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Janusz Budziszewski[1], Katarzyna Pyżewicz[2]

UNUSUAL TRANSFORMATIONS OF SICKLE-SHAPED KNIVES MADE OF OŻARÓW FLINT

ABSTRACT

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Three raw materials played the greatest role in the flintworking of the Samborzec group of the Mierzanowice culture. Chocolate flints were used to make small arrowheads, banded flints were used to make bifacial axe blades, sickle-shaped knives were made from Ożarów flint. The latter were systematically transformed during their use, changing their shape and size. When the blade reached a length of about 11 cm, it could not be shortened any further. However, it was then also not possible to convert the specimen into some other core tool. For this reason, the conversion of sickle knives into other tools was something of an exception. Among the materials from the Małopolska Upland are only two flat bifacial axes made from fragments of damaged sickle-shaped knives from the Ożarów flint. These will be analysed in detail. The creation of these tools was possible due to unusual damage to the sickle-shaped knife (Samborzec) or was due to difficulties in obtaining good quality flint (Majkowice).

Keywords: Samborzec group of the Mierzanowice culture, flint sickle-shaped knives, flat bifacial flint axes, Ożarów flint

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1 Independent researcher, Muszlowa 5/10, 01-357 Warszawa, Poland; budziszewski.janusz@gmail.com; ORCID: 0000-0002-6521-9973

2 Faculty of Archaeology, University of Warsaw, Krakowskie Przedmieście 26/28, 00-927 Warszawa, Poland; k.pyzewicz@uw.edu.pl; ORCID: 0000-0001-9228-9347

Two approaches have been present in the study of prehistoric flintwork for years. One treats the discovered inventories in a static way and, by classifying flint products that comprise them, attempts to reconstruct the structure of the assemblages (Ginter and Kozłowski 1990). The other treats inventories in a dynamic manner in an attempt to reconstruct the *chaîne opératoire* leading to the state found during the discovery of the items (Schmid 2022). In this second approach, it is extremely important to understand the transformations that individual flint pieces underwent during their use. This concerns both the transformation of individual tools in the course of their gradual wear and tear, as well as radical changes transforming the specimen into a completely different tool. The two approaches above can be complementary. They can also lead to an opposing understanding of the materials under study, as was the case, for example, with Middle Palaeolithic scrapers (Dibble 1995). In such considerations, core tools must play a special role. Typically, they are sizable and naturally lent themselves to repeated modifications as the working edges wore out during use.

In the presented paper, we conducted studies based on the concept of *chaîne opératoire*. Using this approach, we had the opportunity to interpret the ways of using selected core tools – lithic axes and bifacial sickle-shaped knives, as well as traces of repairs and changes in their use among the societies of the Mierzanowice culture. We paid special attention to two bifacial axes made from fragments of damaged sickle-shaped knives made of Ożarów flint. A morphometric and traceological analysis of these two specimens was carried out. Microscopic examinations were carried out using standard research methodology. The detailed microscopic analysis was conducted with the digital microscope Keyence VH-Z100R, with a range of magnifications from 50× to 1000×. Before the examination, tools were cleaned with pure acetone. The observations were focused on the macro- and microscopic traces related to the usage and hafting – areas of polish, linear traces, micro-flakescars, fractures, and rounding. The results of analysis were compared with the experimental reference base stored at the Faculty of Archaeology, University of Warsaw.

The community of the Samborzec group of the Mierzanowice culture inhabited a relatively small area of the Sandomierz Upland and the Nida Basin in the first half of the second millennium BC (Kadrow and Machnik 1997, 83-102; Włodarczak 2017, figs 1 and 2). One of the most striking manifestations of its economy was an extremely complex system of flint management (Budziszewski 1991, 194-198; 2020, 270, 271). It was based on rich deposits of flint from the northeastern Mesozoic margin of the Świętokrzyskie Mountains. The greatest role was played by three raw materials used in a manner selected according to their technical properties. Chocolate flint was used for mass production of flakes used to make small arrowheads (Borkowski 1987, 161-167). Banded flint was used to make bifacial axe blades (Machnik 1967, 73; Klekot 1988). Sickle-shaped knives, on the other hand, were made from Ożarów flint (Budziszewski 1980; Libera 2001, 161-167). In addition, the flint inventory is notable for massive scrapers made from large, often cortical flakes of the first

series, obtained during the preparation of the core tools described above (Machnik 1967, 69, 70, pl. 9). Of course, there were times when individual raw materials were used in other ways (Grużdź 2020; Migal 2022), but the tools made in this way never exceed 25% of the known forms and are usually noticeably less. The scale of flint manufacturing in the Samborzec group of the Mierzanowice culture is evidenced by the fact that remnants of manufacturing activity from this time seem to occur at all of the now-known chocolate and banded flint mining sites in the northeastern Mesozoic margin of the Świętokrzyskie Mountains, and most of them were created only at this time.

Axe blades made of banded flint were produced in two types (Machnik 1967, 73; Klekot 1988; Bąbel 2013, 101-103) – either massive, thick specimens (Fig. 1: 1) or flat sub-triangular axes (Fig. 1: 2). This differentiation probably – as in the late Neolithic – corresponds

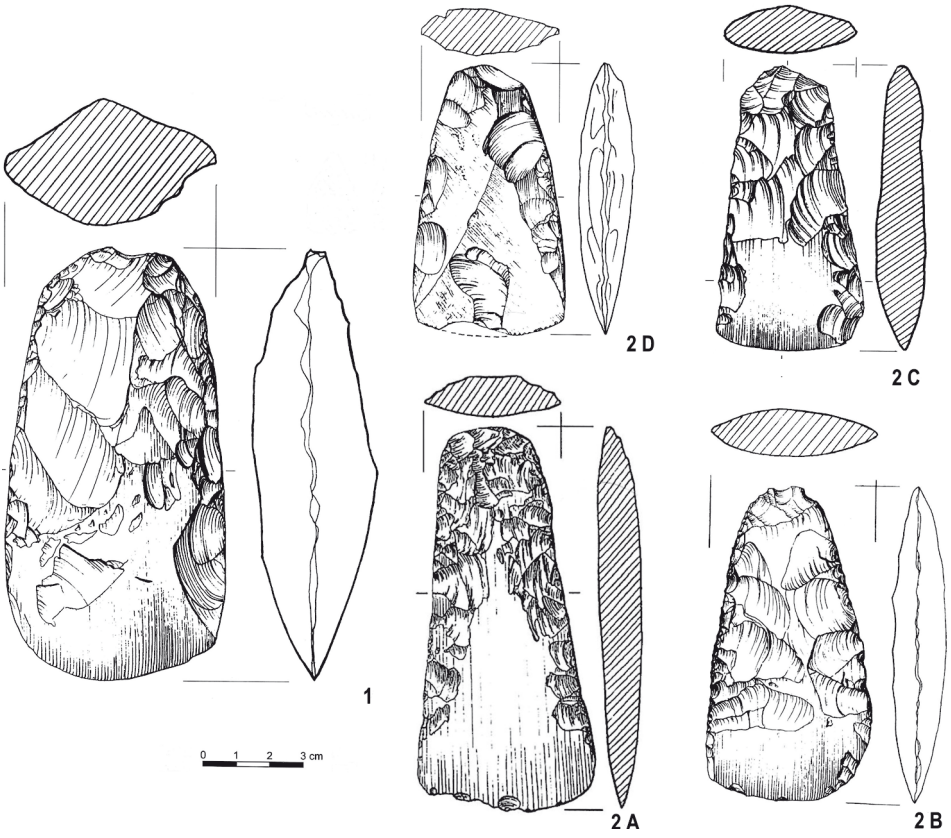

Fig. 1. Bifacial axe blades of the Samborzec group of the Mierzanowic culture made of banded flint. 1. Massive, thick specimen (Mierzanowice, Site I, Grave 27); 2. Flat sub-triangular axes (2A. Mierzanowice, Site I, Grave 55; 2B. Mierzanowice, Site I, Grave 28; 2C. Złota, „Nad Wawrem" site, Grave 255; 2D. Mierzanowice, Site I, Grave 42). After Bąbel 2013b

to the two ways in which the flint blade was hafted – either as a heavy axe mounted in a massive haft or as a light tool with the blade mounted in a knee-shaped handle (Winiger 1981; Suter 1993). Flint axe blades were damaged in the course of use (Jørgensen 1985, fig. 52-55), after which they were repaired, which usually changed their parameters (Budziszewski and Włodarczak 2011). Repairs may have slightly altered the shape of the specimen (Fig. 1: 2B) or may have shortened the entire form, changing its proportions slightly. In the case of flat sub-triangular blades, the original select forms reach a length of 10.0-11.5 cm, and the width of their blades is 5.0-6.0 cm (Fig. 1: 2A). The length of most specimens of this type is between 8.0 and 10.0 cm, and their blades are 4.0-5.0 cm wide (Fig. 1: 2C, 2D). In contrast, the length of the smallest specimens oscillates between 6.0 and 7.0 cm, and their blades are between 3.5 and 4.5 cm wide. The maximum thickness of all specimens is similar and is usually between 1.0 and 1.5 cm (Klekot 1988; Bąbel 2013, 101-103). It seems that a length of about 6 cm and a blade width of 3.5 cm set a limit below which it was impossible to embed this type of flint blade in a haft. Flint blades could have been embedded in lightweight knee-shaped holders in two ways: parallel to the helve as an axe, or perpendicular to it as in adze. The latter way seems to predominate in materials from the Neolithic lake dwellings (Suter 1993). An important contribution to the discussion of this issue could come from the study of the micromorphology of flint blades, determining the degree of their asymmetry in cross-section, which should be more pronounced in the case of adzes. Unfortunately, such analyses have not been conducted so far. Nor have detailed traseological studies of these tools been conducted. Thus, we are left with the conjecture that such tools, regardless of their method of blade fitting, should have been used for many *ad hoc* household activities, including wood or meat processing.

Bifacial sickle-shaped knives were usually produced from the Turonian flint exploited in a single mining field – "Za garncarzami" in Ożarów, Opatów County (Brzeziński 2020). Their form is reminiscent of specimens found in the Early Bronze Age over a wide area from Volhynia in Ukraine to the Netherlands. The artefacts from Małopolska have already been classified in detail several times. Most recently, this was done by Jerzy Libera, who divided them into two varieties – wide-topped and sharp-topped, in each of which he distinguished three sub-varieties, each of which had two classes – slender and stocky. Sickle-shaped knives made of Ożarów flint, appear in 10 of the 12 classes so defined. On the other hand, they dominate two of them – slender or stocky "wide-topped specimens with the working edge slightly convex or straight" (Libera 2011, 161-163). A statistical analysis of shape carried out by Kamil Serwatka a few years ago, which consisted of calculating the allometric coefficient, showed that the above diversity of sickle-shaped knives is probably related to the stages of advanced processing, mainly the transformation of the working edge subject to successive sharpening (Serwatka 2020). This process caused the originally straight working edge (Fig. 2: 1) to become more and more concave while moving toward the middle, thickest part of the tools (Fig. 2: 2-4). There must also have been more fundamental reworking, shortening the tool after the most common damage consisting of the tip

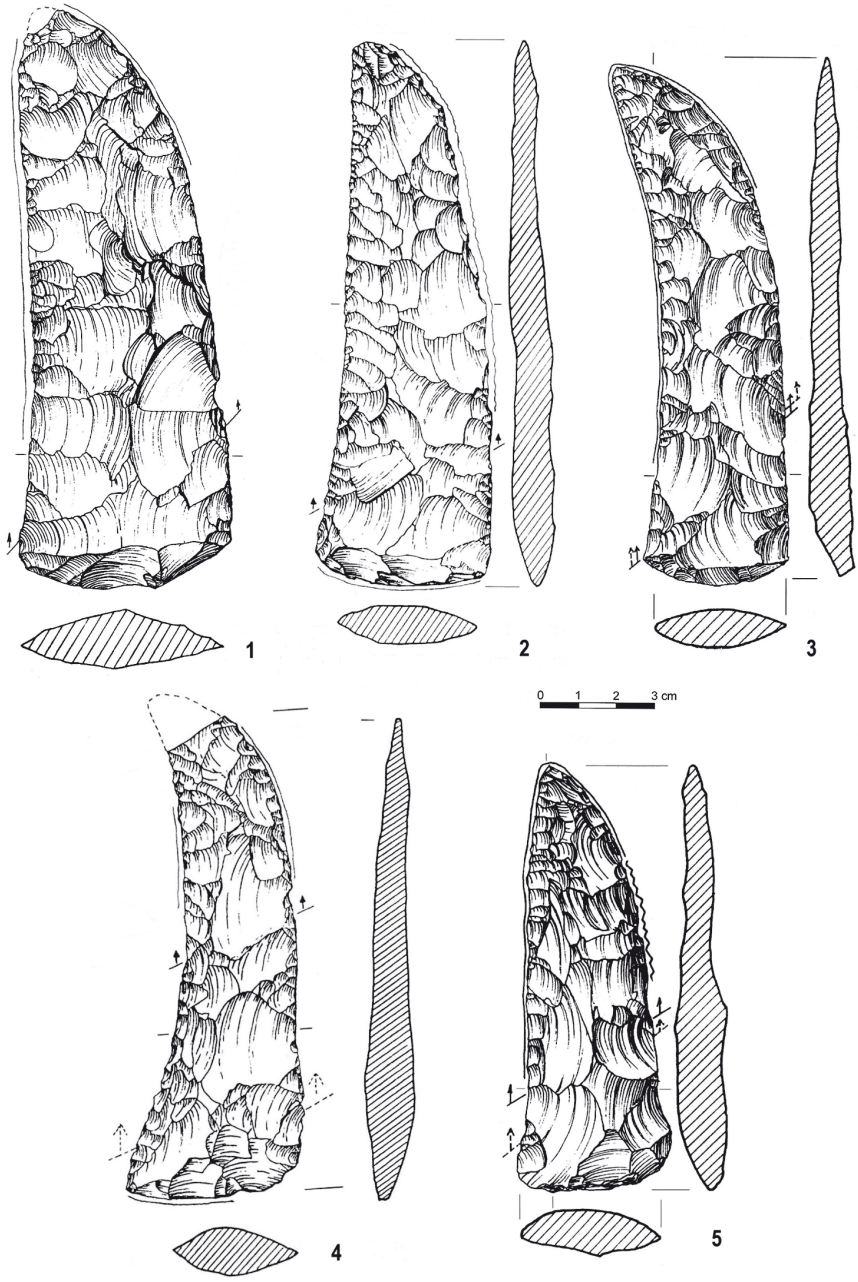

Fig. 2. Sickle-shaped knives of the Samborzec group of the Mierzanowice culture made of Ożarów flint showing different stages of processing: 1. Mierzanowice, Site I, Grave 6; 2. Mierzanowice, Site I, Grave 143; 3. Złota, „Nad Wawrem" site, Grave 25; 4. Mierzanowice, Site I, Grave 155; 5. Złota, „Nad Wawrem" Site, Grave 39. After Bąbel 2013b

breaking off (Fig. 2: 5). As a result, although the most impressive blades of this type reach a length of 15-16.5 cm, most are noticeably smaller. It seems that the limit below which a tool furnished in the standard manner could not be used effectively is a length of about 11 cm. Tools of this type have been repeatedly studied traseologically, beginning with pioneering work in the late 1970s (Bąbel and Budziszewski 1978; Balcer and Schild 1978a; 1978b; 1980) and continuing with professional analyses of recent years (Grużdź *et al.* 2017). The results of traseological studies of sickle-shaped knives made from Ożarów flint are today complemented by analyses of similar forms from the area of the neighbouring Strzyżów culture (Pyżewicz and Grużdź 2019; Wolski 2020; Hyrchała *et al.* 2022) and formally similar artefacts more distant chronologically and spatially (Van Gijn 1988; 2010; Baron and Kufel-Diakowska 2013). In light of all these studies, the thesis that the most common and intense traces visible on their surface are "mirror-like" polishes resulting from their use in the reaping of plants containing silica, probably cereals, is not in doubt today. At the same time, intense scuff marks are visible on the tops of several specimens made of Ożarów flint (Mierzanowice, Site 1: Graves 62, 143, 185), individual forms of the Strzyżów culture from Raciborowice-Kolonia (Wolski 2020, 109-111, fig. 23-2, 24-2), as well as some younger tools from the Dutch sites (Van Gijn 1988), which are interpreted as the effect of contact between the tool and the soil. Their interpretation is still quite doubtful. The most convincing attempts are made to connect them with the cutting of turf for construction purposes (Van Gijn 2010, 193-195), but reliable hypotheses in this regard require solid experiments. This is all the more important because, although traces of this type are extremely rare, they appear over large areas and a considerable time. Thus, it can be thought that they conceal some important information about the economy of Bronze Age communities. The surface of sickle knives also preserves clear traces left by the tool handles. Thus, we have no doubt what parts of the flint blades were in them (Bąbel 2013b; Pyżewicz and Grużdź 2019, fig. 4). On the other hand, there is no basis for a full reconstruction of the handles. It can be expected that they were straight along the axis of the flint blades (Bąbel and Budziszewski 1978, fig. 8), or curved according to the old proposal of S. N. Bibikov (1962, fig. 14; Bąbel 2013a, fig. 41).

Among the materials from the Małopolska Upland are two flat bifacial axes made from fragments of damaged sickle-shaped knives from the Ożarów flint (Fig. 3: 1, 2). The first comes from Pit 99 discovered in 1964 at the settlement of the Mierzanowice culture in Samborzec, Sandomierz District (Kamieńska 1966, 324, fig. 2; Kamieńska and Kulczycka-Leciejewiczowa 1970). In this pit, in addition to a rich ceramic inventory (Kamieńska 1966, fig. 1, 3), a scraper made from a massive flake of Ożarów flint was discovered (Machnik 1967, pl. IX-5), as well as five fragments of flakes – two of Ożarów flint (Machnik 1967, pl. IX-3), one of chocolate flint, one of Jurassic-Cracow flint and one of a raw material of unknown provenance. The flat bifacial axe made of Ożarów flint is 10.1 cm long, has a blade width of 4.6 cm, a maximum thickness of 1.4 cm, and a weight of 75.2 g (Fig. 4: 1). So, the

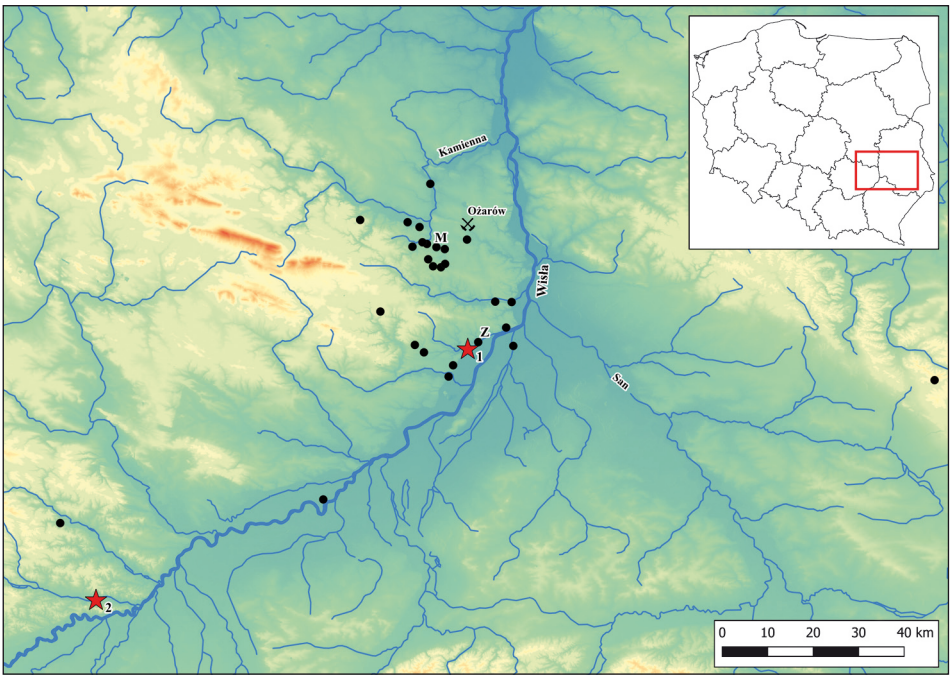

Fig. 3. Location of finds of flat sub-triangular axes made from sickle-shaped knife fragments: 1. Samborzec, Sandomierz County; 2. Majkowice, Proszowice County. The black dots mark the finds of sickle-shaped knives made of Ożarów flint (M – Mierzanowice, Opatów County; Z – Złota, Sandomierz County), while the mining emblem marks the location of the mining field "Za garncarzami" in Ożarów, Opatów County. Drawn by Michał Szubski

dimensions place it among the largest select blades of its kind. It was made from a large fragment of the apex of a sickle-shaped knife bearing not very intensive traces of work.

Traces of use are located on the extensive surfaces of the "old negatives" on both sides of the tool. They appear in the form of highly visible polishes, with a "mirror-like", flat character (Fig. 4: 3). Within them, there are numerous linear traces arranged obliquely relative to the symmetry axis of the tool. The morphology of the traces indicates that they were created while cereals were being cut. Their location – on fragments of negatives, created earlier than those forming the edges of the tool, indicates that they are related to the use of the tool before its transformation into an axe. A new form of the tool was created by modifying the sickle-shaped knife, with a not very precise retouch. To form a relatively symmetrical bottom of the axe, the arched edge and area around the tip of the knife had been modified. The specimen was finished with careful grinding of the slightly asymmetric, flat-convex axe blade and both side edges (Fig. 4: 1). Linear traces created during grinding, which are located near the blade are arranged parallel to the axis of symmetry of the axe, while in the further part, they are less regular and are arranged towards both sides

(Fig. 4: 4). This indicates at least two stages of grinding the axe. The sides of the axe blade are damaged with extensive flakes. There are no traces of use on these surfaces. However, on the preserved fragment of the axe blade, there are areas of polish visible on both sides of the tool. Their morphology (brightness, flat nature) indicates that they were most likely created during woodworking (Fig. 4: 2). Numerous linear traces appearing within the polished area are arranged parallel to the working edge and appear mainly on one side of the tool. These data indicate that the axe blade was most likely mounted perpendicular to the handle. There is one more type of trace left on the surface of the axe, which is related to the hafting. These traces appear in the form of rounding and abrasion of protruding parts (mainly ridges), accompanied by polishing, which in some places resemble that formed during contact with a skin (Fig. 4: 5). Hafting traces were noted in the middle and lower parts of the axe. Most likely, at least some of them were created during the use of the axe, but it cannot be ruled out that some of the hafting traces are remnants of an earlier stage of use of the specimen in the form of a sickle-shaped knife.

The second of the presented axes comes from an accidental discovery in the village of Majkowice, Proszowice County (Fig. 3: 2), that is, from an area far from the Ożarów flint deposits and outside the settlement range of the Samborzec group of the Mierzanowice culture. The flint blade has a length of 5.6 cm, a preserved blade width of 3.7 cm, a maximum thickness of 1.1 cm, and a weight of 26.5 g (Fig. 5: 1). Such dimensions place the specimen between the smallest forms, close to the limits for this type of tool. The axe was made from a small tip fragment of a sickle-shaped knife with clearly visible traces of use.

Despite the areas of polish visible to the naked eye, detailed use-wear analysis was somewhat difficult due to the effects of post-depositional factors. They appear in the form of a shiny patina covering the entire surface of the tool. However, the identification of the traces related to the use of the tool at the sickle-shaped knife stage was not a problem. Clear traces of cereal cutting have been preserved. They appear (analogously to the example described above) in the form of areas of polish with a "mirror-like" and flat character (Fig. 5: 3, 4). Within it, there are linear traces arranged obliquely to the symmetry axis of the specimen. They appear on "old negatives" on one of the sides of the axe and go deep into the surface of the specimen. The tip of the sickle-shaped knife was knocked off earlier – during use, and then it was slightly modified with careless retouching, which largely eliminated its typical asymmetry, and then it was further used. A new form of the specimen was created by modifying the slightly asymmetric, flat-convex axe blade and both side edges with careful grinding (Fig. 5: 1). Linear traces associated with grinding are arranged at a slight angle to the edge of the axe blade (Fig. 5: 2). After transforming the tool into an axe, the specimen was used again. Some uncharacteristic areas of polish visible on the edge of the axe blade have been preserved (Fig. 5: 2), but due to the presence of a patina, it is impossible to determine the type of organic raw material that was processed. During the use of the specimen, its blade was extensively damaged and numerous negatives of chips, flakes, and cracks are visible. It should be added that hafting traces have been

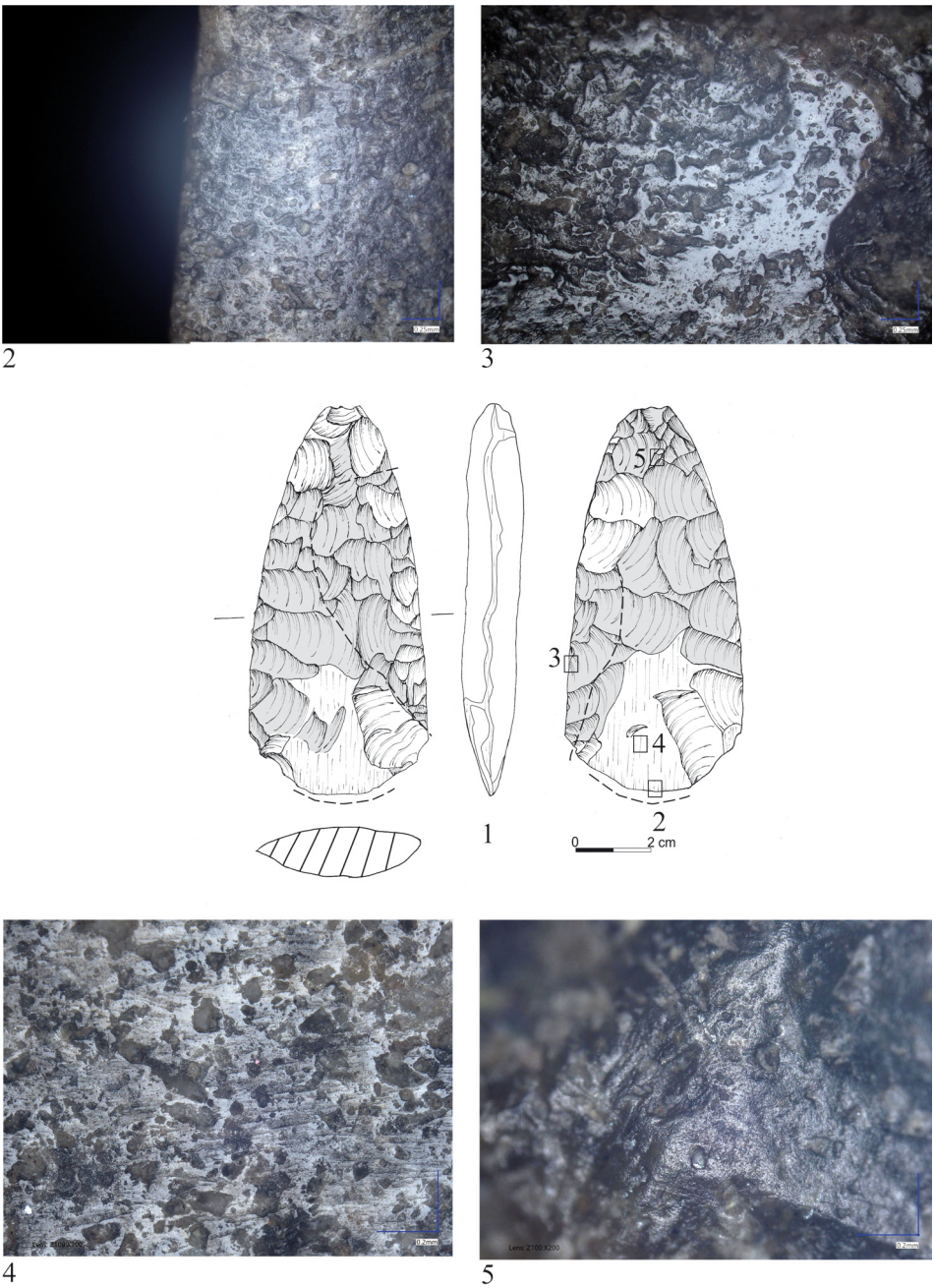

Fig. 4. Samborzec, Sandomierz County, Pit 99. 1. Flat sub-triangular axe made from a fragment of a sickle-shaped knife (drawn by Agnieszka Dziedzic). 2 – use-wear traces related to woodworking; 3 – traces of cereals cutting; 4 – grinding traces; 5 – hafting traces (photos by Katarzyna Pyżewicz)

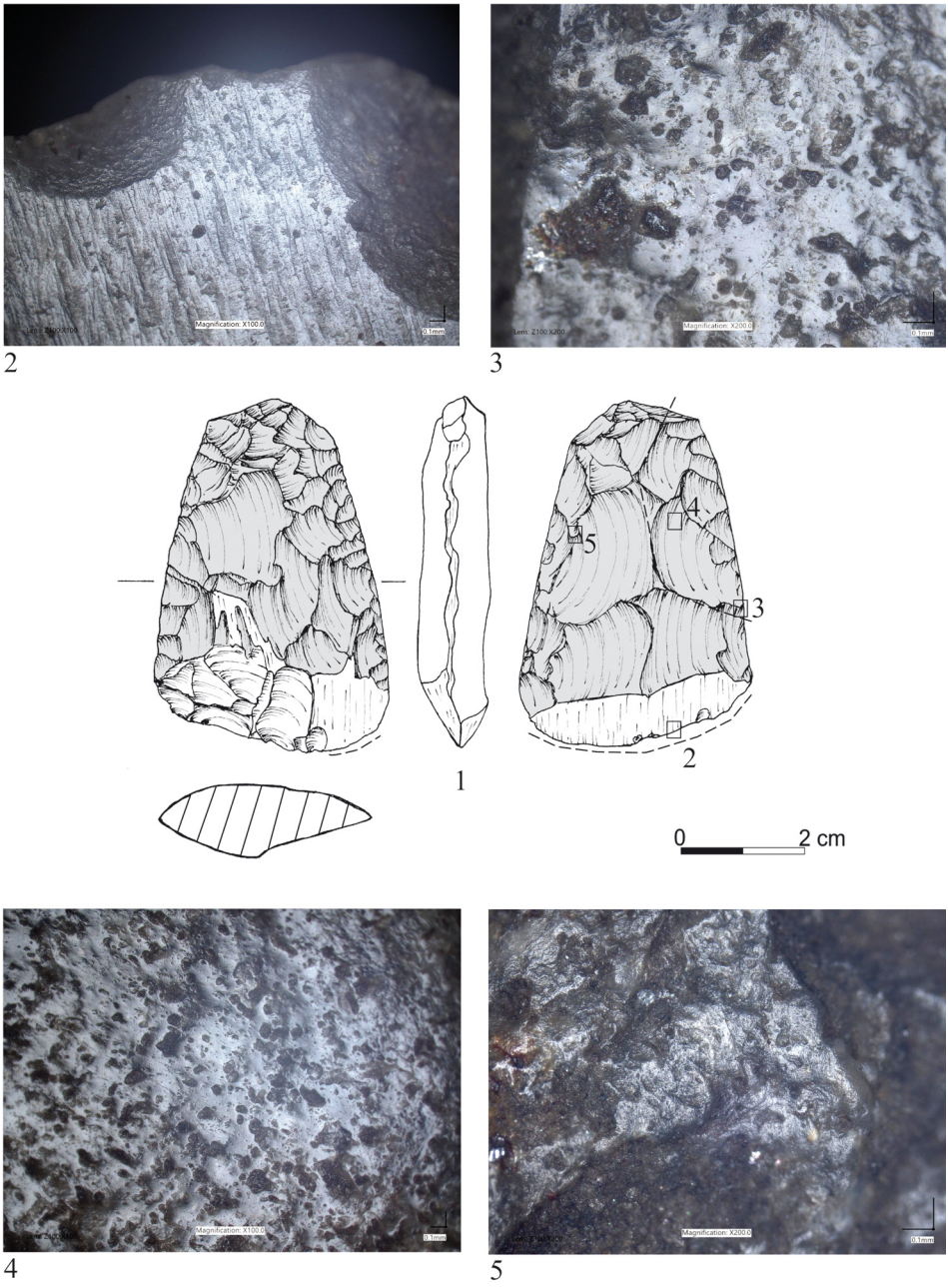

Fig. 5. Majkowice, Proszowice County. 1 – Flat sub-triangular axe made from a fragment of a sickle-shaped knife (drawn by Agnieszka Dziedzic); 2 – grinding and use-wear (?) traces; 3-4 – traces of cereals cutting; 5 – hafting traces (photos by Katarzyna Pyżewicz)

preserved on the tool. They are located in the middle and proximal parts of the axe. They occur in the form of rounding, abrasion, and polishing of protruding parts (Fig. 5: 5). These marks were formed during contact with soft organic material (skin, plants?), but due to the previously mentioned post-depositional factors, the type of raw material cannot be determined with certainty. Also, there are visible concentrations of iron oxides on the surface of the tool, which are probably the result of the destruction of the axe by modern agricultural tools.

The flint blades of sickle-shaped knives wore out through progressive re-sharpening of the working edge. The most common accident disrupting this process was the breaking off of the tip of the tool. Re-sharpening was then done, shortening the entire tool. This process could not be continued when the blade reached a length of about 11 cm. It seems that it was then no longer possible to transform it into some other core tool. For this reason, the reworking of sickle-shaped knives into other tools was something unique. So far, the only reshaping that changed the form and function of sickle-shaped knives were small atypical daggers also used for (ritual?) fire-making (Pyżewicz and Grużdź 2019, 453, fig. 6). The artefacts described above show that it was also possible to transform broken sickle-shaped knives into flat bifacial axe blades used in standard economic activities. The metric relationships between the tools of the two groups are such that axe blades made from broken sickle-shaped knives could even have been among selected specimens of tools of the new type. This was possible in the case of an unusual breakage of the sickle-shaped knife near the end of the holder. However, the case from Majkowice, where the broken-off tip of the knife allowed the making of a small axe blade, close to the limits for this type of tool, seems more likely. Not insignificant in this case may have been the distance from deposits of good quality flint raw material.

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