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BIOGRAPHIES OF MAGDALENIAN LITHIC TOOLS FROM POLAND. AN IN-DEPTH LOOK AT TWO CASES FROM THE KIELECKA UPLAND

ABSTRACT: The purpose of the presented study was to investigate the technology and utilization of lithic materials of the Magdalenian settlement from southern Poland. The studied artefacts came from two excavation sites - Ćmielów 95 and Podgrodzie 16, which are located on the northern part of Kielecka Upland. The applied research methodology was a combination of the use-wear analysis of flint artefacts and experimental research.
The obtained results revealed that Magdalenian societies living in the areas of Ćmielów and Podgrodzie had their economy based on utilization of local, high quality lithic raw materials. The availability of certain raw materials can indicate which blade production method was used. The experimental and microscopic studies showed a clear distinction between functional classes of tools and improved characterization of the production technologies used by Magdalenian societies. The results of performed studies suggest that individual types of tools (e.g. end scrapers, burins, perforators) were used in a specific manner and most of the tool kits were used in hunting and butchering activities.

KEY WORDS: Magdalenian – Lithics – Use-wear analysis – Experimental approach

INTRODUCTION

This paper seeks to explore the methods of production and use of flint tools by the representatives of the Magdalenian societies inhabiting the eastern fringe of their occupation. The studies of manufacturing and utilization of the Magdalenian lithic tools have a long history in Western Europe. On this basis, we know quite a lot about how flint tools were produced (cf. Pelegrin 2000, Sano *et al.* 2011, Surmely, Alix 2005, Valentin 1995: 150–157, 2000, 2008) and used for various types of purposes, mainly for hunting and processing of animal carcass, but also for wood, herbaceous plant or rock materials (cf. Moss, Newcomer 1982, Moss 1983: 108–144, Sano 2009, 2010, 2012a, b, Sano *et al.* 2011, Symens 1986, Taller *et al.* 2012, Vaughan 1985: 49–104). By contrast, the eastern border of the Magdalenian settlement is not well researched with only a few preliminary studies

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of the lithic tools function from Maszycka Cave (Winiarska-Kabacińska 1993), Dzierżysław (Ginter *et al.* 2005) and Wilczyce (Winiarska-Kabacińska 2014). The technological aspect related to Magdalenian flint artefacts from this area is also still under-recognized (Libera, Migal 2009, Pyżewicz *et al.* 2014).

Lithic materials from two Magdalenian sites located in the northern part of the Kielecka Upland have been analysed – Ćmielów 95 ("Mały Gawroniec"), Ostrowiec Świętokrzyski District, and Podgrodzie 16, Ostrowiec Świętokrzyski District. The employed research method comprised microscopic analysis and experiments. Additionally, macro- and micro traces related to the production, setting flint implements in hafts and their use were subject of the precise study.

Attempts at the interpretation of the noted relationship between the method of use, the morphology of the implements and the technique employed for the production of given artefacts along with the choice of the type of raw material allowed me to gain insights into the "history" of individual implements and could be circumspectly used to draw an understanding of the behaviours of the representatives of the Magdalenian communities in the context of the production and use of flint specimens, as well as spatial organisation.

METHODS

The conducted studies were based on the application of three main methods: lithic refitting, experiments and use-wear analysis. The first part of project that dealt with the reconstruction of *chaîne opératoire* with the use of refitting's and flint knapping experiments was partially already published in the separate papers (Grużdź *et al.* 2012, Pyżewicz *et al.* 2014). The results of these technology studies were used for comparison with the following analysis (including relation between technology and function of different tools). These experiments together with a new one focused on establishing function of various tools were conducted with an actualistic approach (cf. Bamforth 2010, Comis 2010, Outram 2008, Shimada 2005). The reference collection is kept at Adam Mickiewicz University in Poznań. The microscopic analysis was performed on a metallographic microscope (Nikon LV150). It supports zooming of 50× to 500×. The flint artefacts were cleaned off contaminations on their surfaces with warm water and detergent as well as pure acetone. The detailed microscopic analysis was performed only on some lithic materials from Podgrodzie and Ćmielów sites. The selection method of particular groups of tools was mostly associated with the state of the preservation of lithic surfaces. Due to white patina and surface sheen the majority of tools were excluded from further use-wear analysis. Simultaneously, the microscopic analysis of technological features was performed on all analyzed lithic tools and a sample of other 200 artefacts, mainly blades and few cores, which were also examined in the context of their function (some of these artefacts were excluded during the next stages of microscopic research).

GENERAL CHARACTERISTICS OF THE SITES AND MATERIALS

The analysed flint materials were yielded by two sites located in the south-eastern part of the Kielecka Upland (*Figure 1*), approximately 3 km from each other as the crow flies, in the region marked by a wealth of high quality flint raw material from primary and secondary deposits, i.e., chocolate, striped, and the so called Rauracian flint. Outcrops of the so called Ożarów, Janików and Świeciechów flint have been found to be located nearby as well (Budziszewski 2008, Król, Migaszewski 2009). All the foregoing varieties of raw flint were recorded in materials uncovered at sites in Ćmielów and Podgrodzie.

Podgrodzie 16, is located on the northern edge of the Sandomierz Upland. Within the micro-regional scale it lies on the edge of the loess plateau marked by a deep cutting, about 1 km east of the Kamienna River valley, limited at this point by steep walls of Oxford limestones. Artefacts unearthed heretofore were largely deposited on a gentle hillside with southern exposure and their maximum spatial distribution does not exceed an area of a few ares in extent. Single pieces of various kind of flint have been registered, otherwise the vast majority of lithic artefacts were made of either Świeciechów and other types of "Turonian" flint or chocolate flint. The site produced more than 2700 artefacts thus far – mostly debitage products plus few tools (Przeździecki *et al.* 2011b, Pyżewicz *et al.* 2009).

The other inventory under examination was uncovered at site Ćmielów 95, which is located on the northern edge of the Sandomierz – Opatów loess blanket, on the border of two different physicogeographical mezoregions – Sandomierz Upland and the Iłża Foothills. "Mały Gawroniec" is a local term for a characteristic, isolated loess monadnock that rises abruptly in the landscape, located at the confluence of the Kamienna and Przepaść Rivers. The artefacts recovered from the site were chiefly deposited on the area of about 30 ares in extent, in the north-western part of the site, on a gentle slope of a small

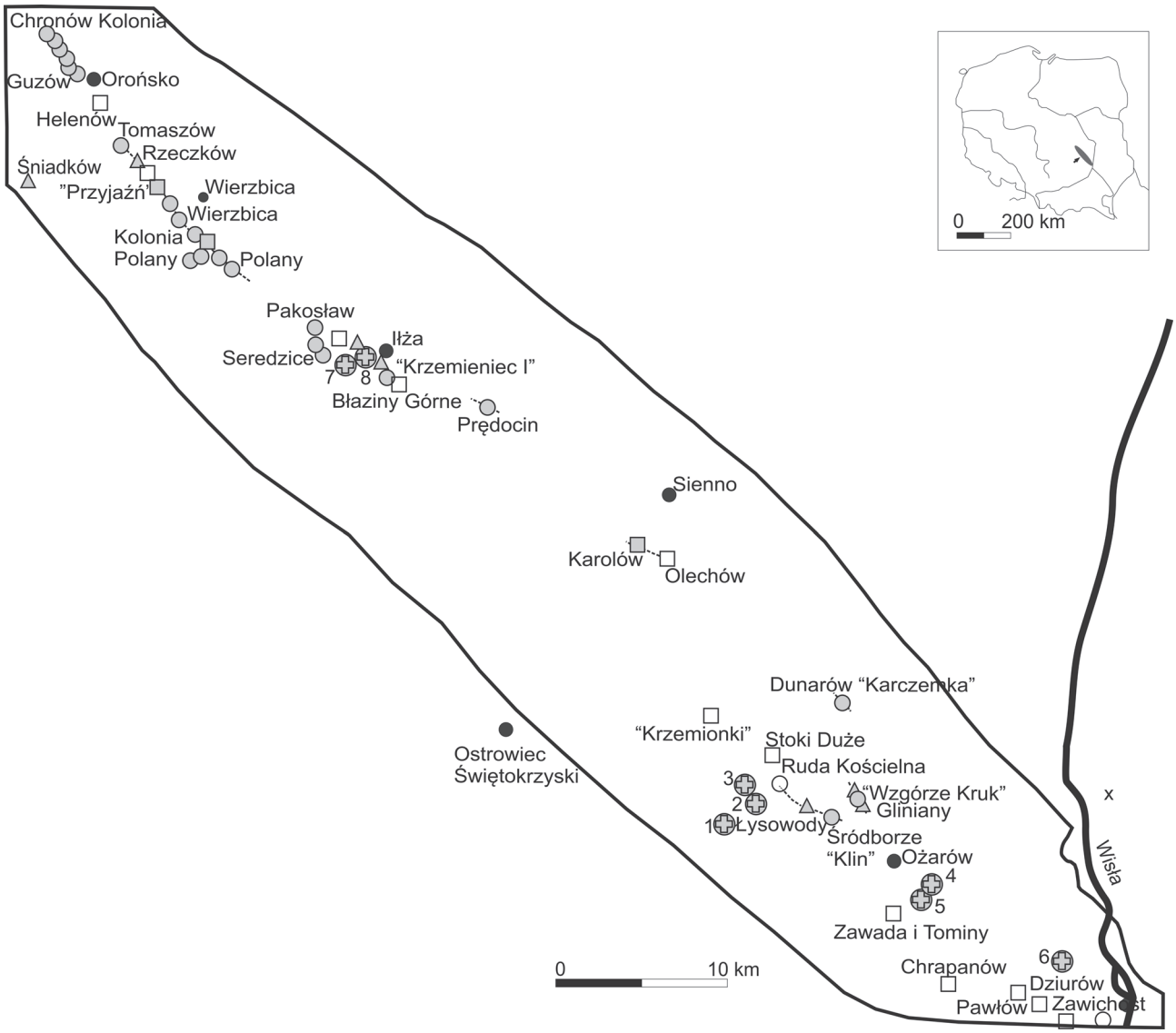

FIGURE 1. The map of Magdalenian sites (including Ćmielów 95 and Podgrodzie 16) located on the background of outcrops of chocolate and Świeciechów flint. Redrawing A. Maron 2009 after Budziszewski 2008. Outcrops of chocolate flint: grey triangle, surface concentrations of flint debris, grey circle, prehistoric exploitation points, grey square, natural exposures or stone quarries. Potential and uncertain occurrence of chocolate flint: white square, natural exposures, white circle, prehistoric exploitation points. Cross, outcrop of Świeciechów flint. Cross in circle, Magdalenian sites: 1, Ćmielów 95; 2, Podgrodzie 16; 3, Podgrodzie 18; 4, Janików 78; 5, Jankowice 49; 6, Zawichost Trójca 29 and 30; 7, Kolonia Seredzice 7; 8, Iłża.

hill forming the culmination of a promontory and located approximately in its central part. The site yielded an inventory of more than 17,500 artefacts, mostly flint specimens – cores, debitage products and tools, primarily from chocolate flint, sometimes "Turonian" flint, including Świeciechów flint and occasionally from other types of raw flint (Przeździecki *et al.* 2011a, b, 2012).

METHODS OF BLANK REMOVAL AND TOOL REFINEMENT

Preliminary results of the analysis have shown that the economy of the Magdalenian groups occupying the area of the excavated sites was largely based on the exploitation of high-quality, local varieties of raw flint,

inter alia, chocolate flint, various types of Turonian, striped or the so called Rauracian flint. The technological analysis of materials from the sites at Podgrodzie and Ćmielów, corroborated by the results of application of lithic re-fitting research (*Figure 2*) alongside microscopic analysis, has allowed me to determine the strategy of flintworking and identify two methods of lithic reduction (which typifies also other Magdalenian sites), aimed at producing two types of blanks. More precise data on production methods and techniques recorded at Podgrodzie and Ćmielów sites were already presented in the separate papers (Przeździecki *et al.* 2011b, Pyżewicz *et al.* 2014).

The first one is related to the manufacture of large, relatively regular blades from single and double platform cores (the second striking platform typically performing a correction role), with the use of tools made from organic materials. The distinguishing characteristic of this method is a special procedure of preparing isolated point of the force adhibition on the surface of the striking platforms (*en éperon*), shaped to remove blades with precision and accuracy (cf. Pelegrin 2000, Sano *et al.* 2011, Surmely, Alix 2005, Valentin 1995: 150–157, 2000, 2008). The results of the conducted microscopic analysis have enhanced our knowledge pertaining to the instrumentary employed for blank removal (cf. Byrne *et al.* 2006, Keeley 1980: 28, Pyżewicz 2013: 28–31, Rots *et al.* 2011, Vaughan 1985, 41–42, Vergès, Andreu 2011). Specific micro deformations of a limited range and analogous to the traces recorded on a comparative experimental material worked with the use of antler tools were noticed on the surfaces of butts and striking platforms of the artefacts under examination (*Figure 3: 1A, Tables 1, 2*).

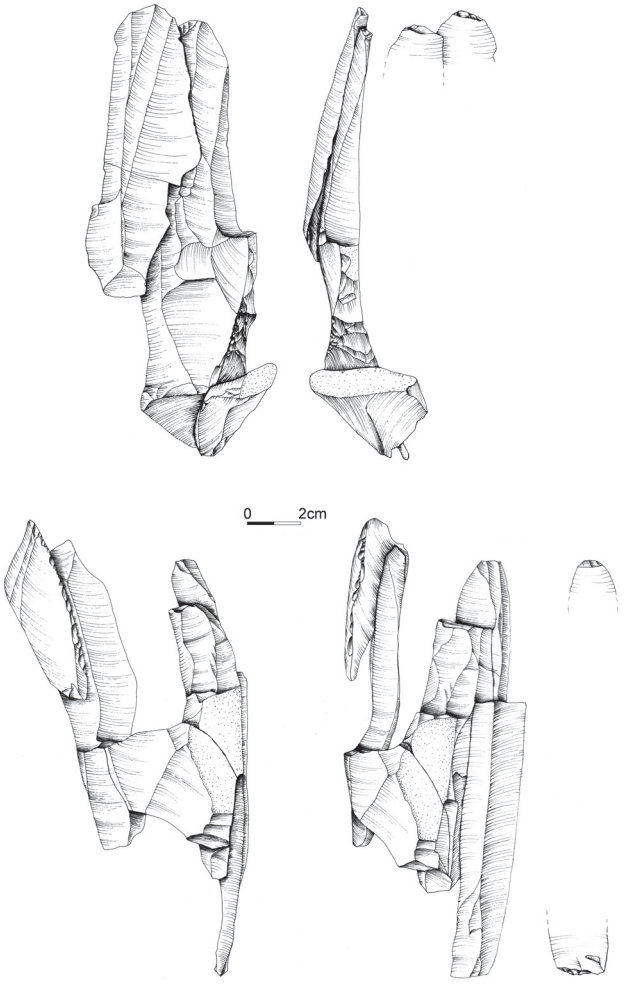

FIGURE 2. Refitted artefacts from Podgrodzie 16 presenting the strategy of blade reduction. Drawings J. Mugaj.

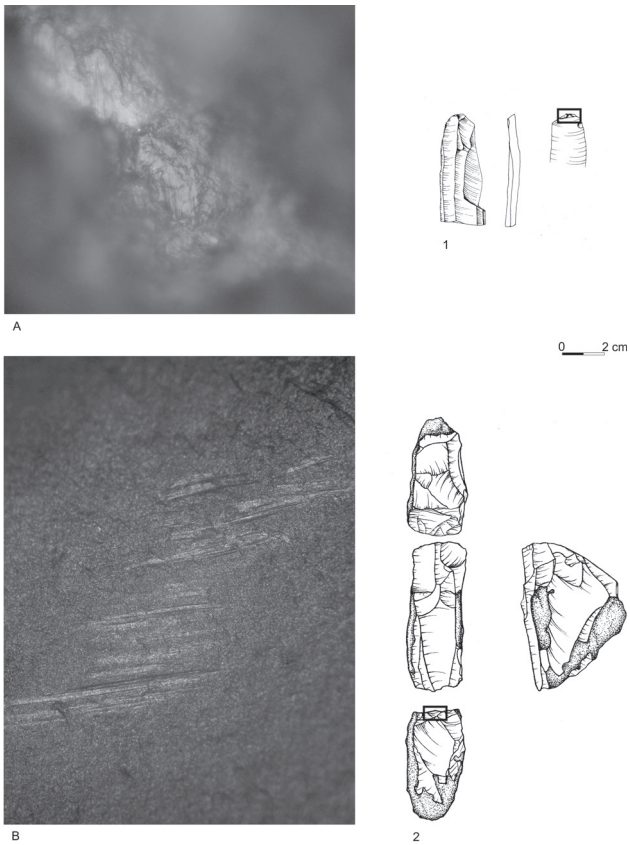

FIGURE 3. Lithic artefacts. 1, Podgrodzie 16, blade; 2, Ćmielów 95, core. A, technological microwear traces left by antler billet; original magnification 200×; B, technological microwear traces left by hammer stone; original magnification 200×. Drawings J. Mugaj and A. Czubińska. Photo K. Pyżewicz.

In some cases also wood could have supposedly been the material of choice for the manufacture of tools used for working particular specimens. Massive blade forms without modifications of their lithic structure indirectly bespeak of the possibility that such a technique was indeed applied. Regretfully, by reason of developed patina on the artefacts and due to the fact that in case of forms knapped with the help of a wooden hammer the resultant polish is typically of transient nature, the attempted verification of the technique turned out to be beyond the bounds of possibility. In case of the said artefacts devoid of any microscopic technological traces, the use of an antler hammer is also likely, as is evidenced by the results of analysis of experimental forms which have shown that some blanks worked by means of antler did not bear characteristic microwear traces (unlike flint replica manufactured with the help of a mineral hammer which reveal evident microscopic diagnostic features) (Pyżewicz *et al.* 2014).

The other method of production was related to the removal of bladelets from single and double platform cores. Technological features of this type of artefacts indicate that this method of flintworking consisted in the direct percussion technique with the use of a mineral hammer (cf. Libera, Migal 2009, Pelegrin 2000, Taylor 2012, Valentin 1995). Such bladelets were further retouched into small backed pieces. The described technological diversity is also reflected in the results of microscopic analysis. The striking platforms of small cores and the butts of the bladelets are covered by traces of distinctive striations – scratches and glossy bands, reflecting the trajectory of the hammers and the raw material they were produced from (*Figure 3: 2B, Tables 1, 2*).

Noteworthy are micro deformations of the flint structure recorded on some forms exploited by means of both organic and mineral hammers. Having resulted from abrasion or trimming the edge between a flaking surface and the striking platform with a stone, these marks are at variance with traces arising from knapping off blanks, orientation of striations and placement of the pressure point and do not coincide with the latter.

Given the results of microscopic analysis, it seems reasonable to propound that a soft organic hammer (of antler and perhaps wood) was used for producing long blades. In contrast, smaller nodules of raw flint were reduced with the use of a harder mineral hammer in a manner comparable to the Late Palaeolithic trends (i.a. Grużdź *et al.* 2012, Inizan *et al.* 1999). The foregoing methods of flintworking might have supposedly been applied within a single nodule. Hypothetically, exhausted cores which were in the first phase processed by dint of the method that comprised the isolation of points of the force adhibition, in subsequent steps of *chaîne opératoire* could have been worked by using the other technique. Unfortunately, this type of working has not been

TABLE 1. Podgrodzie 16. Types of microscopic traces of technique observed on the lithic artefacts.

	Total number of artefacts in the assemblage	Number of analyzed artefacts	Antler	Stone	None/undefined
Tools	119	47	-	1	46
Blades ans bladelets and their fragments	1231	114	53	10	51
Cores	1	1	-	-	1

TABLE 2. Ćmielów 95. Types of microscopic traces of technique observed on the lithic artefacts.

	Total number of artefacts in the assemblage	Number of analyzed artefacts	Antler	Stone	None/undefined
Tools	748	140	-	2	138
Blades ans bladelets and their fragments	2293	69	24	16	29
Cores	38	10	3	4	3

theretofore evidenced (e.g., by refittings) either in the assemblage from Ćmielów or Podgrodzie.

Importantly, another association between the selection of the raw material type and the technique used for the manufacture of blanks for different types of tools has been found, namely macrolithic specimens were produced from raw materials procured both from remote outcrops, i.e., mostly "Turonian", chocolate or striped flint, and from local sources, e.g., "Rauracian" flint, unlike small backed pieces – inserts, which were made almost exclusively from chocolate flint.

Further research has revealed that long blades removed by dint of the first of the foregoing methods were used as ready-made, unretouched tools or, alternatively, were formed into particular types of macrolithic specimens, e.g., endscrapers, perforators or burins. In contrast, small flint artefacts produced by means of the second technique of lithic reduction were typically formed into backed bladelets, with one or two edges retouched. In all likelihood, the final refinement of specimens involved the use of mineral tools, as evidenced by distinct striations, occurring in the form of wide, short and long, straight scratches heavily cut into the structure of flint as well as bands of polish, perpendicular or oblique to the edge of the specimen, their location related to the trajectory of the retoucher.

THE USE OF TOOLS

Patina and surface sheen, which in many cases covered the entire surfaces of flint artefacts recovered from the sites in Ćmielów and Podgrodzie, impeded a fully-fledged use-wear analysis of all artefacts. Their developed form virtually ruled out any observation of micro traces. The presence of patina was often noted with "the naked eye", while its effect on the readability of microscopic traces was verified using optical equipment. Therefore, the conclusions presented hereunder relate only to a representative group of specimens which state of preservation allowed for further, more detailed functional interpretations (*Tables 3, 4*).

Microscopic examination of artefacts from Ćmielów and Podgrodzie backed by experimental tests has shown that groups of particular types of flint tools were characterised by similar functional features (cf. Moss, Newcomer 1982, Moss 1983: 108–144, Sano 2009, 2010, 2012a, b, Sano *et al.* 2011, Symens 1986, Taller *et al.* 2012, Vaughan 1985: 49–104, Winiarska-Kabacińska 1993).

The small backed pieces under examination are likely to have comprised elements of composite tools – they could have been be fitted in individually or in series, on one or both sides of a haft or a handle (cf. Bosinski 2010, Pétillon *et al.* 2011) (*Figure 4*). Lateral insets are believed to have been used for a sole purpose. Distinctive macroscopic and microscopic traces on the surfaces of microlithic artefacts suggest that they were components of throwing weapons. Individual specimens are characterised by distinctive macro fractures. The analysed group of traces includes longitudinal breaks of tips (step or hinge terminating bendig fractures) of

TABLE 3. Podgrodzie 16. Types of use-wear traces observed on the lithic artefacts.

	Total number of artefacts in the assemblage	Number of analyzed artefacts	Hide	Hide + bone/ antler	Bone/ antler	Organic material	Projectile	Strike-a-light	Non/ undefined
Backed bladelets	27	18	-	-	-	-	4	-	14
Endscrapers	5	5	1	-	-	-	-	-	1
Perforators	15	12	-	4	5	-	-	-	3
Burins	18	11	-	-	4	-	-	-	7
Backed blades	1	1	-	-	-	-	-	-	1
Truncated blades	7	2	-	1	-	-	-	-	1
Blades and bladelets and their fragments	1231	29	-	1	1	-	-	1	26

TABLE 4. Ćmielów 95. Types of use-wear traces observed on the lithic artefacts.

	Total number of artefacts in the assemblage	Number of analyzed artefacts	Hide	Hide + bone/ antler	Bone/ antler	Organic material	Projectile	Strike-a-light	Non/ undefined
Backed bladelets	132	24	-	-	-	-	7	-	17
Endscrapers	75	14	5	1	-	-	-	-	8
Perforators	192	49	1	-	18	2	-	-	28
Burins	160	30	-	1	6	1	-	-	22
Backed blades	44	12	2	3	2	-	-	-	5
Truncated blades	35	9	-	2	-	-	-	-	7
Blades and bladelets and their fragments	2293	46	3	6	4	4	-	1	28

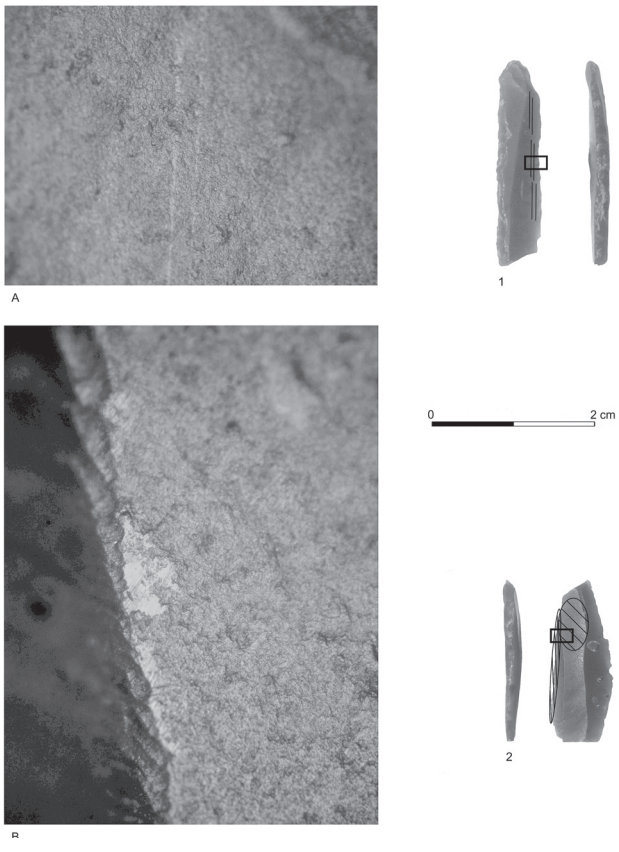

FIGURE 4. Backed bladelets. 1, Ćmielów 95; 2, Podgrodzie 16. A, linear impact traces, original magnification 100×; B, hafting traces, original magnification 100×. Photo K. Pyżewicz.

backed inserts, extending on flint surfaces. Furthermore, micro traces were noted on some artefacts, namely polishes, commonly in the form of long, shining, sometimes bright, in some parts disappearing bands, running on one or both surfaces of flint forms. In addition, I registered linear traces in the form of short or long scratches. Both types of microtraces were likely to be concurrent – particular scratches coincide with polish. Moreover, microscopic examination of some backed insets revealed hafting traces. Distinctive polish, wear along with rounded lateral edges and the ridges between scars occur in the area covered by retouch or nearby.

Implements typologically determined as endscrapers were primarily used for scraping hide (*Figure 5:2B*). The examination of the surfaces of the endscaper fronts revealed that the edges located between the positive surfaces of the tools and the surfaces covered with retouch were heavily rounded. Besides, parts located slightly above the described line, notably the convex parts, were polished. In addition, the analysed forms demonstrate polish typically on the surface of endscraper fronts and most evident on the protruding parts of retouch that shaped an implement. Analogous polish has been noted along the lateral edges of some endscrapers. On the other hand, there are differences regarding the arrangement of striations in the form of irregular long and short scratches or cuts of polished edges. In case of forms employed as scrapers, linear traces are arranged more or less perpendicularly to the working edge – such

an alignment has been recorded on the surface of endscraper fronts. Along the longer sides the scratches on the surface are more parallel to the edge and hence these pieces are believed to have been used for cutting. Additionally, some of these pieces manifest single traces resulting from the contact with antler or bones. The endscrapers under examination were assuredly fitted in some kind of hafts or handles made from undetermined organic material.

A wide variety of burin types were used for scraping, polishing, grooving, and cutting bone/antler or soft tissue (*Figure 5:1A*). The surfaces of the negatives of detached burin spalls were used for scraping or polishing bone/antler. Traces occasionally noted only at the tips of the negatives of the burin spalls of tools under investigation attest to the grooving movements. In other cases use-wear traces have been observed along the longer edges and their characteristics, i.e., the morphology of polish and linear traces suggest that these artefacts were used for processing, cutting animal soft tissue as well as bone/antler. Typological burins manifest traces of having been inserted in organic hafts as well.

Typological perforators and borers comprise a fairly unvaried group in terms of their function. The majority of them were employed for drilling into antler or bones (*Figure 6*). The examination of their beaks has produced distinctive, small polished bands or spots located on protruding lateral parts. Traces of hide working are evident on only one perforator. Given the location and morphology of traces registered on some small perforators and forms with multiple stings, it seems reasonable to conjecture that they were not used as drills. Instead, they were most likely employed for grooving organic material – making one, two or more grooves at the same time. The preserved evidence of contact between the tools and hafts imply that these specimens were sometimes set very deeply.

Becs from the assemblages under examination were used likewise. In some cases, notably when the stings were slightly rounded, these implements were employed in hide working (scraping), as is indicated by relevant traces.

The function of macrolithic backed blades and truncated blades was related to activities connected with cutting animal carcass, as evidenced by traces at the edge of tools, sometimes covering further parts of the surface (*Figure 7: 1A*). In addition, the investigation of forms which are likely to have been in intimate contact with bones revealed the presence of spots scattered along the edges, which typifies this type of raw material. Furthermore, hafting traces on the

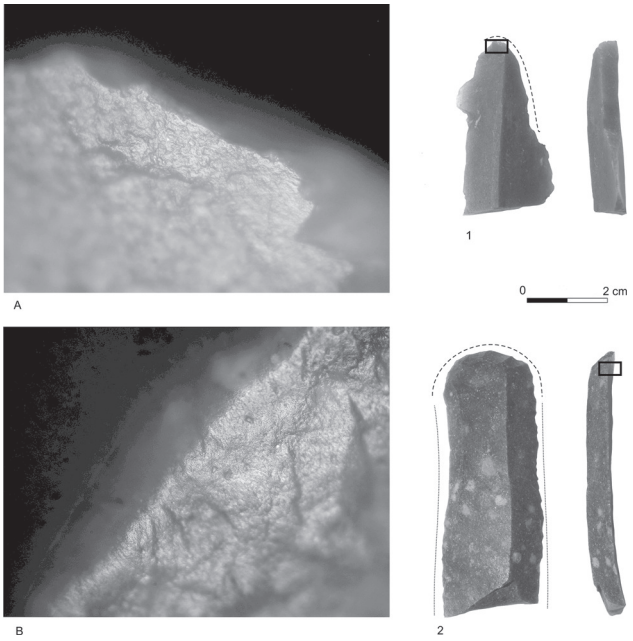

FIGURE 5. Lithic artefacts. Ćmielów 95; 1, burin; 2, endscraper. A, use-wear traces (working in antler/bone), original magnification 200×; B, use-wear traces (scraping of skin), original magnification 200×. Photo K. Pyżewicz.

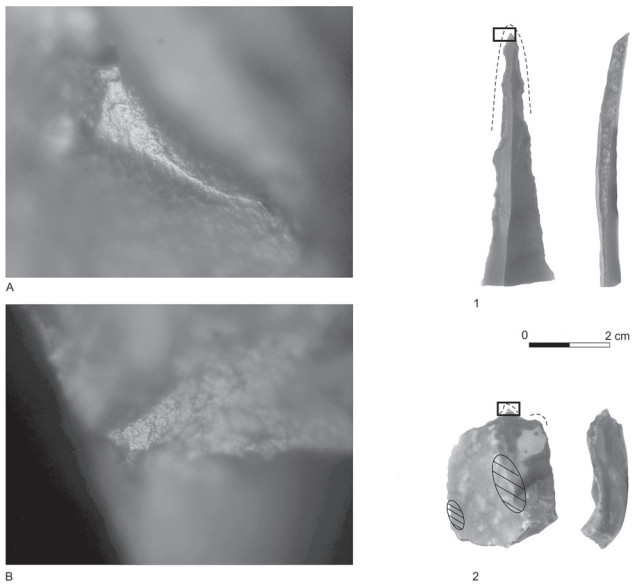

FIGURE 6. Lithic artefacts. Ćmielów 95; 1, perfortaor; 2, microperforator. A, use-wear traces (drilling in antler/bone), original magnification 200×; B, use-wear traces (drilling/grooving in antler/bone), original magnification 200×. Photo K. Pyżewicz.

surfaces of retouched edges in all likelihood demonstrate that the said edges were shaped with a view to adapting the tools to the haft.

Used for working bone, antler, soft tissue, hides included, unretouched blades comprise the most diverse functional group. Owing to the form of lateral edges, most of them were used for cutting organic material – use-wear has been typically observed along one lateral edge, sometimes along both. In individual cases, protruding tip parts were heavily crushed – heavy rounding and polishing are evident on working edges. The results of microscopic analysis have shown that these pieces were used for processing mineral raw materials, and most likely fulfilled the function of a "strike-a-light" (*Figure 7: 2B*). At least some of the analysed blades were set in hafts and some were possibly also intentionally broken to enable their hafting.

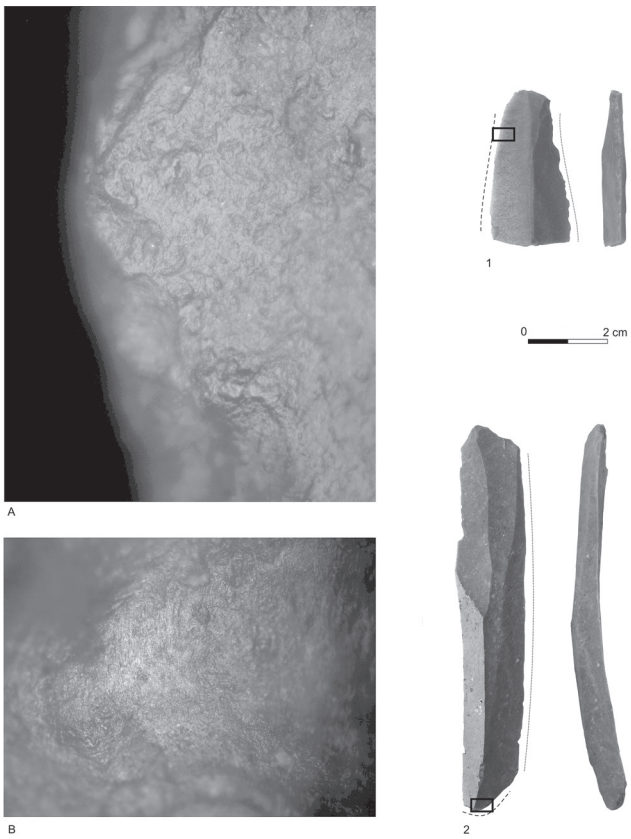

FIGURE 7. Lithic artefacts. 1, Ćmielów 95, backed blade; 2, Podgrodzie 16, blade. A, use-wear traces (butchering activities), original magnification 200×; B, use-wear traces (strike-a-light?), original magnification 100×. Photo K. Pyżewicz.

CONCLUSIONS

The foregoing findings appertain to the procurement of raw flint, production and use of flint tools attest to an informed and careful choice of the Magdalenian groups at different steps of *chaîne opératoire*, excellent knowledge of local outcrops, as well as a high level of practical knowledge. The knowledge of the resources was principally based on the penetration of the surrounding areas – a number of deposits of chocolate, striped, "Rauracian" or Ożarów flint are located within a 10 km radius and deposits of Świeciechów flint are available at a distance of approximately 20–25 km in a straight line.

As regards the results of technological analysis, both flint materials produced by archaeological sites at Podgrodzie and Ćmielów reflect two methods of working raw materials, related to the production of macrolithic tools as well as small blanks. The employment of the two said methods entailed a varied tool instrumentary, as is corroborated by results of microscopic analysis.

To conclude, owing to the results of microwear studies, relations between particular types of tools and their real use became perspicuous. Individual arrays of flint tools were used for activities related to hunting and processing animal carcasses. Only in a few cases the examined flint artefacts were used for other purposes such as working mineral resources. No significant differences regarding the methods of using tools have been noticed between inventories from Ćmielów and Podgrodzie, regardless of the different functions of the two sites attributed to them on the basis of the number and quality of portable finds and recorded features. The Magdalenian remains in Ćmielów are believed to be the relics of a base camp, probably with a longer history of habitation, as is evidenced by unearthed remains of a domestic structure and other features along with substantial quantities of recovered artefacts. On the other hand, the site in Podgrodzie is interpreted as remains of a flint workshop and a short-term occupation (cf. Połtowicz 2013: 154–178). Unfortunately most of the artefacts form the analysed assemblages were excavated from the top soil and hence it was impossible to undertake precise spatial analysis, which could confirm short term activists in different working areas. In the light of the results of traceological analysis, Magdalenian communities performed a whole range of activities at both sites. Remarkably, the vast majority of tools are not marked by intensive use-wear, which would suggest a short-term nature of undertaken activities. The

transience of tool usage could have resulted from the lack of regimented access to resources (raw flint was in abundance in these areas), or alternatively frequent repairs of tools to improve their effective usage.

Last but not least, a truly comprehensive "biography" of all flint tools which make up the material remains of the Magdalenian communities could not have been written due to postdepositional factors, poor development of particular use-wear characteristics, as well as for other reasons.

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