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TECHNOLOGICAL STUDY OF THE LITHIC MATERIALS FROM THE SITE WOŁKUSZ 3 IN NE POLAND. THE CONCEPT OF THE PREFERENTIAL BLADES' PRODUCTION

ABSTRACT

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The article aims to present the results of the technological analysis of the lithic artefacts from the site Wołkusz 3. This comprises a detailed characterisation of one of the two reconstructed flint knapping strategies described as the concept of preferential blades. The Wolkushian culture inventory consisting of almost 3000 pieces was subjected to the analyses. The collection includes the debitage products – cores, flakes and blades, as well as the products of debitage modification – retouched tools and the spalls connected with the process of their production and repairing. The conclusions are based on refitting studies supported by the analyses of the relief of negatives and the morphological attributes.

Keywords: Late Palaeolithic, tanged points complex, Volkushian culture, lithic technological analysis, Wołkusz site no. 3
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INTRODUCTION

The present article is the continuation of the technological characterisation of the lithic artefacts from Site 3 at Wołkusz Lipsk n/Biebrzą commune, Augustów county, podlaskie voivodship, initiated in vol. 64 of Archeologia Polski (Przeździecki 2019). So far, it comprised the detailed discussion on the first of the two technological strategies reconstructed on the basis of this assemblage, namely the concept of the preferential production of points. Here we are going to present the second technological strategy, defined as the concept of preferential production of blades.

The fundamental aim of our discussion – undertaken in both our texts – is answering the question concerning whether the distinctiveness of the Wolkushian culture inventories (Szymczak 1995, 13, 30-40; 1999) described on the basis of their typological structure and the morphology of the retouched tool forms, is also reflected in the applied technologies, *i.e.* in specific features of the debitage and cores. Demonstrating such a correlation would have be fundamental importance in the discussion that has gone on for a long time on the taxonomic classification, definition, and often the validity of differentiating the prehistoric units.

The above-mentioned controversies originate from the syncretic character of the Wolkushian culture inventories, containing the retouched tools traditionally associated with the various TPC (Tanged Point Complex) units. Mainly, this concerns the concomitance of at least two categories of tanged points, *i.e.* those with flat retouch on the ventral face of the tang, that is Świdry and Chwalibogowice types, and those with the retouch exclusively on the dorsal face of the tang, that is finer items of Ahrensburg type, and more massive ones of Bromme type (Taute 1968, 10-13, Abb. 1). The described coincidence, especially when other reliable typological premises are lacking, raises natural doubts as to the homogeneity of such assemblages (Sulgostowska 1989). The alternative suggestion for explaining the phenomenon of simultaneous appearance of the tanged points of various types was given by M. Kobusiewicz (2009). He believes that some types of tools, such as points of Lyngby type, because of their universal functional character, may occur at the same time in the inventories belonging to various taxonomical units. On the other hand, the lately published results of the morphometric analyses of the tanged points from Western and Eastern Europe generally seem to discredit the use of this category of points as cultural indicators (Ivanovaite *et al.* 2019).

The authors think that the doubts mentioned above could be resolved by a detailed technological characterisation of these assemblages. The benefits from such an approach would be as follows:

a. introducing new arguments to the discussion on the Wolkushian culture, which would evaluate the typological criteria on the basis of which the whole unit was differentiated;

b. incorporation of the mass material (debitage, cores, and spalls), to the analyses, which thus far were rather ignored;

c. the possibility to formulate a new type of conclusions concerning the activities connected with flint knapping; they could be examined on the different levels: specific, *e.g.*, individual decisions taken by the flint knappers on a particular site, or more general, *e.g.*, the technological tradition expressed by the permanent replication of the certain technological standards (methods and techniques) by the larger social groups;

d. the comparison of the obtained results with the technological picture of the other TPC cultural units (*e.g.*, Dziewanowski 2006; 2012).

The first step to undertake the investigation in this direction is the detailed analysis of the reference inventory. The conclusions drawn on this stage are going to constitute the starting point to the wider comparative analyses and search for possible analogies. The specificity of the technological investigation which demands the detailed and time consuming analyses, in this case excludes any other procedure.

MATERIALS AND METHODS

We have chosen the assemblage from the site Wołkusz 3 as the reference inventory for three reasons:

a. the presence of a representative set of the retouched tool forms, recognized as distinctive for the Wolkushian culture (Szymczak 1995, 13, 14, 30-36), in that number the rich series of the massive tanged points without the flat retouch on the ventral face of the tang;

b. the presence of a representative set of cores, debitage products, and the spalls, *i.e.* the components which allow the technological observations to be performed;

c. the assemblage belongs to the not too numerous group of the Wolkushian inventories gained in course of the systematic, well documented excavation.

The article concentrates on the analyses of the core refittings. The choice of this category of artefacts was dictated by the following reasons:

a. the information recorded in the core reduction process is the most complete representation of the debitage process;

b. core refittings combine different categories of products, coming from different stages/phases of their implementation;

c. conclusions resulting from the analysis of core refittings provide a context for research on non- refitting artefacts.

Application of this method allowed the identification of the sequence of operations (the succession of detaching), and, what is especially important, the rating of their cause-and-effect relations (Cziesla 1990, 9-45). The important part of the investigation was also the analysis of the morphological details, and the scar pattern analyses (*e.g.*, Bar-Yosef and Van Peer 2009). This gave insight into the individual and cultural choices of the makers/flintknappers. The complementary application of these methods made it possible to reconstruct the process of debitage together with the connection of the technological operations constituting it with the set of morphological attributes of their material correlates.

The concept of the preferential blades' production was identified in the context of 10 refitting blocks. They reflect two varieties of its realization – single striking platform (blocks W3B2, W3B3, W3B21, W3B31), and double striking platform (blocks W3B8, W3B11, W3B17, W3B20, W3B25, W3B198). Both concepts were characterized in detailed individually exemplified by the case studies of blocks W3B2 and W3B8. The most important conclusions obtained in course of this analysis, the technological (*e.g.*, identified links of operation chain), as well as the morphological ones (the set of distinctive features), served to construct tables making it possible to compare also the results of the examination of the remaining refitting blocks (Tables 1, 2). This provided the basis for the synthesis of data and the formulation of general conclusions about the debitage process carried out on the site and the morphological parameters of the products. The summary of the research presents the reconstructions of the idealized model of the chain of operations.

The concept of the preferential method was first described in the late Palaeolithic context by Witold Migal (2007). In his research, he linked the shape of the blades, but above all, the arrangement of the negatives on the upper side of the points (Bromme type) with the scar pattern on the flaking surface on the cores. Since then, elements of this theory have been used, inter alia, in analysis lithic technology of the Swiderian (Dziewanowski 2006ł 2012) and Volkushian (Przeździecki 2019) assemblages.

RESULTS

The concept of the preferential blade production in single striking platform variant. Case study – block W3B2

Block W3B2 of dimensions 112/36/75 mm consists of nine pieces. It represents a strongly exploited single striking platform core (el. 1), 7 technical spalls – 3 flakes (el. 2, 3, 6), 2 crested blades (el. 4, 5), and 3 blades (e. 7-9) (Fig. 1). It illustrates the process of reduction of a single striking platform core with the narrow, rectangular flaking surface situated on the narrower side of the flint nodule, and the unworked, cortical surfaces of the remaining sides and back.

The initial stage of the treatment of block W3B2 was named 'stage 0'. It is represented by a series of percussions aiming to give a nodule its primary core shape. This operation is manifested by a group of the relatively fine, hollow negatives (1-6), which are the effect of the removing of the natural knobbs, a characteristic feature for the nodules of the cetaceous flint of the north-eastern variety.

The second stage is the initial preparation comprising the zone of future striking surface, and then the striking platform. In case of the flaking surface the process was realized in the course of two succeeding operations.

Table 1. Technological operations (knapping stages) identified during the analysis of the refitted cores from the site Wołkusz 3. Note that the second column shows the dominant order of occurrence of the technological treatments or phases. However, in a few cases this order may be changed, so it is important to follow the numbering of negatives (n) and elements (e). The symbol 'x' indicates that a given type of operation did not occur in the reconstructed process or was not identified, *e.g.* due to the low completeness of the block

stage	treatment/phase	W3B2 Fig. 1	W3B3 Fig. 3	W3B21 Fig. 4	W3B31 Fig. 5	W3B8 Fig. 2	W3B25 Fig. 9	W3B17 Fig. 7	W3B11 Fig. 6	W3B20 Fig. 8	W3B198 Fig. 10
0	regularization	n.1-6	x	x	x	x	x	n.1-5, e.2, 3	n.1	-	x
1	sides preparation	x	x	x	x	x	x	x	-	n.1, 10	x
	back preparation	x	x	x	x	x	x	x	n.2, 3	n.2-9, e.2	x
	exposure of the upper striking platform level I	e.3	n.1-4	n.1		n.1	n.1	n.4	n.4, 5	n.17-21, e.6, 7	x
	exposure of the lower striking platform level I	x	x	x	x	e.2	n.2, 3	n.8	n.6	n.12-16, e.3, 4	x
	configuration of the future striking surface	n.7-10, e.2	n.5-8	-	-	n.3-8	n.4, 5	n.6, 7	-	n.11, 23-29, e.8	x
	exposure of the striking surface	n.11-13, e.4, 5	n.9,10	n.3-8	n.1	n.9-12, e.3-6	n.6-8	n.10-18	n.7, 8	n.31, 32	x
	exposure of the upper striking platform level II	e. 6	x	x	x	x	x	x	x	x	x
2	isolation of the preferential blade	n.14, 15	n.11-15	n.4-6	n. 2, 3	n.11-13, e.5,6	n.9, 10	n.19-21, e.5	n.9, 10	n.30, e.9, n.33-36	n.1
	execution of the preferential blade	n.16, 17	n.16, e.2, 3	e.2, n. 9	n. 4	n.14, e.7	n.11, 12	n. 22	n.11, e.2	n.37, 38	n.2
	isolation of the preferential blade	x	x	x	n.5, 7	x	x	n.23, 24	-	x	n.3, 4
	execution of the preferential blade	x	x	x	e.2	x	x	n.25	-	x	n.5
	isolation of the preferential blade	x	x	x	n.8	x	x		-	x	
	execution of the preferential blade	x	x	x	n.9	x	x	x	-	x	
3	serial debitage	n.18-20, e.7	n. 17-20	x	-	n.15-17, e.8, 9	x	x	n.12-16	x	n.6, 7
	exposure of the lower striking platform level II	x	x	x	x	n.18-20	n.13	x	x	e.5	n.9-12
	exposure of the striking surface on the side of the core	n.21, 22	x	x	x	x	n.14, 15	n.26, e.6	n.17	x	n.8, e.2, 3

Table. 2. Group of morphological attributes identified during the analysis of the refittings cores from the site Wołkusz 3. Roman numerals mark the levels of the striking platform and subsequent stages of the evolution of the striking surface. The symbol 'x' indicates that the given morphological feature is not present in the block

Block number	Striking platform			Internal angle between striking platform and striking surface	Striking surface	Sides	Back
	Configuration	Type of surface	Direction of detaching		Horizontal convexity /shape	Type of surface	Type of surface
W3B2	x	I single-negative II single-negative	I from the striking surface II from the striking surface	I 90°- 80° II 90°- 80°	I triangular II flat III double-walled	cortical	cortical
W3B3	x	multi-negative	multidirectional	80°- 70°	I triangular II double-walled	cortical and negative	cortical
W3B21	x	single-negative	from the striking surface	80°- 70°	I triangular II flat	cortical and negative	negative
W3B31	x	I single-negative II single-negative	from the striking surface	80°- 70°	trapezoidal	cortical and negative	cortical
W3B8	I paralel II angular	I single-negative / upper/ I multi-negative / lower/ II multi-negative / lower/	I from the striking surface / upper/ I from the side /lower/ II from the side /lower/	I 80°- 70° /upper/ I 80°- 70° /lower/ II 90°- 80° /lower/	I trapezoidal II flat	cortical and negative	cortical

W3B25	I parallel II angular	I single-negative / upper/ I multi-negative / lower/	I from the striking surface / upper/ I from the side /lower/	I 70°- 60° /upper/ I 90°- 80° /lower/ II 80°- 70° /lower/	I triangular II flat III double-walled	cortical and negative	cortical
W3B17	angular	I single-negative / upper/ I single-negative / lower/ II single-negative / lower/	I from the side /upper/ I from the striking surface / lower/ II from the striking surface / lower/	I 70°- 60° /upper/ I 70°- 60° /lower/ II 70°- 60° /lower/	I flat II double-walled	negative	negative
W3B11	parallel	I single-negative / upper/ I multi-negative / lower/	I from the striking surface / upper/ I multidirectional /lower/	80°- 70° /upper/ 90°- 80° /lower/	I triangular II flat III double-walled	cortical and negative	cortical
W3B20	parallel	I multi-negative / upper/ II single-negative / upper/ I single-negative / lower/ II single-negative / lower/	I from the striking surface / upper/ I from the striking surface / lower/	I 80°- 70° /upper/ II 90°- 80° /upper/ I 80°- 70° /lower II 90°- 80° /lower/	trapezoidal	cortical and negative	negative
W3B198	parallel	I multi-negative / upper/ I single-negative / lower/	I from the striking surface / upper/ I from the striking surface / lower/	I 80°- 70° /upper/ I 90°- 80° /lower/	trapezoidal	negative	cortical

Fig. 1. Block W3B2: single striking platform variant.
Black – cortex; hatched area – thermally damaged surface; red numbers – refitted pieces; black numbers – negatives of removals; arrows – direction of percussion

The first group of these operations, *i.e.* the bifacial shaping of the crested edge (marking the future striking surface), on the narrower side of the nodule, is documented by the negatives Nos. 7-10, and the relatively massive cortical flake (el. 2). This flake, in spite of the function connected strictly with the flaking surface formation, played also a significant role in the procedure of the shaping of the striking platform. It consisted of creating within the limits of the striking surface, or one of the core's sides, the base (a single negative) which would allow the execution of a single, precise blow removing the basal flake and thus forming the a regularly flat, relatively broad striking platform. While analyzing the process of shaping of the crested edge, it is worth mentioning the ad hoc use of the base of the core as the place for a single trimming blow (n. 10). Interesting is that, despite the favorable parameters which potentially would allow the adaptation of the base of the core to play the role of the alternative, opposite striking platform, this possibility was never made use of, and the reduction process was carried on all the time only from one striking platform.

The second phase of the preparation consisted of the exposure of the flaking surface by knapping a series of technical blades. This is illustrated by the refitting of two crested blades (el. 4, 5), and a sequence of negatives Nos. 11-15. They were removed in a way (arrangement and succession) which determined the general cut out of the planned preferential form on the flaking surface (n. 15). The phase of exposing the flaking surface was preceded by knapping a single flake (el. 3), which formed a regular striking platform on the wider end of the nodule (level I).

The end of the operations connected with the core's preparation was marked by the procedure of the shaping of the striking platform (level II). The blow removing a flake (el. 6) was executed somewhat from the left side of the precore/core, slantwise in relation to the axis of the future striking platform which allowed the knapper to obtain an even, uniform platform encompassing the full contour of the core.

The next stage of the core reduction was the detaching of regular blades proper. It is defined by two stages of its generation: predetermination, and the execution of the preferential forms (n. 17). The aim of the first group of the operations mentioned above was the extraction from the contour of the flaking surface the cut out of the future preferential blade. This effect was obtained by the separation along its future edges of the semicortex blades (n. 14, 15), and crested blades (el. 4, 5). The process of generating the preferential form is being closed by the stage of the execution of a blade (n. 16, 17). It seems that in case of the analyzed core the same operation could have been repeated at least twice.

In the third stage, the knapping process changed dramatically. As long as during the stage of the blade detachment proper (stage 2) the effective area of the flaking surface was limited to the narrower side of the core, during the third stage the exploitation axis was moved in the direction of the side plane of the core (n. 18-22). This operation ensured keeping the proper convexity of the striking surface, and detaching the blades without cortex, which would be not possible in the case of holding on to the previous setup of a core, *i.e.*, with the flaking surface limited only to the narrower side of a nodule. As a result of this operation, at the junction of the previous front and side of the core, a "corner" was shaped, creating optimal conditions for the separation of the blades. Of course, the morphological changes correlate with the change in the blades generation concept, *i.e.,* the start of a serial debitage.

In the final phase of the stage 3, the process of core reduction became broken down because of the subsequent mistakes committed by the flint knapper. This is illustrated by a series of hinged negatives (n. 19-22), which are the traces of unsuccessful execution of serial forms. Even though the knapper tried to repair the core, his efforts made the situation worse and worse, leading to him finishing attempts at its further exploitation and to discard it as an already useless piece. These operation are illustrated by the refittings (el. 7-9), and negatives (21-23).

The conducted analysis allows us to draw the following conclusions:

a. Block W3B2 represents almost complete record of the sequence of operations connected with the reduction of a core;

b. The exploitation was carried on with the use of exclusively one striking platform;

c. The main technological axis is defined by a concept of the production of the preferential blades with the parallel run of the edges in their proximal and mesial segments, but converging rapidly in their distal parts, creating in that way a regular sharp pointed tip;

d. The effectiveness of such a process was limited to just one or two predetermined forms meeting the morphological demands described above; Furthermore, a numerous group of (predetermining) technical waste forms was generated.

e. The indirect evidence that the described preferential forms met the expected morphometric standards is a lack of these elements in the refitted block.

The main links of the operation chain reconstructed in course of the analysis of block W3B2 are defined by three groups of operations designating the succeeding stages of reduction.

Stage 0 was giving the nodule more regular shape, which enfolds a series of blows leading to the removal of the knobby or finger shaped protuberances characteristic of the nodules of the cretaceous flint of north-eastern variety (Szymczak 1992).

Stage 1 was just a preparation limited to the zone of future striking platform and future striking surface. Within this stage we have distinguished:

a. the phase of configuration of the future flaking surface – which resulted in forming a bifacial crest on the narrower side of the nodule;

b. the phase of exploitation of the flaking surface – which started with the detaching of a series of crested blades, and the blades next to the crested blades to form a narrow flaking surface with parallel blade negatives and the isolated zone ready to detach the preferential form from it.

The operation which divides those two phases was preparing the striking platform (level I) where as the base for a final blow, the surface of one of the crested blades' negatives was used. The finale of the stage of primary preparation was marked by the detaching of the rejuvenation blade defining ultimately the level (II) and the parameters of the core.

Stage 2 was the process of detaching blades, and consists of:

a. a phase of predetermination of the preferential blades (configuration phase) consisting in the isolation on the flaking surface of the outline of the planned form. It was achieved by the detachment from both sides of the flaking surface the blades next to the crested blades, or subcortical blades.

b. phase of execution of the preferential blades which were the primal aim of the core's processing.

Stage 3 is described as the serial debitage and is defined by the process of the gradual broadening of the flaking surface in the direction of one of the raw sides of a core. As a result, the flaking surface has a specific, two-sided form where one side covers the surface of the primal striking surface, while the second – a fragment of the core's side. The blades are detached from the corner formed in that way.

The concept of preferential blades' production in the double striking platform variant. Case study of block W3B8

Block W3B8 of the dimensions 96/37/69 mm (Fig. 2) presents the refitting of eleven elements representing a nearly complete record of the reduction of the core (el. 1) with a narrow, well prepared striking surface, and flat, cortical or natural (patinated) surfaces of the sides and back.

The first of the reconstructed stages is the primary preparation including two phases. The first one was limited just to forming the upper striking platform (level I) (n.1) with

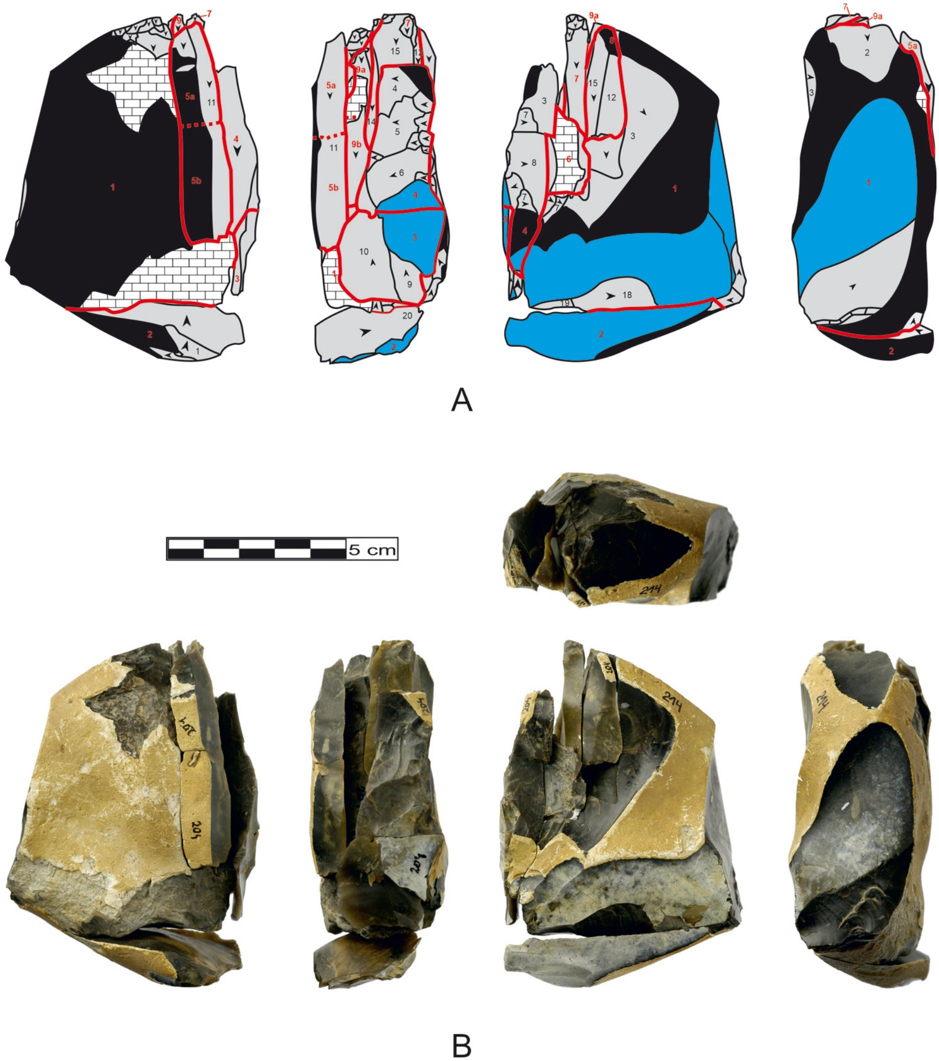

Fig. 2. Block W3B8: double striking platform variant. Black – cortex; blue – patinated surface, hatched area – thermally damaged surface; red numbers – refitted pieces; black numbers – order of removals; arrows – direction of percussion; red line – plane connection (negative object to positive object); red dotted line – connection fractures (broken pieces)

a single blow directed from the side of striking surface, and the lower striking platform with a blow from the core's side (level I) (e. 2) where as a base the surface of the especially designed negative (2) was used. It is worth emphasizing that the analogous operation was reconstructed in the case of the refitting W3B2. The second stage is determined by the operation of preparing the striking surface, and consists of:

a. the phase of configuration of the future striking surface, *i.e.* the bifacial crested edge (n. 3-8) on the narrower side of the nodule;

b. the phase of exposing of the striking surface, from which a series of crested blades (n. 9, 10; e, 4), the blades next to crested blades (e. 3, n. 11, 12), and subcortical blades (e. 5a, b) was detached.

It should be mentioned that the phase of exposing the flaking surface in its initial moment was realized based on the parallel exploitation of both opposite striking platforms. Nonetheless, together with the continuation of the reduction process, the role of the lower striking platform gradually diminished, till the moment when in the terminal phase of the preparation the whole set of operations connected with the process of exposing the flaking surface was taken over exclusively by the upper striking platform.

The second stage of the reduction of block W3B8 is defined by the process of generating the preferential blades (n. 11-14, e. 7, 9a, b). As in the case of block W3B2, it has a two phase course. The phase of configuration is illustrated by the detachment of two predetermining forms (e. 5a, b, 6) which resulted in forming in the central part of the flaking surface a clearly separated zone of isolation of the preferential blades (n. 14).

In the third stage, the concept of blades generating was being modified and takes a character of the serial exploitation, *i.e.* where the execution of one form (e. 7) was integrated with operation of configuration of the next one (n. 15-17, e. 8, 9a, b). This process was carried out within the existing striking surface. In this aspect it differs from the stage of terminal blades' detachment reconstructed in the context of block W3B8. Yet, the common element for both variants is the way of the blows' localization, making it possible to isolate a certain part of the flaking surface restricting the place of the execution of the next blade.

Core reduction ends with the correction of the lower striking platform (level II) (n. 18-20). Most likely this was done to use it to remove the hinges on the striking surface.

Summarizing the information gained in the course of the analysis of block W3B8, special attention should be paid to the following facts:

a. The high degree of the core's reconstruction makes it possible to characterize in detail the process of its reduction.

b. It provides an example of realizing the single striking platform intention of reduction but based on the double striking platform architecture of the core. From this perspective, the property of having two opposite striking platforms has a purely formal character. In the technological context the exploitation process bears all the attributes of the single striking platform concept. The active using of the lower striking platform was connected exclusively with the most initial stage of the striking surface's preparation, and was limited to just 3-4 blows; the remaining part of the reconstructed technical operations was realized on the base of the upper striking platform. This is reflected in the unidirectional arrangement of the negatives on the striking surface, as well as in the refittings of the detached blades.

c. The main technological axis is being defined by the concept of the production of the preferential blades, *i.e.* the forms with parallel edges in their proximal and mesial parts, but converging rapidly in the distal part creating a sharp, pointed tip.

d. The effectiveness of these operations was limited to gaining 2-3 preferential forms. In addition, a few pieces of technical waste forms were also generated.

The individual links of the operation chain which were reconstructed in course of the analyses could be generalized in the following stages:

Stage 1 – initial preparation, comprising:

a. the exposure of the upper and lower striking platform performed in the single-phase variant,

b. preparation of the flaking surface performed in two-phase variant.

Stage 2 – the blades' detaching proper, comprising the two-phase process of predetermination and execution of the preferential forms;

Stage 3 – terminal blades' detachment based on the serial debitage concept.

DISCUSSION

The results of the conducted analysis of the cores point to a number of the multilevel similarities in the manner of their reduction. The analogous features are:

a. The aim of debitage which was the gaining of the single preferential blades, *i.e.* the massive forms of rectangular shapes and with parallel side edges and internegative scars, together with the relatively wide apices.

b. The process of core reduction (the method), which means a strictly defined sequence of technical operations (Table 1).

c. Morphological parameters of the negative and positive forms (Bradley and Giria 1996), in other words – the effects and products of debitage (Table 2).

The fundamental axis of the discussed strategy was determined by the quest of the proper isolation (convexity) of the blade on the striking surface, and preservation of the parallel run of its side edges. In technological aspect this was the superior aim determining the character of the certain technical operations, as well as the morphometric parameters of the core. The conducted analysis have shown that the effect of isolation could be obtained in three different ways:

a. by exposing on both sides of the flaking surface a pair of deep and wide negatives which resulted in shaping in the central part of the well pronounced hump, *e.g.* W3B20 (Fig. 8), W3B21 (Fig. 4), W3B31 (Fig. 5), W3B198 (Fig. 10), W3B13 (Fig. 11:1);

b. by the gradual separation of the isolation zone with the help of knapping off a number of fine blades and bladelets *e.g.* W3B2 (Fig. 1), W3B26 (Fig. 11: 3);

c. by moving the field of the flaking surface towards the side of the core, in a way that shaped it into a two sided form (double-walled), and in such a situation, the blade was

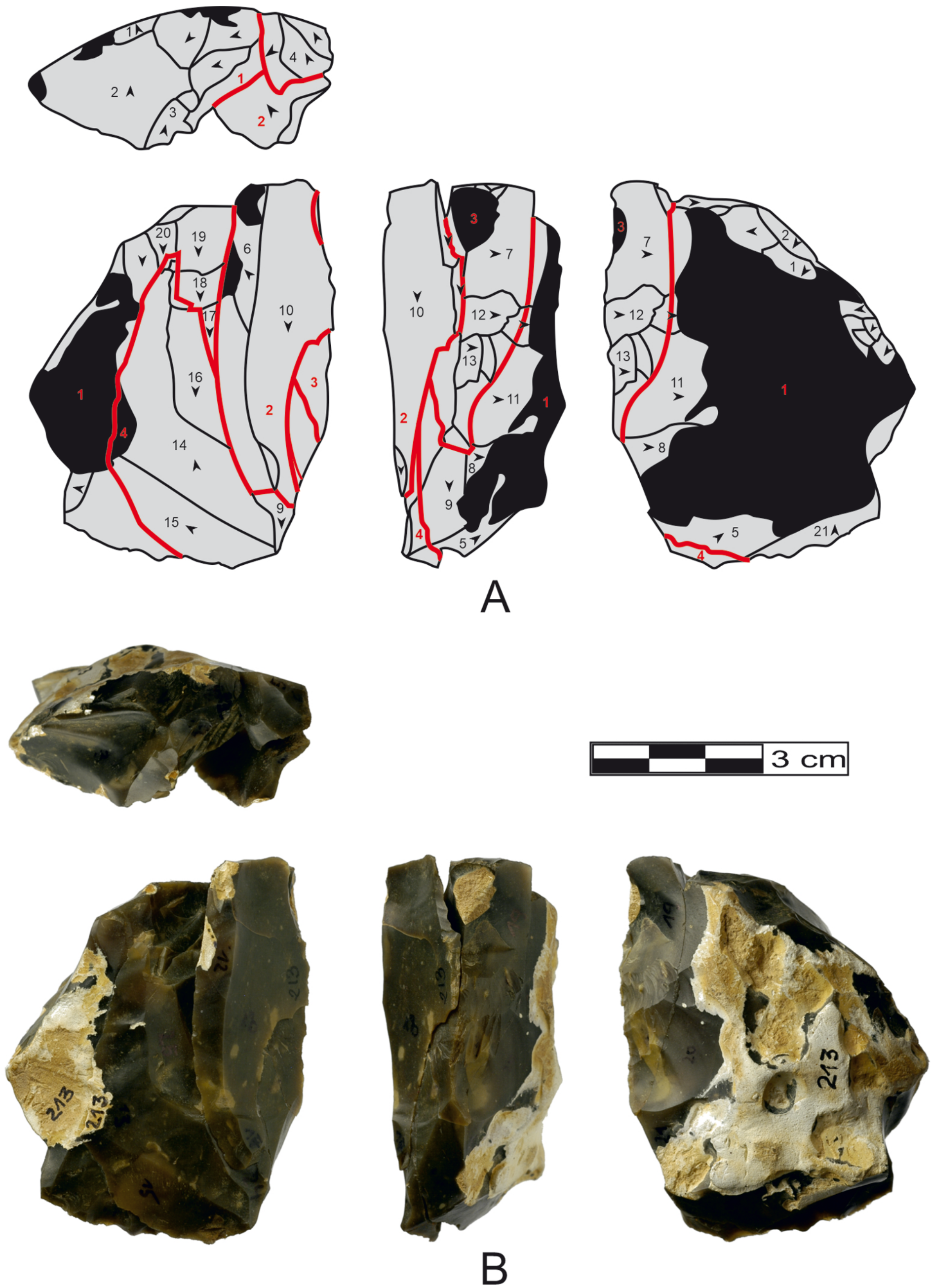

Fig. 3. Block W3B3: single striking platform variant. Black – cortex; red numbers – refitted pieces; red line – plane connection of the pieces (negative to positive); red dotted line – connection fractures (broken pieces); black numbers – order of removals; arrows – direction of percussion

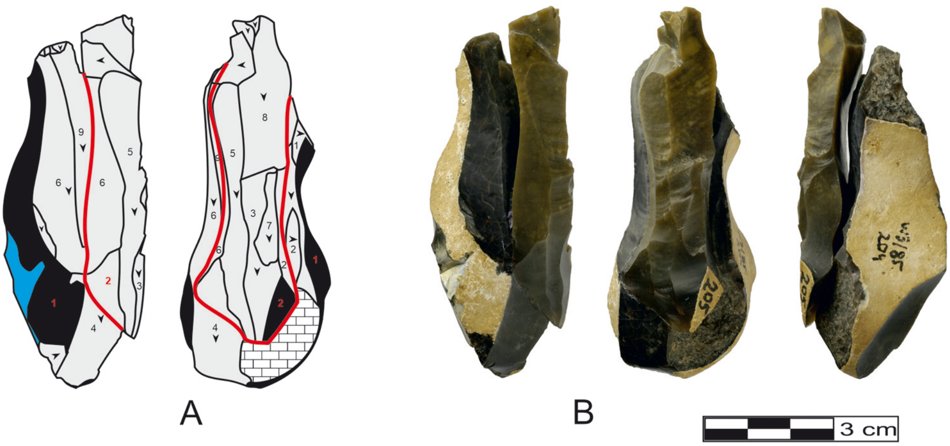

Fig. 4. Block W3B21: single striking platform variant. Black – cortex; blue – patinated surface; hatched area – thermally damaged surface; red numbers – refitted pieces; black numbers – order of removals; arrows – direction of percussion

detached along the corner which was created in the course of this operation. This is perfectly illustrated by blocks W3B11 (Fig. 6), W3B17 (Fig. 7), W3B25 (Fig. 9) and W3B29 (Fig. 11: 2).

The procedures described above undoubtedly have the character of predetermining operations that allow controlling the parameters such as thickness, width, and the course of the side edges of the planned blade. This would mean that the debitage products that were generated in the course of realizing this could be divided to the technical (predetermining) forms, and the preferential (predetermined) ones. This division reflects directly the two subsequent stages connected with the process of generating a preferential form, *i.e.* the phase of isolating the side edges (Fig. 12: 1D, 2B), and the phase of execution (Fig. 12: 2A, C). It should be noted that the convexity shaping process often took place at the stage of flaking surface preparation (exposure phase) (Table 1).

The earliest stage (Fig. 12: 2) of detaching blades was connected with the procedure of generating the preferential form based on the operation of exposition and drawing back of the sides of the flaking surface by detaching massive crested or semicortex blades along both its edges (Figs 4, 5, 8, 11: 1, 3, 4). At that moment, all the operations connected with the process of detachment of blades were strictly limited to the exact striking surface, *i.e.* the zone that was already shaped during the stage of the primary preparation. In another variant, the process of isolating the preferential form was realized by knapping off a series of fine, highly morphologically differentiated blades or bladelets.

In the third stage (Fig. 12: 3), the stadial debitage procedure breaks down in favour of serial debitage. This is related to the loss of the horizontal convexity of the flaking surface

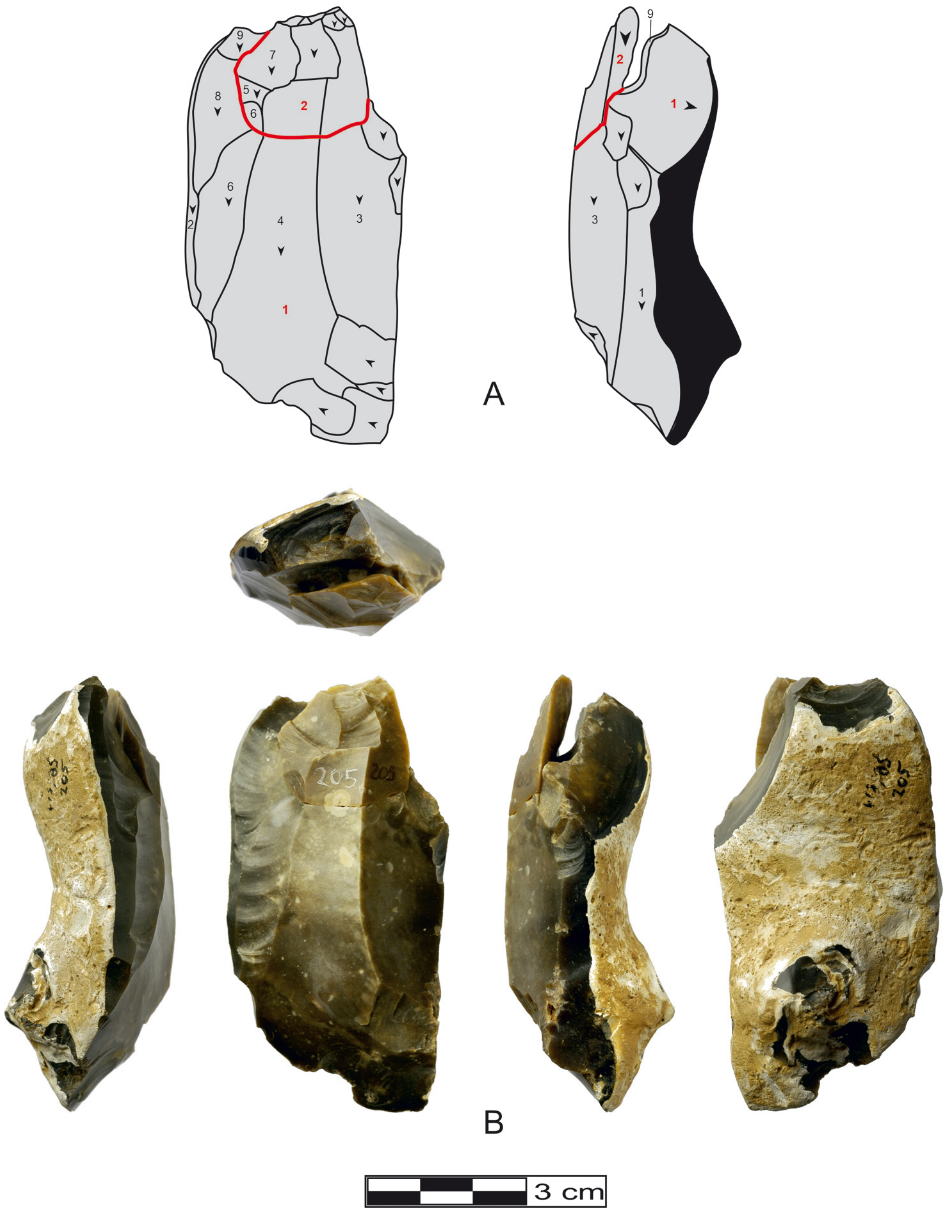

Fig. 5. Block W3B31: single striking platform variant. Black – cortex; red numbers – refitted pieces; black numbers – order of removals; arrows – direction of percussion

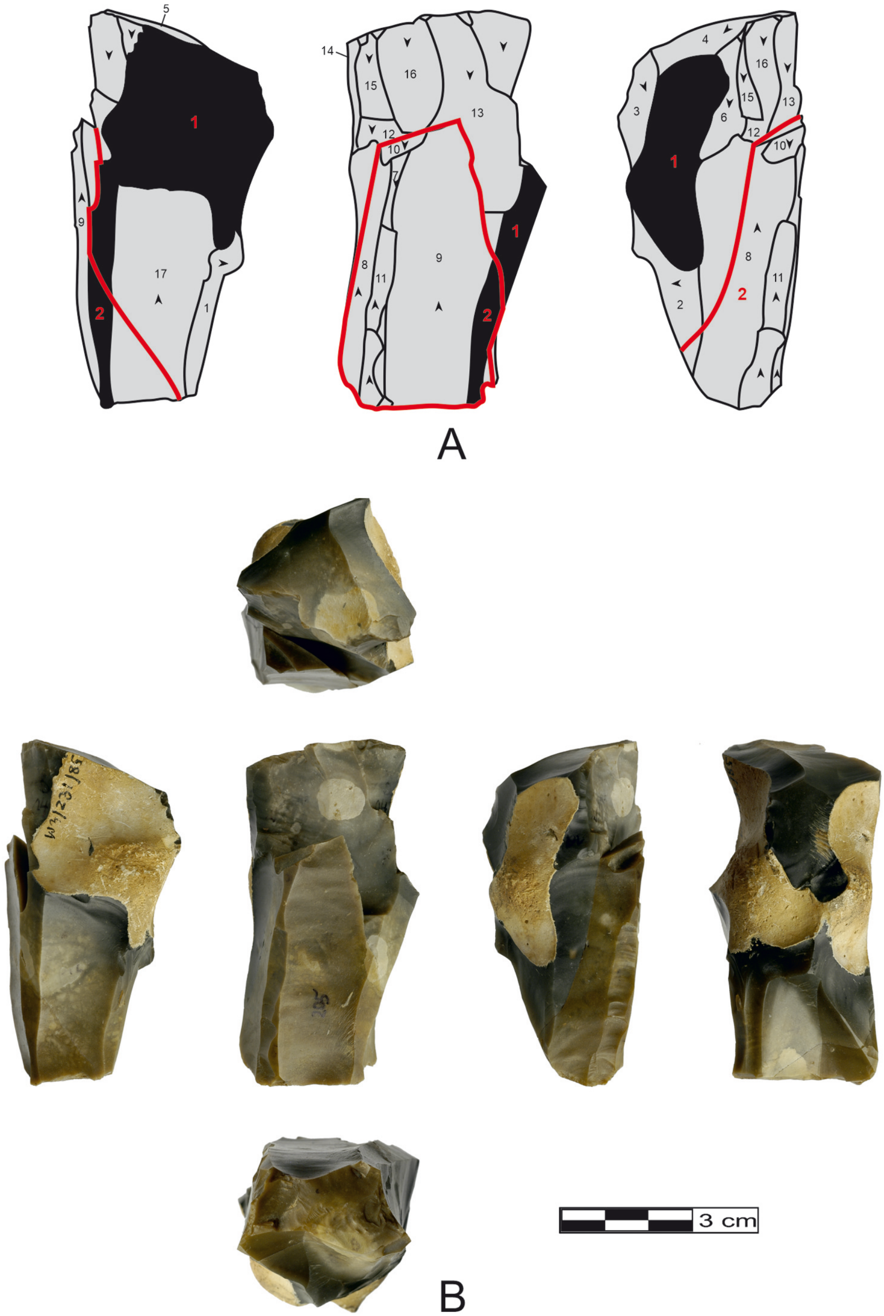

Fig. 6. Block W3B11: double striking platform variant. Black – cortex; red numbers – refitted pieces; black numbers – order of removals; arrows – direction of percussion

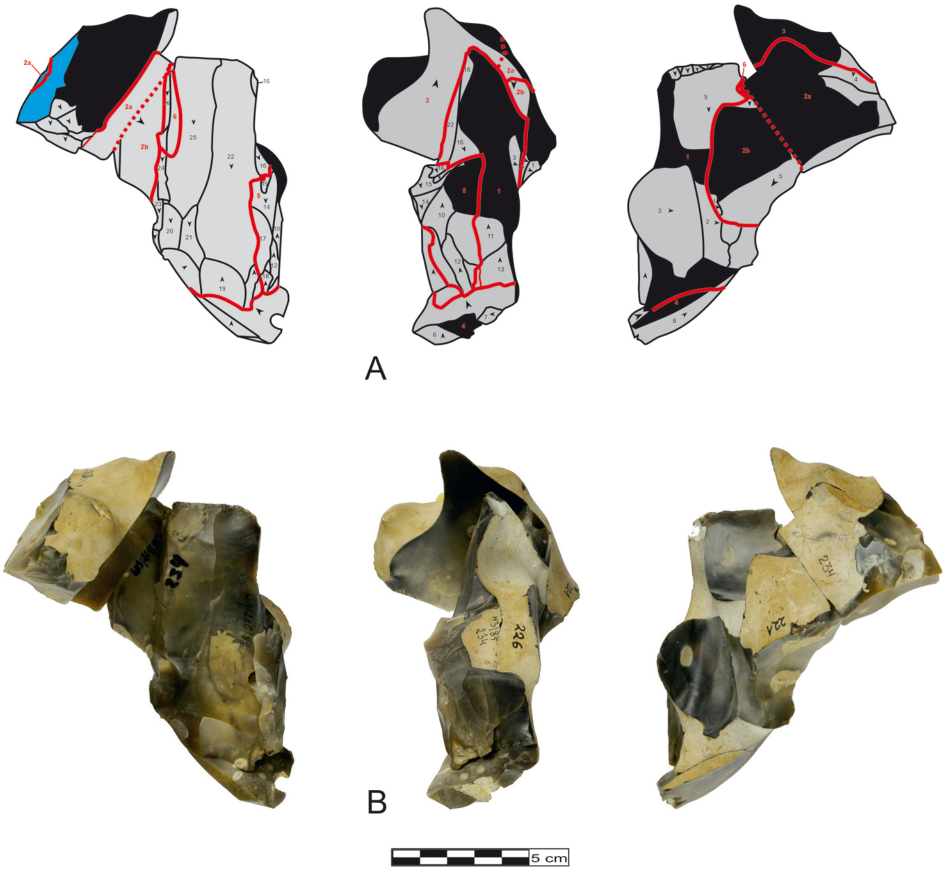

Fig. 7. Block W3B17: double striking platform variant. Black – cortex; blue – patinated surface; red numbers – refitted pieces; black numbers – order of removals; arrows – direction of percussion; red line – plane connection (ventral and dorsal sides); red dotted line – connection fractures (broken pieces)

that until then had a triangular or trapezoidal shape. This impasse was solved by shifting the flaking surface to one of the sides of the core. The result of this operation is the characteristic form of 'the new one'. Serial blades were detached along the corner (Figs 6, 7, 9, 11: 2).

Summing up the results of the study on the refits, it should not be missed that the process of the proper blades' detachment was preceded by one or two separate phases. The first, described as regularization of the raw material (Fig. 12: 0), is illustrated by the deep negatives of the oval outline which are the effect of knocking off the finger like or knobby protrusions. It seems that the 'planes' obtained in that way could also serve as the basal surfaces to execute the most initial blows of the preparation character.

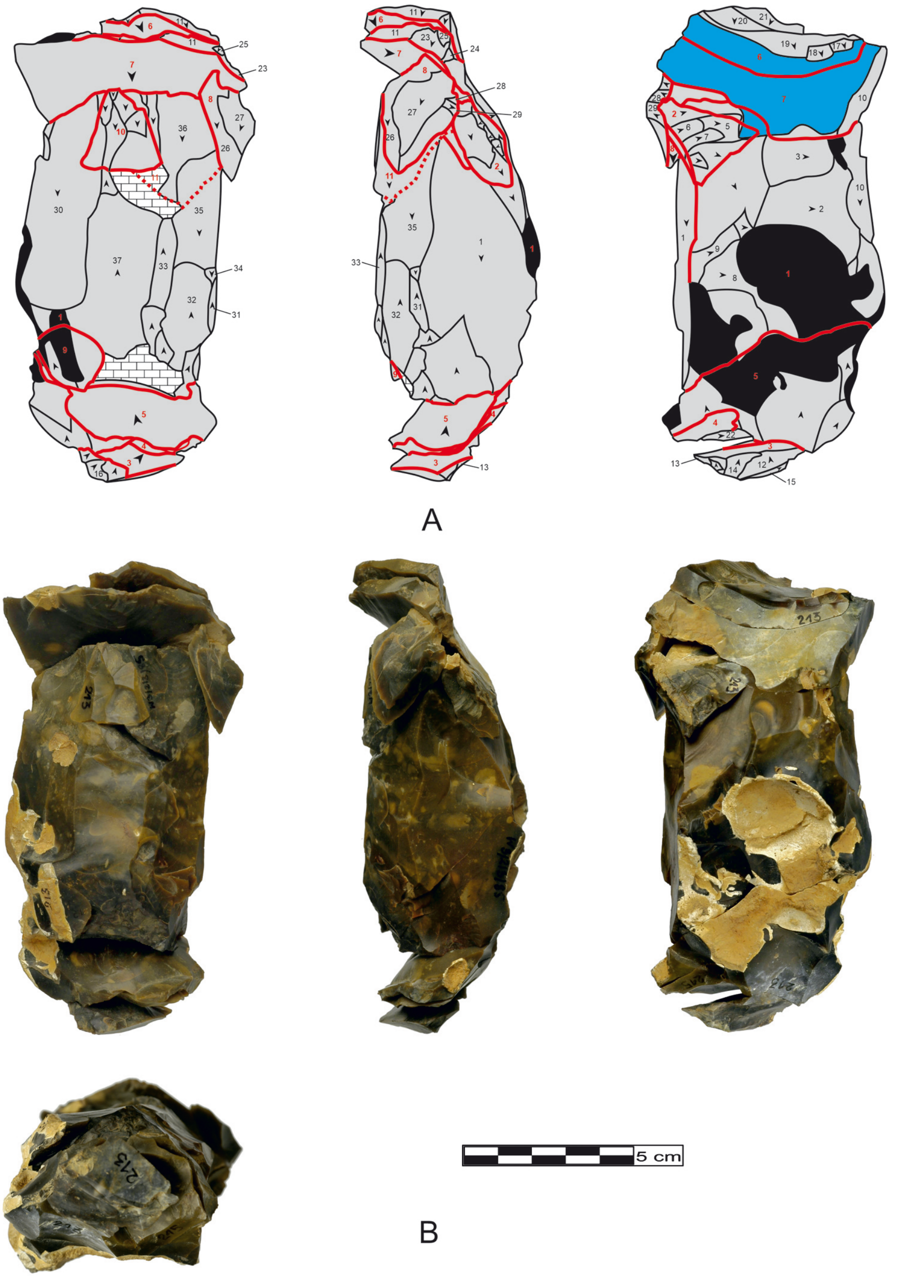

Fig. 8. Block W3B20: double striking platform variant. Black – cortex; blue – patinated surface; hatched area – thermally damaged surface; red numbers – refitted pieces; black numbers – order of removals; arrows – direction of percussion; red line – plane connection (negative object to positive object); red dotted line – connection fractures (broken pieces)

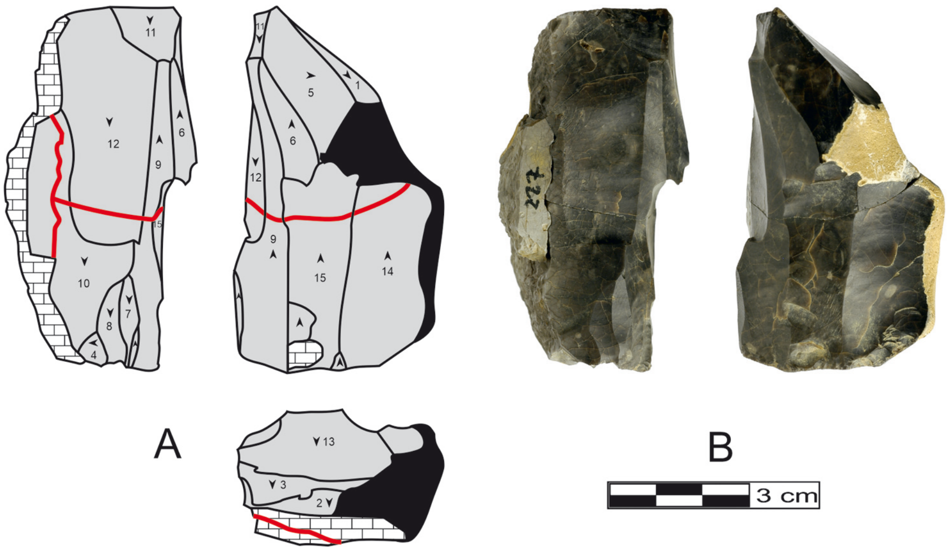

Fig. 9. Block W3B25: double striking platform variant. Black – cortex; hatched area – thermally damaged surface; red numbers – refitted pieces; black numbers – order of removals; arrows – direction of percussion

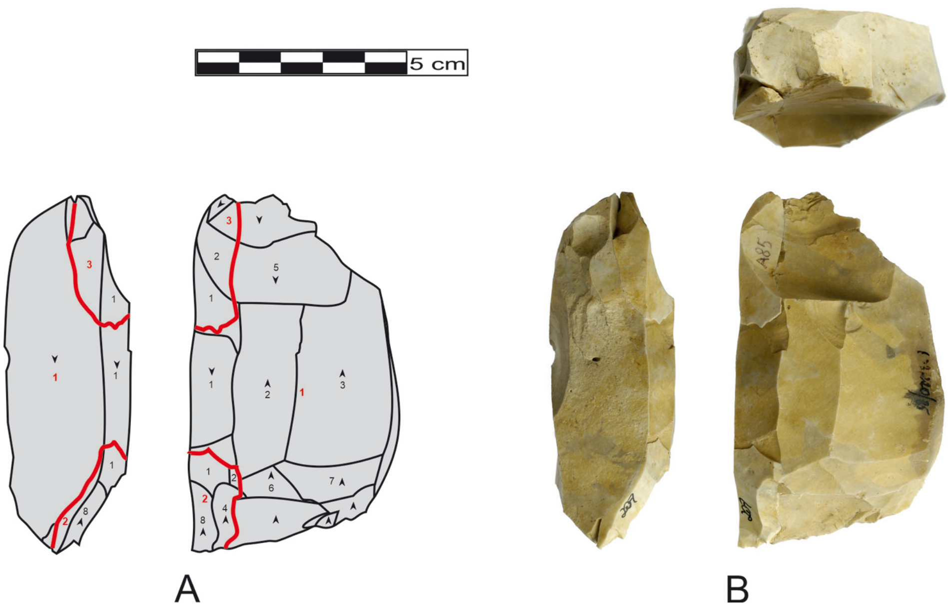

Fig. 10. Block W3B198: double striking platform variant. Black – cortex; red numbers – refitted pieces; black numbers – order of removals; arrows – direction of percussion

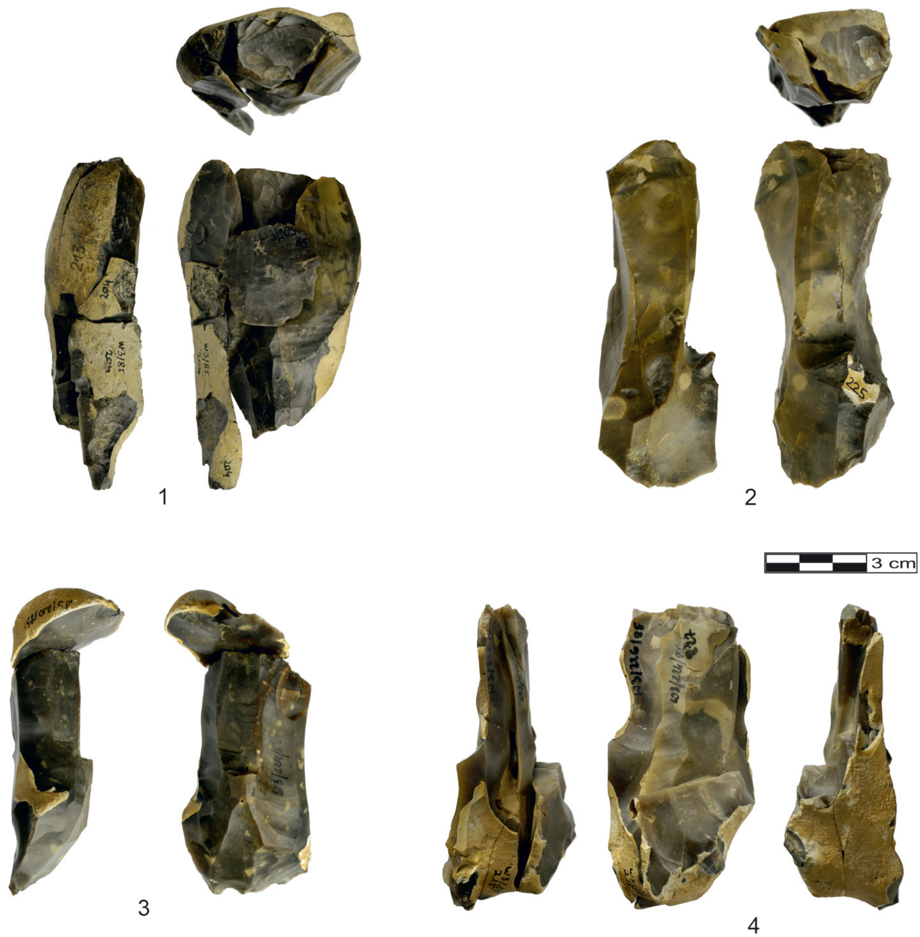

Fig. 11. Selected examples of refittings from the site Wołkusz 3: 1. Block W3B13 – double striking platform variant; 2. Block W3B26 – double striking platform variant; 3. Block W3B29 – double striking platform variant; 4. Block W3B170 – refittings of massive blades (cortex- and semicortex)

The second (Fig. 12: 1) is the initial preparation of the core. Even though it was realized with the use of the relatively simple means, and being spatially limited to the zones of (future) striking platform (s) and (future) striking surfaces, it is characterized by the presence of specific operations that analysis of all the blocks showed were being repeated. The first group of these operations is determined by the two-phase process of the preparation of the striking platform consisting of:

a. Operation of shaping of the bifacial crested edge (future striking surface) compassing the whole, or only a fragment of future flaking surface (Fig. 1: A) As the second of these

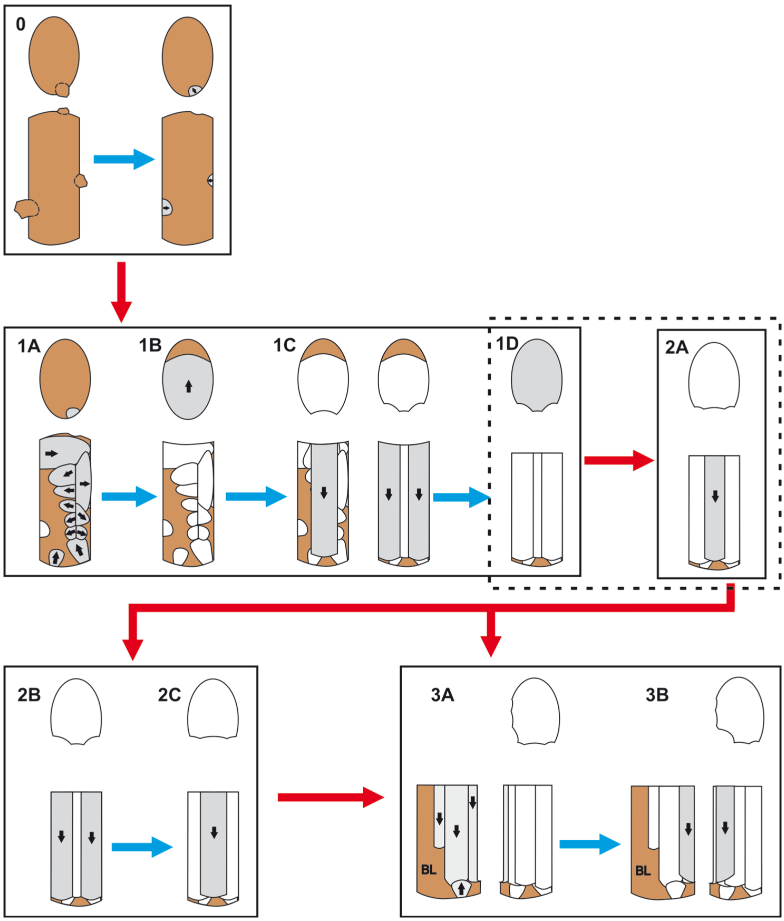

Fig. 12. Idealized scheme of the realization of the concept of the preferential blades' production: Stage 0 – regularization. Stage 1 – preparation of the striking platforms, flaking surface and optionally also side/s/ or back of the core: 1A configuration of the future striking surface; 1B exposing of the striking platform (level I); 1C exposing of the striking surface, optionally integrated with the isolation of the side edges of the preferential blade; 1D exposing the striking platform (level II). Stage 2 – the proper blades' detachment: 2A the phase of executing the first preferential blade; 2B the phase of isolating the side edges of the subsequent blade; 2C the phase of executing the second preferential blade. Stage 3 – the serial debitage detaching (the flaking surface takes a two sided-form)

variants is concerned, the exposure of the remaining part of the flaking surface was realized by the detaching of the series of cortical and subcortical technical forms.

b. Operation of removing the crested blades, and the blades next to crested blades (Fig. 1: C), often already at that point resulting in forming in the central part of the flaking surface the zone of isolating of the preferential form (Fig. 1: D).

The element to separate these two phases was an operation of forming the future striking platform (Fig. 1: B). A surface of one of the negatives after detaching a crested blade served as the base for the final blow. In that way, the optimal conditions to execute the successful blow forming the plane of the striking platform were attained. The last phase of the preparation was usually determined by the operation of detaching the basal technical flake which defines the final level of the striking platform.

The groups of technological operations discussed above find their reflection in the certain ensemble of the morphometric attributes of the products of debitage, in that number the core forms, which are the most interesting for us (Table 2). However, it should be underlined that these attributes are not equally readable which is due to the fact that the concept of preferential blades' production in the Wołkusz 3 site was realized in three different variants with the use of flint nodules of various dimensions, shapes and quality (*e.g.*, nodules strongly cryogenically cracked), and by two different flint knappers representing different level of skills.

In spite of the factors mentioned above make it difficult to define a universal recipe of the core treatment, yet a group of features exists the coexistence of which could be linked with the described technological strategy. These are:

a. Distinctive for the initial phase of the blades' detachment (stage 2), the trapezoidal horizontal convexity of the striking surface, with the clearly distinguished in its central part, of the zone of isolation of the preferential blade, together with the winged back side negatives (Fig. 12: 2). In the terminal stage of blades' detaching the flaking surface becomes flat and sometimes becomes collapsed when it takes a two-sided form (stage 3) (Fig. 12: 3)

b. The dominating, unidirectional, always parallel arrangement of the negatives on the striking surface.

c. The relatively small (usually 3-4) number of the negatives; instead, they are wide and relatively deep, and their length is equal, or only a bit shorter than, the whole length of the striking surface.

d. The back, together with the cortical sides, basically not bearing traces of preparation; the eventual protrusion is regulated by the single blows of *ad hoc* character.

CONCLUSIONS

Based on the technological analysis of the material from the site Wołkusz 3, two different, though linked by a common denominator of technological strategies. were recognized:

a. The one already described in an earlier paper (Przeździecki 2019), that is the concept of the preferential points' production, *i.e.* of single, relatively massive forms of a strictly determined (laurel leaf shaped) form, localized along the axis of symmetry, sharp tip, wedge like profile, and relatively short proportions;

b. The main subject of this article – the concept of the preferential blades' production, *i.e.* slim, though quite massive (thick and wide) forms of the more less rectangular shape.

Their common denominator, which at the same time is the cardinal attribute of the technological characteristics of the inventory, was the idea of the isolation of the cut out of the planned preferential forms (blades or points) on the area of the striking surface. In the case of both concepts, the process of generating the preferential form had a strictly determined multistage (two – or four phase) course with the clear division into:

a. the predetermining group of operations; and

b. the final operation described as the execution of the half product.

What is especially important, the reconstructed sequences of the operations could be connected with the certain set of morphological attributes of the cores and the debitage products.

References

Bar-Yosef O. and Van Peer P. 2009. The chaîne opératoire approach in Middle Paleolithic archaeology. *Current Anthropology* 50/1, 103-131.

Bradley B. A. and Giria Y. 1996. Concepts of the technological analysis of flaked stone: a case study from the High Arctic. *Lithic Technology* 21/1, 23-39.

Cziesla E. 1990. *On refiting of stone artefacts*. In E. Cziesla, S. Eickhoff, N. Arts and D. Winter (eds), *The big puzzle: international symposium on refitting stone artefacts, Monrepos, 1987. Studies in Modern Archaeology* 1. Bonn: Holos Verlag, 9-45.

Dziewanowski M. 2006. Flint Assemblage Dręstwo 37. A Preliminary Analysis of Predetermined Swiderian Debitage. In A. Wiśniewski, T. Płonka and J. M. Burdukiewicz (eds), *The Stone: Technique and Technology*. Wrocław: Instytut Archeologii Uniwersytetu Wrocławskiego, SKAM Stowarzyszenie Krzemieniarskie, 149-166.

Dziewanowski M. 2012. On the Classification of By-Products of the Reduction for Blades – Some Aspects of Technology in Swiderian Assemblages. *Światowit* 9, 223-233.

Ivanovaitë L., Serwatka K., Hoggard Ch. S., Sauer F. and Riede F. 2019. All these Fantastic Cultures? Research History and Regionalization in the Late Palaeolithic Tanged Point Cultures of Eastern Europe. *European Journal of Archaeology* 23/2, 162-185.

Kobusiewicz M. 2009. Czy istniała kultura Bromme? *Folia Praehistorica Posnaniensia* 15, 75-91.

Migal W. 2007. On Preferential Points of the Final Paleolithic in the Central European Lowland. In M. Kobusiewicz and J. Kabaciński (eds), *Studies in the Final Paleolithic Settlement of the Great European Plain*. Poznań: Institute of Archaeology and Ethnology, Polish Academy of Sciences, Poznań Prehistoric Society, 185-200.

Przeździecki 2019. Technological Study of Lithic Materials from Site Wołkusz 3 in North-Eastern Poland. Concept of Preferential Point Production. *Archeologia Polski* 64, 39-70.

Sulgostowska Z. 1989. *Prahistoria międzyrzecza Wisły, Niemna i Dniestru*. Warszawa: Państwowe Wydawnictwo Naukowe.

Szymczak K. 1995. *Epoka kamienia Polski północno-wschodniej na tle środkowoeuropejskim*. Warszawa: Wydawnictwa Fundacji „Historia pro futuro".

Szymczak K. 1999. Late Palaeolithic cultural units with tanged points in North Eastern Poland. In S. K. Kozłowski, J. Gurba and L. L. Zaliznyak (eds), *Tanged points cultures in Europe. Read at the international archaeological symposium, Lublin, September, 13-16, 1993* (= *Lubelskie Materiały Archeologiczne* 13). Lublin: Maria Curie-Skłodowska University Press, 93-101.

Taute W. 1968. *Die Stielspitzen-Gruppen im nördlichen Mitteleuropa: ein Beitrag zur Kenntnis der späten Altsteinzeit* (= *Fundamenta* A/5). Köln, Graz: Böhlau.