Katarzyna Januszek
Faculty of Archaeology, University of Warsaw
katarzyna.januszek@uw.edu.pl
ORCID 0000-0001-7355-3827

The Use of Flints in Prehistory and Modern Times on Open Air Sites from Sandy Lowlands. The Case of the Site Żanęcin 9, Wiązowna Commune, Mazowieckie Voivodship

Abstract

Open-air archaeological sites situated on dunes near various rivers are characteristic of the Polish lowlands. Excavations at these sites typically yield chronologically and culturally diverse artefacts made of non-organic materials, such as fired clay or stone. Assigning these artefacts to specific chronological-cultural units is often challenging due to the absence of a clear stratigraphic context. An additional complication arises from the geological characteristics of these dune sites, which lack local stone resources, including flint, that could have been utilised in situ by past human communities. Consequently, flint artefacts discovered at these locations are almost invariably imports, reflecting the activities of different groups across various periods. The patterns of flint exploitation by the communities inhabiting the site discussed in this study were determined through an analysis of analogous material from one of the best-documented sites of this type. At Żanęcin 9, flint was used in two distinct ways. The first involved processing of two varieties of erratic flint on-site, employing diverse methods and techniques, and tool production. This pattern was characteristic of Late Mesolithic and Early Bronze Age communities. The second approach was limited to the transportation of finished artefacts to the site for various purposes, a practice associated with both Early and Late Bronze Age populations as well as modern times societies.

Keywords: Bronze Age, Trzciniec Cultural Sphere, flint artefacts, gunflint, sandy lowlands

Introduction

Open-air sandy sites are typical of many lowland areas in Poland, particularly those located on dunes near various rivers. From an archaeological perspective, they provide information primarily from non-organic sources. Such sites, usually found near rivers that historically served as communication routes, were settled either long-term or episodically by different communities at various times. This is evidenced by accumulations of habitation traces, typically including pottery and flint artefacts. They are usually found outside clear stratigraphic contexts and in various states of preservation, often damaged (e.g., Grądy-Woniecko 1).[1] The total site area also influences the amount and type of information available on settlement processes. However, the size of the site and the extent of its exploration do not necessarily determine the number of archaeological finds or features. An even greater challenge stems from the lack of clear stratigraphy and the extremely poor conditions for organic matter preservation, both of which severely complicate the dating of discovered artefacts. Therefore, the most reliable method for assessing the synchronicity of finds, as well as the intensity and character of settlement in a given period, is the analysis of the horizontal dispersion of specific categories of finds.

An important research aspect is the possibility of indicating the scope of activities carried out on site by various communities over the centuries based on flint raw material, which, however, does not naturally occur in the dunes. The extent of the use of flint by the site's inhabitants can be assessed on the basis of large-scale excavations with precise localisation of artefacts and ecofacts. Accordingly, this paper draws on data and flint finds re-

[1] Wawrusiewicz *et al.* 2017.

trieved during excavations at Site 9 in Żanęcin, Wiązowna commune, Mazowieckie voivodship (Poland). The site is located on the right bank of the Świder River, on a small sandy elevation.[2] The location lies within a sandy and clayey denudation plain known as the Garwolin Plain, which is part of the Środkowomazowiecka Lowland.[3]

Materials and methods

The excavated section of Site 9 yielded 91 flint finds in varying states of preservation (Tab. 1). Six of these are natural forms, while the remaining 85 can be classified as artefacts. The majority originates from a cultural layer, with only four recovered from secondary deposits resulting from modern disturbances of the original stratigraphy (area unit I14 –feature 320, area units: K11 and K15; Fig. 1). Within the cultural layer, the flint finds were scattered without any discernible clusters, typically found near potsherds of various sizes, most of which are attributed to the classical developmental stage of the Trzciniec Cultural Sphere (TCS). In this context, on average, approximately one to five flint artefacts were found in most of the excavated areas. Only three larger clusters were discovered, located 10 to 30 centimetres apart from each other (area units: D7–19 finds; D11–8 finds; and F11–10 finds). Since the spatial dispersion of finds in the excavated area did not reveal any clearly separated spatial units within the cultural layer, the flint items were analysed together.

Their general structure was analysed following the principles of dynamic technological classification.[4] It involves categorizing artefacts according to the sequence of their manufacture, from extracting the raw material to shaping the final products deposited in a given context within the site. The resulting list of tool types includes retouched flake tools, defined based on morphological criteria, mostly related to the placement and form of retouch, observed in Palaeolithic, Mesolithic, Neolithic and modern times artefacts from various parts of the world.[5] Their technological evaluation followed guidelines described in the literature, focusing on force application techniques by tracing marks of direct or indirect percussion and pressure visible on the debitage.[6]

The raw material was identified based on the characteristic features (colour, shine, translucency of the flint mass, type of inclusions in the flint mass, presence and type of cortex) and compared to representative samples from the lithics collection of the Faculty of Archaeology of the University of Warsaw.

Flint raw materials

The flint finds from the cultural layer were made of two types of raw material: erratic and mined (Tab. 2). The erratic flint included two variants dated to the Cretaceous Period. The first was presumably 'local', appearing frequently in the postglacial sands and gravels of Mazovia in the form of small chunks of heterogeneous and differently coloured flint mass. It is represented by 24.1% of the finds. The second resembles the 'north-eastern flint' described by Karol Szymczak.[7] It is macroscopically identical to the Cretaceous flint raw materials, known from the vicinity of Mielnik or flint mines near Krasnasyelski on the Ros River (Belarus) and in the Volhynian Highland. It is represented by 59.3% of the finds. Based on the translucency of the flint mass, both aforementioned variants may be classified as Group I of erratic flint defined by Piotr Dmochowski.[8] Although divisions within the category of Cretaceous flints are debatable[9] and the classification based on translucency does not entirely support the technological evaluation of the artefacts from Site 9, the aforementioned division into variants will still be applied in this study.

Meanwhile, the mined flints are represented by two variants: chocolate, comprising 8.8% of all finds, and Świeciechów flint, present in 1.1% of the assemblage. The primary and secondary deposits of the chocolate flint are located at the north-eastern edges of the Świętokrzyskie Mountains.[10] In contrast, the outcrops of Świeciechów flint are found in Cretaceous layers in the locality of Świeciechów Poduchowny, in the Annopol commune, Lubelskie voivodship.[11]

In general, the erratic flint is represented by 83.4% of the analysed finds and mine flint by 9.9%. The remaining 6.7% are items made of materials impossible to identify due to scorching or overheating.

Both erratic and mine flints on the site can be considered imports from various, more or less distant, places. This is indicated by Site 9 location within the oldest generation of dunes and aeolic formations.[12] Hence, the few pieces of unprocessed flint of two erratic variants (six finds in total) excavated at the site were presumably brought

[2] Mazurek, Sznajdrowska-Pondel 2020, 6.
[3] Kondracki 2009, 196.
[4] For example, Schild *et al*. 1975, 12n.
[5] Ginter, Kozłowski 1990, 79–169; Whittaker 2009, 52–53.
[6] For example, Inizan *et al*. 1992, 60–65; Inizan *et al*. 1999, 73–79; Migal 2005, 136.
[7] Szymczak 1992, 15–29.
[8] Dmochowski 2006.
[9] *Cf.* Sulgostowska 2016.
[10] Budziszewski 2008, 49–87.
[11] For example, Libera, Zakościelna 2002.
[12] *Cf.* Baraniecka 1982, fig. 8.

Table 1. Żanęcin, Site 9, Wiązowna commune, Mazowieckie voivodship. Inventory of flint finds (* = preserved size of the damaged specimen).

No.	Inventory no.	Location		Category of flint finds	Measurements (cm)		
		Area Unit	No. on the plan		Length	Width	Thickness
1.	334	ZY5	402	natural flake	2.8	1.7	0.7
2.	318	ZY7	279	splinter flake, partially cortical	1.1	1.2	0.2
3.	318	ZY7	285	unipolar splintered piece	1.3	1.3	0.4
4.	318	ZY7	281	laurel arrowhead with a tang	2.7	1.1	0.3
5.	327	ZY8	280	flake	1.2	1.0	0.2
6.	327	ZY8	295	bipolar splintered piece with a single orientation change	2.3	2.6	0.7
7.	309	ZZ7	Feature 339/B	natural flake with retouching edge	3.6	1.9	0.5
8.	317	ZZ7	213	blades core with single striking platform	2.7	1.9	2.4
9.	324	ZZ8	188	splinter flake, partially cortical	2.3	1.3	0.6
10.	324	ZZ8	200	splinter flake, partially cortical	3.0	1.2	0.7
11.	324	ZZ8	207	splinter flake – fragment	2.6	1.6*	0.5
12.	324	ZZ8	209	splinter flake	1.7	1.4	0.3
13.	324	ZZ8	212	partially cortical flake	4.0	3.2	0.7
14.	90	A6	45	partially cortical blade (distal fragment)	2.4*	1.5	0.3
15.	90	A6	43	chip	0.7	1.4	0.2
16.	87	A7	1	blade (distal fragment)	2.4*	1.5	0.2
17.	322	C7	227	frost chip	2.8	1.8	0.7
18.	385	C9	1213	natural flake with broken edges	1.8	2.1*	0.5
19.	385	C9	1208	overpassed blade (distal fragment)	2.6*	1.2	0.6
20.	386	C10	1218	blade (middle fragment)	1.0*	1.0	0.1
21.	386	C10	1217	partially cortical blade (distal fragment)	2.0*	1.1	0.2
22.	386	C10	1216	partially cortical flake	1.4	1.2	0.4
23.	387	C11		bipolar splintered piece	1.6	1.5*	0.7
24.	337	D6	492	bipolar splintered piece	1.5*	1.0	0.7
25.	336	D7	459	scraper	2.4	1.4	0.5
26.	336	D7	428	blade (proximal fragment)	1.5*	0.9	0.3
27.	336	D7	467	retouched blade	3.2	1.4	0.3
28.	336	D7	434	truncation	2.1	1.0	0.4
29.	336	D7	449	technological chunk	1.2	1.8	0.7

Table 1. Cont.

No.	Inventory no.	Location		Category of flint finds	Measurements (cm)		
		Area Unit	No. on the plan		Length	Width	Thickness
30.	336	D7	437	technological chunk	1.6	2.3	0.9
31.	336	D7	438	retouched splinter flake	2.9	3.8	0.8
32.	336	D7	442	technological chunk	2.6	1.8	1.0
33.	336	D7	466	retouched flake, partially cortical	1.2	1.3	0.3
34.	336	D7	469	splinter flake, partially cortical	1.5	1.9	0.4
35.	336	D7	440	retouched blade (distal fragment)	1.0*	0.9	0.3
36.	336	D7	473	partially cortical blade (distal fragment)	1.9*	0.9	0.2
37.	336	D7	427	technological chunk	4.3	2.8	1.0
38.	336	D7	426	retouched flake	1.9	1.9	0.5
39.	336	D7	430	technological chunk	2.5	2.2	1.0
40.	336	D7	445	partially cortical flake	1.4	1.2	0.3
41.	336	D7	435	end-scraper – fragment	1.2*	0.9*	0.4
42.	336	D7	432	bipolar splintered piece – fragment	1.8*	1.7*	1.0
43.	336	D7	433	natural flake	4.1	5.0	1.5
44.	333	D8	398	crested blade – fragment	1.3*	0.8	0.5
45.	331	D10	380	blades core with single striking platform	3.1	2.1	3.0
46.	335	D11	405	blade (distal fragment)	1.4*	0.5	0.2
47.	335	D11	415	flake – fragment	2.0	1.2*	0.6
48.	335	D11	407	partially cortical flake	1.4	1.1	0.3
49.	335	D11	413	chip	1.2	0.8	0.2
50.	335	D11	406	partially cortical chip	1.1*	0.8	0.2
51.	335	D11	424	scraper	2.2	1.4	0.6
52.	335	D11	422	end-scraper	1.4	1.6	0.4
53.	335	D11	412	end-scraper with retouching side edge	3.4	1.3	0.3
54.	374	E8	1199	natural flake	2.2	1.8	0.6
55.	374	E8	1206	blades core with single striking platform – fragment	3.0*	2.2	0.9
56.	349	E9	852	flake – fragment	1.9*	1.3*	0.2
57.	347	E11	804	core tablet	2.0	1.9	0.9
58.	347	E11	755	partially cortical flake	2.7	1.8	0.9
59.	347	E11	757	technological chunk	1.2	1.0	0.6
60.	358	E12	992	splinter flake, partially cortical	2.0	1.5	0.3
61.	358	E12	1002	bipolar splintered piece	2.6	1.0	0.7

Table 1. Cont.

No.	Inventory no.	Location		Category of flint finds	Measurements (cm)		
		Area Unit	No. on the plan		Length	Width	Thickness
62.	373	F8	1167	cortical chip	1.1	0.9	0.1
63.	373	F8	1164	partially cortical blade (distal fragment)	2.1	0.9	0.3
64.	373	F8	1128	partially cortical flake – fragment	2.1*	2.5	0.7*
65.	373	F8	1126	crested blade – fragment	2.0*	1.1	0.5
66.	344	F9	498	flake	2.2	2.4	0.6
67.	344	F9	528	bipolar splintered piece with changed orientation	2.9	2.0	0.4
68.	344	F9	511	splinter flake, partially cortical	4.0	2.7	1.4
69.	346	F10	694	end-scraper with recessed retouching of the side edge	4.4	1.5	0.4
70.	346	F10	567	flake – fragment	2.0*	2.1	0.3
71.	346	F10	647	splinter flake, partially cortical	3.7	1.5	1.0
72.	346	F10	562	unipolar splintered piece	2.0	1.1	0.4
73.	118	F11	83	flake	1.5	1.8	0.4
74.	345	F11	OB. 357/A	flake core	2.3	1.8	1.1
75.	359	F11	962	splinter flake – fragment	1.6*	1.2*	0.3
76.	359	F11	981	splinter flake, partially cortical – fragment	1.3	1.2*	0.3
77.	359	F11	891	partially cortical flake	1.5	1.5	0.4
78.	359	F11	870	partially cortical flake	0.8	1.5	0.3
79.	359	F11	1022	splinter flake, partially cortical	1.1	0.7	0.2
80.	359	F11	924	cortical chip	1.0	1.2	0.1
81.	359	F11	982	technological chunk	2.9	1.9	1.1
82.	359	F11	955	splinter cortical flake	2.9	2.3	1.1
83.	233	F12	108	bipolar splintered piece – fragment	2.6*	2.0*	0.8
84.	369	G9	1061	retouched natural chunk	2.8	1.8	0.7
85.	369	G9		natural chunk	3.7	3.1	1.8
86.	238	G13	130	technological chunk	4.1	1.9	1.2
87.	238	G13	155	splinter flake – fragment	2.1*	2.6	0.6
88.	9/W	K15		flake core	2.4	3.3	3.3
89.	59	K11		gunflint	2.9	2.6	0.8
90.	235		OB. 320/A	flake	2.0	3.6	0.6
91.	?		OB.105	bipolar splintered piece	2.6	1.9	0.8

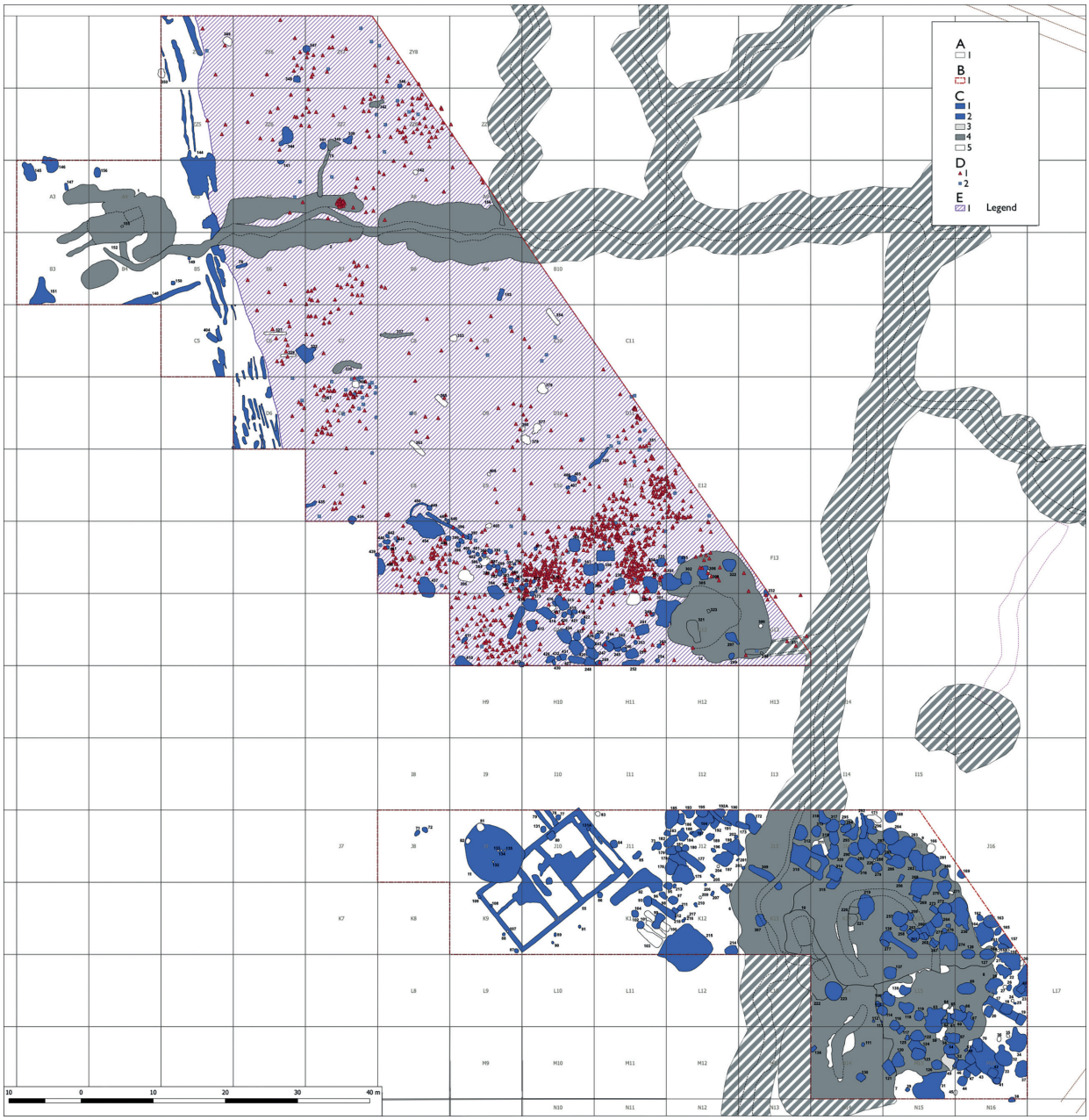

Fig.1. Żanęcin, Site 9, Wiązowna commune, Mazowieckie voivodship. Plan of the excavated part of the site. Legend: A1 – are square; B1 – excavated area; C – features (1 – modern times; 2 – 19th century/20th century; 3 – 20th century; 4 – 1944 AD; 5 – undetermined); D – artefacts (1 – pottery; 2 – flints); E1 – cultural layer (compiled by Adam Nowak, with modifications by Katarzyna Januszek).

there deliberately for future use, because their presence is not a typical feature of the local sandy formations.

Technological characteristics of flint artefacts

The inventory of flint artefacts contains debitage products representative of three knapping methods of blanks for tool-making: blade method, flake method and bipolar splinter method. However, not all of them reflect the whole *chaîne opératoire* related to the exploitation of all the aforementioned flint varieties. This is evident in the finds divided into nine categories of products (excluding six natural forms, see Tab. 2), each belonging to one of three technological groups: preliminary exploitation, blanks preparation and tools.

Preliminary exploitation group

It includes eight technological chunks (9.4% of the inventory of flint artefacts), mostly remains of early

Table 2. Żanęcin, Site 9, Wiązowna commune, Mazowieckie voivodship. Technological and raw material structure of the flint finds.

Categories of flint finds		Flint raw material					Σ
		Erratic		Mine		Undetermined	
		'local'	'north-eastern'	chocolate flint	Świeciechów flint		
Chunks and natural flakes		4	2				6
Technological chunks			6			2	8
Cores	blades	1	2				3
	flakes		2				2
Crested blades		1	1				2
Core tablets			1				1
Overpassed blades			1				1
Flakes		4	6	2	1	2	15
Blades			7	1			8
Bipolar splintered pieces		2	8				10
Splinter flakes		3	10			1	14
Chips		3	1	1			5
Tools	End-scrapers	1		3			4
	Scrapers		1	1			2
	Truncations					1	1
	Arrowheads		1				1
	Retouched flakes	1	2				3
	Retouched blades		2				2
	Retouched chunks and natural flakes	1	1				2
	Gunflints	1					1
Σ		22 24.1%	54 59.3%	8 8.8%	1 1.1%	6 6.6%	91

exploitation of the 'north-eastern' erratic flint (six finds) and scorched specimens made of unidentified raw material (two finds). In addition to the negatives created by initial direct percussion with a hard hammer, these chunks are characterised also by traces of bipolar splintering technique (specimens 982/F11 and 430/D7). Some bear signs of frost-induced fragmentation, which resulted in their destruction during processing. The technological chunks vary in size and depend on the shape of a given flint raw material – flat or polyhedral. They generally fall into three metric ranges: 1.2–4.3 × 1.0–2.8 × 0.6–1.2 cm.

Blanks preparation group

It contains 61 finds (71.7% of the inventory), including forms related to classical core reduction (37.6%)

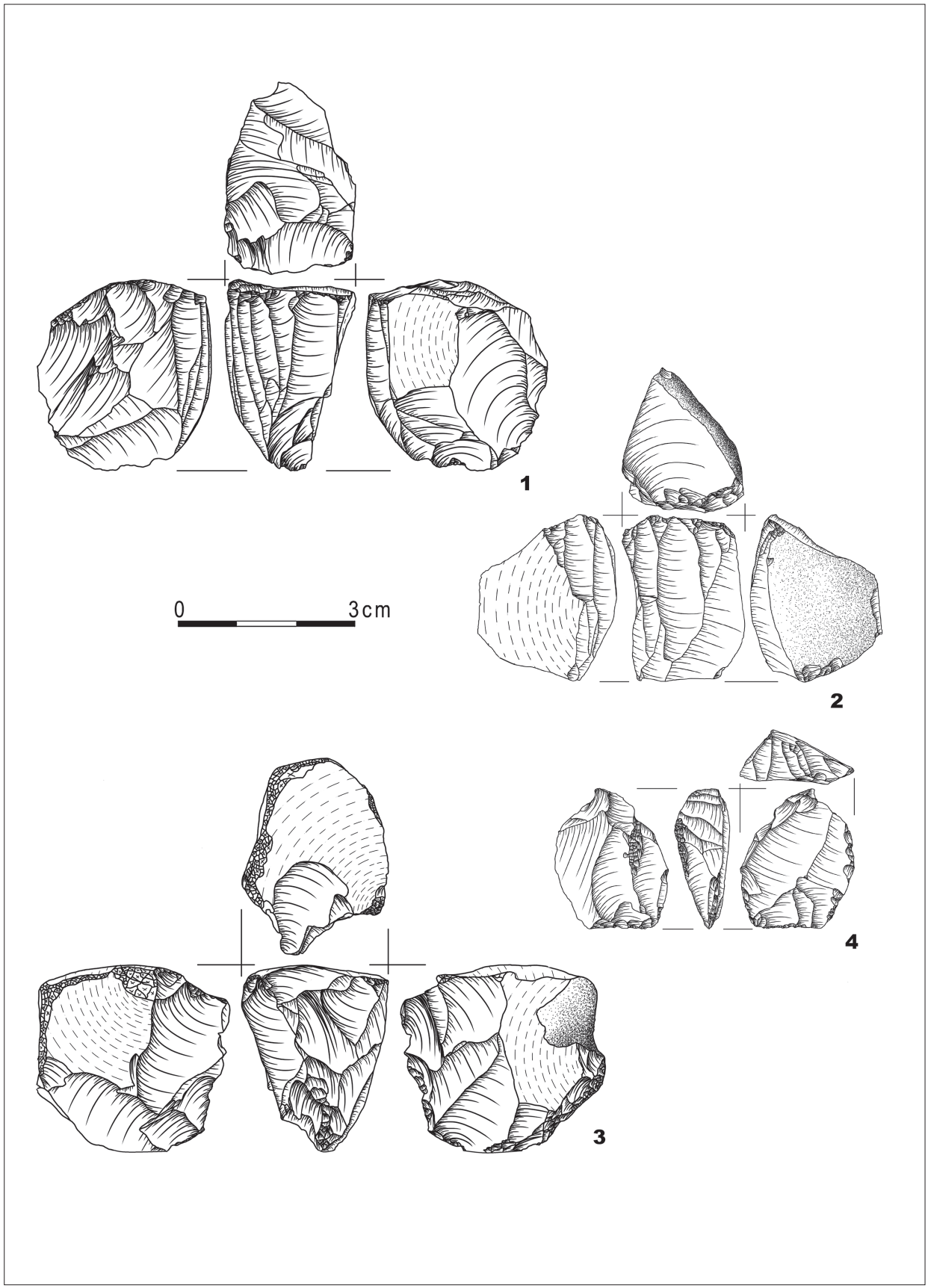

Fig. 2. Żanęcin, Site 9, Wiązowna commune, Mazowieckie voivodship. Selected flint artefacts: 1 – area unit D10/380; 2 – area unit ZZ7/213; 3 – area unit K15; 4 – feature 105 (drawing by Adam Nowak).

using the blade and flake methods, as well as traces of the bipolar splintering method (34.1%).

The blade method is associated with 14 finds (three blade cores, including one damaged, two fragments of crested blades, a broken overpassed blade and eight fragments of blades – 16.4% of the inventory).

The blade cores are single platform forms (one from the 'local' erratic flint and two from the 'north-eastern' variant), discovered in different parts of the excavation area (area units: ZZ7, D10 and E8). The cores made from the 'north-eastern' erratic flint represent two approaches to blade manufacturing.

The first one was formed from a polyhedral chunk, on which an elongated and prepared striking platform was created and, on its narrower side, a surface of debitage (Fig. 2: 1). The apex and rear of the core terminate with a sharp edge created deliberately during manufacturing. One of its sides has been prepared; the other retained its natural surface. The elongated striking platform has a characteristic active part, bearing negatives of rejuvenation flakes, and a passive part with traces of preparation. The edge of the striking platform is gently serrated. On the narrow surface of debitage, the negatives of fairly regular bladelets with sharply distal part are clearly visible. The core angle is set almost at a right angle. The aforementioned characteristic features of the core may indicate that it was used to obtain blades with the use of an intermediary tool. The specimen measures 3.1 × 2.1 × 3.0 cm.

The second core is a form obtained from a flattened, triangular chunk of flint, on which a striking platform was created by the removal of a cortical flake, and a rectangular surface of debitage was created on the narrower side (Fig. 2: 2). The sides of the core remained cortical. On the edge of the striking platform, a number of negatives are visible, likely levelling previous overhangs. Meanwhile, the surface of debitage shows clear negatives of blades with relatively irregular edges and oval or straight distal part. The core angle is acute. The discussed features of the core indicate that it was used to manufacture blades with the direct percussion technique with a hard hammer; the core measures 2.7 × 1.9 × 2.4 cm.

The next find is a form made of 'local' erratic flint with a damaged tip. It was formed from a flat frost flake with a naturally-formed striking platform. The edges of the striking platform show signs of abrasion. The core angle is acute. The blades detached from the core with the direct percussion technique with a hard hammer may have come from this specimen. The preserved size of the core is 3.0 × 2.2 × 0.9 cm.

The technical flakes preserved fragmentarily, that is, two crested blades, including a one-sided specimen and an overpassed blade, are hard to ambiguously link to the aforementioned cores. Only the distal fragment of the overpassed blade, originating from the single platform core and removing part of its apex with the prepared side, corresponds to one of the previously-discussed cores, exploited presumably with the direct percussion technique.

At the same time, all the blades found at the site are fragments (eight pieces) made of two types of flint (seven from 'north-eastern' erratic flint and one from chocolate flint, see Tab. 2). Six fragments were identified as distal (including the chocolate flint specimen), one as medial and one as proximal. The widths of the preserved fragments of blades can be categorised into four metric classes: 1.5 cm, 1.0–1.1 cm, 0.9 cm and 0.5 cm. Only the last of these may correspond to the widths of blade negatives found on the aforementioned core exploited with an intermediary tool. The distal fragment of the bladelet made of 'north-eastern' flint, matching the shape of the negatives on the debitage surface, may have come from the same type of core.

With certain reservations, 17 forms may be classified as remnants of the flake method, which amounts to 20% of the whole inventory. Only two cores and 15 flakes were included in this number. Some of the latter may also be associated with the blade-manufacturing method, as they could have originated during the preliminary preparation of blade cores. In general, the most prevalent types of the discussed artefacts were those made of 'north-eastern' erratic flint (Tab. 2).

One specimen made of the 'local' erratic flint – greatly reduced, reoriented, with one striking platform formed and another, natural, found on the side of the core after reorientation – was also counted among these cores. The core angle is acute. This specimen was exploited by direct percussion with a hard hammer. It measures 2.3 × 1.8 × 1.1 cm. The next specimen is an initial, single platform flake core, from which only one flake was chipped off striking the prepared striking platform. Prior to that, this core could have been a blade pre-core with a discernible crest (Fig. 2: 3), because it matches the core described above in terms of morphology and raw material (Fig. 2: 1).

Among the 15 discovered flakes, forms made of several varieties of flint were distinguished, as well as two specimens that could not be classified in terms of raw material due to being burnt (Tab. 2). Four made of different raw materials are damaged in various areas. Three partially cortical flakes made of 'local' erratic flint were identified, measuring 1.4–4.0 × 1.2–3.2 × 0.2–0.3 and 0.7 cm, including one with perpendicular negatives. Only one negatives specimen, with a damaged base, has unidirectional negatives – consistent with the direction of debitage.

Among the six flakes of the 'north-eastern' variant of erratic flint, one cortical specimen measuring 0.8 × 1.5 × 0.3 cm can be distinguished, along with two partially cortical pieces measuring 1.4–1.5 × 1.2–1.5 × 0.4 cm, including one with perpendicular negatives, and three neg-

atives specimens measuring 1.2–2 × 1–2.1 × 0.2–0.4 cm, one of which also shows perpendicular negatives.

Two flakes are made of chocolate flint – one partially cortical, measuring 2.7 × 1.8 × 0.9 cm, and another damaged specimen with perpendicular negatives, with preserved dimensions of 2 × 1.2 × 0.6 cm. Meanwhile, the only negatives specimen made of Świeciechów flint, obtained from a single-platform core, measures 2.0 × 3.6 × 0.6 cm. The remaining two forms, made of an undetermined raw material, consist of a partially cortical flake and negatives flake with perpendicular negatives. These categories of flakes cannot be directly linked to the discovered cores. Indirectly, based on raw material types, only the products made of erratic flint can be attributed to flake method exploitation at the site. In contrast, the other specimens made from mined flints (chocolate and Świeciechów flint) should not be associated with local production due to the absence of cores and other pre-core forms made of these flint varieties.

Remains of the bipolar splinter method are represented by 29 specimens (34.1% of the inventory), composed almost exclusively of erratic flints, with the exception of one burned specimen. These include 10 bipolar splintered pieces, 14 splinter flakes and five chips. The formation of the latter may also result from the use of other methods involving a hard hammer. Most of the bipolar splintered pieces (eight specimens) are made of 'north-eastern' flint, while only two belong to the 'local' variety of erratic flint. These specimens were processed using a hard hammer on a hard anvil. Among them, four bipolar examples were distinguished, measuring 1.6–2.6 × 1–1.9 × 0.7–0.8 cm, one of which is a transformed rejuvenation flake removing part of the blade core's striking platform (Fig. 2: 4). The next group consists of two unipolar forms measuring 1.3–2.0 × 1.1–1.3 × 0.4 cm, as well as two with altered orientation, measuring 2.3–2.9 × 2.0–2.6 × 0.4–0.7 cm. The remaining specimens are two incomplete bipolar splintered pieces, damaged in various areas. The identified splinter flakes (14 specimens) include a cortical flake measuring 2.9 × 2.3 × 1.1 cm, eight partially cortical flakes measuring 1.1–4.0 × 0.7–2.7 × 0.2–1.0 cm, and two negative flakes with opposed negatives, each 1.7 × 1.4 × 0.3 cm, originating from the exploitation of bipolar splintered pieces. Additionally, three specimens have been preserved only fragmentarily due to burning or frost damage.

The spatial dispersion of bipolar splintering method remains at the site indicates local exploitation. Bipolar splintered pieces and splinter flakes were most commonly recorded as single specimens within the following excavation area units: D7, E12, F9 and F10. However, in unit F11, four splinter flakes were found near area unit F12, where only a single bipolar splintered piece was recorded. A similar situation applies to the northern part of the investigated area, where four splinter flakes were noted within area unit ZZ8, while in the adjacent area unit ZY8, only a single bipolar splintered piece was found.

Tool group

Sixteen tools were identified (18.8% of the flint artefact inventory), classified into eight types. They were formed from blanks obtained through the exploitation of erratic flints and mined chocolate flint (Tab. 2).

The most numerous tools in this group are end-scrapers (four specimens), including three made of chocolate flint, differentiated by the type of blanks used – one flake and two blade specimens – as well as one end-scraper made of 'local' erratic flint. The first of these was made from a flake with multidirectional negatives, measuring 1.4 × 1.6 × 0.4 cm (Fig. 3: 1). The next was manufactured from a partially cortical blade with opposed negatives, originating from a double-platform core. In addition to its shaped scraping edge, this specimen features two inverse retouched notches on its lateral edge and micro-retouching on part of the second lateral edge (Fig. 3: 2). Its dimensions are 4.4 × 1.5 × 0.4 cm. It may also represent a combined tool. The last end-scraper made of chocolate flint was formed from a blade obtained from a single-platform core (Fig. 3: 3). The negatives of regular blades on the dorsal side of the blanks may indicate that it was removal using pressure technique. This tool is characterised by a low scraping edge and additional semi-steep retouch along the lateral edge. Its dimensions are 3.4 × 1.3 × 0.3 cm. The next end-scraper of this type, made from 'local' raw material, is preserved only fragmentarily, making it impossible to determine the specific blank from which it was formed. Its current dimensions are 1.2 × 0.9 × 0.4 cm.

The next tool group – scrapers – consist of two specimens made of flakes obtained from the 'north-eastern' erratic flint (Fig. 3: 4) and chocolate flint (Fig. 3: 5). The first one was created from a partially cortical flake, obtained from a single-platform core through direct percussion with a hard hammer. Its dimensions are 2.4 × 1.4 × 0.5 cm. The second scraper, measuring 2.2 × 1.4 × 0.6 cm, was shaped from a partially cortical flake, removal from a single-platform core with a hard hammer.

The highlighted truncations are represented by a double specimen made of flint raw material undetermined due to burning, found in area unit D7. It was shaped from the distal, bent fragment of a blade from a single-platform core. The dimensions of the tool are 2.1 × 1.0 × 0.4 cm.

The next type – arrowheads – includes a laurel-shaped arrowhead with a short tang (Fig. 3: 6). It was most likely made from a flake of 'north-eastern' erratic flint through surface retouch, covering mostly both sides of the tool. Its dimensions are 2.7 × 1.1 × 0.3 cm.

Three distinguished retouched flakes were obtained from erratic flints (Tab. 2). All of them were documented

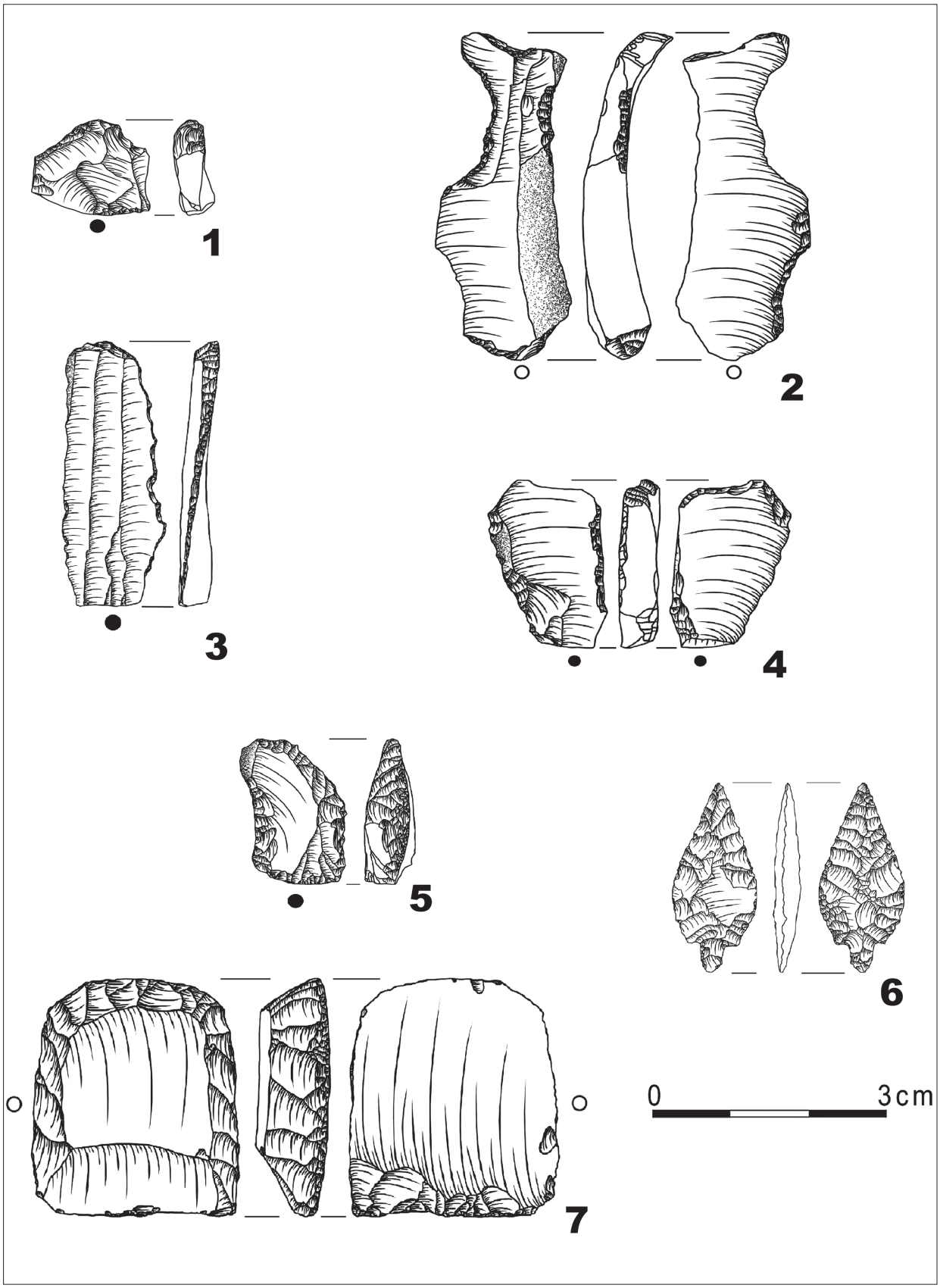

Fig. 3. Żanęcin, Site 9, Wiązowna commune, Mazowieckie voivodship. Selected flint artefacts: 1 – area unit D11/422; 2 – area unit F10/694; 3 – area unit D11/412; 4 – area unit D7/459; 5 – area unit D11/424; 6 – area unit ZY7/281; 7 – area unit K11 (drawing by Adam Nowak).

within the excavation area unit D7. The specimen made of the 'north-eastern' flint is a retouched splinter flake, measuring 2.9 × 3.8 × 0.8 cm. The others, produced through various retouching of negative flakes obtained by direct percussion with a hard hammer, measure between 1.2–1.9 × 1.3–1.9 × 0.3–0.5 cm. One of these, made of the 'north-eastern' erratic flint, with opposed negatives and a natural, flat and wide butt, may originate from core preparation.

Two retouched blades are made of the 'north-eastern' erratic flint, also discovered within the excavation area unit D7. One of them is a distal fragment of a partially cortical blade from a double-platform core, with micro-retouch along the edges. Its preserved dimensions are 1.0 × 0.9 × 0.3 cm. The other specimen comes from a single-platform core and has a partially retouched lateral edge, which is also shiny at the retouch place. The dimensions of this tool are 3.2 × 1.4 × 0.3 cm.

The group of tools also includes retouched chunks and natural flakes. These forms are made from two varieties of erratic flint (Tab. 2). They are represented by a natural flake with retouch along the edge, measuring 3.6 × 1.9 × 0.5 cm, discovered in the excavation area unit ZZ7, and a retouched chunk measuring 2.8 × 1.8 × 0.7 cm, found within the area unit G9.

The last distinguished type is the gunflints. This category includes a specimen measuring 2.9 × 2.6 × 0.8 cm, made of cretaceous flint, most likely of the 'north-eastern' variety, documented outside the finds from the cultural layer in the area unit K11. This gunflint was made from a piece of massive blade (para-blade?) removed from a single-platform core. It was shaped using semi-steep retouch along the broken edges and the lateral edge of the blank (Fig. 3: 7). It belongs to the horseshoe-shaped gunflints subtype according to Marek Lalak's typology.[13] Its sharp striking edge, corresponding to the lateral edge of the blank, is characterised by the presence of splinter retouch, the negatives of which are visible on the ventral face. It is currently not possible to determine the origin of this type of retouch, which may have resulted from the work of a flintlock or could have been created during the final processing of this item on a hard anvil.[14]

Results

Generally, at Site 9, the primary raw material used was cretaceous erratic flint, brought in the form of small chunks. The 'north-eastern' variety of this flint was exploited using the blade method with a punch and direct percussion with a hard hammer. The first technique produced very fine bladelet debitage, and the *chaîne opératoire* at the site ends with this type of waste. There are no tools formed from this type of blanks, however. These remains were recorded within the excavation areas units D10 and D11. On the other hand, larger and especially broader blades were removed from single-platform cores using direct percussion. Unfortunately, the blanks present in the inventory mostly consist of distal parts of blades, the characteristics of which prevent confirmation of the specific technique used to produce them. Only one tool – a retouched blade – was made from blank obtained using this technique and its width corresponds to some of the distal fragments found at the site, suggesting it may also fall within the range of widths of debitage surface of cores exploited through direct percussion. These elements suggest that blanks for blade tools were produced at the site using the mentioned technique and that few tools were made from them. Remains of this process were documented in several adjacent excavation unit areas: ZZ7, A6 and A7 (core and blade fragments), C9 and C10 (blade fragments) and D7 (blade fragment and tool).

In relation to the production of blanks for flake tools from the mentioned variety of erratic flint, it can be concluded that they were likely not manufactured using a separate flake method. This is evidenced by the absence of greatly reduced flake cores. Instead, the necessary blanks for flake tools may have been obtained by forming blade cores through direct percussion with a hard hammer. The fact that the inventory contains cortical or partially cortical flakes, those with opposed negatives, as well as a few flake tools (a scraper made from a partially cortical flake, a retouched flake with a natural butt and opposed negatives) seems to suggest such activities.

The application of the bipolar splinter method using a hard hammer and hard anvil is also linked to the exploitation of the 'north-eastern' variety of flint at the site. Although this method generates the largest number of morphologically diverse flakes in an uncontrolled manner, the latter's use as blanks for tool production is limited to just one retouched specimen.

On the other hand, the traces of processing the 'local' erratic flint suggest the use of both the flake and bipolar splinter method at the site. The presence of a fragment of a blade core, without blades from this variety of raw material, may indicate that this specimen was collected and brought to the site as raw material. The blanks obtained through the flake method were transformed into a few tools (an end-scraper (?), a retouched flake). The use of the bipolar splinter method, however, is different. It pertains exclusively to the formation of bipolar splintered

[13] Lalak 2006, 229.

[14] *Cf.* Lalak 2006, 231, no. 26.

pieces, not the production of blanks for tool making. No tools were recorded to have been made from splinter flake of the 'local' variety of erratic flint.

In the case of the two varieties of erratic raw materials, the demand for tools was met without the need to produce blanks. This is indicated by the retouched natural forms (a flake and a chunk).

Regarding the varieties of mined flint, it should be noted that both chocolate flint and Świeciechów flint were not exploited at the site. The forms present in the inventory made of the former – morphologically diverse tools of two types, as well as a few remains of debitage – suggest that they were probably collected and brought from differently-dated sites. The same applies to the specimen made of Świeciechów flint.

The documented and chronologically diverse elements of weaponry made from cretaceous flint, most likely of the 'north-eastern' variety – namely an arrowhead and a gunflint – also do not suggest local production.

Relative chronology of flint artefacts

Site 9 yielded a relatively undistinctive and rather limited collection of flint artefacts, mostly originating from the cultural layer, which is visible over an area of nearly 40 ares (excavation area units). However, taking into account their context – co-occurrence with pottery, which should be considered a substitute for a calendar – as well as the technological characteristics of the remains from certain stages or the entire *chaîne opératoire* carried out on specific flint raw materials, it is possible, with a reasonable degree of probability, to also suggest their chronological position. Based on these premises, it can be stated that the flint sources point to several chronologically distinct settlement episodes during the Late Mesolithic, the Bronze Age and modern times.

The production of bladelets from single-platform cores, shaped from the 'north-eastern' variety of erratic cretaceous flint, can be associated with the first of the mentioned periods. The form of the recorded core, exploited using an indirect percussion, is similar to the classical Janislavician core.[15] Remains of such activities were noted within the unit areas D10 and D11.

The subsequent settlement episode at the site, which occurred during the Bronze Age (Early Bronze Age), is represented by the majority of the flint materials discovered in association with TCS pottery from its classical phase. These primarily include debitage related to the exploitation of erratic flints using hard hammer with the bipolar splinter method, blade and flake methods, as well as a few tools made from the blanks obtained by these methods. Items made of chocolate flint and Świeciechów flint, associated with earlier cultural units (e.g., Late Palaeolithic – an end-scraper made from a blade obtained from a double-platform core), can also be linked to the activities of the TCS community, most likely as a result of the acquisition of raw material gathered from other sites. Such remains made from chocolate flint are known from camps of the aforementioned cultural sphere in Mazovia, associated with its pre-classical phase (e.g., Raszyn, Site 7; or Reguły, Site 14),[16] and even from a ritual feature linked to the initial phase of this cultural sphere (Skrzeszew, Site 49, Feature 1).[17] This may indicate that during the classical developmental phase of the TCS community in Mazovia, earlier methods of obtaining flint raw material continued to be practised.

Most likely, the small, tanged arrowhead, with retouched surface, found in the northern part of the investigated area (area unit ZY7), can be linked to the Late Bronze Age. The Lusatian culture pottery found at a short distance (area unit ZZ8) seems to confirm the context of the occurrence of this type of arrowhead outside compact assemblages, as noted by other researchers.[18]

On the other hand, the gunflint, discovered outside the cultural layer (area unit K11), is associated with the modern time period. No debitage related to the manufacturing of this type of item have been recorded within the investigated area. Therefore, it can be assumed that this object originates from an unspecified region of mass production of such items. The time span of the use of gunflints is limited to the period when firearms with flintlocks were used. In Poland, this period is very broad: from the 18th century to the early 20th century.[19]

Conclusions

In the case of Żanęcin 9, flint was used in two ways. The first of them concerned the exploitation of two varieties of erratic flints, brought from outside the site and its dune surroundings, using various methods and techniques. This procedure was initially employed by the late Mesolithic Janislavician communities, limiting it only to the production of blades. Later, in the Early Bronze Age, the population associated with TCS not only produced blanks, but also transformed them into makeshift tools.

The second type of use of flint was limited to bringing of finished artefacts for various purposes. One of these could have involved the procurement of flint raw

[15] Wąs 2005, 128–129.

[16] Manasterski, Januszek 2011, 63–66; Januszek, Manasterski 2011, 88–100.

[17] Januszek, Manasterski 2012, 118, 125–129.

[18] Borkowski, Kowalewski 2013, tab. V: 1, 87.

[19] Lalak 2006, 221.

material, sourced from older sites in the form of artefacts made from mined flint. This method of supply was known to the TCS communities. Another purpose could have been related to the use of weaponry. This applied both to the representatives of the Lusatian culture in the Late Bronze Age, who left behind characteristic arrowheads, and to users of flintlock firearms in modern times, who discarded horseshoe-shaped gunflints.

Acknowledgements

I would like to thank Mr. Mirosław Mazurek, owner of the company 'Pracownia Archeologiczna Mirosław Mazurek' for providing flint finds from his excavations conducted in Żanęcin for publication.

Bibliography:

Baraniecka M. D. 1982, Sytuacja geologiczna i rozmieszczenie wydm okolic Warszawy, *Roczniki Gleboznawcze* XXXIII/3–4, 33–57.

Budziszewski J. 2008, Stan badań nad występowaniem i pradziejową eksploatacją krzemieni czekoladowych, in: W. Borkowski, J. Libera, B. Sałacińska, S. Sałaciński (eds), *Krzemień czekoladowy w pradziejach. Materiały z konferencji w Orońsku, 08-10.10.2003,* Studia nad Gospodarką Surowcami Krzemiennymi w Pradziejach 7, Warszawa-Lublin, 33–106.

Borkowski W., Kowalewski M. 2013, Groty strzał z obszaru Mazowsza i Podlasia w kontekście materiałów z epoki brązu, *Studia i Materiały do Badań nad Neolitem i Wczesną Epoką Brązu na Mazowszu i Podlasiu* III, 67–99.

Dmochowski P. 2006, A new classification of erratic flint from western Poland, in: A. Wiśniewski, T. Płonka, J. M. Burdukiewicz (eds), *The Stone: Technique and Technology,* Wrocław, 217–226.

Ginter B., Kozłowski J. K. 1990, *Technika obróbki i typologia wyrobów kamiennych paleolitu, mezolitu i neolitu*, Warszawa.

Inizan M.-L., Roche H., Tixier J. 1992, *Technology of Knapped Stone*, Préhistoire de la Pierre Taillé 3, Meudon.

Inizan M.-L., Reduron-Ballinger M., Roche H., Tixier J. 1999, *Technology and Terminology of Knapped Stone,* Préhistoire de la Pierre Taillé 5, Nanterre.

Januszek K., Manasterski D. 2011, Obozowisko ludności kultury trzcinieckiej z Reguł koło Warszawy, *Studia i Materiały do Badań nad Neolitem i Wczesną Epoką Brązu na Mazowszu i Podlasiu* I, 83–129.

Januszek K., Manasterski D. 2012, Obiekt obrzędowy – depozyt przedmiotów symboliczno-użytkowych społeczności z wczesnej epoki brązu w Skrzeszewie, gm. Wieliszew, woj. mazowieckie, *Studia i Materiały do Badań nad Neolitem i Wczesną Epoką Brązu na Mazowszu i Podlasiu* II, 115–145.

Kondracki J. 2009, *Geografia regionalna Polski*, Warszawa.

Lalak M. 2006, Skałki – nowożytne wyroby krzemienne. Próba typologii, *Archeologia Polski Środkowowschodniej* VII, 219–241.

Libera J., Zakościelna A. 2002, Złoża krzemieni turońskich w przełomowym odcinku Wisły, in: B. Matraszek, S. Sałaciński (eds), *Krzemień świeciechowski w pradziejach. Materiały z konferencji w Ryni, 22–24.05.2000*, Studia nad gospodarką surowcami krzemiennymi w pradziejach 4, Warszawa, 93–109.

Manasterski D., Januszek K. 2011, Obiekt mieszkalny ludności kultury trzcinieckiej z Raszyna koło Warszawy, *Studia i Materiały do Badań nad Neolitem i Wczesną Epoką Brązu na Mazowszu i Podlasiu* I, 51–82.

Mazurek M., Sznajdrowska-Pondel A. 2020, Wstęp, in: M. Mazurek, A. Okoniewska, A. Sznajdrowska-Pondel (eds), Opracowanie III etapu ratowniczych badań wykopaliskowych na stanowisku nr 9 w Żanęcinie, gm. Wiązowna, Rzeszów (maszynopis przechowywany w GDDKiA oddział w Lublinie).

Migal W. 2005, Sposoby i możliwości obróbki krzemienia za pomocą twardego tłuka kamiennego, in: W. Borkowski, M. Zalewski (eds), *Rybniki – „Krzemianka". Z badań nad krzemieniarstwem w Polsce Północno-Wschodniej,* Studia nad Gospodarką Surowcami Krzemiennymi w Pradziejach 5, Warszawa, 129–139.

Schild R., Marczak M., Królik H. 1975, *Późny mezolit. Próba wieloaspektowej analizy otwartych stanowisk piaskowych*, Wrocław-Warszawa-Kraków-Gdańsk.

Sulgostowska Z. 2016, Krzemienie kredowe – pułapka dla początkujących (i nie tylko) badaczy, in: W. Borkowski, B. Sałacińska, S. Sałaciński (eds), *Krzemień narzutowy w pradziejach. Materiały z konferencji w „Mądralinie" w Otwocku, 18–20 października 2010,* Studia nad Gospodarką Surowcami Krzemiennymi w Pradziejach 8, Warszawa, 11–20.

Szymczak K. 1992, Północno-wschodnia prowincja surowcowa kultury świderskiej, *Acta Universitatis Lodziensis. Folia Archaeologica* 15, 3–177.

Wawrusiewicz A., Kalicki T., Przeździecki M., Frączek M., Manasterski D. 2017, *Grądy-Woniecko. Ostatni łowcy-zbieracze znad środkowej Narwi*, Białystok.

Wąs M. 2005, *Technologia krzemieniarstwa kultury janisławickiej*, Monografie Instytutu Archeologii Uniwersytetu Łódzkiego III, Łódź.

Whittaker J. C. 2009, *Flintknapping. Making and understanding stone tools*, Austin.