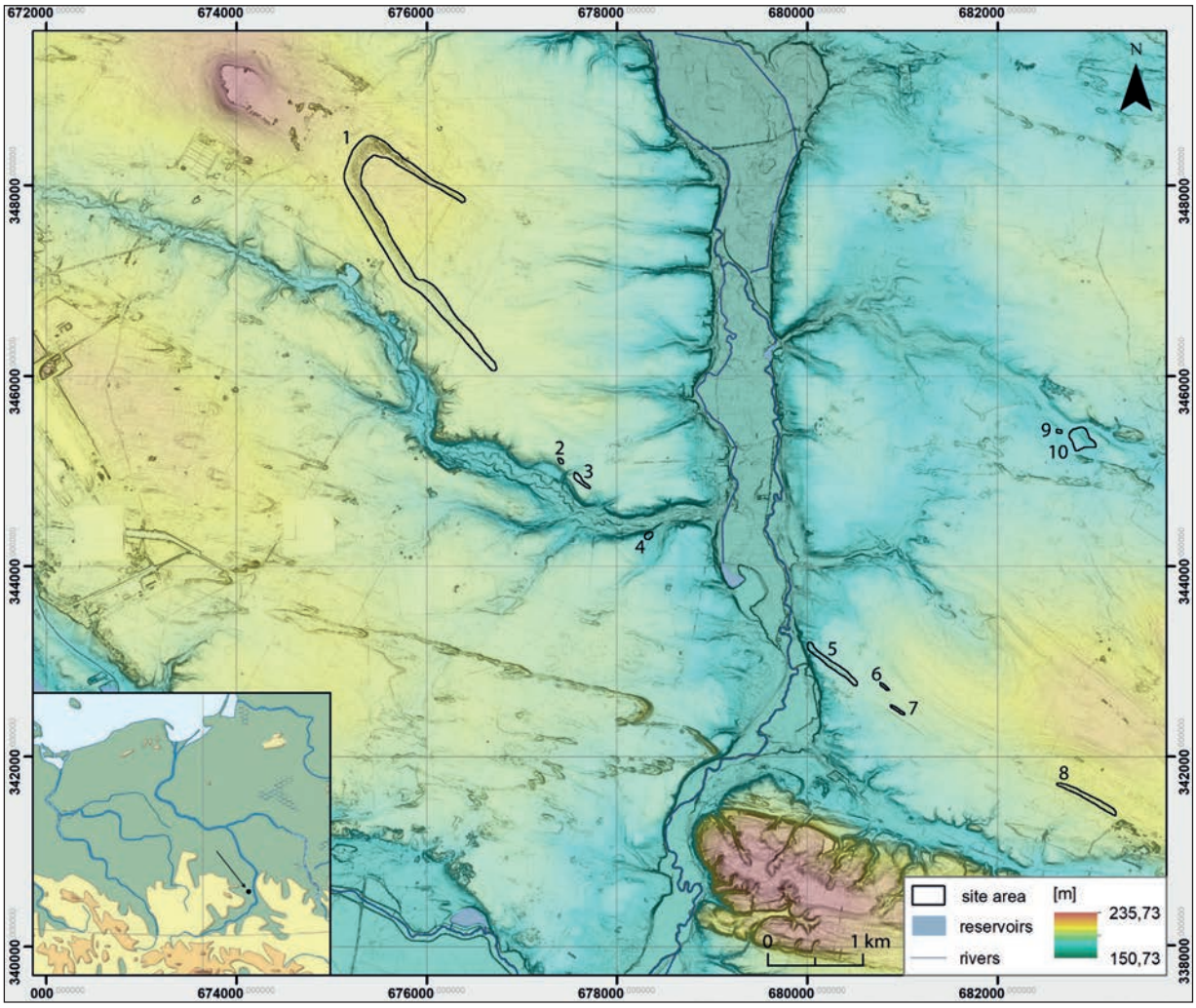



FIGURE 6. Prehistoric mining fields of banded flint along the lower Kamienna river: 1. 'Krzemionki' in Krzemionki, Magonie and Stoki Stare; 2-5. Ruda Kościelna: 2. 'Księża Rola Mała', 3. 'Księża Rola Duża',4. 'Ostroga', 5. 'Borownia'; 6. 'Nowa' in Łysowody; 7 'Krunio' in Łysowody; 8. 'Korycizna' in Wojciechówka; 9-10. Teofilów: 9. 'Skałecznica Mała', 10. 'Skałecznica Duża' (after Budziszewski et al. 2021 with changes)

Among the Globular Amphora communities, the percentage of striped flint in the inventories ranges from 30% to 90%, and in some cases even reaches 100%. The primary purpose was to obtain axeheads and chisels. Their shape and function changed over time. In the Globular Amphora communities, axeheads were tetrahedral and square, flat wedge-shaped, and often fully polished. The axeheads were found in various archaeological contexts, including pits at settlements and human graves, which has led to the suggestion that they were special objects (Bąbel 2014, 14; Włodarczak et al. 2021). During the period of the Globular Amphora communities, striped flint was distributed within a radius of approximately 660 km from the source (Bąbel 1981, 592).

In the lithic assemblages of later communities, striped flint occurs sporadically. Striped flint axes are rarely found among the Corded Ware culture assemblages in Lesser Poland, they are known from only six grave assemblages. Certainly, in most cases (and perhaps always), they were discovered in assemblages associated with phases II and IIIA, i.e., the initial period of the local Corded Ware communities' existence in the Lesser Poland Upland (Włodarczak 2006).

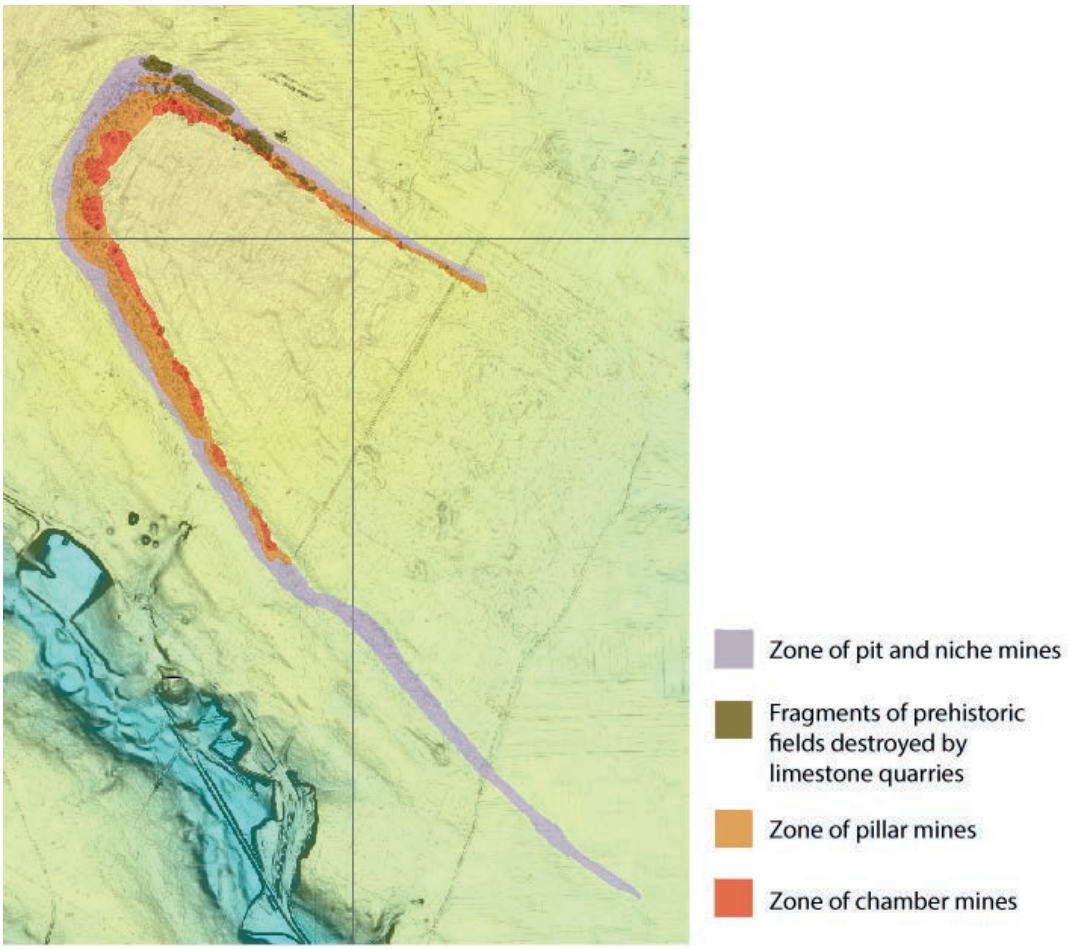



FIGURE 7. Hypothetical plan of the exploitation field in the Krzemionki Reserve (after Bąbel 2014. Map background: M. Skrzatek)

By the end of the Neolithic period, with the rise of Bell Beaker culture communities, striped flint was again used extensively. In Bell Beaker lithic assemblages, striped flint accounts for approximately 75% of the raw materials, forming the bulk of their products. However, there are no known signs of mining activities by these communities at the recorded flint mining sites. (Budziszewski and Włodarczak 2010, 69).

The striped flint played a significant role in the lithic production of the Early Bronze Age, particularly within the Mierzanowice culture communities. It was mainly used in the production of bifacial polished axeheads. The materials related to the activities of Early Bronze Age groups are known from the Krzemionki mining site. Furthermore, recent investigations carried out at the Borownia mining site and the radiocarbon dates obtained suggest that the mine should be linked to the activity of the Mierzanowice culture communities (Lech 2021). During the Early Bronze Age, striped flint was distributed within a radius of approximately 100 km from the mine (Bąbel 1981, 592; Lech 1987; Kadrow 1995; Zalewski 1995; Lech 2021).

## Turonian flint

### Świeciechów flint (grey white-spotted)

Świeciechów flint, also known as grey white-spotted flint, was described as early as 1920 by Stefan Krukowski (1890–1982). The original deposits of this raw material were described by Jan Samsonowicz (1888–1959) in 1923.

## Localisation

Deposits of this raw material occur in Cretaceous rocks of Turonian age in the area of the Rakowska and Gościeradów anticlines, between Annopol, Świeciechów, Wymysłów, and Wólka Gościeradowska (Samsonowicz 1924, 99; Balcer 1975; Król and Migaszewski 2009, 29). Due to the presence of rare faunal assemblages, the age of the marls was determined by Samsonowicz to be Turonian. The Turonian age was indicated by the presence of *Ostrea sp*., *Plicatula nodosa* Duj., *Pecten sp*., and large foraminifers, visible to the naked eye: *Flabellina cordata* Reuss, *Frondicularia angusta* Nilss., *Nodosaria ps*. (Samsonowicz 1924, 99–101).

## Geology

Świeciechów flint is of syngenetic origin, forming simultaneously with the bed (parent) rocks as a sedimentary rock. This raw material occurs as flattened concretions, sometimes exceeding 50 cm in diameter and up to 20 cm thick. Flint-bearing layers are found within the village of Świeciechów Poduchowny-Lasek, primarily on the western slope of the hill that descends towards the Vistula River valley. This area is covered with rendzina formed on the weathered Turonian sediments. Within this small area is a mine that was the main source of this raw material. Above the flint-bearing layers, closer to the surface, are thin, several-centimetre-thick layers of so-called black flint (Balcer 1975; 1976;1980).

## Characterisation of the raw material

The silica mass appears in various shades of grey – from light to brownish, then bluish, and finally dark – and is slightly transparent. Scattered throughout are rounded spots (light, white, and yellowish) ranging in size from very small to 2.5 mm in diameter, with the largest spots taking on an irregular shape, and are remnants of a resinous carbonate rock. In some specimens, silica coagulation phases are observed. The surface of the concretion is even, almost smooth (see Fig. 8; Samsonowicz 1924; Krzak 1965, 219–222; Balcer 1971, 110–110; 1975, 46–52; Domański and Webb 2000, 825; Domański et al. 2009, 1402).

Libera and Zakościelna (2019) have identified two other groups of macroscopically distinguishable lithic raw material from the Cretaceous formations of the Turonian stage in the Annopol and Gościeradów anticlines. Namely, in addition to Świeciechów flint, there is a grey-spotted flint (*krzemień szary plamisty*), also known as Gościeradów flint, and a black flint, also known as blackish flint (Libera and Zakościelna 2019, 24).

*Gościeradów flint*, characterised by a colour ranging from light steel- to dark grey, is therefore darker than Świeciechów flint. Furthermore, the light grey spots, sometimes several millimetres in diameter and clearly standing out against the dark grey flint mass, are smaller and significantly fewer in the Świeciechów variety. Furthermore, this raw material occurs primarily in small (up to several centimetres in length) and irregular concretions. They are nodular in shape with various protrusions, the largest of which reach several centimetres in length.

*Black flint*, of epigenetic origin, was recorded in the primary deposit in two levels, above the Świeciechów flint deposit. It occurs as plate-like concretions (up to 30 cm long and 7–12 cm thick). It has a uniform, almost black colour and lacks distinct dots or spots. Other features include a blue-grey layer surrounding the flint mass, which then gradually transitions into a relatively thick chert layer (Samsonowicz 1924, 100; Balcer 1975, 52, 153–157; Libera and Zakościelna 2019, 26–27).

## Exploitation, use and distribution

Świeciechów flint enjoyed varying popularity in different periods of the Palaeolithic and Mesolithic, and its widest and most distant distribution is known from this period (Libera and Zakościelna 1987, 44; Libera 1995, 21–23; Libera 2002; Sulgostowska 2005, 26). This raw material is known from Middle and Upper Palaeolithic inventories in Hungary and Slovakia. One specimen (flake) of Świeciechów flint was recorded in Upper Palaeolithic settlements in Obłazowa Cave (Valde-Nowak 2003; Sulgostowska 2005, 27). This flint dominates Magdalenian inventories at sites located near their outcrops – Wilczyce and Klementowice (Schild 2014; Wiśniewski 2015). The most extensive distribution of Świeciechów flint is associated with Magdalenian culture communities. In the west, it has been recorded in Thuringia, at Ölknitz; in the south, it was found in Moravia, at Kůlna Cave. Świderian communities also utilised Świeciechów flint. Evidence of processing has been




FIGURE 8. Świeciechów flint. A – an axehead of Funnel Beaker culture communities; B – a view of the exploitation field at Świeciechów-Lasek, Kraśnik district (photo by D. H. Werra)

found at the workshop at Kopiec, which used flint nodules from the nearby outcrop at Świeciechów-Lasek (Fig. 8B). Items made from Świeciechów flint are quite common in Świderian finds from the Sandomierz Valley, though isolated specimens have been discovered almost up to 200 km from the outcrop (Libera 2002, 35–43; Tomaszewski 2002, 59). Notably, Świeciechów flint is almost absent from sites associated with the Tanged Point Technocomplex west of the Vistula River, particularly in the Odra valley (Ginter 1974, 64; Sulgostowska 2005, 28; Sobkowiak-Tabaka 2016).

In the Early Mesolithic, a marked decline in the use of Świeciechów flint is observed, while in the Late Mesolithic it constitutes up to 90% of flint inventories at sites located up to 65 km from these raw material deposits. During this period, a widespread distribution of this raw material is again observed. It is recorded at sites located approximately 130 km east of the outcrop (Nieborów) and up to 180 km north (in the Warsaw Basin). Individual specimens are known from distances of up to 300 km – Wistka Szlachecka, Oleśnica near Płock, and over 300 km – Witowy Most near Ostrołęka and Tarnów near Słupca. Imports of this raw material are known beyond the natural border of the Bug River (Schild et al. 1975, 69; Cyrek 1981, 68; Libera 1995, 23–24; Obuchowski 2002; Sulgostowska 2005, 28).

Świeciechów flint has been recorded in lithic inventories at sites dating to the earliest Neolithic period – the oldest phase of the Linear Pottery Culture. These sites are scattered over a vast area on both sides of the Carpathians (Lech 1989; 2008; 2003; Mateiciucová 2008). This raw material was, however, of marginal importance in the economies of the oldest Danubian communities. The nature of these finds and their marginal share in the inventories (<1%) suggests a non-economic basis for the phenomena directly related to the Świeciechów flint exchange (Szeliga 2014, 92–95). In the younger development horizon of the Danube communities, the territorial range of distribution of this raw material is much larger, which is associated with the increase in its importance in the raw material economy of these communities (Lech 2008; Mateiciucová 2008; Szeliga 2014, table 1 and fig. 8). The presence of this raw material is recorded in flint inventories

in Kujawy, Chełmno Land, western Lesser Poland and eastern parts of the Lublin region. Analysis of these artefacts indicates that Świeciechów flint was distributed sporadically and in forms such as flakes, chips, and tools made from it (e.g., Kruszyn, Site no. 10; Krzywosądz, Site no. 3; cf. Komorowski 1959; Domańska 2002; Kabaciński 2010).

In the earlier period of the Lengyel-Polgar cycle, Świeciechów flint played a marginal role and occasionally served as a supplementary material at some sites in the upland zone (Balcer 1983, 82, 96–97; Domańska 2002, 147).

Funnel Beaker culture communities in the older phase preferred 'chocolate' flint, and Świecechów flint is present in very small quantities (Balcer 1983, table 23; Domańska 2002, 149–151). In contrast, the younger phase, particularly in the Lesser Poland region, is characterised by the use of Świeciechów flint, along with Jurassic and Volhynian flints, indicating high productivity during this period. The primary products manufactured from Świeciechów flint by Funnel Beaker communities were axeheads in tetrahedral, square, or wedge-shaped forms, as well as long blades measuring up to 30 cm in length.

The exploitation of this flint at the Świeciechów-Lasek site is associated with the activities of the Funnel Beaker culture community. Excavations by Bogdan Balcer revealed traces of shallow mining in the form of trenches. However, the presence of other mining structures, such as mine shafts, cannot be ruled out (Balcer 1975; 1981). Świeciechów flint played a dominant role primarily at sites located in the immediate vicinity of the deposits (Balcer 1983, 131–132; Kowalewska-Marszałek 2002). In the Funnel Beaker culture, Świeciechów flint was distributed to sites up to 400 km from the deposits (Balcer 1975, Fig. 56).

Świeciechów flint was used by the Globular Amphora Culture communities to produce tetrahedral axes. However, such finds are rare and come primarily from the Lesser Poland region (Balcer 1983, 210; Domańska 2002, 151; Kabaciński 2010).

Świeciechów flint was a key resource in the economy of communities within the Corded Ware culture, especially among the Kraków-Sandomierz group. Throughout their existence, this raw material was transported over large distances, exemplified by an axe crafted from Świeciechów flint found near Krems in Austria (Balcer 1971, 97; 1983, 227; Włodarczak 2006, 20, 23, 30, 32, 71, 148). Items made of Świeciechów flint, such as points, serve as cultural markers for the Złota culture (Borkowski 2002). Its use during the Bronze Age is harder to trace, with only a small proportion recorded in major cemeteries of the Mierzanowice culture (10–13%). The quantities of lenticular- and oval-sectioned axes are notably limited, restricted to just a few forms. Similar scarcity applies to spears, sickles, and points manufactured from this material (Libera 2001; Bargieł 2002; Wolski 2013).

This raw material was used by the Lusatian culture and is known for its excellent cleavage, which allows for the creation of large tools like sickle-shaped knives. However, these tools tend to dull quickly and require retouching. Recent studies suggest that the Lusatian Culture primarily utilised Gościeradów flint, despite it being of lower quality compared to Świeciechów flint (Libera, Zakościelna 1987, 39, 45–46; Kłosińska 2019, 226).

The extraction of Świeciechów flint by Palaeolithic and Mesolithic communities has not yet been confirmed. However, a workshop is known at the Kopiec Site 4. It is linked to the activities of Masovian communities that produced Świeciechów flint flakes there (Libera and Zakościelna 2019). These workshops are situated in the area of Świeciechów-Lasek. Semi-finished axe blades typical of the Corded Ware Culture are known from the area of this mine, which may indirectly indicate the participation of these communities in the exploitation of Świeciechów flint deposits (Balcer 1971: 76–77, 97; 1975: 150–152; 1983: 227; 2002: 22–24; Bargieł 2002: 125).

## Turonian flint in Ożarów

The flint mining site in Ożarów was discovered by Stefan Krukowski in 1923, and he indicated the need for a surface collection of the material. In the 1960s, Zygmunt Krzak undertook surface prospection. An excavation was undertaken in 1980–1983 by Janusz Budziszewski from the Institute of Archaeology, University of Warsaw (Budziszewski and Grużdź 2015).

## Localisation

The prehistoric flint mine "Za Garncarzami" is located on the northeastern margin of the Mesozoic Holy Cross Mountains. The site is positioned on a long denudation slope. The slope probably




FIGURE 9. Ożarów flint. A – example of a raw material from Ożarów "Za Garncarzami" mining; B – a quarry at Karsy, north of Ożarów (photo by D. H. Werra)

formed after the end of the glaciation, which left behind the glacial till preserved on the hilltop and partly in the upper part of the site (Budziszewski and Grużdź 2020).

## Geology

This flint occurs in Cretaceous Turonian sediments, which form isolated clusters between the lower reaches of the Kamienna River and the Vistula. In the Upper Turonian sediments, where the balance between carbonate and siliceous material varies, siliceous limestone becomes increasingly calcareous. Dark flints of diverse origins and shapes emerge, replacing cherts. In the Ożarów region, these flints cover an area of several square kilometres (Michniak 1980; Krajcarz 2020).

## Characteristic of the raw material

The grey spotted flints, also known as Ożarów flint, occur as large flint nodules with diameters of up to several dozen centimetres and as large tabular flints measuring over a dozen metres in diameter and several dozen centimetres thick. The flint is grey with a brownish tint and is light in places, featuring blurred dark spots or streaks. It has a cortex in a form of a thin layers of limestone. The surface of the concretions is uneven with small outgrowths. Another exploited variety was dark grey flint, with a fairly uniform colour and numerous internal cracks. Similar flint occurs in Karsy, north of Ożarów (see Fig. 9; Budziszewski and Grużdź 2020).

## Exploitation, use and distribution

Distinguishing Ożarów flint is very challenging. In many ways, it resembles other grey, spotted Turonian flints. Attempts to differentiate this raw material with various geochemical methods have not produced the expected results. Ożarów flint was not the best material for toolmaking, as it was inferior to striped flint, 'chocolate' flint, and Świeciechów flint in this respect. Its products are small and have a predominantly local distribution. Although used by Palaeolithic communities, this was on a small scale and only sporadically. The situation changed in the third millennium BCE, when Ożarów flint attracted the attention of the Złota and Corded Ware cultures. Nevertheless, its use remained minor and played a marginal role in the economy. A significant shift occurred in the second millennium BCE with the emergence of settlements of the Mierzanowice culture in the Sandomierz Upland. This raw material was ideally suited for the manufacture of macrolithic sickle knives. Most of the extraction features from the „Za Garncarzami" mine date to that period (Budziszewski 2020).

## Cretaceous flint

Cretaceous flint is the most widespread raw material across the North European Plain and beyond (see Fig. 7). It appears on the surface and in glacial rafts and has received limited, specific research, with only a few analyses published. This scarcity likely stems from the fact that, compared to other flint types used by prehistoric peoples in present-day Poland, this type is the most difficult to work with. This is due to its high colour variability, the presence of fossil microorganisms, and heterogeneous composition (Fig. 10). Additionally, its sources remain unidentified (Krukowski 1920; 1922; Kozłowski and Pawlikowski 1989; Kamińska-Szymczak and Szymczak 2002, 302–303; Přichystal 2013: 101; Sobkowiak-Tabaka et al. 2016).

## Localisation

Among this type of flint, several types can be distinguished. Widely distributed, these raw flints vary in size, colour, and the presence of cortex.

1. (Baltic) Erratic Flint – occurs in the whole area of present-day Poland, mostly in the Lowlands, and is characterised by its abundance in fluvioglacial till deposits or on the surface (Krukowski 1920; Bobrowski and Sobkowiak-Tabaka 2012).
2. Cretaceous flint sources involve glacial rafts. Rich occurrences of lithic raw materials are known from the Toruń-Eberswald marginal-ice valley, the central Warta Valley, and the region of the Silesian-Moravian border. This flint mostly occurs in bluish-grey nodules (Sobkowiak-Tabaka et al. 2016).
3. Pomeranian flint, shaped like pebbles (often called *swallow eggs*), appears in yellowish-brown or pink hues. It is found in the central and western areas of the Pomeranian region of northwest Poland (Balcer 1983, 49–51).
4. Rugian flint – West Cretaceous flint. Occurs on Rügen island on the Baltic coast to the west of the Oder estuary, where its natural outcrops are localised.
5. South-East Cretaceous flint. It is localised in the Lublin Upland and in the east, along the Vistula River. Occurs in glacial rafts closely related to Pleistocene glacial activity.
6. Mielnik Cretaceous flint. Localised in the vicinity of Mielnic town in the Bug River middle terrace and in natural exposures of weathered rocks in moraines.
7. Volhynian flint. High-quality Cretaceous flint. Outcrops are localised in southeastern Poland and western Ukraine.
8. Rajowiec flint. Localised on the Chełm Hills, situated at the northern foreland of the Lublin Upland (Dobrowolski et al. 2022).




FIGURE 10. Cretaceous flint. A – an example of the diversity of this raw material; B – modern quarry at Mielnik, Siemiatycze district (photo by D. H. Werra)

## Characteristic of the raw material

The colour of Cretaceous flint varies considerably, from grey-ash to bluish-black and reddish-white. The silica mass is densely dotted with numerous spots of different sizes, shapes, and colours. Traces of frost cracks are also common (Kozłowski and Ginter 1975; Sulgostowska 2016).

Several visual classifications of Cretaceous flint have been presented so far, based mostly on size, colour, the presence or lack of microfossils and other properties. There are several distinguished types and varieties (e.g. Balcer 1983, 49–50; Cyrek 1983; Dmochowski 2006; Jurys 2006; Król and Migaszewski 2009). However, much work still needs to be done, even though it is more than 100 years since this flint was discovered (Sulgostowska 2016).

## Exploitation, use and distribution

Cretaceous flint has been the most common raw material used by prehistoric communities from the Palaeolithic era through the Bronze Age and beyond. Its widespread occurrence and the macroscopic similarity between individual types make the analysis of distribution difficult to substantiate. The exception is Volhynian flint, which has distinct macroscopic characteristics (lustre, colour, banding) and allows for analysis of its use (Balcer 1983, 47–49). However, there is a risk of confusing items made from it with erratic („Baltic") flint, Rejowiec flint, Mielnik flint, or flint from the Ros River (Ukraine).

Volhynian flint was used by Magdalenian communities (*i.e.*, Maszycka Cave, Połtowicz-Bobak 2016, 141–142). In Early Neolithic communities, the use of Volhynian flint was local, limited to the eastern settlement centres. This raw material played a significant role in the eastern settlement peripheries located closest to the deposits (see Dębiec and Dzbyński 2007, 54).

The situation changed in the Eneolithic period, when intensive settlement of the Lublin-Volhynian Culture developed in the vicinity of the Volhynian deposits, especially during the classical phase. During the Lublin-Volhynian Culture period, the distribution of Volhynian raw material reached its greatest extent, *i.e.*, in the Polish Lowland, it is known for individual finds from the Brześć Kujawski culture community sites in Kujawy. The scale of Volhynian flint use by the Lublin-Volhynian Culture communities varied and depended on the distance from the outcrops. In the eastern zone of the Lublin-Volhynian Culture, Volhynian flint predominates completely (from 75.6% to 88.5%). In the western zone, 'chocolate' and Jurassic raw materials played the primary role, but Volhynian flint is also present in the inventories, ranging from 1.7% to 19.6%.

In the Funnel Beaker culture, Volhynian flint products appeared earliest in the classical and final phases, mainly in finished form. This did not affect the local communities' raw material economy; it had only a social (symbolic) dimension, reflecting the existence of inter-group ties and an extensive exchange network. It is debatable whether the communities of the southeastern Funnel Beaker culture group had direct access to the deposits or utilised them through the Lublin-Volhynian Culture or from Trypillia culture communities (Pelisiak 2007, 85; Zych 2007, 71–73). The influx of Volhynian flint to the Funnel Beaker culture communities in the Polish Lowlands is linked to the Vistula River (Kujawy and Chełmno Land), where several deposits are located 540–550 km from flint-bearing areas. The finds of Volhynian flint from the Lower Silesian settlement in Strachów are at the greatest distance from the deposits (approx. 600 km from those located on the upper Horyń and about 580 km from those on the upper Dnister). The influx of Volhynian raw material in the Globular Amphora culture is diametrically different. It is incidental and limited exclusively to the Lublin Region. Such a low frequency, limited essentially to one group of products – axeheads. A distinctive circulation of Volhynian flint existed within Corded Ware culture communities, with strong eastern influences primarily visible in the availability of raw materials. Volhynian flint consistently appears in the inventories of the Corded Ware culture, mainly as flint axeheads and blades, mostly found in Lesser Poland and southeast Poland. There are very few artefacts known from sites located west of the Vistula River, and only a few items have been registered in northern Poland. The circulation of Volhynian flint in the Bronze Age is hard to determine due to the unsatisfactory state of knowledge (see Fig. 11; Wojciechowski 1988, 53, 55; 2002, 143–145; Budziszewski 1991; Domańska 1995, 90; Włodarczak 2006; Libera and Zakościelna 2011; Adamczak and Sudoł-Procyk 2024).

Cretaceous flint was primarily obtained through surface collection or shallow digging. However, examples of more organised mining are known, including near Gorzów Wielkopolski, the Mielnik region, the Maków mine near Racibórz, and the Rybinki-Krzemianka mine near Białystok. Volhynian flint mines are known from Ukraine, primarily associated with the Trypillia culture (Lech 1981; 1983; Skakun et al. 2018; Bobrowski and Sobkowiak-Tabaka 2018).

## Radiolarite

Radiolarite is a siliceous rock of organic origin with a compact, biomorphic texture, often obscured by recrystallisation. It is mainly composed of radiolarian skeletons and an opal-chalcedony-quartz cement. It frequently contains mixtures of iron compounds or carbonaceous matter, giving



FIGURE 11. Large bifacially-worked flint point, Early Bronze Age, from Strzyżów, Strzyżów district (photo by D. H. Werra)

it a cherry-red, green, or black colour (Fig. 12A). It is typically an abyssal deposit, often geosynclinal, but also occurs in shallow-water formations (Ryka and Maliszewska 1991, 301).

## Geology

The Pieniny Klippen Belt is a key source of high-quality radiolarites in Central Europe (Fig. 12B). It is an exposure of Mesozoic and Palaeozoic rock formations that runs through the Tertiary domain. This geological formation separates the Outer and Inner Carpathians, stretching from Romania in the south-east, through eastern Slovakia and Poland (including Podhale and Pieniny), Slovakia, and Moravia (covering the Vlarska Pass, the White Carpathians, and the Small Carpathians), up to Austria near Vienna. Many mountainous regions

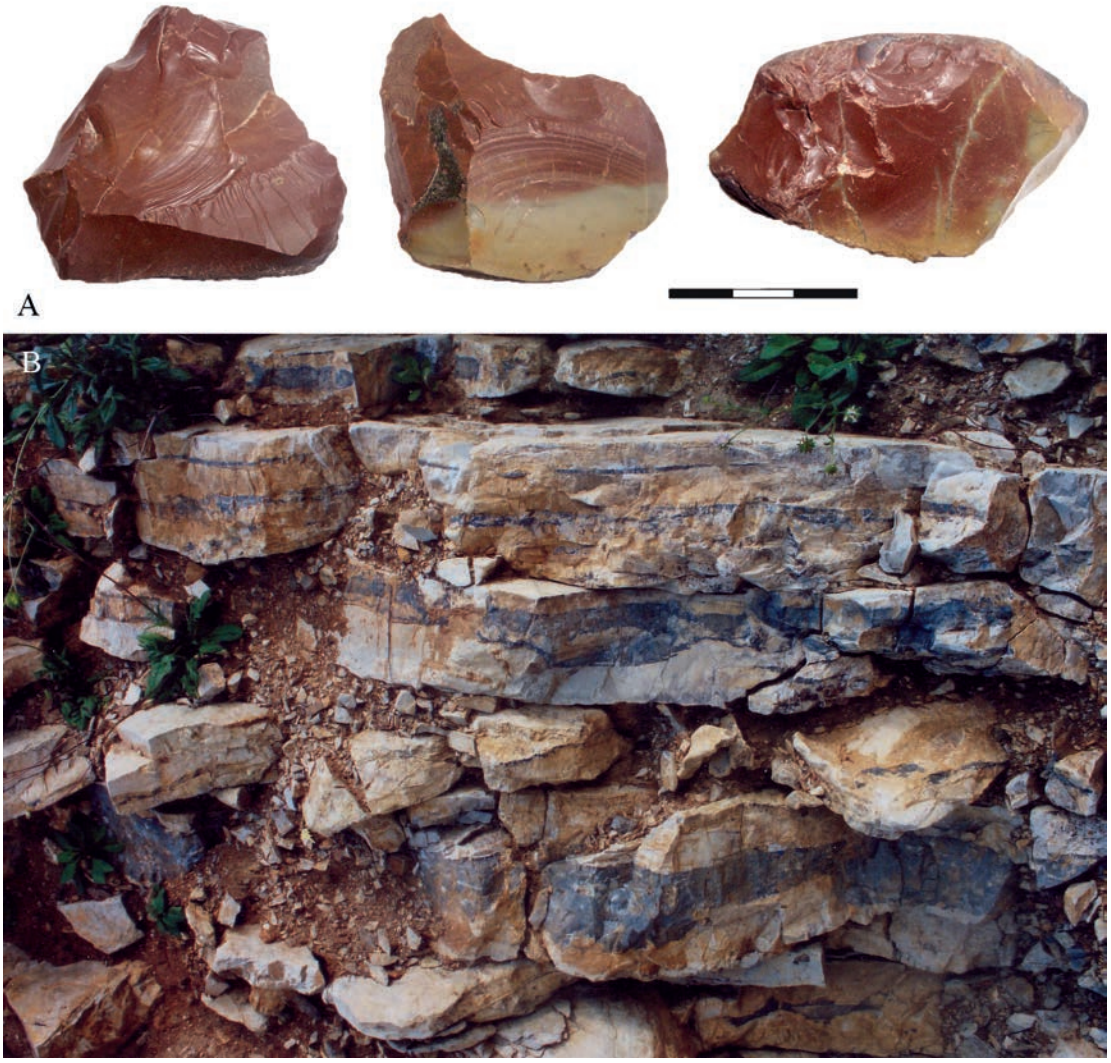



FIGURE 12. Examples of samples of raw material from the Pieniny Klippen Belt (PKB) in Poland; B – radiolarite outcrops from Szaflary, Nowy Targ district (after Valde-Nowak and Kerneder-Gubała 2019)

across Europe contain dark Ordovician-Carboniferous radiolarite layers, formed during Palaeozoic mountain-building events. Additionally, radiolarites are found in the Outer Flysch Carpathians, within the Silesian and Sub-silesian series that extend along the Carpathian Arc in Poland and surrounding areas (Brandl et al. 2013; Přichystal 2013; Valde-Nowak and Kerneder-Gubała 2019, 158–159).

## Localisation

In Poland, the Pieniny Klippen Belt appears at the surface between Stare Bystre and the Małe Pieniny Mountains, with younger sediments covering it to the west. It mainly includes rocks formed in the sedimentation zone, ranging from the shallow Czorsztyńska unit to the deeper Braniska and Pieniny units, as well as other units in Slovakia and surrounding areas. These form lithostratigraphic layers, some of which contain radiolarite in the Sokolica, Czajakowa, and Jarmuta formations, which are further subdivided. Radiolarites also occur as secondary deposits in streams, rivers, and Erratic boulders in Orava, covered by younger sediments (Valde-Nowak and Kerneder-Gubała 2019, 159–162; Kerneder-Gubała 2024).

## Exploitation, use and distribution

In the Polish part of the Pieniny Klippen Belt, there is as yet no direct evidence for mining methods of radiolarite exploitation (although known examples exist from other countries). The use of radiolarite has been recognised since the Middle Palaeolithic, with mostly single artefacts found at a few sites. The largest number of sites with radiolarite artefacts is associated with the Late and Final Palaeolithic, beginning with the Magdalenian culture. Early Mesolithic communities also processed radiolarite to a limited extent, although it was not widely distributed. In the Late Mesolithic, it was still used to a limited degree, but sites with larger quantities of red radiolarite artefacts are present. Radiolarite artefacts are rarely found at sites linked to Early and Middle Neolithic communities. Some isolated radiolarite items have been noted at sites associated with the Late Neolithic and Early Bronze Age communities in Lesser Poland and Subcarpathia, with some sites containing a higher number of artefacts made from this raw material (Mateiciucová 2010; Valde-Nowak and Kerneder-Gubała 2019, 166–168).

The siliceous raw materials discussed in this chapter, covering their geological diversity and distribution across modern-day Poland, were crucial in shaping the development of prehistoric communities. The presence of local siliceous rock deposits affected not only the organisation of the raw materials economy but also settlement patterns, exchange networks, and social structures. It is important to note that this chapter focuses solely on the most significant and widely used siliceous raw materials, which played a central role in prehistoric economic systems. Numerous other materials, such as quartzite and rock crystal, were also used on a smaller scale, often locally and sporadically (see i.e. Pelisiak 2018). Considering these less common raw materials enables a more complete understanding of the variety of supply strategies and environmental adaptations.

Siliceous raw materials played a crucial role in the production of tools for prehistoric communities. The observed long-distance flows of flint demonstrate extensive interregional contacts that facilitated the exchange of goods and knowledge. As a result, analysing siliceous raw materials, whether predominant or scarce, provides not only a foundation for reconstructing prehistoric manufacturing techniques but also a key to understanding wider social and economic processes. This enhances our understanding of the dynamics of communities inhabiting present-day Poland and their place within the broader prehistoric European context.

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# PALAEOLITHIC





# EXPLORING PREHISTORIC POLAND
## FROM PALAEOLITHIC TO NEOLITHIC

# PALAEOLITHIC

Iwona Sobkowiak-Tabaka

This chapter contends that the evolution of Palaeolithic settlement in present-day Poland reflects ongoing human adaptation to shifting environments, advancing technologies, and transforming social structures. It outlines the earliest human occupation in the Lower Palaeolithic, the growth of habitation during the Middle Palaeolithic, and significant cultural transitions in the Late Palaeolithic at the close of the Pleistocene. Particular attention is given to technological developments, from basic flake tools to Levallois methods and Upper Palaeolithic core processing traditions. The chapter describes survival strategies such as modifying subsistence practices and shelters to endure tundra and steppe environments. It also examines mobility, settlement patterns, intergroup interactions, and symbolic and funerary customs. The chapter discusses the Lower Palaeolithic (c. 3.3 Ma-400 ka; however, it should be emphasized that in Poland, settlement older than 600 ka is not confirmed), Middle Palaeolithic (c. 400–45 ka), Upper Palaeolithic (c. 45–15 ka), and Late Palaeolithic (c. 15–11.5 ka).

## Lower Palaeolithic

The territory of present-day Poland during the Lower and Middle Palaeolithic has long been interpreted as a marginal ecological and settlement zone, shaped primarily by its proximity to the centres of Scandinavian glaciation (Milecka, in this volume, Fig. 1).

The early human dispersal into Europe emphasizes colonization waves originating in southwestern Asia by *Homo erectus* (Dennell et al. 2011; Garba et al. 2024). Initial expansions (1.6–0.8 Ma)[1] occurred under relatively favourable climatic conditions but were repeatedly disrupted by glacial cycles (Ehlers and Gibbard 2007). The cycles varied from shorter ones – c. 41 ka[2], structured by orbital obliquity to relatively stable c. 100 ka – the so-called Early-Middle Transition (c. 1.2 to 0.6 Ma) (Head and Gibbard 2005).

Prior to c. 0.7 Ma, the majority of early sites were located to the south of the Alps and the Pyrenees (Arzarello and Peretto 2010). Central Europe, including Poland, probably served as an area where populations moved into and out of in response to environmental factors – within a broader demographic system of fluctuating populations (Hublin and Roebroeks 2009; Dennell et al. 2011; Arzarello et al. 2012). As climatic conditions shifted, human groups periodically expanded into northern latitudes during interglacials (warmer periods), when conditions were favourable for settlement, and retreated or disappeared during colder phases (glacials), leading to a discontinuous archaeological record.

Early industries were dominated by simple flake and pebble technologies with low reduction efficiency (Barsky et al. 2010; Moyano et al. 2011). Later, during the period c. 0.78–0.3 Ma, more advanced Acheulian technologies emerged, including the production of bifacial tools (Fig. 1) – stone tools worked on both sides to produce long cutting edges (Moncel et al. 2013). However, central Europe displays a delayed and regionally distinct technological trajectory, with flake-based industries persisting (Fig. 2) and classic Acheulian forms appearing relatively late (J. K. Kozłowski and S. K. Kozłowski 1977; Svoboda 1987; Burdukiewicz 2003). The transition to Levallois prepared-core technology – a method involving careful preparation of stone cores to allow the removal of uniformly shaped flakes – in the Middle Palaeolithic marks a significant

[1] Ma – *megaannum* = $10^6$, million years ago.
[2] ka – *kiloannum* = $10^3$, thousand years ago.

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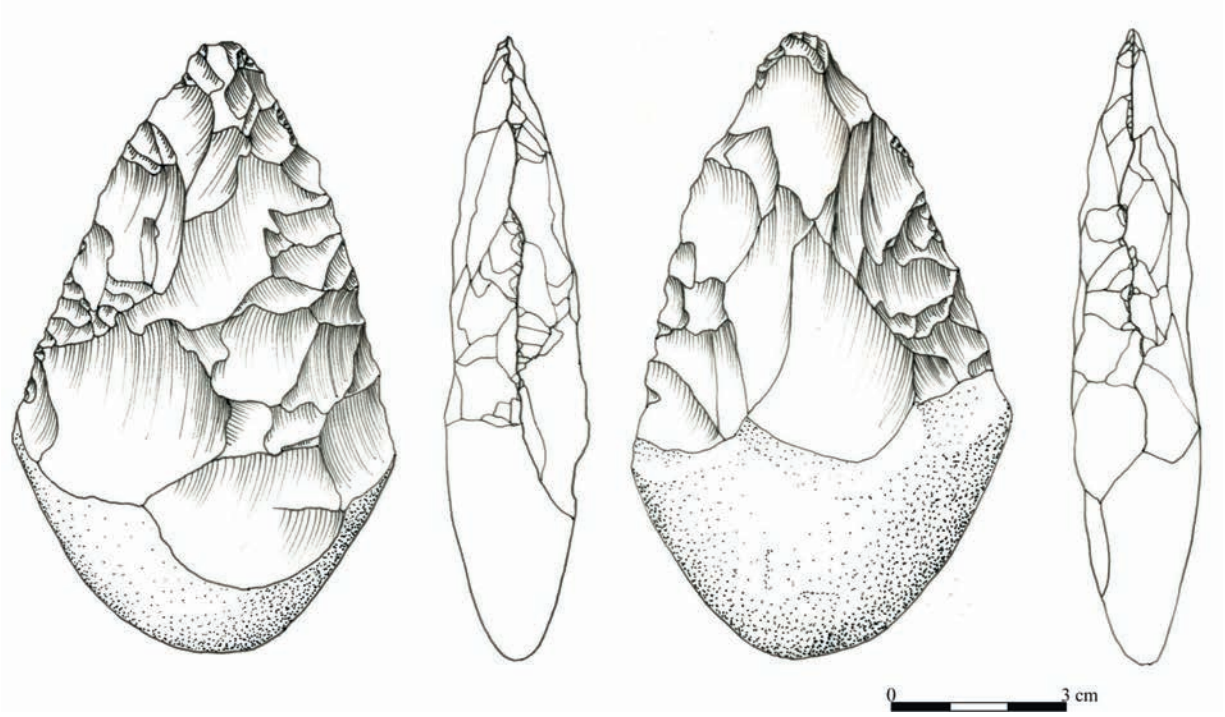



FIGURE 1. Replica of hand-axe (drawn by J. Mugaj)

cognitive and adaptive shift (Biśnik Cave), (Cyrek and Sudoł-Procyk, in this volume) often associated with the emergence of Neanderthals (Richter 2011; Hublin 2014).

Despite broader trends, the archaeological record in Poland remains inconclusive. No Lower Palaeolithic site currently has an unchallenged and well-dated stratigraphic context. Key sites such as Trzebnica (Trzebnica district), Rusko (Świdnica district), and Tunel Wielki (Kot, in this volume) offer significant but equivocal evidence due to artefact redeposition, slope-induced movement, and intricate sediment histories (Burdukiewicz 2003; Cyrek 2013). Frequent geological reassessments have questioned previous chronologies, complicating efforts to link human presence to specific Marine Isotope Stages (Fig. 3). Thus, while some assemblages are provisionally associated with interglacial periods like MIS 13 or MIS 11, these correlations remain tentative.

## Settlement patterns

Settlement patterns from available data suggest a preference for river valleys. This probably reflects access to water, food resources, and raw materials. Most sites are open-air with low artefact densities and limited stratification. These traits are consistent with short-term occupations. Cave sites, though rare, provide slightly richer evidence (Fig. 4). They include traces of hearths and repeated, but temporally dispersed, use (Cyrek 2013). The predominance of locally sourced raw materials further supports the interpretation of high mobility and limited territorial investment. Building on these settlement observations, it is possible to explore the specific nature of human activity in these contexts.

The nature of human activity remains difficult to reconstruct. While some assemblages suggest butchery and tool production, the absence of refitting sequences – reconstructing original tool forms from found fragments – and the disturbed contexts of many sites preclude detailed behavioural analysis. Nevertheless, evidence for controlled use of fire is increasingly recognized as a significant adaptive feature (Gowlett et al. 2005; Roebroeks and Villa 2011). Furthermore, technological variability, including the coexistence of microlithic (very small stone tools) and larger flake industries (tools made from larger stone flakes), probably reflects

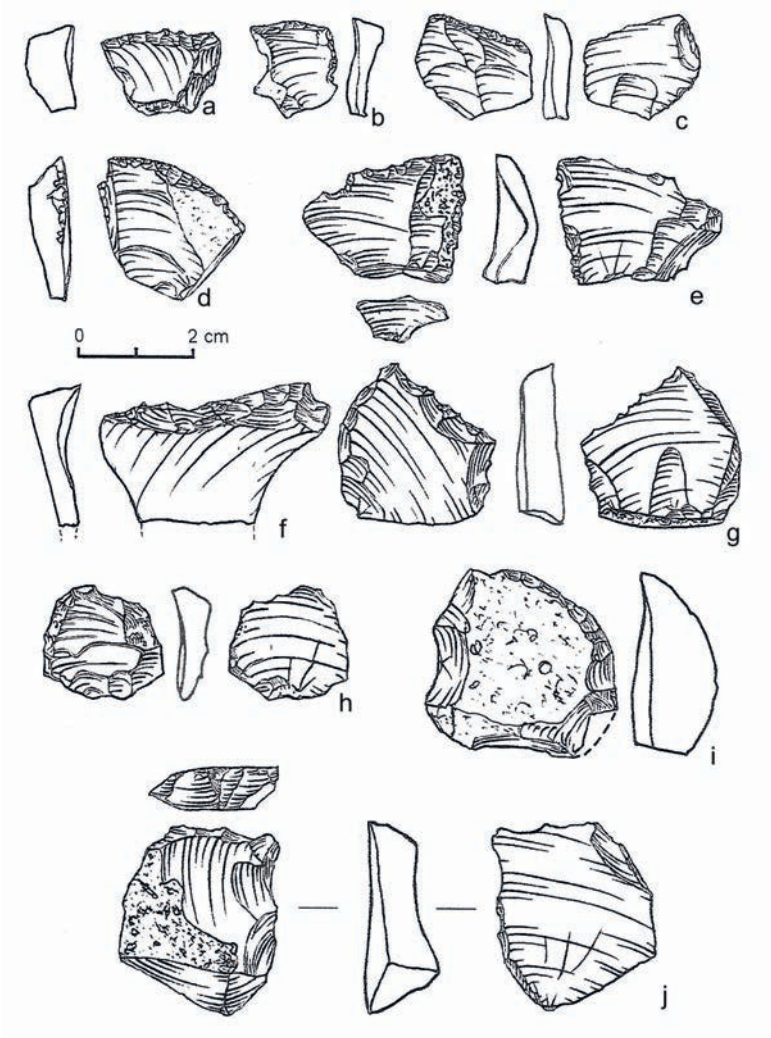



FIGURE 2. Trzebnica, site 2, lower level. Microlithic assemblage (after Burdukiewicz 2003)

multiple factors, such as raw material constraints, functional requirements, and possibly cultural traditions (Svoboda 1989; Burdukiewicz 2003; 2005).

## Middle Palaeolithic

The Middle Palaeolithic record shows a gradual intensification of occupation (Fig. 5). As human groups expanded further north, they adapted to increasingly harsh environments. Climatic fluctuations during MIS 8–MIS 6 imposed significant constraints; however, evidence from sites such as Biśnik Cave (Cyrek and Sudoł-Procyk, in this volume) suggests repeated, though brief, occupations even under steppe or tundra conditions (Litt et al. 2007; Cyrek et al. 2010). The adoption of Levallois technology and the decline of bifacial tools reflect broader shifts that impacted mobility, planning depth, and social organization. These technological and social changes enabled more flexible adaptation to marginal environments. The introduction of changes in material culture corresponds chronologically with biological transformations, namely the expansion of *Homo heidelbergensis*, which, in evolutionary terms, gave rise to Neanderthal populations (Hublin 2014).

The evidence from Poland and adjacent regions challenges the traditional view of marginal zones as areas of negligible or purely episodic human presence. Instead, these regions appear to have been integrated into wider settlement systems. These systems, characterized by complex demographic dynamics, technological diversity, and intermittent

but recurrent occupation, suggest broader settlement patterns. Although the archaeological record remains fragmentary and methodologically constrained, it nonetheless points to a nuanced model: here, marginality is not synonymous with insignificance but rather reflects a distinct mode of human adaptation within the Pleistocene landscape.

The period between about 59 ka and 45–40 ka years ago, during Marine Isotope Stage 3 (MIS 3, a period of global climate fluctuation seen in ice and marine cores), marks a critical phase in the Late Middle Palaeolithic (a prehistoric era distinguished by specific stone tool traditions) of Central Europe. Climate changes recorded in ice and marine cores define their chronology. The period starts with a warming event; its upper limit relies on radiometric dates from key Polish sites (Ciemna Cave, Kraków Księcia Józefa street, Pietraszyn, site 49a (Wiśniewski et al. 2019), Piekary IIa, and Stajnia Cave; Sitlivy et al. 2009; Urbanowski et al. 2010; Nowaczewska et al. 2013; Valde-Nowak et al. 2014). From the latter site, eleven teeth belonging to seven dated much earlier (eight) individuals of *Homo neanderthalensis* are known (Picin et al. 2026), see below.

During this time, human presence intensified north of the Sudeten and Carpathian mountains. This challenges earlier views of a settlement pause between MIS 4 (an earlier cold stage) and the rise of Early Upper Palaeolithic (EUP, the earliest Upper Palaeolithic cultures) industries (J. K. Kozłowski 2000; Wiśniewski et al. 2013).

## Environmental and climatic context

During MIS 3, pronounced climate oscillations occurred, including Dansgaard–Oeschger (DO) cycles 17–12 (rapid warming and cooling events) and the Heinrich event H5 (~45 ka, marked by massive iceberg discharges). These events are identified through Greenland ice-core records (NGRIP). Correlating these data with terrestrial (land-based) sequences remains challenging because of chronological uncertainties (Behre and van Plicht 1992).

Despite fluctuating conditions, MIS 3 is generally considered relatively mild (Kindler et al. 2013). Mean annual temperatures in southwestern Poland may have reached about +6.3°C, while cooler regional estimates (+2 to +3°C) indicate spatial variability (Skrzypek et al. 2011; Socha 2014). Seasonal contrasts were pronounced, with summers up to 18°C and winters from –20 to –8°C (Barron et al. 2003).

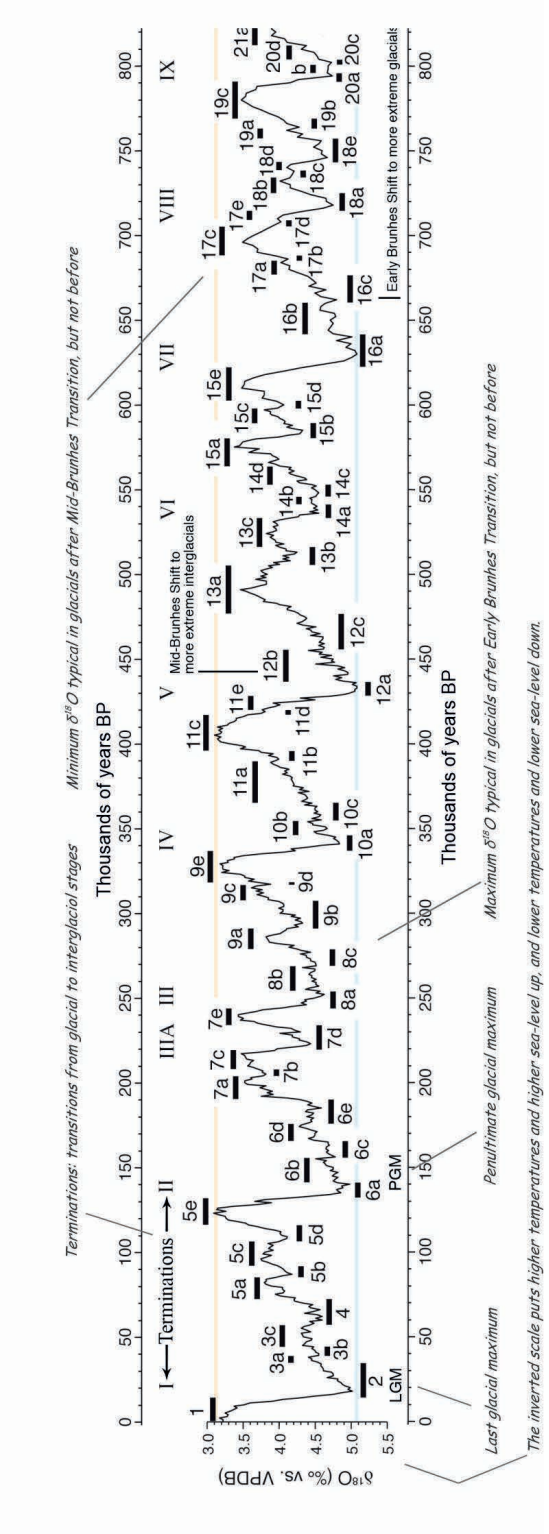



FIGURE 3. Marine Isotope Stages (MIS) after Shackleton 1969 and Railsback et al. 2015

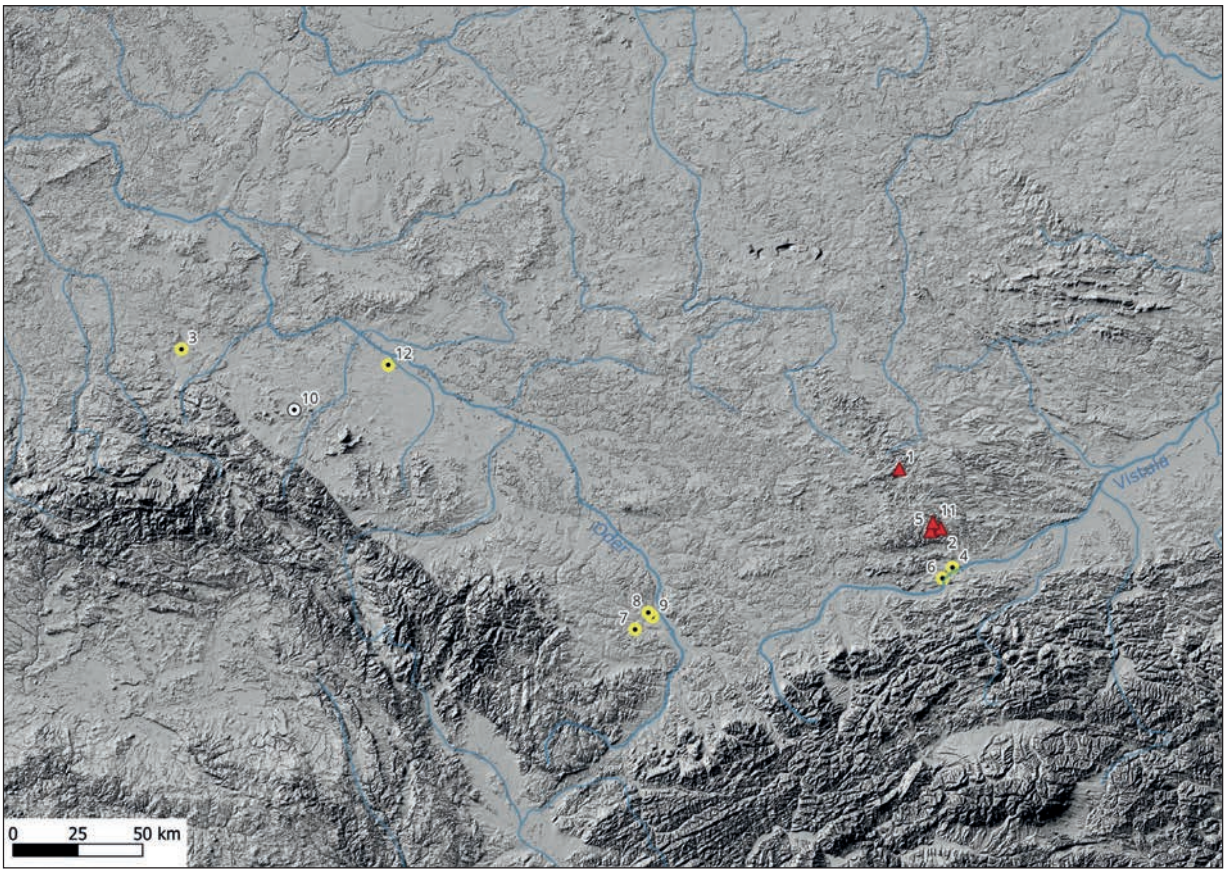



FIGURE 4. Distribution of the Lower Palaeolithic and Early Middle Palaeolithic sites in Poland

Triangles – cave sites, circles – open-air sites. 1 – Biśnik Cave, 2 – Ciemna Cave, 3 – Konradówka, 4 – Kraków Zwierzyniec, 5 – Nietoperzowa Cave, 6 – Piekary II, 7 – Pietraszyn, Site 49, 8 – Racibórz Ocice, 9 – Racibórz Studzienna, 10 – Rusko, 11 – Tunel Wielki, 12 – Wrocław Haller Avenue (drawn by W. Szambelan, after Wiśniewski 2016)

The environment was dominated by tundra (treeless, cold plains) and steppe–tundra biomes (grassland plains with sparse trees and cold temperatures), with occasional patches of cool mixed forest. Fauna from different ecological niches – forest and tundra species – coexisted, showing MIS 3's mosaic ecosystems (Huntley and Allen 2003; Wiszniowska et al. 2002). This environmental variety probably encouraged adaptable subsistence and technological strategies (Milecka, in this volume).

## Cultural variability

Technological evidence from MIS 3 reveals both continuity and innovation. Raw material procurement remained largely local, with no clear evidence of long-distance transport or of crossing major geographic barriers such as the Carpathians or the Sudetes (Neruda 2011). At the same time, lithic production strategies became increasingly diverse.

This diversity is seen in several core reduction techniques: Levallois methods (where flakes are struck in specific, organized patterns such as selecting a main surface – preferential, using circular directions – centripetal, or focusing the shape toward the centre – convergent), discoidal (using a disc-shaped core), and polyhedral (exploiting all available angles of a many-sided stone). Levallois technology was especially common for making flakes and points used as hunting tools. Blade production, which was rare earlier, appears at sites like Piekary IIa (Kraków district) and Kraków (Księcia

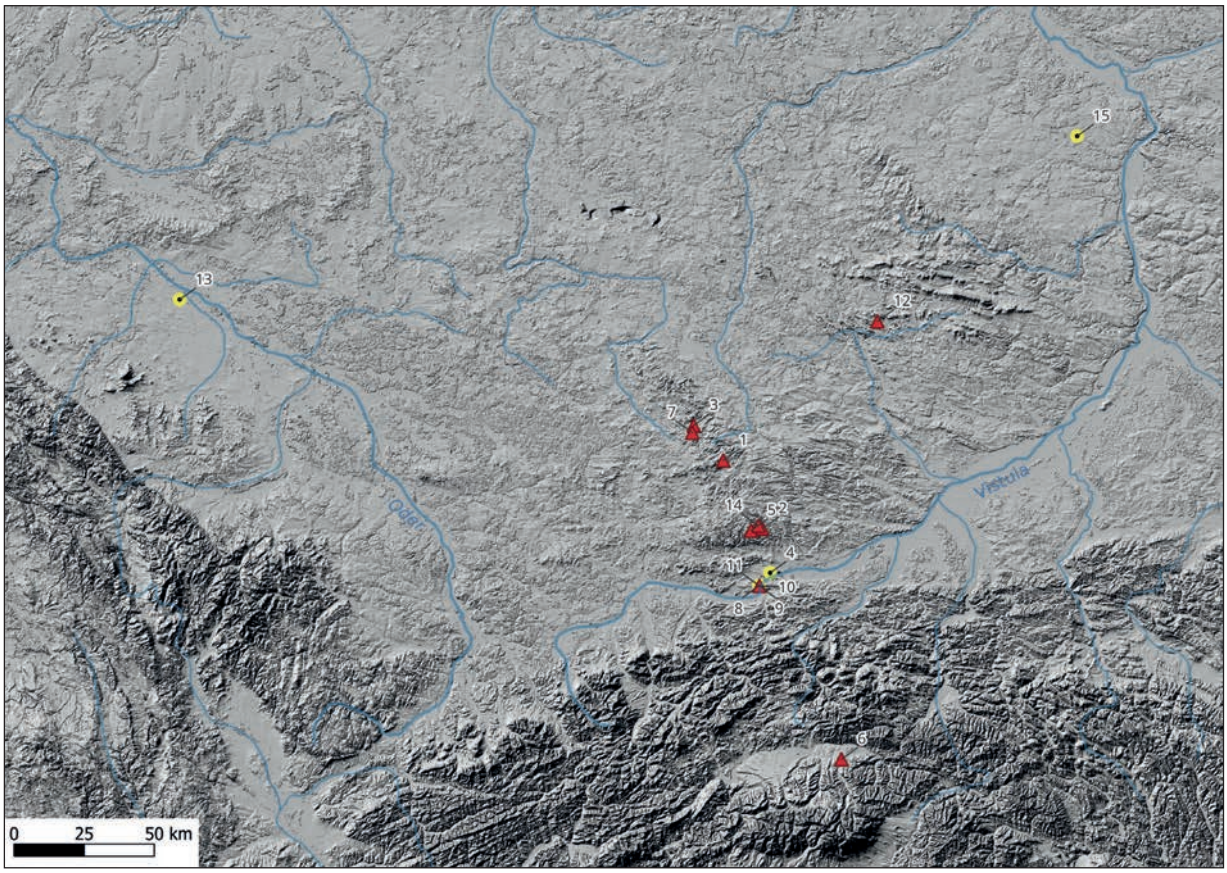



FIGURE 5. Distribution of the Middle Palaeolithic sites in Poland
Triangles – cave sites, circles – open-air sites. 1 – Biśnik Cave, 2 – Ciemna Cave, 3 – Dziadowa Skała Cave, 4 – Kraków Zwierzyniec I, 5 – Nietoprzowa Cave, 7 – Okiennik Cave, 8 – Piekary I (Galoska Cave, Jama Cave, 9 – Piekary II, 10 – Piekary III, 11 – Piekary IV (Gołąbiec Cave), 12 – Raj Cave, 13 – Wrocław Haller Avenue, 14 – Wylotne Rockshelter, 15 – Zwoleń (drawn by W. Szambelan, after Wiśniewski 2016)

Józefa street), suggesting either local innovation or influence from new types of stone tool industries (Soressi 2004; Sitlivy et al. 2008).

Reflecting these technological changes, tool assemblages show greater stylistic diversity and can be grouped as follows: (a) bifacial industries, which focus on shaping tools on both sides (e.g., Micoquian); (b) flake-based industries, where production centres on tools made from flakes, either using the Levallois method or other methods; and (c) industries that combine both flakes and blades.

Considering these assemblage types, bifacial tools, mainly knives – including characteristic "Ciemna knives" – probably served multifunctional roles, particularly in butchery (Cyrek et al. 2014). Their variability may reflect functional, raw material, or stylistic factors. In contrast, flake-based industries often show minimal retouch and emphasize expediency. Blade-containing assemblages may represent transitional phases toward the Upper Palaeolithic.

Taken together, the coexistence of these technological traditions suggests dynamic interactions between cultural groups. Evidence indicates bidirectional exchange between the Micoquian and Mousterian groups, probably aided by episodic contact across shared landscapes (Gamble 1999).

From the Middle Palaeolithic, more precisely from the period c. 130–150 ka, comes the oldest example from the Polish lands of behaviours that may be associated with broadly understood art. From

Dziadowa Skała comes an artefact made from the radius of a brown bear with incisions[3] (Płonka et al. 2024).

## Settlement patterns

Archaeological evidence from approximately a dozen sites dated using absolute methods (such as radiocarbon dating) indicates continuous occupation across MIS 3 (roughly 57 ka–29 ka years ago). These sites cluster in regions previously inhabited before MIS 4 (the preceding glacial period), including the Kraków–Częstochowa Uplands, the Vistula valley, and the Oder basin. Their placement near water sources, raw material outcrops, and animal migration routes underscores strategic landscape use (Fig. 6).

MIS 3 sites are distinguished by unprecedented artefact densities and diversity. Assemblages frequently include thousands of lithic (stone tool) artefacts, abundant faunal (animal) remains, occasional human remains, and features such as hearths. For instance, Kraków (Księcia Józefa street) yielded up to 280 artefacts per square metre, while the site at Obłazowa Cave reached densities of 538 artefacts per square metre (Valde-Nowak and Nadachowski 2014). Such intensification suggests repeated site use, seasonal occupation, or increased population density.

Functional differentiation of sites is evident. Residential camps, such as Ciemna (Valde-Nowak, in this volume) and Obłazowa caves, exhibit evidence of diverse activities, including tool production and carcass processing. Temporary camps – identified at sites such as Biśnik Cave, Wrocław Haller Avenue, Pietraszyn (Wiśniewski, in this volume), Site 49 and Kraków (Księcia Józefa street) – reflect specialized activities, such as tool maintenance or short-term subsistence tasks. The latter site is particularly notable for its 29 hearths (fireplaces) and extensive lithic (stone tool) assemblage (~22,000 artefacts), indicating organized and repeated occupation episodes (Sitlivy et al. 2009; Zięba et al. 2010).

Mobility strategies appear to have combined residential (long-term stays) and logistical (task-specific forays) patterns, consistent with broader Eurasian trends. Resource procurement was predominantly local (within 5 kilometres), though hunting-related movements could extend beyond 35–40 kilometres. Over time, certain areas developed into intensively exploited "local operational zones," meaning regions used repeatedly and efficiently for resources (White and Pettitt 2011; Davies 2012).

In examining spatial organization, two main ecological and cultural zones can be identified. The first, in the Kraków–Częstochowa Uplands and the Vistula valley, provided many shelters (caves and rock shelters), raw materials, and good hunting spots. The second, in the upper Oder basin, served as a pathway linking the Moravian Gate and facilitated seasonal movement and cultural exchange. These zones were probably linked, forming part of a larger Central European area that reaches into Moravia, Slovakia, and western Ukraine.

The settlement patterns seem to have followed natural routes shaped by landforms and the types of environments present. Yet it is unclear how these movements occurred – whether people expanded gradually in a connected sequence (a "string of pearls") or settled in separate steps – because the dates of these events are uncertain and there are gaps in the archaeological evidence (Wiśniewski 2016).

## Early Upper Palaeolithic

The period from about 42–35 ka marks a transitional phase in European prehistory. Researchers classify this phase as either the Early Upper Palaeolithic (EUP) or the end of the Middle Palaeolithic, depending on their perspective. This uncertainty arises from the mixed nature of the archaeological finds from this time. The collections contain both Middle and Upper Palaeolithic tool types (J. K. Kozłowski 1996; Bolus 2004; White et al. 1982). In Central Europe, these finds are usually called the "Leafpoint Complex", which refers to the presence of bifacial leaf-shaped tools (Bolus 2004).

The emergence of these industries continues to be a matter of considerable scholarly discussion. Current interpretations are generally framed within two principal explanatory models. The first advocates an autochthonous trajectory among Neanderthal populations, arguing for the endogenous development of cognitive and cultural capacities that led to increasingly complex technological behaviours (J. K. Kozłowski 1996; Svoboda 2006). The

[3] For a broader discussion of Palaeolithic art, Płonka and Furczyk, in this volume.

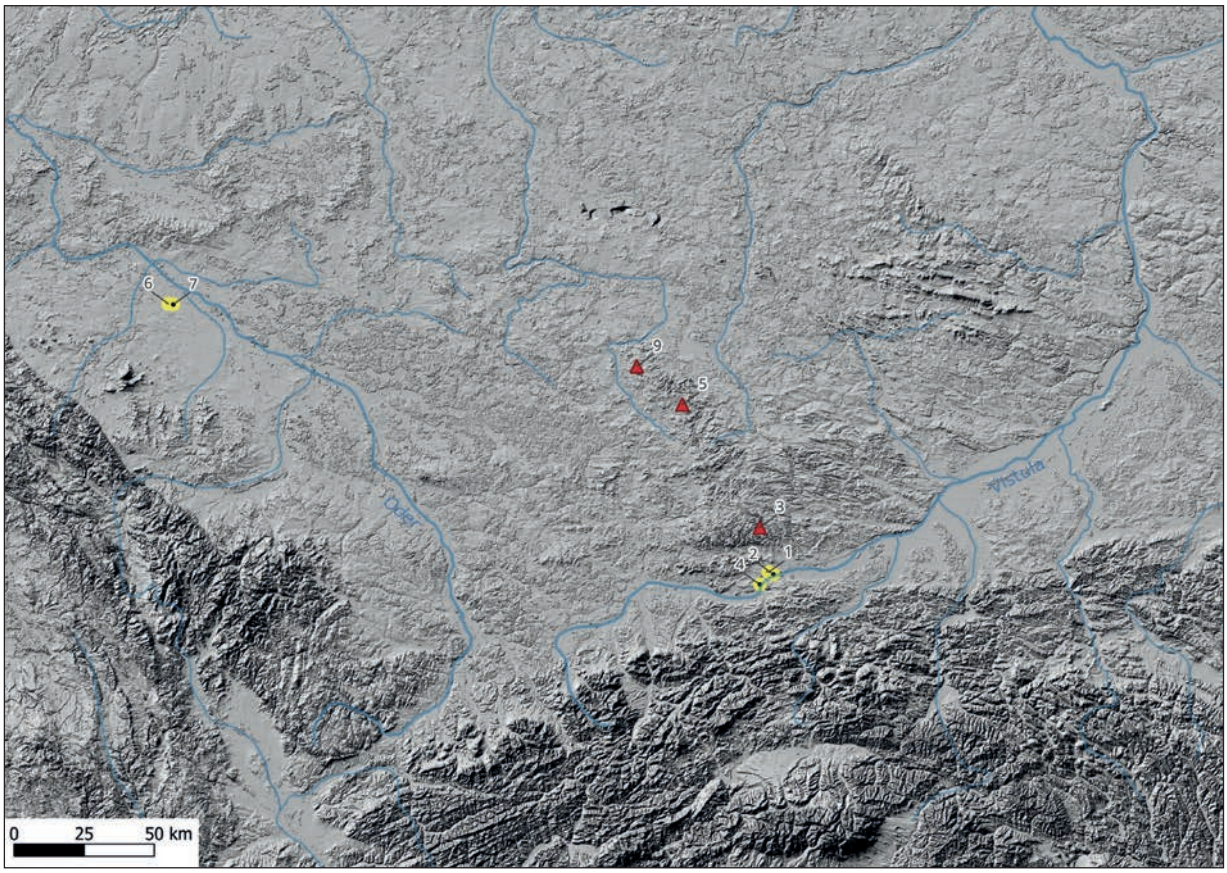



FIGURE 6. Distribution of the Middle Palaeolithic sites dated to MIS 3 in Poland
Triangles – cave sites, circles – open-air sites. 1 – Kraków Zwierzyniec I, 2 – Kraków, Księcia Józefa street, 3 – Łokietka Cave, 4 – Piekary IIa, 5 – Stajnia Cave, 6 – Wrocław-Oporów A1, 7 - Wrocław-Oporów A1, 9 – Zamkowa Dolna Cave (drawn by W. Szambelan, after Wiśniewski 2016)

second model stresses the importance of external stimuli, attributing a significant role to anatomically modern humans (AMH) in the formation of these industries, whether through direct interaction or processes of cultural diffusion (Bar-Yosef 2006; Flas 2011). The debate is further complicated by the absence of a clear and consistent relationship between biological populations and material culture.

## Environmental and climatic context

Environmental conditions during this period showed significant climatic instability. The EUP coincided with relatively warmer interstadials (GI-11 to GI-5), interspersed with colder episodes, culminating in Heinrich Event 4 (Blockley et al. 2012). Paleoenvironmental data from Poland indicate a mainly open tundra or steppe landscape, with limited forest found only in some southern regions (Milecka, in this volume). Faunal assemblages support this, suggesting an ecosystem dominated by cold-adapted species (Wojtal 2007). These conditions probably required highly mobile subsistence strategies. However, localised forest refugia may have supported more diverse niches, as evidenced by the presence of thermophilic fauna at Borsuka Cave (Wilczyński et al. 2014).

## Cultural variability

The chronological framework of EUP industries in Poland is complex and continues to be refined. The Szeletian Culture appears to represent the earliest manifestation. Sites such as Lubotyń 11 are dated to approximately 45–40 ka (Bobak et al. 2013). The Ranis–Lincombian–Jerzmanowician (RLJ) complex

is identified at sites like Nietoperzowa Cave. It also occupies an early position in this sequence, with dates corresponding to Greenland interstadials GI-9 and GI-8 (Chmielewski 1961; J. K. Kozłowski 2002). Both complexes predate the earliest Aurignacian assemblages in the region, which are generally dated to 40–35 ka (Wojtal 2007). This temporal overlap suggests only limited opportunities for direct interaction between leafpoint-producing groups and Aurignacian populations. Potential contact zones have been proposed in the Danube corridor (Nigst et al. 2014; Wright et al. 2014).

Technologically and stylistically, EUP industries in Poland show considerable variability. This probably reflects different production strategies and possibly distinct cultural traditions. The RLJ complex is characterized by blade-based technologies and the production of elongated leafpoints (Fig. 7), often interpreted as spearheads (Desbrosse and Kozłowski 1988). The Szeletian, by contrast, employs a blade-flake technology with bifacially worked leaf points that exhibit significant morphological variability (Lech 2021). This suggests flexible production strategies (Połtowicz-Bobak et al. 2009).

Chronological issues are equally contentious, particularly regarding the duration and disappearance of these industries. Under the autochthonous scenario, their decline may be linked either to the arrival of modern humans or to environmental pressures such as climatic deterioration (Müller et al. 2011). On the other hand, if AMH are considered the primary agents, the disappearance of leafpoint industries may reflect their gradual transformation into fully Upper Palaeolithic technological systems (Bar-Yosef 2013). Furthermore, recent advances in radiocarbon dating, especially concerning early Aurignacian contexts and Neanderthal remains, suggest a period of coexistence between Neanderthals and AMH in Europe lasting approximately 2,600 to 5,400 years (Higham et al. 2014; Nigst et al. 2014; Banks et al. 2013). In Central Europe, and especially in Poland, there are no human remains directly linked to EUP assemblages. This makes researchers rely on indirect evidence, such as technological parallels and chronological links with better-documented regions of Western and Southern Europe (Tostevin 2012). As a result, ideas about the biological ties of these industries stay tentative.

## Settlement patterns

Settlement patterns in Poland during the EUP reflect a dispersed and highly mobile population. Archaeological sites are concentrated mainly in upland regions, particularly the Kraków–Częstochowa Jura and the Głubczyce Plateau (Fig. 8). There is a notable absence of sites in lowland areas. Open-air sites are often located on elevated terrain and seem to have functioned as repeatedly-visited activity areas. These sites show evidence of lithic production and diverse subsistence activities (Fajer et al. 2004). In contrast, cave sites like Nietoperzowa Cave contain higher proportions of formal tools, particularly leafpoints. These caves are interpreted as short-term camps focused on specific tasks, possibly including hunting and tool maintenance.

## Upper Palaeolithic

The arrival of AMH (*Homo sapiens sapiens*) in the territories of present-day Poland marked a major transformation in settlement organization, subsistence strategies, lithic technology, and symbolic behaviour during the Upper Palaeolithic. Archaeological evidence demonstrates that these changes were associated with the spread of the Aurignacian culture and the later development of Gravettian and Epigravettian traditions across Central Europe (Nigst et al. 2014). The Upper Palaeolithic, therefore, represents not only a technological transition but also a profound restructuring of human adaptation to changing environmental and social conditions.

The association between the emergence of modern humans in Europe and the Aurignacian technocomplex underscores the significance of this archaeological culture. Unlike earlier transitional industries associated with Neanderthals, the Aurignacian appears to have originated outside Europe and spread gradually from the Balkans into Central Europe between approximately 50 and 40 ka calibrated years BP (Nigst et al. 2014). Anthropological remains recovered from Aurignacian sites belong exclusively to modern humans, reinforcing the interpretation that this culture was introduced by migrating populations rather than developing directly from local Neanderthal traditions.



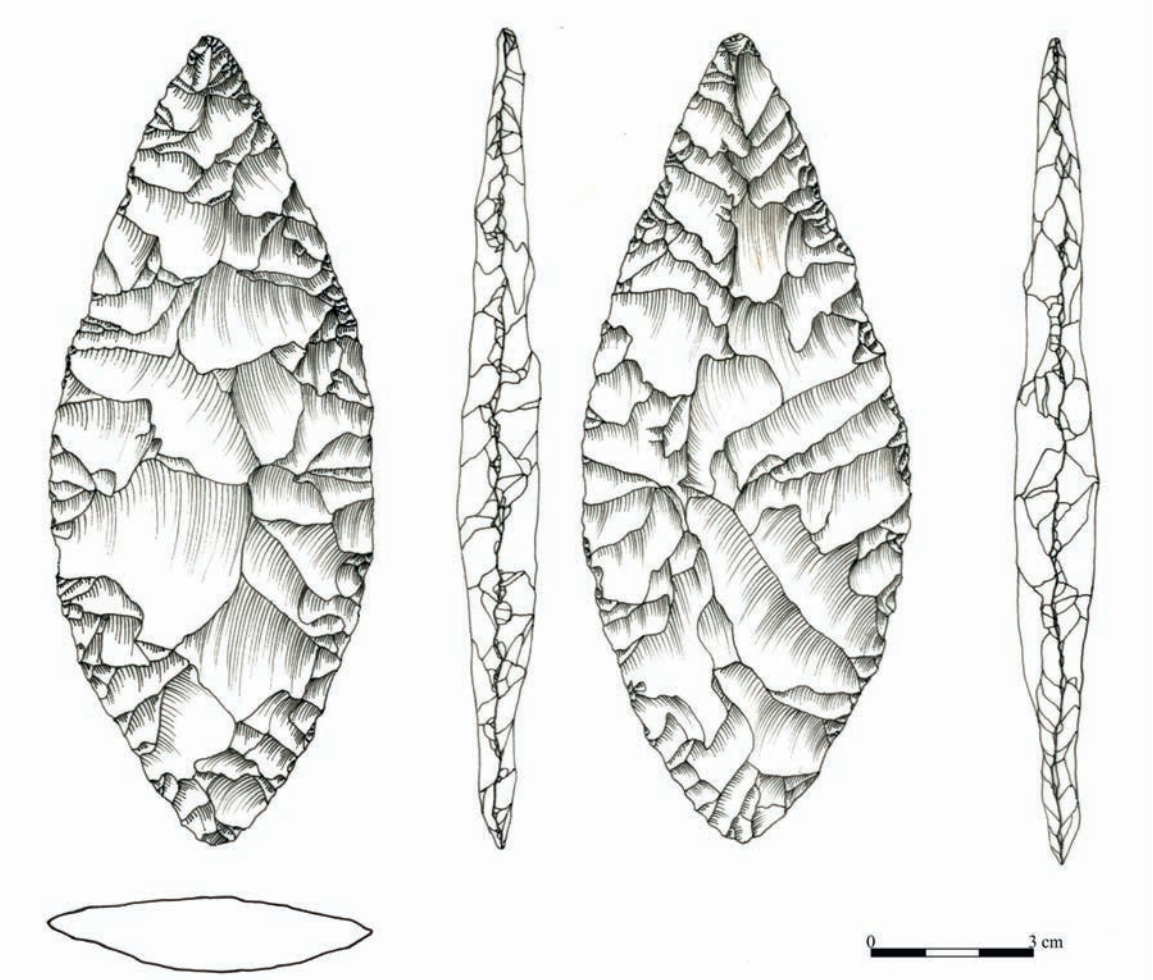



FIGURE 7. Replica of leaf point (drawn by J. Mugaj)

## Cultural variability

### Aurignac culture

The adoption of the "volumetric concept" of core reduction was the key innovation. This method involved careful preparation and exploitation of cores to produce standardized blades and bladelets. Aurignacian assemblages from sites such as Kraków-Zwierzyniec, Piekary II, and Góra Puławska (Puławy district) demonstrate advanced lithic reduction strategies using single-platform and multidirectional cores. These blade blanks were then transformed into specialized implements, including endscrapers, burins, retouched blades, and microlithic points. The efficiency of blade production enhanced portability and reduced waste, thereby facilitating greater mobility for hunter-gatherer groups (Krukowski 1938–1948; J. K. Kozłowski 1966; Chmielewski 1975). The truly innovation of the Upper Palaeolithic was the development of more effective projectile technology. Indirect evidence suggests that Aurignacian populations employed bows and arrows, as evidenced by microlithic points such as Krems and Dufour bladelets, interpreted as arrowheads. This suggests Aurignacian hunting efficiency and tactical flexibility.

Upper Palaeolithic communities revolutionized symbolic culture and organic technology in Polish territories. Aurignacian assemblages include numerous artefacts made of bone, antler, ivory, and tusks, including points, smoothers, 'baguettes', and perforated batons. Obłazowa Cave has yielded a remarkable collection, including bone artefacts, pendants made from *Conus* shell and arctic fox teeth, and a worked mammoth tusk interpreted as a boomerang (Fig. 9). The site also yielded two human

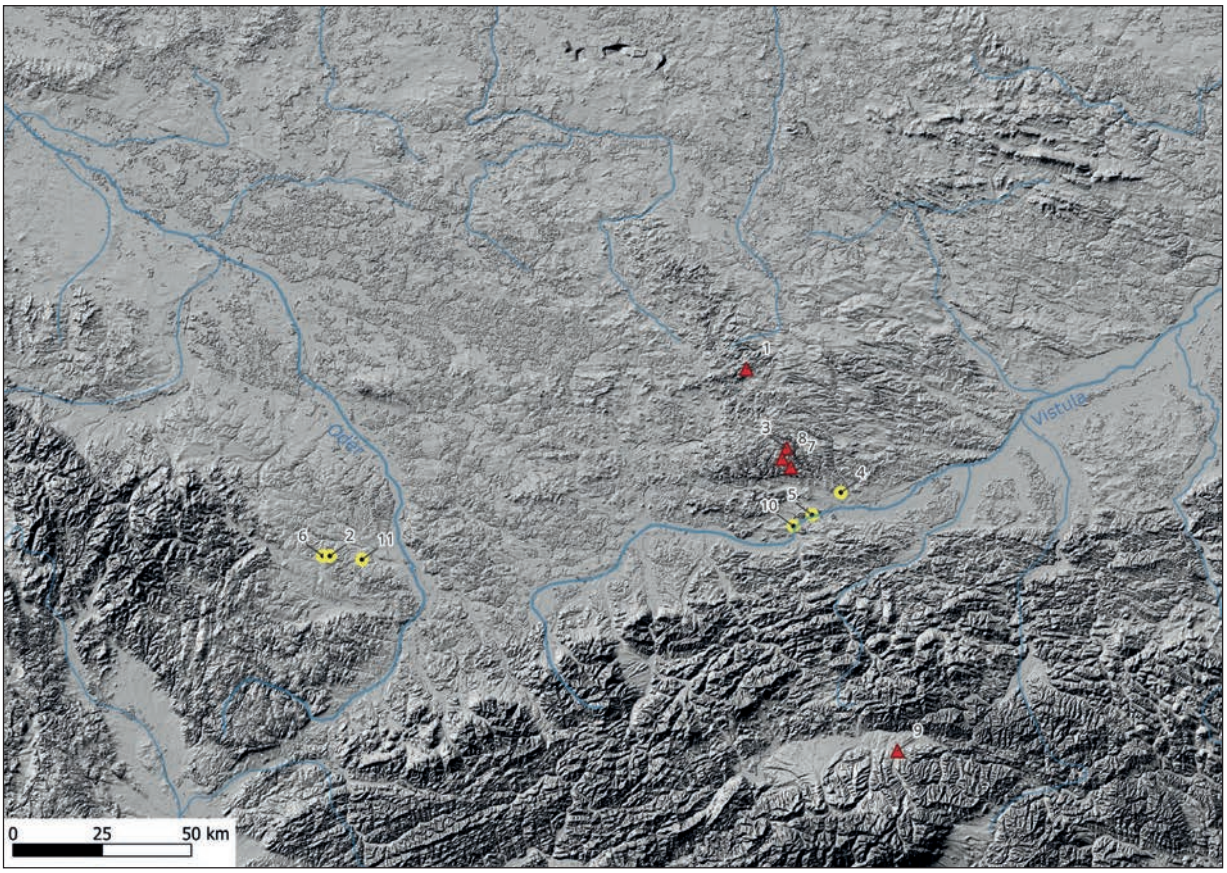



FIGURE 8. Distribution of the Early Upper Palaeolithic sites in Poland
Triangles – cave sites, circles – open-air sites. 1 – Biśnik cave, 2 – Dzierżysław, Sites 1, 4, 8 and 3 – Koziarnia, 4 – Kraków Prądnik Czerwony, 5 – Kraków, Księcia Józefa street, 6 – Lubotyń, 7 – Mamutowa Cave, 8 – Nietoperzowa Cave, 9 – Obłazowa Cave, 10 – Piekary II, IIa, 11 – Pietraszyn (drawn by W. Szambelan, after Wiśniewski and Wilczyński 2016)

phalanges, the oldest known remains of modern humans in Poland (Valde-Nowak et al. 2003). The newest Bayesian modelling of radiocarbon determination from Layer VIII confirms the early age of it, ranging from 42.3 to 38.5 ka (Talamo et al. 2025).

The decorated hematite object from Piekary IIa, incised with transverse lines, is regarded as one of the oldest examples of portable art discovered in Polish territory. Similarly, ornaments made from marine shells and animal teeth indicate the development of symbolic communication and long-distance exchange networks.

The extensive use of imported raw materials highlights the broad mobility and interaction of Upper Palaeolithic populations. Although local Jurassic flint dominated many Polish assemblages, archaeologists have identified radiolarite, obsidian, limnoquartzite, and chocolate flint imported from distant regions (Werra, in this volume). Marine shell ornaments discovered at Obłazowa Cave and Jaksice II demonstrate either direct migration or participation in extensive exchange networks connecting Central Europe with the Black Sea and Mediterranean regions. Such evidence suggests that Upper Palaeolithic societies operated within broad systems of social and economic interaction unprecedented in earlier periods.

Palaeolithic occupation in Polish territories was geographically focused in the upland and karstic environments. Important cave sites included Koziarnia Cave, Tunel Wielki Cave, Deszczowa Cave, Puchacza Skała Shelter, and



FIGURE 9. Obłazowa Cave. Boomerang made of mamooth ivory
Boomerang from the Obłazowa Cave, Wikimedia Commons, 0 (CC BY 3.0)[4]

Obłazowa Cave, while major open-air occupations included Kraków-Zwierzyniec and Piekary II (Fig. 10). However, determining the chronology of Aurignacian assemblages in Poland remains difficult because many sites were disturbed by periglacial processes during the Last Glacial Maximum (LGM). Solifluction frequently mixed Aurignacian material with earlier Szeletian and Zwierzyniecian artefacts, complicating stratigraphic interpretation (Chmielewski et al. 1977). Radiocarbon dating indicates that the Aurignacian settlement in southern Poland occurred mainly during approximately 40–34 ka and 37–33 ka. Charcoal remains from Aurignacian sites further suggest the presence of sparse woodland vegetation near settlements, indicating comparatively favourable climatic conditions during this phase of occupation.

## Gravettian culture

The subsequent Gravettian period introduced new transformations in settlement, hunting, and social structures. Debates over the origins of the Gravettian deepen our understanding of cultural development in Europe. Some scholars argue that the Gravettian developed in southern Moravia and Lower Austria around 34–32 ka while others suggest origins in the Swabian Jura or propose a multicentric model involving several independent European centres (Conard and Moreau 2004; Svoboda 2007; J. K. Kozłowski 2013, 12).

Gravettian occupations emerged in Central Europe around 34 ka and are frequently associated with specialized mammoth-hunting communities. Characteristic Gravettian assemblages include double-platform blade cores, backed bladelets, shouldered points, and Kostienki knives. Large open-air settlements such as Pavlov, Dolní Věstonice, and Předmostí in Moravia (Czech Republic) demonstrate a remarkable degree of social organization, including permanent or semi-permanent habitation structures, human burials, clay figurines, and massive accumulations of mammoth bones (Svoboda 2007).

[4] https://commons.wikimedia.org/wiki/File:01985_Boomerang_from_the_Ob%C5%82azowa_Cave,_ca_30_000_BC,_Ob%C5%82azowa_Cave,_Poland.jpg [17.06.2026]

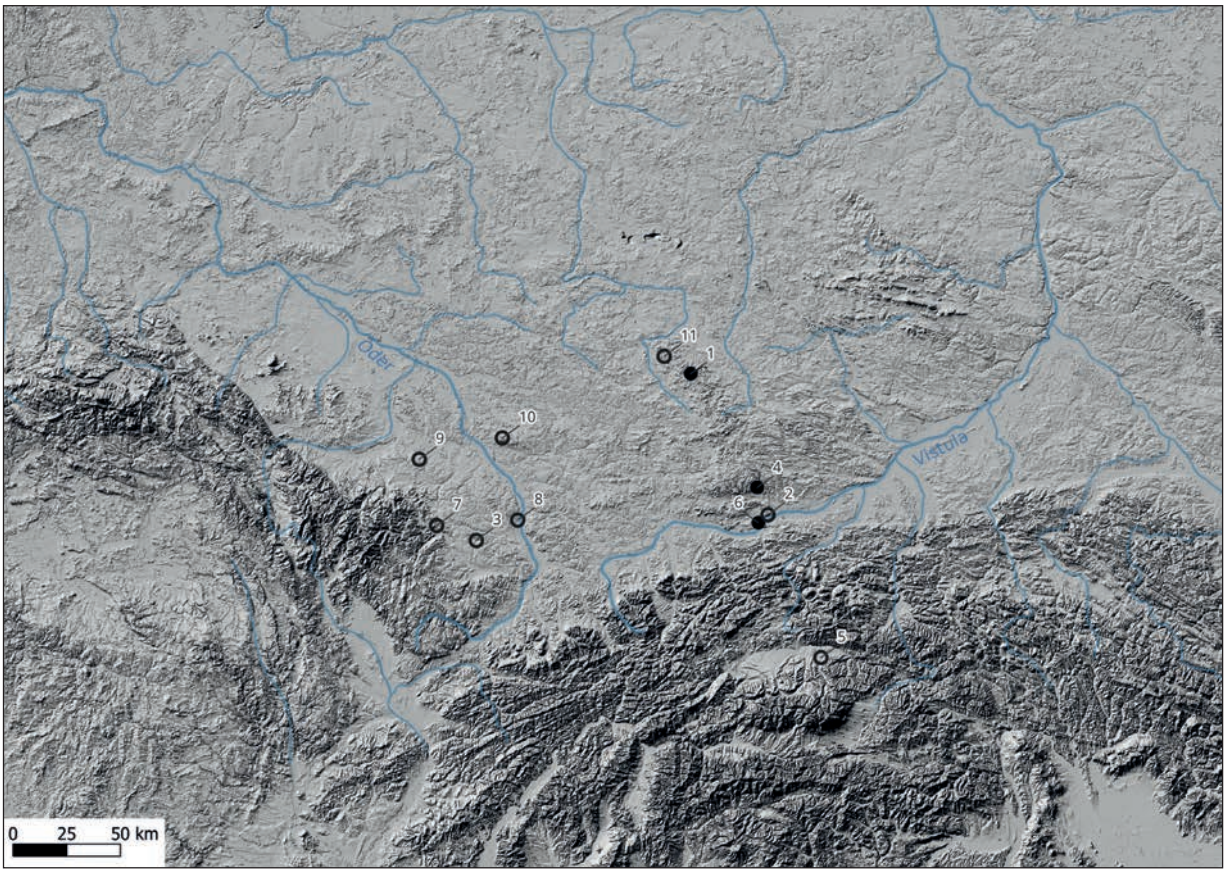



FIGURE 10. Aurigniacan sites in Poland

Black filled circles – dated sites; empty circles – undated sites. 1 – Deszczowa Cave, 2 – Kraków-Zwierzyniec, Kraków, Spadzista str., Kraków Sowiniec, Kraków Wawel, 3 – Lubotyń, 4 – Mamutowa Cave, Borsuka Cave, Koziarnia Cave, Tunel Wielki Cave, Puchacza Skała Shelter – 5 – Obłazowa Cave, 6 – Piekary II, Piekary IIa, layer 6, 7 – Pietrowice Wielkie, 8 – Racibórz Miedonia; Racibórz Studzienna, 9 – Śmicz, 10 – Wysoka, 11 – Zamkowa Góra Cave (drawn by W. Szambelan, after Wilczyński 2016)

Gravettian assemblages differ substantially from Aurignacian inventories, particularly in the absence of characteristic Aurignacian tool forms. Nevertheless, some Gravettian collections contain bifacial leaf points reminiscent of earlier transitional industries, suggesting possible continuity or interaction between cultural traditions. Early Gravettian (or Pavlovian) presence in present-day Poland is reflected in the limited number of archaeological sites. Henryków 15 in Upper Silesia is currently the only site confidently attributed to the Pavlovian tradition, with radiocarbon dates ranging from 36 to 32 ka (Płonka and Wiśniewski 2004). A more ambiguous but highly important assemblage comes from Borsuka Cave that may signal early burial practices in modern Polish territory (Fig. 11). Although radiocarbon dating places the assemblage in the Late Aurignacian/Pavlovian, specific stylistic features of the ornaments suggest links to Aurignacian traditions. Kraków Spadzista (Wilczyński, in this volume) serves as the prime example of a Late Gravettian settlement and mammoth exploitation site in southern Poland. Excavations at this locality uncovered extensive accumulations of mammoth remains associated with large lithic assemblages, ornaments, and bone tools. Initially interpreted as mammoth-bone dwellings, subsequent taphonomic studies demonstrated that the bone concentrations more probably represent kill and butchering areas (Kozłowski and Kubiak 1972;

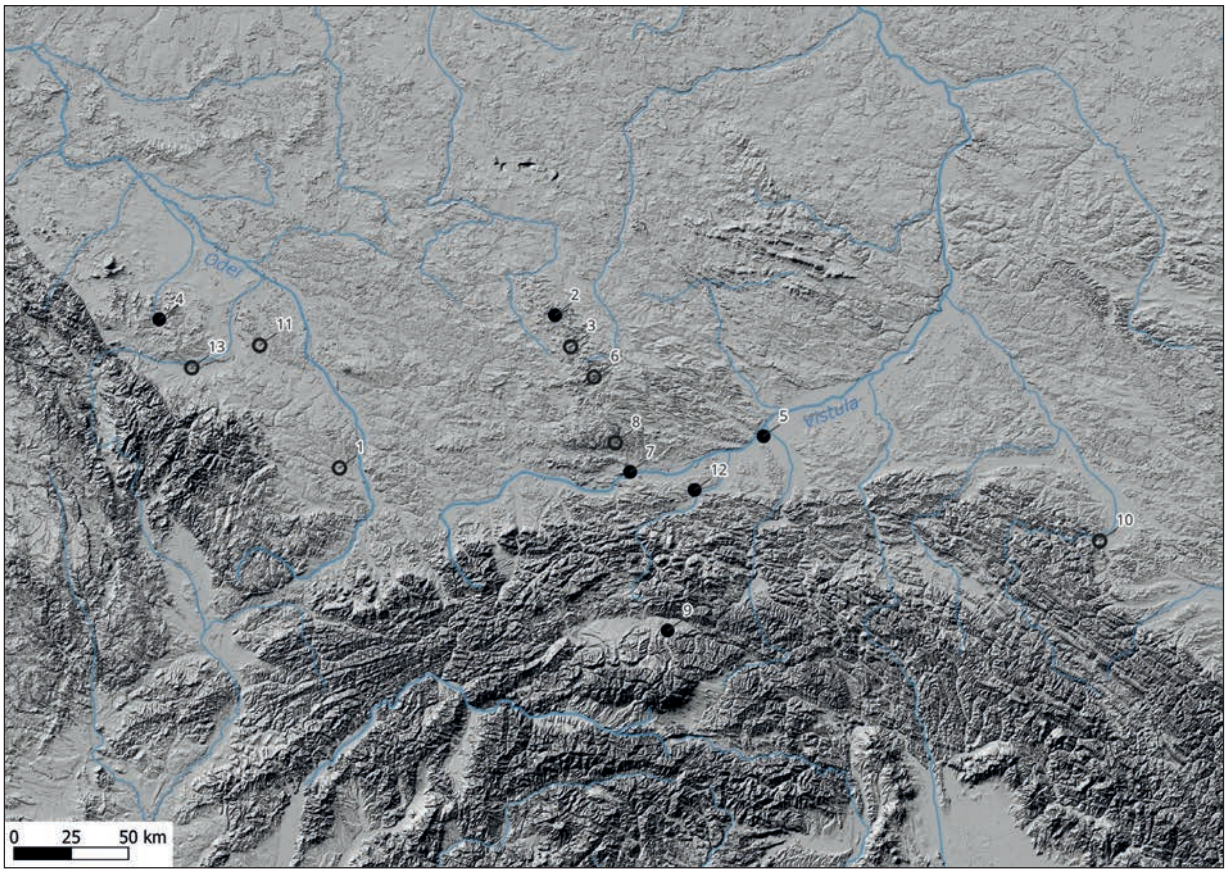



FIGURE 11. Gravetian and Epigravettian sites in Poland
1 – Cyprzanów, 2 – Deszczowa Cave, 3 – Dziadowa Skała Cave, 4 – Henryków, 5 – Jaksice, 6 – Jasna Cave, 7 – Kraków Spadzista Str. layer 6, 8 – Mamutowa Cave, 9 – Obłazowa Cave, 10 – Przemyśl, 11 – Sowin, 12 – Targowisko, 13 – Wójcice (drawn by W. Szambelan, after Wilczyński 2016)

Wojtal and Sobczyk 2005). The lithic inventory includes shouldered points, backed blades, burins, and Kostienki points manufactured primarily from local Jurassic flint, although imported Carpathian raw materials such as radiolarite and obsidian are also present (Wilczyński 2007). Functional analyses of Gravettian shouldered points and backed implements from sites such as Kraków-Spadzista indicate that many of these artefacts were used as projectile elements attached to hurled weapons. Detailed analysis of Kraków-Spadzista reveals diverse activity zones and faunal exploitation patterns (Wilczyński et al. 2012). Use-wear analyses further demonstrated that many shouldered points and backed implements had been employed as projectile weapons. The dominance of mammoth and arctic fox in the faunal assemblage, alongside remains of horse, reindeer, wolf, and bear, highlights the resourcefulness and adaptability of Upper Palaeolithic communities, whose technological and social innovations transformed human occupation in the region. The site also yielded numerous radiolarite artefacts and a marine shell pendant probably originating from the Black Sea or Red Sea region (Wilczyński 2016).

## Epigravettian culture

Following the LGM, Epigravettian populations reoccupied southern Poland. Compared with earlier Gravettian occupations, Epigravettian settlement is archaeologically less visible and consists mainly of specialized flint workshops and short-term hunting camps. Important sites include Kraków-Spadzista, Piekary IIa, Targowisko 10 (Wieliczka district), and Sowin 7 (Nysa district). Technologically,

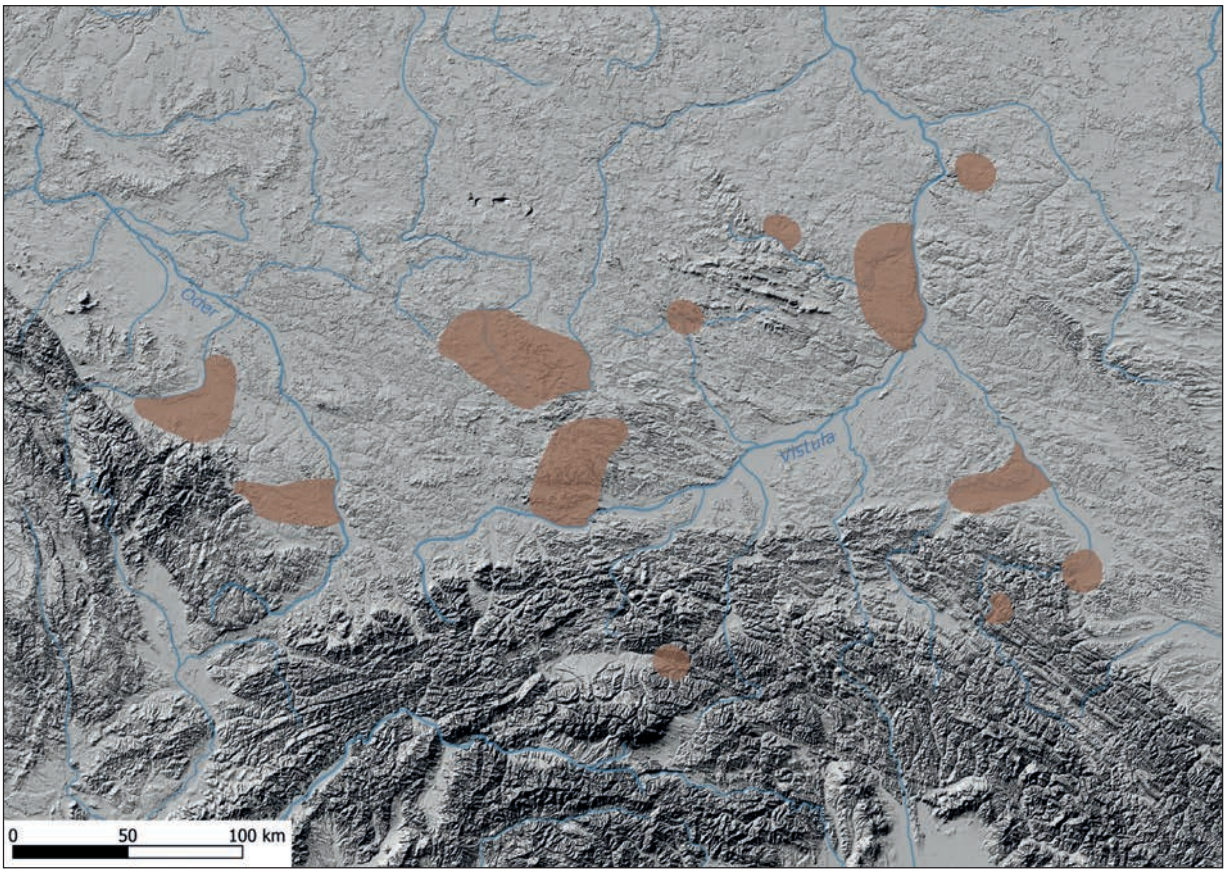



FIGURE 12. The areas occupied by Magdalenian groups in Poland (drawn by W. Szambelan, after Połtowicz-Bobak 2016)

Epigravettian assemblages differ from earlier Gravettian industries through the dominance of massive single-platform blade cores rather than opposed-platform cores.

Radiocarbon dates from Targowisko 10 indicate occupation around 18.0 ka, making it one of the youngest Epigravettian sites in Poland (Wilczyński 2009). Spatial analyses at this site identified separate areas devoted to butchering, flint knapping, and tool repair, demonstrating organized logistical planning even within short-term camps. The assemblage also produced the largest collection of obsidian artefacts known from Palaeolithic Poland, indicating continued long-distance interaction with regions south of the Carpathians.

Faunal assemblages from Epigravettian sites reveal important changes in subsistence practices. Mammoth remains became increasingly rare, while reindeer and horses gained greater economic importance. This shift may reflect climatic changes leading to the decline of mammoth populations in southern Poland and the growing importance of smaller herd animals in Upper Palaeolithic subsistence systems.

Ultimately, the Epigravettian settlement in Polish territories was replaced by the Magdalenian tradition, which arrived from western Europe around 18.5–18.0 ka (see below). This process marked the final stage of Upper Palaeolithic cultural transformation in the region.

## Settlement patterns

One of the most significant consequences of the arrival of modern humans was the expansion and intensification of settlement systems. Upper Palaeolithic sites in Polish territories are considerably more numerous than Middle Palaeolithic occupations and often contain tens of thousands of lithic artefacts. Open-air camps became especially common in the loess uplands and karstic landscapes of southern Poland, particularly around Kraków.

## Magdalenian culture

The Last Glacial Maximum (LGM) was a major climate event that significantly reshaped where people lived in Europe (Milecka, in this volume). Large parts of central, northern, and northwestern Europe became too harsh for people to live in, causing groups to move and form new cultures. In this period, people with Gravettian traditions survived in eastern and southern safe areas and slowly developed into the Epigravettian culture. At the same time, southwestern Europe, especially the Iberian Peninsula and southern France, developed the Solutrean and Badegoulian traditions before the rise of the Magdalenian. Unlike earlier groups, the Magdalenian spread widely after the LGM, reaching as far east as present-day Poland (Połtowicz-Bobak 2013). This created a clear cultural divide between Magdalenian and Epigravettian Europe.

Poland held a peripheral yet significant position at the northeastern frontier of the Magdalenian world. Research into this cultural complex began in the 19th century with excavations at Maszycka Cave. Since then, the field has expanded considerably. These sites cluster mainly in southern upland regions, such as Silesia (Dzierżysław – Połtowicz-Bobak and Ginter, in this volume), the Kraków-Częstochowa Upland, the Sandomierz Upland, and southeastern Poland (Wierzawice – Połtowicz-Bobak and Bobak, in this volume). Settlement patterns show a preference for gently undulating terrain at elevations of 200–500 m above sea level (Fig. 12). There is a notable absence of occupation beyond the upland–lowland boundary. This boundary appears to have served as a natural limit to expansion (Połtowicz-Bobak 2016).

Dates for Magdalenian sites in Poland mostly depend on radiocarbon dating, with additional support from layer and artefact analysis. The earliest confirmed site is Maszycka Cave (about 18.5–18.0 ka showing an unusually early visit by Middle Magdalenian groups (see below in burial rites part) using the *navette* style. The main period of settlement lasted from about 17 ka to 14 ka years ago and included both cold and warmer times. This ongoing occupation shows that people were highly adaptable, rather than only moving in because of the better climate (Połtowicz-Bobak 2016).

It is hard to fully understand what people ate, because animal bones are not well preserved. Available evidence indicates that horses and reindeer were important food sources, as in other Magdalenian groups. Signs from some sites suggest people stayed in autumn and winter (for example, Wilczyce and Maszycka Cave) and in summer to autumn (Klementowice-Kolonia), indicating they moved flexibly depending on available resources (Schild et al. 2014).

Most of the artefacts are stone tools, showing both how people used them and what materials were nearby. Local flint – especially Jurassic, chocolate, and Świeciechów flint – was used mostly, with only a few items coming from farther away. The presence of rare stones such as radiolarite and Volhynian flint indicates that the groups had long-distance contacts across Central Europe and possibly links to the Epigravettian people. Typical Magdalenian tool types, such as burins, endscrapers, perforators, and backed bladelets, are common, though local variations occur due to different uses and customs: Dzierżysław (Połtowicz-Bobak and Ginter, in this volume), Wrocław-Żernik and Wierzawice (Połtowicz-Bobak and Bobak, in this volume).

Several distinct assemblage types can be identified in Poland, including those with geometric microliths (e.g., Dzierżysław), Lacan-type burins associated with the Nebra group (e.g., Ćmielów-Mały Gawroniec, Klementowice-Kolonia, Kleszczowa, Krucza Skała Rockshelter, Perspektywiczna Cave), and assemblages with arched-backed pieces potentially linked to late or Epi-Magdalenian phases. Compared with Central and Western European Magdalenian traditions, Polish assemblages show similarities in toolkits but differ in regional variability. These differences indicate adaptations to local conditions, yet Polish assemblages maintain clear cultural affiliations, especially with Central European groups, and to a lesser extent, with Western Europe (Cyrek et al. 2000; Cyrek et al. 2022; Ginter et al. 2002; Połtowicz -Bobak 2013; Sudoł-Procyk 2020). Bone and antler tools are rare but important finds. The Maszycka Cave group stands out for its decorated antler and bone tools, such as navettes, sagaies, and a *bâton percé*, similar to French Middle Magdalenian artefacts. Other places, like Wilczyce, have smaller but varied bone tools such as needles, points, and awls. These finds reveal both ongoing technological developments and local adaptations in Magdalenian culture (S. K. Kozłowski et al. 1995).

## Settlement patterns

Settlement organization in Poland diverges from classical Western European models, which are

characterized by dense clusters focused on large base camps. In contrast, Polish sites are widely dispersed and predominantly consist of small, short-term hunting camps. Only a few of the sites in Poland can be categorized as large, multi-activity bases (e.g., Wilczyce in Sandomierz district, Dzierżysław in Głubczyce district. Ćmielów – Mały Gawroniec in Ostrowiec Świętokrzyski district, Klementowice-Kolonia in Puławy district). Unlike Western Europe, Poland presents a marked scarcity of clear microregional settlement systems and satellite-site hierarchies, highlighting its peripheral status as an exploitation zone, probably seasonally occupied by highly mobile groups (Połtowicz-Bobak 2016).

## Late Palaeolithic

The transition from the Late Pleniglacial (Greenland Stadial GS-2) to the earliest phase of the Late Glacial interstadial (Greenland Interstadial GI-1e, c. 12.75 ka) marked a fundamental reorganisation of environmental and ecological systems across the Northern European Plain. First, this period saw a rapid increase in temperature of approximately 10°C. As a result, vegetation expanded into previously periglacially sterile landscapes north of the Central European uplands. Subsequently, the development of tundra and early shrub communities created conditions conducive to the re-establishment of large ungulate populations – particularly reindeer (*Rangifer tarandus*) and wild horse (*Equus* sp.). This ecological transformation, in turn, facilitated renewed human penetration into the formerly glaciated lowlands (Latałowa 2004; de Klerk et al. 2008; Milecka, in this volume).

## Hamburgian culture

The Hamburgian groups presence in the Polish Plain is archaeologically attested from approximately 15 ka. Key sites include Olbrachcice (Wschowa district), Siedlnica (Wschowa district), Krągola 25 (Konin district), Myszęcin 19 (Świebodzin district), and Mirkowice 33 (Wągrowiec district) (Burdukiewicz 1987; Kabaciński et al. 1999; Kabaciński and Sobkowiak-Tabaka 2012). These sites demonstrate systematic penetration of both old and young moraine landscapes (Fig. 12 and Fig. 1 in the Text Box Mirkowice). As a result, Hamburgian groups were not restricted to marginal ecological zones; instead, they actively exploited a wide range of newly deglaciated environments. Lithic assemblages are characterised by blade-based reduction systems employing soft-hammer percussion. These systems produced shouldered points, Zinken-type perforators, and backed tools – diagnostic typological markers of the culture (Eriksen 1999; Sobkowiak-Tabaka 2011).

The origin of the Hamburgian remains debated. One hypothesis links its emergence to eastward influences from Eastern European Upper Palaeolithic traditions. However, a more widely accepted model situates its development within terminal Magdalenian populations in western Europe (Kobusiewicz 1973; Burdukiewicz 1987; Grimm and Weber 2008). Regardless of its genesis, the archaeological and palaeoenvironmental record demonstrates that Hamburgian groups rapidly colonised the Northern European Plain during the earliest Late Glacial warming. They established a durable, spatially extensive settlement system that extended from the Netherlands and northern Germany to western Poland and possibly beyond.

Two phases of Hamburgian development are generally distinguished: an earlier "classic" phase and a later phase marked by Havelte-type points. While all currently identified Polish assemblages belong to the earlier horizon, this suggests that the Polish Plain represents an early stage of eastward expansion. Although chronological evidence is limited, it supports this interpretation. For instance, radiocarbon dates from Olbrachcice (~14.95 ka) and Mirkowice (~12.3 ka) broadly correspond to the GI-1e interstadial. Caution is warranted, however, since large standard deviations affect interpretation (Lanting and van der Plicht 1996; Grimm and Weber 2008).

The subsistence economy of Hamburgian groups in Poland appears highly flexible and regionally variable. Sites such as Meiendorf, Stellmoor, and Poggenwish in northern Germany and Denmark demonstrate a strong focus on reindeer hunting. In contrast, Polish assemblages, particularly Mirkowice (Kabaciński, in this volume), indicate a broader exploitation of aquatic and small terrestrial fauna, including fish (pike, perch, Cyprinidae) and lagomorphs (*Lepus* sp.) (Kabaciński and Sobkowiak-Tabaka 2009).

The Polish evidence demonstrates that Hamburgian hunter-gatherers were not marginal or ephemeral occupants of postglacial landscapes. Instead, they were highly adaptable pioneer

populations capable of exploiting rapidly changing environments at the onset of the Late Glacial. Their settlement strategies reflect a complex interaction between climatic amelioration, ecological succession, and technological flexibility. This marks a critical phase in the recolonisation of northern Europe following the LGM.

## Federmesser culture

About 14 ka, a larger cultural shift known as azilinization occurred, best documented in the Paris Basin (Bodu et al. 2006). This involved the simplification of lithic technology and hunting equipment, as evidenced by the widespread use of short endscrapers and backed lithic forms. These traditions are regionally and chronologically diverse, leading to several related technocomplexes such as the Azilian, Arch Backed Piece technocomplex, Federmesser-Gruppen, Tarnowian, Witowian, and others across western, central, and parts of eastern Europe (Bodu and Valentin 1997; Pettitt and White 2012).

The Arch Backed Piece (ABP) technocomplex, known in Polish archaeology, was a widespread Late Glacial cultural phenomenon. About 500 sites are known across the North European Plain, including around 100 in present-day Poland (Burdukiewicz 2011), Fig. 13. These site groups vary regionally and include both blade- and flake-based industries, with short endscrapers, burins, and backed tools. Despite this variability, ABP groups show a pattern of simplified production: frequent use of single- and double-platform cores and hard-hammer percussion results in short, thick flakes and blades (Schild 1984; Libera et al. 2008; Lubrza – Sobkowiak-Tabaka, in this volume).

The origin of ABP-related groups has been widely debated. Some researchers argue for western European origins linked to Federmesser migrations from the Franco-Cantabrian region during post-glacial recolonization of the European Plain (J. K. Kozłowski 2004). Others propose multi-directional influences, including movements from the western German Plain, the Tardigravettian world beyond the Carpathians, and populations from the eastern European Plain (Schild 1975; J. K. Kozłowski and S. K. Kozłowski 1977; Chmielewska 1978). This has led to the interpretation of Federmesser and related ABP groups not as a single coherent cultural entity, but rather as a set of technologically and economically similar, yet potentially heterogeneous populations adapted to comparable environmental conditions.

Within Poland, understanding the ABP is nuanced by identifying several subgroups: Federmesser, Tarnowian, and Witowian. Debate remains about their classification, partly due to inconsistent criteria and the frequency the material comes from stray finds (Schild et al. 2014). Stone tool production involves both blade and flake methods, producing a variety of tools. Kozłowski's system, categorizing long, medium, and short curved-backed pieces, assists in interpreting functional, spatial, and possible chronological differences within these groups (S. K. Kozłowski 1987).

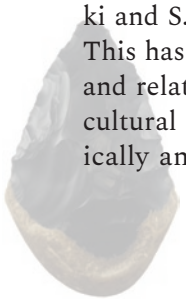
Settlement patterns indicate ecological flexibility, with sites ranging from short-term hunting camps and small family-based occupations (often 5–12 individuals) to larger, more complex base camps such as Witów, Całowanie, and Rydno (Schild et al. 2011; 2014). Larger sites suggest repeated or seasonal use, while smaller ones reflect highly mobile subsistence. The spatial distribution of these sites shows exploitation of diverse environments, indicating adaptability during the Allerød interstadial.

Subsistence strategies were primarily based on hunting large and medium-sized ungulates, including red deer, roe deer, horse, and elk, supplemented by smaller game and aquatic resources, as evidenced by data from both Polish and western European sites. Fish also constituted an important dietary component in many regions (Sobkowiak-Tabaka and Diachenko 2022).

Material culture suggests extensive raw material procurement networks, including the use of local Cretaceous flint, Jurassic and chocolate flint, obsidian from the Carpathian region, and hematite from mining areas such as Rydno (Schild et al. 2011; Werra, in this volume).

Chronologically, ABP occupations in Poland are mainly associated with the Allerød interstadial (c. 13.9–12.7 ka). Some assemblages extend into the Younger Dryas. Radiocarbon evidence shows both regional and chronological variability. However, dating precision is often limited by large standard deviations and contextual uncertainties (Schild et al. 2014).

ABP communities in Poland produced relatively limited but notable examples of ornamentation. These include amber objects (Nowa Wieś – Burdukiewicz, in this volume), engraved bone artefacts,



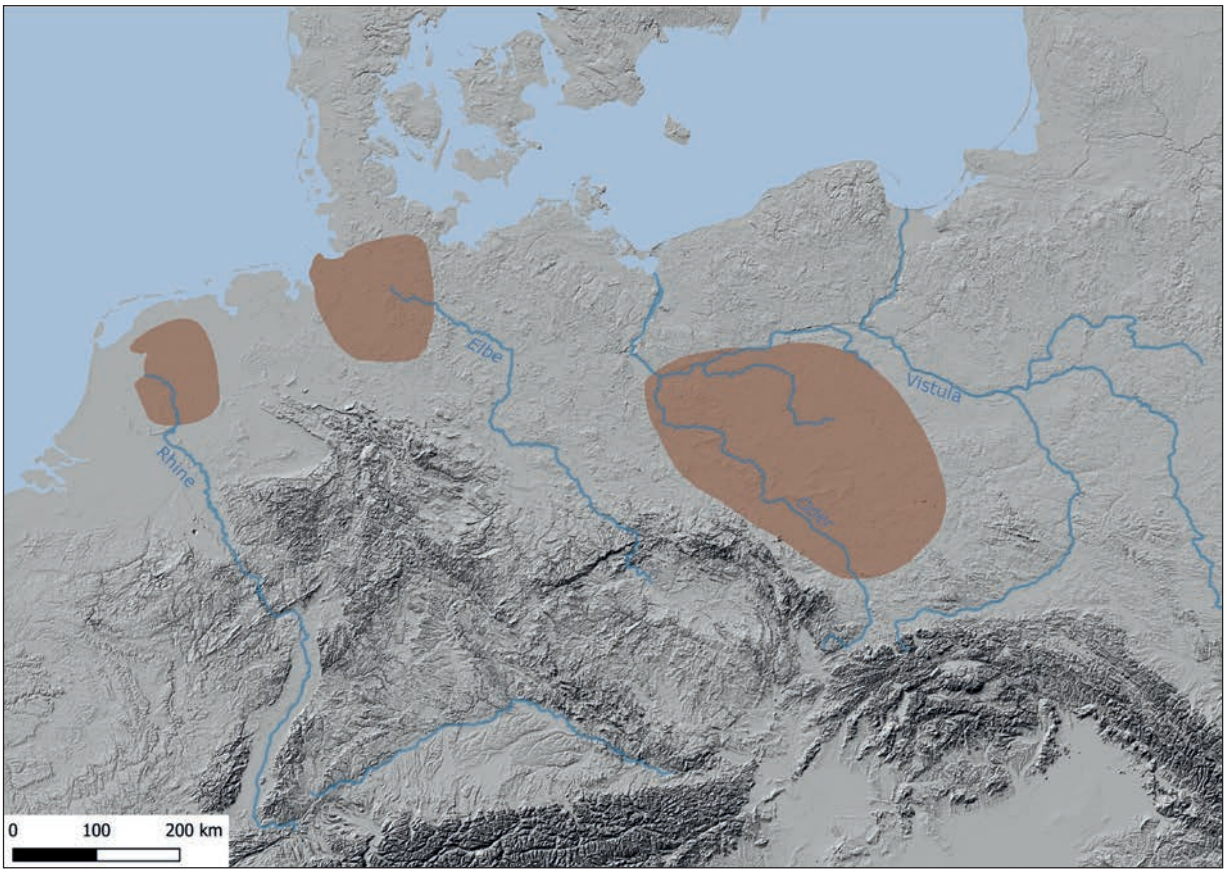



FIGURE 13. The area occupied by Hamburgian groups in Poland (drawn by W. Szambelan, after Kabaciński 2016)

and decorated antler items. Such finds indicate symbolic behaviour. However, they remain rare compared to the number of finds of lithic assemblages (Burdukiewicz 2007; Płonka et al. 2011).

In summary, the ABP technocomplex shows that Late Glacial cultures in Europe are best seen as a mosaic of related groups, not a single culture. These groups adapted to changing climate, varied environments, and new ways of moving, using resources, and interacting (J. K. Kozłowski 2004; Schild et al. 2011; Sobkowiak-Tabaka 2017).

## Bromme

The latter part of the Late Glacial (second half of the 12th millennium BCE) in the is linked to the spread of lithic industries with tanged projectile points of the Lyngby type. These assemblages are part of the earliest Tanged Point Technocomplex, which expanded across the northern European lowlands. This expansion originated in the British Isles and North Sea region, extending through Jutland and the Danish archipelagos, reaching as far east as Lithuania (Vilnius group) and Belarus (Valdai Culture) (Schild et al. 1999). Despite decades of research, the cultural and evolutionary origins of these groups, particularly the Bromme culture, are still debated and subject to competing interpretations. A. Fischer (1991) argued that the Bromme culture developed from the Federmesser technocomplex, especially the Wehlen group, based on scraper types and early tanged points. More recently, cultural changes have been explained as caused by environmental phenomena. F. Riede (2008) stated that the eruption of the Laacher See volcano in western Germany caused ecological stress and population changes, which may have led to the emergence of the Bromme stone tool tradition.

Within Poland, the cultural attribution of Bromme-related assemblages remains contentious. The "Nowy Młyn industry", defined by L. Sawicki (1936), includes assemblages with arch-backed

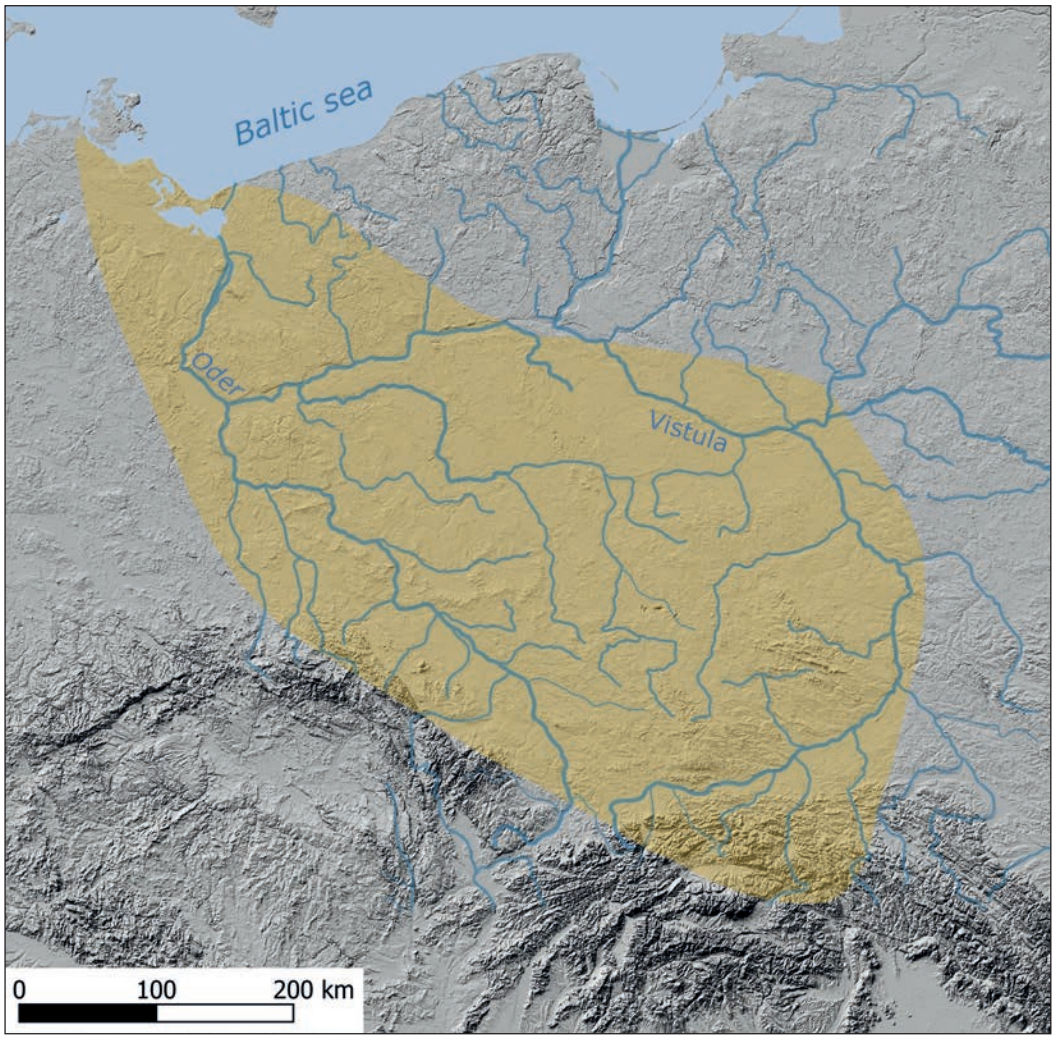



FIGURE 14. The area occupied by APB groups in Poland (drawn by W. Szambelan, after Sobkowiak-Tabaka 2016)

pieces, burins, perforators, and scrapers. J. K. and S. K. Kozłowski (1977) later reassigned these to the Bromme culture. Since the 1970s, the validity of a Bromme presence east of the Vistula River has been questioned. K. Szymczak (1995) proposed making Lyngby-bearing assemblages in northeastern Poland and Lithuania a distinct Perstuń culture. M. Kobusiewicz (1999) initially supported a separate Lyngby taxon, but later rejected its cultural autonomy, influenced by B. Ginter (1966).

Technologically, Bromme assemblages in Poland are characterised by a simplified lithic production system compared to both earlier Magdalenian and Hamburgian and later Swiderian industries. Core reduction strategies predominantly involve single-platform, subconical cores, which were exploited using hard-hammer percussion, producing large blades and flakes (Sulgostowska 1989). The tool spectrum is notably restricted, typically comprising endscrapers, burins, and tanged Lyngby points, with occasional arched backed pieces in specific regional variants such as the Tolk group (J. K. Kozłowski and S. K. Kozłowski 1975).

The Całowanie (Otwock district) site is a key example, preserving a complete sequence of Bromme lithic production, including cores, blanks, and finished tools. Radiocarbon and palynological data assign the occupation to the later Allerød, a possible phase of climatic deterioration (Schild et al. 1999; Schild et al. 2014). The Rydno site complex also shows cultural ties to the Bromme-Segebro tradition of southern Scandinavia, suggesting seasonal

movement or resource-driven expeditions, especially for hematite procurement (Schild 1975; Schild et al. 2011).

Other site clusters in northern Poland (e.g., Bierzwnik, Chłopowo, Jaglisko in Choszczno district and Gościm in Strzelce-Drezdenko district) Fig. 14, have been linked to the Tolk variant of the Bromme culture, although their typological integrity is debated due to taphonomic degradation (Bagniewski 1998). In response to such debates, broader models now emphasize the fluidity of cultural boundaries in the Late Glacial period. From this perspective, Bromme is seen as a possible regional expression of broader Federmesser-derived populations rather than a clearly defined cultural entity (Fischer 1991).

The Bromme phenomenon in Central and Northern Europe shows a complex mix of technological simplification, ecological adaptation, and population mobility during rapid climatic change. Rather than being one unified culture, it may be a mosaic of regional responses within the Tanged Point Technocomplex, shaped by both environmental pressures and long-distance interaction networks.

## Świderian culture

Between roughly 12.8 and 11.4 ka hunter-gatherer communities occupied a large area spanning the Central European Plain to northern Scandinavia and the British Isles, and extending to the middle Volga. These groups produced diverse tanged projectile points. Researchers have referred to this phenomenon as the Tanged Point Group (Stielspitzen-Gruppen) (Taute 1968), Pedunculated Point Technocomplex (Schild 1984), Tanged Points Complex, and Tanged Point Technocomplex (Burdukiewicz 2011), Fig. 14. These cultural forms are closely tied to Late Glacial tundra and park-tundra environments of the Younger Dryas and early Preboreal. Regional variants include the Ahrensburgian, Swiderian, and Desnian (Krasnosielian) traditions, found in the Vistula, Pripet, Desna, and upper Dnipro basins.

In Poland, over 1,000 Swiderian sites have been recorded. This points to intensive, widespread use of lowland, upland, and even marginal mountain environments (Burdukiewicz 2011). After tanged points were first found at Leżajsk in 1851, the Świderian technocomplex has been redefined many times. Researchers have linked the origins of the Swiderian culture to several Upper Palaeolithic traditions, including the Szeletian, Gravettian, Solutrean, Magdalenian, and Kostienki–Avdeevo complexes (Sawicki 1936; Krukowski 1939–1948; Chmielewska 1978). However, excavations in Masovia tie Świderian assemblages to Younger Dryas conditions rather than to direct continuity from earlier Arched-Back Point industries. Schild (1975) argued that the Świderian culture emerged when Bromme–Segebro-derived populations adapted to the tundra. He highlighted technological and ecological similarities with the Ahrensburgian. This view led to the theory that both groups formed a techno–socio system suited to Late Glacial open landscapes (Schild 1975, 332; Fischer and Tauber 1986; Kobusiewicz 1999).

Świderian lithic production used standardized blade industries. Cores were opposed, or single-platform, with soft-hammer techniques creating long parallel-edged blades (Sulgostowska 1989). The toolkit included blade endscrapers, various burin types, and tanged points. Leaf-shaped forms and microlithic truncations varied by region. Harpoon heads (such as Havelan types), Lyngby mattocks, and Gumbinen points indicate Swiderian hunters had a functionally diverse toolkit for hunting and processing (J. K. Kozłowski and S. K. Kozłowski 1975).

Recent scholars propose three developmental phases for the Tanged Point Technocomplex in Poland. The first phase, linked to Bromme groups in Allerød forests, featured hard-hammer use and Lyngby-type points (Schild et al. 1999). The second, Świderian sensu stricto, developed in the Younger Dryas tundra. It used more advanced core reduction and opposed-platform systems. The third phase, during the terminal Younger Dryas and the early Preboreal, saw microlithization and the emergence of new hybrid forms. Radiocarbon data indicate these persisted into the earliest Holocene (Schild et al. 1999; Goslar et al. 2006).

Reconstructing the subsistence strategies of Younger Dryas communities in present-day Poland is challenging because faunal evidence is scarce. Most researchers label these groups as reindeer hunters, but direct proof is rare; only a few identified reindeer remains lack a clear archaeological context. Fragmented, often burned animal bones at several sites provide little dietary information, though evidence does show that these communities exploited mammals, birds, and fish. Use-wear

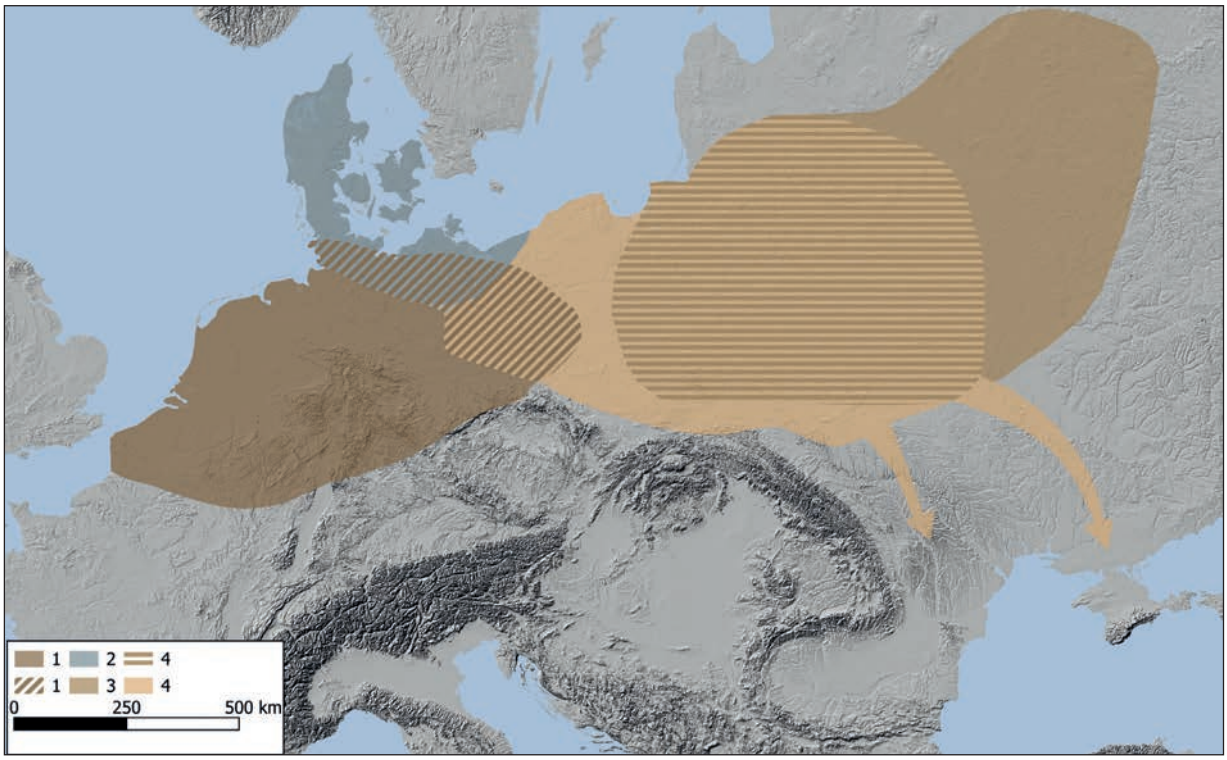



FIGURE 15. The areas occupied by groups of Tanged Point Technocomplex
1 – Ahrensburgian, 2 – Bromme-Lyngby, 3 – Desna, 4 – Świdry
(drawn by W. Szambelan, after J. K. Kozłowski 2004)

analyses of tools indicate that fishing occurred, and antler artefacts suggest the use of reindeer materials. Comparing these findings with better-documented regions, such as the Ahrensburgian sites, indicates that these groups practised diverse seasonal subsistence strategies, including hunting, fishing, and plant gathering. In sum, these communities probably relied on a flexible, broad-spectrum economy rather than just reindeer hunting.

Key settlement sites like Całowanie and Rydno (Skarżysko-Kamienna district) show complex layouts. They include dwelling structures, activity zones, workshops, and processing areas. Evidence points to repeated or seasonal use, often tied to reindeer migration and river crossings (Fiedorczuk 2006). At Rydno, hematite-processing zones point to integrated economies that combined stone tool production, pigment use, and hide processing (Schild 1975; Winiarska-Kabacińska 2014).

The Świderian raw material economy was highly structured. Groups relied on wide-ranging mobility and exchange. They systematically used chocolate flint, Jurassic flint, Świeciechów flint, and radiolarite, transporting them hundreds of kilometres (Sulgostowska 2005; Libera 2002). Sites like Orońsko (Kerneder-Gubała, in this volume) and Gojść show organized mining and large-scale pre-core and blade production, sometimes for export (Budziszewski 2008). Rare obsidian finds in southern Poland hint at long-distance or symbolic exchange networks (Sobkowiak-Tabaka et al. 2015).

Environmental reconstructions indicate that Świderian settlements responded to rapid Late Glacial climate swings. The Younger Dryas brought sharp cooling, changes in vegetation, and increased open land. Warming at the start of the Holocene happened within decades to centuries (Alley et al. 1993; Ralska-Jasiewiczowa et al. 2003). These shifts affected animal populations, especially reindeer, and probably influenced Swiderian seasonal movements. Whether there was cultural continuity or a break between Late Palaeolithic and Mesolithic groups is still debated (see the next chapter: Mesolithic).

The Tanged Point Technocomplex was a flexible system that responded to Late Glacial instability. Instead of separate cultures, Świderian and

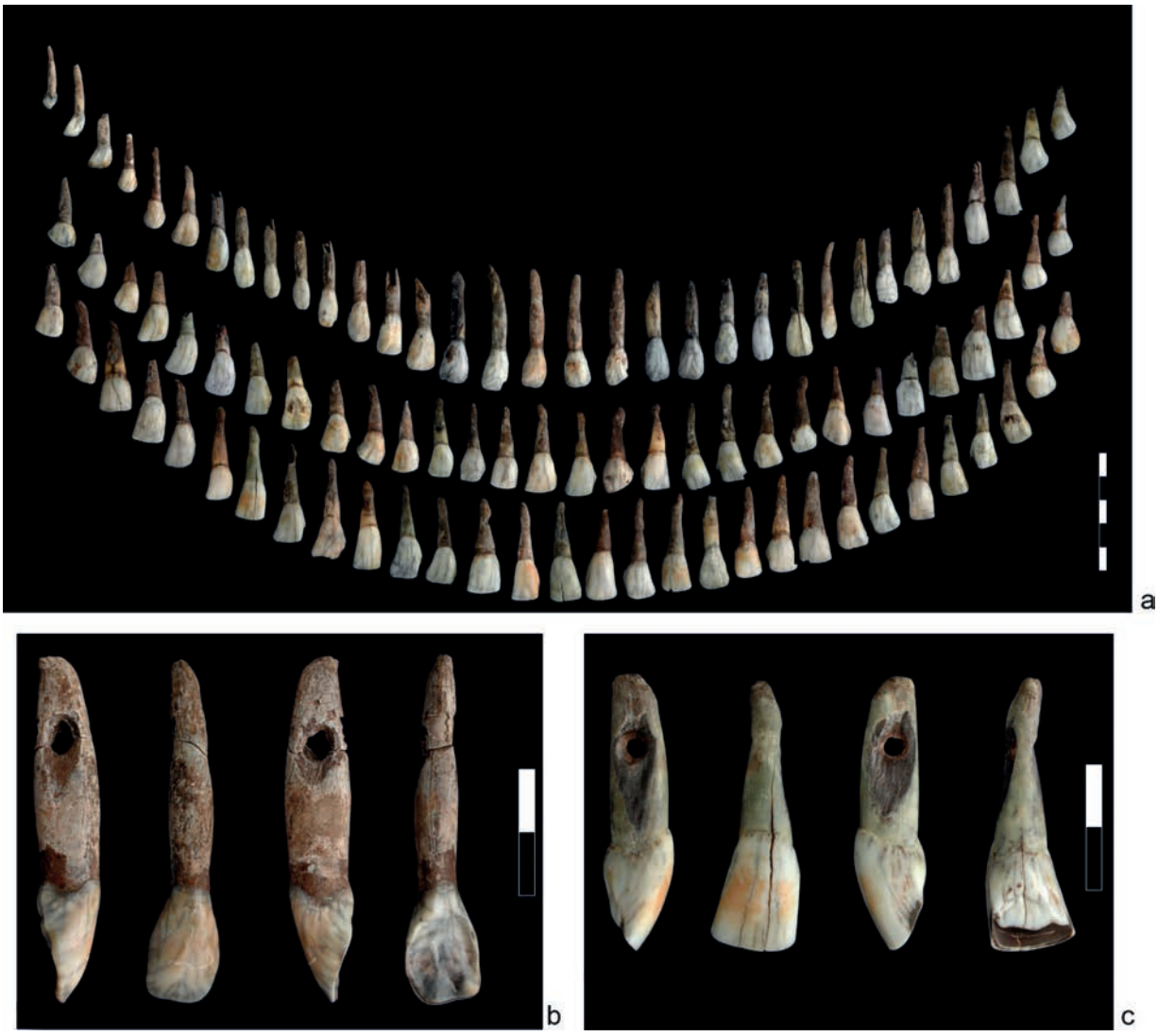



FIGURE 16. Borsuka Cave. a - reconstructions of necklace made of European moose and aurochs/bison teeth found in the child burial, b - pendant made form Eurasian moose incisor, c - pendant made form aurochs/bison incisor (photo by J. Wilczyński)

Ahrensburgian groups are better seen as local versions of a broader adaptive network. This network featured high mobility, standardized tools, and varied subsistence strategies to match rapidly changing landscapes at the end of the Pleistocene.

## Burial rites

Palaeolithic burials in present-day Poland are known from only five sites in the southern part of the country. Four of these are located in caves: Stajnia, Obłazoiwa, Borsuka i Maszycka. These burials are typically partial. They consist of limited skeletal elements, such as teeth, phalanges, and cranial fragments. An exception is the burial of a young girl from the open-air site at Wilczyce, which is more complete. The absence of burials in the Polish Lowlands may be explained by the prevalence of sandy substrates formed by the advance of the Baltic ice sheet. These conditions are unfavourable to the preservation of organic remains.

Turning to the oldest finds, which are over 100,000 years old, eleven teeth from Stajnia Cave belonged to at least seven (maybe eight) Neanderthals. Estimates place all samples in Marine Isotope Stage (MIS) 5, with ages from about 119,7 to 92,5ka. This is the oldest group of Neanderthal

genetic remains found in Central Europe (Picin et al. 2026). So far, these are the only known Neanderthal remains from present-day Poland.

Two phalanges recovered from Obłazowa Cave are attributed to a single individual, identified as female, from Layer VIII, dated between c. 42.8–38.5 ka (Valde-Nowak et al. 2003; Talamo et al. 2025). At Borsuka Cave, six isolated deciduous human teeth were discovered, belonging to a child aged approximately 12–18 months and dated to c. 31–29 ka (Fewlass et al. 2023).

One of the most enigmatic burial contexts is represented by the remains of multiple individuals from Maszycka Cave, dated to around 18 ka. This assemblage comprises of at least 10 individuals, including six adults and four children. Detailed analysis of bone surfaces – encompassing skulls, mandibles, and long bones – has identified 36 specimens bearing clear anthropogenic modifications. Cranial and mandibular fragments exhibit evidence of scalping, defleshing, and disarticulation, while cut marks and percussion traces indicate deliberate actions associated with brain extraction. Although the placement of some cut marks resembles patterns observed in skulls prepared for the production of so-called skull cups, their overall distribution is irregular and less intensive than at other sites. This suggests that the primary objective was access to the brain rather than the preparation of cranial vessels. Furthermore, the systematic breakage of long bones indicates marrow extraction, a nutrient-rich, high-calorie food resource.

The data from Maszycka Cave suggest a short-term occupation, while the age profile may indicate the presence of a small family group that was attacked, defeated, and subsequently consumed. Simultaneously, the dispersal and evidence of modification of human remains may alternatively be interpreted as the result of symbolic practices or as the collection of war trophies, embedded within a broader context of intergroup competition.

More broadly, cannibalism during the Magdalenian period was neither a regular nor a culturally homogeneous phenomenon. Its occurrence was episodic and closely dependent on local environmental conditions, demographic pressures, and the dynamics of intergroup relations (Marginedas et al. 2025)

At the Magdalenian hunting camp at Wilczyce, the remains of an infant, dated to approximately 13,000 years ago, have been identified. About 60% of the skeleton was preserved, having been deposited within an ice wedge.

The most common elements accompanying Palaeolithic burials – indicating symbolic or ritual practices – are pendants made from animal teeth and shells. At Borsuka Cave, the assemblage yielded 112 animal-tooth pendants: 78 made from steppe wisent or aurochs' incisors and canines, and 34 from European elk (Wilczyński et al. 2014), Fig. 16. In contrast, at Obłazowa Cave, pendants made from shells (*Conus* sp.) and arctic fox teeth were recovered. At Maszycka Cave, the grave goods included lithic artefacts, bone and antler objects, as well as pendants fashioned from animal teeth and *Dentalium* shells. At the Magdalenian site of Wilczyce, pendants crafted from arctic fox teeth were also found; at least 33 animals provided about 100 pendants (Schild et al. 2014). Notably, red pigment was recorded at three sites: Obłazowa, Borsuka, and Maszycka caves (Sulgostowska 2019).

## Summary

The Lower and Middle Palaeolithic record in present-day Poland reflects a peripheral yet repeatedly settled area, influenced by climate change and proximity to Scandinavian glaciers. Early human settlement was uneven, with groups moving north during warmer periods (interglacials) and leaving as the climate cooled. Archaeological evidence mainly shows temporary, highly mobile settlements focused on river valleys, with people mostly using locally available stone and developing more advanced stone tool techniques. These include Acheulian bifaces and Levallois prepared-core methods. Although the record is fragmentary and dating is uncertain, Middle Palaeolithic finds point to more frequent settlement and better adaptation to harsh conditions.

The peak of Middle Palaeolithic settlement density in areas now part of Poland occurred during MIS 3, a relatively warmer phase that lasted from about 57 to 29 ka. Compared to earlier times, the number of sites and the number of artefacts found increase significantly, particularly in open, cold environments such as tundra–steppe (grassland with few trees). This pattern shows both population growth and better ways of living in challenging surroundings.

In summary, the Early Upper Palaeolithic in Poland was a dynamic period marked by technological

change, adaptation to diverse environments, and possible contact among diverse groups. The archaeological evidence shows multiple cultural traditions existing at the same time.

The Polish Upper Palaeolithic shows a series of cultural and environmental changes as modern humans spread across Europe. Aurignacian populations introduced blade technology, advanced throwing weapons, symbolic behaviours such as art and ornamentation, and extensive movement networks. Gravettian societies became more specialized in hunting, especially mammoths, and developed more complex living arrangements. During the Last Glacial Maximum (LGM, the coldest part of the last Ice Age), Epigravettian groups adapted by becoming more mobile, flexible in organizing their activities, and changing their food sources. These changes show how Upper Palaeolithic groups could adjust and innovate as their world changed quickly.

In the Late Upper Palaeolithic and Late Palaeolithic, settlement systems in present-day Poland became more widespread and varied, with high mobility and adaptation to changing conditions after the Last Glacial Maximum. Magdalenian groups mostly lived in southern hilly regions, setting up widely distributed hunting camps with strong ties to Central Europe. Later, the Hamburgian, Federmesser, Bromme, and Świderian technocomplexes spread across the Northern European Plain. These communities responded flexibly to climate change by using mobile hunting, exchanging stone materials over wide areas, and employing a variety of stone tool technologies, demonstrating how people recolonized northern Europe at the end of the Ice Age.

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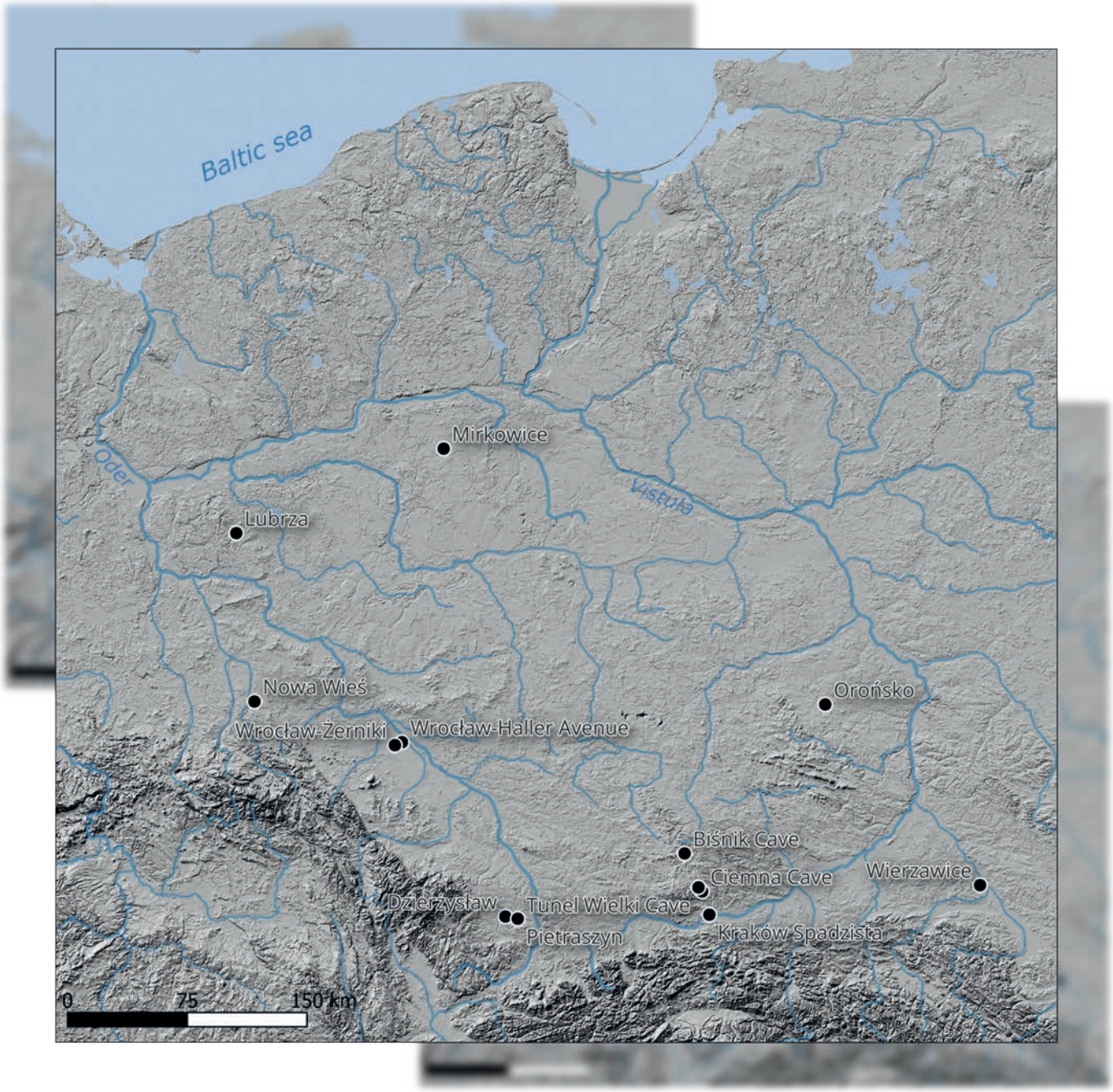
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# LOCATION OF THE SELECTED PALAEOLITHIC SITES DESCRIBED IN THE FOLLOWING PAGES



# TUNEL WIELKI CAVE

Małgorzata Kot

The Tunel Wielki Cave is located in the southern part of the Kraków-Częstochowa Upland, a limestone plateau in southern Poland renowned for its karst landscape. The area is one of Poland's most significant regions for speleological studies, with caves ranging from small crevices to extensive underground systems. These caves often hold important paleontological and archaeological findings, providing insights into prehistoric human activity and the region's geological history.

The Tunel Wielki Cave is situated on the eastern slope of the Koziarnia Gorge in the Sąspów Valley, within the picturesque Ojców National Park. It is one of the highest-located caves in the valley (440 m a.s.l.) and lies in the topmost part of the well-exposed Sadlane rocks, some 25–30 m above the bottom of the Koziarnia Gorge.

The cave has a tunnel-like structure in the form of a nearly straight course some 23 metres long connecting two entrances. It widens in two places to form two chambers connected by a narrow, 8 m-long corridor. The north chamber is wide with a large cave mouth (6×1.5 m), while the south one is elongated (10×4–5 m), with a higher ceiling and a small opening (1×2 m) additionally sheltered by boulders. The cave is dry and draughty, with relatively even surfaces. The north cave mouth is preceded by a large, flat terrace located approximately 50 m above the bottom of the valley, whereas the south entrance overlooks a steep slope leading down to the bottom of the gorge. Currently, the north chamber is more illuminated and easier to access. A very different stratigraphy characterises both chambers and has been used separately in the past.

## History of research

Tunel Wielki Cave has been excavated three times so far. The very first trenches were opened in 1967–1968 by Waldemar Chmielewski, within the framework of an archaeological project concentrated on prehistoric settlement in the whole Sąspów Valley (Chmielewski 1988). At the time, four trenches were opened in both cave chambers (Fig. 1), two adjacent ones at the entrance of the northern chamber and the other two in the southern chamber. Interestingly, Chmielewski's fieldwork revealed the absolutely different stratigraphy in both cave chambers. The north chamber excavations brought to light a 4m deep sequence with 15 identified geological strata (Madeyska 1988). Already, the first fieldwork revealed the presence of a single Middle Pleistocene rodent species, *Pliomys lenki* (Nadachowski 1988), which then started a discussion on the presence of Middle Pleistocene layers in the site. Some 40 flint artefacts were found within the topmost loamy layers and were interpreted as being of Middle Palaeolithic chronology (Chmielewski 1988).

At the same time, only thin Holocene and Late Pleistocene layers were found in the southern chamber. One of the more notable findings was a post-medieval child inhumation burial discovered within the southern part of the cave (Wojenka et al. 2021), which will be described in detail further on. The southern chamber was revisited in 2016. Thanks to modern fieldwork methods and wet screening of the sediments, multiple sparse human remains were found that were radiocarbon dated to the Neolithic (Wojenka et al. 2017).

The further reexamination of the results obtained by Chmielewski, which remained unpublished since the 60s, started in 2018 and aimed at studying the site's Pleistocene stratigraphy and chronology in depth. The new project focused on the old collections, including a detailed reexamination of artefacts and bones. On the other hand, the old trenches in the northern chamber were

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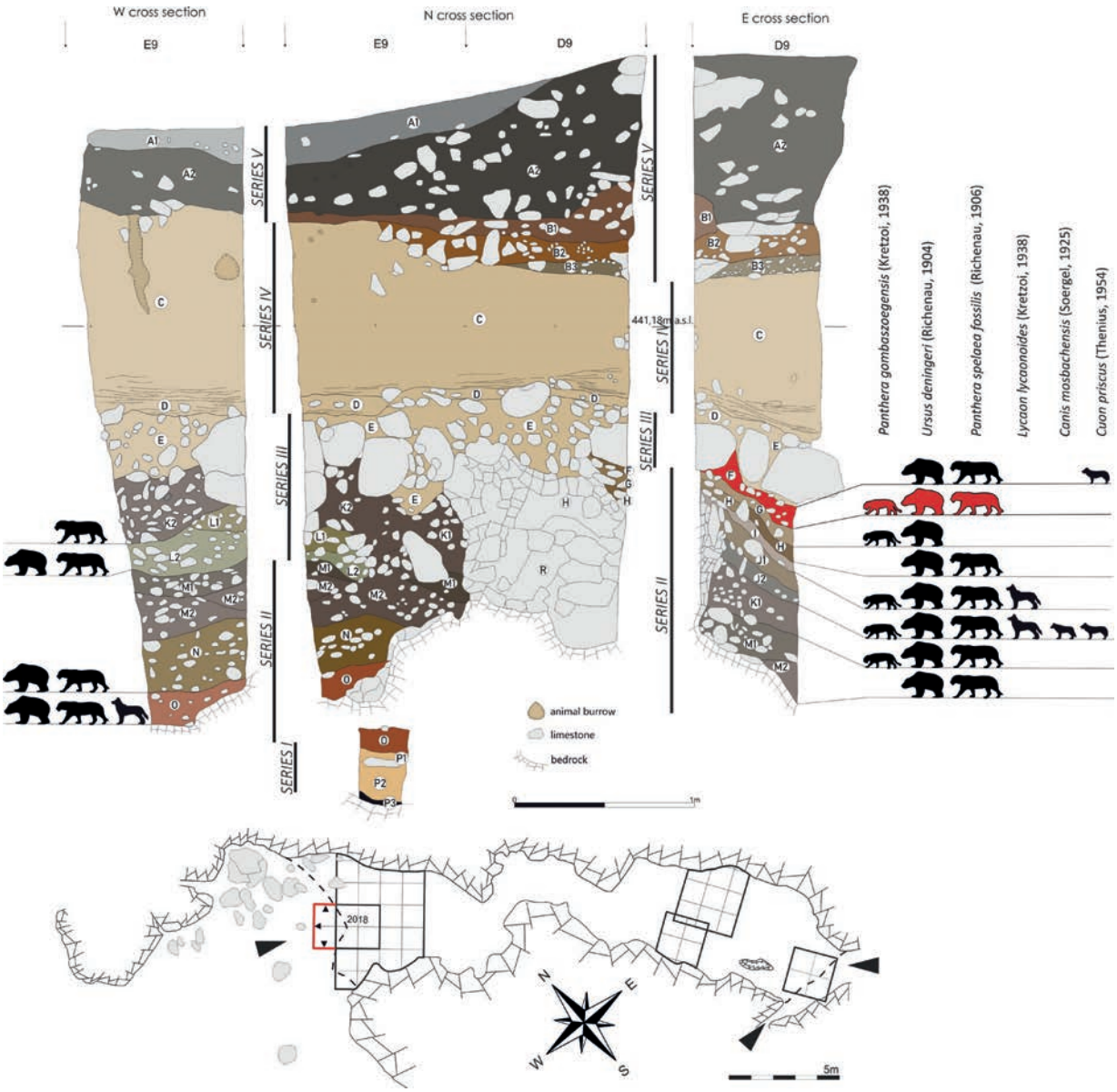



FIGURE 1. Cross section of deposits in in the Tunel Wielki Cave from the 2018 fieldwork together with a distribution of carnivores within different Pleistocene layers. Layer F, containing lithic artefacts, is marked in red

reopened to collect new samples and verify the stratigraphy in 2018. Besides the detailed documentation of each in situ finding, the whole excavated sediment was wet-sieved on a 1 mm mesh and dried and screened to collect the animal and human remains, shells, charcoals and small artefacts. Thanks to such methodology, the new fieldwork brought over 10,000 Pleistocene bones and 118 lithic artefacts, which could be further compared with the old collections.

Tunel Wielki Cave is one of few caves in the region that was not excavated/destroyed at the beginning of the late 19th and early 20th centuries. What is more, it was profoundly excavated in the late 1960s by an interdisciplinary team, including a geoarchaeologist, with great attention to all the findings. Further excavations have been conducted in both chambers within the last 10 years, with a focus on the Pleistocene and Holocene layers.

Thanks to these circumstances, Tunel Wielki Cave gives us a glimpse into several distinct human occupation phases at the site. Interestingly enough, during the last five thousand years, the site has been used at least three times in three distinct periods as a cemetery, making it quite special compared with other caves in the region.

On the other hand, thanks to the cave's location in the uppermost parts of the rocks and high elevation, it has preserved, at least partially, the Middle Pleistocene sediments in the lowermost parts of the section. Such precedence let us not only study the Middle Pleistocene fauna and make paleoenvironmental reconstruction of the MIS 14–12 timespan but also, due to the presence of lithic artefacts within Middle Pleistocene layers, gives us the very first evidence of the cave used by Middle Pleistocene hominins in Central Europe.

## Stratigraphy, chronology and faunal remains

The stratigraphy of Tunel Wielki Cave is composed of several distinct lithological series. The 4m depth profile in the northern chamber begins on the top with a black Holocene layer, about 1.5m thick, of humus with limestone rubble (Layers A2, B1, B2 and B3), in the uppermost parts of which a few Neolithic artefacts were found. Below is Layer C, a 1m thick loess deposit covering Layer D of with limestone fragments. Under this are erosional layers of mixed silty loam and large limestone rubble fragments (Layers E, K1, L1 and L2). Below them is as 1.5m series of clay layers with clasts of manganese and limestone rubble (layers F, G, H, I, J1, J2, M1, M2, N, and O). The lowermost strata are created by thin, silty and sandy loams without limestones (Layer P1-P3) (Kot et al. 2022).

The analysis of small mammal assemblage indicated that the cave sediments contained fauna of two horizons. The uppermost assemblage, related to the Late Pleistocene and the Holocene, was composed of a few remains of *Dicrostonyx torquatus* and *Lemmus lemmus* in the loess layers C and D, and a typical Holocene fauna in the upper layers A and B. The lower assemblage found within loamy strata (Layers F-P) is composed of different lists of rodent taxa, which were attributed, among others, to the following species: *Arvicola mosbachensis*, a small *Alexandromys oeconomus*, *Allocricetus bursae*, *Microtus* (*Terricola*) aff. *arvalidens*, *Pliomys coronensis (=Pliomyslenki)*, and *Pliomys episcopalis* (Berto et al. 2021). Such a taxonomic composition allowed us to correlate this part of the small mammal sequence with the Early Toringian (Fig. 2). However, the faunal remains of the lower assemblage probably accumulated in two different intervals, related to interstadial and stadial environment conditions, although the second one was more doubtful. Thus, the accumulation of these layers took place between MIS 14 and MIS 11.

The analyses of the large mammals, primarily carnivores, collected during both the old and new fieldwork seasons also indicated the presence of the Middle Pleistocene species, e.g. *Panthera gombaszoegensis, Canis mosbachensis, Ursus deningeri* (Marciszak et al. 2023; 2025), in the lower part of the section (layers F-O) confirming the MIS 14–12 chronology of the layers (Fig. 2).

## Lower Palaeolithic

The lithic assemblage in the Middle Pleistocene layers consists of 161 artefacts made of local Jurassic flint, which can be found at the bottom of the Koziarnia Gorge, some 30 m below the cave. The artefacts are highly patinated and have severely postdeposionally damaged edges (Fig. 3). Therefore, only a few could be attributed securely as retouched pieces. No bifacial artefacts nor flakes from bifacial reduction have been identified. The assemblage consists of flakes and several cores, including mostly cores on flakes of less than 5 cm in length. Cores on flakes were made on thick flakes. They were exploited on their ventral side, with a butt treated as a striking platform. In some cases, the distal edge of the core/flake is crushed with traces of removals going onto both sides of the core, which led to the interpretation of the use of the bidirectional on-anvil technique. The core reduction scheme is relatively simple. The flakes were detached from the sides of the core. The obtained flakes were asymmetric with a single sharp and a second slightly blunted or cortical edge.

The debitage consists mainly of thick, irregular backed flakes of unidirectional or orthagonal scar pattern, but bidirectional removals also appear. Cortical flakes consist of 50% of the debitage, indicating the on-side knapping process. Three Kombewa flakes were identified in the assemblage (Fig. 4). Three flakes were identified as intentionally retouched pieces due to continuous edge retouch, which changed the parameters of the edge in the content manner.

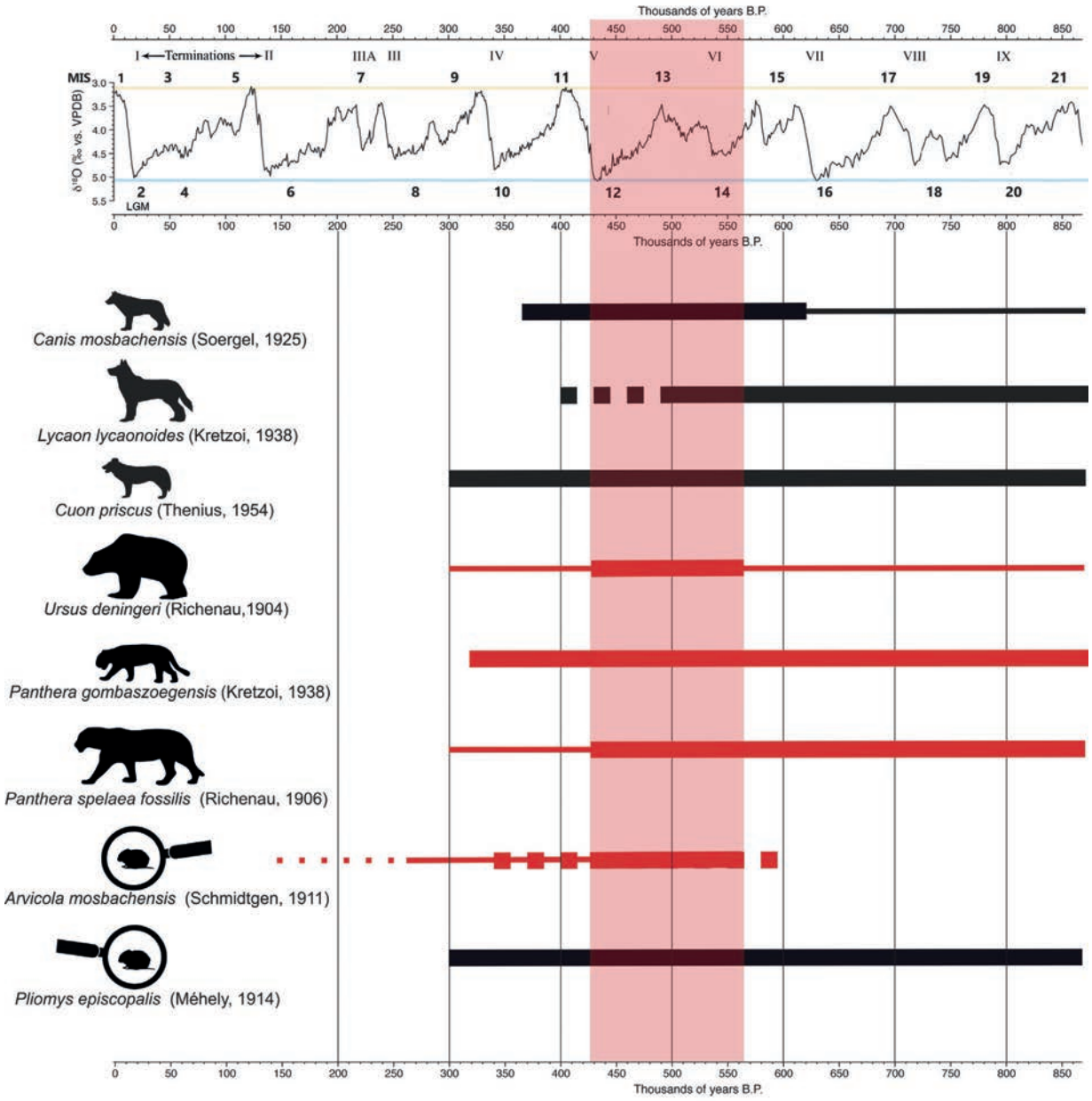



FIGURE 2. Reconstructed chronology of the carnivores and small mammals from Tunel Wielki Cave based on their morphology. The thin lines refer to the occurrence of the species in Central Europe. Thick lines refer to the chronology of the individuals of the morphology observed in Tunel Wielki Cave. The dotted line refers to the probable occurrence. The red bar indicates the most probable chronology of the human occupation in Tunel Wielki Cave based on mammal taxonomy and morphology

## Final Palaeolithic

The loess layers (layer C) contained a small lithic assemblage, which can generally be attributed to the Final Palaeolithic. The artefacts can be easily differentiated from the Middle Pleistocene ones due to the lack of neither severe patination nor post-depositional edge damage. The small assemblage consisting of single blades and tools restricted further extensive interpretations; however, the short-time Final Palaeolithic

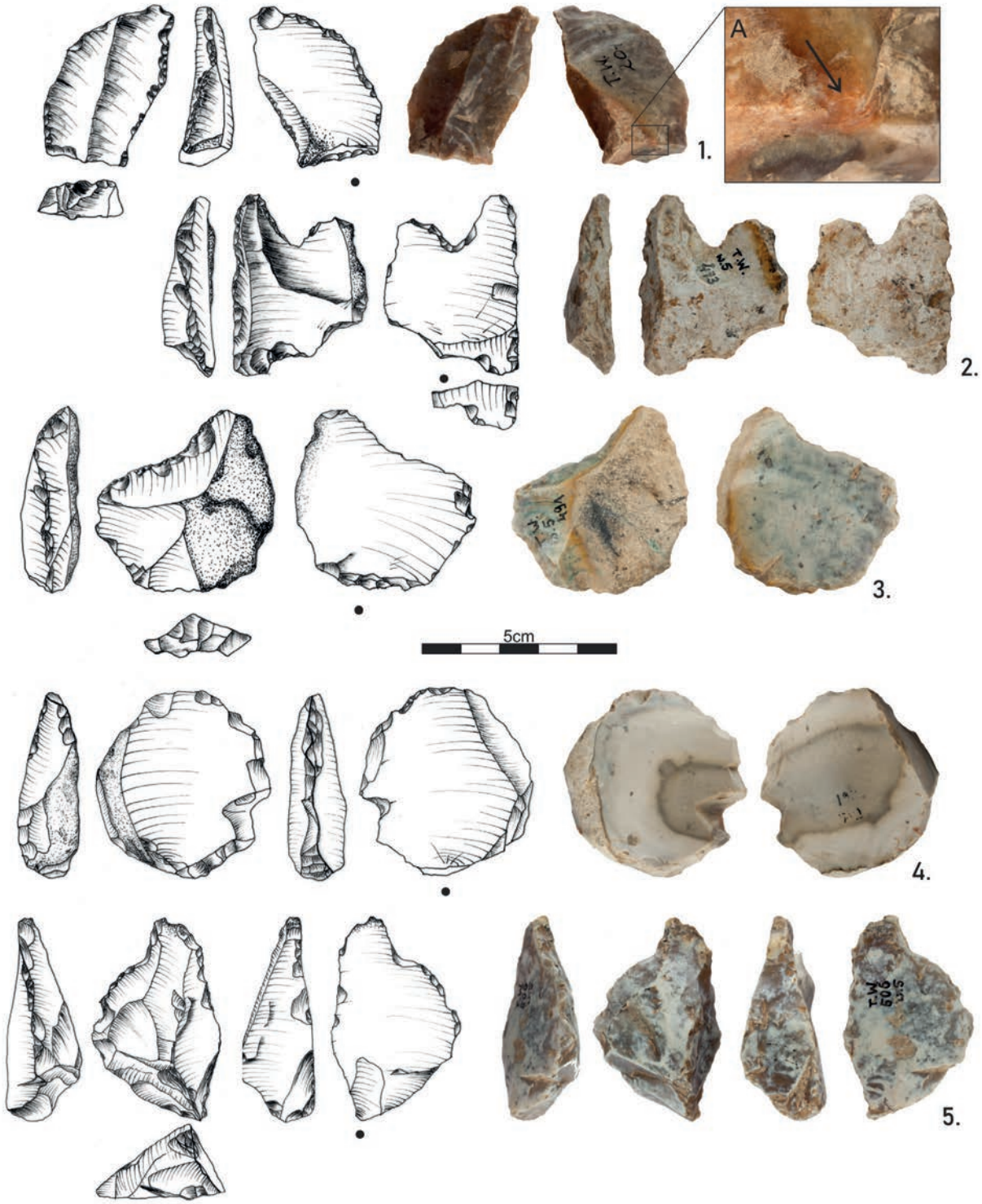



FIGURE 3. Lithic artefacts from Tunel Wielki Cave. Notice the patination of the flake's surface, and the postdepositionally damaged edges. 1-5. Flakes



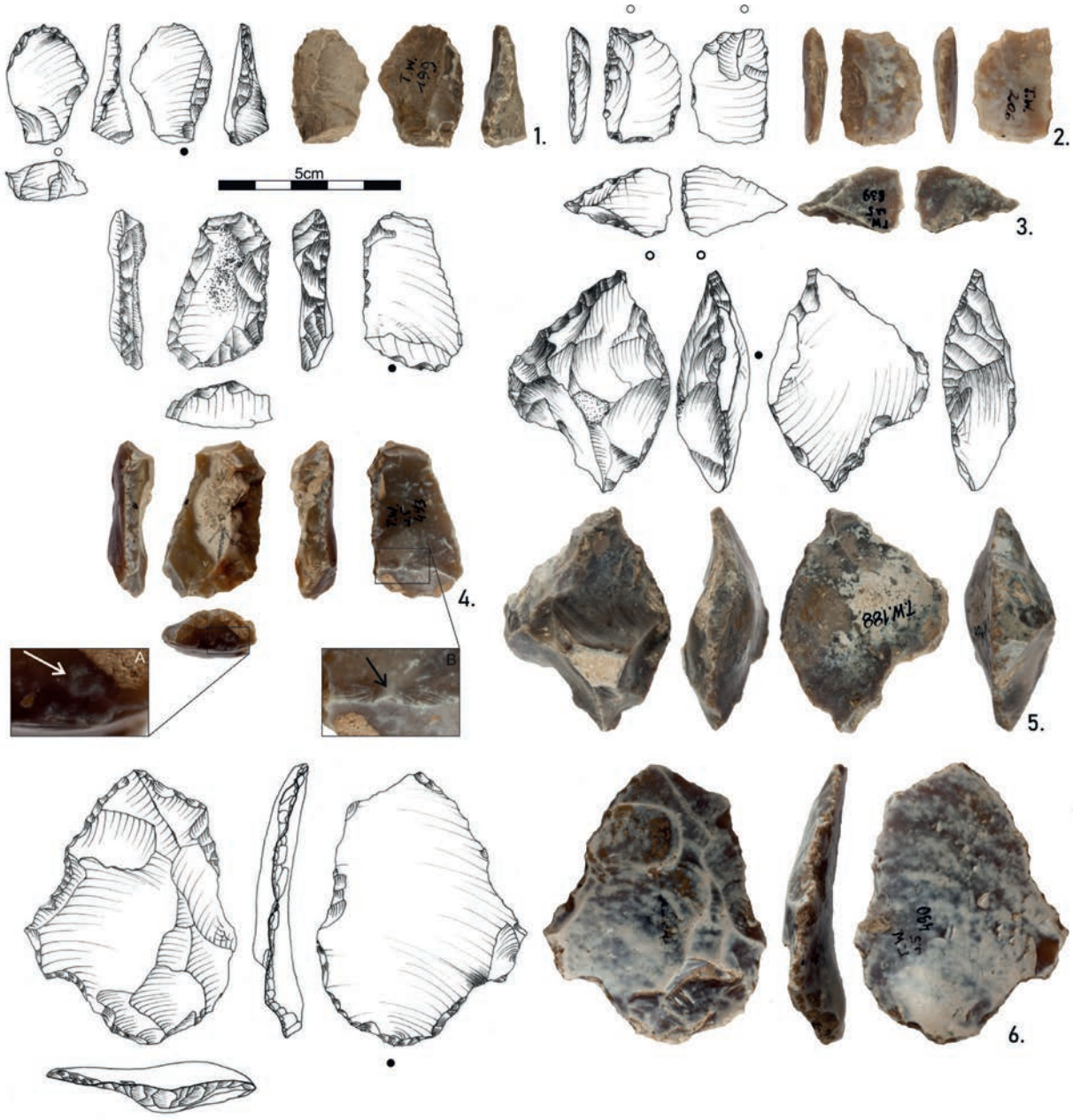



FIGURE 4. Lithic tools from Tunel Wielki Cave. 1. Kombewa flake; 2. Kombewa flake with a retouched edge; 3. Broken Kombewa flake; 4. Longitudinally retouched flake; 5. Transversally retouched flake; 6. Flake with heavily postdepositionaly damaged edges. Its big size, longitudinal curvature, and massive bulb and equal thickness throughout the whole length indicate the use of free-hand technology; A. Hertzian cone of the unsuccessful flake detachments; B. Protruding point of percussion on the ventral side of the flake

campsite found in the Rockshelter above Niedostępna Cave, which is located directly under Tunel Wielki Cave in the same rock might be of the nearest analogy.

## Neolithic

The traces of Neolithic human activities in the Tunel Wielki Cave are peculiar and still not fully understood. Both trenches in the north and south

chambers revealed multiple human remains dispersed throughout the uppermost stratigraphical units with no anatomical order. The bones represent mostly teeth, phalanges and small bones. No long bones have been found there. The rough estimates based on the 2026 trench indicate at least 18 individuals between 6 months and 60 years old. The radiocarbon dating of six individuals indicates a very coherent time frame of 3600–3450 cal BCE. The number of individuals indicates that certain Neolithic communities used the cave as an ossuary/common burial. The lack of long bones and skulls indicated that they had been removed from the cave deliberately, perhaps by the community members. The huge number of teeth might indicate that the removed bones were already in relatively bad shape at the moment of being taken away (the teeth could have fallen out of the skulls). All these and the narrow chronological timeframe give us a glimpse into unknown burial rituals of Middle Neolithic communities in southern Poland.

## Bronze Age

Interestingly, one of the radiocarbon-dated human bones (a clavicle) indicated a different chronology and was dated 1736–1617 cal BCE. A similar HaC chronological attribution was given to the pottery piece found at the same square metre (Kot et al. 2020). As long as no other traces of the Trzciniec culture were found at the site, one may assume that Tunel Wielki had been used once again in the Bronze Age as a funeral place for a single individual. This would be the first evidence of using caves as funeral places by Trzciniec culture communities in Poland.

## From Iron Age up to the Middle Ages

The cave was visited several times between the Early Iron Age and the Middle Ages, but the artefacts indicate rather ephemeral human visits to the site. An interesting find is three bronze arrowheads found during recent fieldwork, indicating that early Iron Age Lusatian culture communities hunted in the cave's surroundings.

## Seventeenth century

The cave became a funeral place one more time in the past. Unexpectedly, it happened in the middle of the 17th century when a young girl was buried there. The child had been given a surprising funeral gift in the form of two finch heads. One of the bird's skulls was found in the girl's mouth, while the second one was lying next to her cheek. No other grave offerings have been found. The burial was discovered during the very first fieldwork in 1967. The recent analyses, including the palaeogenetic ones, shed more light on the uncommon findings (Wojenka et al. 2021). The new analyses let us propose an interpretation that the girl is associated with Finno-Karelian troops of a Swedish garrison stationed at the adjacent Ojców Castle during King Carl Gustav's invasion of Poland in 1655–1657.

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# BIŚNIK CAVE

Krzysztof Cyrek, Magdalena Sudoł-Procyk

Biśnik Cave (50°23'N, 19°40'E) is located on a hillside of the currently dry Wodąca Valley (Fig. 1A) in the middle part of the Kraków-Częstochowa Upland (Cyrek et al. 2010). The main entrance is 405 m above sea level and 6 m above the current bottom of the valley (Fig. 1B). The cave consists of several interconnected chambers and rock shelters, initially almost filled with deposits. The site also includes the area in front of the cave, protected on three sides by stone walls and on top by a large overhang (Fig. 1C).

This cave is one of the most important archaeological sites in the Kraków-Częstochowa Upland. It contains preserved complexes of artefacts from the Middle Ages to the Lower Palaeolithic. However, it owes its greatest fame to a sequence of several Middle Palaeolithic levels. Thanks to a series of Mousterian and Micoquian cultural levels, Biśnik Cave can be considered one of several benchmark Middle Palaeolithic sites for this part of Europe (Cyrek 2002; Cyrek 2013; Cyrek et al. 2010, 2014; Wiśniewski 2014).

The Biśnik Cave sediments reach 7 m in thickness. It has a complex stratigraphy and lithology. Thirty-five layers have been distinguished, some of which occur in several side variants or show internal stratification, so the total number of stratigraphic units is more significant. Five lithostratigraphic series were distinguished (Krajcarz et al. 2014a) in which (apart from the oldest, Middle Pleistocene, Series I) numerous bone remains and archaeological finds were documented (Fig. 2). Layers 20–19bc (Series II) constitute colluvial sediments redeposited within the cave during dynamic slope processes (Krajcarz and Cyrek 2011). The final deposition of sediments of this series is associated with MIS 8 / 7 and consists of material containing much older bone remains and archaeological artefacts (Cyrek 2013). The most significant thickness is Series III (Layers 19a - 8), composed of clastic cave sediments, i.e. silty and sandy clays rich in limestone rubble (Mirosław-Grabowska 2002). This series of sediments is dated from the late part of the Middle Pleistocene (MIS 7 and MIS 6) to the end of the early phase of the last glacial period (MIS 5a) (Krajcarz et al. 2014a). Many fauna remains have been preserved in these sediments, with the cave bear dominating and several Middle Palaeolithic cultural levels (Cyrek et al. 2010). The next Series (IV, Layers 7–3), consists of sandy sediments associated with the Plenivistulian and Interplenivistulian (MIS 4–2). The richest archaeological assemblages were documented in the sediments of this series (Cyrek 2010, 2014). The youngest Series (V, Layers 2–1) includes loess from the last glacial maximum, in which tundra fauna was found (Stefaniak et al. 2021) and Holocene humus sediments developed on a loess substrate.

## Research history

The first season of survey research was conducted by Andrzej Pelisiak in 1991 (Pelisiak 1993–1994). Since 1992, for 25 seasons (in the years 1992–2000 and 2003–2018), the research was led by Krzysztof Cyrek, who coordinated the work of the interdisciplinary team. In recent years, research in the Biśnik Cave has been more *ad hoc*, aiming to sample sediments for analytical purposes, mainly dating (Wiśniewski et al. 2022) and molecular dating. The inter- and multidisciplinary team included researchers representing various branches of research on prehistory, palaeontology, stratigraphy, sedimentology, speleogenesis and chronometry. Among those who were involved the longest and who made the most substantial impact in the research

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FIGURE 1. Biśnik Cave

A. Location in the Wodąca Valley (photo by P. Szczepanik), B. Entrances to the cave (photo by P. Szczepanik), C. Site plan: green line - contemporary entrance holes (1 - to the main chamber, 2 - to the side chamber), orange lines - excavated entrance holes (drawn by Ł. Czyżewski)

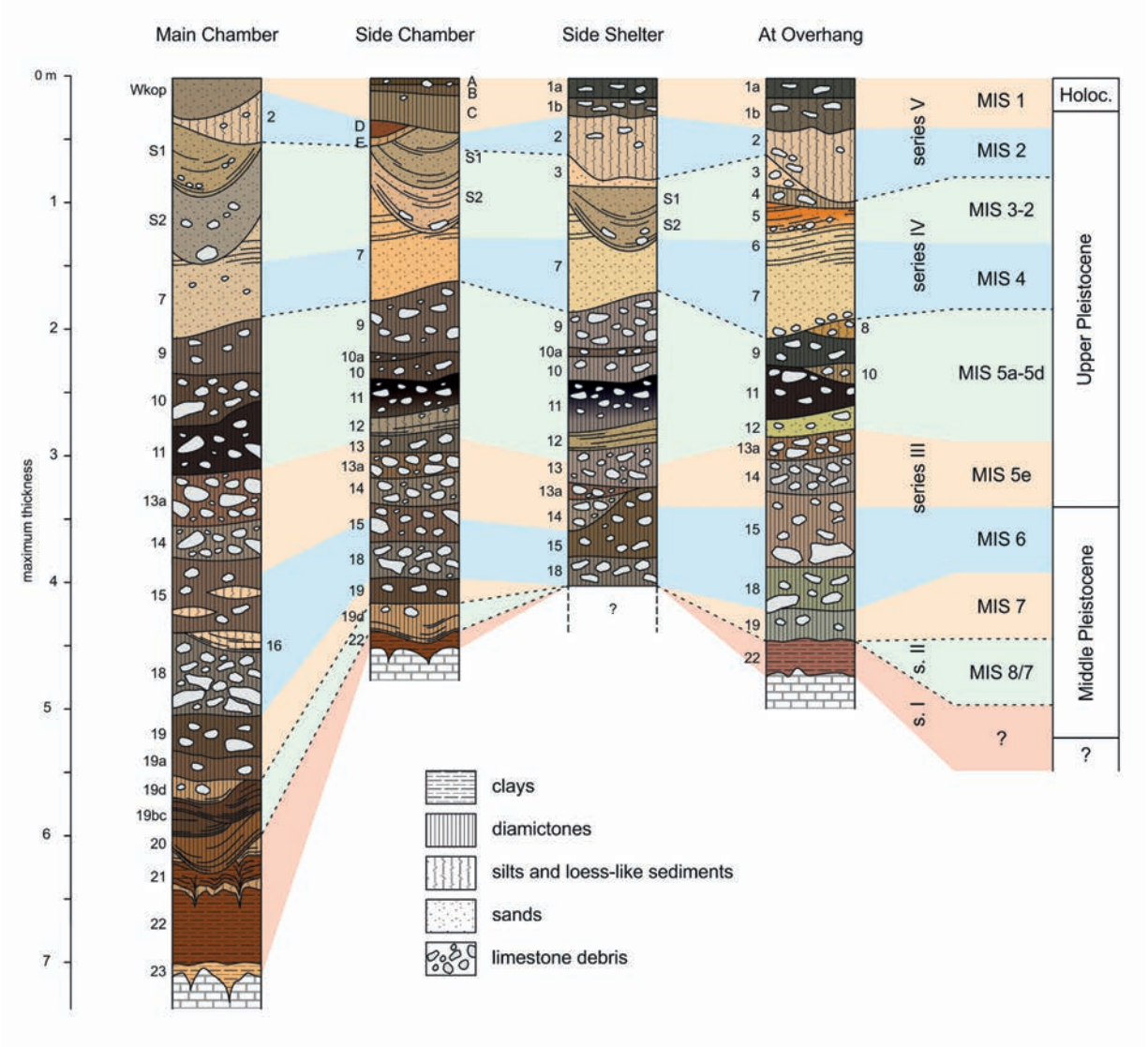



FIGURE 2. Compilation of sedimentary sequences of individual parts of the Biśnik Cave (after Krajcarz et al. 2014)

were, among others, archaeologists: Magdalena Sudoł-Procyk and Łukasz Czyżewski (Nicolaus Copernicus University); archaeozoologists Magdalena Krajcarz (Nicolaus Copernicus University) and Piotr Wojtal (Institute of Systematics and Evolution of Animals PAS); paleozoologists: Teresa Wiszniowska†, Krzysztof Stefaniak, Adrian Marciszak, Paweł Socha and Urszula Ratajczak-Skrzatek (Wrocław University); palynologists: Maryna Komar (Institute of Geological Sciences of the National Academy of Sciences of Ukraine) and Zofia Tomczyńska (W. Szafer Institute of Botany PAS); geologists: Teresa Madeyska, Joanna Mirosław-Grabowska, Michał Gąsiorowski and Maciej T. Krajcarz (Institute Geological Sciences PAS); Pavel Bosák (Geological Institute of the Czech Academy of Sciences); geomorphologists and geographers: Andrzej Tyc and Katarzyna Kasprowska (University of Silesia); physicists dealing with radiometric dating: Helena Hercman and Grzegorz Sójka (Institute of Geological Sciences PAS), Tomasz Goslar (Poznań Radiocarbon Laboratory), MS Jarosław Kusiak (Lublin University) and Marine Frouin (Oxford University) (Sudoł-Procyk et al. 2023). Such a diverse research team allowed a detailed identification of the prehistoric settlement in the cave




FIGURE 3. Antlers with a pierced hole, from Layer 18 in the Main Chamber (photo by W. Ochotny)

and the reconstruction of changes in the natural environment over several hundred thousand years.

## Research methods

Interdisciplinary research in the Biśnik Cave is related primarily to archaeological, paleontological and geological finds.

The sedimentary sequences have been studied to investigate the chronostratigraphy and palaeoenvironment. The sediment studies were conducted based on sedimentological, geochemical, and palaeontological data (Mirosław-Grabowska, 2002; Cyrek et al. 2010). The latest multi-proxy study conducted by M. T. Krajcarz is based on the application of new methods for the site: analysis of sedimentary and post-sedimentary structures, weathering stage of limestone rubble and fossil bones, pollen analysis, molecular biomarkers, palaeomagnetic analysis, and radiometric dating (Krajcarz et al. 2014a).

The palaeontological sources have been comprehensively developed, taking into account biostratigraphic, palaeoecological, molecular and chronometric approaches, both synthetically (Cyrek et al. 2010) and about individual species of Pleistocene fauna (e.g., Hercman and Gorka 2002; Van Asperen and Stefaniak 2011; Tomek et al. 2012; Krajcarz et al. 2014b; Socha 2014).

Archaeological sources, which consist mainly of flint products, have been analysed from a typological, technological and cultural perspective (Cyrek 2013, 2021; Sudoł and Cyrek 2013), form modification (Cyrek, Sudoł 2008), intentionality of retouching (Cyrek and Sudoł 2012), functional (Cyrek et al. 2014), use of raw materials (Krajcarz i in. 2012, Sudoł-Procyk and Cyrek 2023), the presence of composite tools (Cyrek and Cyrek 2009), as well as the chronostratigraphy of the oldest finds (Krajcarz and Cyrek 2011, Wiśniewski et al. 2026). The spatial diversity of archaeological finds, primarily flint and bone products and the accompanying hearths, were correlated with sedimentological and paleozoological research (Cyrek et al. 2014, 2016). This made it possible to trace the conditions for the settlement of the Biśnik Cave in the Pleistocene and the adaptation of individual areas of the site by Neanderthal man (Cyrek and Sudoł 2009, 2010). The cave settlement was also analyzed for the record of anthropogenic biomarkers (Krajcarz et al. 2013; Gryczewska et al. 2025).




FIGURE 4. Bifacial knives from Layer 15 in the Main Chamber (photo by W. Ochotny)




FIGURE 5. Bifacial knives (1-2) and Levallois core (3) from Layers 5-6 under the overhang (photo by W. Ochotny)

## The most important finds

The oldest finds, in the form of flint products, hearth relics and animal bones, come from redeposited Layers 19b-d. This inventory is heterogeneous, and the artifacts it contains may have originated from different parts of the cave inhabited by humans during the earliest stages of its use (Cyrek 2013).

In Layers 19a-8, at least 20 levels of Neanderthal cave occupation were documented. They were in the form of relics of hearths and the accompanying concentrations of flint and bone products (Fig. 3). The alternating or simultaneous presence of Micoquian and Mousterian cultural elements in the individual layers is characteristic. Among the flint products, apart from numerous side-scrapers, the early appearance of the method of manufacture of the bifacial knife, already in MIS 6 (layer 15), is noteworthy (Fig. 4). This tradition is observed in several Middle Palaeolithic cultural levels up to Layer 5 (MIS 3) (Fig. 5:1–2) (Cyrek et al. 2010,

2014). A unique aspect is elements associated with the Levallois technology (Fig. 5:3) from the earliest phases of the cave's occupation, represented by cores, flakes and blades (Cyrek 2021, Wiśniewski et al. 2026). Another unique find is a flake with relics of a binder (Cyrek and Cyrek 2009).

In the sandy sediments of MIS 4–2 (Layers 7–3), the wealthiest archaeological assemblages related to the Micoquian culture, typical of the end of the Middle Palaeolithic, were found. Here, single- and double-backed knives and cores with copious Levallois debitage (Cyrek et al. 2010, 2014). In addition to the flint artefacts, the upper part of this series contains a documented structure interpreted as one of the oldest residential structures in Europe in the form of a windbreak situated in front of the cave entrance (Cyrek 2002; Cyrek and Sudoł 2010), where deer antlers were stored and processed (Mazza et al. 2022).

In the youngest Holocene layers, numerous fragments of medieval, Neolithic, and early Bronze Age pottery were found, as well as numerous flint products representing all stages of flint axe production (Cyrek 2002).

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# HALLER AVENUE IN WROCŁAW

Andrzej Wiśniewski

The site is located in the western part of Wroclaw (SW Poland). It is a multicultural open-air site representing at least two episodes of the Middle Palaeolithic, identified as the Mousterian and the Central European Micoquian (CEM). There were also remains of more recent activity in the area of the site: Mesolithic, Neolithic, Bronze Age, Roman time and Medieval.

Geographically, the site is located in the southern part of the North European Lowland Belt, about 60 km NE of the edge of the Sudeten Mountains. The site lies at an elevation of 124–125 metres above sea level, about 15 metres above the level of the modern Oder River, at the highest point of the watershed separating the Oder and Sleza valleys. It has been established that this elevation is a remnant of the higher terrace of the Oder floodplain, which eventually formed in the Early and Middle Vistulian.

The thickness of the Quaternary sediments at the site, formed during the last glaciation, reaches 3 metres. The geology of the area was studied by a team of geologists led by B. Przybylski and J. Badura. Excluding the glacial deposits of the subsoil, the lowest layer was the erosional pavement (Complex A), which forms a continuous layer in the western part of the site (Fig. 1B, C). Immediately above the pavement layer (A) was a series of gravelly-sandy braided river sediments with silty-sandy interbeds (Complex B). Above the B complex layers were river sediments associated with slower flow conditions (Complex C'). The C' river sediments were marked in the western and northern part, i.e. in the largest depression. The formations of the next complex (D') were the filling of small depressions of periglacial origin (thermokarst basins). Above the formations of the complex of sediments filling local reservoirs (D'), another episode of fluvial sedimentation was marked (C''), with features analogous to those of complex C'. The sediments of the D'' complex replicate the sequence of filling local basins of periglacial character. The whole sequence of fluvial and periglacial basin sediments is covered by a layer of dusty and clayey sands with a maximum thickness of 50 cm (E). These sediments have been almost completely transformed in the soil profile already formed in the Holocene.

Middle Palaeolithic lithic artefacts and animal bones were found in the context of fluvial (A/B and C') and lacustrine (D') sediments of varying lateral extent. More than a dozen OSL dates of quartz grain samples have been carried out in the area of the site using the SAR protocol (Wisniewski et al. 2024). The sediments of the bedrock of the site are correlated with the South Polish Glaciation, while the pavement (A) covering it was probably formed during the Eemian Interglacial or at the beginning of the Vistulian. The sediments of fluvial complex B are dated to MIS 5a/4 while the sediments of fluvial complex C' are dated to the beginning of MIS3 (average 55.6 ka). Similar OSL ages are given for the sediments of complex D' (early MIS3). In the past, a number of isotopic studies have been carried out to determine palaeotemperatures at the time of human presence in the area. The results indicate that the average annual temperatures during both phases of occupation oscillated around 6°C (Skrzypek et al. 2011; Skrzypek et al. 2016). However, it is important to note that these results apply only to the Oder Valley ecosystem (Pushkina et al. 2020).

## Research history

The site was discovered by the author in 1990 during construction work, and the first excavations in the northern part of the site were carried out in

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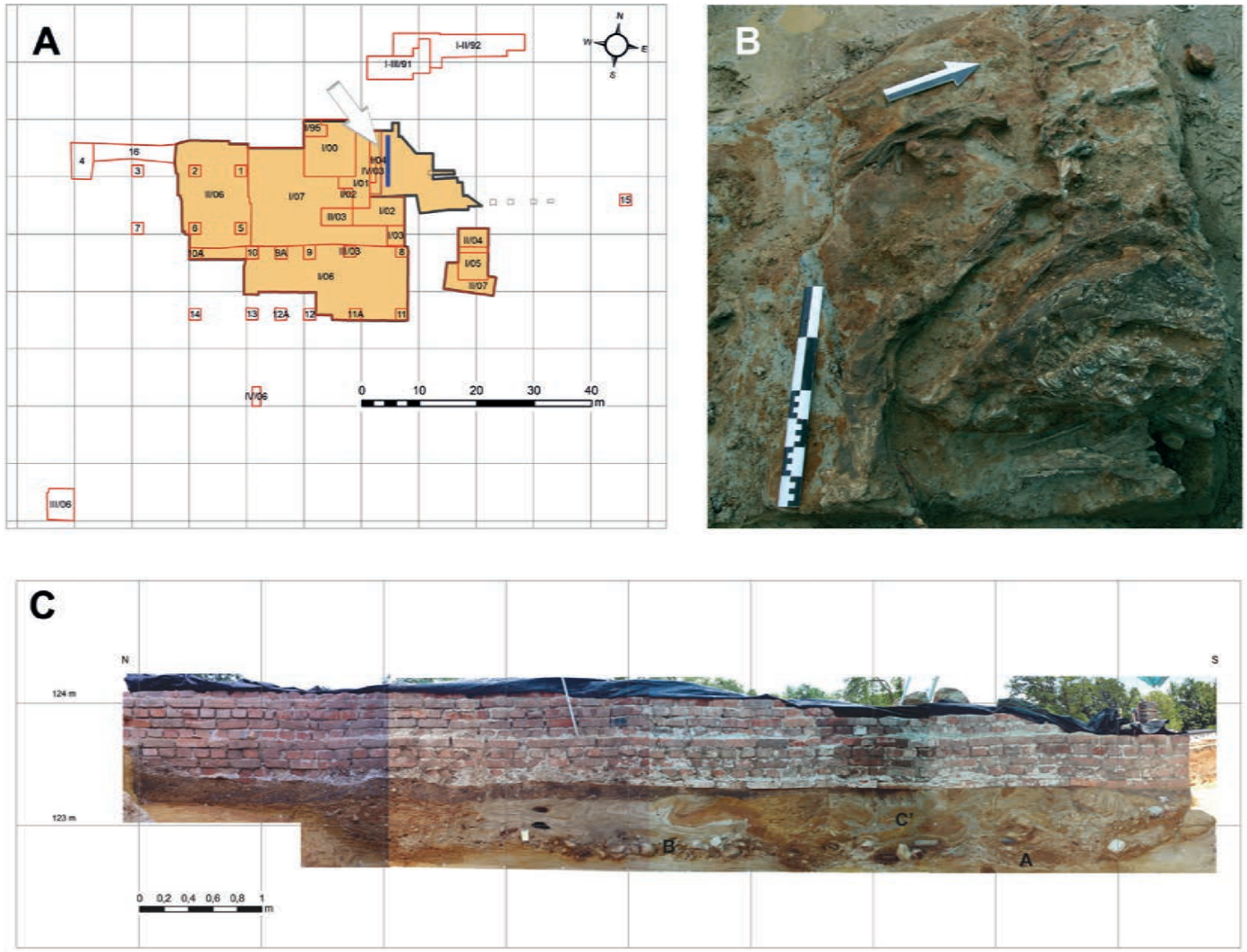



FIGURE 1. Wrocław, Haller Av. site: A-Location of the trenches (orange colour indicates the central sector from which the finds discussed in the paper originate); B-fragment of the bison skeleton discovered in 2006 in horizon B; C-eastern profile of the 2016 excavation, preserved under the foundations of a building erected in the first half of the 20th century. Description of sediments in the text. Drawn up and photographed by A. Wiśniewski

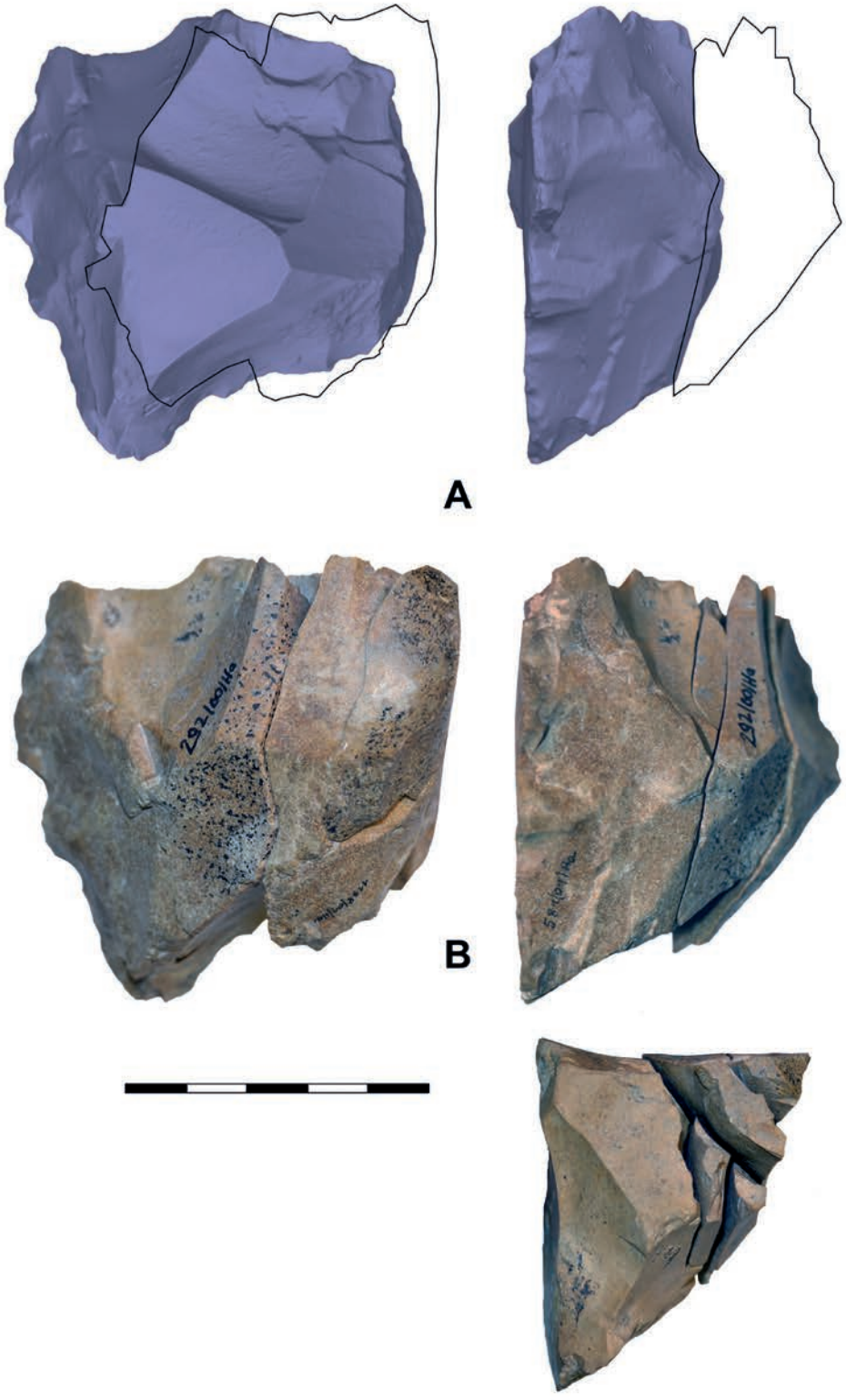



FIGURE 2. The block of refits presents bidirectional core reduction. 3D model (A) prepared by M. Mackiewicz, photo (B) by A. Wiśniewski

1991–1992. Unfortunately, the area had previously been disturbed in the first half of the 20th century during the construction of a road and buildings. It was not until 1995 that research began on a less intact block of Quaternary sediments in the area to the south, where a building and a sports field existed. This work was completed in 2016. The excavation area from the sector with the least sediment destruction (the middle sector) was 829 $m^2$ (Fig. 1A, Wiśniewski et al. 2013; Wiśniewski et al. 2023).

## Research methods

A variety of specialised geological, geochemical and geophysical analyses were conducted during the course of the study, as well as environmental analyses and subsistence strategies of humans incorporating paleozoology, taphonomy and anthracology. The archaeological studies encompassed traditional typological and technological analyses supported by refits of lithics, raw material analyses of the geological background, use-wear analyses of stone tools, and morphometric tests (Weiss et al.,2017; Wiśniewski et al. 2013; Wiśniewski et al. 2023).

## Results

### Lithic artefacts

Lithic artefacts were predominantly composed of erratic flint. In the area of the site, flints were found in the pavement layers (Complex A), but their quality indicates that there must have been limitations on the size of the available lumps, which were mostly small in size. The presence of single products made from erratic rocks was also noted. A total of 2214 artefacts were discovered, including 94 tools and 97 cores.

The location of the finds, the state of preservation, and the technological features enabled the distinction of at least two phases of occupation of the area. The relics found in the A/B settlements mark the older phase. These relics were dispersed throughout the central sector (Wiśniewski et al. 2013). These artefacts were not found in high concentrations and are likely to represent a mixture of several episodes. The distribution of these assemblages indicates that they were dispersed and depleted due to fluvial processes. The processes of secondary displacement and burial are hypothesised to have occurred with different dynamics in the area. It is hypothesised that in the western and northern parts, where substantial cobbles were recorded in the depression, this process may have been more dynamic than in the central or eastern parts. The presence of flint artefacts bearing traces of fire contact in the lower levels further supports this hypothesis.

From a taxonomic perspective, these can be combined with assemblages containing traces of the use of Levallois technology and uni- and bifacial tools.

The artefacts included in the upper horizon were located on B deposits and were partially covered by C' and D' deposits. These occurrences were exclusively confined to the eastern and central regions. These were distinguished by the presence of distinct clusters. The upper level is represented by 878 items, including 25 tools and 42 cores. The state of preservation of these artefacts is superior to that of the lower horizon finds. Of particular note is the presence of numerous refits. These refits offer significant insights into the reduction processes employed, particularly in the fabrication of tools, including bifacial specimens. Taxonomically, the artifacts correspond to CEM assemblages.

Among the artefacts of the lower horizon are heavily patinated forms, which may mark an even older episode of human presence at the site.

The traceological investigation carried out by B. Kufel-Diakowska (Wiśniewski et al. 2013) yielded interesting results. In the lower horizon (Complex A/B) traces of tool contact with animal tissue or skin, wood, but also bone and organic material of medium and high hardness were found. The presence of traces of tool binding was demonstrated. Among the tools of the upper level (C' and D') only single traces of use were found, indicating contact with animal tissue or hide and medium or hard organic matter.

### Animal bones

Skeletal remains studied by the team led by S. Stefaniak and J. Wilczynski were found in the geological sediments forming the deposits of both horizons. In the older horizon (A/B, B), remains of the following taxa were isolated: mammoth, woolly rhinoceros, *Stephanorinus kirchbergensis*, steppe bison, reindeer, horse and moose. Most of the identified skeletal remains belonged to the primary bison (MNI=8).

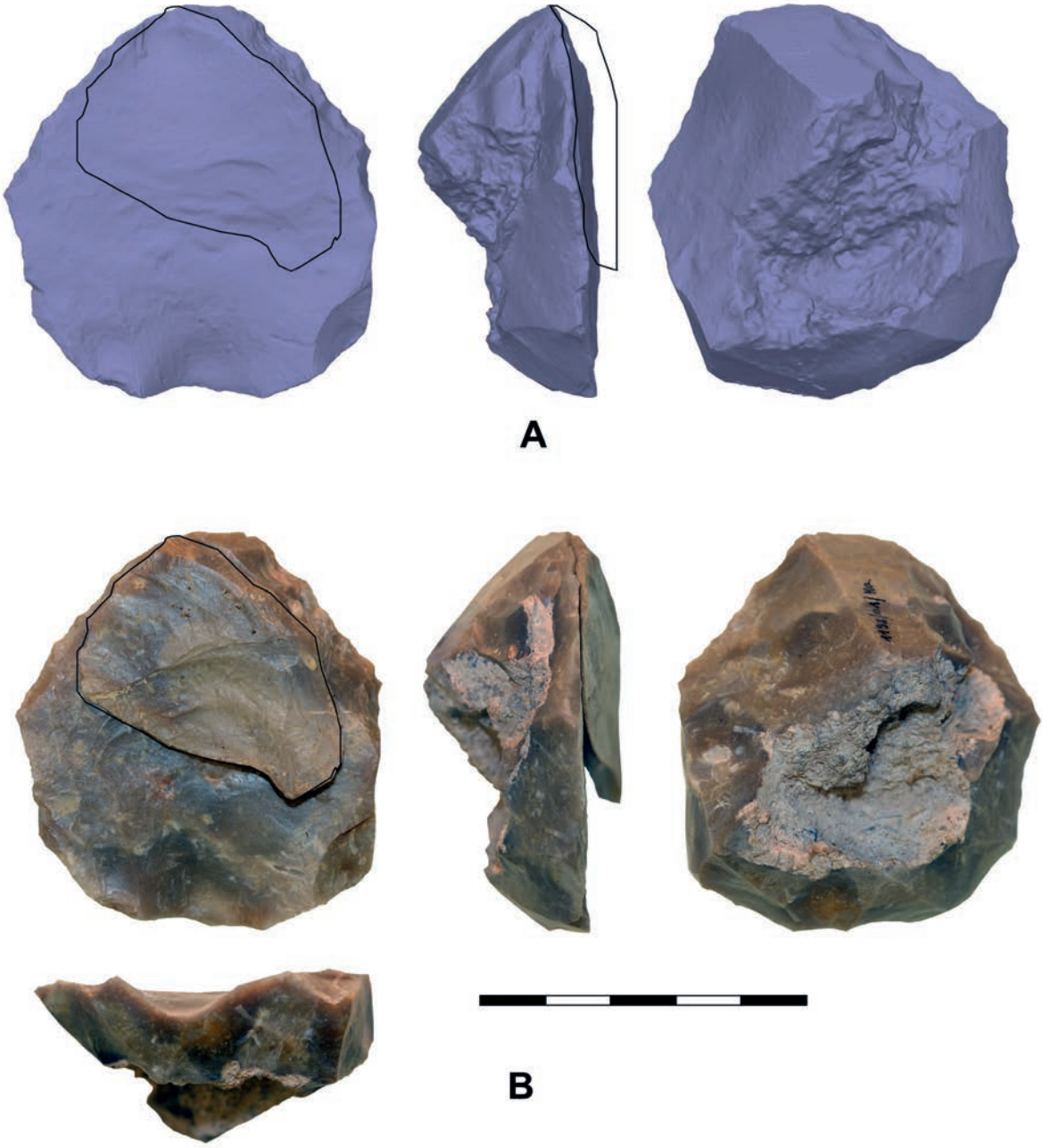



FIGURE 3. Levalloisian core with flake from regulation of distal convexity of flaking surface. 3D model (A) prepared by M. Mackiewicz, photo (B) by A. Wiśniewski

In the so-called upper horizon, only the remains of a mammoth, a woolly rhinoceros, a horse and a steppe bison were isolated (MNI=2). In the collection of the lower level there are single bones with traces of crushing and marrow extraction.



## Conclusion

Given the nature of the lithics and the associated bones, it is possible to present a slightly different scenario of hunter-gatherer behaviour for the two phases of occupation.

During the earlier phase of occupation of the area near the site, practices related to the acquisition and distribution of food were probably carried out. This is evidenced by the technological profile of the lithic inventory, which shows the manufacturing of flake tools with sharp edges using the radial and discoidal method or the uni- and bidirectional methods (Fig. 2 and 3). The target of the hunt was probably the steppe bison, whose age profile indicates that adult specimens were selected. Tools were also made in the area and may have been used outside the site. This is evidenced by a clear proportion of predetermined technology.

The lower horizon of the Haller Avenue site in Wroclaw is part of the list of open-air sites that represent remnants of Late Neanderthal activity in the European lowland region. The data from this site confirm the high flexibility of technological behaviour and the well-established knowledge of the environmental resources of valley areas. These remains allude to killing and/or butchering type sites known from Europe, where traces of bison-oriented hunting have been discovered. These include sites such as La Borde. La Quina and Mauran (France), as well as Wallertheim (Germany) and Il'skaya (Russia) (Farizy 1994; Gaudzinski 1995; Hoffecker et al. 1991; Jaubert and Brugal 1990; Rendu et al. 2012). Obviously, such sites must have been abundant. It seems that their location in the area of river valleys may have contributed to their burial or destruction in the course of later processes.

The younger phase was characterised by a much narrower range of activities. They concentrated on the preparation of tools, most of which were transported outside the site. Only individual specimens were used on site. An interesting find is a lump of quartz crystal found in one of the concentrations, which should be treated as a non-utilitarian object. Due to the dominance of traces of the manufacturing cycle, this inventory is similar to the finds from the Pietraszyn 49a site (Wiśniewski et al. 2019).

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# CIEMNA CAVE

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Ciemna Cave is located in the Kraków-Częstochowa Upland, in the Prądnik Valley near Ojców, at ≈375 m asl and 80 m above the valley bottom. It is an extensive cave system formed in Jurassic limestone (Gradziński et al. 2007). The karstic processes have caused slope destruction and partly exposed its western portions. The complex filling of the cave reflects the changing depositional circumstances, including inner (clays) and outer eolian agents (loess) during the Late Pleistocene. The investigation of Ciemna Cave started at the beginning of the 19th century (Czarnowski 1924). It focused mostly on the western part of the cave system, especially the portion known as Ogrojec (Sector CO) – a large, roofless chamber – which opened during the first Pleniglacial (MIS 4) and provided favourable conditions for settlement, as is indicated by a Micoquian occupation. Test excavations of Holocene layers by J. Czarnowski occurred at the beginning of the 20th century. Later excavations in 1918–19 (Krukowski 1939–1948) uncovered substantial evidence for an Ojców industry and Prądnician cycle characterized by the presence of Prądniks and the Prądnik technique which is now included within Micoquian Middle Palaeolithic. The materials from S. Krukowski's research were analyzed in detail almost a hundred years after their discovery (Sudoł 2014).

S. Kowalski (1967; 2006) conducted test excavations of the Ogrojec again in the 1960s, providing archaeological insights similar to those of the earlier test excavations. Within the MIS 3 interpleniglacial member, a dense and compacted Micoquian level was documented, covered by a thick loess layer.

Ongoing research at Ciemna Cave has been carried out since 2007 and was suspended due to the COVID-19 epidemic in 2021. A primary focus has been the first test excavation within the inner part of the system – primarily the Main Chamber (Sector CK), which has never been excavated before (Fig. 1). Ground-penetrating radar was used to assess the depth of the fill before excavations (Szynkiewicz 2007) and during excavations (Karczewski and Ostrowski 2013). The thickness of sediments in the main chamber can reach a depth of up to approximately 10 m. About 100m$^2$ of adjoining trenches were excavated, exploring to almost 7 metres in the deepest sectors. In some places, it was possible to reach the rocky bottom. All excavated lithics and bones were coordinated with a total station and georeferenced with photogrammetry. Arbitrary 10 cm spits in 1 x 1 m grid units were used to collect sediments for wet-sieving through 1 mm mesh. Plant and animal macrofossils were obtained by flotation and wet-sieving (0.5 mm mesh) of samples from each unit (Valde-Nowak et al. 2016b).

During recent excavations, a rich geological sequence and archaeological levels characterized by relatively stable horizontal and vertical deposition have been uncovered and documented in the Main Chamber. An important result of the recent work was establishing a relationship with Krukowski's excavations located at the entrance. A fragment of his excavation was reached in the trench in the Main Chamber. This allowed for stratigraphic synchronization of the whole space of the cave system.

So far, seven archaeological levels document Late Pleistocene cultural contexts (IX to III from the bottom) in the Main Chamber. Among them, several Middle Palaeolithic lithic traditions are represented: Level IX – undetermined; Level VIII – Mousterian; Level VII – Levallois-Mousterian; Level VI – Taubachian, and Levels V–III – Micoquian. Mixed Palaeolithic, and Neolithic material (Gaszka 2022), including the burial of a child of the Baden culture (Valde-Nowak et al. 2017) and

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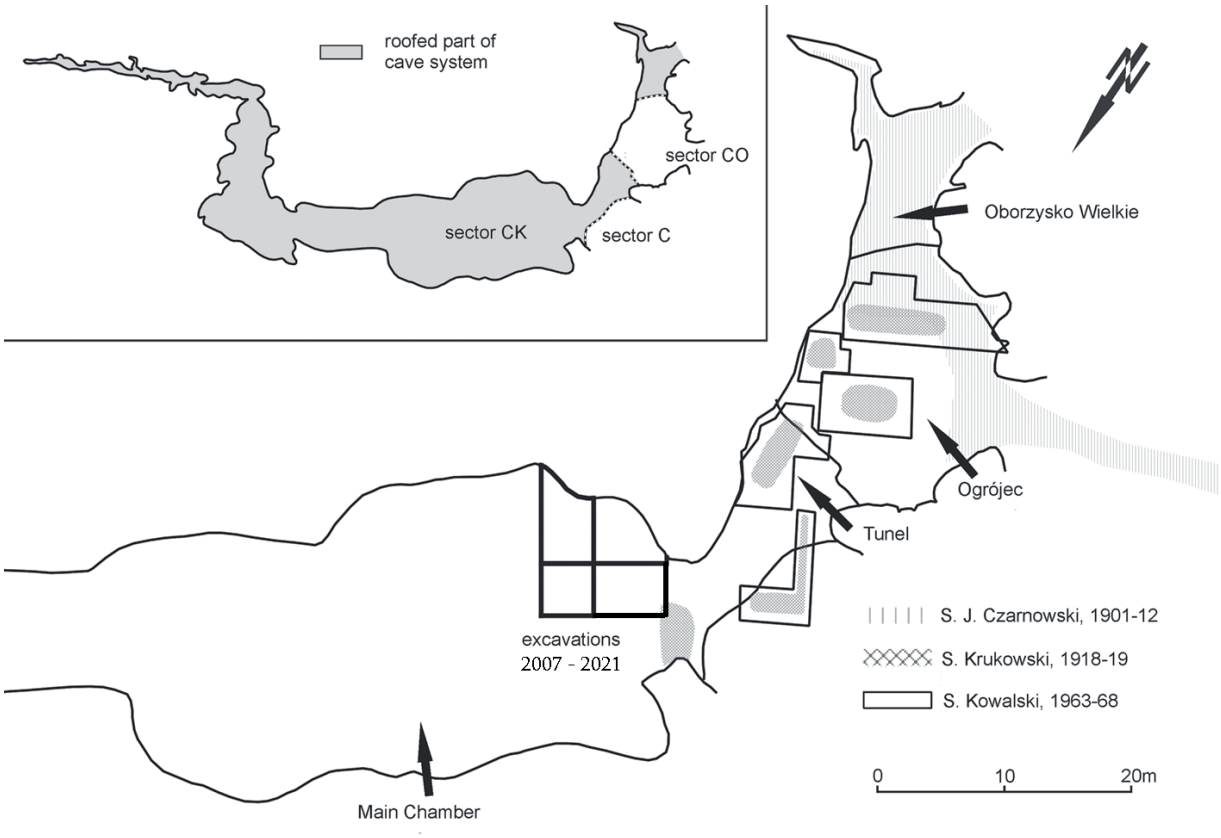



FIGURE 1. Plan of the Ciemna Cave system

younger prehistoric material, especially numerous from the Roman period and the Middle Ages, comes from Levels II and I (Fig. 2).

Micoquian inventories differ from each other. The oldest Level (V) is without Levallois features, containing scrapers, denticulated pieces, some knives, and a small handaxe (Fig. 3). The inventory of Level IV is weak, with Levallois elements, and scrapers, knives, and denticulated pieces.

The III cultural levels are relatively abundant, with parallel recurrent Levallois, and can be synchronized with the Prądnician, i.e., „main cultural level", (according to Krukowski, Kowalski), in which characteristics are asymmetrical knives, retouched Levallois blades, scrapers, and some bifacial elements.

In the faunal assemblage, a paucity of herbivore remains is contrasted by an exceptional number of carnivore remains in the Main Chamber (Sector CK) and the more exterior Ogrojec section (CO). Sediment from the Main Chamber contained thousands of deciduous cave bear teeth as well as limb bones from very young bears. Therefore, the overall density of bear remains, and especially the abundance of very young individuals, suggests that Ciemna Cave was frequently used as a hibernation den and only occupied by humans in the absence of carnivores (Wojtal 2007; Valde-Nowak et al. 2016a, 2016b).

Excavations conducted in recent years in the Middle Palaeolithic sediments of the Main Chamber have also yielded bone fragments recognized as Neanderthal. A human incisor (Fig. 4) comes from level III, the most recent Micoquian level, and has been identified as Neanderthal (Willman et al. 1919a). A heavily corroded pair of isolated manual phalanges from layers dated to the Eemian interglacial (MIS 5)reported in the literature as coming from humans (Wilman et al. 2019b), following recent paleogenetic analyses conducted by Dept. of Geosciences & Senckenberg Centre for Human Evolution and Palaeoenvironment University of Tübingen, turned out to belong to a cave bear (courtesy information by Prof. CosimoPosth).

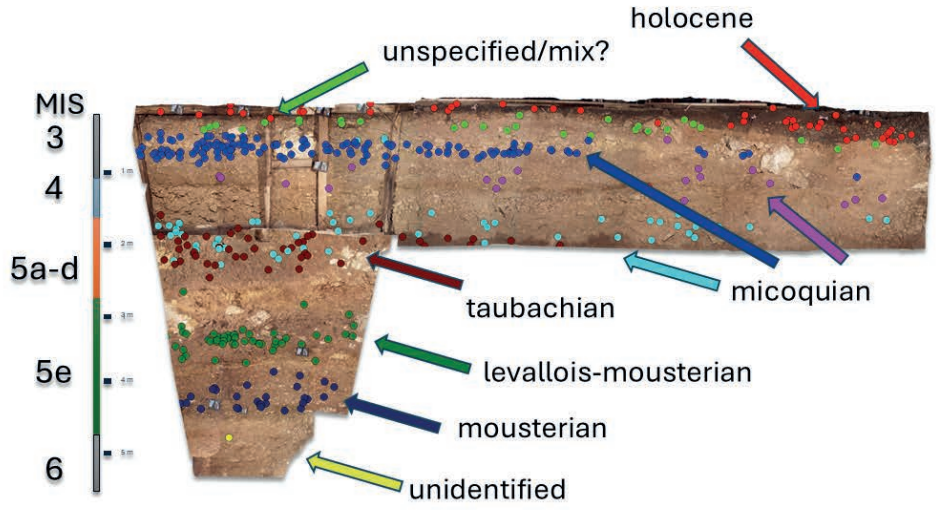



FIGURE 2. Ciemna Cave. Generalized stratigraphy of the Main Chamber (layout by D. Stefański)

Archaeological level III exhibits the greatest concentration of artefacts (n = 150), which includes cores, blanks, and waste as well as numerous distinct tool types (bifacial and partly prepared knives, notched and denticulate side scrapers, and retouched flakes). However, the density of the scattered cultural material is low, since the potential living area is relatively vast – stretching across the full extent of the chamber. A relatively large number of flakes, a few cores with refitted elements, bifacial knives, and a bone retoucher suggest a processing area, probably at the periphery of more stable settlement areas. These finds are a valuable counterpoint to the palimpsest record in the Ogrojec section of the cave complex, which seems to have offered the most favourable occupational location during that time.

The archaeological level III of the Main Chamber was dated by several radiocarbon methods, but different sample materials (i.e., bone, charcoal, and unburned wood) and dating methods provided results that are difficult to interpret (Alex et al. 2017). All radiocarbon dates from bone samples from Ciemna archaeological levels III, IV, and V produced minimum ages, or dates beyond the radiocarbon calibration curve, whereas a charcoal sample produced a significantly younger age than bone from the same stratigraphic sequence (Alex et al. 2017). However, an undisturbed process of sediment formation, and a lack of subsequent disturbances in this part of the cave system, are supported by detailed spatial analyses of flint artefacts and faunal remains. The latest dates, based on screened bone collagen of long bones, correspond well with the dating of other Micoquian sequences at Kůlna (Neruda 2017), Stajnia (Urbanowski et al. 2010), and Obłazowa (Alex et al. 2017).

The excavations conducted so far in the whole Ciemna Cave system have yielded several thousand flint artefacts produced by Neanderthals during the last glaciation. Some of these products obtained during the old excavations were initially classified as a material representation of the „Prądnicki industry", which was eventually accepted by Western European researchers as one of the links in the Micoquian complex. Further series of artefacts obtained from this site in recent years in the Main Chamber show another previously unknown layer with Micoquian artefacts (Level V) as well as cultural layers, placed deeper in the sediments, produced by Neanderthals, but significantly different from the Micoquian complexes. As a result, the cultural content of the layers of the cave system in the Ciemna Cave has been significantly enriched.

One of the important findings from the latest research on the Ciemna Cave refers to the late age of the Micoquian finds at this site. The chronometric analyses carried out place one of the last Neanderthal episodes in this cave at a time when Homo sapiens was already present in Europe. However, in

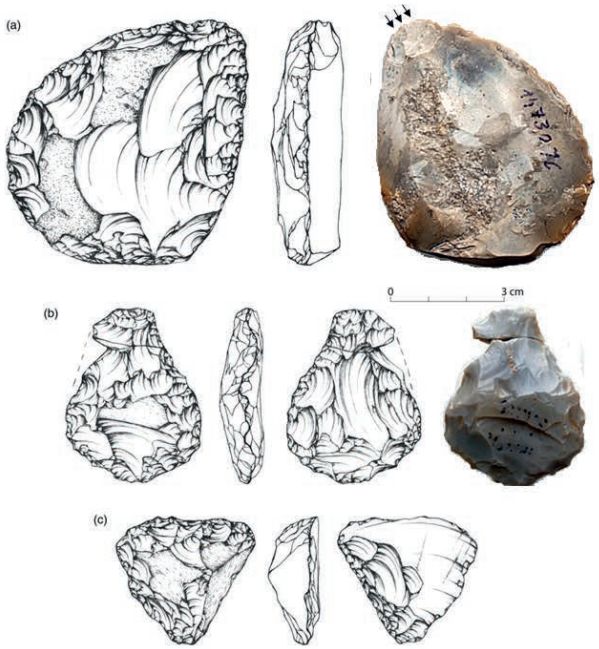



FIGURE 3. Selected tools from Ciemna Cave, Main Chamber, Vth cultural level (the oldest Micoquian) without Levallois features, with scrapers (a, c), denticulated, knife, refitted little handaxe (b). a, c - local Jurassic flint, b - radiolarite from the Pieniny Klippen Belt

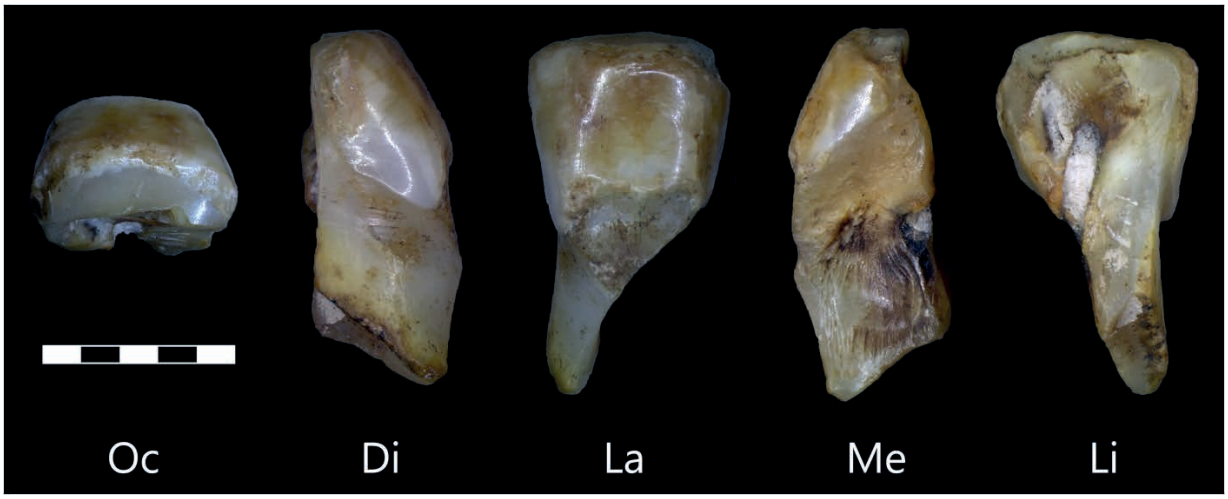



FIGURE 4. The Ciemna 1 mandibular incisor in occlusal (Oc), distal (Di), labial (La), mesial (Me), and lingual (Li) views. Scale bar represents 1 mm increments

various parts of Europe, including Southern Poland, the Neanderthal creators of the Micoquian complex may have survived until the appearance of anatomically modern humans. A significant role in this process was played by humans classified as so-called transitional cultures, a complex of cultures with leaf-points, especially Lincombian-Ranisian-Jerzmanowician, well known from the Ojców Upland.

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# PIETRASZYN, SITE 49A

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Pietraszyn Site 49a is an open-air site related to the late phase of the Middle Palaeolithic, located in the eastern part of the Głubczyce Plateau. Its southern part is adjacent to the Moravian Gate. The site lies approximately 14 m above the recent bottom of the Troja River valley (see Wiśniewski et al. 2019).

Geological studies conducted by a team (Badura, Kalicki and Heim) have enabled the identification of four members, which are associated with different sedimentary environments and have been labelled members A-D (starting from the top of the section), while the layers forming them have been marked with Arabic numbers. Member D is characterised by fluvio-glacial sands with a gravel component. The subsequent members, C and B, consisted of colluvial and fluvial sediments, respectively. Member C was composed of sand mixed with silt, and was distinguished by structures of convolute deformations. Member B was composed of gravel, sand, and silt, and a layer of sandy silt was formed on the surface of the eroded members C and D (B9). This layer, constituting the basal part of the accumulation of member B, exhibited a thickness ranging from 10 to 20 cm. The majority of lithic artefacts and single bones were recorded in the upper and middle parts of this layer (Fig. 1). It can be hypothesised that Middle Palaeolithic human activity occurred subsequent to the sedimentation of this layer. The overlying layers of member B indicated the development of slope and fluvial processes in small channels. The complex of member A at Pietraszyn Site 49a consists of a modern humus layer (20 cm thick) and remnants of features belonging to the Lusatian culture (Bronze/Iron Age). A few artefacts were also found in Trench 2/2012, but the stratigraphic situation in this part of the site differed from that in Trench 1/2012. In the bottom of Trench 2/2012, fluvial deposits were recorded, which had been cut by a layer of sand and gravel formed during the process of solifluction.

T. Lauer's pIRIR-225 dating suggests that the substrate sediments (D) belong to MIS 6 (Wiśniewski et al. 2019). The age assessment of set C suggests its deposition during MIS 4, while layer B9 with lithic artefacts and single bones was deposited at the beginning of MIS 3 or the end of MIS 4 (60 ± 6 ka). The higher layers of this assemblage received similar dating. These results completely undermine the earlier dating of the level with finds at Pietraszyn (Kozłowski 2016). Slightly later, using the OSL quartz method, Layer B9 in the northern profile of the site during P. Moska's research obtained a younger result (47.3±2.6 ka) (Wiśniewski et al. 2024).

## History of research

The site was discovered by amateurs during informal explorations in the early 1990s. The collection was compiled by E. Foltyn, who carried out survey work and sampling for dating. Based on luminescence dating (TL) of mineral sediments, the age of the finds was correlated with the oldest stage of the Micoquian in Central Europe, placed at the end of the Middle Pleistocene (MIS 6) (Kozłowski 2014). In 2001, two volunteer archaeologists found bifacial tools on the surface of a field not far from the published Site 49 (Fajer et al. 2001a; Fajer et al. 2001b), which we learned about a decade later. Field investigations in 2011, in which one of the researchers participated, ended with the discovery of further artefacts (Wiśniewski et al. 2015). Excavations in the area of the site between 2012 and 2022 yielded over 25,000 lithic artefacts and animal remains (Wiśniewski et al. 2019).

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FIGURE 1. Pietraszyn, Site 49a: A - layer B9 with finds of bone remains (including a mammoth tooth) and lithic artefacts; B - photogrammetric model of metre square with a cluster of lithic artefacts in layer B9 (created by A.Wiśniewski)

## Research methods

Field research at Pietraszyn 49a has been carried out from the beginning using traditional methods consisting of the exact location of finds and wet sieving of sediments. Geological and geophysical analyses were directed at finding out the physical and chemical characteristics of the sediments and their lateral and vertical extension. Palaeobiologists were also involved due to the presence of charcoals, and palaeozoologists analysed the animal bone remains. Lithic material studies have so far focused on reconstructing the process of bifacial tool manufacture and the manner of the use of the various tools found on the site. Accordingly, a refitting study and use wear analysis of retouched tools has been carried out. In addition, attempts have been made to compare the formal tools from Pietraszyn with other sites utilising the geometric-morphometric method (Wiśniewski et al. 2020).

## Results

### Tool manufacture

All tools were made of erratic flint, except for single quartz/quartzite and sandstone pebbles and their fragments. Most of the tools are made from Senonian flints, but flints from outside the Baltic basin are also present (Přichystal et al. 2022). The inventory includes objects in various stages of preparation and use, from nodules and chunks with single flake scars, through unfinished tools, e.g. due to unpredictable breakage, to heavily reduced tools brought to the site (see Fig. 2A and 3). It can be seen that a selection of flat nodules/chunks was made for shaping (Wiśniewski et al. 2020).

From the traceological examination, it is clear that a mineral hammer was used during the roughing and shaping phases. Bones/antlers were also used. However, the generally accepted pattern of first using a mineral hammer and then an organic hammer could not be confirmed. Ridge grinding was also used. When analysing the technique of flake detachment, we found that faceting was often used to prepare the striking platform. The angle formed during the shaping of the flat surfaces is very close to the angle of preparation of the Levalloisian cores. Many overshot flakes were formed during shaping. In general, it can be said that the retouch was mainly concentrated on the distal parts of the tools (tips, posterior parts and upper fragments of the cutting edge). The use of elliptical Fourier-based contour analysis suggests that the average shapes of the tools from Pietraszyn and several German sites are identical. It is suggested that cultural information may underlie these morphotechnical convergences. Overall, the structure of some of the tools from Pietraszyn 49a is similar to the scheme used at the Bockstein Schmiede cave site (Bavaria, Germany) (Çep, 2014).

### Area of activity

From the research carried out so far, it seems that Pietraszyn was a major site for tool manufacturing. Based on the present evidence, it can be concluded that hunting activities were also carried out at or near the site.

In the context of a large quantity of bifacial tool preparation debris, there were also tools that, according to K. Pyżewicz, showed traces of use. These tools represent typological forms such as sidescrapers, knives, retouched flakes, and single hand axes. They show traces of contact with skin and bone. Only in one case were other traces found: probably from contact with wood. The use-wear traces are clearly associated with butchery.

Bone remains of animals were found in the excavation area in Layer B9 (Fig. 1A). Unfortunately, the bones were badly weathered. Mammoth teeth, a rhinoceros tooth and horse teeth were preserved (in fragments). Most of the specimens were small and indeterminate fragments. It is worth noting that charcoal from *Pinus* sp. also occurred in Layers B9 and B8. However, apart from isolated artefacts, no other flint with traces of contact with fire has been found so far.

In conclusion, Pietraszyn Site 49a can be interpreted as a place of tool manufacture associated with hunting and butchering activities that probably took place nearby. Tools with sharp edges and penetrating tips (see Fig. 4), commonly interpreted as butcher's knives, played a key role (Claud 2015; Giria 2004; Jöris 2006; Rots 2009; Veil et al. 1994). Some of the tools produced at the site were used and abandoned. Some were made and transported out of the site, as evidenced by refits without the finished tools.

The site is one part of an extensive system developed by generations of Neanderthals living in the highlands and lowlands of central Europe. Similar elements of territorial organisation are known from other regions, such as Crimea (Chabai and Uthmeier 2006).

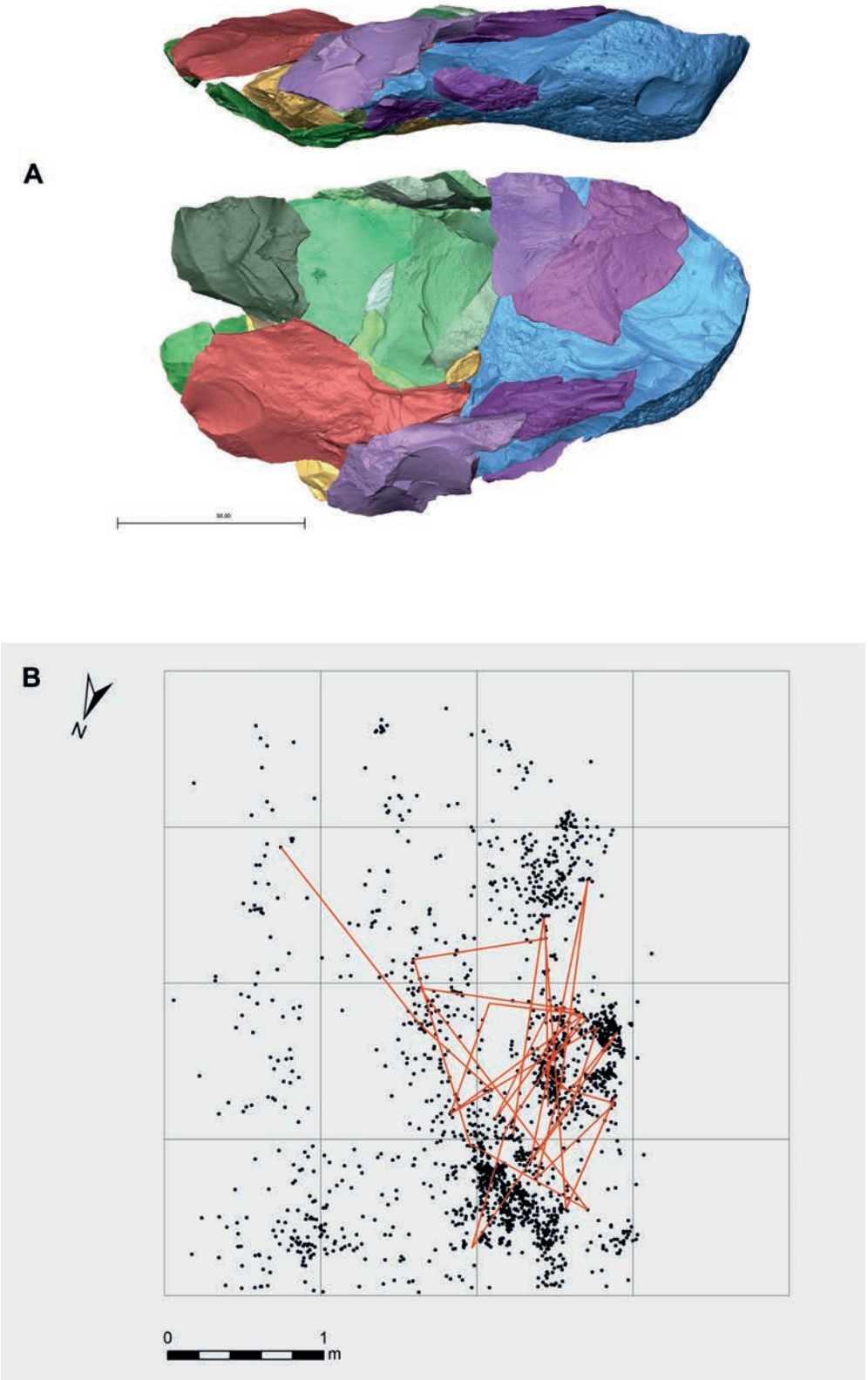



FIGURE 2. Refit No. 1 consists of 32 elements: A - 3D model; B - planigraphy of the southern part of a cluster with marked connections of the conjoined elements of the block (creation of 3D model by M. Weiss)



FIGURE 3. Block of refitted flakes and bifacial tool made of flint

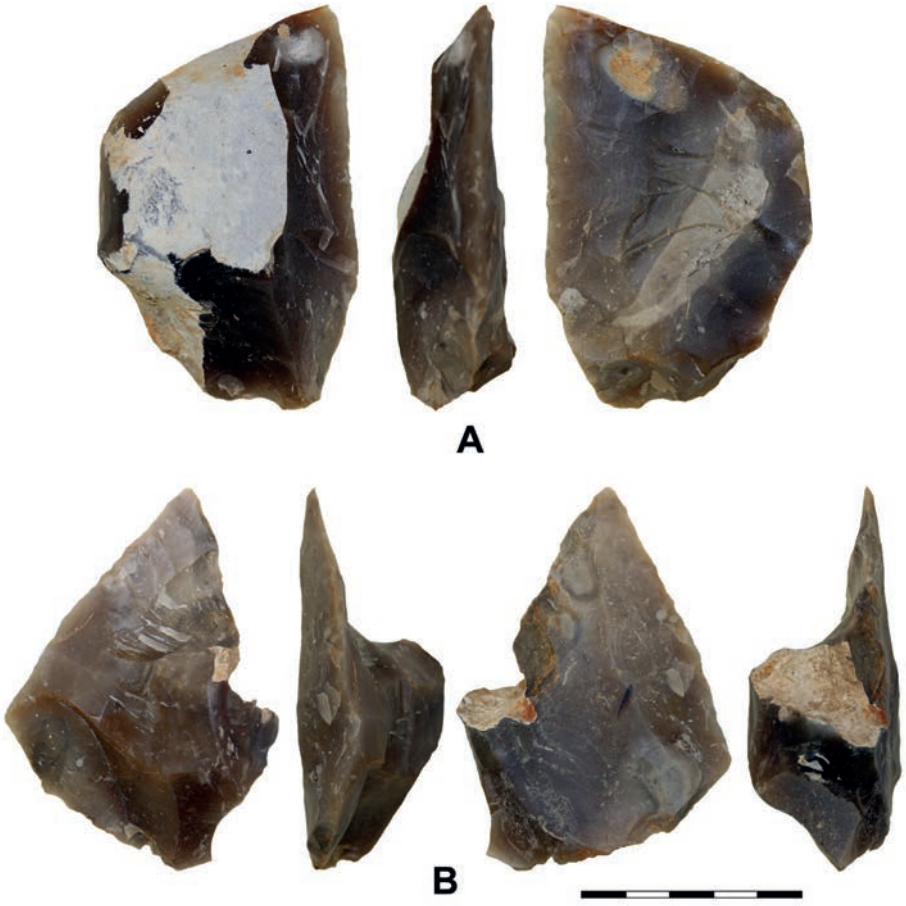



FIGURE 4. Bifacial knives made of flint

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# KRAKÓW SPADZISTA

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The open-air site Kraków Spadzista is the largest concentration of mammoth bones and teeth in Poland (both in terms of the number of bone remains and the number of animals). In this respect, it is one of the largest in Europe and the world, and in terms of archaeology, it is one of the most important Gravettian sites in Europe. Research at this site has been conducted from the beginning jointly by the Institute of Archaeology of the Jagiellonian University in Cracow and the Institute of Systematics and Evolution of Animals of the Polish Academy of Sciences (Sobczyk 2015).

The Kraków Spadzista site is located on Vlastimil Hofman Street, which until the early 1970s was called Spadzista Street (the symbolist painter Vlastimil Hofman had his studio here - hence the idea to change the street's name). Kraków Spadzista is located on the high northern headland of Sikornik hill (also known as St. Bronisława Hill), in the eastern part of the Sowiniec horst, on its northern slopes descending to the Rudawa River valley (Fig. 1A). The horst structure is composed of Jurassic limestone covered with a thin clayey residuum, over which patches of Miocene clays occur in places, while the entire surface of the Sowiniec horst is covered by loess. The archaeological site occurs on the surface of a triangular plateau, located in the northern part of the Sikornik hill. While the south-western part of the site gently transitions through a neck several dozen meters wide into the top part of the Sikornik hill, the northern part is delimited by a steep rocky cliff. On the western side is a relatively gentle gorge about 150 m long, and in the east and partly in the southeast runs a fairly deep gorge about 160 m in length. Today the total surface area of the headland is ~2 ha; the surface of the plateau itself is ~1.5 ha. The absolute height of the plateau ranges from 250 to 254 m a.s.l. and rises about 50 m above the bottom of the Rudawa river, a left tributary of the Vistula river (Łanczont et al. 2015; Sobczyk 2015).

Generally, the site's archaeological material can be treated as occurring in three layers. The Epigravettian lithic assemblage was deposited in Layer 5, which consists of Upper Pleniglacial loess deposits (MIS 2). The Late Gravettian artefacts were deposited in Layer 6 - soil composed of silty material, light grey in colour. It is very strongly disturbed by solifluction manifested by the deformations of involution type, the surfaces of which are accentuated by gleying and enrichment with iron compounds (Łańczont et al. 2015). Below the Late Gravettian layer, a yellow silty-clayey, strongly gleyed Layer 7 was described, from where single Aurigniacian artefacts were discovered. In the contact zone between Layers 6 and 7, strong disturbances and redeposition of sediments are visible, as well as secondarily displaced single bones and mammoth teeth.

Kraków Spadzista is the best dated Late Gravettian site in east Central Europe. The radiocarbon dates from the site indicate the site was occupied between 27 and 28.6 ka cal BP (Wilczyński et al. 2020). Compared to the Greenland ice core record (Rasmussen et al. 2014), the beginning of the occupation of the site can be correlated with the beginning of the short GI 4 interstadial between 28.9–28.6 b2k but the time span of the rest of the site overlaps the GS 4 stadial period between 28.6 and 27.8 b2k, then again hits the short 200 year-long interstadial GI 3. This record suggests that the first occupation of Kraków Spadzista was related to milder and humid climate but extended into a period of cold environmental conditions.

The spatial distribution of the bones and refittings of lithic artefacts show that solifluction

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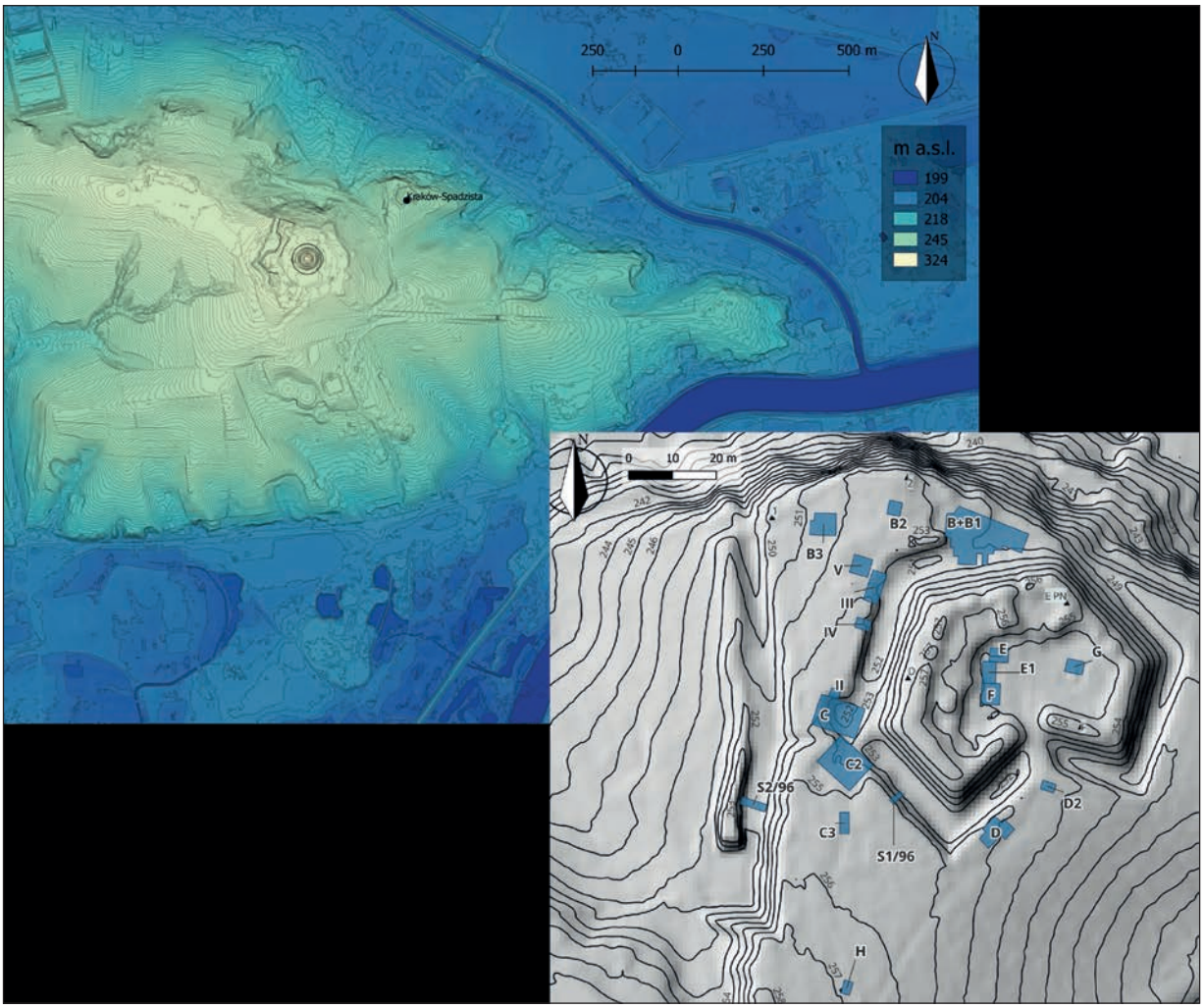



FIGURE 1. Location of the Kraków Spadzista in relation to the models of relief (1A) and the plan of the trenches at the site (1B)

has disturbed the original positions of bones and artefacts. The movement of sediments and their enclosed bones and stone artefacts due to solifluction in Zone III was directed from the east part of the bone assemblage to west. This movement generated greater thickness (up to 50–70 cm) of the bone remains in the western part of the assemblage. However, it is difficult to state how much this process has changed the original pattern of bone accumulation (Kalicki et al. 2007; Wilczyński 2007).

## History of research

The site was accidentally discovered in the late autumn of 1967, and systematic research organized by J. K. Kozłowski and H. Kubiak began in 1968 (Kozłowski et al. 1974). The site began to be noticed in the serious international literature shortly after this. In the 75th issue of the Paris journal *L'Anthropologie* dating from 1971, an article by J. K. Kozłowski and H. Kubiak was published bearing the tell-tale title of "*Premières Huttes d'Habitation du Paléolithique Supérieur en Os de Mammouth Découvertes en Pologne*", in which they clearly suggested the existence of two huts constructed from mammoth bones at the Spadzista site.

To determine the stratigraphic conditions for the archaeological and paleontological material present at the site, a series of controlled excavations were planned. As a result of many years of fieldwork, number of trenches that covered almost the whole surface of the plateau (Fig. 1B). The main



FIGURE 2. Kraków Spadzista, Trench B3. General view on the trench excavated in 2023 (photo by J. Wilczyński)

excavations exploring the site were conducted by J. K. Kozłowski (Trench B, Trenches II and V, C, C2), K. Sobczyk (Trench B1, C3, D, E and F) and J. Wilczyński (Trenches B1, B2, B3, C2, D2, E1, G, H).

## Methodology

Kraków Spadzista was one of the first sites in Poland to use three-dimensional documentation of artefacts. Here, too, since 2011, wet-sieving of the entire sediment including cultural layers has been performed. Radiocarbon dating results were also obtained very early for the material from this site, concerning samples from the Kraków Spadzista C2 area – (Kozłowski and Sobczyk 1987). Currently, archaeological, geological and zoological material from this site is subjected to a full spectrum of physicochemical analyses, including XRF scanning and stable isotope analyses of loess-paleosol (LPS) sequences, use of Near Infrared spectrometer (NIR) for quantifying collagen preservation in osteological material, mammoth aDNA sequencing or the Sr isotopic measurements using laser ablation multi-collector inductively coupled plasma mass spectrometry (LA-MC-ICPMS).

## Results

Based on many years of research conducted by three generations of archaeologists (J. K. Kozłowski, K. Sobczyk and J. Wilczyński), the Kraków Spadzista site is a short-term, winter hunting camp, where Palaeolithic hunters hunted mammoths. Here, they also quartered the hunted animals and took the meat to their camps (these would be the so-called „killing site" and „butchering site"). Late Gravettian hunters came to this site many times, staying there for several or a dozen weeks. During this time, they hunted mainly mammoths and Arctic foxes. As a result of many years of research, it was possible to determine the spatial organization of the site. Currently, it is divided onto three Zones (Sobczyk 1995; Wilczyński et al. 2012):

***Zone I (Camp area)*** includes Trenches C, C2, C3 and D, D2 and H. The considerable intensity of human activities carried out here, related to the

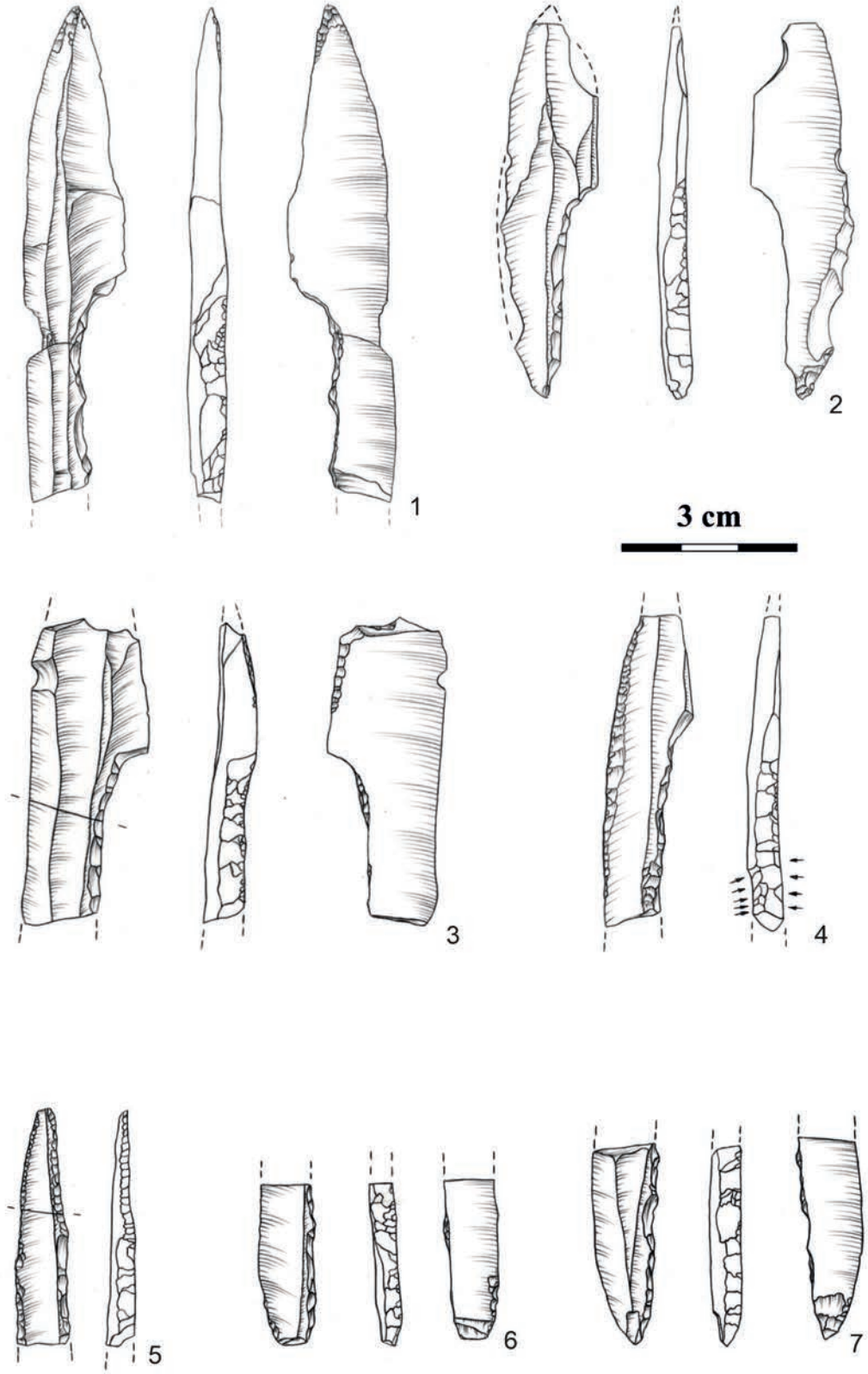



FIGURE 3. A set of shouldered points and backed blades discovered at Kraków Spadzista, Trench B+B1

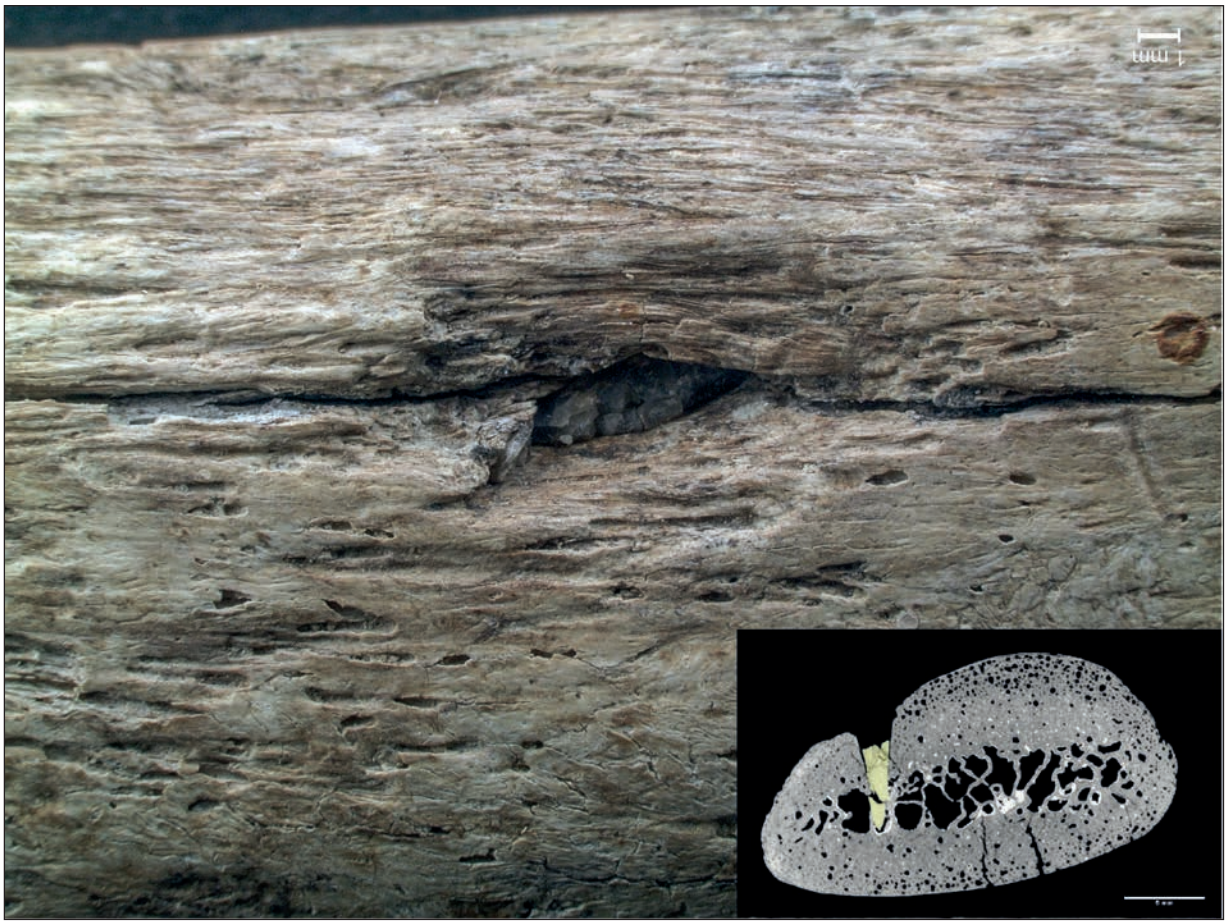


FIGURE 4. Part of a woolly mammoth rib from Kraków Spadzista, with an embedded tip of a flint point

production of tools and their use (e.g. processing of meat, stone tools production) is demonstrated by the large number of stone artefacts including retouched tools, which represent more than 10% of the stone inventory. A varied function of Zone I is also pointed out by the presence of teeth pendants as well as bone and ivory objects. Furthermore, numerous burned bones, which constitutes the remains of the bones used as a fuel in camp hearths, indicate the home/camp character of this zone. No signs of storage pits or dwellings structures were found which would speak in favour of a longer occupation.

***Zone II*** *(**Workshop area and area of animals processing**)* includes Trenches E, E1, F and G. Here was the area of stone tools production and processing of animals other than mammoth – Polar foxes. Small mammoth bone fragments including bone flakes, and lack of complete bones could suggest that they were broken within this zone. It has a mixed character between the two other Zones I and III. The absence of art objects makes it similar to Zone III. But small number of mammoth remains and the character of the stone tool inventory make it more similar to Zone I.

***Zone III*** (***Accumulation of mammoth bones***) is located in the north part of the site, confined by a rocky cliff, and the Trenches B+B1, B "workshop" in Trenches III and V, B2 and B3 are included in it (Fig. 2). In this zone, the mammoths were killed. Mammoth carcasses were there skinned, dismembered and filleted (Kozłowiski et al. 1974; Sobczyk 1995; Wojtal and Sobczyk 2005; Wilczyński et al. 2012). We would like to stress strongly that the creation of the assemblage of mammoth bones here is a result of human activity. There is a high concentration of remains of these animals within a small area, more than 30,000 woolly mammoth

bones and teeth, belonging to more 120 individuals, suggest that they were the prey of Gravettian hunters (Wojtal et al. 2019). This very high density of mammoth remains makes Trench B+B1 an absolutely extraordinary/unusual locality.

In this area we also observe a very high share of retouched tools, constituting about 20% of the stone inventory. Of these, almost half are elements of hunting weaponry – mainly shouldered points and backed blades (Fig. 3). On the basis of use-wear studies, it is possible to state that most of backed implements (more than 57%) from Kraków Spadzista Trench B+B1 were used as inserts of thrown hunting weapons (Kufel-Diakowska et al. 2016). This research was complemented by the discoverya projectile point tip embedded in a mammoth rib (Wojtal et al. 2019). This object cannot be recognized as proof a mammoth was directly killed by humans with spears/arrows. Embedded points did not penetrate into the thoracic cavity to damage lungs or heart. However, the fact that there is no trace of early bone healing on the Kraków Spadzista specimens indicates that the wounds were perimortem and death followed very soon after the injury. The lithic object is embedded in a segment of mammoth rib 20 cm in length, probably broken by trampling or solifluction. Features of this specimen suggest it was a distal part of rib. A fragment of outer cortical bone was chipped off when the point hit the rib (Fig. 4). This unique additional find confirms that the impact-damaged stone points and blades were used as killing implements.

In the last few years, it has been possible to infer the mobility pattern of woolly mammoths whose remains were discovered at the Kraków Spadzista site (Kowalik et al. 2020). The migration routes of mammoths from Kraków Spadzista most likely overlapped, as indicated by the very similar Sr isotopic composition of their dental tissues. The positive correlation of $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ indicates that the Kraków Spadzista site was the winter destination of the mammoths in this population. In early summer, mammoths set out to reach cooler areas and find forage, probably heading north. Similar results were obtained from Polar fox remains (Pryor et al. 2020). Laser ablation strontium isotope analysis of teeth from five individuals indicates that each analysed fox was born and grew up in a different and isotopically distinct location, and had migrated tens or hundreds of kilometres into the vicinity of Kraków Spadzista before being killed by Gravettian hunters. Data on the season of death gathered from the dental cementum of 14 fox individuals demonstrate that the majority were killed in a window between late winter and late spring. Given the predictable nature of seasonal changes in Arctic fox hide quality and bodily fat reserves, we argue that the foxes were most likely killed at the start of this window, i.e. in late winter. On this basis, we can assume with great probability that groups of Late Gravettian hunter-gatherers inhabited this site during the winter season. The number of mammoth individuals discovered here rather indicates that these communities inhabited this site many times, and the obtained radiocarbon dates indicate that this settlement covered a period spanning several hundred years (Wilczyński et al. 2020).

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# DZIERŻYSŁAW, SITE 35

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The Moravian Gate is an important communication corridor linking southern and northern Europe and, on a more local scale, the regions of Moravia and Silesia. Movements along the Odra valley through the Moravian Gate are documented from the early phase of the Middle Palaeolithic through to historical times. This is reflected in the strong cultural connections between the two regions.

Upper Palaeolithic settlement, including Magdalenian groups, also spread along this route (Neruda 2018; Bobak and Połtowicz-Bobak 2010). One of the richest and largest campsites associated with this cultural unit is the site at Dzierżysław (Głubczyce County).

The site was discovered in 1996 by Marek Gedl from the Institute of Archaeology at the Jagiellonian University, and since 1997 it has been investigated by the authors of this text.

## Excavation methods

The site was investigated using classic methods of Palaeolithic site exploration: its area was divided into square metres. Distinct artefacts (cores, tools, and characteristic forms) were recorded in three-dimensional coordinates, while debitage and waste were documented within quarters and in layers with a thickness of 5 cm. A total of over 400 square metres were investigated, encompassing virtually the entire campsite. Most artefacts lay in situ on the surface of the loess layer and in the basal part of the marsh soil. The site's surface was damaged due to human activity and (to a lesser extent) as a result of natural erosion processes.

## Location and stratigraphy

The site is located on the right bank of the Morawka River, within one of its palaeomeanders, about 2.5 kilometres east of the centre of Dzierżysław, on a slight morphological elevation situated roughly one metre above the average level of the valley bottom. It is surrounded by hills rising 50–60 metres above the valley floor (Ginter et al. 2002) (Figs. 1–2).

The stratigraphy of the site is not very diverse. The oldest deposits in the vicinity are grey Miocene claystones with gypsum. Above them, in the valley bottom, there are variably thick layers of glacial gravels and sands, followed by the youngest loess deposits (on the elevated areas). Overlying these is a layer of yellow-brown clay with admixtures of re-deposited loess. The Magdalenian archaeological material is located in the upper part of this layer.

On top of the clay layer there are dark, organic lacustrine sediments: remnants of a lake that formed later when the valley was blocked (during the Atlantic period) by a slope landslide of Miocene clays. Shallow, near-shore waters of this lake inundated the site and washed out the anthropogenic Magdalenian layer, causing partial displacement of the archaeological material. The youngest deposits are organic marsh-type layers in which features with Roman-period artefacts have been encountered.

The Magdalenian people settled on a small slope of a hill above the ancient Morawka River, which at that time was a fast-flowing melt-water stream (ibid.).

## Materials

The investigated campsite is an example of a typical seasonal domestic camp. In the excavated area, well-preserved spatial arrangements have been identified: concentrations of artefacts, hearths, and the remains of a dwelling structure.

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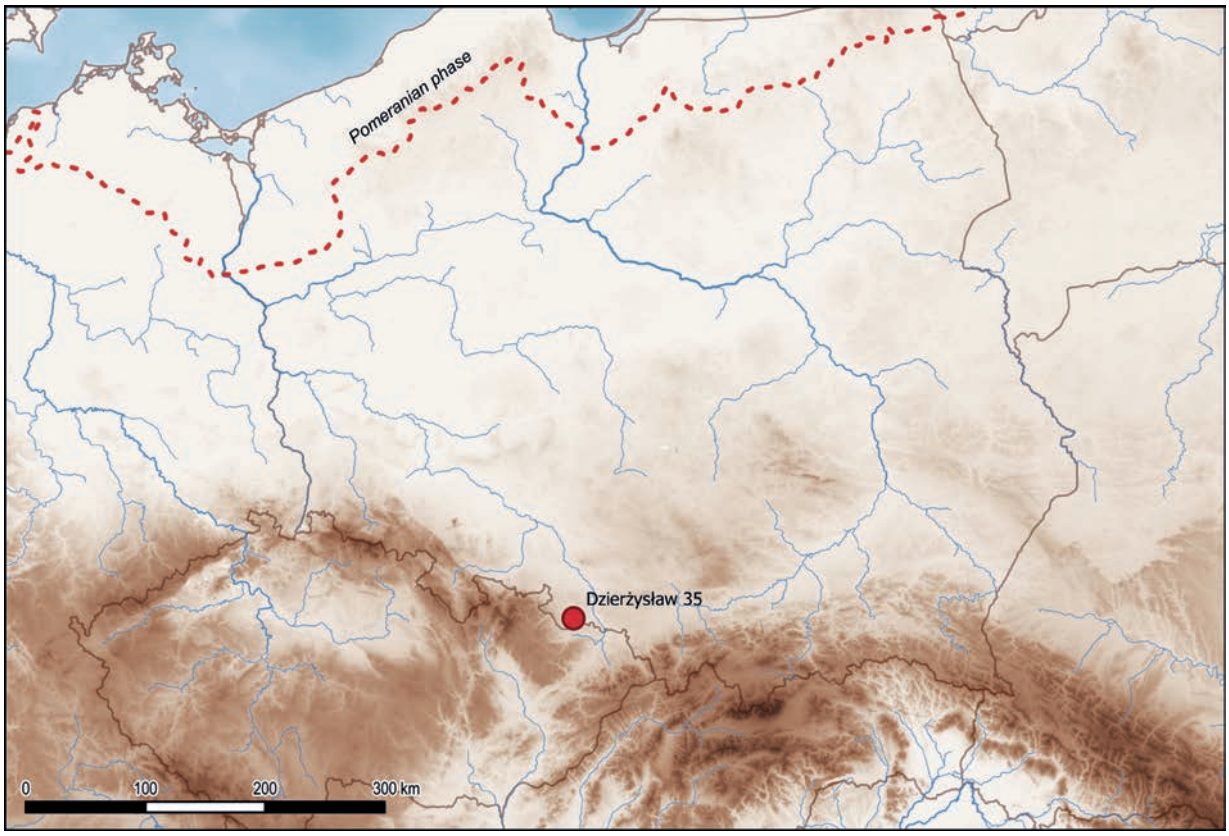



FIGURE 1. Location of the site

The flint inventory comprises over 34,000 artefacts, dominated by debitage and flakes. Accompanying them are stones – cobbles and stone slabs, most of which are part of the camp's structural elements – and very few animal bones and teeth. An additional several thousand artefacts come from the surface and the plough layer.

Local glacial erratic flint was almost the only raw material used; it occurs abundantly in the glacial deposits immediately adjacent to the site. A very small admixture of raw materials consists of quartzites and dark brown radiolarite. The quartzites appear to come partly from local glacial gravels and partly (probably) from the Sudeten region (analyses by M. Pawlikowski). The radiolarites originate from areas located south of the Sudetes and the Carpathians. These imports confirm connections between Silesia and regions situated south of the Moravian Gate. The flint artefacts are covered with a white patina.

The composition of the inventory is typical for a campsite: debitage and waste account for about 90% of all knapped forms, cores number over 500 (about 2%), and tools (approximately 2,500 pieces) make up about 5–6%. Burins are also numerous. The presence of a small group of burin-like tools (Fig. 3:15–16) is worth noting.

Cores, almost exclusively blade cores and, less frequently, bladelet cores, are represented by specimens from all stages of reduction, with a predominance of exhausted forms. Initial cores are rare; however, both their presence and the occurrence of waste products from all stages of preparation and rejuvenation indicate that the production of blanks took place on site. Single-platform cores clearly outnumber double-platform ones.

Within the tool assemblage, projectile points are the most numerous category (Figs. 3:1–14). Two main groups can be distinguished. The first and most abundant consists of asymmetrical triangles of various types, with retouch on two or three edges, including specimens with denticulated retouch. The second group comprises backed bladelets, among which simple backed bladelets are



FIGURE 2. View of the site

the most common. All projectile points are small in size, with most measuring around 30 mm. Another of the most important and numerous categories is burins (Figs. 3:18–20), primarily wedge-shaped forms, with angle burins represented to a lesser extent. Other types occur in much smaller numbers.

Together, projectile points and burins account for approximately 50% of all tools.

The remaining tools include well-represented perforators (below 20%) of various types, including the Zinken type. However, the characteristic long-point perforators typical of the Magdalenian are absent. Scrapers and splintered pieces are very scarce. Moreover, the scrapers are often crudely made, sometimes produced on short, thick blades or flakes; specimens with high scraping edges are also present. While splintered pieces in Magdalenian assemblages generally do not represent a significant tool category, the small number of scrapers is noteworthy. The assemblage is supplemented by tools typical of Magdalenian complexes, such as backed pieces (Figs. 3:21–22) and composite tools (Fig. 3:17), as well as retouched blades and flakes and a small number of blade tools and endscrapers. Evidence of tool repair and reworking is noticeable, indicating prolonged use of the materials discovered at the site were preserved *in situ*, which makes it possible to observe the spatial organization of the campsite. Two zones can be distinguished: a richer and more diverse southern zone and a northern zone. Both were occupied by communities belonging to the same Magdalenian facies, most likely within a similar time span. Spatial analysis, however, shows that these two zones were used separately and were not connected (Ginter and Połtowicz-Bobak 2020).

The spatial layout of the site is typical of seasonal Magdalenian campsites. It comprises 21 concentrations (Clusters) of finds of varying size and composition, separated by areas containing only a small number of dispersed artefacts. Some of these materials are clearly in a secondary context and may originally have formed part of the concentrations. The largest concentration (No. 11) covers an area of over 8 $m^2$ and contains more than 4,000 artefacts, whereas the smallest

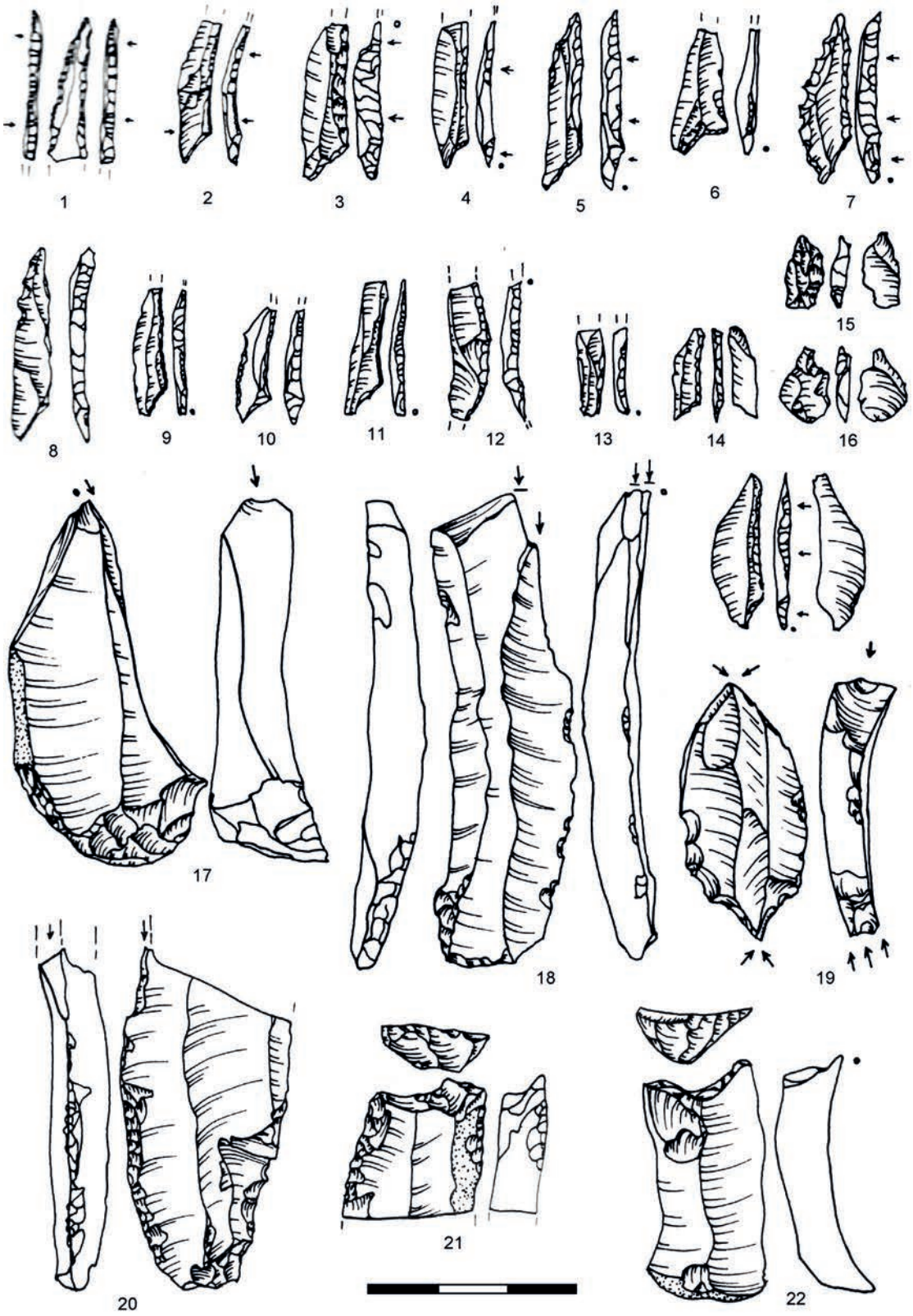



FIGURE 3. Selection of flint tools: 1–14 inserts, 15–16 microburins, 17 combined tool, 18–20 burins, 21–22 truncations (after Ginter et al. 2005)




FIGURE 4. Remains of a dwelling structure

consist of only a few dozen. Variation among the knapped artefacts primarily concerns the frequency of cores and tools. The observed differences in tool composition concern mainly the three most numerous categories: projectile implements, burins, and borers. In some concentrations, the knapped artefacts are accompanied by stones - pebbles or, less frequently, stone slabs – as well as clusters of burnt bones (e.g. Cluster 11). The occurrence of the latter is clearly confined to specific locations. Similarly, accumulations of ochre nodules are present in certain areas – another important indicator for the functional interpretation of the site. The most important structure is an arrangement discovered in the eastern part of the camp, interpreted as a dwelling feature (Fig. 4). The preserved traces allow it to be reconstructed as a type of yurt- or tipi-like structure with a circular or polygonal ground plan, with the construction based on a central post with a stone setting and posts arranged along the perimeter. The distribution of postholes suggests that the structure was erected several times, probably during different seasons of occupation of the site. The interior area covered approximately 9 $m^2$.

The spatial organization is also evident within the structure itself. Above all, a clear division can be observed between an activity zone and a resting zone. The latter is located in the eastern part of the structure, beneath its "wall", whereas traces of activity are concentrated near the west-facing entrance and partly inside the shelter. Such differentiated use of space, with a clear division into activity and resting zones, has been identified at various Magdalenian sites in Central and Western Europe alike (Ginter and Połtowicz 2006).

In the centre of the structure, beneath the occupation level, two deposits were discovered, consisting of raw nodules and cores made of local material. This is an example of stockpiling raw material used for the production of blanks and tools, indicating not only a longer-term occupation of the campsite but also its repeated use, that is, the return of groups of hunter-gatherers (Ginter and Połtowicz-Bobak 2008).

In front of the hut there is a hearth and a pit filled with hematite dust, in which animal bones and a small number of artefacts have been found. The function and significance of this pit, which appears to have been dug before the construction of the dwelling structure, are unclear.

The dwelling structure was located in the highest part of a promontory sloping down toward the river. Behind it there are more clusters marking different zones of activity: these include both workshops (Cluster 12) and concentrations in which, alongside prevailing debitage, numerous tools are present. Zones of tool production and repair are also delineated by concentrations of flakes. Within the largest cluster, located behind the hut (Cluster 11), numerous small, burnt bones were identified, along with elements of stone constructions, lumps and objects made of hematite. Particularly noteworthy are finds of hematite artefacts (a pendant, a fragment of a hematite bead, a female figurine?) as well as lamps made from limonite concretions (Ginter and Połtowicz 2002; Ginter et al. 2002).

Another zone with distinct concentrations of artefacts is observed in the northern part of the site. The tool assemblage is as that known from the southern part, but the quality of manufacture (especially of projectile inserts) is poorer. There are no traces of fixed constructions here, either, be it dwelling structures or hearths, and evidence of hematite is likewise absent (Ginter et al. 2020).

## Summary

The site at Dzierżysław is an example of a large, repeatedly occupied seasonal domestic camp. The dwelling structure, hearths with stone constructions, elements of portable art, and functional differentiation of space – all these features are indicators of a primary-type camp, inhabited for an extended period, where a group of Magdalenian gatherers and hunters carried out their daily activities. The activities carried out at the site: processing bone and other organic raw materials, working stone, and tanning hides, all reflect the classic set of tasks performed at domestic-type sites. The numerous projectile inserts are typical components of hunting weapons. The fauna hunted by the camp's inhabitants consisted of large herbivorous mammals: horse, reindeer, and mammoth - a typical assemblage of species at the heart of Magdalenian subsistence, especially horse and reindeer. The poor number of preserved remains does not allow the determination of a dominant species (Ginter et al. 2006).

The northern zone may represent an area that was functionally somewhat different, where occupation phases lasted for a shorter time.

The site at Dzierżysław is undoubtedly one of the most important traces of Magdalenian settlement in the eastern part of Central Europe. It is also one of the few Central European sites belonging to the "triangle" facies (Adaileh 2020; Sécher 2017; Höck 2000). The site closest and most likely related to the camp at Dzierżysław is the rich site at Hranice in Czech Silesia, on the southern side of the Moravian Gate (Moník et al. 2019; Neruda and Kostrhun 2002). Both camps may have been inhabited by the same people.

The radiocarbon dates, indicating the 17th millennium cal BP, as well as characteristic projectile inserts (asymmetrical triangles) allow it to be attributed to the final phase of the Middle Magdalenian (Sécher 2017) and make it one of the oldest Magdalenian sites in this part of Europe (after Maszyce Cave). Its location on the northern foreland of the Moravian Gate and its close connection with areas to its south indicate a route (or at least one of the routes) by which the Magdalenian complex spread into the territory of present-day Poland. The size of the camp and its richness, as well as the fact that it was occupied repeatedly and long-term, are all hints that this settlement was not episodic. Since the late phase of the Middle Magdalenian, it was part of a systematic reoccupation of Central European territories, including the part lying north of the arc of the Sudeten and the Carpathian mountains.



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# WIERZAWICE, SITE 31

Dariusz Bobak, Marta Połtowicz-Bobak

South-eastern Poland, including parts of the Carpathian mountains and the Subcarpathian region, as well as the southern section of the Sandomierz Basin, marks the eastern limits of the Magdalenian complex. The earliest find identified with this taxonomic unit in Poland was an isolated bone harpoon, discovered accidentally in Przemyśl in 1943 during earthworks (Kozłowski 1977).

The last twenty-five years have brought the discovery and field investigation of several sites that make it possible to identify settlement of this cultural unit along the San River and its tributaries (Bobak and Połtowicz-Bobak 2018; Połtowicz-Bobak 2020). One of them is the campsite at Wierzawice, Leżajsk County.

The site was discovered in 2009 by Sylwester Czopek (Archaeology Institute, University of Rzeszów – IA UR) during field surveys associated with the construction project for the Leżajsk ring road. Initial test excavations carried also in 2009 by Sabina Tokarczyk led to the identification of Magdalenian materials. Excavations were conducted between 2009 and 2012 by Dariusz Bobak (FROA) and Marta Połtowicz-Bobak (IA UR). Geological research was undertaken by Maria Łanczont, Przemysław Mroczek, and Jarosław Kusiak (University of Maria Skłodowska-Curie) (Bobak et al. 2010).

The site was investigated using standard methods applied in Palaeolithic research: excavation was carried out within a one-metre square grid, and artefacts were recorded three-dimensionally. During the final field season in 2012, sediment screening was also employed.

## Location and stratigraphy

Site 31 at Wierzawice is located on the eastern periphery of the Kolbuszowa Plateau (Fig. 1). The site's topography clearly reflects the environmental preferences of its Palaeolithic occupants. It lies in the lower part of a long, gently sloping east-facing incline of a residual hill with a summit reaching 221.4 m a.s.l; this elevation – the highest point in the surrounding area, with excellent vantage properties – is situated only about 700 m from the site. It offers an extensive view to the north and east, overlooking the valley depressions of the Błotnia and San rivers, which were probably migration routes for game. The site is situated at an elevation of 188 m a.s.l., which, during its occupation, provided a location close enough to the valley floor (at least 10 m lower) while remaining safe, and also offered protection from the prevailing westerly winds of the period (Bobak et al. 2017; 2022).

The archaeological site lies within an area of cover deposits developed as periglacial stratified silty-sandy sediments with a thickness of about 10 m, closely bordered from the northwest by an isolated, island-like patch of loess.

The layered surficial deposits at the site were investigated to a depth of 2.7 m. The sediment profile is divided into three units (Fig. 1). The upper unit (0.25–0.6 m thick) is disturbed (ploughed) modern soil composed of silty sands and sandy clay. The middle unit (approximately 0.4 m thick), dominated by silt-sized fractions, contains structures characterized primarily by segregated grain sizes, interpreted as the result of secondary material sorting, probably caused by cryogenic processes. The lower unit of the profile (with the top of this section lying at a depth ranging from 0.45 to 1.0 m) is a rhythmite sequence composed of thin layers of varying thickness, from 2–5 cm up to 10–15 cm, with irregular, wavy bedding. These layers consist of differently coloured sands as well as clayey and silty sands with pronounced grain-size segregation, transitioning into yellowish-grey loose

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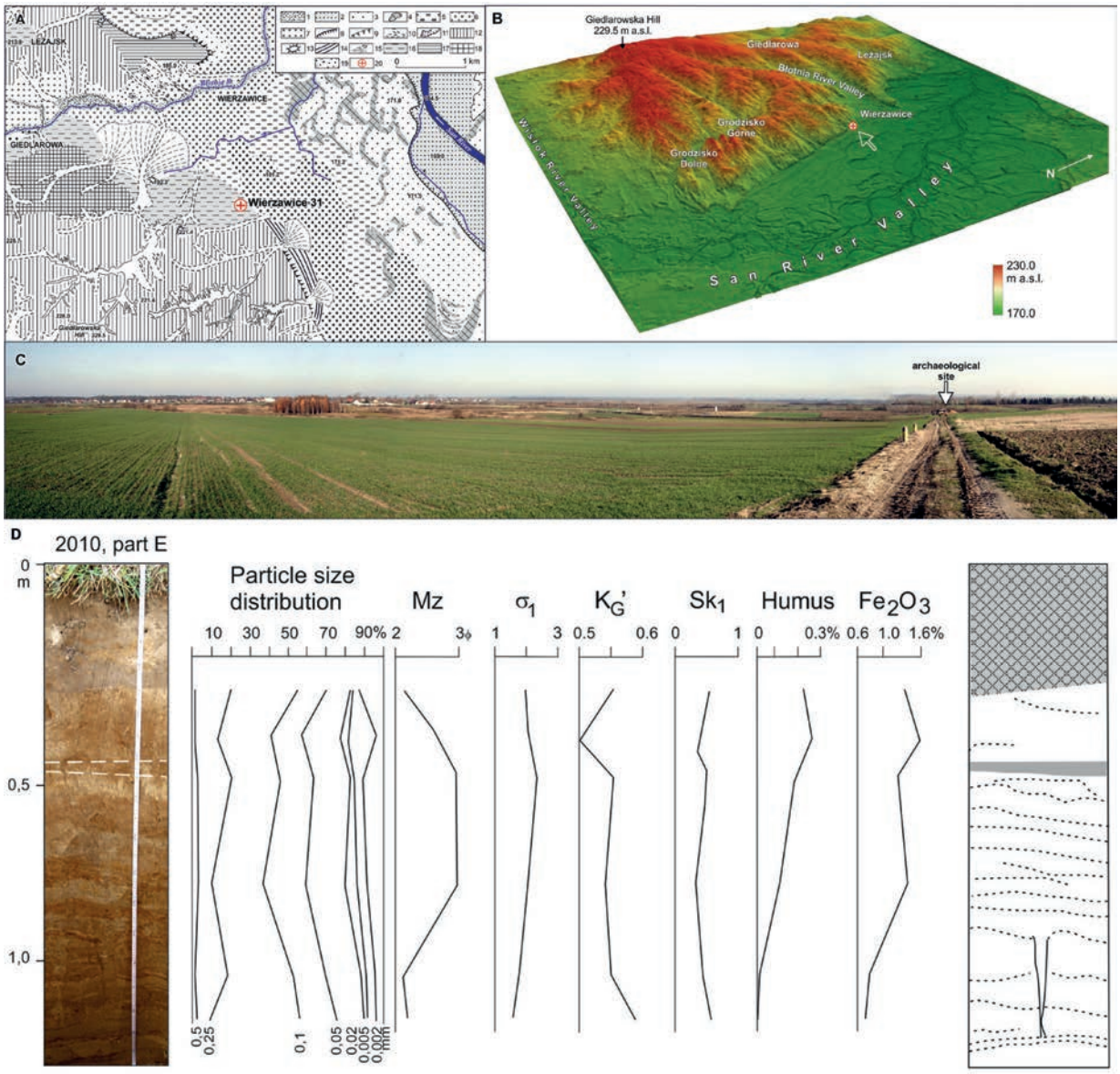



FIGURE 1. Location and stratigraphy of the site (as in Bobak et al. 2017, modified; drawn by D. Bobak)

quartz sands containing occasional gravel. The near-surface layer of this lower unit (about 0.1 m thick) is characterized by partially-obscured sedimentary structures, a slight enrichment in humus (up to 0.15%), and a higher $Fe_2O_3$ content (1.6–1.8%) compared to the modern soil, as well as traces of pedofauna activity, indicating the onset of pedogenesis. Stone artefacts were present in this layer. The deposits on which the initial soil horizon with the cultural layer developed were formed under a cold, periodically humid periglacial climate as a result of the combined action of various slope processes (wash, mudflows, solifluction) and aeolian processes (Bobak et al. 2017; 2022).

## Archaeology

From the investigated area, covering nearly 40 $m^2$, just over 3,400 stone artefacts produced by knapping techniques were recovered, along with stones, some of which form an in situ structural arrangement. The technological and typological characteristics

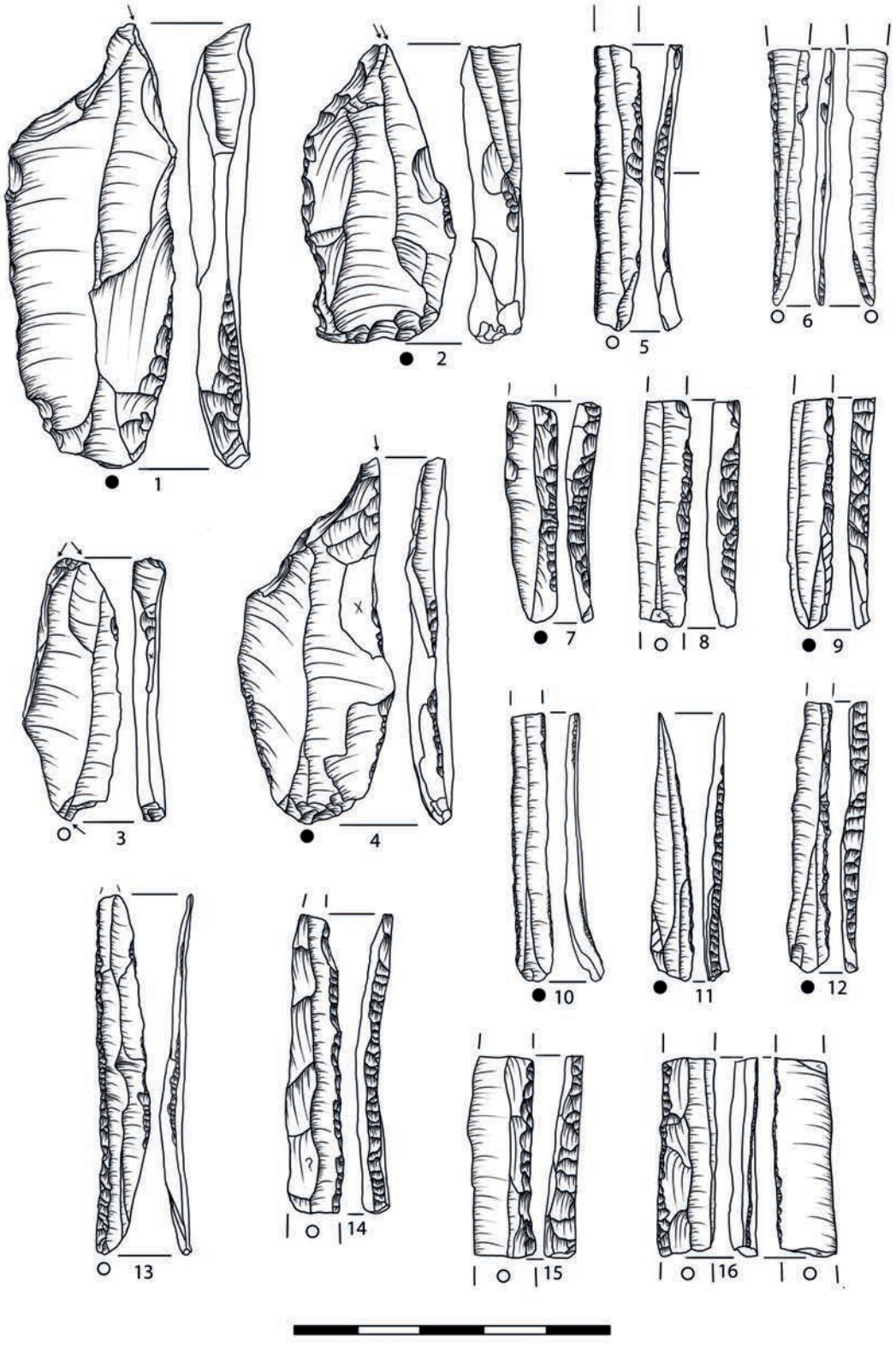



FIGURE 2. Flint artefacts: 1–4 burins, 5–16 lithic armatures (as in Bobak et al. 2017)

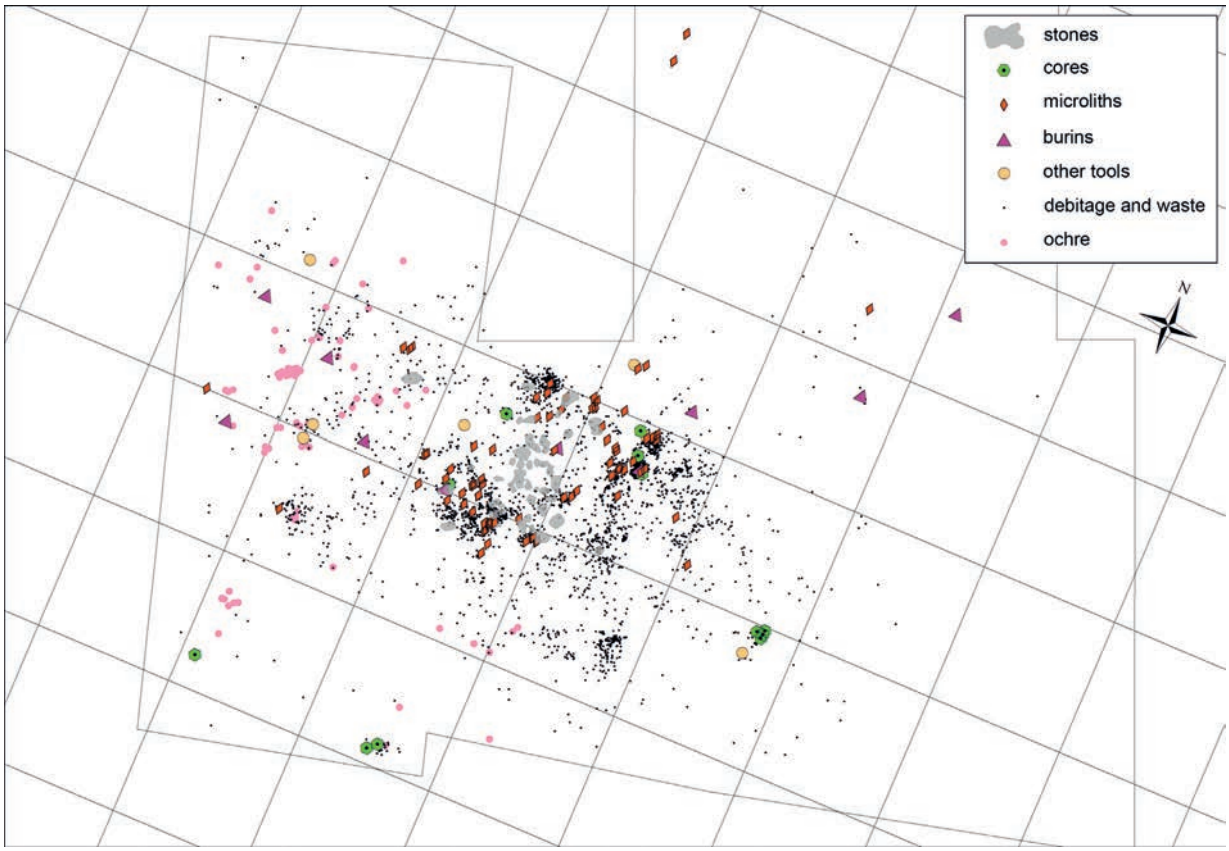



FIGURE 3. Site plan (drawn by D. Bobak)

of the assemblage suggest a remnant of Magdalenian occupation (Bobak et al. 2017; 2022).

In the flint inventory, local erratic flint prevailed, whose deposits may be found on the Kolbuszowa Plateau, along with smaller quantities of chocolate flint and Świeciechów flint. Other flint types occurred only sporadically, including single specimens of Jurassic flint and possibly Volhynian flint. Both chocolate and Świeciechów flints originate from more than one source. These two types indicate a network of contacts connecting areas along the middle and lower course of the San, which also corresponds to concentrations of Magdalenian sites in south-eastern Poland and on the Sandomierz Plateau, at the confluence of the San and Vistula rivers.

The cores preserved in the assemblage are mainly heavily exploited blade cores, with a predominance of opposed-platform forms. A clear discrepancy between the size of the cores and the length of the blades indicates strong reduction of the nodules and thus their intensive exploitation. The cores were prepared outside the site, as evidenced by the near absence of waste from the early stages of preparation. Classic blade cores are absent, although blades are present within the débitage as well as among the lithic armatures.

The tool assemblage, comprising 96 pieces, represents about 3% of the entire inventory, a proportion fairly typical for a campsite (Fig. 2). Of special interest is the distribution of tool types. The assemblage is overwhelmingly dominated by lithic armatures, which account for 68% of all tools (Figs. 2, 5–16).

Typologically, this is a relatively diverse group. Ordinary distal blades prevail (over 50% of all striking platforms), accompanied by backed blades with retouch on the second edge, including a few with ventral-side retouch, as well as backed blades with retouch on the shorter edge and backed blades with inverse retouch. However, no rectangular or curved-end backed blades are present. The lithic armatures were made on flakes or narrow blades, and the tools exhibit features indicating that they



FIGURE 4. Hearth (photo by D. Bobak)

represent different stages of use or production. Undoubtedly, some of them were produced on-site as part of the maintenance and renewal of the toolkit. At the site, refits were found that illustrate different stages in the production of lithic armatures. The presence of both new and used forms is also confirmed by traceological analyses – a significant portion of the lithic armatures show no use-wear, suggesting they are freshly made tools intended as inserts for organic handles, while others exhibit traces of impact or other types of use (Bobak et al. 2017).

Lithic armatures are accompanied by much less numerous burins, which account for 18% of

the assemblage (Figs. 2.1–4), including Lacan-type burins (Fig. 2.1–2; 4), as well as a few end-scrapers, truncations, flakes and retouched flakes, and single examples of perforators, denticulated tools, composite tools, bipolar cores, and fragments of other retouched forms. Notably, perforators are almost entirely absent – tools that are usually fairly common in Magdalenian assemblages.

One of the most important features of the Wierzawice site is its excellent state of preservation, with artefacts remaining in situ (Fig. 3). This allows for the reconstruction of the campsite and the analysis of the spatial and functional variability within the investigated area.

The central feature of the campsite is a hearth surrounded by a stone setting made of granite cobbles and sandstone slabs (Figs. 3, 4). Traces of burning are preserved as scattered charcoal fragments mixed with the sediment, accompanied by small, partially burnt flint artefacts.

Around the hearth, clearly associated small, dense concentrations of flint can be observed, representing the remains of lithic armatures production areas. Refits indicate that these are locations where backed blades were both manufactured and, it can be assumed, replaced or renewed in their handles. The backed blades found in the vicinity of the hearth are accompanied by a few cores, mainly for small narrow flakes, as well as associated débitage. Additional cores were located at a greater distance from the centre. Two concentrations of cores and débitage can be interpreted as the remains of small work areas where débitage was produced.

The final distinctive area is located on the western periphery of the campsite. This sector is the only one where numerous traces of hematite were identified, primarily occurring as powdered residue mixed with the sediment. The area also contained many burins, and some individual artefacts were coated with hematite dust. Both the hematite stains and the tools (burins and a few end-scrapers) suggest that this was a zone for working animal materials – probably a place for butchering carcasses or processing hides.

No traces indicating the presence of a dwelling structure were identified.

The characteristics of the site (both the composition of the stone assemblage and its spatial organization) allow for an interpretation of its type and function. Most likely, it represents a typical, small, short-term hunting camp, occupied for a brief period (perhaps a few days) by a small group of hunters. The campsite was probably a stopover during a hunting expedition, where game was butchered, tools and weaponry were repaired or replaced, and perhaps partly processed game was prepared for transport along the journey. Cores, brought to the site already as prepared forms, were discarded once they had been fully exploited.

The spatial arrangement in which the lithic armatures are found in direct proximity to the hearth is known from other Magdalenian sites (Monruz, Gönnersdorf) (Bobak et al. 2017, with further literature there). This connection arises not only from the comfort of the producers but also from the need to use fire for melting the binders used to set the inserts in organic mounts. Similarly, at other sites, the zones for butchering game and processing hides were located on the outskirts of camps, which is usually explained by broadly defined hygienic considerations and comfort. In the case of Wierzawice, these "peripheries" are only two metres from the hearth, but this is a designated area located outside the centre of the camp and beyond the zone that was most intensively used. The very limited and short-term use of the campsite is also evidenced by the very small number of domestic tools, alongside a high proportion of tools from the weapon category. This function, directly related to hunting activities, perfectly aligns with the site's location at a vantage point on a possible game migration route.

Wierzawice is one of several important Magdalenian sites located on the eastern fringes of this taxonomic unit's distribution. Alongside it, noteworthy sites include the campsite at Hłomcza in the Carpathians, the stray find of a harpoon from Przemyśl, as well as Grodzisko Dolne situated on the border between the Lower San Valley and the Kolbuszowa Plateau and the more distant site at Łąka, situated on the Wisłok River, a tributary of the San. With the exception of the single randomly found harpoon, the rest of these sites have yielded meagre inventories, and constitute remnants of small camps that must have been occupied briefly. So far, no site has been discovered that could be considered a large primary campsite. The types of stone raw materials, also documented at other sites in the region (chocolate flint and Świechów flint), indicate connections with areas located further north, at the confluence of the San and Vistula

hosting large, long-occupied camps. South-eastern Poland may thus have served as an economic hinterland for the settlement centre from the Sandomierz Upland (Połtowicz-Bobak 2020).

Notably, the settlement was very young. Two radiocarbon datings obtained from charcoal from the hearth yielded results of 13471–13300 and 13160–12714 cal BP, corresponding to the Allerød period. Therefore, it is one of the youngest Magdalenian sites. At the same time, the inventory did not provide artefacts with "late" features such as bow backed blades or short end-scrapers known, for example, from the Epimagdalenian site in the Kůlna Cave (Valoch 1988, 2001). Perhaps both the relatively young age of the site and its classical character can be explained by its peripheral location (Połtowicz-Bobak 2020).

The nature of Magdalenian settlement in south-eastern Poland and its connections with areas located farther to the west, north, and south should be the subject of further research. Above all, new, well-documented sites are needed. Undoubtedly, the camp at Wierzawice is – and will remain – one of the key points on the map of Magdalenian settlement along the eastern limits of this cultural unit's range.

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# WROCŁAW-ŻERNIKI, SITE 25

Jan Michał Burdukiewicz

The Magdalenian site Wrocław-Żerniki Site 25 (AZP 79-27-121) was discovered during preventive excavations undertaken in Wrocław city in 2007 before the construction of a new motorway A8. The rescue excavations at the site Wrocław-Żerniki 25 after discovering numerous lithic artefacts were changed into an interdisciplinary project, which was carried out from May to October of 2007 (Burdukiewicz et al. 2023). The site is located in the western part of Wrocław city (geographic coordinates N 51°04'11", E 16°56'01").

## Stratigraphy of the site

Within the cross-section (117–115 m a.s.l.), the following soil horizons and geological layers were distinguished (Fig. 1):

- 0–27 cm – Ap – arable layer – sandy humus, composed of fine-grained sands (2.5YR3/2 in Munsell's soil scale),
- 27–51 cm – E –light yellow color (10YR 6/3), degraded loess sediments,
- 51–77 cm – Bv – loess and fine-grained sand locally hardpan (10YR 5/6),
- 77–191 cm – level C–fine-grained sand with layers of gravel at depths,
- 111–113 and 176–178 cm, there were distinct layers of gravel (the bottom of the trench). Lithic artefacts were mostly found below in the humus in degraded loess.

## Lithic concentration

The most interesting finds at the site are the remains of an oval-shaped lithic concentration, 18 m length, 14 m width and 0.4 m thick, containing about 4,500 flint artefacts (Fig. 2). There were 129 cores and 163 retouched tools. In the central part of the concentration hearth traces and numerous stone slabs were found (Burdukiewicz et al. 2023).

The site is located close to the Odranian moraine rich in erratic flint nodules and chunks. The size of the cores, based on lengths wide-ranging between 33 and 97 mm and the mean core length was 56.9 mm. On this basis, it can be observed that medium-sized flint nodules were used. An exception was one of the initial cores, which was up to 97.72 mm long and 110.35 mm wide. A clue in this regard is the length of the biggest blades, which reaches up to 97.37 mm. However, longer blades are rare and of the others the length of only six blades exceed 60 mm. Certain flakes reached also large sizes and the length of one of them is 66.39 mm, which clearly exceeds the average length of the cores. The state of preservation of the flint artefacts suggests that the raw material used at Wrocław-Żerniki 25 site must be classified as of good quality.

The debitage was obtained from flint nodules and chunks, especially from grey and brown flint, the share of which on the site is the most marked and for each of them exceeds 34% of the total. The remaining raw materials, such as cream and brown flint, do not exceed 10% of the total amount of pieces. The striking angle was important to get good blades and flakes and quite often were prepared striking platforms and flaking surfaces. Their use and important role in giving the desired form to the cores are indicated by characteristic blades and flakes, such as the crested blades, of which a total of 12 occurred in the Wrocław-Żerniki 25 assemblage.

The flint processing method includes single and double-platform cores as well as cores with changed orientation, the percentage of which is the biggest of all technological phases and

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constitutes over 70%. The most numerous are single-platform cores, especially for blades (18.4%) and blade-flake cores (16.1%), as well as cores with a changed orientation for blades and flakes (Fig. 3). It should be stressed that of all kinds of the cores, the specimens from which the blades and flakes were obtained are dominant, and the highest percentage of them is noted among cores with a changed orientation (19.54%). The high amount of this kind of cores is probably related to the technique of rejuvenation of the core angle, as evidenced by the so-called hinges stopping further use. There were 87 specimens cores of all kinds in the advanced sequence of core reduction (not counting core fragments, which were included in the group of advanced core exploitation sequence). In terms of core preparation, the most numerous are specimens with a formed platform, characteristic blades, such as the crested blades.

The preparation of flaking surface was important in the blade technology, as it allowed the cores to be shaped into narrow to get slender blades. The most characteristic is usage of the striking platform by shaping very flat bulbs characteristic for the Magdalenian.

## The tools

The number of tools and waste from their production are quite limited compared to all other technological sequences, and their proportion amounts to only 4% of the total lithic inventory. Almost 59% of the tools were made from blades, while flake tools account for 38% of all tools, which gives them the second place in terms of the most-used blanks.

The statistical analysis shows the highest proportion of retouched blades (30%) and flakes, which constitute over 24% of all tools. In this group, the most numerous are the ones retouched on one edge, parallel to the knapping direction. The backed bladelets are particularly important tools because they are often considered the forms distinctive of the Magdalenian. The share of these tools is over 9% and is comparable to the end-scrapers. Small backed bladelets are among the forms that always appear in the lithic concentrations of the Magdalenian, and in entire ensembles they usually very numerous.




FIGURE 1. Stratigraphy of Wrocław-Żerniki 25. Location of the lithic artefacts (white dots) in loess layer

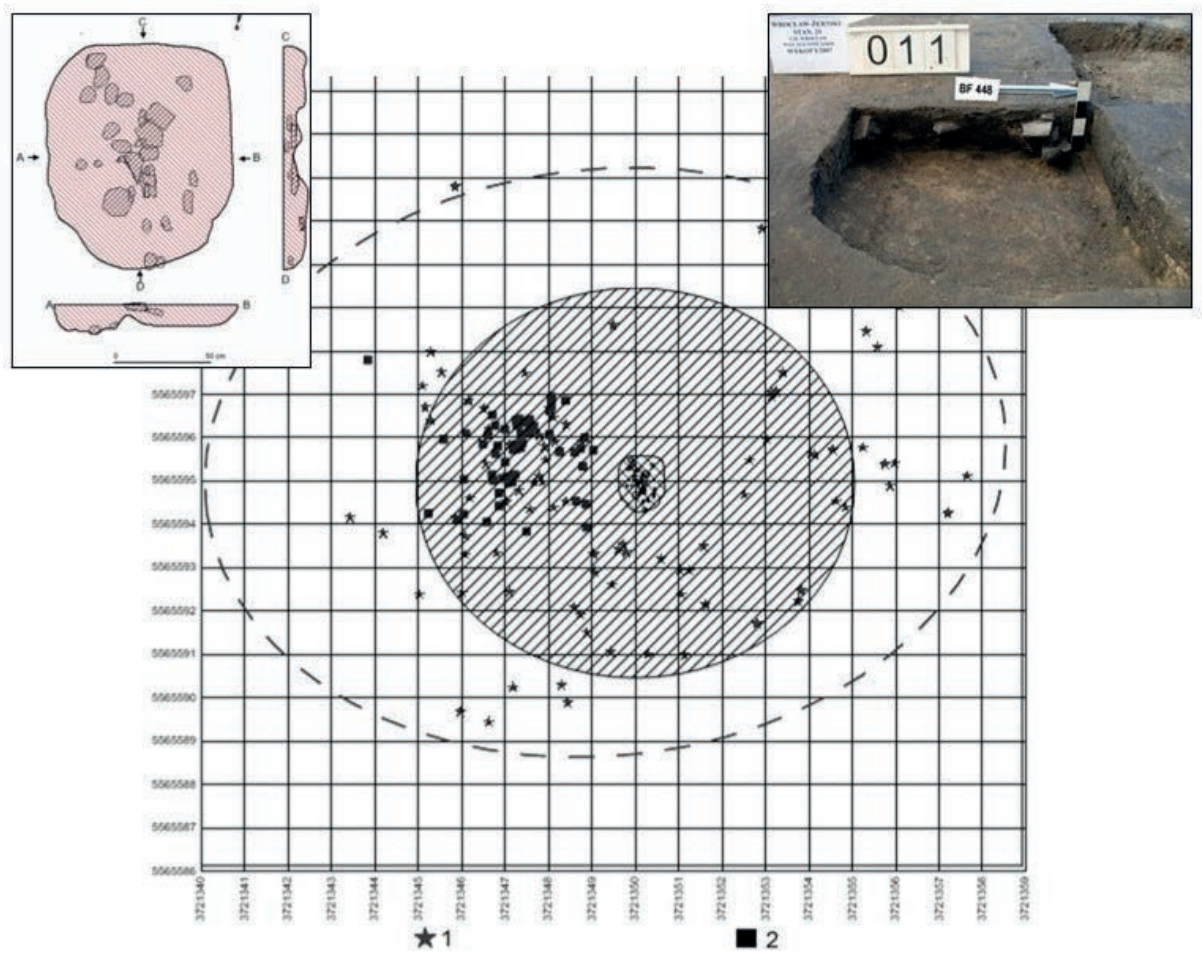



FIGURE 2. Wrocław-Żerniki 25. The lithic concentration (larger circle), the habitation (smaller circle) with hearth in the centre, burnt flints (stars) and stone slabs (squares)

The most frequent backed bladelets in the analyzed complex are triangle points, the forms of which end in a slanted truncation, giving them the shape of an elongated, non-equilateral triangle. Most of the specimens were unfinished by the manufacturers, as evidenced by the partially retouched back (Fig. 4). The other point types, such as the full-arched point and wavy-back point are rare.

Among the end-scrapers, the most numerous are slender blade specimens retouched on the distal part and frequently with additional retouch on one or both edges. Specimens with a rounded, oblique, and pointed end-scraper front predominate. Short end-scrapers are rare and are represented by just two specimens. One of the end scrapers was made from a core.

Burins are rare and represented by two specimens; one of them is a burin on unprepared end the second is a core-burin. On the other hand, the more frequent production of burins is evidenced by the number of burin spalls, among the 6 specimens, 2 burin spalls show retouched edge, which means that they were removed from burins on the retouched end.

In the group of denticulated and notched tools more numerous are the latter, amounting to almost 9% of the group. On the other hand, two saws on one edge constitute only 1% of all tools.

The truncated blades are slender with mainly oblique and transverse truncations, with straight or concave retouch (Fig. 4). Only one truncated piece with a concave oblique truncation was made

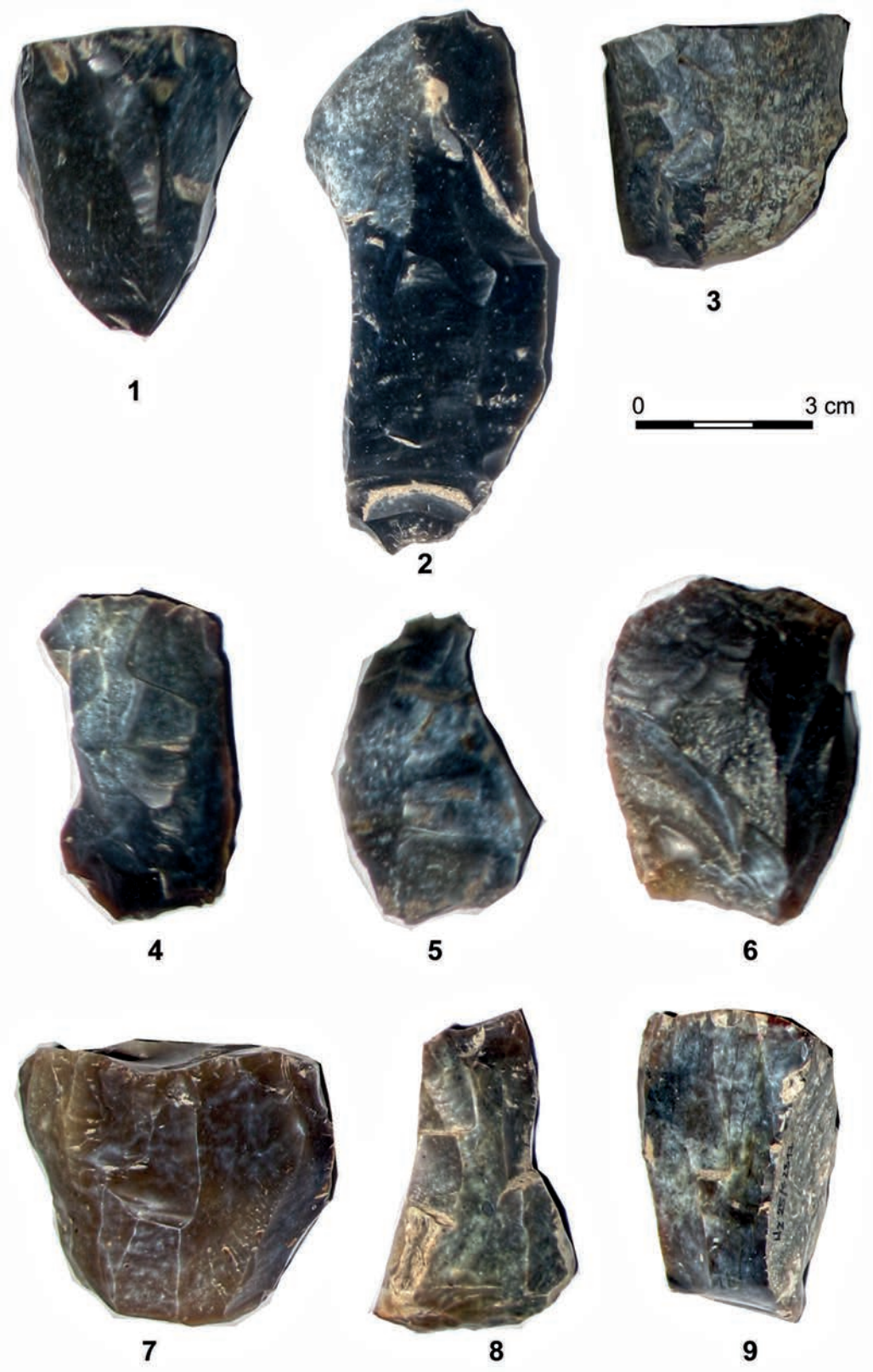



FIGURE 3. Wrocław-Żerniki 25. The cores: 1–3 – double platform cores; 4–9 – single platform cores

of a flake. this tool group account for over 7% of the total.

Further groups are Zinkens, perforators and borers. These were less numerous, and their share amounts to 5% of the total. Perforators prevail, including types with long prong (Fig. 4). The borers, of various types, often very small, are relatively rare, and their share in other Magdalenian sites usually amounts to about 5% of all tools. Only one piece was identified as a single end Zinken.

Another group of diagnostic tools which were found in Wrocław-Żerniki 25 are shouldered points represented by two pieces (Fig. 4). Both shouldered points were retouched on one edge shaping the point and asymmetrical shaft. Such shouldered points are mostly seen as distinctive of the Hamburgian culture, but are they are also numerous in the fourth phase of the Magdalenian technocomplex.

Additional tools diagnostic of the Magdalenian technocomplex are so called combined tools. In Wrocław-Żerniki 25 was found a combination of perforator and truncation (Fig. 4). Three pieces partly retouched were classified as unspecified tools because they were broken.

The tool shaping process was completed using various retouching techniques. Steep edge retouching was commonly used, the share of which is almost 47% among the tools. Many tools show a scale retouch (24%) and a notched retouching up to 10%. Surface retouching is rare and amounts to less than 1% of tools.

## The hearth and stone slabs

The flat hearth was found in the middle of the lithic concentration. It had an irregular oval shape with dimensions of 1.22 × 0.98 m and 0.16 m deep with a flat bottom. In its filling there were black burnt pebbles made of crystalline rocks and flint artefacts (Fig. 4). The hearth was surrounded by numerous burnt flint artefacts, which confirms the contemporaneity of the usage of the hearth and the lithic artefacts. The hearth was associated with a cluster of quartzite sandstone slabs located in the western part of the lithic concentration (Fig. 4). Such flat hearths are known from several Magdalenian sites.

A cluster of 53 quartzite sandstone slabs with a thickness of 9.23 to 36.46 mm was designated as Feature 012. The slabs formed a kind of floor at the western side of the hearth, 3.8 m long, 3 m wide and 0.4 m thick (Fig. 4, 5). This was located before the hearth discussed above, on the riverside shore. On several slabs are visible white calcite spots. A detail examination of the slabs enabled refitting of 33 of the slabs into seven larger blocks, consisting of 9 to 2 pieces (Fig. 5). Such slabs are known from numerous Magdalenian sites but the nearest is known from Groitsch in Saxony (Hanitsch 1972), If we can assume that the hearth was in the centre of a habitation then it is possible that the slabs formed a kind of floor between entrance and the hearth.

## Discussion

Technological and typological features of the lithic concentration in Wrocław-Żerniki 25 site show its similarity to the Magdalenian assemblages in Central Europe, especially to Groitsch by Eilenburg in Saxony (Hanitsch 1972). On these Magdalenian sites, large lithic concentrations and numerous stone slabs were discovered like Wrocław-Żerniki 25. However, the lithic concentration in Wrocław-Żerniki 25 is characterized by a low proportion of cores and tools.

Some diagnostic tools like shouldered points and Zinken perforators also occur in Hamburgian assemblages, but they are recognized by a slightly different technology (Burdukiewicz and Schmider 2000). The closest Hamburgian sites were discovered about 100 km to the north, in Kopanica Valley.

Nevertheless, Hamburgian sites are characterized by a simplified lithic technology and easier arrangement of the camp sites. It is necessary to stress that the numerous shouldered points and Zinkens are also known from Magdalenian ensembles in Southern Germany, Switzerland, and partly Burgundy in France (Burdukiewicz and Schmider 2000; Weber 2012).

Unfortunately, during excavations we did not find any sample of sediment rich enough in charcoal suitable for radiocarbon dating. Even TL dating was unsuccessful. The association of Wrocław-Żerniki 25 with the Magdalenian IV is indicated by the presence of several oblique backed bladelets and especially the presence of geometric points in the form of asymmetric triangles.The occurrence of some forms of retouched tools, like asymmetric triangles and shouldered points may be seen as a feature of Magdalenian IV phase, which existed in Central Europe during Bølling interstadial (14.7–14 ka cal BP).

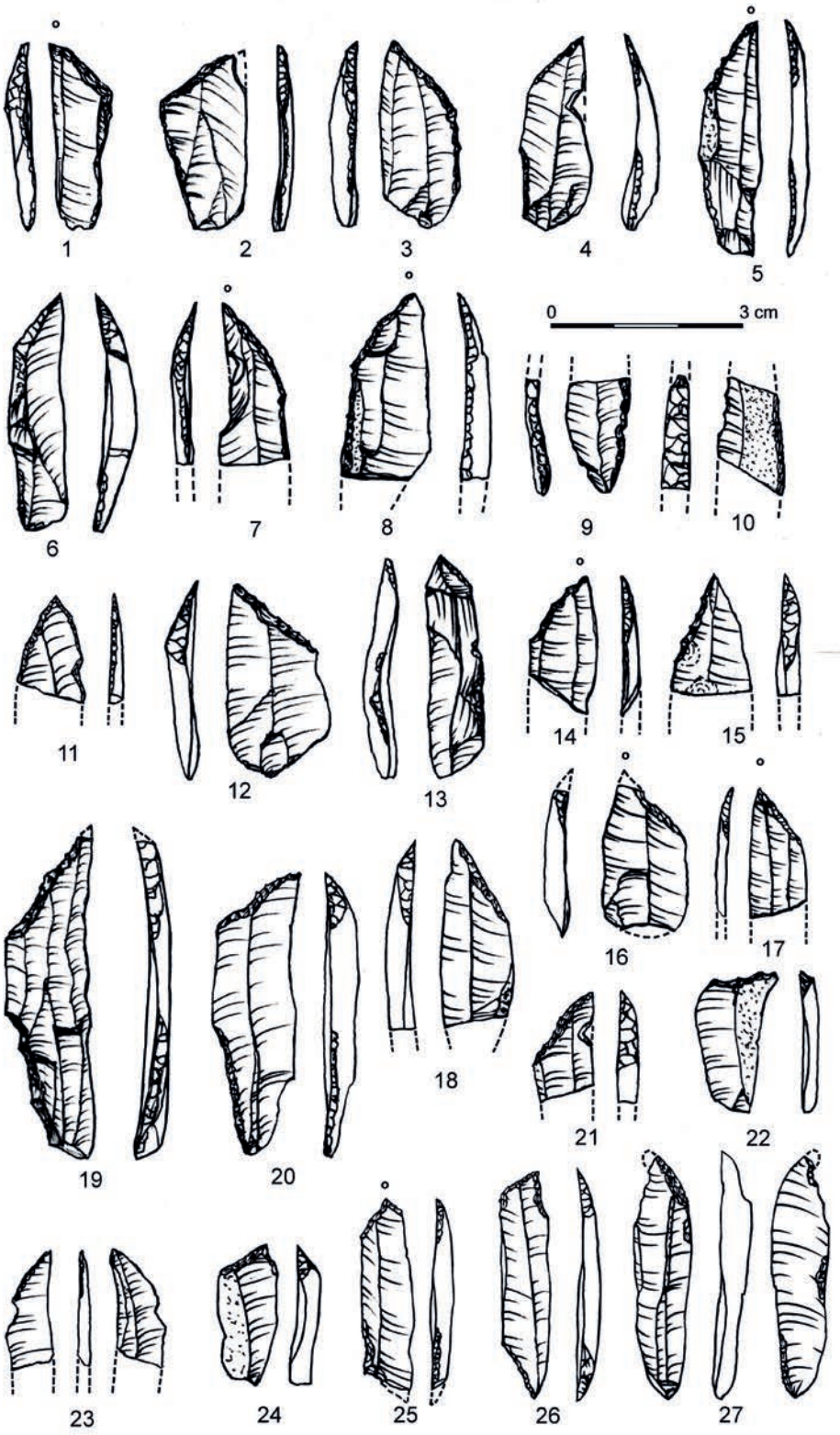



FIGURE 4. Wrocław-Żerniki 25. The tools: 1–11 – various backed pieces, 12–18, 21–23 – truncated pieces, 19, 20 – shouldered points, 24, 25, 27 – borer, 26 – combined tool

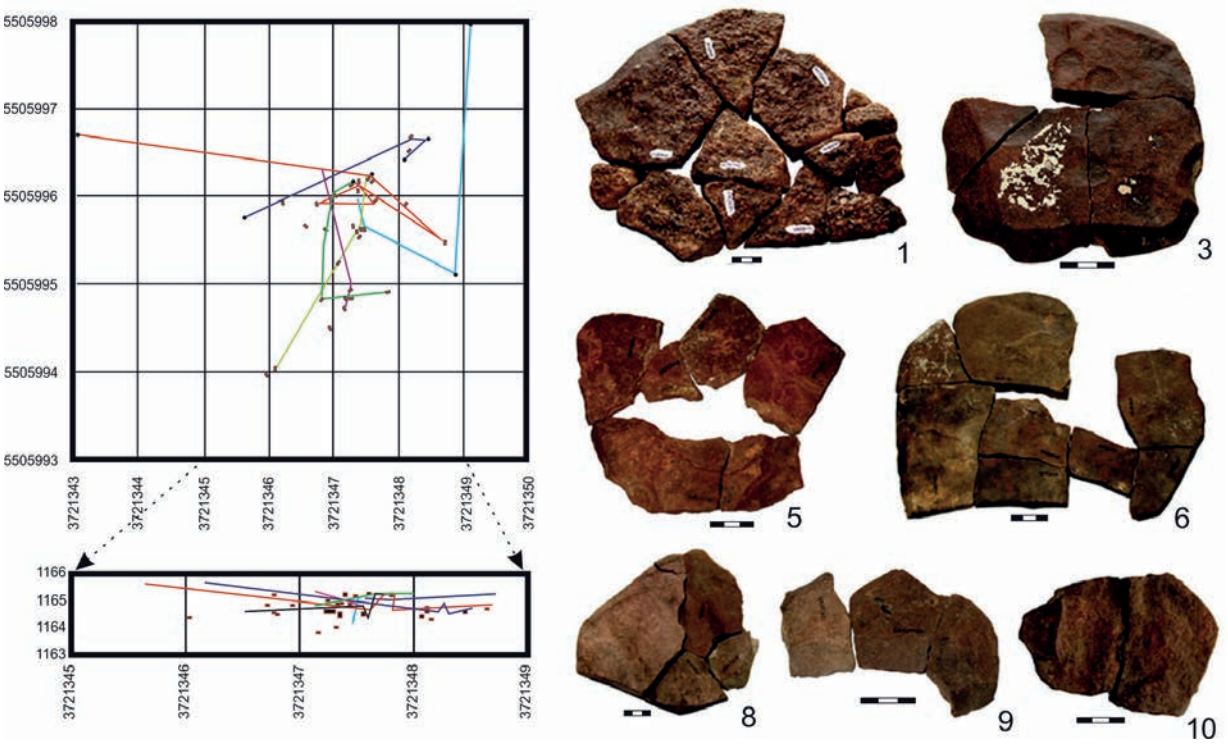



FIGURE 5. Wrocław-Żerniki 25. Refittings of stone slabs and their horizontal and vertical dispersal

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# MIRKOWICE, SITE 33

Jacek Kabaciński

The earliest traces of human presence on the Polish Lowlands, part of the North European Plains, are associated with Neanderthals who penetrated the vast areas north of the main habitation zones during the Eemian Interglacial (Wiśniewski 2016). These occupation traces are very rare (Wąs et al. 2020) and sometimes questioned (Adamczyk 2016). Additionally, most Neanderthal occurrences are covered by thick sediments from the Vistulian. This last long-lasting cold climatic event began around 115 ka BP, reaching its maximal southern extension in Poland (Leszno Phase) about 24–23 ka BP (Marks 2012). It also made the Lowlands inaccessible to humans. In the millennia following the Last Glacial Maximum (LGM), the glacier slowly retreated, freeing up successive areas to the north. Around 16 ka BP, the southernmost front of the ice sheet was located approximately along the line of today's southern shore of the Baltic Sea (Gardno Phase; Tylmann and Uścinowicz 2022). At this time, most of northern Poland was still an arctic desert.

The disappearance of the arctic desert correlates with the beginning of the Late Glacial (Rasmussen et al. 2014) and the gradual expansion of arctic and then shrub tundra environments in northern Poland (Latałowa 2004; Housley et al. 2014). Starting around 14,700 years ago, this caused the appearance of animals adapted to these new conditions (Kabaciński and Sobkowiak-Tabaka 2009a). The presence of huntable animals, in turn, enabled the recolonization of the Northern Plains.

The first Late Palaeolithic settlers, the Hamburgians, appearing during the first warm oscillation of the Late Glacial (GI-1e), most likely came from the west, originating from the area of today's north-western Germany, and occupied the western part of Poland relatively intensively. Several Hamburgian sites known from the Polish province (Fig. 1) seem to be functionally, seasonally, and socially differentiated. These include stray finds, possibly indicating individual hunting spots; single occupation units (Krągola); small aggregations suggesting seasonal, multiple occupation episodes (Mirkowice); and large concentrations of individual occurrences (Myszęcin), which may suggest seasonal, perhaps winter, aggregation of different Hamburgian groups (Kabaciński and Sobkowiak-Tabaka 2009b; Kabaciński 2016; Mugaj 2020). The Mirkowice 33 site is exceptional among Polish Hamburgian sites as it also provides a unique environmental record.

Mirkowice 33 is an open-air site located in western Poland, about 70 km northeast of Poznań, north of the maximal extension of the Vistulian moraines. The human settlement was recorded on a polygenetic dune situated within a young moraine landscape characterized by a slightly undulating terrain with gentle slopes. The site was discovered at the very northern end of the dune, adjacent to an unnamed watercourse that is part of an alluvial system of troughs and small valleys carrying water to the Toruń-Eberswald ice marginal stream valley from the southeast.

In 1994, rescue excavations revealed the presence of Neolithic Funnel Beaker culture (FBC) materials in the upper dune sands, one of the earliest known from western Poland (Chłodnicki and Kabaciński 1997; Kabaciński and Sobkowiak-Tabaka 2005). The next season uncovered much older materials connected with the Hamburgian culture. Several years of excavation between 1995–2005 and in 2010 allowed the identification of six separate concentrations of Hamburgian lithic materials (Fig. 2). This arrangement was further confirmed by refitting analysis suggesting multi-seasonal occupation of the site (Mugaj 2020, 2025).

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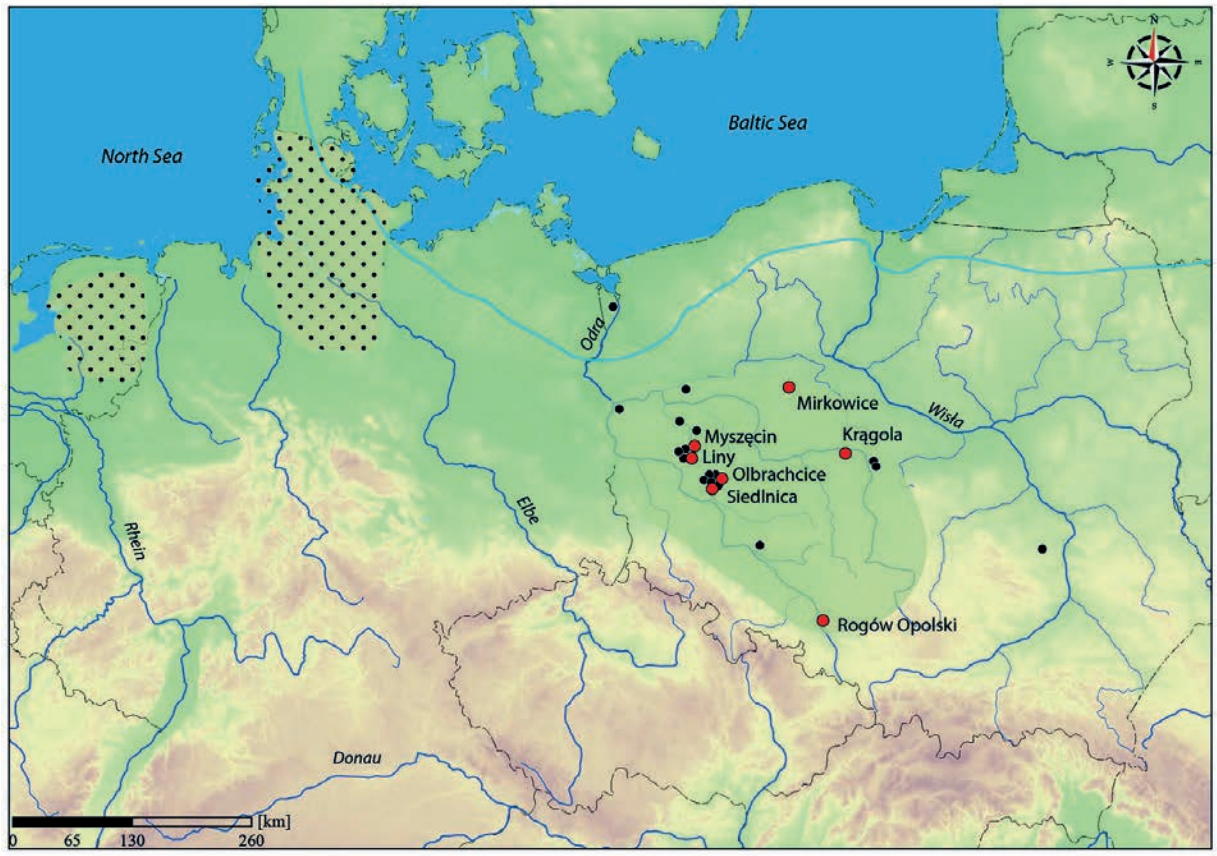



FIGURE 1. Distribution of Hamburgian sites in Poland

Over 3,000 lithics were found, containing a typical set of tools such as end-scrapers on blades with retouched sides, a variety of burins, truncations, numerous perforators including Zinken, and shouldered points (Fig. 3). The majority of lithics were stratigraphically associated with a patchy dark-coloured, well-developed fossil soil developed within the upper part of the lower sand series, which was most probably deposited at the end of the Pleniglacial or the very beginning of the Late Glacial, as confirmed by TL-dates (Kabaciński et al. 2002; Kabaciński and Schild 2005). These sands were in turn covered by a younger aeolian series containing most of the younger Neolithic and Younger Bronze Age materials, accompanied also by some Hamburgian materials in secondary position.

In the central part of the largest concentration of lithic materials a hearth (Concentration 1) was recorded. It was built of several burnt stones (granitoids and sandstones), including few stone tools like grinders and hammers. Between and below these stones, tiny fragments of charcoal, a few flint artefacts including two Zinken, and several dozen burnt animal bones were discovered. These bones were identified as remains of hare (*Lepus* sp.), pike (*Esoxlucius* L.), and carp family (*Cyprinidae*) (Kabaciński et al. 1999). Additionally, a single burnt fragment of an antler belonging to a large animal was also found. Hare bones were radiocarbon dated at the Groningen Laboratory, producing a 14C date of 12,290 ± 70 BP (GrA-17715). The calibrated age of this estimate, with 81% confidence, lies between 14,555 and 14,053 BP. So far, this is the only direct absolute date for the Hamburgian in Poland.

Several dozen metres to the north, a small peat bog was excavated. Alluvial, aeolian, and biogenic sediments discovered there reflect the paleoenvironmental changes of the site area from Pleniglacial II up to the end of the Late Glacial (Fig. 4). The sequence, dated with a long, though not always very consistent, series of AMS, 14C, and

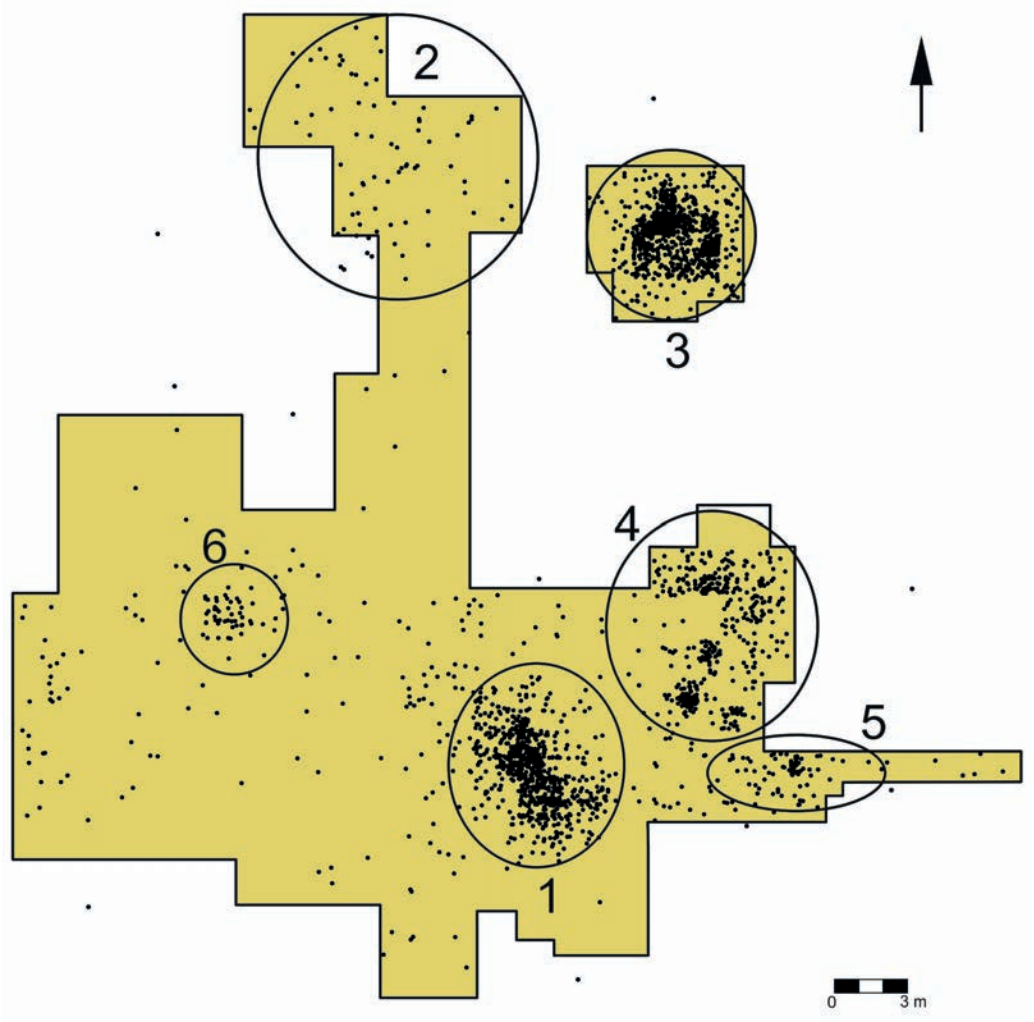



FIGURE 2. Mirkowice 33. Concentrations of lithic materials (after Mugaj 2020)

TL dates (Housley et al. 2014), begins with various sediments (alluvial fine sands (Bed 1), glacial clay (Bed 2), alluvial sand and gravels (Bed 3), sealed with a lower aeolian series (Bed 4) of the Pleniglacial II and the very beginning of the Late Glacial, environmentally associated with an arctic desert. These were overlaid by a calcareous silt (Bed 5) reflecting the existence of a relatively deep lake, possibly from the Meiendorf oscillation (GI-1e). Arctic tundra overgrew the area, including various sedges, grasses, rushes, sorrels, and dwarf shrubs such as polar willow (*Salix polaris*), white dryas (*Dryas octopetala*), and dwarf birch (*Betula nana*). A series of four AMS dates indicate that the lake existed during the second half of the 14th millennium BP, and the Hamburgian settlement on the neighbouring dune can be correlated with that lake.

Lake sediments were overlaid by a several-centimetre-thick layer of coarse detritus gyttja (Bed 7; possibly from the Bølling *sensu stricto* /GI-1c3), indicating the existence of a shallow lake basin. From a paleoenvironmental perspective, the area around that shallow lake was occupied by shrub tundra, dominated by the expansion of sea-buckthorn (*Hippophae rhamnoides*), *Betula nana*, and *Salix polaris*. Upper dune sands (Bed 8) covering the coarse detritus gyttja reflect climatic deterioration and a dry, cold climatic event. Some AMS dates point to the Older Dryas/GI-1c2 oscillation.

A greyish-brown calcareous gyttja in the upper part of the stratigraphic sequence reflects the existence of a deeper lake again. Plant macroremains and pollens indicate a birch forest environment around the site, with *Betula 'alba'* accompanied by

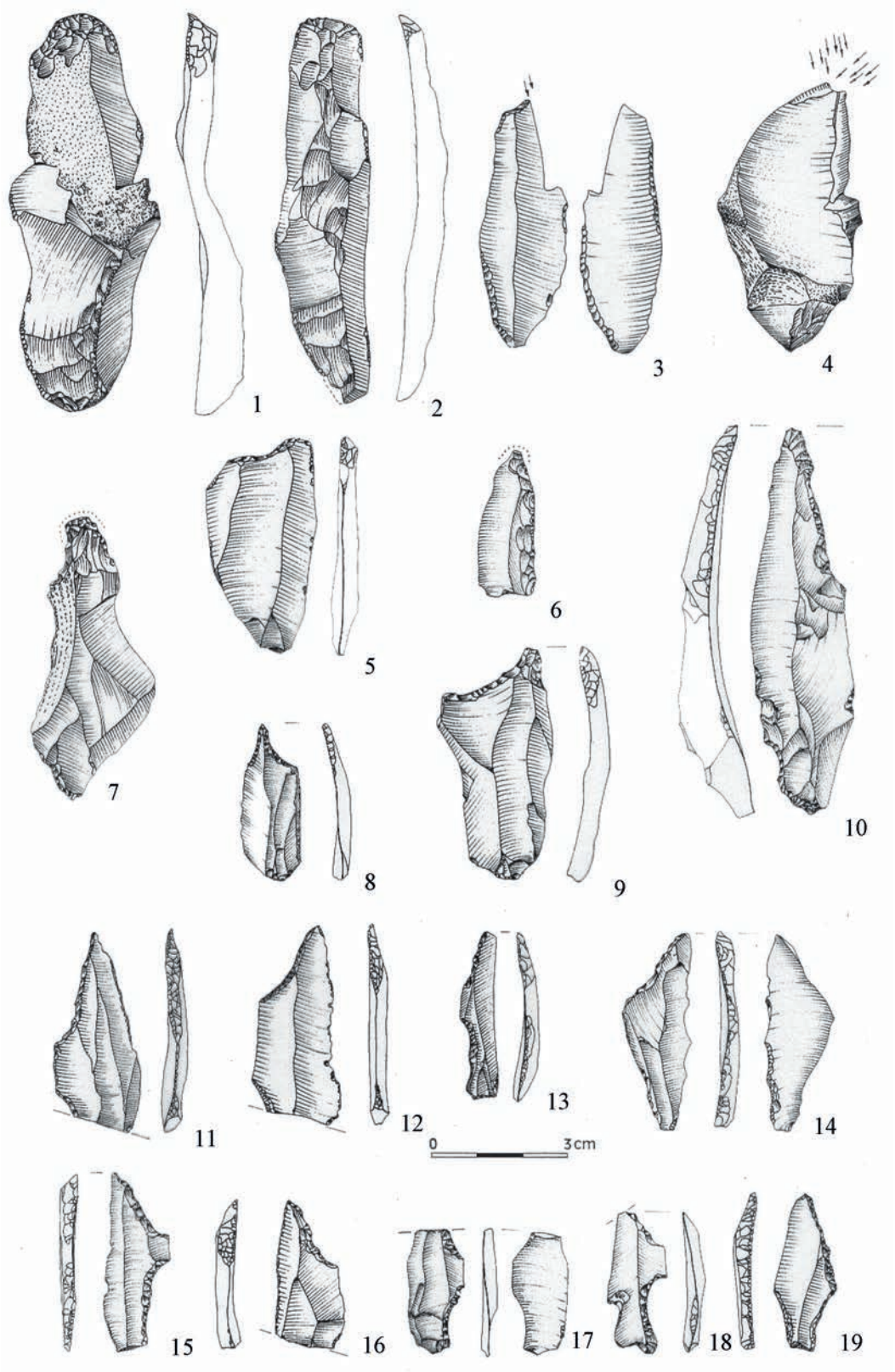
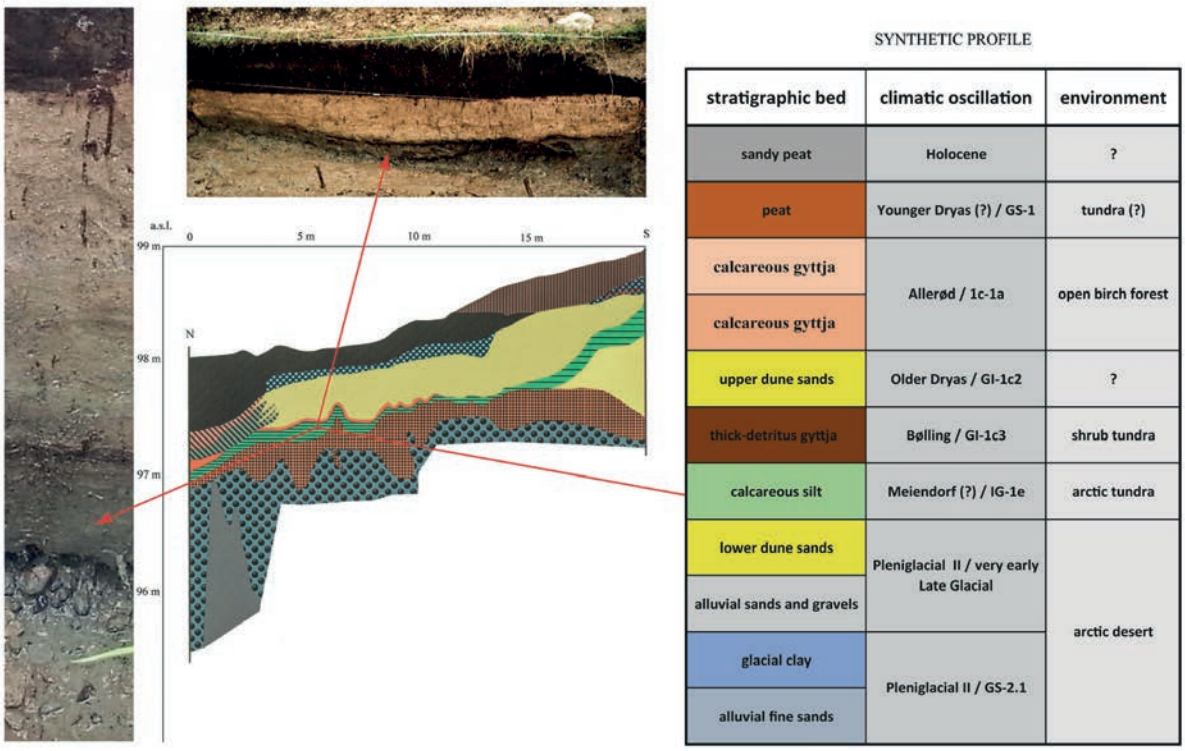



FIGURE 3. Mirkowice 33. Selection of flint tools: 1-2 – end-scrapers on blades; 3 – burin on truncation; 4 – dihedral burin; 5-10 – perforators; 11-19 – shouldered points




SYNTHETIC PROFILE

| stratigraphic bed | climatic oscillation | environment |
|---|---|---|
| sandy peat | Holocene | ? |
| peat | Younger Dryas (?) / GS-1 | tundra (?) |
| calcareous gyttja | Allerød / 1c-1a | open birch forest |
| calcareous gyttja | | |
| upper dune sands | Older Dryas / GI-1c2 | ? |
| thick-detritus gyttja | Bølling / GI-1c3 | shrub tundra |
| calcareous silt | Meiendorf (?) / IG-1e | arctic tundra |
| lower dune sands | Pleniglacial II / very early Late Glacial | arctic desert |
| alluvial sands and gravels | | |
| glacial clay | Pleniglacial II / GS-2.1 | |
| alluvial fine sands | | |

FIGURE 4. Mirkowice 33. Late Glacial stratigraphic sequence

the expansion of terrestrial *Carex rostrata*. The few AMS dates on plant macro-remains are inconsistent; however, some point to the Allerød (GI-1a). The sequence is sealed with peat, which is either of Younger Dryas or Holocene origin.

From the coarse detritus gyttja (Bed 7), a few thousand bones of small fauna were recovered during sediment flotation, including bones of fish such as pike, river perch, *Cyprinidae*, and *Salmonidae* families; birds, for example grouse and common crane; small mammals; reptiles; and amphibians (Fig. 5; Kabaciński et al. 1999). This assemblage, only partially studied by Bodil Bratlund, reflects the richness of the background fauna at the beginning of the Late Glacial.

Research in Mirkowice, besides providing a valuable collection of lithics reflecting the recolonization of the Central European Lowland, delivered unique paleoenvironmental evidence demonstrating dynamic environmental and landscape changes during the Late Glacial on local and sub-local scales. What makes this site especially important is the paleozoological record, which substantially changes and broadens our understanding of the subsistence strategies applied by early human groups living in the arctic tundra at the end of the Pleistocene on the North European Plains. The consequence of that record is that, besides big game hunting – confirmed at north German and Danish sites – the Hamburgians also applied a less spectacular but very effective subsistence strategy based on small game hunting, especially fish, which were abundant in the braided rivers of the arctic tundra.



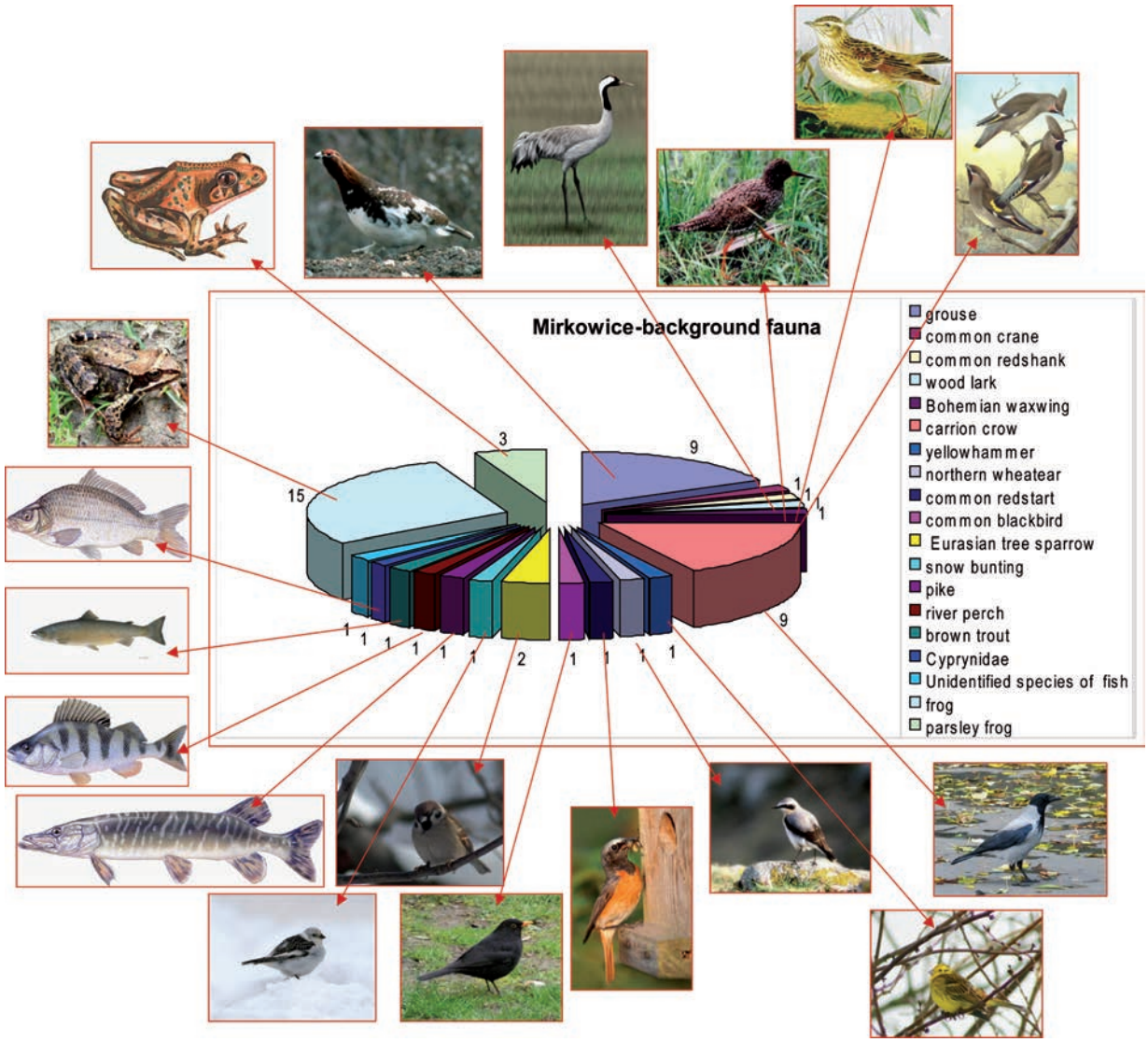



FIGURE 5. Mirkowice 33. Early late Glacial background fauna from coarse detritus gyttja

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# NOWA WIEŚ, SITE 2

Jan Michał Burdukiewicz

During the construction of the A4 motorway in 2004, at site Nowa Wieś 2, Bolesławiec county (geographical coordinates N 51º19.577, E 15º37.497'), traces of Federmesser culture settlement were discovered in the form of two concentrations of flint artefacts and an amber workshop. The site is located on the floodplain terrace of an unnamed watercourse flowing into the Bobrzyca River, a tributary of the Bóbr River. All artefacts were recorded three-dimensionally, and the sediments containing artefacts were sieved using 4 mm sieves.

## Stratigraphy

Site 2 in Nowa Wieś lies on the highest part of a gently sloping, non-floodplain terrace:

- 0–30 cm – the sandy humus(10YR5/3),
- 30–60 cm – Bv horizon – quartz sands and gravels – can be distinguished, ranging in colour from white yellow to rusty-brown (10YR6/4), medium-grained interbedded with gravels,
- Below 60 cm – C horizon (10YR8/3–7/3) – fluvioglacial sands and gravels (Fig. 1).

## Lithic concentrations

The flint artefacts were found in two Clusters (S and N) associated with amber workshop, covering an area of approximately 150 $m^2$ (Fig. 2). Lithic concentration S was an oval cluster of 147 stone artefacts, its diameter reaching 7 m along the S-N line and 6 m along the W-E line. This cluster covered over 30 $m^2$ and contained 5 cores, 62 flakes, 42 blades, 25 wastes, and 11 retouched artefacts. The more irregular flint Cluster N, from Feature 37, turned out to be more numerous in flint artefacts.

This cluster contained 362 flint artefacts, including 20 cores, 215 flakes, 28 blades, 77 waste, and 22 retouched items (Fig. 2). Cluster N contained half as many tools as flint Cluster S, and its share of refitted artefacts was several times greater. Regarding the tool group, it is interesting that refitted artefacts constitute a small percentage – 9%, while artefacts made of Baltic brown flint and chert each constituted 4.5%. Much more impressive is the N Cluster, which contains a total of 20 cores, 11 of which are preserved in fragments. Single-platform cores predominate – 5 specimens, 3 cores with altered orientation.

The inferior quality of the raw material meant that the makers had frequently to reorient the cores during exploitation. Most of the specimens were small – less than 10 cm long. The most numerous specimens were in the 20 to 60 mm range, with an average length of 39 mm and width of 44 mm. In this respect, they are not far behind blades and flakes, whose average length does not exceed 20 mm (Burdukiewicz and Furmanek 2007, 56).

The cores yielded flakes and flake blanks, which is consistent with the predominance of the former in this group. Specimens from the final phase of coring predominate – 62% – but this high percentage is overestimated by fragmentarily preserved cores, classified as belonging to this phase. Damaged cores composed 50% of the entire assemblage, most likely the result of cracks caused by temperature changes. Due to their shallow deposition, some of them may have been damaged by ploughing (Burdukiewicz and Furmanek 2007, 56).

## Tools

The entire inventory contained a total of 34 tools. In Cluster S, tools composed 7.5% of all items, and in Cluster N, over 6%. Clear diversity is visible within this group. The tools included: a disc-shaped

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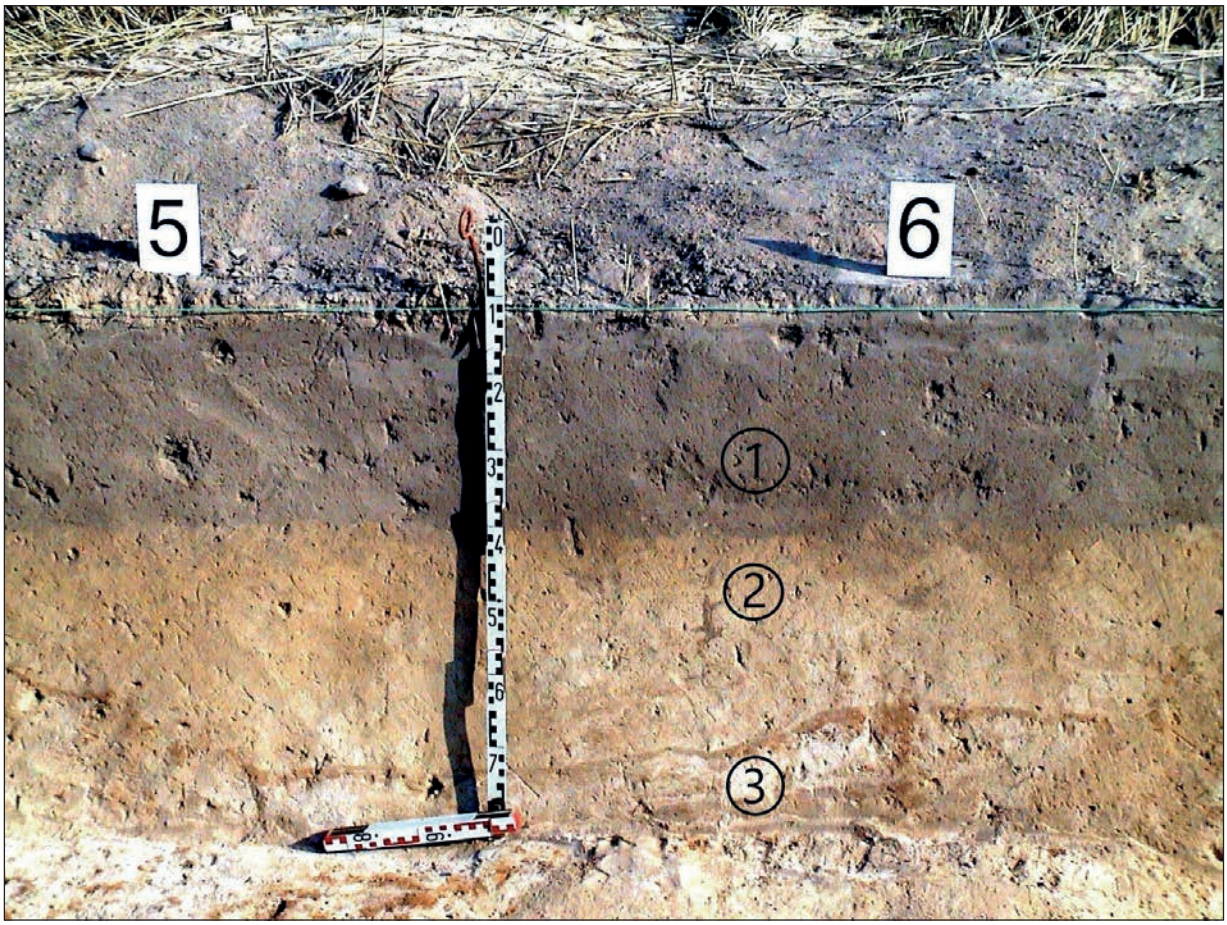



FIGURE 1. Nowa Wieś 2. Stratigraphy: 1 – humus, 2 – Bv horizon, 3 – C horizon

end-scraper, a handle of an end-scraper with retouched sides, two single-sided saws, a bilateral and a single-sided recessed tool, a retouched bladelet, a fragment of a retouched bladelet, and a retouched flake (Fig. 3). The tools are represented by two straight flake end-scrapers, one rounded end-scraper, a dihedral burin, a transverse burin on unprepared end, two transverse truncations, a perforator fragment, three blades with notches, a saw on one edge, a combined tool (burin + end-scraper), a micro-perforator, three retouched blades, two retouched flakes, and two fragments of unidentified tools (Fig. 3). The small proportion of the tools, amounting to only 6.5%, may indicate that most of the retouched items were transferred by the makers when they moved. The relatively high proportion of short flake end-scrapers in the inventory, as well as the presence of burins and truncations, suggests that it is most closely related to the Federmesser assemblages, although it lacks clear diagnostic forms, such as arched backed pieces (Burdukiewicz and Furmanek 2007, 56).

The dominant groups are blanks and wastes, with a share of nearly 90%. Flint Cluster N has a significantly higher share of cores, exceeding 5%. In contrast, flint Cluster S has a slightly higher proportion of tools, accounting for almost 8%. One feature that distinguishes the two flint clusters is that Cluster N has a six-fold greater proportion of burnt artefacts. The taxonomic and technological criteria, as well as the tool set, which includes a considerable proportion of short flake scrapers, show the closest relationship to the Federmesser culture (13.5–12.9 ka cal BP).

## Spatial arrangement

The distribution of cores, blanks, and tools clearly defines two flint clusters. In Cluster S, artefacts are

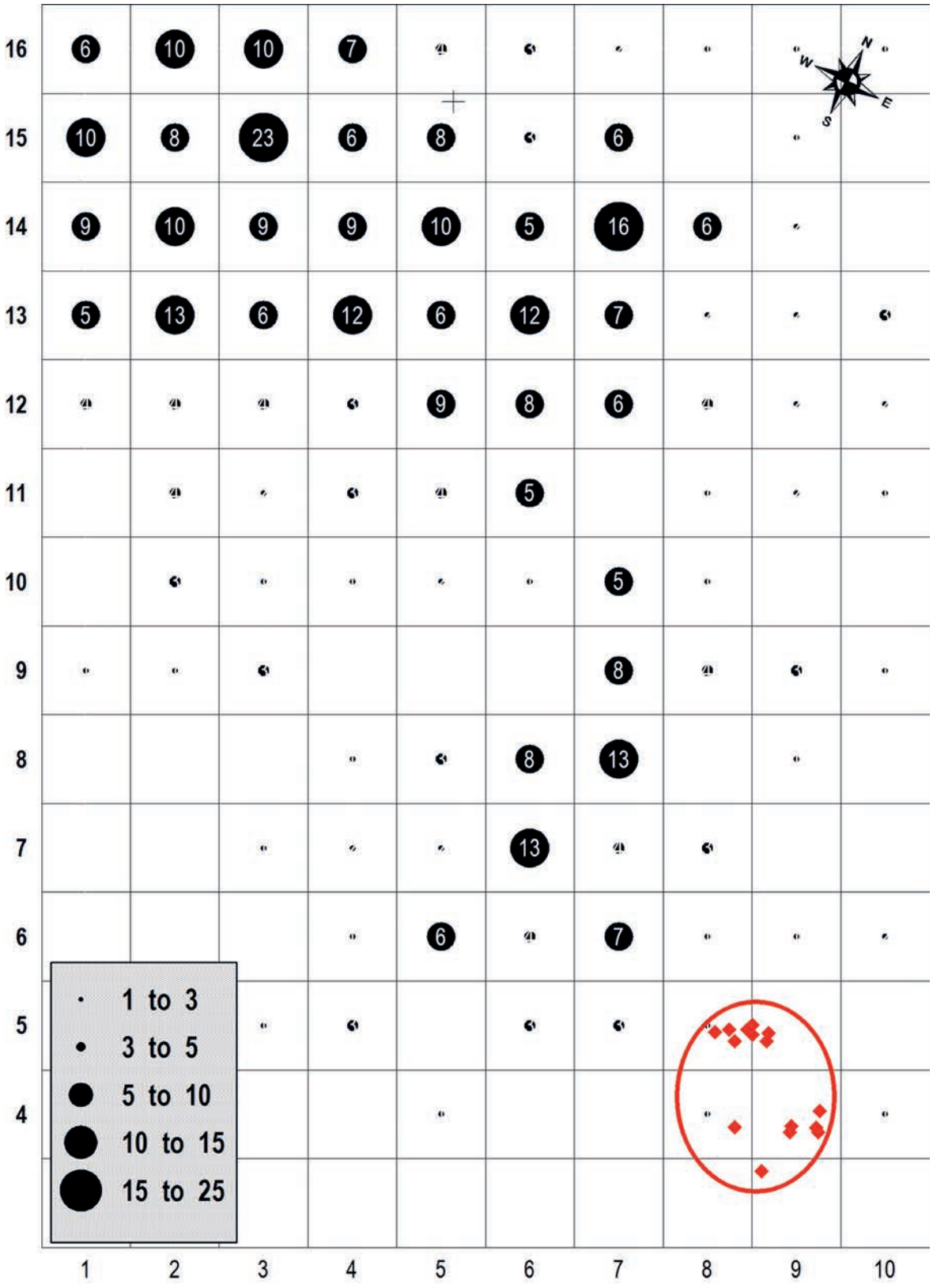



FIGURE 2. Nowa Wieś 2. Lithic artefact and amber concentrations

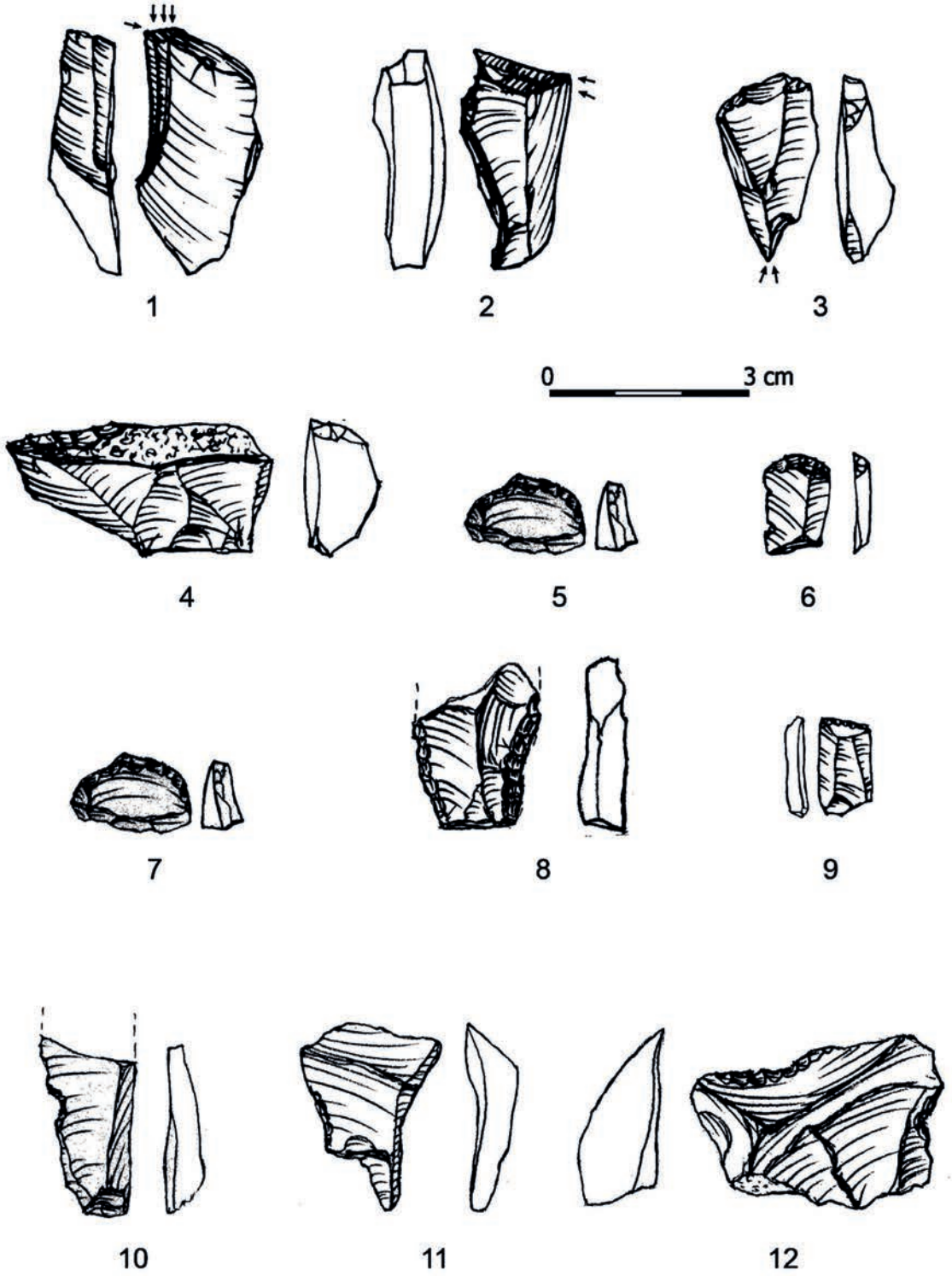



FIGURE 3. Nowa Wieś 2. Flint tools: 1, 2 – burins; 3 – burin + scraper, 4–8 – flake scrapers; 9 – truncation; 10 – notched tool; 11, 12 – retouched flakes

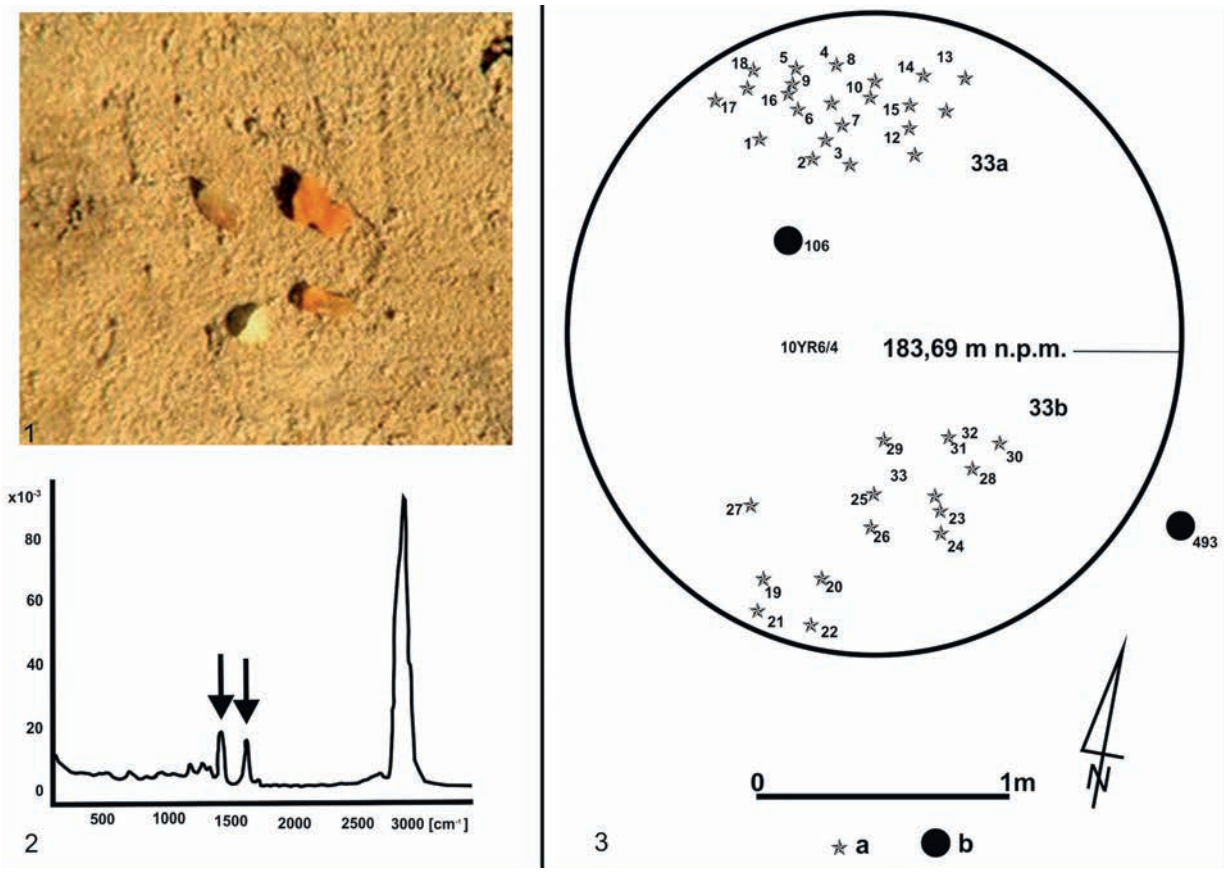



FIGURE 4. Nowa Wieś 2. Amber workshop: 1 – amber pieces in situ, 2 – Raman spectroscope diagram of amber, 3 – amber concentration: a – amber, b – flint artefacts

concentrated in the central part, creating the highest density in two adjacent metre squares (Fig. 2). In Cluster N, there is no clear density of artefacts in any one location, and the metre squares containing the largest number of artefacts are distributed across the entire flint site (Fig. 2). In the case of the distribution of cores and waste, the activity of post-depositional processes partially disrupted the original arrangement. The distribution of individual tool types does not form visible clusters; they are scattered across the surface of both flint clusters (Fig. 2). This may indicate that there were no distinct production zones for specific types and that all tools were made in one location. However, it should be remembered that post-depositional processes also influenced this state of distribution.

The arrangement of both flint clusters, as well as the presence of artefacts from all phases of core reduction, indicates that the entire production process was carried out on-site, from the initial flaking to tool production. Most likely, these hunter-gatherers were satisfied with the use of ad hoc finds of flint concretions from the surface in the immediate vicinity. Such sites have been described in the literature as home workshops.

The results of technological analysis show that the flint sites from Nowa Wieś were the result of short stays of small groups, probably simple families, or the same group that established short-term camps there twice (Burdukiewicz and Furmanek 2007, 60). The proximity of a watercourse may support this idea.

## Amber workshop

One of the most unique finds in Nowa Wieś 2 was the amber workshop (Fig. 4). A concentration of amber pieces occurred over an area of two square

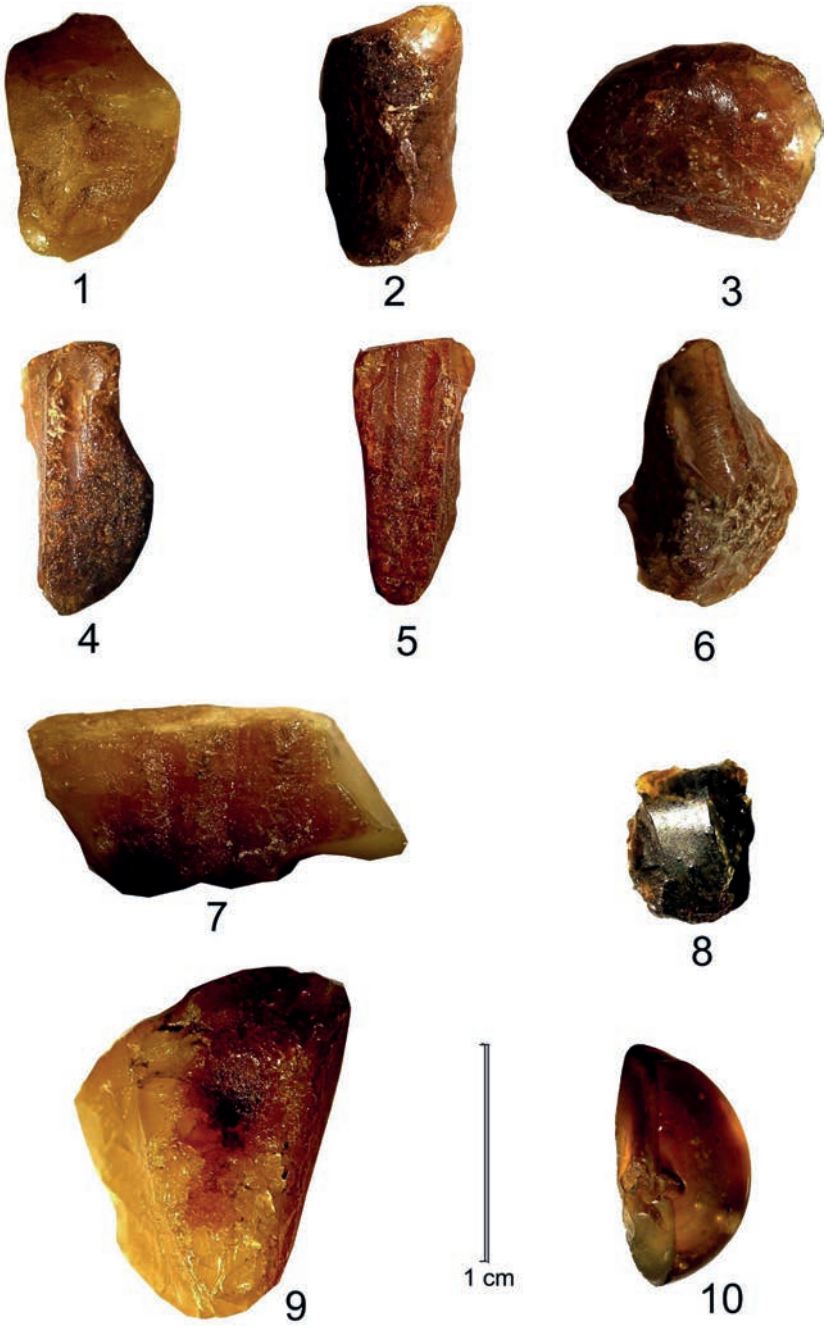



FIGURE 5. Nowa Wieś 2. Amber pieces

metres partly overlapping flint Cluster S. It contained a total of 44 amber specimens. The remaining specimens were located up to 6 metres apart. This shows that part of the concentration was scattered during the ploughing or removal of the humus.

There were identified 37 pieces of raw amber, consisting of fragments of nuggets and plates, three semi-finished products with traces of drilling, polishing, etc., and four fragments of ornaments, including one fragment of a bead with a hole (Fig. 5:10). Analysis of the amber using the Rahman spectroscope showed the Baltic origin of the amber (Burdukiewicz and Sachambiński 2007). The amber pieces and ornaments varied in colour. Yellow and red specimens predominated, but deep brown to almost black specimens also occurred. In terms

of size, they were not impressive. Their maximum dimensions were as follows: length – 13.28 mm, width – 8.27 mm, and thickness – 7.28 mm. The average length, width and thickness were 7.66 mm, 5.26 mm, and 3.58 mm, respectively.

Amber working in Poland has been known since the Hamburgian culture, i.e., the beginning of the Late Palaeolithic. Numerous amber objects were made in the Middle and especially the Late Neolithic, particularly within the Globular Amphora culture and the Forest cultures (see Mazurowski 1983).

The most remarkable piece in Nowa Wieś collection of amber is a bead with lenticular cross-section (Fig. 5:10). Archaeological research at the Magdalenian site in Hauterive Champréveyres in Neuchâtel (Switzerland) yielded the discovery of amber bead ornaments. Amber finds also come from another Swiss site of the same culture, namely Moosbühl near Bern (Leesch 1999). Items from Magdalenian culture sites have yielded numerous finds of lenticular beads, very similar to the specimen found in Nowa Wieś (Burdukiewicz 2009).

Amber working in Central Europe is known since the Late Palaeolithic. The oldest amber artefacts date back to 15,5–13,1 ka BP and were found in the form of plaques at the Hamburgian Culture site in Meindorf in Schleswig-Holstein. Other amber artefacts dating to this period were discovered at Siedlnica 17a. They consisted of two ornaments and six small amber fragments (Burdukiewicz 1999, 99). Fragments of an amber elk figurine were recently found at the Federmesser culture site in Weitsche (Lower Saxony). This figurine is similar in shape and craftsmanship to an amber horse figurine from Dobiegniew (Western Pomerania).

The direct spatial connection, processing techniques, and product forms suggest that the amber workshop in Nowa Wieś may have originated in the Late Palaeolithic and is associated with the Federmesser culture (Burdukiewicz and Furmanek 2007, 86). If the above assumptions are correct, the oldest traces of an amber workshop have been found in Nowa Wieś. These arguments undoubtedly require further testing and confirmation. It should be remembered that numerous amber artefacts were made in the Middle and Late Neolithic. They are known from the Late Stone Age and the early Bronze Age. In the case of the finds from Nowa Wieś, a younger origin of the amber artefacts cannot be excluded, as their variability and processing methods are not chronological and cultural determinants (Burdukiewicz and Furmanek 2007).

## Chronology and taxonomy

As mentioned above, the results of the dynamic technological classification and the analysis of tool assemblages support the Late Palaeolithic character of the assemblages from Nowa Wieś. Unfortunately, the lack of diagnostic forms hinders a detailed determination of the cultural affiliation of these assemblages. Small flints with few tools are characteristic of the Federmesser assemblages. The predominance of single-platform blade-and-flake cores, the very large number of flakes, and the presence of scrapers and burins are most consistent with the Federmesser culture from the second half of the Allerød interstadial (13.5 to 12.9 ka cal BP) (Burdukiewicz 1999, 100). The large number of burnt artefacts also suggests this affiliation; forest fires were a frequent and natural phenomenon during this period.

## Conclusion

The analyses have shown that the flint concentrations from Nowa Wieś and the amber workshop have provided a significant new insight into the understanding of Late Palaeolithic settlements, particularly the Federmesser culture, which has been poorly recognized in western Lower Silesia until now. At the same time, the new amber workshop demonstrates the advanced symbolic and aesthetic needs of hunters and gatherers at the end of the Ice Age.



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# THE LUBRZA SITE COMPLEX

Iwona Sobkowiak-Tabaka

The Lubrza sites are located in the Lubuskie Lake District in western Poland, about 1.4 km northeast of Lake Lubrza, along the Jordanów-Niesulice Glacial Channel. These sites are found within a relatively recent moraine landscape formed during the Poznań phase of the Vistulian glaciation. The area's topography was mainly shaped by erosion and meltwater accumulation, along with the presence of dead-ice block formations (Chmal 2003; Żynda 1967). As climate conditions improved, the retreat of ice blocks created lake basins and various depositional features such as islands and sandy peninsulas, aligned both parallel and perpendicular to the main direction of the glacial channel. The archaeological activity areas are situated on sandy kames next to former lakebeds, which have since been filled with biogenic sediments, primarily peat and gyttja (Sobkowiak-Tabaka et al. 2018; Sobkowiak-Tabaka et al. 2022).

The maximum recognized depth is 9.50–10 m, occasionally reaching as deep as 14.80 m in the hollows of fossil basins. Four such fossil basins were identified based on the results of geological drilling (Sobkowiak-Tabaka et al. 2018). Originating from the vast area of the North European Plain, the archaeological remains of the Federmesser complex date between the second half of the Bølling (Greenland Interstadial-GI-1e) and the start of the Younger Dryas (GS-1), roughly 12,300–10,600 BCE (Sobkowiak-Tabaka 2017). The Swiderian groups appeared in present-day Poland during the Younger Dryas and early Preboreal, around 10,350–9600 BCE (Sobkowiak-Tabaka 2016).

## History of the research

Archaeological research on the Late Palaeolithic and Mesolithic record at Lubrza has a long tradition, with particular emphasis on reconstructing local palaeoenvironmental conditions. Systematic excavations began in 2008 following the identification of Late Glacial and early Holocene occupations at Sites 42 and 11 (Fig. 1), yielding over 10,000 flint artefacts attributed to successive hunter-gatherer groups active during the Allerød. The assemblages comprise Federmesser materials represented by domestic and workshop contexts, Swiderian occupations dated to the Younger Dryas, and a small Mesolithic assemblage assigned to the Atlantic period of the Holocene (Kabaciński and Sobkowiak-Tabaka 2010, 2011).

Subsequent excavations conducted between 2011 and 2014 focused on Site 10 (Fig. 1) and produced more than 5,000 flint artefacts from 13 concentrations, including Federmesser domestic and workshop features and Swiderian activity areas. The most recent fieldwork (2017–2019) has concentrated on Site 37 (Fig. 1), where Hamburgian, Swiderian, and Mesolithic occupations were identified. Surveys and excavations at this site yielded approximately 2,300 flint artefacts.

In parallel with the excavation work and geomorphological analyses, biogenic sediment cores were collected to reconstruct past environmental conditions. Three biogenic sediment cores were collected. Two cores were taken from the northern (LB13 and LB 2013) and southern edges (L-33/2) of Paleo-lake 1, located between Sites 42 and 1, and Site 10. The third core (LU 18B) was extracted from the centre of Basin 3, between Sites 10 and 37 (Fig. 1).

## Results

Analysis of camp spatial layout reveals apparent differences between Federmesser and Swiderian

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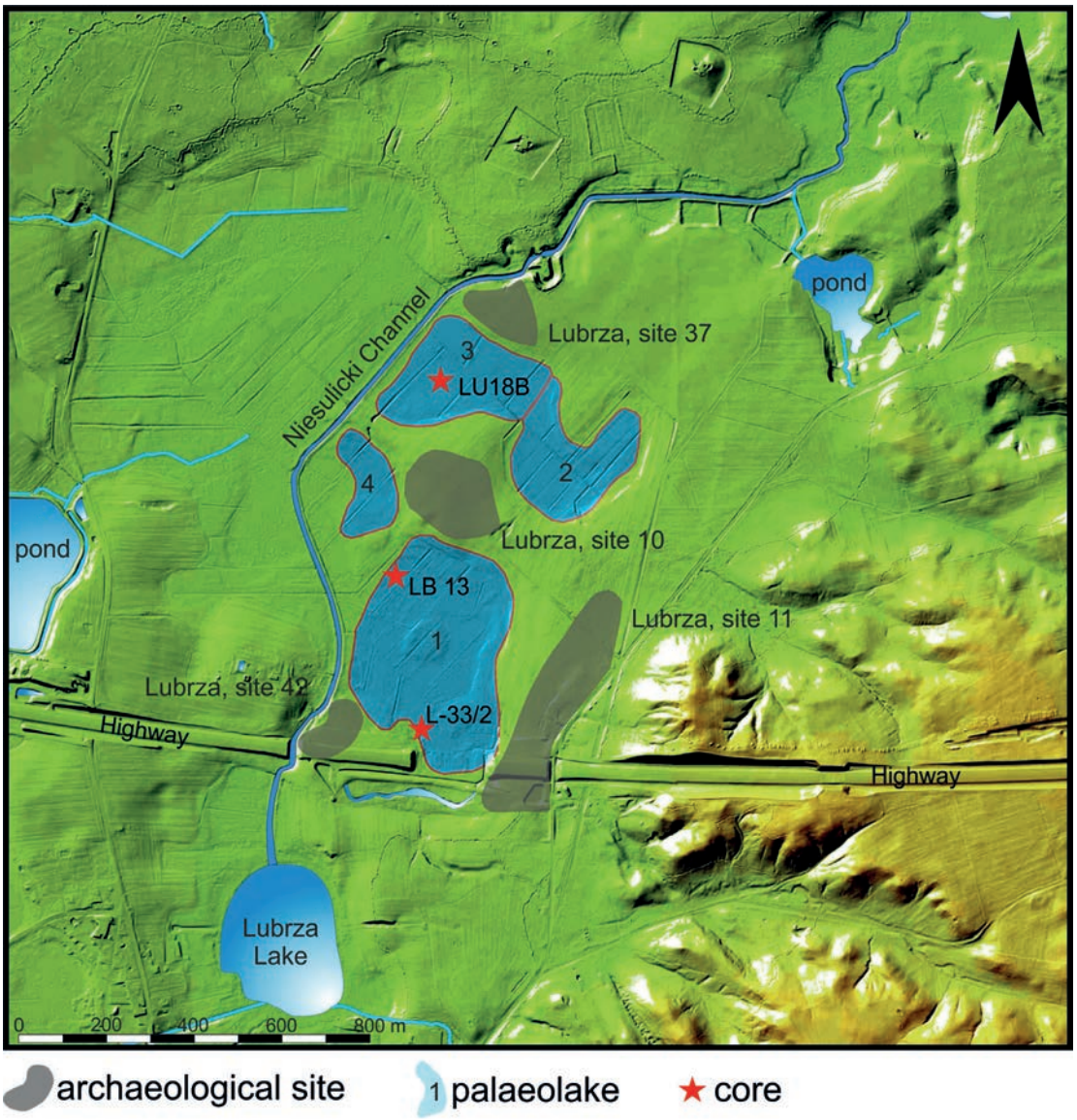



FIGURE 1. Location of the Palaeolithic sites near Lubrza. Digital terrain model based on GEOPORTAL2 resources

occupations. The most noticeable contrasts involve cluster size and artefact density. Aside from Concentration 1, Federmesser clusters are generally smaller (3–9 $m^2$) and contain fewer artefacts (40–62 items) than Swiderian clusters, which range from 4 to 17 $m^2$ and include 86–330 artefacts.

Although the total number of artefacts in the Federmesser and Swiderian clusters is similar, apparent differences emerge in toolkit composition and usage (Figs. 2–3). The Federmesser assemblages mainly consist of end-scrapers on flakes, primarily used for processing fresh hides, while the Swiderian toolkits focus on tools for working with wood and herbaceous plants (Fig. 4). Unretouched blades and flakes are present in both assemblages, but serve different purposes. Additionally, burins in each culture were used on various materials. These functional differences suggest different activity patterns, with Federmesser groups mainly working with hides and Swiderian groups primarily processing plants and wood (Sobkowiak-Tabaka and Kufel-Diakowska 2019).

These differences align with inferred seasonal patterns of site use. Fresh hide processing




FIGURE 2. Lubrza, Site 10. Selected Swiderian cores (photo by M. Jórdeczka)

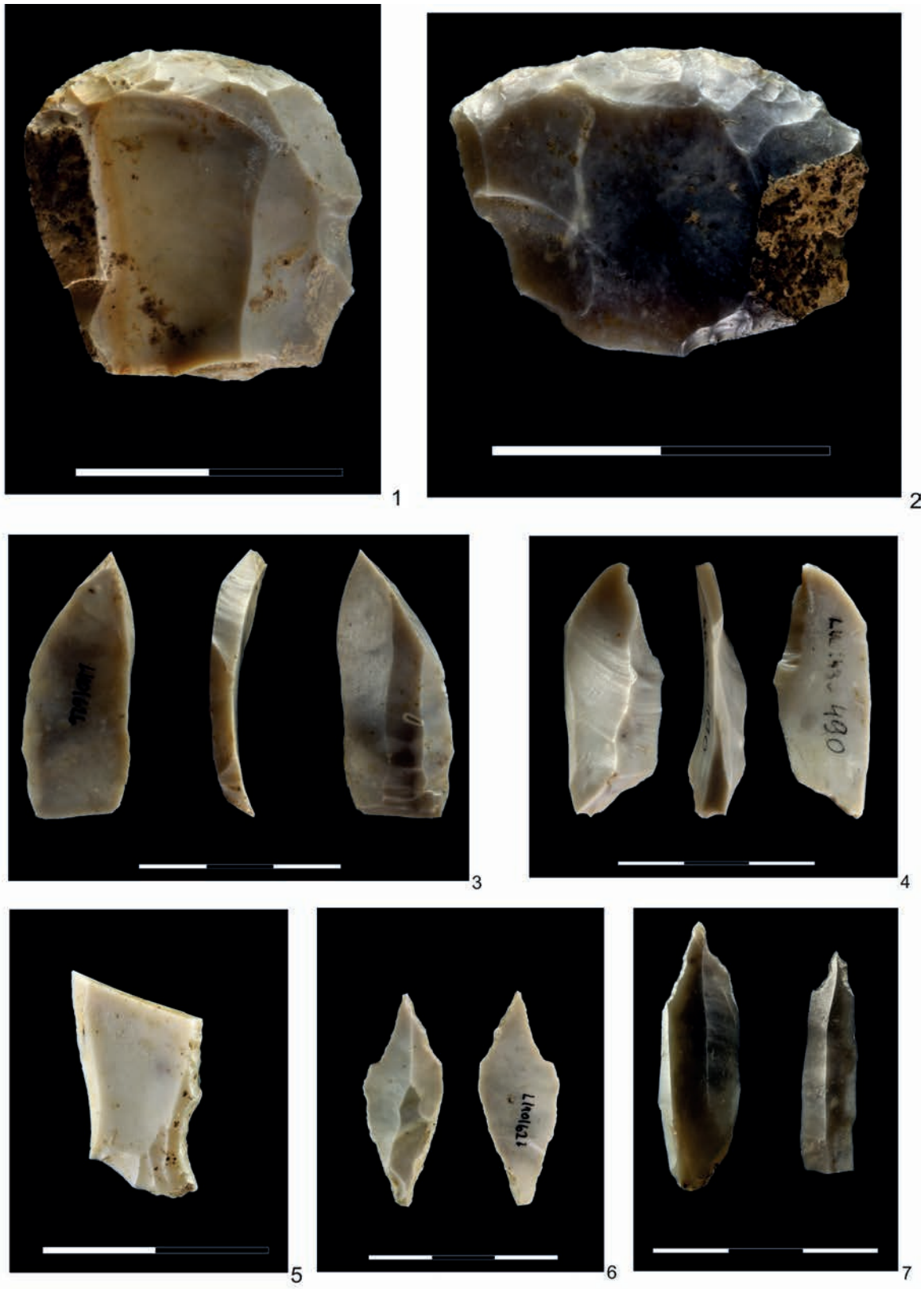



FIGURE 3. Lubrza, Site 10. 1–5: Selected Federmesser assemblage, 6–7: Selected Swiderian assemblage (photo by M. Jórdeczka)

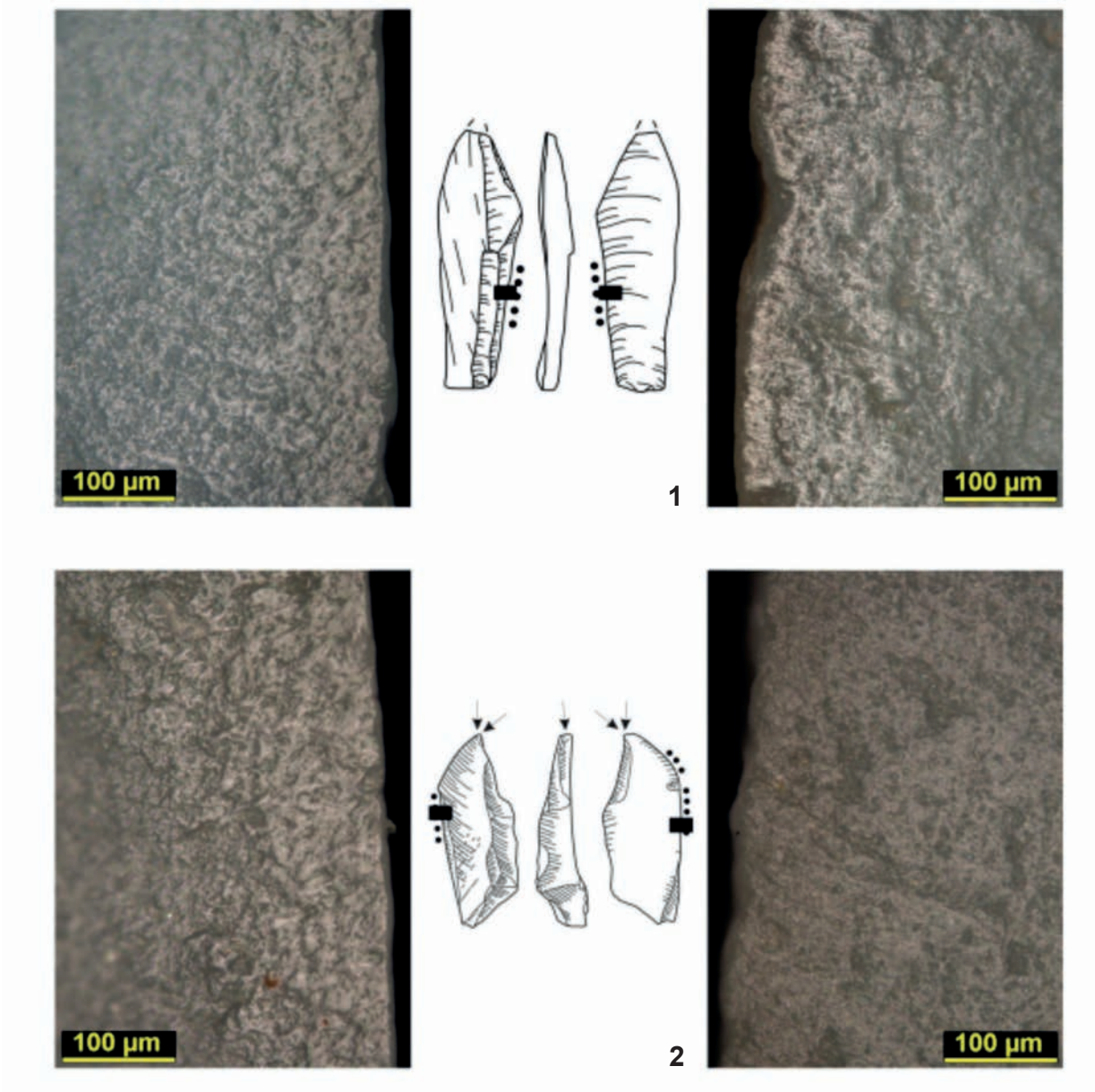



FIGURE 4. Lubrza, Site 10
Microphotographs of plant-like traces from the Swiderian concentration no. 12. 1 – untretouched blade, 2 – burin (photo B. Kufel-Diakowska)

suggests summer or early autumn occupations for Federmesser groups, while the dominance of plant-processing activities among Swiderian groups indicates occupation between late spring and early autumn. Notably, more Federmesser tools exhibit hafting, and the greater variety of tool types within Concentration 1 further supports a more extended occupation period than at the Swiderian camp. Differences are also evident in overall camp organization. Both sites include domestic units and workshops; however, only the Federmesser site has a documented dwelling structure. The spatial layout of Federmesser clusters is relatively spread out, in contrast to the denser arrangement of Swiderian activity areas. Hearth shapes also vary significantly: Federmesser fireplaces are larger, thicker, and probably recessed, indicating longer-lasting fires, whereas Swiderian hearths are smaller, with

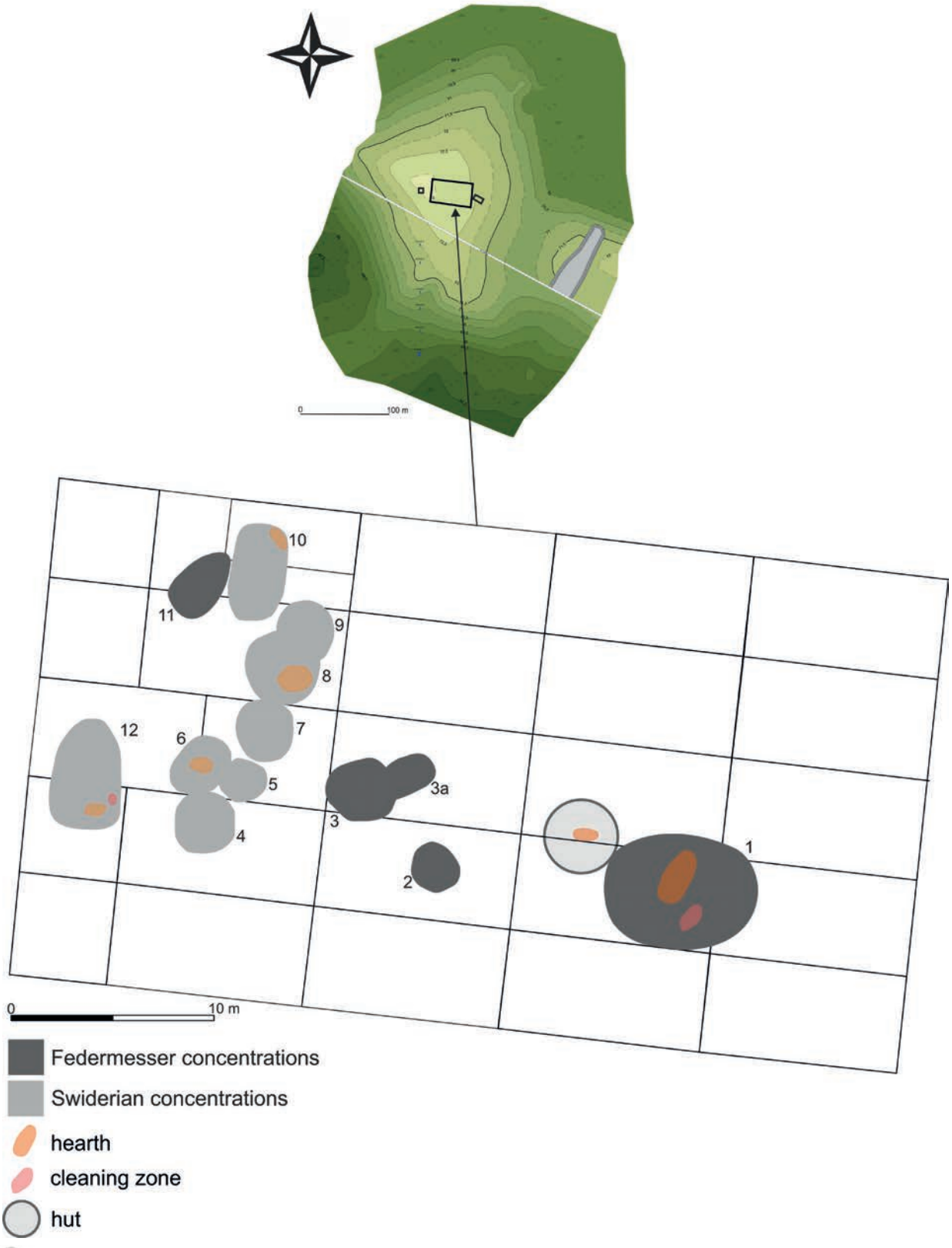



FIGURE 5. Lubrza, Site 10. Feddermesser and Swiderian of Swiderian camp

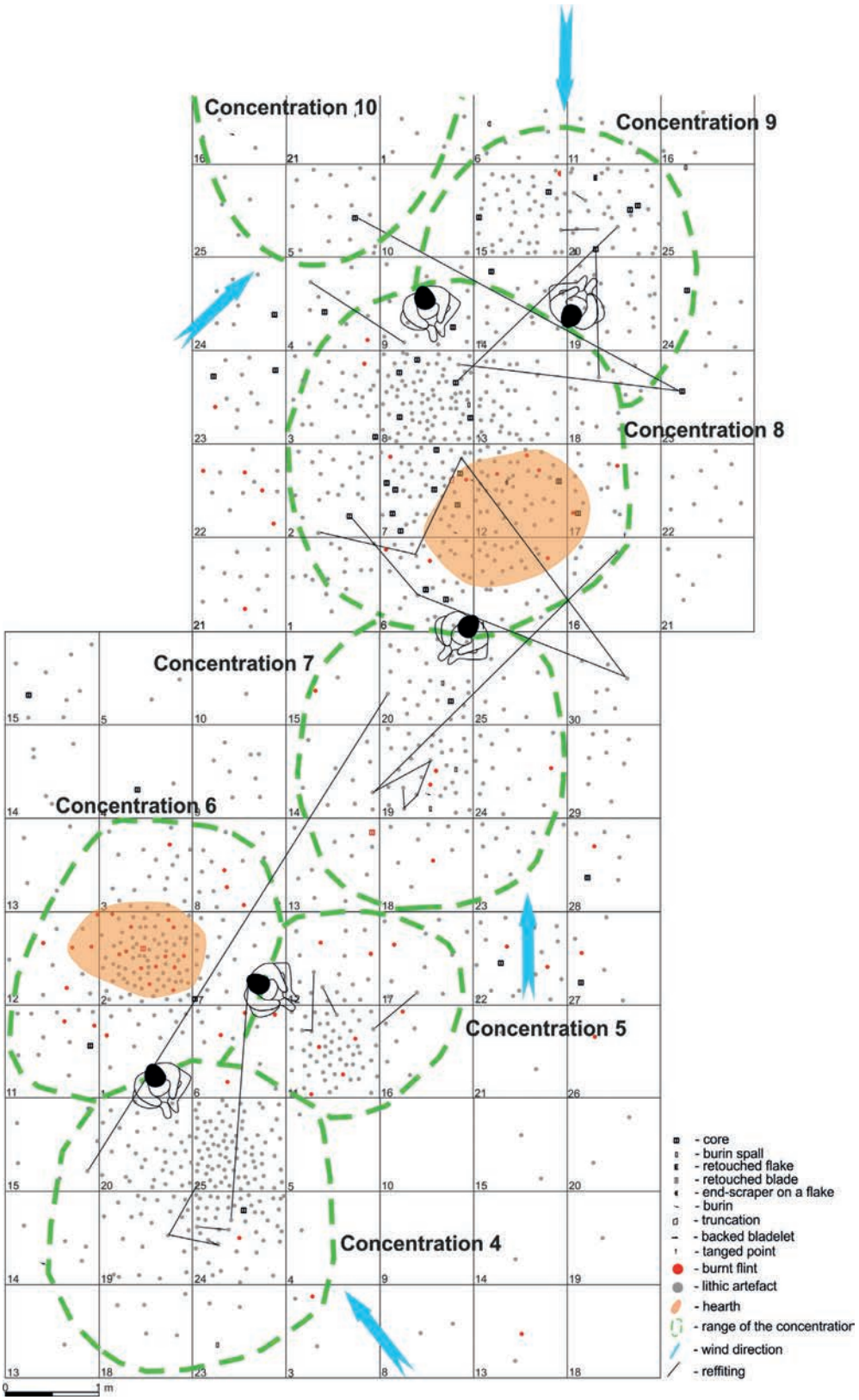



FIGURE 6. Lubrza, Site 10. Internal organization of Swiderian Units 1 and 2

surface features consistent with shorter-term use and greater mobility.

The application of spatial analysis techniques, including nearest neighbour statistics, has provided insights into the organization and temporal aspects of the Federmesser and Swiderian camps at Lubrza 10. This approach enables the identification of key features such as hearths, hearths' cleaning zones, dwelling structures, and outdoor activity areas, along with their structural relationships.

The hearths identified at Lubrza 10 show distinct patterns linked to each cultural phase. During the Federmesser occupation, Concentration 1 features a hearth (Hearth A) situated near a cluster of burnt flints, with evidence of burnt bones along its edge. This hearth is connected to a hearth's cleaning zone (Cluster B), located about 1 metre away. The depth of burnt flints at Hearth A indicates it was used for an extended period, possibly in a shallow pit, reaching temperatures of up to 300°C at a depth of 15 cm. In contrast, other hearths in Concentration 1 are surface features, including Hearth C, an isolated open fire probably situated inside a hut. This hut was probably round, as suggested by the distribution of discarded materials around it. The cluster of burnt flints near the entrance probably represents flint knapping activity.

In the Swiderian layers, hearths identified in Concentrations 10, 6, and 12 also show a clustered arrangement, although some features, like Hearth E, are less prominent due to fewer associated finds. Hearths D and F, situated in the northeast and central parts of their respective concentrations, share similarities with Federmesser hearths in terms of placement and their relationship with surrounding features. In Concentration 12, two groups of burnt artefacts suggest the presence of Hearth G and a hearth's cleaning zone (H), located near its edge (Sobkowiak-Tabaka and Diachenko 2020) (Fig. 5).

Archaeobotanical and sedimentary evidence indicate that pine and willow were the primary fuel sources during the Allerød, with bone and possibly moss as supplementary fuel, as shown by charred remains in lake sediments. Calcined animal bones found at Hearth A suggest high-temperature fires, consistent with waste disposal or bone fuel use. Residue analyses also suggest the use of fire-starting tools.

Despite its shorter occupation span, the Swiderian camp exhibits a complex internal organization, characterized by successive activity units arranged around hearths and shifting wind directions (Fig. 6). Flint-knapping areas, domestic spaces, and seating positions can be reconstructed from artefact distributions and hearth placements, indicating a highly structured yet adaptable use of space during repeated short-term occupations.

Multi-proxy studies carried out in the Lubrza area over recent years have provided high-resolution insights into Late Glacial climatic and environmental changes and show that the local palaeolakes are essential archives of human activity. Vegetational development started in the Oldest Dryas with a subarctic tundra dominated by dwarf shrubs, followed by the expansion of sea-buckthorn. The first hunter-gatherers, linked to the Hamburgian culture, appeared shortly afterward in a largely open landscape, where they built hearths and cooking fires.

Federmesser groups occupied the camp during the late Allerød, as indicated by radiocarbon dating of burnt bone from Concentration 1 (11326 (95.4%) 1111 BCE; (Poz-65348) 11,300 ± 60 BP). At that time, the surrounding landscape was characterised by open woodland dominated by birch (*Betula nana*, *Betula pubescens/tortuosa*), with a minor component of pine (*Pinus sylvestris*). Wetland vegetation developed along the lake margins and included sedges (*Carex rostrata*, *Carex vesicaria*, *Carex* cf. *limosa*, *Carex paniculata*), bogbean (*Menyanthes trifoliata*), and marsh willowherb (*Epilobium palustre*).

Evidence for the local Federmesser occupation and their various activities is well documented in both the lithic and archaeobotanical records; the use of campfires and burning local marsh vegetation is supported by microscopic charcoal and charred herbaceous plant particles deposited in Palaeolakes 1 and 3, located near the Federmesser sites. Human activities were also recognised through Cladocera and geochemical records (Sobkowiak-Tabaka et al. 2018).

During the Younger Dryas, a marked climatic deterioration led to Swiderian occupation within a more open environment with substantially reduced forest cover. Locally, this is reflected in the expansion of juniper (*Juniperus communis*) and extensive open areas dominated by mugwort (*Artemisia*) and grasses. Lake margins were vegetated by various sedge species and clubmoss (*Selaginella selaginoides*). Despite these conditions, intense Swiderian occupation is documented at

Sites 10, 11, 37, and 42, with clear evidence of human impact on the landscape through burning and the exploitation of woody and herbaceous plant resources (Sobkowiak-Tabaka et al. 2018; Sobkowiak-Tabaka and Kufel-Diakowska 2019). During both phases, the local environment provided favourable conditions for hunter-gatherer subsistence activities.

## Summary

The Lubrza region in western Poland is an outstanding example of a landscape repeatedly used by hunter-gatherer groups during multiple phases of the Late Glacial and the Holocene.

The area serves as a focal point of human activity, with four Late Palaeolithic sites identified within approximately 1 km$^2$ (Sobkowiak-Tabaka et al. 2018). Such landscapes, often called *persistent places*, are widely recognized in both temporal and spatial contexts (e.g., Schlanger 1992; Vanmontfort et al. 2010; Turner et al. 2013). Due to their repeated use by hunter-gatherers, these areas offer especially favourable settings for studying past human presence and activity through natural archives, including peatlands and ancient lake sediments.

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# ORORŃSKO, SITE 2

Katarzyna Kerneder-Gubała

Orońsko Site 2 is located in the Orońsko commune, Szydłowiec district, Masovian Voivodeship, Southern Poland, in the northwestern part of the chocolate flint outcrops along the northern margin of the Holy Cross Mountains. It is situated in the Oronka Valley, which is a tributary of the Vistula River (Bernat 2004; Warmuzek 1991, 44–45).

The chocolate flint outcrops are found as flint-bearing layers within the Upper Jurassic Belt. These sediments consist of limestones and are covered by glacial clays and sands (Budziszewski 2008; Gutowski 1998). Orońsko Site 2 features the remains of a Late Palaeolithic flint mine, along with adjacent flint workshops and hunting camps.

## History of research

Research on the exploitation of chocolate flint outcrops on the northern margin of the Holy Cross Mountains were initiated by Stefan Krukowski and geologist Jan Samsonowicz at the beginning of the 20th century (Krukowski 1922, 1923; Samsonowicz 1923). During this period, surface surveys were also conducted around Orońsko and the surrounding agricultural fields (Krukowski 1939–1948). In 1935, excavations at the Orońsko Site 2 uncovered several mining pits and shafts (Kozłowski 2008; Krukowski 1939–1948).

Subsequent research in the region was conducted by Romuald Schild (Schild 1971, 1976), who carried out extensive surface surveys to verify and accurately locate the flint extraction points identified by S. Krukowski. He also analyzed the chocolate flint as a raw material from various outcrops. Later, J. Budziszewski studied the area and identified several mining fields (Budziszewski 2008). In the years that followed, ongoing surface surveys were conducted in this region as part of a national program called "Archeologiczne Zdjęcie Polski" (AZP). The latest research, which began in 2016, is being led by the authoress and the Institute of Archaeology and Ethnology at the Polish Academy of Sciences (Kerneder-Gubała 2019; Kerneder-Gubała et al. 2017; Osipowicz et al. 2019; Werra and Kerneder-Gubała 2021). Recent fieldwork has uncovered new, previously unrecorded mining shafts at Orońsko Site 2. However, the location of Krukowski's trenches is still unknown today (Kerneder-Gubała et al. 2017).

## Methods of research

The research has employed a range of comprehensive non-invasive methods alongside regular surveys, excavations, and laboratory analyses. Detailed surface research has enabled precise mapping of the mining fields in the Orońsko area, particularly at the Orońsko Site 2. The extent of the mining field was assessed using LIDAR technology to identify potential post-mining structures; however, these structures have not been preserved (Kerneder-Gubała et al. 2017).

The mining site was further investigated using survey methods and traditional excavation techniques. Each artefact was precisely located, which facilitated spatial analysis and the reconstruction of the mining shaft fillings. Geophysical techniques, including magnetic surveys, electrical resistivity imaging, and ground-penetrating radar, were also employed to determine the extent of the mining fields. Additionally, geological investigations were conducted both on the mining shafts and in the surrounding areas.

All collected data were analyzed using Geographic Information System (GIS) tools, and

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FIGURE 1. Orońsko, Site 2, Shaft 1, profile (photo by K. Kerneder-Gubała)



FIGURE 2. Orońsko, Site 2, Shaft 6: the bottom (A) and niche with flint bearing layers (B) (photo by K. Kerneder-Gubała)

a three-dimensional model of the excavated areas and mining shafts was created. The mining artefacts were subjected to specialized geological analyses, microscopic examinations, and chemical testing of red pigment samples found on the tools. Various techniques were employed for the analyses, including Scanning Electron Microscopy (SEM), X-ray Fluorescence (XRF), Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS), Raman spectroscopy, and Instrumental Neutron




FIGURE 3. Tanged points from Shaft 6 (photo by K. Kerneder-Gubała)

Activation Analysis (INAA). Flint and bone artefacts underwent traceological analysis, while bone and antler samples were examined through zooarchaeologicl methods, also by Mass Spectrometry (ZooMS) studies. Additionally, palaeobotanical analyses were performed, and charcoal and antler bone samples found in the backfill of the mining shafts were dated using the radiocarbon (14C) method.




FIGURE 4. Bone mining tools (photo by K. Kerneder-Gubała)

## The main results

Recent excavations have revealed the outlines of approximately 50 mining shafts, primarily located in the central part of the Orońsko 2 mining field. Some areas have been studied in detail, showing shafts dug into the primary limestone rock, which contains layers rich in flint. In the vicinity of these shafts, several sites have been identified as flint workshops and hunting camps situated along the river valley. These sites are mainly associated with the Tanged Point Technocomplex, linked to the Brommian and Swiderian.

## Mining shafts: construction, stratigraphy, methods of flint extraction:

The mining shafts exhibit various shapes influenced by geological conditions, location, characteristic of flint bearing layers and probably the specific needs and skills of the prehistoric miners. Shafts 1–3 are simple structures, with depths of approximately 3.8 metres, excavated through both residual clay and primarily limestone layers. These shafts have round, regular outlines at the top and have tetrahedral shapes at the bottom (Fig. 1A, B). In contrast, Shaft 6 is more complex, displaying side niches and a diameter of about 5.5 metres at the top, and about 1.5 metres at the bottom (about 4 m deep).

Shafts 1 and 2 revealed a total of eight backfill layers. These layers are made of limestone in the bottom, dust fractions from weathered limestone, sand, clay rubble, and at the top, contemporary soil deposited through agricultural activity (Fig. 1B). The backfill of Shaft 6 is primarily composed of reddish clay intermixed with sand and small limestone fragments. The presence of limestone rubble at the bottom of the shaft indicates that the niches were deliberately filled after exploitation. These niches reach a depth of 1 metre and contain mainly cracked rock fragments, showing signs of fire use (Fig. 2A, B). Various mining methods combined with the use of fire were adapted for exploitation of flint bearing layers. Tools made from flint, other stones, antlers, and animal bones were employed in the mining activity (Fig. 4–5; Osipowicz et al. 2019).



FIGURE 5. Antler from mining Shaft 1 (photo by K. Kerneder-Gubała)

## Artefacts from the mining shafts

The Orońsko Site 2 chocolate flint mine has yielded over 11,000 flint artefacts and thousands of natural flint nodules, primarily linked to the Late Palaeolithic period. The collection includes a significant number of flakes and blades from every stage of core preparation and exploitation. Many blades are categorized as either forms from initial core exploitation or as half-products or final retouched tools. The group of cores primarily consists of single and double-platform blade cores. The tool assemblage features retouched flakes and blades, alongside specific forms such as backed blades, burins, and tanged points (Fig. 3). Numerous mining tools, including pikes, macro-scrapers, and side scrapers, were also discovered.

Artefacts from the shaft mine backfills include bone and antler tools made predominantly from elk remains, most of which show regular signs of use as mining tools (Fig. 4–5; see Osipowicz et al. 2019). A substantial part of the collection shows traces of red pigment, probably from ochre found within the walls of Shafts 1 and 6, which may have been brought to the site intentionally or could have local origins. On the walls of Shaft nr 6 some markings made with the use of charcoal probably mixed with fat have been found.

## Chronology

Radiocarbon dating from 13 samples (11 charcoal, bone and antler) indicates a timeframe at the end of the Allerød and the Younger Dryas periods (GI-1a – GS1, see Kerneder-Gubała 2019; Osipowicz *et al.* 2019; Werra, Kerneder-Gubała 2021). Based on the compilation of artefacts and radiocarbon dates, we can suggest that the mine was in use for several hundred years, particularly in association with the Tanged Point Technocomplex – Brommian and the Swiderian communities. Earlier excavations conducted in the 1930s revealed that this area was also occupied by communities connected to the Federmesser groups during the Allerød period (Krukowski 1939–1948; Schild 1971).

## Orońsko mine in the Late Palaeolithic

Orońsko Site 2 was mined during the Late Palaeolithic period. Intensive underground mining occurred from the end of the Allerød period through the Younger Dryas, as supported by radiocarbon

dating and a wealth of flint inventories. The environment at the end of the Allerød and beginning of the Younger Dryas in the Oronka River valley – adjacent to the Orońsko 2 chocolate flint mine – was favourable for the presence of elks. Therefore, it can be assumed that these communities combined mining with targeted hunting activities. The chocolate flint mine in Orońsko may be considered as one of the important prehistoric mining sites in Europe, due to its early chronology and the concentration of mining facilities, workshops, and hunting camps in a small area around the mine. The abundance of artefacts and sites reflects the region's significant economic and social importance, indicating large-scale imports of raw materials (see Sulgostowska 2005; 2008).

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# HUNTER-GATHERER ART FROM POLAND: OLD FINDS AND NEW AVENUES

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The use of the term "art" when referring to Stone Age engravings, paintings and figurines has been questioned on many occasions the argument being that the function of these objects was a far cry from what we understand as art today (Conkey 1983; Marshack 1991; Moro Abadia 2006; Nowell 2006; Fritz et al. 2015). Nevertheless, in view of its usefulness as an umbrella term covering the multi-faceted phenomenon, it shall be used in this text, keeping to the reservations made by Lewis-Williams (2002, 41), aware all the while of various limitations and nuances in its significance and interpretation. Some forms of Palaeolithic and Mesolithic art – viz. rock art – are not represented in the archaeological record from Poland; what we have at hand is portable art in the form of engravings on bone, antler, and stone, and figurines.

Earlier approaches to the problem of forager art – and prehistoric art in general – in Polish literature tended to focus largely on stylistic issues, description of ornaments and typology of motifs (cf. Gąssowski 1975; Janiak 2002), devoting less space to the relationship between the object and its ornamentation, the dynamics of the ornamentation process, and social context of the functioning of these artefacts within hunter-gatherer communities.

The application of microscopy techniques and 3D imaging has enabled more detailed studies of ornaments on Palaeolithic and Mesolithic art: execution techniques used, the sequence of execution of individual elements of a given ornament, the dynamics of their execution, and the metric parameters of different parts of the engravings (Marshack 1991; d'Errico 1992; 1994; Fritz 1999; Bello et al. 2013; Płonka et al. 2023).

In the text, we present the latest research results on objects of art (in a broad sense) from the area of present-day Poland. The biographic approach was used to reconstruct successive stages in the life of art objects, starting from their inception through to their abandonment. Special attention was paid to social aspects of the use of these items, i.e., the place they occupied in the life of Palaeolithic and Mesolithic hunter-gatherer groups.

## The oldest evidence

The earliest example of simple engraved marks, made intentionally but lacking an understandable practical meaning, are seventeen incisions on an ursid (brown bear) radius (Fig. 1) excavated in the Dziadowa Skała Cave (Chmielewski 1958), at Skarżyce (Zawiercie) in the Częstochowa Upland, from a deposit dated to the Eemian (115–130 kyr) (Płonka et al. 2024).

The bone is broken at both ends, with at present a length of 10.6 cm. Its surface shows varying degrees of postdepositional damage. The seventeen incisions form a row approximately on the axis of the bone, oriented at right angles or diagonally to it. They appear to form a closed group – there are empty spaces between the outlying incisions and the broken ends of the bone. The incisions range in length between 4.3 and 11.9 mm, have a width of 0.7–1.4 mm, and an average depth of 91 µm. They were made by cutting with a retouched tool, possibly a knife (incisions made with an unretouched edge of a flint flake would have different metric parameters). There is evidence that the incisions on the ursid bone from Dziadowa Skała

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FIGURE 1. Dziadowa Skała Cave. Incised radius, Archaeological and Ethnographic Museum in Łódź (photo by Tomasz Gąsior)

Cave were touched up in the same direction. The characteristic comma-like outline of some of the incision ends (Fig. 1) was revealed during experimental replication to result from a movement made by a right-handed individual towards themselves. The incisions have similar features, suggesting they were made by the same person, most likely within a relatively brief period of time.

The same kind of incisions, and longer engraved lines are sometimes seen on bone and stone finds dated to the Middle Palaeolithic, more rarely, to the Lower Palaeolithic, recorded on different continents (Majkić et al. 2018). In this part of the world inhabited during the period of which we speak, their most likely maker would be a Neanderthal. His, or her intentions are hard to recover – possibly we have evidence here of early symbolic behaviour, an attempt at recording a brief message, or number notation.

## Magdalenian art

For a larger number of finds of art objects from Poland we have to wait until the very end of the Upper Palaeolithic; they derive from Magdalenian



FIGURE 2. Maszycka Cave. Ornamented point, Archaeological Museum in Cracow (photo by Maksym Mackiewicz)

sites (Płonka 2012; Połtowicz 2013). These fall into two groups which belonged to two different periods of settlement of southern Poland. The first corresponds to the Middle Magdalenian and is represented by a single site – the Maszycka Cave dated to 18.5–18 kyr cal BP (Ossowski 1885; Kozłowski 1963; Kozłowski 1995; Kozłowski et al. 2012; Pfeifer 2022), the second is attributed to the Late Magdalenian, the period dating to around 16.4–12.9 cal BP (Połtowicz 2013; Bobak and Połtowicz-Bobak 2014).

The assemblage of finds from the Maszycka Cave represents forms analogous to those known from the Middle Magdalenian facies *à navettes* from southern France. This would have been the source area of the group of arrivals who occupied the Maszycka Cave, and presumably died there. The assemblage from this site includes different categories of objects featuring an engraved ornament: points (Figs. 2, 3), navettes, polishers and a remarkable slotted artefact fashioned from the rib bone of a large mammal. While the latest study



FIGURE 3. Maszycka Cave. Ornamented point, Archaeological Museum in Cracow photo by Maksym Mackiewicz)

of the exceptional art assemblage is still at an early stage, it is possible to formulate some general remarks; the inhabitants of the cave were familiar with diverse techniques of applying ornamentation: shallow and deep engraving, relief and gouging. The lines of the ornament were typically produced by repeating the movement of the cutting edge of a flint tool, two or more times. The largest group of decorated objects are spear points fashioned as a rule from reindeer antler (Figs. 2, 3). The form of ornamentation seen on the spear points ranges from simple patterns of strokes to complex patterns incorporating curved lines (arcs, ovates and ledges, and cupules) executed using the technique of relief or by gouging. The two groups of decorated points differ markedly by the effort expended but it is unclear whether the differences had to do with different symbolic messages, or differences in the proficiency of individual makers. The slotted artefact is an example of a complex composition built of simple elements – engraved strokes and zigzag lines. We are currently making studies to resolve




FIGURE 4. Wilczyce Site 10. Flint figurine of woman, Institute of Archaeology and Ethnology Polish Academy of Sciences in Warsaw (photo by Tomasz Płonka)

whether the ornament originated during a single episode or cumulatively during a larger number of sittings.

Late Magdalenian art has been recorded in three open sites in Poland. The site Wilczyce 10 found in the south of the country yielded c. 60 figurines of small sizes, representations of women, made from flint and organic material: two specimens made from bone, and two from mammoth ivory (Boroń et al. 2011). The figurines are in a style typical of the Late Magdalenian known from Western and Middle Europe (Fiedorczuk et al. 2007). The female silhouette is represented sketchily in profile, showing only the thorax, buttocks and upper thighs, sporadically, also breasts. Finds of unfinished pieces, or figurines damaged during working show that these objects were made on the site. They represent anthropomorphic portable art unique for the Upper Palaeolithic, because of their raw material and technique of execution – by retouching flint flakes and blades (Fig. 4). The most outstanding figurine by far was carved from a plate of mammoth ivory. Apparently, it portrays a gravid woman, a rare representation in Magdalenian culture (Boroń et al. 2013).



FIGURE 5. Vicinity of Dobiegniew. Amber figurine of horse, currently in the State Hermitage Museum in Saint Petersburg, Russia (photo by Hans-Dietrich Meyer)

Another site with Late Magdalenian portable art is Dzierżysław 35 situated in the region of the Moravian Gate. It yielded a damaged hematite plaque given the schematic shape of a woman, shown in profile, with a marked head and breasts, and traces of an attempt to model the buttocks (Ginter et al. 2002). The assemblage of finds from the Magdalenian encampment at Ćmielów 95 in eastern Poland includes items of portable art not described previously: several stone plaques with linear engravings and engraved ochre *rondelles*. The latter are quite unique because of their material – hematite (Płonka et al. 2020).

While the art objects of the Late Magdalenian age recovered in Poland are similar to forms known in the West, they document innovation in the choice of materials used.

## Late Palaeolithic art

The art of this period is poorly recognized, but apparently combines earlier traditions and new trends of geometric art. Distant Magdalenian traditions are probably ancestors of zoomorphic representations made from amber, some of which are thought to date to this particular period (Veil et al. 2012), for example, an amber horse discovered in the nineteenth century between Drezdenko and Dobiegniew, presumably closer to the latter locality (Płonka 2020). The figurine is marked by careful modelling of the body and head, complete with its features, forelegs and hind legs connected by a bar; rows of dots, apparently engraved, run from the muzzle down the spine to the back of the figurine (Fig. 5). As in the case of the aamber elk figurine from Weitsche, Germany (Veil et al. 2012),



FIGURE 6. Rusinowo. Ornamented artefact from elk antler, National Museum in Szczecin (photo by Tomasz Gąsior)

the piece in question has been attributed to the hunter-gatherer groups described as the complex with Arch-Backed Points.

Another group of finds from our part of the European Lowland are objects with engraved geometric designs, consisting most often of rows of strokes and zigzag lines. Motifs of this description have been observed on some Late Palaeolithic harpoon finds from the Polish Lowland (Galiński 1990; Płonka 2012; Orłowska and Osipowicz 2018).

A quite different item of portable art is an object fashioned from a fragment of elk antler, found at Rusinowo in NW Poland (Fig. 6) and dated to around 10,800–10,700 cal BCE. On both its sides, it includes an ornamentation of several groups of zigzag lines. On side A, next to a single zigzag line, are six groups of between two and ten zigzag lines; on side B there are eight groups of between two and nine zigzag lines. Between them is a striking anthropomorphic representation built by engraved lines, interpreted with some confidence as a woman. Analysis of the ornaments revealed that they were made by several individuals who used different tools; the wear of the antler surface and of



FIGURE 7. Szczecin-Podjuchy. Ornamented baton, National Museum in Szczecin (photo by Tomasz Gąsior)

the lines of the ornament indicate extended use of this object (Płonka and Kowalski 2017). The ornaments on side A were engraved by one or a larger number (as many as three?) individuals, proficient engravers. The level of skill displayed by the ornamentation on side B is less impressive – except for the figure engraved with admirable proficiency by means of repeated touching up of the lines. Apparently, the zigzag ornaments were made by several individuals (possibly as many as seven), presumably over an extended period of time.

The composition engraved on the elk antler from Rusinowo apparently refers to the concept of a world structured into several different realms, and to myths. A short zigzag engraved next to the anthropomorphic representation could be a birth symbol, whereas a break at the centre of the upper group of two zigzag lines could represent a passage, over which was engraved a short diagonal line – possibly representing a symbolic closed access to a different level of the world. The evidence of wear of the antler surface and ornaments shows that this object remained in extended use, possibly during recurring ritual activities. Next to the engraved ornaments, the antler includes obvious traces of rituals: marks of picking administered to the ornament on side A, and a dent on side B from percussion – possibly from a ritual "killing" of the artefact prior to its discarding.

## Mesolithic forager art

Finds of Mesolithic art objects are mostly recorded in Poland in its northern regions where there were favourable conditions for the survival of bone and antler artefacts. Some of these pieces include geometric ornamentation in a style characteristic of the northwestern province of Mesolithic art. Zoo- and anthropomorphic motifs are extremely rare, but they too are marked by a geometricized style

of portrayal of the silhouette. While some of these objects derive from regular archaeological excavations (Pobiel Site 10, Bolków Site 1, cf. Bagniewski 1990; Galiński 2024), the most spectacular of these pieces are stray finds (Płonka 2003; Osipowicz et al. 2017). The earliest examples of engraved ornamentation come from the site Bolków 1 in the region of Szczecin – they may be of Preboreal date (Galiński 2024). However, the majority of the Mesolithic art objects dated to the Boreal period. In this group the most elaborate engraved ornaments are observed on perforated batons made of red deer antler. Their complex ornamentation covers much of their surface – scraped with care prior to applying the designs. Our study of the decorated batons identified two scenarios of ornamentation: in some, e.g., on the specimens from Pułtusk and Woźniki, the ornamentation was created at a single sitting. On other batons, e.g., the specimen from Szczecin-Podjuchy (Fig. 7), the designs were the result of several episodes, and on occasion, some motifs applied earlier were removed with a flint knife. However, by and large, the baton from Szczecin-Podjuchy is unique, because its engraved imagery is anthropomorphic: a human figure with one leg raised (the other does not survive) is portrayed in motion, possibly while dancing; a line engraved running from the head of this figure to the hole in the baton apparently represents symbolically the route of the person to a passage leading to a different world. Some designs in the middle of the baton are partly worn where the object would have been gripped, apparently during an extended use.

Artefacts of this description are quite characteristic of the early Mesolithic of northwestern Europe. Outside northern Poland, we find them also in northern Germany and in Denmark. They are most frequently decorated with zoo- and anthropomorphic designs in comparison to other ornamented artefacts from the Mesolithic, with the exception of bone daggers with flint insets. Quite often they also include zonal ornamentation – motifs arranged in alignment with the longer axis of the object alternate with motifs placed perpendicular to that axis, thereby creating zones of ornament possibly representing the zonal structure of the world, characteristic of shamanistic beliefs.

## Conclusion

While the number of Palaeolithic and Mesolithic art objects found in Poland is very modest, they include exceptional forms, not encountered in other parts of Europe. In-depth studies of these artefacts has enabled in many cases reconstruction of their biography: their execution technique, the technique used in engraving their ornament, ornamentation phases and uses. Thanks to this research we have obtained insight into social behaviours of hunter-gatherer groups and into the function of ornaments in the life of forager societies.

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# MESOLITHIC



# EXPLORING PREHISTORIC POLAND
## FROM PALAEOLITHIC TO NEOLITHIC

# MESOLITHIC

Iwona Sobkowiak-Tabaka

The world of the Mesolithic was a period of transition – not only between archaeological periods, but between climates, landscapes, and ways of life. As ice sheets receded and forests spread across Europe, human communities were forced to rethink how they lived, moved, and interacted with their environment.

The term Mesolithic itself reflects this transitional character, denoting a period that bridges two major archaeological epochs – the Palaeolithic and the Neolithic. The term Mesolithic emerged in nineteenth-century French and English literature almost simultaneously. In 1865, John Lubbock organised the growing number of "Stone Age" finds discovered in the mid- and late nineteenth century by defining the Palaeolithic and Neolithic periods. In his interpretation, however, there also appeared an unnamed "period intermediate between that of the Polished Stone implements and of the great extinct mammalia" (Lubbock 1869: 327, cited in Peter Rowley-Conwy 1996: 941).

A year later, Thomas Johnson Westropp described similar materials from Danish and Irish sites. Later still, Jules Reboux introduced the term *Mésolithique* in France to describe the period characterized by stone technologies that fall between "flake" and "polished" tools (Warren 2025). In 1874, the Swedish geologist Otto Martin Torell first used the term to describe the transitional period between the Palaeolithic and the Neolithic (Galiński 2002). The first clearly defined Mesolithic culture in Europe was the Tardenoisian culture, a name that remained in use in Poland until the mid-twentieth century (Chmielewska 1954).

## History of research on the Mesolithic in Poland

The study of the Mesolithic period in Poland has a long and evolving history, reflecting broader trends in European archaeology. Interest in Mesolithic artefacts began in the late 19th century and is linked to scholars like, Zygmunt Gloger, Erazm Majewski, Józef Przyborowski, and later Włodzimierz Antoniewicz, Józef Kostrzewski, Leon Kozłowski, Stefan Krukowski, Ludwik Sawicki, and Zygmunt Szmit (Galiński 2002). However, the peak of Mesolithic research in Poland took place in the 1960s and involved researchers such as Hanna Więckowska and Romuald Schild, who studied sites in the Mazovia region (Chmielewska et al. 1975; Schild et al. 1975). A key figure in these studies was Stefan Karol Kozłowski, who in the early 1970s produced the first synthesis of the prehistory of the Polish lands during the Early Holocene (Kozłowski 1972).

Today, different models of understanding Mesolithic dominate. Some archaeologists define it as a system of adaptation to the new Holocene environmental conditions of the European Plain (Milecka, in this volume). In this view, it represents a socio-economic formation linked to a specific type of adaptation driven by environmental factors (S. K. Kozłowski 1972). Other researchers emphasise technological and typological aspects. Highly specialised hunting, fishing, and gathering forest resources in the young-glacial landscape required a toolkit with clearly defined technological and typological features, setting it apart from other contemporary cultural groups.

This chapter provides a synthetic overview of the most significant research on the Mesolithic in Poland, with the discussion expanded through selected examples of archaeological sites and cultural phenomena.

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## Cultural and environmental changes at the Pleistocene–Holocene transition

Around 9600 BCE, the onset of the Mesolithic period in the territory of present-day Poland coincided with profound climatic transformations associated with the termination of the Last Glacial Period, marking the transition to the warmer and more stable conditions of the early Holocene. The abrupt climatic warming, accompanied by the expansion of forest ecosystems, constitutes one of the defining features of the Holocene period (Ralska-Jasiewiczowa 2004). Changes in vegetation cover, initially characterised by the prevalence of birch–pine woodlands, followed by the gradual incorporation of elm, hazel, and oak (Milecka, in this volume), significantly influenced the lifeways of Mesolithic populations. These developments were not confined to local scales but extended across northern Europe, where post-glacial transgressions of the oceans and seas led to substantial landscape reconfiguration, including the eventual submergence of Doggerland (Bailey and Jöns 2020).

The end of the Mesolithic period is usually linked to the emergence of agriculture. In Poland, this was represented by early farming communities associated with the so-called Danubian cultural groups, whose beginnings are dated to 5350 BCE (Oberc et al. 2002). However, adopting innovations such as plant cultivation and animal husbandry was a gradual process that took different paths across various regions of Poland (Wierzbicki, in this volume).

At the onset of the Holocene, the North European Plain was still inhabited by Late Palaeolithic communities associated with the so-called Tanged Point technocomplex, typically divided into the Ahrensburgian groups in the west and the Swiderian groups in the east. The transition from Late Palaeolithic to Mesolithic societies is clearly reflected in profound changes in lithic assemblages, manifested in the processes commonly referred to as microlithisation and geometrisation.

The disappearance of Late Palaeolithic communities in the North European Plain and the subsequent emergence of Mesolithic groups in this region are most frequently interpreted in terms of: (a) adaptation to new environmental conditions; (b) cultural continuity; and/or (c) population replacement.

Within the adaptive framework, particular emphasis is placed on the natural environment's crucial role as a driving force behind cultural change. Climatic and ecological shifts led to adjustments in subsistence strategies and lithic technologies (Szymczak 1995). At the same time, current research questions the simplified division between Palaeolithic big-game hunting and Mesolithic economies based on small-game exploitation and fishing, instead highlighting continuity, flexibility, and regional differences in subsistence strategies (Kabaciński et al. 2008; Kabaciński and Sobkowiak-Tabaka 2009). These changes were often quantitative rather than qualitative, although they were accompanied by notable technological innovations, such as the bow, watercraft, and axes (Eriksen 1996).

Concepts of continuity highlight the internal development of Late Palaeolithic communities, leading to the rise of Mesolithic groups (Płonka et al. 2020). Special significance is given to the Ahrensburgian and epi-Ahrensburgian traditions, as well as phenomena such as the Long Blade Industry. Scholars indicate a possible technological and settlement continuity, seen in the evolution of tool designs and flint-working techniques. The process of change seems to have been gradual and two-way, involving both innovation and the selective adoption of elements from other cultural traditions. Considering radiocarbon dates from Lesser Poland, Damian Stefański (2017) suggests that Świderian groups existed even during the Boreal period of the Holocene.

In contrast, the population replacement model assumes a disruption in settlement continuity and the influx of new groups, particularly Maglemosian communities. Supporting arguments include significant changes in the use of flint raw materials, the collapse of earlier distribution networks, and a marked decline in the number of sites in certain regions (Schild 1996; 2001; Kobusiewicz 1999; Kabaciński and Sobkowiak-Tabaka 2010). Furthermore, radiocarbon data indicate a roughly 300-year gap between the latest Palaeolithic and the earliest Mesolithic communities, suggesting a period of depopulation. This model also suggests that Świderian groups migrated northeastward. Similarities in leaf-point technology seen in the Kunda and Butovo cultural complexes suggest they may be successors to Świderian communities (Sulgostowska 1999). Additionally, on the Scandinavian Peninsula, the Fosna, Komsa, and Suomusjärvi cultures seem to continue Late Palaeolithic traditions, as evidenced by the production of tanged points (S. K. Kozłowski 1999).

There is little doubt that the changes during the Pleistocene–Holocene transition were complex and can best be understood as the result of the interaction of adaptive processes, the development of local traditions, and – at least in some regions – migration and population replacement.

Table 1. An overview of diverse communities that occurred in the territory of present-day Poland during the Neolithic period, including insights into their flint and bone assemblage

The first cultural unit, known as the Maglemosian Complex and named after the site of Magle Mose, extended from Britain to western Poland and developed during the Early and Late Mesolithic. Due to its wide distribution, the complex shows significant regional variation: the southern group is linked to the Duvensee group, while the eastern group is associated with the Komornica culture, which is often related to the Narvian cycle (S. K. Kozłowski 1989; Fig. 1; Table 1). At the same time, communities of the Kunda culture inhabited the eastern regions of present-day Poland (Brzozowski and Siemaszko 1996; Fig. 1).

This spatial and cultural differentiation is further complemented by evidence of continuity into later periods. Notably, during the Atlantic period, some communities associated with the Komornica culture persisted in regions of present-day Poland. Among various indicators, the presence of trapezes in lithic assemblages supports this interpretation, as these are considered characteristic of the tradition (S. K. Kozłowski 2009).

The Kunda culture represents an earlier horizon, with origins dated to 8600–8300 BCE (Brzozowski and Siemaszko 1996; Koltsov and Zhilin 1999; Siemaszko 2001; Table 1). Its presence in present-day Poland is seen at several sites, including Miłuki in the Mrągowo district (Brzozowski and Siemaszko 1996) and Tłokowo in the Olsztyn district (Sulgostowska 2003). These well-documented sites provide important evidence for understanding the northeastern range of Early Mesolithic settlement systems.

The Komornica culture emerged slightly later, as shown by radiocarbon dating, which places its beginnings in the late Preboreal. Early sites include Chwalim (Zielona Góra district), Krzyż Wielkopolski (Czarnków-Trzcianka district), and Bolków (Police district), while sites such as Całowanie (Otwock district) and Łajty (Giżycko district) appeared about two centuries later (Schild 1996; Sulgostowska 1996; Kabaciński 2016). This chronology demonstrates both the temporal depth and regional spread of Komornica communities.

A broader transformation in lifeways and technological practices becomes evident during the Late Mesolithic across the European Plain. This period is marked by significant changes in lithic production, particularly the adoption of new knapping techniques. The pressure technique emerges as a defining innovation, while in the later phases of the Atlantic period, the punch technique is also introduced. These developments are closely associated with cultural units such as the Kongemose culture of north-western Europe, which in its early stages is characterised by slender, elongated triangular microliths, followed by rhombic and trapezoidal forms (Groß and Rimkus 2025). In subsequent phases, assemblages display an increasing prevalence of transverse arrowheads (Hartz 1985).

Several distinct cultural groups of the Late Mesolithic have been identified in present-day Poland. The Chojnice-Pieńki and Janisławice cultures are especially important (S. K. Kozłowski 2009; Fig. 1). The Chojnice-Pieńki culture holds a key place in current research. Its lithic inventories are distinctive, and its role reflects regional adaptations to new conditions (see Table 1).

The Janisławice culture is linked to the Vistulian cycle. It was first identified from lithic and organic assemblages found in a grave at its namesake site (S. K. Kozłowski 1964; Fig. 1). Earlier, researchers had assigned these materials to the Tardenoisian culture (Chmielewska 1954). Later analysis proved that Janisławice is a separate entity. Sites associated with this culture are spread across present-day Poland, Ukraine, Belarus, and the Baltic region (Grużdź et al. 2025). This wide distribution underscores its importance for the Late Mesolithic cultural landscape.

## Settlement patterns and human lifeways

Throughout the entire period of their existence, Mesolithic communities set up their camps along river valleys, which served as the main routes for communication (Kabaciński 2016; Masojć 2016). In some areas, such as the Wojnowo region in western Poland, campsites are lined along the Obra River in a dense, almost continuous manner, making it hard to tell where one occupation ends and another begins (Sobkowiak-Tabaka et al. 2020).

TABLE 1

| Name of the culture | Chronology (BCE) | Flint assemblage | Raw materials | Bone/antler/wood assemblage | References |
|---|---|---|---|---|---|
| **Komornica** | 9600-6000 | Small cores, both single- and double-platform, without advanced preparation (usually flaking surface above the striking platform); often reoriented during the reduction process.<br><br>Soft-hammer percussion, with less frequent use of indirect percussion.<br><br>Blanks used to make microlithic forms such as triangles, backed bladelets, truncated pieces, perforators, end-scrapers and scrapers. Macrolithic tools include tranchet adzes and picks | On the Polish Plain: locally available, relatively low-quality erratic Baltic flint.<br><br>In southern Poland: higher-quality raw materials procured through mining, including Jurassic and chocolate flint. | Antler adzes, hoes, and handles for flake axes, as well as composite points (combining antler with wood or bone and flint), awls, poles, fragments of arrow shafts, and throwing spears. | S. K. Kozłowski 1972, 2009; S. K. Kozłowski, J. K. Kozłowski 1977; Kabaciński 2016. |
| **Kunda** | 8500-5000 | Exploitation of cores (most commonly single-platform cores) using the pressure technique, which resulted in blades with parallel edges. Intentionally fragmented blades – the resulting pieces were mounted as inserts in the working edges of tools made of bone and antler. The characteristic tool assemblage includes tanged points, regarded as survivals of Palaeolithic traditions, as well as retouched inserts, end-scrapers, burins, and retouched blades. | Baltic erratic flint, chocolate and Świeciechów flint. | Single-barbed harpoons, single-row barbed harpoons, antler hoes, bone points with flint inserts. | S. K. Kozłowski 1972, 2009; S. K. Kozłowski, J. K. Kozłowski 1977; Sulgostowska 2016a. |

| Name of the culture | Chronology (BCE) | Flint assemblage | Raw materials | Bone/antler/wood assemblage | References |
|---|---|---|---|---|---|
| **Chojnice-Pieńki** | 6000-4000 | Small single-platform cores, sometimes exhibiting changes in orientation during reduction. Striking platforms were either prepared by a single blow or left natural, while flaking surfaces were carefully prepared, often by cresting.<br><br>Direct percussion and the punch techniques employed in core exploitation.<br><br>Long scalene triangles, backed and truncated pieces, end-scrapers, scrapers, and trapezes. Macrolithic tools include tranchet adzes and picks | Baltic erratic flint, chocolate flint. | Single-barbed harpoons, single-row barbed harpoons, antler hoes. | S. K. Kozłowski 1972, S. K. Kozłowski, J. K. Kozłowski 1977; 2009; Grużdź et al. 2025. |
| **Janisławice** | 6000-5000 | Core preparation usually involved creating narrow flaking surfaces and faceted striking platforms.<br><br>Blades were often produced using punch technique.<br><br>The typical tool assemblage includes triangles, backed pieces, truncated pieces, trapezes, and scrapers. | On the Polish Plain both Baltic erratic and chocolate (possible use of flint mine in Tomaszów) and Świeciechów flint were used.<br>In the south-western part of Poland, particularly in Silesia, a great variety of raw materials were used: radiolarite from the Bardzkie Mountains, as well as rock crystal and related varieties (citrine, amethyst, and smoky quartz), diverse types of jasper, chalcedony, opal, agate, lydite, quartzite, and crystalline rocks such as trachybasalt and rhyolite.<br><br>Imported raw materials: Szentgál-type radiolarite from Hungary, quartzites from the Czech Republic, Platten silex from the Bavarian Forest in Germany, Vlára radiolarite from Slovakia, and various Moravian cherts. | Single-barbed harpoons, punches made of deer antler, antler hoes, bone points with flint inserts. | Chmielewska 1954; S. K. Kozłowski 1972, 2009; S. K. Kozłowski, J. K. Kozłowski 1977; Bronowicki 2016; Grużdź et al. 2025. |

Less frequently, camps were located along lake shores; however, when such sites were chosen, the associated biogenic sediments often contain many artefacts made from organic materials, as shown at sites like Chwalim (Fig. 3), Krzyż Wielkopolski, Bolków, Łajty, and Pobiel (Góra district) (Bagniewski 1990; Galiński 2006; Kabaciński et al. 2009; Kobusiewicz and Kabaciński 1993; Sulgostowska 1996).

Another characteristic feature of Mesolithic communities is the placement of camps on dunes near water sources (Figs. 4–5).

Only a limited number of residential features are known from the Early Mesolithic. Among the most well-investigated are those from Bolków, where several dwelling structures have been identified. These features are oval or circular and were built with pine posts and poles. The same site has also provided features interpreted as storage pits (Galiński 2024; Sobkowiak-Tabaka, in this volume).

One of the best-preserved Late Mesolithic dwelling units comes from Pomorsko. It features a semi-dugout structure with several hearths (Kobusiewicz and Kabaciński 1991; Kobusiewicz 1999). The outline is irregular, measuring about 5 × 4 metres and reaching a depth of roughly 0.6 metres. Inside, six concentrations of ash and charcoal were found, with numerous flint artefacts scattered between them. In one corner, a cache of cores was discovered alongside a lens of yellow pigment. Both inside and outside the hearths, many burnt animal bones – mainly of deer and roe deer – as well as human remains of a child were identified (see below).

A similar structure, with eleven hearths and ten postholes, along with lumps of red pigment and about 3,000 flint artefacts, is known from the site of Dąbrowa-Krępnica in the Bolesławiec district (Bagniewski 1982, 104–107).

From several other sites, oval or rectangular features constructed with poles – evident in postholes – have also been documented; these probably served as hut-like shelters. Their interiors usually contain flint artefacts and burnt animal bones (e.g., Bobrowski and Sobkowiak-Tabaka 2016; Osipowicz 2021). Numerous sites have also revealed single hearths (Fig. 6), found both inside dwellings and in open areas outside them (Kobusieiwcz 1999; Sobkowiak-Tabaka et al. 2017). The site of Paliwodzizna (Golub-Dobrzyń district) stands out for its distinctive stone-built structures, such as wall-like features, fences, hearths, and pavements (Osipowicz and Orłowska, in this volume).

Considering the spatial distribution of artefacts at sites identified through archaeological excavation, two main types can be distinguished. The most common is the so-called 'pattern' without visible concentrations of flints, which features an extensive area, often several dozen metres across, nearly evenly scattered with lithic artefacts. Sites of this kind represent remains of multiple seasonal camps, indicating repeated visits by Mesolithic hunter-gatherers to the same location. It can be assumed that these areas were occupied over several decades or even longer, and any evidence of spatial organisation or the arrangement of successive camps has been completely erased (Kobusiewicz 1999). Examples of such sites include Smolno Wielkie (Zielona Góra district) (Bobrowski and Sobkowiak-Tabaka 2019) and Kopanica (Wolsztyn district) (Sobkowiak-Tabaka et al. 2020; Fig. 7).

Less frequently, a similar 'pattern' occurs, but in these cases, certain artefact concentrations are preserved, allowing the identification of the location of specific activities carried out within the camp. These sites also result from multi-seasonal occupation but are less intensive than those in the previously described category. Examples of this type include Tanowo (Szczecin district), Jastrzębia Góra (Puck district), and Dobra (Goleniów district) (Kobusiewicz 1999).

Subsistence strategies of Mesolithic groups underwent notable reorganisation compared with those of Palaeolithic groups. The earlier emphasis on hunting seasonally migrating herds gradually gave way to more specialised, small-scale hunting practices targeting individual animals, such as deer, moose, roe deer, wild boar, aurochs, lynx, and beaver. In addition, Mesolithic diets relied heavily on aquatic resources, particularly fish, and were further supplemented by the systematic gathering of plant materials.

Faunal assemblages from Early Mesolithic campsites usually include remains of large and medium-sized animals, such as bison, bear, elk, horse, red deer, and roe deer, with wild boar appearing less often. In some sites, evidence of specialised subsistence can be observed; for example, the assemblages from Krzyż Wielkopolski and Bolków contain many remains of fish and hazelnuts (Kabaciński 2016). Birds were also hunted. Remains from the camp at Bolków include those of a heron or stork, as well as a swan, while the site at Krzyż has yielded remains of a bittern, grey heron, crane,

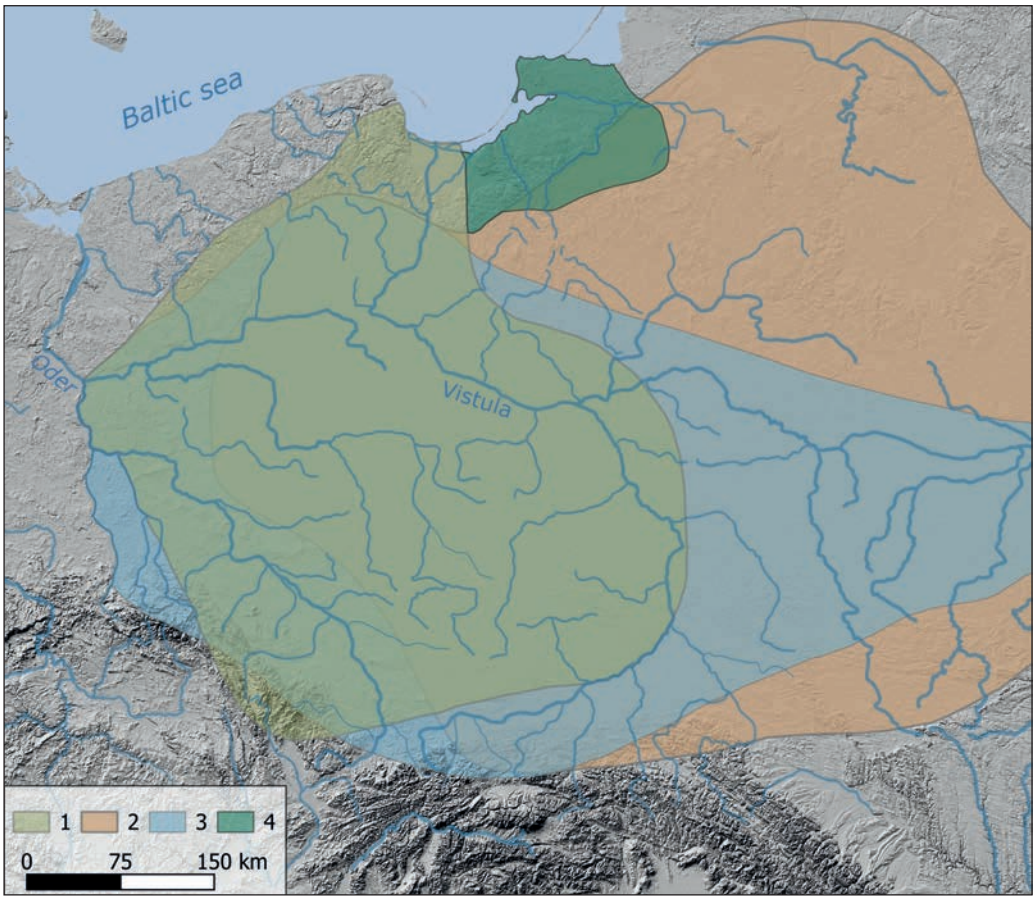



FIGURE 1. Extensions of Mesolithic entities in Poland (drawing by W. Szambelan)
1 – Chojnice-Pieńki, 2 – Janisławice, 3 – Komornica, 4 – Kunda



FIGURE 2. Cores from the Late Mesolithic Kopanica site (photo by I. Sobkowiak-Tabaka)



FIGURE 3. Excavation at Chwalim site (after Kobusiewicz and Kabaciński 1993)

duck, goose, and capercaillie (Kabciński 2023). Remains of many bird species are also known from the Dudka site (Giżycko district) (Gumiński 2005, tab. 3a). The contribution of fish to the diet increased significantly during the Mesolithic, as shown by the abundant fish remains – mainly catfish and pike – found at the sites of Bolków, Krzyż, and Dudka (Gumiński, in this volume).

It is worth noting that the boreal layers at Krzyż have yielded remains of several dozen turtles, which may have been part of the supplementary diet. However, they could also have been used for their shells (carapaces), which would have made excellent containers for storing food (Kabaciński 2023).

Antler and animal bone were also extensively used to make various tools, including points, fishhooks, adzes, axes, handles for tranchets, and objects commonly called "magic sticks" (Galiński 2002).

Hunting was mainly conducted with bows and arrows fitted with flint or wooden tips with conical ends. The arrows also had flint barbs on their upper sides, with flint triangles being mostly used for this purpose. Wooden bows made of elm were found in large quantities at the site in Bolków. Reconstructed examples show that their sizes were similar, measuring 150–165 cm in length, 3.6–4.2 cm in maximum width, and 0.8–1.2 cm at the end of the limb near the grip (Galiński 2002).

Mesolithic communities also engaged in advanced processing of plant raw materials. Various wood species were used to create handles for tools made of bone, antler, and flint (Kabciński 2023). Additionally, fishing involved the use of woven nets shaped like conical baskets or elongated funnels with internal throats (Galiński 2002). Plant fibres of different thicknesses were commonly used, for example, in basketry. Remains of baskets have been found at the sites of Krzyż and Bolków (Galiński 2002; Kabciński 2023).

## Portable art and personal adornments

The motivations behind the creation of art and its function in Mesolithic communities remain largely speculative (Płonka and Furczyk, in this volume). The raw materials used for making artistic objects during this time were generally accessible, including minerals, animal bones and teeth, antler, fossils, and amber (Sulgostowska 2019).

From the Mesolithic period, there are also examples of features that may be seen as forms of sacred or ritual art. This category includes the

complex at Mszano, with its carefully made grave pits, associated hearth features, and mounded grave structures in the form of conical accumulations or stone pavements (Marciniak and Marciniak, in this volume). Particularly notable is the so-called shamanic sanctuary at Bolków, studied by Tadeusz Galiński (Sobkowiak-Tabaka, in this volume).

Most commonly, however, artistic expression in Mesolithic communities is represented by so-called portable (mobile) art, which includes personal ornaments and figurative items, usually recovered from burials. These mainly consist of necklaces made from animal teeth (see above), as well as bone elements attached to clothing. Additionally, everyday objects – such as tools and weapons made of bone or antler – were often decorated (Sobkowiak-Tabaka, in this volume; Kabaciński, in this volume). Within this collection, items depicting human figures are exceptional (see Płonka and Furczyk, in this volume).

Zoomorphic representations are relatively common at Mesolithic sites in Poland, appearing on various bone objects and as full-figure artefacts made of amber, wood, or antler. Wooden figurines representing a wolf, a possible bird, and a fish are known from Bolków; a staff with a handle shaped as an elk head comes from Krzyż (Sobkowiak-Tabaka, in this volume; Kabaciński, in this volume); and amber figurines shaped like a boar and a bear have been recorded at Słupsk (Fig. 8).

## Burial rites

Mesolithic burials are known from 14 archaeological sites, mostly located in northeastern Poland, often near water bodies (Fig. 9). Only one burial – of an *Infans* I child – has been found in a cave in southern Poland, specifically at Bramka Cave (Sulgostowska 2016b). Grave pits usually measured about 2 × 1 metres, with depths reaching up to 1.5 metres. An exception is the grave at Giżycko-Perkunowo, where the dimensions were adjusted to fit the child's size (0.35 × 0.7 metres). The pits were generally rectangular with rounded corners, except for the burial from Woźna Wieś, where the pit was oval.

Mesolithic communities practiced inhumation, biritualism, and cremation, although skeletal burials clearly predominate. Complete cremation was identified at only three sites (Krępnica, Pomorsko, and Wieliszew), where the remains were deposited in pits within settlement areas.

The deceased were most commonly laid supine in grave pits, although other positions are also attested: with knees drawn up to the chin (Dręstwo, Site 10), or on the left side with slightly flexed legs (Mszano). Male burials in a seated position are also known (Janisławice, Woźna Wieś, and most likely Mszano). The greatest diversity in body positioning is observed at the cemetery in Dudka, where individuals were interred mainly in seated (with flexed legs) positions (Gumiński and Bugajska 2016).

The deposition of bodies in containers has been documented only at Mszano (Marciniak and Marciniak, in this volume), where the deceased were wrapped in the bark of deciduous trees. The possibility of binding the bodies of the dead has also been suggested, as indicated by the position of the male individual from the aforementioned site of Dręstwo, Site 10.

Analysis of grave goods shows no clear patterns in how the deceased were furnished based on sex or age. No grave goods were found in cremation burials; however, their original presence can't be confirmed because they may have been destroyed during cremation. The most common items deposited were pendants made of animal teeth, mainly from elk, aurochs, and red deer (e.g., Perkunowo, Janisławice), as well as objects made from fossils and amber (Dudka). Flint artefacts were typically found as single items near human remains. An exception is the grave of an adult male from Janisławice, which contained 38 artefacts made of chocolate flint, representing the entire *chaîne opératoire* – from raw nodules, through cores and blades, to retouched tools, mostly insets (Chmielewska 1954).

Pigments were a standard part of the funeral ritual, appearing in nearly all Mesolithic graves. Usually, this was hematite; in several instances, lumps of white minerals were also found (Janisławice, Giżycko-Perkunowo, Mszano, and Woźna Wieś). Animal remains were also present in the graves, including a hedgehog, birds, turtle shells in Dudka, and burnt horse bones in Woźna Wieś. Items made of bone and antler were only occasionally discovered in graves, such as bone daggers found in the burial from Janisławice.

Funerary practices were probably accompanied by rituals that could have been either episodic or ongoing. In the case of the burial from Woźna Wieś, burnt horse bones were added during the ceremony, as indicated by their stratigraphic position; they are interpreted as



FIGURE 4. Reconstruction of a Late Mesolithic camp at Kopanica, based on paleoenvironmental and use-wear analysis (drawing by A. Hurnowicz)

the remains of a ritual feast. A similar pattern has been found at the site of Kamieńskie, where a ritual feast seems to have occurred after the burial was covered, as indicated by both burnt and unburnt animal bones placed in a pit above the grave (Sulgostowska 2019). Moreover, at one of the graves at Mszano, evidence shows that the grave was reopened, and a later individual was added. Features related to the graves are interpreted as signs of practices associated with the cult of fire and the dead, as well as leftovers of feasting activities (Marciniak 2001).

## Summary

The Mesolithic is a transitional period between the Palaeolithic and Neolithic, first conceptualised in the nineteenth century. The shift from Late Palaeolithic to Mesolithic societies is understood through various models, including environmental adaptation, cultural continuity, and population replacement. These processes were complex and differed across regions, involving both gradual changes and, in some cases, demographic shifts.

Beginning around 9600 BCE, the start of the Holocene brought significant climate warming and



the expansion of forest ecosystems across Europe, greatly influencing human lifeways. Mesolithic communities adapted to these new conditions through flexible subsistence practices, including hunting, fishing, and gathering, supported by technological innovations like the bow, watercraft, and advanced lithic production techniques.

On the European Plain, including present-day Poland, the Mesolithic is represented by several cultural complexes, such as the Maglemosian, Komornica, Kunda, and later Kongemose-related groups. These cultures are distinguished by specific lithic technologies, raw material procurement methods, and settlement patterns, usually focused along rivers and lakes.

Mesolithic communities are evidenced by semi-sedentary settlement systems with seasonal camps, simple dwellings, and evidence of repeated occupation. Their material culture included not only stone tools but also objects made of bone, antler, and wood. Artistic expression was mainly portable, consisting of ornaments and occasional figurative representations, while burial practices reveal various rituals, including inhumation and cremation, often accompanied by grave goods and pigment use.

The end of the Mesolithic is typically linked to the gradual adoption of agriculture, introduced by early farming communities, marking a major transformation in human economies and social structures.

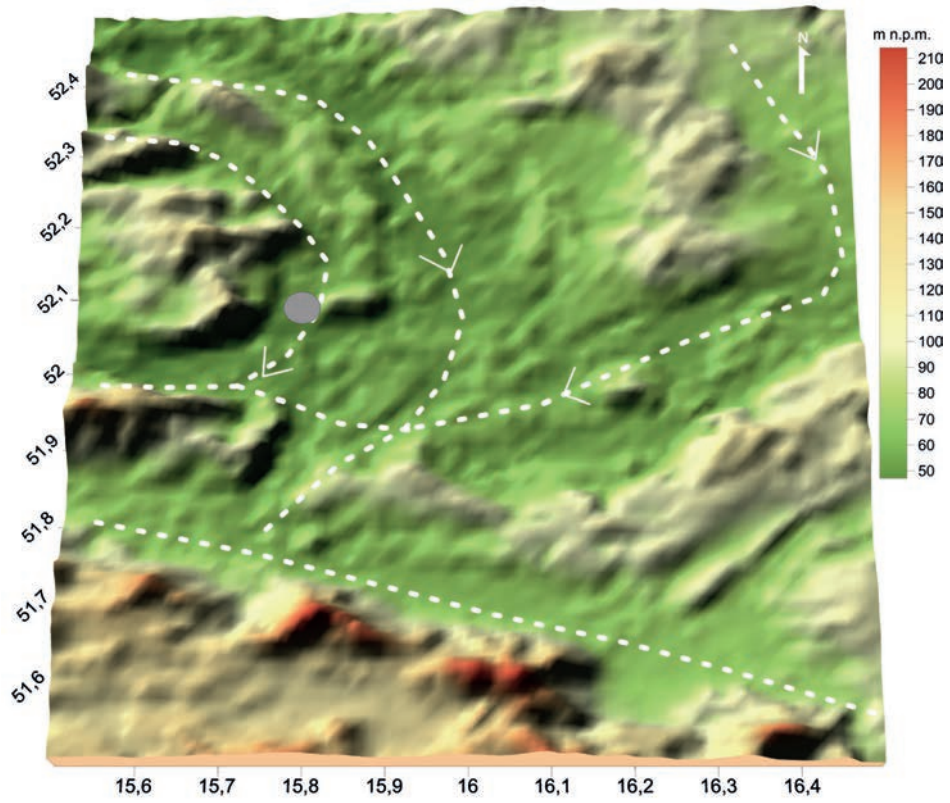



FIGURE 5. Possible routes of communication in the Wojnów region. The grey shading indicates a Mesolithic settlement cluster near the Wojnów Lakes (after Hildebrandt-Radke 2019)




FIGURE 6. Remains of a hearth from the Late Mesolithic Wilenko site (after Sobkowiak-Tabaka et al. 2017)

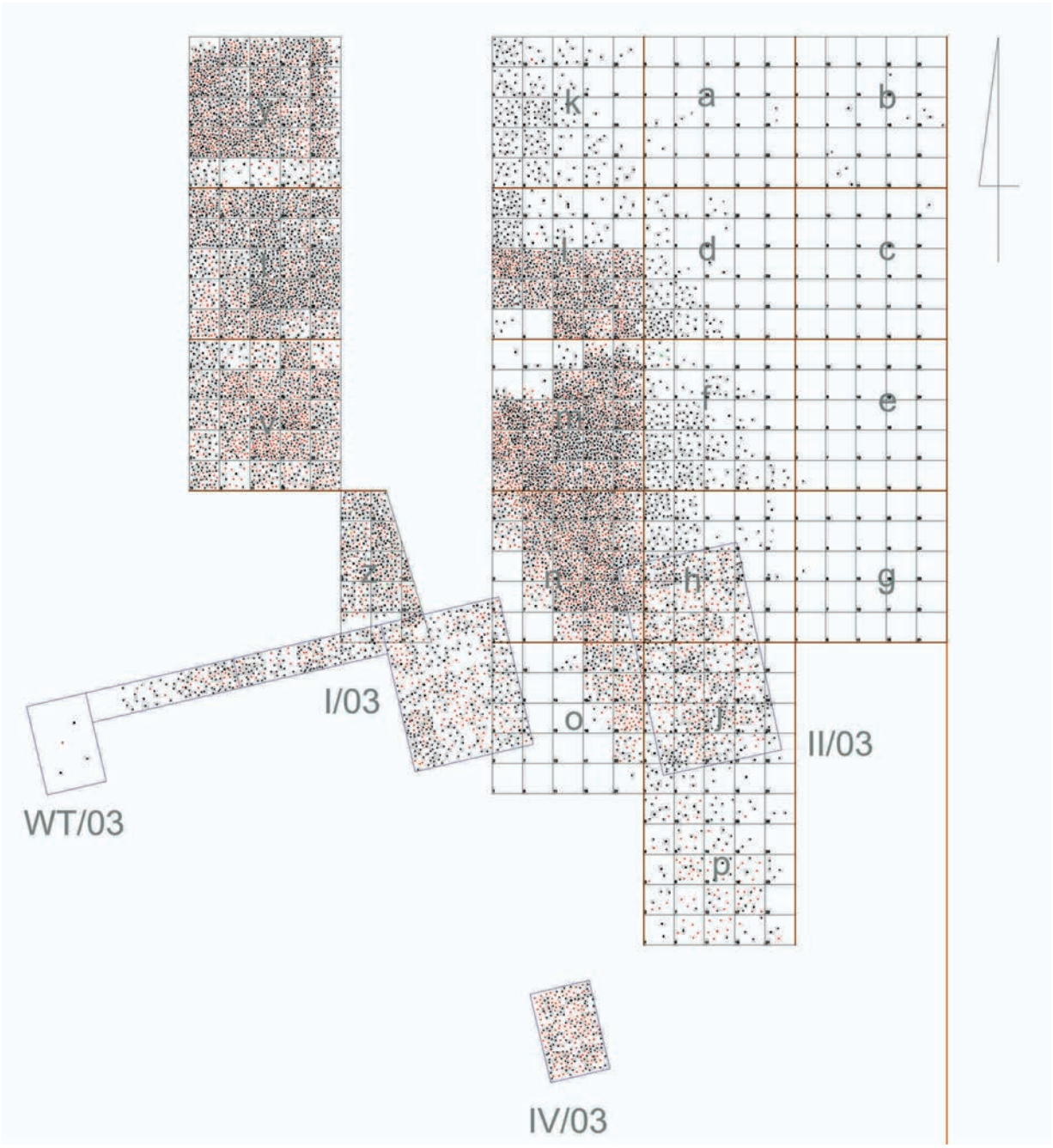



FIGURE 7. Distribution of lithic artefacts at the Kopanica site (drawing by P. Wiktorowicz)



FIGURE 8. Amber bear figurine discovered in peat near Słupsk, Middle or Late Stone Age, 10 × 2.4 × 3.5 cm (MNS/A/22067; photo by G. Solecki, A. Piętak)[1]

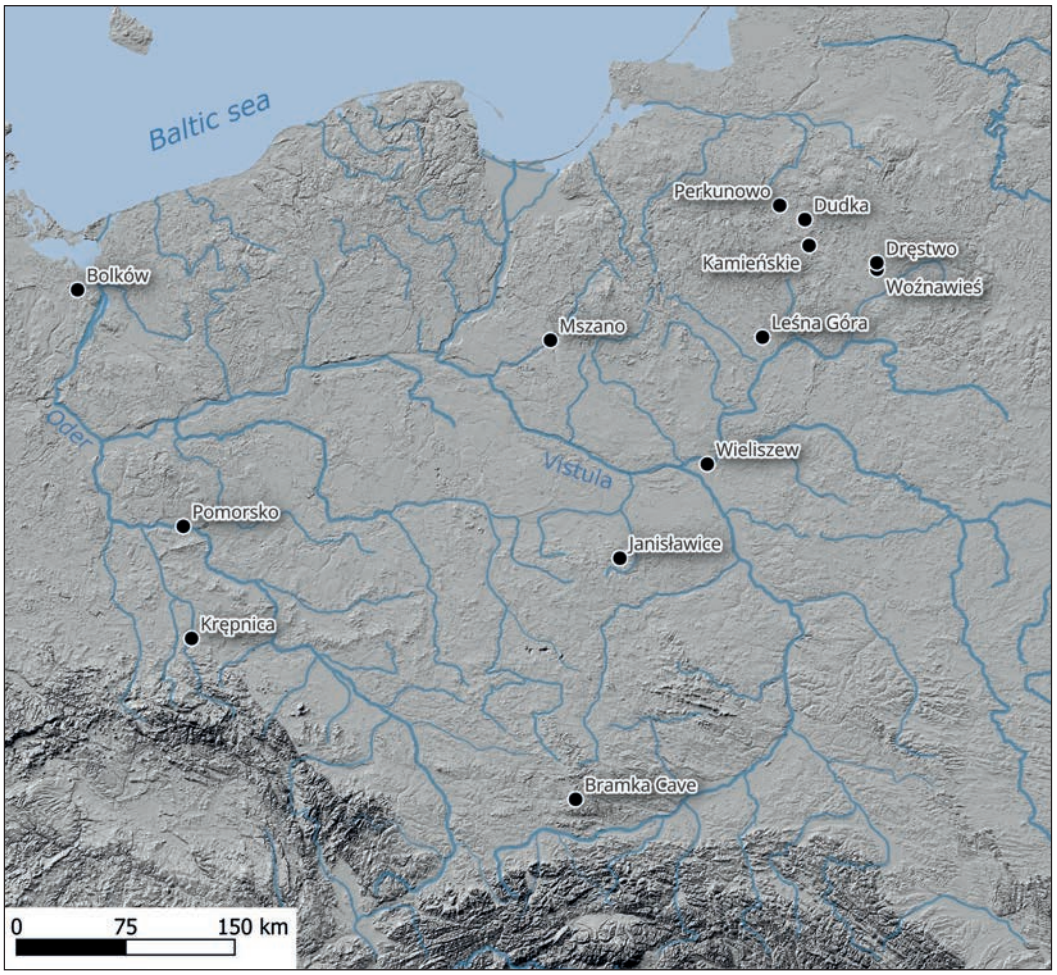



FIGURE 9. Location of Mesolithic burials in Poland (after Sulgostowska 2019, with additions; drawing by W. Szambelan)

[1] https://muzeum.szczecin.pl/zbiory/archeologia [25.03.2026].

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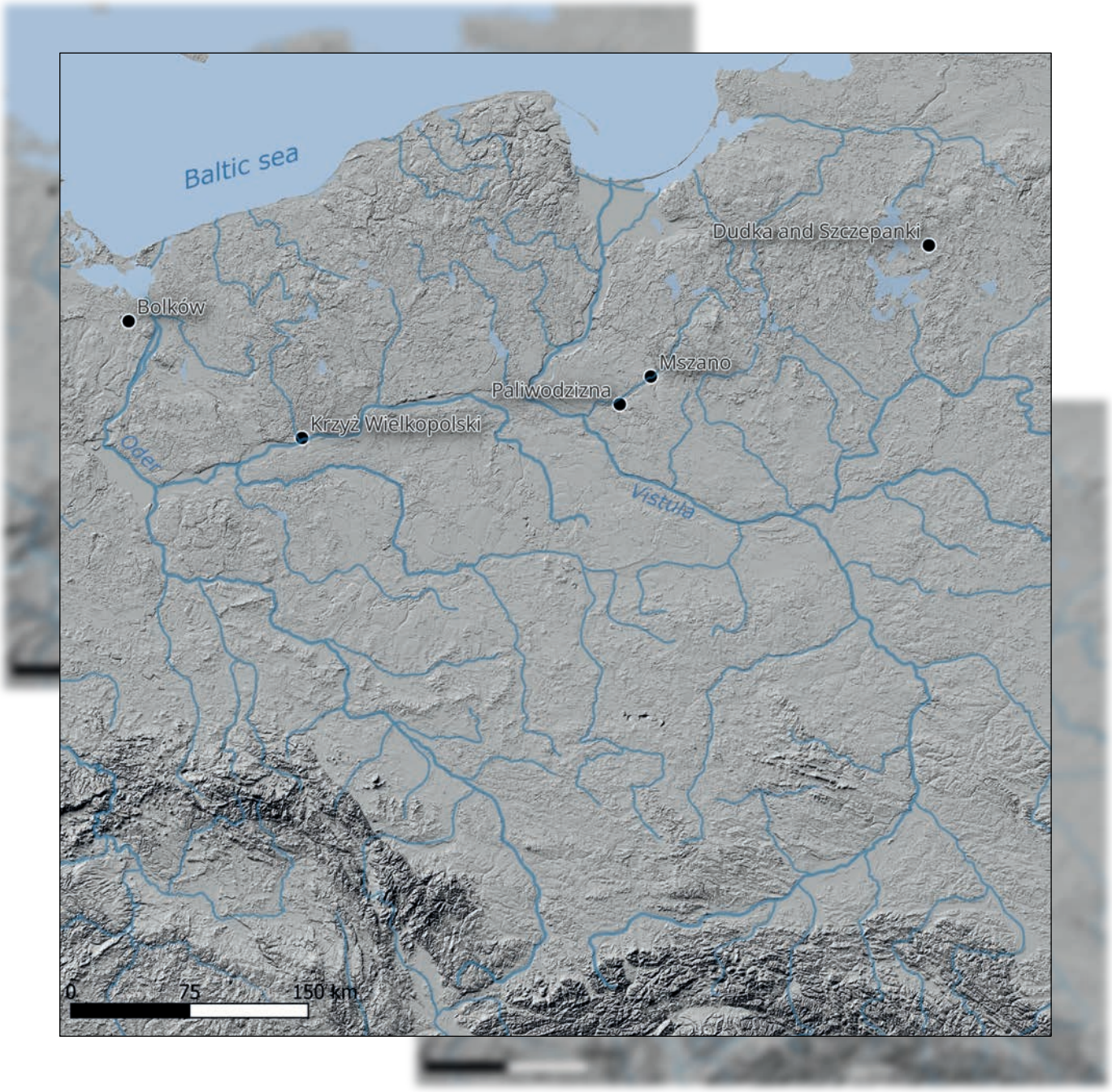
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# LOCATION OF THE SELECTED MESOLITHIC SITES DESCRIBED IN THE FOLLOWING PAGES



# KRZYŻ WIELKOPOLSKI, SITE 7

Jacek Kabaciński

The surface geology of the North European Lowlands is dominated by acidic fluvioglacial deposits from the Vistulian glaciation, which are unfavourable for the preservation of organic matter. Therefore, what has survived to the present day are usually only numerous collections of lithic assemblages. Only in rare cases, such as waterlogged sites, has our knowledge of material culture been extended to objects made of antler, bone, wood, and other plant materials. One such unique site is Krzyż Wielkopolski.

The site is located in Western Poland, on the northern low terrace of the Toruń-Eberswald marginal stream valley, which extends from the Vistula River in the east to north of Berlin in the west. This extensive valley, currently occupied by the Noteć River, carried glacial meltwaters westward during the Late Glacial. Around the middle of the Younger Dryas, the river eroded a channel adjacent to the northern terrace and subsequently abandoned it, forming a basin approximately 500 metres long and 12–15 metres wide (Fig. 1). This basin, constantly filled with water, attracted numerous hunter-gatherer populations for several millennia until it was completely filled with sediments around the early Atlantic Period.

The earliest traces of human occupation at Krzyż are associated with the Late Glacial groups of the so-called Swiderian culture. These people, living in a tundra environment (Latałowa 2004), left behind a limited lithic assemblage along with the remains of at least three dogs (Fig. 2). A series of radiocarbon dates, ranging from 12,700 to 11,800 years BP, indicate two separate settlement episodes during the second half of the Younger Dryas and possibly the very beginning of the Preboreal Period. Isotopic analysis shows that fish comprised the main diet of these dogs (Kabaciński 2023), suggesting that some dogs may be dated to the early Preboreal due to a reservoir effect estimated at 500–700 years for the Krzyż site. Taphonomic analysis of dog remains strongly indicates the dogs were used for labour; however, cut marks on some suggest they also served as food or that their skins were used after death.

Rapid environmental changes across the Northern Hemisphere at the end of the Late Glacial (Alley et al. 1993; Rasmussen et al. 2014) also affected the Polish Plain. In the Wielkopolska region, tundra was replaced by open birch forests with aspen and willow, subsequently dominated by pine forests. Over time, as the climate warmed progressively, the forests became denser with a significant presence of thermophilic deciduous trees (*Quercetum mixtum*; Ralska-Jasiewiczowa et al. 2003; Latałowa 2004). These changes led to a drastic transformation in fauna: arctic animals were quickly replaced by forest species such as elk, horse, deer, aurochs, roe deer, wild boar, and smaller animals. These environmental shifts would have also impacted the lives of Holocene prehistoric hunter-gatherers.

The earliest evidence of Mesolithic occupation in Western Poland comes from the Chwalim site, dated around 11,000 BP and culturally linked with the Duvensee/Komornica culture (Kobusiewicz and Kabaciński 1993). The first human traces at Krzyż during the early Holocene are about 200 years younger (around 10,800 BP), placing the site among the oldest Mesolithic occurrences in Poland (Kabaciński 2016). Based on dozens of radiocarbon dates, we know that hunter-gatherer communities continuously inhabited the Krzyż site until about 9,100 years ago. Thus, settlement lasted approximately 1,700 years, spanning the Preboreal and Boreal periods. Human occupation ended at the beginning of the Atlantic period, probably linked to the disappearance of water in the abandoned

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FIGURE 1. The extension of Site 7 at Krzyż Wielkopolski, along the northern edge of the paleochannel

Noteć River channel, which by then was fully filled with sediments.

Material culture strongly suggests that the early Holocene inhabitants of Krzyż Wielkopolski were probably associated with the Duvensee/Komornica culture (Fig. 3, upper and middle row), also known from west of the Oder River (modern Germany). However, during the Boreal period, archaeological evidence at Krzyż Wielkopolski shows the presence of the Maglemosian culture. The arrival of the Maglemosian people coincided with the displacement of earlier Northern European communities caused by rising sea levels during the Boreal and Atlantic periods. These groups primarily exploited lake environments with a subsistence strategy based on hunting, gathering, and intensive fishing. Krzyż Wielkopolski is one of the oldest Maglemosian sites in Poland, characterized by distinctive flint artefact assemblages and axes made from aurochs bones (Kabaciński 2017).

Until recently, knowledge of Duvensee/Komornica groups in Western Poland was limited to vast collections of lithic assemblages, but research at Krzyż has greatly broadened our understanding of these people. The discovery of a human skull in 2018 allowed closer study of Krzyż's Early Holocene population. A large cranium fragment belonged to a woman who died around age 40 between approximately 10,200 and 9,900 years ago (Fig. 3, bottom row). The excellent preservation of the skull enabled fossil DNA analysis, revealing that the woman was directly related to Western European hunter-gatherer populations dating back 14,000 years, known as the Oberkassel cluster (Posth et al. 2023). Like her ancestors, she probably had dark skin and blue eyes.

Isotope studies of the skull showed that freshwater fish were the dominant part of her diet. Interestingly, the isotopic ratios for $C^{13}$ and $N^{15}$ from these human bones closely match those from the older Late Palaeolithic dogs living at Krzyż Wielkopolski 1,500–2,000 years earlier.

The abundance, diversity, and excellent preservation of archaeological remains of Mesolithic

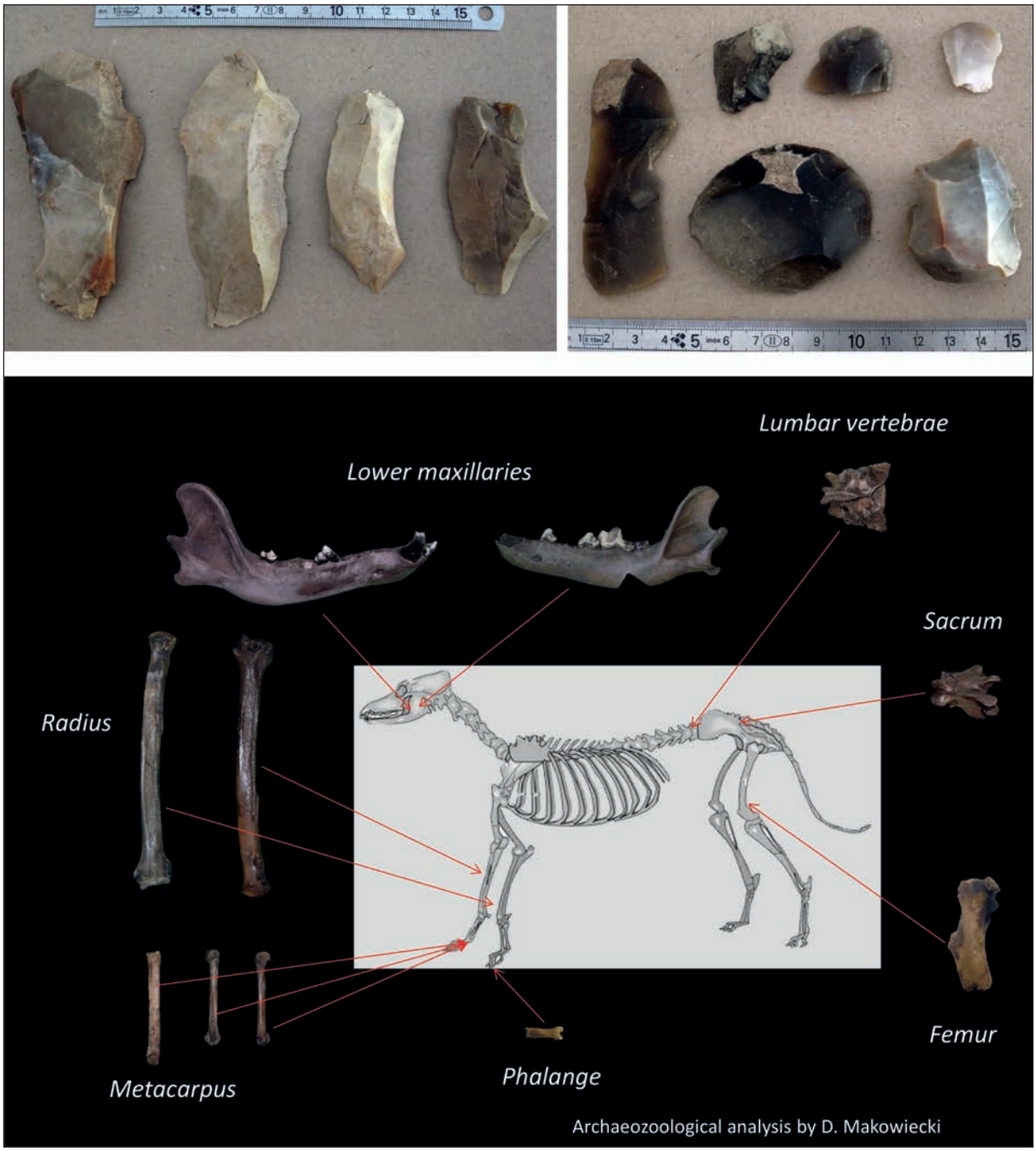



FIGURE 2. Orońsko, Site 2, Shaft 6: the bottom (A) and niche with flint bearing layers (B) (photo by K. Kerneder-Gubała)

hunter-gatherers at Krzyż Wielkopolski – especially those made from organic materials like bone, antler, wood, and plant materials – offer detailed insight into their daily life.

Undoubtedly, they were primarily hunters, as evidenced by ubiquitous fragments of hunted animal skeletons, including elk, horse, deer, roe deer, wild boar, and smaller fauna (Fig. 4, upper and middle row). The animal remains indicate that people at Krzyż brought whole carcasses to the settlement and butchered them onsite. Avian remains, though relatively few, include waterfowl



FIGURE 3. Krzyż Wielkopolski, Site 7. Mesolithic flint tools (upper and middle row); human skull in situ (bottom row)



FIGURE 4. Krzyż Wielkopolski, Site 7. Red deer antlers (upper row); elk antlers (middle row); turtle shells (bottom row)

and migratory species such as great bittern, grey heron, crane, duck, goose, and common capercaillie (Makowiecki 2014).

During the Boreal period, fishing and wild plant gathering played a significant role in diet diversity. Among fish remains, cyprinids dominate (about 80%), mainly common bream, crucian carp, tench, roach, and rudd. Fish from the Percidae family were also caught, including perch and pikeperch. Pike, wels catfish, and eels were captured on a smaller scale. Most fish were relatively small, suggesting that some were caught directly in the

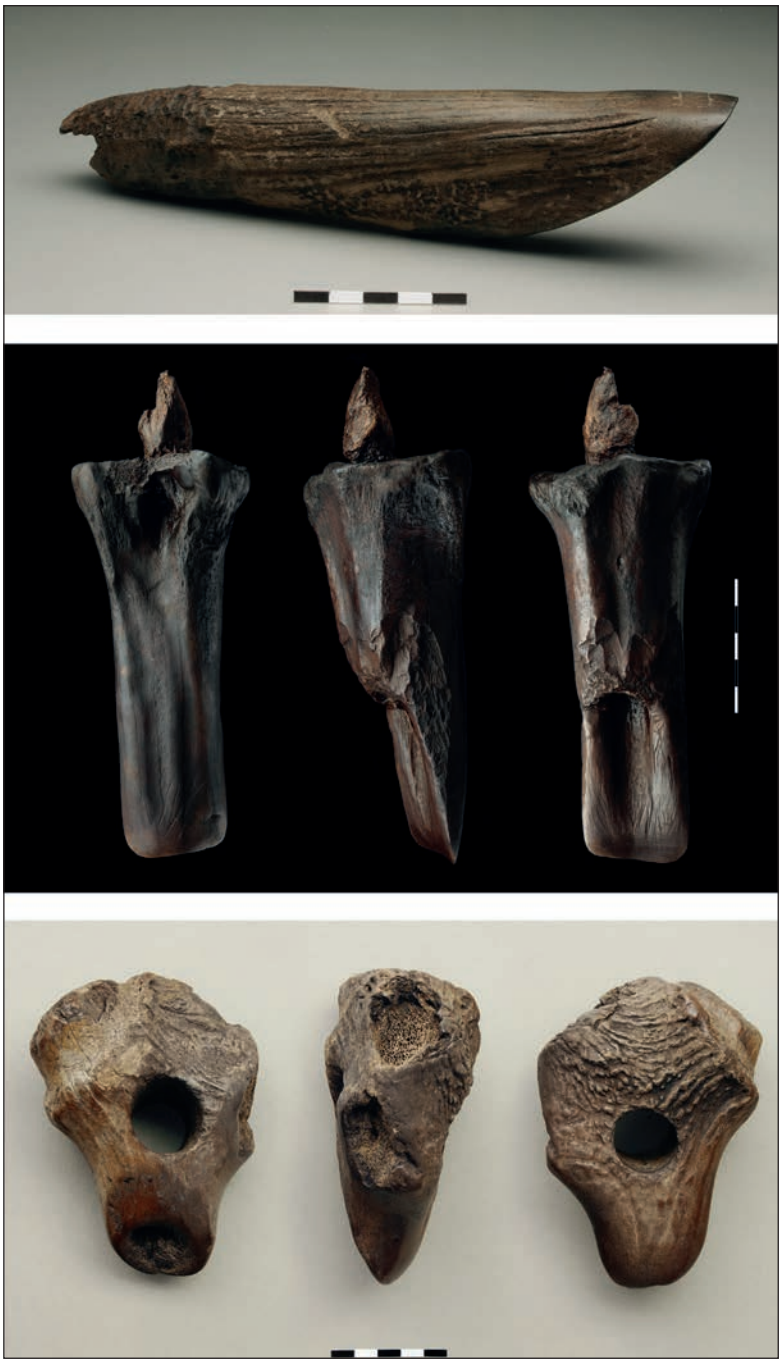


FIGURE 5. Krzyż Wielkopolski, Site 7. Elk antler blade axe (upper row); adze made of aurochs bone (middle row); red deer antler axe (bottom row)

abandoned river channel. Fishing was primarily done during the spawning season between March and July, depending on species, but fish were probably also caught under ice in winter (Zabilska et al. 2015). During the same period, hazelnuts were collected in large quantities for edible seeds, as indicated by tens of thousands of nutshells found in Boreal layers.

Turtles held a special place in food processing starting from the Boreal period. Remains of several dozen turtles were found. It appears that turtles were hunted mainly for their shells, used



FIGURE 6. Krzyż Wielkopolski, Site 7. Fragments of arrow's wooden shafts (pine; upper left corner); small bone point (upper right corner); spear composite point (upper row, middle); woven plant pleat (bottom, left corner); wooden disc (bottom, right corner)



FIGURE 7. Krzyż Wielkopolski, Site 7

as containers for storing food and as kitchenware. Fire traces on the shells' edges suggest they were placed near open fires (Fig. 4, bottom row).

Meat from hunted animals was either consumed immediately or dried, while hides were tanned using flint tools. Antlers and bones were crafted into various everyday tools. Three types of tools were made onsite. During the Preboreal and early Boreal periods, elk antler blade axes (Fig. 5, upper row), and adzes made from metapodial bones of aurochs, sometimes elk or red deer were produced (Fig. 5, middle row). In the Boreal period, axes made

from red deer antlers were also produced (Fig. 5, bottom row).

Hunting weapons, which could also serve for combat, were essential. The primary hunting equipment included bows and arrows. Although no well-preserved bows have been found, some processed wood fragments may be remains of such objects. Numerous fragments of wooden arrow shafts, usually made from specially selected pine wood, were excavated (Fig. 6, upper left corner). Arrows were armed in two ways: small flint microlithic tools were embedded at the shaft's end, or bone points several centimetres long were attached to obliquely cut shaft ends using plant fibres and birch bark tar. Evidence from Krzyż Wielkopolski includes bone points, obliquely cut arrow shafts with birch bark tar residue, and traces of binding materials (Koch et al. 2024; Fig. 6, upper right corner).

Another type of hunting weapon was a spear with a bone point. Bone points were crafted by splitting large mammal long bones like elk, deer, or horse, then shaped using flint tools and sandstone grinding stones. A well-preserved asymmetrical bone spear point about 11 cm long was found at the site. It was attached in two places to a pine wood shaft using plant fibres, probably poplar, and coated with liquid birch bark tar for waterproofing and balance. This composite spear was probably used to catch fish or hunt small fur-bearing animals (Fig. 6, upper row, middle; Kabaciński et al. 2023).

Processing of plant raw materials was well developed to meet various needs. Wood was shaped with multiple flint tools. Axe handles were made from different woods; hafts for antler, bone, and flint tools were probably made from pine root wood. Shafts for arrows and spears were also pine. Excavations revealed many partially worked wood pieces of various sizes, probably remains of tool production or collected raw materials.

Objects with unclear purposes, such as wooden discs, were also made at the site. They may have been prestige items or had ritual significance, but it is also possible they had practical uses like for fishing (Fig. 6, bottom, right corner).

Various plant fibres were commonly obtained. Thin fibres served as threads in making composite tools (using multiple raw materials). Thicker bast fibres were used in basketry. Fragments of finely woven plant pleats, with delicate twigs interwoven with bast, were possibly parts of containers or baskets (Fig. 6, bottom, left corner).

Two discovered objects appeared non-utilitarian and were probably related to prestige or ritual functions, referred to as „magic sticks." These are often made from antler fragments with ends shaped like animal heads, frequently with drilled holes and decorated surfaces. One fragment of red deer antler, dated ca. 11,100 BP, has a processed end resembling an elk's head (Fig. 7, bottom row). Similar objects of this age are known from other parts of the North European Lowland, suggesting the elk's significance in hunter-gatherer rituals (Kabaciński et al. 2011). Another likely „magic stick" fragment is notable for its decoration: several parallel carved lines with regularly spaced depressions filled with tar (Koch et al. 2024; Fig. 7, upper row).

The Krzyż Wielkopolski site is an exceptional example of a peatbog site, containing a significant and unique archaeological record that is crucial for understanding the history of the oldest human inhabitants of Krzyż Wielkopolski, the Wielkopolska region, and broadly, Northern Europe.

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# PALIWODZIZNA, SITE 29

Grzegorz Osipowicz, Justyna Orłowska

The Paliwodzizna 29 site is located in central Poland, in the Drwęca River Valley, which separates the Dobrzyń and Chełmno Lakelands (Fig. 1A; cf. Solon et al. 2018). The site is situated on a flat-topped ridge next to the place where the subglacial valley of Lake Grodno and Lake Plebanka becomes the valley of the Drwęca River.

The subglacial tunnel-valley of Lake Grodno and Lake Plebanka (Fig. 1B) exhibits a meridional course. It is incised into the flat surface of the moraine plateau that was formed during the Vistula Glaciation. Its width in the southern part ranges from 400 m to 900 m in the area of Lake Plebanka, while in the northern part, in the vicinity of Lake Grodno, it is approximately 700 m. The immediate vicinity, as well as the floor and the walls of the tunnel-valley, stand out particularly due to their very rich diversity of glacial, fluvioglacial, denudation and erosive landscape features. The channel's bed rests at an altitude of 65–66 m above sea level in the northern section and 67–68 m above sea level in the southern section. A series of uneven thresholds mark the topography of the area. The depressions of the channel bottom, situated between these thresholds, are filled with peat deposits lying on gyttja or occupied by the waters of the Grodno and Plebanka lakes (Osipowicz et al. 2023). This location was of significant importance during the Mesolithic period, as it regulated animal migration over extensive distances and facilitated effective communication, utilising the vast network of waterways in this region.

Site 29 in Paliwodzizna is one of several Stone Age sites located in the valley of Lakes Grodno and Plebanka. Archaeological research began here in 2016 with financial support from the National Science Centre in Kraków (project number 2016/23/B/HS3/00689) and the Voivodeship Conservator of Monuments in Toruń.

Over the course of seven years of archaeological work, the site area, measuring 589.6 $m^2$, was thoroughly explored, with 529.6 $m^2$ of this area being excavated in the sandy (dry) part of the site, and 60 $m^2$ being excavated in the wetland (in the coastal zone of the former lake). The analysis of the material unearthed in the dry zone of the site led to the identification of four settlement zones of Mesolithic features and artefacts (Settlement Zones 1–4; Fig. 1C). However, it should be noted that only materials from Settlement Zone 2 were subjected to more detailed analyses (Osipowicz 2021).

## Site chronology and current knowledge of its function

The chronologies of prehistoric settlements at the site were established on the basis of the preliminary results of technological and typological analyses of the archaeological material that had been discovered, in addition to radiocarbon dating, which was performed primarily using the AMS method (cf. Osipowicz et al. 2023).

The initial use of the site in Paliwodzizna occurred during the Late Palaeolithic period. At this stage of research, several dozen flint artefacts and at least two pits can be associated with this period (Osipowicz et al. 2022). The nature of this settlement remains ambiguous.

The site was primarily used during the Mesolithic period. Archaeological material from this period was discovered in its sandy (dry) part and in the peat trenches (in the coastal zone of the former lake; Fig. 2). In the „dry" zone, flint artefacts were identified within clearly distinguishable flint scatters and the cloud-like structures related to numerous hearths, economic pits, as well as other types of structures (Figs. 3–5). In the "wetland" zone of the

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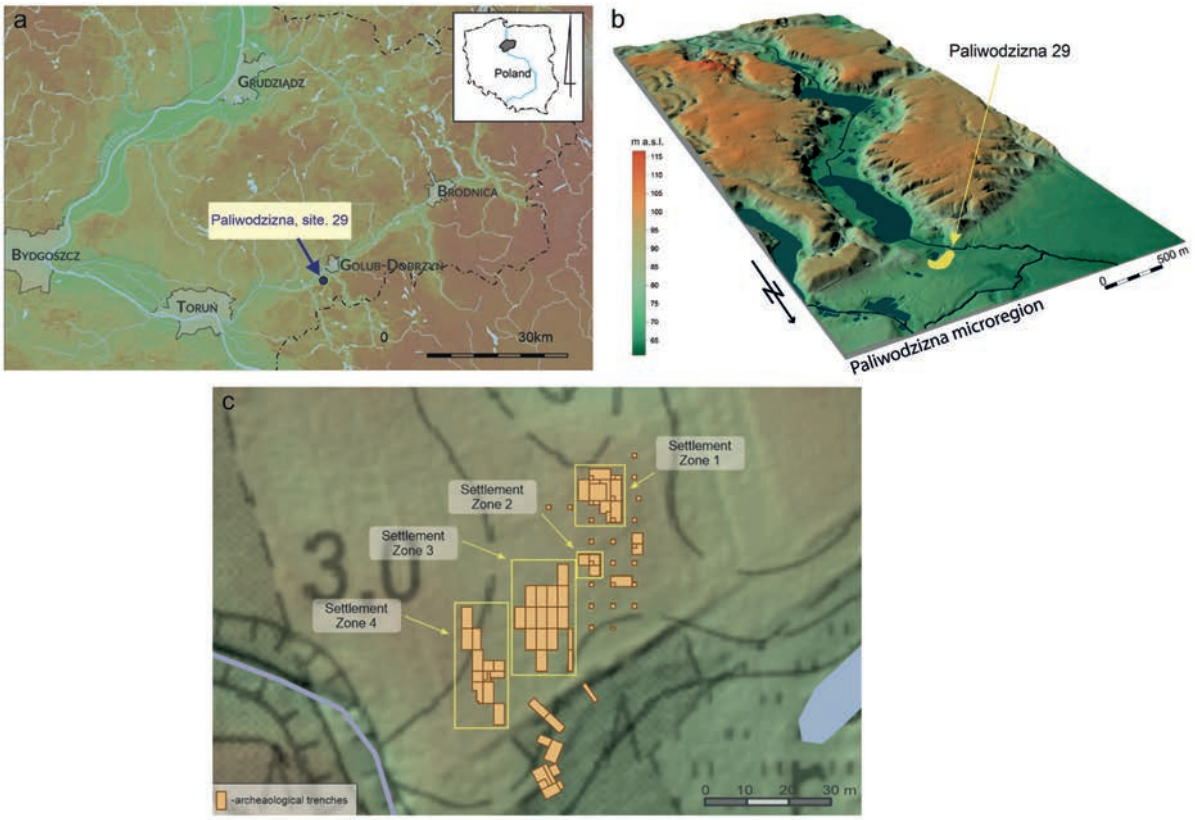



FIGURE 1. Location of Site 29 in Paliwodzizna: a - location within the Chełmno-Dobrzyń Lakeland; b – location in the valley of Grodno and Plebanka Lakes; c – situational-altitude plan of the site with the archaeological trenches and settlement zones

site, Mesolithic materials occurred mainly within two denudation layers associated with early Mesolithic settlement.

The radiocarbon dating performed allowed the distinction of three phases of Mesolithic settlement at the site (cf. Osipowicz et al. 2023).

The oldest is determined by two, almost identical dates obtained for a wooden item and charcoal samples retrieved from cultural structures situated in the sand zone of the site. They date these structures to a period between 9281 and 8834 cal BCE, that is, the middle stage of the Preboreal period.

The next period of occupation of the site is the so-called „wetland phase". This is dated by six radiocarbon determinations made for five charcoal samples and one of bone from two thin denudation layers identified in the wetland zone and one AMS determination obtained for macroremains from the same depositional context. These designations place the early Mesolithic settlement between 8701 and 7794 cal BCE, corresponding to the second half of the Preboreal period and the first half of the Boreal period. Only one radiocarbon date from the sand zone corresponds well to this phase. The other two are placed between 7518 and 7187 cal BCE, the final stage of the Boreal period. From the perspective of the calibration curve, their lower dating ranges do fit within the possible range of the "wetland phase".

The Late Mesolithic phase of settlement at the site (6220 and 5627 cal BCE) is designated by four AMS determinations obtained for charcoal samples from cultural features located in the sandy part of the site.

Archaeological and paleobiological studies conducted at the site so far have allowed the first interpretations of how this place was used by Early Holocene hunter-gatherers (cf. Osipowicz et al. 2023).

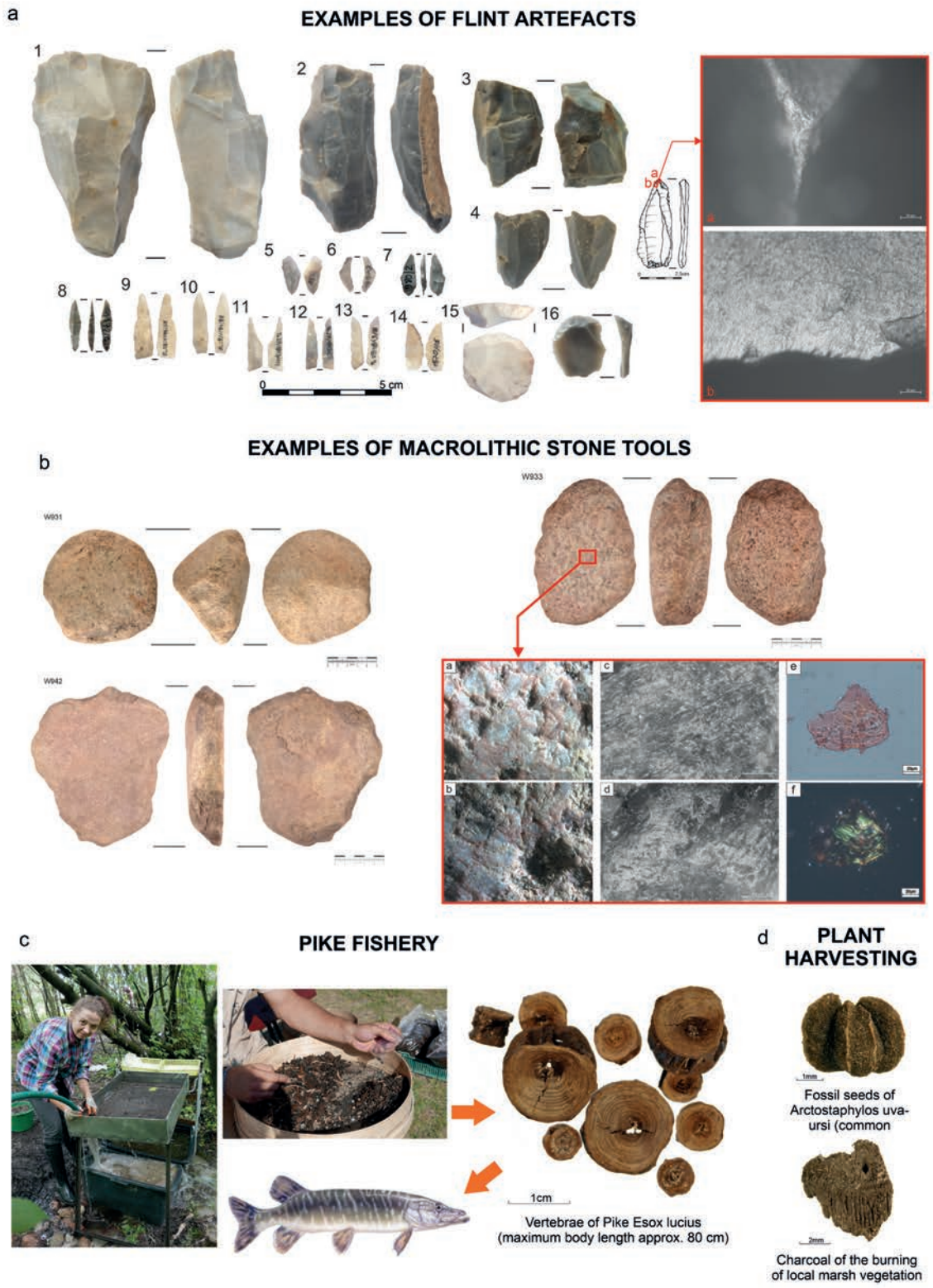



FIGURE 2. Paliwodzizna, Site 29. Mesolithic artefacts: a – examples of flint artefacts: 1–4 – cores; 5–14 – geometric inserts; 15–16 – end scrapers. On the right: example of use-wear traces identified on one of the flint tools (after Osipowicz et al. 2023); b – example of macrolithic stone tools. On the right: Specimen W933 and the examples of the use-wear and organic residues observed on its surface: a, b) sinuous micro-relief of the used surface and grain extractions; c–d) a smooth, domed, and occasionally striated micro-polish; e–f) PSR stained residues documented in extracted solutions under the TL (after Cristiani et al. 2024); c – pike vertebrae discovered during flotation of the Mesolithic layers (after Osipowicz et al. 2020); d – example of plant macrofossils from the site (after Osipowicz et al. 2020).

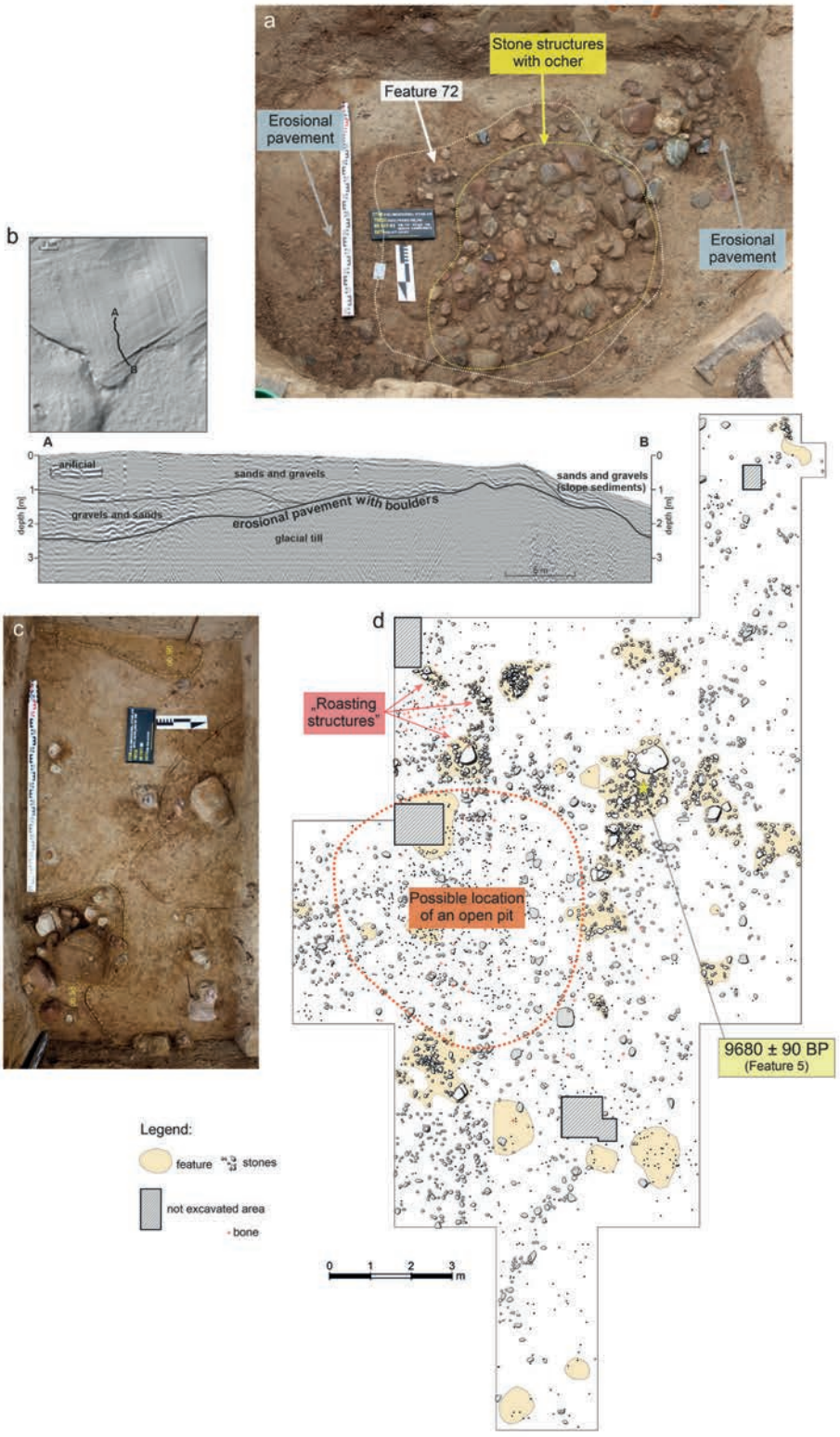



FIGURE 3. Paliwodzizna, Site 29: a – Settlement Zone 1: Feature 72 with visible stone structures with ochre and remnants of erosional pavement; b – localisation of the ground penetrating radar (GPR) scans performed at the site with an obtained profile showing, among others, the depth of occurrence of erosional pavement with boulders and potential deep pits (analysis performed by P. Weckwert from the Department of Geomorphology and Paleogeography NCU in Toruń); c – Trench 3090/8630 DW – moraine pavement level. Visible bottom parts of Feature 96 and redeposited moraine pavement stones in Feature 98; d – settlement zone 3: planigraphy of flint artefacts, bones, stones and features discovered at the site with the marking of the possible location of an open pit and „roasting structures"

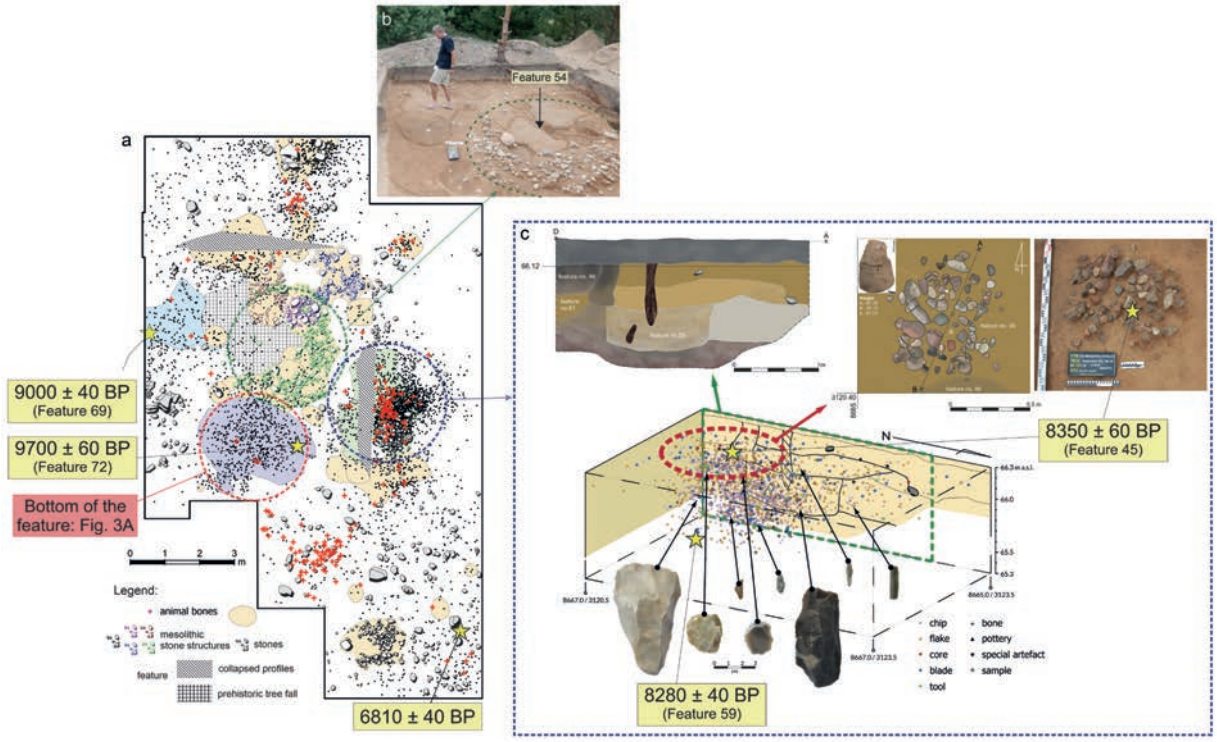



FIGURE 4. Paliwodzizna, Site 29: a – settlement zone 1: planigraphy of flint artefacts, bones, stones and features discovered at the site; b – photo of Feature 54; c – Feature no. 59: on the upper left – a digitized drawing of the feature's profile; on the upper right – stone structures of the Mesolithic hearth (Feature 45) built on Feature 59 after its intentional filling up (both features have the same AMS results; photo in the top left corner shows a Late Palaeolithic core deposited between the stones); below – 3D spatial distribution of the artefacts inside the feature (after Osipowicz et al. 2020, fig. 3 with changes)

In the early Mesolithic, the site was visited seasonally, in spring, to catch pike (superfood) in the shallow bay of Lake Grodno, located directly next to it and the floodplains that were probably formed here. This is evidenced primarily by the dominance of these fish remains among animal bones from that period (52.5% of all bones from the „wetland" zone, 92.8% among fish bones identified here) and the structure of identified macroremains and geomorphological data (Fig. 2C). In the late Mesolithic, this area was occasionally visited by small groups of hunters (hunting stands). However, the connection between the Mesolithic settlement and the gradually overgrowing Lake Grodno remains clear. The changes in this water body most likely made spring pike fishing on a larger scale impossible, but they were conducive to turtle catching. The remains of representatives of this species (mainly fragments of carapace) constitute about 56% of all taxonomically identified animal remains in Settlement Zone 4, which was radiocarbon dated to the Atlantic period.

## Site's secrets still to be discovered

### Open pit mine for stone raw materials?

The geological history of the area in which Paliwodzizna Site 29 is located is of particular interest. Geomorphological studies conducted at the site have revealed that a sudden water flow from Lake Grodno occurred during the Late Glacial period. This was due to the breaking of the threshold separating the basin of the present Lake Grodno from the Drwęca River Valley (Osipowicz et al. 2023).

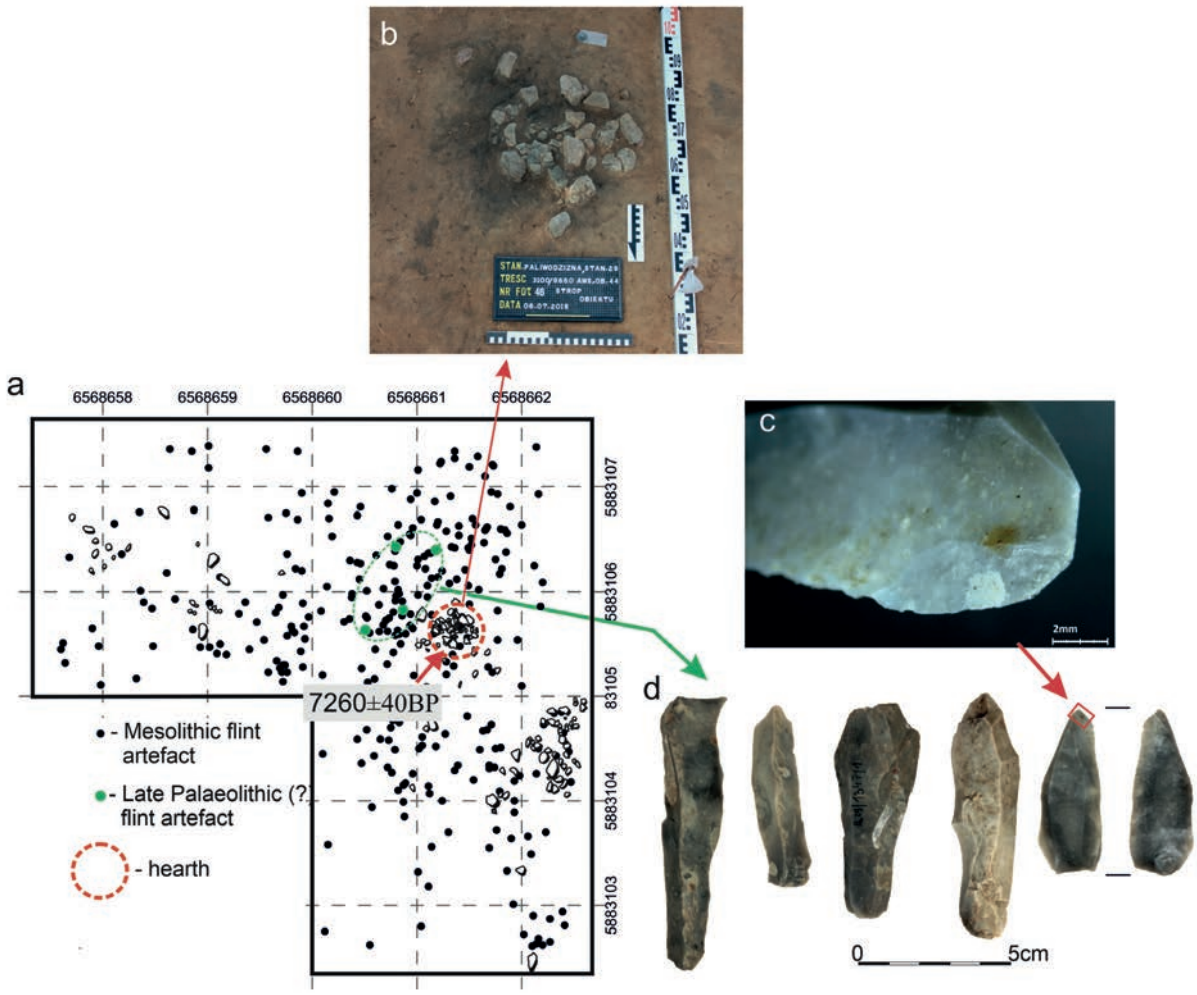



FIGURE 5. Paliwodzizna, Site 29, Settlement Zone 2: a – a distribution of the Mesolithic and probably Late Palaeolithic specimens; b – Mesolithic hearth, Feature 44; c – microphotography of the working edge of one of the burins with a secondary retouch visible; d – artefacts (after Osipowicz 2021, fig. 5 with changes)

As a result, the site area was covered with a gravelly-boulder pavement, created as a result of intensive outwash of fine fraction resulting in the separation of sands from gravels and boulders during a Froude supercritical flow regime (Weckwerth et al. 2019, 2021). It is reasonable to hypothesise that this pavement was initially visible on the surface of the site (especially in the lake shore zone), during the early Mesolithic period. However, in other parts, it remains covered with a layer of sand with a thickness exceeding 1.5 metres (Fig. 3A-C). It is hypothesised that the presence of this pavement significantly influenced the Mesolithic settlement in Paliwodzizna. Numerous deep pits were discovered on the entire examined surface of the site, reaching the level of the pavement in the bottom parts, which was clearly extracted, as evidenced by clear losses in the stone arrangements observed during the exploration. The outlines of some of the pits, the diameter of which often exceeds several metres, are marked on the surface (Mesolithic level) by the deployment of stones, which were initially part of the explored pavement (Fig. 3D). Ground penetrating radar (GPR) scans performed at the




FIGURE 6. Paliwodzizna, Site 29. Example of stone structures resembling nests identified at the site (photo by G. Osipowicz)

site showed the presence of this type of deep features throughout the entire area examined in this way (cf. Fig. 3B). It is noteworthy that some of the pits under discussion may have had some kind of wooden shuttering, as evidenced by the vertical arrangement of their walls and the presence of wood remains in the fills (possibly remnants of the structures used to prevent collapse of the walls). Dating of several features (or stone structures associated with them) has been undertaken, showing that their chronology falls in the Early and Middle Mesolithic. The question should be asked why the Mesolithic people dug these pits and what the purpose was of exploiting the moraine stone




FIGURE 7. Paliwodzizna, Site 29. An engraved sandstone slab (photo by G. Osipowicz)

pavement found at the site. The answer may be the desire to obtain stone raw material used to create hearths and other features with stone structures that are numerous at the site. However, features of this type are a secondary result of the actions taken, and the primary goal here may have been the desire to obtain erratic flint raw material, concretions of which occur in large numbers in the moraine pavement. This flint was processed, as evidenced by the incipient forms identified in the fills of the described features (also at the level of the moraine pavement itself).

## Features with stone structures

The specificity of the site in Paliwodzizna is also the large number and variety of features with stone structures, unique for the Mesolithic of the Central European Lowland. In addition to various types of walls and fences (of different states of preservation and unspecified purpose), the most numerous categories of structures of this type here are hearths (Figs. 4, 5B). These are features of very different sizes, ranging from about 0.5 to even 2.5 metres (e.g. Feature 54, Fig. 4B), which were built from boulders obtained from the moraine pavement. These objects occur at various stratigraphic levels, and their chronology in the light of the obtained radiocarbon dates falls in the entire Mesolithic. In addition to them, fascinating structures resembling nests were also identified, in the case of which the stone structure surrounds an empty space with an oval outline and a diameter of about 30 cm (Fig. 6). Their depth usually does not exceed about 30 cm. Due to the presence of burning in some of these features and a type of black tar substance that appeared on some of the boulders that were part of the stone structures that built them, these structures were initially considered to be remains of birch tar kilns (cf. Osipowicz et al. 2020). However, subsequent chemical analysis of the fills failed to substantiate this hypothesis. Consequently, the function of these structures remains ambiguous (possibly settings of large posts?).

The third category of objects with stone structures identified in Paliwodzizna that are worth mentioning here, are irregular concentrations of stones, sometimes forming a kind of rectangular pavements, up to about 2 metres long and about a metre wide. These features are particularly interesting due to the numerous bones sometimes found within their fill, suggesting a potential functional connection with food preparation (working name: roasting structures, cf. Fig. 3D). In this context, another specificity of the site in Paliwodzizna is also noteworthy, the identification of pits containing

numerous macrolithic ground stone tools, including, for example, a type of large grinding plate with a diameter of up to 40 cm and a weight of several dozen kilograms and several (even 8) grinders. Initial traceological and residue studies indicated that these tools were utilised to process animal raw materials (Cristiani et al. 2024).

## Ritual behaviours?

The site in Paliwodzizna also provided numerous examples of the activity of the Mesolithic population that can be initially perceived in the category of ritual and ceremonial activities. One such example is Feature no. 59 (Fig. 4C), where a substantial quantity of flint material (672 artefacts) was identified in the fill. This material was the result of a standard flint knapping process, but it had been, however, deliberately crushed to a significant extent. The presence of a significant quantity of flint dust in the feature suggests that the process was conducted in close vicinity to the feature. The feature was most likely deliberately filled in shortly after its excavation, with the thrown sand mixed with crushed flints. The short history of this pit is evidenced by the perfectly vertical outline of its walls (especially in the floor part), which is rare in a sandy environment. The fact that a large part of the flints were deposited vertically in its fill suggests that the feature was deliberately filled. The presence of a hearth (Feature 45) in the upper part of the pit (following its filling) further supports this hypothesis. It is noteworthy that both of these structures constitute a single, homogeneous cultural act. This is indicated by the radiocarbon determinations obtained for charcoal taken from the floor of the pit and the hearth, which are basically the same (despite the 80 cm of layers separating them).

An even more interesting example of Mesolithic features from the site in Paliwodzizna with noticeable, deliberate interference in the fill is Feature 72, which is most likely one of the above-described "mining" outcrops aimed at exploiting the moraine pavement. The research results on this structure will be discussed in detail elsewhere, but it is also worth noting here. The uppermost parts of this feature do not differ in any way from other such structures discovered at the site. However, the situation differs in its bottom part, containing the moraine pavement (Fig. 3A). As demonstrated by geomorphological studies, an extremely interesting procedure was carried out here. After the pavement and the flints lying in it were extracted to the surface, (selected) boulders that formed it were placed again at the bottom of the pit. However, smaller fractions (small stones and gravel) were not thrown in with them but replaced with three types of fractions strongly selected in terms of granulation. The first was dominant and composed of ochre, while the other two were two types of soil from the area outside the site, one of which was most likely sand from the lake. In this depositional context, there were also rudimentary flint forms.

An interesting example of practices of probably ritualistic nature among the Mesolithic population discovered at the site in Paliwodzizna may be two intentional (as it seems) deposits of large Late Palaeolithic artefacts that were identified under some early Holocene hearths or in their immediate vicinity. They contain several (maybe a dozen or so) selected flint forms (Fig. 5), and we can probably speak of two such cases. Palaeolithic products were probably collected near the site. In some cases, they bear traces of repair (maybe ritual), e.g. refreshing of burin spall (Fig. 5C), which were carried out before they were placed under the hearths as a deposit.

The last interesting find from Paliwodzizna that we would like to mention here is a precisely processed and intentionally formed sandstone slab, on the surface of which engravings were made (Fig. 7). The connection of this artefact with the Mesolithic context is beyond doubt and it is currently being subjected to multi-aspect laboratory analyses.

Excavations at the Paliwodzizna 29 site have now been completed. The subsequent stage of the project will entail the arduous phase of specialist laboratory analyses, the results of which it is hoped will shed more light on the above and other „secrets" of this unique complex of early Holocene hunter-gatherer camps.

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# BOLKÓW, SITE 1

Iwona Sobkowiak-Tabaka

Bolków Site 1 is situated on the left bank of Western Pomerania, relative to the Oder River. It lies on the southern edge of the Wkrzańska Forest, about 20 km northwest of Szczecin, within the municipality of Dobra Szczecińska in Police County. The site is at the northern tip of the marshy Lake Krynickie, roughly 750 metres northwest of the Bolków Ornithological Station buildings, around 400 metres southwest of Lake Świdwie's boundary, and along the road from Bolków to the village of Stolec.

The site occupies part of a broad, slightly elevated sandy terrace that stretches between Lake Krynickie and Lake Świdwie. Based on surface surveys and test excavations, flint artefacts linked to the site are spread over an area of about 1 hectare, forming a roughly rectangular zone measuring approximately 80 by 120 metres. A significant portion of this area was used by numerous Palaeolithic and Mesolithic camps of various types, dispersed across the entire terrace (Galiński 2020, 2021, 2024). Materials from later settlement phases, associated with Neolithic groups such as the Funnel Beaker Culture and the Corded Ware Culture, are found in the northeastern part of the terrace, closer to Lake Świdwie (Galiński 2002; Galiński and Jankowska 2006).

Between 1981 and 1985, the site was the focus of excavation research conducted by Dobrochna Jankowska on behalf of the Faculty of Archaeology (then the Department of Archaeology) at Adam Mickiewicz University in Poznań (Galiński and Jankowska 2006). Later, test excavations were carried out by T. Galiński in 2005–2006 and in 2010, followed by extensive excavation campaigns between 2012 and 2019, funded by the Ministry of Science and Higher Education (Galiński 2024).

A total of over 20,000 flint artefacts were recovered from the Mesolithic site at Bolków, including 771 tools, 95 stone artefacts, and 260 tools and other objects made from organic raw materials like antler, bone, wood, and bark, along with three amber fragments. These finds come from twelve different assemblages representing Mesolithic settlement, including the so-called shamanic sanctuary – analyzed and published separately (Galiński 2021) – as well as an assemblage uncovered by Dobrochna Jankowska in the 1980s (Galiński and Jankowska 2006).

## Results

Within the Mesolithic assemblages, two Flixtonian clusters (F/2010W and F/2010E), five Duvensian clusters (D/1981, D/1985/2012, D/2011N, D/2012E, and D/2011S), one transitional Flixtonian–Duvensian cluster (FD/2018), and two Maglemosian clusters (M/2006 and M/2013) have been identified. The Flixtonian clusters and several Duvensian clusters (D/1981, D/2012E, and D/2011S) display characteristic dump-type spatial arrangements. These are typically oval-shaped, with diameters between 7 and 11 metres and surface areas around 60–65 square metres. Their lithic inventories include between 1,400 and 1,900 flint artefacts, with 73–84 tools. Cluster D/1981 is also oval but slightly larger in size and surface area, containing a significantly greater amount of flint material.

These assemblages are seen as the remains of relatively long-term occupations or repeatedly used camps associated with the same social groups or closely related groups operating within a shared cultural-information system. They probably represent communities composed of several basic social units – probably around a dozen or slightly more.

The remaining Duvensian clusters (D/1985/2012 and D/2012E), together with the transitional

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FIGURE 1. Bolków, Site 1, trench I/2012 "E". View of the remains of the hut at the level of the white sand ceiling (photo by T. Galiński)

Flixtonian–Duvensian cluster (FD/2018), likewise display dump-type spatial patterns, but differ markedly in their smaller extent and, above all, in the limited volume of accumulated flint material. These features are typically oval in plan, with diameters of approximately 6–9 m and surface areas ranging from about 40 to 52 $m^2$.

Their lithic assemblages range from 150 to 900 flint artefacts, including 17–47 tools. All clusters of this type contained remains of single dwelling structures interpreted as huts. These were circular (3.8–3.9 m in diameter) or oval in plan (4.3 × 3.6 m to 4.8 × 4.5 m), constructed using pine posts and poles, either in four-pole frameworks or in combined post-and-pole arrangements. Walls were made of slender pine poles covered with hides, while floors consisted of pine bark or animal skins secured with wooden pegs. Entrances faced mainly northwest in the oldest huts and east in the newer ones, suggesting placement with their rear or side facing the lake. Small hearths (65–75 cm in diameter) were located near the entrance, either inside or immediately outside the structures, and small storage pits were found within or adjacent to the huts. The usable floor area of the dwellings ranged from about 11 to over 16 square metres, with the largest structure recorded in cluster D/2011S. These Duvensian assemblages show a high degree of consistency regarding the frequency of key tool types. They are characterized by Stawinoga-type backed pieces, arch-backed and fully arch-backed pieces, Komornica-type truncated forms, double trapezoid truncated pieces, as well as isosceles and obtuse scalene triangles with a short long side.

The Maglemosian clusters consist of several flint concentrations. In cluster M/2006, at least three oval concentrations measuring 3.5–4 × 3 m were identified, while cluster M/2013 contained four oval concentrations ranging from 4 × 3 m to 7 × 5 m. The total surface areas of the clusters were roughly 140 $m^2$ and 160 $m^2$, respectively, with no significant technological or typological differences among individual concentrations. The assemblages are mainly made up of backed pieces, including Creswell points, isosceles triangles, and scalene triangles. Taxonomically, they



FIGURE 2. Bolków, Site 1, sanctuary. Artefact made of antlers decorated with engraved ornament (photo by T. Galiński)




FIGURE 3. Bolków, Site 1, Concentration F/2010W. Microliths made of Lower Odra flint (photo by T. Galiński)

sit between the Early Maglemosian assemblages of the North-West European Plain and the classic Sværdborg-type assemblages of the Baltic zone. Radiocarbon dates place them in the first half of the Boreal period ($^{14}$C – 8700±40 BP and 8650±40 BP). The younger cluster M/2006, dominated by scalene triangles, represents a typical Baltic Maglemosian (Sværdborg type) and has been dated to the late Boreal period ($^{14}$C – 8230±60 BP).

## Spiritual life

The Duvensian settlement at Bolków is notable for a unique feature identified as a shamanic sanctuary (Galiński 2015, 2019, 2021a). This territorially distinct complex includes various elements, such as wooden installations, offering deposits, and scattered artefacts, all directly connected to ritual activities. Located on the shore of Pre-Boreal Lake Krynickie, between a slope and nearby hut structures and stone circles, the sanctuary covers an area of at least 70 m$^2$. Detailed analysis of the preserved components has enabled a comprehensive reconstruction of the site. Another ritual-related feature from the Mesolithic occupation is a burial (Galiński 2021b), dated to the Boreal or early Atlantic period and associated with Maglemosian settlements. The burial is an inhumation, with the individual laid supine, legs flexed and elevated. Ochre was used as part of the funerary rite, and the deceased was buried with numerous objects, including wooden figurines and zoomorphic masks, statuettes, amulets, specially decorated points, and other ornamented artefacts, reflecting complex ritual and symbolic practices.

## Subsistence strategies

Post-consumption bone material from all campsites provides a comprehensive record of the animal and fish species exploited by the site's inhabitants. The assemblage reflects the typical fauna of the central-western European Plain during the Pre-Boreal and early Boreal periods. Among mammals, deer predominate, followed by aurochs and wild boar, while beaver and pond turtle remains occur with relatively high frequency. Hunting was the foundation of the Mesolithic economy, with bows as the primary weapon. Two main types of arrows were used: flint-tipped and fully wooden, with conically planed and polished tips. At Bolków, numerous fragments of hunting bows were recovered, including pieces up to 62 cm long, representing at least eight bows, found across the Flixtonian cluster (F/2010 W), classic Duvensian clusters (D/2011 S, D/2012 E, and the sanctuary), and Boreal Maglemosian assemblages (M/2013 E).

Large and potentially dangerous animals like bears were probably hunted with throwing spears, which worked alongside leister points primarily used for fishing. While leister and harpoon heads were barbed, throwing spears had smooth, lanceolate blades, reflecting different hunting strategies.



FIGURE 4. Bolków, Site 1, Concentration D/2012E. A spear or javelin shaft after assembling the parts (photo by T. Galiński)

Both throwing spears and bows were key parts of the Mesolithic hunter-warrior' s toolkit.

Evidence of fishing was also found in the southern part of Trench I/2019, along a fragment of the Pre-Boreal Krynickie Lake shoreline. Fishing traps, made of hazel rods (1.0–1.5 cm in diameter) driven into the ground at slight angles, formed structures 60–80 cm wide and extended about 2.5 m parallel to the shoreline. Bone remains from these contexts are dominated by large predatory fish, such as pike and catfish, though smaller local species like roach, perch, bream, carp, and tench were

probably also exploited. Additional hunting tools recovered from the Mesolithic camps included javelins and thrusting spear points, crafted from simple wooden shafts of young pine, usually up to 3.5 cm in diameter, demonstrating a versatile toolkit adapted for various subsistence activities.

## Summary

The Bolków site documents a continuous cultural sequence from the late Younger Dryas through the Pre-Boreal and Boreal periods, illustrating close interactions between human groups and changing climate and environmental conditions. Epi-Ahrensburgian hunter-gatherers locally adapted to the expanding forests, leading to the earliest Mesolithic, or Flixtonian, occupations. These were later followed by incoming Duvensian groups from the south and later by Maglemosian settlers from the Jutland Peninsula. The sequence ends in the early Atlantic period, when rising water levels made the site largely unsuitable for continued habitation.

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# DUDKA AND SZCZEPANKI

Witold Gumiński

Both sites were situated on islands of former Lake Staświn, one of the largest in Great Masurian Lakeland. In many respects they are exceptional sites not only in Poland but also in the European Plain including Southern Scandinavia. One of their features is the extremely long period of the settlement for hunter-gatherer sites, in this case from the Late Palaeolithic (Allerød and Younger Dryas) through the Early- (Preboreal and Boreal) and the Late Mesolithic (early and middle Atlantic), next three periods of the Para-Neolithic Zedmar culture – the early, classic and post-Zedmar and in the Late Neolithic in the end. This long chronology is indicated by over hundred $^{14}C$ dates. It should be emphasized, that in the Late Palaeolithic the settlement has rather occasional character, in the Mesolithic recurrently-seasonal and from the early Zedmar already year-round, although dwelling and main activity places on both islands were practically the same.

The next exceptional trait of both sites is the preservation of very abundant organic remains, c. 40 000 determined wooden remains and 150 000 bones. Thanks to them, changes in natural environment and hunting economy with some gatherer activity, particularly connected with hazel nuts were reconstructed. It should be stressed that till the end of the Neolithic, the local economy is entirely of hunter-gatherer character, however bones of domestic animals appearing from the early Zedmar, but concerns just a few percent of hoofed animals. In both youngest periods, i.e. in the post-Zedmar and Late Neolithic, fish bones distinctly decreasing, from c. 40 to 10%, which was most probably connected with the overgrowing and disappearance of the lake in the Subboreal, and the settlement finally vanished simultaneously with the end of Neolithic.

Both sites yielded many and very diversified wooden implements, from which the most spectacular is a paddle made of ash-wood distinguished by the hydrodynamic curve of the blade (like in modern paddles) as well as by painting the blade in red and the shaft with a yellow and black spiral. Both sites stand out also by the very numerous implements made of antlers, bones and teeth, from which about 50 are well-preserved heavy antler tools and at least few times more other different bone items with sharp end.

As distinct from bone and antler implements, flint artefacts from the Mesolithic are very occasional and singular microliths such as backed pieces and truncated blades occur. From the early Zedmar till the Late Neolithic, truncated blades, trapezes and Neolithic points occur simultaneously. Dudka and Szczepanki yielded exceptionally numerous and diverse stone head tools, such as axes, adzes, hummers, mattocks and picks, and, at the same time, no such products made of flint.

Zedmar ceramic appeared at both sites, as well as in the whole Zedmar culture comparatively late, from c. 5600 BP (c. 4500 cal BCE). From the very beginning they are significantly technologically varied and poorly fired. It distinctly distinguished from other Para-Neolithic pottery among others by flat bottoms and scanty ornamentation restricted to corrugation of the rim and horizontal or diagonal sequence of impressions, sometimes lines, made by sticks, nails, rarely stamps, situated on the upper part of the belly.

Particularly exceptional is the cemetery at Dudka counting over 120 burials, which make it one of the most numerous hunter-gatherer cemeteries in Europe. Besides, several graves were uncovered at other part of the Dudka Island and at Szczepanki, and they are dated from the Late Palaeolithic to the

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FIGURE 1. Dagger made of splintered and straightened rib, Szczepanki, Younger Dryas, the Late Palaeolithic




FIGURE 2. Bone fishhook with remains of willow bast cord bound with birch tar, Dudka, Preboreal, the Early Mesolithic




FIGURE 3. T-shaped antler axe with integrated handle, Szczepanki, late Atlantic, early Zedmar

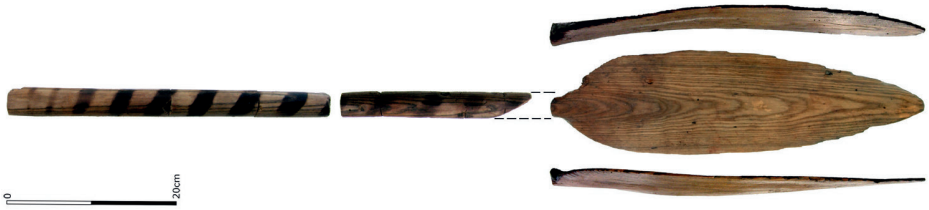



FIGURE 4. Wooden paddle made of ash-wood with hydrodynamic bent blade painted with red ochre and shaft painted spirally by birch tar, Szczepanki, late Atlantic, early Zedmar



FIGURE 5. Grave VI-7 at Dudka of old man (Maturus/Senilis) buried in squatting--sitting position, Dudka, late Atlantic, early Zedmar




FIGURE 6. Grave VI-15 at Dudka containing cremated bones of adult man (white bones) and secondary burial of a dog (brown bones) buried together probably in a basket with partition, Dudka, Atlantic/Subboreal, classic Zedmar

Late Neolithic. Very numerous are also temporary burials (over 70), from which singular or several bones or teeth remains. The most spectacular trait is extremely differentiated forms of burials. There are cremation and inhumation burials, and among the latter they are in very different positions, in a squatting-sitting position, sitting with crossed legs, on side in crouched position, flat on the back, as well as on the back with legs turned over chest or legs astride. The latter one is dated to the Late Mesolithic, the former one to the Late Neolithic, but most of graves from the cemetery come from the early and classic Zedmar. It should be added that on both sites dog burials also occur and one of them is in the central place of the cemetery and was the richest grave there.

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# MSZANO, SITE 14

Marian Marciniak, Filip Marciniak

Located in the municipality of Brodnica, the site lies on the border of the Chełmno and Dobrzyń Lake Districts, in the valley of the Drwęca, on the right bank of the river, on a dune ridge formed on the VI terrace. The dune ridge runs NW–SE and measures 60×30 m, rising 2–3 m above the terrace surface. It forms a promontory to the north and northeast, adjacent to a currently completely overgrown kettle lake with a diameter of 1.5 km, and is eroded from the east by the Drwęca River.

## History of excavations

Marian Marciniak discovered the site and investigated it between 1986 and 1995. Approximately 600 $m^2$ have been excavated, representing about three quarters of the site preserved to this day. Exceptionally rich remains of Mesolithic settlement were recovered, associated with the Komornica culture, the Chojnice–Pieńki culture, and the Paraneolithic forest-zone cultural milieu (the Neman culture and Linin-type pottery), as well as with the Linear Pottery culture, the Funnel Beaker culture, the Globular Amphora culture, the Corded Ware culture, and extending as far as the Iwieńska culture. The excavations have yielded nearly 500,000 finds (lithic artefacts, pottery fragments, and bones).

## Research methods

The site was surveyed using what was at the time an innovative method combining the trench-and-grid system with large-area excavation, drawing on the advantages of both approaches. Excavation units measuring 5×5 m and 5×10 m were explored in mechanical layers 0.5–2 cm thick, with three-dimensional recording of finds. All lithic artefacts and items made of other raw materials were individually recorded by assigning them unique identification numbers. Selected lithic artefacts had the orientation of their long axes documented. Drawings have been supplemented with photographic documentation and video recordings (VHS). The image of the excavation floor (features), recorded after sunset (when sand moisture increased), was markedly more legible than that observed with the naked eye. Material for natural and physicochemical examination was collected from the fill of the pits. All stones were also gathered as presumed objects intentionally brought to the site.

The following specialized analyses were conducted: geomorphological, archeobiological, archeozoological, anthropological, dendrological, radiocarbon dating, and a chemical analysis of ochre. In an experiment on material recovered from the site, a successful attempt was also made to produce a red dye from iron compounds ($2FeO_3*3H_2O$ and $Fe_2O_3$) from the ore layer at the Drwęca River bank using calcination at a temperature of 600°C with forced oxygen access[1].

## Research results

The geomorphological analysis revealed six soil horizons within the dune. The artefacts, preserved in a partially intact stratigraphic arrangement, occurred in the illuvial horizon below the second fossil soil (Marciniak 2017). This soil formed in the middle of the last millennium BCE. Beneath it lay a horizon (locally separated by a layer of aeolian sands) of Preboreal and Allerød soils (hereafter this horizon is referred to as the Eoholocene soil). The upper surfaces of all Mesolithic features became discernible only from the level of the Eoholocene

[1] A complete list of reports and analysis results is available in the archives of the Museum in Brodnica.

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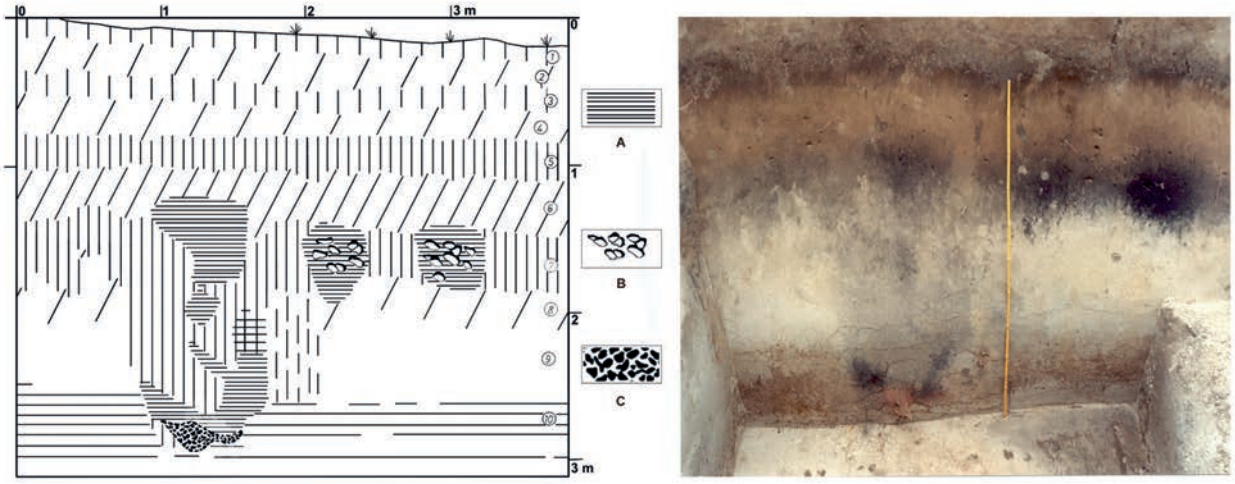



FIGURE 1. Mszano 14. Profile of Grave 5 and lithological-soil structure of the site
A – Intense Charcoal, B – Stones, C – Ochre (1 and 2 – poorly developed soil [ranker], formed after 1945, 3 – the first buried soil covered after 1945, 4 – layer of iron oxide accumulation, 5 – strongly transformed humus layer of buried reddish soil [with few fragments of ceramics from the Lusatian culture, period of Roman influence and late Middle Ages], 6 – alluvial layer – highly silty, fine-grained yellow-orange sand. This layer contained archaeological materials from the early Bronze Age to the earlier Mesolithic, 7 – humus: mineral layer of reddish buried soil with root disturbances and of cryogenic origin. In some profiles, this layer is divided into two parts, separated by a 5–10 cm layer of aeolian sands. It was formed during the Allerød and Preboreal periods [Referred to in the text as "Eoholocene soil"], 8 – a lightening of colour between the accumulation layer and the alluvial layer, indicating deflationary destruction of the previously existing accumulation layer and the accumulation of sandy deposits in this area, 9 – alluvial layer of reddish buried soil with numerous iron streaks, 10 and 11 – fractionally layered sands forming the VI terrace of the Drwęca River)

soil. Within its upper part, down to a depth of 10–15 cm, flint materials typical of the Early Mesolithic were present. Below this, in the illuvial horizon of the Eoholocene soil, pseudo-fibres occurred with a course undisturbed by the Mesolithic features cutting through them (Fig. 1).

The most interesting finds included: a residential structure, five bi-ritual human graves, a cremation burial of wild boars, and a circle of cultic hearths associated with the grave field.

The residential structure, visible from the level of the Eoholocene soil, was a circular feature with a diameter of 315 cm, sunk approximately 40 cm below its upper surface. Its structure originally consisted of about 90 poles with diameters ranging from 3 to 12 cm, set densely along the circumference of the circle. The inclination of the pole impressions indicates that they may have been 4–5 m long and met at their tops. A corridor-type entrance, also sunken, was oriented toward the NEE. Approximately 50 cm of its length was documented (the remainder having been destroyed by a World War II trench).

Inside the structure, near its south-western wall, remnants of a hearth measuring 80 x 100 cm were discovered, lined with medium-sized stones. The wall by the hearth was coated with clay, preserving impressions of vertical poles and horizontally intertwined branches. Among the impressions, a birch leaf and a bulrush root were also identified. The flint artefacts found within the structure (Fig. 2) link it to the later Mesolithic period – specifically, the Chojnice-Pieńkowo culture (Marciniak 1993a, 1993b).

Five human graves and their accompanying pits were discovered (Marciniak 2001). The construction of all graves began with the removal of the Eoholocene soil horizon over a larger area encompassing the grave and pit. The grave pits, with a regular rectangular shape, were deepened



FIGURE 2. Reconstruction of the residential structure discovered at the Mszano 14 site

until reaching the level of medium-grained sands of the river terrace. The pits, shaped like inverted truncated cones, were shallower, reaching a depth of several dozen centimetres. In all the graves, the presence of a specially prepared mixture of sand with red dye was identified. The mixture was sprinkled over the remains and even used to fill the bottom of Grave 3 with a layer of 30–35 cm in thickness (Fig. 3). In all the graves, the percentage content of ochre ranged from 0.98% to 1.51%. Given that approximately 3.5–4 $dm^3$ of pure dye was used to prepare the mixture from the grave, a hypothesis was put forward regarding the possibility of producing it on-site through the calcination of local $Fe_2O_3$ deposits. The side walls of the graves were reinforced with wooden structures arranged vertically (Graves 1 and 4) or horizontally (Graves 3 and 5) (Fig. 4).

In three of the graves, the remains were buried in containers made of deciduous tree bark. The arrangement of the bodies varied. In Grave 1, a woman lay on her right side with a child nestled against her chest. Graves 3 and 5 contained children (ages 5–9) positioned on their backs, while Grave 4 held an adult individual in a seated position with legs lowered. The axes of all the Graves (the heads of the remains) were oriented at an angle of 60–75° east of magnetic north. In all the graves, the presence of teeth (incisors) from deer, moose, and aurochs, probably used as clothing ornaments, was noted. The child from Grave 3 had at least 70 of these teeth. The woman from Grave 1



FIGURE 3. Grave No. 3 during exploration

was equipped with a necklace made of wild boar incisors with holes in the root sections. In two burials (1 and 5), pieces of amber were found, along with intentional offerings of flint artefacts (Graves 3 and 5) and a piece of Cretaceous gaize (Grave 3). The contents of all the graves were burned before burial (possibly indicating bi-ritual funerals?). The intensity of the fire is evidenced by the fact that in Grave 1, pine beams with diameters of 15–25 cm were charred. The presence of intense fire was also noted in the accompanying pits.

Burials were accompanied by hearths set 10–15 cm into the Eoholocene soil. These hearths had a diameter of 30–40 cm and were spaced several dozen centimetres apart, probably forming a circle with a diameter of several metres. Before the fire was extinguished, they were covered with flat stones. Their diameter suggests that they did not serve a utilitarian (functional) purpose. Near one of the circle's hearths, which was constructed differently (covered with three layers of stones arranged in the shape of an inverted truncated cone with an upper diameter of 80 cm and a lower diameter of 50 cm), an aggregated cluster of charred bones was discovered. This cluster, measuring 25 cm in diameter, contained the remains of two wild boars: an adult and a piglet. The bones weighed 400 g and came from nearly complete skeletons, indicating that they represented an intentional cremation burial (Fig. 5). In 2018, samples taken over 20 years earlier (potentially younger samples) from the hearths forming the circle and from the hearth associated with the burial of the wild boars were successfully radiocarbon dated (C-14). This dating confirmed their connection to the grave field.

Radiocarbon Dating of Features:

- Grave 1 – 8890+/-180 BP (Gd-6432) i 8680+/-130 BP (Gd-6436)
- Grave 3 – 8650+/-140 Bp (Lod-504)
- Grave 4 – 8840+/-170 BP (Lod-491)
- Grave 5 – 8100+/-70 BP (Gd-7932)
- Hearths from the circle – 6749 +/- 29 (MKL-A4042)
  Burial of wild boars – 6748 +/- 29 (MKL-4041)

Specialist analyses – including a paleozoological study demonstrating a high proportion of post-consumption bones of pike and European pond turtle,



FIGURE 4. Grave No. 5 during exploration

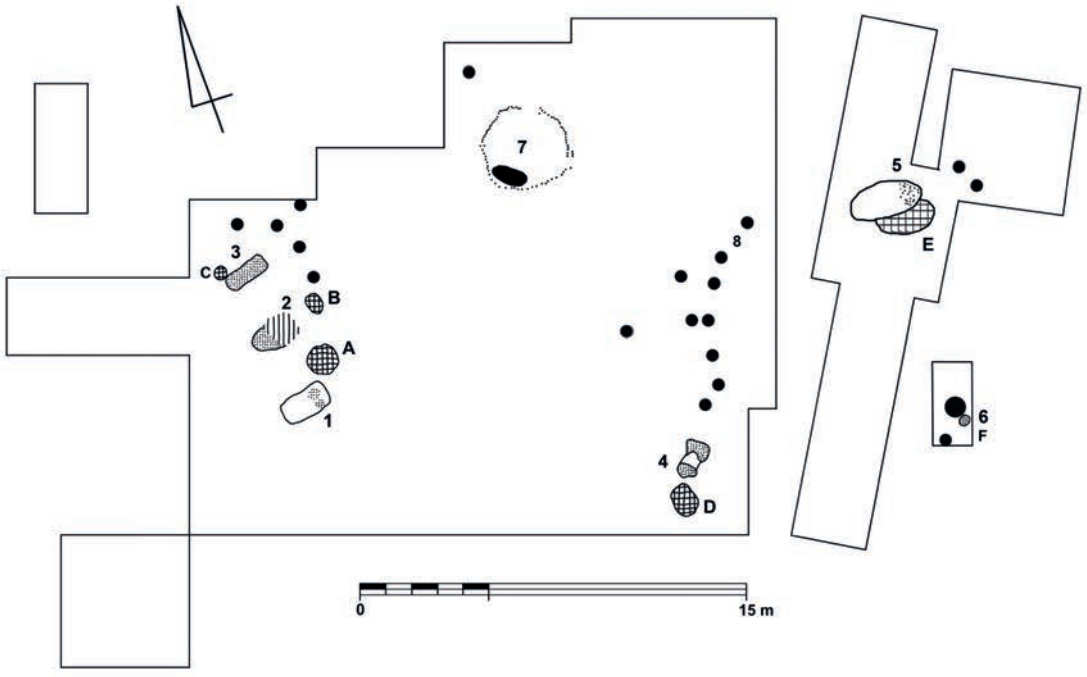



FIGURE 5. Mszano 14. Location of boreal structures associated with the grave field. 1 – A, 2 – B, 3 – C, 4 – D, 5 – E: Graves and accompanying pits, 6 –F: Fire pit with stone paving and the burial of a boar, 7 – Residential structure, 8 – Circle of fire pits covered with stone paving

and a paleoastronomical analysis identifying contemporary sunrise points on the horizon defined by the axes of the graves – indicate an early spring character of Boreal-period settlement on the dune. During this period, the site bordered to the north and northeast with a lake and with a river to the east. Notably, there are no remains of domesticated animals among the post-consumptive bones at the site while almost all forest species are represented. Additionally, in the flint material, there are practically no specimens from periods younger than the Mesolithic. We could risk the thesis that the inhabitants of the campsite in Mszano 14 were hunters-gatherers until the early Bronze Age (Iwieńska culture). The silting up of the lake led to the decline of settlement at the site.

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# MESOLITHIC IN KUYAVIA, CENTRAL POLAND

Dominik Kacper Płaza

Kuyavia (Fig. 1) is one of the most well-researched archaeological regions in Poland. The history of systematic research began at the end of the 19th century. At the beginning of the 20th century, this area was under well-organised heritage protection care, which resulted in discoveries on a global scale, such as the Neolithic sites of the Lendziel culture in Brześć Kujawski (Grygiel 2004) or the cemetery of megalithic long barrows in Wietrzychowice (Papiernik and Płaza 2017). Currently, over 200 Mesolithic sites have been identified (Fig. 2), of which several have been excavated, and interesting Mesolithic inventories have been analysed. Importantly, materials associated with hunters and gatherers have also been discovered in the context of Neolithic sites of the first farmers (Fig. 2), and the latest analyses and results, including strontium isotope analysis (recent unpublished research of Wiesław Lorkiewicz and Dominik Płaza) and DNA, have provided extremely important data (Lorkiewicz 2012) for discussion about interactions between the last hunters and the first farmers.

Unfortunately, we have only limited information about Mesolithic site discoveries from the period before 1939. A few Mesolithic finds were made just before and during World War II. After 1945, for many years, the Mesolithic period was not particularly well-studied. Individual materials were discovered during research of sites from later periods, and a small number of sites were recorded as part of the Polish Archaeological Record project. Immediately after World War II, the Museum of Archaeology and Ethnography in Łódź began its activity in the area, and in the 1970s, the Kuyavian Research Team from Poznań and from 1980s the Institute of Archaeology of the University of Łódź joined it. It was at these institutions that colleagues made their first discoveries of extremely interesting materials related to the Mesolithic period. Among the most important people involved in this work were Prof. Lucyna Domańska from the Institute of Archaeology at the University of Łódź (Domańska 1990; Domańska and Wąs 2025), who excavated Site 29 in Dęby in the 1980s (Domańska 1991), associated with the Janisławice culture (Domańska 1998), and in the early 2000s, together with Prof. Marcin Wąs, Dąbrowa Biskupia Site 71, associated with the Maglemose culture (Domańska and Wąs 2006). At that time, she also discovered other sites, including those in the Kolankowo area and analysed, for example, Site 32 in Podgaj (Domańska 1995; 2016). Piotr Olszewski from the Kuyavian Research Team also made important discoveries in Korzecznik, where he found materials related to the Middle and Late Mesolithic periods (Olszewski 1987). Archaeologists from Poznań also discovered Mesolithic materials, e.g. at multicultural sites in Rybiny and Opatowice (Domańska 2006), which showed that Mesolithic hunters occupied diverse ecological niches (Domańska 2016; Płaza 2025). Extremely interesting and important discoveries related to the Mesolithic period were made by employees of the Museum of Archaeology and Ethnography in Łódź, dr. Piotr Papiernik and the author of this article, at Site 20 in Redcz Krukowy and Site 1 in Antoniewo (Papiernik and Płaza 2016; 2018; Płaza 2025). Together with their colleagues from the Museum, they also explored vast areas of central and southern Kuyavia, discovering numerous Mesolithic sites (Fig. 2), including more than 50 in the area of the Wietrzychowice Cultural Park. Several of those sites were explored by test trenching, collecting very interesting materials, including a harpoon from a peat context in Śmieły (Papiernik and Płaza 2017). The oldest materials

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FIGURE 1. Location of Kuyavia

come from sites in Smólsk and Redcz Krukowy, Cluster 3. Among other things, Zonhoven-type truncation (Fig. 3:1), core axe (Fig. 3:2) and Maglemosian type leaf point (Fig. 3:4) were discovered there. In the context of describing the state of research on the Mesolithic period in Kuyavia, the most important discoveries were made at Site 20 in Redcz Krukowy (Papiernik and Płaza 2018). At

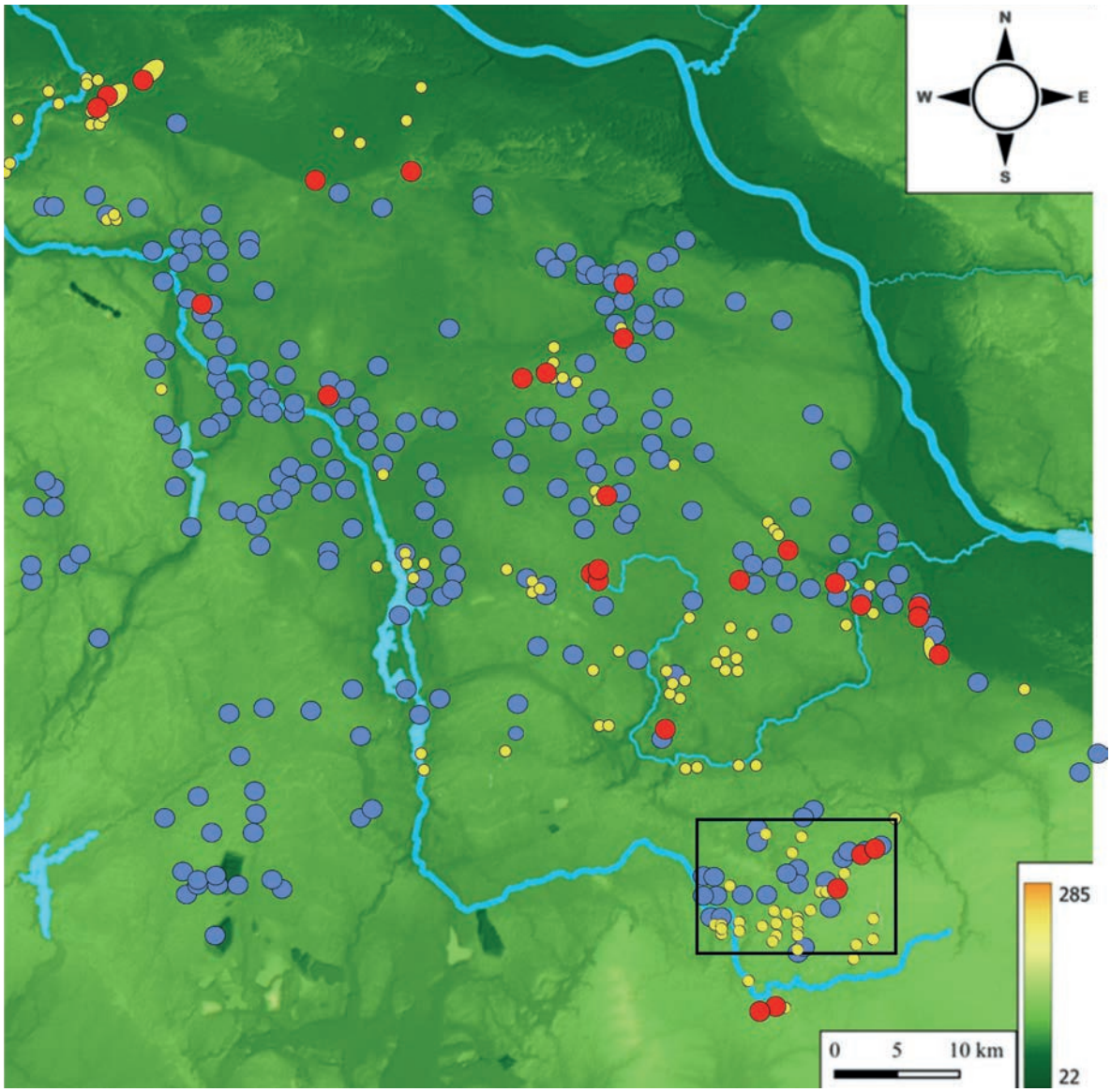



FIGURE 2. Location of stone age sites. Red colour – Mesolithic excavated sites; yellow colour – Mesolithic sites known from surface surveys; blue colour – Neolithic sites (according to J. Pyzel 2010, with modifications by the author)

this site, 13 isolated concentrations of material were excavated, as well as numerous loose materials between artefact clusters of long and varied chronology (Płaza 2025). Materials from the early Mesolithic period were obtained, including backed blade points truncation (Fig. 3:4), and barbed points (Fig. 3:5; Płaza 2013) connected with microlithic end scrapers (Fig. 3:6). Several concentrations associated with the Middle Mesolithic were also excavated, containing so-called Maglemosian materials similar to those found in Dąbrowa Biskupia 71 (Domańska and Wąs 2006). These include regular conical cores and various types of long, slender triangular blades (Fig. 3:7–9). In addition to materials related to the early Mesolithic period, Late Mesolithic flint associated with the Janisławice culture was also excavated. These are classic materials with trapezoids and triangles (Fig. 3:10–12), which at the site in question were found in the stratigraphy with Neolithic FBC pottery and flint items. Similar diverse materials were also excavated at Site 1 in Antoniewo, which date back to the

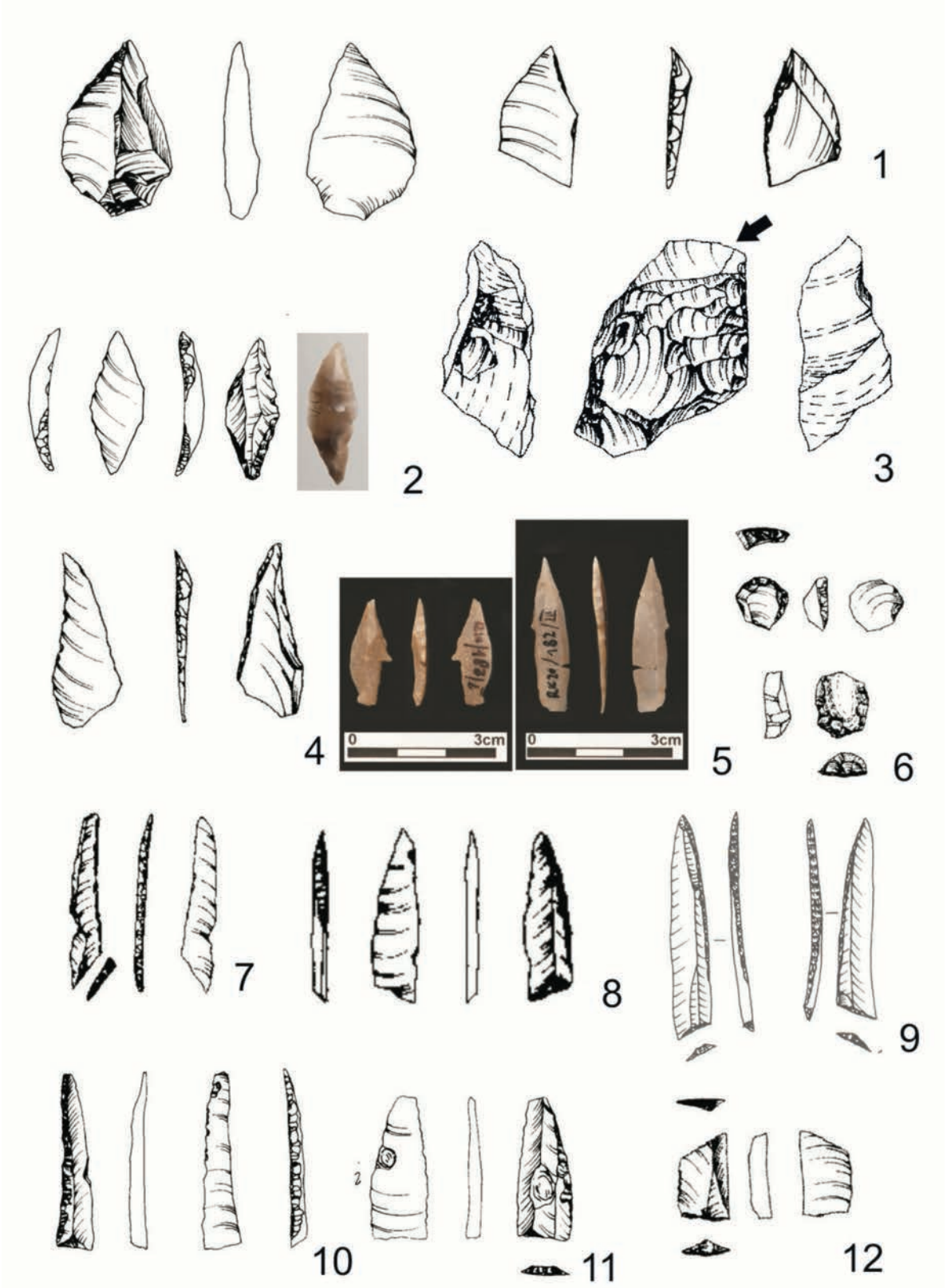



FIGURE 3. The most characteristic flint artefacts of the Mesolithic period in Kuyavia. 1–6: Early Mesolithic; 7–9: Middle Mesolithic; 10–12: Late Mesolithic

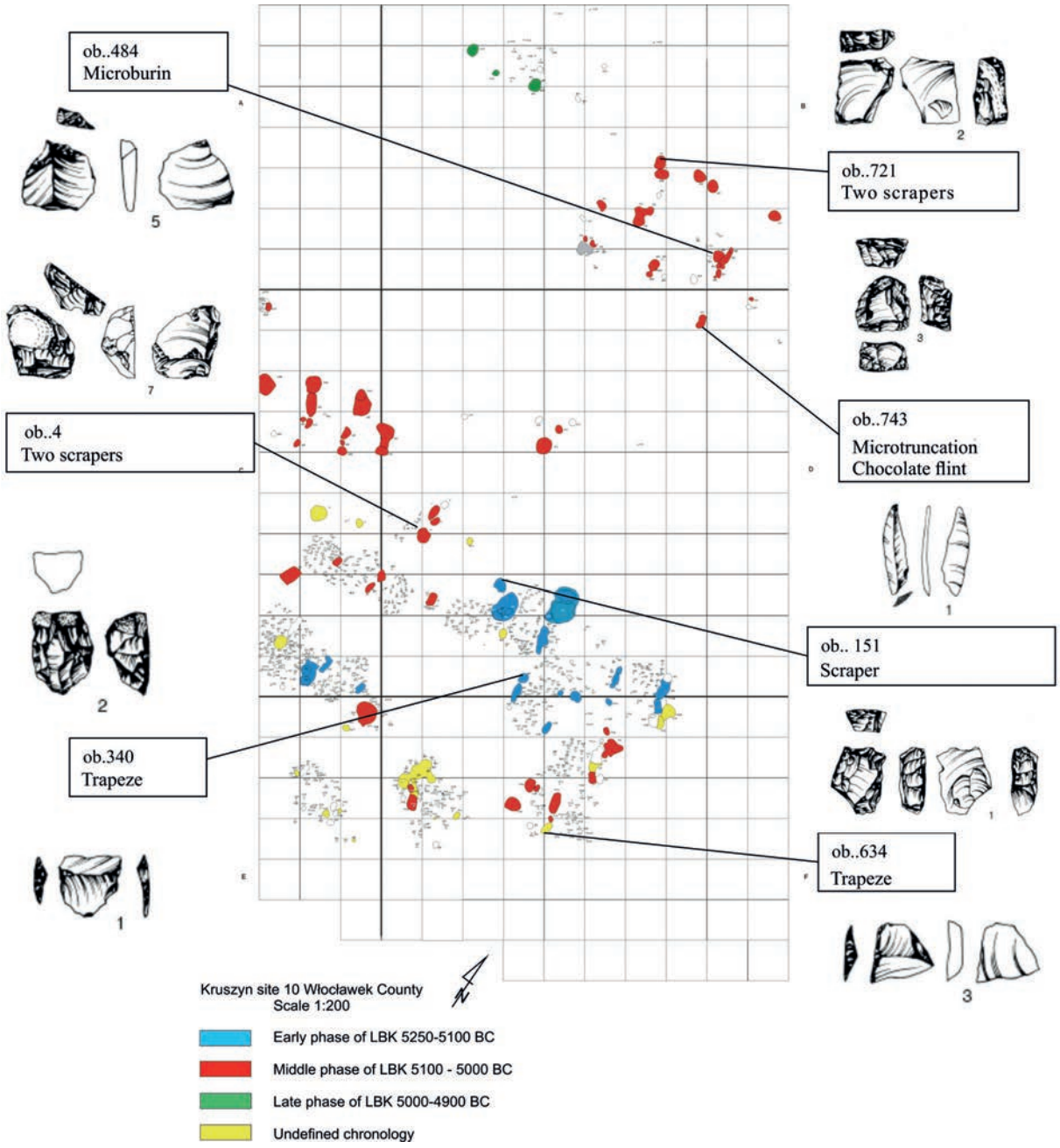



FIGURE 4. An example of Mesolithic flint artefacts in the context of the settlement of the first LBK farmers in Kruszyn (according to D. Płaza 2021)

first half of the Atlantic period (Płaza 2025). Since 2009, a multidisciplinary project has been underway to study the surroundings of the Kuyavian Long Barrows in Wietrzychowice. It is a combination of non-invasive surface surveys, reconnaissance excavations and environmental analysis. During this time, over 50 traces of Mesolithic hunter camps have been found in a small area of approximately 160 km$^2$ (Papiernik and Płaza 2017; Papiernik et al. 2020). Particularly important are the results of research conducted on the shores of Lake Karaśnia in Śmieły, where traces of several visits by Mesolithic hunters were found, and from an excavation in the peat at the base of Site 9 in Śmieły, a horn harpoon dating from the turn of the Boreal and Atlantic periods was recovered (Papiernik and

Płaza 2017; Płaza 2025). A summary of available sources and data related to the Mesolithic period has shown that the Kuyavia Lake District, with its post-glacial origins, was very attractive to Mesolithic hunters, similar to other lake districts in the European lowlands (Płaza 2023; 2025).

Flint tools, but not only flints, data concerning the Mesolithic period were also excavated from sites and contexts dating back to the early Neolithic period. The first farmers arrived in Kuyavia around 5300 BCE, quickly settling and exploring almost the entire region (Grygiel 2004; Pyzel 2010). Flint artefacts undoubtedly associated with the Mesolithic period were excavated from several Neolithic settlements (Płaza and Papiernik 2020). An example of such a site is the settlement at Site 10 in Kruszyn, where Mesolithic flint tools were discovered in several archaeological features. These were tools such as scrapers, slander truncation, and waste from the production of a microlithic point – microburin (Siciński et al 2016; Płaza 2021; 2024; Płaza and Papiernik 2021). An analysis of available sources from the literature shows that individual Mesolithic flint objects have also been discovered at other LBK sites, such as Miechowice or Brześć Kujawski (Grygiel 2004). It is important to note that at Site 10 in Kruszyn, in the oldest pits at this site, dated to around 5200 BCE, the bones of domesticated animals were found alongside the bones of wild animals such as deer, roe deer and horses (Płaza 2021). The situation changes somewhat in discoveries concerning the so-called younger Danubian societies. Unlike LBK, which largely used flint imported from the south of present-day Poland from the Świętokrzyskie Mountains, Jura, i.e. chocolate flint and Jurassic flint, but also single imports of obsidian after the LBK, and especially the Brześć Kujawski Group, practically ceased importing flint from the south and relied on local raw material resources (Papiernik 2008). This is a difficult change in behaviour to explain. Other aspects of the life of the first farming communities in the 5th millennium BCE seem to indicate a Neolithic lifestyle, but DNA analysis of bones from people buried in cemeteries in Osłonki and Brześć Kujawski showed that among the deceased with a Neolithic genome, there are women buried with Mesolithic genetic traits from the so-called haplogroup U. These graves are dated to around 4300/4200 BCE, which clearly indicates the presence of hunter-gatherer groups in the vicinity of Neolithic settlements, who probably coexisted peacefully with farmers. This discovery may suggest a revision of previous findings and a search for elements related to the Mesolithic period at Neolithic sites from the 5th millennium BCE (Lorkiewicz et al. 2015; Fernandes et al. 2018).

The most important findings concerning Mesolithic communities in Kuyavia at this stage of research are:

- Mesolithic sites in Kuyavia cover the entire chronological development from the Preboreal to the Atlantic period,
- Mesolithic groups developed in Kuyavia at the same pace and on the same scale as in other areas of the European lowlands,
- At this stage of research, there is no connection between the oldest Mesolithic and Palaeolithic groups,
- confirmed relations between late Mesolithic hunters and the first farmers on the edge of the Kuyavia Upland,
- in connection with the results of genetic research on skeleton No. 38 from Osłonki associated with Brześć Kujawski Group, the shift of the Mesolithic period in Kuyavia to the end of the 5th millennium BCE.

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# NEOLITHIC





# EXPLORING PREHISTORIC POLAND
## FROM PALAEOLITHIC TO NEOLITHIC

# NEOLITHIC

Jacek Wierzbicki

The introduction of agricultural production based on plant cultivation and animal husbandry is considered the primary distinguishing feature of the younger Stone Age (Neolithic). This was a major breakthrough in the history of humanity. The previous lifestyle of gatherers-hunters-fishers, based on frequent migrations in search of food (only fishing provided greater stability), underwent transformation. While sometimes this change was quite sudden, most often it was a process taking many centuries. The changes also affected the ideological sphere, religious beliefs, and social relations, leading to a significant increase in the complexity and hierarchy of Neolithic communities.

## The Environment

The physical-geographical division of present-day Poland can, in broad terms, be represented as six latitudinal zones. The first, starting from the north, is the southern Baltic coastal region. To the south of these lies a broad zone of lake districts, dominated by young-glacial relief, followed by a zone of lowlands. In Polish archaeological literature, these lowlands together with the southern part of the lake districts are often referred to as the Great Valley Zone. In these areas, podzolic sandy soils predominate; only occasionally (for example, in Kuyavia) do larger patches of more fertile soils, such as black earths, appear. Further south lies a zone of uplands, largely covered with fertile soils developed on loess (including chernozems), and south of them (along the entire southern border of Poland) stretches the zone of mountains and foothills. This zonal arrangement of the landscape and natural conditions was highly significant for the populations inhabiting these areas, particularly for Early Neolithic farmers, primarily interested in regions with highly fertile soils.

The transition of Neolithic populations from the middle Danube basin to the territory of present-day Poland around 5400/5350 BCE occurred during the middle part of the Atlantic period (c. 6900/6700–3850/3650 BCE), considered the climatic optimum of the Holocene. At that time, the mean annual air temperature was approximately 1.5 °C higher than today (around 13 °C), and precipitation was about 15% higher. The climatic conditions at that time were comparable to the northern Mediterranean region as we know it today and provided particularly favourable conditions for the development of vegetation (Kruk and Milisauskas 1999, 252; Czekaj-Zastawny 2017, 25; Włodarczak 2017b, fig. 1).

At that time, these areas were covered by dense deciduous forests dominated by oaks, with admixtures of thermophilous trees such as linden, elm, maple, and ash, supporting a typical forest fauna consisting of deer, roe deer, and wild boar. Only on less fertile substrates – sandy soils (outwash plains, dunes) or wetlands (e.g., in valley areas) – did these forests become more open or give way to pinewoods, alder riparian woodland, or low mixed forests.

The Subboreal period, which followed the Atlantic interval, brought a cooling (although the mean temperature remained higher than the 20th-century average) and an increase in precipitation. This characteristic cool and wet phase is dated to around 3700–3250 BCE and represents the most pronounced climatic change of the entire Northgrippian (Włodarczak 2017a, 284). Significant changes occurred in the species composition of mixed oak forests; elm and linden declined, while hornbeam and yew expanded (Wierzbicki 2013, 183–184). This may have been caused by cooling or by anthropogenic pressure resulting from economic changes (e.g., cutting young elm shoots for cattle fodder) and settlement. In the case of elm,

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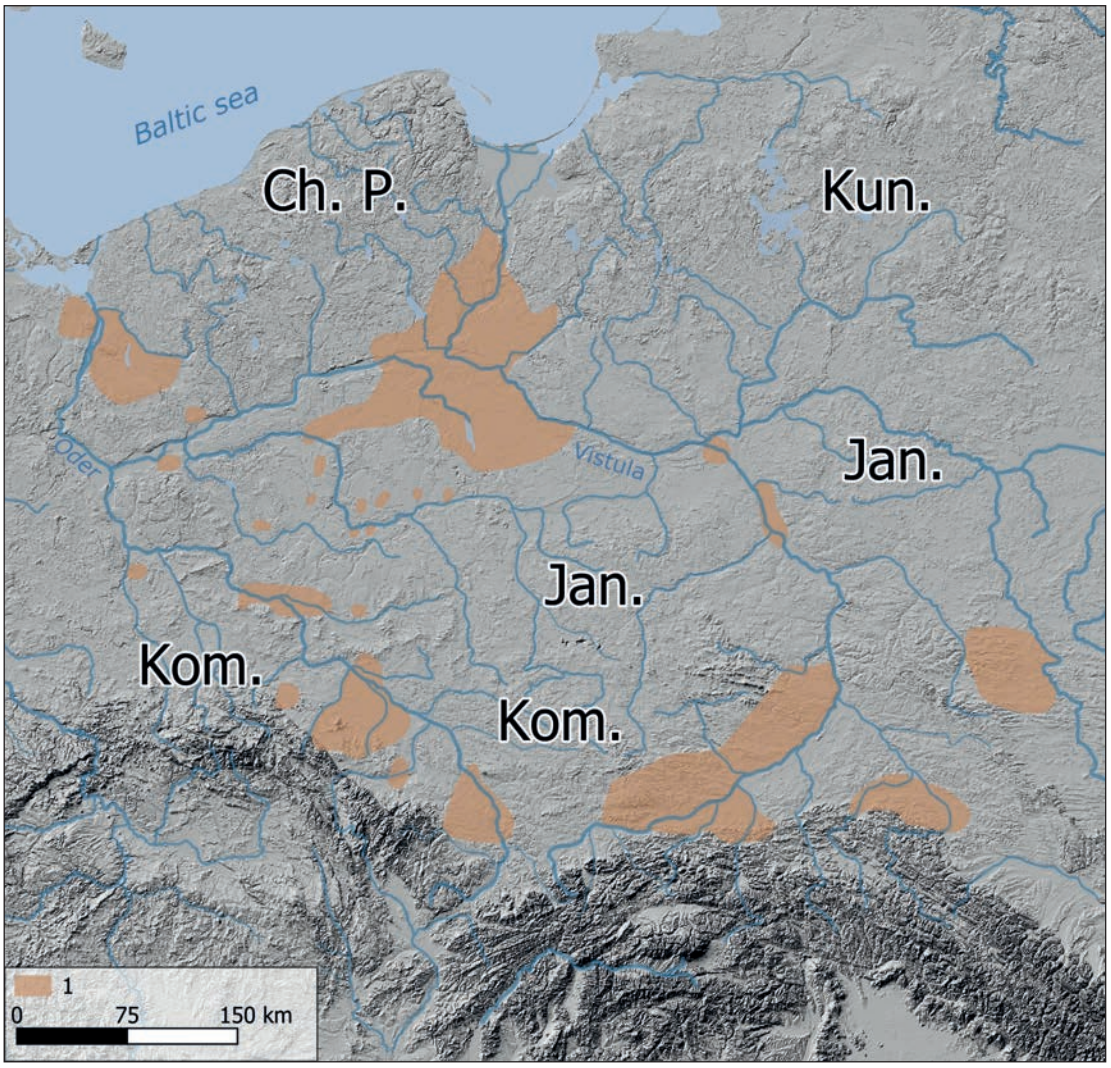



FIGURE 1. Maximum settlement range of the Linear Pottery culture
1 – Linear Pottery culture, Ch. P. – Chojnice-Pieńki, Kun. – Kunda, Jan. – Janisławice, Kom. – Komornica (drawn by W. Szambelan)

the occurrence of the so-called Dutch elm disease must also be taken into account.

By the end of the Neolithic, regional differences had intensified due to the scale of changes brought about by agricultural practices, impacting the natural environment for more than 3,000 years. These effects were driven primarily by deforestation, leading to further alterations in the vegetation cover. However, the intensity of anthropogenic pressure varied. Areas particularly suitable for Neolithic agriculture (favouring both cereal cultivation and animal husbandry, and located near important mineral resources, e.g., flint, salt) were continuously and intensively settled and exploited since the early Neolithic, and were therefore significantly altered by human activity.

## Cultural variability

The process of Neolithisation, which began in the Near East, gradually progressed into Europe from the southeast, along at least three main routes. However, for Central Europe, the most significant was the route associated with the middle Danube basin, where a large complex of painted pottery cultures developed. It was here that the original Anatolian-Balkan model of the Neolithic was adapted to Central European environmental conditions,

particularly those prevailing on the loess plains (Czekaj-Zastawny 2017, 23, fig. 1).

At the end of the first half of the 6th millennium BCE, in the territory of Transdanubia, the Linear Pottery culture (LPC[1]) emerged on the basis of the Starčevo culture. Over 3–4 centuries, this cultural unit spread the achievements of Neolithic civilization throughout Central Europe, occupying extensive areas of the continent in a patchy, island-like pattern. The main phase of the expansion occurred around 5450–5350 BCE. By the early 5th millennium BCE, the LPC populations already inhabited extensive areas, from the Paris Basin to Ukraine and Moldova, nearly reaching the Black Sea (Pavúk 2004; Czekaj-Zastawny 2017, 24–25, fig. 2). In the territory of present-day Poland, the LPC settlements probably appeared somewhat later, around 5350 BCE (Czekaj-Zastawny and Oberec 2021, 315, 333).

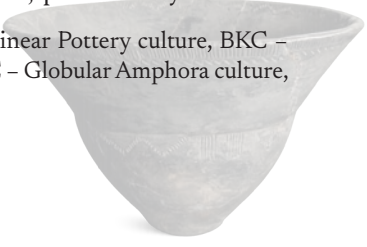
The LPC populations reached the territory of present-day Poland during the first phase of their expansion, occupying areas from the upper Oder basin to the Western Volhynian Uplands (e.g. Gwoździec (Czekaj-Zastawny et al., in this volume), and in the north also Kuyavia and Chełmno Land (Fig. 1). They most likely arrived from western Slovakia, Bohemia, and Moravia via the Moravian Gate and the Kłodzko Valley. The development of this cultural group has been divided, based on changes in ceramic style (primarily decoration), into three main phases: the Early (Proto-Notenkopf, Flomborn) phase, the Classic (Notenkopf) phase, and the Želiezovce phase (Czekaj-Zastawny 2017, 27, fig. 3; Furmanek et al. 2019b, 57). The decline of the LPC (c. 5000–4800/4700 BCE) took different forms. In the western regions (including Silesia), internal developments within the LPC led to the emergence of the Stroked Linear Pottery culture, while in Kuyavia, there was a gradual evolution toward the formation of the Brześć Kujawski culture (BKC). The process of the LPC decline in south-eastern Poland is less clear. No elements associated with the final stage of this cultural group (Želiezovce III phase) have been found, nor are there any proto-Lengyel materials that might indicate a smooth transition to the Samborzec-Opatów group of the Lengyel culture (Czekaj-Zastawny 2017, 56). According to J. K. Kozłowski, the hiatus in settlement (c. 5000–4700 BCE) was caused by climatic changes during the Atlantic interval, but possibly also by epidemics that decimated populations inhabiting Małopolska and Slovakia (Kozłowski 2004). The LPC population groups may have survived in the vicinity of Rzeszów and served as the basis for the emergence of the Malice culture, which would explain its post-Linear nature (Czekaj-Zastawny 2017, 57).

The origins of the younger Danubian cultures are dated to the period 5000–4800 BCE, with the earlier stage of their development ending around 4100/4000 BCE (Kadrow 2017, 71). In western Poland (Silesia, Kuyavia, and partly Pomerania), the Stroked Linear Pottery culture emerged (Fig. 2), developing out of the LPC in the regions of Bohemia and Lower Silesia. The transition from one culture to the other is reflected in the ceramic styles: the Šárka style, typical of the late LPC and dominated by stamping techniques, evolved into the incised ornamentation characteristic of the Stroked Linear Pottery culture. However, the changes were more profound. In flint production, the use of raw materials imported from the upper Vistula region was abandoned, and communities began to rely exclusively on locally available erratic Baltic flint. A tendency also emerged to expand into areas with less fertile soils, even into wetlands and floodplain regions (Kadrow 2017, 95).

Cultural changes in Małopolska at the interface of the LPC and the Malice culture, as well as the closely related Samborzec-Opatów group (Fig. 2), can be perceived either as the result of a new wave of migration from the south, as a consequence of complex autochthonous processes, or as a combination of both. Incised ornamentation on vessels was replaced by puncturing (Fig. 3), but in other respects (including demography) the populations of the Samborzec-Opatów group of the Lengyel culture and the Malice culture were continuators of the LPC population (Kadrow 2017, 97–98, fig. 19).

The Lublin-Volhynia culture (LVC) emerged with contributions from the Polgár and even Trypillia cultures (Fig. 4), and the possibility of the influx of a larger group of immigrants from the Tisza River basin is not excluded (Kulczycka-Leciejewiczowa 1979, 116; Kadrow 2017, 98). The most characteristic feature of this culture is the use of white paint to decorate ceramic vessels, particularly in those

[1] The following abbreviations for archaeological cultures will be used in this text: LPC – Linear Pottery culture, BKC – Brześć Kujawski culture, LVC – Lublin-Volhynia culture, FBC – Funnel Beaker culture, GAC – Globular Amphora culture, CWC – Corded Ware culture, BBC – Bell Beaker culture.



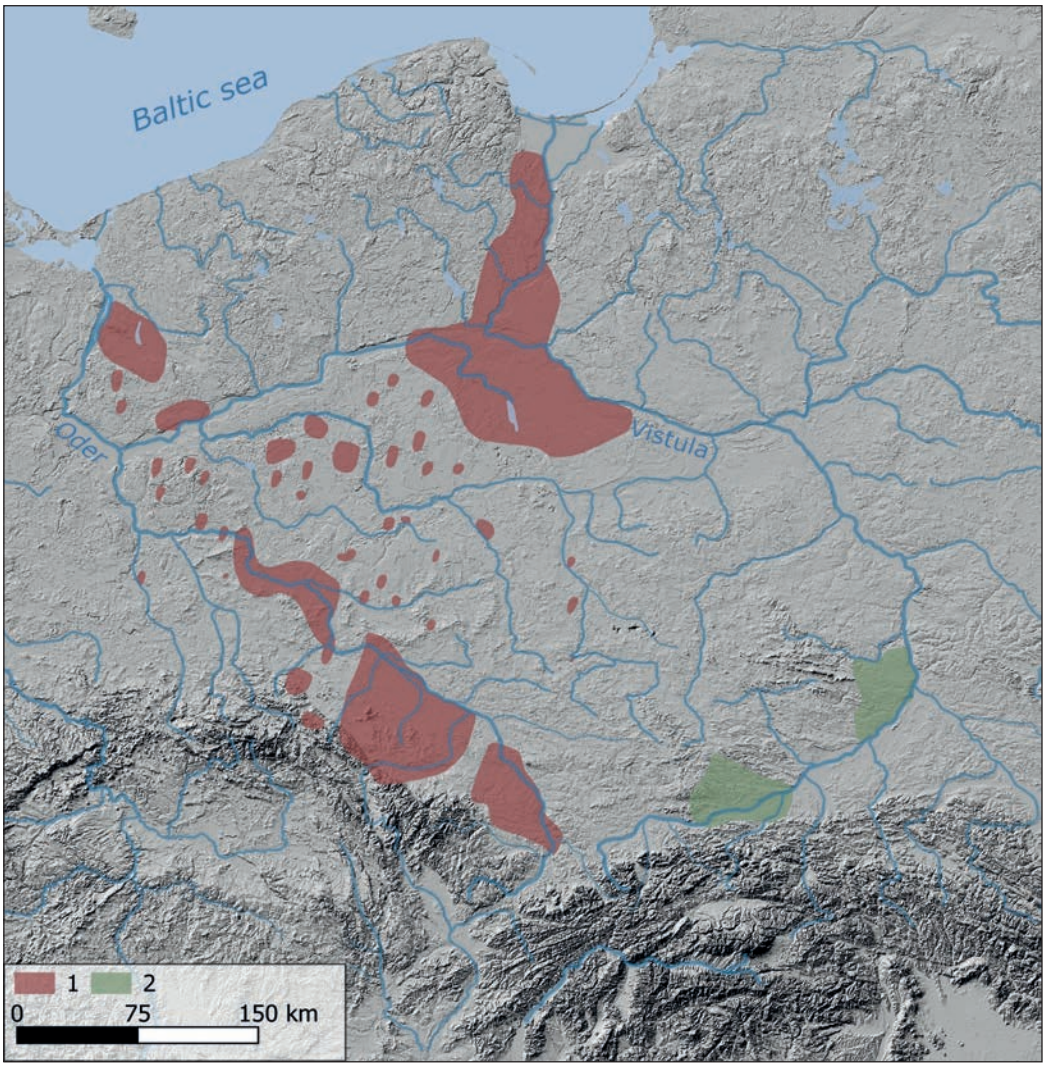



FIGURE 2. The situation after the disappearance of the Linear Pottery culture
1 – Stroked Linear Pottery culture, 2 – Samborzec–Opatów group (drawn by W. Szambelan)

from sites on the Sandomierz loess. In its later phase, influences from the west (even visible in vessel forms) from the Baalberge and Michelsberg cultural milieus appear (Kadrow 2017, 98, fig. 20).

According to S. Kadrow, the beginning of the Eneolithic coincides with the onset of the classical phases of the LVC, BKC, and the Jordanów culture, and can be dated to around 4100/4000 BCE, with its early phase ending around 3600 BCE (Kadrow 2017, 71). However, R. Grygiel dates the transition between the early and classical phases of the BKC (which corresponds to the arrival of the first numerous copper artefacts) much earlier, to around 4500/4450 BCE (Grygiel 2008, 1855, 1918, tab. CCXLVI).

The Eneolithic brought changes across a range of cultural, social, and economic elements: deceased individuals were no longer buried within settlements but in separate burial sites. Organized extraction and distribution of flint, salt, and copper ores developed, long-distance exchange intensified, and competition for control over objects and raw materials of symbolic significance increased. A clear rise in the social status of men is also evident, resulting from the development of the male warrior ethos (Kadrow 2017, 65–67, fig. 3). Later – during the existence of the Funnel Beaker culture (FBC) – the ability to harness animal traction appeared, for example, for ploughing fields with the aid of an ard (Kadrow 2017, 100).




FIGURE 3. Two vessels with combed decoration from the settlement of the Sandomierz–Opatów group of the Lengyel culture at Kraków-Nowa Huta-Mogiła, Site 59, Małopolska Voivodeship (photo by J. Wierzbicki)

The emergence of the BKC in Kuyavia (Fig. 4) was a complex process, involving the gradual merging of the late Linear Pottery elements with the subsequently incorporated younger Lengyel elements. These were carried by populations arriving in Kuyavia from Silesia and from the region between the Saale and Elbe rivers in central Germany, that is, communities of the later phase of the Stroked Linear Pottery culture and the contemporary Rössen culture (Kadrow 2017, 96). In northern Poland, this was the first group to actively and effectively participate in the Eneolithic system of information circulation and inter-cultural contacts (Szmyt 2022, 226). At the transition between the classical and late phases of the BKC, this system underwent profound changes. During this period, central settlements were fortified, the previously observed rules differentiating burial practices by sex were abandoned, and animal burials appeared. All of this indicates deep transformations in the socio-cultural sphere, characterized by secondary egalitarianism and the collapse of the micro-regional networks that had previously connected communities inhabiting central settlements. The process of changes in ceramic forms and technology associated with this led to the emergence of the earliest phases of the Globular Amphora culture (GAC), though not without the involvement of other cultural groups, mainly the FBC (Czerniak 1994, 142–144, fig. 2; Grygiel 2008, 1916–1917; Kadrow 2017, 94, 97; Szmyt 2017, 262).

In the course of the development of the Younger Danubian cultures (Fig. 4), a division of the Polish territories into three cultural regions gradually crystallized. In Małopolska, the Eneolithic cultural milieu included the LVC and the Wyciąże-Złotniki group of the Polgár culture; in Silesia, the Jordanów culture; and in Kuyavia, the BKC. In each of these regions, however, cultures of a still distinctly Neolithic nature also persisted at that time: in Małopolska, the Malice culture in its Rzeszów phase and the Modlnica group of the Lengyel culture; in Silesia, various small groups of the Lengyel-Polgár cycle, such as the Ocice group (Kadrow 2017, 72, figs. 4–5).

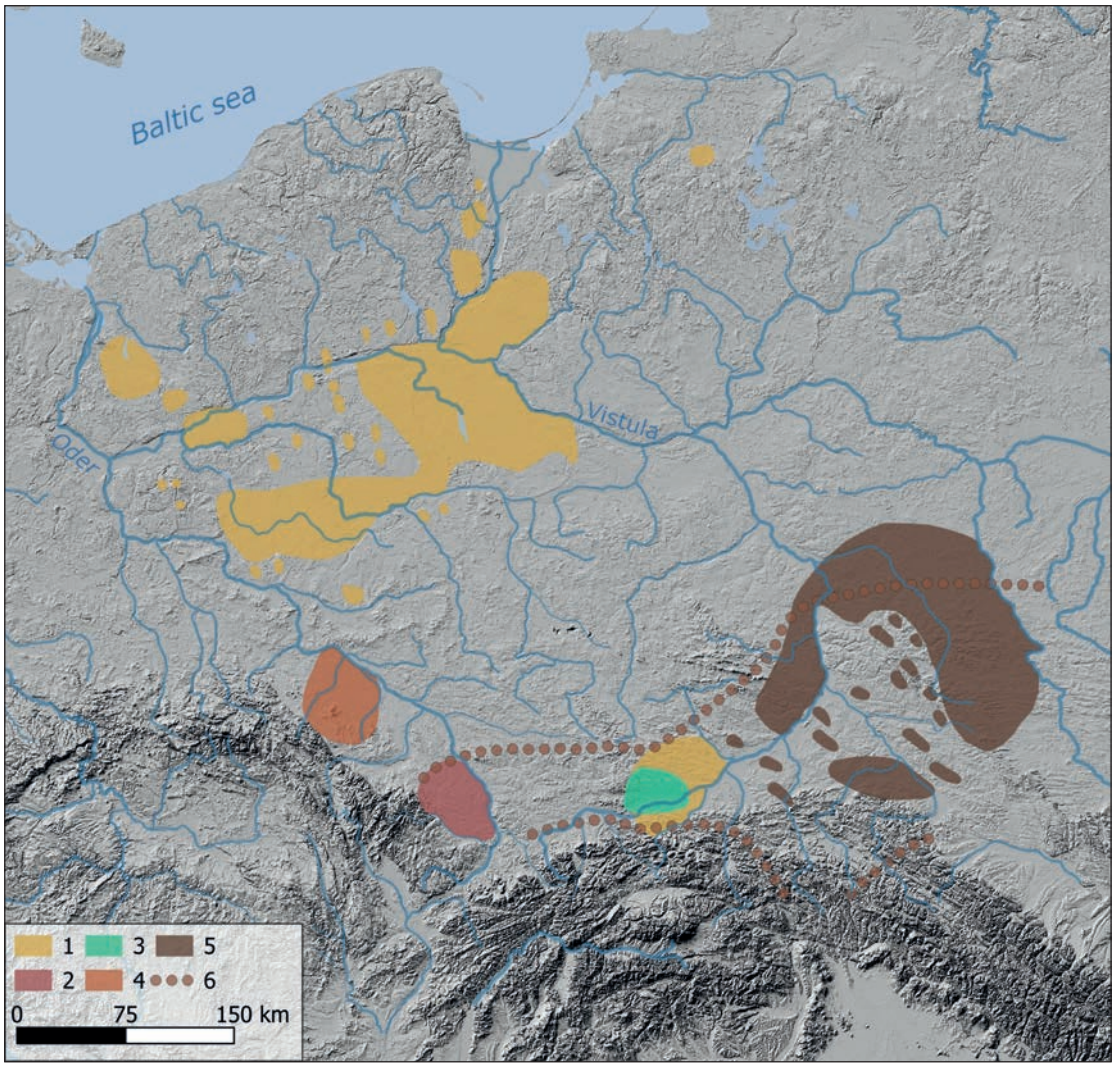



FIGURE 4. Cultures and groups of the Lengyel-Polgár cycle
1 – Brześć Kujawski culture, 2 – Ocice group, 3 – Wyciąże-Złotniki group, 4 – Jordanów culture, 5 – Lublin-Volhynia culture, 6 – Malice culture (drawn by W. Szambelan)

The principal element linking these three regions was the use of copper objects primarily for symbolic purposes. Such items emphasized the aspirations of specific individuals to attain high social status. For men, this status was expressed above all through fulfilling the role and attributes of a warrior, manifested chiefly in copper weapons, but also in bone daggers and antler axes. In the case of women, status was probably derived from being wives or daughters of warriors and was expressed through owning and wearing numerous ornaments, including those made of copper. The significance of objects made from this metal among Eneolithic communities is best evidenced by their frequent deposition in graves (Kadrow 2017, 100). An analysis of the funerary rite, which so clearly emphasized differences between women and men (through distinct rules governing the positioning of bodies and the composition of grave goods) points to close connections with the customs prevailing in the Tiszapolgár and Bodrogkeresztúr cultures in areas south of the Carpathians. This must have been the result of an increasingly pronounced differentiation of the social roles of the two sexes in everyday life, as well as the emergence of a male warrior ethos (Kadrow 2017, 93–94, fig. 17). The strength and reach of Bodrogkeresztúr cultural influences are best demonstrated by the presence of

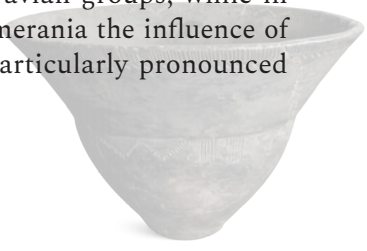
its pottery at Dąbki (Kabaciński et al., in this volume) near Koszalin, directly on the Baltic coast, more than 1,000 km from the culture's core area (Czekaj-Zastawny and Kabaciński 2017, 114, fig. J).

A new stage in the life of Neolithic communities in Central Europe was marked by the emergence of the FBC, which at its maximum extent ranged from the central Netherlands in the west to western Ukraine in the east, and from southern Norway in the north to Lower Austria and Moravia in the south (Nowak 2017b, 126, 132, 164, fig. 1; Czebreszuk et al. 2019, Pl. 1). At present, the most widely accepted view places the beginnings of this new cultural system around 4100/4000 BCE (Nowak 2009, 281, 567–569, figs. 114; 2017b, 128), although some scholars suggest an earlier date, as early as 4400 BCE (Szmyt 2022, 230). The most probable area of emergence of the earliest phase of this cultural phenomenon (from c. 4200 BCE) is the south-western Baltic zone, extending from eastern Holstein to Pomerania. Nevertheless, alternative views persist, linking the origins of the discussed cultural unit with the Kuyavia region and the BKC (Papiernik and Brzejszczak 2018, 273–274). Key sites associated with this early phase include Tanowo, Dąbki, and most likely also Rzucewo (Czekaj-Zastawny, Kabaciński 2018, 67, 69). The hunter-gatherer-fisher groups in this area had been selectively adopting and locally transforming various Neolithic elements since at least around 5000 BCE. The emergence of this system could have been driven by the need to justify and legitimise the privileged position of men (at least some of them) within the community (Kadrow 2017, 69).

The resulting new model of Neolithic culture initially spread southwards along the Elbe, as well as to the south-east and east within the lowland zone of present-day Poland. Small-scale migrations of the Baalberge culture groups from the Elbe-Saale interfluve cannot be ruled out either; from around 3900/3800 BCE onward, these groups may have reached Kuyavia via Wielkopolska, moving along the great valley zone (Grygiel 2016, 970–977, 1009–1010, fig. 707; Nowak 2009, 540–542, 567–568; 2017a, 157–158, 172–173; 2017b, 131, 164).

Following L. Czerniak, we may also ask which origin of the FBC we are referring to: was there a single FBC, or rather two (or even more) distinct formations? Within the FBC complex, two broad zones can be distinguished. The north-western zone comprises the western and northern groups of this cultural phenomenon, occupying the previous domain of the Final Mesolithic Swifterbant and Ertebølle-Ellerbek cultures (including the north-western part of present-day Poland, i.e., Pomerania). The south-eastern zone encompasses the eastern and south-eastern FBC groups, which settled territories to a large extent colonised by Neolithic communities of the Lengyel-Polgár cultural cycle. After posing this initial question, another one naturally follows: to what extent did the expansion of the FBC involve the spread of a full "FBC package", defined as a complex of traits: ceramic style, agricultural economy, and social and religious transformations manifested, for example, in the construction of earthen long barrows; and to what extent did it consist merely in the dissemination of a distinctive ceramic style, which in some regions (like parts of Pomerania) preceded the appearance of the complete "package" (Czerniak 2018, 114–116).

The spread of the FBC was only partially triggered off by migration. This cultural model, with its flexible agro-pastoral economy, stable yet spatially flexible settlements enabled by environmental versatility, a ceramic repertoire including funnel-shaped cups, amphorae, and plates, and a burial custom combining communal practices with the earliest monumental structures, was sufficiently attractive to gain widespread acceptance across diverse cultural contexts. It appealed to the late hunter-gatherer groups still occupying large areas of what is now Poland outside the enclaves of Danubian settlers, and to the latter themselves. This process probably began around 3900/3800 BCE, but on the loess uplands of Silesia and Małopolska it was not completed until approximately 3600 BCE (Nowak 2017a, 157–158; 2017b, 164–165, figs. 24–25), coinciding with the onset of the so-called classical phase of the FBC in south-eastern Poland (Włodarczak 2006, 33–34, fig. 2). In terms of demography and cultural traditions, onto which the traits of the "Funnel Beaker" model were superimposed, the complex Mesolithic-Danubian substrate contributed to the FBC's wide diversity since its very inception. Within the territory of present-day Poland, three territorial FBC groups can be distinguished: the eastern, south-eastern, and Upper Silesian-Moravian groups, while in Western and Central Pomerania the influence of the northern group is particularly pronounced (Nowak 2017b, fig. 1).



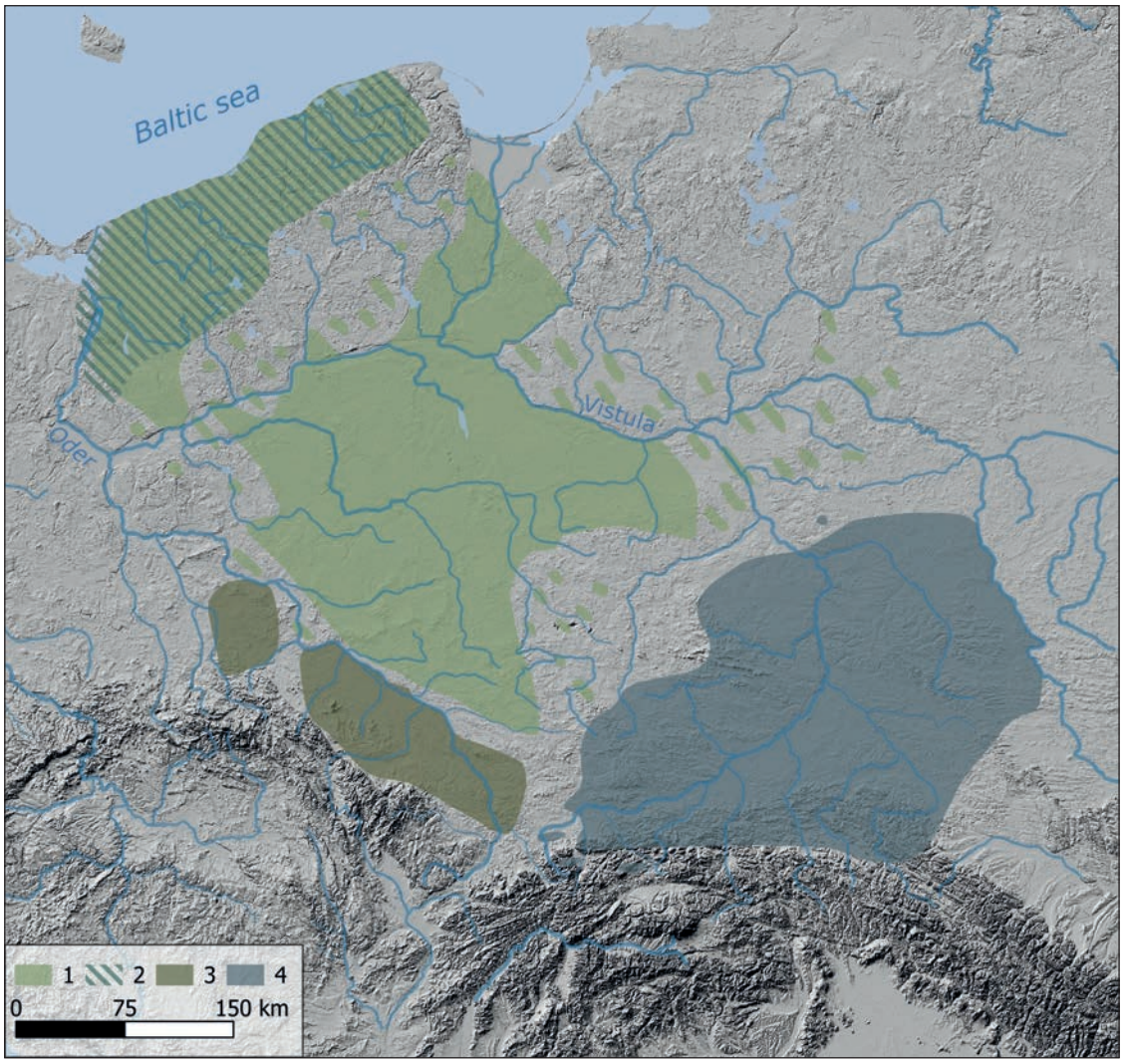



FIGURE 5. Maximum settlement range of the Funnel Beaker culture
Territorial groups: 1 – eastern, 2 – northern, 3 – south, 4 – southeast (drawn by W. Szambelan)

The FBC societies in the territory of present-day Poland existed for nearly 1,500 years (c. 4100–2600 BCE) within a complex system of interactions with representatives of other cultures (Fig. 5). At the end of the 5th millennium and during the first half of the 4th millennium BCE, they coexisted with the late groups of the Lengyel-Polgár cycle (LVC, Wyciąże-Złotniki group), primarily in Małopolska and Silesia, where these groups may have survived until c. 3700/3600 BCE, eventually transforming into the southern variants of the FBC (Nowak 2017b, 159). By around 3650 BCE, FBC communities (mainly on the loess plateaus of the Kraków region and Upper Silesia) came into contact with a new, influential cultural environment of the Baden culture. This environment proved so attractive that, starting around 3500/3400 BCE, the FBC communities in these areas rapidly adopted elements of the culture, giving rise to a syncretic FBC complex of the Bronocice type, Phases IV–V (Włodarczak et al., in this volume), most clearly reflected in the style of ceramic vessels. Consequently, the FBC gradually declined and, by around 3200/3100 BCE, transformed into the Baden culture. The reception of these patterns (so-called Badenisation) is, however, visible to varying degrees across almost all areas occupied by the FBC populations (e.g., Kowalski et al. 2019, 4374). In the distant Kuyavia region *(the nearest enclave of*

*Baden culture settlement emerged around 3200/3150 BCE in Kraków* – Przybył 2017, 177–178, 180, figs. 1, 4), a very intensive, though selective, acceptance of Baden ceramic occurred. As a result, this led to the development of a distinctive decorative style of the Radziejów group, and a similar one of the Mrowino group in Wielkopolska (Nowak 2017b, 160–161; Przybył 2017, 182–183, 189–193, fig. 22).

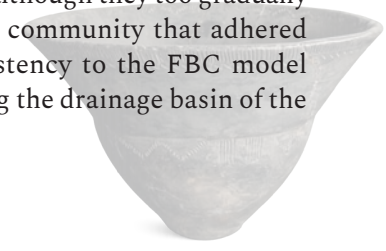
The Wyciąże group: an unexpectedly late offshoot of the Lengyel-Polgár cycle (c. 3500–3100 BCE), a very small unit known from only eight sites in and around Kraków, located almost exclusively on the left bank of the Vistula, also underwent Badenisation. In this case, superficial Baden influences are manifested in the presence of certain ceramic elements (cups with handles that rise above the rim) and in the funerary rite, including cremation and "atypical" inhumation graves, like those recorded at Szarbia. The cause of this growing multi-cultural character (multiculturalism?) noted in many Eneolithic settlement centres (e.g., along the middle Warta River within the Mrowino group: Szmyt, Żurkiewicz 2018, 309, 311) may have been threatening events – possibly invasion and warfare. The occurrence of such events is suggested, for example, by the fortification of the settlement at Bronocice in its Phase V (Kadrow et al. 2021, 152, 156, fig. 1), as well as of several other sites dating to the same period. All of these fortified settlements appear to share one common feature: they operated as centres of salt production and/or distribution. Therefore, this type of settlement may have prevailed toward the end of the development of communities cultivating the FBC traditions in western Małopolska (Przybyła 2020, 189–193).

Meanwhile, in the mid-4th millennium BCE, a new cultural system, the GAC, emerged in the Polish Lowlands (in Kuyavia around 3600/3500 BCE, and in other areas around 3300 BCE: Szmyt 2017, 212, 218). Its spatial range was broadly comparable to that of the FBC. In its origin, both late Danubian units (with similar settlement patterns and comparable pottery-making techniques) and the FBC of the Wiórek phase played a role, the latter contributing, among other things, the adaptation of a symbolic system encoded in ceramic ornamentation as well as analogies in flint-working practices. The GAC was not a simple sum or resultant of its components, but above all a response to the challenges faced by post-Linear communities, such as the BKC, arising from their social organization and economic system (Szmyt 2017, 262). The emergence of the GAC across vast areas of Europe was not the outcome of a single mechanism; instead, various factors and processes must be considered, including migration, adaptation, and acculturation (Wiślański 1979a, 262–264; Szmyt 2017, 262).

In contrast to the FBC communities, whose subsistence was based primarily on cereal cultivation, the GAC populations relied chiefly on cattle and pig husbandry. As a result, a distinctive economic dualism emerged, persisting at least until c. 2800/2700 BCE (Nowak 2017b, 161; Szmyt 2017, 212–213) and, in some regions, even until c. 2400 BCE (Szmyt 2017, 218), that is, until the end of the FBC. Notably, the GAC incorporated numerous elements derived from the FBC, most prominently in ceramic styles, although these were modified. On the other hand, reciprocal influences are almost non-existent. Therefore, the Neolithic cultural model represented by the GAC must have been sufficiently attractive that the FBC communities inhabiting the lowland areas gradually transformed into the GAC (Wierzbicki 2013, 281; Nowak 2017b, 161).

The marked distinctiveness of the socio-economic organisation of the GAC communities is striking. Since the very beginning of its development, around 3500–3300 BCE, permanent settlements disappeared, while domesticated animals assumed a much more prominent role: not only as the basis of subsistence, but also in social life and ritual practice. Although definitions of the GAC tend to emphasise characteristic features of ceramic production, such as specific tempers as well as vessel forms and decoration, far more significant are the changes in land-use strategies and cultural practices. This includes the construction of stone-built graves for selected members of the community, the use of collective or multiple burials, as well as the ritual killing of domesticated animals (particularly cattle and pigs) and the interment of their bodies in specially prepared locations (Szmyt 2017, 212; 2022, 235).

As a result of the development of the GAC communities and, subsequently, the Corded Ware culture (CWC), around 2600 BCE the dominance of the FBC in Central Europe came to an end. In some areas, however, small groups faithful to this tradition continued to exist, although they too gradually abandoned it. The only community that adhered with remarkable consistency to the FBC model was the group inhabiting the drainage basin of the



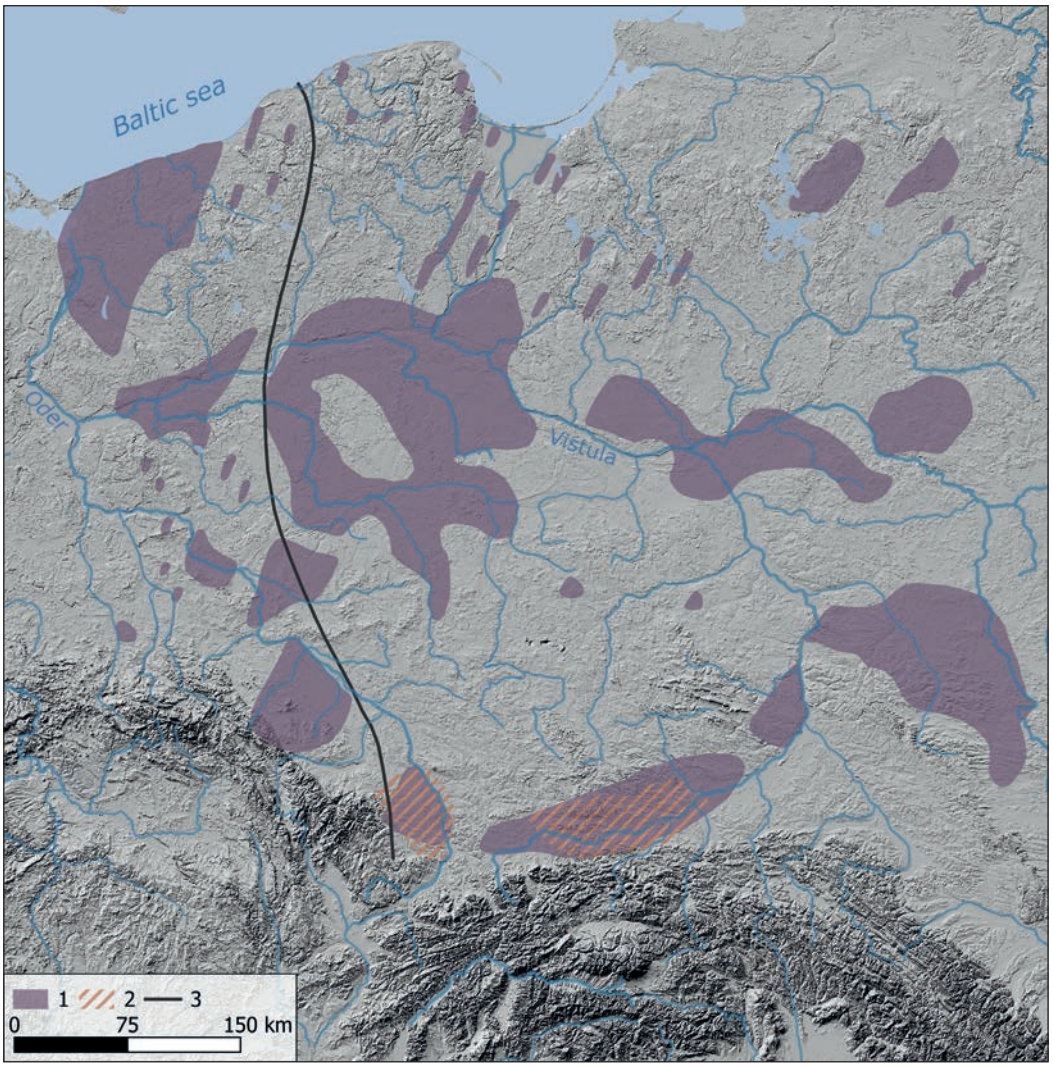



FIGURE 6. The range of the Globular Amphora and Baden cultures
1 – Globular Amphora culture, 2 – Baden culture, 3 – the border of the transition zone between the western and central (Polish) groups (drawn by W. Szambelan)

small Łupawa River in Central Pomerania, which deliberately cut itself off from external contacts. This isolation resulted in its exceptional longevity: the group survived within its enclave at least until the beginnings of the Bronze Age (Wierzbicki 1998, 57, 59; 1999, 251–252; Nowak 2017b, 166).

Almost the entire area within present-day Poland was occupied by the central (Polish) group (Fig. 6). However, in the west (from Western Pomerania in the north to Lower Silesia in the south) there extended a broad zone of interaction with the western group of the GAC (Szmyt 2017, 234, fig. 1; Czebreszuk et al. 2019, pl. 2). Yet throughout more than 500 years (and in some areas perhaps even 700–1000 years; cf. Szmyt 2017, 218) of the intensive development of GAC, there was no single case, period, or location in which its population represented the entirety of the local inhabitants. On the contrary, the GAC communities everywhere coexisted with, cooperated with, or competed against populations from other cultural groups (Szmyt 2017, 212, 257).

For the GAC communities, defining their relationships with other cultural groups – above all with FBC populations – is of key importance. However, the exchange of cultural patterns between these units was relatively limited. Most borrowings in the symbolic sphere (ceramic ornamentation) document

the genetic links of the GAC with the earlier FBC. Much more clear are the connections with the Baden culture. The GAC populations adopted, transformed, and incorporated a small number of elements, including certain ceramic forms (Szmyt 2017, 257), which allows the GAC to be regarded as a group that to some extent underwent Badenisation. On the other hand, areas intensively colonised by the Funnel Beaker-Baden communities, such as the loess uplands of the Kraków region, were not taken over by the GAC settlement (Kruk, Milisauskas 1999, 193).

The GAC communities to the east and west of present-day Poland underwent disintegration around 2600–2400 BCE. The same process within the central group occurred somewhat later, around 2400–2350 BCE. In some areas, however, small clusters of the late GAC persisted longer and gradually losing their cultural identity, eventually dissolved into the final phase of the Neolithic (Szmyt 2017, 263).

Around 2800/2700 BCE, the CWC emerged in Central Europe (Fig. 7), representing a fundamentally different cultural, social, and economic model. It consisted of small groups of highly mobile stock-breeders, itinerant shepherds, and warriors who left behind almost no traces of permanent settlements. The primary archaeological evidence of their presence is provided by distinctive burial forms, including barrows, furnished with a relatively standardized set of grave goods. These are the defining features of the earliest phase of this cultural unit, referred to as the pan-European horizon (also known as Horizon A), which represented a highly standardized cultural phenomenon across vast areas of Central Europe. These developments are regarded as the beginning of the final stage of the Neolithic, commonly termed the Final Eneolithic (Machnik 1979, 339, 341; Kruk and Milisauskas 1999, 217, 225–227; Włodarczak 2017a, 276–277, 286, 288).

The similarity of artefacts discovered in different regions of Europe, as well as of many elements of the funerary rite (including the presence of burial mounds), gave rise to bold migration hypotheses that assumed the spread of new ideas by foreign newcomers arriving from distant areas (Machnik 1979, 338; Włodarczak 2017a, 277). Genetic studies have shown that some individuals associated with the CWC indeed could be linked to the Eastern European steppes. The identity of these migrants is further corroborated by stable isotope analyses (Furmanek et al. 2019b, 116; Szmyt 2022, 241). However, according to other scholars, artefacts typical of the earliest Horizon A (boat-shaped axes, amphorae, beakers, and pots with a wavy plastic ridge beneath the rim) occur in a variety of contexts, sometimes together with finds displaying features characteristic of different cultures (for example, in graves of the Złota culture or in settlements of the Rzucewo culture). Therefore, they primarily represent a specific chronological phase (c. 2800–2600 BCE), clearly associated with the spread of a new ideology and should not be regarded as indicators of population homogeneity (Włodarczak 2017a, 306–307, figs. 1, 7). However, these views are not mutually exclusive, since the bearers of this new ideology were people of a specific ethnic identity, and it was through their activity that its expansion occurred, followed by its adoption by ethnically diverse communities from various cultural groups of the Late Neolithic (Final Eneolithic). Horizon A is therefore a phenomenon of local, Central European origin, but stemming from allochthonous influences.

Within the relatively short period of 2800–2700 BCE (Włodarczak 2017a, 286), these newcomers brought about a significant cultural homogenisation of areas stretching from the Rhine in the west to the upper Volga in the east, subordinating earlier farming groups inhabiting these regions. This was a complex process which, depending on place and time, could take the form of acculturation, assimilation, or extermination. In some areas it also affected still-existing post-Mesolithic communities, or those of the so-called forest Neolithic (para-Neolithic, sub-Neolithic), primarily in north-eastern Poland, present-day Belarus, and the Baltic states (Sobieraj 2017, 338–341, fig. 1). Nevertheless, in many areas groups of people loyal to earlier traditions persisted. Moreover, within the CWC itself largely autonomous cultural units emerged, with original elements of material culture but also by at least partly distinct belief systems and economic practices. Within the territory of present-day Poland these include the Złota culture (Małopolska, the Sandomierz area) together with the Kraków-Sandomierz group of the CWC, as well as the Rzucewo culture (also known as the Coastal culture) along the Gulf of Gdansk and the Vistula and Curonian Lagoons. In other regions, the CWC finds are relatively sparse; only in Western Pomerania (the Lower Oder group) and in Kuyavia

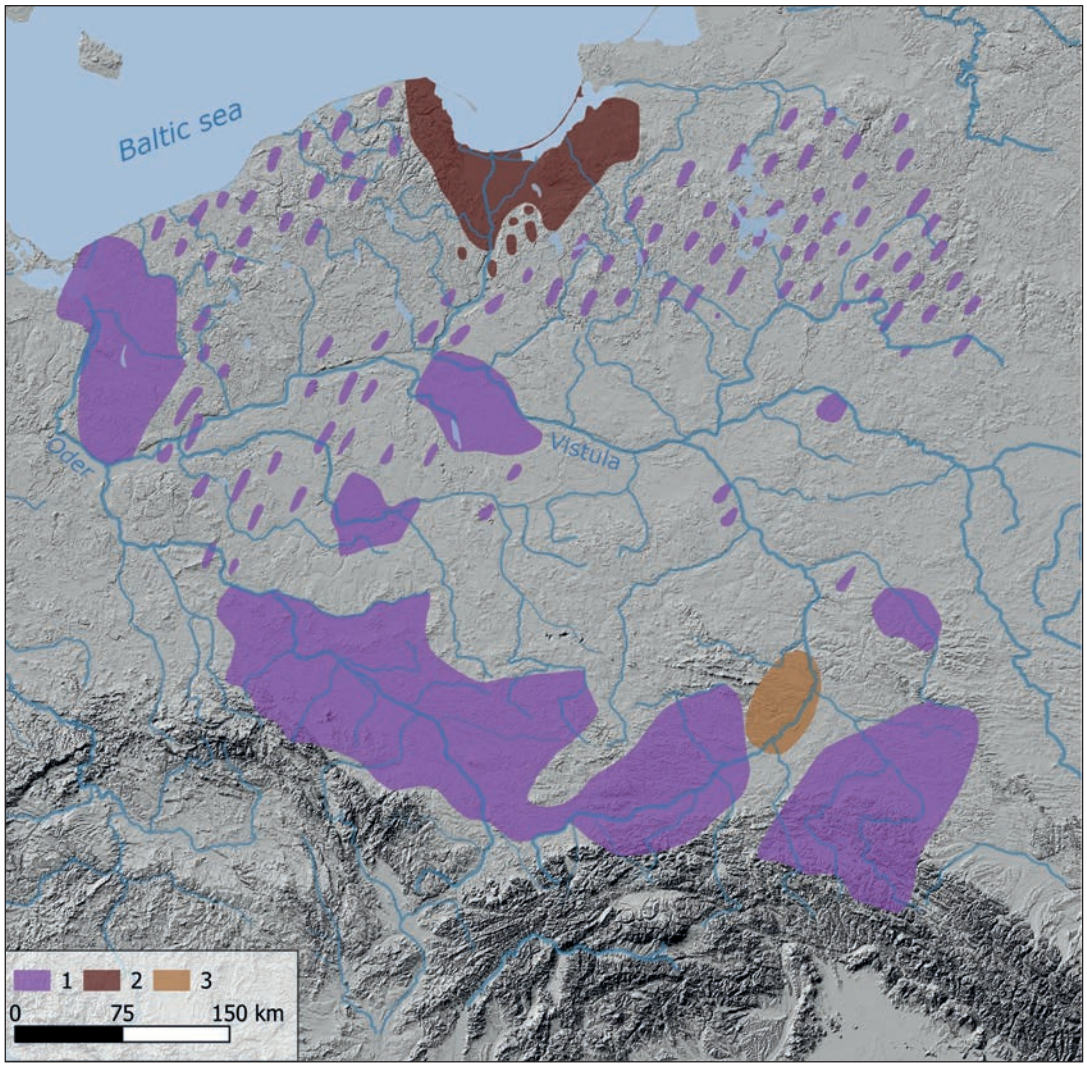



FIGURE 7. Corded Ware Culture Circle
1 – Corded Ware culture, 2 – Rzucewo culture, 3 – the so-called Złota culture (drawn by W. Szambelan)

do larger concentrations occur, revealing links with the northern branch of the CWC, known as the Single Grave culture (Machnik 1979, 366–375).

The Złota culture is known almost exclusively from the burial sites in Złota near Sandomierz (Fig. 7). It is distinctive for its syncretic ceramic style, whose main components are related to the GAC and CWC, with noticeable references to the cup-Baden style, along with a specific burial ritual. For this reason, the unit is often referred to as a phenomenon rather than a separate culture as such (Machnik 1979, 379; 389, 391–392; Kruk and Milisauskas 1999, 209–211). Even its cultural affiliation is controversial. Most researchers consider it part of the Corded Ware milieu (Włodarczak 2017a, 286), but some associate it with the GAC, denying it the status of a separate cultural unit. In this view, the Złota ceramic style is believed to have developed on the Sandomierz Upland based on the GAC, influenced by contacts with the Baden-Beaker group from the Kraków loess, and subsequently with populations from earlier phases of the CWC. The tradition of the site and the sepulchral rituals practiced at the cemeteries in Złota were to play a key role in this process (Kruk and Milisauskas 1999, 212–213).

Around 2400/2300 BCE, during the late period of the CWC development, elements of the

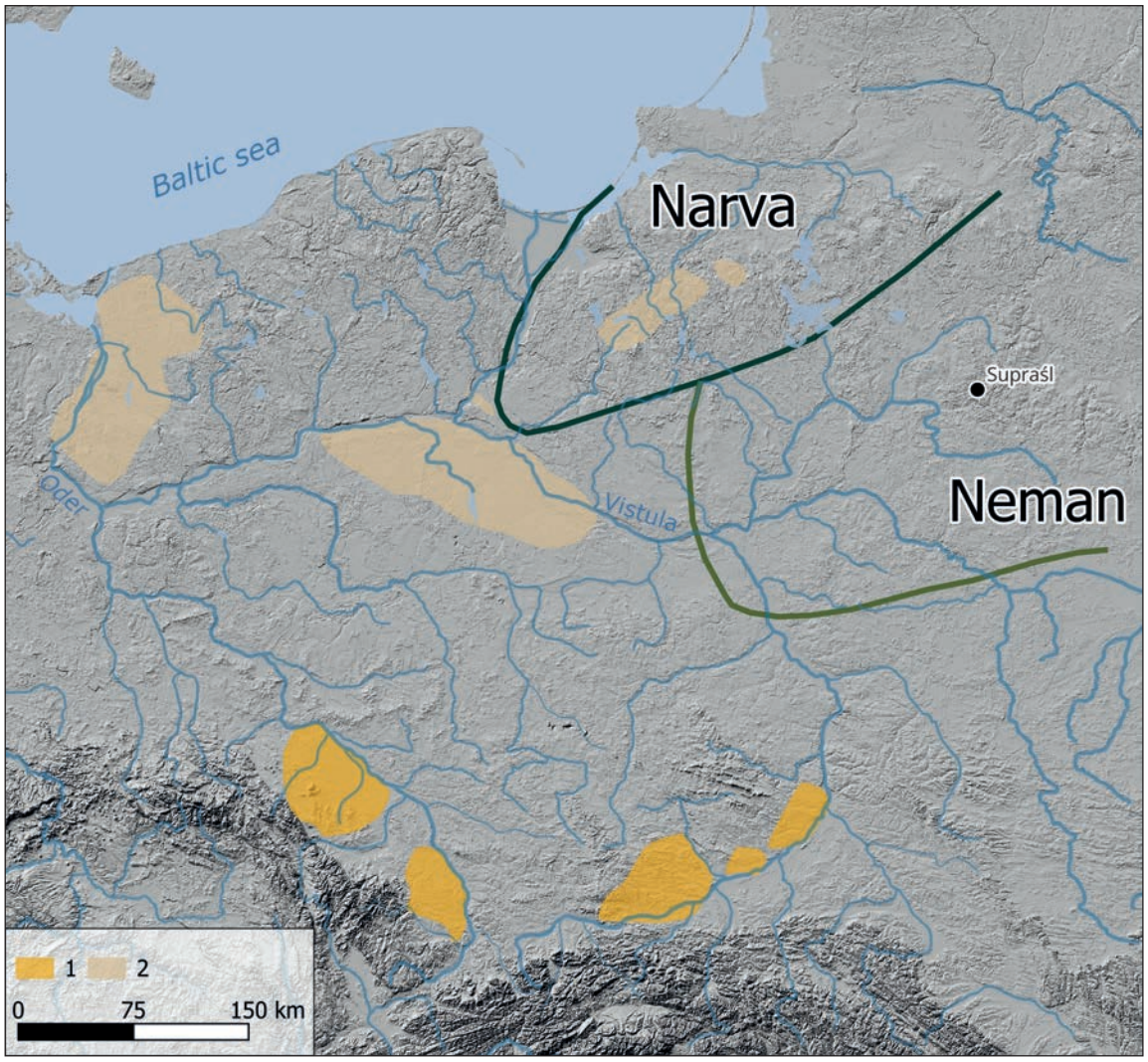



FIGURE 8. The cultural situation in the late Neolithic
1 – Bell Beaker culture and the unique and isolated site in Supraśl, 2 – areas of increased beaker acculturation; approximate ranges of compact settlement of the Narva and Neman cultures (drawn by W. Szambelan)

pan-European Bell Beaker culture (BBC) appeared in the Polish lands (Fig. 8). The primary indicator of this phenomenon consists of graves containing, in addition to ceramics (cups, mugs, jugs, bowls), archery equipment (including flint arrowheads, arrow-straighteners, stone archer's wrist-guards), prestigious items (daggers, ornaments) made of copper, gold, or silver, and amber knobs with a V-shaped opening (Włodarczak 2017a, 276, 279, 286, fig. 5). The BBC population were evidently migrants from the south; this is indicated by the nature of the grave goods but also by the anthropological features (specific characteristics of the skulls) of the deceased buried in these graves (Włodarczak 2017a, 308).

This new cultural trend reached the territories of Poland from both the south and the northwest (Czebreszuk and Szmyt 2012, 158, fig. 2). This related to the migrations of small groups of people (Włodarczak 2017a, 286). During this period, to a much greater extent than in earlier stages of the Neolithic, the concept of archaeological culture denotes a set of attributes from various social and demographic realities (Włodarczak 2017a, 276).

The presence of the BBC in Silesia was an episode that ended around 2300/2200 BCE, which can

be considered the decline of the final Eneolithic and the entire Neolithic period. The demographic potential of this community was small, but it left a distinct mark on local societies and became a catalyst for the changes that led to the emergence of the Únětice culture (Furmanek et al. 2019b, 125). Around this time, stable settlement of the Mierzanowice culture appeared in the south-eastern territories of Poland. Both units are classified as part of the early Bronze Age, but in areas located further to the north and northwest, the cultural patterns of the CWC and BBC persisted at least until around 2000, for example, the Dobre group in Kuyavia or the Lower Odra group in West Pomerania (Włodarczak 2017a, 286).

Beyond the main stream of cultural changes, small communities originating primarily from the local late Mesolithic environment remained throughout the Neolithic period. In the 4th millennium BCE, they were joined by migrant groups from the east (the Neman culture), who essentially continued a hunter-gatherer-fishing lifestyle, at the same time adopting certain achievements of the Neolithic civilization, which is why these cultural units are referred to as sub- or paraneolithic. The history of contacts between Neolithic farmers and late Mesolithic populations began at least as early as when the first LPC communities entered the lowland areas. This is evidenced, for instance, by the use of amber by these populations and the presence of the LPC pottery at the Mesolithic site of Dąbki (Kabaciński et al., in this volume) on the Baltic coast. These contacts intensified after the establishment of the BKC.

Traces of sub-Neolithic communities from the 4th and 3rd millennia BCE are scattered throughout northern Poland, especially in its north-eastern part (Sobieraj 2017, fig. 1; Czebreszuk et al. 2019, fig. 1: red). These are usually remains of short-term camps of small groups of people, clustered on sandy soils near lakes and rivers, as well as in marshy areas (these terrains were very unattractive to agricultural communities). The only evidence of the connection of these people with the Neolithic world is pottery bearing certain features typical only to itself, but also some borrowed from, for example, the FBC, GAC, or the CWC. Such sites are clustered on the fringes of the agricultural ecumene, for instance, in Lubusz Land or in north-eastern Poland, but they have also been found in regions densely populated by farmers since the very beginning of the Neolithic, like in Kuyavia (Szmyt 2022, 242–243).

## Settlement patterns

The earliest farmers in Poland, representing the early phase of the LPC (5450–5350 BCE), primarily expanded into the loess uplands in the Upper Oder and Vistula river basins, and by the end of this phase, they reached Kuyavia and Chełmno Land, occupying smaller and larger patches of the most fertile soils, which provided the highest productivity in the area. Therefore, their settlement was of insular nature (e.g., in Silesia – Furmanek et al. 2019a, fig. 3). This first phase of migration from the south stemmed from the preliminary exploration of new territories and did not lead to the establishment of permanent settlements. This only happened later, reaching its maximum intensity in the phase II of LPC. From this time, the largest number of large, permanently inhabited settlements is known, built with long post houses (Czekaj-Zastawny 2017, 28–29, fig. 4; Furmanek et al. 2019b, 56–58, 61, fig. 4; Szmyt 2022, fig. 2). Important factors influencing the intensification of settlement included access to natural resources: flint outcrops and saline springs.

For the settlement of the western Małopolska LPC communities on the left bank of the upper Vistula, the proximity of flint-bearing areas was of paramount importance, as evidenced by the large number of camps with substantial quantities of flint material clustered on the Kraków-Częstochowa Upland and along the route passing through it. For the communities living on the right bank of the upper Vistula, the most important factor was their location between the settlement area on the left bank and the eastern Linear Pottery milieu (as evidenced by imports of pottery and obsidian), as well as, presumably, the presence of saline springs near Wieliczka and Bochnia. However, there is no direct evidence that these sources were exploited by the LPC populations (Czekaj-Zastawny 2017, 52–53).

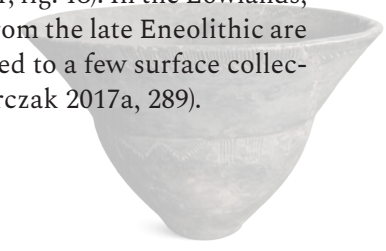
Communities of younger Danubian cultures continued the traditions of the LPC and exploited the same landscape zones, morphologies, and soils in the loess uplands. They were particularly attracted to fertile habitats in the lowest terraces of larger river valleys, which offered the highest utility in the area. In the later, Eneolithic, phase of the development of Danubian cultures, settlements

began to be more frequently located within upland zones. In the lowland areas, however, regions with black and brown soils continued to be preferred.

A different picture is presented by FBC settlements, which occupied various landscape zones in a relatively continuous, rather than patchy, manner. However, some areas were clearly more sparsely populated, for example, the sandy outwash plains (Wierzbicki 2013, 165, 177, 190–194, 203, 269–270; Szmyt 2022, fig. 5). On one hand, this means that the FBC appeared in areas not previously subject to permanent Neolithic settlement and had until then remained the ecumene of hunter-gatherer populations with Mesolithic traditions. On the other hand, the FBC ultimately also settled on fertile soil areas that had been inhabited since the middle of the 6th millennium BCE by Danubian communities (the so-called early farming enclaves). The Neolithic model in the FBC version (the second stage of Neolithisation) connected communities living in very diverse ecological conditions. This means it either represented groups of people capable of functioning even in extremely different environments, or it is a common material reflection of demographically diverse communities utilizing various environmental zones. Regardless of the ecological conditions of a specific area, the number of the FBC sites is always several to dozens of times greater than the total number of all Danubian culture sites combined (this also applies to enclaves of ancient farmers), which indicates significant demographic changes (Nowak 2017b, 133, fig. 4). In fact, these differences in land use forms, the varied structure of individual settlement microregions, and the diversity of residential building types are a reflection of spatial behaviour flexibility, allowing for comfortable existence in diverse environmental conditions. This was probably one of the main factors that contributed to the extraordinary success of this cultural formation (Nowak 2017b, 137).

The GAC settlement covered almost all of Poland, but sites of this group are much rarer than the FBC, except for a significant concentration in Kuyavia (Szmyt 2022, 235, fig. 9). Moreover, a considerable portion of these sites consists solely of finds of single striped flint axes (Szmyt 2022, 235, fig. 10: c), one of the most distinctive artefacts of this group. The occupation of very diverse natural environments by these communities is proof of their adaptability (Szmyt 2017, 227). There is a striking difference in the socio-economic organization of the GAC peoples compared to the FBC. In many areas, the GAC is a culture that is primarily known based on the funerary sources and loose finds of flint axes. However, in Kuyavia and Silesia, remains of settlement prevail (Szmyt 2017, 220; Furmanek et al. 2019b, 111–112, fig. 59). From the moment of the group's emergence and expansion, large permanent settlements disappeared, replaced by significantly smaller, temporary, or semi-permanent ones. The larger ones consisted of one or at most a few (2–5) households, while the others were short-term camps, after which no remnants of more durable structures have survived (Wiślański 1979a, 278, 280; Szmyt 2017, 220, 229, 253). Due to the dispersed nature of settlement and the dominance of small settlements and camps, it is believed that the basic social unit was small family groups that only periodically integrated with others into larger communities. The cohesion and identity of these communities were strengthened by communal activities, primarily manifesting themselves in the complex rituals and funerals, in ceremonies and joint rituals at the graves of the ancestors (Wiślański 1979a, 299; Szmyt 2017, 229, 240, 253, 256, 259–260).

The CWC population left behind almost no traces of permanent settlements or more durable camps, which long ago formed the basis for the theory advocating a mobile lifestyle of these communities and the fundamental importance of animal husbandry in their economy, with nearly negligible roles for grain cultivation. Mobility and characteristic cultural features reinforce theories regarding the significant role of population movements, including migrations, leading to fundamental cultural and social changes. In the distribution of the CWC settlements, there is a clear preference for areas that were deforested in earlier stages of the Neolithic, which had long been subject to anthropogenic pressure. In southern Poland, the remains of camps are located almost exclusively in the valleys of large rivers, which is most prominent in the earlier phase of the development of the CWC (around 2800–2600 BCE). The main unit of their organization was probably a small clan community that moved across large areas. Often, the only traces of their presence are graves, but burial sites were located in higher parts of the terrain (Włodarczak 2017a, 276, 288; Szmyt 2022, 240–241, fig. 13). In the Lowlands, remains of settlement from the late Eneolithic are scarce and usually limited to a few surface collections of pottery (Włodarczak 2017a, 289).



The CWC population intensified its expansion towards the maximum colonization and economic utilization of all ecological zones. Ultimately, it extended far beyond the traditional Neolithic ecumene. This expansion was directed, among other areas, towards the mountainous regions of the Carpathians and Sudetes. An even more significant process occurred – the colonization of the so-called forest zone, particularly the areas of Mazovia and north-eastern Poland (Włodarczak 2017a, 282).

## Habitation sites and dwellings

The basic unit of spatial organization of LBK populations was a permanent settlement accompanied by satellite camps. Such settlements were usually established on the floodplain terrace of a river, with convenient access to water, and consisted of several (on average 3–4, at most up to 8) long rectangular post-built houses (sometimes up to 48 m in length), oriented along the north-south axis, each of which formed the centre of a separate homestead. The interior of the house was probably divided into three parts related to the functional arrangement of the space (Lüning 1982; Furmanek et al. 2019b, 59; Pyzel et al. 2019, 38, tab. 2.1, fig. 2.19). The southern part (where the entrance was located), probably with an additional level supported by reinforced posts, served as a storage room and granary. The central part, the largest, served residential functions. Sometimes graves were located there, probably of deceased household members. The northern part was either a space for domestic animals or possibly a bedroom (Lüning 1982, 17; Czerniak 2008, 154–155; Czekaj-Zastawny 2017, 30, fig. 6–9; Czekaj-Zastawny et al. 2021, 338–340).

Around the house, within the homestead, there were storage and refuse pits, small hearths, areas for meal preparation, and places for the production of pottery and flint tools. Between the homesteads, there was space for communal structures serving all the inhabitants of the settlement, including storage pits, larger hearths, kilns for firing pottery, and sometimes even wells (such as in Ludwinowo in Kuyavia) and graves (Kruk and Milisauskas 1999, 39; Czekaj-Zastawny 2017, 32–34, figs. 10–11; Pyzel et al. 2019, 23, 26; Pyzel 2019, 79, fig. 2.6; Czekaj-Zastawny et al. 2021, 340–346).

In the younger Danubian cultures in Małopolska (the Malice culture), small, single homesteads or settlements consisting of two to four post buildings prevailed. In the area of the houses, the number of finds is surprisingly small, which proves a clear separation between the residential part and the production-consumption area. In the Eneolithic stage of development of the younger Danubian cultures in Małopolska, for example in the Lengyel, Malice, and LVC cultures, fortified settlements appeared, covering areas of up to three hectares. They were surrounded by at least one ditch, accompanied by an embankment and a wooden palisade (Kruk and Milisauskas 1999, 71, 74–75, 77; Kadrow 2017, 74, figs. 6–7).

In Kuyavia, the settlement microregions of the BKC near Brześć Kujawski and Osłonki (Grygiel and Bogucki, in this volume) consisted of one large central settlement and several smaller satellite settlements located at distances ranging from a few hundred metres to 1–2 kilometres. The central settlements served as residences for the elites. This is confirmed by the presence of very richly equipped graves (including copper ornaments), not found in the satellite settlements (Grygiel 2008, 1855–1857). A similar situation probably existed in the area of one of the few fertile soil islands near Racot in Wielkopolska (Czerniak et al. 2016).

The central BKC settlements consisted of 8–10 long trapezoidal houses existing at the same time and covering an area of about two hectares. Other settlements were smaller and typically comprised one house and several utility structures. The fortifications of the settlement in Osłonki consisted of a ditch and a palisade, but only on the easily accessible sides, as it was surrounded by the waters of a lake to the east. There was only one entrance leading into the settlement (Nowak 2009; Czerniak and Pyzel 2019, 67–74, fig. 3–5, tab. 1; Szmyt 2022, fig. 3).

In Silesia, for the LPC and later units of the Lengyel-Polgár cycle, the most typical settlements were single-homestead sites (one trapezoidal house and a few associated structures). An exception is the settlement at Zarzyce, considered one of the largest post-Linear culture settlements in Poland, covering over 6 hectares. It was at least partially surrounded by a ditch and palisade. This probably also applies to the settlements of the Jordanów culture at Tyniec Mały and Dobkowice (Kadrow 2017, 76; Furmanek et al. 2019b, 73, 79, 87, figs. 13, 19, 30).

A separate issue is the so-called rondels (circular Neolithic enclosures with an outer diameter of approximately 80–100 m, typically consisting of

three moats and palisades, with four entrances oriented according to the cardinal directions), several of which have been discovered in Silesia, Kuyavia, and West Pomerania (Nowe Objezierze – Czerniak et al. 2019) (Czerniak and Matuszewska, in this volume). These were constructed with significant effort by the population of the Stroked Linear Pottery culture. All of these monumental structures were built in a short period during the late phase of this cultural unit and had a unique purpose. They are most often regarded as places for conducting specific rituals of a cult or social nature, associated with periodic gatherings of the local population, possibly linked to specific astronomical events, such as the winter or summer solstice (Furmanek et al. 2019b, 73–74, fig. 14).

In the area of Małopolska, the population (older stage of the development of the younger Danubian cultures), such as the Malice culture, built rectangular post-and-plank houses (10–12 m long) consisting of a single row of posts. Each of these houses was adjacent to one large pit from which clay was extracted for building the walls (e.g., Targowisko, Zagórze). Another frequent type was the rectangular post house (9–13 m long) oriented along the NNW-SSE axis (e.g., Rozbórz). Little is known about the dwellings from the Eneolithic period of the development of the younger Danubian cultures in Małopolska (Kadrow 2017, 78–79).

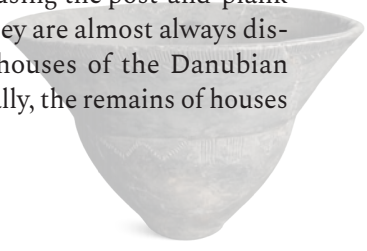
In Kuyavia, monumental houses in the shape of a strongly elongated trapezoid definitely prevailed. These were very solid structures with posts placed at a considerable distance from each other, an internal row of posts, and (most characteristic of the BKC) side walls made of posts densely set in deep foundation trenches surrounding the entire house. Small houses measured about 15–20 m in length, classic ones around 25–30 m, while the longest reached nearly 40 m. The house, along with its courtyard (homestead), where various structures: storage and waste pits, hearths, and designated areas for processing different materials were located, served as the focal point of human life (Grygiel 1986; Kruk and Milisauskas 1999, 78–81; Czerniak and Pyzel 2019, 65, fig. 2).

Communities of the LPC in Silesia also lived in long houses built on posts (up to 24 m long, 100–285 $m^2$ in area) constructed on a trapezoidal plan along a north-south axis, with entrances facing south (Stary Zamek). The roofs were supported by internal rows of posts, initially three, then two, and ultimately one. Sometimes, the walls of such houses were built from posts arranged in pairs, with thin branches placed between them and covered with clay (unlike the earlier LPC structures, these houses did not have long clay banks along their sides). It is intriguing that to date, no ovens or hearths have been discovered in these houses. By contrast, from the period of the Lengyel-Polgár cycle in Silesia, only sunken-floor shelters and semi-sunken-floor shelters are known. Evidence of post constructions is quite rare (Kadrow 2017, 79–80).

The FBC population established various types of settlement systems. These could be highly dispersed, with individual settlements and camps existing as independent entities. However, in some cases, we encounter complex structures consisting of a central settlement, satellite settlements, and burial grounds, particularly featuring monumental megalithic tombs. Classical examples include the Bronocice microregion, where a two-tiered settlement hierarchy has been suggested for the developed phase of the FBC (around 3600 BCE) (Milisauskas and Kruk 1984, 19–23; 1999, 124, 126–127, 135–141). Additionally, in the central basin of the Łupawa River, megalithic tombs appear to form two lines of boundary markers surrounding a microregion with the central settlement located in Poganice (Wierzbicki 1998; 1999, 199–208, figs. 64–65).

In general, compared to the Danubian and Mesolithic cultures, the FBC settlement shifted to higher landscape zones and deeper into the uplands. The FBC settlements were highly diverse in size. Over time, there was an increasing number of larger settlements (ranging from several to several dozen hectares), particularly concerning the loess areas of the "old agricultural" regions. An exception appears to be the settlement of the Łupawa group in Poganice, covering about 14–16 hectares. However, it essentially consists of many smaller settlements that developed in the area over nearly 1,500 years of the group's existence (Wierzbicki 1999, tab. 15).

Unlike the situation in the Danubian communities, there was no model of a typical residential house in the FBC; instead, there is a wide range of various types of constructions, from earthen dwellings and semi-earth houses to post houses, log houses, or those built using the post-and-plank construction. However, they are almost always distinctly smaller than the houses of the Danubian population groups. Generally, the remains of houses



are relatively rare, considering the large number of known settlement sites. Therefore, these must have primarily been structures that did not leave visible archaeological traces. This does not imply, however, that they were always lightweight structures (Nowak 2017b, 137). A case in point are small (25–30 $m^2$) rectangular or slightly trapezoidal post houses (Grygiel 2016, 949), long rectangular ones, such as in Barłożno in Eastern Pomerania (18.5 m), and possibly even up to 45 m in length (Felczak 2005, 202–209, figs. 10–11; 2020b, 179–181), or in Pogonice, trapezoidal structures, measuring 13–20 m, that in addition formed arrangements resembling farmsteads (Świderski and Wierzbicki 1990, 31–32, 35, figs. 7–9; Wierzbicki 1999, 196–197, figs. 57–58).

Apart from the houses, an important component of settlements consisted of elements of infrastructure, such as wells, for example those at Kiekrz in Wielkopolska (Krzyszowski and Kaniewska 2024, 36, 39–40, fig. 2), or at Ludwinowo in Kuyavia, where at least seven such features have been identified (Papiernik 2017, 99; cf., a database of known wells across the entire TRB distribution area – Żurkiewicz 2022), as well as defensive installations in the form of ditches and palisades, for example at Mrowino (Wielkopolska) and at Stryczowice, Bronocice (Włodarczak et al., in this volume), Miechów, and Gniazdowice in Małopolska (Uzarowicz-Chmielewska 1985; Przybyła 2020).

In the case of the GAC, there is little information concerning the construction and dimensions of residential buildings. They were usually small structures, several metres in length and with an internal floor area of up to 20 $m^2$, with a quadrangular or trapezoidal plan and an internal hearth, built in post construction (the posts could also be set in foundation trenches) or as semi-subterranean buildings, exceptionally reaching an area of up to 60 $m^2$. In some cases, the preserved remains indicate intensive use of the internal space (Wiślański 1979a, 278, 280, fig. 165; Szmyt 2017, 228, fig. 15; Czebreszuk et al. 2019, 810, figs. 5–6). Only in Kornice in Silesia have long (20–25 m) trapezoidal post houses been identified, the presence of which may reflect the survival of older Neolithic cultural traditions in this area (Furmanek et al. 2019b, 111–112, fig. 59).

Settlements of the Zesławice-Pleszów group of the Baden culture were relatively extensive (2–5 hectares), and their internal layout shows evidence of a spatial organization resulting from the presence of above-ground buildings and associated clusters of utility features, which together formed individual household units. The settlement at Kraków-Zesławice included even an enclosure for domestic animals. A characteristic feature of Baden culture settlement, however, is the use of caves in the Kraków-Częstochowa Upland. Some of these probably represent traces of small groups arriving from the Transcarpathian region in search of flint raw materials (Kruk and Milisauskas 1999, 182, 184, 186, fig. 60).

The population of the CWC left very few traces of more permanent settlements. Most often these consist of ephemeral remains interpreted as short-term camps, composed of light hut- or tent-like structures. Moreover, they were established in sheltered locations in lake and river valleys, on sandy soils where organic material underwent relatively rapid decomposition (Szmyt 2022, 240). Only Kuyavia and Wielkopolska host settlements with more durable built structures. However, these were relatively unstable constructions and, in addition, dated quite late, only after c. 2400 BCE (Włodarczak 2017a, 289).

The situation was different in the Rzucewo culture. Its population built solid rectangular houses with walls formed by double rows of posts, up to 12 m in length, and inhabited permanent settlements located on elevations, often on the edge of a plateau descending toward the sea, as for example at Suchacz and Rzucewo (Włodarczak 2017a, 289; Król 2018, 117–122). In the floodplain areas of the Vistula delta, temporary camps were also used.

## Economy and subsistence

In the LPC, population groups intensively exploited the area in the immediate vicinity of settlements. At a distance probably not exceeding 1.5–2 km, crops were cultivated on small plots located on fertile soils. These consisted mainly of cereals, above all wheat – primarily emmer wheat (*Triticum dicoccon*) and einkorn wheat (*Triticum monococcum*) – as well as barley (*Hordeum vulgare*) and maybe millet (*Panicum miliaceum*), but also legumes (peas), flax, and poppy. The soil was previously loosened using hoes and digging tools made of stone, antler, or wood. This type of agricultural practice is referred to as hoe-farming. Away from the settlements, domestic animals were pastured: cattle (approximately 80% of all post-consumption faunal remains

belong to this species) and sheep/goats, with pigs occurring less frequently. Cattle were raised for meat but also for milk, which was then processed into cheese (Kruk and Milisauskas 1999, 41–51; Salque et al. 2013; Czekaj-Zastawny 2017, 41–44; Furmanek et al. 2019b, 68, fig. 12; Czekaj-Zastawny et al. 2021, 350–353). The supplementation of the diet with meat from wild animals was of marginal importance. Their remains usually account for about 6–7% of the mammal bones recovered from settlements, but a substantial proportion of these (antler used for tool production) derived from non-consumptive parts.

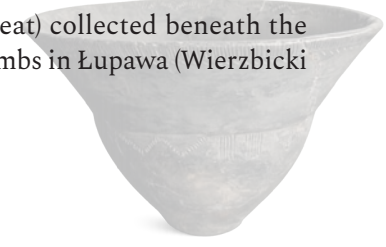
In the younger Danubian cultures in Małopolska, this economic model did not undergo major changes. The basis remained intensive garden cultivation of small, well-sunlit plots scattered throughout forested areas (the so-called bush-fallow or shifting garden system), along with stationary animal husbandry. Certain changes occurred at the beginning of the Eneolithic, when slash-and-burn agriculture gained in importance. Areas located close to valley bottoms were still generally used for cultivation (primarily varieties of wheat) but the exploitation of drier environments on uplands, intended mainly for barley, increased. The basic agricultural tools consisted of stone axes used for forest clearance and digging sticks or hoes for loosening the soil. Small plots surrounded permanently inhabited settlements. When they became exhausted, they were abandoned and left to regenerate, while new locations were sought and converted into fields. However, this does not imply the use of a rotational settlement model. Animal husbandry probably played a much smaller role and was a supplementary activity. Among domesticated animals, the dominance of goats and sheep over pigs decreased (Kruk and Milisauskas 1999, 66, 68, 83, 85–86; Kadrow 2017, 81).

The same model of farming was effective in the Kuyavia region. The high levels of strontium/calcium and strontium/zinc ratios in the bones of individuals buried in the Osłonki (Grygiel and Bogucki, in this volume) microregion indicate that their diet was largely vegetarian. Foods containing animal proteins, such as meat and milk, supplemented their diet to a small extent (Kadrow 2017, 82).

Areas located on the right bank of the upper Vistula were attractive to populations of the younger Danubian groups also because of the presence of saline springs, which the Pleszów-Modlnica group began to exploit for salt production. Special vessels for this purpose, known as briquetage, were made from clay with a high sand content and were given a specific shape – pointed bottoms and tulip-shaped flared edges. After firing, they had a red or orange colour and a hard, rough surface. At the site in Kraków-Barycz, ditches were discovered that conveyed brine to reservoirs, where it concentrated through evaporation. The salt was then finally evaporated in briquetage structures on open hearths, where it solidified and took on the characteristic conical shape of a "salt head" (Jodłowski 1971, 69–74, fig. 24, photo 1; Kruk and Milisauskas 1999, 90–94).

The FBC communities obtained most of their food through crop cultivation and animal husbandry. The most important cultivated plants were cereals, primarily varieties of wheat – again led by emmer wheat and einkorn. Barley and legumes were also grown, as well as flax and poppy, although finds of the latter two species are much rarer. At nearly all the FBC sites, domestic animal bones overwhelmingly predominated, while remains of wild animals accounted for only a few percent. These are mainly the bones of large mammals: deer, roe deer, horses, and wild boars. Among domesticated animals, cattle bones prevail almost everywhere over those of pigs, sheep, and goats (Nowak 2017b, 138–139, figs. 8–9). Exceptions are rare, such as the settlement in Pogonice, where pig remains accounted for over 70% of all mammal bones and more than 74% of all domesticated animals (Wierzbicki 1999, pp. 210, 212–213). Among the FBC sites in Poland, the diversity of bone remains is limited, but two animal husbandry models stand out: the lowland and loess models. In the latter (which also includes the chernozems of Kuyavia), there is a higher proportion of sheep and goats (Wiślański 1979b, 212, 216; Laprus-Madej 2000, 103).

It is difficult to assess the extent of the FBC population's impact on the environment, but it was certainly varied. Relatively permanent deforestation should be expected primarily in areas of "ancient agriculture", where it continued practices already employed by Neolithic Danubian cultures. This occurred even in Central Pomerania, where a significant degree of deforestation is confirmed by pollen (including wheat) collected beneath the mounds of megalithic tombs in Łupawa (Wierzbicki 1999, 229, fig. 71).



In agricultural production, the FBC population began to use slash-and-burn farming, and at least in some of the areas they inhabited, animal traction started to be employed to loosen the soil using an ard (Kruk and Milisauskas 1999, 104–105, 162–170) and to pull four-wheeled carts (Kruk and Milisauskas 1999, 104–105, 158–161), although evidence for this is only indirect. Examples include vivid representations of two animals joined by a yoke, such as the bronze figurines of oxen from Bytyń (Wielkopolska) and clay representations of rams from Krężnica Jara (Lublin region), as well as more or less stylized depictions of two- and four-wheeled carts on vessels discovered in practically all regions inhabited by the FBC population (e.g., Wierzbicki 2015, figs. 26–27; Grygiel 2016, 1017–1018, fig. 225: 8). The most spectacular example comes from Bronocice (Włodarczak et al., in this volume) in Małopolska, dated to around 3500 BCE (Kruk and Milisauskas 1999, 166–170, photo 4; Kruk 2008, 253). Another group of evidence consists of traces of ploughing (tillage with an ard) discovered beneath megalithic tombs, for instance, in Sarnowo and Gaj in Kuyavia, as well as in Muszkowice in Silesia (Niesiołowska-Śreniowska 1982, 111–114; Wiklak 1982, 40–41, fig. 7; Kruk 2008, 255–258; Nowak 2017b, 143; Papiernik and Płaza 2017, 112, 120; Furmanek et al. 2019b, figs. 43, 45) (Przybył, in this volume).

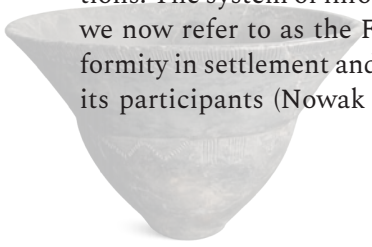
It is likely that the FBC population continued to exploit the salt springs around Bochnia and Wieliczka. This is supported by the findings of briquetage vessels: tall, cup-shaped with a foot, made rather carelessly from clay mixed with grog, crushed stone, and a large amount of sand. This suggests a technology similar to that previously used for the same purpose by the Pleszów-Modlnica group of the Lengyel-Polgár cycle. Around 3200/3100 BCE, the FBC began to decline in the vicinity of Kraków, giving way to the Baden culture. Its representatives continued the tradition of salt production, using almost identical vessels (Kruk and Milisauskas 1999, 189; Nowak 2017b, 156; Przybyła 2017, fig. A).

From the perspective of settlement and economic issues, the FBC is a conglomerate encompassing a number of local and genetically diverse populations. The system of information exchange, which we now refer to as the FBC, did not impose uniformity in settlement and economic behaviours on its participants (Nowak 2017b, 140). This is even more evident in many areas outside the borders of modern Poland. It has become common to refer to any find with the FBC ceramics (as well as some later Neolithic cultures, such as the GAC or the CWC) as remnants of Neolithic settlement. However, this is only accurate chronologically, as it may also pertain to communities still practicing an epimesolithic hunting-gathering-fishing economy. In some spatially limited enclaves, encompassing areas that were environmentally unattractive for Neolithic farmers (e.g., the southern part of the Kashubian Lake District and many regions in north-eastern Poland), such human groups may have survived even into the Bronze Age (see also Nowak 2017b, 162–163).

The GAC population represented a different model of agriculture, where animal husbandry dominated over crop cultivation. The significance of livestock is evidenced by a diverse array of sources, including animal deposits (animal burials), fragments of animal carcasses placed in human graves as grave goods, as well as post-consumption remains found in settlements, including cattle, pigs, sheep, goats, as well as horses and dogs. The significance of wild animals was marginal. In Kuyavia, among the post-consumption remains from the earlier GAC horizon, pig bones were the most numerous, while in the classical phase, cattle bones prevailed. During this time, cattle also had special ritual significance, as evidenced by animal deposits, often referred to as animal graves. Greater use of pigs was typical for consumption, but pig bones (especially skulls) were commonly found in human graves, indicating their importance in burial rituals (Wiślański 1979a, 281–282; Kruk andMilisauskas 1999, 202–205; Szmyt 2022, 235, fig. 23).

At the GAC sites, remnants of cereals, including wheat and barley, as well as peas and broad beans, have been identified. However, their overall quantity is small. The secondary significance of plant cultivation is confirmed by the modest number of stone axes, grinders, pestles, and flint tools used for harvesting grains (Szmyt 2022, 235).

The CWC population is commonly perceived as small groups of nomadic shepherds, particularly in the earlier phases of its development. Isotope analysis confirms that the CWC population primarily consumed products containing animal protein: meat and milk (Kruk and Milisauskas 1999, 248–252; Włodarczak 2017a, 287, 325; Szmyt 2022, 241). The great significance of horses for these communities



is often emphasized; however, in archeozoological materials, remains of cattle and small ruminants prevail, while pig remains are less common (their presence increases toward the end of the Eneolithic and in the early Bronze Age). Horse remains are found only sporadically (Kruk and Milisauskas 1999, 249; Włodarczak 2017a, 309).

In some areas (the loess regions of Sandomierz-Opatów and Kraków), more stable forms of settlement emerged, known as the Kraków-Sandomierz CWC group (Włodarczak 2017a, 325). This grouping, at the height of its development, led to the destruction of established settlements and the interruption of agricultural traditions in the loess uplands that had persisted uninterrupted for nearly 3000 years since the beginnings of the Neolithic (Kruk and Milisauskas 1999, 229, 237–238). Even there, the cultivation of cereals declined (Włodarczak 2017a, 309).

This does not apply to specific regions, such as the shores of the Gdansk Bay and the Vistula Lagoon, where the Rzucewo culture developed as a local variant of the CWC. Its community took advantage of the natural environment, engaging in the fishing of selected species and seasonal seal hunting. Agriculture and animal husbandry played a minimal role: remains of domestic animals at the settlement in Rzucewo accounted for only 0.9% of the total collection (Machnik 1979, 375; Włodarczak 2017a, 290; Makowiecki et al. 2018, fig. 4). An important role was played by the extraction and processing of amber, as evidenced by the discovery of a complex of sites related to the extraction and processing of this raw material in the Vistula Delta. The inhabitants of the coastal zone thus exhibited a unique model of Neolithic economy, the beginnings of which precede the CWC itself (Włodarczak 2017a, 290–291).

In the lake districts of north-eastern Poland, remains of the multi-season CWC camps have been found, along with elements of underwater wooden structures. No evidence of cereal cultivation has been collected there, but the domesticated animal husbandry, particularly cattle, played a significant role. Most of these sources (including ceramic finds stylistically related to the BBC tradition) are dated to the late phase of the final Eneolithic and the beginnings of the early Bronze Age, from around 2400 to about 2000 BCE. The economy based on cattle husbandry in this area was more efficient than plant-based agriculture. The strength of the new model, along with its associated ideology, led to the acculturation of local hunter-gatherer communities (the so-called III stage of Neolithisation), primarily associated with the Neman culture (Sobieraj 2017, 351–352; Włodarczak 2017a, 291–292, 309).

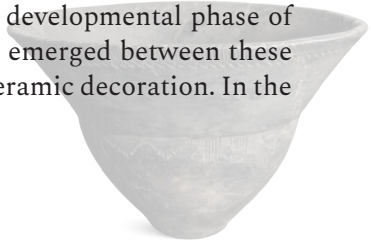
Clearly, there were considerable regional differences in the economy of late Eneolithic communities, but the increasing role of animal husbandry, particularly cattle, was a common denominator. Domestic animals were utilized in various ways: for meat but also for milk production, wool, and probably as pack animals and possibly in wheeled transportation (Włodarczak 2017a, 309). However, theories regarding the significant role of horses in the economic, cultural, and ethnic transformations of that time are not supported by the evidence. Throughout the late Eneolithic, horse bone finds are exceptional. The economic significance of the domesticated horse was negligible, perhaps even less than in the GAC (Włodarczak 2017a, 310).

## Material culture assemblages

### Pottery

In understanding the Neolithic period, ceramic vessels are one of the most important archaeological sources which serve as the primary criterion for defining all cultural, chronological, and spatial classifications. Pottery acts as a unique fingerprint for each archaeological culture, representing some aspects of it. In some cases, it can even be specific to the inhabitants of a single settlement.

It was pottery that prompted the division of the Polish part of the LBC into two distinct regions. In the ceramic tradition of this population, more pronounced regional differences emerged even in the classical phase, manifested in slightly different pottery production technologies. In the Vistula basin, the most characteristic additive to reduce the clay mass was organic substances (plant chaff), while in the Oder basin, mineral additives (sand and finely crushed stone) prevailed. In both regions during this time, vessels were decorated with engraved lines with music-note points. The motif of dotted lines appeared frequently along the Oder, while it was quite rare along the Vistula. However, in the third developmental phase of the LBC, a clear division emerged between these two regions in terms of ceramic decoration. In the



Vistula basin, the Želiezovce style emerged (incised lines intersected by deep vertical notches), while in the Oder basin, vessels were ornamented in the Šárka style (incised lines with dense triangular stamp impressions/notches).

For the production of cooking vessels, organic additives, grog (crushed fragments of old pottery), or sand were used as a tempering agent added to the ceramic fabric). In contrast, thin-walled tableware was largely made from clay without any thinning additives or with only a small amount of very fine-grained admixture (Czerniak 2008, 156; Czekaj-Zastawny 2017, 44–46; Furmanek et al. 2019b, 62–66, figs. 6–9).

In the FBC, pottery (alongside burial rituals) seems to best bind this otherwise highly diverse cultural complex. There are noticeable trends in the use of similarly prepared clay across almost all areas, with vessels being given characteristic proportions and decorated according to certain generally recurring rules. In the production of ceramic vessels, there is a clear pattern indicating that the FBC operated as a unified community, linked by a common flow of information. This community developed a standard set of practices related to pottery production and usage, which makes similarities between materials from all parts of Poland immediately recognizable. At the same time, regional, local, and temporal differences are also easily noticeable (Czerniak 2008, 170).

As for the production of ceramic vessels, a shared pattern can be identified that makes it possible to view the FBC as a single community functioning on the basis of a flow of information that unified it. This community developed a certain standard of practices related to the production of ceramics and the use of vessels. As a result, similarities among materials from all parts of Poland are apparent at first glance, while differences – regional, local, and chronological – are also easily discernible (Czerniak 2008, 170).

One of the shared features of the FBC pottery in present-day Poland is the use of grog as a temper. It occurs in the vast majority of ceramic fragments from all areas inhabited by the FBC communities. This is an indication that this technological pattern was exceptionally durable and deeply rooted. It also proved to be resistant to changes caused, for example, by fashion or by contacts with other cultural milieus, which almost always had some impact on vessel style – sometimes on their morphology, and almost always on their decoration. An exception to this rule is the Pomeranian region, where a ceramic technology based on crushed stone temper prevailed. This type of temper was commonly used by the FBC communities west of the Oder River (Nowak 2017b, 146) attributed to the northern group. This is one of the arguments supporting the concept that Pomerania (especially its north-western part) was an arena of mutual interaction and interpenetration of influences from the northern and eastern FBC groups (Wierzbicki 1999, 10, fig. 2).

The vessel types most characteristic of the FBC include funnel beakers (Fig. 9), collared flasks, plates, and amphorae with ovoid and biconical bodies, with the periods of use of some of these forms being strictly limited in time. These are almost exclusively tableware vessels. Less distinctive were coarse wares: kitchen and storage vessels (pots). In some areas, for example within the south-eastern FBC group, a tendency toward an increase in vessel capacity over time has been observed, although vessels from this region were generally much larger than in the Lowlands or in Pomerania (Nowak 2017b, 147). This was probably determined by the higher quality of pottery technology (inherited from groups of the Lengyel-Polgár cycle), which made it possible to produce vessels of sometimes considerable size, additionally equipped with large and sturdy handles (Nowak 2017b, 150).

Another persistent trend in the development of the FBC pottery production was the increasing intensity of vessel decoration. It manifested itself in the introduction of ever new decorative motifs, the gradual expansion of the vessel surface covered by ornamentation, and an overall rise in the number of decorated vessels. This is a general tendency, but one that is strongly differentiated at the local level. In Kuyavia, for example, it led to the contemporaneous existence of several different styles incorporating elements of foreign and local origin alike. Across the entire European range of the FBC settlement, the richest and most intensive vessel ornamentation occurs within the northern group (particularly on the island of Zealand), with its intensity diminishing progressively toward the south – a pattern that can be explained, at least in part, by the strong presence of the Lengyel-Polgár traditions in those areas.

The FBC communities also developed a decorative style unique to themselves. In its most common



FIGURE 9. Funnel-beaker from Szlachcin/Nietrzanowo, Środa Wielkopolska County, Wielkopolska Voivodeship (photo by K. Zisopulu-Bleja)

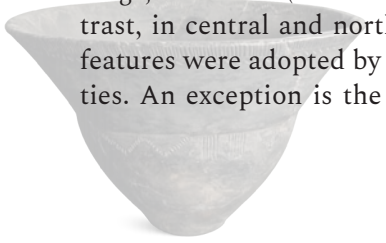
form in present-day Poland, corresponding to the earlier phases of the group's development, it can be briefly defined as a horizontal ornamental ribbon beneath the rim of vessels, sometimes repeated in the uppermost part of the belly, along with vertical decorative ribbons on the upper part of the belly (up to its maximum bulge), spaced at certain intervals from one another. These vertical ribbons are usually based on ladder or grid motifs. The lower parts of the necks and bellies were left undecorated. The FBC decorative style is generally alien to other decorative arrangements, such as dispersed or all-over surface ornamentation (though these do occur in the northern group), as well as curvilinear or diagonally oriented designs. The set of popular decorative techniques is complemented by incision (used, for example, to create grid and ladder motifs), impressions made with the finger (generally on storage vessels), and impressions produced with a three-strand cord (plaited like a braid), which represent the most important distinguishing feature of the younger stage in the development of the eastern group (the Luboń phase).

The FBC ceramic vessels make for a highly distinctive assemblage unique to this cultural unit and are not a simple derivative of any earlier or contemporary cultural group. Across the vast area inhabited by the FBC populations over nearly one and a half millennia of their existence, various contacts with nearer and more distant neighbours naturally occurred. This must have left traces in the form of new elements in vessel technology or decoration, but they were almost always of secondary importance. Considering the exceptionally large temporal and spatial extent of the FBC, their number is surprisingly small (Nowak 2017b, 147–148). Perhaps one of the best-known exceptions is the so-called pottery with ribbon comb ornamentation (Jażdżewski 1936, 247), which (although it occurs exclusively and always in the context of the FBC ceramics) differs from typical vessels of this group in every respect: manufacturing technology,

as crushed shells were used as temper to thin the ceramic fabric; form, since these are pot-like or mortar-like vessels; decorative technique, employing a four- or five-toothed comb; and ornamental motifs, usually vertical or diagonal, and sometimes wavy or zigzag ribbons, occasionally extending almost to the very bottom of the vessels, as well as the notching of their rims. This striking sense of "foreignness" of the ceramic group has been explained in many different ways (Kośko 1981, 72–90; Kukawka 1991, 120–137; Nowak 2017b, 159–160, fig. 23), sometimes quite surprising (Daszkiewicz and Prinke 2001; Prinke 2008, 436). However, the hypothesis of its south-eastern connections with the Trypillia culture must be definitively rejected (Rybicka 2017, 107, 141).

For the GAC ceramics (Czerniak 2008, 184), the most typical feature is the use of crushed stones as an additive coupled with frequent ornamentation of vessels with cord impressions. The fundamental change in the decoration of vessels, compared to the BKC, indicates transformations in symbolism and communication. This is encoded in the ornaments covering the vessels (largely congruent with the FBC decoration), and besides specific decorative motifs, it encompasses their relationship with the overall shape of the vessel. The spatial differentiation of decoration (especially between the three territorial groups) is more acute than its variability in individual regions over time (Wiślański 1979a, fig. 155–164; Szmyt 2017, 214, 221, figs. 3, 6–8).

With the expansion of the CWC across all regions of Poland, a new style of ceramic vessel production became widespread. The number of vessel forms significantly decreased, practically limited to pots, beakers, and amphorae. The dominant type of vessel became pots with an S-shaped profile, decorated with plastic ribs made by finger impressions. These pots are universal vessels – interregional and even intercultural (Czerniak 2008, 191; Włodarczak 2017a, 317, figs. 7, 30–31), but they are relatively rarely found in graves, where the more common components are primarily cups decorated with cord impressions and amphorae (Włodarczak 2017a, 318). The arrival of the BBC population in southern Poland brought another change in ceramic style – the dominant forms became beakers, jugs, mugs, and bowls (Włodarczak 2017a, 319). In contrast, in central and northern Poland, these new features were adopted by various local communities. An exception is the unique European-scale group of objects of a ceremonial-burial deposit from Supraśl (Wawrusiewicz et al., in this volume) in Podlasie (Fig. 8), featuring ceramics and other items typical of the western BBC communities.



## Flint

The LPC population used several types of flint; this stemmed from the proximity of deposits of the specific raw material. In Małopolska, Jurassic flint from the Kraków region prevailed (even over 90% of all utilized materials), in eastern Lublin it was Volhynian flint, and in Kuyavia, chocolate flint and Baltic erratic flint were used. In the area of Jurassic flint outcrops on the Kraków-Częstochowa Upland, cave sites predominate, most of which were probably associated with the temporary stays of groups arriving there to procure flint raw material. Flint workshops using this raw material were mainly located on the left bank of the upper Vistula valley, while the right bank hosted sites for receiving and distributing flint raw materials, processed to varying degrees. This indicates that among the LPC communities inhabiting the area of the upper Vistula, there was a certain specialization in this field of production (Kruk and Milisauskas 1999, 55–57; Czekaj-Zastawny 2017, 47–48). This flint was then passed on in large quantities further west and northwest, into the Odra River basin and the area of the Polish Lowlands, as well as southward, to the regions beyond the Carpathians, where it could be exchanged for obsidian (Kruk and Milisauskas 1999, 57).

Among the most characteristic stone products of the LPC are stone hoes, probably used for various purposes (woodworking, clay extraction, soil aeration), shaped like shoe-last tools with a flat-convex cross-section (Czekaj-Zastawny 2017, 49, figs. 21–32). The vast majority of these tools were made from amphibolite; early Neolithic mines of this raw material have been identified in the Jizera Mountains, near Tanvald in the Czech Republic (Přichystal 2009).

In the earlier period of development of the younger Danubian cultures (the Samborzec-Opatów group, the Pleszów group, the Malice culture), various flint raw materials were used: chocolate flint prevailed in the Sandomierz-Opatów Upland, while Jurassic flint was most common in the western part of the Małopolska Upland. The utilized cores were up to 8 cm long, and the resulting flint

semi-finished products were up to 7 cm. In the later period (the Modlnica group, the Wyciąże-Złotniki group, LVC), the sizes of the cores and semi-finished products increased to about 20 cm (Kadrow 2017, 82, fig. 12). This phenomenon is referred to as the metric breakthrough. Another significant change was the sudden increase in the frequency of lithic flakes (Kadrow 2017, 82–83).

Essential raw materials were obtained using mining methods from funnel-shaped shafts of considerable size (up to 4.5 m deep and up to 3.5 m in diameter at the top). Jurassic flint was exploited, among others, in Sąspów and Bębło (Trela-Kieferling 2021, 196–197), while chocolate flint was excavated in Tomaszów. In Kuyavia, the basis of flint production was local Baltic erratic raw material (hence the greater significance of the splintered technique), but among the tools, there are specimens made from imported materials: chocolate, Jurassic, Volhynian, Świeciechów flints, and even obsidian (Kadrow 2017, 83). The extraction and preliminary processing of flint required extensive mining knowledge and specific technical skills. These tasks could only be performed by specialists (Kruk and Milisauskas 1999, 99–100).

Flintknapping in the FBC in the territory of modern Poland was highly diverse. The environmental versatility of the settlements of these communities meant that they had to utilize a range of raw materials with varying functional and technical properties. Both higher quality mining raw materials and even the poorest varieties of erratic flint (Baltic flint in the Pomeranian variant) were used. All of this must have had an impact on processing methods and on the technical possibilities for producing specific categories of tools. We can assume that the demand of the FBC communities for specific types of tools was broadly similar everywhere, whereas the possibilities of meeting this demand were entirely different, for example in Pomerania and in Małopolska.

The model of flintknapping practiced by the population of the south-eastern FBC group is referred to as the Małopolska industry (Balcer 1983). It was a macrolithic industry focused on the production of semi-finished products in the form of regular blades about 30 mm wide, from which macrolithic tools were made, mainly end scrapers, retouched blades, and truncated blades. A second line of production involved the manufacture of flint axes: massive, quadrangular in cross-section, and often only slightly polished. This required raw material of very high quality, so flints extracted by mining methods were used: Świeciechów flint, Volhynian flint, and Jurassic flint (striped flint was used rarely and in practice only for the production of axes). Advanced systems of distribution of these raw materials must therefore have existed, as well as of finished products, which were manufactured by specialized flint knappers. Flintknapping typical of the Małopolska industry has also been identified in Lower Silesia, Kuyavia, and Wielkopolska, but on a much smaller scale (Nowak 2017b, 151–152, fig. 18).

In Kuyavia, the so-called Sarnowo industry developed, based on chocolate flint imported from the south. It was oriented toward the acquisition of blade semi-finished products of somewhat smaller size, about 15–20 mm in width. A third model of flintknapping, with the widest spatial distribution, comprises local industries based on local varieties of glacial erratic flint, thus operating under conditions of a permanent shortage of higher-quality material. Such raw material allowed only the production of irregular, small blades and flakes; hence the significance of the bipolar technique (Nowak 2017b, 152–153). In Pomerania and the Chełmno Land, as well as in some parts of Wielkopolska, the demand for high-quality flint raw material was so great that imported flint axes were treated not as tools but as blocks of valuable raw material and, after breakage (or perhaps even immediately), were reworked into blade semi-finished products (Wierzbicki 1999, 232–233; 2013, 104) or even crushed using the bipolar technique (Kabaciński 2004, 56).

The origin of all the differences in the FBC flintknapping is difficult to explain, although the Małopolska industry has clear counterparts in groups of the late phase of the Lengyel-Polgár cycle. The beginnings of the Sarnowo industry may be sought both among Mesolithic communities and among local groups of the younger Danubian cultures. Even more difficult is the answer to the question of the origins of the last flintknapping model. It appears that its overall nature was fundamentally shaped by raw-material constraints. These may have resulted in the abandonment of local production of larger tools and a general decline in the skill level of local flintknappers (Nowak 2017b, 153–154, 162–163). The most striking feature of these assemblages is their expedient character. Most of the tools appear to have been made on the

spot, in response to immediate needs (Kabaciński 2004, 57; Wierzbicki 2013, 105–106).

An important part of the economy of the FBC populations was also the working of stone raw materials, from which basic household tools were manufactured: querns, grinders, and polishing slabs, as well as a whole range of battle axes. Among these, the most typical for this group are axe-hammers with a button-shaped butt, modelled on specimens cast in copper (Łęczycki 2004, fig. 5; Czerniak 2008, 173; Furmanek et al. 2019b, fig. 46).

In the GAC flintknapping, striped flint axes come to the fore (Czerniak 2008, 188) as one of the main cultural markers of this unit. This exceptional raw material was obtained using advanced mining methods in the unique mining complex at Krzemionki Opatowskie, employing the most advanced mining techniques and creating the deepest and most complex chamber mines, in deposits located at depths of over 10 m (Wiślański 1979a, 290–291; Szmyt 2017, 231). Axes made of striped flint reached areas located as much as 500 km away from the mines (Wiślański 1979a, fig. 171; Szmyt 2017, fig. 22). These axes, usually very carefully polished, did not serve practical functions; instead, as prestige objects, they emphasized the social status of their owner and perhaps were symbols of power.

In the Lowland areas, local glacial erratic flint was used almost exclusively. Its processing relied mainly on the splintered technique, and more rarely on the classical core technique. More sophisticated tools were made from mined raw materials, such as chocolate flint, Świeciechów flint, Jurassic flint, striped flint, and Volhynian flint. After damage, axes made of high-quality raw materials were reworked into cores, from which blades and flakes were then produced (Szmyt 2017, 237–238, fig. 24).

At Goszczewo in Kuyavia, a stone raw-material extraction area has been identified. It was an open-cast quarry located within a zone of glacial erratic pavement. The site revealed pits dug to obtain erratic boulders, exploratory trenches, and a tool-production workshop (axes, querns, and grinders), together with semi-finished products and production debris (Szmyt 2017, 230, 238).

For the CWC population, selected flint raw materials were highly sought after and circulated over long distances. In addition to their functional values, they held prestige, similar to amber, copper, and certain types of stone raw materials. This was the case in Małopolska; axes made from Świeciechów flint were found in graves in Slovakia, Moravia, even Austria. Chocolate flint deposits were also exploited using mining methods, but in other areas, local erratic flint was used, and the exchange of raw materials was less significant. Throughout the late Eneolithic, the production of arrowheads (initially slender, then more robust) played an important role, and towards its end, around 2400–2300 BCE, the custom of using bifacial flint daggers became widespread, coinciding with the expansion of BBC patterns and the emergence of copper daggers (Włodarczak 2017a, 315–316).

In the CWC period, stone battle axes gained special importance. Around 2800–2400 BCE, they were the most important prestige items found in male graves, with the deceased always equipped with only one such axe. A clear concern for form and the type of raw material used is evident. Rocks with a greenish-blue hue were especially popular, among which serpentinite, sourced from Lower Silesia, was predominant. Some raw materials were imported from distant deposits. The oldest axes of the CWC were type A axes, which spread around 2800 BCE. Their characteristic traits included a boat-shaped design and the presence of an elongated rib on the upper surface. Many varieties of stone axes were inspired by the shapes of copper axes (Włodarczak 2017a, 313–314, figs. 1: 3, 26).

## Bones and antlers

This field of production is still poorly recognised, as without specialized trace evidence studies, we are left only with conjectures regarding the actual function of individual tools; it is unclear to what extent their conventional, typological classification (for example as stitching awls or needles) reflects the truth. Recent trace evidence analyses have revealed that some Neolithic bone tools from Pomerania and Wielkopolska, classified as chisels and stitching awls, were actually used as weaving swords, serving to push down the weft during weaving on looms (Wielgus-Wawrzyniak personal communication). Another factor contributing to the limited research interest in this topic is the intercultural nature of most of these objects. This results in their minimal value for studies on the chronological, spatial, and cultural differentiation of individual taxonomic units of the Neolithic (this

observation equally, if not more, applies to later chronological periods).

All Neolithic peoples engaged to some extent in the processing of bone and antler, the most commonly used raw materials, alongside wood, for the production of tools, ornaments, household items, and various other objects. Most often, this production was domestic, for personal use. However, it sometimes took on an organized form, manifested through the occurrence of specialized workshops. One such workshop was discovered, for example, in the courtyard of one of the houses of the BKC community in Brześć Kujawski. It specialized in the production of T-shaped axes made from antler, and it was the only workshop of this type in the settlement (Grygiel 1986, 76–79). Workshops for shell processing have also been identified, where beads for typical women's ornaments in the form of hip belts were produced. Additionally, an object has been identified with traces of use in leather tanning (Grygiel 1986, 134, 145).

In the FBC, the processing of bone and antler was highly developed, and the scale of the activity seems to be larger compared to the Danubian communities. However, there are areas where, due to prevailing natural conditions that hinder the preservation of organic materials, there is no information about products made from these raw materials. As far as can be judged, the production of tools like piercers, stitching awls, and needles, as well as T-shaped axes, was common and especially practiced in larger settlements (Gumiński 1989, 147–162; Reszczyńska 2003, photo 3; Waszczuk 2015; Makowiecki et al. 2018, 491; Winiarska 2021).

The GAC population crafted typical awls, chisels, and piercers from bone, most often from domesticated animals, especially cattle, but also unique ornaments: T- and D-shaped plaques, and tools: double-edged blades discovered in ceremonial contexts, e.g., in animal deposits (Szmyt 2017, 221, figs. 11: 1–3).

## Amber

In the FBC, amber was not very common (Fig. 10) and almost always appeared in the form of small ornaments (beads). The GAC population began to use Baltic amber (succinite) on a much larger scale, interested in it as a raw material with ritual and ceremonial significance (Mazurowski 1983). Various items (ornaments/amulets/emblems) were crafted from it, primarily deposited in ritual and burial contexts, during the burial of humans and animals or in later funeral ceremonies. A range of different types of ornaments, very characteristic of this group, were made, most frequently deposited in graves (Szmyt 2017, 221, 238, 242).

The beginning of the 3rd millennium BCE brought an increased interest in amber. In the CWC, ornaments made from this material became grave goods with prestigious significance. Alongside copper ornaments, they were among the most valuable and sought-after items. It can be assumed that the main producers and distributors of amber ornaments were the communities of the Rzucewo culture, inhabiting the area along the shores of the Gdansk Bay from the end of the 4th millennium BCE until the early Bronze Age (Włodarczak 2017a, 316–317).

## The first metals

The first copper artefacts appeared in the Eneolithic phase of the development of the younger Danubian cultures in Małopolska and are mainly obtained from graves, particularly those from the late phase of the LVC. These include primarily ornaments, and among the weapons are daggers with a reinforcing rib and holes for rivets to attach a handle. Two axes have also been found in the graves from Książnice. Most of these items show connections with the Carpathian Basin and Transylvania. In Złota near Sandomierz, traces of copper metallurgy have been found, probably based on raw materials imported from the south, including clay nozzles and crucibles (Kruk and Milisauskas 1999, 96, 98).

Copper artefacts found in the graves of the Wyciąże-Złotniki group have closer analogies in the Lengyel culture, as do two binocular-shaped pendants from the LVC, unique in that region (Kadrow 2017, 84–86). Most of the copper artefacts in Kuyavia, a region with a significant saturation of copper items, were probably imported from the areas above the Upper Danube (possibly through the Jordanów culture?). Some of the metallurgical production might have also occurred locally. The BKC communities deposited significant quantities of ornaments in graves from the classical phase.

Copper finds from Silesia are attributed to the Jordanów culture. All of them closely follow models




FIGURE 10. Two amber rings from the central grave in a megalithic tomb of the Funnel Beaker culture at Łupawa, Słupsk County, Pomeranian Voivodeship, Site 18 (photo by Jacek Wierzbicki)

from the Middle Danube, the Carpathian Basin, and Transylvania. Battle axes of Carpathian and Transylvanian origin also appear here, connected with the Polgár cultural circle (Kadrow 2017, 86).

Finds of copper in the FBC are fewer than in the later Lengyel-Polgár groups (Nowak 2017b, 155; Kowalski et al. 2019, 4374), but the assortment changes fundamentally: ornaments deposited in graves almost completely disappeared, replaced by items of prestige significance. Five hoards are known (Bytyń, Kałdus, Kietrz, Rudki, Szczecin-Śmierdnica), scattered individually across almost all of Poland, along with several dozen individual specimens (e.g., Świderski and Wierzbicki 1990, fig. 19; Adamczak et al. 2015; Grygiel 2016, 957, 958). These include, for example, a flat axe and a dagger from central graves in the barrows at Słonowice, as well as daggers from the megalithic grave in Gaj and from a grave in Nowe Kichary, and probably also a dagger from the grave in Wola Luborzycka. All of these daggers belong to the Usatovo type (Papiernik et al. 2023, 179, 181; Zastawny 2023).

Most likely, the majority of copper artefacts originated from the Carpathian Basin (Adamczak et al. 2015, 214–215; Kowalski et al. 2019, 4355) and possibly from Volhynia. However, the Bygholm-type axe from the settlement in Poganice (Fig. 11) and a lump (drop) of copper found at the site have a chemical composition corresponding to so-called Danish copper and probably come from raw materials sourced in the Rudawy Foothills (Świderski and Wierzbicki 1990, 115). Perhaps the main horizon of copper influx into the FBC can be synchronized with the dating of the hoard from Kałdus (Adamczak et al., in this volume) to around 3600–3200 BCE (Adamczak et al. 2015, 214–215). Later, copper artefacts were increasingly rare, consisting only of small ornaments like the tiny rings from Mrowino (Garbacz-Klempka 2018).




FIGURE 11. Two copper axes from a Funnel Beaker culture settlement in Poganice, Słupsk County, Pomeranian Voivodeship, Site 4. The differences in their coloration result from the use of different conservation methods (photo by Jacek Wierzbicki)

The KPL population had been familiar with the basics of copper metallurgy, as evidenced by a few finds of crucibles and casting nozzles with traces of copper (e.g., from Kotowo in Wielkopolska, dated to around 3800–3700 BCE – Żurkiewicz 2020, 114, 124). However, production was certainly very modest and probably limited to simple modifications and repairs of damaged imported items. This is a strange situation, as in the later phases of the Lengyel-Polgár cycle, copper artefacts were much more numerous, similar to those in the northern FBC group (Klassen 2000). Judging by the copper daggers found as grave goods with adult men buried in the central graves of megalithic tombs, such items appear to have held symbolic and prestige-related significance for Funnel Beaker communities rather than serving a practical function (Nowak 2017b, 155–156).

In the GAC, copper artefacts are exceptionally rarely discovered. In this group, for example, there is the only dagger from Janiszewko, made of arsenic copper, as well as two double-sided awls – all from Kuyavia (Wiślański 1979a, 286; Szmyt 2017, 221, 239).

In the late Eneolithic, the significance of metal artefacts, mainly copper, increased, locally, particularly in Małopolska, the place of origin of the vast majority of such finds. A noticeable increase in the number of graves equipped with metal items occurred after around 2600/2500 BCE. Copper artefacts were primarily discovered in the CWC catacomb graves and those associated with the BBC tradition. These were mainly ornaments. The first gold ornaments also appeared (hair rings or braids from the grave in Nowe Kichary and items made of an alloy of gold and silver (a plate from the grave in Złota). Larger copper items, such as

axes, are exceptionally rare finds. A unique case in point is the axe from the grave in Szczytna, whose form has analogies in Eastern Europe, in the Middle Dnipro cultures and the pit-grave cultures (Włodarczak 2017a, 311).

## Art

Art is a concept difficult to define, but most people understand it well intuitively. In the Stone Age it was imbued with the essence of the sacred and served primarily as a means of communication within the group. Among its most important functions was forging bonds between the real and the supernatural worlds, the living and the dead, gods and humans, and humans and animals.

In the Neolithic period, people attempted to express and preserve their feelings, thoughts, and beliefs in the form of figurative art or through the decoration of thousands of everyday objects, above all ceramics. The scope of this art is defined by the surviving artefacts. Therefore, unfortunately, we know nothing about artistic fields like music, dance, and singing, which certainly existed and inspired visual creativity.

## Figurative plastics

Figurative art in Neolithic cultures in the territory of present-day Poland is relatively rare. In the Linear Pottery Culture (LPC) in Małopolska, it is sometimes represented by zoomorphic knobs applied to the surfaces of vessels, and more rarely by fragments of zoo- or anthropomorphic figurines, usually depicting female figures or parts of them (Kulczycka-Leciejewiczowa 1979, fig. 32; Czekaj-Zastawny 2017, figs. E, 28–29). Among the later Danubian cultures, the most numerous assemblages of anthropomorphic figurative representations are provided by the Pleszów-Modlnica group of the Lengyel culture and by the LVC (Kulczycka-Leciejewiczowa 1979, fig. 83). However, when compared with the number of anthropomorphic figurines in the Neolithic cultures of the Balkans and the Carpathian Basin or in the Eneolithic Tripillian culture, this collection is extremely modest (Kadrow 2017, 92). Anthropomorphic sculpture is strongly stylized. Female figurines are typical, usually preserved only fragmentarily. However, the most intriguing object is a male head from Kraków-Pleszów, Site 17, with realistically rendered, distinctive facial features, referring to representations known from the Hamangia culture of the western coast of the Black Sea (Kadrow 2017, 92, fig. 15).

Among the most interesting discoveries of the Malice culture are three representations of human figures, modelled using ribbed plastic strips applied to the upper parts of the bodies of amphorae found at three different locations in the village of Targowisko (Małopolska). The best-preserved of these most likely depicts a female figure (Grabowska and Zastawny 2008; Kadrow 2017, fig. 16). By contrast, no evidence of plastic representations has been discovered either in the BKC or in Silesia within the Jordanów culture, while such representations occur only exceptionally in the late Lengyel Ocice group (Kulczycka-Leciejewiczowa 1979, fig. 82).

A different picture is presented by the plastic art of the FBC. In general, representations of humans are absent here, and depictions of rams become the most common motif (especially in south-eastern Poland). The most numerous group consists of schematically rendered ram heads crowning the upper ends of high handles (Wiślański 1979b, figs. 99: 1, 9; 100: 1). In some cases, the entire handle becomes an extension of the ram's horns. Exceptional in the whole of the Polish Neolithic is an extraordinarily large (height 32.5 cm), hollow ram figure from Jordanów Śląski (Wiślański 1979b, fig. 137: 5). The figurative art of the FBC also confirms that these communities made use of animal traction power. From Krężnica Jara (Lublin region) comes a fragment of a jug handle topped with figurines of two rams connected by a yoke (Wiślański 1979b, fig. 137: 2, 2a), and in Bytyń (Wielkopolska) a hoard of copper objects was discovered containing two unique figurines of oxen in harness, shown with collars around their necks and a yoke. These have analogies in Anatolia and most likely originate from there (Wiślański 1979b, 237, figs. 136: 1; 137: 1, 1a; Nowak 2017b, fig. 22B).

The only example of a plastic representation of a pig is a fragment of the animal's head, forming part of a figurine or, more likely, a knob decorating a vessel, from a settlement of the Łupawa group of the FBC in Poganice in Central Pomerania (Wierzbicki 1999, fig. 69). The commemoration of an animal of this specific species is understandable, as pig remains accounted for over 74% of all domestic animal remains at this settlement, which has no parallels elsewhere in the territory of present-day Poland (Wierzbicki 1999, pp. 212–213).

## Ornaments

Ornaments of dress or body, made from various raw materials (bone, shells, amber, clay, graphite), occur most frequently in grave inventories. They are quite diverse, but in most cases display intercultural features: spherical and tubular beads made of bone and shells, or pendants fashioned from perforated animal teeth, were more or less popular among all Neolithic groups. For the LBK, the most characteristic items, although relatively rare, are beads and pendants made from the shells of the oyster *Spondylus gaederopus* (Czekaj-Zastawny 2017, 55, fig. 38).

In the Jordanów culture, diadems, earrings, and hip belts occurred exclusively in female graves, whereas other types of ornaments (rings, bracelets, and pendants, including copper ones) were present in the graves of both sexes. In male graves, weapons and tools were also usually deposited (Czerniak 2012). Hip belts made of hundreds of small shell beads, alongside broad shoulder ornaments and bracelets made from animal ribs, were also a typical element of women's attire placed in graves of the BKC, for example those of the two "princesses" from Krusza Zamkowa in Kuyavia (Czerniak 1980, 101, figs. 42–43, 52: 1–2; 2008, 164–165; Czekaj-Zastawny and Kabaciński 2017, figs. 12–13). The ornamentation of these items directly refers to the northern European Mesolithic tradition of the Maglemosian culture (Czerniak 1994, fig. 44). Likewise, the presence of necklaces made from the teeth of wild animals, pendants fashioned from wild boar tusks, and beads made from fish vertebrae in male graves should also be regarded as a Mesolithic legacy (Czekaj-Zastawny and Kabaciński 2017, 118–119, fig. 11).

Among copper ornaments, most commonly found in the later phases of younger Danubian cultures (LVC, Jordanów, BKC), earrings and bracelets are the most prevalent, sometimes in a spiral form, as well as double spiral pendants (Kadrow 2017, 86). Notably, the female grave from the LVC period in Książnice (Małopolska) stands out in this respect – the deceased buried there had as many as 10 different copper ornaments (Wilk 2014; Kadrow 2017, fig. 13).

In the Jordanów and BKC cultures, copper beads (including spiral ones) have been commonly discovered as elements of necklaces, but the most significant were probably the binocular-shaped pendants and Stollhof-type discs. Another characteristic element is the spiral bracelets with two or four coils, made of flat or flat-convex metal sheets. Interestingly, in Kuyavia, head and neck ornaments have been identified almost exclusively in Osłonki (Grygiel and Bogucki, in this volume), whereas most ornaments for arms and legs were deposited in graves within the settlement of Brześć Kujawski (Kadrow 2017, 86, fig. 14).

In the FBC, copper ornaments are very rare and have not been discovered in graves but in hoards. In Rudki (Wielkopolska), three pendants consisting of two spiral discs connected by a small spiral, as well as six spiral bracelets made from narrow strips, were discovered in 1879. Additionally, fragments of a silver spiral bracelet made from a wide strip were found (Koehler 1900, pl. XXV; Wierzbicki 2013, 241).

Another set of ornaments was discovered in the graves of the GAC population; a case in point is the exceptional grave of 15 individuals from Koszyce (Małopolska) (Przybyła et al., in this volume). The grave goods of the buried individuals included T-shaped bone plates, amber beads: tubular, circular with a V-shaped opening, and in the shape of a double axe, as well as boar tusks (Przybyła et al. 2013, 22–23, 26–28, figs. 12, 20). A typical set of ornaments from the GAC population also included bone plates/pendants/buckles shaped like the letter D, as well as amber discs with a central hole, featuring an ornament in the form of a four-armed cross made up of small, shallowly drilled cavities (Włodarczak and Przybyła 2013, fig. 1; Szmyt 2017, 215, 242–243, figs. B, C: c–d), which is most commonly considered a solar symbol. Sometimes, amber ornaments were discovered in large numbers in graves; in one grave from Zaborze (Mazovia), as many as 79 such items have been discovered (Mazurowski 1977, 169–171, pl. IV–VI, fig. 10).

Other Neolithic cultures were no stranger to ornaments made from amber, but it was used less frequently. In the FBC, two large (averaging 43 and 46 mm) rings from the megalithic grave in Łupawa (Fig. 10), located in Central Pomerania, are particularly noteworthy (Wierzbicki 2017).

In older burial mounds of the CWC, amber ornaments were not yet present, but over time, they became a permanent element of the grave goods for this population. They were incorporated into interregional trade, becoming part of the defining attributes of the BBC community. They were

produced by the Rzucewo culture population, which manufactured large quantities of elliptical, circular, cylindrical, and rectangular beads, as well as pendants, rings, and discs. The latter were primarily found in richly equipped male graves in Kuyavia, Wielkopolska, and Małopolska (Butrimas 2018; Włodarczak 2017a, 316–317).

## Burial rites

In the LPC, graves were an integral part of many settlements. An exception is the cemetery in Modlniczka (Małopolska), where 39 pit graves containing cremated remains have been discovered. There was only one burial in each of them, which typically included ceramics and a last-shaped hoe made of amphibolite – always present in male graves (Czekaj-Zastawny, Przybyła 2012, 38, 42, 50, figs. 2, 21–25, 27). In addition, nearly 20 burial sites are known from Poland (Czekaj-Zastawny 2017, fig. 13). These are primarily individual graves within settlements, or occasionally small clusters of graves on the outskirts of settlements. All graves contained single inhumation burials, placed in oval pits, only incidentally reinforced with wooden structures. The deceased were always placed in graves in the same manner: in a crouched position on the side, with arms bent at the elbows and hands near the face, legs tightly bent at the hips and knees, and feet close to the pelvis. Regardless of gender and age, the deceased were laid on either the right or left side.

Sometimes the deceased were sprinkled with ochre, and their grave goods usually consisted of ceramic vessels, ornaments, and various tools, such as flint or bone awls (Czekaj-Zastawny 2017, 39–40).

Little is known about the burial rites of the Stroked Linear Pottery. The northernmost burial site was discovered at Brody Pomorskie (Eastern Pomerania). It consisted of three very poorly preserved graves, most likely all inhumations. The first grave contained five vessels as grave goods, while the other two contained only one each (Felczak 2020a, 45–51).

In graves from the earlier phases of development of the younger Danubian cultures in Silesia, the skeletons have not been preserved, making it difficult to say anything about possible differentiation by sex. However, more is known about the burial practices of the Jordanów culture, for example from Domasław (Furmanek et al., in this volume). The deceased were almost exclusively buried by the inhumation rite, with their bodies positioned head to the south, in a crouched position, with women on their left side and men on their right side. The most common grave goods were ceramics: usually two or three vessels placed next to the head. Graves with a larger number of vessels were also richer in copper and stone artefacts. Weapons and tools were placed in men's graves, while diadems, earrings, and hip belts were discovered in women's graves. Some types of smaller jewellery (rings, bracelets, pendants) were found in the graves of both sexes (Kadrow 2017, 90–91).

The number of discovered graves from the younger Danubian cultures in Małopolska is significantly larger compared to the LPC, with the most numerous being the graves from the LVC (over 100). The vast majority of graves from the Samborzec-Opatów group were found in the site complex in Kraków-Nowa Huta-Pleszów. While all graves were located within settlements, they did not form any clusters. They were oval or rectangular pits, each containing only one person placed in a crouched position, typically on their right side, with hands arranged near the face and head oriented to the south. The deceased were provided with vessels (Kadrow 2017, 88).

Graves of the Malice culture have been found within settlements, most often as single burials. The deceased were placed in pits, either specially dug or even of a settlement character, sometimes on wooden mats. Almost every grave contained ceramic vessels, and many also included stone tools (axes) as well as artefacts made of flint and bone (Kadrow 2017, 88). All graves of the Pleszów-Modlnica group of the Lengyel culture were also located within settlements, although sometimes the deceased were buried in the abandoned parts. In other respects, the burial rites of this population did not differ from those of the previous cultures.

The largest number of graves in Małopolska is attributed to the LVC (it is the only Lengyel-Polgár group that is better known from funerary rather than settlement evidence). Even in the earliest phase of this culture, the practice of burying the deceased outside the settlements emerged alongside graves located within them. At the turn of the classical and late phases, this practice spread throughout the culture, and all the deceased were buried in small sites (up to 10 graves) located outside the settlements. During this time, rules emerged that mandated different approaches to the graves of

men and women, often located in different parts of the burial site. Typically, at its centre, there was a male grave with opulent grave goods. Additionally, it became customary to place women in a crouched position on their left side, while men were positioned on their right side; this principle also applied to children (Zakościelna 2010, 77, 95, 201, 213; Kadrow 2017, 89).

The most common element of grave goods was pottery, more numerous in female graves. In male graves, tools and weapons were placed around the waist, while prestigious items like axes made of stone, antler or copper, stone and copper hatchets, and bone and copper daggers, were positioned next to the head. Wild boar tusks were placed in the graves of both sexes, including children. The typical equipment of female graves consisted of body and clothing adornments, such as copper earrings and bracelets, as well as shell necklaces. The variation in the wealth of grave goods is easily noticeable, with the richest graves belonging to adult men. Rare tools and weapons made of copper, antler axes, bone and flint daggers found in these graves are indicators of the highest social status. They were placed in the graves of men deserving the highest level of valorisation, often alongside sacrifices of women and children buried with them (Zakościelna 2010, 200, 204, 208, 213–217; Kadrow 2017, 89).

Information about the burial rites of the Polgár population from the Wyciąże-Złotniki group comes primarily from a single burial site in Kraków-Wyciąże, where materials from 13 graves were collected (Kozłowski 1971; Kaczanowska 2009, 95–105). All of these graves contained only one inhumation burial, sometimes placed in a dug-out pit. The deceased were laid in a crouched position, with women on their left side and men on their right, facing south. The most common grave goods included ceramic vessels and copper ornaments, such as Hlinsko-type pendants and Stollhof-type discs, while men's graves featured large bracelets but also a copper dagger and axe (Kadrow 2017, 89–90).

In Kuyavia, the burial rites in the BKC were similar, although the deceased were not buried in separate sites but in a designated area of the settlement, separated from the residential part by a fence. Differences between the sexes were marked by the positioning of the bodies and the grave goods: men's graves primarily contained weapons (T-shaped antler axes, bone daggers) and tools, while women's graves included adornments (shell belts, bone armlets). In the final phase of the BKC development, these customs continued, accompanied by different ways of positioning the bodies (lying on the back or stomach, with limbs chaotically spread, oriented east-west with the head facing east). Furthermore, these graves, established in dug-out pits, lacked grave goods but featured a stone enclosure, and animal graves also emerged (Czerniak 1980, 123–124, figs. 52–53; Grygiel 2008, 1944; Czerniak and Pyzel 2019, 75–77, figs. 3–5). This has been interpreted as an evolution towards the customs practiced by the GAC communities (Czerniak 1980, 171).

Fundamental differences in the treatment of the deceased were introduced by the FBC population, although inhumation burial rites still prevailed almost everywhere. Cremation graves appear in various parts of Poland, but they are always rare (Wierzbicki 2008, fig. 16). The only significant exception is the Łupawa group with almost exclusive cremation graves, located both in megalithic tombs and flat graves (Wierzbicki 1992, 83–87). This includes the only grave discovered within the settlement in Poganice (Świderski and Wierzbicki 1990, fig. 5: Feature 286; Wierzbicki 1999, 251). Another exception is the cremation cemetery in Konarzewo (Wielkopolska), where at least five graves dated to the early Luboń phase have been recorded (Wierzbicki 2008).

The deceased buried in inhumation rites were placed in graves always in an prone position on their backs. This positioning clearly contrasts with the customs prevalent in Danubian societies but is reminiscent of practices used by Mesolithic communities inhabiting the southern part of the Baltic basin. There were instances of the deceased buried within settlements, but far more significant was the emergence of small, separate burial sites (e.g., Gorczyca 2015).

The most spectacular phenomenon in the burial rites of the FBC population is the construction of monumental tombs exceeding 200 metres in length (Pospieszny et al. 2018), although they are generally smaller (Król 2021, fig. 5). These tombs were made from large erratic boulders, smaller stones, earth, or wood. Various combinations of these materials are also possible within a single burial place. Such structures are quite abundant in the lowland and in the upland region alike, including "early-agricultural" enclaves. Emergence thereof started only after the initial stabilization of the entire cultural

system, no earlier than around 3900/3800 BCE (Nowak 2017b, 1420, though probably somewhat later). Their widespread adoption in the eastern FBC group occurred no earlier than around 3650 BCE (Król 2021, 99–104, 121).

In the territory of present-day Poland, megalithic tombs are represented only by long mounds without a megalithic chamber (with the exception of a few sites in Pomerania, including the passage tomb at Borkowo – Wierzbicki 2005). These mounds have a shape resembling a strongly elongated trapezoid, sometimes almost triangular, and are bordered with a stone setting made of large erratic boulders. The primary burial was usually located in the wider, frontal part of the mound, most often oriented to the east.

In some areas, a variation of these tombs appeared in the form of structures with a surrounding enclosure made of wooden posts set in a foundation trench. They are referred to as megadendrons or megaxylons, or as Niedźwiedź-type tombs (Rzepecki 2011, 91–156). These structures are often found in regions poor in erratic stones, such as loess areas. The most well-known example of a burial site consisting of such objects is Słonowice near Kraków (Tunia 2017).

These monumental tombs were a lasting element of the landscape, facilitating the preservation of memories of the deceased and aiding in their cult. They may have also symbolized a central point in space, becoming a component of the sacred landscape around which the spatial life of the community was organized. At the same time, due to their extraordinary size, they emphasized the strength and stability of a specific social group, its group identity, and legitimized the group's rights to a specific territory (Nowak 2017b, 142). It is certain that the significance of these monuments for the FBC communities cannot be overstated, and the sepulchral function they served was certainly not the only (and perhaps not even the most important) role they played for their builders (Wierzbicki 2006).

The grave goods of the deceased buried in the central tombs of megalithic graves (generally older men) do not stand out in wealth (if it is present at all) compared to the equipment of individuals placed in ordinary flat graves. However, the grave goods often include prestigious items like stone axes with button-like heads, flint or copper daggers (e.g., in Gaj in Kuyavia – Papiernik et al. 2023, 179, 287, figs. 104, 106), or flat copper axes. Such goods were also found with the deceased buried in the Niedźwiedź-type tombs (e.g., Słonowice – Przybyła and Tunia 2013, 154–157, figs. 7, 12: 1–2).

Nevertheless, the monumental burial structures were more important for the living than for the dead. This is confirmed by the remains of accessible interior spaces (tomb temples?) at the wider end, as well as traces of (ritual?) ploughing beneath their mounds. All of these are manifestations of behaviours with ceremonial and communal significance, probably stemming from beliefs, possibly even sympathetic magic. They were probably intended to establish contact with the afterlife and facilitate the inclusion of the deceased buried in the tombs among the ancestors (Nowak 2017b, 143). Cult structures were probably erected in some settlements: Kałdus (Adamczak et al., in this volume) in the Chełmno Land and in Kietrz in Silesia (Adamczak et al. 2015, 214).

For the GAC communities, the most characteristic features are collective graves, most often with a stone box construction (some tombs can even be classified as megalithic), as well as the ritual killing of domestic animals, especially cattle and pigs. Some graves may have been covered with an earthen mound. The bodies of the deceased were placed in a crouched position on their side, or were partially or completely dismembered (fragmentary burials). Alongside the prevailing inhumation rite, partial or complete cremation was also practiced. The custom of depositing multiple deceased individuals in a single (possibly family) grave was widespread. Graves containing collective or multiple burials resulted from two different forms of funerary practice: the simultaneous interment of several individuals in one grave, or the addition of successive deceased individuals to the same grave. In Kuyavia, the number of individuals buried in a single grave ranged from 2 to 14, while in the grave from Chodzież (Wielkopolska) the remains of as many as 30 individuals were deposited. In some graves, the deceased were interred successively over a period of more than 200 years, as was the case at Kierzkowo (Eastern Pomerania). The bodies of the dead were subjected to various types of manipulation, even long after the initial burial in the grave chamber. It appears that the primary purpose of graves with stone structures was to ensure relatively easy access to the burial chamber over an extended period. In this sense, such graves

primarily served the living members of the group (Szmyt 2017, 244–245; 2022, 235).

One of the distinctive features of the GAC was its specific attitude toward domestic animals. This is evidenced by discoveries of so-called animal graves. These consist of animal carcasses, whole or in parts, deposited in grave pits, often in the immediate vicinity of human graves (almost always 1–2 m to the west of them) or within settlements. An excellent example of such an arrangement comes from Koszyce (Małopolska) (Przybyła et al., in this volume). There, next to a grave containing 15 individuals, a pit was found with the remains of seven pigs, accompanied by an amphora and three fragments of grinding slabs (Przybyła et al. 2013, 11, figs. 1–3, 18: 1; Włodarczak and Przybyła 2013, 220, 223, fig. 3).

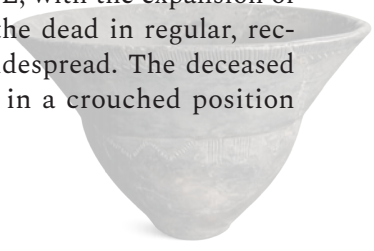
Typically, domestic animals (mainly cattle and pigs) were deposited in animal graves, more rarely dogs (an exception is the grave of eight dogs at the settlement in Kornice in Silesia – Furmanek et al. 2019b, 113, fig. 61), as well as sheep and horses. Sporadically, wild animals (deer and aurochs) were also buried. Animals interred in these features were often accompanied by offerings, including vessels or small discs made of bone or amber. Rituals associated with animal deposits were of great importance to the cultural identity of the GAC populations – they represented one of the main factors of self-identification and served to consolidate members of the community (Szmyt 2017, 249–250; 2022, 236–237, figs. 11–12).

The funerary rite of the CWC is far better known than the settlement evidence of this population. The most characteristic features are pit graves surrounded by a ditch (the remains of a small wooden enclosure, possibly a palisade) with a diameter of about 5 m, covered by a circular earthen barrow with a diameter of 10–20 m. The grave sometimes had a stone construction, and in some cases the edges of the grave pit were reinforced with wickerwork made of thin branches. Such graves contained the remains of a single individual – almost exclusively adult males. Flat graves without mounds are also known; some of these had stone constructions, such as a more or less compact stone pavement at the bottom of the grave or a loose stone cover placed over the grave pit. The vast majority of barrows are dated to around 2800–2600 BCE. Later, new ones were built less frequently, while graves were more often inserted into existing mounds. During this period, burial sites also developed. In the graves, a single individual was usually buried; however, in about 20% of cases two individuals were interred: for example, a woman and a child or a man and a child, and in roughly 10% of cases as many as three or four bodies were deposited. An exceptional example is the grave at Pikutkowo in Kuyavia, where the remains of 14 individuals were found, including nine children and five adults (Włodarczak 2017a, 293–295, figs. 10–12; Szmyt 2022, 240, fig. 14). Another example of a mass burial is the niche grave from Szczepanowice (Włodarczak et al., in this volume).

The deceased were most often placed more or less on their side, in a crouched position – men usually on the right side and women always on the left. Grave goods almost always consisted of a fixed set of items: vessels (a beaker or a pot) and weapons (stone axes, flint arrowheads, and flint daggers). More rarely, ornaments made of copper, amber, or bone were deposited, while parts of animal carcasses were only sporadically included. Vessels and weapons were placed exclusively with the bodies of men and children (boys?), whereas women were interred with vessels and ornaments or flint tools. This funerary rite clearly reflects the dominant role of warrior males in the CWC communities (Włodarczak 2017a, 293, 296, 304–305, 322; Furmanek et al. 2019b, 117–118, fig. 63; Szmyt 2022, 240). The change in burial practices that occurred after around 2800 BCE is therefore evident and encompasses the widespread adoption of barrows as a form of single burial and, on the other, the emergence of an entire set of new features, including grave construction, the positioning of the body, and the type of grave goods (Włodarczak 2017a, 293–294).

In northern Poland (Western Pomerania, Wielkopolska, Kuyavia), the funerary rite shows links to the ritual known from the Single Grave culture of the western Baltic basin. This becomes evident in the younger phase of the CWC, around 2600–2500 BCE. Characteristic grave forms occur here, including those with stone constructions, as well as specific grave goods, such as flower pot-shaped beakers and amber ornaments (Włodarczak 2017a, 297).

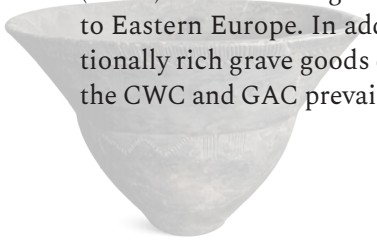
Around 2400/2300 BCE, with the expansion of the BBC, the burial of the dead in regular, rectangular pits became widespread. The deceased continued to be placed in a crouched position



on their side, although slightly different limb arrangements were preferred. However, in southern Poland, a significant change occurred: men were buried on their left side and women on their right (Włodarczak 2017a, 296–297, fig. 14), with men positioned with their heads to the north and women to the south (Furmanek et al. 2019b, 121–122, fig. 68). Funerary rituals thus clearly emphasized gender dichotomy. This also applied to grave goods: the richest assemblages were deposited in the graves of adult men – warrior-archers (Włodarczak 2017a, 279, 304–305). These included exclusive vessels, often richly decorated, stone archer's wrist-guards, arrow straighteners and anvils, flint arrowheads, bone and amber buttons with a V-shaped perforation, and occasionally copper or flint daggers (Furmanek et al. 2019b, 120–122, figs. 70–72).

The emergence and spread of the barrow burial rite around 2800 BCE did not result in complete standardization of funerary practices in the territory of present-day Poland. In many regions, burials continued to display distinctive features or to refer to customs prevailing in earlier centuries. In Kuyavia, graves appeared with construction, grave goods, and type of burial defying any specific archaeological culture. They contain materials typical of the earlier phases of the CWC, while other elements of the funerary rite refer to the GAC or even to the Radziejów group of the FBC (Kośko and Kurzawa 1997; Włodarczak 2017a, 298–299, fig. 15). Likewise, some GAC graves in the Lublin Upland display features shared with the CWC burial rite. Thus, the ideological changes of that period were of intercultural nature (Włodarczak 2017a, 299).

This phenomenon is best exemplified by the distinctive funerary rite of the so-called Złota culture, which emerged around 2900–2800 BCE and lasted for five centuries; it is known primarily from two large burial sites at Złota near Sandomierz. There were buried the dead from a community undergoing a transformation from the GAC to the CWC. This is evidenced not only by details of the funerary rituals – similarly to the GAC, these were multiple-burial graves with secondary burials and fragmentation of bodies, and isolated cases of using ochre and cranial deformation. The catacomb (niche) form of the graves is genetically linked to Eastern Europe. In addition, among the exceptionally rich grave goods elements associated with the CWC and GAC prevail, although features of the Baden or rather Beaker-Baden tradition are also present (Włodarczak 2017a, 300–303).



## Summary

The Younger Stone Age in the territory of present-day Poland was a period of profound transformations, initiated by the arrival from the south of populations from the LPC. These were farming communities that favoured cereal cultivation as well as the husbandry of cattle and sheep/goats. Although their settlement spread to nearly all regions, it was largely confined to areas with the most fertile soils, which are most abundant in southern Poland. This insular pattern of settlement meant that early Neolithic colonization did not wipe out hunter-gatherer groups, and in some spatially-limited enclaves, the process was not fully completed even by the early Bronze Age. The economic and settlement model initiated by the first farmers was continued in an almost unchanged form by later groups of the LPC. However, these communities underwent more profound social transformations, discernible in the rising social status of men, whose importance in the role of warriors was increasing.

Significant changes were brought about by the emergence of the FBC, whose populations practiced agriculture on almost all soil types, which led to the spread of Neolithisation across vast areas of central and northern Poland as well. These groups were highly versatile in terms of settlement patterns and subsistence strategies, favouring cereal cultivation and the breeding of cattle and pigs, yet also able (under specific conditions) to shift toward hunting, fishing, or gathering. Within these communities, some men attained such high status that enormous stone-and-earth megalithic tombs were erected for them, often exceeding 100 metres in length, becoming monuments that defined the cultural landscape for centuries.

The economic model prevailing in the Early and Middle Neolithic, oriented primarily toward cereal cultivation, underwent gradual changes with the emergence of the GAC. In the Late Neolithic, marked by the spread of the CWC and BBC, it was replaced by an economy dominated by animal husbandry, chiefly cattle breeding. As a consequence, the stable settlements typical of farming communities disappeared, giving way to small camps characteristic of a more nomadic way of life. Cereal cultivation continued to play a significant role

only in the most fertile areas of southern Poland. Social structures were further transformed, dominated by groups of warriors armed with bows, stone axes, and flint or copper daggers.

Neolithic communities were economically self-sufficient and produced for their own needs almost all essential goods: pottery vessels, flint and stone tools, and textile products. Nevertheless, there was always a demand for luxury items or objects made from raw materials unavailable locally (e.g. obsidian or jadeite). As a result, the acquisition of amber and the development of flint mining expanded; these activities supplied raw materials not only with specific morphological properties suitable for the production of macrolithic tools, but also materials valued for their visual appeal, such as striped flint.

Weapons and ornaments made of copper also probably conferred special prestige on their owners. Most of these items were imported from the Carpathian Basin, but the techniques of copper metallurgy were quickly mastered in the Polish lands, enabling communities (such as those of the FBC) to melt and cast their own products. Another important area of production was salt extraction, practiced wherever feasible, at least from the early phases of the LPC.

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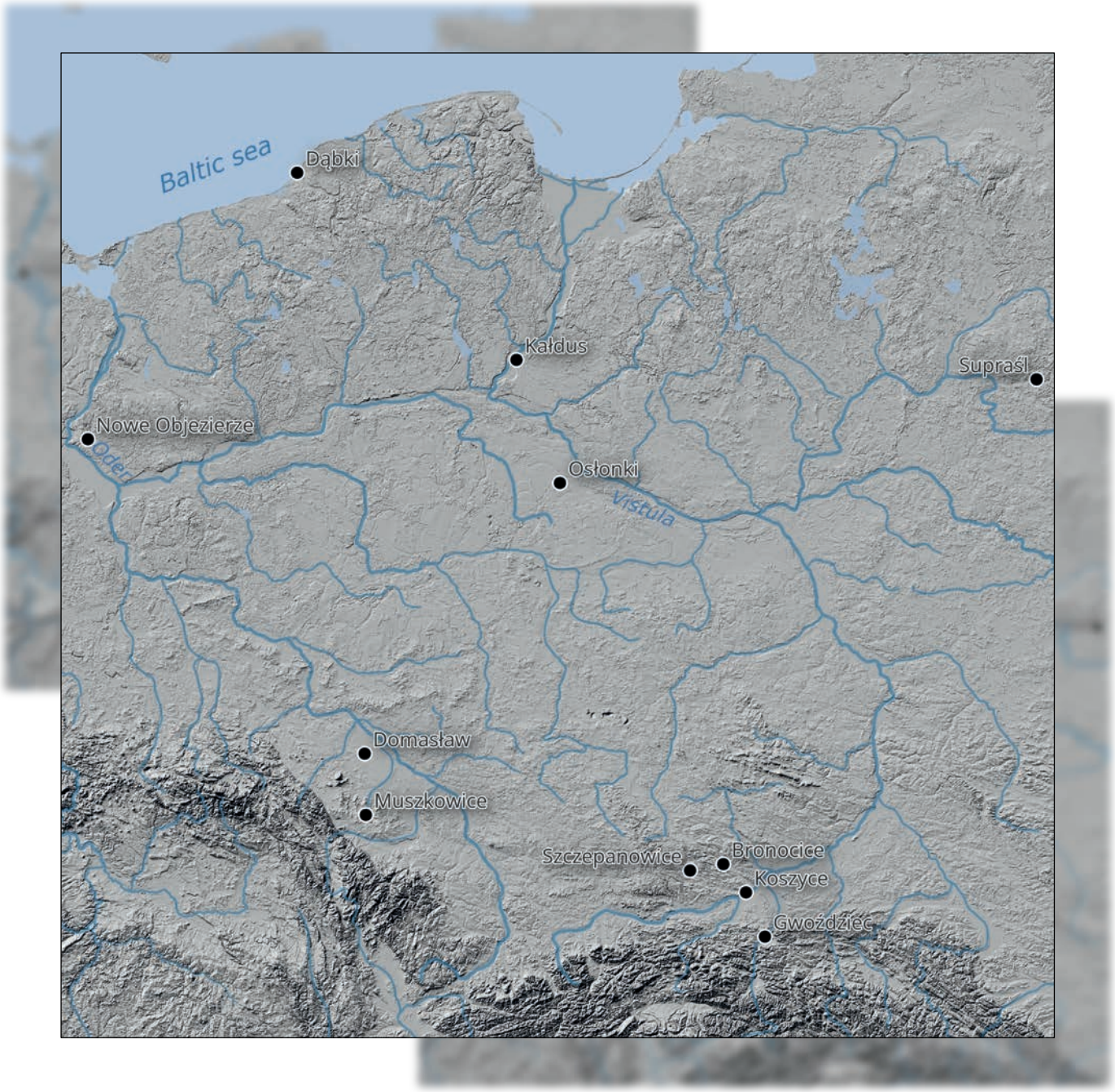
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# LOCATION OF THE SELECTED NEOLITHIC SITES DESCRIBED IN THE FOLLOWING PAGES



# GWOŹDZIEC, SITE 2

AGNIESZKA CZEKAJ-ZASTAWNY, AGNIESZKA KUKUŁKA, ANNA RAUBA-BUKOWSKA

Site 2 in Gwoździec is the only settlement from the oldest phase of the Linear Pottery culture (LBK) in Poland that has been excavated on a large scale (Czekaj-Zastawny et al. 2020; 2021; 2025). Field research and a wide range of interdisciplinary analyses have made it possible to identify issues previously unknown for this period, such as the genesis, dating, economy, and spatial development system of the settlement. This settlement is also special because of its location (Fig. 1). It is located in the Carpathian Foothills (333 m.a.s.l.) near to the passes through which the first farmers from the south migrated. It was also certainly an attractive place from an economic point of view – situated between the flint sources in the Kraków Upland and the area of the Eastern-Linear Circle, with which contacts were constantly maintained. An additional advantage is the fact that it is a monocultural site, so no LBK features were disturbed/destroyed by younger settlements. Based on a large series of radiocarbon dates, it has been established that the LBK settlement from Gwoździec functioned continuously from c. 5330 BCE to c. 5160/5060 BCE. It is currently the oldest settlement of this culture in Poland (Oberc et al. 2022; Czekaj-Zastawny 2025). The discoveries in Gwoździec gave the impetus to conduct extensive studies on the absolute chronology of the oldest LBK materials in these areas. This allowed for the verification of previous views. The most important determinations indicate that the LBK population had crossed the Carpathians only around 5330/5320 BCE. It took place quite late, but further expansion occurred very quickly. Only slightly later dates are known from the European Lowland – Kuyavia, Chełmno Land, and Brandenburg–than from the southern loess uplands (Oberc et al. 2022; Czekaj-Zastawny 2025).

## History of research

Site 2 in Gwoździec was discovered in 1989 during surface survey conducted by A. Szpunar and J. Okoński as part of the Archaeological Survey of Poland (AZP, area No. 106-64). In 1996 and several subsequent years, test trenches were carried out to identify the nature and chronology of the settlement (Kukułka 2001). They were led by A. Kukułka from the Regional Museum in Tarnów. The extremely interesting and promising results led to the inclusion of this site in a large research project financed by the National Science Centre (2014/15/B/HS3/02460, *The oldest phase of the Linear Pottery Culture in the Lesser Poland (5600/5500–5300BC) – genesis, dating, settlement, economy*). The large-scale excavations in Gwoździec became its main element. The grant and excavation research were headed by professor Agnieszka Czekaj-Zastawny (Institute of Archaeology and Ethnology, Polish Academy of Sciences, Kraków). The field research was conducted in cooperation with the Regional Museum in Tarnów.

## Research methods

The whole project was carried out from 2015 to 2019. In 2016, before the first excavation season, geophysical surveys were carried out on an area of two hectares. Then, three seasons of excavations were carried out between 2016 and 2018. They covered an area of over 30 ares (Fig. 2). In total, 172 LBK features and a fragment of the cultural layer were discovered and examined. Almost the entire area from the oldest phase of settlement was excavated, discovering the remains of a house with a farmyard from Phase I of the LBK and the surrounding economic zone. More than 10,000 artefacts were

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FIGURE 1. Gwoździec, Site 2. Air photo of the site. Photo by Stahdron (Czekaj-Zastawny et al. 2021, fig. 5)

obtained. A series of surveys were also carried out around the site in order to collect raw material for identifying clays for research on vessel technology.

During the excavation, the exploration of the pits was carried out by removing successive mechanical layers with a thickness of 10 cm. These levels were documented in drawings at a scale of 1:20 and photographed. All finds and samples were measured using 3D for GIS analysis. Most of the pit infills were taken in their entirety for washing on sieves. During the 2017 research season, after the entire surface associated with House I had been exposed, a series of flights were conducted with a DJI Phantom drone.

In total, over 500 samples were taken for various specialist analyses such as: 14C AMS dating (31 dates), mineralogical, petrographic and physicochemical analysis of ceramics (38 thin sections and clay samples), Organic Residue Analysis (samples of 20 vessels), archaeozoological analysis (all animal remains), archaeobotanical analysis (c. 400 soil samples), palynological analysis (two profiles), use-wear analysis (all stone artefacts).

## Research results

### Settlement features

The most important discovery was the remains of a household from the oldest phase of the LBK (Fig. 2B). The main building was a tripartite division house of post-built construction that retained traces of three internal lines of load-bearing posts made of oak (*Quercus*) and ash (*Fraxinus excelsior*) trunks. It originally measured about 23 m long and about 6 m wide. Along the longer walls there were elongated, narrow pits. This type of structure is characteristic only of Phase I of the LBK (Modderman 1986). In the central part of the site there was a cluster of five pits interpreted as domestic pits and designated as Household II (also from Phase I of the LBK). The cluster of features associated




FIGURE 2. Gwoździec, Site 2. A – plan of the trenches with the outlines of the discovered features, B – features related to House I (Czekaj-Zastawny et al. 2021, fig. 21, 23)

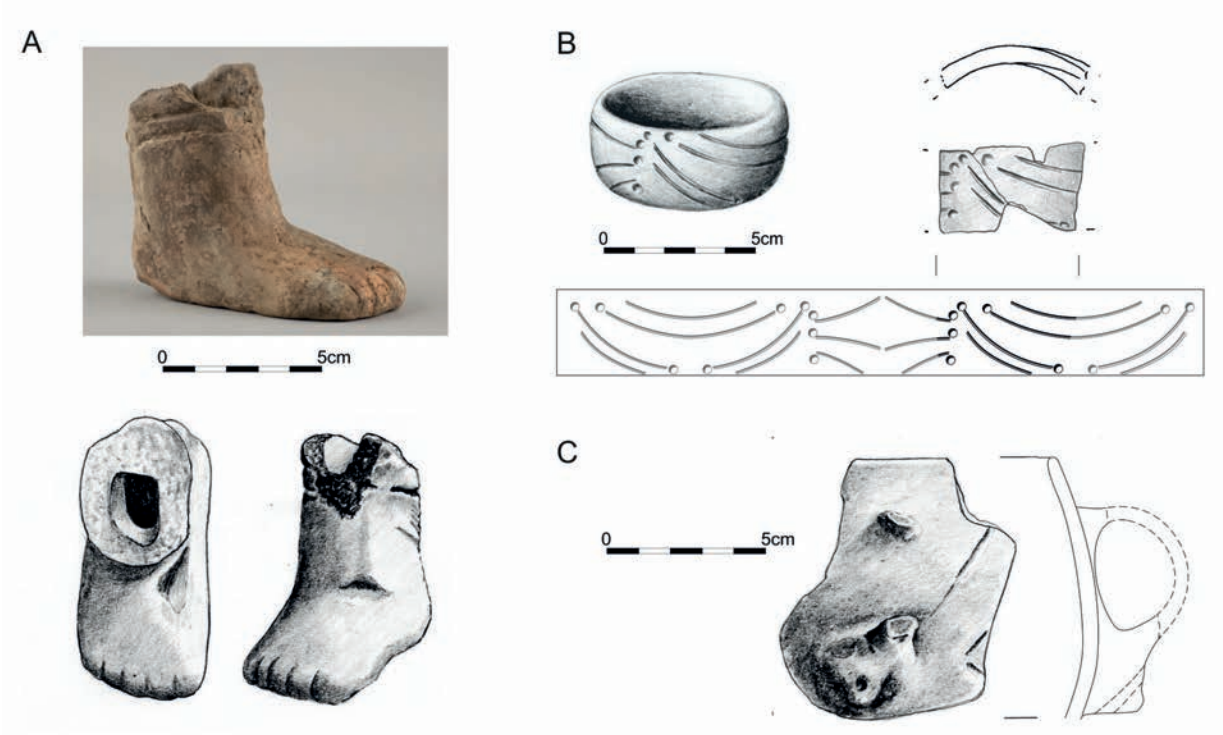



FIGURE 3. Gwoździec, Site 2. Exceptional clay items: A – fragment of anthropomorphic figurine from Feature 23, B – preserved fragments and reconstruction of a clay bracelet from Feature 14, C – fragment of zoomorphic handle from Feature 31 (Czekaj-Zastawny et al. 2025, fig. 10)

with House III was located in the southwestern part of the site (Phase II of the LBK). In total, a large part of the remains of this household was uncovered, including a fragment of a post-built structure with accompanying complexes of elongated pits. The remains of House IV were discovered in the northwestern part of the site. Only the southern part of the house, a construction pit and two utility pits located a few metres to the southeast were uncovered (Phase II of the LBK).

## Pottery and the use of vessels

The collection of pottery from Gwoździce consists of 8789 fragments. It is diversified by ceramics imported from the Eastern-Linear Circle and other artefacts, such as figurative art (primarily a fragment of a human leg with a preserved foot; Fig. 3), spindle whorls and loom weights.The most important materials here are fragments of vessels characteristic of Phase I of the LBK, made in two types of style – Gniechowice-Bíňa-Bicske and Zofipole-Milanovce-Ačkovy (Fig. 4). They co-occur in the same compact assemblages. These are mainly open bowls and, to a much smaller number of spherical bowls and vessels with neck. In the subsequent settlement phases, ornamentation in the early Music-Note style appears, and then the early Želiezovce style. The vessels were made of specific types of ceramic fabric using technology typical of the oldest pottery, and from local raw materials (Czekaj-Zastawny et al. 2020; 2021; 2025). In porous, thick-walled vessels, meat of ruminants, sometimes with the addition of leafy plants, were more frequently processed. Animal-based products coming from animals other than ruminants, namely domestic pig or freshwater organisms were more commonly processed in thin-walled vessels made of homogenous, more compact ceramic fabrics. Plant products (cultivated and wild) were also used intensively. Lipids from insect products are also present in the vessels. One of the most important discoveries is the presence of lipids from freshwater organisms. Apart from fragments of vessels,

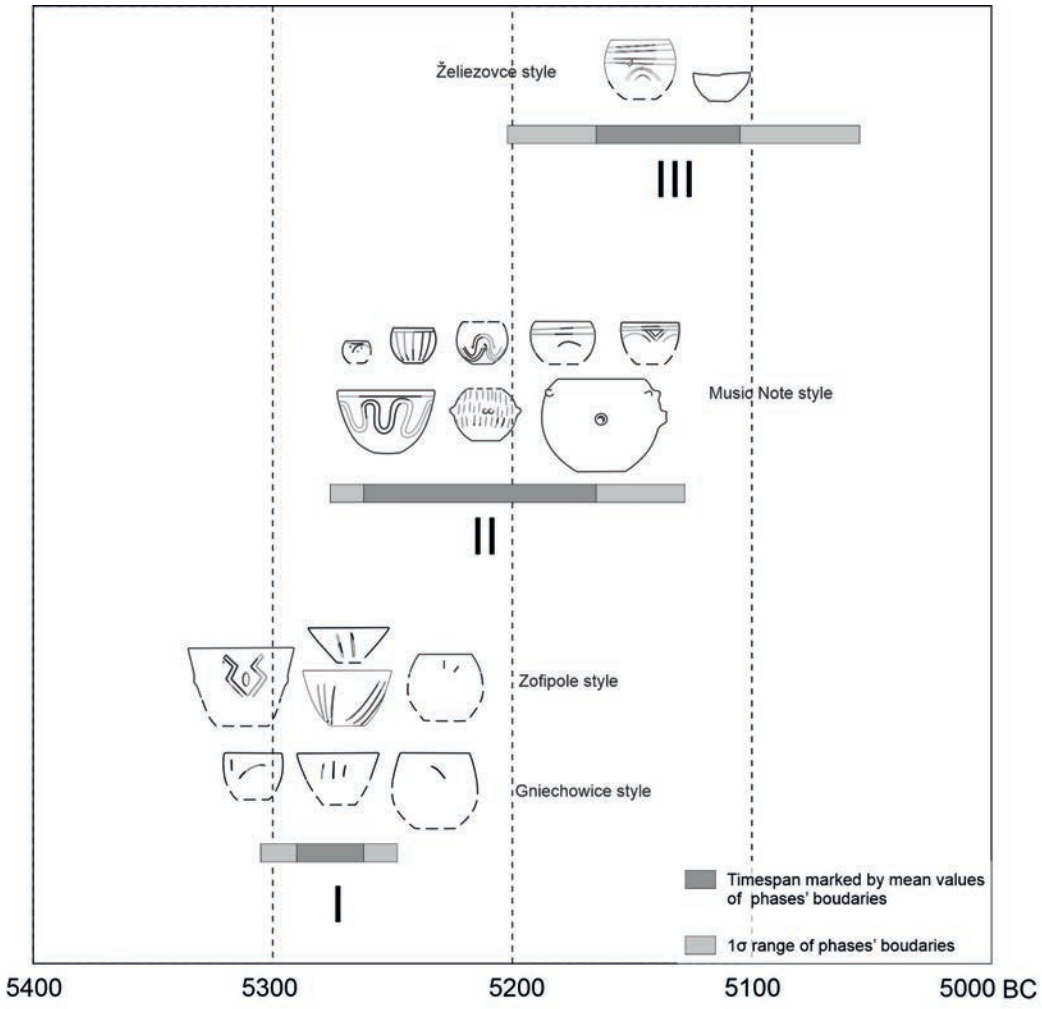



FIGURE 4. Gwoździec, Site 2. Changes in the pottery styles during the development of the settlement (Phases I–III of the LBK). Bars represent duration of phases on the time scale (Czekaj-Zastawny et al. 2025, fig. 12)

very important ceramic products include the aforementioned set of loom weights, which testify to the presence of a simple loom. These are currently the oldest relics of this type of device known (Fig. 5).

## Stone artefacts

Among the stone materials, cores, flint hammerstone, flakes, blades, retouched tools, chips and chunks were noted, as well as macrolithic stone tools (including grinding stones) processed by grinding, and less frequently by chipping. The dominant stone raw materials used are Kraków Jurassic flint, which constitutes almost 98% of the inventory. The set of raw materials is supplemented by individual products from other rocks, including those of Transcarpathian origin (including quarried quartzite, obsidian, radiolarite) and Sudeten mountains (amphibolite). In all phases of settlement development, there is a clear predominance of tools for processing animal raw materials over tools used for obtaining and processing plants (Czekaj-Zastawny et al. 2020; 2021; 2025). The presence of trapezes used as arrowheads is very interesting.

## Plant remains and their processing

Throughout the development of the settlement, the main cultivated crop was emmer *Triticum dicoccon*,

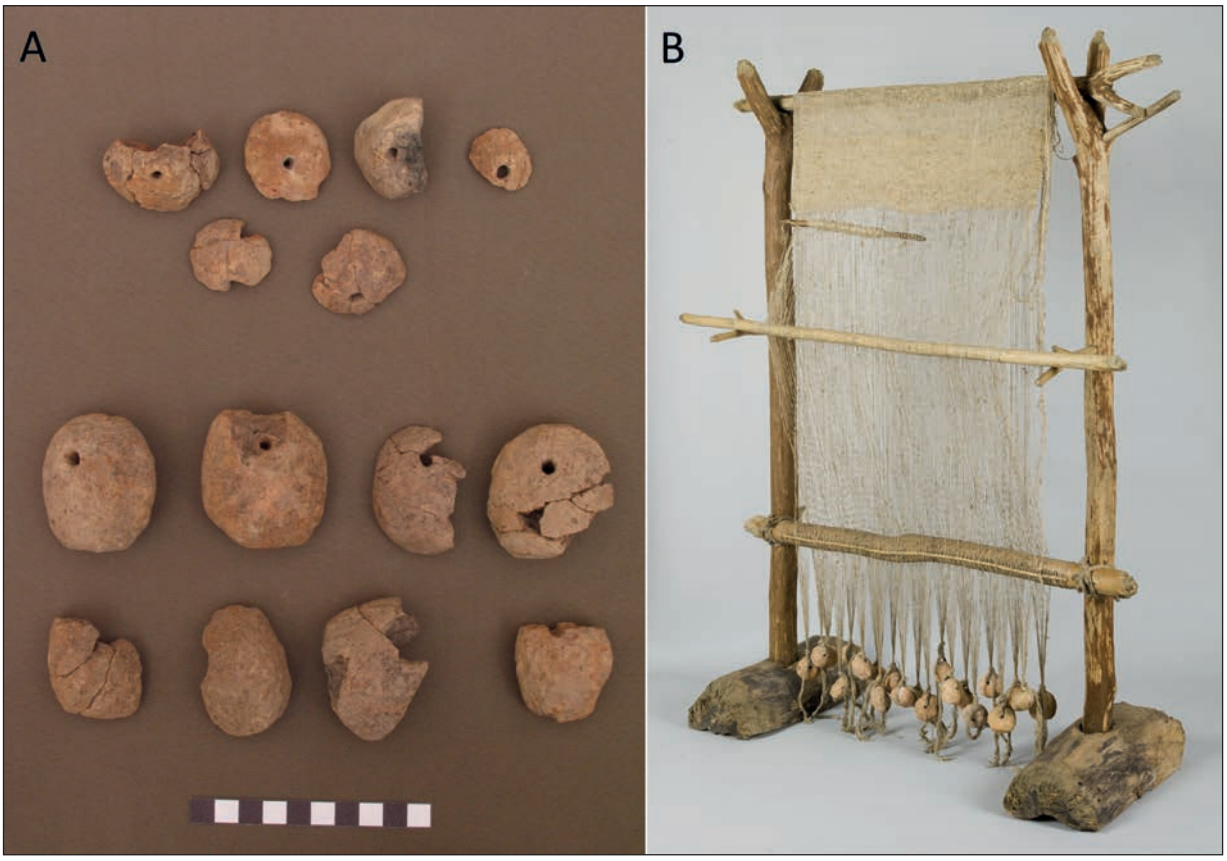



FIGURE 5. Gwoździec, Site 2. A – spindle whorls and weaving weights from Feature 15 by House III, B – reconstruction of looms from Feature 15 by House III, made for the exhibition of the Regional Museum in Tarnów (Czekaj-Zastawny et al. 2021, fig. 88, 89)

with a small contribution of the other species of hulled wheat (*T. monococcum*). In Phase II of the LBK there emerged small amounts of barley *Hordeum vulgare*. Emmer was undoubtedly cultivated as a monoculture as well, which is evidenced by a pure reserve of its grains found within Feature 1. Remains of weeds, very numerously represented in archaeological materials, got into the pits altogether with harvested crops. The use of wild apple has also been documented. Other wild herbaceous plants could have also been used for consumption. Firstly, this concerns brome grass (*Bromus*) and white goosefoot (*Chenopodium album*), undoubtedly, hazelnuts, and fruits of Maloideae trees. The predominance of oak and ash remains is related to the use of the trunks of these trees for building houses. Whereas remains of charcoal found within hearths revealed the type of fuel wood and certain strategies employed for obtaining this resource; for this purpose, various species of trees and shrubs were utilised, such as oak, hazel, ash and maple. An increasing share of remains of Maloideae trees was also recorded during the development of the settlement. This may indicate the ability to control fruit trees around the settlement. This is an exceptional discovery, in addition to the presence of the oldest remains of wild apple fruit (undoubtedly eaten, as only the seed endocarp has been preserved).

Within the flint inventory, there were encountered forms bearing use-wear traces indicating their intense utilisation for obtaining and processing plant materials. These forms include sickle inserts used for crop harvesting. Sickle inserts were hafted at an angle in a curved shaft use binding substance. On one of the specimens remains of a dark brown substance were recorded, being the remains of binding material. The flint assemblage also contained tools bearing traces of working with

silica-rich plants other than cereals. Knives for cutting these plants could have resembled sickles. Amongst the flint artefacts from Phase II of the LBK, tools used for processing plant fibres occurred, obtained from e.g., common flax or nettle. There were also recorded tools bearing traces of working with wood. They served for sawing, planing or debarking of branches, as well as cutting slots in shafts or engraving of decorative motifs.

## Animal remains and their processing

Only bones of domesticated animals were discovered, including cattle, goat or sheep, and pig. In addition to bone fragments, there is other evidence indicating animal use. The assemblage of flint artefacts contained numerous tools for processing soft materials of animal origins, such as meat and hide, as well as used for portioning animal carcasses (mainly unretouched specimens). The most numerous were tools bearing use-wear traces left by cutting meat.

Despite the lack of remains of wild animals, it can be concluded that hunting played a significant role in everyday life of the settlement inhabitants. Due to a lack of bone materials, we can formulate this conclusion based on the analysis of lipids preserved within the walls of vessels and micro use-wear analysis of flint tools. It is certain that the LBK community also exploited the aquatic environment of nearby creeks where fish, aquatic birds/mammals, shellfish, and mollusc were captured. This is evidenced by an occurrence of fatty acids. An occurrence of trapezes used as arrow points supports an assumption of hunting wild animals. The archaeological material also confirms that the processing of bones and antler (sawing/cutting, planning, and scraping) was performed at the site (Czekaj-Zastawny et al. 2020; 2021; 2025).

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# NOWE OBJEZIERZE, SITE 22

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In the history of the "Danubian Neolithic" society, monumental ceremonial centres appeared around 4800 BCE and lost their importance around 300 years later (Pásztor et al. 2015; Řídký et al. 2019; Schier 2023). The name "rondels" refers to the currently preserved architectural form, dominated by concentric ditches. Rondels occurred in the area from the middle Danube in the south, the Vistula in the east, and the Rhine in the west. Although intensive research on rondels has been carried out for over half a century, there is still a long list of controversial issues, including such basic ones as: 1) use-life of individual structures, 2) potential astronomical functions, 3) appearance and 4) modus of operation.

## Site description

The rondel at Nowe Objezierze is situated in the Lower Oder region (52.848455 N; 14.338117 E). It was constructed by communities associated with the Stichbandkeramik culture (SBK). The site was investigated through non-invasive methods, such as aerial photography and geophysical surveys, as well as through excavations. The latter, conducted over four seasons from 2017 to 2020, covered about 15% of the rondel's area (Czerniak et al. 2022). The research focused on the gates, which were examined in three trenches with a total area of 2,175 $m^2$. The rondel is circular, with a maximum diameter of 112 m. It consists of four concentric ditches with characteristic Y-shaped cross-sections and a depth of about 2 m. Inside the circle, there were three concentric grooves, forming the foundation of a wooden surrounding wall that enclosed an internal, empty courtyard with a diameter of 48 m. Three symmetrically located ‚gates' provided access to the interior of the structure (Fig.1).

## Dating

Forty-four samples were dated, all of which were single fragments of disarticulated animal bones. Bayesian chronological modelling was conducted (Czerniak et al. 2024). Model 1 was based solely on the recorded stratigraphy in Nowe Objezierze. Alternative models were also developed to verify their consistency with the radiocarbon evidence. Initially, these were models (2A-C) that explored different scenarios of the construction and initial use of the complex, followed by models (3, 4A-B) that examined various types of termination of the rondel's use.

From the perspective of chronological model selection, the distinction between the system of ditch infilling at the time of the rondel's abandonment and the system of multiple infillings of each ditch immediately after ceremonies is particularly significant. For rondels with multiple ditches (and the possibility of sequential ditch functioning), it can be assumed that older bones could have entered each ditch than the period of its use. However,

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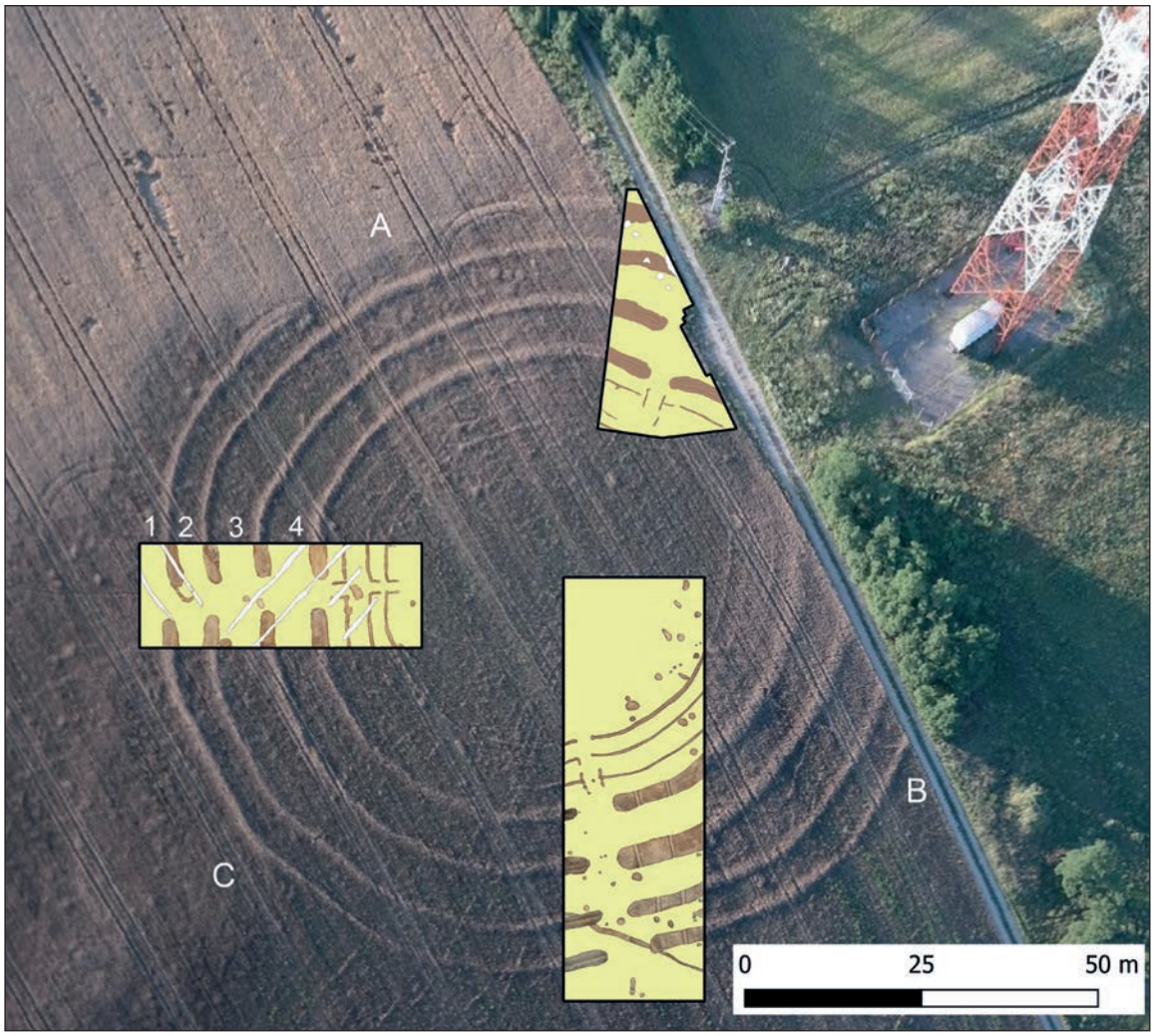



FIGURE 1. Nowe Objezierze, Moryń commune, Site 22. General plan of the rondel showing the extent of excavations and labelling of ditches (graphic design and measurements: Michał Jakubczak). The plan was created by compiling aerial photogrammetric imaging with the results of geophysical and excavation research

bones younger than the moment of ditch infilling cannot be placed there. In other words, the results of dating the moment of ditch closure can be used as one of the criteria for evaluating the tested models. Since 14C dating suggests that Ditches 2 and 1 were closed later than Ditches 3 and 4, this decreases the archaeological credibility of Model 1 (excavating all ditches, infilling ditches, abandoning the site) and significantly weakens the validity of Model 2 (ditches may be excavated in any order or simultaneously). Model 4B is most consistent with this criterion, allowing for the construction of all trenches at the beginning of the 48th century BCE, but sequential abandonment of the trenches in the order 4 > 3 > 2 > 1. In further analysis, we considered the possibility that similar dating of the opening of all ditches might result from contamination with older bones. In other words, if the end of ditch use was sequential, why not the beginning? Consequently, Model 3 should be adopted, which assumes: first, Ditch 4 was excavated, maintained, and infilled; then Ditch 3 was excavated, maintained, and infilled; followed by Ditch 2 and, finally, Trench 1. In summary, the choice between the application of Models 3 and 4B requires new arguments.

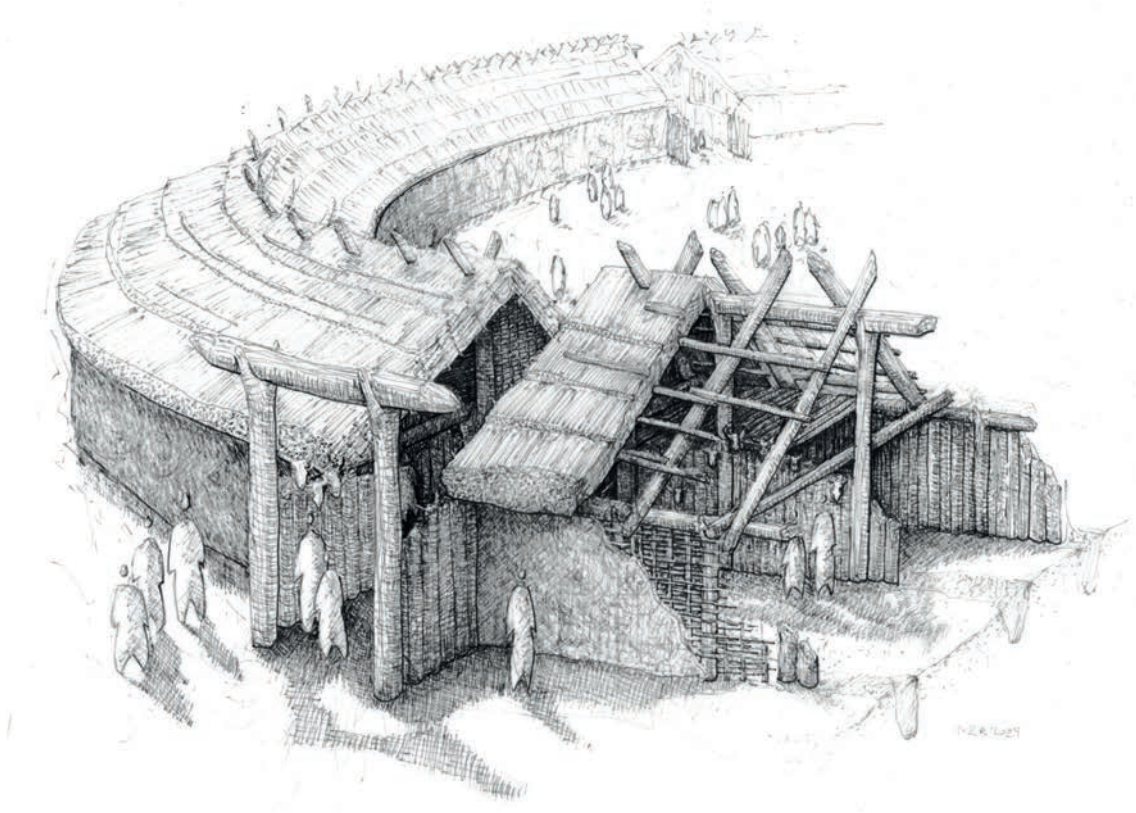


FIGURE 2. The interior of the rondel at Nowe Objezierze was surrounded probably by a wooden wall with clay-lime plaster and a reed-covered roof (drawn by Marek Z. Barański)

The most convincing hypothesis is that the ditch closest to the centre of the rondel was the main ditch. Data can be cited showing that ditches located in this position tended to be deeper and wider, and more frequently re-excavated than others. This suggests that the initial intention was always to build and use a single ditch (Řídký et al. 2019, 80–83). According to data collected by Řídký et al. (2019, fig. 6.17), up to 83% of rondels have 1–2 ditches, and only 3% have four. Considering the low population density in the Nowe Objezierze region, it can be assumed that the four ditches of the rondel were the result of prolonged use rather than the construction of a complete structure with four ditches. This is an argument for rejecting Model 4B and adopting Model 3, which assumes the sequential excavation and abandonment of trenches in the order 4 > 3 > 2 > 1. It describes a system of cyclical ditch excavation and infilling. The result of chronological modelling is the determination that the rondel in Nowe Objezierze served local communities for many generations (approximately 250–300 years).

## Palynology

A precisely dated palynological profile, developed using a series of AMS dates and located approximately 1.5 km from the rondel, was analyzed at high resolution, providing detailed data on paleoenvironmental changes. The analysis of both archaeological and paleoenvironmental data offered an excellent opportunity to integrate independent observations and construct a biography of the rondel based on this foundation (Czerniak et al. 2023).

A strong anthropogenic signal appeared at the beginning of the palynological Phase 3 (4840 BCE) and coincides with the commencement of the rondel's construction (4800 BCE). At that time, significant deforestation, increased fire intensity, and a rise in agricultural activity were observed. These

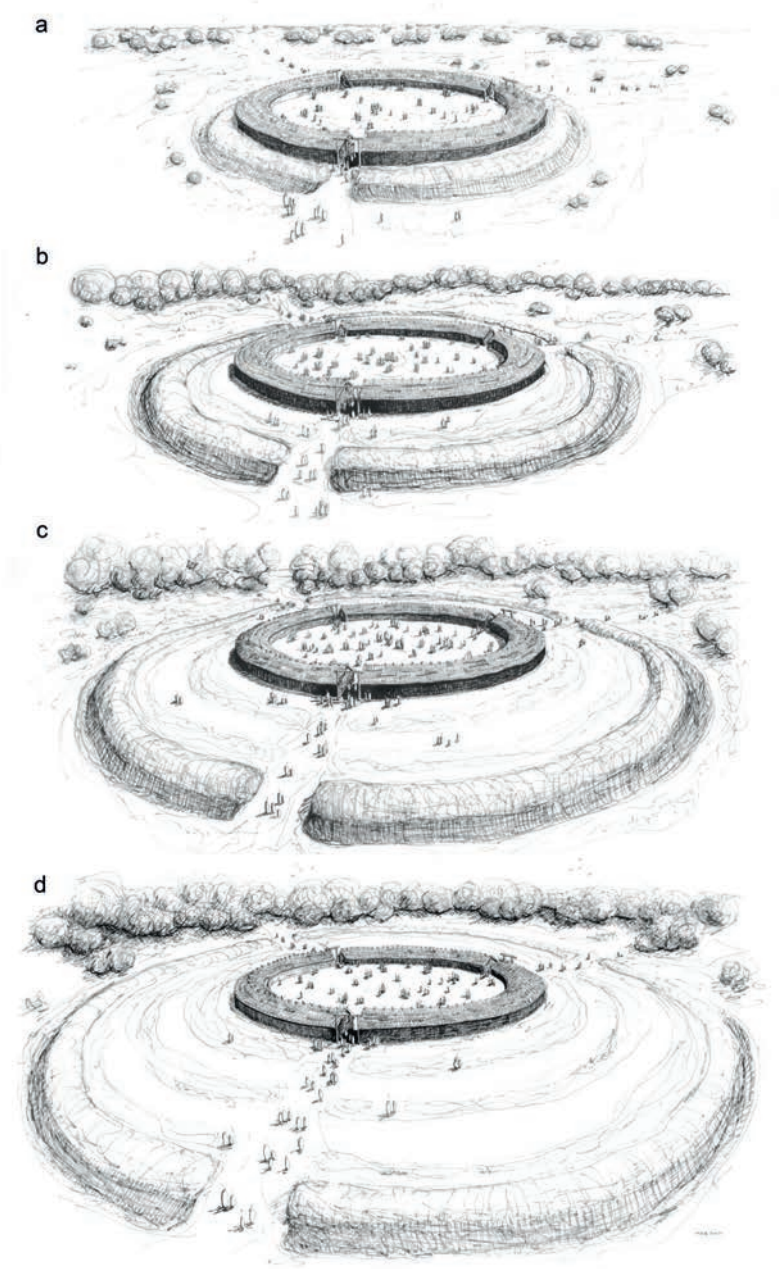



FIGURE 3. Four subsequent phases of use of the rondel at Nowe Objezierze (a–d). The ditches were only opened during ceremonies and then backfilled. Observations concerning the functioning of the ditches directly support their intentional backfilling after the end of use and the sequential opening of new ones (drawn by Marek Z. Barański)

data suggest that the construction of the rondel was associated with a substantial increase in the local population. Another factor concerning the course of events is the emergence of a new set of material culture traits. The community that built the rondel lived in longhouses with trapezoidal foundation trenches and produced pottery in the SBK IVa style, which represents a new culture in the Lowlands and its oldest phase.

The migration events marked not only the beginning, but probably also the end of the rondel period. Here, we can combine data from Subphase

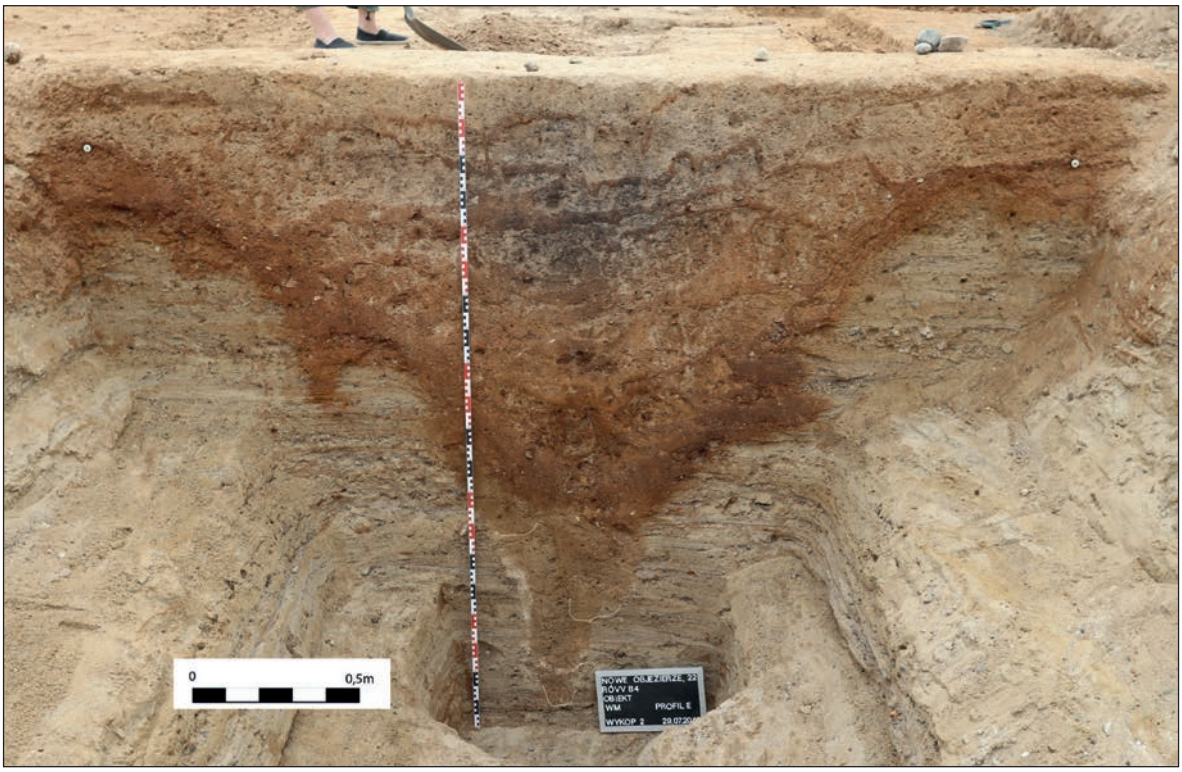



FIGURE 4. Nowe Objezierze, Moryń commune, Site 22. Example of a typical cross-section of a rondel ditch: ditch 4B, southern gate. The white lines mark the outlines of the bottoms of three separate grooves, which illustrate the different depths of the renewed trenches (photo by Lech Czerniak)

3b of the profile (4574–4457 BCE) and the last phase of rondel operation (4550–4450 BCE). This suggests that a sudden drop in signals of human activity marked the beginning of Phase 3b (c. 4574 BCE), but the rondel may have continued to function for another 2–3 generations. Its youngest ditch (No. 1) had been renovated at least several times during this period and was backfilled by depositing the surviving remains of the bucranions in it, repeating the ‚closure' practices used in earlier ceremonial cycles.

## How did the rondel at Nowe Objezierze look and function? Palisade or surrounding wall?

The most popular view is that single, double, or triple foundation trench systems were used to install wooden posts forming palisades. However, some researchers do not rule out the possibility that it could have been a "more complex structure, such as roofed atria, possibly even with plastered wicker walls" (Řídký et al. 2019, 98). The strongest argument for reconstructing this part of the Nowe Objezierze rondel is its long period of use. If the rondel functioned for about 250–300 years, it is unlikely that a wooden palisade alone would have survived for such a long time. In our opinion, a slight modification of the technology used in the construction of longhouses would have achieved the desired effect: sealing the wood with clay or clay-lime plaster, building a reed-covered roof, and performing regular maintenance (Fig. 2).

## Open or closed ditch? The issue of the embankment

The presence of constantly open ditches is the most deeply rooted stereotype related to the visualization of rondels. The excavations at the rondel in Nowe Objezierze demonstrate that the ditches were only open during ceremonies and were

subsequently filled in and re-excavated before the commencement of a new cycle. This cyclical system of digging and backfilling simultaneously explains the problem of the embankment. It is evident that in such a situation, the soil extracted from the ditch was necessary for its backfilling. The embankment present by the open ditch should be considered, in this case, a periodically exposed architectural feature of the rondel. Alongside the open ditch, it might have served as a signal for entering the ceremonial phase of the rondel (Fig. 3).

We have two groups of evidence supporting this hypothesis. The first pertains to the short period during which the ditches remained open and their repeated renewal, while the second group concerns the intentional closure of the ditches' life cycles through backfilling and sequential establishment of new ones. Among the first group, the perfectly preserved shapes of the ditch cross-sections are of primary significance. This indicates that the ditches remained open for a short period after their excavation (Fig. 4). Additionally, all the ditches exhibited signs of multiple (from two to five) renewals, visible in the characteristic ‚Y-shaped' cross-sections as displacements of the narrow groove line formed at the bottom of the ditch.

The second group of observations pertains to the functioning of the ditches and directly supports their intentional backfilling after use and the sequential opening of new ones. Micromorphological studies revealed varying degrees of podzolization in the upper layers of the ditches, indicating that during the use of the more externally located Ditches 1 and 2, Ditches 3 and 4 were already filled in. A cluster of several dozen TRB ceramic vessel fragments was found in the uppermost layer of Ditch 2. Their arrangement indicates that around 4000 BCE, this ditch was already completely filled, and a vessel was broken on its surface, the fragments of which formed a thin, ‚trampled' layer.

## One or more ditches at the same time?

The most critical consequence of the static interpretation of rondels is the assumption that facilities with four ditches were more complex than those with fewer. Bayesian chronological modelling of radiocarbon dates and stratigraphic analysis showed that the number of ditches at Nowe Objezierze was most likely dynamic, sequential, and dependent on the length of the exploitation period.

## Conclusions

1. The construction of monumental ceremonial centres is easier to comprehend when placed in the context of the ‚collapse' of the LBK. This collapse was accompanied (to varying degrees in different regions) by population decline, settlement relocations, and settlement dispersion. These processes, even though they disrupted the sense of security and common identity, lasted for many generations and had to consolidate as new settlement practices and more particular identities. The formation of new settlement centres of LgK and SBK ushered in a new period of prosperity: settlement agglomeration and demographic growth, leading to increased competition for land and decreased sense of permanence of possession. The introduction of rondels, with their function as ceremonial centres, could have played a leading role in reintegration and ensuring the legal security of property. Rondels can be seen not only as gathering places for celebrating cyclical holidays but also as monuments commemorating ancestors, whose reference could be the main justification for territorial claims.
2. In the Lowlands, the group of newcomers also needed symbols to justify their right to settle. Rondels could have also served as effective tools for negotiation and understanding with the local "epi/post-LBK" population. The relatively low frequency of rondels in the Lowlands is a problem worth considering separately. We know of a few similar monuments from this area (e.g., Wenecja and Tylice), but the chances of discovering many more are decreasing. Therefore, we suppose that the scale of migration to the Lowlands of groups using rondels was too small, and perhaps they did not find imitators on a wider scale. An additional reason could be the low demographic potential of the local post-LBK groups, as well as other needs shaped by 200 years of relative isolation of the Lowlands after the collapse of the LBK.
3. The end of the use of the rondel at Nowe Objezierze can be observed from two independent perspectives: the palynological profile and the archaeological dating of the ditches. It can be suggested that after the construction of the last ditch, there was a split in the local community, with the majority leaving the microregion and the

remaining part continuing to use the structure. It is possible that this was the general process of abandoning rondels: as the decline of an institution which, through increased rivalry and violations of the ethics of egalitarianism, turned out to be too costly a tool for maintaining community.

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# OSŁONKI, SITE 1

Ryszard Grygiel, Peter Bogucki

Located 160 kilometres NW of Warsaw, the large Neolithic settlement of Osłonki exemplifies the cultural florescence during the second half of the fifth millennium BCE in the lowlands of northern Poland known as the Brześć Kujawski Group. The excavations at Osłonki were the direct outgrowth of decades of investigations at Brześć Kujawski, about 8 kilometres to the east Fig. 1). Under the direction of Konrad Jażdżewski and Stanisław Madajski, the first excavations at Brześć Kujawski Sites 3 and 4 took place between 1933 and 1939. They revealed distinctive trapeziform longhouses and elaborate burials which established Brześć Kujawski as a landmark site in European prehistory. Additional field research was carried out by Maria and Waldemar Chmielewski in 1952, and Lidia Gabałówna analyzed the Brześć Kujawski finds for her doctorate in 1966. In 1976, Ryszard Grygiel (Museum of Archaeology and Ethnography, Łódź) and Peter Bogucki (then at Harvard University) renewed the excavations at Brześć Kujawski, which continued through 1984. This work formed the background to subsequent research at Osłonki.

Neolithic settlement in the Polish Lowlands began in the second half of the sixth millennium BCE. Settlements of the Linear Pottery Culture were established between c. 54/5300 BCE and lasted until c. 5000/4900 BCE. Ceramic sieves from lowland Linear Pottery sites have provided the earliest evidence for cheese production. Toward the middle of the fifth millennium BCE, the Brześć Kujawski Group emerged with its large settlements with multiple longhouses and burials. It flourished until the end of the fifth millennium BCE.

Located on a low expanse of ground moraine bordered by relict glacial landforms, Site 1 at Osłonki was discovered through surface survey in the spring of 1985 under the Archaeological Record of Poland (AZP) program. A test trench in 1987 revealed not only a trapeziform longhouse but also yielded a substantial sample of well-preserved animal bones. Excavations began at Osłonki in 1989 and continued through 1994. Students from the United States, Germany, Slovakia, and Poland received valuable training in archaeological field techniques while working on this site. Open-area excavations exposed the settlement plan. Features were investigated by hand, with soil screened through hardware mesh. Samples were collected for archaeobotanical analysis. In total, nearly 15,000 square metres were investigated over the course of six excavation seasons (Fig. 2).

The most distinctive features of the Neolithic settlement at Osłonki are its trapeziform longhouses built using foundation trenches (Fig. 3). Approximately 30 have been identified, oriented on a NW-SE axis with their wide end toward the SE, ranging in length from nearly 40 metres to under 20 metres, about 2–4 metres across at their narrow end and 5–7 metres at the wide end. At any moment, approximately 4 to 6 houses were occupied. An oval, tub-shaped pit about two metres long is often located along the inside of the eastern wall. Large pits adjacent to the houses provided clay for plastering the walls.

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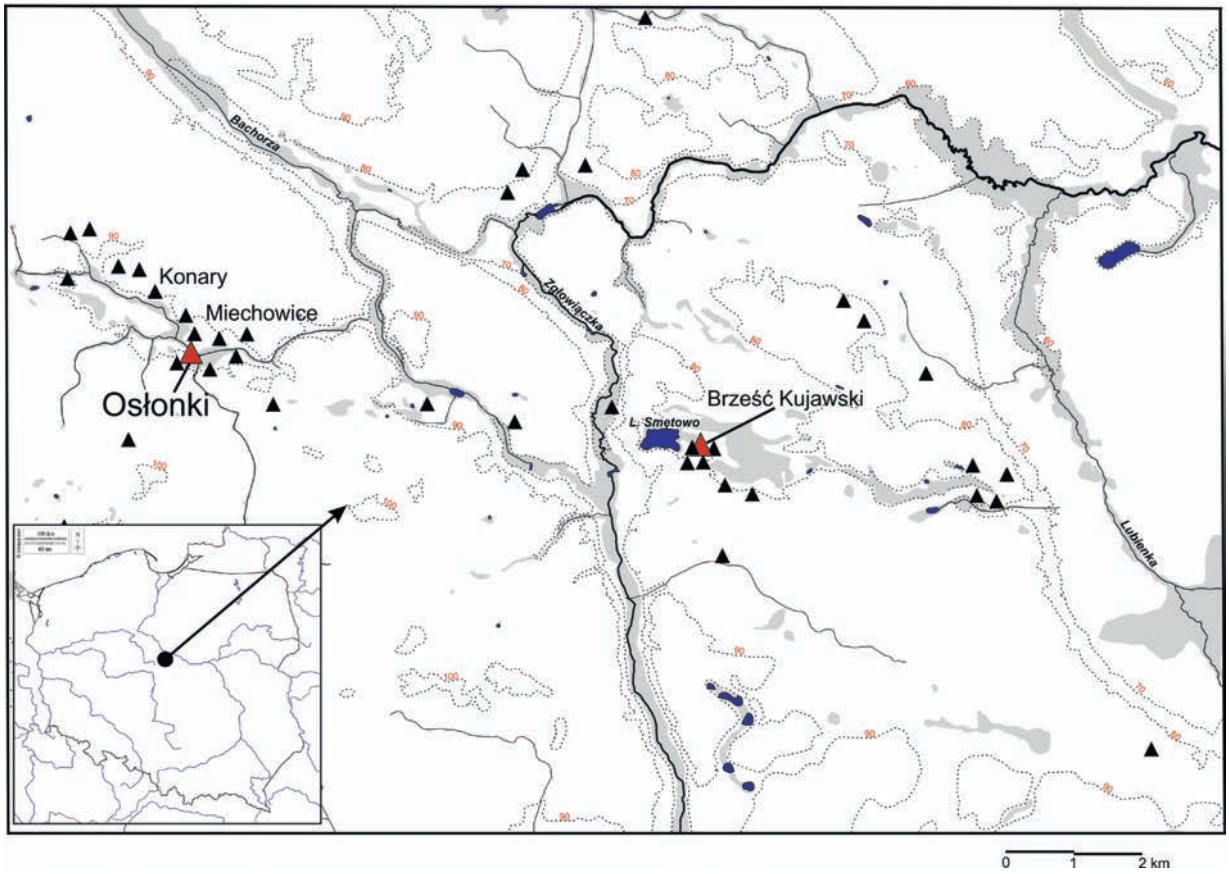



FIGURE 1. Map of settlement of the Brześć Kujawski group of the Lengyel culture in the area of Brześć Kujawski and Osłonki)

A large curving ditch with a V-shaped profile demarcated the settled area from the surrounding terrain. We interpret this ditch as a defensive feature, for it is also backed by a palisade. A gap in the ditch about 3 metres wide provided a passage into the settled area (Fig. 4).

Among the houses at Osłonki were nearly 90 inhumation burials, including several double burials and one triple burial, often in small clusters of several adjacent graves. In most cases, the bodies were in a contracted position with their heads toward the south or southeast. Males lay on their right side and females on their left. Some burials are found in rubbish pits, ditches, and other features with varied orientations and body positions.

Many burials at Osłonki were richly provisioned with grave goods. Shell beads, occasionally numbering in the thousands, formed hip belts of women Bone knives and antler T-axes are found in many male graves, interpreted as denoting warriors. One individual had a cluster of bone points at the base of his back, interpreted as arrows placed point-down in a quiver. About 25% of the burials, usually women but also some men, contained copper ornaments in the form of beads, pendants of copper sheet, bracelets of copper ribbon, and occasionally "spectacle spiral" pendants. Several graves had spectacular displays of copper. In one, a diadem was made of strips of copper, many with repoussé ornament, bent around a band of leather or fabric (Fig. 5).

Pottery at Osłonki was the mica-tempered ware typical of the Brześć Kujawski Group. The earliest wares reflect the latest stage of Stroke-Ornamented Ware (Zapotocká's Phase IV) found in Silesia and Bohemia, followed by classic Lengyel pottery with minimal surface ornamentation. Pottery forms situate the Brześć Kujawski Group within the Lengyel cultural sphere of the late fifth millennium BCE in east-central Europe. Baltic erratic flint was the primary raw material used for chipped stone tools. Nonetheless, a small

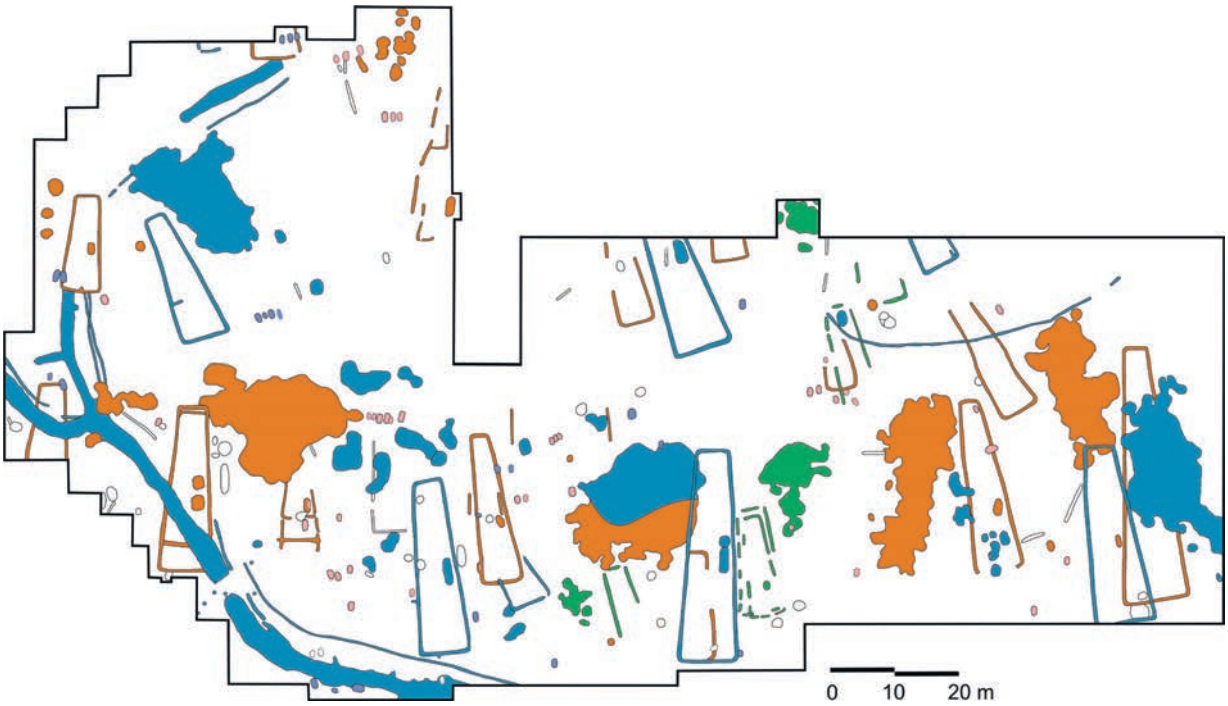



FIGURE 2. Osłonki, Site 1. Plan of the settlement of the Brześć Kujawski Group of the Lengyel culture. Key:green = early phase (47/4600-4500 BCE); orange = "classic" phase (4500-4300 BCE); blue = late phase (4300-41/4000 BCE); diamonds indicate human burials

quantity of chocolate and Jurassic flint was imported from southern sources. Ground stone tools were made from the local coarse-grained materials. In addition to axes, querns and handstones reflect household activities.

Calibrated AMS dates on human bone from 17 of the burials complement a series of legacy determinations made on charcoal. Bayesian modelling of the dates, with appropriate compensation for old wood, situates the onset of occupation at 4515–4280 BCE with an ending at 4235–3945 BCE. Based on pottery stylistics, it is possible to estimate the peak period of occupation between 4400 and 4200 BCE, after an initial phase beginning c. 46/4500 BCE and a final period persisting until c. 41/4000 BCE.

The faunal sample from Osłonki comprises over 5,000 identified specimens. Of the large mammals, about 34% are cattle, 35% sheep and goat, and 25% pig. These proportions are typical of sites of the Brześć Kujawski Group. Wild taxa, primarily red deer and roe deer, comprise the remaining number. Fish (mainly Cyprinidae although also pike), turtles (*Emys orbicularis*), and birds (especially waterfowl) are represented abundantly.

Palaeobotanical samples from Osłonki and nearby sites have yielded thousands of cereal grains and chaff fragments, almost all from wheat, as well as a weed assemblage characteristic of sustained cultivation. Occasional concentrations of grain are found, such as the burnt wheat in Pit 149. A remarkable feature of the palaeobotanical samples is a tremendous quantity of awns of feathergrass, *Stipa pennata*, a xerothermic steppe species not native to Kuyavia with significantly different habitat requirements from local indigenous taxa.

Palaeoenvironmental research was carried out in palaeolake basins adjacent to Osłonki. Several millennia of biogenic sediments were studied for their palynological, malacological, cladoceran, and mineral content. Core segments corresponding to occupation by the Brześć Kujawski Group contain corroded sporomorphs caused by the inflow of mineral particles and charcoal, showing that the surrounding landscape was exposed to erosion. Terrestrial snails among an otherwise aquatic snail



FIGURE 3. Osłonki, Site 1. The two largest trapezoidal houses from the 1989 excavations





FIGURE 4. Osłonki, Site 1. Section of the settlement of the Brześć Kujawski Group of the Lengyel culture with a visible defensive structure from the 1992 excavations

population in layers containing charcoal and mineralogical material indicates delivery of sediment from nearby land surfaces. Cladoceran species that prefer clear water disappear in the mineralized layer to be replaced by those that tolerate a high level of nutrients. The environmental impact was a temporary condition. Following the end of settlement at Osłonki the inflow of minerals declined and vegetation regenerated.

A total of 92 human skeletons provide a demographic profile of the Neolithic community. Most adults died between 30 and 50 years of age. One interesting observation is that the adult inhabitants of the central settlement at Osłonki were significantly taller than those at outlying sites. Poor diets and hard labour took their toll on some inhabitants of Osłonki. *Cribra orbitalia* was found in 80% of the children and persisted in 20% of the adults. Many individuals show enamel hypoplasia. Facets caused by habitual squatting are found on the ankles, while Schmorl's nodes on vertebrae also indicate biomechanical stress. Occlusal grooves on the anterior teeth of several adults, primarily females, were the result of fibre or sinew passed between clenched teeth (Fig. 6).

Nearly a third of adult males had traumatic skull injuries, often lethal. Not only adult men were victims of violence. A triple burial contained an adult female 25–35 years old, a child about 10 years old, and a child 4–6 years old. The woman and the older child had been killed by blows to the head with a pointed round object about 45mm across, about the diameter of one of the antler T-axes (Fig. 7).

Nine individuals from Osłonki and two from Konary were sampled for mtDNA. Most belonged to haplogroups H, T, and HV0, typical of post-Linear Pottery genomes of central Europe. A male aged 35–45 yielded a U5a haplogroup, characteristic of indigenous Mesolithic populations. Collagen from a sample of Osłonki skeletons was analyzed for $\delta^{13}C$ and $\delta^{15}N$ isotope values. Those with copper artefacts exhibited significantly higher $\delta^{13}C$ values, indicating a higher-quality diet.

After excavations were completed at Osłonki Site 1, additional longhouses and burials were found nearby at Miechowice and Konary. These



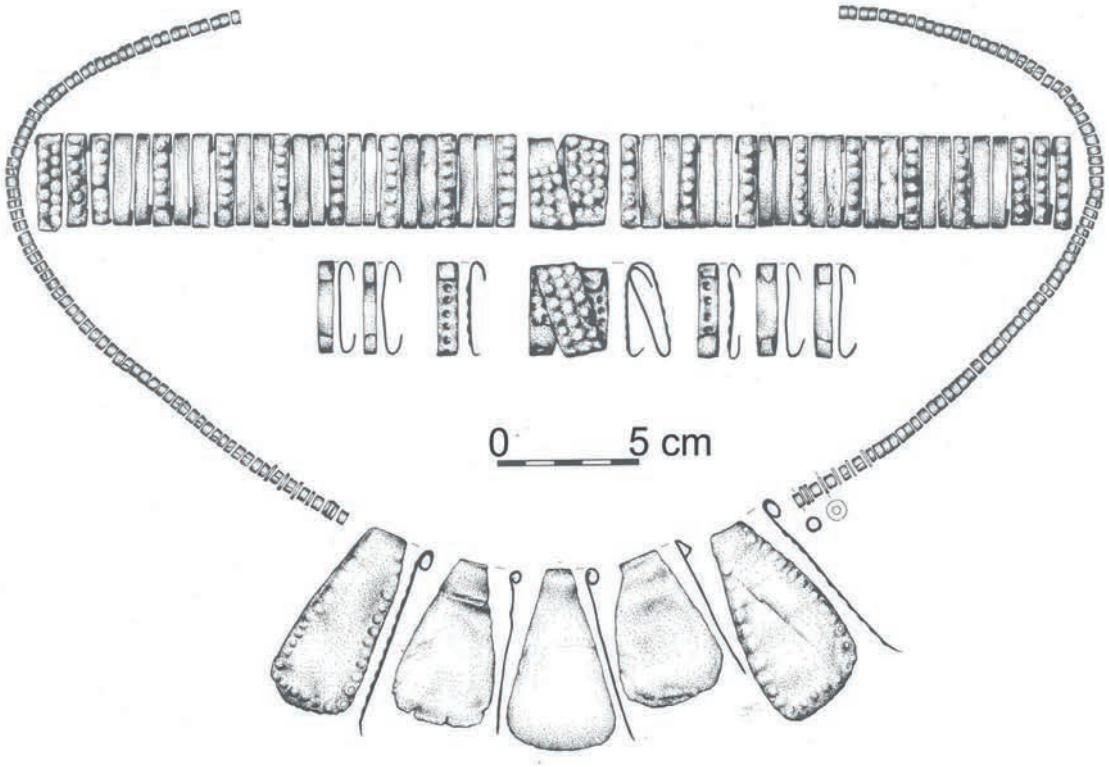



FIGURE 5. Osłonki, Site 1. Richly furnished female Grave XIII with copper diadem and copper necklace



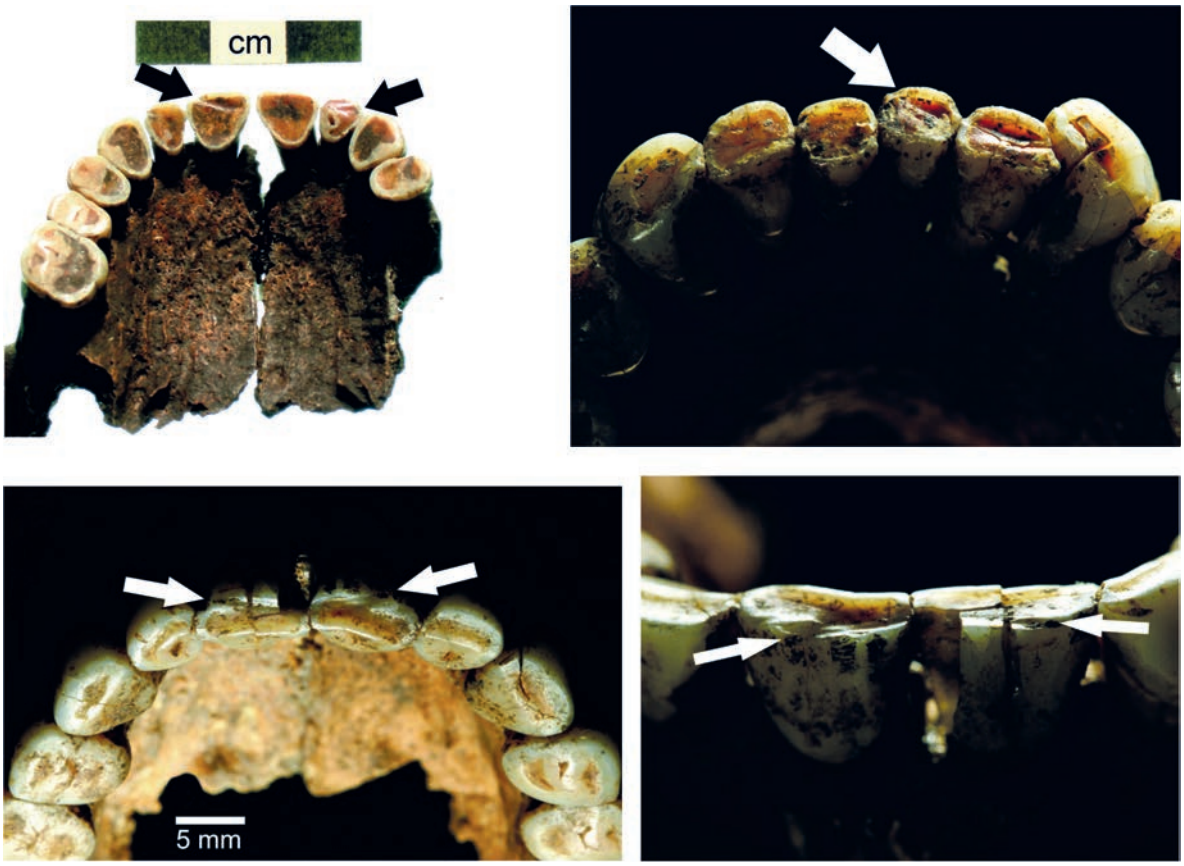



FIGURE 6. Osłonki, Site 1. Occlusal grooves showing of the use of teeth as tools for processing plant fibres by the inhabitants of the settlement of the Brześć Kujawski Group of the Lengyel culture

settlements were smaller, however, and appear to have a "satellite" character. Notable finds include a well at Konary, which contained an intact biconical pot covered with stroked decoration, and a burial containing over 8,000 beads in multiple strands around its pelvis.

Over the past 50 years, our understanding of the Brześć Kujawski Group has expanded dramatically, and the research at Osłonki has contributed in large measure to our knowledge. As recently as the late 1980s, only a handful of sites were known, whereas now dozens have been found, reflecting a high density of settlement in particular microregions. The spatial extent of the Brześć Kujawski Group has expanded significantly from its traditional core in Kuyavia north to Chełmno Land and the lower Vistula valley, and southwest into Wielkopolska.

The story of the Brześć Kujawski Group is one of persistent frontier households that settled in areas colonized during the previous millennium by the Linear Pottery Culture, although not always on the same sites. At the centre of these homesteads was a longhouse, surrounded by a complex of features including burials, clay pits, and other rubbish pits. They practiced a diversified agropastoral economy that had a considerable impact on the environment.

Mortuary ceremonialism was a significant aspect of household life. The dead were commemorated with a standardized burial ritual and often were interred with grave goods that appear to reflect their social standing since the acquisition costs of the copper ornaments were not trivial. The Brześć Kujawski Group lay at the northern end of a supply chain that stretched hundreds of kilometres to the south and southwest toward Carpathian and Alpine sources during the second half of the fifth millennium BCE.

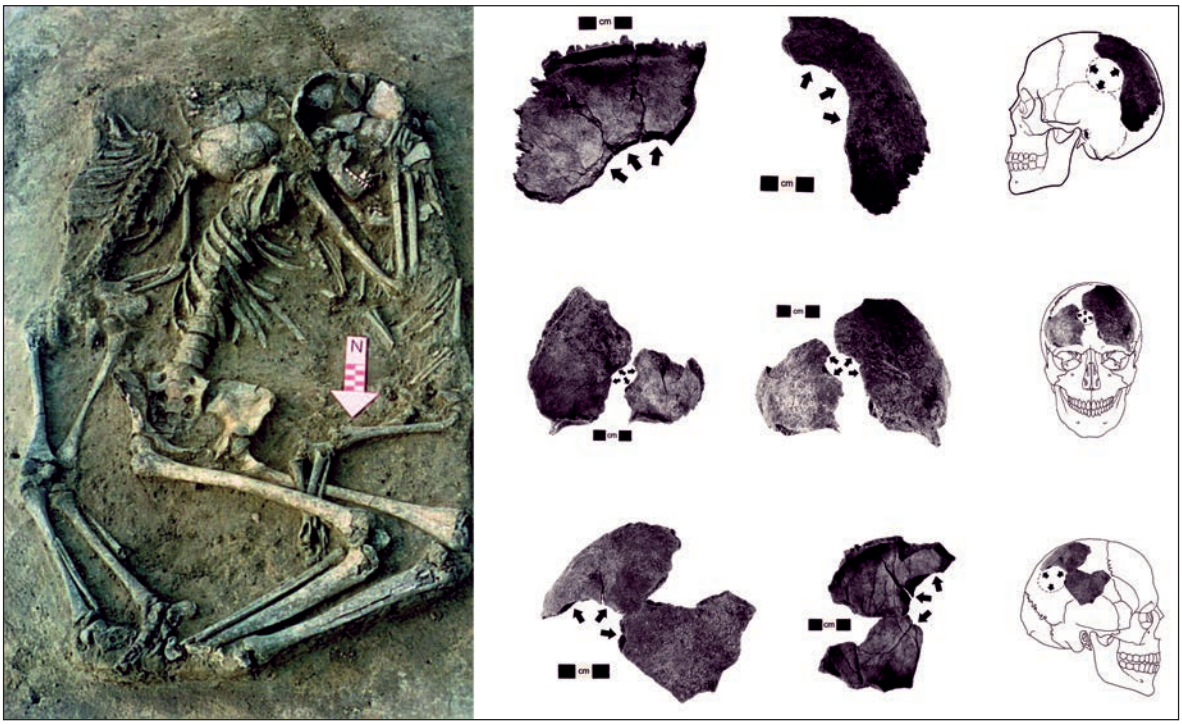


FIGURE 7. Osłonki, Site 1. Collective Grave LXXIII of a murdered young woman and two children (all three skulls show signs of fatal injuries inflicted with an antler axe)

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# DOMASŁAW, SITE 10/11/12

Mirosław Furmanek, Agata Hałuszko, Marta Mozgała-Swacha, Leszek Żygadło

The Jordanów Culture cemetery in Domasław (Kobierzyce commune, Wrocław district, Lower Silesian Voivodeship) was located within a vast and multi-cultural site, designated as Sites 10/11/12. It lies approximately 20 km southwest of Wrocław, on the northeastern slope descending toward a waterlogged reservoir.

Based on a series of radiocarbon datings, the period during which the cemetery was in use, probably spanning 3–4 generations, can be dated to approximately 4300–4000 BCE (Furmanek and Mozgała-Swacha 2017).

Sites 10/11/12 in Domasław were discovered in 1986 during surface surveys conducted as part of the Polish Archaeological Record (AZP). Subsequent surface surveys in 1996 and test excavations in 2005 confirmed that they form a large, multi-cultural settlement and burial complex, dated from the Stone Age to modern times. The discovery of the Jordanów Culture cemetery within this complex was associated with extensive rescue excavations conducted between 2006–2008 as part of the construction of the Wrocław Bypass Motorway. These excavations were carried out by the Rescue Excavation Team of the Institute of Archaeology and Ethnology of the Polish Academy of Sciences, Wrocław Branch, under the commission of the General Directorate for National Roads and Motorways. The excavations were supervised by Prof. Dr. Hab. Bogusław Gediga and Prof. Dr. Hab. Grzegorz Domański, with fieldwork directed by Dr. Leszek Żygadło.

In addition to multi-faceted archaeological analyses, including the characterization of burial practices and the study of various categories of artefacts (Mozgała-Swacha and Murzyński 2017), the discovered materials were subjected to numerous specialized analyses. Human remains underwent comprehensive anthropological analyses (Hałuszko 2017). Stone and bone artefacts were analyzed for raw material, technological, and stylistic characteristics, as well as subjected to traseological analysis (Diakowski 2017; Kufel-Diakowska et al. 2017). Radiocarbon dating was performed by Prof. T. Goslar at the Poznań Radiocarbon Laboratory, and the results were subjected to statistical analysis and modelling (Furmanek and Mozgała-Swacha 2017). Shell artefacts underwent malacological analysis (Apolinarska 2017), and copper artefacts were analyzed through metallurgical techniques (Miazga and Mozgała-Swacha 2018). Petroarchaeological raw material identifications were carried out by Dr. Agnieszka Wójcik. The environmental context of the site was addressed through comprehensive geological, geomorphological, malacological, palynological, and other analyses (e.g., K. Apolinarska, M. Malkiewicz, M. Masojć, K. Sadowski, Adam Szynkiewicz). Further research, including genetic and isotopic analyses, is currently ongoing and being developed.

During the excavation of Site 10/11/12 in Domasław, in addition to rich evidence of the use of space by various communities from the Stone Age to modern times, 25 graves of the Jordanów Culture were uncovered. Twenty-four of these graves formed a distinct cluster, while one was located approximately 80 metres south of the others. The deceased members of the buried community in Domasław were placed in rectangular pits, most often dug in a north-south direction. In some pits, dark streaks were observed, suggesting the presence of wooden structures in which the deceased

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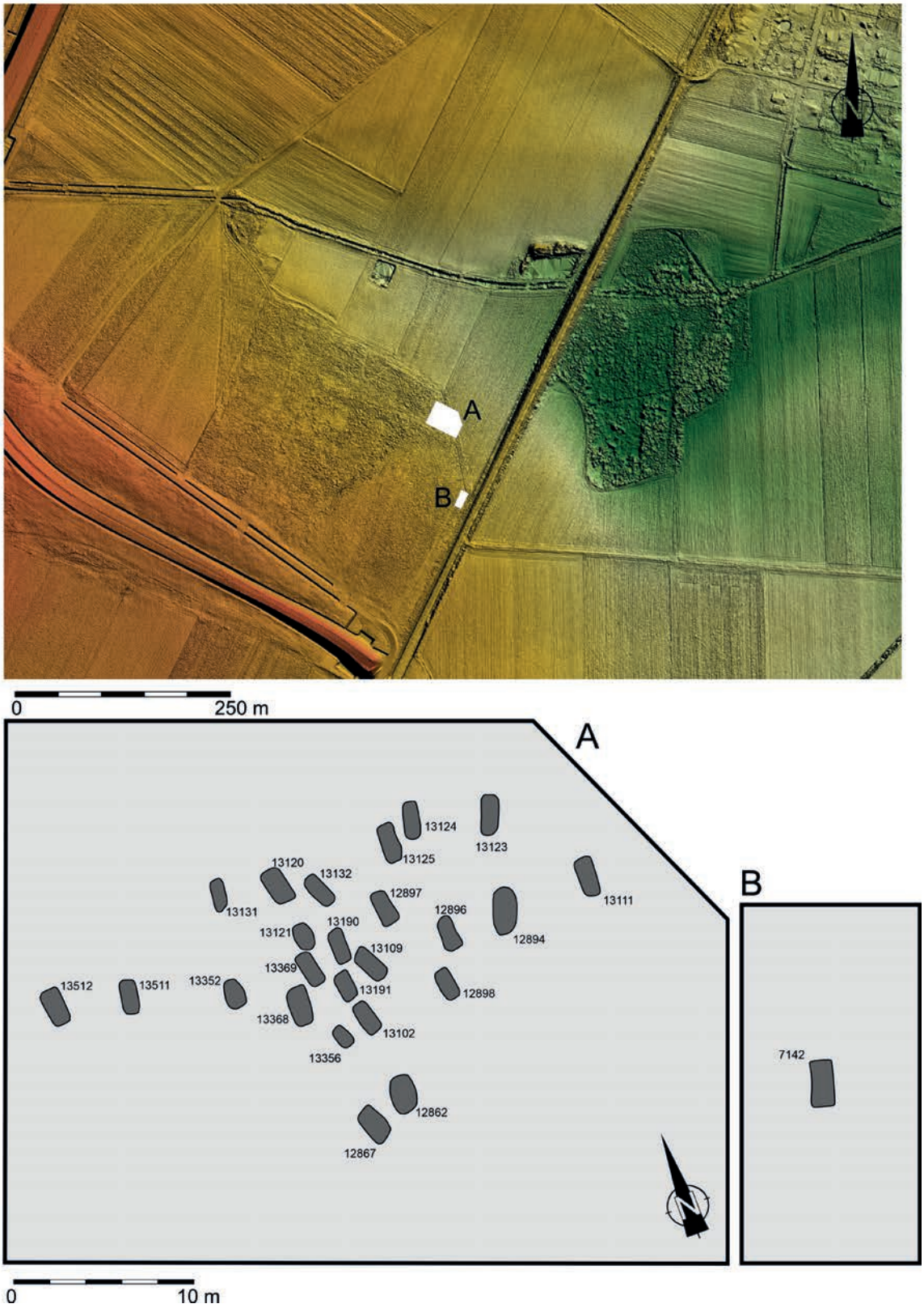



FIGURE 1. Domasław, cemetery of the Jordanów Culture. Site location and grave layout (prepared by Mirosław Furmanek)

were placed, along with sporadic arrangements of stones along the edges of the burial pits. The deceased were placed in a lateral position, with bent legs, heads positioned to the south, and arms bent at the elbows. A strict rule was observed, with women buried on their left side and men on their right. Almost all graves (except one child's burial) contained various items: clay vessels, numerous copper artefacts, as well as bones, antlers, and both siliceous and non-siliceous rocks. Twenty-one of the graves contained vessels, placed near the head in quantities of 1–4. These often included a set consisting of a kanatros or amphora, along with a bowl or a bowl on a hollow stem. Animal bones found at the bottom of the burial pits or in the bowls with hollow stems were likely remains of food offerings. The uniqueness of this site is further evidenced by the large quantity of copper items.

The deceased were probably buried in ceremonial and elaborate attire, as indicated by the preserved elements made of durable materials. The burial rites involved the inclusion of ornaments made of copper and other materials. Copper pendants, spiral and tubular beads were part of necklaces worn regardless of gender. Besides copper elements, other materials were also included, such as a necklace from Grave 13124, composed of 38 components, including the red deer canines. Occasionally, necklaces were made of stone beads. Women's hairstyles were held in place with bone pins. Head ornaments also included biconvex pendants, sometimes embellished with additional elements. Shells were occasionally found at hip level, as part of belt decorations. Both men and women wore copper bracelets on their arms and rings on their fingers. The analyzed ceramic material also revealed textile impressions, possibly from mats, threads, or cords. Some skeletons also showed dark discolorations, likely remnants of decomposed textiles.

Four copper axes and a chisel were found, exclusively in the graves of adult men, along with stone axes made from amphibolite. In two male graves, T-shaped antler axes made from red deer antler were also discovered. In men's graves, artefacts made from wild boar or pig tusks were also found, though they were not ornaments. Traseological analyses revealed that two of these tusks were used as knives, possibly for crafting arrowheads, bow handles, or other tool components. The others did not show signs of tool use. Their co-occurrence with stone tools suggests that they may have been part of pouches used for storing utensils. In the graves of adult women, near their heads, bone awls/piercers were found. While slight traces of piercing skins were observed on them, it cannot be ruled out that they may have been part of the deceased's hairstyles.

The flint tool assemblage comprises 425 specimens. These tools were discovered in the graves of women, men, and children (Kufel-Diakowska et al. 2017). Most of the tools were made from local glacial raw material (over 80%), while imported raw materials included Jurassic-Cracow silicites and, sporadically, chocolate flint, Volhynian flint, quartzite, and others. The local raw material was processed on-site, while Jurassic flint was brought as finished products or semi-finished items. One-third of the tools deposited in the graves showed signs of use. Men were typically equipped with tools associated with the harvesting and processing of cultivated plants (sickles, knives, and semi-finished products, possibly used for making interchangeable inserts for tools), as well as hunting weapons in the form of arrow bundles or tool kits with various functions (e.g., for cutting plants or processing hides). Women's graves mainly contained short-lived tools. The placement of these items near the deceased suggested how they were stored or carried during daily activities. The arrangement of numerous items in the graves may suggest that these were personal belongings of the deceased, used during their lifetime.

In 21 graves, skeletal remains were found, in varying conditions, although generally in poor preservation (Hałuszko 2017). Gender was identified in the cases of six women and seven men. A significant proportion of the buried individuals were children or young individuals, particularly young women. A relatively high proportion of the group reached adult age, which, given the estimated life expectancy, may suggest favourable living conditions for the local group and good biological health of the individuals. This is further supported by the high sexual dimorphism index – the average height of men was estimated at approximately 164.5/163 cm, and that of women at 151.3/152.2 cm. Despite this, several pathological changes were observed, some of which resulted from heavy physical labour. These individuals suffered from degenerative and overuse-related disorders of the spine, particularly in the cervical and lumbar regions. Other conditions, observed in nine individuals (42.9%), were

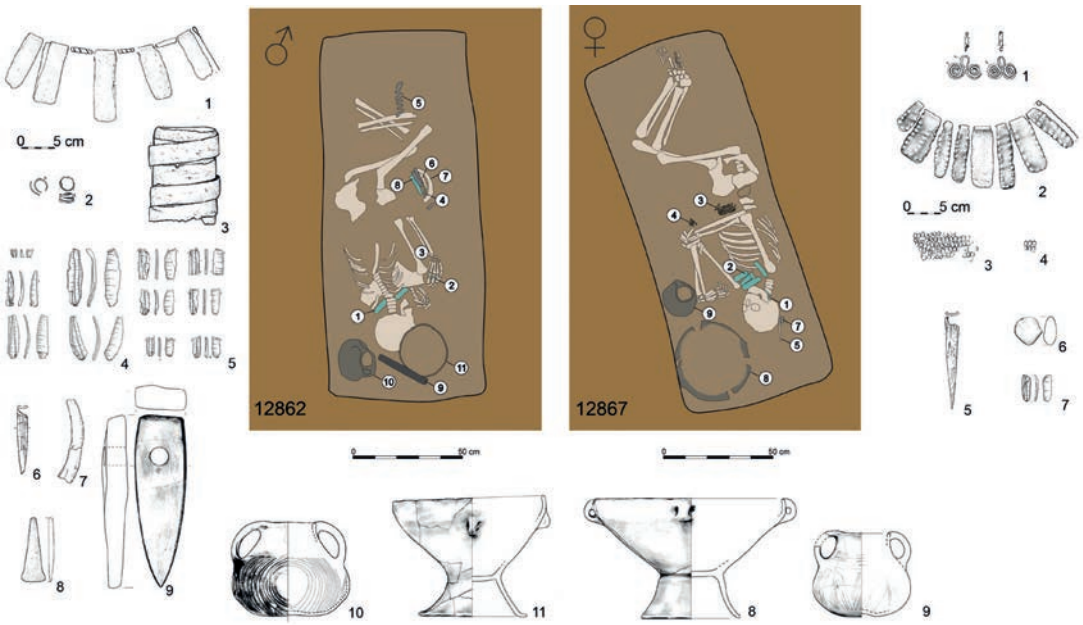



FIGURE 2. Domasław, cemetery of the Jordanów Culture. Examples of female and male graves and their furnishings (prepared by Mirosław Furmanek and Nicole Lenkow; collection: Polish Academy of Sciences, Centre for the Study of Culture of Late Antiquity and Early Medieval)




FIGURE 3. Domasław, cemetery of the Jordanów Culture. Examples of female and male graves (photo by L. Nowaczyk; collection: Polish Academy of Sciences, Centre for the Study of Culture of Late Antiquity and Early Medieval)

related to food shortages (*cribra orbitalia*, Harris lines). Enamel hypoplasia and dental caries were rare. The extensive wear of tooth crowns might indicate a particular diet or the use of teeth as tools.

The observed sex-based differences in the skeletal material suggest that they arose from distinct life functions and the different daily activities undertaken by men and women. This is also supported by the different sets of everyday items found in the graves. Men appeared to be more mobile, while women more frequently showed evidence of adopting a crouching position.

In the case of one-quarter of the individuals buried in Domasław, injuries were observed. Most often, these were perimortem skull injuries. In one individual, such an injury was accompanied by a broken left tibia, which caused their death. Skull injuries in three women were inflicted with sharp-edged tools.

The Domasław community was part of a network of extensive interregional connections. In local ceramic production, both local and supraregional elements can be seen, documenting the universality of transformations occurring in this area across broader regions of Central Europe. A significant indicator of these contacts is the presence of copper artefacts. Current analyses do not definitively determine the source of the metal used by the Jordanów Culture in Lower Silesia (Miazga and Mozgała-Swacha 2018). The presence of certain flint raw materials also points to eastward connections (Jurassic flint from the Kraków region, chocolate flint, Volhynian flint).

While genetic studies would be necessary to definitively determine the origin of the Jordanów Culture community, it is likely that they were primarily descendants of early agricultural communities. However, as with other early Eneolithic groups in Central Europe, certain features of the emerging new ideology and the revaluation of male identity associated with the rise of the hunter-warrior status are evident (e.g., Kadrow 2008; 2011). Evidence of this phenomenon can be seen in the hunting tool assemblages found in the graves or the appearance of antler axes, which are considered a result of influences from the hunter-gatherer world. New burial customs emerged, expressing differentiation based on gender and the need to display privileged positions through the demand for prestigious goods.

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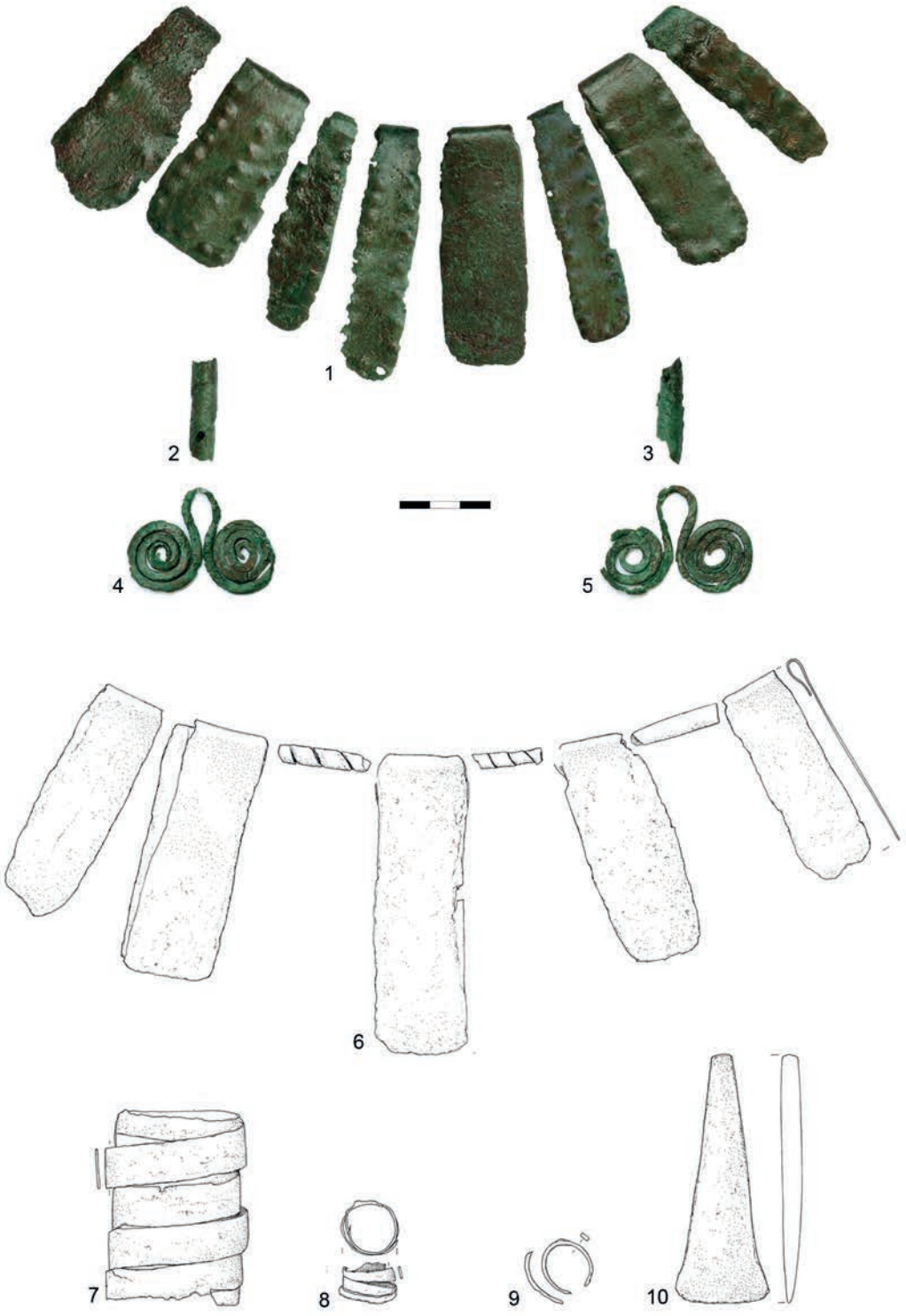



FIGURE 4. Domasław, cemetery of the Jordanów Culture. Examples of copper artefacts were unearthed in two graves of the Jordanów Culture: female grave 12867 (1-5) and male grave 12862 (6-10). (photo by I. Daszkiewicz-Dolata, drawn by Nicole Lenkow; collection: Polish Academy of Sciences, Centre for the Study of Culture of Late Antiquity and Early Medieval)

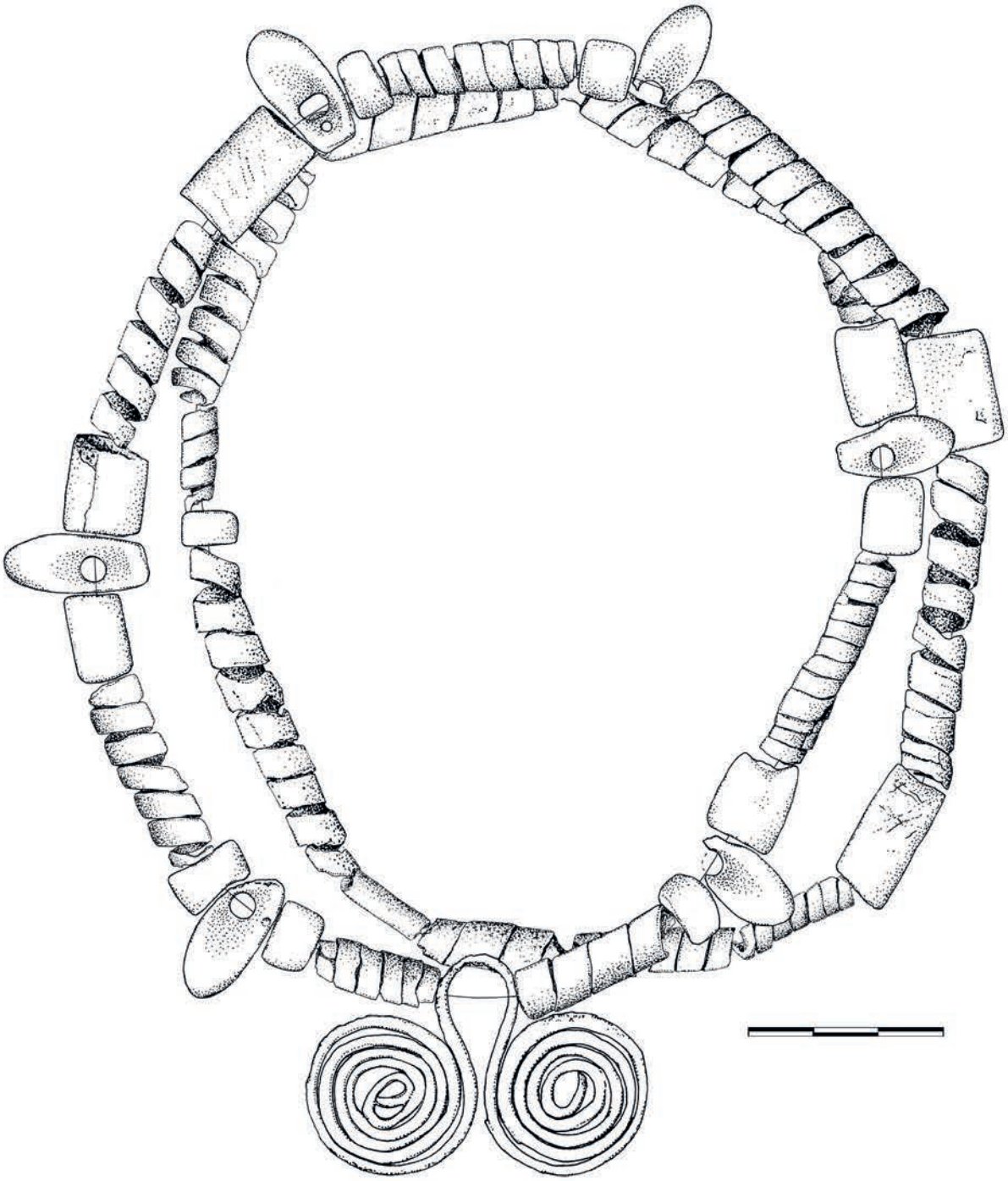


FIGURE 5. Domasław, cemetery of the Jordanów Culture. Necklace from a woman's grave 13124 (drawn by Nicole Lenkow; collection: Polish Academy of Sciences, Centre for the Study of Culture of Late Antiquity and Early Medieval)



# DĄBKI, SITE 9/10

Jacek Kabaciński, Thomas Terberger, Agnieszka Czekaj-Zastawny

Pomerania is the part of today Poland stretching south of the shores of the Baltic Sea to the broad Toruń-Eberswald marginal stream valley, and between Oder and Vistula River valleys from west to east. It was occupied by different groups of foragers since the middle part of the Late Glacial (c. 13600 BP) to the middle Holocene (c. 6000/5500 BP; Kabaciński and Sobkowiak-Tabaka 2012; Kuczkowski 2014). In the 8th and 7th millennium BP, that area was inhabited by descendants of Mesolithic Maglemosian societies living in Southern Scandinavia, identified in Pomerania already in the Boreal Period, called post-Maglemosian (Kozowski 1989; Kabaciński 2016). The Mesolithic and Early Neolithic occupation recorded in Dąbki, dated between the late 8th and beginning of 6th millennia BP belongs to this cultural unit (Kabaciński 2001). The first archaeological remains were discovered there in the late 1970s and since that time they have been the subject of intensive multidisciplinary international investigations (Ilkiewicz 1989; Kabaciński et al. 2016). What makes the site under discussion so unique and important is the multi-spectrum evidence of subsistence of late Mesolithic societies recorded during the excavations within the waterlogged environment of a fossil lake. That long-lasting project demonstrates also the presence of long-distance exchange network within which the foragers of Dąbki seem to play a crucial role.

In the times when late Mesolithic groups occupied the southern shores of the Baltic Sea, foragers inhabiting the area to the south as far as the southern uplands experienced since the middle of 8th millennium BP a crucial change evoked by the appearance of the first groups of farmers. These were Linear Band Pottery culture (LBK) people that crossed the mountains passes of the Sudeten and Carpathian Mountains from the south, initiating a long history of farmers in that region. Moving fast to the north, they settled the fertile regions of Pyrzyce, the Lower Oder and Lower Vistula valleys, located on the western and eastern fringes of Pomerania (Czekaj-Zastawny 2017). In this way, they became the neighbours of Mesolithic societies living in Pomerania, including those living by the southern shores of the Baltic Sea. And that situation substantially influenced the foragers' life.

The foragers of Dąbki settled on the island of the Dąbki Lake, a fossil basin filled today completely by biogenic sediments. According to current research, the lake itself was initially a several metres deep proglacial lake that developed as early as the late Younger Dryas. During the Holocene, it was gradually filled with sediments and most probably no longer existed as a water reservoir by the Iron Age. At the time of Mesolithic occupation, the lake and the island was c. 4 km distant from the seashore. In the middle Holocene, the Dąbki Lake was separated from the neighbouring Bukowo Lake by a narrow barrier of Pleistocene deposits not allowing Baltic Sea waters entering to Dąbki Lake, except for two episodes before and after main occupation phase (Lampe 2016). The island itself is an elongated structure c. 1.7 km long and maximally 0.4 km wide, relatively flat with two pronounced hillocks reaching c. 6 m a.s.l. (Fig. 1).

In the course of the project, several settlements of various function were documented. The main settlement, Dąbki 9/10, functionally diversified, covered c. 100 metres of the island shore. To the west a vast residential area was located, with numerous storage pits, and habitation features: rectangular

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FIGURE 1. Dąbki, Site 9/10. A – location of site 9 and 10; B – bone point; C – T-shaped antler axe; D – ulna dagger; E – bone adze

roofed huts, and houses with wooden construction. Economic activity is confirmed by workshops for flint working and amber processing (Kabaciński and Terberger 2016; Sobkowiak-Tabaka 2016).

To the east, the main economic zone was placed where different activities were performed, like intensive fish and animal tissue processing, including beaver skinning for their furs and fat. Flint was processed here as well as production of bone and antler tools took place. In this area of the lake, fish were procured on a mass scale with the help of fence-like traps. That evidence comes from a waterlogged dumping layer about a metre thick recorded by the adjacent lake shore containing tens of thousands of artefacts made of organic raw materials. Beside the main occupation area (Dąbki 9/10), small settlements, hunting stands, and numerous other traces of penetration were recorded on the island.

The project allows defining and dating phases of the Dąbki island occupation. The main phase is related to hunter-gatherer-fisher Late/Final Mesolithic groups. The earliest presence detected so far is directly dated to c. 7200 BP, and relates to the harvesting of hazel nuts (Kotula et al. 2016, table 1). That activity was most probably terminated by the Littorina Transgression around 7100 BP, when the waters of the Baltic Sea entered the Dąbki Lake. However, a series of AMS radiocarbon dates made on remains of different terrestrial fauna and wooden objects shows continuation of Mesolithic occupation of the island from the late 8$^{th}$ to the end of the 7$^{th}$ millennium BP, perhaps with some break around the transition of the 9$^{th}$ and 8$^{th}$ millennia BP (Kotula et al. 2016, table 1).

The millennium of Mesolithic occupation left copious evidence of technical and economic advancement allowing optimal exploitation of different environments. These advanced hunter-gatherers produced not only a variety of bone/antler/wooden tools and objects, including T-shape antler axes, ulna bone daggers, bone points and adzes (Fig. 1). At a certain moment, Mesolithic foragers began manufacturing ceramic vessels. That production was limited to two types of vessels: pointed-bottom pots and lamps (Fig. 2). Pots served for cooking as evidenced by thick food-crusts preserved on inner walls of the vessels. Both animal tissues and fish were processed, as well as dairy products (Courel et al. 2020; Lucquin et al. 2023). On the other hand, lamps were most probably used for lighting (Robson 2022). Establishing the beginning of pottery production encountered problems due to the reservoir effect, however most probably it was initiated at least in the second half of 7$^{th}$ millennium BP.

About 6100/6000 BP, a new style in clay vessel manufacturing appeared within the Final Mesolithic in Dąbki with evident traits of continuation. From a technological and stylistic point of view the new form of vessels – beakers – refer to the earliest northern group of the Funnel Beaker culture (FBC) ceramic (Czekaj-Zastawny and Kabaciński 2016; fig. 3). These earliest FBC people continued their subsistence basing on advanced hunting, gathering and fishing until at least c. 5900/5800 BP, and production of Mesolithic T-shape antler axes is confirmed for the middle of the 6$^{th}$ millennium BP. Only a few hundred years later the first signs of agriculture are readable in the paleobotanical record (Kalis et al. 2016).

What makes the Dąbki sites so unique is not only exceptionally rich inventory of different organic materials that were preserved in the dumping zone of the settlement documenting technological and social advancement of foragers inhabiting the island. After all, Dąbki is also one of very few sites evidencing long-lasting relations with different Neolithic cultures of the Lowland (Czekaj-Zastawny et al. 2013). That record is about 800 years long and shows a tendency of growing intensity in the course of time measured in the increase of 'foreign' pottery discovered in the Mesolithic context, especially of Danubian cultures (Czekaj-Zastawny 2016).

The earliest (6900/6800 BP), limited evidence (fragments of two vessels) is related to the late Linear Band Pottery culture (LBK). Other vessels belong to Stroke Band Pottery (SBK) culture. That pottery is more differentiated, containing small open bowls and probably also a characteristic pear-shape cup decorated with rectangular comb incisions as well as larger undecorated bi-conical pots. Such vessels can be dated to c. 6800–6600 BP. The most spectacular is the evidence of Brześć Kujawski Group (BKG). Fragments of at least 82 BKG vessels were found (Czekaj-Zastawny 2016). A variety of forms occurred, including S-shape profile pots, amphorae and different bowls, undecorated with few exceptions. Typological analysis suggests that pottery is typical for the early and classical phase of BKG in Kuyavia and may be dated to the second half of 7$^{th}$ millennium BP. Two axes from the Dąbki site (including one with a perforation) may be connected




FIGURE 2. Dąbki, Site 9/10. Mesolithic pottery. Upper row – lamps; below – pointed--bottom pottery

with the same horizon, unless they also relate to SBK people (Ilkiewicz 2005).

However, the most intriguing find from Dąbki were several potsherds coming from one or more vessels of Eneolithic Bodrogkeresztúr culture of the Hungarian Plain. That pottery is unique for Northern Europe: high-quality black vessels completely covered by *Furchenstich* ornamentation (Czekaj-Zastawny et al. 2011; 2013; fig. 4).

The imported Neolithic pottery and stone tools found in the Mesolithic context at Dąbki is a univocal evidence of contacts between two worlds that were so different from each other: hunter-gatherer-fishers and farmers. The earliest sources of the imports may be linked with the Lower Oder/Pyrzyce or Kuyavia region. In the case of SBK a south-western origin of those imports is suggested while connection of BKG vessels with the Kuyavia region seems to be undisputable.

The most distant source of pottery – c. 1000 km - is the Hungarian Plain where Bodrogkeresztúr culture vessel/vessels came from. It is highly improbable that they were imported directly during one trade trip. Most probably those vessels reached Dąbki through a longer network of exchanges that involved different Neolithic groups. Finds of copper axes and Bodrogkeresztúr vessels in southern and central Poland make this hypothesis reliable (Czekaj-Zastawny et al. 2011). And recent finds of amber decoration of pots in the Tiszapolgár culture around 6300 BCE (Czekaj-Zastawny 2017) additionally support the existence of such trade network.




FIGURE 3. Dąbki, Site 9/10. Early Funnel Beaker culture pottery

No matter which way the Bodrogkeresztúr pottery appeared in Dąbki, its exceptional value underlines the unique status of that place as, perhaps, a central meeting place for exchange goods and ideas leading to subsequent integration of two worlds, hunter-gatherers and farmers. These finds allow a better understanding of the complicated nature of the relations between them.



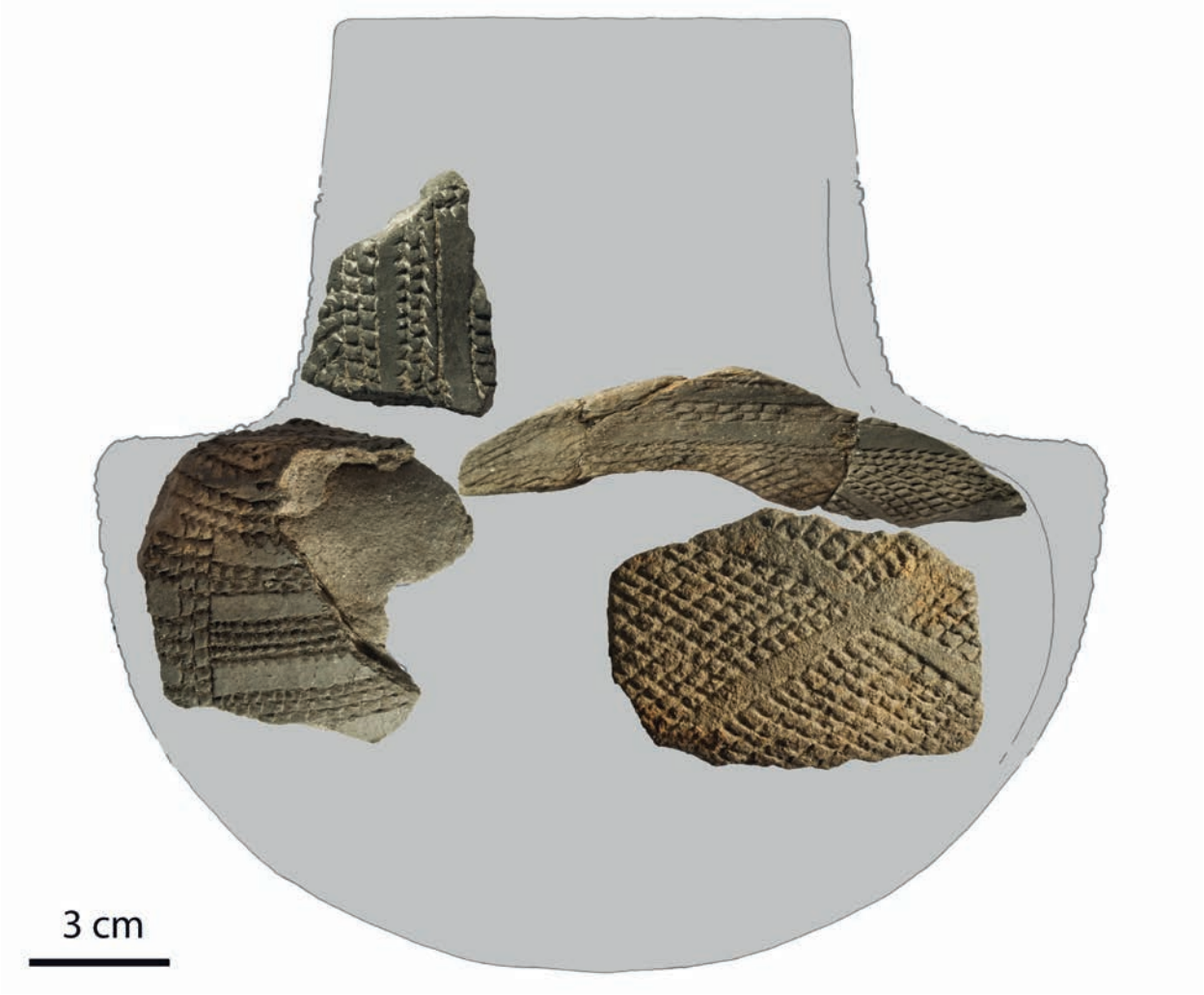



FIGURE 4. Dąbki, Site 9/10. Bodrogkeresztúr pottery

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# THE KAŁDUS SITE COMPLEX

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The archaeological site complex at Kałdus is located on a till plain, near the border of the Chełmno-Dobrzyń Lakeland and the Lower Vistula Valley, ca. 3 km south of Chełmno in north-central Poland (Fig. 1). Four distinct sites (1–4) were arbitrarily delineated in Kałdus, encompassing a total area of approximately 15 hectares. To date, excavation has exposed 15% of the site's extent.

The site was first occupied in the late Neolithic period, continuing until the late medieval period (Chudziak 2003). The stratigraphy of the site is indicative of extensive settlement activity and displays a complex stratum. Three predominant accumulations of cultural layers and features have been recorded at the site, which correspond to three distinct periods of increased anthropogenic activity. The first horizon dates to the Neolithic period and is associated with the Funnel Beaker culture (hereafter: TRB). The subsequent horizon developed during the Early Iron Age when the site was occupied by the Lusatian and Pomeranian cultures. The final horizon spans the early medieval period, when the site housed the pre-location Chełmno, also known as the *sedes regni principalis* of the early Piast dynasty (Chudziak 2003). Throughout the greater portion of the site, these three cultural horizons are separated stratigraphically by layers of sterile aeolian sands. Beyond the three primary settlement horizons, the Kałdus site has yielded material evidence attesting to the presence of several other prehistoric and historic communities.

Kałdus stands as a unique palimpsest-type site in northern Poland, offering a valuable archaeological repository for the study of the prehistory and early history of the Lower Vistula region. This phenomenon may be attributed to the distinctive landscape features of this location. The Kałdus site complex is located on the edge of an upland, offering an extensive view over the Lower Vistula Valley, the adjacent moraine plateaus, and the fords that cross the Vistula river. The landscape is dominated by a dune hill known as St. Laurence Hill (Polish: *Góra św. Wawrzyńca*), which has been repeatedly remodelled through anthropogenic intervention in the past. At the foot of St. Laurence's Hill, the presence of a water spring has been identified, with the formation of ponds in the area (Chudziak 2003; Luc–Szmańda 2018). These landscape features were presumably highly valued by the prehistoric and early historic communities that inhabited the site.

Research into the TRB in Kałdus is a relatively recent development. The preliminary stage of this research, as well as the wide range of evidence for TRB activity, currently makes it difficult to ascertain the function of this site in the late Neolithic. Archaeological research has yielded a rich array of features associated with settlement, economic activities, and funerary practices at the site, along with a remarkable accumulation of evidence pointing to ritual activities. The decoration of the TRB vessels corresponds to the classical and late *Wiórek* phases (Fig. 2). The local pottery is also evident of influences from north-eastern Subneolithic groups and those of the Baden culture originating from southern Poland and the Carpathian Basin. The stylistic and technological features of the ceramics

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FIGURE 1. A view of the site complex at Kałdus with the panorama of the Lower Vistula Valley (photo by W. Stępień)

from Kałdus clearly align with the late Eastern TRB group, and can be dated to the second half of the 4th millennium BCE.

## History of excavations

The history of archaeological research at the Kałdus site extends back to the 19th century. The initial phase of fieldwork at the site was undertaken by Prussian scholars, with Abraham Lissauer among those responsible for the discovery of early medieval and prehistoric materials. In the period following the Second World War, systematic excavations were conducted in 1957–1958 by the Department of Archaeology of the University of Łódź. Following this, work at the site was continued by the Department of Archaeology at Nicolaus Copernicus University in Toruń between 1967 and 1973. In 1996, Wojciech Chudziak of the Institute of Archaeology at Nicolaus Copernicus University in Toruń pioneered an interdisciplinary research programme at the Kałdus site, centring on the material culture and historical developments of the early medieval period (Chudziak 2003, 14–17). This ongoing programme continues to date. Its scope encompasses a range of interdisciplinary studies, drawing upon analytical and data-driven methodologies to explore the acquired archaeological, archaeozoological and archaeobotanical evidence, with a focus on the multifaceted issues that underpin the origins of the Polish state in Vistula Pomerania.

The first comprehensive study of TRB materials from Kałdus was published in the late 1970s, providing a detailed analysis of findings obtained by the Department of Archaeology at the University of Łódź (Kaszewski 1979). The study presented and discussed the relative chronology of the archaeological materials, and concluded in highlighting the potential for further research at the site. The first excavation and research into the TRB culture from Kałdus was led by Kamil Adamczak and Łukasz Kowalski of the Institute of Archaeology



FIGURE 2. Selection of vessels associated with the Funnel Beaker culture from Kałdus (photo by W. Ochotny)

at Nicolaus Copernicus University in Toruń in 2015. This research has since continued to the present day. A decade ago, analytical studies that focused on TRB materials from Kałdus were started (Adamczak et al. 2015; Kowalski et al. 2019; Kowalski et al. 2020; Adamczak et al. 2021; Adamczak and Sudoł-Procyk 2024; Kofel and Adamczak 2024). These largely addressed case studies and focused on particular materials or assemblages that demonstrated exceptional scientific value. Thus far, the absolute chronology of TRB settlement in Kałdus has only been comprehensively explored and analysed (Adamczak et al. 2024).

## Research methods

The TRB materials recovered from the site were analysed through methodologies conventionally employed in the study of archaeological features and materials (e.g. excavation method, stylistic and technological analyses of ceramic and flint artefacts, archaeozoological analyses, traceology, radiocarbon dating) along with advanced analytical techniques. Interdisciplinary studies were the standard approach, engaging the research institutions in Poland and abroad. Microscopic imaging techniques, including scanning electron microscopy (SEM-EDS), confocal microscopy, and micro-computed tomography (m-CT) were employed for the investigation.

Metal artefacts were analysed for their chemistry and elemental composition, as well as the origin of copper used for their production and the manufacturing technology. This was carried out using a range of analytical techniques, including energy-dispersive X-ray fluorescence spectrometry (ED XRF), lead isotope analysis (MC-ICP-MS), as well as X-ray imaging and microstructure analyses. The ceramic vessels underwent a comprehensive investigation, combining mineralogical-petrographic and geochemical methods (i.e. trace and rare earth elements). Archaeobotanical studies of materials obtained from the fills of archaeological features, as well as daub and ceramic vessels, involved carpological and anthracological analyses.

## Research results

The most significant research outcomes comprise a series of radiocarbon dates, which indicate a continuous occupation of Kałdus by the TRB people that extended over the total site area (15 hectares) within a relatively short time period of approximately 200 years, between 3520 cal BCE and 3320 cal BCE (Adamczak et al. 2024, 8). This conclusion receives support from the stylistic uniformity of the ceramic vessels (the total assemblage comprises thousands of potsherds). Evidence suggests that the TRB central-place at Kałdus was comparable to the so-called large settlements in the



FIGURE 3. The metal hoards from Kałdus, displaying a deposition pattern of metals and ceramic vessels (photo by W. Ochotny)



loess upland zone of Lesser Poland (e.g., Mozgawa, Gródek). However, in contrast to the TRB settlements in southern Poland, Kałdus revealed a remarkable accumulation of pits that suggest sacrificial or ritual functions, as suggested by their arrangement and fillings. In addition, a small cremation burial cemetery has been discovered on the south-eastern edge of the site.

The application of archaeometallurgical studies to copper artefacts from Kałdus represents a significant achievement in the field, marking the first documented implementation of lead isotope analysis for Neolithic metalwork from Poland (Kowalski et al. 2019). Two pits containing metal hoards have been discovered in Kałdus. One of them (Pit 1186) contained a hammer-axe, an *Usatovo*-type dagger originating from the Black Sea region, and a spiral ornament of the *Rudki* type (Fig. 3). In the other, Pit 470, a single spiral ornament of the same type was found (Adamczak et al. 2015; Kowalski et al. 2019). Further analysis revealed that the copper used to produce the dagger was deliberately alloyed with arsenic, which is one of the earliest arsenic bronze objects found in Poland. The results of lead isotope analysis for the *Rudki*-type spiral ornaments from Kałdus and Przeuszyn (Lesser Poland) revealed that the copper used in these ornaments originated from the Špania Dolina–Banská Bystrica–Kremnica region in central Slovakia. Metallurgical analyses and micro-computed tomography yielded insights into the manufacturing technology used for these ornaments (Kowalski et al. 2019).

In addition to the metal hoard, Pit 1186 also contained a macrolithic retouched blade made of Świeciechów-type flint, two small flint arrowheads, a bone awl, a richly decorated ceramic spindle whorl, and an amber disc (Adamczak et al. 2015; Adamczak and Sudoł-Procyk 2024). The pit was discovered within the remains of a pole construction, interpreted as a ceremonial house. The same pit contained numerous potsherds, among which was a neck fragment of richly decorated amphora. A similar deposition pattern involving metal objects alongside a fragment of a decapitated amphora and a comb-band-decorated beaker was observed in Pit 470 (Fig. 3). The main decorative motif incised on the fragment of the amphora from Pit 1186 can be interpreted as a depiction of a spiral ornament or a four-wheeled cart. In terms of chronology, the TRB central-place in Kałdus corresponds to the earliest documented depictions of carts and other wheeled vehicles in Poland (e.g., Bronocice, Dopiewo, Sławęcinek, Ostrowiec Świętokrzyski). As such, the narrative scene incised on the Kałdus amphora represents further evidence of the use of carts and sleds, in addition to animal traction, across the TRB culture in Central Europe during the second half of the 4th millennium BCE.

The vessels from a feasting set found at Site 4 (see Fig. 4) have prompted a number of interesting results. This set includes a funnel beaker, a small goblet, an ornamented vase, and a bone spoon (Kowalski et al. 2020; Adamczak et al. 2021). Based on the findings from geochemical and mineralogical-petrographic analyses, the vase – which shares stylistic and formal features with the TRB pottery from Silesia and Lesser Poland – has been identified as a local product from the Lower Vistula region. The clay fabric used for the vase contained small fragments of crushed and burnt bones, which were analysed for histomorphological characteristics. The results indicate that a likely candidate for the bone added to the vase from Kałdus is red deer, which provides further evidence of the valorisation of deer during the TRB era in Poland. Further to this, the site yielded a few examples of wide-mouthed funnel beakers (Fig. 4), which also contained a bone admixture. The shape of these vessels and their ornamentation suggest that they may have served as ceremonial ware for libations performed at the site (Kowalski et al. 2020).

Compared to other TRB sites in the region, the archaeological record from Kałdus reveals a significant proportion of imported items, particularly metal artefacts and flint tools, including macrolithic retouched blades and implements fashioned from raw materials originating in the Polish and Ukrainian Uplands (Adamczak and Sudoł-Procyk 2024).

The occupation of Kałdus by TRB communities occurred over a relatively short time period, extending over approximately 8–10 generations. The site is defined by a remarkable accumulation of evidence for ritual activity, alongside concurrent settlement remains, thus indicating that the Neolithic site of Kałdus could be a primary political and religious centre that exerted a significant impact on the wider settlement and cultural landscape of TRB communities along the Lower Vistula region.





FIGURE 4. A feasting set from Kałdus, comprising ceramic vessels and a bone spoon, alongside examples of wide-mouthed beakers with bone admixture (photo by W. Ochotny)



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# MUSZKOWICE, SITE 18

Agnieszka Przybył

The archaeological site No. 18 in Muszkowice (Ciepłowody municipality, Ząbkowice district) is a Neolithic cemetery containing six earthen long barrows. It is located in southwestern Poland (Lower Silesia), in the northeastern part of the Sudeten Foreland, more precisely within the Niemcza-Strzelin Hills Mesoregion. The site is hidden within a small forest complex, situated in a loess area between the Ślęza and Oława rivers. These medium-sized left-bank tributaries of the Oder River, with their moderate flow rates, played a crucial role in the development of Neolithic settlement in this region of Poland (Kulczycka-Leciejewiczowa 1993; Furmanek 2019).

The cemetery is situated in a highly undulating landscape, further shaped by a network of deep erosion gullies, numerous streams, and springs, which divide the area into upland plateaus and promontories. Elevation differences range from 30 to 50 metres. The cemetery itself occupies a prominently exposed upland plateau at an altitude of 285 metres above sea level (Fig. 1). The area is densely covered with mixed forest, primarily beech, with thick undergrowth (Fig. 2; Wojciechowski and Cholewa 2011a, 94).

The long barrows at Muszkowice are characterised by earthen mounds with frames of large upright stones, constructed on an elongated trapezoidal plan (Fig. 3). The mounds are slightly eroded, and the stone boulders are mostly obscured by a layer of displaced soil. Five of the six barrows are of similar dimensions, measuring between 28 and 36 metres in length and between 7 and 9 metres in width at their widest point at the base. One of the barrows is slightly smaller, with dimensions of 5.5×14.5 metres. The preserved heights of the mounds, at their highest points, range from 1 metre to over 1.5 metres. All the barrows share a similar orientation in the landscape, positioned along a NW-SE axis, with their highest sections facing SE (Wojciechowski and Cholewa 2006, 227, fig. 2; 2011a, 93, fig. 3). This orientation generally aligns with the principles governing the location of the so-called 'Kuyavian barrows' type, while in terms of size, they resemble burial mounds recorded in Central Pomerania, in the Łupawa River basin (cf., Chmielewski 1952; Midgley 1985; Wierzbicki 1992; Król 2021).

Expressing the megalithic idea, these non-megalithic monuments are associated with the Funnel Beaker culture society. However, determining the precise date of their construction and duration of use remains challenging. Despite the availability of some radiocarbon dating results from samples taken from two local mounds, establishing a definitive chronology for these monuments is difficult. They were most likely constructed in the latter half of the fourth millennium BCE, that is, between 3500 and 3360 BCE (Wojciechowski and Cholewa 2011a, 103; Król 2017; Dreczko 2018, 270–272; Przybył 2021, 177–182).

The research history of the site is particularly interesting. It was first recorded in the "Archaeological Record of Poland" (AZP) in the mid-1980s. A decade later, after a period of relative oblivion, it was accidentally "rediscovered". At that time, it was the first and only cemetery with earthen long barrows recorded in southwestern Poland. The discovery quickly attracted significant interest among Polish archaeologists, as the presence of such a cemetery in this part of the country was unexpected. Until then, the highlands of the Sudeten Foreland were considered beyond the range of such monuments. Earthen long barrows were more commonly associated with the megalithic traditions of lowland communities of the Funnel Beaker culture, inhabiting the northern regions of Poland (cf. Wojciechowski and Cholewa 2006, 228–229; 2011a, 91–92; Przybył 2014, 68).

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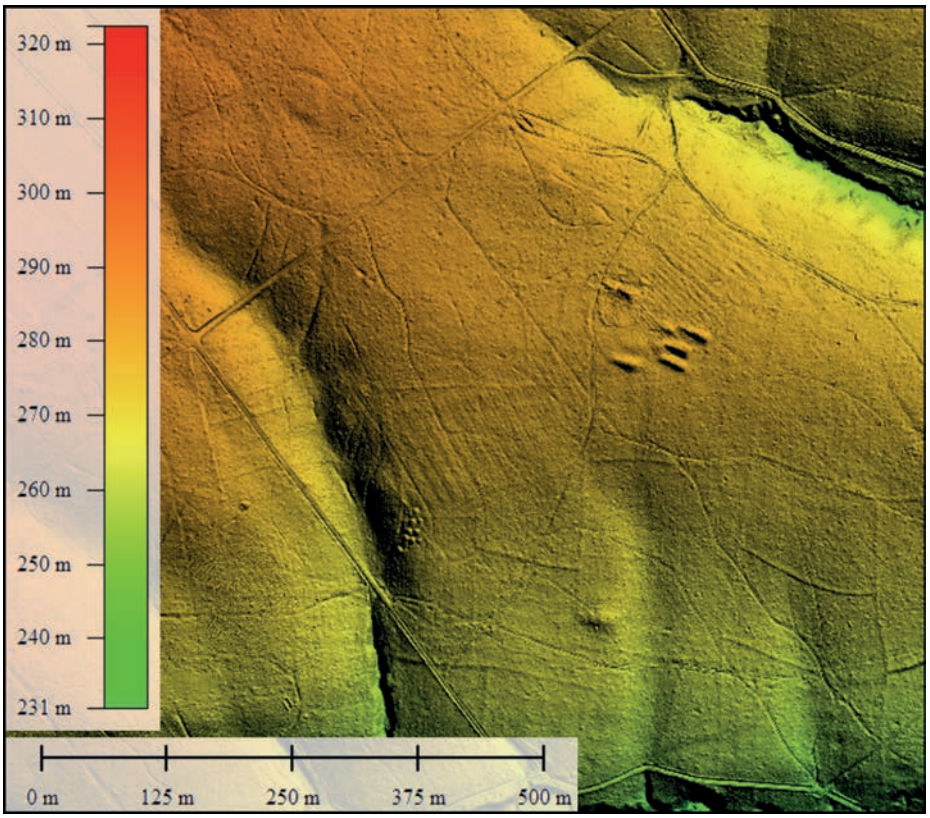



FIGURE 1. Digital terrain model (DTM) of the Muszkowice site 18 area, derived from aerial LiDAR data

In addition, the site is located well beyond the areas where such monuments typically occur, within the territory associated with the Silesian-Moravian group of the Funnel Beaker culture (cf., Rzepecki 2011, fig. 67, no. 73; cf., Šmid 2003). This regional entity, situated in the loess areas of Lower Silesia, exhibited a distinct cultural identity. Although it was composed of communities originating from the lowland Eastern group of the Funnel Beaker culture, it formed a new, autonomous unit – an alternative variant of the broader cultural system. Its uniqueness is reflected in the archaeological record (Bukowska-Gedigowa 1975).

Based on these observations, researchers have suggested that the absence of earthen long barrows in southwestern Poland reflects the distinctive burial customs of local communities. It has been hypothesised that these customs differed from the 'Kuyavian barrow' tradition of the lowland Funnel Beaker culture, which may explain why such monuments are not present in this area (Wojciechowski and Cholewa 2006, 229; cf. Rzepecki 2011; Król 2012; 2021).

Following the discovery of the Neolithic cemetery in Muszkowice, a team of researchers from the University of Wrocław, led by Włodzimierz Wojciechowski, took an interest in the site. Between 2001 and 2005, an extensive interdisciplinary research programme was launched under the direction of Piotr Cholewa. The successive stages of the project have been reported multiple times in specialist literature by the excavation authors (Cholewa et al. 2003; 2004; Wojciechowski 2005; Wojciechowski and Cholewa 2006; 2011a; 2011b; Wojciechowski et al. 2002). In addition to fieldwork, the project included a series of specialist analyses to identify environmental elements. In particular, it was the first project in Poland to conduct a detailed petrographic analysis of the stone boulders that form the barrow frames (Cholewa et al. 2004, 50; 2008, 103; Madej and Wójcik 2004; Wojciechowski and Cholewa 2011a, 98, footnote 1).



FIGURE 2. Muszkowice, Site 18 (Lower Silesia, Poland), excavation season 2005. View from the end (NW) of the long barrow No. 2 (photo by P. Cholewa)

Unfortunately, despite the involvement of numerous specialists from various disciplines and the successful completion of the field phase, the results were never fully summarised and published. The situation became further complicated by the death of the chief archaeologist, who was unable to finalise the analysis of the collected documents and archaeological findings (cf. Przybył 2021).

The largest of the six barrows, Barrow No. 2, located in the northern part of Muszkowice Site 18, was selected for excavation (Wojciechowski et al. 2002; Cholewa et al. 2003). The designated excavation area, encompassing both the barrow and its surroundings, was divided into exploration sectors. The central axis of the excavation followed the longitudinal profile of the feature, symmetrical to the shape of the mound. The boundaries between the sectors were marked by transverse profiles set every 5 metres along the central axis (Fig. 4; Wojciechowski and Cholewa 2006, 229).

Ultimately, at the Muszkowice 18 monumental cemetery, two of the six funerary mounds were excavated. The first, Barrow No. 2 – the largest – located in the northern part of the site, was fully investigated. The second, Barrow No. 3 – the smallest – situated at the centre of the cemetery, has only been partially examined to date. The excavations aimed to document the construction details of the mounds and their internal structures. Researchers sought to identify the strata composing the mounds, document their internal layouts, and gather data to establish a chronology. The results of the fieldwork were published in a series of reports (Cholewa et al. 2003; 2004; Wojciechowski 2005; Wojciechowski and Cholewa 2006; 2011a; 2011b; Wojciechowski et al. 2002; see also Przybył 2021). Finally, information on the construction details of Barrow No. 2 was summarised in a publication presenting a description of the hypothetical stages of its construction (Wojciechowski and Cholewa 2011a, 97–98).

The description was based solely on archaeological observations. The authors of the initial surveys were convinced that a form of soil bedding was first constructed to serve as a foundation layer, upon which a frame of stones was placed and subsequently filled with layers of soil. This conclusion was drawn from the documented stratigraphy of the horizontally

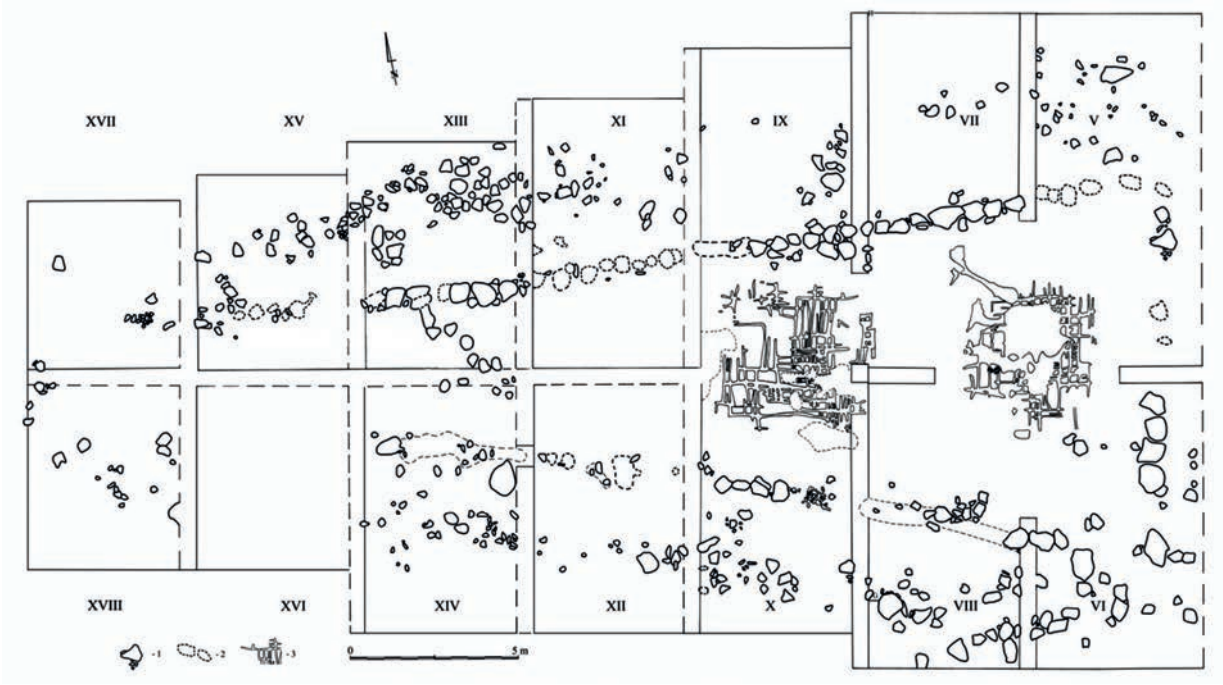



FIGURE 3. Muszkowice, Site 18 (Lower Silesia, Poland). Plan of the earthen long barrow No. 2. Legend: 1 – stone boulders; 2 – absent stone marks; 3 – Neolithic ploughing marks (drawn by N. Lenkow)

stacked successive layers of the mound, which exhibited varying colours (cf. Cholewa et al. 2004, Fig. 6). In their reports, the authors repeatedly highlighted a 'reversal of the stratigraphy of the natural surroundings of the barrow'. This consisted of layers where the lowest, framed by stones, was the darkest ('tar-black humus'), while the upper layers showed an increasing admixture of light yellow loess (Wojciechowski and Cholewa 2011a, 98; cf. also Wojciechowski and Cholewa 2006, 231).

However, only the results of detailed soil and micromorphological analyses, initiated in 2014 and continued between 2018 and 2021, made it possible to verify this earlier interpretation, which had been based solely on a visual assessment of the changing colouring of the barrow mound. The soil forming the mound of an analogous earthen long barrow at another site, Muszkowice 45, was subjected to a detailed soil survey (Kabala et al. 2015, 187–199; 2019). Contrary to earlier observations, the darkest black humus layer, a few tens of centimetres thick, visible beneath the mound's foundation level and extending slightly beyond the stone frame, was not an anthropogenic creation or a hypothetical 'soil bedding' (cf. Cholewa et al. 2004, fig. 6). Instead, it was an unaltered remnant of the original humus with chernozem characteristics. This was confirmed by the results of soil analyses, which have reshaped the researchers' understanding of the genesis of the Lower Silesian 'chernozem' (Kabala et al. 2015, 190; 2019; 2025).

At the widest part of Barrow No. 2, at its front, a burial place was documented. The remains of the deceased were barely preserved. The body had been placed in a pre-prepared area that showed signs of deliberate ploughing (Fig. 5). A tooth fragment indicated that the deceased had been positioned with the head facing west. Two pottery vessels (Figs 6–7) were placed in the grave as funerary offerings: a funnel-shaped beaker, decorated on the upper part with symmetrically placed small V-shaped applications, and a jug adorned with rows of vertical impressions made with a rectangular stamp (Wojciechowski and Cholewa 2011a, 97).

A second cross-ploughed area was also discovered within the barrow (Figs. 8–9). They were both roughly rectangular and aligned along its symmetrical axis. The first measured 4.0



FIGURE 4. Muszkowice, Site 18 (Lower Silesia, Poland), excavation season 2004. Burial place with ploughing marks

× 4.5 m, while the second was slightly larger, at 4.4 × 4.6 m. These features were located at the front of the mound, 2.8 m apart. The plough furrows exhibited a V-shaped cross-section and were spaced between 0.10–0.20 m and 0.07–0.24 m, respectively. Their documented depth ranged from 0.16–0.2 m. The furrows were distinguishable against the yellow loess and were filled with black humus (Wojciechowski and Cholewa 2011a, 100, figs 7–8).

The excavations yielded several dozen artefacts from the barrow mound, including pottery fragments and small flint artefacts. A single pottery assemblage was also found within the stone frame. The recovered fragments belonged to a vessel with technological characteristics and a form consistent with the Funnel Beaker culture (Wojciechowski and Cholewa 2006, 231, fig. 9; 2011a, 102, fig. 11).

During the 2019 excavation season, further investigations were conducted at Muszkowice 18. In contrast to previous years of research, the focus was on the smallest elongated mound (Barrow No. 3). This excavation led to an unexpected and very important discovery: a Late Neolithic burial associated with the Corded Ware culture had been interred within a pre-existing barrow mound originally built by the Funnel Beaker culture community. The person whose body was placed in the burial was equipped with a quiver of arrows for the bow, of which flint arrowheads have been preserved. Otherwise, the Late Neolithic archer had no other funerary offerings (Przybył et al. in prep.).

As early as the early 2000s, archaeologists had already begun questioning whether Muszkowice 18 was an isolated case of a unique monumental cemetery or was part of a broader phenomenon occurring across present-day Lower Silesia (Wojciechowski 2005, 165). In 2012, Agnieszka Przybył conducted a non-invasive research project that included a comprehensive survey of the Muszkowice Forest. This led to the discovery of numerous cemeteries with round barrows, as well as 15 additional sites featuring earthen long barrows. Interestingly, at one of the sites, two small round mounds superimposed on a Neolithic long barrow have been identified (Przybył 2014; 2016).

As part of a large-scale project conducted between 2018 and 2021, researchers confirmed that the placement of small round barrows atop Neolithic mounds was a recurrent practice. Excavations at Muszkowice, Site 45, further reinforced earlier



FIGURE 5. Muszkowice, Site 18 (Lower Silesia, Poland), pottery from the grave of the Funnel Beaker culture (photo by P. Cholewa)



FIGURE 6. Muszkowice, Site 18 (Lower Silesia, Poland), pottery from the grave of the Funnel Beaker culture



FIGURE 7. Muszkowice, Site 18 (Lower Silesia, Poland), excavation season 2004. View from the front (SE) of the long barrow No. 2 with the ploughing marks in the foreground (photo by P. Cholewa)

hypotheses concerning their early medieval origin. This evidence indicates that burial practices at Muszkowice originated in the Neolithic, with early medieval cremation mounds representing the final stage of barrow construction at the site. Considering the findings at Muszkowice 18, this suggests that these cemeteries were repurposed for burials in a continuative way, not only in the Neolithic but also in later periods (Przybył 2014, 2016, 2019).

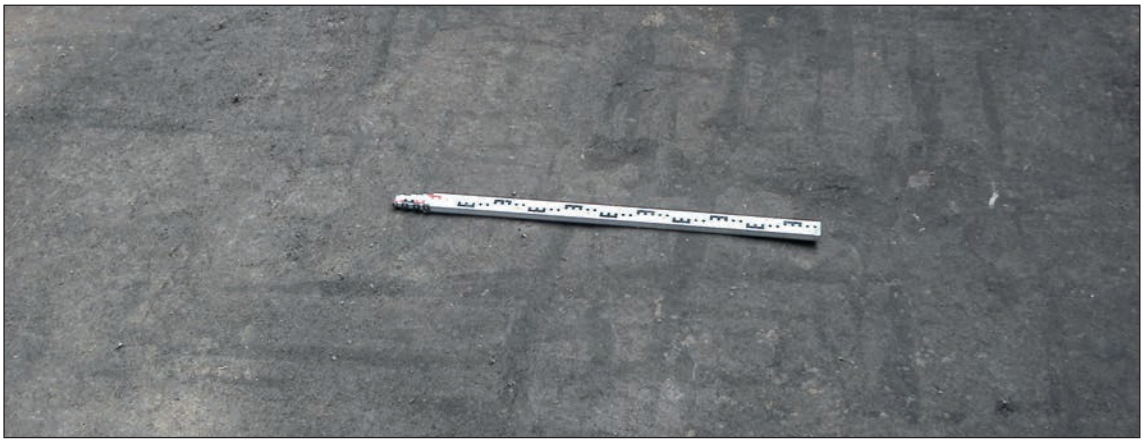


FIGURE 8. Muszkowice, Site 18 (Lower Silesia, Poland), excavation season 2004. The ploughing marks inside the barrow mound

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# BRONOCICE, SITE 1

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Site 1 in Bronocice, Działoszyce commune, Pińczów County, is situated in western Lesser Poland on three loess hilltops (locally known as Baski) above the Nidzica Valley, a right-bank tributary of the Vistula River. Research conducted by a Polish-American expedition here in the 1970s yielded fundamental discoveries for studies of the Eneolithic period in southeastern Poland. Their work resulted in the creation of a chronological framework (finally: Kruk, Milisauskas 2018; Kruk et al. 2018) and the development of a model of settlement and economic changes (e.g., Kruk et al. 1996; Kruk, Milisauskas 1999). At that time, this was a large-scale project: covering a total area of 5,608 $m^2$. Although this represented only a small percentage of the site's surface, rich material from several chronological phases was recovered, offering particularly valuable sources for research on Eneolithic settlement in the 4th millennium BCE.

The significance of the initial discoveries in Bronocice led to the undertaking of verification fieldwork in 2020–2022 to refine earlier results. A new project, titled "The Earliest Phases of Settlement in Bronocice", was funded by the National Science Centre (project no. NCN OPUS 2019/35/B/HS3/03860). Its main goals were: non-invasive exploration of the entire site using magnetic prospection, and testing previous findings regarding the earliest phases of the Eneolithic settlement through excavations. These excavations took place on the western peak of Baski Hill, in Area C (Fig. 1). The trench arrangement was designed to provide novel insights into the extent and character of settlement during the Funnelbeaker and the Lublin-Volhynian culture periods. The goal was to gather homogeneous assemblages of artefacts, especially relating to Phase BR I of the Funnelbeaker culture.

Magnetic prospection, which covered nearly the entire Bronocice Hill, clearly revealed the spatial organisation of settlements from different prehistoric periods (Przybyła et al. 2026). Particularly striking is the depiction of defensive ditches linked with the Lublin-Volhynian culture (Area C), the Funnel Beaker culture (Area A), the Funnel Beaker-Baden group (Area B), and the Trzciniec culture (Area C). The arrangement of utility pits, forming zones of intensive use, is also evident, especially in Areas A and B.

New excavations (2021–2022) took place at Site C, covering an area of 5,000 $m^2$ (Fig. 2). During these works, additional fragments of the previously identified Lublin-Volhynian culture settlement were examined (Kruk, Milisauskas 1985). A total of 47 different types of pits, one burial, and a defensive fortification system were uncovered. The latter consisted of an external moat with a V-shaped cross-section, measuring 2–3 m in width, with a palisade groove on the inner side. This fortification enclosed an area of 3.13 hectares (220×190 m). Ceramic finds from the settlement pits are quite homogeneous and reflect the style of the late phase of the Lublin-Volhynian culture. Notably, the inventories of the Lublin-Volhynian culture contain relatively numerous sherds with features of Subneolithic pottery. A series of radiocarbon dates suggests a period of approximately 3800–3650 BCE.

Forty-four Funnelbeaker culture settlement features were found in the western part of Area C, specifically in Trenches C11 and C14 (Fig. 1). These pits were situated near features investigated in the

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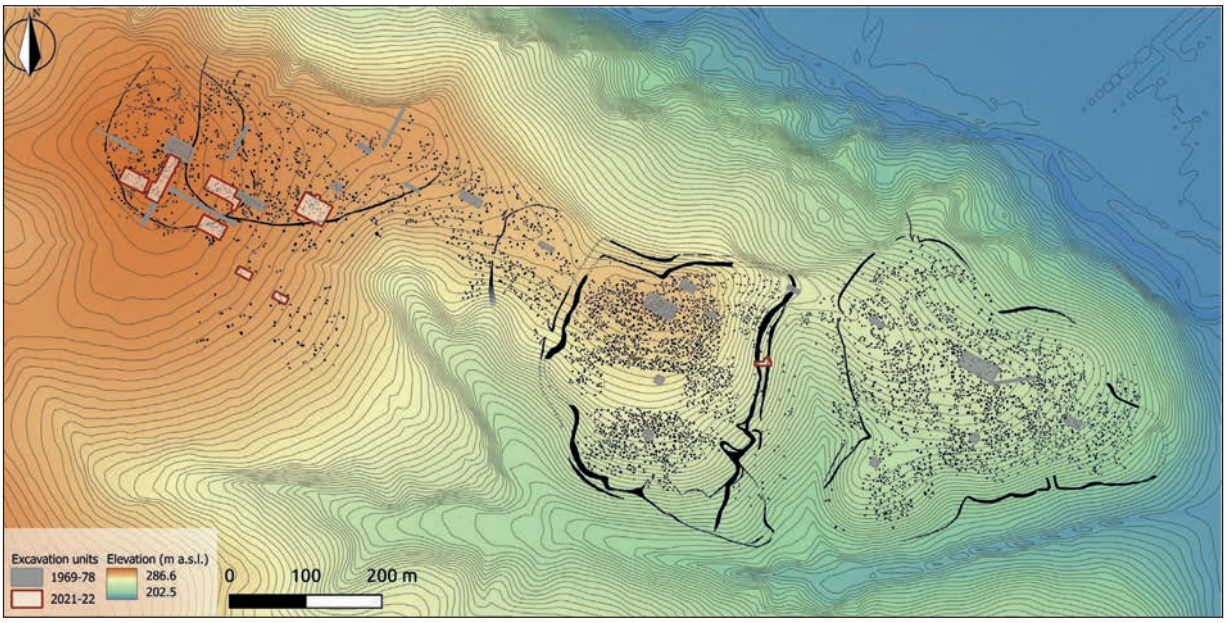



FIGURE 1. Plan of Site 1 in Bronocice, with location of excavation units and interpretation of magnetic survey overlaid on the elevation map (illustration by T. Oberc, M. M. Przybyła, and M. Podsiadło)

earlier studies, classified as phase BR I (Kruk, Milisauskas 2018, plates 6–8). They are linked to the oldest Funnelbeaker culture settlement on Bronocice Hill. Radiocarbon dating for these features clearly shows they date to after approximately 3650 BCE. Consequently, the BR I phase settlement is slightly younger than the Lublin-Volhynian culture settlement. It lies in the same zone of the hill as the older Eneolithic settlement. In terms of technological and stylistic traits, ceramic materials from this phase represent the earliest stage of the Funnelbeaker culture in the loess uplands of western Lesser Poland.

Twenty Funnelbeaker culture graves were found directly beside the settlement pits. These burials formed part of a cemetery also documented during earlier research (Milisauskas et al. 2016). The graves were shallow, rectangular, and oriented in various directions. They were typically simple pits without stone enclosures. Therefore, Feature 24-C13 was a unique find – a burial in a massive stone enclosure (Fig. 3A). This type of feature resembles primary burials from megalithic tombs of the megaxylon type. Given the erosion at the top of the hill in Bronocice, it cannot be ruled out that long Funnelbeaker culture graves had been levelled, as at other sites in western Lesser Poland. In this case, the megalithic cemetery would have been situated directly east of the early Funnelbeaker culture settlement. It is also possible that this cemetery was linked to a somewhat younger settlement (BR II), located in area A.

In the eastern part of Area C, 25 pits of the Funnelbeaker-Baden group were uncovered. These features are linked to a settlement from Phase BR IV. Based on several radiocarbon dates, their age is roughly 3400/3300–3100 BCE. These finds significantly increase the collection of Funnelbeaker-Baden artefacts in Area C, suggesting intensive occupation during this period, similar to that in Areas A and B.

Survey research conducted at Site 1 in Bronocice revealed several decorated sherds and also axes made of striped flint associated with the Globular Amphorae Culture. During excavations in 2022, four shallow pits associated with this culture were discovered. A particularly abundant and distinctive ceramic assemblage was discovered in Pit 35-C17. Radiocarbon dating of Globular Amphorae Culture features indicates a period around 2850–2600 BCE, i.e., the initial phase of the Final Eneolithic in western Lesser Poland. The specific and sparse



FIGURE 2. Bronocice, Site 1. General view of excavations in 2022 (photo by P. Włodarczak)

Globular Amphorae pits are relics of a short-lived (seasonal?) settlement.

Unexpected was the discovery of a cluster of five Corded Ware graves, including four catacombs. These features were oriented with their longer axes toward a poorly preserved pit grave (Feature 52-C11), possibly a central barrow burial. Among them, a unique find was Feature 38-C11 – a multiple burial in which were the remains of five individuals: two men and three children (Fig. 3B). The remains were accompanied by burial equipment typical of the Kraków-Sandomierz Corded Ware culture group: three ceramic beakers, a stone axe, a flint axe, 15 flint arrowheads, two blade tools, three flakes, a bone chisel and awl, a pendant made from a wild boar's tusk, a stone grinding plate, and a copper retoucher. The burial also revealed a concentration of yellow pigment, jarosite, deposited in a container made of organic material (Siuda et al. 2025). The newly discovered Corded Ware burials date similarly to Feature 67-B1 from Hill B (Milisasuskas, Kruk 1984), i.e., to the beginning of the second half of the 3rd millennium BCE.

In the eastern part of Area C, numerous Bronze Age Trzciniec culture pits were discovered. Remnants of settlement from this period were also documented in research from the 1970s. The Trzciniec culture settlement was surrounded by a defensive ditch – similar to earlier Eneolithic settlements (in earlier publications on the site, this ditch was associated with the Beaker-Baden settlement – e.g., Kruk, Milisauskas 1981, 73). Within the clusters of settlement pits, objects of a funerary or cult nature were discovered. Human burials and sacrificial deposits of animals were discovered within them (Fig. 4). The Bronze Age settlement, studied in conjunction with the study, is currently one of the most valuable sets of sources for the study of the Trzciniec culture in the Western Lesser Poland Loess Upland.

The results of fieldwork from 2021–2022 indicate that the Bronocice site probably holds many more surprises in as-yet unexplored parts of the hill. Excavations have revealed new elements of settlement structures from the Eneolithic and Bronze Age. Fragments of cemeteries from various periods were also documented, including relics of a potential long barrow from the Middle Eneolithic period and a barrow from the Late Eneolithic. Research focused on Area C indicates the feasibility of undertaking similar work in Areas A and B of Baski Hill.




FIGURE 3. Bronocice, Site 1. A - Grave 24-C13 (Funnel Beaker culture), B - Grave 38-C11 (Late Corded Ware) (photo by M. Podsiadło, T. Oberc)




FIGURE 4. Bronocice, Site 1. Feature 7-C13 (Trzciniec culture) (photo by M. Podsiadło)

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# KOSZYCE, SITE 3

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The multiple burial discussed in this paper was discovered in 2011 at Site 3 in Koszyce, Proszowice County (SE Poland). The excavations, headed by Marcin M. Przybyła, were carried out in relation to the construction of a water supply network (Przybyła M. M., Szczepanek A., Włodarczak P., eds. 2013). In addition to the human burial, Feature No. 506 (200×120 cm) was also discovered: an animal burial containing complete or partially preserved skeletons of seven domestic pigs. The assemblage associated with the animal burial consisted of a single, nearly complete, richly decorated amphora and three fragments of grinding stones.

The human multiple burial (Feature 523) was discovered at a depth of 60 cm, approximately 1.5 m east of the animal burial. It was oriented along a north–south axis and had a rectangular plan with rounded corners (dimensions approximately 245×135 cm). The remains of 15 individuals were identified in the grave, arranged in an antipodal layout, with skulls placed at two opposite ends of the feature and the lower limbs oriented toward the centre, partially intermingled. Most of the skeletons lay in positions close to extended or slightly flexed, on their backs and partly on their sides. The anatomical articulation of all the skeletons and the numerous observed interactions between them clearly indicate that the burial was deposited in a single event. This is further confirmed by the position of the grave goods, placed on top of the layer of human remains (Fig. 1). The rich assemblage comprised 76 artefacts and six unprocessed animal bones. It included six ceramic vessels, eight amber ornaments, two bone ornaments, two bone tools, one unspecified bone object, 13 wild boar tusks, and 44 flint artefacts (five axes, two chisels, 30 blades and their fragments, six flakes, and one core). Almost all the vessels were placed in the southern part of the grave, while the remaining elements of the assemblage were located in the northern part. This burial is among the best-equipped and contains the largest number of individuals among the multiple graves of the Globular Amphora culture discovered to date. For the features from Koszyce, 23 radiocarbon dates were obtained, suggesting a date range of the first half of the 3rd millennium BCE (with the highest probability: 2880–2870 BCE). Similarly, most other graves of the Globular Amphora culture from Małopolska are dated to this period. This coincides with the age of the earliest Final Eneolithic burials: the Złota culture and the early stage of the Corded Ware culture.

The discovery of richly furnished graves of this culture on the loess uplands of western Małopolska alters the reconstructed picture of cultural relations in the region. Until now, this area had been included within the settlement zone of the Baden and post-Baden cultural milieu.

All individuals interred exhibited perimortem cranial trauma, which may have directly caused death (Konopka et al. 2016). Although the perpetrators cannot be identified, the victims were buried in accordance with the funerary practices characteristic of the Globular Amphora culture. Consequently, alongside explanations invoking intra- or inter-group violence, the possibility that the killings had a ritual dimension should also be considered. The most common injuries are cranial fractures, indicating that the individuals died from blows to the head (Fig. 2). The nature of the injuries and the near absence of limb fractures

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FIGURE 1. Koszyce, Site 3: reconstruction of the multiple burial (as in Schroeder et al. 2019)




FIGURE 2. Koszyce, Site 3: examples of perimortem trauma identified on the skeletal remains of the buried individuals (as in Schroeder et al. 2019)

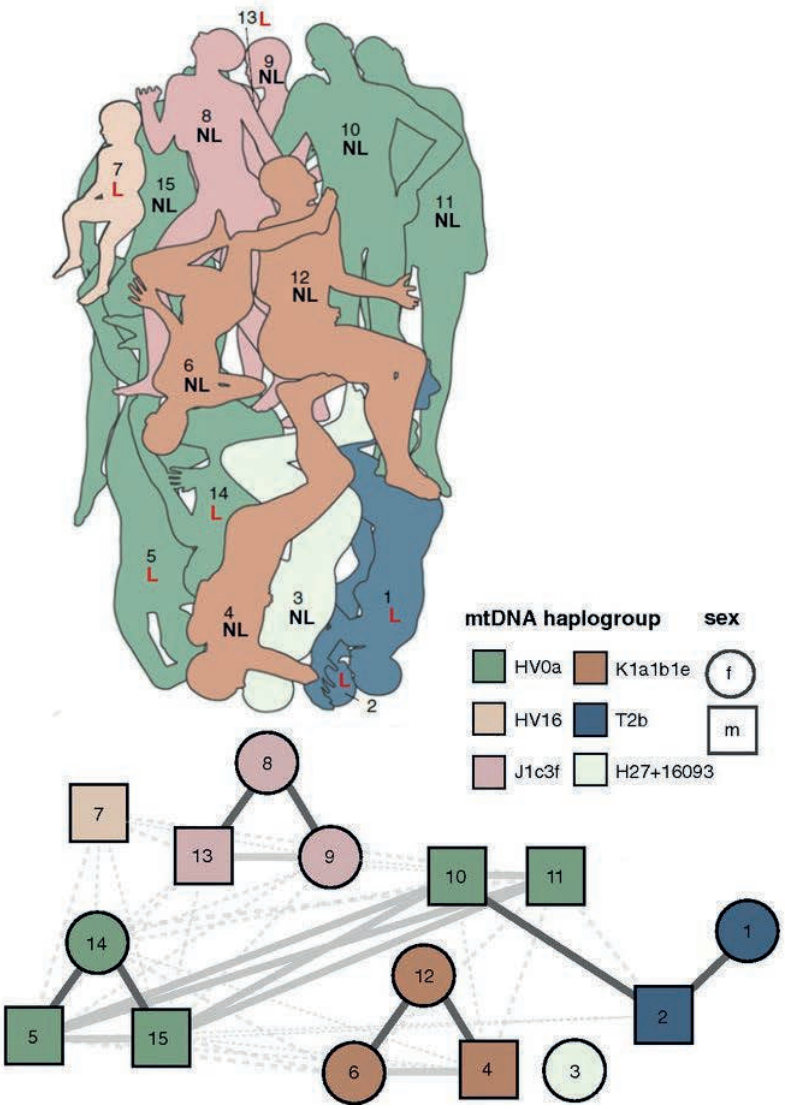



FIGURE 3. Koszyce, Site 3: genetic kinship and provenance of the interred individuals (as in Schroeder et al., 2019; Włodarczak, Szczepanek, Przybyła 2021)

suggest that the deceased were captured and executed, rather than killed in hand-to-hand combat.

The genomes of all 15 individuals were sequenced (Schroeder et al. 2019). The results indicate that the burial contained a multigenerational family and that the community responsible for the interment was aware of the familial relationships among the deceased (mothers were placed next to their children, and siblings were placed next to each other). Genetic data and morphological analyses allowed the identification of eight males and seven females within the grave. An analysis of mitochondrial DNA (mtDNA) revealed the presence of six distinct maternal lineages, while an analysis of the non-recombining region of the Y chromosome showed that all males shared the same Y-chromosome haplotype: I2a-L801. The individuals from Koszyce were not closely inbred, although their ancestral population was small. The burial represents a large, multi-generational family connected through several first- and second-degree relationships. In total, four nuclear families were identified, most of which are represented by mothers and their children (Fig. 3). For example, Individual 14, the

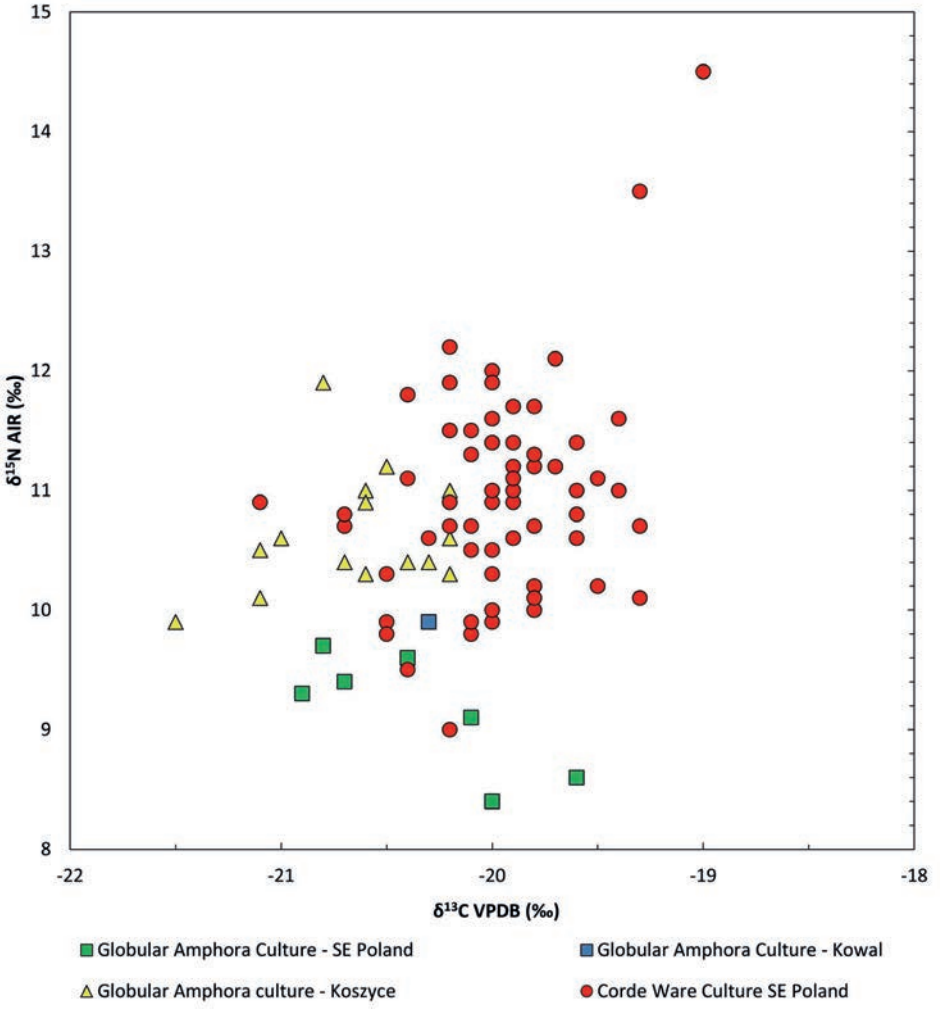



FIGURE 4. Stable carbon and nitrogen isotope composition in human bone collagen (as in Włodarczak, Szczepanek, Przybyła 2021)

oldest individual in the grave, was buried near her two sons (Individuals 5 and 15), whereas Individual 8, a 30–35-year-old female, was interred with her teenage daughter (Individual 9) and 5-year-old son (Individual 13). Individuals 5, 10, 11, and 15 appear to be brothers, but they do not share the same mother (Individual 14 is the mother of Individuals 5 and 15, but not of 10 and 11), suggesting that they may be half-siblings. However, all four share the same mitochondrial DNA haplotype, suggesting that their mothers may also have been related. Most of the older males/fathers are absent from the grave, indicating that they may have been responsible for burying their relatives. The only father present in the grave is Individual 10, opposite whom his son and the child's mother were interred together. Remains of a boy (Individual 7), aged 2–2.5 years, were also identified; his parents are not present in the grave, but he was placed next to other individuals to whom he was related. Only one adult female (Individual 3) is not genetically related to the other group members. The presence of unrelated women alongside related men is significant, as it suggests that the Koszyce community was organised according to a patrilineal descent system, which connects with the growing evidence for the predominance of this form of social organisation among Late and Final Eneolithic communities in Central Europe. Patrilineal social organisation is typically associated with female

exogamy, i.e., the practice of women marrying outside their own social group.

The results of archaeological research suggest that Globular Amphora communities specialised in animal husbandry, often focusing on cattle. Analysis of stable carbon and nitrogen isotopes in bone and tooth samples from the interred individuals indicates a terrestrial diet based on C3 plants, supplemented with animal protein (Fig. 4). Age-related differences among the interred individuals are also apparent, with a distinct group of the youngest children (Individuals 2, 7 and 13). Differences between adult females and males are not pronounced, although most men exhibit slightly higher $\delta^{15}N$ values (Włodarczak et al. 2021).

Analyses of strontium isotope composition ($^{87}Sr/^{86}Sr$) in human tooth enamel, combined with anthropological and genetic data and the determination of local strontium isotope ranges in south-eastern Poland, allowed for a more detailed assessment of the origins of the interred individuals (Fig. 3). Based on local bio-available strontium isotope values ($^{87}Sr/^{86}Sr$) ranging from 0.7095 to 0.7105, it appears likely that some members of the interred family were born in the vicinity of Koszyce, while others, exhibiting slightly more radiogenic strontium isotope values ($^{87}Sr/^{86}Sr$ = 0.7113–0.7120), may have been born in a different region of south-eastern Poland (Włodarczak et al. 2021). Considering the complex geology of the region, the likely area of origin for the remaining individuals was either the Sandomierz Upland or the Świętokrzyskie Mountains, where the geological substrate is rich in rocks and sediments characterised by high $^{87}Sr/^{86}Sr$ values. Strontium analyses indicate that the studied group (or at least part of it) had been residing in western Małopolska for several years. At the same time, isotopic evidence clearly indicates an allochthonous origin for some members. They probably migrated from the aforementioned Świętokrzyskie Mountains–Sandomierz Upland region, a conclusion further supported by archaeological evidence based on the analyses of grave inventories.

Biological data and burial evidence indicate that the social relationships considered most important in these communities corresponded closely to genetic and reproductive ties. However, they also show that nuclear families were part of larger, multi-generational groups living together either year-round or for part of the year.

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# SZCZEPANOWICE, SITE 1

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Rescue archaeological excavations conducted in advance of the construction of the S7 expressway, commissioned by the General Directorate for National Roads and Motorways, resulted in the discovery of numerous cemeteries dating to the Final Eneolithic and the Early Bronze Age. Among them was a spectacular find: a multiple human burial of the Corded Ware culture at Site 1 in Szczepanowice, Miechów County, Małopolska (Fig. 1). The excavations carried out in 2016 were headed by Izabela Gomułka, on behalf of a consortium comprising the University of Wrocław, Adam Mickiewicz University in Poznań, the Archaeologia Silesiae Science Foundation, and the Institute of Archaeology and Ethnology of the Polish Academy of Sciences. The Corded Ware culture burial (feature B40) was located near the western boundary of an extensive excavation area, with scant evidence of Neolithic (Malice culture) and Early Bronze Age settlement (associated with the Mierzanowice and Trzciniec cultures). More substantial finds were attributed to later settlements, namely the Pomeranian culture and the Late Middle Ages (Dreczko et al., eds. 2021). In addition to the grave itself, the ceremonial–funerary complex dating to the Final Eneolithic also included five oven pits: features characteristic of Corded Ware culture cemeteries. These ovens indicate the presence of a larger number of Final Eneolithic graves, most likely situated near the boundaries of the investigated area.

Grave B40 had a niche construction, characteristic of the younger phase of the Małopolska Corded Ware culture (Fig. 2.1). The entrance pit was rectangular in shape and located on the southeastern side of the niche. Initially, the burial niche was an empty chamber measuring 295×230 cm and 170 cm deep from ground level. On its floor, the remains of four individuals were uncovered: a female aged 30–35 years (Individual A), a girl aged 12–13 years (B), a boy aged 8–9 years (C), and a male aged 45–50 years (D). The deceased were laid in a flexed position, arranged antipodally in same-sex pairs: the males with their heads oriented to the southwest, and the females with their heads oriented to the northeast (Fig. 2.2). Two trepanation openings were identified on the left parietal bone of the adult male.

All grave goods were deposited at the level of the buried individuals (Figs. 3 and 4). They were arranged on the southwest, northwest, and southeast sides. The southeastern sector (near the entrance to the grave) was the only place with no offerings deposited. An amphora, a beaker, as well as an antler wedge and a copper awl were excavated, clustered to the south of Individual B. Two beakers lay near the skull of Individual C. A third group of finds was uncovered northwest of the bones of Individual D: two beakers, a stone battle-axe, a flint axe, two small flint arrowheads, a bone chisel, a bone awl, two retouched blades, a preform of an arrowhead, and five flakes. This assemblage was most likely dedicated to the adult male. In contrast, ornaments were discovered with the bones of the female and the girl. Associated with Individual A were two copper hair-rings (near the skull), a crescent-shaped copper pendant (within

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FIGURE 1. Szczepanowice, Site 1. Corded Ware culture collective burial during excavation




FIGURE 2. Szczepanowice, Site 1. Corded Ware culture collective burial during excavation

the rib area), and two beads made from animal teeth, together with a figure-eight-shaped bone pendant (near the pelvis). With the burial of the girl (B), the following items were found: a copper hair-ring (near the skull), six oval beads made from animal teeth (near the cervical vertebrae), a fragment of a bovine rib (near the rib bones), and a bone tube (near the pelvis). In addition, a flint arrowhead was discovered directly adjacent to the femur of Individual A. This artefact was covered with a whitish patina indicative of a metabolic coating formed as a result of long presence in the victim's body.

Grave B40 from Szczepanowice displays ritual features characteristic of the younger phase of the Corded Ware culture in southeastern Poland. The deceased were arranged and oriented in a manner typical of western Małopolska; notable aspects include the aestheticised placement and

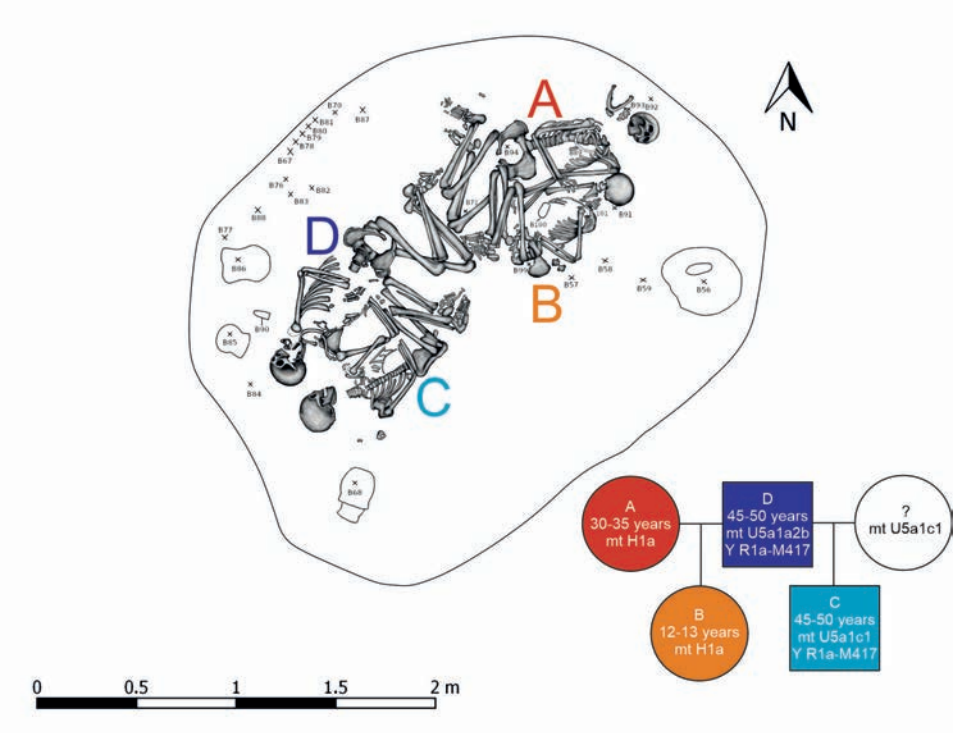



FIGURE 3. Szczepanowice, Site 1. Feature B40. Corded Ware culture grave (drawing by M. Podsiadło) and diagram illustrating the results of the aDNA analysis (as in Haak et al. 2023)

symmetrical arrangement of the bodies within the grave, as well as the attribution of specific grave goods to particular individuals. In terms of the quantity and quality of grave offerings, the burial under discussion ranks among the best-furnished graves in western Małopolska. All six vessels (the amphora and five beakers – Figs. 4.1–6) display technological and stylistic traits (including S-twisted cord impressions) characteristic of the Kraków area (Włodarczak 2006). By contrast, the other elements of the assemblage exhibit features typical of southeastern Poland, including typological standardisation and deliberate raw material selection. Flint for all artefacts was sourced from the eastern margin of the Świętokrzyskie Mountains, located more than 100 km from Szczepanowice. The battle-axe (Fig. 5) was made of antigorite serpentinite, probably originating from Lower Silesia (analysis by Michał Borowski). The copper, likewise, most likely originated outside Małopolska, although its precise source remains challenging to determine (possibly southern Slovakia). The multidirectional and, at times, long-distance provenance of the elements of the grave assemblage reflects patterns of raw-material valorisation in Final Eneolithic communities, in which selected materials held particular prestige (Włodarczak 2017).

Based on four radiocarbon dates obtained from the burial bones, the absolute age of Grave B40 from Szczepanowice has been determined to fall within the range of approximately 2400–2300 BCE (the mean calibrated date is 2364 BCE, with an age uncertainty of ±54 years). This corresponds to the latest phase of the Corded Ware culture in southeastern Poland, which overlaps with the chronology of Bell Beaker culture cemeteries. The relatively late date of the Szczepanowice grave is further corroborated by features of certain vessels, which exhibit stylistic parallels with Early Bronze Age ceramics.

Using aDNA analyses, the degree of kinship among the four individuals from Szczepanowice was determined (Haak et al. 2023). It was revealed that the burial was familial, consisting of a mother, a father, and two children. The analyses showed that the man was the father of both children. At the same time, the woman was the mother only of the girl

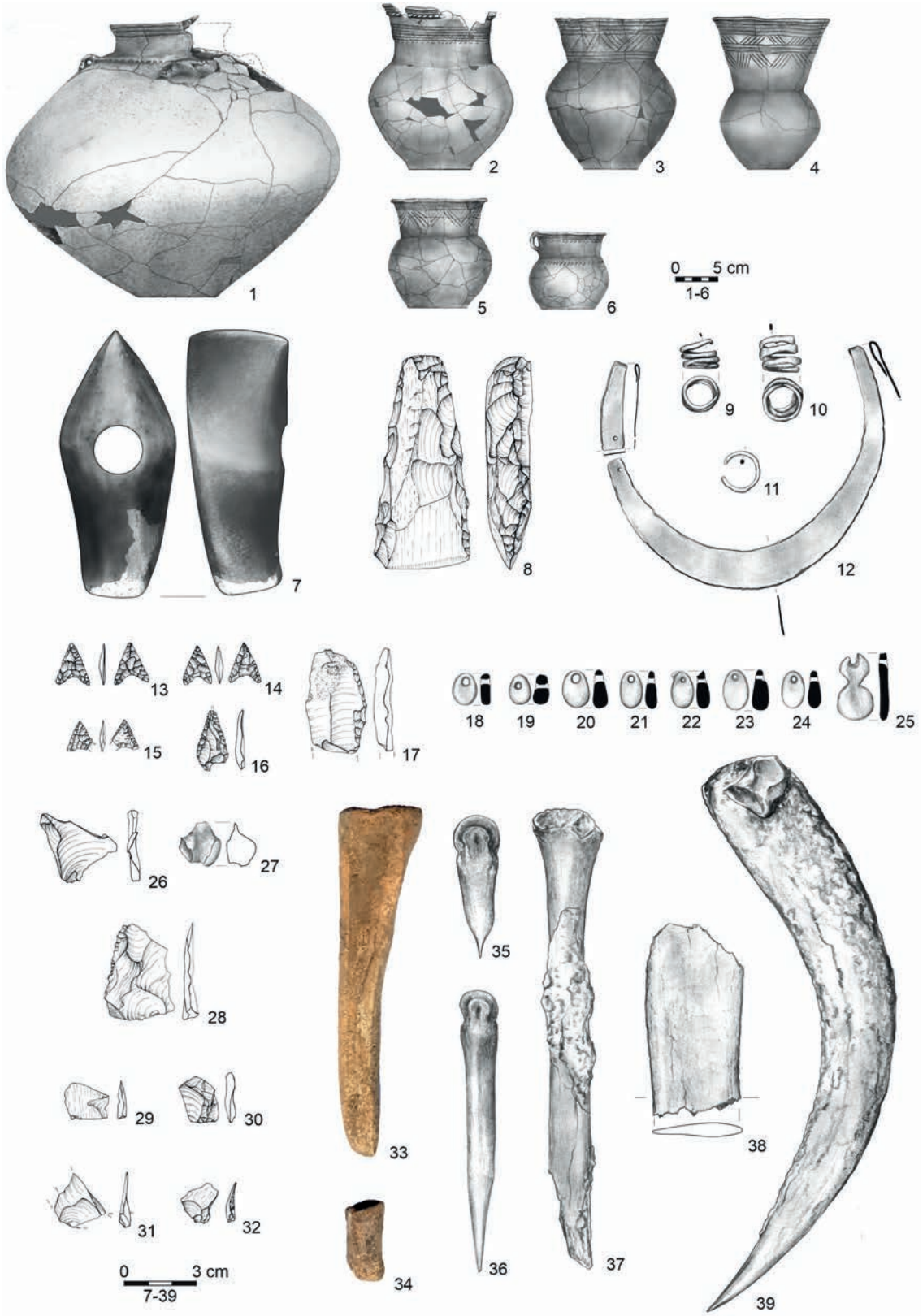



FIGURE 4. Szczepanowice, Site 1. Feature B40. Grave goods of the Corded Ware culture burial (drawing by N. Lenkow and A. Dziedzic, photo by I. Gomułka)




FIGURE 5. Szczepanowice, Site 1. Feature B40. Serpentinite axe (photo by M. Borowski)

buried alongside her (Fig. 4). In Małopolska, close kinship relationships have also been documented in a paired burial at Site 15 in Święte, Jarosław County, where the remains of a mother and daughter were discovered (Linderholm et al. 2020). Kinship among the deceased was also identified in separate niche graves located in close proximity to one another (Święte, Site 20; Linderholm et al. 2020). The results of archaeogenetic studies thus corroborate the suggestive picture that emerges from archaeological analyses of the burial ritual. These analyses indicate that the appearance of the grave, the nature of the grave goods, and the arrangement of the bodies reflect an attempt to reproduce, in burial, the social and familial relationships of the deceased.

Stable carbon and nitrogen isotope analyses provide insight into the diet of the individuals buried at Szczepanowice. The $\delta^{13}C$ values are very similar, ranging from –19.7‰ to –19.5‰. Slightly greater variation is observed in $\delta^{15}N$ values, from 10.5‰ (for the boy) to 11.2–11.5‰ (for the woman and man). The $\delta^{13}C$ values are noticeably higher than those recorded for Early Eneolithic and Bronze Age populations from western Małopolska. They also indicate a significant role of meat in the diet. These results are broadly consistent with values obtained for individuals of the Corded Ware culture from various regions of southeastern Poland (Szczepanek and Jarosz 2022). In her detailed anthropological analysis, Agata Hałuszko determined indicators of both quantitative and qualitative dietary deficiencies in the buried individuals. Additionally, the bones of the adult male and both juvenile individuals showed injuries most likely incurred *perimortem*.

The Szczepanowice burial exhibits features of a funerary ritual typical not only for western Małopolska. Similar graves have been found in other parts of Europe, suggesting a broadly shared concept of Final Eneolithic family burials. An identical case is the well-known Burial 6-0099 from Eulau in Central Germany, which also contained the remains of a woman, a man, and two children (Meyer et al. 2009, 414, Fig. 1:A). Other analogues include features from Oechlitz, also in Central Germany (Fröhlich, Becker 2017), Kösching in Bavaria (Tillmann 1996), and Bronocice in Małopolska (unpublished research, 2021). In all of these cases,

there is a clear intention to represent, through the arrangement of the bodies, the social and familial bonds linking the buried individuals.

Genetic studies indicate that both male individuals carried the Y-chromosome haplogroup R1a-M417, characteristic of Corded Ware culture populations (Haak et al. 2023). This haplogroup has a steppe origin and the area where it occurred underwent rapid expansion in the early 3rd millennium BCE. Burials showing evidence of violent trauma are generally dated to this period (after c. 2900 BCE). At Szczepanowice, the individuals buried together were most likely closely related and appear to have been victims of intergroup armed violence. Their kin buried them, aware of the familial relationships linking the deceased. The evidence of violence documented here, as in the aforementioned collective burials from Central Germany, indicates victims of armed skirmishes. This interpretation is further supported by injuries identified in Final Eneolithic graves (including Szczepanowice) caused by arrows. By contrast, the traces of violence recorded in somewhat earlier burials of the Globular Amphorae culture, for example, at Koszyce, Proszowice County, appear to have a different character. There, the systematic nature of the recorded injuries suggests a ritualised form of violence (Konopka et al. 2016).

In terms of data quality and the scope of the specialist analyses conducted, the Szczepanowice burial ranks among the most important sources for understanding Final Eneolithic communities in southeastern Poland. It also underscores the great significance of multiple burials in bioarchaeological studies, which today play a leading role in prehistoric interpretations.

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# SUPRAŚL, SITE 3

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Understanding the Neolithic and Early Bronze Age in north-eastern Poland requires focusing on sites with specific topographical locations. Settlement and ritual remains in this region are closely linked to the economy of hunter-gatherer communities, prevailing in the cultural landscape up to the Bronze Age. Consequently, archaeological investigations are primarily concentrated within and immediately adjacent to river valleys - areas naturally defined by elevations, islands, and promontories (cf. Wawrusiewicz 2022, 34, fig. 2).

One such location is Site 3 in Supraśl (municipality of Supraśl, Białystok County, Podlaskie Voivodeship), situated on the North Podlasie Lowland. It was a ritual site located on a small erosional outcrop within the Supraśl River valley, which at this point reaches a width of approximately 600 m and runs latitudinally, separating an esker ridge from a moraine plateau (Fig. 1). The surface of the elevation has largely retained its original form, undergoing only minor modifications in modern times when shepherds started to set up camps there.

The site itself is weakly stratified. Only a modern humus layer with grass and tree roots can be distinguished, overlying a subsoil/illuviation layer, beneath which lies the geological substrate composed of coarse-grained fluvio-glacial sands and gravels. Artefacts made of flint and fragments of vessels associated with the Neolithic hunter-gatherer camps, the Corded Ware culture, or much later Iron Age societies were documented exclusively in the central segment. While the identified episodes did not manifest themselves in finds of particular interpretative value, four compact and exceptionally well-preserved assemblages containing prestige and symbolically significant objects associated with Eneolithic Bell Beaker groups may be described as spectacular.

The site was first documented in 1988 based on a small and fragmented collection of artefacts of little cognitive value. Initial archaeological surveys were conducted here in the summer of 2014 under the direction of Dariusz Manasterski. The work was carried out by the Podlaskie Museum in Białystok and the Faculty of Archaeology at the University of Warsaw as part of the Knyszyn Forest Microregion project. The decision was motivated by an analysis of the terrain's form, which corresponded to the settlement patterns of local Neolithic and Early Bronze Age groups. The proximity of Site 6 in Supraśl, where remains of ritual activities containing elements of the Bell Beaker culture were identified, was also of significance (Wawrusiewicz et al. 2015, 90n.; Manasterski et al. 2021). The discovery of a funerary-ceremonial deposit associated with Bell Beakers, exotic in this area, was the impetus for continuing work from 2015 to 2017 (Wawrusiewicz et al. 2015, 31–90; Manasterski et al. 2020). In total, an excavation area of 270 $m^2$ was investigated, covering most of the summit of the elevation, where three more similar structures were identified, as well as its southern slope where finds from the Early Iron Age prevail.

The location of the site, its geological structure, and the specificity of the archaeological sources determined the scope of the field research methods. The forest cover on the edges and parts of the summit, along with the sub-surface nature of the documented materials, rendered non-invasive

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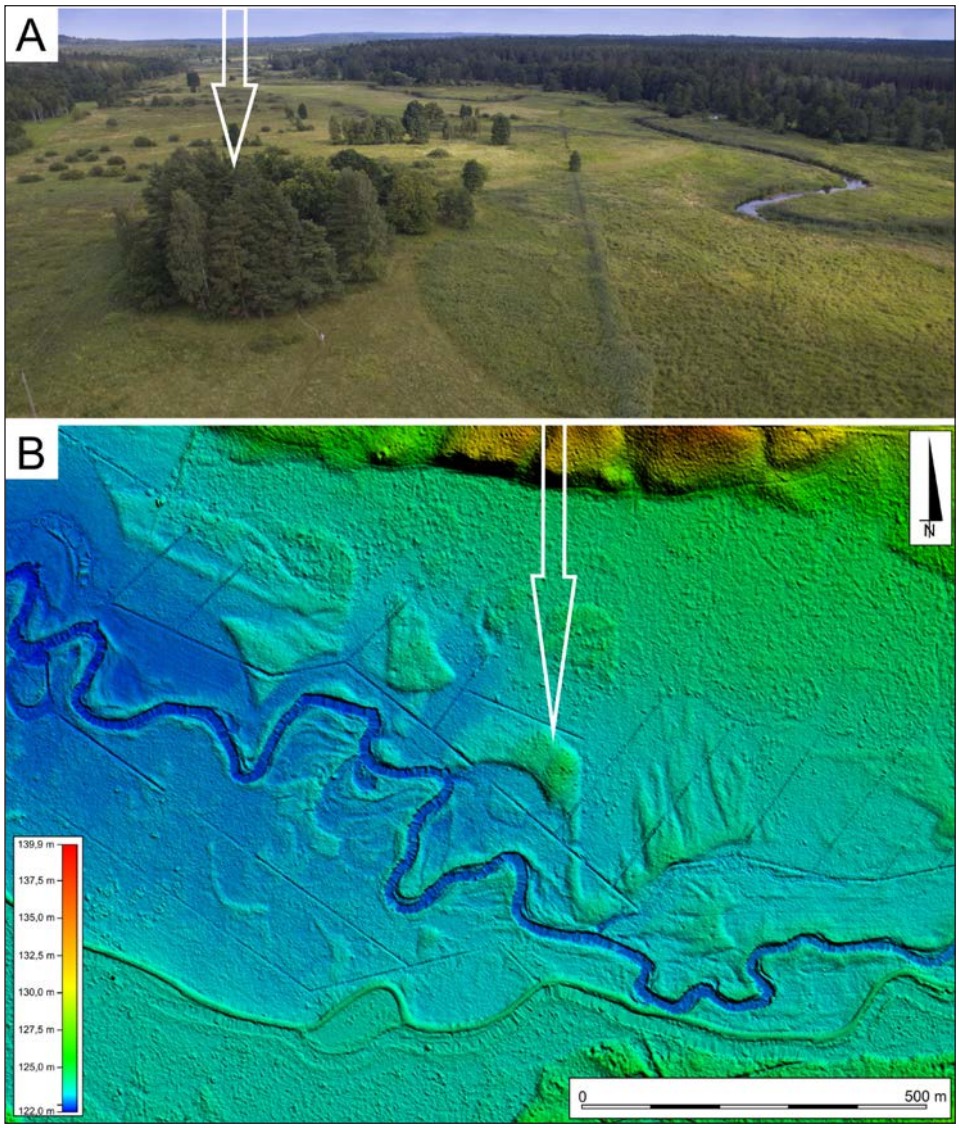



FIGURE 1. Supraśl, Site 3, Białystok region, Podlaskie Voivodeship. The location of the site is marked on the aerial photograph (A) and the digital terrain model (B) of a fragment of the Supraśl valley

methods impossible. Therefore, the process of field research was limited to excavation methods.

The cognitive significance and diversity of evidence identified within the ritual structures prompted the undertaking of multi-faceted specialized analyses. Off-site studies focused on determining the environmental context of the site (Kwiatkowski 2015) and traces of human presence recorded in the nearby palynological profile (Kupryjanowicz and Szal 2015).

The cremated bones were subjected to osteological analyses (Jaskulska 2015). Amber ornaments and stone items were examined in terms of raw materials (Kwiatkowska 2015; Krajcarz 2015). The remains of organic substances preserved on the surface and inside the pottery were also analyzed (Rosiak and Kałużna-Czaplińska 2015; Pietrzak 2015). To refine the chronology, a series of radiocarbon dating was carried out; however, the results were not satisfactory (see Wawrusiewicz et al. 2015, fig. 45).

In total, the four discovered structures of the Bell Beaker culture formed a pattern of points spaced approximately 2 to 3 metres apart, marking a line running along the E-W axis. They were

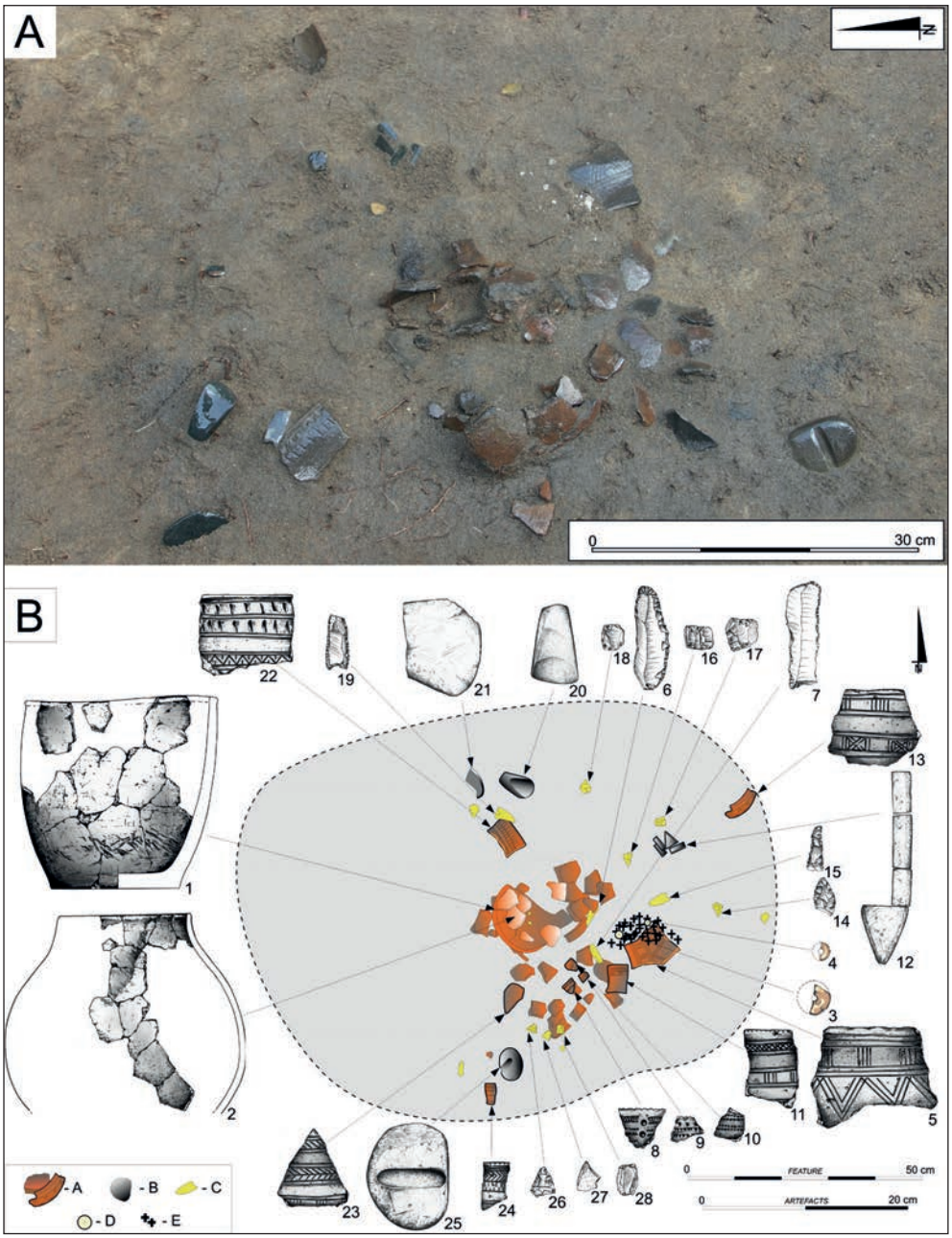



FIGURE 2. Supraśl, Site 3, Białystok region, Podlaskie Voivodeship. View of Feature 1 – the funeral-ritual deposit of the Bell Beaker culture during exploration (A) and a graphic reconstruction of the arrangement of individual ecofacts and artefacts (B): A – fragments of pottery; B – stone products; C – flint artefacts; D – amber beads; E – cremated human bones (after Manasterski et al. 2020, fig. 4, supplemented)

recorded in the same stratigraphic context: items were placed in small pits excavated about 0.3 metres into the subsoil and geological substrate. The outlines of the depressions were poorly defined, due to the geology of the site, composed of coarse-grained sands susceptible to hydrological permeability.

The centre of the first structure was marked by an undecorated goblet-shaped beaker, within which fragments of another, non-decorated vessel

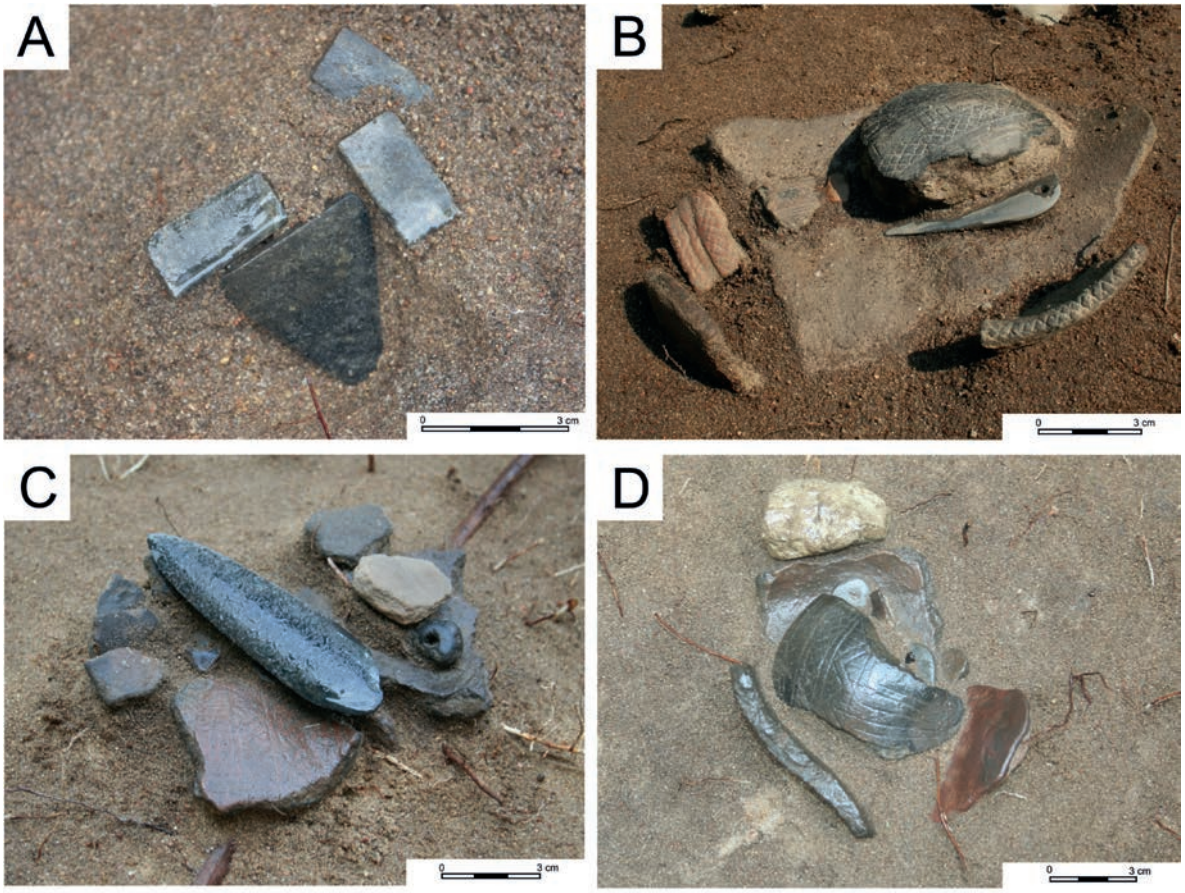



FIGURE 3. Supraśl, Site 3, Białystok region, Podlaskie Voivodeship. Details of the arrangement of artefacts within the ritual features of the Bell Beaker culture: stone inserts of a dagger from Feature 1 (A); central part of Feature 2 with the visible filling of an organic container covered by a fragment of a bowl (B); overall view of the arrangement of artefacts within Features 5 (C) and 6 (D)

were preserved (Fig. 2). Nearby, there was a small concentration of cremated human bones from at least two individuals (Jaskulska 2015, 249–251) and fragments of two amber beads. The assemblage, originally placed in an organic container, was covered with a piece of a richly decorated vessel. Around the central beaker, fragments of eight other beakers and bowls were deposited. Next to them lay a stone axe, a straightening tool for arrows, and a blade of a knife/dagger made from the same material. The concentration of stone inlays suggests that the assemblage originally included a dagger (?) fitted with inserts (Fig. 3: A). The collection was completed with flint tools: blade knives, damaged arrow tips, and microlithic blades (Wawrusiewicz et al. 2015, 33–83; Manasterski et al. 2020, 377).

A similar assemblage was identified within subsequent features. However, complete vessels were absent there, and the central element was defined by compact concentrations of sandy–silty sediments representing the infill of organic containers, most likely some form of pouch (Figs. 3: B; 4). Their interiors contained cremated animal bones (Feature 2) or human bones (Feature 6) mixed with fragments of amber beads and flint arrowheads. There were as many as seventeen arrowheads found inside the "pouch" from Feature 6 (Manasterski et al. 2020, 378–379, fig. 5, 7). The assemblage was complemented with small fragments of decorated vessels and small flint tools. The entire group of material was placed on a base made of ornamented fragments of large




FIGURE 4. Supraśl, Site 3, Białystok region, Podlaskie Voivodeship. Graphic reconstruction of the arrangement of individual ecofacts and artefacts within Feature 2 – a ritual deposit of the Bell Beaker culture: A – fragments of pottery; B – stone products; C – a lump of calcareous tufa; D – filling of an organic container and cremated animal bones (according to Manasterski et al. 2020, fig. 5)

ceramic vessels, and covered with pieces of richly decorated bowls (Figs. 3: B, D; 4). Next to it, stone objects were added: a rectangular plate with an engraved diagonal cross or an intentionally broken pendant made of slate, decorated with motifs similar to those visible on the ceramics (Manasterski

et al. 2020, fig. 5: 20, 7: 20). In Feature 2, a slate item resembling the blade of a copper dagger with holes for rivets was found (Fig. 4: 19). Around the central spot, larger stone objects (an axe and an arrow-shaft straightener) were deposited, together with ornamented fragments of additional vessels and lumps of calcareous tufa (Fig. 4) (Manasterski et al. 2020, 378–379, figs. 5, 7).

The last of the Features (no. 5) had a similar form. However, the central "pouch" was missing, replaced by a stone dagger (Fig. 3: C). Next to it, a fragment of an amber pendant, arrowheads, small arrowheads, a flake, a stone pendant, and a polished pebble with an engraved "Y" mark were excavated. The outer outline of the deposit was formed by ten fragments of decorated parts of vessels (Manasterski et al. 2020, 378–379, fig. 6).

A distinctive feature of this site is the repetitiveness of the inventories associated with individual features, which points to their symbolic significance. Particularly evident are prestige items, such as amber objects and stone daggers. While the amber items are morphologically similar, the stone blades display variation, ranging from monolithic lancet-like and triangular forms to composite types reinforced with stone inlays (Manasterski et al. 2020, 383). A recurring element is the presence of attributes of archers - flint arrowheads and stone arrow-shaft straighteners (Januszek et al. 2019; 2022) - suggesting a deliberate emphasis on this social role. As a rule, fragments of ornamented Bell Beaker vessels were deposited; these derived from different containers and show no attributes linking them to the other sources documented at the site. Their presence may have stemmed from the need to emphasize cultural distinctiveness - origin or group affiliation (Januszek et al. 2017). Stone pendants and decorated plaques may be interpreted as having a similar symbolic significance. The cremated human or animal bones placed in "pouches" should likewise be considered symbolic in nature. Their small quantity does not correspond to the potential contents of complete graves; rather, they may be understood as symbols of ancestors or, in the case of animal remains, as substitute offerings (Wawrusiewicz et al. 2015, 164–168).

Site 3 in Supraśl was not an agriculturally attractive area, as confirmed by palynology analyses (Kuprianowicz and Szal 2015). These environmental limitations did not deter hunter-gatherers, who dominated this region after the Bronze Age. Therefore, an important question arises: why did representatives of the Bell Beaker culture arrive here, thereby breaking the ecological and cultural barrier of the "Late Neolithic world" of Western Europe and the traditional hunter-gatherer East? The analysis of the natural and archaeological context could provide answers. A potential trigger could have been the network of water connections and routes that linked two major river basins: the Vistula and the Neman, through the Narew, Supraśl, and Świsłocz (Wawrusiewicz et al. 2015, fig. 101). It is possible that access to this area was driven by attempts to organize communication routes linked, for example, to the distribution of high-quality chalk flint extracted along the Roś River (western Belarus). This is suggested both by the discovery of individual artefacts in the context of those mines and by the symbolic finds of calcareous tufa nodules from Supraśl (Wawrusiewicz et al. 2015, 190–191, fig. 106; Manasterski et al. 2020).

While the material evidence of the presence or influence of the Bell Beaker culture in the western borderlands of Eastern Europe is limited to individual finds, imports, or imitations, in the case of Supraśl, we are dealing with the direct presence of these representatives of Western European Eneolithic culture. However, the discovered deposits do not testify to settlement processes. Both the choice of location and the contents indicate that we are dealing with relics of a specific form of ritual practice. A hypothesis could be put forward that the site itself served as a sacrificial space, and the deposited prestigious items, symbols of cultural distinctiveness, or metaphorically treated ancestral remains, were meant to symbolically sanction the appropriation of the territory - either part of the valley or the entire route.



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