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Bright Spots and the Question of Hafting

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Abstract

Bright spots (frictional spots) have often been considered as related to post-depositional processes. They were interpreted as being produced by the friction of stone artefacts against each other. An extensive presence of bright spots often resulted in the omission of the artefact for further microscopic analysis. We present new experimental data showing that these spots comprise sound evidence for hafting. Hafting bright spots can be easily distinguished from other bright spots, as for example post-depositional ones, mainly based on distribution, extent and associated traces. We argue that hafting can be interpreted, which has important implications for future archaeological interpretations.

Keywords: hafting, stone tools, microscopy, experiments.

Résumé

*Les points lumineux (*bright spots*) ont toujours été considérés comme étant liés aux processus post-depositionnels. Ils étaient interprétés comme produits par la friction des pièces lithiques l'une contre l'autre. Un grand nombre de* bright spots *était la preuve que la pièce devait être omise des analyses. Nous présentons ici des données nouvelles pour démontrer un lien très clair entre les* bright spots *et l'emmanchement. Des* bright spots *liés à l'emmanchement peuvent être facilement distingués des autres types, comme par exemple ceux liés aux processus post-depositionnels, sur base de leur distribution, leur étendue et les traces associées.*

1. INTRODUCTION

Hafting has always been a frequently discussed issue in prehistoric investigations (e.g., Keeley, 1982; Stordeur, 1987). Researchers acknowledged its importance for adequate archaeological interpretations (e.g., Keeley, 1982), but a systematic investigation was considered impossible due to a lack of identifiable traces. Analysts generally believed that hafting traces—if at all produced—remained limited and unpatterned. We strongly contest this opinion and argue that hafting can be interpreted, often even on a macroscopic level.

In scope of a more extensive investigation of hafting traces, a wide range of experiments has been undertaken aimed at characterising the variability of hafting traces. We focus on the most obvious hafting evidence: bright spots (or frictional spots). After an introduction on the general opinion regarding bright spots, we demonstrate that bright spots systematically occur in relation with hafting. Subsequently, we investigate which factors influence their production process and their characteristics. Action, worked material and hafting arrangement are considered. Lastly, we argue that hafting bright spots can be distinguished from bright spots caused by other factors: flint-on-flint friction, transport, prehension, use, de-hafting and post-depositional processes.

2. BACKGROUND

"Bright spots" or "frictional spots" occur on tool surfaces (mainly flint) and consist of smooth, highly reflective polish spots often visible macroscopically. Bright spots have been observed by many and were generally considered as not interpretable (e.g., Moss, 1983: 81–82; Vaughan, 1985: 185–187) or as evidence of post-depositional alterations (e.g., Levi-Sala, 1986: 231–232, 241). Different types have been distinguished, as flat and ripply ones, domed and raised, striated, and it has been suggested that these types correspond with different formation processes, post-depositional in nature (Vaughan, 1985: 185–187; Levi-Sala, 1986, 1996). Stapert (1976) challenged the idea that bright spots were produced by friction between stones in the soil and suggested a possible origin in bioturbation (root activity or the effect of certain lower organisms) or hafting. Moss continued in this line of thought and distinguished two types of bright spots. She attributed the first, flat in nature, to natural processes and the second, "Polish G", raised in nature, to curation, maybe hafting (Moss, 1983: 81–83, 221–224). Neither of them did experiments to substantiate data for this non-natural origin. Juel Jensen (1994: 123–129) is the first to argue that bright spots may be linked with hafting, in particular the friction with resin (tempered with hard particles) in the haft. She does not, however, mention experimental evidence to substantiate her interpretation.

Several experiments have been undertaken in an attempt to reproduce (natural) bright spots. Levi-Sala devoted attention to the impact of both mechanical and chemical processes on the production of sheen and bright spots (Levi-Sala, 1986, 1996). She managed to reproduce flat bright spots by friction of flint on flint with water as a medium. Length of rubbing time and especially flint microtopography and pressure seemed to be important factors, while water was judged essential (Levi-Sala, 1986: 234). Her trampling experiment did not produce the expected bright spots. She managed to reproduce flat unstriated bright spots by an immersion in a solution of distilled water and Calcium Carbonate of about 80–90 °C. Such bright spots were always produced in combination with sheen or patina (Levi-Sala 1996: 62–64). Other analysts concentrated on the impact of chemical actions on usewear traces, but bright spots were not observed (Plisson & Mauger, 1988; Coffey, 1994). In all cases, these experiments resulted in an advice of caution towards polishes on artefacts showing bright spots, since these might be the result of the same mechanical or chemical post-depositional process.

We present some indubitable experimental evidence for a direct link of some bright spots with hafting. We do acknowledge the fact that natural processes can be responsible for bright spot formation, especially when soil sheen or patina is associated. We believe however, that hafting bright spots are well distinguishable from natural ones based on their specific characteristics.

3. PROCEDURE

A stereoscopic microscope Wild (M5-22827, magnifications $6\times-100\times$) is used according to the principles set out by Tringham *et al.* (1974) and further elaborated by Odell (1977). Tools were further analysed with a metallographic microscope Olympus BX60M (MPlan 5, MPlan 10, MSPlan 20, MSPlan 50), using bright field illumination, according to Keeley (1980). For the latter type of analysis, all experimental tools were shortly immersed in a 10 % hydrochloric acid-solution (0.1 N), to remove adhering residues. During the analysis, tools were cleaned with acetone.

4. HAFTING BRIGHT SPOTS

For the hafting experiments, a wide range of variables were taken into account, including hafting arrangement, hafting material, use, tool morphology, retouch, etc. Specifically, we consider both male and juxtaposed hafted tools, for which the tool is respectively inserted into a handle or mounted against it. Haft materials include wood, bone and antler. When a further fixation of the tool was required, we used leather or vegetal bindings, resin or a leather wrapping. The hafted tools were used in a variety of actions and worked materials. Here we include tools for adzing wood and earth, and chiselling and scraping wood. Tool uses extended from a few minutes for some tools up to four hours for others.

We consider bright spots to be produced in regions submitted to very high friction. This friction can be the result of natural causes or be induced by man. Hafting bright spots can be identified based on their organised distribution and the traces they are associated with.

4.1. Types

Three main types of hafting bright spots can be distinguished. The first is a smooth and flat type, clearly abrasive in nature. In the first development stages it is distributed on the higher parts of the microtopography (fig. 1), which it gradually abrades until it is completely linked up (fig. 2). In some cases such bright spots show grooves (fig. 3). We consider this type to be produced by a flint particle detached in the haft where it got stuck and caused an intense localised friction between tool and haft. This is confirmed by a flint-on-flint rubbing experiment and the close association of these spots with scarring (*cf. infra*).

A second type is more undulated in nature, sometimes associated with small grooves and perhaps partially additive in nature (fig. 4). Such spots are only observed on tools in direct contact with an antler haft explaining their strong resemblance with a well-developed antler polish. This type was thought to be produced

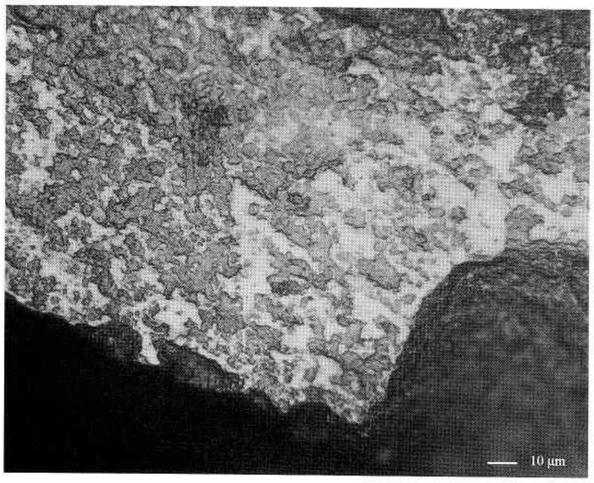

Fig. 1 — Hafting bright spot on ventral medial edge of tool used to adze wood (30 min).

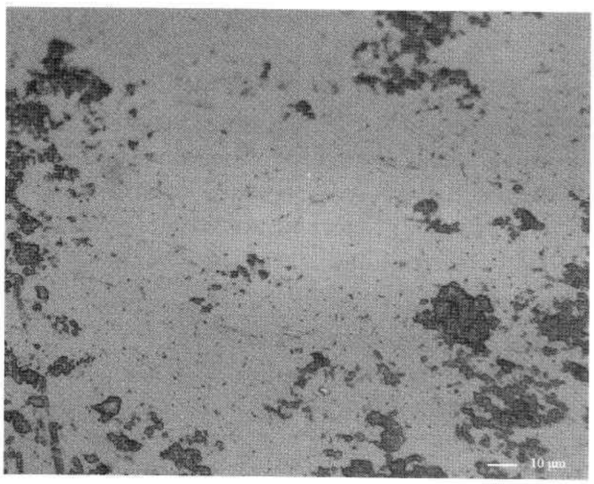

Fig. 2 — Hafting bright spot on proximal ridge of tool used to adze wood (2 min).

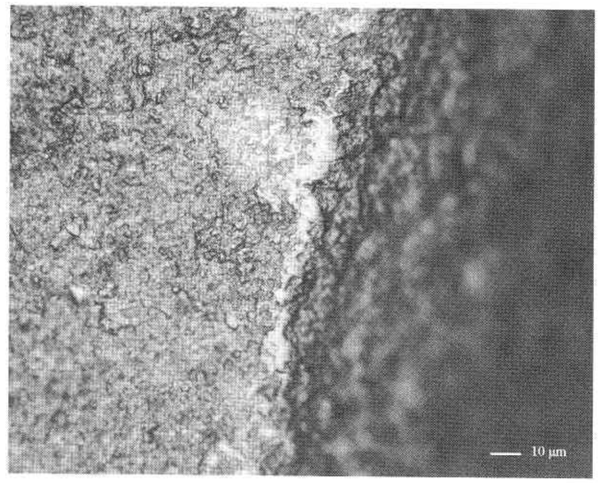

Fig. 3 — Striated hafting bright spot on dorsal proximal ridge of tool used to adze earth (4 h).

Fig. 4 — Hafting bright spot on dorsal proximal surface of tool used to adze wood (36 min).

by an antler particle that detached from the haft and got stuck in between tool and haft, but a proton microbeam analysis did not demonstrate any elemental deposition to support this. We are probably dealing with a combination of flint and antler particles, which is confirmed by the occasional gradual transition from this type of bright spot into the other, flat type.

The third type only occurs in case of resin hafted tools. It is rough, rather dull, and flat or rippled. We believe it is produced during de-hafting as a result of the friction with a resin particle (*cf. infra*).

We can conclude that generally only the first type of bright spots is produced, while the others solely occur under the specified conditions: in case of antler hafts (type 2) or fixations with resin (type 3).

4.2. Localisation and distribution

Hafting bright spots can be very large, covering extensive parts of the tool surface, sometimes in a linear distribution. They show an organised pattern, limited to the hafted portion of the tool. They mainly occur on edges and ridges and on surfaces near edges, especially around the haft limit and the butt (or tool part opposite the used edge). This distribution can be explained based on the distribution of pressure during use. When a tool is for instance used for adzing (launched percussion), most pressure is concentrated in the aforementioned tool parts: the butt is "pushed" against or into the haft and the haft limit functions as a kind of lever. Due to the high pressure, scarring is easily produced, logically resulting in frequent bright spots. Their distribution is thus not random, but by contrast clearly patterned. This trait distinguishes hafting bright spots from all other examples.

4.3. Association with other trace types

Hafting bright spots occur in close association with macro- and/or microscarring (fig. 5) and regularly with striations (fig. 6). Latter striations are abrasive in nature and are thought to be produced by the same process based on their similar association with edge scarring (fig. 7). In some cases, such striations—like bright spots—can mark the haft limit (fig. 7). On ridges, the bright spots can often cause a rounding. A hafting polish is usually present in the surrounding area without the spots being clearly associated with it. Bright spots always retain a somewhat isolated nature.

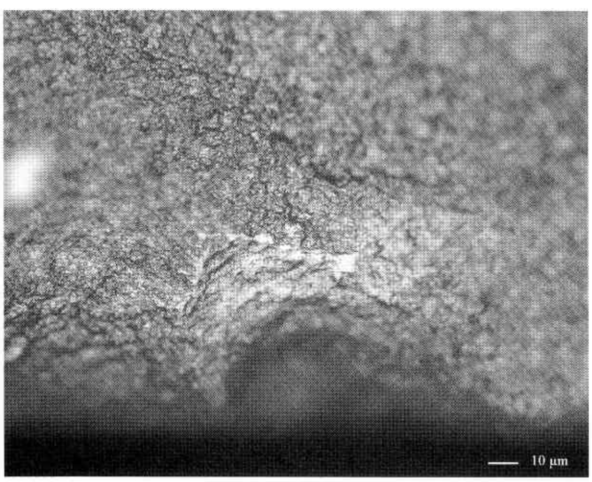

Fig. 5 — Hafting bright spot on ventral proximal edge of tool used to scrape wood (30 min).

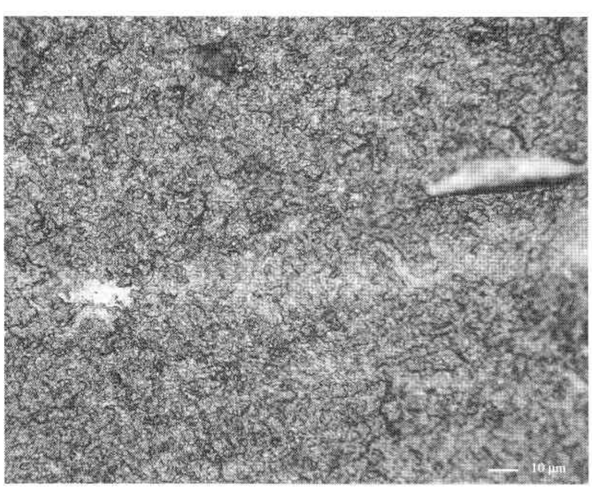

Fig. 6 — Hafting bright spot with striation on ventral proximal surface of tool used to adze wood (30 min).

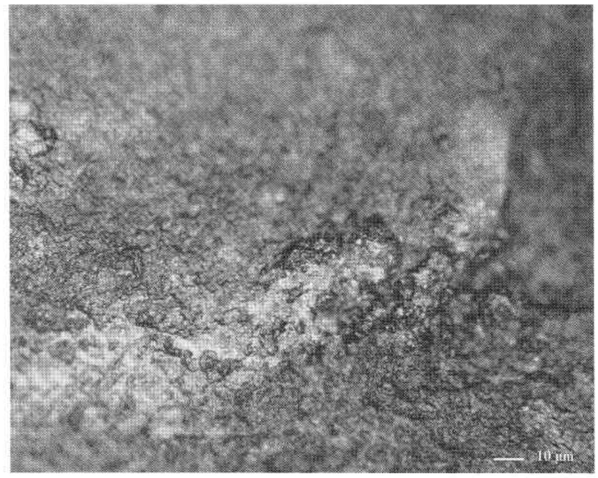

Fig. 7 — Hafting striation associated with scarring corresponding with the exact haft limit on the dorsal medial surface of tool used to scrape wood (30 min).

4.4. Amount and development

The amount and development stage of bright spots varies according to different variables. We distinguish here the presence of fractures or heavy crushing, worked material, action and hafting arrangement.

4.4.1. Fractures—heavy crushing

The fact that fractures and heavy crushing have an important influence on the amount of bright spots is no surprise given their cause. While a fracture at the haft limit hardly produces bright spots, as no real friction occurs and further use is impossible, a fracture in the haft can be responsible for a large amount of bright spots. Indeed, the user does not always notice the fracture and subsequent use may lead to a substantial friction in the haft. In some cases, one tool part slides over the other one, causing an organised though differential distribution of bright spots: in both contact zones bright spots are numerous, while they are practically absent on the opposite faces.

In a similar way, heavy crushing can enhance the production of bright spots. Since crushing depends on the pressure that is executed during use, tools used in high-pressure actions (e.g., adzing) will show more bright spots.

4.4.2. Action and worked material

The extent, localisation and development of bright spots is influenced by the action undertaken and the material worked. The higher the pressure executed during use, the more bright spots (and the more fractures) occur. This implies that adzing generally enhances the production of bright spots, while cutting, executed parallel to the haft axe with low pressure on the hafting arrangement does not. Next to action, also the resistance of the worked material determines the pressure executed on the hafting arrangement. Wood for example is far more difficult to intrude than earth, implying that in the former case, more pressure is executed on the hafting arrangement than in the latter. Consequently, more bright spots occur under the former conditions than under the latter. This means that knowledge related to the exact use of a tool is important for judging the amount of bright spots to be expected. In case of doubts related to the origin of the observed bright spots, this can be used as an external control.

Consider for example wood and earth adzing. Obviously, the amount of bright spots is higher when wood is worked, even if the duration of use is the same. In particular, wood adzing produces a large amount of well-developed bright spots all over the tool's hafted part (fig. 1, 2). When the butt is positioned against some kind of stopping ridge, bright spots are even larger and more extensive due to heavy crushing of the butt under use pressure. Working the lower resistant material earth does not have such an intense effect on the butt, nor on the other tool parts: bright spots are limited and small (fig. 8).

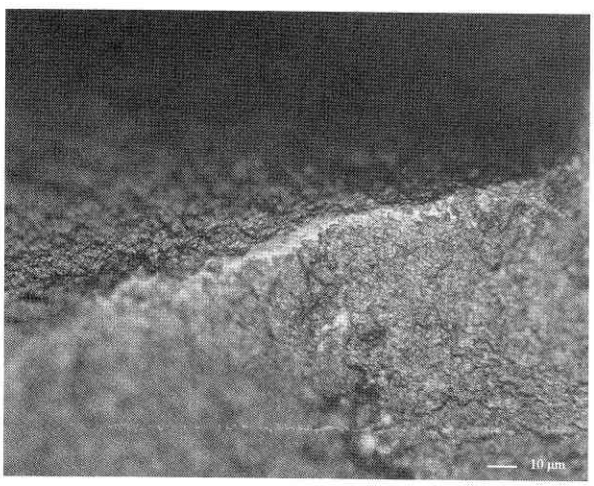

Fig. 8 — Hafting bright spot on medial ridge of tool used to adze earth (1 h).

If we compare this situation to chiselling wood, differences are small. The pressure executed on the hafting arrangement is only slightly different: adzing puts more pressure on the haft limit. Bright spot production is similar and they can be as extensively distributed, only their development may be more reduced (fig. 9, 10). They are mainly concentrated in the most proximal zone and/or on the higher parts of the microtopography.

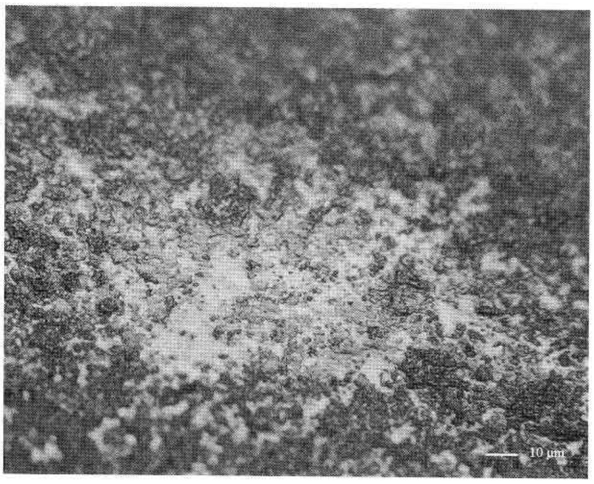

Fig. 9 — Hafting bright spot on ventral proximal surface on tool used to chisel wood (30 min).

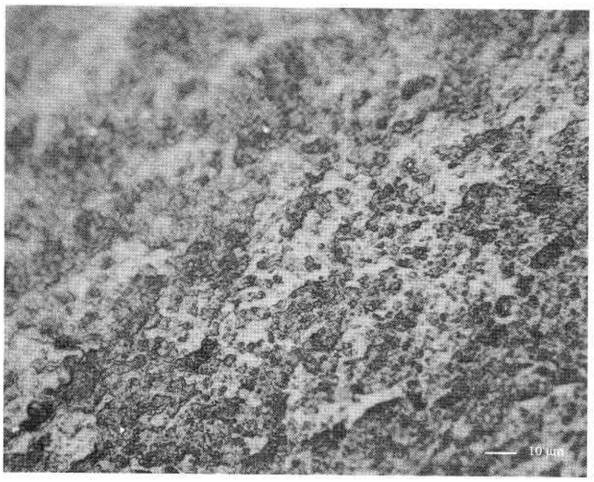

Fig. 10 — Hafting bright spot on ventral proximal surface of tool used to chisel wood (25 min).

Wood scraping results in a different pattern. While the amount of bright spots is similar to wood adzing, their exact localisation differs. They are concentrated near the haft limit and close to the butt, and are practically absent in between. They can be very large and highly linked up (fig. 11). They are preferentially located on the surface in direct contact with the haft and in general they occur in association with edge scarring, sometimes with striations,

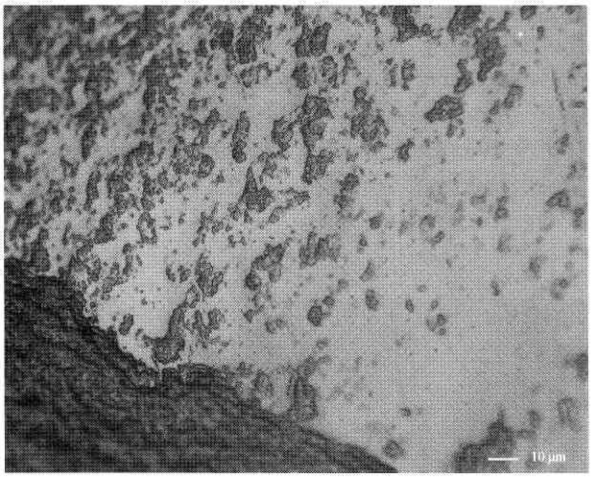

Fig. 11 — Hafting bright spot on dorsal medial surface of tool used to scrape wood (30 min).

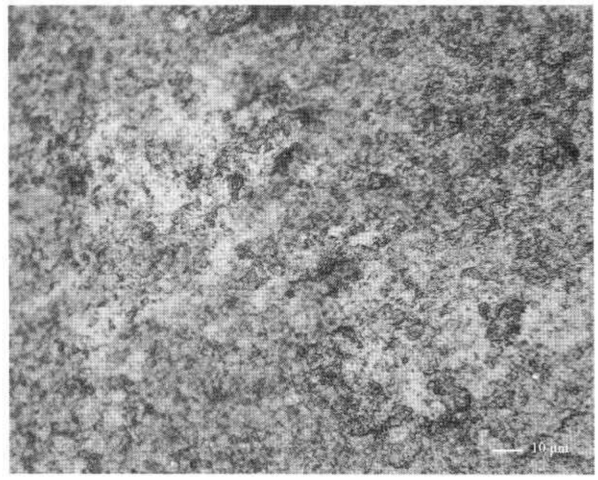

Fig. 12 — First development stage of hafting bright spots on ventral medial surface of tool used to chisel wood (25 min).

on surfaces near edges, on the edges themselves and on dorsal ridges.

4.4.3. Hafting arrangement

The fact that the hafting arrangement can influence bright spot production was already suggested when distinguishing different types of bright spots. We also referred to the fact that a contact with a hard haft material enhances their production. The latter implies that most bright spots occur on the surface in direct contact with the haft. In addition, when a tool protrudes from its haft, tool edges are more fragile and easily damaged. Bright spots will thus be more frequent when the tool is wider than the haft, in particular when the edges are not retouched.

A last factor is the use of a wrapping. With wrapping we refer to a leather (or vegetal) piece wrapped around the tool before it is mounted in or on the haft. This piece protects the tool's edges and reduces the amount of friction in the haft. Less scarring is produced and hardly any bright spots occur.

4.4.4. Development process

Our experiments further improve our knowledge related to the development process of bright spots. We consider a dull, somewhat rough stage as the initial stage (fig. 12). Spots are isolated in nature, but they already show the characteristic organised distribution. They are however, not yet "bright". The second stage is slightly smoother in morphology and brighter in appearance (fig. 13). From then onwards, the smooth and bright character is present, with differing degrees of linkage.

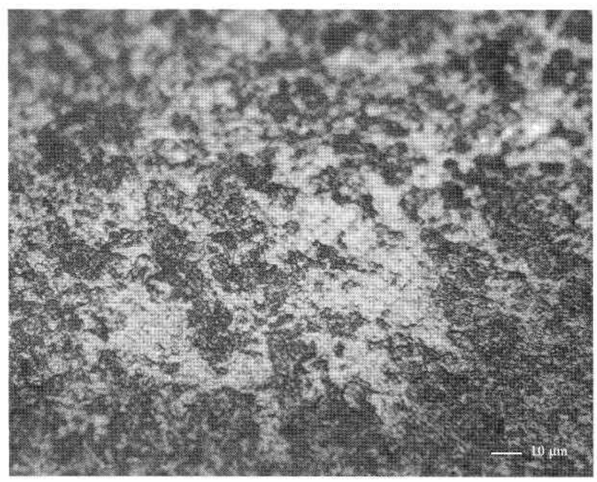

Fig. 13 — Second development stage of hafting bright spots on ventral proximal surface of tool used to chisel wood (25 min).

5. Other bright spot causes

5.1. Flint-on-flint friction

The earliest development stages of bright spots described above correspond to what one can obtain by rubbing two flints against each other. Although other analysts have stated that water was a necessity for producing friction bright spots (Levi-Sala, 1986: 234), we succeeded to produce them without water. The first stage, after about 2 minutes, is rough and dull (fig. 14) and while the rubbing time gets longer (up to 5 minutes), spots become smooth and bright (fig. 15). In all cases, an edge was rubbed with high pressure against a surface. Reproducing similar bright spots by rubbing two flint surfaces against each other is less straightforward. Similar to hafting bright spots, friction bright spots are visible macroscopically.

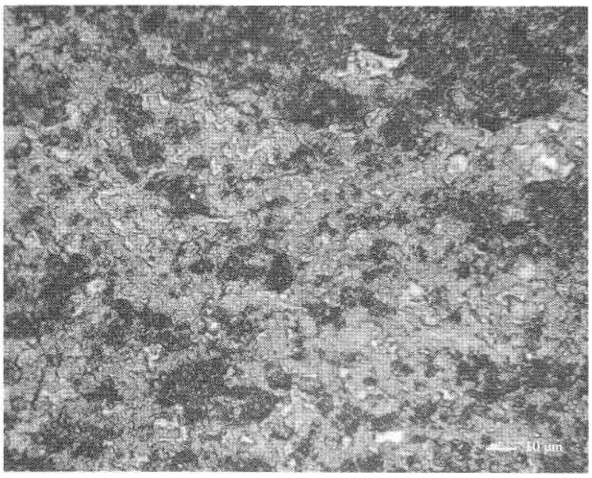

Fig. 14 — Low developed flint-on-flint bright spot on ventral surface, dry rubbing (2 min).

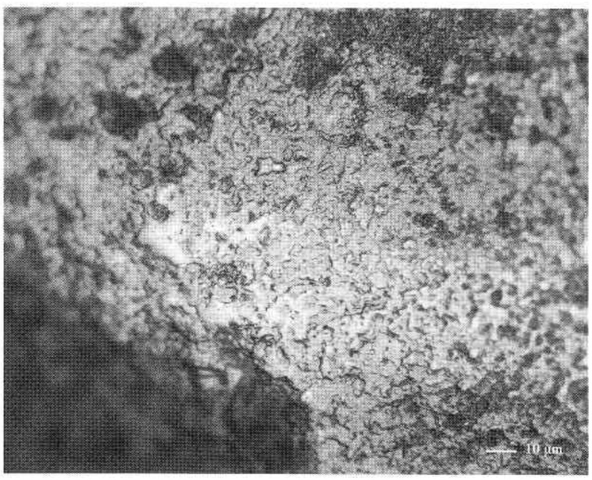

Fig. 15 — Better developed flint-on-flint bright spot on bulbar ridges, dry rubbing (5 min).

Some morphological differences can nevertheless be observed. Parallel grooves are systematically present, due to the intentional two-directional rubbing motion. Spots are not isolated in nature and they are characterised by better developed (smoother and brighter) higher zones and less developed (more rough and dull) lower zones. The latter is due to the rubbing motion itself, making contact with a large surface, but with a lower pressure than in case of hafting. Consequently, mainly the higher zones are attacked. Hafting bright spots, on the contrary, are produced by a flint particle that moves back and forth in the haft and causes an intense friction in a very limited area. Depending on the intensity of the motion, small or larger parts of the surface will be damaged, but in all cases pressure is high and results in an abraded surface.

Bright spots produced with wet rubbing are different in nature, they never reach a bright and smooth stage (about 2 minutes, fig. 16). Numerous grooves (parallel, linked to motion) are again present, which is typical for spots produced by an intentional motion.

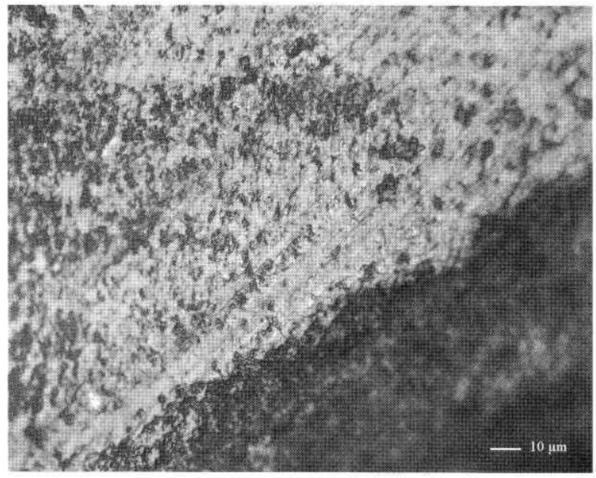

Fig. 16 — Flint-on-flint "bright spot" on ventral surface, wet rubbing (2 min).

5.2. Transport

With transport we refer to the carrying around of tools and other equipment in a bag. Five situations are compared:

- flint tools in a leather bag, carried around outside the belt;
- flint tools in a leather bag, carried around in the pocket of a pair of trousers;
- flint tools, wrapped in one large piece of leather, one after the other. The whole is placed in a leather bag carried around outside the belt;
- each flint tool is wrapped individually in a small leather piece, fixed around the artefact with a string. This set of tools is placed in a leather bag and carried around in the pocket of a pair of trousers;
- the results are clear-cut. In the former two situations a high amount of friction is possible allowing extensive bright spot production, in the latter hardly any friction occurs.

In the first situation, an all-round abrasion polish is produced after a few days. Bright spots are generally small, flat, smooth and highly linked. A rounding is clearly associated with the abrasive polish and bright spots. The more the latter two are developed, the more extensive the rounding. This rounding is especially visible on dorsal ridges. A transport of 18 days produces a heavily damaged artefact and a macroscopically visible gloss on dorsal ridges (fig. 17). This gloss consists of a series of bright spots on a microscopic level (200 ×). Bright spots are randomly present all over the tool. Macroscopic retouches are numerous and their indirect link with the presence of bright spots is indubitable. After a total transport of 88 days, macroscopic scratches are present all over the tool, as well as a macroscopically visible polish line on the ridges. On a microscopic level, an extensive well-developed abrasion polish and numerous bright spots can be observed (fig. 18). A clear rounding is present.

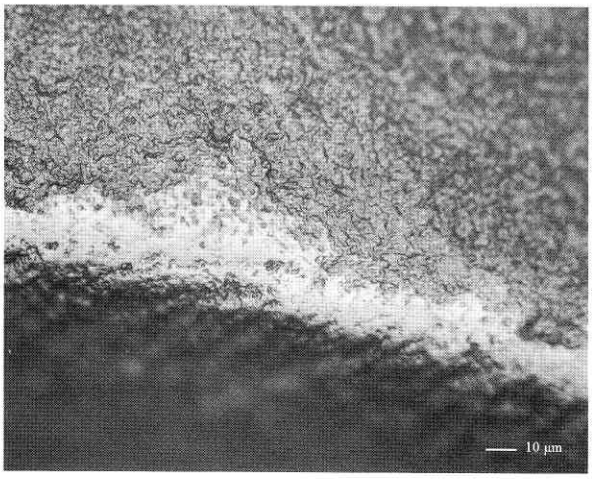

Fig. 17 — Transport bright spot on dorsal medial ridge (18 days).

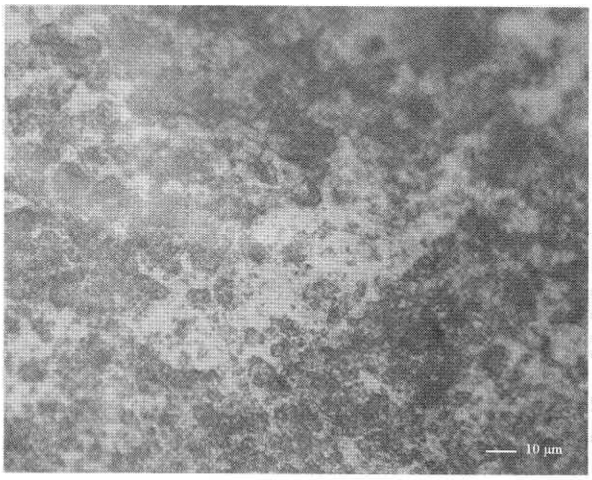

Fig. 18 — Transport bright spot on ventral bulb (88 days).

The same counts for the second case scenario, but here traces are produced much slower. Only after a transport of 14 days, a light, bright and smooth abrasion polish can be observed on the dorsal ridges, in some zones it is somewhat more extensive and forms a bright spot. The polish does not intrude much into the inner surface of the tool. A total transport of 98 days causes a relatively well developed, but limited hide polish on portions of the tool's surface. A well-developed abrasion polish, as well as bright spots can be observed.

In the last two cases, hardly any traces are produced. After 79 days, some minor polish is formed on the dorsal ridges of the third series of tools. This polish is hardly developed and is nothing more than what can be expected from friction during knapping. Similar observations were made on the last set of tools, with one remarkable exception. The zones corresponding with the location of the string around the leather wrapping, show a light abrasion polish on ridges and edges and light abrasive striations corresponding with the string direction. Minor damage is associated, but no bright spots are produced. The pressure executed by the string, amplified during transport, can account for these traces. Only in one case, a few bright spots were produced due to the position of the string on a protruding part of the tool's edge. This resulted in more extensive damage and pressure, finally leading to bright spot production on the edge. Bright spots (type 1) remain very limited and small.

Abrasion polishes are more frequent on transported tools than bright spots. After all, friction is rarely sufficiently intense and localised to allow their production. A constant low-pressure friction can perfectly explain an all-round abrasion polish. The high bright spot production in the first case scenario confirms this interpretation. Only in a loose hanging bag, tools are "smacked" against each other with sufficient pressure to allow bright spot production. Transport bright spots are easily distinguishable, due to their association with abrasion polish and their all-round random distribution.

5.3. Prehension

In a few circumstances of hand-held use, the pressure of the fingers causes sufficient friction to result in bright spots. An important condition is that hands are "dirty" during work, with which we refer to the presence of particles—generally detached from the worked material—that increase the friction with the tool and are responsible for trace production. In particular mineral particles (e.g., when working slate), can result in an intense prehension polish, the morphology of which is determined by the material worked. Small, smooth bright spots may be produced (fig. 19), but these are always integrated in an extensive well-developed mineral prehension polish, often combined with a substantial rounding. No association with striations or scarring can be observed. In addition, there is no clear limit in their distribution, or a restriction to a specific well-defined tool part. The trace pattern corresponds with the position of the hand during use. It seems unlikely that these bright spots could be confused with hafting ones.

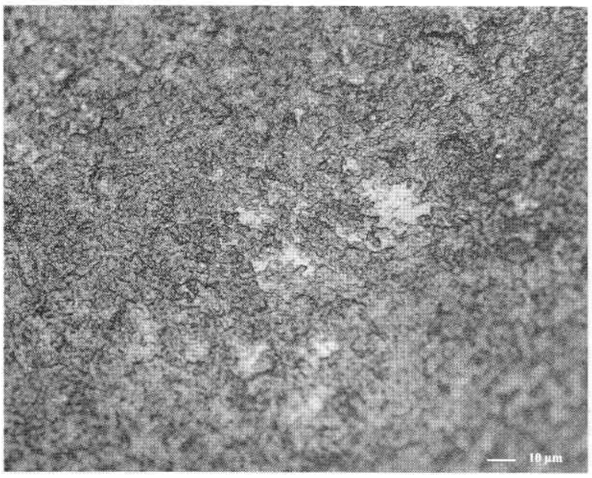

Fig. 19 — Prehension bright spots on tool used hand-held to groove schist (3 h 30 min).

5.4. Use

When a hard or medium-hard material is worked, a flint particle detached from the working edge during use can sometimes get stuck in the worked material. This results in a short but intense friction with the working edge during subsequent use that may lead to the production of one or a few tiny bright spots. Such spots are limited to the working edge and integrated within the use polish or even largely removed or superposed by it. In the same way, mineral particles present when a material is worked (e.g., hide with ochre), can be responsible for bright spot production (fig. 20).

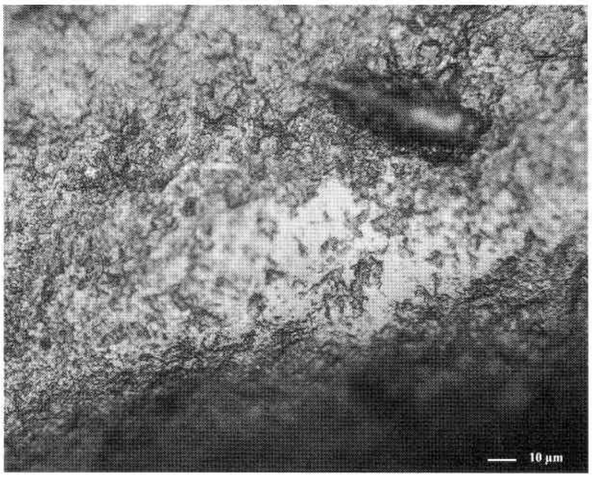

Fig. 20 — Usewear polish with integrated bright spot from scraping hide with abrasives, on ventral scraperhead (30 min).

5.5. De-hafting

If resin is used for hafting, frictional spots can occasionally be produced while de-hafting. This was for instance noted on experimental tools hafted with the aid of resin in a male antler haft. The resulting spots are somewhat rough, flat or rippled and less bright than hafting bright spots (fig. 21). Sometimes tiny parallel grooves are present (fig. 22). In all observed cases, the lithic tool was de-hafted by fracturing the resin instead of first heating and softening it. We therefore believe that resin spots are produced by the friction with a hard resin particle upon extraction of the tool out of its haft. This is confirmed by the lack of variation inflicted by action and worked material, as well as by the unpatterned localisation of resin spots over the hafted part. Most often, resin bright spots occur on protrusions. They frequently occur on ridges, near edges, or on higher zones of the surface, but they can also occur within the concavity of a scar. No association with other types of

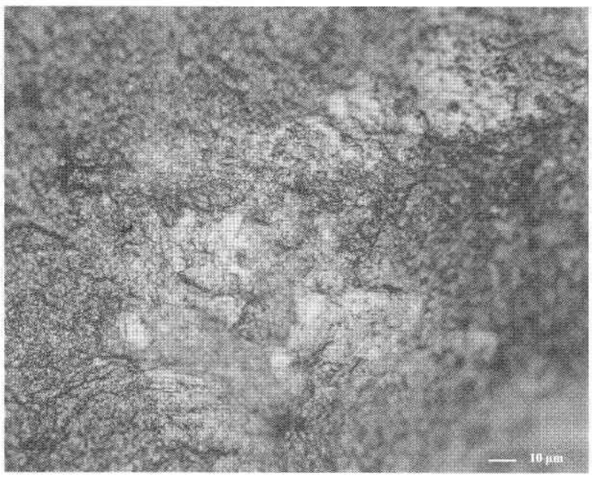

Fig. 21 — Resin bright spot from de-hafting on ventral most proximal edge.

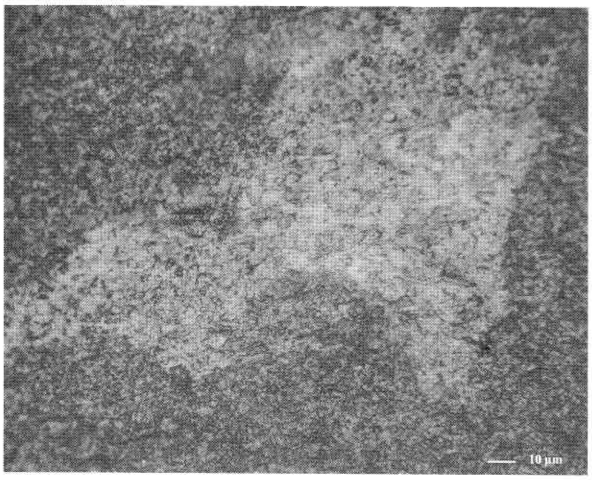

Fig. 22 — Resin bright spot from de-hafting on dorsal proximal left edge.

traces could yet be identified apart from an occasional light friction polish. This type of spots corresponds to what Juel Jensen (1994) observed. She, furthermore, suggested resin friction as cause.

5.6. Post-depositional

Post-depositional bright spots can easily be distinguished based on their random distribution all over the tool and their frequent association with a macroscopically visible patination or light alteration (sheen). Even if such bright spots occur in the neighbourhood of scarring, they are not associated with it.

6. DISCUSSION

We can conclude that bright spots cannot simply be attributed to post-depositional alterations, as was often believed in the past. We have provided experimental evidence for their variable causes, including hafting. We further argued that such bright spots allow one to assess confidently whether a tool was used hafted. Hafting bright spots have specific characteristics, including an organised pattern and a close association with scarring, based on which they can easily be distinguished from bright spots produced by other causes. Further, variables could be identified that influence their formation process. These variables have bearing on the exact use conditions, the worked material, the action undertaken, the hafting arrangement, etc. The influence of these variables is recurring throughout our experimental reference collection, and we therefore believe that we dispose of an important criterion that allows the identification of once hafted tools. Obviously, analysts should remain careful in using bright spots for detecting hafting in case of heavily alterated archaeological assemblages, as counts for all traces observed on such artefacts.

Bright spots are not the only traces that allow an identification of whether a tool was used hafted, but they are certainly the most obvious ones. They can often be observed with the naked eye, and an investigation of their pattern and associations does not demand a high investment, while opening a wide range of further inferences, all of which cannot be mentioned here, but were elaborated upon by Keeley (1982). In addition, we can shortly state that the choice to haft a tool has an important influence on the complete life cycle of a tool, from raw material procurement up to discard. Hafting a tool demands a higher time investment than using it in the hand, but this investment is compensated by the fact that a haft prolongs the use-life of a tool and increases its efficiency. Hafts can also be re-used frequently. Depending on the hafting arrangement used, one can expect adaptations of the tool's morphology to fit the haft (e.g., when the lithic tool needs to be inserted into a hole), since this is far more straightforward than constantly adapting the haft, which quickly turns it unusable. A link between hafting and standardisation seems therefore likely, but needs further investigation.

Undoubtedly, the identification of interpretable haft wear opens up many types of investigations that were unthinkable before and we strongly encourage that hafting traces are included in future analyses. The topic has been neglected far too long in functional analysis simply due to the strong disbelief regarding its interpretative possibilities. We hope to have provided sufficient convincing evidence to counteract this opposition and to stimulate a renewed interest in the potential of hafting wear.

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