COMPLEXITY OF USE-WEAR TRACES FORMED ON FLINT PROJECTILE POINTS – A VOICE IN DISCUSSION

La complejidad de las huellas de uso en puntas de proyectil de sílex – Una contribución para el debate

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ABSTRACT In this paper we describe an experiment designed to provide guidelines for a detailed classification of use-wear traces formed on flint projectile points, resulting from striking a range of organic and non-organic materials. We verify the existing findings, and pay particular attention to microscopic damage (retouches, polish and striations). The list of traces characteristic for projectile points is formed mainly on the basis of morphology (current microscopic observations) and only indirectly on functional classifications. In the course of our experiment 122 arrowhead replicas were used: 33 points, 31 arrowheads with bifacial surface retouch, 26 trapezes and 16 composite arrowheads (made of a lateral inset/barb and point inset each). Our classification includes 22 diagnostic features, divided into 4 main groups: fractures, retouch, polish and striations. Among the fractures, the most characteristic were the complex splintered ones as well as certain types of fractures with retouch (especially those with spin-off spalls). Among the retouched ones and crush-outs the most abundant ones exhibited burin-like fractures and spin-off spalls, though retouches such as: toothed, splintered, post-impact and splintered from the shaft were considered as important too. Attention was also paid to slanting edge retouch, which is not found on other types of functional tools. Among the different types of polish special attention was given to those formed as a result of a tool's rapid friction against a hard material at the point of impact. Prime importance was given to patch-like and linear polish; large significance was also given to specific types of ridge and edge polish. Linear traces were found to be of little use for the interpretation of a projectile weapon's insets function. Our observations suggest that the identification of prehistoric projectile points may require a much more precise analysis than those hitherto conducted. Relying solely on the basic types of

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post-impact traces is inadequate. Traces of this type are in fact only present on a small percentage of the total number of insets. In addition, some kinds of them formed only in specific circumstances, in which both the type of arrowhead and the kind of target were of importance.

Key words: Projectile Points, Use-Wear Analysis, Experimental Archaeology, Stone Age, Flint.

RESUMEN En este artículo describimos un experimento programado para proporcionar pautas para una clasificación detallada de las huellas de uso generadas en las puntas de proyectil de sílex por golpeo sobre una variedad de materiales orgánicos y no orgánicos. Verificamos los resultados existentes y prestamos especial atención al daño microscópico (retoques, pulido y estrías). La lista de trazas características de las puntas de proyectil se estableció principalmente sobre la base de la morfología (observaciones microscópicas actuales) y solo indirectamente a partir de las clasificaciones funcionales. En el transcurso del experimento se utilizaron 122 réplicas de puntas de flecha: 33 puntas, 31 puntas de flecha con retoque bifacial, 26 trapecios y 16 puntas de flecha compuestas (realizada cada una mediante la inserción de una punta y una barba lateral). Nuestra clasificación incluye 22 rasgos de diagnóstico, divididos en 4 grupos principales: fracturas, retoque, pulido y estriaciones. Entre las fracturas, las más características fueron los astillamientos complejos, así como ciertos tipos de fracturas con retoque (especialmente las producidas con levantamiento de esquirlas). Entre los retocados y los aplastados, los más abundantes mostraban fracturas burilantes y negativos de esquirlas, aunque retoques denticulados, astillados postimpacto y astillados del astil se consideraron importantes. También se prestó atención a los retoques en el filo que no se encuentran en otros tipos de útiles funcionales. Entre los diferentes tipos de pulidos, se prestó especial atención a los producidos como resultado de la rápida fricción del útil contra un material duro en el punto de impacto. Se dio una gran importancia al pulido lineal y al extenso; también se consideraron significativos los tipos específicos de pulido en aristas y bordes. Se encontró que las huellas lineales son de poca utilidad para la interpretación de la función de las inserciones de los proyectiles. Nuestras observaciones sugieren que la identificación de puntas de proyectiles prehistóricos puede requerir un análisis mucho más preciso que los realizados hasta ahora. Depender únicamente de los tipos básicos de estigmas posteriores al impacto es inadecuado. Las huellas de este tipo solo están presentes en un pequeño porcentaje del número total de inserciones. Además, algunos tipos de ellas se formaron solo en circunstancias específicas, en las que tanto el tipo de punta de flecha como el tipo de blanco tenían importancia.

Palabras clave: Puntas de proyectil, Análisis de huellas de uso, Arqueología experimental, Edad de Piedra, Sílex.

INTRODUCTION

The bow, arrows as well as the spear thrower and its projectiles are undoubtedly the most effective types of projectile weapons used by the prehistoric people. The spear thrower is the earliest; the oldest examples deriving from the Combe-Sauniere site in South-Western France, which are dated to 19.000-18.000 years BP (Junkmanns, 2001:7). The oldest known bows and arrows are known from

Stellmoor near Hamburg in Germany[1], where two pine bows and about a hundred arrows made of the same material were uncovered on a camp site dated to 12000 years BP (Comstock, 1992:86; Junkmanns, 2001:12). Here, archaeologists also discovered *ca*. 1000 reindeer (*Rangifer tarandus*) remains at the site, some of which still contained fragments of flint arrowheads (Bratlund, 1999:51). For a period of time both types of weapons were probably in parallel use, up until the Mesolithic when progressive forestation perhaps caused the spear thrower to be superseded by the – much more effective – bow. Nonetheless, harpoon heads (dart points) are uncovered on Mesolithic sites relatively frequently (Galiński, 2002:fig. 17) and the use of spear throwers in this period cannot be entirely excluded.

Both the arrows and darts were often armed with sharp flint points, the purpose of which was to enhance the penetration force of the projectile and to increase the damage caused by the impact. Arming of projectiles was conducted in two ways (of course, a choice of variations of these techniques was possible): with the use of a single point (which is most often the case with arrows) or with the use of a slotted organic point armed with series of flint barbs (fig. 1; see Galiński, 1997:227; compare, for example, Clark and Piggot, 1970:171; Nuzhnyi, 1993:41-53; Galiński, 2002:312). Such barbs are usually the only traces of projectile weapons that can

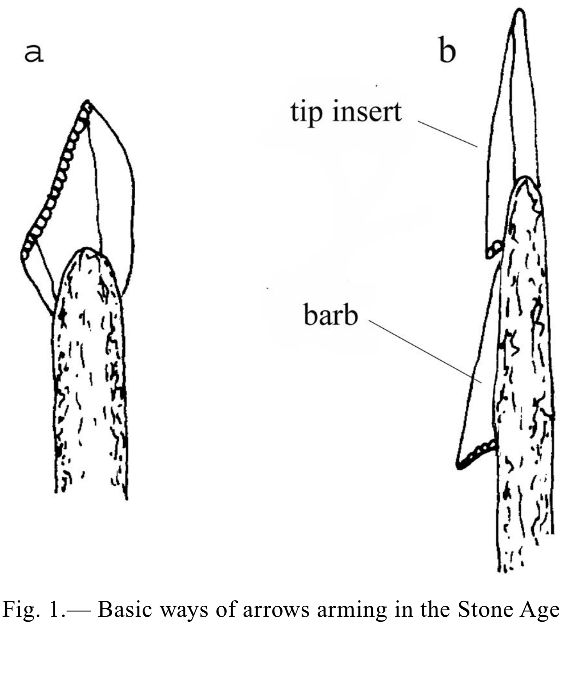

Fig. 1.— Basic ways of arrows arming in the Stone Age.

1. Results of some studies indicate the possibility of an even older fragment of a bow linked with the Magdalenian culture (Rosendahl *et al*., 2002). However, the function of the wooden object dated so, is debatable.

be found on archaeological sites, which is why scholars have studied them for a long time. However, in Poland, they were mostly the subject of technological and typological/stylistic analysis. Such studies were undertaken by: Konrad Jażdżewski (1936:289), Jan Żurek (1953:19), Elżbieta Kempisty (1973:31-32), Romuald Schild (1975), Danuta Król (1983:235), Jolanta Małecka-Kukawka and Stanisław Kukawka (1984:16-19), Lucyna Domańska (1987), Janusz Czebreszuk (1996:54), Jacek Woźny (1996), Wojciech Borkowski and Mariusz Kowalewski (1997:208-210; Borkowski, 2002:267), Jan Michał Burdukiewicz and Béatrice Schmider (2000), Jerzy Libera (2001:22), Michał Kobusiewicz (2009), Katarzyna Pyżewicz (2012), Jacek Kabaciński, Iwona Sobkowiak-Tabaka and Małgorzata Winiarska-Kabacińska (2014), Damian Wolski and Mateusz Kalita (2015), as well as Kamil Serwatka and Felix Riede (2016).

Experimental studies of projectile points have a long tradition in Europe. Firstly, broader research was presented in the 1980s (e.g. Barton and Bergman, 1982; Moss and Newcomer, 1982; Bergman and Newcomer, 1983; Fisher *et al.*, 1984; Odell and Cowan, 1986; Fisher, 1989; Geneste and Plisson, 1989). Subsequent works concentrated on artefacts of specific periods (e.g. Geneste and Plisson, 1989; Shea, 1993; Cattelain and Perpère, 1993; Crombe *et al.*, 2001; Borgia, 2008; Grimaldi, 2008; Márquez and Muñoz, 2008; Pétillon *et al.*, 2011; Lazuén, 2012; Rios-Garaizar, 2016; Rots, 2016). However, most of them have avoided the subject of enormous differentiation of use-wear damage of tools, providing only a general characterisation. Usually, only typical impact-caused damage was described (cf. van Gijn, 1989:45; Korobkova, 1999:102), as an effect of general acceptance of results obtained in the 1980s (Fisher *et al.*, 1984; Fisher, 1989). Over the years, on the basis of archaeological and experimental studies a combination of criteria has been proposed that allowed to describe different kinds of damages observed on the projectile points. Two basic groups of traces were distinguished: visible to the naked eye (macroscopic) and identifiable only with the use of a microscope (Fisher *et al.*, 1984:21-24, 27-31). The first one consists of so-called “diagnostic impact fractures” (DIF; cf. Barton and Bergman, 1982; Moss and Newcomer, 1982; Bergman and Newcomer, 1983), with typology leading to a large uniformity of this group and it is composed of a number of basic categories. Definitions and terminology used here was created for all flint objects, no matter what their function (Ho Ho Committee, 1979).

One of the diagnostic values shared amongst authors over the years were the following terms, flute-like and burin-like fractures (Witthoft, 1968; Barton and Bergman, 1982; Bergman and Newcomer, 1983). The first describes shallow, large and elongated scars whilst the second refers to a removal propagated along one of the lateral edges of a point. The term flute-like fracture seems to be one of the most confusing terms (compare Coppe and Rots, 2017:117) and some authors consider it to be a synonym of Fischer’s bending fracture (Lazuén, 2012; Villa and Lenoir, 2009), while others consider it as a synonym of a spin-off (Clarkson, 2016).

Danish scholars distinguished two basic types of fracture traces (Fisher *et al.*, 1984:22-23, fig. 4): cone fractures that resulted from a specific application of force, located close to or in the zone of direct contact with the affecting material. These had a characteristic, concaved cross section and were not divided into further subgroups. The second group are bending fractures, formed also outside the zone of direct contact, as a result of force applied on a larger surface. Traces of this type are divided into 11 subgroups, based on differentiation of the terminations. Three of these were established to be the most commonly found on points (Fisher *et al*., 1984:23, fig. 5): hinge, feather and step terminating bending fracture (cf. Odell and Odell-Vereecken, 1980:100; Odell and Cowan, 1986:204; Crombe *et al*., 2001:258). According to the authors, fractures with a spin-off, divided into four basic variations accordingly to location of a spin-off and its extent (Fisher *et al*., 1984:25, fig. 7; Shea, 1988:442; Caspar and De Bie 1996:442), were most characteristic for projectile points. However, such fractures can also be found on other tool types (Fisher *et al*., 1984:24).

Damage characteristic for actual projectile points includes burin-like fractures, transversal fractures and crush-outs (Epstein, 1963:194-195; Odell and Odell-Vereecken, 1980:100; Odell, 1981:206; Odell and Cowan, 1986:204; Shea, 1988:442; Holdaway, 1989:80; Caspar and De Bie, 1996:442,444; Dockall, 1997:326-327; Crombe *et al*., 2001:260). The so-called lateral macro-fracture (Dockall, 1997:325-326) is very important for identification of points amongst trapezes (Nuzhny, 1990:116).

In recent years, most researchers continued to use (at least partly) presented above typological system (e.g. Lombard, 2005; Lombard and Pargeter, 2008; Lazuén, 2012; Wilkins *et al*., 2012; Chesnaux, 2014). And more recently, an important work was published by Justin Coppe and Veerle Rots (2017), in which the authors revealed numerous inconsistencies in fracture terminology over the years.

In comparison to the described classification, typology of microscopic (abrasive) traces was less developed. Registered linear polish was simply described as "elongated bright strips", and the scratches identified were characterized with the use of an imprecise term "very short" (Fisher *et al*., 1984:28), but presently, the issue of morphology and origin of striations formed on points is a bit more precise (e.g. Dockall, 1997:324; Lammers-Keijsers *et al*., 2015:460). Yet, it was properly assumed that traces of this type should be oriented parallel to the point's axis, with the exception of some cases, for instance tool distortion resulting from impact against a target. Abrasive damage also includes the rounding and blunting of edges or surfaces (Odell, 1975:229; Shea, 1988:443). However, such traces were assumed not to be useful – found alone they did not prove a tool to be a projectile point (Odell and Cowan, 1986:204; Rots and Plisson, 2014).

This method of classification of use-wear traces formed on projectile weapon insets was adopted in the literature and is still in use (Dockall, 1997; Crombe *et al*., 2001:258-259; Coppe and Rots, 2017 – see references therein for further reading). The selective approach to usefulness of different use-wear damage type (controversial concentration on macroscopic traces -cf. Caspar and De Bie, 1996:445-) and their characterisation with the employment of taxa created for analysis of different tool types were established here. Projectile weapon points and barbs (the functional ones) were not utilised surely for typical household tasks (requiring a long term usage of the tool). Use-wear traces and damage formed on them are decisively different from those formed on other tool types. Thus, it can be assumed that the classification created and used now is not exhaustive. Probably, it might be possible to identify further categories on the basis of different typological criteria. Application of a new system of damage identification could allow for verification of some of the theories concerning prehistoric projectile points based on the traditional identification model.

The studied flint material was analysed using a Nikon SMZ-2T microscope-computer set. It permitted an objective magnification of up to 12.6x (actual magnification up to 120x) as well as computer digitalisation and conversion of optical images. The same setup was used to produce a part of the presented microscope photographs. The remaining, were prepared with the use of Zeiss-Axiotech microscope-computer set, which provides an objective magnification of up to 50x (actual magnification up to 500x). This set was used for observation and analysis of the structure of polish and striations. Analysed objects were cleaned with C_2H_5OH and washed with a detergent diluted in water.

The article is the modified version of the paper published recently in polish (Nowak and Osipowicz, 2012).

ARCHAEOLOGICAL EXPERIMENTS WITH PROJECTILE POINTS

Experimental studies of projectile points and barbs have advanced since their inception (e.g. Browne, 1940; Barton and Bergman, 1982:239-240; Fisher *et al*., 1984; Odell and Cowan, 1986; Shea, 1988:442; Fisher, 1989; Solecki, 1992; Caspar and De Bie, 1996:440-442; Crombe *et al*., 2001; Cheshier and Kelly, 2006; Grimaldi, 2008; Chesnaux, 2009, 2014; Gaillard *et al*., 2015; Lammers-Keijsers, 2015; Rots, 2016). Similar works were also performed in Poland (e.g. Dmochowski and Pyżewicz 2012; Serwatka 2018). Experiments with tools of this type were usually performed with great respect for and attention devoted to compliance with the experimental methodology. As a rule, shooting was undertaken with a prehistoric bow replica, against a whole animal body (Barton and Bergman, 1982:239-240; Fisher *et al*., 1984:20; Odell and Cowan, 1986:199; Shea, 1988:442; Fisher, 1989:35-36; Nuzhny, 1990:115; Caspar and De Bie, 1996:440; Crombe *et al*., 2001:258; Cheshier and Kelly, 2006:354-357). Usually, shots were also taken at objects the prehistoric projectile points could have encountered in case they missed the target, such as trees, bushes, grass and earth. In some cases, experimental projectile points were used for various activities designed to imitate the conditions of formation of post-depositional traces (trampling) or different type use-wear traces, such as cutting meat (Fisher *et al*., 1984:20). The number of tools used in the experiments was usually large enough to form a sufficient base for drawing conclusions on prehistoric specimens. For example, in the experiments conducted in Denmark 153 projectile points (mainly tanged points and trapezes) were shot, 85 of which were analysed with a microscope (Fisher *et al*., 1984:19). Conclusions were drawn from the microscopic examination of 510 prehistoric arrowheads (Fisher, 1989:30). During the studies conducted by G. H. Odell and F. Cowan 80 experimental tools were shot, half of which were points with surface retouch (Odell and Cowan, 1986:199)[2]. P. Crombé and his colleagues used 183 insets of five types, all of which were microliths (Crombe *et al*., 2001:258). Results were used during microscopic analysis of 346 prehistoric microliths (Crombe *et al*., 2001:261).

The cited research is reliable, and most of the conclusions drawn from it are sufficiently argued. Thus, the experiment described below was subjected to use wear tests only, and adjusted to the conditions necessary to provide this type of work except a number of parameters that should be taken into account when experiments similar to those carried out in the Western Europe are carried out.

The experiment

Our experiment was conducted on 122 replicas of arrowheads and arrowhead insets, which were in use from the Final Palaeolithic to the Early Bronze Age. This assemblage was composed of 33 tanged points (primarily Swiderian), 31 arrowheads with bifacial surface retouch (mainly laurel-leaf forms), 26 trapezes (of various style) and 16 composite arrowheads (made up of a barb and a tip inset each fixed in a holder –organic, antler/bone part of the arrowhead). Several types of backed blades as well as triangular insets were also used.

Shafts of the arrows were made of beech (*Fagus* L.) wood. They were *ca*. 70 cm in length and had a diameter of *ca*. 1 cm. Points were set into 10-cm-long arrowheads attached to shafts by a sleeve (fig. 2). Five shafts were used during the experiment. Insets were attached by means of a water-soluble glue (it allowed for their easy removal), and (in some cases) birch tar obtained in experimental production, without the use of ceramics (Osipowicz, 2005). In parallel to the experiment, another one was conducted to study the utility of this binder. During the course of our experiment a flat bow with a draw weight of 19 kg was applied.

The target was built up to imitate an animal body. It was composed of a few subsequent layers: a boar hide (outer layer), meat (middle layer) and ribs with meat (inner layer). Using this type of target is a little unfortunate, because it does not fully reflect the situation of hitting the body of a real animal (whose acquisition proved to be impossible). However, using a target constructed of layers has certain advantages. It allowed us to trace the precise path of the target penetration by the arrowhead and the identification of all types of tissues in contact with the tool (which has obvious influences on the traces formed on it). To acquire use-wear traces of points, which have not been in contact with bone, a series of experiments with a leather shield was

2. Results of these works are only partially helpful towards the presented study, as the products used during their duration were made of chert, which is a material not found on the sites studied here. However, it is worth mentioning, that the results drawn from this experiment were very close to those achieved by Danish researchers.

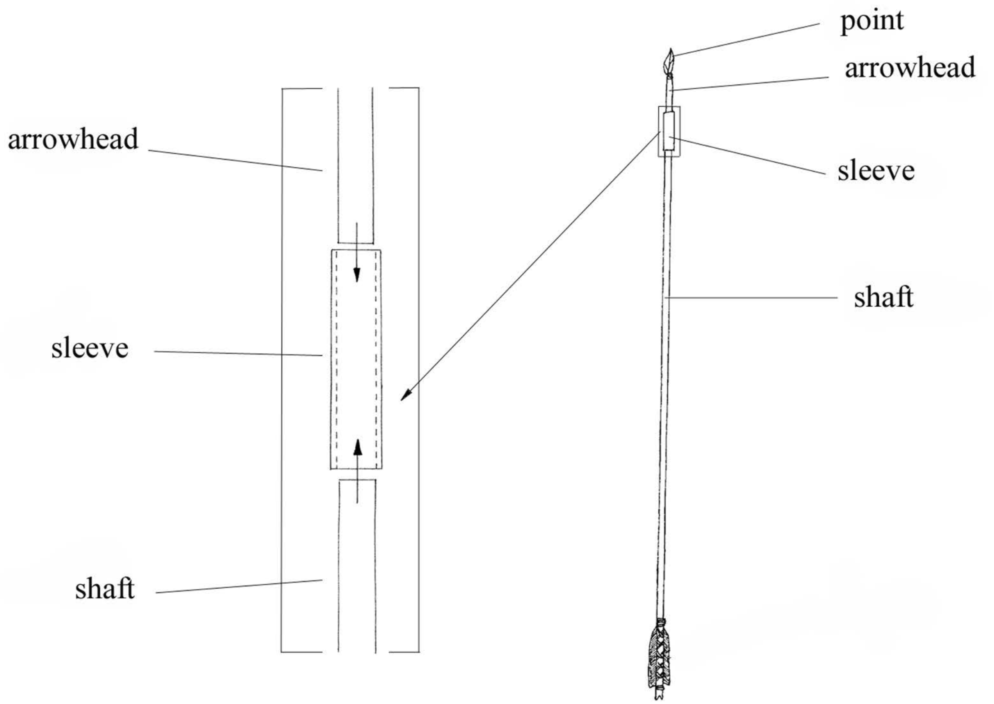

Fig. 2.— Diagram of arrow construction and ways of arrowheads' setting on shafts.

also conducted. It was constructed by placing two thick layers of bacon (ca. 5 cm each) onto a traditional straw target. This was covered with a wild boar hide (with fur) and set on a wooden easel. In addition, experiments were made with materials that could have accidentally been hit by prehistoric arrowheads. Hence, shots were taken against a wooden target (the trunk of a pine) and soil. Shooting was carried out from a distance of 10-15 m.

A total of 63 arrowheads were shot at the target imitating animal flesh, including 13 arrowheads with surface retouch, 10 tanged points, 17 trapezes, and 14 composite arrowheads. In the experiment with the leather target 9 tanged points and 2 composite arrowheads were used. A total of 24 arrowheads were shot at the wooden target: 3 tanged points, 13 arrowheads with surface retouch and 8 trapezes. In the experiment with a "soil target" 18 arrowheads were used: 11 tanged points, 5 arrowheads with surface retouch and 2 trapezes.

In the experiments conducted hitherto each arrowhead was used only once (e.g. Barton and Bergman, 1982:240; Fisher *et al.*, 1984:20). Some of the experimental arrowheads analysed here were shot several times (table 1), concluding shooting usually after the arrowhead was severely damaged. As indicated by the results, flint arrowheads can be reused many times, even if they shot into thick skin, such as that of elephants (Shea, 1988:442; Solecki, 1992:209)[3]. High resistance generated by such arrowheads is also confirmed by use-wear analysis conducted both on experimental specimens and prehistoric ones, indicating that the hunters of the Stone Age did not dispose of specimens fit for further use. Typical traces characteristic for arrowheads usually become clearly legible after a few shots (Odell, 1988:341; Shea, 1988:445; van Gijn, 2010:55). As can be concluded from the complexity of use-wear traces present on some of them, they were used repetitively until destroyed or lost. Ignoring this fact could have a major impact on the results of microscopic analysis of the prehistoric products.

Experimental results (table 1)

Arrowheads shot against a target made of hide, meat and bone stayed in the target, and some pierced through it and flew on. Most of the inset types used in this experiment (with the exception of trapezes) were fractured on the apex part (fig. 3)[4]. It was also observed that they had clearly visible crush-outs on cutting edges. Of 14 composite arrowheads, only nine penetrated the target to the depth allowing the formation of damage on barbs. In other cases, only the tip inset penetrated the target. Five of the barbs had no contact with the target and therefore were excluded from further analysis.

All the arrows released against the leather target pierced through it. As a rule, shooting ended once the inset/point was broken out. Among the arrowheads utilised, specimens with no clear macroscopic evidence of use dominated. There were only slight negatives and fractures visible on their apexes. Only two specimens (tanged points) were fractured in the middle part, and two barbs broken in the area of contact with the holder.

Approximately 3/4 of the arrowheads shot at a wooden target were stuck in it. More robust arrowheads (large tanged points and some points with surface retouch) have been broken or partially broken at the apex. Usually, the broken part remained in the target, from which it was picked out with a sharp stick. Less massive arrowheads usually broke in several places. Trapezes stayed in target without any major damage – only some flaking was macroscopically visible. During the experiment shafts were often split.

3. Similar observations were made for obsidian arrowheads (Cheshier and Kelly, 2006:357).

4. In order to precisely describe the location of the traces recorded on arrowheads three parts were distinguished: apex containing the blade tip (also called upper), middle and base (also called the lower part), incorporating the base part of the arrowhead inserted into the arrows shaft. Each section is about 1/3 of the arrowhead.

TABLE 1
GENERAL CHARACTERISTICS OF THE CONDUCTED EXPERIMENTS

Target type	*Inset type*	*No. of arrowheads*	*No. of shots*	*Min. No. of shots made with one arrowhead*	*Max. No. of shots made with one arrowhead*	*Comments*
Hide/meat/bone	Bifacial surface retouch arrowhead	13	13	1	1	10 arrowheads penetrated all of target's layers, 2 penetrated hide, meat and stopped in bone, 1 glanced off of bone, 1 split the shaft
	Point	10	12	1	2	6 arrowheads penetrated all of target's layers, 2 penetrated hide, meat and stopped in bone, 1 glanced off of bone, 1 penetrated only hide, 1 split the shaft
	Trapeze	17	20	1	3	7 arrowheads penetrated all of target's layers, 3 penetrated hide, meat and stopped in bone, 1 glanced off of bone, 5 penetrated only hide and meat, 1 glanced off of hide, 6 split the shaft
	Tip insert	14	16	1	2	10 arrowheads penetrated all of target's layers, 2 penetrated hide, meat and stopped in bone, 1 pen-etrated only hide and meat, in 1 case the type of hit is uncertain
	Barb	14	16	1	2	4 arrowheads penetrated all of target's layers, 2 penetrated hide, meat and stopped in bone, 1 glanced off of bone, 5 barbs had no contact with the target
Hide	Point	9	30	1	5	—
	Tip inset	2	2	1	1	—
	Barb	2	2	1	1	—
Wood	Bifacial sur-face retouch arrowhead	13	14	1	2	9 arrowheads pierced wood, 1 glanced off, 1 bounced off target, 3 split the shaft, in 2 cases the type of hit is uncertain
	Point	3	3	1	1	2 arrowheads pierced the target, 1 shattered against it
	Trapeze	7	7	1	1	All arrowheads pierced the target
Soil	Bifacial sur-face retouch arrowhead	5	8	1	3	—
	Point	11	48	1	15	—
	Trapeze	2	3	1	1	—

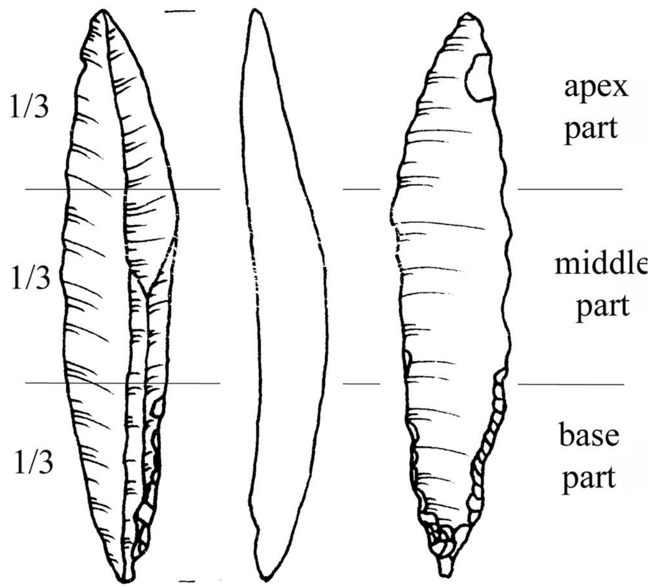

Fig. 3.—Diagram of arrowheads' construction.

The overall conditions of the tools that had been shot into soil varied. More robust arrowhead forms (tanged points) broke in several places, usually at the base. Of 11 tanged points, 8 broke in this region. Other specimens broke in the central part and at the base. Similar effects were observed on tools with surface retouch. Retouch was also formed on the apex parts. Of all the arrowheads used in the experiment, only trapezes did not break. Hitting the target by arrowheads resulted frequently in split of the arrow shafts.

Our results confirmed the remarkable efficiency of the trapezes (Fisher, 1989:38). No doubt they are amongst the most effective flint projectile points. In many respects (penetration strength, flight stability, durability during impact) the specimens used in the experiment clearly prevailed over other types of projectile points. Bifacial points seem to be less effective than trapezes, although they are more durable in comparison with unretouched tools (tanged points). The main advantage of tanged points is probably the simplicity of their production and possibility of quick supplementation of their losses. Searching for the ideal parameters of an arrowhead has no point, even though such attempts have been made in the past (Browne, 1940:209).

Use-wear traces observed on tools used in the experiment

The classification of use-wear traces formed on projectile points presented below is based on the results of our experiment. As in the older classifications, the main goal was to identify all types of damage found on analysed arrowheads, and to find traces not present on tools used for other activities. However, unlike the Western classification, no rigid list of damages was searched for, rather an attempt to formulate a typology from the beginning was made (based on microscopic observations). The group of major taxa was based not only on shape and orientation of traces, but also their location, complexity and relationship with other types of damage. The use-wear terminology was based on the conceptual schemes developed by the Ho Ho Committee (1979:133-135), P. C. Vaughan (1985:10-13, Glossary), A. L. van Gijn (1989:16-20), H. Juel Jensen (1994:20-27) and G. F. Korobkova (1999:17-21). Comparative material for the observations consisted of a set of approximately 300 experimental tools used for various activities (cf. Osipowicz, 2010:38-39).

All of the arrowheads used in the experiment were subjected to microscopic analysis. This led to the formation of four main groups of use-wear traces found on projectile points: fractures, retouch and crush-outs, polish, and striations. This division differs somewhat from the commonly accepted classification (division of the group of fractures and use retouch), yet in the light of observations made this appears to be justified as it facilitates the typologisation of utility damage. Coexistence of specific damage types means that the presence of one type of retouch did not exclude the presence of other variations.

Use-wear traces generated on points and barbs are essentially identical, and therefore will not be described separately. They differ only in location. The top part of a barb is protected by shaft. Thus, it usually does not fracture and all of use-wear traces form at a distance from it (usually not found in parts originally contained within the holder —cf. Caspar and De Bie, 1996:444).

Fractures (DIF) (A)

The term fracture is defined as the breaking of an arrowhead into two or more parts (Inizan *et al*., 1999:142), with a cross-section generally corresponding to the one of the original tool. The length of the part broken off (measured perpendicular from the fracture) is equal to its thickness, with a minimum value of at least 3 mm[5]. Exceptions to this are some longitudinal and oblique fractures where the transversal cross-sectional of individual parts may be different from the original tool's cross-section[6]. Fractures may be accompanied by various types of use retouch.

5. Fragments of length lesser than the accepted limit and which did not correspond to the proportions between he length and thickness adopted for the broken parts were treated as utilitarian retouch.

6. In some cases, distinguishing a fracture from an intentional tool fixing retouch can be a problem. It is assumed that the fracture surface is gently rounded and, what is characteristic, one of its edges has a sharp lip or a negative of one in the form of a recess (Epstein, 1963:194).

Most of the arrowheads used in the experiments were fractured in some way. It was usually the result of hitting the target; some tools, however, were broken during their removal from the target (in case of the wooden one). Fractures occurred in various parts of the arrowheads. In most cases they were found in the apex and the central part, less often in parts within the arrow shaft (base). Some of the arrowheads were completely crumbled. Observations allowed the distinction of four basic types of fractures encountered on projectile points.

A1. Simple fractures: simple fracture into two or more parts. As a rule – not accompanied by any use retouch. Only occasionally small isolated scalar-like negatives can be seen on the surface of the fracture (fig. 4; fig. 5a).

A2. Fractures with retouch: fractures accompanied by retouch of various types, starting out from a fracture towards the dorsal or ventral side of the tool (fig. 4). Spin-off spalls are often found here.

A3. Complex, splinter fractures: fractures often causing complete destruction of the point. Besides fracturing into many parts, its "delamination" is often caused too. Arrowhead shards are covered with splinter retouch (fig. 4).

A4. Fractures from the shaft: fractures at the contact point of the arrowhead and the shaft's edge or within latter which is sometimes accompanied by retouch of splintered character and a burin-like fractures (cf. Epstein, 1963:194). In some cases, the fracture is in the form of a Ω-shaped negative[7] (fig. 4). Fractures of this type arise on arrowheads when hitting the target at an angle even slightly deviating from zero (Holdaway, 1989:80).

Retouch and crush-outs (B)

Use retouch, also known as microchipping, microflaking, edge scarring, utilisation damage, edge damage, edge removals (Keeley, 1980:24-25; Vaughan, 1985:10-11; Korobkova, 1999:17) is an edge or surface chipping that does not follow the definition of a fracture. It forms on the edge of a tool under the influence of pressure (see Odell, 1975:229). Depending on the work being done until now it is assumed that the total length of its component negatives should not exceed 2 mm (Keeley, 1980:24-25; Osipowicz, 2010:26). The specificity of use-wear traces formed on arrowheads makes the introduction of such limit impossible.

Retouch, crushing and crush-outs constitute the most characteristic type of use-wear traces found on flint arrowheads – it was observed on all experimental specimens. Moreover, this group of traces is very diverse (Caspar and De Bie, 1996:444; Lazuén, 2012:2305). This is probably due to differences in shapes of arrowheads as well as different types of targets. Basically, three main places of

7. See B10 type retouch.

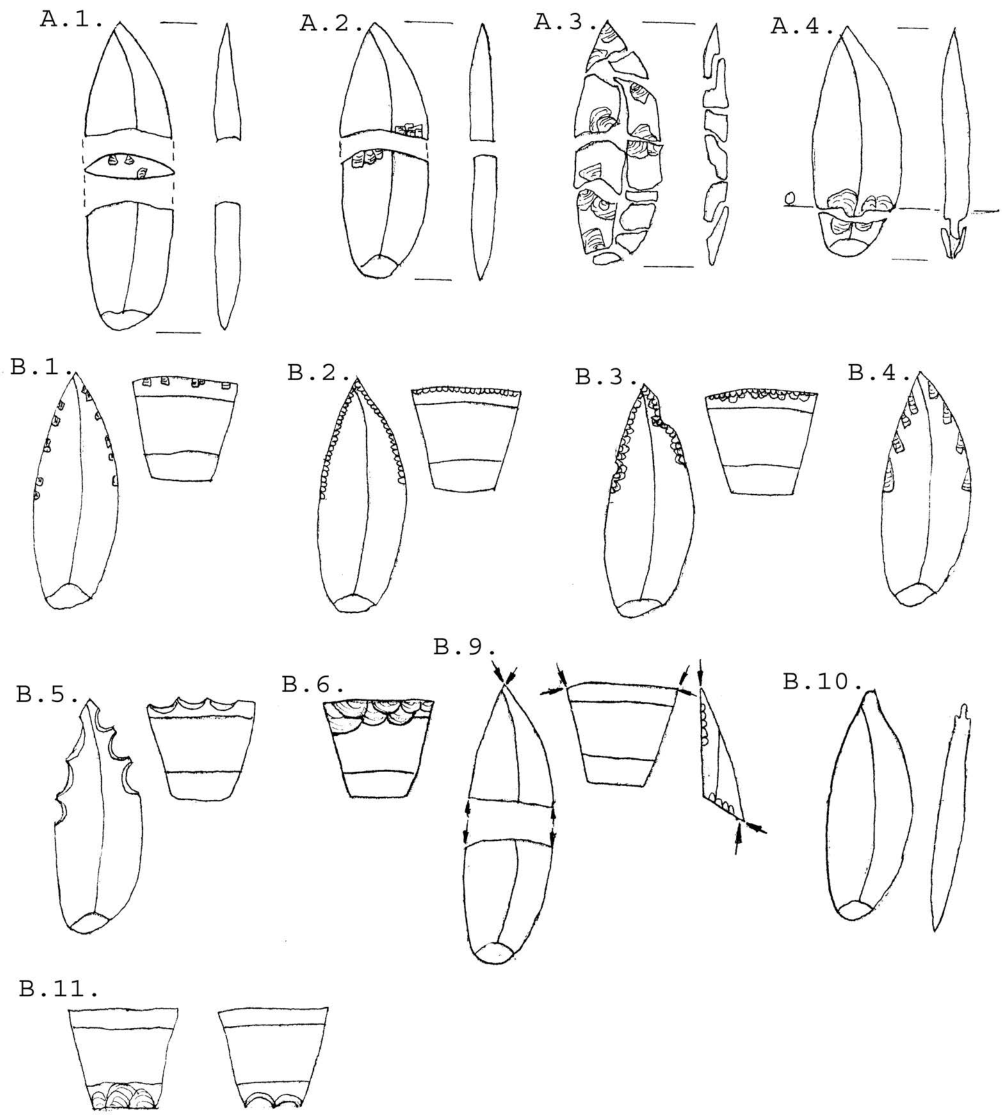

Fig. 4.— Types of fracture and retouch observed on experimental flint arrowheads.

retouch formation can be found: the tip and cutting edges of the point, areas situated directly near the fracture and the part of the point contained within the shaft. Burin-like fractures were also included in this group, as well as the so-called Ω-shaped negative/spin-off spalls (cf. Odell and Cowan, 1986; Korobkova, 1999:102; Lazuén, 2012:2305).

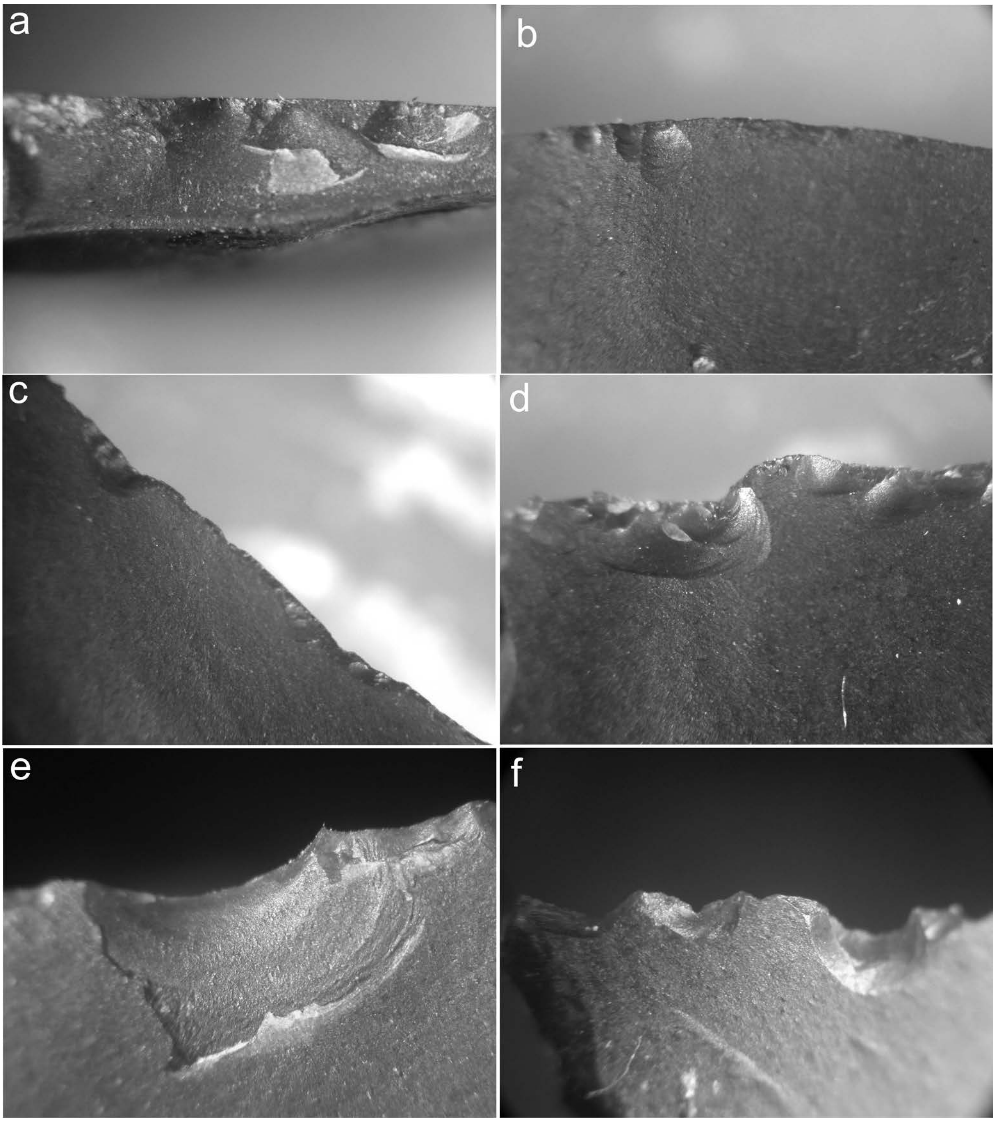

Fig. 5.— Use wear traces observed on experimental arrowheads: a) Simple fractures A1 (x20; ob.20); b) Simple discontinuous, edge retouch B1 (x20, ob. 20); c) Simple continuous, edge retouch B2 (x30, ob. 20); d) Complex edge retouch B3 (x20, ob. 20); e) Slanting edge retouch B4 (x20, ob. 20); f) Toothed retouch B5 (x20, ob. 20).

B1. Simple discontinuous edge retouch (wide/regular and irregular): occurs on the cutting edges of the point or its blade (trapezes) in the form of a single or (rarely) grouped scalar-shaped negatives with feather termination (fig. 4; fig. 5b).

B2. Simple continuous edge retouch (close/regular and irregular): occurs on the lateral (cutting) edges of the point or on its blade (trapezes) as a fine, single-step, irregular continuous retouch usually covering a larger part of the working edge (fig. 4). Negatives are usually feather-like terminated, although in some cases step and hinge termination occurs. Sometimes retouch gives the edge a saw-like appearance which, however, can only be observed under the microscope (fig. 5c).

B3. Complex edge retouch (close/irregular and wide/irregular): occurs on the point's cutting edges. This is a multi-step retouch, with grouping negatives with step and hinge termination, and less than in previous cases, feather terminations. Retouch is often accompanied by crush-outs (fig. 4; fig. 5d).

B4. Slanting edge retouch: simple, usually single-step retouch, with negatives arranged obliquely to the cutting edge of the point, which usually terminate step- or hinge-like (fig. 4; fig. 5e).

B5. Toothed retouch (close regular/irregular): simple retouch with negatives arranged perpendicular to the cutting edge of the point, occurring singularly on the cutting edge or, in the case of trapezes, on blades. The retouch gives the cutting edge a saw-like profile (fig. 4; fig. 5f).

B6. Splinter, post-impact retouch (close/regular and wide/irregular): complex splinter retouch, found on points with perpendicular working edge (trapezes). Characterised by single or grouped negatives, with step and hinge terminations (fig. 4; fig. 6a).

B7. Simple, fracture neighbouring retouch (close/regular): visible as a fine, one-step, multi-negative retouch of scalar-like negatives (with feather or, less often, hinge terminations) starting out from the fracture and progressing onto the dorsal or ventral side of the point (fig. 6b).

B8. Splinter, fracture neighbouring retouch (close/irregular): splinter retouch neighbouring post-impact fractures. Characterised by multi-step, single or grouped negatives, coming out of the fracture. Most of them have step or hinge terminations (fig. 6c).

B9. Burin-like fractures: occurs at the apex, on trapezes in place of blades' contact with retouched edges and on barbs, or accompanies fractures and may differ in size (fig. 4 – places of occurrence of burin-like fractures marked with an arrow). It is formed as a result of direct impact or various types of pressure force (pressure at the base when hitting the target, on barbs when extracted). Usually has hinge or step termination (fig. 6d).

B10. Ω-shaped negative (spin-off spall): characteristic, tongue-like negative with hinge or step termination cutting off the apex, present on one or both sides of the tool (fig. 4; fig. 6e) (see Fischer *et al.*, 1984:fig.3b,c; Korobkova, 1999:102).

B11. Splinter retouch, from the shaft (usually close/irregular): visible in the form of a single or grouped negatives of splinter character (fig. 4); usually two-sided, formed due to the pressure of the shaft on the point during impact (compare Shea, 1988:443).

B12. Various peck ness of the point's tip: fine, varying size, tightly packed and overlapping negatives concentrated around the working edge, forming a rough/course, porous surfaces (Korobkova, 1999:18) (fig. 6f).

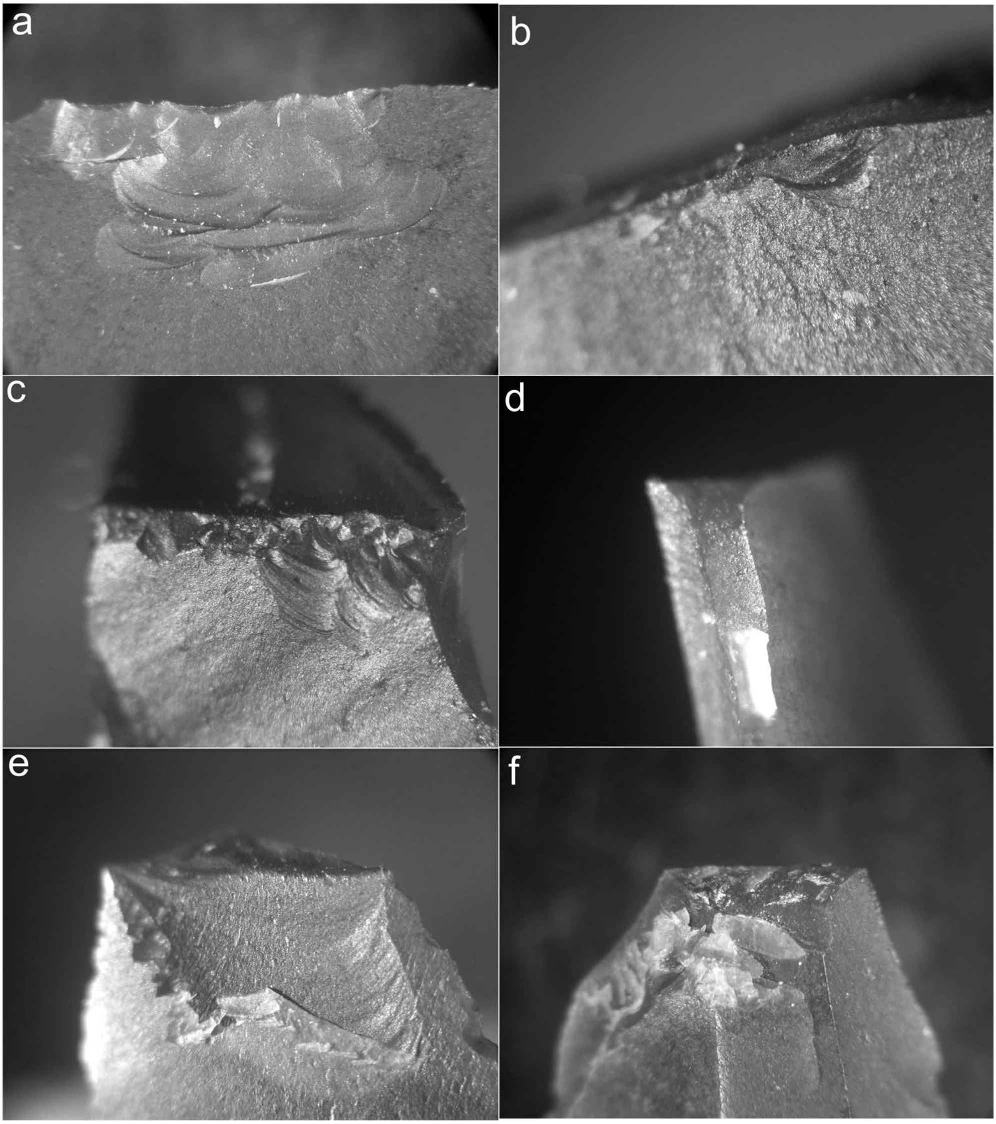

Fig. 6.— Use wear traces observed on experimental arrowheads: a) Splinter, post-impact retouch B6 (x10, ob. 10); b) Simple, fracture neighbouring retouch B7 (x40, ob. 20); c) Splinter, fracture neighbouring retouch B8 (x20, ob. 20); d) Burin-like fractures B9 (x30, ob. 20); e) Ω-shaped negative (spin-off spall) B10 (x20, ob. 20); f) Various peck ness of the point's tip B12 (x10, ob. 10).

Polish (C)

Contrary to what one would expect, polish rarely manifests itself on arrowheads. It was observed only on 36.2% of the specimens. However, when present it is characteristic enough to distinguish it from the types observed on other kinds of tools. Polish is present only on these parts of the arrowhead that are in direct contact with the target (the blade of the point, cutting edges) or within the shaft (fig. 7), and often is (especially in case of prolonged usage of a tool) of abrasive character (i.e. abrasive polish, see Odell, 1975:229; Shea, 1988:443). Types of polish observed (structure, glossiness, etc.) depend on the type of material hit by the arrowhead.

Basic types of polish observed on experimental arrowheads:

C1. Patch-like, linear polish: polish-abrasion covering only the upper part of micro relief of the flint, or shearing it (fig. 8a). If well developed, its topography is domed or flat; it may be of a varying reflectivity (which is usually quite bright) and texture.

C2. Edge polish: flowing, surface polish, visible as a line or a band along the cutting edges of an arrowhead. Penetrates the micro relief (fig. 8b). Developed, it has domed or cratered topography, typically a smooth texture, and may be of a varying reflectivity. As a rule, it is invasive.

C3. Polish on ridges: bright, sometimes oily (hide) polish shearing flint's micro relief, found on internegative ridges (fig. 8c). Similarly, as the previously described types of polish, it can have varying topography, texture and reflectivity.

C4. Surface polish: pale, linear polish of fleshy character, penetrating micro relief of the flint (fig. 8d). In most cases, it is of atypical initial polish character.

Striations (D)

Striations were rarely preserved (25% arrowheads) and come in two basic forms:

D1. Related to polish: grouped striations and scratches of varying length, thickness and depth. Always found within the borders of polish (fig. 8e).

D2. Not related to polish: single or sometimes grouped scratches of varying thickness and length, occurring independently of the polish (fig. 8f).

DISCUSION AND CONCLUSIONS

The list of use-wear traces observed on the insets is long. A natural question arises: which of them are the most distinctive, and which should be considered less important?

Approximately 32% (n = 32) of the experimental arrowheads where fractured (table 2)[8]. In this group similar amount of simple fractures A.1 (9.4%, n = 11), fractures with retouch A.2 (10.2%, n = 12) and complex, splintered fractures A.3

8. Similar results were achieved also in other studies (Fisher *et al.*, 1984:25; Odell and Cowan, 1986:204; Crombe *et al.*, 2001:260).

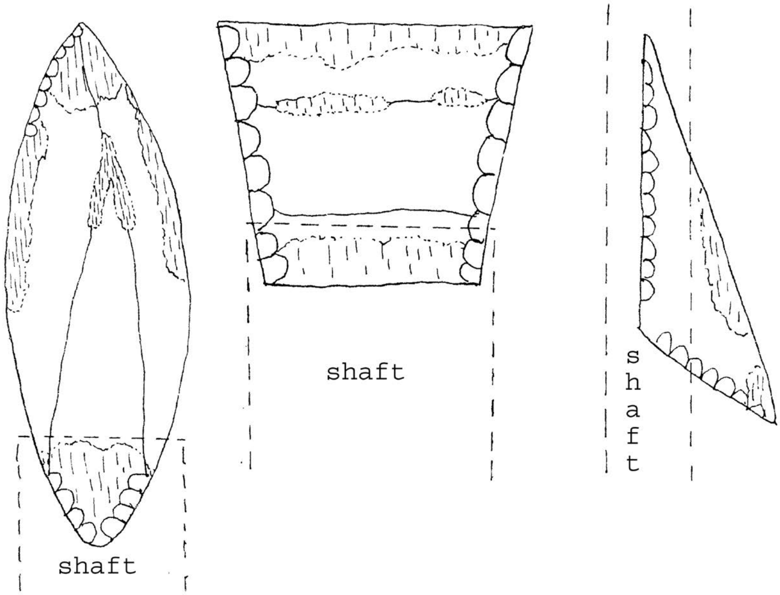

Fig. 7.—Locations of polish and striations formed on flint arrowheads.

(9.4%, n = 11) were found. Their numerical superiority over fractures from the shaft A.4 (6%, n = 7) is not sufficient to recognise them as more typical than other types. No major differences were registered between fractures of various types of arrowheads. A slight advantage of simple fractures on barbs is noticeable, though, as with complex splinter fractures on points (table 2). The analysed sample is too small to determine whether we are dealing with a regularity. Interesting observations were made during the analysis of traces formed on arrowheads shot against various targets. It is noticeable that fractures with retouch A2 are almost twice as numerous when compared to those arrowheads used against the leather target (table 2). They did not occur on all of the specimens shot into the soil, where simple fractures A1 dominated (not present on those used in experiment with the leather target). Complex splinter fractures A3 were primarily identified on the specimens used in the experiment with targets made of hide, flesh and bone (14.3%, n = 9). Traces of this type did not occur on arrowheads shot into the soil or leather target and are only present on two arrowheads shot into the wooden target.

Use retouch was formed on over 79.5% (n = 93) of the experimental arrowheads. In the group of edge retouch, the simple discontinuous B1 is predominant; it was identified on 23.9% (n = 28) of specimens. Others in relatively high proportions are slanting edge B4 (11.9%, n = 14) and toothed retouch B5 (11.1%, n = 13). Over 28% (n = 33) of the observed arrowheads had burin-like fractures; it is the most numerous type of use-wear retouch present on the studied material. Approximately 24% (n =

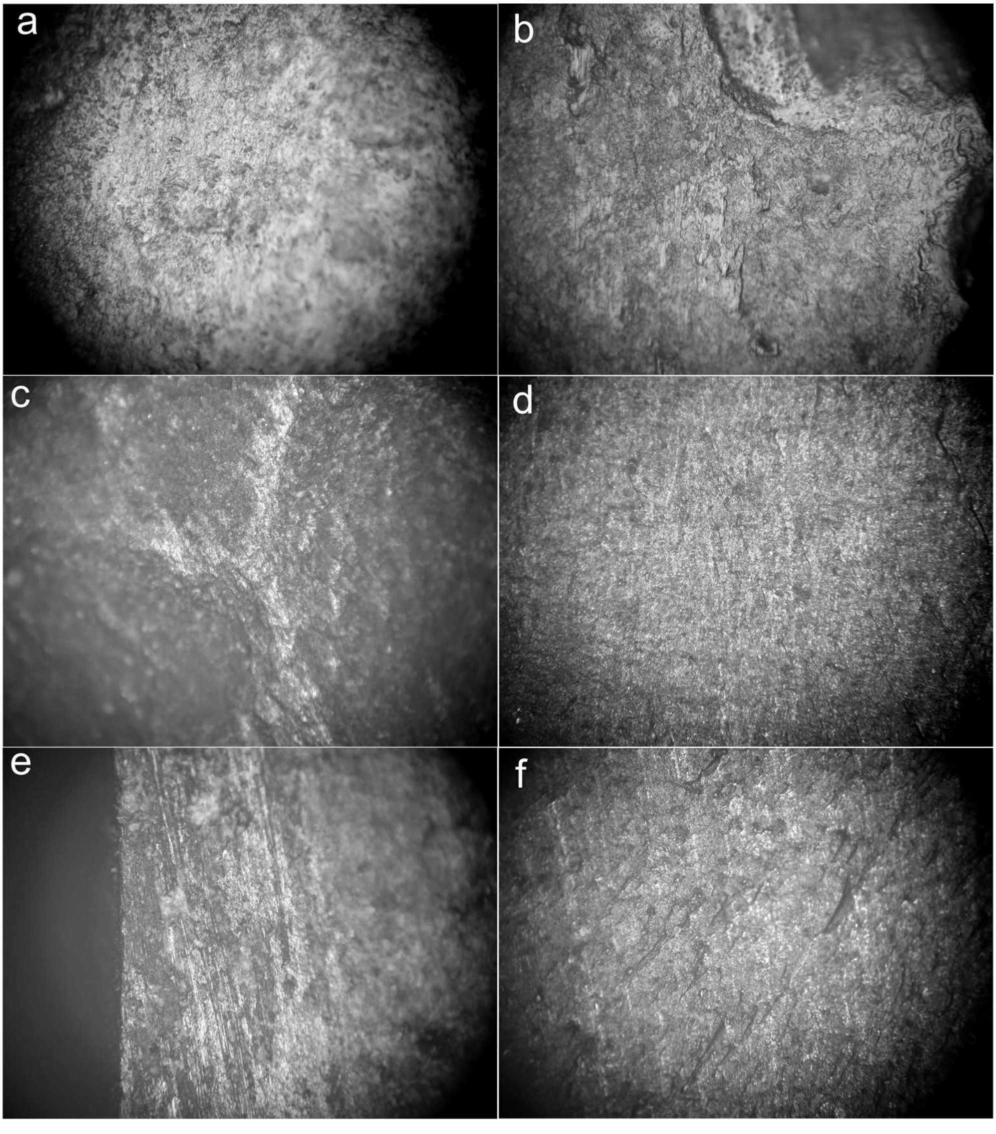

Fig. 8.— Use wear traces observed on experimental arrowheads: a) Patch-like, linear polish C1 (x65, ob. 5); b) Patch-like, linear polish C1 (left side) and edge polish C2 (right side, near the cutting edge) (x250, ob. 20) C2 (x250, ob. 20); c) Polish on ridges C3 (x65, ob. 5); d) Surface polish C4 (x65, ob. 5; e) Striations related to polish D1 (x65, ob. 5); f) Striations not related to polish D2 (x65, ob. 5).

28) of the points bear Ω-shaped spin-off negatives; splinter retouch from the shaft B11 was recorded on 15.4% (n = 18) of specimens. Other types are less common.

None of the retouch types can be considered as characteristic for all of the arrowheads. However, there were certain regularities worth mentioning. Over 51.5%

TABLE 2

SUMMARY OF SHARE OF USE-WEAR TRACES REGISTERED ON SETS OF ARROWHEADS SHOT AT VARIOUS TYPES OF TARGETS AS WELL AS OF MORPHOLOGIC TOOL GROUPS (PERCENTAGES GIVEN IN PARENTHESES)

		Use wear traces																					
		A1	*A2*	*A3*	*A4*	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*	*B7*	*B8*	*B9*	*B10*	*B11*	*B12*	*C1*	*C2*	*C3*	*C4*	*D1*	*D2*
Target types	Hide, meat and bone	5 (7,9)	4 (6,3)	9 (14,3)	4 (6,3)	14 (22,2)	2 (3,2)	1 (1,6)	8 (12,7)	6 (9,5)	3 (4,7)	2 (3,2)	5 (7,9)	21 (33,3)	13 (20,6)	10 (15,9)	3 (4,7)	1 (1,6)	4 (6,3)	3 (4,7)	2 (3,2)	1 (1,6)	10 (15,9)
	Wood	2 (8,7)	4 (17,4)	2 (8,7)	1 (4,3)	3 (13)	3 (13)	—	2 (8,7)	4 (17,4)	—	3 (13)	1 (4,3)	6 (26)	5 (21,7)	5 (21,7)	2 (8,7)	3 (13)	3 (13)	1 (4,3)	2 (8,7)	3 (13)	3 (13)
	Soil	4 (22,2)	—	—	1 (5,5)	8 (44,4)	—	—	2 (11,1)	1 (5,5)	1 (5,5)	1 (5,5)	—	2 (11,1)	4 (22,2)	2 (11,1)	1 (5,5)	6 (33,3)	6 (33,3)	6 (33,3)	4 (22,2)	4 (22,2)	4 (22,2)
	Hide	—	4 (30,7)	—	1 (7,7)	5 (38,4)	5 (38,4)	—	2 (15,4)	2 (15,4)	—	1 (7,7)	1 (7,7)	4 (30,7)	6 (46,1)	1 (7,7)	—	—	7 (53,8)	3 (23,1)	—	—	5 (38,4)
Arrowhead types	Point	4 (12,1)	4 (12,1)	2 (6)	3 (9,1)	17 (51,5)	4 (12,1)	—	6 (18,2)	3 (9,1)	—	3 (9,1)	—	5 (15,2)	14 (42,4)	2 (6)	1 (3)	3 (9,1)	12 (36,4)	7 (21,2)	3 (9,1)	2 (6)	10 (30,3)
	Tip inset	2 (12,5)	2 (12,5)	3 (18,7)	—	2 (12,5)	2 (12,5)	—	3 (18,7)	—	—	1 (6,2)	1 (6,2)	8 (50)	5 (31,2)	—	—	—	1 (6,2)	1 (6,2)	2 (12,5)	—	5 (31,2)
	Barb	2 (18,2)	1 (9,1)	—	1 (9,1)	3 (27,3)	—	—	3 (27,3)	—	—	—	1 (9,1)	5 (45,4)	—	—	—	—	3 (27,3)	1 (9,1)	—	—	2 (18,2)
	Trapezes	—	—	3 (11,5)	—	6 (23,1)	1 (3,8)	1 (3,8)	—	9 (34,6)	4 (15,4)	—	2 (7,7)	12 (46,1)	—	15 (57,7)	—	4 (15,4)	—	—	2 (7,7)	4 (15,4)	4 (15,4)
	Bifacial surface retouch arrowhead	3 (9,7)	5 (16,1)	3 (9,7)	3 (9,7)	2 (6,4)	3 (9,7)	—	2 (6,4)	1 (3,2)	—	3 (9,7)	3 (9,7)	3 (9,7)	9 (29)	1 (3,2)	5 (16,1)	3 (9,7)	4 (12,9)	4 (12,9)	1 (3,2)	2 (6,4)	1 (3,2)
	In total	11 (9,4)	12 (10,2)	11 (9,4)	7 (6)	28 (23,9)	10 (8,5)	1 (0,8)	14 (11,9)	13 (11,1)	4 (3,4)	7 (6)	7 (6)	33 (28,2)	28 (23,9)	18 (15,4)	6 (5,1)	10 (8,5)	20 (17,1)	13 (11,1)	8 (6,8)	8 (6,8)	22 (18,8)

(n = 17) of tanged points formed simple discontinuous edge retouch (B1). Quite often, it also occurs on the barbs (27.3%, n = 3) and trapezes (23.1%, n = 6; table 2). The toothed retouch B5 is very characteristic for the latter (34.6%, n = 9). Other types of retouch, not found on any other groups of points, were recorded here as well: post-impact splinter retouch B6 (15.4%, n = 4), especially numerous retouch from the shaft B11 (57.7%, n = 15) and complex/edge retouch B3 (3.8%, n = 1). For the barbs, the slanting edge retouch seems to be of some significance B4 (27.3%, n = 3). It is also quite frequent on the other types of arrowheads (table 2). Around half of the experimental barbs (45.4%, n = 5), trapezes (46.1%, n = 12) and point insets (50%, n = 8) have burin-like fractures B9 (table 2). On tanged points they are replaced by spin-off negatives B10 (42.4%, n = 14), frequently found also on tip insets (31.2%, n = 5) and arrowheads with surface retouch (29%, n = 9). Most of the peck ness of the point tips B12 were also observed on the latter (16.1%, n = 5).

It is worth noting that retouch and crush-outs found on tools shot against different types of targets vary (table 2). The B2 retouch is characteristic for the leather target (38.4%, n = 5) and rarely on other cases. The spin-off spalls B10 are more than twice as numerous here (46.1%, n = 6) as on arrowheads shot against other types of targets. This is probably due to the destruction of this type of trace by more invasive chipping and fractures formed on tools interacting with targets built of harder materials. Relatively numerous are B1 (38.4%, n = 5) and B9 (7%, n = 4) retouch types. There were no B3, B6 and B12 retouches. On arrowheads shot into the soil target the B1 retouch (44.4%, n = 8) and spin-off spalls (22.2%, n = 4) were identified most often. No trace of B2, B3 and B8 types were registered. In cases in which target consisted of hide, meat and bones B1 type retouch seems to be significant (22.2%, n = 14), as well as others, i.e. B9 (33.3%, n = 21), B10 (20.6%, n = 13) and B11 (15.9%, n = 10). On arrowheads used in experiments with the wooden target a large proportion of B5 (17.4%, n = 4) and B7 (13%, n = 3) types was observed. Similarly, as in the case of targets built of hide, flesh and bones, the B9 (26%, n = 6), B10 (21.7%, n = 5) and B11 (21.7%, n = 5) type retouches are very important.

Among the polishes on the edge, one predominated (C2 - 17.1%, n = 20; table 2). It was most often recorded on tools that had contact only with leather (53.8%, n = 7). Less numerous is the ridge polish C3 (11.2%, n = 13) and patch-like, polish-abrasion C1 (8.5%, n = 10). The first one was recorded mainly on tools shot into the soil (33.3%, n = 6) and slightly less often on leather (23.1%, n = 3). Only occasionally it occurred on specimens used in experiments with a target made of wood (4.3%, n = 1) and animal hide, meat and bones (4.7%, n = 3). The second type of polish was also most often formed as a result of contact with the soil (33.3%, n = 6). It was not recorded on points shot against a leather target. Tools least numerously represented are those with a surface polish C4 (6.8%, n = 8), which was also not registered on specimens used in the experiment with the leather target.

Striations were observed only on certain insets. More numerous are striations not related to polish D2, which were found on 18.1% (n = 22) of used tools (table 2). They were formed mainly on arrowheads shot against a leather target (where they are particularly numerous –38.4%, n = 5)[9] or soil (22.2%, n = 4). Striations related to polish were observed only in less than 6.8% (n = 8) of specimens. They are not visible on tools that had contact with leather only (table 2).

The results of the conducted analysis indicate that it is not possible to create an exhaustive list of use-wear traces typical for the all types of arrowheads. Their great diversity is associated with a huge amount of variables affecting the tools, resulting from their shape, type of target, force and type of impact, etc. Different types of damage are concomitant with each other in various frequencies and configurations. Some suggestions can be made here the verification of which should solve the described problem:

Arrowheads fracture in different places and in many ways (Holdaway, 1989:80; Solecki, 1992:209). Despite their smallest number, complex, splinter fractures (A3) should be considered most characteristic for arrowheads, as traces of this type are not found on tools used for other tasks. In most cases, they are formed as a result of forces exerted on the tip in case of impact. As mentioned previously, some of the A2 fractures with retouch are also very characteristic (especially those with spin-off spalls). Other types of these are less important, mainly because they are also found on other types of functional tools. In the group of retouch and crush outs, burin-like fractures (B9) are of fundamental importance, the same as spin-off spalls (B10). As it was already indicated, both types of traces are generally considered as the main indicator of described functions. However, the B5, B6 and B11 retouches seem to be equally important (especially for the interpretation of trapezes function). The B4 retouch should be mentioned here, as it (same as B6 and B11 traces) is usually not found on other tools (especially if the negatives of which it is composed are tilted in one direction).

Polish on arrowheads occurs rarely. However, a special role is played here by the kinds of polish originating from fierce friction of the tool against a hard material at the time of impact. Mainly the C1 type polish is formed in this way, although some types of C3 and, to a smaller degree, C2 polish can also be formed like this. Traces of C1 and C3 types are rarely found on other types of functional tools, which increase their interpretative value. Yet, taking into account the fact that sometimes they do occur (especially in the case of perforators and chisels), these polish types should never be interpreted independently, but only in the context of other types of use-wear traces.

Striations form on all types of functional tools. In most cases, they are very similar to each other so that their cognitive value is small (especially when asking about the kind of worked material). During the functional analysis of projectile points, the most important information concerning such traces is their location and orientation. Very often, the extent of such traces on tools excludes the possibility

9. They were probably formed as a result of the points' contact with sand trapped in fur on the hide.

of their use in any other type of work. It is not significant here whether they occur within or outside the polish.

Considering the observations, it can be suggested that identification of some prehistoric tools of this type may require much more rigorous analysis than the one just conducted. In the light of the data relying solely on the basic types of post-impact traces (such as Ω-shaped negatives) it seems to be insufficient. Traces of this type occur only on a small percentage of arrowheads. Additionally, some types of traces form only in specific conditions, in which are important both the type of arrowhead and the kind of target. They are not found on tools of different type, or such that are subject to other work conditions.

The list of presented types of use-wear traces typical for projectile points is not complete. It is only a preliminary proposal formulated on the basis of a small number of experiments, which may raise reasonable doubt. Future analyses will strengthen the argument and verify and supplement and existing guidelines. However, we can put forward some suggestions that extend our knowledge concerning the destruction processes and formation of use-wear traces of such tools. Perhaps further analyses conducted in this direction will help (which is suggested by some observations made here) to create a more precise characterisation of traces typical for different types of flint arrowheads, and various types of targets. After all, the existence of differences in this regard was already considered earlier (cf. Shea, 1993:22).

Analysing the conclusions of a traceological character formulated by Western scholars and comparing them with the results of work described here, we cannot agree with the statement that polish and striations recorded on arrowheads are usually formed as a result of friction with fragments of flint tool fractured from its surface or from contact with dirt (Nance, 1971:363; Odell, 1975:229; Fisher *et al*., 1984:28; Dockall, 1997:322 and further literature therein). In some cases, it is present though some traces may also be formed as a result of contact of the point with the material being struck. This type of damage certainly includes edge and surface polish, and in some cases those occurring on the ridges too. Among others, this is testified by their scattered and less invasive structure, but also their similarity to polish registered on typical (cutting-scraping) work tools.

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