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BACKED BLADELET PRODUCTION AMONG MAGDALENIAN GROUPS IN SOUTH-EASTERN POLAND – SELECTED EXAMPLES

ABSTRACT

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In the presented article, we attempted to interpret Magdalenian backed bladelets in terms of recognizing the methods of their production. For this purpose, we studied the microblade technology, the intentional fracturing of blanks using specific procedures, including the microburin technique, and retouching. We applied typological, morphometrical, and morphological studies. We based our conclusions on the results of technological studies of 154 artefacts – backed bladelets and microburins, coming from three sites – Ćmielów 95 "Mały Gawroniec", Podgrodzie 16, and Maszycka Cave. As a result, we obtained preliminary data on the final stages of the *chaîne opératoire* in the production of backed bladelets.

Keywords: backed bladelets, lithic technology, microburin technique, Magdalenian, south-eastern Poland, morphometric analysis
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INTRODUCTION

In the last decade, numerous publications on the Magdalenian blade technology and the lithic tools manufacture in Poland have been published (*e.g.*, Schild *et al.* 2011, 101-125; Połtowicz-Bobak 2013; 2016; Schild 2014; Wiśniewski T. 2015; Przeździecki and Migal eds 2020; Wiśniewski A. *et al.* 2020). Most of them well document the individual stages of the *chaîne opératoire* related to the production and usage of flint tools. However, still, not enough attention has been paid to the process of the production of backed bladelets. This article aims to analyse the methods of forming backed bladelets, including, in particular, the presence of the microburin technique in the Magdalenian.

In this article, we have attempted to analyse the production of backed bladelets among the Magdalenian groups that existed in south-eastern Poland in the final stages of the Upper Palaeolithic. We have focused on the studies related to methods of fracturing lithic bladelets – microburin technique and segmentation. In addition, we have tried to determine whether the microburin technique was associated with the microlithization of blade production. For this purpose, we have analysed selected materials from the archaeological sites: Ćmielów 95 „Mały Gawroniec", Podgrodzie 16, and Maszycka Cave. In this work, we applied typological, morphometrical, as well as morphological analysis to achieve the goal. The inspiration for our studies was the article published by the jubilarian of this volume, Professor Jerzy Libera (Libera and Migal 2009).

THE PHENOMENON OF MICROBLADE TECHNOLOGY IN THE UPPER PALAEOLITHIC IN POLAND

The Upper Palaeolithic societies that inhabited the areas of today's Poland, based their blank production on blade technology. There was often a specific dichotomy of production within it. This consisted of the production of both large blades and bladelets. The first of them focused on obtaining macrolithic blades, which were processed into formal tools such as end-scrapers, burins, perforators. The second is related to the production of blades from small cores. This method, which in terms of size products can be described as microlithic, was used to produce segments. The division into two metrically differentiated blade technologies has already been noted among the Aurignacian groups (see *e.g.*, Krukowski 1939-1948; Chmielewski 1975; Sachse-Kozłowska and Kozłowski S.K. 1975; Sachse-Kozłowska 1978; 1982, Kozłowski J.K. 2000; Jarosińska 2006, Wilczyński 2016), then it appeared in the Gravettian (see *e.g.*, Wilczyński 2007; 2015; 2016a; 2016b; Wilczyński and Wojtal 2011, Wilczyński *et al.* 2015a, Płonka and Wiśniewski A. 2006; Wiśniewski A. *et al.* 2015). This phenomenon should probably be associated with a new type of composite tools in which small lithic elements were put in the hafts to comprise the working edge of the tools (*e.g.*, Bosinski 1989; 2010, Pétillon *et al.* 2011; Tomasso *et al.* 2018; Roux *et al.* 2020).

This solution should probably be related, among other things, to the properties of flint raw material, which is brittle and easily blunted when working in harder materials. To maintain its "sharpness", its edge should be renewed. The sharpest fracture is achieved among lithic blanks without being retouched. In order to obtain and maintain such a tool edge, a continuous exchange of inserts is required. Alternatively, there is a possibility of renewing the edge, such procedures are known from bifacial technologies, *e.g.* by resharpening Prądnik knives with tranchet blow. However, in the blade technologies that occurred in the Upper Palaeolithic, the inserts were most likely replaced with new ones when they were worn out and flint raw material was available. The small size of the blanks does not require a good quality raw material base, which additionally favors the adaptation and dissemination of the technology related to composite tools. The drawback of this type of product is certainly the need to standardize the flint inserts, which must be similar in size and relatively straight. Obtaining this type of small blade could be carried out with the use of various debitage techniques, but the production of inserts and segmentation process itself assumed getting rid of parts of the blanks that were too curved or thick. There were several ways to separate these types of unnecessary blade parts. This could have been done by successive retouching, the microburin technique (*e.g.*, Krukowski 1914; Ginter and Kozłowski 1990, 62, 63, 204, 205; Inizan *et al.* 1999, 82-84; Kozłowski 2009), or by percussion directed precisely at blanks lying on a pad (*e.g.*, Rankama, Kankaanpää 2011; Sørensen 2017). Of these three methods, the microburin technique is the only one that leaves characteristic waste products (see *e.g.*, Inizan *et al.* 1999, 82-84). One of the first publications describing the mentioned procedure was an article by Stefan Krukowski (1914), thanks to which the microburin technique has been relatively well known in Polish literature for years.

THE PHENOMENON OF MICROBLADE TECHNOLOGY IN THE MAGDALENIAN IN POLAND

The Magdalenian groups in Poland are known both from open and cave sites. Their main occupation started during the Oldest Dryas, and the youngest traces of settlement are dated to the Allerød (Kozłowski S.K. *et al.* 1993; Kozłowski S.K. and Pettitt 2001, Ginter and Połtowicz 2007, Połtowicz 2006; 2007, Połtowicz-Bobak 2009a; 2009b; 2013; 2016, Sobkowiak-Tabaka 2011; Kozłowski *et al.* 2012; Wiśniewski *et al.* 2012; Bobak, Połtowicz-Bobak 2014; Schild 2014, Maier 2015; Wiśniewski T. 2015; Bobak *et al.* 2017; Wiśniewski A. *et al.* 2017; Przeździecki and Migal eds 2020). In the group of formal tools, apart from macrolithic examples (end-scrapers, burins, perforator, etc.), were tool forms produced from small blanks obtained from specially prepared cores (see *e.g.*, Libera and Migal 2009; Wiśniewski T. 2015, 48; Migal *et al.* 2020; Przeździecki 2020, 92). Blade production in this concept was associated with other debitage methods and techniques. In the case of obtaining large blades, organic hammers were used, and a characteristic procedure for the striking platform was applied (*en éperon*). However, small blades were produced without the use of this procedure. Among various lithic inventories (mentioned in the text), we also observe the use of other debitage techniques in both technological groups. In the case of large blades, direct percussion with a soft organic hammer was dominant. In turn, small blades were obtained mainly with the use of soft stone hammers (at the same time, we do not rule out that some of the bladelets could have been obtained using a soft hammer made of another raw material). These data are confirmed by microscopic analysis of the butts of blades and bladelets and the striking platforms of cores (Pyżewicz 2015a; 2015b; 2020). Additionally, based on microscopic analysis, we know that formal tools from Ćmielów, Podgrodzie (Pyżewicz 2015a; Pyżewicz 2020), Klementowice-Kolonia (Pyżewicz 2015b), and Sowin (Wiśniewski A. *et al.* 2020), obtained both from large and small blades were retouched using stone retouchers. The small semi-products were divided into segments using the microburin technique. As a result of its application, the distal and proximal parts of blades were detached, leaving a straight and regular middle section. The remains of this procedure are known from Polish Magdalenian sites, *e.g.* Dzierżysław (Ginter *et al.* 2002; 2005), Wilczyce (Królik 2014), Podgrodzie (Pyżewicz *et al.* 2014), Klementowice-Kolonia (Wiśniewski T. 2015), and Ćmielów (Przeździecki 2020). The microburin technique itself could also be used in a slightly different way. One of them was suggested by Michał Przeździecki (2020). It was to be distinguished by the formation of a long notch along the longer edge of the blank, which was shaped with a steep retouch. The notch was intended to be the back of the future segment. Then the distal and proximal part of the small blade was broken off, while from the middle part of the product, from one to several segments were created. According to the author (Michał Przeździecki), this solution is analogous to some interpretations of the Palaeolithic strategies of producing backed bladelets (see Ginter and Kozłowski 1990, 63, 205; Bosinski 1989; Bolus 2012). Although the solution seems to be extremely ergonomic in the context of producing small inserts in the type of Magdalenian backed bladelets, we only have a few examples of waste parts with characteristic notches to support it (Przeździecki 2020). This may be due to the specificity of the procedure, which does not leave a lot of waste products and a small chance for researchers to create flint refittings from these types of artefacts.

ANALYSIS OF MORPHOLOGY AND MORPHOMETRY OF BACKED BLADELETS AND MICROBURINS

For the analysis we selected materials from three Magdalenian sites, differing chronologically and functionally. These are:

– Maszycka Cave – a small, basic, unique campsite, the material came from Stefan Karol Kozłowski excavations (Kozłowski S.K. and Sachse-Kozłowska 1993);

Fig. 1. Examples of backed bladelets (1-9) and microburins (10-12) from Ćmielów 95 "Mały Gawroniec" (2, 5, 7-8, 11-12) and Podgrodzie 16 (1, 3-4, 6, 9-10)

– Ćmielów 95 "Mały Gawroniec" – a large, basic camp (Przeździecki and Migal eds 2020) (Fig. 1: 2, 5, 7-8, 11-12);

– Podgrodzie 16 – a short-term camp and flint workshop (Pyżewicz *et al.* 2014) (Fig. 1: 1, 3-4, 6, 9-10).

The analyses are preliminary and were aimed more at testing if the method is reliable rather than to synthesis the data on the morphometry of Magdalenian backed bladelets. The sites such as Maszycka Cave yielded small number of specimens, but we decided to include them to present the method, although we are fully aware that the sample in not statistically valid for answering certain question.

Our studies at this stage were carried on to test if such a simple morphometric approach is reliable. We used materials attributed by some researchers to different stages of Magdalenian in Poland (Wiśniewski *et al.* 2017). Future studies could add more contextual data, but at this stage we are aware that differences between sites and their chronology can influence our conclusions.

As the studies focus on the interpretation of the last stages of the *chaîne opératoire* related to the formation of formal tools from small blades, we chose backed bladelets and microburins for analysis. In the case of the material from the "Mały Gawroniec" site at Ćmielów, numerous remains of their production and use were found, we selected the

Table 1. Analysis of the morphology of backed bladelets (bb) and microburins' (m)

site	number of artifacts	part of blank				retouch side (direction)			arrangement of break					direction of negatives				number of negatives					profile	
		proximal	mesial	dorsal	whole	dorsal	ventral	dorsal/ventral	straight	oblique	straight and oblique	other	lack	unidirectional	bidirectional	traces of cresting	?	1	2	3	4	5	striaght	curvy/ plunged
Maszycka cave	bb - 7	3	4	0	0	7	0	0	2	2	0	3	0	6	1?	0	0	0	4	2	1	0	5	2
Ćmielów	bb - 130 +6?	49	60	23+1?	3	120	12	4	33+1?	76	13	6	7	119+7?	4+1?	1+3?	1	1	79	45	10	1	108	28
Podgrodzie	bb - 16	1	12	3	0	10	5	1	1	14	1	0	0	16	0	0	0	0	9	7	0	0	15	1
Ćmielów	m - 6	5	1	0	0	4	0	2	1	5	0	0	0	6	0	0	0	0	1	5	0	0	3	3
Podgrodzie	m - 2	2	0	0	0	0	2	0	0	2	0	0	0	2	0	0	0	0	0	1	1		1	1

material consisting of 136 backed bladelets and fragments of them, and six microburins, from 171 forms distinguished by Michał Przeździecki (2020, 97). In our studies we used backed bladelets, and excluded pieces such as less extensive retouched forms that had probably played a similar role but typologically were more close to retouched blades. From inventories obtained from the sites in Podgrodzie and the Maszycka Cave, where far fewer such forms were recorded, all available specimens were examined (seven artefacts from Maszycka Cave and 18 from Podgrodzie).

The basic criterion for the selection of the backed bladelets was the existence of abrupt or semi-abrupt retouch at least on one edge of the specimen. We also noted when there was additional retouch of the base. We noted the part of the blade (proximal, mesial, distal) from which the tool was made, and the side on which the retouch was made (dorsal, ventral). As most of the backed bladelets had breaks, we examined their arrangement concerning the axis of symmetry of the tool, describing them as straight or oblique. Determining the direction of the flake scars on the dorsal side is limited to describing them as: unidirectional, bidirectional, or with traces of cresting. It is worth mentioning that, due to the small size of the specimens, the assessment of the direction of the flaking scars was often difficult. We also counted the number of flake scars – when they reached half of the specimen (minor chipping, originating, *e.g.* from trimming, was excluded). Additionally, we examined how many specimens had straight or curved/plunging profiles. Detailed analyses are presented in Table 1. We measured all analysed forms (more later in the text). Performing the measurement procedure and characterization of breaks is an important element in the discussion of intentional fractures at one or both ends. Based on these data, it can be concluded which forms have been broken by accident as a result of the use or postdepositional processes, and which are the result of intentional shortening.

The conducted analyses showed a few regularities in the production of the backed bladelets. The tested sample included 53 backed bladelets with preserved butts and seven microburins with proximal parts. There is no record of the butt preparation in the *en éperon* type on any of the specimens, which confirms the separability of technological cycles in Magdalenian. We can confirm there were two separate methods: first regarding the production of large blades and a second for making bladelets.

We can conclude that the blanks for the formation of backed bladelets were selected from small blades, and the middle parts (76 specimens) were preferred. The proximal and distal parts were also used, especially when these fragments were not plunging or the bulb was not massive. It is worth adding when the direct percussion technique with a soft hammer is applied (which was preferred during the production of the blanks of backed bladelets), the bulbs are usually less pronounced. So their presence did not have to necessitate removing them to produce an insert. We observed on the specimens with the butt preserved that the retouch was done from the side that was closer to the blade ridge. The retouched back was placed as close as possible to the ridge (Fig. 2). Based on this observation, we can conclude that most of the small blades could have in this way, a strongly re-

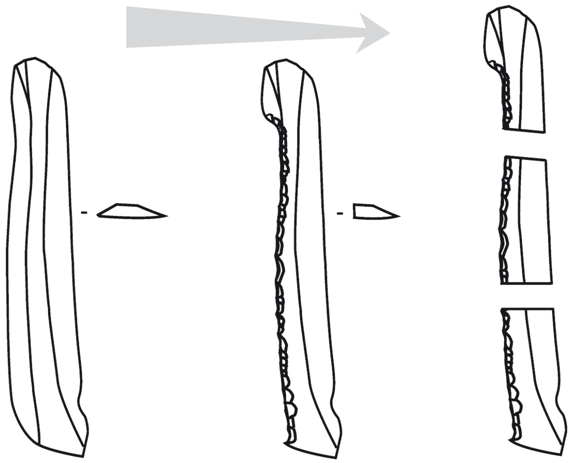

Fig. 2. The scheme of the production of backed bladelets using the microburin technique

duced flake scar surface. On the analysed forms, at least two negatives of previous removals are practically always visible – 92 pieces, or more flake scars – 66 specimens, which gives the distribution typical for most blade technologies. However, a clear trapezoidal cross-section and possible reduction of one flake scar with retouched back would indicate that flat blades with more than two negatives of previous removals were preferred. We can also conclude that there was a tendency to retouch the backed bladelets towards the dorsal side of the blank, with sporadic registration of the retouched specimens towards the ventral surface. With the application of the first type of retouch (towards the dorsal side), the back was steeper. And it was less steep when it was directed towards the ventral side of the blade. Most of the fractures were oblique (106 specimens), while straight fractures (51 specimens) were less common. We also noticed that blanks with straight profiles were used for the production of backed bladelets (128 specimens). Only individual specimens with curved/plunging profiles were recorded (31 specimens). Based on the results of the analysis of the dorsal sides, we can conclude that most of the artefacts were characterized by the unidirectional arrangement of the flake scars (148 specimens). We noticed bidirectional character or traces of cresting less frequently. Among the analysed backed bladelets, the most common blank selected for tool production was the mesial part (76 specimens), then the proximal (53 specimens), and the less numerous group was made from distal parts (27 specimens). Only three inserts were made from one whole bladelet without segmentation. Next to the tools, we recorded eight microburins that morphologically share many attributes with backed bladelets. Some of these features are break patterns and a steep retouch on one of the sides of microburin looking like the retouch on the backed bladelet.

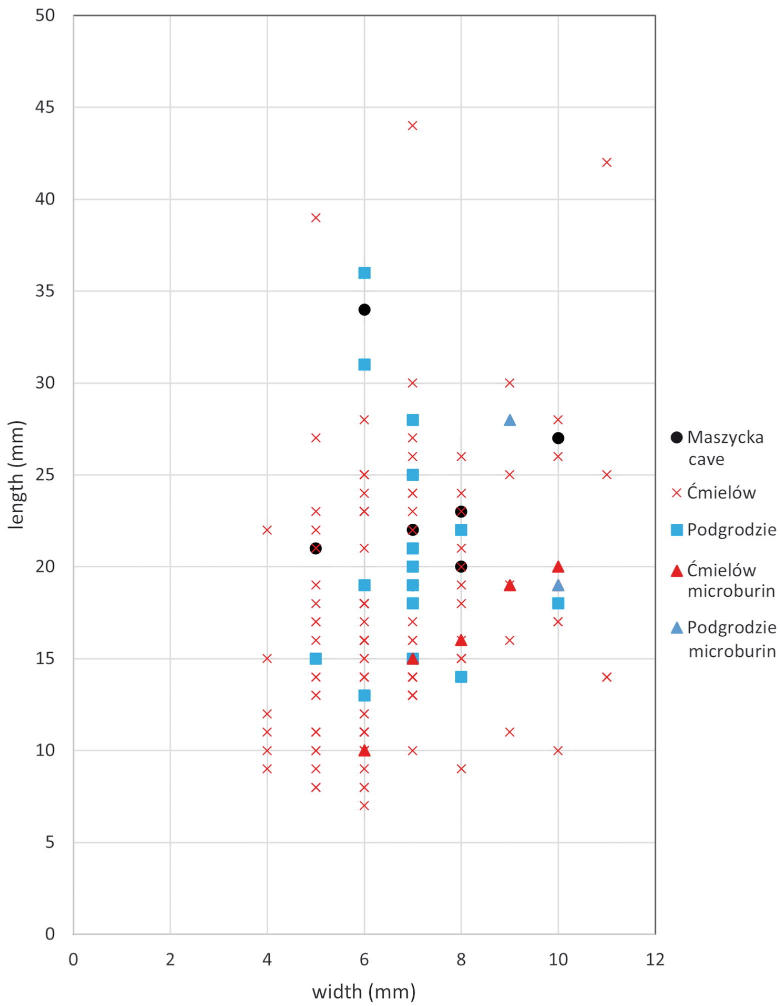

Fig. 3. Graph presenting distribution of blacked bladelets and microburins from the analysed sites

The morphometric analysis was based on the measurements of the length, width, and thickness of individual backed bladelets and microburins. Based on the quantitative and qualitative research, we decided to present the metric range of backed bladelets and check whether the microburins are within it. This would be another argument – apart from the context of finding (their coexistence at one site within layer) – that these two types of specimens should be combined into one technological set. The first observation concerns the comparison of the length and width of individual backed bladelets and microburins from the studied sites (Fig. 3).

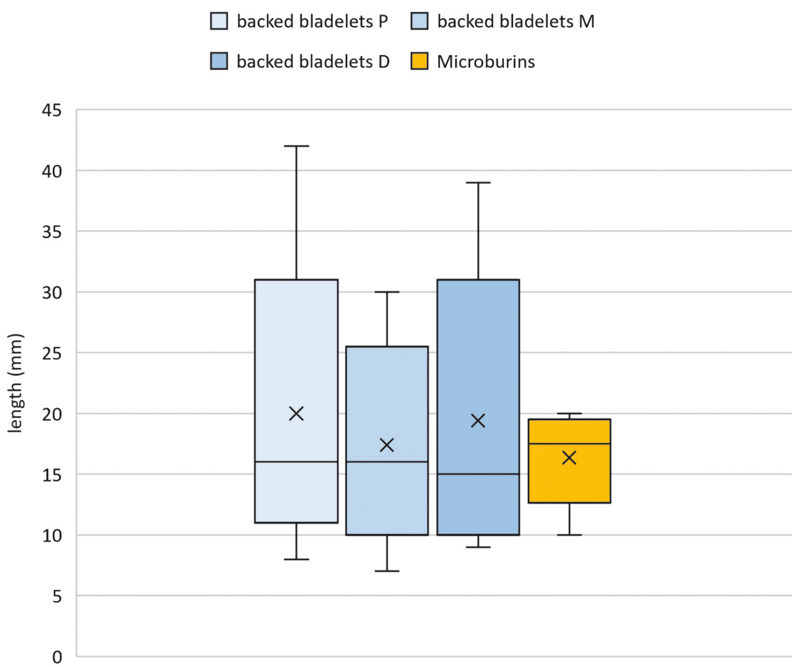

Fig. 4. Graph depicting length of backed bladelets from proximal (P), mesial (M), distal (D) parts, and microburins from Ćmielów 95 "Mały Gawroniec"

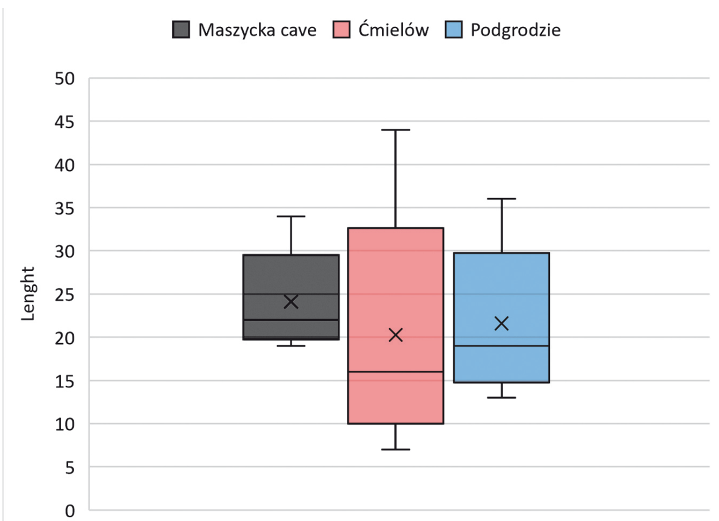

Fig. 5. Graph depicting the length of backed bladelets (different parts of bladelets altogether) from the analysed sites

The largest number of analysed backed bladelets coming from Ćmielów shows considerable variability, ranging between 4 and 11 mm in width and between 7 and 44 mm in length. The microburins compared with them fit into these morphometric ranges, they are not usually long, but more wider. The examined backed bladelets from the Maszycka Cave are usually longer than the specimens from Ćmielów, but they also contribute to the variability of the collection, similar to the specimens from Podgrodzie. It is also worth noting that microburins always fall within the ranges for their respective clusters within the corresponding sites. Their distinguishing feature is their thickness. Most of them oscillate between 1 and 2 mm, rarely being 3 mm in thickness. However, in the case of microburins, the rule is their measurements oscillate around 3 mm. Of the eight specimens, only one was 2 mm thick and another – 4 mm thick.

As the fractures always occurred on the examined backed bladelets, we decided to try to check morphometrically whether we can justify their presence by intentional production. After preliminary analysis, we noticed that the collection includes specimens with accidental fractures that may have resulted from use or postdepositional processes. Assuming that such fractures arise in various parts of bladelets because they are not controlled, we decided to examine the statistically largest collection from Ćmielów in terms of the length of backed bladelets and microburins. In addition, we decided to split up the studied collection of backed bladelets into types corresponding to the parts of the blanks – proximal, mesial, and distal. Thanks to this, we could check whether the segments from individual parts were equal, which would be a clue about their intentional execution by breaking at least one of the parts. The studied collection consisted of 133 backed bladelets, and six microburins, three non-segmented backed bladelets were excluded (Fig. 4).

The analysed data show that in each tested tool group, different fragments – proximal, mesial, and distal parts, are of a similar length, and their medians were practically identical. It is a similar case among the microburins, which, while seemingly shorter, fit into the scope of the previous tool groups. In the end, we analysed backed bladelets without dividing them into the parts from which they were made but comparing them between sites (Fig. 5).

CONCLUSION

Based on the above studies, we consider that these data reflect the actions of manufacturers for whom the achievement of regularity and the appropriate length of tools were the most important elements in their production. A large number of backed bladelets made of proximal and distal parts of bladelets confirm that various parts of the blanks were segmented for their production, not only the most regular mesial parts.

We assume that the small proportion of microburins is the result of the rare practice of rejecting them (they could be converted into backed bladelets). The leaving of microburins unprocessed was most likely due to the thickness or the strong plunging of the rejected blanks. Additionally, we can confirm that the proportions of the length and width of the microburins are in line with the parameters of backed bladelet production and this is an argument for connecting them into one production cycle. Further arguments are: the morphological features observed on the butts and the bulbs, and the regularity of the ridges and side edges, which are analogous to those observed on the backed bladelets made of proximal parts. Also, the retouch of some microburins is similar to that observed on backed bladelets.

To sum up, we can conclude that the production of backed bladelets in Ćmielów and Podgrodzie was probably similar to the scheme proposed by Michał Przeździecki (2020). The first stage of the procedure, after selecting the bladelet, was to create a long notch – in the form of a back and then segmentation with the use of striking (Fig. 2). This was usually done along one of the ridges occurring on the bladelet. It seems, based on the knowledge resulting from experiments (*e.g.*, Rankama and Kankaanpää 2011; Sørensen 2017), that manufacturers could use pads and precise strokes for this purpose. There was no need to perform precise notches as in Mesolithic microburin procedures known from the territory of Poland (see *e.g.*, Kozłowski 2009). We can conclude, that during the production process, the manufacturers tried to divide the blanks into parts, that were equal to each other. The standardization of the length facilitated possible repairs during the usage of composite tools. If one or more inserts were damaged, the manufacturer could form and insert them at any time. If each insert was different, the blades would have to be shortened and transformed before each repair. During the last stage of production (after breaking), the inserts were additionally retouched in order to correct their shape.

Finally, we should also attempt to interpret the additional reasons for fractures of backed bladelets, not only those related to intentional segmentation. The distinction between these reasons is an important element in the study of the production of backed bladelets. To sum up, based on the research conducted so far, we can conclude that these tools were broken during their use as hunting weapons. In the study group of backed bladelets, we noticed fractures resulting from their usage (like characteristic impact fractures), which was confirmed by use-wear studies (Pyżewicz 2015a, 2020). Most likely, there are also some fragments that broke due to postdepositional factors. However, detailed experimental and technological studies, including analysis of relationship between length and mode of fragmentation, should be undertaken in the future in order to be able to distinguish different types of genesis of fractures of backed bladelets.

To sum up, we can conclude that backed bladelets were at least partially shaped using the microburin techniques, as evidenced by the studies presented above. Additionally, it should be noted that the characteristic waste products – microburins, were also registered in other inventories from the Magdalenian sites in the Polish territories. Specimens of this type are found in Dzierżysław (Ginter *et al.* 2002; 2005), Wilczyce (Królik 2014) or Klementowice-Kolonia (Wiśniewski T. 2015). In the course of further studies, it would be worth undertaking analogous morphometrical and morphological studies and compere with studies presented above.

References

Bobak D., Łanczont M., Mroczek P., Połtowicz-Bobak M., Nowak A., Kufel-Diakowska B., Kusiak J. and Standzikowski K. 2017. Magdalenian settlement on the edge of the loess island: A case study from the northern foreland of the Carpathians (SE Poland). *Quaternary International* 438, 158-173.

Bobak D. and Połtowicz-Bobak M. 2014. Bayesian age modelling of the Magdalenian settlement in the territory of present-day Poland. *Recherches Archéologiques, Nouvelle Serie* 5-6, 51-67.

Bolus M. 2012. Rückenmesser. In H. Floss (ed.), *Steinartefakte vom Altpaläolithikum bis in die Neuzeit*. Tübingen: Kerns Verlag, 429-434.

Bosinski G. 1989. Die große Zeit der Eiszeitjäger. Europa zwischen 40 000 und 10 000 v. Chr. *Jahrbuch des Römisch-Germanischen Zentralmuseums* 34/1987, 3-139.

Bosinski G. 2010. The hafting of backed bladelets in the Late Magdalenian. In J. M. Burdukiewicz, K. Cyrek, P. Dyczek and K. Szymczak (eds), *Understanding the Past. Papers offered to Stefan K. Kozłowski*. Warsaw: Center for Research on the Antiquity of Southeastern Europe, University of Warsaw, 55-58.

Chmielewski W. 1975. Paleolit środkowy i górny. In W. Chmielewski and W. Hensel (eds), *Prahistoria ziem polskich* 1. Warszawa, Kraków, Gdańsk, Wrocław: Zakład Narodowy im. Ossolińskich, 9-158.

Ginter B. and Kozłowski J. K. 1990. *Technika obróbki i typologia wyrobów kamiennych paleolitu, mezolitu i neolitu*. Warszawa: Państwowe Wydawnictwo Naukowe.

Ginter B. and Połtowicz M. 2007. Magdalenian settlement in Poland before the Bølling oscillation. In M. Kobusiewicz and J. Kabaciński (eds), *Studies in the Final Palaeolithic Settlement of the Great European Plain*. Poznań: Institute of Archaeology and Ethnology Polish Academy of Sciences, Poznań Branch Poznań Prehistoric Society, 7-19.

Ginter B., Połtowicz M., Pawlikowski M., Skiba S., Trąbska J., Wacnik A., Winiarska-Kabacińska M. and Wojtal P. 2002. Dzierżysław 35 – stanowisko magdaleńskie na przedpolu Bramy Morawskiej. In J. Gancarski (ed.), *Starsza i środkowa epoka kamienia w Karpatach polskich*. Krosno: Muzeum Podkarpackie w Krośnie, 111-145.

Ginter B., Połtowicz M., Pawlikowski M., Skiba S., Trąbska J., Wacnik A., Winiarska-Kabacińska M. and Wojtal P. 2005. Dzierżysław 35 – ein neuer Fundplatz des Magdalenien in Oberschlesien. *Archäologisches Korrespondenzblatt* 35, 431-445.

Inizan M. L., Reduron-Ballinger M., Roche H. and Tixier J. 1999. *Technology and terminology of knapped stone*. Nanterre: CREP.

Jarosińska U. 2006. Aurignacian material from layer 4 at Zwierzyniec I site. In S. K. Kozłowski (ed.), *Wylotne and Zwierzyniec. Paleolithic sites in Southern Poland*. Kraków: The Polish Academy of Arts and Sciences, Warsaw University, 349-360.

Kozłowski J. K. 2000. The Problem of Cultural Continuity between the Middle and Upper Paleolithic. In O. Bar-Yosef and D. R. Pilbeam (eds), *The Geography of Neandertals and Modern Humans in Europe and the Greater Mediterranean* (= *Peabody Museum Bulletins* 8). Cambridge: Harvard University Press, 77-105.

Kozłowski S. K. and Pettitt P. B. 2001. Absolute dating of the Polish Magdalenian. *Fontes Archaeologici Posnanienses* 39, 31-35.

Kozłowski S. K. 2009. *Thinking Mesolithic*. Oxford: Oxbow Books.

Kozłowski S. K. and Sachse-Kozłowska E. 1993. Magdalenian Family from the Maszycka Cave. *Jahrbuch des Römische-Germanischen Zentralmuseums Mainz* 40, 115-205.

Kozłowski S. K., Połtowicz-Bobak M., Bobak D. and Terberger T. 2012. New information from Maszycka Cave and the Late Glacial recolonisation of Central Europe. *Quaternary International* 272-273, 288-296.

Królik H. 2014. Chipped Flint and Quartzite Artifacts. In R. Schild (ed.), *Wilczyce A Late Magdalenian Winter Hunting Camp in Southern Poland*. Warszawa: Institute of Archaeology and Ethnology of the Polish Academy of Sciences, 173-240.

Krukowski S. 1914. Nowy odpadek mikrolitu neolitycznego. *Sprawozdania Warszawskiego Towarzystwa Naukowego* 7/1, 14.

Krukowski S. 1939-48. Paleolit. In S. Krukowski, J. Kostrzewski and R. Jakimowicz (eds), *Prehistoria ziem polskich*. Warszawa: Polska Akademia Umiejętności, 1-117.

Libera J. and Migal W. 2009. Klementowice – Magdalenian Core Processing. In J. M. Burdukiewicz, K. Cyrek, P. Dyczek and K. Szymczak (eds), *Understanding the Past. Papers offered to Stefan K. Kozłowski*. Warsaw: Center for Research on the Antiquity of Southeastern Europe, University of Warsaw, 223-237.

Maier A., 2015. *The Central European Magdalenian: Regional Diversity and Internal Variability*. Dordrecht: Springer, 288-296.

Migal W., Pałasz A., Styś O. and Woźniak M. 2020. Metody i techniki krzemieniarskie. In M. Przeździecki and W. Migal (eds), *Na granicy światów. Obozowisko kultury magdaleńskiej w Ćmielowie, woj. świętokrzyskie*. Warszawa: Uniwersytet Warszawski, Wydział Archeologii, Państwowe Muzeum Archeologiczne w Warszawie, 156-222.

Pétillon J.M., Bignon O., Bodu P., Cattelain P., Debout G., Langlais M., Laroulandie V., Plisson H. and Valentin B. 2011. Hard core and cutting edge: experimental manufacture and use of Magdalenian composite projectile tips. *Journal of Archaeological Science* 38/6,1266-1283.

Płonka T. and Wiśniewski A. 2006. Some remarks on core exploitation methods at the Gravettian site Henryków 15 in the Sudeten Foreland. In A. Wiśniewski, T. Płonka and J. M. Burdukiewicz (eds), *The Stone: Technique and Technology*. Wrocław: Uniwersytet Wrocławski, Stowarzyszenie Krzemieniarskie SKAM, 99-103.

Połtowicz M. 2006. The eastern borders of the Magdalenian culture range. *Analecta Archaeologica Ressoviensia* 1, 11-28.

Połtowicz M. 2007. The Magdalenian period in Poland and neighbouring areas. *Archaeologia Baltica* 7, 21-27.

Połtowicz-Bobak M. 2009a. Magdalenian settlement in Poland in the light of recent research. In M. Street, N. Barton and T. Terberger (eds), *Humans, Environment and Chronology of the Late Glacial of the North European Plain, Proceedings of Workshop 14 (Commission XXXII "The Final Palaeolithic of the Great European Plain/ Le Paléolithique Final de la Grande Plaine Européenne") of the 15th U.I.S.P.P. Congress, Lisbon, Sepember 2006* (= *RGZM – Tagungen 6*). Mainz: Verlag des Römisch-Germanischen Zentralmuseums, 55-66.

Połtowicz-Bobak M. 2009b. Środowiskowe uwarunkowania osadnictwa magdaleńskiego w Europie Środkowej. In L. Domańska, P. Kittel and J. Forysiak (eds), *Środowisko – Człowiek – Cywilizacja* 2 (= *Seria wydawnicza Stowarzyszenia Archeologii Środowiskowej. Środowiskowe uwarunkowania lokalizacji osadnictwa*). Poznań: Bogucki Wydawnictwo Naukowe, 39-48.

Połtowicz-Bobak M. 2013. *Wschodnia prowincja magdalenienu*. Rzeszów: Wydawnictwo Uniwersytetu Rzeszowskiego.

Połtowicz-Bobak M. 2016. On the peripheries of the Magdalenian world. Magdalenian hunters north of the Carpathian and Sudety Mountains. In J. Kabaciński (ed.), *The Past Societies. Polish lands from the first evidence of human presence to the Early Middle Ages* 1*, 500 000-5500 BC*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences, 129-152.

Przeździecki M. 2020. Struktura techno-typologiczna zabytków krzemiennych. In M. Przeździecki and W. Migal (eds), *Na granicy światów. Obozowisko kultury magdaleńskiej w Ćmielowie, woj. świętokrzyskie*. Warszawa: Uniwersytet Warszawski, Wydział Archeologii, Państwowe Muzeum Archeologiczne w Warszawie, 88-155.

Przeździecki M. and Migal W. eds 2020. *Na granicy światów. Obozowisko kultury magdaleńskiej w Ćmielowie, woj. świętokrzyskie*. Warszawa: Uniwersytet Warszawski, Wydział Archeologii, Państwowe Muzeum Archeologiczne w Warszawie.

Pyżewicz K. 2015a. Biographies of Magdalenian lithic tools from Poland. An in-depth look at two cases from the Kielecka Upland. *Anthropologie* 53/3, 519-529.

Pyżewicz K. 2015b. The use-wear analysis of the artefacts found at the Magdalenian site in Klementowice. In T. Wiśniewski (ed.), *Klementowice. A Magdalenian site in eastern Poland*. Lublin: Uniwersytet Marii Curie-Skłodowskiej w Lublinie, 184-214.

Pyżewicz K. 2020. Użytkowanie narzędzi krzemiennych przez społeczności magdaleńskie bytujące na obszarze „Małego Gawrońca". In M. Przeździecki and W. Migal (eds), *Na granicy światów. Obozowisko kultury magdaleńskiej w Ćmielowie, woj. świętokrzyskie*. Warszawa: Uniwersytet Warszawski, Wydział Archeologii, Państwowe Muzeum Archeologiczne w Warszawie, 355-369.

Pyżewicz K., Migal W. and Grużdź W. 2014. Magdalenian blade technology from the northeastern European perspective. In F. Riede and M. Tallavaara (eds), *Lateglacial and postglacial pioneers in northern Europe* (= *British Archaeological Reports, International Series 2599*). Oxford: Archeopress Publishers of British Archaeological Reports, 67-78.

Rankama T. and Kankaanpää J. 2011. First evidence of eastern Preboreal pioneers in arctic Finland and Norway. *Quartär* 58, 183-209.

Roux E.G., Cattin M.-I., Yahemdi I. and Beyries S. 2020. Reconstructing Magdalenian hunting equipment through experimentation and functional analysis of backed bladelets. *Quaternary International* 554, 107-127.

Sachse-Kozłowska E. 1978. Polish Aurignacian assemblages. *Folia Quaternaria* 50, 1-37.

Sachse-Kozłowska E. 1982. Rdzenie i półsurowiec zespołu oryniackiego ze stanowiska Zwierzyniec I. *Archeologia Polski* 27/1, 57-78.

Sachse-Kozłowska E. and Kozłowski S.K. 1975. Nowa kultura górnopaleolityczna w Europie Środkowej: ze studiów nad materiałami ze stanowiska Zwierzyniec I. *Archeologia Polski* 20/2, 275-313.

Schild R. ed. 2014. *Wilczyce. A Late Magdalenian Winter Hunting Camp in Southern Poland*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences.

Schild R. Królik H., Tomaszewski A. J. and Ciepielewska E. 2011. *Rydno. A Stone Age Red Ochre Quarry and Socioeconomic Center. A Century Research*. Warszawa: Institute of Archeology and Ethnology, Polish Academy of Sciences.

Sobkowiak-Tabaka I. 2011. *Społeczności późnego paleolitu w dorzeczu Odry*. Poznań: Instytut Archeologii i Etnologii Polskiej Akademii Nauk Oddział w Poznaniu.

Sørensen M. 2017. How to classify lithic artefact materials- if at all: the case of the burin. In M. Sørensen and K. B. Pedersen (eds), *Problems in Palaeolithic and Mesolithic Research* (= *Arkæologiske Studier* 12). The Saxo Institute, University of Copenhagen, Museum of Southeast Denmark, 207-225.

Tomasso A., Rots V., Purdue L., Beyries S., Buckley M., Cheval C., Cnuts D., Coppea J., Julien M.-A., Grenet M., Lepers C., M'hamdi M., Simon P., Sorin S. and Porraz G. 2018. Gravettian weaponry: 23,500-year-old evidence of a composite barbed point from Les Prés de Laure (France). *Journal of Archaeological Science* 100, 158-175.

Wiśniewski A., Połtowicz-Bobak M., Bobak D., Jary Z. and Moska P. 2017. The Epigravettian and the Magdalenian in Poland: new chronological data and an old problem. *Geochronometria* 44, 16-29.

Wilczyński J. 2007. The Gravettian and Epigravettian lithic assemblages from Kraków-Spadzista B+B1: dynamic approach to the technology. *Folia Quaternaria* 77, 37-96.

Wilczyński J. ed. 2015. *A Gravettian Site in Southern Poland: Jaksice II*. Kraków: Institute of Systematics and Evolution of Animals, Polish Academy of Sciences.

Wilczyński J. 2016a. A new beginning: modern humans in Poland. In J. Kabaciński (ed.), *The Past Societies. Polish lands from the first evidence of human presence to the Early Middle Ages* 1*, 500 000-5500 BC*. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences, 111-128.

Wilczyński J. 2016b. Variability of Late Gravettian lithic industries in southern Poland: A case study of the Kraków Spadzista and Jaksice II sites. *Quaternary International* 406, 129-143.

Wilczyński J. and Wojtal P. 2011. Jaksice II – a new Gravettian site in southern Poland. *Přehled výzkumů* 52, 37-41.

Wilczyński J., Wojtal P., Łanczont M., Mroczek P., Sobieraj D. and Fedorowicz S. 2015. Loess, flints and bones: Multidyscyplinary research at Jaksice II Gravettian site (southern Poland). *Quaternary International* 359-360, 114-130.

Wiśniewski A., Furmanek M., Borowski M., Kądziołka K., Rapiński A. and Winnicka K. 2012. Lithic raw material and Late Palaeolithic strategies of mobility: a case study from Sowin 7, SW Poland. *Anthropologie* 50/4, 391-409.

Wiśniewski A., Kufel-Diakowska B., Chłoń M., Michalec G. and Różok Z. 2020. Not only simple workshop: New research of Magdalenian horizon at site Sowin 7, SW Poland. *Anthropologie* 58/2-3, 321-337.

Wiśniewski A., Płonka T., Jary Z., Lisa L., Traczyk A., Kufel-Diakowska B., Raczyk J. and Bajer A. 2015. The early Gravettian in a marginal area: New evidence from SW Poland. *Quaternary International* 359-360, 131-152.

Wiśniewski T. ed. 2015. *Klementowice. A Magdalenian site in eastern Poland*. Lublin: Uniwersytet Marii Curie-Skłodowskiej w Lublinie.