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Rozalia Christidou, Alexandra Legrand-Pineau

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Hide working and bone tools: experimentation design and applications

Rozalia Christidou and Alexandra Legrand

This paper examines the methodology and the first results of experiments with hide working. Based on ethnographic, historical, and experimental data, the technical process used to work a hide is directly related to the origin of the hide and to the type of product desired. Moreover, differing processes or phases of processes may well involve different tools and gestures. Based on this information, an experimental program was designed which included fleshing, softening, and perforating deer- and cowhide. The experimental tools used to process the hides were made from long bones and ribs, and they resemble in form edged tools and awls studied by the authors in various Neolithic sites in Greece, Turkey, Cyprus, and Syria. In the following presentation, emphasis is put on the systematic character of the experiments, the performance of the tools under examination, and the wear produced on the active ends of those tools.

Rozalia Christidou, UMR 5133 – “Archéorient”, Maison de l’Orient et de la Méditerranée – Jean Pouilloux, 7 rue Raulin, 69365, Lyon cedex 07; roschri@otenet.gr

Alexandra Legrand, UMR 7041 ARSCAN, “Préhistoire en Méditerranée Orientale: Chypre et Jordanie”, Maison de l’Archéologie et de l’Ethnologie René Ginouvès, 21 Allée de l’Université, 92000, Nanterre; a.legrand@free.fr

Hide working is generally acknowledged as an important craft practiced in prehistoric and traditional communities (Beyries 1999; Edholm & Wilder 1997; Hayden 1993; Plisson 1993; Sliva & Keeley 1994). Bone tools are found in the Neolithic villages of Europe and the Eastern Mediterranean in a wide variety of forms. Several of them, mainly edged and pointed ones, have been associated, tentatively or not, with hide working (Christidou 1999; Efe 1998; Legrand in print; Maigrot 2003; 1997; Russel 1990; Sidéra 1993a; Stordeur & Christidou in print). Ethnographic evidence supports the idea that bone tools were used to process hides (Albright 1984; Beyries 1999; Le Mouël 1977; Masson 1889; Steinbring 1966; Stewart 1973). Moreover, the faunal record of Neolithic villages is very rich in domesticated and wild taxa (sheep, goat, cattle, pig, deer, bear, hare, etc.), so that, the use of various animal hides would be anticipated.

Experimentation is the best means to recognize and classify use wear patterns on archaeological tools (Keeley 1980; Plisson 1985; Vaughan 1985). An experimental program has been set up in order to explore bone scraper and awl use modes and wear patterns related to hide working. This program is part of a larger one that centers on stone, mainly obsidian tools and their connections with various crafts including the processing of animal bone and hides. The study of the similarities and differences in the use of stone and bone tools is also part of the same program. The *Société des Autoroutes Paris-Rhin-Rhône* and the UMR 6130 of the *Centre National de la Recherche Scientifique* (France) provide funding for the program.

Methodology

Based on ethnographic evidence, cultural perceptions and local technologies related to hide working vary enormously, making the reconstruction of ancient hide treatment methods extremely difficult. Both the environmental and the socio-economic context of production influence the choice of hides and of the techniques used to work and preserve them (Beyries 1999; Forbes 1966; Hayden

1993; Ibáñez *et al.* 2002; Lemorini 1999; Robbe 1975; Rodríguez Rodríguez 2002; 1999). A wide variety of products are manufactured from hides and these are chosen and processed accordingly (see also Edholm & Wilder 1997; Owen 1993; Pécheux 1922; Philibert 1993; Villon 1889). The material and the morphology of the tools used to work hides also vary and include, apart from bone and stone, metal and wood. Moreover, different tools can be used for the same purpose (Plisson 1985); the same tool can be used in different phases of one and the same process (Edholm & Wilder 1997); different tools made from the same material, bone for example, can be used in the same phase of a process for the treatment of different parts of the hide (Bird & Beeck 1980).

We used both ethno-historical and experimental information to define the lines along which variability in prehistoric bone tool use modes could be monitored. By these means, we established the morphology of the tools, the origin and state of the worked hide, and the movements used during work as the three major factors affecting variability.

Fleshing and softening are the two main stages of hide working that are related to bone scrapers. These are also used in other operations, such as dehairing, membranizing, and wringing. Generally, bone scrapers are used to process fresh and wet hides. They are usually made from long bones and ribs. They have a straight or a concave working edge, usually parallel to the grain of the bone. The working edge can also be convex. Toothed edges are also reported. Regardless of which tool is used, the edge is kept sharp when flesh and other tissue need to be removed; if not, blunt edges, including those rounded by use, are employed. Previous experiments with bone tools confirm the importance of re-sharpening (Sidéra 1993b).

The tool is held in one or both hands depending on its morphology, the hide's position, and the use motion. Tools with long and more or less concave working edges are held in both hands and they are used in order to scrape hides laid on a beam. The other edges are used in various ways, but it would seem that convex ones are chosen to work with a gouging motion when the hide is stretched on a frame. It should nevertheless be noted that the hide's position also depends on other factors: whether the hide is worked with the hair still present and/or the size of the hide.

Bone awls are typically referred to as perforating tools, but they can also be used to reopen holes made in the hides, pass thongs or threads through the holes or untie knots of cords, thongs and threads. As perforators, they are used on fresh, wet, damp, tanned, and untanned hides in two ways: by indirect percussion or by rotation.

The experiments discussed below were simple actions executed while *fleshing* and *softening*. Each experiment could thus examine one or two of the aforementioned variables, that is, tool morphology and motion as well as origin and state of the worked hide, as possible factors effecting the variability of wear features and development. Indeed, the various operations that impose different conditions on the tools, when the latter are being used, can be expressed as combinations of variables (González Urquijo & Ibáñez Estévez 1994; Gutiérrez-Sáez 1993). By adopting this analytical approach it is possible to organize sets of experiments, which correspond to operations. Each set is part of a larger process as indicated by ethno-historical evidence.

Use duration being a critical factor in wear's development (Vaughan 1985), the length of time for which the experimental tools were used was also recorded. Because previous analyses showed that the surface texture of the tools, both stone and bone ones, has an influence on wear development (Astruc *et al.* 2001; Keeley 1980; Semenov 1964; Vaughan 1985; see also below), the materials and techniques used to make the tools were kept constant.

The experimental scrapers were made from fragments of long bones (femurs, tibiae, metapodials) and ribs (Fig. 1), while the awls were made only from long bones (Fig. 2). Flaking, grinding or scraping was used in order to shape the tools. These are similar to the most common edged and pointed tools found at the Neolithic sites we study in Cyprus, Greece, Turkey, and Syria. The morphological characteristics of the scrapers with which experiments were mainly concerned are the shape of the active edge (convex, straight; single and double-beveled) and the edge angle. The overall size and thickness of the active end of the pointed tools varied: there were long and stout tools with varying tip angles. The shape of the active end also varied: there were points with flattened ends and with rounded ones.

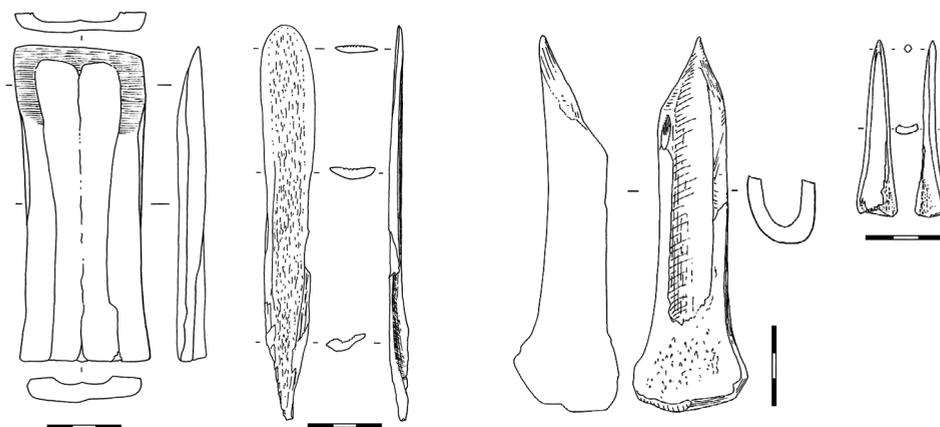


Fig. 1. Experimental scrapers from a metapodial (left) and a rib (right).

Fig. 2. Experimental awls.

Two types of hides were selected for their different physical characteristics and therefore their possible different uses and subsequent treatment: red deer and cowhide. In almost all cases, the hides were left with the hair on.

While being fleshed the hides were fresh, soaked, damp, and only sometimes dry; they were stretched in a wooden frame, staked to the ground, laid on a wooden plank or simply laid on the ground (Figs. 3–4). The bone tools were hafted in only a few pilot experiments. Generally,

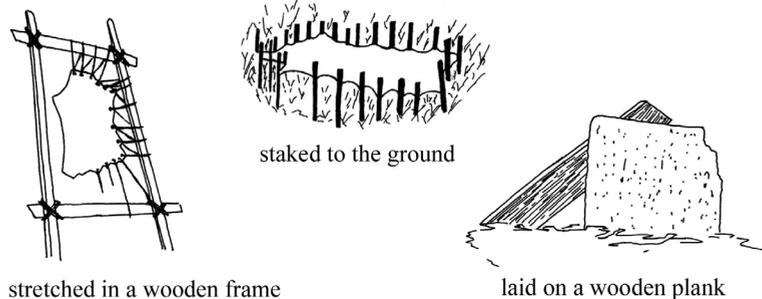


Fig. 3. Position of hides.

scrapers were held in hand and used by percussion, with a gouging motion (Fig. 5), or by friction, with a pushing or pulling motion (Fig. 6). “Contact angles” (Anderson 1981; Juel Jensen 1994) were, therefore, in both cases low.

Both low and high angles, unidirectional and back-and-forth motions were used for softening soaked and damp hides. Softening by spitting on drying red deer hide was also tested. Scrapers were held in hand. In only two instances were stationary stakes, mounted on one side with obsidian blades and/or bone splinters with cutting fracture edges (Fig. 7), used to soften hides and hide strips.



Fig. 4. *Wooden plank laid on the ground.*

Fig. 5. *Fleshing with a gouging motion. Incorrect orientation of the bevel of the tool: to effectively flesh the hide, the beveled face should be the leading face.*

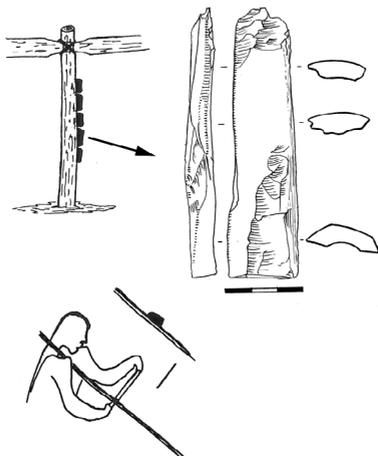


Fig. 6. *Fleshing with a pulling motion.*

Fig. 7. *Types of stakes where bone splinters with cutting fracture edges were mounted. The tool (right) is a splinter shaped by retouch and mounted on a stake.*

Awls were mainly used to perforate raw and fleshed, wet and dry hides by rotation (Fig. 8) and by indirect percussion (Fig. 9). When indirect percussion was used to punch holes, the hide was laid on a wooden plank, usually with a hide piece interposed between the plank and the worked hide.

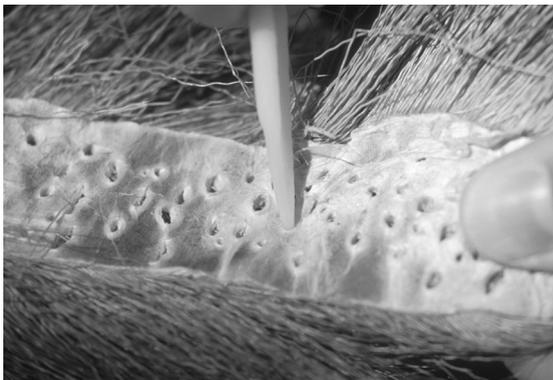


Fig. 8. Perforating by rotation.



Fig. 9. Perforating by indirect percussion.

Observations on tool use

Collectively, experiments in *fleshing* showed that:

- Single-beveled scrapers with low edge angles ($\leq 30^\circ$) and well-sharpened cutting edges were best adapted to the task. The “contact surface” of the tool (Anderson 1981; Juel Jensen 1994) is the one opposite to the bevel (Fig. 5). These observations are supported by evidence from other experiments (Edholm & Wilder 1997).

- Scrapers made from ribs wore at a much slower rate than those made from long bones. The former could still be used effectively after 105 minutes of working while for the latter the maximum duration of effective use was 55 minutes (after that they had to be re-sharpened). It should be noted, however, that red deer hide is more abrasive than cowhide. This observation applies to both obsidian and bone tools (L. Astruc, A. C. Rodríguez Rodríguez, pers. comm.).

- Bone scrapers were very efficient fleshing tools. They can be used to thoroughly clean the flesh side of the hide (Figs. 10–11).

Considering *softening*, our observations mainly concern:

- Hides from which excessive membrane needs to be removed during softening: in this case, the working edge of the scraper has to be kept sharp. However, bone splinters mounted on stakes were not suited to the task.

- Working by spitting on the hide: although effective, this is a particularly time-consuming technique.

Considering the use of *awls*, the following points should be stressed:

- Indirect percussion is most effective, and often necessary, when the worked hide is thick and/or stiff.



Fig. 10. Red deer hide laid on the ground and fleshed with a rib scraper.

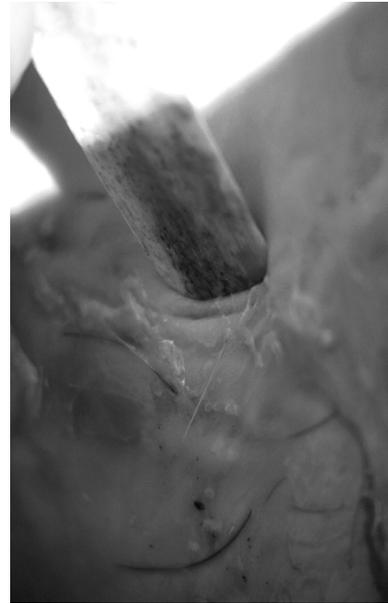


Fig. 11. Close up of the scraped surface shown in Fig. 10.

- Awls with thick points ($>25^\circ$) are not well adapted to hide perforation.
- All types and sizes of points used in the experiments damaged the thin dry hides, such as that from red deer, by cutting holes in them (Fig. 12).
- Oblong holes made in fresh hides or in soft and thin dry hides stretch out over time.
- Incisions made with flattened points with cutting borders tear open when thongs, threads or cords are passed through these holes. It is evident that the shapes of the holes made by the various tools do not serve the same function.



Fig. 12. Holes cut in a strip of dry red deer hide.

Use wear

Use-wear analysis is employed to define criteria for distinguishing the different uses of the bone tools (Christidou 1999; LeMoine 1989; 1997; Maigrot 2003; Peltier & Plisson 1986; Sidéra 1993b, with references). Below, we present examples where the use wear is more or less well developed on the tools. The observation of traces was carried out with a Leica and a Nikon metallographic microscope. Bright field and Differential Interferential Contrast were used at 100x and 200x magnifications.

A basic line of distinction can be traced between indirect percussion and rotation when considering: 1) the development and orientation of the use striations on the active parts of the pointed tools, and 2) the state of their tips. On the tools used by indirect percussion to punch holes into wet hides, the wear consists of a dense network of longitudinal, long, and continuous narrow dark striations that cover the entire polished surface (Fig. 13). Frequent non-linear rough-bottomed depressions occur, as well as micro-pits. Overall, the polish has a grainy appearance. All surface elevations are worn down and smoothly rounded. The tips of the tools are usually crushed with the asperities becoming smoothed and polished as the wear develops.

Working by rotation also produces longitudinal striations, but in a less marked form, as well as transverse and oblique ones (Fig. 14). The tips of the tools are usually rounded or slightly faceted. Otherwise, the nature of the striations and non-linear depressions, the grainy texture of the polish, as well as the continuous smoothing and polishing of the topography are common features of the tools used either by indirect percussion or by rotation.



Fig. 13. *Micro-wear observed on the active end of an awl used to perforate cowhide by indirect percussion (metallographic microscope, 200x).*

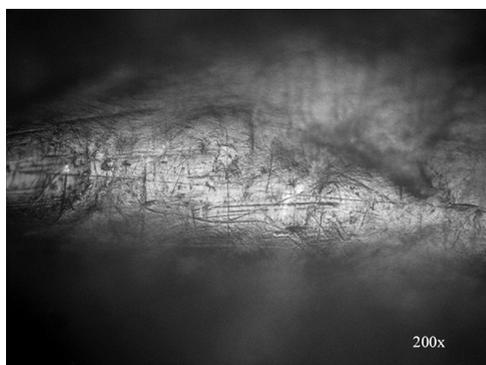


Fig. 14. *Micro-wear observed on the active end of an awl used to perforate cowhide by rotation (metallographic microscope, 200x).*

Hand-held scrapers exhibit rough-bottomed striations and non-linear depressions as well as smoothing and polishing of the topography (Figs. 15–16). Continuous rough-bottomed striations with pointed ends are numerous on the tools used with a back-and-forth motion. In general, the polished elevations and ridges have a grainy texture and are crossed by fine dark striations. Micro-pits are present as well. The wear overlaps the rounded edge and clearly affects the “leading face” (Anderson 1981; Juel Jensen 1994) of the fleshers. It includes most of the same features as those described for the contact face but in a less marked form. On the scrapers used to soften hides, the wear hardly affects (if at all) the leading face, but surface wear components are overall very similar to the ones observed on the fleshers.



Fig. 15. *Micro-wear observed on the active end of a scraper used to flesh red deer hide (metallographic microscope, 200x).*



Fig. 16. *Micro-wear observed on the active end of a scraper used to soften wet red deer hide. Excessive membrane was removed during this operation (metallographic microscope, 200x).*

The margin of the contact surface of the tools used with a pulling or pushing motion to work hides laid on a hard surface displays after the use a tiny, rather steep-angled facet that is semicircular in shape and convex in profile. This damage obliges the tool user to increase the working angle, thus preventing the steady slicing movement guaranteed by the low angle used before rounding appears. The edge is regularly smoothed. Edge damage in the form of scars is rare. On the other tools, which are not in contact with a hard surface, faceted margins are not very distinctive.

The wear on splinters mounted on stakes, consists of a dense network of similarly orientated and superimposed rough troughs with pointed or open ends, alternating with elevations of a grainy texture displaying micro-pits (Fig. 17). Rough-bottomed non-linear depressions also occur. The working edge of the splinter is wavy and slightly rounded in cross-section.

Importantly, surface wear pattern alone is not sufficient for distinguishing between fleshers and tools used for softening; other features such as the differences in the localization of the wear are more important in this respect. But, on the whole, the degree of wear on tools used for softening can be more developed than on fleshers as the former can be used for longer periods of time: edge sharpness (and therefore re-sharpening) is not always important in the case of the

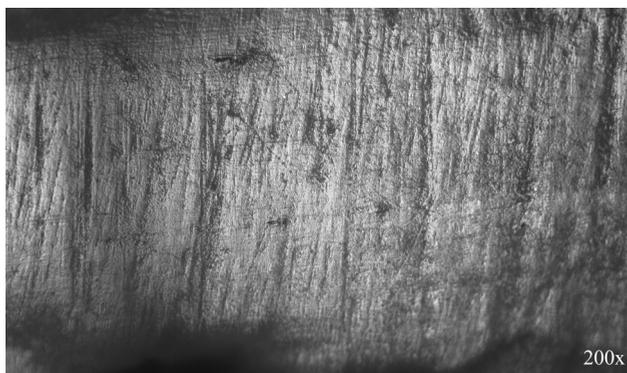


Fig. 17. *Micro-wear observed on the active end of a long bone splinter mounted on a stake and used to soften wet red deer hide (metallographic microscope, 200x).*

tools used for softening. The surface-wear pattern described for the tools mounted on stakes represents an example of intense wear that hide softeners can display.

In the above examples, variations in wear development also occur in the first stages of the tool's use. These variations are also related to the roughness of the tool's original topography, produced when the tool was shaped. As an example, two *general* categories of topographies of ground bone surfaces will be considered:

- Topographies characterized by similarly oriented irregular rough-bottomed striations, pits, and non-linear rough-bottomed depressions of variable size (Fig. 18). The elevations are indicated by peaks or flat light-reflective plateaus. These surfaces are produced when free abrasives are present in quantity over the surface against which the bone is rubbed. In our experiments we used abraders lubricated with water and sand.

- Topographies characterized by superimposed, long, and continuous striations (Fig. 19). The elevations have the form of ridges or flat and continuous light-reflective strips with a more or less homogeneous granular texture. These surfaces are produced when no free abrasives are present in quantity (see also Christidou 1999).

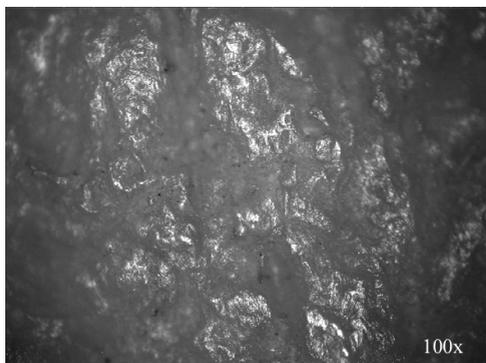


Fig. 18. *Surface produced on a tool after grinding against an abrader lubricated with water and sand (metallographic microscope, 100x).*

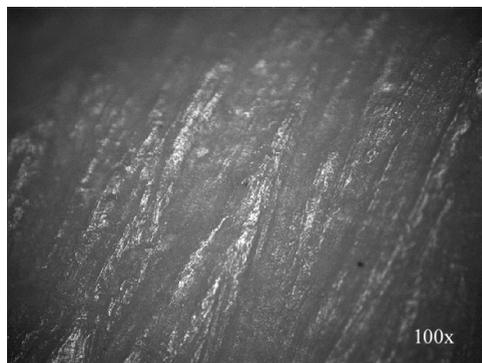


Fig. 19. *Surface produced on a tool after grinding against an abrader. No lubricants used (metallographic microscope, 100x).*

After use, when the features of the first type of surface are still visible, they are responsible for the irregular aspect of the topography of the worn surface (Fig. 20). When studying moderately worn surfaces, which preserve features of the original topography, it is necessary to take into account the nature of the latter.

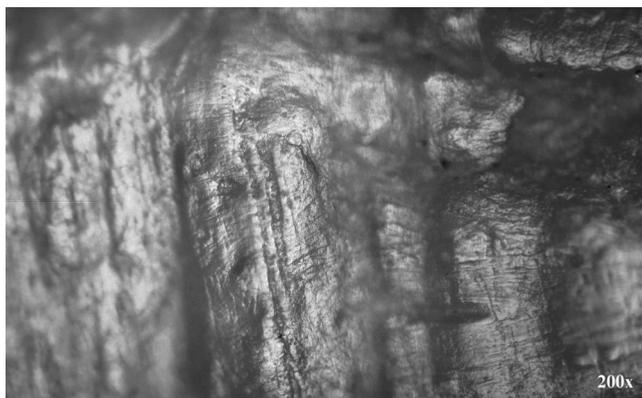


Fig. 20. *Micro-wear developed on a rough surface like the one shown in figure 18 (metallographic microscope, 200x).*

Conclusions

The experimental data suggest that the morphology of the active end of the tools should be an important consideration for both the tool user and the analyst. More precisely, edge angle, profile and sharpness are highlighted as the most important variables that determine the scrapers' *efficiency* in fleshing. The use of long bones and ribs also determines the *duration* of the tools' efficient use. Likewise, the tip size and distal cross-section morphology determine the functional possibilities of the pointed tools. However, one should bear in mind that these data define limitations in tool use. Other technological variables, such as edge shape or type of debitage product, may vary without significantly influencing the tools' efficiency. Such variations on the same site or between sites could depend on local traditions, economic considerations, and, generally, contexts of tool production and use.

In terms of use wear, it is suggested that tool use modes are reflected in use traces. It should be noted, however, that the distinctions outlined above are largely dependent on the degree of tool wear and on the actual methods employed to work the hides. Combined analysis of macroscopic and microscopic traces is also a key for distinction between the various activities.

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