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FIELD SURVEY AND MATERIALS

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THE MAGDALENIAN SITE KLESZCZOWA 9, PILICA COMMUNE, SILESIAN VOIVODSHIP (KRAKÓW-CZĘSTOCHOWA UPLAND, POLAND). MULTI-ASPECTUAL ANALYSIS OF THE FLINT INVENTORY AND THE IMPORTANCE OF THE SITE

ABSTRACT

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This paper presents the results of multi-aspectual analysis of the flint inventory from Late Paleolithic inventory from the site Kleszczowa, located in the middle part Kraków-Częstochowa Upland. The technological and typological features of flint artefacts indicate a Magdalenian cultural tradition. Raw materials used for production of artefacts were high quality Jurassic flints, the outcrops of which occurred within direct surroundings of the site.

In this paper the authors would like to stress the results of use-wear analysis. Nearly half of the artefacts investigated in this respect bore traces of utilisation for processing of wood, meat and hide. Some of the forms bore traces indicating processing of silica plants and elaboration of soaked bone and moreover traces of hafting and organic substance.

The results of analysis correspond well with the current knowledge referring to utilisation of tools by the Magdalenian societies, and they undoubtedly extend our knowledge upon behaviour of humans at the decline of the Pleistocene in southern Poland.

Keywords: Late Palaeolithic, Magdalenian Culture, flint inventory, typological analysis, raw material analysis, use-wear analysis

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INTRODUCTION

Site no. 9 in Kleszczowa, lying within a distance of c. 7 km from the locality named Pilica (Silesian voivodship), is situated on the highest part of the Sachalin Hill, located in the northern part of the so-called Barańskie Mountains, at an altitude of c. 406 m.a.s.l. (Fig. 1). The Barańskie Mountains is a cuesta-type ridge situated c. 2-3 km to the west of the Udorka Valley. The western slope of the ridge is steep and falls to another valley, parallel to the Udorka Valley, currently dry. The location of the site is convenient for occupation since it opens towards two valleys; moreover, there are outcrops of a few variants of flint along its boundaries (Sudoł-Procyk 2021).

Field surveys conducted in this area since the beginning of the 1990s by K. Cyrek, J. Moszczyński, B. Muzolf and A. Pelisiak (Cyrek *et al.* 1992), and then, in the years 2014-2016 by J. Jędrysik and T. Wagner (Wagner and Jędrysik 2016), have revealed an occurrence of numerous sites associated with the Neolithic. Therefore, a discovery of the Magdalenian site in Kleszczowa 9 during a survey aimed at mapping of siliceous material outcrops carried out by a geologist, M. Krajcarz, in 2012 (Sudoł *et al.* 2016), was quite surprising.

In August 2014, in the region of the site, preliminary research was conducted, the objective of which was to verify the spots where surface accumulations of flint materials were encountered. This survey confirmed the existence of two concentrations of flint artefacts as well as allowed the specifying of their cultural and chronological affiliation, indicating the Magdalenian provenance. Within the investigated parts of the site, under the topsoil

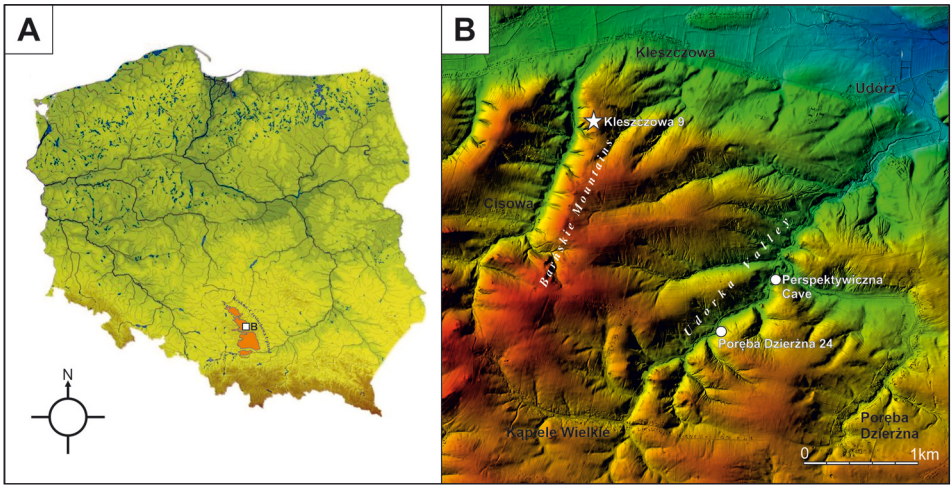

Fig. 1. Location of the Udorka Valley region on the map of Poland (A) and the site Kleszczowa 9 (B) in this region (drawing M. Jakubczak and M. Szubski, with authors' changes)

layer, there were identified loess sediments with a thickness ranging from 10 to 70 cm, lying directly over the residual clay.

In this paper, the authors present the results of typological, functional and raw material analyses of the assemblage, and draw conclusions based on the analysis of these data.

MATERIALS AND METHOD

A technological analysis encompassed the entire flint assemblage, namely 930 specimens coming from trial trenches and the ground surface in their direct surroundings. The great majority of the flints were collected from the surface (67%) and topsoil layer (29.7%), and only a few (3.3%) were recorded within the loess sediments *in situ*. Therefore, it is unsurprising that many finds were covered with patina and bore traces of post-depositional destruction.

All of the specimens were classified into particular typological groups, following the rules established for the standard classification of assemblages of this type (Sonneville-Bordes and Perrot 1956; Ginter and Kozłowski 1990; Demars and Laurent 1989). Due to the location of the site within an area intensively exploited for agricultural purposes and impossibility to determine whether some objects were prehistoric flint processing waste and recent plough-related debris, such controversial specimens were excluded from the investigations. Moreover, this article does not cover six natural flint concretions found on the ground surface. From the statistical viewpoint, their number does not seem to be reliable since it is very likely that due to their close location to flint outcrops and a workshop type of the site, they must have been much more numerous and could have been strongly fragmented during many years of farming activity, which is confirmed by a great number of flint chunks.

An analysis of raw material structure was based on a classification system proposed by M.T. Krajcarz (Krajcarz *et al.* 2012, 2014; Krajcarz 2023), using the comparative material obtained from flint outcrops surrounding the site, in various states of preservation, including specimens with "fresh" (non-patinated) and patinated fractures (with various intensity of patina cover), aeolized materials and objects discoloured due to natural factors, water activity, among other factors. The flint assemblage was investigated based on a few main criteria, such as the nature of the flint substance, the occurrence of intrusions within the flint substance as well as the occurrence and the nature of cortex. Strongly patinated or burnt specimens were not classified into either of the raw material categories. The selection of flint specimens presented in Figures nos. 2-6 was dictated by their diversified nature in terms of typology, raw material and function.

A use-wear analysis covered 70 artefacts, previously cleansed with pure ethyl alcohol, using the Nikon SMZ-2T microscope-computer set, coupled with the Nikon D7100 camera. This equipment allows obtaining lens magnification up to 12.6× (objective lens magnification up to c. 120×) as well as computer-aided digitalisation and processing of optical

images. For observation of polishes on the flint surface the Zeiss-Axiotech metallographic microscope was used, coupled with the Axiocam 105 camera, which enables obtaining lens magnification up to 50× (objective lens magnification up to 500×). With the use of the above-described equipment, a series of micro-photographs were taken, presented in the Figures nos. 7: A-N; 8: H, M-O and 9: A, E-O. Other micro-photographs were taken using the Zeiss Axioscope 5 metallographic microscope, coupled with the Axiocam 208 camera.

Use-wear terminology applied in this paper was based on the nomenclature used in the related literature (Ho Ho Committee 1979, 133-135; Vaughan 1985, 10-13, Glossary, VII; van Gijn, 1989, 16-20; Juel Jensen 1994, 20-27; Korobkowa 1999, 17-21; Osipowicz, 2010, 24-35), but adapted to the needs and requirements of the analysis presented here.

RESULTS

Typolo-technological and raw material analysis

The raw material structure of the assemblage in question was clearly strongly correlated with local outcrops of siliceous rocks occurring within a radius of 3 km from the site (Krajcarz *et al.* 2012, 2014; Krajcarz 2023). Half of the specimens were made of flint from the Barańskie Mountains (49.8%). Less numerous were specimens made of local variants of chocolate flint (18.9%) and striped flint (15.5%). The least frequently represented were flints from Wierbka (2.5%) and the Udorka Valley (1.3%). Concerning 2% of the assemblage raw material revealed mixed traits of local Jurassic flint, due to which such specimens were counted to a general group of undetermined Jurassic flint (Table 1). Moreover, there was recorded a marginal proportion of Cretaceous flint and cherts (including banded variants) (0.5%). In reference to 9% of the specimens, it was impossible to classify them into any of the raw material groups due to a convergence of morphological traits or their state of presentation (strongly burnt or patinated) (Table 1).

In terms of typology, the most numerous were blanks enclosing both flakes and blades. Most likely due to the nature of the site, more than half of these artefacts have been preserved fragmentarily (51.6%). Flakes and their fragments in the number of 428 specimens constituted as much as 46% of the entire flint assemblage, while blades and their fragments were nearly twice less numerous (221 items = 23.7%) (Table 1).

Particularly noteworthy were blades with the so-called *en éperon* butt (Inizan *et al.* 1999, 134, 136), which are very rarely recorded at archaeological sites in Poland. The *"en éperon"* technique was typical of the Magdalenian lithic tradition and they were used for the production of long and slender blades. Blanks obtained in this manner were the major material for production of tools (Połtowicz-Bobak 2013, 232). Within the assemblage recovered from the site Kleszczowa 9 there were identified 21 such blades (or their fragments), of which eleven specimens have retouched edges. Preferences in the selection of

Table 1. Kleszczowa, site 9. Typological and raw material structure of flint products

Typological structure / Raw material structure	Cores and cores forms*	Flakes*	Blades*	Technical forms	Other		Tools									
						Retouched flakes*	Retouched blades*	Endscrapers	Burins	Perforators/ Borer	Truncation pieces	Backed pieces	Combination tools	Mining tools	Unidentified tool fragments	TOTAL
Flint from the Barańskie Mountains	19	181	75	51	26	45	27	10	13	4	1	0	2	8	2	**464**
Chocolate flint	11	62	37	14	2	26	9	3	5	1	3	1	0	2	0	**176**
Striped flint	6	40	29	20	11	12	14	2	4	2	1	0	0	3	1	**145**
Flint from Wierbka	0	9	6	4	1	1	1	0	0	0	0	0	0	2	0	**24**
Undetermined local Jurassic flint	0	6	2	2	3	3	1	0	1	0	0	0	0	1	0	**19**
Flint from Udórz	0	6	3	0	4	0	0	0	0	0	0	0	0	0	0	**13**
Other (cretaceous, chert)	0	1	0	1	1	0	0	0	1	0	1	0	0	0	0	**5**
Undefined	3	29	17	5	17	7	0	1	4	1	0	0	0	0	0	**84**
TOTAL	**39**	**334**	**169**	**97**	**65**	**94**	**52**	**16**	**28**	**8**	**6**	**1**	**2**	**16**	**3**	**930**

* – including fragments

certain raw material for the production of blades with *en éperon* butts (48% flint from the Barańskie Mountains, 24% chocolate flint and 19% striped flint) corresponded well with the general tendencies observed at the site.

Noteworthy was also a significant number (146 items) of retouched flakes (*e.g.*, Figs 2: 3-4; 4: 5-7) and blades (*e.g.*, Figs 2: 1, 5; 3: 2; 4: 2, 4; 5: 1, 3; 6: 1), which together with their fragments constituted 22.4% of blanks. Concerning this group, the raw material structure was also consistent with the general raw material tendencies visible at the site. The great majority of the blanks were made of flint from the Barańskie Mountains (49.3% of all retouched blanks), chocolate flint (23.9%) and striped flint (17.8%).

Advanced exploitation of cores at the site is confirmed by technical forms, the total number of which amounted to 97 artefacts (10.4% of the entire assemblage). Amongst them, there were distinguished platform rejuvenation flakes (41 specimens; 42.2% of all technical forms), partly-crested blades (17 items; 17.5%), crested blades (16 pcs; 16.4%)

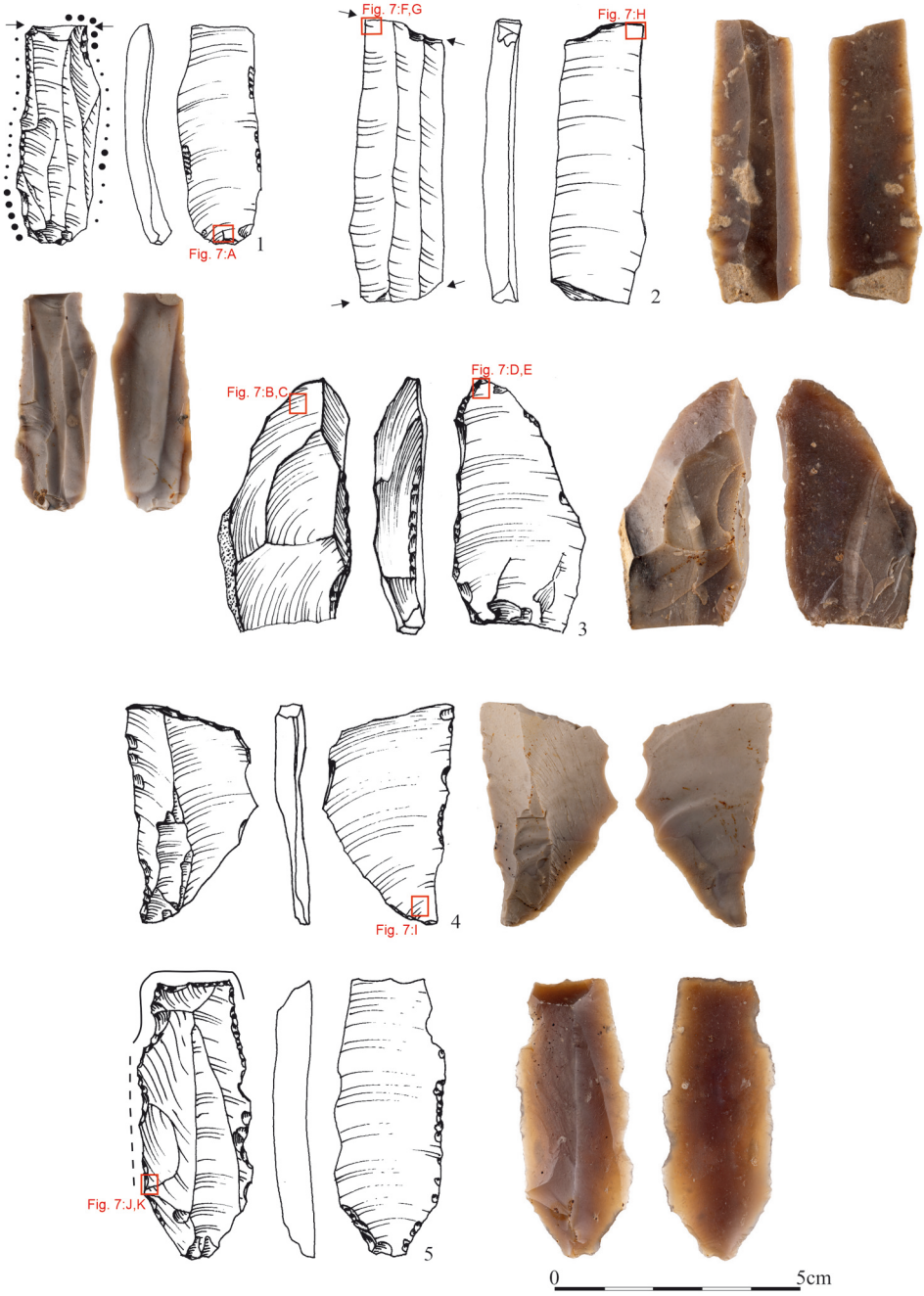

Fig. 2. Selection of flint products with the location of micro-photographs marked (drawing M. Sudoł-Procyk, photo W. Ochotny)

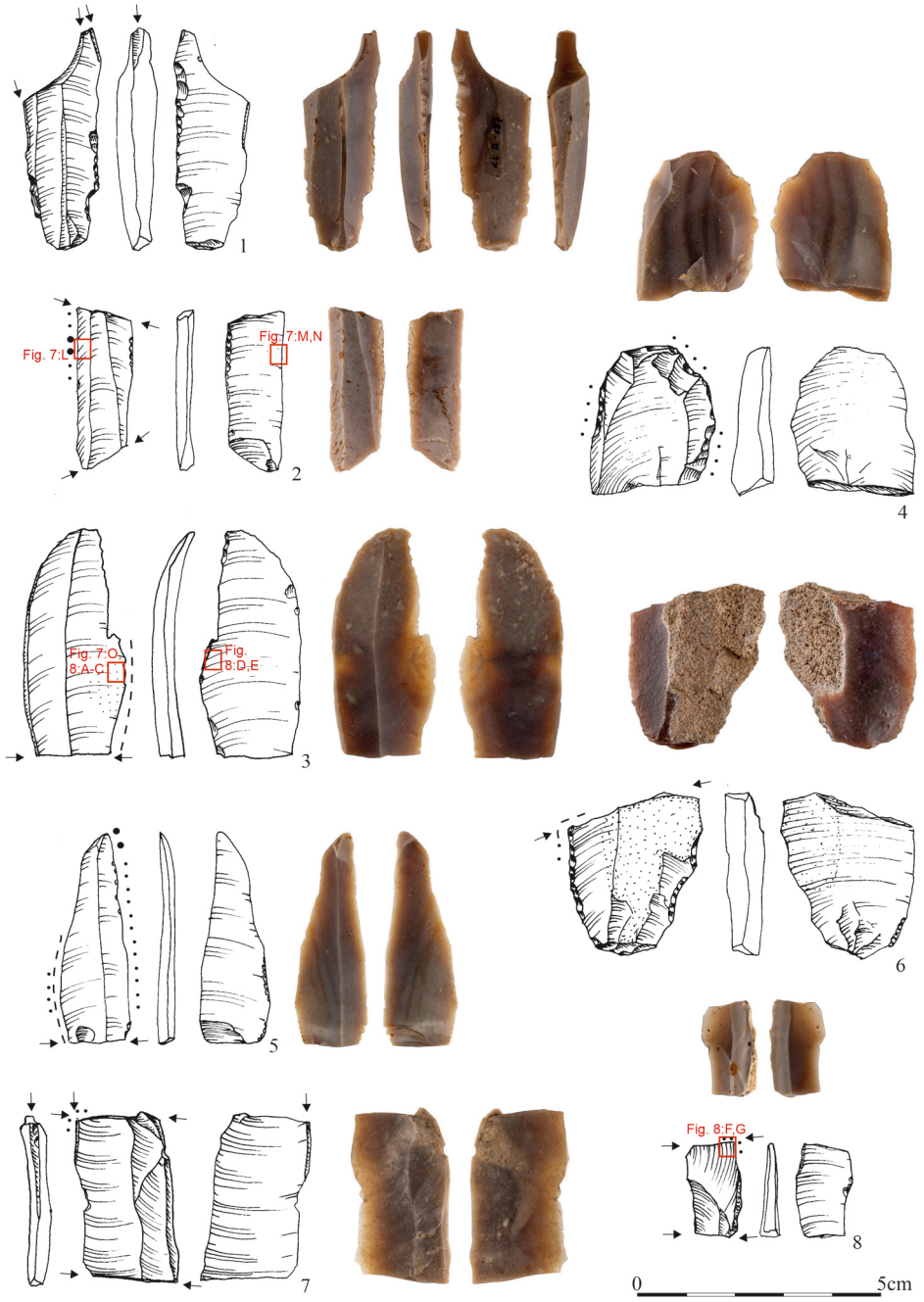

Fig. 3. Selection of flint products with the location of micro-photographs marked (drawing M. Sudoł-Procyk, photo W. Ochotny)

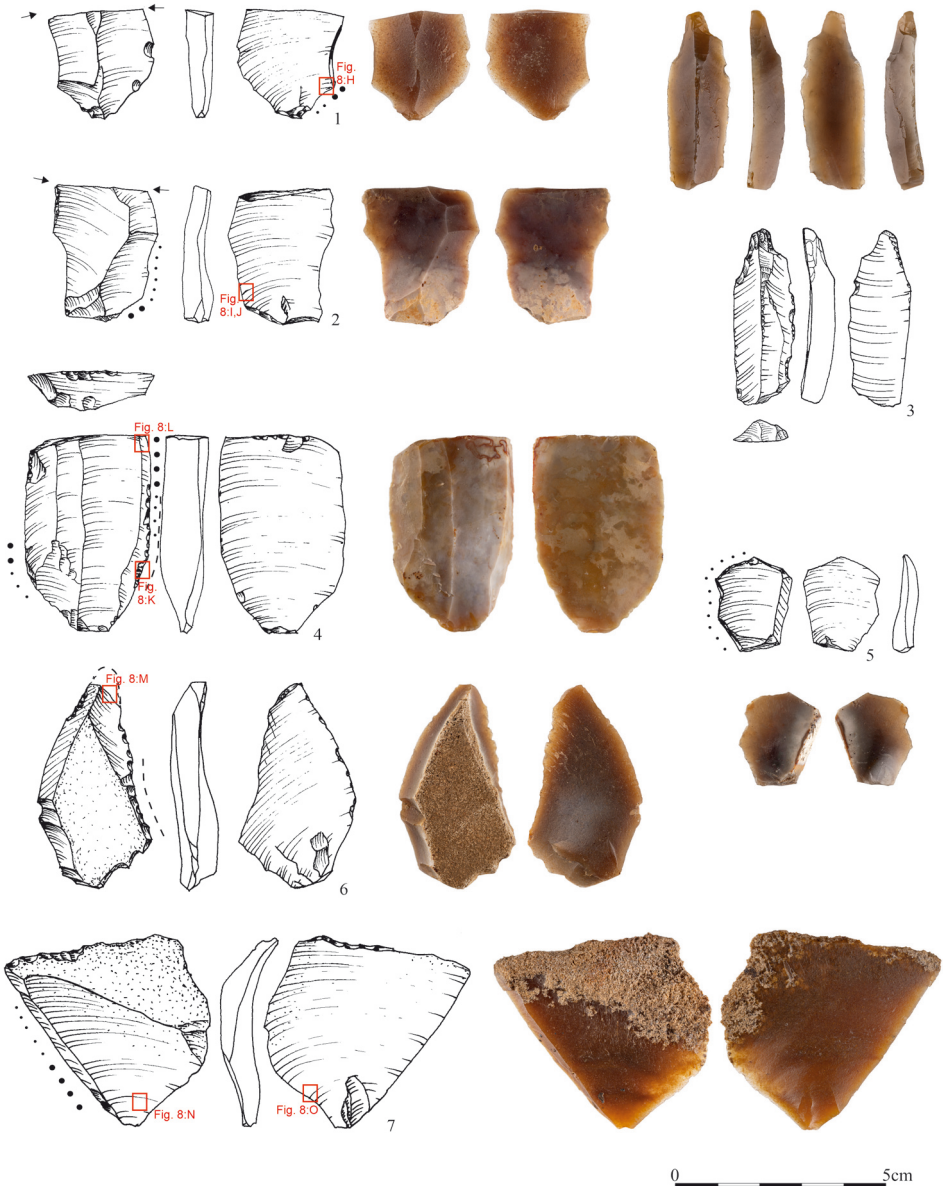

Fig. 4. Selection of flint products with the location of micro-photographs marked (drawing M. Sudoł-Procyk, photo W. Ochotny)

Fig. 5. Selection of flint products with the location of micro-photographs marked (drawing M. Sudoł-Procyk, photo W. Ochotny)

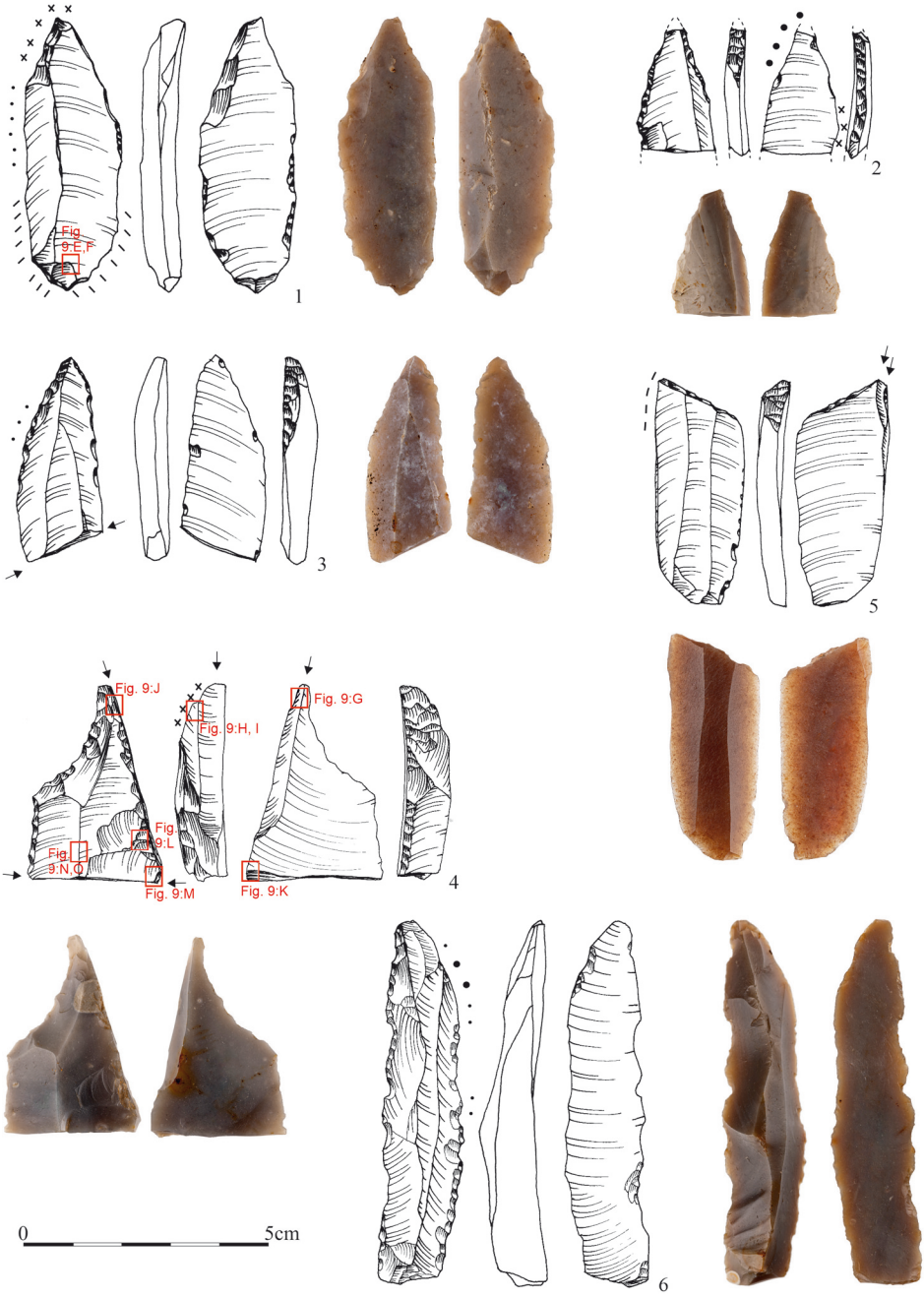

Fig. 6. Selection of flint products with the location of micro-photographs marked (drawing M. Sudoł-Procyk, photo W. Ochotny)

and core-tablets (10 examples; 10.3%). Other undetermined technical forms constituted 9.2% of the group in question. Such a high proportion of core processing debitage confirms the workshop nature of the site.

A group of cores included forms with initial blows, cores and their fragments. There were 28 cores (3% of the entire studied assemblage). They were represented by single-platform cores for blades, preserved at various stages of exploitation (Sudoł-Procyk 2021). Cores registered in Kleszczowa provided information about each stage of the production cycle. The ratio of cores in the preliminary phase of production is similar to the number of cores in the main as well as residual phase of production. Most débitage products are plain flakes that show that the cores were meticulously processed to produce regular, thin blades. Striking platforms were prepared and they bore traces of rejuvenation or correction. Cores at an advanced stage of exploitation were characterised by an acute angle between the prepared striking platform and the flaking surface; the latter, in some cases, embraced also the sides of the core. The backs of the cores were formed by concentric blows made from the core sides. A characteristic trait of the cores in question was also an occurrence of traces of changing orientation of striking platforms, which were identified on 31% of all cores (9 specimens). Moreover, there were noticeable tendencies in the exploitation of fragments of cores, residual forms or cores with unsuccessful blows, for shaping simple, *ad hoc* tools, mainly hammers. The secondary use of cores as hammers is often found in other flint workshops, especially in areas where access to other hard mineral raw materials (*e.g.*, stone pebbles) was difficult. This situation was met, on a much larger scale, in the case of the neighbouring site related to the extraction and preliminary processing of raw materials at Poręba Dzierżna 24 (Sudoł-Procyk *et al.* 2021b). In addition to 28 cores, there were also encountered six residual forms (20%).

Amongst tools, the total number of which accounted for 80 specimens (8.6% of the entire assemblage), a group of burins was distinctive (28 items; 35% of all tools; Fig. 3: 1, 7; 6: 4, 5). This category of tools was represented by: dihedral burins (9 specimens), truncation burins (4 examples), burins on a break (2 items), and single examples of the following forms: multiple burin; double burin; double ended burin; and a Lacan burin. For the production of burins, apart from blades and flakes, waste products were also used. In terms of raw material, burins were mainly made of flint from the Barańskie Mountains, and less frequently, from chocolate and striped flints (Table 1). Production of burins at the site is also confirmed by an occurrence of burin spalls (4 specimens found).

Less numerous endscrapers (Fig. 3: 4; 5: 2, 5, 6), represented by 16 specimens, constituted 20% of all tools. The great majority of them were made on slender blades, the width of which, in most cases, did not exceed 3.5 cm. Their fronts were low and poorly distinguished. Endscrapers were made exclusively of local variants of flint, outnumbered by flint from the Barańskie Mountains (10 items; 62.5% of all endscrapers).

Six artefacts were counted into the category of perforators (Fig. 6: 2, 3), constituting merely 8.7% of all tools. In general, they were made on shortened blades. Only one specimen

was made on a larger flake. One perforator revealed an alternating retouch, which brings it closer to a borer, in terms of typology (Fig. 4: 3; 6: 1).

There were 16 specimens (20%) of mining tools (items typical of workshops located near flint extraction areas). They were characterised by a considerable variability in terms of typology and a significant primitivism of forms (Ginter 1974, 32). Mining tools from the site in Kleszczowa were formed on massive waste products or fragments of cores, rarely on massive flakes. The great majority had a transversal edge shaped with abrupt or semi-abrupt retouch, forming a sort of simple side-scraper.

A significant proportion of the assemblage under analysis was constituted by waste products, of which 63 specimens were found (6.77% of the entire inventory). These resulted from fragmentation of artefacts due to post-depositional processes or human activity in the past and in the more recent past. Few of them (5 items) bore traces of intentional retouch. In this regard, there were identified distinctive fragments of intentional forms, which together with scarce chips were counted to the category named "other" (comp. Table 1).

Modern farming activity has undoubtedly contributed to a considerable destruction of the flint materials from this site. As mentioned above, most of the artefacts were obtained from the topsoil layer, which is reflected in the assemblage by an occurrence of pseudo-retouch, in some cases, undistinguishable from intentional retouch. Interestingly, there were detected hardly any waste products of chocolate flint (Table 1).

Use-wear analysis

Traceological analysis showed an extremely high degree of postdepositional damage, including different types of natural polish (particularly glossy) and natural retouch (contemporary as well). Detailed results of performed microscopic analysis with thorough characteristics of recorded use-wear (and other) traces are presented in the Table 2. The data contained there are merely generally summarised below.

Amongst 70 flint artefacts subjected to the use-wear analysis, 29 specimens bore traces supporting an assumption that they might have been used as tools (Table 2). Nevertheless, 17 of them (about 58%) were changed post-depositionally to such a degree or/and had been used so briefly that it was possible to classify them merely to groups named "used" or "probably used", without any more precise interpretation of their primary function. The remaining artefacts constituted a collection quite uniform in terms of their function, dominated by tools associated with hide processing and meat cutting, as well as tools for wood processing, represented by equal numbers of artefacts (7 specimens, *i.e.* 41% per each group). Moreover, there were identified two artefacts most likely connected with processing of herbal plants with high amounts of silica, so-called Si-accumulators (later called here "silicious plants"; *cf.* for example: Anderson-Gerfaud 1988; van Gijn 1989, 40; Anderson 1992; Juel Jensen 1994, 28). Another one could have been used for processing of soaked bone.

Table 2. Kleszczowa, site 9. Results of the traceological analysis of the selected flint artefacts. Explanations: Edge A – left edge, Edge B – right edge, Surface A – dorsal (upper) face of the debitage, Surface B – ventral (lower) face of the debitage, Surface C – side surface

No.	Morphological description	Use-wear	Function	Comments	Fig.
T1	Blade with distal part broken off	**Edge A:** *Retouch:* close/regular, on one side, single- and double-step, scars with mainly feather terminations; *Polish:* none **Edge B:** *Retouch:* practically none on most of the edge length (visible scars of post-depositional origins). By the fracture in the distal part, one can observe varied retouch on the dorsal face of the artefact. *Polish and striations:* in the central part of the edge generic weak polish and singular, oblique linear traces. In the distal part (by the fracture): polish on both sides of domed topography, smooth texture and medium degree of intrusion.	**Edge A:** probably used. **Edge B:** central part – used, possibly for planing of soft wood; distal part (fracture) – used, most likely for carving of wood.	On a bulb bright polish in the form of bright spots (Fig. 7: A), most likely traces of hafting.	2: 1
T2	Flake with retouch	**Surface A** (distal part of the artefact): *Retouch:* microburin scars and single-step retouch formed by scars with feather and hinge terminations; *Polish and striations:* very bright/ glossy, abrasive, of domed/flat topography and slightly rough texture. Linear traces: mainly filled in striations, oriented slightly obliquely to the line of the distal edge (Fig. 7: B, C). **Surface B**: *Polish:* abrasive, glossy, destroys completely flint's micro-relief, flat/corrugated topography, slightly rough texture, very invasive degree of intrusion. Linear traces associated with polish: linear depressions – wide, semicircular in cross-section, arched in longitudinal section, concentrating in groups (Fig. 7: D, E). Distal part: striations analogical to those visible on the Edge B, rougher polish texture. **Surface C:** peck-ness and scattered polish of invasive extent;	Used: distal part, most likely for processing (carving) of bone soaked in natural acids.	Polish on the Surface C – most likely of post-depositional origin.	2: 3
T3	Mesial part of a blade	**Surface A:** *Retouch*: individual scars with feather terminations. *Polish:* bright/glossy, linear, invasive degree of intrusion, covering upper parts of the micro-relief, flat and slightly pitted topography (from a wider perspective, slightly corrugated), smooth texture, oriented obliquely to the line of the working edge (Fig. 7: F, G). *Linear traces*: aligned obliquely, filled in, wide and narrow linear depressions and striations. **Surface B**: *Retouch*: formed by a few scars with feather terminations. *Polish and linear traces:* hardly legible polish, which rounds and abrades the upper parts of the micro-relief, flat topography and smooth texture (Fig. 7: H).	Probably used	Polish on the upper surface can be considered a post-depositional "abrasion", however, its correlation with the polish on the ventral face can indicate that the artefact in question could be a specific "planing" tool used for processing of material containing (probably) acids. An accurate interpretation of the possible function of this specimen undoubtedly requires further experimental studies.	2: 2
T4	Truncation piece made on a flake combined with a notched tool	**Edges A and B:** *Retouch:* on both sides, formed by scalar and half-moon scars, with various terminations, single- and double-step (a significant part of the retouch is of post-depositional origins). No other traces of use-wear destruction. **Truncation:** none	Probably used (due to traces of hafting)	In the lower part of the artefact, mainly on the dorsal face, remains of black, pitchy substance (glue?) most likely marking the extent of hafting. On a bulb bright polish of flat topography and rough texture (Fig. 7: I), most likely also connected with hafting (though, post-depositional origins cannot be excluded).	2: 4
T5	Blade with retouched edges/ truncation blade	**Edges A, B and truncation:** *Retouch:* close/irregular, on both sides, from single- to multi-step, formed by scars with various terminations. *Polish:* preserved in the zone of the Edge "A", various, in some parts strongly abrasive with flat or (eventually) domed topography and slightly rough texture (Fig. 7: J). In other parts, of definitely more "hide-like" characteristics, with cratered/domed topography. Cutting edge: rounded (Fig. 7: K).	Probably used, the "marginal" extent of polished areas hinders a reliable interpretation of their genesis.	Remains of black substance (tar?), side edges crushed, with post-depositional retouch, lots of destruction traces of very "fresh" characteristics.	2: 5

Table 2.

No.	Morphological description	Use-wear	Function	Comments	Fig.
T7	Mesial part of a blade with retouch	**Edge A:** *Retouch:* singular scars on both sides of the edge (wide/irregular retouch), formed by scars with mainly feather terminations; *Polish:* discontinuous, thin line along the edge, marginal to medium degree of intrusion, glossy, flat topography, smooth texture (dorsal face: Fig. 7: L; ventral face: Fig. 7: M, N). **Edge B:** *Retouch:* close/irregular, mainly on the ventral face, a great majority of scars of a very "fresh" nature;	**Edge A:** cutting of silicious plants, most likely grasses, wet reed, etc. (not cereals)	Initial traces. Retouch on the Edge B – uncertain origins (hafting? post-depositional?)	3: 2
T8	Blade with proximal part broken off	*Retouch:* individual scars with feather terminations. **Surface A:** *Polish:* very invasive, semicircular shape of the polished area, linear, flat topography, rough texture, associated with linear traces: filled in and black striations oriented perpendicularly to the line of the working edge (Fig. 7: O; 8: A-C). **Surface B**: *Polish:* an individual bright spot, with a polish of flat topography and slightly rough texture, associated with linear traces (black, and filled-in striations), oriented only slightly obliquely to the line of the working edge (Fig. 8: D). It does not correspond with traces observed on the dorsal face. Moreover, on this side, one can observe gentle, metallic polish that slightly rounds the upper parts of the micro-relief. It has a smooth texture and undetermined topography. There are no linear traces. (Fig. 8: E)	Used + post-depositional alterations?	Polish on the dorsal face in some parts resembles "hide-like" or polish typical of the contact side of the so-called polish type 23. Nevertheless, in other parts, it looks like a result of covering the artefact with some substance (Fig. 8: C), so its origins cannot be determined without more precise analysis.	3: 3
T9	Initial endscraper	**Surface A:** *Retouch:* multi-step, on the dorsal face, formed by scars with step and hinge terminations. *Polish:* generic weak, practically illegible;	Probably used, a scraper for processing hard materials?		3: 4
T10	Blade with proximal part broken off	**Edge A:** *Retouch:* close/irregular, on both sides, single-step, formed by scars with feather terminations; *Polish:* thin line along the edge, bright, cratered topography, smooth texture. Cutting edge rounded. **Edge B:** *Retouch:* on one side (on the dorsal surface), single-step, formed by scars with feather terminations. In the part marked with double dots in Fig. 3: 5, oblique with hinge terminations (fresh). *Polish:* none	Edge A: probably used (maybe for cutting of meat);	Retouch on the Edge B is most likely of post-depositional origins	3: 5
T11	Proximal part of a flake	**Edge A:** *Retouch:* on the fracture, apart from intentional retouch, there is a visible single-step use retouch formed by scars with step and hinge terminations. There are also microburin scars. *Polish:* none	Probably used (maybe burin used for a short period of time)	By the butt, on the dorsal face, bright polish of post-depositional origins.	3: 6
T12	Mesial part of a bladelet	*Retouch:* clearly visible microburin scar (possibly intentional) on the surface of the fracture and single-step retouch formed by scars with feather terminations. *Polish:* linear, orientation slightly oblique, domed topography (covers the upper parts of the micro-relief), invasive degree of intrusion, smooth texture (Fig. 8: F, G)	Carving of wood		3: 8
T13	Burin on a break	**Edge A:** *Retouch:* multi-step, formed by scars with hinge terminations. Visible peck-ness. *Working edge and polish:* The working edge slightly rounded. From the dorsal face visible bright polish of domed topography, slightly rough texture and marginal degree of intrusion.	Carving of wood	On the cutting edge, in some parts, there were observed zones with completely abraded micro-relief, which could indicate the processing of more abrasive materials. Nevertheless, these traces are most likely of post-depositional origins.	3: 7

No.	Morphological description	Use-wear	Function	Comments	Fig.
T14	Proximal part of a blade-flake	**Edge A:** *Retouch:* on both sides, close/irregular, formed by tiny scars with feather terminations; *Polish:* on both sides (but mainly, from the ventral face) one can observe a pale polish of slightly rough texture and cratered/slightly pitted topography (Fig. 8: H). *Working edge:* slightly rounded.	Cutting of meat (alternatively, soft hide)	Pitted topography and slightly rough texture of the polish indicate that the processed material could have been contaminated with some abrasive substance, which makes the interpretation of hide processing more probable.	4: 1
T15	Fragment of a flake	**Edge B:** *Working edge:* rounded; *Retouch:* mainly on the ventral face, close/irregular, single-step, formed by scars with feather terminations; *Polish:* scattered, smooth texture, cratered topography turning into domed, in some parts even flat/slightly pitted; invasive degree of intrusion, visible as a line along the edge. Polish associated with linear traces: singular filled-in striations, parallel to the tool edge orientation (Fig. 8: I, J).	Cutting of hide		4: 2
T16	Flake	**Edge A:** *Retouch:* single- and double-step, on one side, formed by scars with step and hinge terminations, visible delicate peck-ness; *Polish:* thin, discontinuous line along the edge, marginal to medium degree of intrusion, bright, domed topography, slightly rough texture. Polish, visible only on the dorsal face, covers mainly the upper parts of the micro-relief.	Probably used		4: 5
T17	Proximal part of a massive blade	**Edge A:** Retouch and polish like on the Edge B, outside of the zone marked "red" in the Figure 4: 4. **Edge B:** *Retouch:* In the zone marked „red", visible retouch on one side, multi-step, oblique, formed by scars mainly with step and hinge terminations. In the remaining part tiny retouch, on both sides, close/irregular, formed by scars with feather terminations; *Polish and striations:* in the middle part, on the ventral face, surface polish, bright, obliquely linear, of invasive degree of intrusion, domed topography and smooth texture. It is accompanied by linear traces in a form of oblique, filled-in striations (Fig. 8: K). In the part of the edge that is not covered with oblique retouch, from the side of the fracture, there is a blurred, pale polish "melting" the working edge. It has cratered topography and smooth texture (Fig. 8: L). Its degree of intrusion is marginal and it is legible as a thin, discontinued line along the edge.	The zone marked „red" of the Edge B was most likely used for planing of wood. It was a secondary activity in relation to meat cutting, which was performed with the tool earlier. Most probably, the Edge A also served for cutting meat.		4: 4
T18	Flake with retouch	**Edge B:** *Retouch:* indistinguishable from the intentional one; peck-ness, intentional retouch made with a hard hammer; *Polish:* none **Tip of the flake:** *Polish:* linear, cratered topography, parallel to the line of the side edge of the flake, smooth texture, medium and invasive degree of intrusion (Fig. 8: M). Cutting edge is rounded in this part.	Edge B: unused or used for a short time; Distal part: most likely used for cutting of hide	Distal part: use-wear traces preserved partially due to the breaking of the edge	4: 6
T19	Flake	**Edge A:** *Retouch:* none; *Polish:* thin line along the edge, marginal and medium degree of intrusion, bright, "melting" the line of the cutting edge, visible only from the ventral face. On the dorsal face, legible abrasive destruction resembling grinding. **Edge B:** *Retouch:* none; *Polish:* On the dorsal face legible "bright spots" of the bright/glossy polish of invasive degree of intrusion, flat topography and smooth texture (Fig. 8: N). On the lower face there is a polish of completely different characteristics: invasive, in a form of a band along the edge, gently linear (perpendicular/oblique), of domed/flat topography and smooth texture (Fig. 8: O).	Probably used. Edge A could have been used for cutting soft material, possibly meat.	In various parts of the artefact there is a visible very bright polish of post-depositional origins. The tool could have been used, which is supported mainly by the characteristics of the polish observed on the ventral face of the specimen. Significant alterations having modified the surface of the specimen due to post-depositional processes hinder any reliable interpretation of its function.	4: 7

Table 2.

No.	Morphological description	Use-wear	Function	Comments	Fig.
T20	Retouched blade	On all of the edges of the artefact (except for the fracture edge) there is a legible multi-step retouch formed by scars with various terminations, which is not accompanied by any polish.	Probably used, maybe as a scraping tool for processing of hard materials		5: 1
T21	Endscraper	**Endscraper front:** *Retouch:* indistinguishable from the intentional one. *Polish:* visible on a few protruding points, where the working edge is gently rounded. Polish of smooth texture, domed topography and marginal degree of intrusion.	Used (used for a very short time, possibly rejuvenated; most likely used for scraping soft wood).	Endscraper front was secondarily retouched with a hard hammer, possibly for rejuvenation. Its right side is covered with multi-stage peck-ness of post-depositional origins.	5: 2
T22	Endscraper	**Endscraper front:** *Working edge:* strongly rounded; *Retouch:* indistinguishable from the intentional one, due to rounding of the working edge practically illegible; *Polish:* band along the edge, quite bright, cratered topography, slightly rough texture, degree of intrusion – up to invasive. Polish is associated with linear traces – short, irregular striations, oriented perpendicularly (Fig. 9: A). **Edge B:** *Retouch:* wide/irregular, on both sides, single-step, formed by scars mainly with feather terminations; *Polish and striations:* thin, discontinuous line, basically points, marginal degree of intrusion, merely by the endscraper front there is a band of medium extent. Polish bright, of domed topography and smooth texture.	Endscraper front: scraping of soft (greasy) hide	Edge B: traces of post-depositional origins (though, it cannot be excluded whether this edge was also used, to a small extent, for planing of wood)	5: 5
T23	Retouched blade	**Edge A:** *Retouch:* close/irregular, on both sides, single-step, formed by various types of scars with various terminations; *Polish:* atypical/initial, on both sides, thin, discontinuous line along the working edge (which is slightly rounded), degree of intrusion – mainly marginal to medium; topography and texture illegible.	Probably used	There are no use-wear traces on the Edge B, retouch was most likely performed to make the opposite side blunt, for more convenient hafting or better handling.	5: 3
T25	Endscraper	**Endscraper front:** *Retouch:* indistinguishable from the intentional one; *Polish and striations:* thin line along the edge, degree of intrusion up to medium, domed topography, smooth texture, linear (Fig. 9: B). **Edge A:** *Retouch:* on both sides, though mainly on the ventral face, practically single-step, close/irregular (tiny scars with feather terminations), merely in some parts disrupted by scars of different characteristics; *Polish:* visible as a thin line along the edge, which is rounded, bright, mainly marginal degree of intrusion, cratered topography, slightly rough texture. The polish is associated with linear traces – oriented parallel to the line of the working edge singular black striations of various characteristics (Fig. 9: C, D). **Edge B:** *Retouch:* close/irregular, singular scars with various terminations, oriented mainly towards the dorsal face; *Polish and striations:* dispersed, the working edge in some parts is gently rounded, mainly individual points, atypical.	Endscraper front: planing of wood Edge A: sawing of wood; Edge B: used for cutting of soft materials		5: 6

No.	Morphological description	Use-wear	Function	Comments	Fig.
T26	Borer/perforator	**Edge A:** *Retouch:* close/irregular, on both sides, singular scars with various terminations; *Polish:* singular points, cratered topography, smooth texture, linear (parallel to the line of the working edge); associated with linear traces: thin and shallow, black striations perpendicular to the line of the working edge. **Edge B:** *Retouch:* on one side, multi-step, formed by scars with hinge and step terminations, close/irregular; *Polish:* thin line along the edge on the very tip of the sting, bright, linear, domed topography, smooth texture.	Edge A: cutting of soft hide (used also for scraping of this raw material); Edge B: carving of wood	In the proximal part there are visible hafting traces of "hide-like" characteristics (rounding of side edges and negative ridges, as well as "hide" polish - Fig. 9: E). By some "protruding" points much brighter polish can be observed, most likely having emerged as a result of contact with the bone (?) part of the handle (Fig. 9: F).	6: 1
T27	Perforator/fragment of a backed bladelet	**Edge A:** *Retouch:* indistinguishable from the intentional and post-depositional one; *Polish:* thin, discontinuous line along the edge, on both sides, cratered topography, smooth texture. In some places "bright spots" of abrasive characteristics. **Edge B:** *Polish:* gentle "melting" of the cutting edge; filling up the micro-relief; cratered topography and smooth texture.	Edge A: hafting traces Edge B: cutting of meat (?)	There are visible "bright spots" of post-depositional origins. The artefact is broken and it cannot be excluded whether it was actually a fragment of an arrowhead.	6: 2
T28	Blade with truncation	**Edge A:** *Retouch:* in the retouched part - indistinguishable from the intentional one; in the remaining part of the edge: close/irregular, on both sides, basically single-step, formed by scars with various terminations; *Polish:* in the retouched part there is no legible use polish. In the central part of the edge, spots of polish can be observed on both faces. This polish has a marginal degree of intrusion, cratered topography and smooth texture. The cutting edge is gently rounded here.	Probably used, possible contact with soft material of organic origins	Patinated artefact and covered with retouch of post-depositional origins.	6: 3
T29	Lacan burin	*Retouch:* there is no retouch that can be univocally considered utilitarian. However, the presence of multi-step retouch (directed on one face) should be stressed, formed by scars with step terminations, on the tip of the truncation (at the base of burin spall scars); *Polish:* there is no use polish on the burin spall scar. There is also no polish next to the burin spalls from the ventral face of the „sting" of the specimen. Merely on its very tip (from the ventral face) there is a legible slight rounding of the edge and polish of domed/cratered topography and smooth texture (Fig. 9: G). A more developed polish of invasive degree of intrusion was observed at the base of the burin spall scar. It is bright, linear, of domed topography and smooth texture. Also, it is associated with singular linear traces (Fig. 9: I) in a form of narrow and short, black striations oriented slightly obliquely (similar to the polish linearity) to the line of the side edge of the tool (Fig. 9: H). This polish covered probably a wider area, but it was partially "removed" by the burin blow. It can be suggested that it is connected with the primary function of the tool. An identical polish was observed on the other surface of the edge, on the specimen's dorsal face (Fig. 9: J). The cutting edge in this zone is additionally significantly rounded.	Used, processing of plants	By the fracture, on one side of the artefact (Fig. 9: K) and on the ridges between scars (Fig. 9: L) one can observe a polish of "hide-like" characteristics. Additionally, a bright/glossy abrasive polish associated with oblique striations was observed on one of the ridges. It overlaps the rounding and "hide-like polish" (Fig. 9: M). Along the main ridge, there is a line of glossy polish of flat topography and smooth texture, bearing traces of having been etched with plant acids (Fig. 9: N, O).	6: 4
T31	Truncation burin	**Surface C:** *Retouch:* on the burin spall scar – tiny, single-step retouch on one side, scars with feather terminations; *Polish:* initial/atypical;	Probably used (carving of wood?)		6: 5
T32	Blade	In some, better preserved parts, on one of the side edges there is a visible gentle rounding and a polish with marginal extent, undetermined topography and rather smooth texture.	Probably used	The artefact is strongly destructed by a post-depositional process (strongly developed, invasive retouch and peckness).	6: 6

DISCUSSION

Results of multi-aspect analysis of flint assemblage obtained from the site Kleszczowa 9 allow linking it with the Magdalenian Culture. The general technological and morphological characteristics of cores and blade blanks (*cf.* Sudoł-Procyk 2021) under scrutiny correspond well with similar artefacts discovered at other Magdalenian sites in Poland, particularly with regard to the method of obtaining blades with *en éperon* butts, *e.g.* in Wilczyce (Schild 2014), Hłomcza (Łanczont *et al.* 2002), Klementowice (Wiśniewski 2015), Stare Baraki (Wiśniewski 2020). Moreover, the structure of the toolset and the stylistics of tools reveal a close resemblance to other Magdalenian sites in Poland, in particular, in the context of the discovery of a Lacan burin (Fig. 6: 4), considered a distinctive form for the Magdalenian Culture (Brézillon 1968, 179, 180; Połtowicz-Bobak 2013, 269).

The assemblage presented in this paper displays additional traits typical of workshop sites. This concerns the regular utilisation of core processing waste products for the production of simple, *ad hoc* tools. Moreover, the workshop nature of the site under scrutiny is manifested by the dominance of blanks in the assemblage, which has already been underlined in the related literature (Sudoł-Procyk 2020, 300). A noticeable high percentage of retouched flakes and blades within the inventory in question was also recorded at other Magdalenian sites of similar characteristics, among others, in Klementowice (Wiśniewski 2015, 56) or Sowin (Wiśniewski *et al.* 2012, 403).

In the surroundings of the site in Kleszczowa, there occur numerous outcrops of various siliceous rocks (Baranowski and Sudoł-Procyk 2023). The site itself lies directly over the outcrops of various types of Jurassic flints, such as flint from the Barańskie Mountains, however, within a distance not exceeding 3 km from the site there are located outcrops of local striped flint, flint from the Udorka Valley, flint from Wierbka or chocolate flint (Krajcarz *et al.* 2012). The flint from the Udorka Valley was the raw material of the greatest extent and most easily available. Nevertheless, at the site in Kleszczowa, there were no fine blades or tools made of this raw material recorded, most likely due to its low utilitarian quality. Instead, the most preferably utilised materials are represented by three variants, namely predominant flint from the Barańskie Mountains (part of the outcrops of which occur within the extent of the site itself), followed by chocolate and striped flints, with outcrops situated within a distance up to 3 km from the site. This tendency is well visible in both the general raw material structure of the assemblage, as well as within particular typological groups, including tools. More than 85% of all tools were made from the three aforementioned types of raw materials, i.e., Barańskie Mountains flint, striped flint and chocolate flint. In the group of tools, no significant preference of any of these types was observed. The only exception may be found in the group of cores, dominated by chocolate flint, significantly outnumbering specimens made of flint from the Barańskie Mountains and striped flint. Interestingly, outcrops of chocolate flint are located within the greatest distance from the site. Therefore, it can be assumed that this particular raw material was

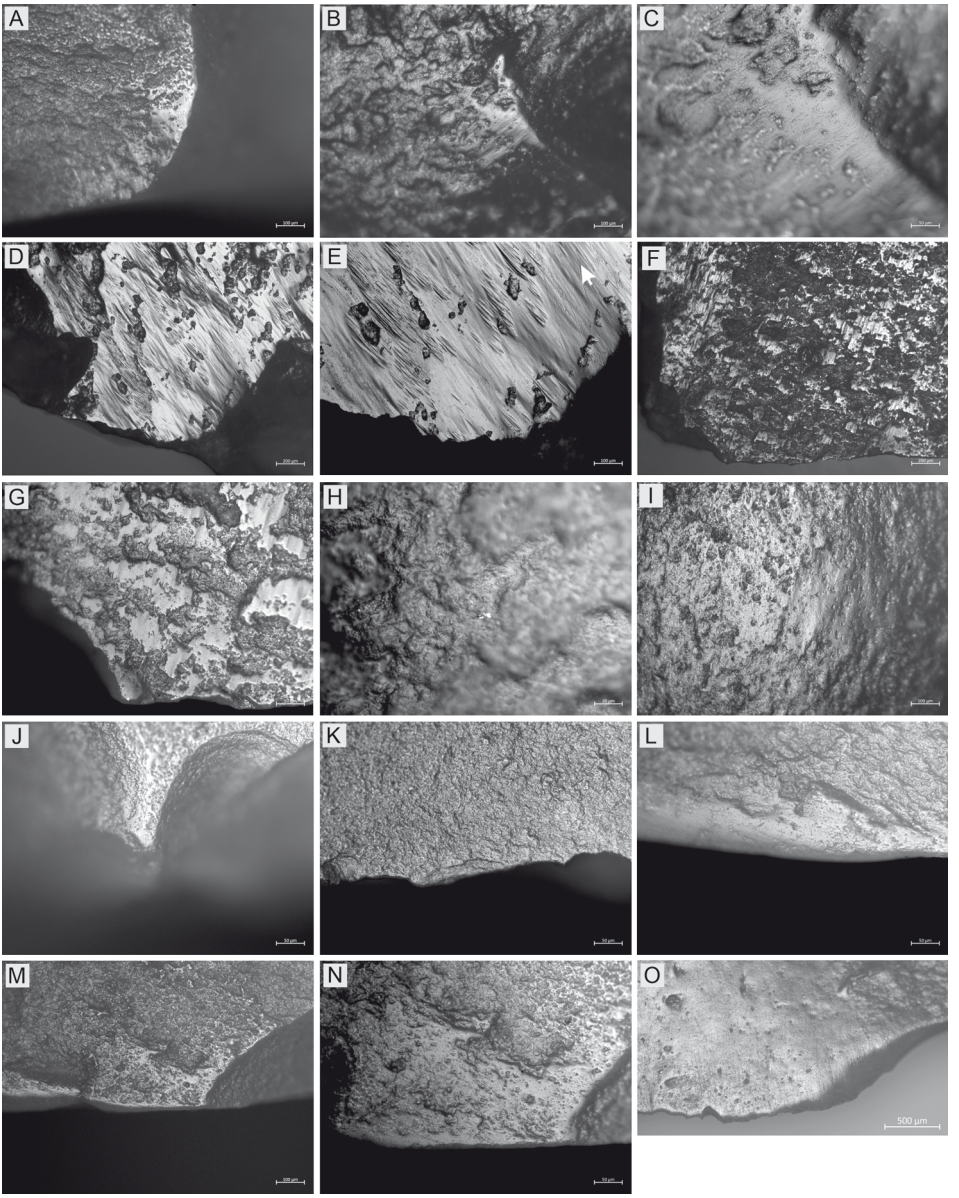

Fig. 7. Micro-photographs of use traces on flint products (photo G. Osipowicz)

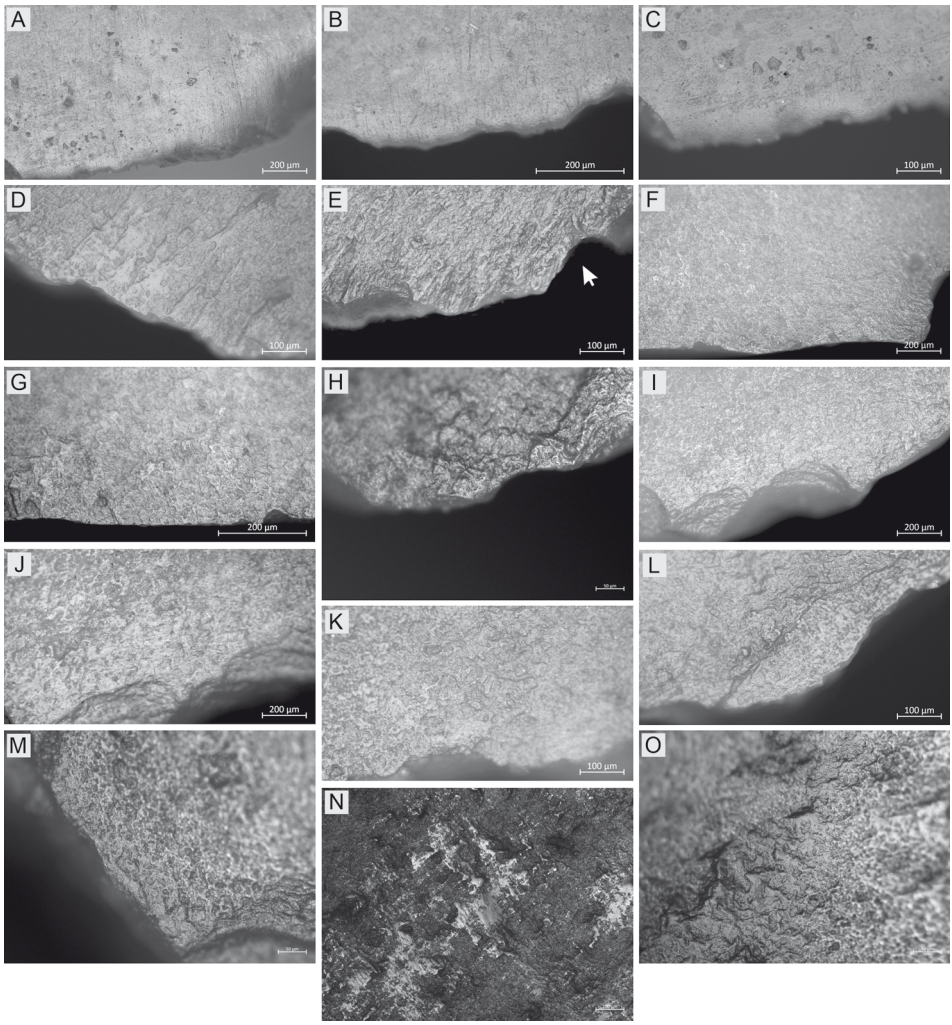

Fig. 8. Micro-photographs of use traces on flint products (photo G. Osipowicz)

exceptionally appreciated, which is additionally confirmed by the smallest number of waste products of chocolate flint.

The flint materials from the site Kleszczowa 9 are a perfect example of a collection, the state of preservation of which seems to be very good in macroscopic assessment, though under microscopic analysis it reveals post-depositional damage to such a degree that it hinders conducting any reliable functional studies for the great majority of artefacts. The most problematic are not only various types of pseudo-retouch, being the most common type of post-depositional damage observed on the edges of prehistoric flint artefacts. A far

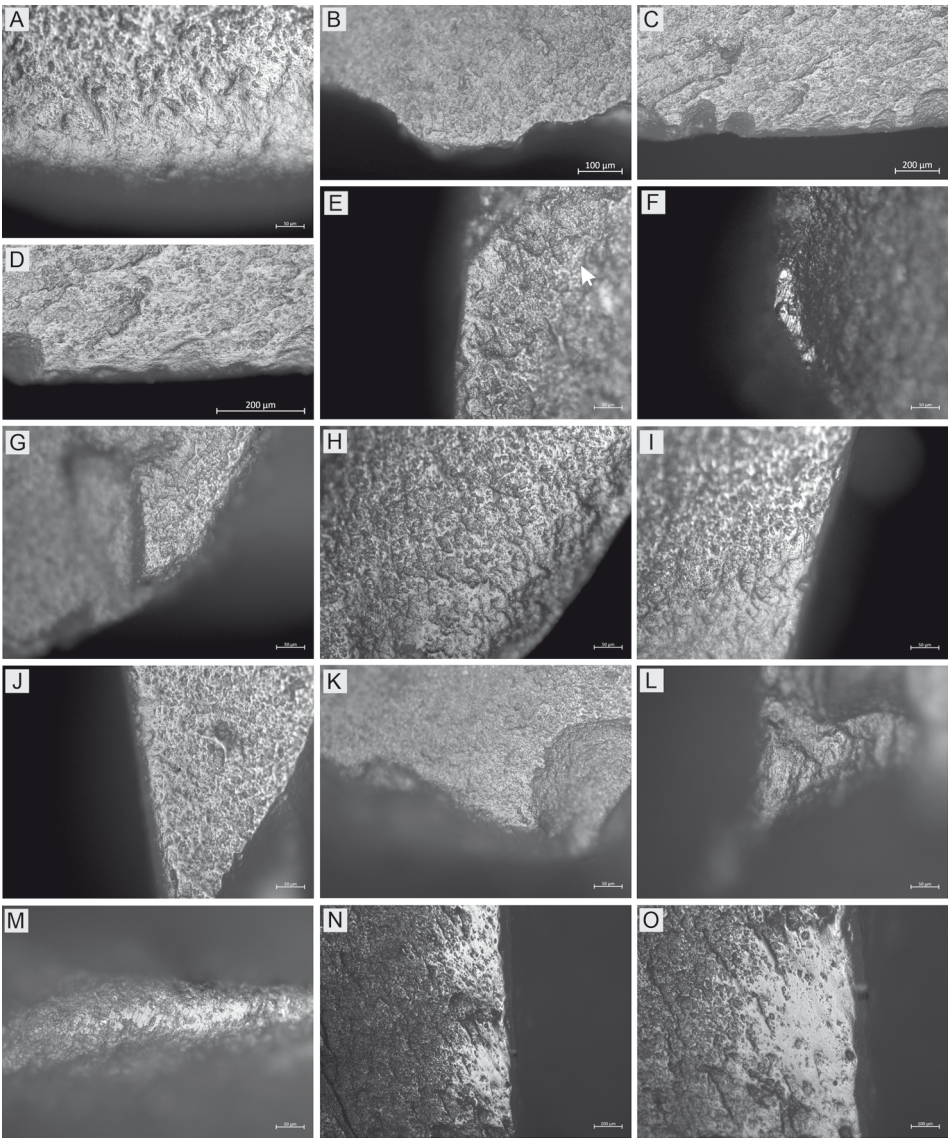

Fig. 9. Micro-photographs of use traces on flint products (photo G. Osipowicz)

more troublesome obstacle in such studies is natural polish, usually changing completely the structure of micro-relief of flint materials over large surfaces and therefore, totally removing use-wear traces if there were any. Importantly, in many cases these polishes reveal characteristics resembling those of use-wear traces and can be very uniform over larger surfaces or radically changeable along one edge of the artefact (*cf*. Table 2, for example

artefacts T5 – Fig. 2: 5 and T19 – Fig: 4: 7). In this context, an exceptional case is represented by glossy polishes of flat or corrugated topography, of which there is a high variability observed on the materials from Kleszczowa. Some of their identified types display a unique structure (*e.g.*, Fig. 7: D, E) and understanding their genesis should be undoubtedly a goal of independent interdisciplinary studies. Investigations of this kind would be surely very helpful for an accurate and univocal interpretation of traces with characteristics like those identified on the artefact T3 (*cf.*, Table 2, Fig. 2: 2), which to a certain degree resemble destruction traces visible on a few types of the so-called *curved knives* (Osipowicz 2019). Such studies could also be important for the explanation of the genesis of extremely interesting traces observed on the artefact T8 (*cf.*, Table 2, Fig. 3: 3). The "hide-like" characteristics of the abraded zone visible on the dorsal face of this specimen (Fig. 8: A, B), with clear striations oriented perpendicularly to the line of the working edge and rounding of the tool end, in the context of the "silicious" characteristics of the *bright spot* recorded on the ventral face, could provide the grounds for interpreting these traces as a variant of the so-called polish type 23. A difficulty in this case is an inconsistent pattern of striations within the *bright spot* and its individuality, which supports an assumption that it emerged as a result of post-depositional processes. The other type of polish visible on the ventral face of the artefact (Fig. 8: E) is non-specific, though different from the one recorded on the dorsal face. This could be an argument for placing the described artefact "functionally close", at least, to the group of tools associated with the Type 23 polish (van Gijn 1989, 85; 2010, 105). However, an intriguing issue is an exceptionally invasive extent of the abraded zone of "hide-like" nature on the dorsal face (about 1 cm; see Fig. 7: O), and its characteristics at particular spots (see Fig. 8: C), which indicates an occurrence of some sort of a substance on the surface of micro-relief of flint within the abraded zone, changing partly, if not completely, its properties. This hinders any univocal determination of the genesis of the traces observed on the artefact in question, before commencing more thorough multi-aspect studies on the described "modification" (or other similar alterations recorded on artefacts from Kleszczowa).

Due to the post-depositional destruction of artefacts, traceological studies on the assemblage from Kleszczowa provided only a few data in relation to what could have been obtained if their state of preservation had been better. Nevertheless, it confirmed the pre-Neolithic chronology of the collection, since in the group of tools identified as being for silicious plant processing, there were no sickle inserts for cutting of cultivated cereals. The investigations also revealed the great significance of wood, hide and meat processing in the activity of the society occupying the Kleszczowa site.

Undoubtedly, the most interesting specimen subjected to analysis was a Lacan burin (Fig. 6: 4). This tool was surely mounted in a hafting made of hide and possibly bone. Interpretation of its function is troublesome. The retouched zone and the scar of the burin blow did not display any traces of utilisation, whereas the edge by the burin blow scar was most likely used for processing soft wood, possibly even lignified stems of silicious plants,

in a manner resembling carving/cutting. Such an interpretation, however, does not explain the reasons for performing the burin blow. Maybe, this was an unsuccessful treatment, namely it was supposed to rejuvenate the worn-out cutting edge of the tool, but it was made slightly aside of the intended spot. Noteworthy are also traces visible on the tip of the artefact, on its ventral face. Characteristics of the polish observed there may indicate processing (cutting? carving?) of dried and hard hide. Nevertheless, the low invasiveness of the recorded traces does not provide much support for such an interpretation. Along the main ridge of the artefact, there is a line of glossy polish of flat topography and smooth texture, revealing traits of having been etched by plant acids (Fig. 9: N, O). The genesis of this polish is uncertain, although it is surely not of post-depositional origins. It might have emerged as a result of close contact of this part of the tool with fluids coming from the material being processed or results from a specific manner of hafting of the artefact (such as using a cord/material made of fresh silicious plants).

There have been discussions about the typological and functional interpretation of tools of the Lacan burin type since the middle of the 20th century (Cheynier and Bouyssonie 1955) and are caused by a sequence of treatments that is unusual when compared with other burins (Połtowicz-Bobak 2013, 239). This type of burin is shaped by a concave, strongly oblique retouch, following the burin blow, and forming a sort of a tip, one side of which is sometimes reduced by a secondary retouch (Demars and Laurent 1989, 74). Thus, the Lacan burin was produced using a specific method, where the retouch (concave truncation) followed the burin blow (Tixier 1978, after Stefański 2013). Thorough, in-depth analysis of use-wear traces visible on this tool will undoubtedly contribute greatly to the discussion concerning its application at the end of the Pleistocene.

SUMMARY

The site in Kleszczowa is an example of one of few Magdalenian workshops known from the territory of Poland (Połtowicz-Bobak 2013, 155). A summary structure of artefacts (Table 1) univocally indicates that the most numerous group was represented by flakes and blades, constituting over 75% of all the recovered flint materials. This percentage would even grow if technical forms were also included (nearly 11%). The occurrence of technical forms confirms the special preparation of cores at the site, which means that we are dealing with a workshop site where the raw material was being processed, mainly aimed at the production of fine, long blades, employing a common and distinctive method of preparing the spot for the blow, namely forming an *en éperon* butt (Pyżewicz 2022, 67). Another trait of the site in question in the occurrence of numerous retouched blanks, which corresponds well with assemblages gathered from other Magdalenian workshop sites in Poland, such as the Zalasie Cave or Sowin (Bocheński *et al.* 1985; Połtowicz-Bobak 2013, 368, 377, 378). At the site Kleszczowa 9 the percentage of tools was also relatively

high (9%). The high percentage of blanks and tools, including utilised tools, which was confirmed by the results of use-wear analysis, can be explained by the possible existence of various functional zones within the site boundaries, enclosing flint workshops and utilitarian zones where everyday activities were performed. This conclusion is also confirmed by an occurrence of concentrations of artefacts within, at least, two regions of the site, recorded during both field surveys and trial excavations (Sudoł-Procyk 2021).

The Magdalenian societies consciously made a selection of high-quality raw materials. Despite the common availability of flint from the Udorka Valley, it was not used on a greater scale since it did not provide flint knappers with the opportunity to produce fine blades and flakes. Instead, more preferably used raw material sources were local outcrops of flint from the Barańskie Mountains, chocolate and striped flints, which in total constituted 84% of the entire assemblage. However, due to excluding specimens revealing convergent morphological traits, patinated and burnt, from raw material classification an assumption can be made that the contributon of the above-mentioned three variants of flint could have amounted to over 90%.

The investigations carried out in Kleszczowa have proven how important the region of the Kraków-Częstochowa Upland was to Magdalenian societies. This is the region where the largest archaeological sites of workshop type have been encountered, such as Brzoskwinia (Sobczyk 1993; Krygiel-Kozłowska 2010), Wołowice (Sobczyk 1992), and finally, Kleszczowa 9 described in this paper. This phenomenon is connected with the occurrence of numerous outcrops of flint, and the location of flint workshops in the area of these outcrops reflect the strategies of raw material management, distributed to other regions. The best example is chocolate flint, which was distributed from Poland over the territories of Western and Southern Europe (Přichystal 2018). In this context, the region of the Barańskie Mountains and the Udorka Valley could have affected the development of the Magdalenian communication routes and distribution of siliceous materials (Sudoł-Procyk *et al.* 2021a; Sudoł-Procyk 2021).

The Magdalenian settlement in its eastern zone, including the territory of Poland, was associated with short-term, seasonal periods of occupation by hunting societies, also engaged in the exploitation of siliceous and mineral materials, which corresponds well with the results of studies presented in this article (Połtowicz-Bobak 2013; 2016). The results of research on the described site have provided new data on Late Paleolithic human activity in the central part of the Upland. It seems that the location of the Kleszczowa 9 site is directly related to the raw material management of very good quality flints. The Udorka Valley region undoubtedly played a certain role on the communication routes of Magdalenian communities. We observe such stops of Magdalenian groups, for example, in the form of short-term cave camps, documented in the central and southern Kraków-Częstochowa Upland (*e.g.*, Sudoł-Procyk 2020).

Investigations on the function of tools made of siliceous rocks coming from those sites refer to individual assemblages and their tradition is much younger when compared with

Western Europe. Nevertheless, they have proven that flint tools were used for activities connected with hunting and processing of animal carcasses, as well as work connected with the processing of mineral materials, and extraction and processing of wood and herbaceous plants (Pyżewicz 2022, 67). The results of the analysis performed for the assemblage from the Kleszczowa 9 site can successfully be related to the current state of knowledge regarding the use of tools by Magdalenian societies, and they undoubtedly extend our knowledge of behaviour of humans at the decline of the Pleistocene in the territories of the Kraków-Częstochowa Upland.

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