

Flint arrowheads from the inventories of the Corded Ware culture: morphology and function - on the example grave from Mydlów (Sandomierz Upland)

Author: Jerzy Libera, Piotr Mączyński

PL ISSN 0081-3834, e-ISSN: 2719-647X

DOI: <https://doi.org/10.23858/SA/76.2024.1.3574>

<https://rcin.org.pl/dlibra/publication/279409>

Jak cytować:

Libera, J., & Mączyński, P. (2024). Flint arrowheads from the inventories of the Corded Ware culture: morphology and function - on the example grave from Mydlów (Sandomierz Upland). Sprawozdania Archeologiczne, 76(1), 555–582.
<https://doi.org/10.23858/SA/76.2024.1.3574>

Jerzy Libera¹, Piotr Mączyński²

FLINT ARROWHEADS FROM ASSEMBLAGES OF THE CORDED WARE CULTURE: MORPHOLOGY AND FUNCTION – THE EXAMPLE OF THE GRAVE FROM MYDŁÓW (SANDOMIERZ UPLAND)

ABSTRACT

Libera J. and Mączyński P. 2024. Flint arrowheads from assemblages of the Corded Ware culture: morphology and function – the example of the grave from Mydlów (Sandomierz Upland). *Sprawozdania Archeologiczne* 76/1, 555-582.

Flint arrowheads are one of the most common artefact types found in funerary materials attributed to the Corded Ware culture. One of the most numerous assemblages was discovered in Mydlów (on the Sandomierz Upland) in 1990. It was composed of 27 arrowheads deposited in Feature 2. In order to better understand the character of this collection, it was re-examined with the use of new findings concerning the most recent research into Corded Ware flint-knapping across Lesser Poland. To obtain new information, the investigation was considerably enriched with microscopic analyses of the surfaces of the artefacts – conducted to identify potential use-wear patterns on them.

Keywords: flint arrowheads, graves, Corded Ware culture, Sandomierz Upland, use-wear analysis

Received: 30.09.2023; Revised: 18.11.2023; Accepted: 15.03.2024

¹ Institute of Archaeology, Maria Curie-Skłodowska University; M. Curie-Skłodowska sq. 4, 20-031 Lublin, Poland; jlibera@o2.pl; ORCID: 0000-0002-5233-9124

² Institute of Archaeology Maria Curie-Skłodowska University; M.C. Skłodowska sq. 4, 20-031 Lublin; archeolublin@gmail.com; ORCID: 0000-0002-4690-5089

INTRODUCTION

Numerous graves discovered across Lesser Poland and attributed to the population of the Corded Ware culture (hereinafter referred to as the CWC) yielded different types of assemblages of portable finds. The literature concerning them is quite substantial, and the most recent, synthetic paper discussing such material found across the upland part of south-eastern Poland presents artefacts discovered in nearly 600 better or worse preserved graves. The most numerous group is the compact Kraków cluster, which contrasts with more scattered groups in the Sandomierz, Lublin and Rzeszów regions (Libera 2022). Flint tools are also frequent finds – although not always present in such graves. The most common ones include axes, retouched blades, scrapers and arrowheads. This article is devoted to the last of these categories of artefacts. They can be described as bifacial points having a nearly triangular shape, formed on relatively thin flakes, with retouch on their entire surfaces or near the edges (sometimes both types are present on the same specimen). Their length can be up to several centimetres. They comprise the most numerous group of artefacts among flint inventories used as burial goods. Their numbers in particular features vary from several to nearly 30 specimens. These materials have been the subject of numerous analyses aimed at their description and classification (Borkowski 1987; Włodarczak 2006; Libera 2022). Work has also been carried out to determine the function of specimens discovered in graves that were considered to have been knives or blades of thrown weapons (for example, Drobniewicz 1979; Winiarska-Kabacińska 2007; 2008; 2019; Boroń and Winiarska-Kabacińska 2014, 218-224; Pyżewicz 2017).

The group of such items from Mydlów, Opatów District (within the Sandomierz cluster) can serve as an example of such a large group (Fig. 1). A systematic surface survey conducted in 1990 within the framework of the Polish Archaeological Record (Polish: Archeologiczne Zdjęcie Polski, AZP) resulted in a discovery of several features exposed in the loess escarpment of a dirt road leading through a gorge (site 37, region 88-70). The rescue research subsequently conducted on the site resulted in exploring several features, *e.g.*, Grave 2 attributed to the CWC. The partially damaged niche of the grave yielded over ten small bones in an unintelligible arrangement, probably belonging to a male about 30 years old. The cultural attribution is corroborated by a set of 26 undamaged arrowheads and a fragment of another arrowhead – a broken off wing. They were scattered, which made it impossible to reconstruct their original arrangement in relation to the skeleton, whose position was also unclear. Another discovery in the same grave were large fragments of a four-handle amphora. Beside them, fine pottery fragments, flint blades and flakes attributed to the Mierzanowice culture (see Bargieł 1990) were found in a stratigraphically unspecified position. Based on sources provided by other grave inventories from southern Poland, we can suspect that the man buried in Mydlów was accompanied by other flint artefacts, which might have been destroyed during the erosion of the sides of the dirt road (see Włodarczak 2006, 66-77). The discussed feature was associated with subphase III of

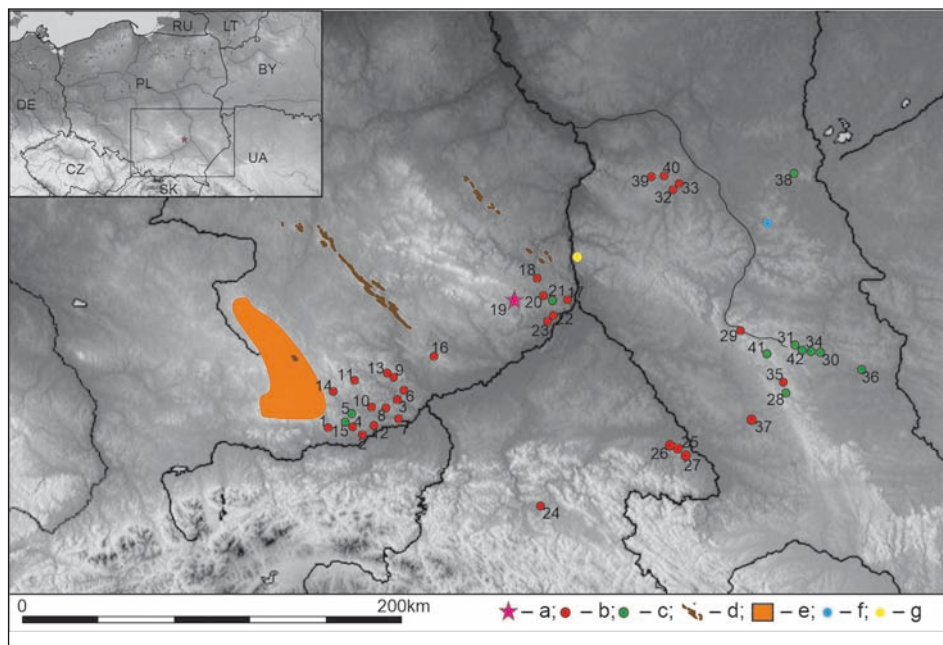


Fig. 1. Location of selected CWC graves with arrowheads from south-eastern areas of Poland (Kraków cluster): 1 – Bosutów; 2 – Igołomia, Site 21; 3 – Kazimierza Mała; 4 – Kocmyrzów, Site 17; 5 – Koniusza; 6 – Krzyż, Site 1; 7 – Książnice Wielkie; 8 – Łękawa, Site 15; 9 – Małżyce, Site 30; 10 – Ostrów, Site 25; 11 – Rosiejów, Site 2; 12 – Rudno Górne, Site 8; 13 – Stradów, Site 1 (currently Zagaje Stradowskie); 14 – Szczepanowice; 15 – Zielona, Site 3; 16 – Żerniki Górne, Site 1; (Sandomierz cluster): 17 – Kichary Nowe, Site 2 (currently Nowe Kichary); 18 – Mierzanowice, Site 1; 19 – Mydlów, Site 37; 20 – No-wy Daromin, Site 20 (currently Daromin); 21 – Wilczyce, Site 10; 22 – Złota, sites „Grodzisko II”, „Nad Wawrem” and 6; 23 – Żuków; (Rzeszów cluster): 24 – Bierówka; 25 – Mirocin, Sites 24 and 27; 26 – Rozbórz, Site 42; 27 – Szczytina, Sites 5 and 6; (Lublin cluster): 28 – Brzezinki, Site 1 (currently part of the village Wola Wielka); 29 – Guciów, Site 6; 30 – Hubinek, Site 3; 31 – Klekacz, Site 10; 32 – Lublin-Stawinek, Sites 1 and 2; 33 – Łagiewniki, Site 10; 34 – Łubcze, Site 24; 35 – Łukawica, Site 13; 36 – Machnówek, Site 1; 37 – Młodów-Zakęcie, Site 68 (currently part of the village Młodów); 38 – Nieborowa, Site 1; 39 – Stugocin, Site 5; 40 – Snopków, Site 18; 41 – Ulów, Sites 3 and 4; 42 – Wierszycza, Site 29.

Map legend: a – Mydlów; b – location of CWC graves containing at least two arrowheads; c – inventories of CWC with use-wear analysis; d – source of Chocolate flint; e – source of Jurassic sub-Kraków flint; f – Rejowiec flint; g – Source of Świeciechów and Gościeradów flint.

Prepared by P. Mączyński (base map: <https://maps-for-free.com>)

the CWC development, which allows us to date it to *ca.* 2500-2300/2200 BC (Włodarczak 2006, pl. 65: 15-19; 127).

The subject of the present consideration is the set of arrowheads discovered in Mydlów (Sandomierz Upland), in Grave No. 2, analysed in the context of similar inventories from closed assemblages located within the range of the CWC settlement in Lesser Poland (Fig. 1). The assemblage in question has previously been analysed (description and classification) carried out by Barbara Bargieł (2009). Nevertheless, in order to better understand the

character of this collection of arrowheads, we need to have a new look based on recent findings concerning CWC flint-knapping, and taking into account the results of microscopic research aimed at identifying potential use-wear patterns on their surfaces.

MORPHOLOGY

With respect to the metric and morphological features of the discussed artefacts, the most numerous group are arrowheads having a nearly triangular frontal outline, with slightly convex edge (in the case of two-thirds of the collection) or straight edges, base cut at nearly a right angle (two thirds of the collection), or arched and symmetrical sides (all but two specimens). The studied assemblage does not include classic heart-shaped arrowheads, but several artefacts have somewhat arcuately undercut sides. Based on the metric values and proportion between the length and maximum width, it was observed that the most numerous group are rather small and heavyset items. Only three artefacts can be considered as slender. Their extreme dimensions are: height of 13-23 mm, width of 9-14 mm, thickness of 2.5-4 mm, and the average results are respectively 18 mm – 12 mm – 2.7 mm. Their masses vary from 0.2 to 1.1 g, with the average of 0.4 g (Bargiel 2009, pl. 1).

They were made of relatively thin blanks in the form of flakes or scaled flakes, which had been retouched on both sides with flat or semi-steep retouch near their edges and sometimes with quite fine correction retouch. There are also examples of both retouch types on a single specimen. Certain specimens have retouch negatives in the form of pseudo-troughs, whereas in others they are in the shape of (pseudo) serrations. In most cases, the tips of the arrowheads were formed in the bulb parts of the employed blanks. Only some of the arrowheads have their tips on the opposite side. Generally speaking, their shapes do not differ from the forms of the points discovered in CWC graves and analysed by Wojciech Borkowski (1987, 156ff) and Jerzy Libera (2022, 70ff).

METHODOLOGY

The use-wear analysis was performed with two types of microscopes. In the early stage of research, stereoscopic equipment by Carl Zeiss (SteREO Discovery.V8), was used. It is capable of producing real magnifications from 10 to 80 times (zoom no greater than 50 was used). The microscope was employed together with a dedicated source of cold LED light. The next step was the observation of arrowheads using the Meiji Techno MC-50T equipment. It is a metallographic microscope which allows for much larger magnifications: 50-500x (magnifications of 50x, 100x, 200x was used).

The microscopic analysis was aimed at identifying several types of use-wear traces. The first category were modifications that might have been caused by using the arrowheads as

elements of projectile weapons (Fischer *et al.* 1984; Nowak and Osipowicz 2013; Wolski and Kalita 2015). We also focused on recording patterns that may attest to keeping the arrowheads in a quiver. The use-wear traces were identified based on archaeological literature and experimental research conducted by the author. Because of the fact that flint arrowheads were not used as autonomous tools, but they were attached to arrow shafts, stress was also put on the possibility of finding remains of adhesives that might have been used in fixing them (see Bąbel 2013a, 114, 115; 2013b, ryc. 41: 11; 205: 1-14; 206: 1-11; Budziszewski *et al.* 2016, ryc. 17, 405).

RESULTS OF USE-WEAR ANALYSIS

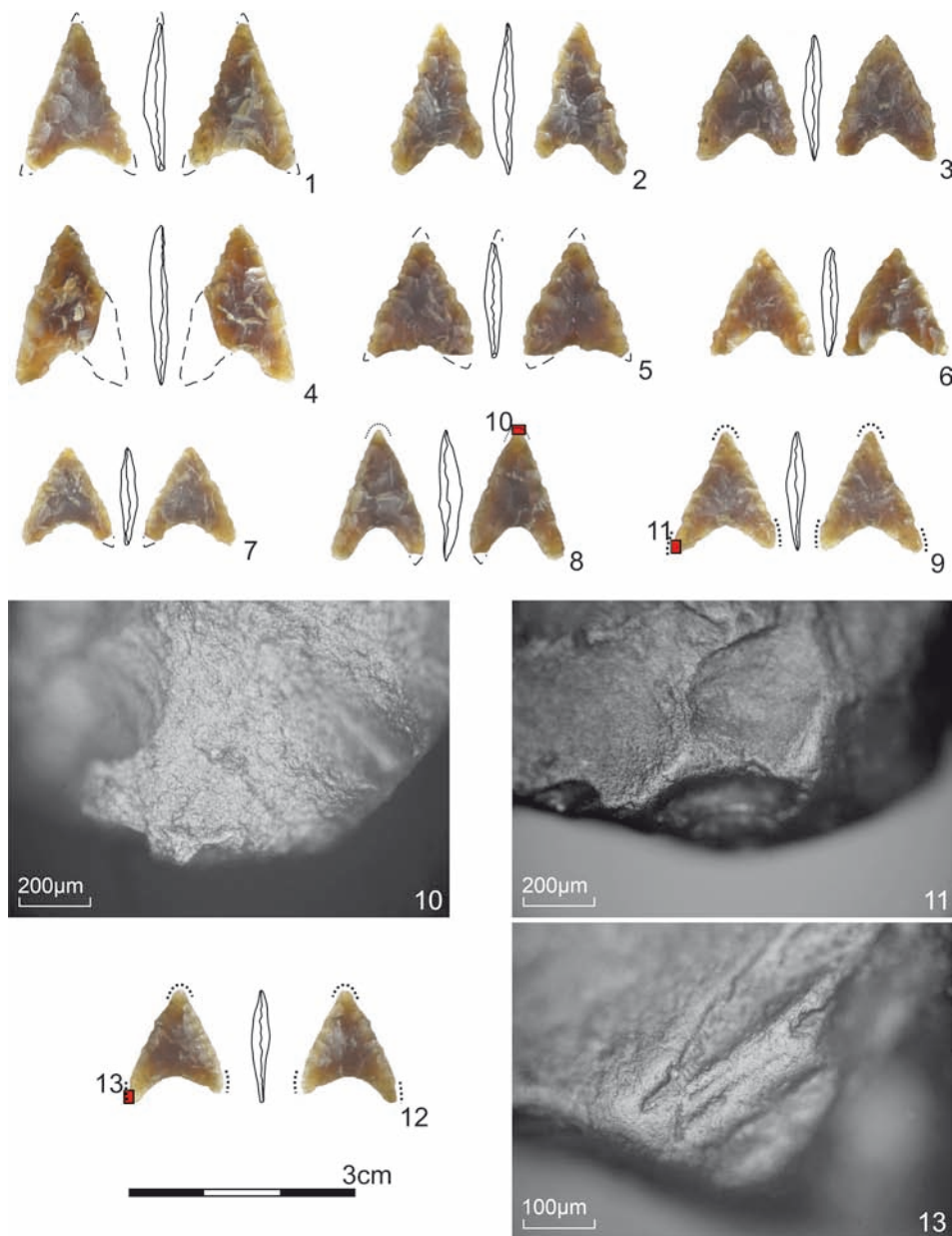
Altogether, 26 arrowheads were analysed (Table 1). The last item found in the assemblage, the broken off wing of a further arrowhead was not available. The examined items were very well preserved, and their surfaces were not covered with patina, but carbonate residues (which did not influence the quality of the research) were detected on several specimens (Fig. 2: 1, 7, 8; 3: 3; 4: 1, 5; 1, 8; 6: 4). It is also worth noting that linear traces were discovered on the surface of one of the specimens, but the accompanying residues of metal suggest that it is modern damage (Fig. 2: 4). It is also worth noting that during the

Table 1. Results of use-wear analysis of arrowheads from Mydłów

No.	Morphology	Results of use-wear analysis	Fig.
1	Triangular arrowheads with concave base (with a broken tip and wings)	Use-wear traces no observed	Fig. 2: 1
2	Triangular arrowheads with concave base	Use-wear traces no observed	Fig. 2: 2
3	Triangular arrowheads with concave base	Use-wear traces no observed	Fig. 2: 3
4	Triangular arrowheads with concave base (with a broken wing)	Use-wear traces no observed	Fig. 2: 4
5	Triangular arrowheads with concave base (with a broken tip and wings)	Use-wear traces no observed	Fig. 2: 5
6	Triangular arrowheads with concave base	Use-wear traces no observed	Fig. 2: 6
7	Triangular arrowheads with concave base (with a broken wing)	Use-wear traces no observed	Fig. 2: 7
8	Triangular arrowheads with concave base (with a broken wing)	Tip – weak developed traces of contact with soft material (transport in a quiver)	Fig. 2: 8, 10
9	Triangular arrowheads with concave base	Tip and wings – traces of contact with soft material (transport in a quiver)	Fig. 2: 9, 11
10	Triangular arrowheads with concave base	Tip and wings – traces of contact with soft material (transport in a quiver)	Fig. 2: 12, 13

Table 1.

No.	Morphology	Results of use-wear analysis	Fig.
11	Triangular arrowheads with concave base (with a broken wing)	Tip and wings – traces of contact with soft material (transport in a quiver). Traces also appeared on the broken part of wing	Fig. 3: 1-4
12	Triangular arrowheads with concave base	Tip and wings – traces of contact with soft material (transport in a quiver)	Fig. 3: 5, 6
13	Triangular arrowheads with concave base	Tip and wings – traces of contact with soft material (transport in a quiver)	Fig. 3: 7, 8
14	Triangular arrowheads with concave base	Tip and wings – traces of contact with soft material (transport in a quiver). Traces on the tip are more intense	Fig. 4: 1, 2
15	Triangular arrowheads with concave base (with a broken tip and one wing)	Tip (slight broken) and wings – weak developed traces of contact with soft material (transport in a quiver). Traces also appeared on the broken part of tip. The chronological position of the fracture on the wing is unclear	Fig. 4: 3, 4
16	Triangular arrowheads with concave base	Tip and wings – weak developed traces of contact with soft material (transport in a quiver)	Fig. 4: 5, 6
17	Triangular arrowheads with concave base	Tip and wings – traces of contact with soft material (transport in a quiver)	Fig. 4: 7, 8
18	Triangular arrowheads with concave base (with a broken wings)	Tip and wings – traces of contact with soft material (transport in a quiver). Most likely use-wear traces also covering the broken part of wing	Fig. 5: 1, 2
19	Triangular arrowheads with concave base (with a broken wing)	Tip and wings – traces of contact with soft material (transport in a quiver). The chronological position of the fracture on the wing is unclear	Fig. 5: 3, 5
20	Triangular arrowheads with concave base (with a broken tip)	Tip (slight broken) and wings – traces of contact with soft material (transport in a quiver). Traces also appeared on the broken part of tip	Fig. 5: 4, 7
21	Triangular arrowheads with concave base (with a broken wing)	Tip and wings – traces of contact with soft material (transport in a quiver). Use-wear traces also covering the broken part of wing. Tip – well developed traces, wings – weak developed traces	Fig. 5: 6, 8, 9
22	Triangular arrowheads with concave base (with a broken tip)	Tip (slight broken) and wings – traces of contact with soft material (transport in a quiver). Traces also appeared on the broken part of tip	Fig. 6: 1, 2
23	Triangular arrowheads with concave base (with a broken wing)	Tip and wings – weak developed traces of contact with soft material (transport in a quiver). The chronological position of the fracture on the wing is unclear	Fig. 6: 3, 5
24	Triangular arrowheads with concave base	Tip and wings – well developed traces of contact with soft material (transport in a quiver)	Fig. 6: 4, 7, 9
25	Triangular arrowheads with concave base (with a broken tip)	Tip (slight broken) and wings – traces of contact with soft material (transport in a quiver). Traces also appeared on the broken part of tip	Fig. 6: 6, 8
26	Triangular arrowheads with concave base (with a broken wings)	Tip and wings (slight broken) – traces of contact with soft material (transport in a quiver). Traces also appeared on the broken part of wings	Fig. 7: 1, 2



Legend: ----- a; b; c; ■ d

Fig. 2. Arrowheads from Mydlów. 1-9, 12 – arrowheads; 10, 11, 13 – use-wear traces created during contact in a quiver. Legend: a – reconstruction of arrowheads; b – well-developed use-wear traces; c – poorly developed use-wear traces; d – place where the photograph was taken. Photo by P. Mączyński

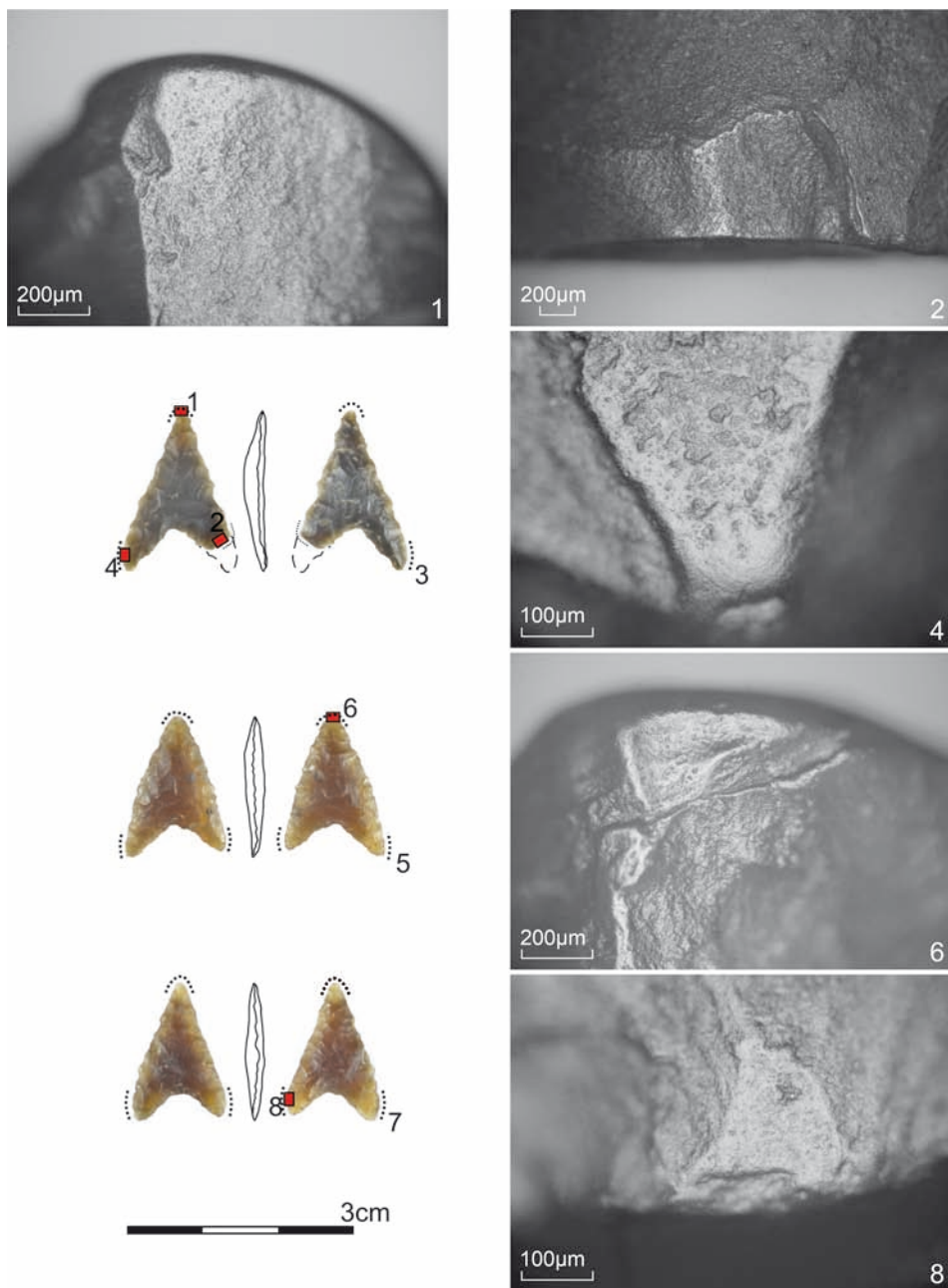


Fig. 3. Arrowheads from Mydłów.

3, 5, 7 – arrowheads; 1, 2, 4, 6, 8 – use-wear traces created during contact in a quiver.
Photo by P. Mączyński

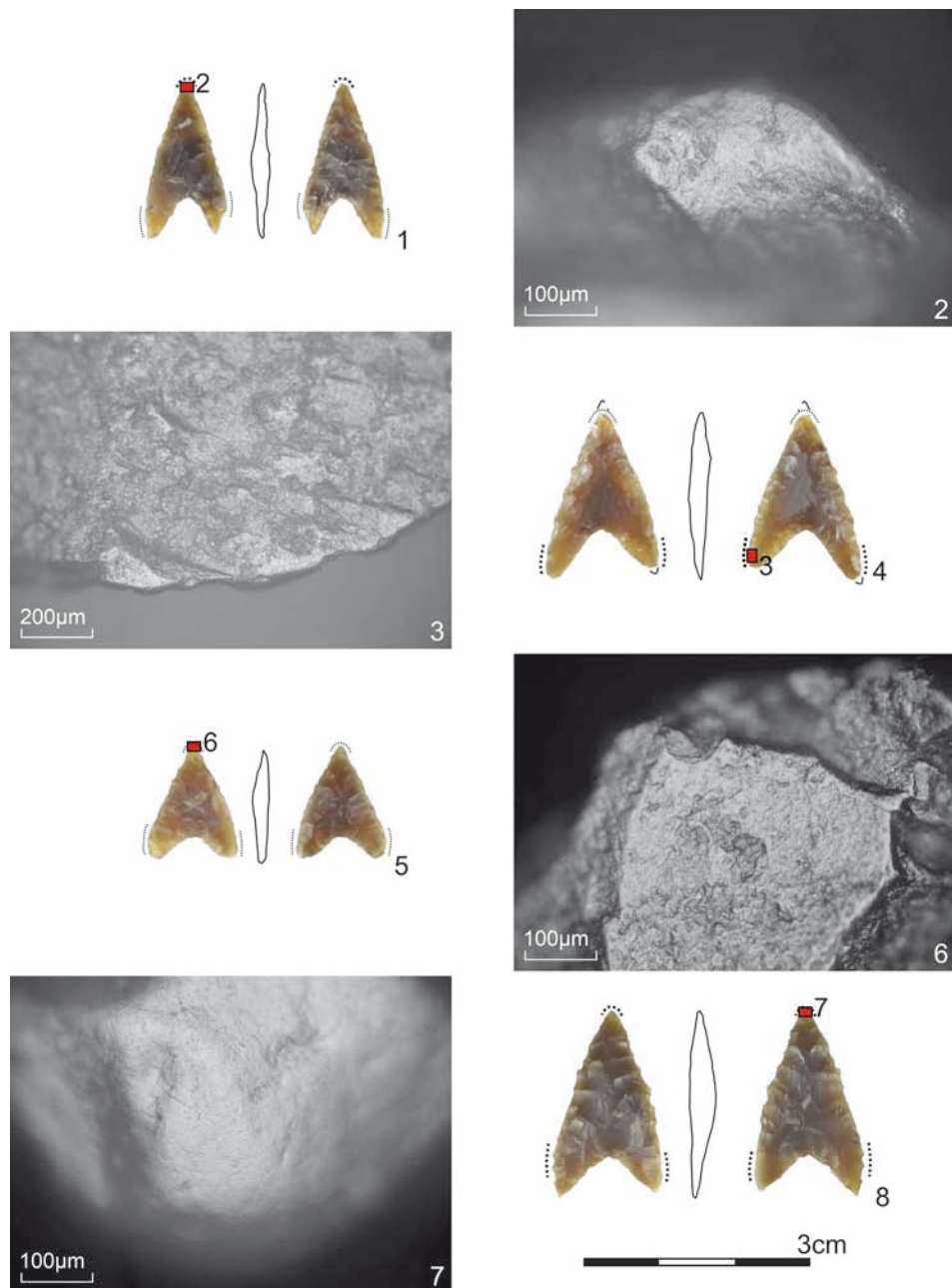


Fig. 4. Arrowheads from Mydlów.

1, 4, 5, 8 – arrowheads; 2, 3, 6, 7 – use-wear traces created during contact in a quiver.
Photo by P. Mączyński

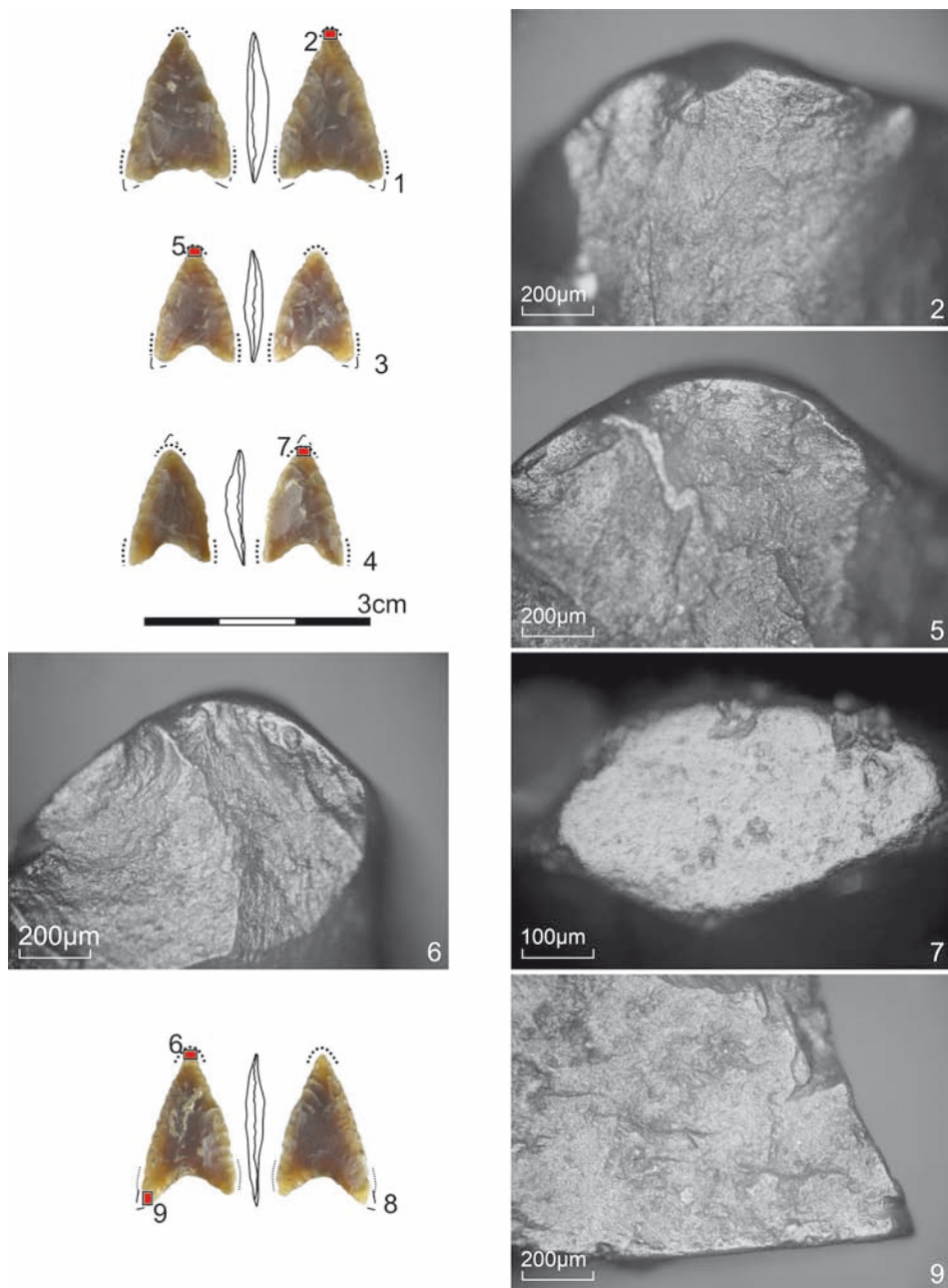


Fig. 5. Arrowheads from Mydłów.

1, 3, 4, 8 – arrowheads; 2, 5, 6, 7, 9 – use-wear traces created during contact in a quiver.
Photo by P. Mączyński

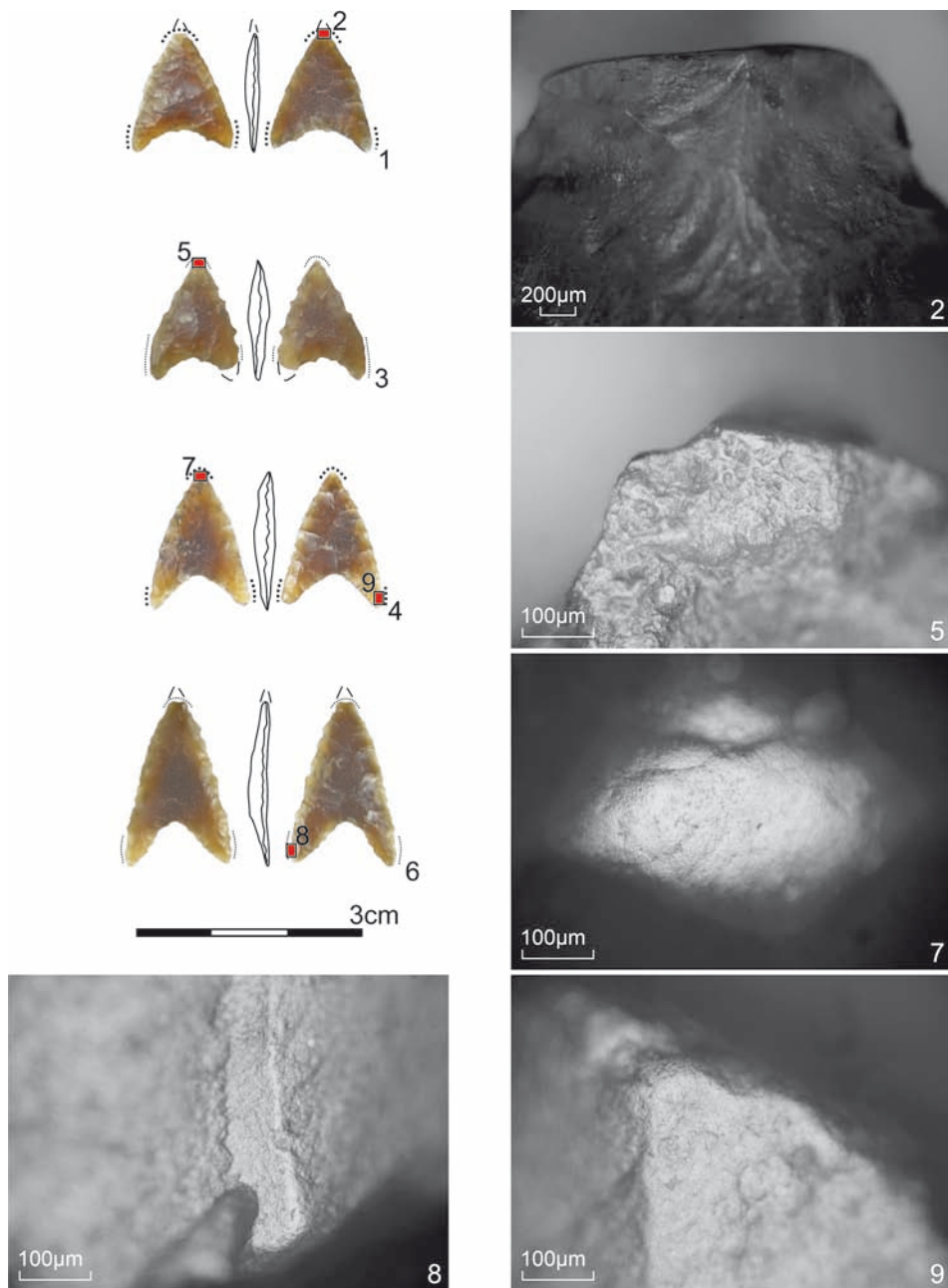


Fig. 6. Arrowheads from Mydlów.

1, 3, 4, 6 – arrowheads; 2, 5, 7-9 – use-wear traces created during contact in a quiver.
Photo by P. Mączyński

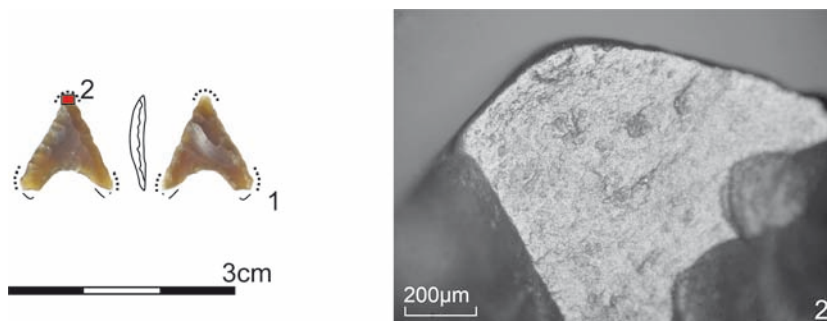


Fig. 7. Arrowheads from Mydłów.

1 – arrowhead; 2 – use-wear traces created during contact in a quiver.

Photo by P. Mączyński

observation, no traces of adhesives used to attach the arrowheads to the shafts, such as wood tar, were found on the surfaces of the arrowheads.

In the first stage, the analysis was aimed at identifying patterns that would indicate keeping the arrowheads in a quiver or some other container. Such traces usually consist of polishing and abrasions of the surfaces that came into contact with a quiver. In triangular and heart-shaped specimens, such surfaces are the protruding parts of the arrowheads – usually external edges of the sides and tips. As a result of the conducted analysis, the above-described patterns were detected on 19 arrowheads (Fig. 2: 8, 9, 12; 3: 3, 5, 7; 4: 1, 4, 5, 8; 5: 1, 3, 4, 8; 6: 1, 3, 4, 6; 7: 1), and the remaining lacked visible use-wear traces (Fig. 2: 1-7).

In the next part of the research, attention was paid to the possibility of detecting damage resulting from using the arrowheads as projectile elements. Nevertheless, such patterns were not discovered. Still, it should be mentioned that traces of this type are only rarely formed. They usually are created as a result of an arrow hitting a hard target; hitting soft materials probably would not have left any identifiable traces, thus their absence cannot be considered as an indicating that arrowheads were not used.

We need to bear in mind that several specimens had broken off tips and wings, but not characteristically enough to be treated as evidence of archery activities. What is interesting, most of the fractures were smoothed, which suggests that the damage occurred as a result of keeping the arrowheads in a quiver or earlier, at the stage of shaping or hafting these artefacts (Fig. 4: 4; 5: 4, 7-9; 6: 1, 2). The same applies to strongly damaged specimens. An example is arrowhead with a broken off wing, whose fracture is covered with abrasions resulting from storing it in a quiver (Fig. 3: 2, 3). This indicates that even strongly damaged, but still usable, specimens were used as points having a value that was equivalent to the unbroken ones.

FLINT ARROWHEADS IN CWC SETS FROM LESSER POLAND

Graves containing sets of arrowheads (more than two specimens) were discovered in all four CWC clusters from Lesser Poland. We know about 490 specimens, which makes almost 42% of the total number of flint artefacts discovered in grave pits (Table 2). They were found in the Sandomierz region – 188 specimens in 15 graves (nearly 12.5 specimens in one feature on average; the greatest number – 29 – found in Wilczyce, Feature 15), in the Kraków cluster – 158 specimens in 21 features (over 7.5 in one feature on average; the greatest number – 16 – found in Koniusza, Grave 3). Similar collections of arrowheads were discovered both in the Lublin region (75 in nine features; eight on average; the greatest number – ten specimens in Młodów-Zakęcie) and in the Rzeszów region (72 in 13 features; 5.5 on average; the greatest number – ten specimens in Mirocin Site 24, Grave 110) (Libera 2022, 70ff.).

Most often, arrowheads discovered in a single place near a skeleton are interpreted as remains of arrows deposited in a quiver or in a bundle. In the latter case, we cannot rule out the possibility that they were kept in an organic container (sack). The locations of arrowheads in relation to skeletons are different – they could have been placed next to the head (Żerniki Górne, Grave 128; Mierzanowice, Grave 81); near the arms (Mierzanowice, Grave 94); back (Książnice Wielkie; Zielona; Mirocin, Graves 50 and 54; Szczytina, Barrow I, Grave 4; Lublin-Sławinek); ribcage (Nieborowa); pelvis (Igołomia; Koniusza; Ostrów; Rosiejów; Mierzanowice, Graves 100, 200 and 209; Żerniki Górne, Graves 132 and 133; Mirocin, Grave 110; Rozbórz); lower limbs (Malżyce, Barrow 2, Grave 10; Mierzanowice, Grave 199; Mirocin, Grave 110); feet (Łagiewniki; Mirocin, Grave 360). Sometimes, arrowheads were recorded at a considerable distance from the buried individuals. Such situations are completely different from cases of discovering single arrowheads in different parts of a skeleton or in its nearest vicinity – within the outline of a buried body, *e.g.*, in the ribcage (Malżyce, Barrow 2, Grave 10), arm (Mierzanowice, Grave 94), pelvis (Mierzanowice, Grave 200), ribs (Szczytina, Barrow 1, Grave 56), as well as near the thigh (Zielona) or shank (Mierzanowice, Grave 100).

Grave 2 from Nowy Daromin is a separate case. In this feature, single arrowheads were discovered in three different places: under the right clavicle and right hand as well as near the feet. Another example is Grave 15 from Złota 6; besides three arrowheads found between the ribs, there was also another one near the knee. These locations may suggest the cause of death of the buried individual. In several cases, arrowheads co-occurred in both places, *e.g.*, several arrowheads near the lower limbs and one in the ribcage (Malżyce, Barrow 2, Grave 10), next to the pelvis with a separate specimen near the shank (Mierzanowice, Grave 100), near the pelvis and lower limbs with two arrowheads between the femurs (Mirocin, Grave 110). In materials from Zielona, archaeologists found 10 arrowheads, out of which seven were grouped behind the back of the buried man, and three others were

Table 2. List of graves from the CWC from the Małopolska region containing at least two arrowheads

No.	Site, No.; municipality	Kurgan, grave/feature	Type of grave/feature	Sex	Age	Number of arrowheads: type of flint	Location at the skeleton	Presence of flint flake	Phase (Włodarczak 2006)	References
Kraków cluster										
1	Bosutów, No. 1; Zielonki	3	niche grave?	M	?	3 V?	„from the side”	-	IIIB	Krauss 1960, 63
2	Igłomia, No. 21; Igłomia-Wawrzęczyce	3*	niche grave	M	?	9?	„near the arm”	-	?	Włodarczak 2020, 97 and next
3	Kazimierza Mała; Kazimierza Wielka	70	niche grave	?	?	3?	?	-	IIIB	Włodarczak 2006, 167, tabl. 40
4		79	?	?	?	15?	?	-	IIIC	Włodarczak 2006, 167, tabl. 40
5	Kocmyrzów, No. 17; Kocmyrzów-Luborzyca	5	niche grave	F, M, Ch	?	8?	?	-	IIIA	Włodarczak 2006, 167, tabl. 40
6	Koniusza; Koniusza	3	niche grave	M	<i>maturus</i>	16: 12 C, 3 J? 1 S	between the spine and pelvis – disorderly arranged	38 C	IIIB	Tunia 1979, 49-51; Drobniewicz 1979
7	Krzyż, No. 1; Czarnocin	2*	niche grave	-	-	8 C	the skeleton was not discovered	-	III	Tunia 1997, 184 and next
8	Książnice Wielkie; Koszyce	II (5/2)	niche grave	M	?	3 J	behind the back	-	IIIA	Machnik 1964, 344-345
9	Łękawa, No. 15; Kazimierza Wielka	4	?	-	-	7, 6 C, 1 radiolarite	the skeleton was not discovered	-	IIIB	Tunia 1999, 173 and next
10	Malzyce, No. 30; Czarnocin	kurgan 1, 2	niche grave	?	?	6?	?	-	IIIB	Włodarczak 2006, 169, tabl. 40
11		kurgan 2, 10	niche grave	M	<i>maturus</i>	9: 6 C, 3 J	near the lower limbs (8), within the chest (1)	10 J	IIIB	Jarosz <i>et al.</i> 2009

12	Ostrów, No. 25; Proszowice	18	niche grave	M	<i>maturus</i>	4 C	near the pelvis	-	IIIB	unpublished research P. Jarosz, J. Libera and P. Mączyński
13	Rosiejów, No. 2; Skalbierz	kurgan E, 35	niche grave	?	?	13: 9 J, 4 S	near the pelvis	-	IIIB	Reyman 1948, 73 and next
14	Rudno Górne, No. 8; Igołomia- Wawrzeńczyce	21	niche grave	M	<i>maturus</i>	4?	?	-	III	Włodarczak 2020, 99
15	Stradów, No. 1 (currently Zagaje Stradowskie); Czarnocin	4a	niche grave	M	?	8?	?	9 J	IIIB	Włodarczak 2006, 171-172
16	Szczepanowice; Miechów	3/VIII	niche grave	F, M, 2 Ch	<i>adults</i> , <i>infans</i> II	3?	?	-	IIIB	Gomulka and Haluszko 2017, 26
17	Zielona, No. 3; Koniusza	3	niche grave	M	<i>maturus</i>	10: 8 J? 1 C, 1 Cr/E	behind the back (7), within the chest (2), near the head (1)	9 J	IIIA	Włodarczak 2004; Winiarska-Kabacińska 2007; 2008
18	Żerniki Górne, No. 1; Busko-Zdrój	85	niche grave?	2 M	?	4: 3 C, 1 S	at the feet	-	IIIB	Kempisty 1978, 78-82
19		128	niche grave	M	<i>maturus</i>	3 C	at the head	-	IIIB	Kempisty and Włodarczak 2000, 76 and next
20		132	niche grave	M	<i>maturus</i>	5: 3 C, 1 S, 1 J	behind the pelvis	-	IIIB	Kempisty and Włodarczak 2000, 86,87
21		133	niche grave	M	<i>iunivis</i>	3: 2 C, 1 J	behind the pelvis	-	IIIB	Kempisty and Włodarczak 2000, 87,88

Table 2.

No.	Site, No.; municipality	Kurgan, grave/feature	Type of grave/feature	Sex	Age	Number of arrowheads; type of flint	Location at the skeleton	Presence of flint flake	Phase (Włodarczak 2006)	References
Sandomierz cluster										
22	Kichary Nowe (currently Nowe Kichary), No. 2; Dwikozy	26	niche grave	?	?	10?	?	-	IIIAB	Włodarczak 2006, 172, tabl. 40
23		29	niche grave	?	?	12?	?	-	IIIB	Włodarczak 2006, 172, tabl. 40
24	Mierzanowice, No. 1; Wojciechowie	81	?	M	?	11 C	near the head		IIIB	Uzarowiczowa 1970, 202 and next.
25		94	?	M	?	4, 3 C, 1?	the skeleton was very poorly preserved, at the feet (3), in the bone mass of the right arm (1)	-	IIIAB	Uzarowiczowa 1970, 207, 208
26		100	?	M	?	9 C	behind the pelvis (8) – arrowheads oriented in one direction, at the right lower leg (1)	-	IIIB	Uzarowiczowa 1970, 208-210
27		199	?	M	?	13 C	at the knees – tip of arrowheads turned towards feet	5 (15) C ¹	IIIAB	Uzarowiczowa 1970, 213, 214
28		200	?	M	?	3 C	at the pelvis under the sacrum	-	IIIAB	Uzarowiczowa 1970, 214, 215
29		209		M	<i>adultus</i>	7, 5 B, 2 C	behind the pelvis		IIIB	Bąbel 1979, 76
30	Mydlów, No. 37; Iwaniska	2*	niche grave?	M?	<i>adultus</i> ?	26 + one piece C	scattered (post-deposition?)		III	Bargiel 1990; 2009

31	Nowy Daromin (currently Daromin), No. 20; Wilczyce	3	?	M?	?	3: 2 C, 1 Bu	under the right collarbone (1), under the right hand (1), at the feet (1)	7: 4 C, 1 S, 2?	IIIB	Antoniewicz 1925, 250-252
32	Wilczyce, No. 10; Wilczyce	15	niche grave	-	-	29: 12 T, 10 C, 7 Cr/E	the skeleton was not discovered	69: 57 S, 8 J, 4 Cr/E	II	Boroń and Włodarczyk 2019, Winiarska- Kabacińska 2019
33	Złota, „Grodzisko II”; Samborzec	15	niche grave	M	?	8 C	various places in niche	46: C	IIIB	Krzak 1958, 353 and next.
34		16	niche grave	M	?	4: 2 C, 1 S, 1 V	various places in niche	-	IIIB	Krzak 1958, 357-359
35	Złota, „Nad Wawrem”; Samborzec	90	?	?	?	7: 6 C, 1 S	?	-	IIIB	Machnik 1966, 236
36	Złota, No. 6; Samborzec	15	?	M	<i>maturus</i>	4: 3 C, 1?	between the ribs (3), at the knee (1)	-	IIIB	Florek and Zakoscielna 2006, 43 and next
37	Żuków; Samborzec	1(2)	pit grave	M	adult	21: 19 J, 2 S	near the knees	-	IIIB	Marciniak 1960, 47-49
Rzeszów cluster										
38	Bierówka; Jasło	kurgan B, 4a	central grave	-	-	6 J	the skeleton was not discovered	-	II	Gancarski and Machnikowie 1990, 114, 115
39	Mirocin, No. 24; Przeworsk	50	niche grave	M	<i>maturus</i>	8, 6 V, 1 S, 1 Br	behind the back	15: 12 V, 3?	IIIB	Machnik <i>et al.</i> 2019, 1 3 and next
40		54	niche grave	M	<i>maturus</i>	6: 4 V, 2 C	near the torso	-	IIIB	Machnik <i>et al.</i> 2019, 20 and next
41		110	niche grave	M M	<i>maturus</i> (No I) <i>maturus</i> (No II)	14: 6 V, 4 C, 2 J, 1 G, 1 radiolarite	near the pelvis and in the lower limbs (9), between the femurs (2); for the rest there is no further data	49: 18 V, 14 Cr/E, 10 C, 2 G, 1 S, 4?	IIIB	Machnik <i>et al.</i> 2019, 34 and next

Table 2.

No.	Site, No.; municipality	Kurgan, grave/feature	Type of grave/feature	Sex	Age	Number of arrowheads: type of flint	Location at the skeleton	Presence of flint flake	Phase (Włodarczak 2006)	References
42	Mirocin, No. 27; Przeworsk	360	niche grave	M, F	<i>senilis</i> (M) <i>maturus maturus</i> (F)	8: 5 V, 2 C, 1?	in the area of man's feet	-	IIIB	Machnik <i>et al.</i> 2019, 58 and next
43	Rozbórz, No. 42; Przeworsk	2006	pit grave	M	<i>juvenis-adultus</i>	8: 6 Cr/E, 1 S, 1 C	near the pelvis	-	II	Ligoda and Podgórska-Czopek 2011, 217 and next; information P. Jarosz
44	Szczytna, No. 5; Pawłosiów	220	niche grave	2 M	<i>maturus</i> (No. I) <i>maturus-senilis</i> (No. II)	7, 4 V, 2 C, 1?	various places in niche and entrance corridor; near the head of individual II (I), in the bone retention zone (2), beyond skeletons (4)	5: 3 C, 2 S	IIIB	Hozer <i>et al.</i> 2017, 19 and next
45	Szczytna, No. 6; Pawłosiów	kurgan I, 4	niche grave	M	<i>adultus</i>	5: 4 C, 1?	behind the back	40: 31 V, 9 C	III	Hozer <i>et al.</i> 2017, 38 and next
46		kurgan I, 56	niche grave	M	<i>adultus</i>	3 V	between the ribs		III	Hozer <i>et al.</i> 2017, 51 and next
Lublin cluster										
47	Guciów, No. 6; Zwierzyniec	kurgan IX	central grave	-	-	8, 5 V, 3 R – two clusters	the skeleton was not discovered	-	IIIC?	Jarosz 2018, 67, 68

48	Lublin-Sławinek, No. 1-2; Lublin	2*	?	?	?	5, 2 S, 2 C, 1 Cr/E	between the ribs	-	IIIB	Polanska 2016, 310- 315
49	Łagiewniki, No. 10; Niemce	lower	pit grave	?	<i>maturus</i>	5: 4 C, 1 V	near the feet (3+1), near the head (1)	-	IIIB	Kubera and Zawislak 2016
50	Młodów Zakęcie (currently Młodów), No. 68; Lubaczów	*	?	-	-	10 V	the skeleton was not discovered	11 V	III	Machnik and Pilch 1997
51	Nieborowa (part of Łowcza-Kolonia), No. I; Sawin	-	pit grave	?	?	7: 5 V?, 2 Cr/E	negative after the skeleton; near the chest	-	IIIB	Boroń and Winiarska- Kabacińska 2014
52	Śługocin, No. 5; Jastków	1	central grave	-	-	3: 2 C, 1?	the skeleton was not discovered	111 C	III	Bienia <i>et al.</i> 2016
53	Snopków, No. 18; Jastków	118	pit grave	-	-	5: 2 B, 2 C, 1 Cr/E	the skeleton was not discovered	5: 4 C, Cr/ N	III	Borowska <i>et al.</i> 2016, 297 and next
54	Ułłów, No. 3; Tomaszów Lubelski	kurgan I, 95/1	central grave	-	-	6 V?	the skeleton was not discovered	-	?	Niezabitowska- Wiśniewska 2008, 81; Pyzewicz 2017
55	Ułłów, No. 4; Tomaszów Lubelski	kurgan II	central grave	-	-	6?	the skeleton was not discovered	-	?	Pyzewicz 2017

* – destroyed features or partially recognized; F – female; M – male; Ch – child; B – Banded flint; Bu – burned flint; C – Chocolate flint; Cr – Cretaceous flint; E – Erratic flint; G – Gościńskich flint; J – Jurassic sub-Kraków flint; R – Rejowiec flint; S – Świeciechów flint; T – Turonian flint; V – Vollnian flint.

1 There is no consistency in the description of the grave (Uzarowiczowa 1970 – on the page 213 gives information „5 flake”, while in the inventory description on the page 214 lists them “fifteen”).

found near the skeleton (two near the ribcage and one in the place of the unpreserved skull) (Włodarczak 2004, 318; Winiarska-Kabacińska, 2007, 173, fig. 5). In several features, it was observed that skeletons had been dislocated post-mortem, which undoubtedly might have disrupted the original arrangements of the deposited artefacts. Grave 220 in Szczytina can serve as an example. Bones of two individuals – as well as the arrowhead assemblage – were discovered in different parts of the niche and the entrance corridor. As a result, a single arrowhead was found near the head of individual II, and two others occurred in the place where the bones were lying. Another four specimens were found outside of the skeletons (Hozer *et al.* 2017, 21ff.). In several cases, the locations of the discovered arrowheads in relation to the skeletons were very vaguely indicated (*e.g.*, Bosutów, Grave 3; Mirocin, Grave 54; Złota ‘Grodzisko II’, Graves 15 and 16; Szczytina, Grave 220). In nine features, no buried remains were found. We have no data on skeletons and locations of arrowheads in another eleven graves.

The most common raw material used in the production of arrowheads in the four clusters was chocolate flint, making 38.7% of the whole collection (out of 494 specimens). Volhynian and Jurassic sub-Kraków flints were used to a moderate degree (14.9% and 11.7% respectively). Cretaceous and erratic flints were even less popular (6.1%). Świeciechów and unspecified grey Turonian flint were employed in similar quantities. Striped flint (1.4%), radiolarite, limestone and Dnistr flint were extremely seldomly used.

Unfortunately, we do not know the weight of the majority of the arrowheads included in the discussed sets. In the case of more numerous series, such measurements were taken for the specimens from Mydlów and Mirocin, Grave 360. In the former case, the specific weights of the specimens grouped in the collection of 26 arrowheads vary from 0.2 to 1.1 g (average weight of 0.4 g; Bargieł 2009, 199, tabl. 1). On the other hand, each of the eight artefacts from Mirocin weighs between 0.3 and 0.8 g (Libera 2022, 147).

More than ten features contained great amounts of half-products: minute flakes (often fragmented) and, less frequently, scaled flakes. Their presence was recorded within all the clusters (in different quantities, from several to 111 specimens): in the Kraków group (Koniusza, Grave 3 – 38 specimens; Malżyce, Grave 10 – 10 specimens; Zagaje Stradowskie, Grave 4 and Zielona, Grave 3 – 9 specimens in each), in the Sandomierz cluster (Wilczyce, Grave 15 – 69 specimens; Złota ‘Grodzisko II’, Grave 15 – 46 specimens; Mierzanowice, Grave 199 – 15 (?) specimens; Nowy Daromin, Grave 3 – 7 specimens). In the Rzeszów cluster (Szczytina, Grave 4 – 40 specimens; Mirocin, Grave 110 – 49 specimens, Grave 50 – 15 specimens), in the Lublin cluster (Śługocin – 111 specimens; Młodów-Zakęcie – 11 specimens) (*cf.* Libera 2022, figs 17, 34, 44 and 59).

Numerous arrowheads were discovered especially in niche graves of the Kraków, Sandomierz and Rzeszów regions, but they did not occur in the Lublin cluster, where they were found only in central and pit graves. In the development of the CWC, arrowheads in closed assemblages appeared as early as in phase II (2700-2550 BC). Nevertheless, they became more frequent in later times, especially in subphase IIIB (2500-2300/2200 BC),

at the end of which they ceased to appear (cf. Table 2). Their occurrences are associated with richly equipped male graves, which usually contained weaponry represented by flint arrowheads and axes, as well as battle-axes, sometimes made of materials other than flint (cf. Włodarczak 2006, 143ff.).

In general, the morphological and metric features of the arrowheads from Mydlów, Grave 2, are not different from the properties of similar artefacts from the Sandomierz region and the other three clusters. Such features as deeply incised bases and quasi-serrated lateral edges can be found on many points discovered across all of the above-mentioned clusters (see Libera 2022, figs 13, 32, 42, 57). It is possible that the flint blades and flakes discovered in Mydlów were also elements of assemblages. Arrowheads co-occurred with flake blanks in numerous closed assemblages across the entire area of the CWC settlement (cf. Table 2). Also this phenomenon is considered as an indication of eastern influences. Their appearance should be linked with phase II of the development of this culture (Wilczyce, Grave 10) and its continuation in phase III (cf. Włodarczak 2006, 73).

FLINT ARROWHEADS IN THE FUNCTIONAL VIEW

Use-wear analysis as a method of studying flint artefacts has been known for several decades (Vaughan 1985, 3). It is currently one of the standard techniques. The technique gives very interesting results when it accompanies examination of materials representing different contexts – settlements, hoards and graves. However, some of the most intriguing results can be obtained when studying the functions of flint artefacts found close to buried individuals, because they not only allow us to learn about how they were used, but also better understand the character of burial gifts (see, for example, van Gijn 2010, 144-149).

Materials associated with the CWC were discussed in a series of studies aimed at analysing use-wear patterns. Still, because of the character of such sets, most of them were limited to presenting results of analyses conducted on materials from particular graves or small cemeteries (Drobniewicz 1979; Budziszewski *et al.* 2008, 48-53; Winiarska-Kabacińska 2007; 2008; 2019, 89-97; Boroń and Winiarska-Kabacińska 2014, 218-224; Włodarczak *et al.* 2016, 42, 43; Baron *et al.* 2018, 174-178; Pyżewicz 2017; 2022, 168; Skłucki *et al.* 2021, 182-184). A considerable part of previously analysed assemblages included arrowheads from the following localities: Koniusza, Dąbrowa Biskupia, Nieborowa, Wilczyce 10, Ulów 3 and 4, Zielona 3, Żuków. This issue was more extensively discussed by Grzegorz Osipowicz, who focused on a series of arrowheads from the Sokal Ridge and Eastern Roztocze (such sites as: Brzezinki, Site 1; Hubinek, Site 3; Klekacz, Site 10; Łubcze, Sites 24 and 25; Łukawica, Site 13; Machnówek, Site 1 and Wierszyczka, Site 29), but they were somewhat modest collections containing one or two arrowheads (Osipowicz 2022). Jointly, the use-wear analysis was conducted on 109 arrowheads. This group was complemented with the 26 chocolate flint arrowheads discovered in Mydlów that are the topic of this paper.

Such a number of analyses allows us to draw some broader conclusions concerning the ways of using arrowheads. Still, it should be stressed that due to the considerable time period during which the analyses were performed and different attitudes of the researchers to particular examinations, there are certain differences in interpretations, resulting from employing different methodologies and equipment as well as depending on knowledge and attitudes of particular scholars. In many cases, researchers recorded patterns indicating abrasions on the edges of the wings and/or on the rounded tips of the examined specimens (Drobniewicz 1979; Budziszewski *et al.* 2008, 48; Winiarska-Kabacińska 2007; 2008; 2019, 89-97; Boroń and Winiarska-Kabacińska 2014, 218-224; Włodarczak *et al.* 2016, 42, 43; Pyżewicz 2017; 2022, 168). The same applies to the materials from Mydlów, where such traces were discovered on 19 arrowheads (Table 1). These traces were interpreted as resulting from chafing against the walls of a container made of some soft material. In the case of the discussed artefacts, we suspect that it was a quiver. Grzegorz Osipowicz thinks differently. He suggests that the traces detected on the artefacts from the Sokal Ridge might have been a result of protecting the arrowheads glued to the shafts by placing them in rigid sheaths made of leather. He assumes that they were tubular and their diameters were similar to the widths of particular arrowheads (Osipowicz 2022, 224). There are two other inventories that require more profound analyses. The first of them, examined by Barbara Drobniewicz, is an assemblage composed of one retouched blade and 16 arrowheads, *'the tips of the first 14 points are polished to different degrees'*, another two were not covered with use-wear traces. Despite a different interpretation proposed by the scholar – that the artefacts might have been used as knives (Drobniewicz 1979, 91, fig. 1: c-e) – it appears that in fact the patterns recorded on the arrowheads should be interpreted as a result of keeping them in a quiver (likewise Budziszewski and Tunia 2000, 122, further literature there). Also, the results of microscopic observations of the materials found in Zielona require a commentary. Seven specimens were covered with use-wear patterns (abrasions on the tips and/or wings). The traces were interpreted by the author of the research as a result of processing hide or employing lithic technologies (Winiarska-Kabacińska 2007, 173, fig. 7; cf. 2019, 89, 90, fig. 6: 1).

In most cases, researchers conducting analyses did not record patterns indicating that the arrowheads had been used as projectile points. The same conclusions were drawn in the case of the materials from Mydlów. Only one scholar performing microscopic analyses discovered traces that might have been caused by using an examined arrowhead as a projectile element. The specimen in question was discovered in Wilczyce, where the apex of one of the 29 examined arrowheads was characteristically broken off (Winiarska-Kabacińska 2019, 89-90, fig. 6: 2a-d). Due to the lack of use-wear traces on the arrowheads, it is also difficult to interpret the specimens discovered where bodies were supposedly located. Because of the lack of use-wear patterns on their surfaces, the obtained results might indicate that none of the discovered arrows had been used as projectiles. Still, we should bear in mind that this state of affairs may be the result of the way in which patterns

are formed on arrowheads. Generally, traces indicating that an arrowhead was used as a projectile element are recorded rather seldomly and greatly depend on how hard targets were. In the case of hitting soft targets, there are fewer chances of recording use-wear traces on an arrowhead. This is why it appears that lack of such traces cannot be considered as an indication that the arrows were not used, even though it is probably true for many of them. We have to remember that deciding whether an arrow was to be used once or many times was to a great degree a matter of an individual choice.

Then, how can we interpret the remaining arrowheads that were not covered with use-wear patterns? Most probably, most of the artefacts discovered near buried individuals were deposited by the people preparing the burials, who did this according to their material possibilities and prevalent burial practices. We can assume that artefacts discovered in graves (especially arrowheads) were used by the buried individuals during their lives, or they had belonged to the people preparing a burial. Arrows discovered in clusters had probably been kept in quivers, but some artefacts that do not have characteristic abrasions might have been placed in quivers much later. It is possible that some of such arrows were made specifically for the funeral. Some artefacts might have been connected with the deaths of the buried individuals. Such assumptions can be tentatively drawn for specimens discovered near bones (theoretically within the body). Still, it is worth stressing that such locations might have been linked with ritual practices or caused by intermingling materials by roots or rodents. Finding an arrowhead lodged directly in the bones of a buried individual would be direct and certain confirmation the assumption that it was related to the cause of death (see Flohr *et al.* 2015). Nevertheless, so far, no such artefacts have been discovered in CWC materials. Unfortunately, because of the considerable numbers of potential interpretations, it is often impossible to decisively answer the above-presented question. Still, the only type of information that can be confirmed is the fact that the arrowheads without visible traces of keeping them in a container were later added to the quiver of their owner during his life, or after his death – by the people preparing the burial.

CONCLUSION

The collection of 27 specimens, consisting of chocolate flint arrowheads discovered in Mydlów, is one of the largest that has been discovered in the area of the Polish lands. The only larger assemblage is that from Wilczyce, which includes 29 arrowheads.

The inventory from Mydlów is functionally diverse. It includes specimens with use-wear patterns on their surfaces – which indicate that they were kept for a long time in a quiver – as well as those without such traces, which allows us to suspect that they were added to the rest some time later.

The presence of artefacts in the grave bearing intense wear traces indicative of carrying in a quiver suggests that these set of arrowheads were not specifically prepared for burial

purposes (at least not all of them). This observation is consistent with the results of analyses of other (CWC) grave inventories, where artefacts with use-were traces also recorded.

References

- Antoniewicz W. 1925. Eneolityczne groby szkieletowe i ziemianki mieszkalne w Nowym Darominie (pow. sandomierski, Małopolska). *Niederlův sborník. Obzor praehistorický* 4, 243-274.
- Bargiel B. 1990. Badania wykopaliskowe na terenie gminy Iwaniska w województwie tarnobrzskim. In J. Gurba (ed.), *Sprawozdania z badań terenowych Katedry Archeologii UMCS w 1990 roku*. Lublin: Uniwersytet Marii Curie-Skłodowskiej Katedra Archeologii, 18-24.
- Bargiel B. 2009. Z problematyki występowania grocików krzemiennych na przykładzie znaleziska z Mydlowa, pow. opatowski, woj. świętokrzyskie. In H. Taras and A. Zakościelna (eds), *Hereditas praeteriti. Additamenta archaeologica et historica dedicata Ioanni Gurba Octogesimo Anno Nascendi*. Lublin: Wydawnictwo Uniwersytetu Marii Curie-Skłodowskiej, 195-208.
- Baron J., Mirosław F., Hałuszko A. and Kufel-Diakowska B. 2018. Differentiation of burial practices in the Corded Ware Culture. The example of the Magnice site in SW Poland. *Praehistorische Zeitschrift* 93/2, 169-184.
- Bąbel J. 1979. Groby neolityczne ze stan. I w Mierzanowicach, woj. tarnobrzskie. *Wiadomości Archeologiczne* 44/1, 67-87.
- Bąbel J. T. 2013a. *Cmentarzyska społeczności kultury mierzanowickiej na Wyżynie Sandomierskiej. Część 1. Obrządek pogrzebowy*. Rzeszów: Fundacja Rzeszowskiego Ośrodka Archeologicznego, Instytut Archeologii Uniwersytetu Rzeszowskiego.
- Bąbel J. T. 2013b. *Cmentarzyska społeczności kultury mierzanowickiej na Wyżynie Sandomierskiej. Część 2. Źródła*. Rzeszów: Fundacja Rzeszowskiego Ośrodka Archeologicznego, Instytut Archeologii Uniwersytetu Rzeszowskiego.
- Bienia M., Budziszewski J., Niedźwiedź E., Niedźwiedź J. and Włodarczak P. 2016. Kurhan kultury ceramiki sznurowej na stanowisku 5 w Sługocinie, pow. lubelski. In P. Jarosz, J. Libera and P. Włodarczak (eds), *Schylek neolitu na Wyżynie Lubelskiej*. Kraków: Instytut Archeologii i Etnologii PAN, 257-286.
- Borkowski W. 1987. Neolithic and Early Bronze Age heart-shaped arrow-heads from the Little Poland Upland. In J. K. Kozłowski and S. K. Kozłowski (eds), *New in stone age archaeology (= Archaeologia Interregionalis 8)*. Warsaw, Cracow: Warsaw University, Jagiellonian University, 147-181.
- Boroń T. and Winiarska-Kabacińska M. 2014. Analiza wyposażenia grobowego w kulturze ceramiki sznurowej na przykładzie pochówku szkieletowego z Nieborowej na Polesiu Lubelskim. *Archeologia Polski* 59/1-2, 209-230.
- Boroń T. and Włodarczak P. 2019. Obiekt 15: konstrukcja i wyposażenie. In P. Włodarczak (ed.), *Wilczyce, stanowisko 10. Norma i precedens w rytuale pogrzebowym małopolskiej kultury ceramiki sznurowej (= Ocalone Dziedzictwo Archeologiczne 9)*. Kraków, Niepołomice-Pękwice: Wydawnictwo i Pracownia Archeologiczna Profil-Archeo, Stowarzyszenie Archeologów Terenowych „Stater”, Instytut Archeologii i Etnologii PAN, 17-29.

- Borowska J., Budziszewski J. and Włodarczak P. 2016. Groby kultury ceramiki sznurowej ze stanowiska 18 w Snopkowie, pow. lubelski. In P. Jarosz, J. Libera and P. Włodarczak (eds), *Schylek neolitu na Wyżynie Lubelskiej*. Kraków: Instytut Archeologii i Etnologii Polskiej Akademii Nauk, 293-306.
- Budziszewski J., Czebreszuk J., Winiarska-Kabacińska M. and Chachlikowski P. 2008. Grób społeczności kultury ceramiki sznurowej z Dąbrowy Biskupiej, stan. 21, pow. Inowrocław, woj. kujawsko-pomorskie. In J. Bednarczyk, J. Czebreszuk, P. Makarowicz and M. Szmyt (eds), *Na pograniczu światów. Studia z międzymorza bałtycko-pontyjskiego ofiarowane Profesorowi Aleksandrowi Koško w 60 rocznicę urodzin*. Poznań: Wydawnictwo Poznańskie, 31-70.
- Budziszewski J., Jarosz P., Libera J., Szczepanek A., Witkowska B. and Włodarczak P. 2016. Kurhany ze stanowiska 30 w Stryjowie, pow. krasnostawski. In P. Jarosz, J. Libera and P. Włodarczak (eds), *Schylek neolitu na Wyżynie Lubelskiej*. Kraków: Instytut Archeologii i Etnologii Polskiej Akademii Nauk, 381-409.
- Budziszewski J. and Tunia K. 2000. A Grave of the Corded ware culture arrowheads producer in Koniusza, southern Poland. Revisited. In S. Kadrow (ed.), *A Turning of Ages. Im Wandel der Zeiten. Jubilee book dedicated to Professor Jan Machnik on His 70th anniversary*. Kraków: Institute of Archaeology and Ethnology of Polish Academy of Sciences, 101-135.
- Drobniewicz B. 1979. Analiza traseologiczna wyrobów krzemiennych z cmentarzyska kultury ceramiki sznurowej w Koniuszy, woj. Kraków. *Sprawozdania Archeologiczne* 31, 91-94.
- Fischer A., Vemming Hansen P. and Rasmussen P. 1984. Macro and Micro Wear Traces on Lithic Projectile Points. Experimental Results and Prehistoric Examples. *Journal of Danish Archaeology* 3, 19-46.
- Flohr S., Brinker U., Schramm A., Kierdorf U., Staude A., Piek J., Jantzen D., Hauenstein K. and Orschiedt J. 2015. Flint arrowhead embedded in a human humerus from the Bronze Age site in the Tollense valley, Germany – A high-resolution micro-CT study to distinguish antemortem from perimortem projectile trauma to bone. *International Journal of Paleopathology* 9, 76-81.
- Florek M. and Zakościelna Z. 2006. Wyniki badań ratowniczych na stanowisku 6 w Złotej, pow. sandomierski, w latach 2002-2004. *Archeologia Polski Środkowowschodniej* 8, 41-56.
- Gancarski J., Machnikowie A. and J. 1990. Kurhan B kultury ceramiki sznurowej w Bierówce, gmina Jasło, w świetle badań wykopaliskowych. *Acta Archaeologica Carpathica* 29, 99-124.
- Gomułka I. and Hałuszko A. 2017. Zbiorowy grób ludności kultury ceramiki sznurowej ze Szczepanowic, pow. miechowski, woj. małopolskie. In M. Masojć, M. Cendrowska and M. Kopec (eds), *XX Śląskie Sympozjum Archeologiczne, Wrocław, 24-27 maja 2017 roku*. Wrocław: Instytut Archeologii Uniwersytetu Wrocławskiego, Wrocławskie Centrum Akademickie, Muzeum Archeologiczne (oddział Muzeum Miejskiego Wrocławia), Polska Akademia Nauk (oddział we Wrocławiu), Ústav Archeologie Slezská univerzita v Opavě Filozoficko-přírodovědecká fakulta v Opavě, Fundacja Nauki „Archaeologia Silesiae”, 26.
- Hozer M., Machnik J. and Bajda-Wesołowska A. 2017. Groby kultury ceramiki sznurowej i domniemane kultury mierzanowickiej w Szczytnej, pow. Jarosław. Źródła, analiza, wnioski. In P. Jarosz and J. Machnik (eds), *Nekropolie ludności kultury ceramiki sznurowej z III tysiąclecia przed*

- Chr. w Szczytnej na Wysoczyźnie Kańczuckiej (= *Via Archaeologica Ressoviensia* 12). Rzeszów: Fundacja Rzeszowskiego Ośrodka Archeologicznego, 7-130.
- Jarosz P. 2018. Groby oraz pozostałości osadnictwa ze schyłku neolitu i wczesnego okresu epoki brązu w Guciowie, na stan. 6. In J. Górski and A. Tyniec (eds), *Fenomen miejsca. Nekropola kurhano-wa z neolitu, epoki brązu i wczesnego średniowiecza w Guciowie, pow. zamojski* (= *Biblioteka Muzeum Archeologicznego w Krakowie* 6). Kraków: Muzeum Archeologicznego w Krakowie, 67-85.
- Jarosz P., Tunia K. and Włodarczak P. 2009. Burial mound No. 2 in Małyce, the district of Kazimierza Wielka; Grobowiec nr 2 w Małycach, pow. Kazimierza Wielka. *Sprawozdania Archeologiczne* 61, 175-212; 213-231.
- Kempisty A. 1978. *Schylek neolitu i początek epoki brązu na Wyżynie Małopolskiej w świetle badań nad kopcami* (= *Rozprawy Uniwersytetu Warszawskiego* 121). Warszawa: Wydawnictwo Uniwersytetu Warszawskiego.
- Kempisty A. and Włodarczak P. 2000. *Cemetery of the Corded Ware Culture in Żerniki Górne* (= *Światowit, Supplement Series P: Prehistory and Middle Age* 5). Warszawa: Institute of Archaeology Warsaw University.
- Krauss A. 1960. Cmentarzysko kultury ceramiki sznurowej w Bosutowie, pow. Kraków. *Materiały Archeologiczne* 2, 61-67.
- Krzak Z. 1958. Cmentarzysko kultury złockiej na stanowisku „Grodzisko II” we wsi Złota, pow. Sandomierz. *Archeologia Polski* 2/2, 327-388.
- Kubera M. and Zawiślak P. 2016. Grób kultury ceramiki sznurowej na stanowisku 10 w Łagiewnikach, pow. lubelski. In P. Jarosz, J. Libera and P. Włodarczak (eds), *Schylek neolitu na Wyżynie Lubelskiej*. Kraków: Instytut Archeologii i Etnologii Polskiej Akademii Nauk, 349-358.
- Libera J. 2022. Grobowe inwentarze kamienne ludności kultury ceramiki sznurowej z obszaru Małopolski. In A. Szczepanek, P. Jarosz, J. Libera and P. Włodarczak (eds), *Společnosti schyłkowego eneolitu w południowo-wschodniej Polsce w świetle badań archeologicznych i analiz interdyscyplinarnych*. Pętkowice-Kraków: Wydawnictwo Profil-Archeo, 45-212.
- Ligoda J. and Podgórska-Czopek J. 2011. Katalog; The Catalogue. In S. Czopek (ed.), *Autostradą w przeszłość. Katalog wystawy; Motorway to the past. Exhibition catalogue*. Rzeszów: Fundacja Rzeszowskiego Ośrodka Archeologicznego; Instytut Archeologii Uniwersytetu Rzeszowskiego; Muzeum Okręgowe w Rzeszowie. Rzeszów, 133-295.
- Machnik J. 1964. Groby kultury ceramiki sznurowej w Książnicach Wielkich, pow. Kazimierza Wielka. In S. Nosek (ed.), *Studia i materiały do badań nad neolitem Małopolski* (= *Polska Akademia Nauk Oddział w Krakowie. Prace Komisji Archeologicznej* 4). Wrocław, Warszawa, Kraków: Zakład Narodowy im. Ossolińskich, Wydawnictwo Polskiej Akademii Nauk, 339-372.
- Machnik J. 1966. *Studia nad kulturą ceramiki sznurowej w Małopolsce*. Wrocław, Warszawa, Kraków: Zakład Narodowy imienia Ossolińskich. Wydawnictwo Polskiej Akademii Nauk.
- Machnik J., Jarosz P. and Mazurek M. 2019. Groby ludności kultury ceramiki sznurowej w Mirocinie, pow. Przeworsk. In P. Jarosz, J. Machnik and A. Szczepanek (eds), *Nekropolie ludności kultury ceramiki sznurowej z III tysiąclecia przed Chr. w Mirocinie na Wysoczyźnie Kańczuckiej* (= *Via*

- Archaeologica Ressoviensia* 15). Rzeszów: Fundacja Rzeszowskiego Ośrodka Archeologicznego, Instytut Archeologii Uniwersytetu Rzeszowskiego, 7-139.
- Machnik J. and Pilch A. 1997. Zaskakujące odkrycie zabytków kultury środkowodnieprzańskiej w Młodowie-Zakąciu koło Lubaczowa, w woj. przemyskim. *Sprawozdania Archeologiczne* 49, 143-170.
- Marciniak J. 1960. Materiały neolityczne z Żukowa, pow. Sandomierz. *Materiały Archeologiczne* 2, 43-56.
- Niezabitowska-Wiśniewska B. 2008. Kompleks osadniczy w Ulowie, powiat tomaszowski – wstępne podsumowanie sześcioletnich badań wykopaliskowych. *Archeologia Polski Środkowowschodniej* 10, 67-93.
- Nowak D. and Osipowicz G. 2013. Krzemienne zbrojniki broni miotanej z ziemi chełmińskiej w świetle analiz traseologicznych i badań eksperymentalnych. *Acta Universitatis Nicolai Copernici. Archeologia* 32, 57-112.
- Osipowicz G. 2010. *Narzędzia krzemienne w epoce kamienia na ziemi chełmińskiej. Studium traseologiczne*. Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.
- Osipowicz G. 2022. Wyniki analizy traseologicznej wytworów krzemiennych kultury ceramiki sznurowej ze stanowisk kurhanowych zlokalizowanych na Grzędzie Sokalskiej i Roztoczu. In A. Szczepanek, P. Jarosz, J. Libera and P. Włodarczak (eds), *Společnosti schyłkowego eneolitu w południowo-wschodniej Polsce w świetle badań archeologicznych i analiz interdyscyplinarnych*. Pętkowice, Kraków: Wydawnictwo Profil-Archeo, 213-262.
- Polańska M. 2016. Grób kultury ceramiki sznurowej odkryty w rejonie ulic Głęboka – Gliniana w Lublinie. In P. Jarosz, J. Libera and P. Włodarczak (eds), *Schylek neolitu na Wyżynie Lubelskiej*. Kraków: Instytut Archeologii i Etnologii Polskiej Akademii Nauk, 287-292.
- Pyżewicz K. 2017. Use-wear analysis of flint artefacts from the barrows of the Corded Ware culture in Ulów. *Folia Quaternaria* 85, 117-134.
- Pyżewicz K. 2022. *Przykłady strategii produkcji i użytkowania paleolitycznych oraz mezolitycznych narzędzi krzemiennych*. Warszawa: Wydawnictwa Uniwersytetu Warszawskiego.
- Reyman T. 1948. Dokumentaryczne wartości odkryć w kopcu wschodnim w Rosiejowie, w pow. Pińczowskim. *Slavia Antiqua* 1, 42-83.
- Skłucki J., Kraszewska A., Micyk P. and Valde-Nowak P. 2021. Corded Ware culture at Zagórze in the Middle Beskid (Polish Western Carpathians). *Acta Archaeologica Carpathica* 56, 175-192.
- Tunia K. 1979. Cmentarzysko kultury ceramiki sznurowej w Koniuszy, woj. Kraków. *Sprawozdania Archeologiczne* 31, 47-77.
- Tunia K. 1997. Groby kultury ceramiki sznurowej w Krzyżu, woj. Kielce. *Sprawozdania Archeologiczne* 49, 181-190.
- Tunia K. 1999. Cmentarzysko kultury ceramiki sznurowej w Łękawie, woj. świętokrzyskie. *Sprawozdania Archeologiczne* 51, 159-180.
- Uzarowiczowa A. 1970. Groby kultury ceramiki sznurowej z cmentarzyska wielokulturowego w Mierzanowicach, pow. Opatów. *Wiadomości Archeologiczne* 35/2, 201-234.
- Van Gijn A. 2010 *Flint in Focus. Lithic Biographies in the Neolithic and Bronze Age*. Leiden: Sidestone Press.

- Vaughan P. C. 1985. *Use-Wear Analysis of Flaked Stone Tools*. Tucson: The University of Arizona Press.
- Winiarska-Kabacińska M. 2007. Przywódca neolityczny z Zielonej. Badania traseologiczne. In W. Dzeduszycki and J. Wrzesiński (eds), *Środowisko pośmiertne człowieka (= Funeralia Lednickie. Spotkanie 9)*. Poznań: Stowarzyszenie Naukowe Archeologów Polskich w Poznaniu, 169-175.
- Winiarska-Kabacińska M. 2008. Functional analysis as a tool for the interpretation of mortuary practices. A case-study of the Corded Ware Culture graves at Zielona, southern Poland. In L. Longo and N. Skakun (eds), *Prehistoric Technology. 40 years later: Functional Studies and the Russian Legacy (= British Archaeological Reports. International Series 1783)*. Oxford: Archaeopress, 331-335.
- Winiarska-Kabacińska M. 2019. Analiza funkcjonalna zabytków kamiennych i kościanych. In P. Włodarczak (ed.), *Wilczyce, stanowisko 10. Norma i precedens w rytuale pogrzebowym małopolskiej kultury ceramiki sznurowej (= Ocalone Dziedzictwo Archeologiczne 9)*. Kraków, Niepołomice-Pętkowice: Wydawnictwo i Pracownia Archeologiczna Profil-Archeo, Stowarzyszenie Archeologów Terenowych „Stater”, Instytut Archeologii i Etnologii PAN, 89-102.
- Włodarczak P. 2004. Cemetery of the Corded Ware culture in Zielona, Koniusza commune, Małopolska. Cmentarzysko kultury ceramiki sznurowej w Zielonej, gm. Koniusza, woj. małopolskie. *Sprawozdania Archeologiczne* 56, 307-360.
- Włodarczak P. 2006. *Kultura ceramiki sznurowej na Wyżynie Małopolskiej*. Kraków: Wydawnictwo Instytutu Archeologii i Etnologii Polskiej Akademii Nauk, Oddział w Krakowie.
- Włodarczak P. 2020. Schyłek epoki kamienia i początki epoki brązu w okolicach Igołomi i Wawrzeńcyc. In K. Tunia (ed.), *Kartki z dziejów igołomskiego powiatu*. Kraków, Pętkowice: Wydawnictwo i Pracownia Archeologiczna Profil-Archeo, 93-114.
- Włodarczak P., Boroń T., Kurzawska A., Osypińska M., Szczepanek A. and Winiarska-Kabacińska M. 2016. Grób kultury ceramiki sznurowej ze stanowiska 10 w Wilczycach, pow. sandomierski. *Przegląd Archeologiczny* 64, 29-57.
- Wolski D. and Kalita M. 2015. An attempt at interpreting untypical modifications of flint Arrowheads: an experimental and use-wear perspective. *Sprawozdania Archeologiczne* 67, 301-314.