Morphological and Functional Differentiation of the Early Neolithic Perforators and Borers – a Case Study from Tominy, South-Central Poland

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Abstract: This contribution presents a collection of 68 typological perforators and borers discovered during excavations conducted in 2006–2009 at site 6 in Tominy, Opatów district (south-central Poland), which is currently one of the largest collections of such tools across the territorial range of Linear Pottery Culture (LPC). In the light of previous findings from the area of Poland, that collection is characterized by a very unusual material structure (domination of Świeciechów flint), as well as the degree of morphological diversity (high share of forms with clearly shaped, intensively constricted points, including the Vedrovice perforators). The results of conducted microwear analyses indicate a relatively limited range and method of practical usage of particular pieces, i.e. as a tool primarily intended for processing (mainly drilling) of bone/antler. It indicates indirectly the functioning within the settlement in Tominy of a workshop specialized in processing these raw materials, for the production of specific products.

Keywords: perforators, borers, early Neolithic, Linear Pottery Culture (LPC), morphological and microwear analyses

Introduction

Perforators and borers are among the most distinctive – in terms of morphology – components of tool instrumentarium of early agrarian communities both in the Anatolian-Balkan region, as well as in areas bordering the Danube (e.g. Gatsov 1987: 46–47; 2009: 50–98; Kaczanowska and Kozłowski 2012: 164–167). Their presence in early Neolithic European inventories is particularly marked during the development of Linear Pottery Culture (LPC), and confirmed in the whole of its territorial coverage (e.g. de Grooth 1977: Tab. 12; Löhr *et al.* 1977: 231–236; Cahen *et al.* 1986: 32; Larina 1999: 44; Allard 2005: Fig. 21). Their occurrence has been documented throughout the entire period of development of this formation, starting from the oldest, pre-music note phase (e.g. Tichý 1962: 269; Gronenborn 1997: 90–91), clearly intensifying in the younger stages of its development (Mateiciucová 2008: 88–89).

Despite such an extensive chronological and territorial spread of occurrence of these two categories of tools in context of LPC pottery, and in some cases also numerous representations within particular inventories, their percentages definitely are inferior in relation to frequencies of most other forms of prepared tools, especially endscrapers, truncated blades and retouched blades and flakes. This is clearly reflected in the collective structures of numerous tool inventories from central and western Europe, generally revealing the very low content of perforators and borers, oscillating to amounts of only a few percent, and only occasionally a little higher, i.e. between 10 and 15% (e.g. Davis 1975: 42–51; Kaczanowska 1985: 44–45; Gronenborn 1997: 91). These proportions have remained at a similar level over the entire period of LPC development, regardless of the classification of individual inventories in the context of the internal periodization of this formation (Mateiciucová 2008: graphs 18–19).

Perforators and borers in LPC inventories of Poland

The data obtained from the area of Poland correspond very well with this general picture. In the light of the current state of research, the presence of perforators and borers has been recorded across all clusters of LPC settlement, known both from the area of the Polish Lowland, as well as upland areas in the basins of the upper Vistula and Oder. Their sporadic presence has already been documented in some units of the pre-music note phase of LPC (Małecka-Kukawka 1992: 65; Kukułka 2001: 35; Grygiel 2004: Tab. X, XIV; Kabaciński 2010: 204), but much more often and in greater numbers in inventories corresponding to the classical and late stage of LPC development (e.g. Kozłowski 1970: 83–85; Milisasuskas 1986: 134–135; Kowalski 2007: 56). Regardless of the stylistic ceramic context of particular units, the overwhelming majority of them provided

a very small series of perforators and borers, mostly represented by a single or up to few pieces, representing usually up to 10% of prepared tools (e.g. Kozłowski 1970: Tab. II; Kaczanowska and Lech 1977: 14; Lech 1979: 129; Kaczanowska *et al.* 1987: 102, 107; Wilczyński 2014: Tab. 7), and only occasionally more (e.g. Breitenfellner and Rook 1991: 14, 17). Only in the case of several sites has a greater number of these types of tools been recorded. The largest of them is the collection from site 4 in Cracow-Olszanica, Cracow district, including a total number of 73 pieces, of which 40 are perforators and 33 are borers (Milisasuskas 1986: Tab. 74),[1] being the most numerous, and until recently the only such large series of these types of tools in the whole basin of the Vistula and Oder. Also of extreme interest is the large, but unspecified precisely, set from site 1 in Karwowo (Police district, West Pomeranian Voivodeship) represented by 'several dozen' perforators and borers, obtained mainly from a single LPC object and represented by very fine, almost microlithic specimens with clearly marked, very soft points (Kowalski 2007: 36). This modest list of the richest inventories includes very numerous, and at the same time a very unusual set of perforators and borers obtained in recent years at site 6 in Tominy, Opatów district, Świętokrzyskie Voivodeship. Its presentation, especially in the context of raw material and the morphological and functional differentiation of individual pieces, is a fundamental objective of this contribution.[2]

Morphological and functional differentiation of perforators and borers

Despite the low occurrences and usually small numbers of perforators and borers in LPC inventories, these tools have a significant degree of morphological and metrical diversity, resulting on the one hand from the type and size of blanks used for their production, and on the other from varying degrees of shaping and method of formation, as well as metric parameters and location of points. This diversity was emphasized in current literature (e.g. Kozłowski 1974: 20; Balcer 1983: 66) and often were reflected in the uneven typological classification systems developed for different regions (e.g. Kaczanowska 1985: 14; Cahen *et al.* 1986: 32; Allard 2005: 63–64; Mateiciucová 2008: 175, graph 19). In the light of the current state of research, among the findings from the area of Poland, by far the largest group are forms made of blades, represented on the one hand by pieces provided with weakly distinguished, rather stocky and massive points, located on the point of contact of two gradually converging retouched edges of blades, and on the other by forms with well distinguished and carefully formed, thin and delicate points (e.g. Kaczanowska and Lech 1977: 14; Lech 1979: 129; Balcer 1983: 66; Mateiciucová 2008: 88–89). Among the latter ones, by far the most effective group of finds are the Vedrovice-type perforators, distinguished by especially precisely formed, highly elongated, and at the same time very narrow and thin points, located often within proximal parts of the blades (Kaczanowska 1980: Abb. 4, 1985: 14). This type of perforator has been defined on the basis of findings from the eponymous site of Vedrovice-Zábrdovice, Znojmo district, connected with the music note phase (Ondruš 1975–1976: 136–137), but the occurrence of similar forms was emphasized in relation to the oldest stage of LPC development (e.g. Tichý 1962: 269, Obr. 9: 3–5; Kaczanowska 1980: 87) and was interpreted as a manifestation of the continuation of older Anatolian-Balkan traditions (Kozłowski 1970: 74). So far the presence of these types of tools on Polish territory has been recorded only at Spytkowice, Nowy Targ district, and Brzezie, Wieliczka district, where they have been discovered in the context of pottery decorated in the music note style (Dryja 1998: ryc. 1; Wilczyński 2014: Tabl. XX: 12–18).

In addition to perforators and borers made of blades, flake forms are also known from LPC inventories of Poland, usually shaped with stocky, thick and short points, located generally within the distal parts of the blanks. They were produced mainly of flakes with wholly or partly flaked (e.g. Balcer 1983: ryc. 8: 14, 18–19; Lech 1981: ryc. 1: n; Breitenfellner and Rook 1991: ryc. 6: o; Grygiel 2004: ryc. 130: 7; 210: 5), and only occasionally completely natural dorsal surfaces (Kaczanowska *et al.* 1987: Pl. VII: 13), originating from very different stages of preparation and exploitation, as well as repair and modification of blade and flake cores. These forms usually occur in very low numbers within particular inventories, generally revealing much lower frequencies in relation to pieces made of blades. This corresponds to observations made at many other LPC sites in central and western Europe (e.g. Bender 1992: Abb. 195; Gronenborn 1997: Abb. 3.29), reflecting – as it seems – some general preferences in the selection of blanks for production. Inventories from Bolechowice-Zielona, Cracow district, and Cracow-Olszanica, Cracow district, deviate from this principle, revealing the clear outnumbering of flake forms (Milisauskas 1986: Tab. 75; Breitenfellner and Rook 1991: 17). In the case of the Cracow-Olszanica sites, their clear dominance was also recorded in the assemblages of typological perforators, while among the borers the forms made of blades clearly prevailed (Milisauskas 1986: Tab. 75).

The high degree of morphological diversity of the perforators and borers suggests the uneven extent of their distribution and practical application by early Neolithic communities. It seems to confirm the results

[1] Despite such a large number of perforators and borers, their share in the overall tool-structure of the site was estimated at only 3% (Milisasuskas 1986: Tab. 77).

[2] The research was founded by the National Science Centre, granted pursuant to decision No DEC-2011/03/N/HS3/02016.

of previous use-wear studies, according to which these tools were used for the working of very different, mainly hard, organic and mineral raw materials, including wood, hide, bone/antler, shells, ceramic and stone (e.g. Cahen *et al.* 1986: 52–55; Caspar *et al.* 1989: Tab. 1; van Gijn 1990: 30–36; Vaughan 1994: Tab. II; Allard 2005: 209; Mateiciucová 2008: 90). This functional diversity only partially reflects the current data from the area of Poland. The evidence, however, is very modest and incomplete, since it concerns only a dozen examples, obtained from sites located mainly in the areas of the Polish Lowland, including, primarily, within Chełmno Land, and to a much lesser extent Kuyavia also. Among them the most numerous were drilling tools used for bone/antler processing, and – far less frequently – wood, some of which also had traces of hafting (Małecka-Kukawka 2001: 35–49; Osipowicz 2010: 160–180, 227). In particular cases the perforators for hide have also been identified (Małecka-Kukawka 2001: 43; Grygiel 2004: Tab. LII). Traces of wood and unclean, dry hide were also recognized on two pieces from site 62 at Cracow-Nowa Huta-Mogiła, Cracow district (Caspar *et al.* 1989: 192). So far, these are the only examples of typological perforators to have been subject to microwear analyses across the whole highland zone of LPC settlement in Poland. The results of research on pieces from Tominy that are presented in the following part of the article significantly increase this extremely modest source database for these terrains.

The assemblage from Tominy

Site 6 at Tominy is located within the south-eastern edge of the Iłża foothills, in the immediate vicinity (*c.* 1km) of the compact loess cover of the Sandomierz upland (Kondracki 1998: Fig. 38). It is situated at the culmination of the gentle, south-western slope of the headland, on the eastern edge of the steep-walled valley of a small watercourse, the so-called Wyszmontowski Stream (Fig. 1). The excavations carried out at this site since 2006 have led to the recognition of an area with a total extent of over 1ha, and the discovery of large quantities of remains of a multicultural, prehistoric settlement, including, in particular, the remains of an LPC settlement from the music note and early-Želiezovce phases. Several features and a rich collection of artefacts have so far has been associated with that horizon, including very large inventory of flints (Szeliga 2008: 9–13). Its raw material and morphological structure indicate the productive nature of the settlement, oriented on the processing of local varieties of Turonian flints, including primarily Świeciechów (grey, white-spotted) flint (Szeliga 2014: Figs 3–4).

Raw material differentiation and context of finds

The presented collection of artefacts was acquired in 2006–2009 and contains a total of 68 typological tools, including 63 perforators and only five borers (Fig. 3: 1; 4: 12, 16, 18–19), made mostly of Świeciechów flint and only occasionally of other types of flints and obsidian (Tab. 1). Only a small proportion (11 pieces) represent finds from features, obtained from only a few fixed objects (Fig. 2: 1–3, 5–6, 11, 17, 23; 4: 1, 6, 16). By far the largest part of the presented collection is represented by pieces discovered from within layers outside the features, i.e. in humus, especially deluvial layers. Their connection with the LPC is justified on the one hand by the fact that they were obtained in the area of the greatest concentration of permanent relics of the Early Neolithic settlement, within the excavated part of the site, and on the other by the high morphometric convergence to both the artefacts obtained from the features and those pieces from other sites of that culture.

State of preservation

In terms of preservation, the analyzed collection is characterized by the quantities of incomplete pieces, represented both by fragments of tools with partially, or completely broken points or, sometimes, opposite parts (Fig. 2: 22–24, 28), and by various fragments of points, bearing traces of single or double-sided breakages (Fig. 2: 1–2, 6–12). Entirely preserved perforators and borers represent a much smaller group of finds (26). Some of them are also characterized by macroscopic usable chipping on the vertices of points (Fig. 2: 16, 22; 3: 17; 4: 18), which also indicates the partially transformed and incomplete state of preservation. Such findings, linked to the clear predominance of incomplete forms, creates serious difficulties when it comes to interpreting particular pieces, and at the same limiting the ability to make a correct and reliable typological classification of the entire collection.

Blank

The material analysis of perforators and borers reveals the clear dominance of pieces produced from blades (61). The overwhelming majority of these was made of blades from more or less advanced phases of the exploitation of single platform cores, manifested by the presence of completely negative (34 finds), or partially – mainly longitudinally – natural (25 finds) dorsal surfaces, and by the compliance of scar orientation with the direction of blade removal. Only two finds represented forms made of blades with completely natural upper surfaces (Fig. 3: 2, 13). Regardless of the nature of dorsal surfaces, the current sizes of the complete and slightly reduced samples allow us to assume that quite narrow blades (with lengths of up to *c.* 50mm, and only occasionally larger) were selected primarily for the production of perforators and borers (Fig. 2: 21, 27; 3: 4–5, 13; 4: 2–3). Most of these were also characterized by parallel or narrowing of their edges

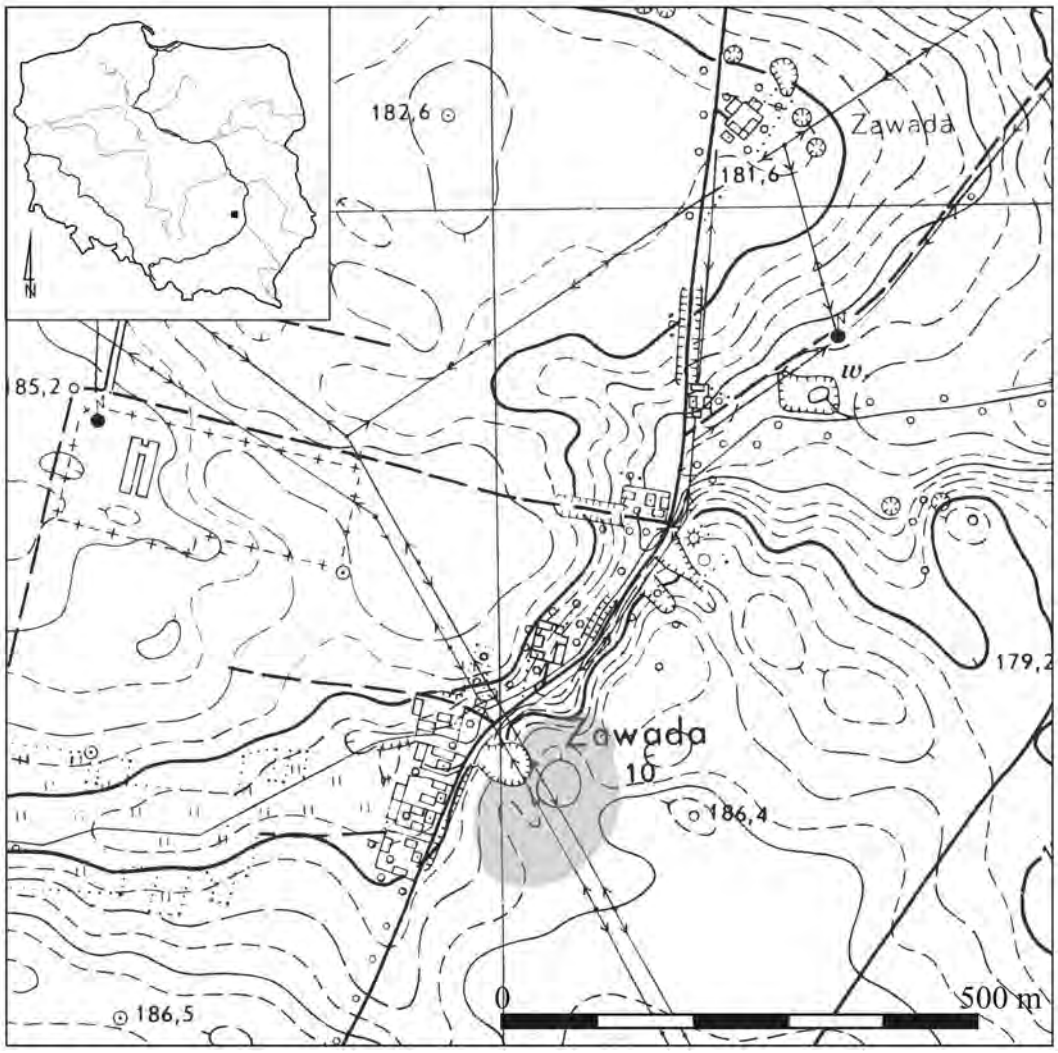

Fig. 1. Tominy, site 6, Opatów district. Location and extent of site (fragment of map 145.313 Bidziny, scale 1:10 000; published by the Main Centre of Geodetic and Cartographic Documentation in Warsaw, Warsaw 1979. Graphic design: M. Szeliga.

to the distal end and distinct curvature of the apical parts. These properties naturally determined the distal location of points and their symmetrical arrangement in relation to the *débitage* axis of the blank, as well as a more or less claw-like nature – the predominant features of the tools analyzed (Fig. 2: 14–15, 19). The dominant collection of blade tools is supplemented by forms made of flakes, represented by only 3 borers and 4 perforators (Fig. 4: 13–19). Next to non-distinctive negative or cortical flakes of undefined technological origin (Fig. 4: 15, 17), products of secondary reduction and transformation of blade cores were used for their production, with fragments of the negatives of blade removal on their dorsal surfaces (Fig. 4: 13–14, 16, 18–19). These forms have generally well distinguished and elongated points, located symmetrically each time within the narrower and thinner parts of the blanks, and most frequently (but not always; see Fig. 4: 13, 15, 17) on their distal ends.

Formal differentiation

Despite the above-mentioned limitations of interpretation, arising from the incomplete state of preservation of most of the pieces, analysis of the degree of separation, and the method of forming and size of their points, reveals two basic formal varieties of perforators/borers, showing fairly clear differences in this respect. The first group is represented by blade forms with well distinguished, slender and elongated points, the production of which was connected with intense transformation of the natural course of the side edges of blades and prominent reduction of their basic width (Fig. 2). This highly advanced and precise processing led to the shaping of extremely narrow and delicate points, with minimum widths of even 1.5–2mm (Fig. 2: 3, 8). Most often this was the result of the radical narrowing of a partially or completely retouched (Fig. 2: 14–15) fragment, and, to a much lesser extent, the

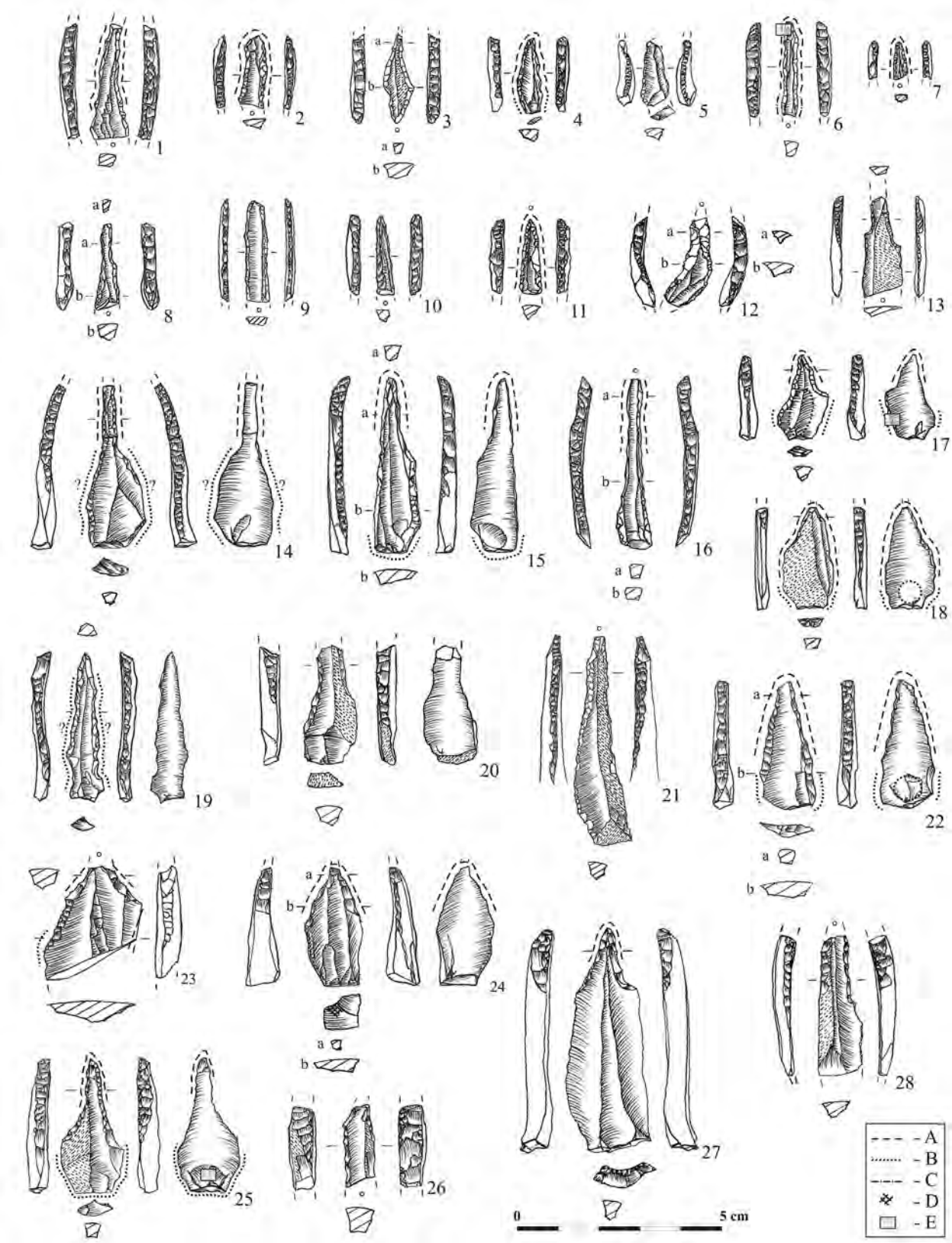

Fig. 2. Tominy, site 6, Opatów district. Perforators and borers discovered between 2006–2009: 1–2, 11 – feature No. 94; 3, 5–6, 17, 23 – feature No. 108; 4, 7–10, 12–16, 18–22, 24–28 – outside LPC features. Raw materials: 1–3, 8–10, 13–23, 25–27 – Świeciechów flint; 5, 7, 11 – Jurassic-Cracow flint; 4, 6, 28 – Chocolate flint; 12 – Obsidian; 24 – dark-grey Turonian flint.
Drawn: M. Szeliga, (1–2, 11–12; after Szeliga 2008: ryc. 3: 22; 14: 10–12). Character of microscopic traces: A – use-wear; B – hafting; C – use-wear/hafting; D – technological; E – photographed areas of tools, presented in Fig. 5–6.

natural (Fig. 2: 25, 27) edges of the blades. Moreover, in the case of several pieces, at least, the processing covers the entire, or almost entire, length of both edges of the blade blanks, leading to their complete transformation into types of particularly narrow and piercing points, mostly with single (Fig. 2: 1, 16), and occasionally with two oppositely situated vertices (Fig. 2: 3). In most cases the points were located within the distal, and only occasionally the proximal parts of the blades (Fig. 2: 11–12, 16, 21, 23, 28), and shaped with abrupt retouch, with values often close to right angles. A few pieces also presented evidence of additional thinning treatment – to a very limited extent (i.e. to the very vertices of the points) within the dorsal surface of the blank (Fig. 2: 6, 25).

In terms of the degree of separation and final dimensions of the points of particular pieces, as well as their large number, the group of tools under discussion represents a unique collection in terms of known LPC discoveries from the area of Poland, with rare and not particularly close analogies elsewhere. This applies particularly to some blade perforators with long and slender points located at the proximal or distal parts, and much broader, usually un-retouched, opposite parts (Fig. 2: 1, 12, 14, 16, 21). These pieces reveal accurate morphological references to Vedrovice-type perforators, so far known only from Spytkowice, Nowy Targ district, and Brzezie, Wieliczka district (Dryja 1998: 146; Wilczyński 2014: 506). It is very likely that this type is represented also in the Tominy inventory by some fragments (Fig. 2: 6–8, 10, 20, 23, 28).

From the discussed pieces, the second group of perforators and borers, made of blades and flakes, clearly differs, generally manifested by a greater size (especially thickness) and weight (Fig. 3–4). The selection of such blanks had a fundamental influence on the morphometric properties of finished tools, especially on their final parameters and dimensions of points. These points are usually quite wide and stocky, and at the same weakly distinguished and gently tapering to the top, due to a slight reduction of the initial width of the blades and flakes, only slightly distorting the natural course of the edges. They were located each time on the narrower and thinner parts of the blank, primarily within their distal and only exceptionally their proximal (Fig. 3: 10; 4: 9, 17) parts. The extent of retouch has a fairly high degree of differentiation, including both relatively small sections of the side edges of the blanks (Fig. 3: 7, 13) as well as the substantially larger or even whole extent (Fig. 3: 8–9, 12, 18) of their course. As in the case of the previously described pieces, the vast majority of the points was formed solely by retouch of the side edges. Only occasionally did the processing include also the dorsal and/or ventral side of the blank, and only within the apical part of the point (Fig. 4: 2, 13).

Functional differentiation

All the previously mentioned typological perforators and borers have been subjected to microwear analyses. Its main purpose was to try and determine the actual destination, range and usage of particular pieces, especially within the context of the observed morphological diversity. The research was carried out using the methods and instruments commonly used in microwear analyses. The tools were analyzed at magnifications of 50x, 100x and 200x, revealing the precise locations and detailed identifications of various traces, i.e. micro-flake scars, linear traces and polish. Interpretations of all observed deformations were carried out on the basis of comparative studies; microscope images of surfaces of the Neolithic pieces was referenced to the experimental forms, used in all kinds of activities.

During the preliminary analysis all the potential deformations were identified that were caused by post-depositional factors. It was possible to conclude that most of the artefacts do not have extensive evidence of this type of wear. Such damage occurred mainly in the form of a more or less intense surface sheen related to the location of the artefacts in the sediment (e.g. Plisson and Mauger 1988: 4; van Gijn 1990: 53; Levi-Sala 1993; 1996: 31–32, 71). Such changes were particularly visible in the items made of chocolate flint, but generally they were not intense enough to impede or prevent the interpretation of the microscopic image. Their occurrences mostly influenced the ability to identify hafting traces, which are usually slight, and on the interpretation of usage polish, tending to be poorly developed. Apart from the surface sheen previously mentioned, the second type of post-depositional deformation recorded on particular flint pieces was the damage caused as a result of their contact with high temperatures.

We may summarise, that the presence of these effects of post-depositional factors did not allow to recognize the location and identification of potential microscopic traces of usage in 23 (*c.* 33.82%) of the analyzed tools. In this group, 11 tools were characterized by the presence of fractures, micro-flake scars or the crushing of points, indirectly confirming their use in an unspecified way.

Only a few pieces recorded microscopic traces of the processing methods used. On the surfaces of two preserved butts (Fig. 2: 24; 3: 14) were traces of contact with stone tools visible, suggesting that hammerstones were used for acquiring blanks intended for use as perforators. In turn, on the third piece (Fig. 4: 1), in the areas of the bulb parts of the scars of the chips forming the point, there were clear line traces revealing the trajectory and nature of the stone retoucher. The detailed use-wear research (Tab. 1) revealed that most of

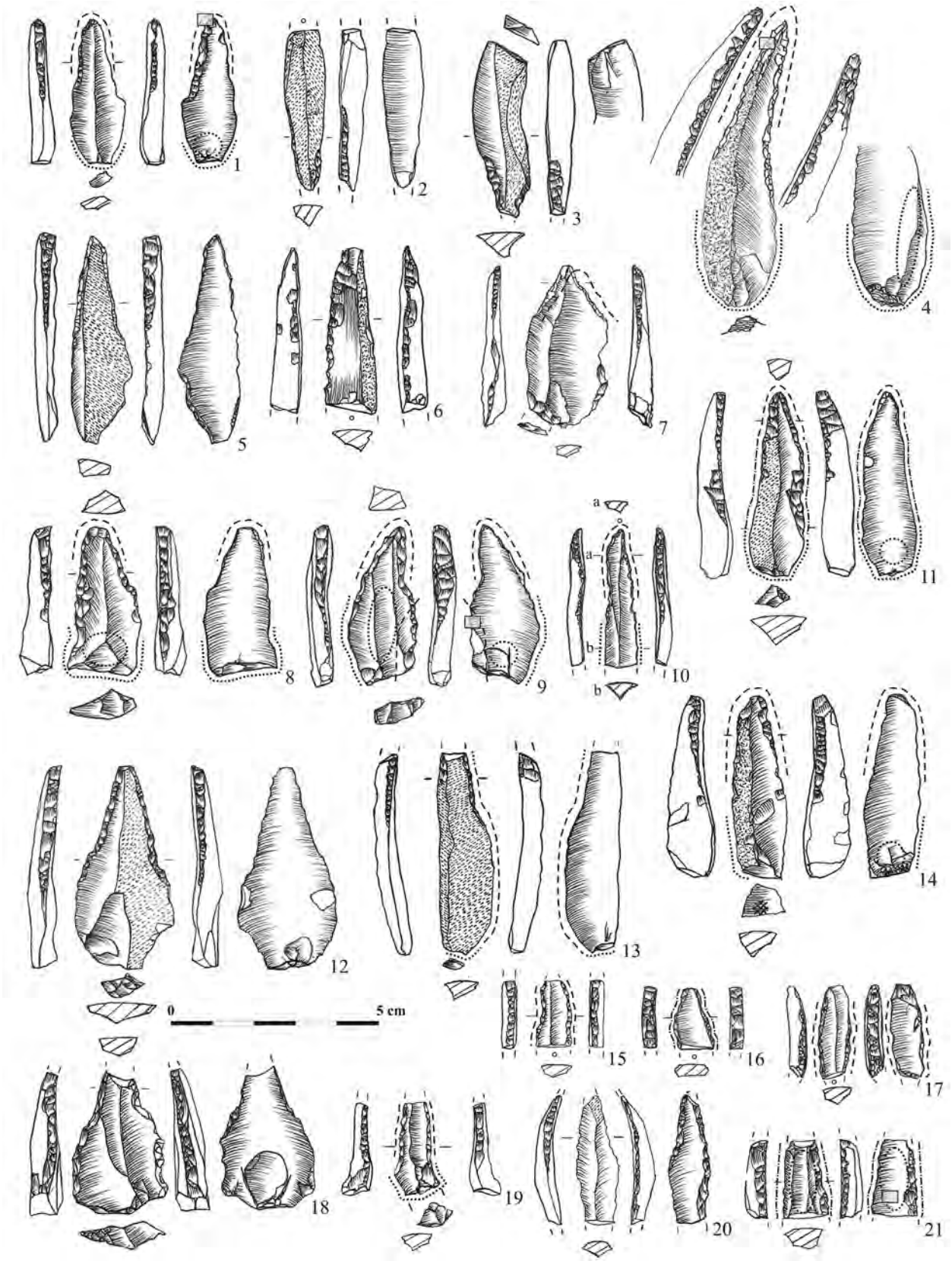

Fig. 3. Tominy, site 6, Opatów district. Perforators and borers discovered outside LPC features between 2006–2009. Raw materials: 1–9, 11–16, 18–19, 21 – Świeciechów flint; 10 – Jurassic-Cracow flint; 17, 20 – dark-grey Turonian flints. Drawn: M. Szeliga. Character of microscopic traces according to Fig. 2.

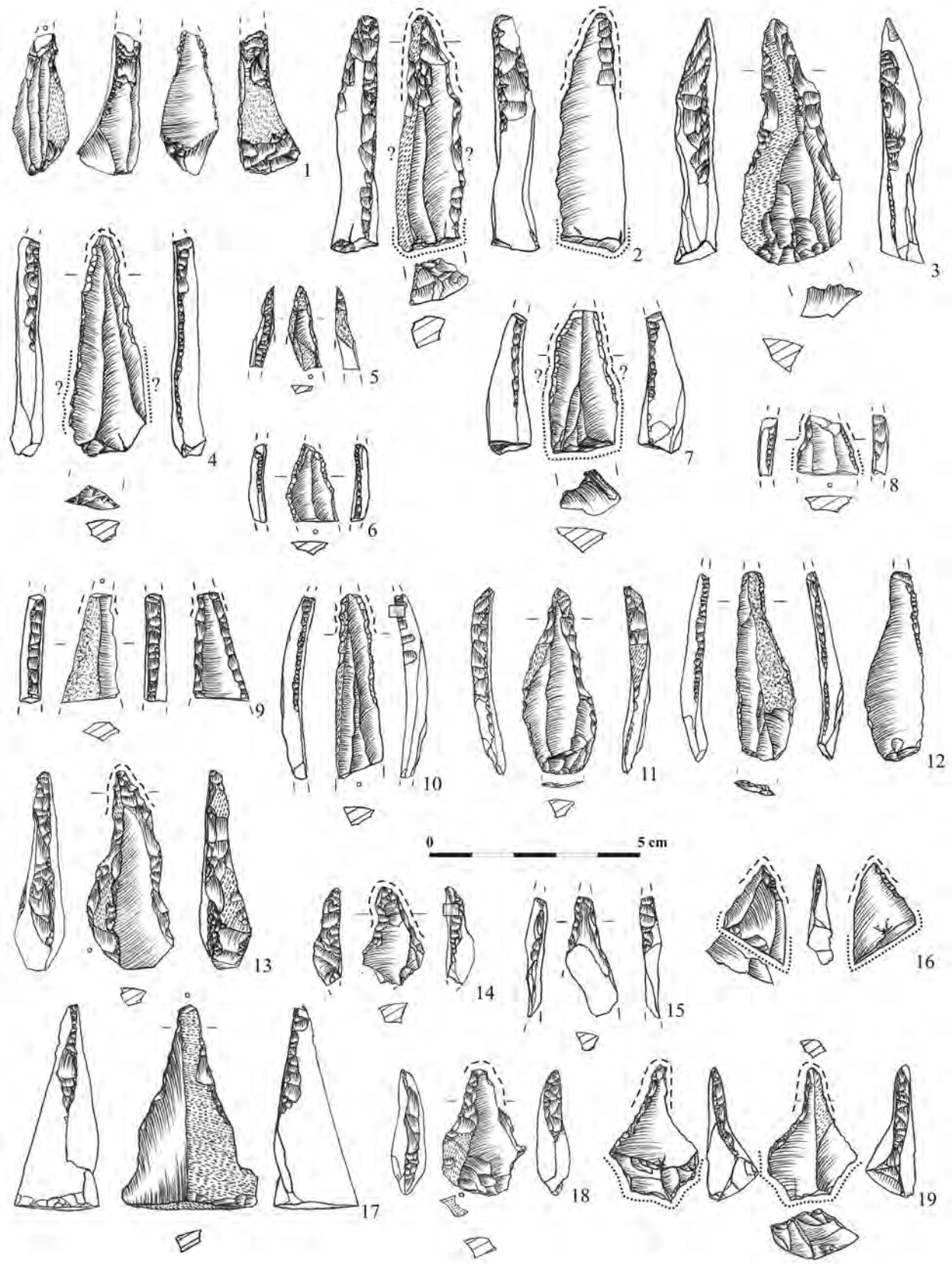

Fig. 4. Tominy, site 6, Opatów district. Perforators and borers recovered between 2006–2009: 1 – feature No. 39; 6 – feature No. 105; 16 – feature No. 50; 2–5, 7–15, 17–19 – outside LPC features. Flint raw materials: 1, 6, 14 – Chocolate flint; 2–5, 7–13, 15–19 – Świeciechów flint. Drawn: M. Szeliga. Character of microscopic traces according to Fig. 2.

artefacts, regardless of their parameters, raw material variation, morphological properties and typological classification (perforator – borer), were characterized by the presence of fairly uniform traces of usage. The microscopic polish recorded was usually the result of contact of the tool with organic materials (38 items). For locations where the traces were characterized by a more intense form, it may be concluded that the processed materials were mainly bones or antlers (based on the previous experimental studies it should be added that in some cases microscopic traces resulted from bone and shell processing can be similar), and sometimes also wood (e.g. Keeley 1980: 35–36, 42–49, 55–60; Moss 1983: 86–92; Vaughan 1985: 31–34; van Gijn 1990: 30–36; Juel Jensen 1994: 34; Pawlik 1995: 86–89; Korobkowa 1999: 38; Osipowicz 2005: 54–65; Fig. 5: 1–4). In the context of the described polish, some tools revealed the linear orientation of traces (Fig. 5: 1–2), indicating that the

Table 1. Tominy, site 6, Opatów district. Results of use-wear analysis of perforators and borers discovered between 2006–2009. Raw materials: Ś – Świeciechów flint; T – dark-grey Turonian flints; C – Chocolate flint; J – Jurassic-Cracow flint; O – Obsidian. Identification of use-wear traces: B/A – bone/antler; H – hide; W – wood; OM – undefined organic material; MM – undefined mineral material.

Lp.	Raw materials	Point			Hafting traces	Technological traces	Notes	Figures
		Polish	Breakage	Functional identification				
1	Ś	+	-	B/A?	-	-	-	4: 18
2	Ś	+	-	B/A?	-	-	-	3: 7
3	Ś	+	+	B/A?	+	-	-	3: 21; 6: 4
4	Ś	+	+	B/A or W	-	-	-	4: 13
5	Ś	+	+?	MM	+	-	-	2: 18
6	T	+	+?	B/A	-	-	-	3: 17
7	Ś	+	+	B/A	+	-	previous traces of siliceous plant cutting	3: 9; 5: 5
8	Ś	?						3: 5
9	C	+	-	B/A	-	-	-	4: 14; 5: 1
10	Ś	?						4: 3
11	Ś	+	-	OM	+	-	-	3: 8
12	Ś	?						3:18
13	Ś	+	-	B/A and H?	+	-	-	3: 11
14	Ś	+	-	B/A	+	-	-	3: 4; 5: 3
15	Ś	-	+?	?	-	-	-	3: 13
16	Ś	+	+	H	-	-	-	4: 10; 5: 6
17	Ś	+	+	B/A	+	-	-	2: 14
18	Ś	?						2: 8
19	Ś	+	+?	B/A	+	-	-	2: 22
20	C	-	+?	?	-	+	-	4:1
21	C	-	+?	?	-	-	-	2: 28
22	Ś	+	+	MM or/and H	+?	-	-	4: 4
23	Ś	+	-	B/A or W	-	-	-	2: 27
24	Ś	+	+	OM	-	-	-	4: 9
25	Ś	-	+?	?	-	-	-	4: 15
26	Ś	?						4: 11
27	Ś	+	+	B/A	+	-	-	4: 19
28	Ś	+	-	OM	+	-	-	4: 16
29	Ś	?						4: 17

Lp.	Raw materials	Point			Hafting traces	Technological traces	Notes	Figures
		Polish	Breakage	Functional identification				
30	Ś	?						2: 21
31	Ś	?						2: 13
32	Ś	+	-	B/A	+	-	-	2: 15
33	Ś	+	+	B/A	-	-	-	2: 1
34	Ś	+	+	B/A	-	-	-	2: 2
35	J	+	+	B/A	-	-	-	2: 11
36	O	-	+	?	-	-	-	2: 12
37	Ś	-	+?	-	-	-	-	2: 9
38	Ś	?						3: 12
39	T	+	+	OM	-	-	-	3: 20
40	J	+	+?	B/A or W	+	-	-	3: 10
41	Ś	-	+?	?	-	-	-	3: 2
42	Ś	?						4: 5
43	Ś	+	+	B/A or W	-	-	-	2: 26
44	Ś	+?	+?	H?	+?	-	-	3: 16
45	Ś	-	-	-	+?	-	-	2: 19
46	Ś	?						3: 3
47	J	+	+?	B/A or W	-	-	-	2: 7
48	C	+	+	B/A	+	-	-	2: 4
49	Ś	-	+?	?	-	-	-	2: 10
50	Ś	+	+	OM	+	-	-	2: 16
51	Ś	+	+	B/A	+	-	-	3: 1, 5: 2
52	T	+	+?	B/A	-	+	-	2: 24
53	Ś	?						3: 6
54	Ś	+	-	B/A	+	+	-	3: 14
55	Ś	-	+?	?	-	-	-	2: 20
56	C	-	+?	?	-	-	-	4: 6
57	Ś	+	-	B/A	+	-	-	4: 2
58	Ś	+	+	H	+	-	-	3: 13
59	Ś	+	+	OM	+	-	previous traces of siliceous plant cutting	2: 23
60	Ś	+	+	B/A	+	-	-	4: 8
61	Ś	+	+	B/A	-	-	-	3: 15
62	Ś	+	+	B/A	+	-	-	3: 19
63	Ś	+	+	OM	+	-	-	2: 25; 6: 1
64	Ś	+	+	OM	+	-	-	4: 7
65	C	+	+	B/A or W	+	-	-	2: 6; 5: 4; 6: 2
66	J	-	+?	?	-	-	-	2: 5
67	Ś	+	+	?	+	-	-	2: 17; 6: 3
68	Ś	-	+	?	-	-		2: 3

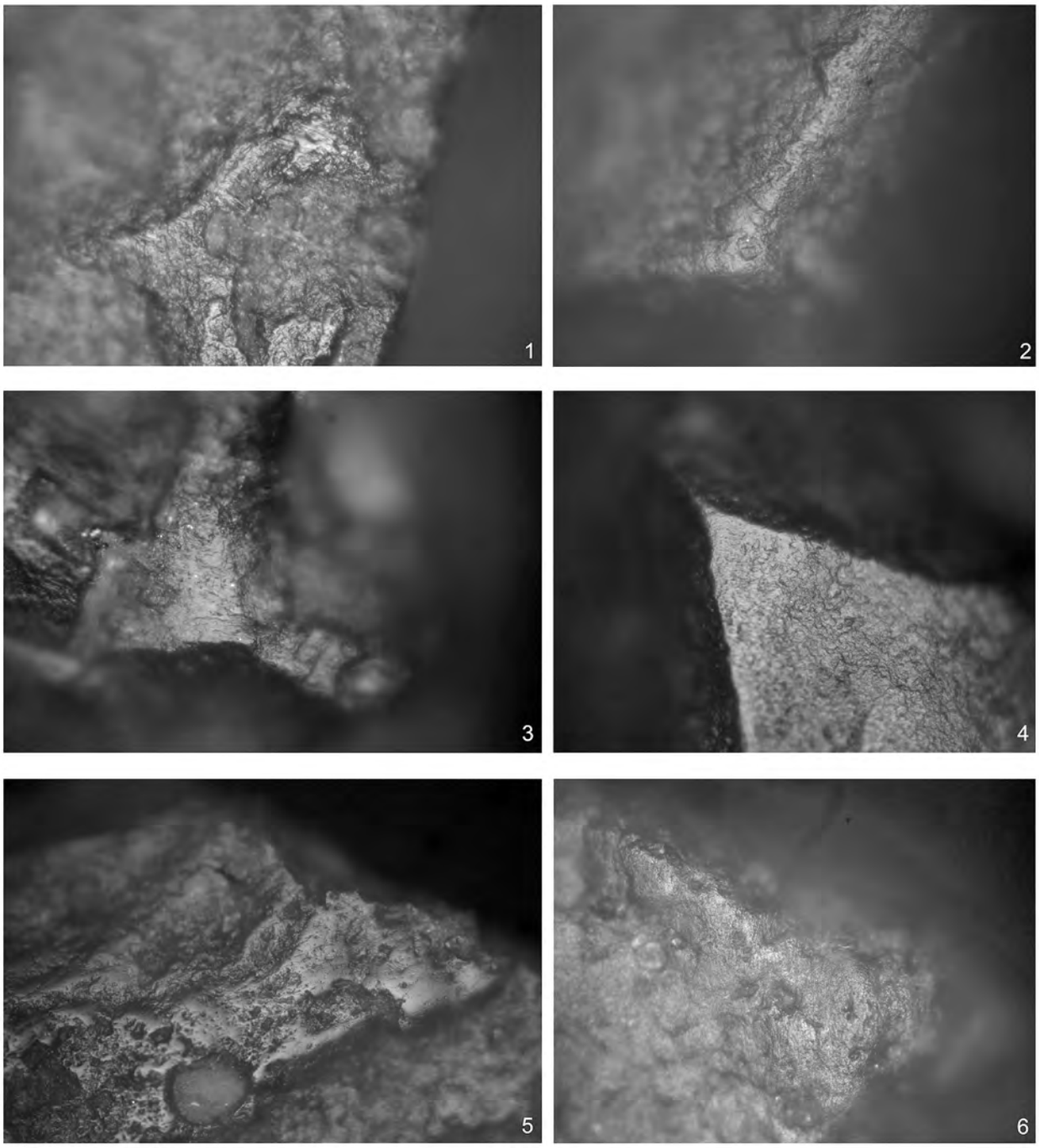

Fig. 5. Tominy, site 6, Opatów district. Use-wear traces related to the processing of: bone/antler (1–4); siliceous plants (5) and hide (6). Magnification: 200x (1–4) and 100x (5–6). Photo: K. Pyżewicz.

tools performed rotary movements. The microscopic traces often extend to the very large, protruding parts of points. In addition, usually the vertices of the points have been broken or crushed, probably during, or as a result, of the usage of the flint tools.

On the surfaces of tools other kinds of traces were also observed. These occurred in the form of a rounding of the protruding parts and polish spots, resulting from contact with organic material (Fig. 6). These traces have been located on the projecting parts of the artefacts (mainly on ridges), mostly on their non-retouched parts. These traces could be the result of mounting in organic hafts (e.g. Rots 2010). It is also possible that some of studied pieces, especially those with smaller parameters, were the components of more sophisticated 'devices' designed to drill holes.

Exceptions include usage traces of other types, recorded only on particular artefacts of larger size. These are

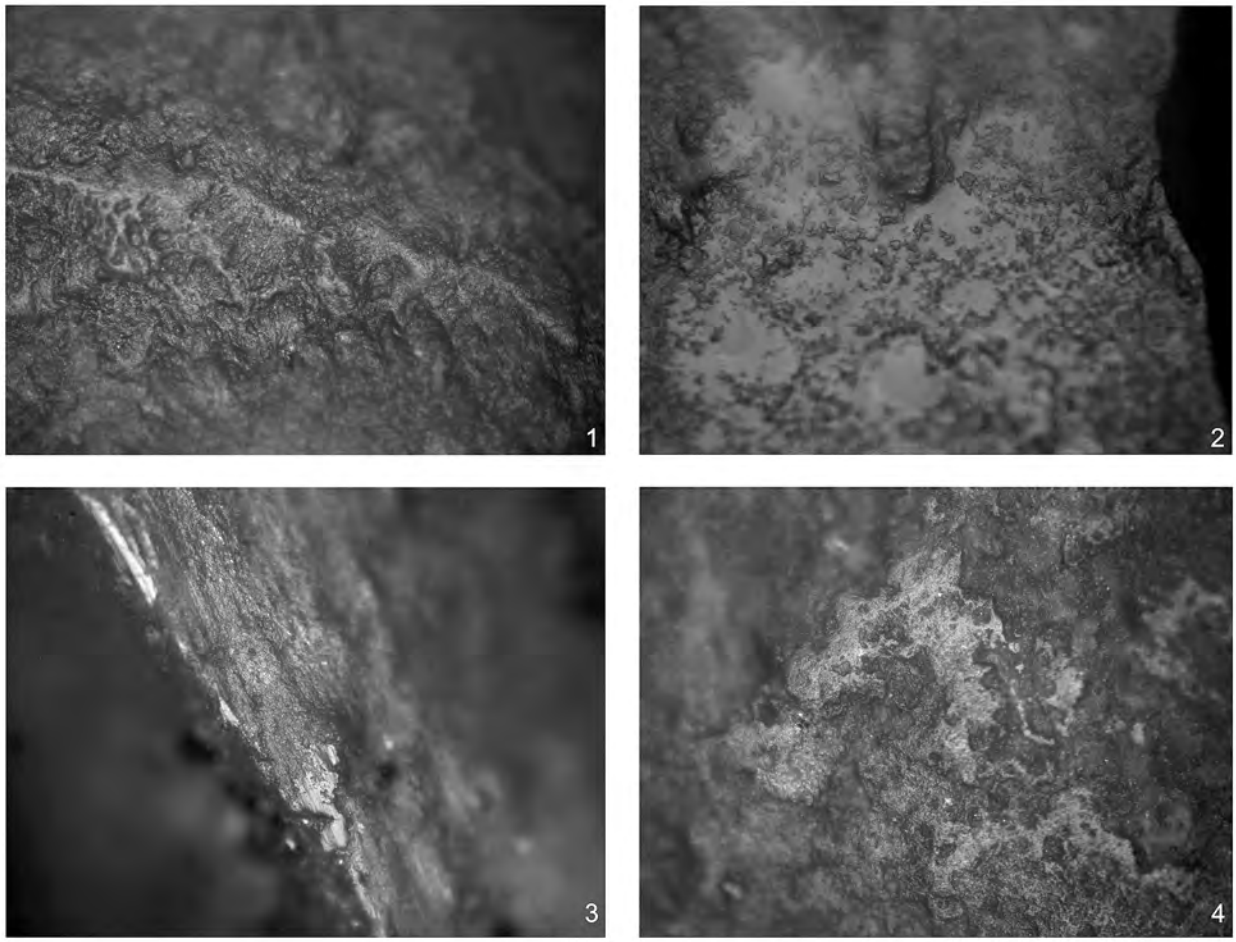

Fig. 6. Tominy, site 6, Opatów district. 1–4 – Hafting traces. Magnification: 200x (1, 3–4) and 100x (2). Photo: K. Pyżewicz.

deformations caused by drilling or cutting different types of materials, including unspecified mineral raw material, hide (Fig. 5: 6) or siliceous plants (Fig. 5: 5). On one of the examples of this type – a massive blade perforator (Fig. 2: 23) – traces of reuse were observed; some traces of plant cutting had been partially obliterated by retouch and the item reused as a borer. A second item in this group (Fig. 3: 13) has hide incision traces extending along the whole long edge, while traces of hafting were recorded at the proximal and distal parts. Another find – a large blade perforator (Fig. 4: 10) – was characterized by the presence of intense traces caused as a result of contact with hide, but their linear nature indicates that this tool performed rotary movements. Moreover, on the surfaces of two other artefacts were traces of the processing of an indefinite mineral raw material (Fig. 2: 18; 4: 4). One of these (Fig. 4: 4) had also usage traces resembling those caused by contact with hide.

Summarizing the results of use-wear research, it must be stated that the perforators and borers analysed were used mainly for work related to the processing of bone and antler, including – at least partially – the drilling of holes. Evidence of this is the location of usage traces, and in particular examples also their linear orientation, transverse to the cutting edges, as well as the morphological properties of particular tools. The heterogeneous diameters of their points shows in the diverse widths of the holes drilled. Moreover, it is possible, that some of the analyzed pieces were used for woodworking. Traces of contact with other materials (hide, indefinite minerals) were recorded very much less frequently. These observations correspond very well with previously referenced results of analyses on this category of tools, conducted both on findings from Poland, as well as other areas occupied by LPC communities (e.g. Caspar *et al.* 1989: 192, Tab. 1; van Gijn 1990: 30–36; Vaughan 1994: Tab. II; Małecka-Kukawka 2001: 134, 146; 2012; Grygiel 2004: Tab. LII; Allard 2005: 209; Osipowicz 2010: 160–180, 227). In the context of the rather rare presence of functional perforators and borers among the analyzed inventories of Neolithic flint artefacts highlighted by the authors of particular studies, the data presented – in connection with above-average numbers of collections and frequency of recorded traces of usage – is a particularly important

contribution to use-wear studies on these types of products.

Conclusion

The collection of perforators and borers from Tominy is one of the largest sets of such typological tools obtained throughout the whole territorial range of LPC. Due to its morphological diversity (including its high proportion of forms with very narrow and thick points, including Vedrovice-type pieces), its atypical raw material structure (the dominance of Świeciechów flint, unknown from any other sites of this culture), and its context of discovery (production settlement), this collection represents a very significant contribution to the study of this discussed group of tools in the early Neolithic.

In this context, therefore, the results of the microwear analyses are very important. They reveal – regardless of raw material classification and morphometric properties of particular pieces – the very slightly varied nature of the documented micro-traces of usage, limited in the greatest extent to deformations typical of contact with bone and antlers. This may indicate a limited range of practical use of typological perforators and borers by early agrarian communities from Tominy, i.e. as specialized tools primarily intended for processing (mainly drilling) these materials. It seems, that this phenomenon has some analogies at other LPC sites. In addition to the previously mentioned, relatively modest data from the area of Poland, on a fairly narrow range of functional diversity of typological perforators and borers within similarly dated inventories, seem to indicate also the results of analyses of a much more numerous series of such tools from some sites in western Europe. This is fairly clear in the case of the collection from Darion (Liége area, Belgium), where there are occurrences of the usage of these types of artefacts primarily for woodworking and dry hide processing, and occasionally also for ceramic use (Caspar *et al.* 1989: Tab. 1). A similar situation has also been recorded at sites located in valley of the River Aisne in the Paris Basin (after Allard 2005: 209). These data, in addition to the results presented of the analyses from Tominy, may indirectly indicate the functioning of workshops specialized in the processing of particular raw materials for production of specific tools within LPC settlements. Attention has been paid to this situation much earlier, in relation to a large collection of perforators accompanying a concentration of animal bones, tools made of them and their half-finished products, from Feature 098/1972 from Vedrovice-Zábrdovice, by interpreting this as a workshop specialized in the processing of this raw material and possibly also in the production of composite tools (Lech 1982: 51, 1983: 13). The presented results of microwear analyses from Tominy may provide new, quite suggestive and convincing data in this respect.

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