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Investigating status with hideworking use-wear : a preliminary assessment

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RÉSUMÉ

Les observations ethnographiques indiquent que les vêtements de peaux de haute qualité étaient coûteux en main d'œuvre. Ils étaient par conséquent utilisés comme symboles de statut social et réservés aux familles riches de la zone tempérée nord-américaine. Les familles plus pauvres n'utilisaient pas du tout de vêtements de peaux ou bien utilisaient des peaux préparées de façons beaucoup plus frustres. Les différences que l'on escompte trouver dans les types d'outils et de traces d'usure associés aux peaux de haute qualité autorisent l'examen des différences socio-économiques préhistoriques à l'aide de l'analyse de la morphologie et de l'usure de ces outils. Cependant, il faut poursuivre les recherches pour interpréter la variabilité morphologique et tracéologique des outils servant au travail des peaux. Un des problèmes les plus importants est de faire une distinction entre les morphologies et les traces qui résultent du dépouillement et celles qui résultent de l'assouplissement. Un autre problème est celui de savoir si les peaux d'animaux différents donnent des traces différentes. Des résultats très préliminaires indiquent que ces différences existent bel et bien, mais des recherches beaucoup plus poussées sont nécessaires pour confirmer ces résultats.

ABSTRACT

Ethnographic observations indicate that carefully-prepared skin garments were labor-intensive to produce, that they were used as status display articles and that they were confined to wealthy families in temperate North America. Poorer families either used no skin garments or used skins that had been minimally prepared. Because of anticipated differences in the types of tools and use-wear associated with finely prepared skins, it is possible to examine prehistoric socio-economic differences using tool design analysis and use-wear. However, much more research is required in order to interpret the morphological and use-wear variability of hide-working tools. One of the most important problems involves whether flensing use-wear or tool morphologies can be distinguished from currying use-wear and tool morphologies. A second question asks whether hides from different kinds of animals produce different kinds of use-wear. Very preliminary results indicate that such differences do exist, although much more research is required to confirm these initial results.

Introduction

In this chapter, I will be primarily concerned with the position of hideworking activities in the overall economic context and adaptation of hunting and gathering societies on the Interior Plateau of British Columbia. I believe this problem is also relevant to archaeological problems elsewhere in the world such as the differences between some Middle Paleolithic and Upper Paleolithic assemblages in Europe.

In order to fully understand hideworking and its economic significance in the British Columbian Interior, it is necessary to determine :

1. Whether hide garments were essential for overwintering and what the availability of suitable hide-bearing animals was in the past.

2. Whether all hides were prepared in fashions that were the most labor-efficient for basic needs, or whether some hides were prepared in a labor-intensive fashion so that they became status-display items affordable only by families with unusual control over labor.

3. What the production sequences (« chaînes opératoires ») were for producing these different kinds of skin products, including the locations at which various stages in the sequences were carried out.

4. What kinds of stone tool morphologies, and what kinds of raw materials, or other tools, were used for working hides in their various stages and locations of processing.

5. What kinds of use-wear are related to the various production stages of hide processing and to the different significant characteristics of hides (such as thickness, fat content and moisture content).

6. Estimates of the use-lives of the various tools used in hide processing.

7. How the various types of tools and use-wear are distributed between dwellings, or sites, that have other indications of wealth, poverty, or specialized activities.

The ultimate objective of this research is to determine whether specific types of hideworking can be used as a reliable indicator of socio-economic inequality, and whether inferences about the type and intensity of hideworking activities can be used to identify wealthy households or wealthy communities. On the basis of previous work (Hayden, 1990), there is a good possibility that specific types of hideworking can be used in this fashion. If so, there are many implications that such analyses would have for the socio-economic organization of communities and the importance of labor, particularly female labor.

Dealing with the above topics is obviously quite an ambitious research undertaking, requiring far more efforts than a single individual can provide. It is also multi-stage research. I began the first, conceptual, stage of this work several years ago (*ibid.*), and I am progressing towards succeeding stages with the present chapter and plans for future research. Fortunately, many advances have been made in the last decade by Anderson (1981), Plisson (1985), Vaughan (1985), Knutsson (1988), Grace (1989) and others in the successful identification of hide-working use-wear and in refining the identification of distinctive wear characteristics, at least to the level of determining relative moisture content of skins. Fortunately, there are also good ethnographic descriptions for the particular region that I am dealing with, and these are relevant for the last 5 000 years of Prehistory, since only relatively minor climatic and cultural changes occurred during this time period. This enables us to provide information on a number of the seven parameters listed above.

Ethnographically, it is clear that hide garments were not essential for overwintering in the Interior Plateau, even though the climate is continental, and winter temperatures sometimes reach -20 to -40 degrees Celsius. In fact, many poor families had only bark fiber capes during the winter (Hayden, 1990). Although there were not enough ungulates in the region to clothe everyone, it is also clear that a great deal of labor was required to manufacture the carefully curried and tailored skin garments used in the area. Only wealthy families could afford to have these garments made or could obtain them in trade. In fact, the rich families are described as having many fine clothes (Teit, 1906).

From the ethnographies, we also know that large, igneous, coarse-grained, spall scrapers were used for softening or currying hides in the area, and that most hides were procured high in the mountains during the fall. Presumably, hides would have been defleshed before drying and transporting them to winter villages for tanning, although it is not clear whether all defleshing was performed at procurement sites or whether some of this work might have been performed at the winter villages on the river terraces. Sylvia Albright (personal communication) observed from her ethnographic work among the Tahltan (1984) and Lytton Indians that hides are always defleshed before they dry out. At the fall campsites in the mountains, when entire families were together for several weeks, defleshing and even some tanning and currying would be carried out at the mountain camps. However, hides from animals killed during the winter or on shorter hunting trips would be brought back to the winter villages. The hides could be used to make sleds to transport meat from the kill back to the main camp. The hides could then be stored frozen in snow banks in a fresh state, until enough hides had accumulated to do a batch of them together. This work was preferentially done in the early spring. Because hides are always defleshed in the fresh state, requiring a sharp edge, defleshing tools should be re-sharpened frequently and exhibit the greasy luster characteristic of working fresh hides. On the other hand, because hides are softened until they are dry or nearly dry and tools are useful or even preferred in the dull state, currying tools should frequently exhibit extreme wear states and the duller lusters characteristic of working dry or semi-dry hides. It appears that much of the tanning and softening work was carried out at the semi-permanent residences in the winter villages. Skins were stretched on wood frames during most of the processing stages.

While these ethnographic and use-wear data provide critical anchors for establishing the interpretations that I seek, there are other parameters that are not clearly established. My work at one large winter village site has produced preliminary evidence of hide-working in the form of heavy use-wear (at low power magnifications) on stone tools. However, rather than this wear occurring on a single type of hide-working tool as described in the ethnographies, there are *three* morphologically distinct types of stone tools at the winter villages. There are the large spall scrapers described ethnographically, which so far have only been found in large residential structures ; there are endscrapers made on microcrystalline cherts and basalts, for which there is no ethnographic description in the area ; and there are miscellaneous microcrystalline flakes or anomalous pieces bearing heavy hide-working use-wear. At this stage in our research, we do not know if these morphologically different types of hide-working tools represent tools used in different stages of the production sequence, tools used on different sizes or different thicknesses of animal skins, tools used at different locations with different mobility constraints, or tools fashioned according to differential raw material availability. As Plisson commented informally at the Liège meetings, no one has ever demonstrated that a particular tool was used for the defleshing part of the production sequence. At this point, it seems that we simply do not know what prehistoric defleshing tools looked like.

In British Columbia, we do not know why there are three different types of hide-working tools, although we have some reasonable hypotheses. Certainly, one of the major questions to be resolved is what stage of the production sequence end scrapers were used in. The microcrystalline materials end scrapers are made of, and their generally sharper edges (in contrast to the spall scrapers), seem to indicate that these tools have been used for defleshing or thinning rather than softening. If so, the occurrence of end scrapers at winter villages, rather than fall hunting camps in the mountains, may be due to the curation and occasional loss of these tools at winter residences, or to the use of end scrapers at winter residences when occasional winter kills were made. However, these interpretations are far from demonstrated.

Goals of this study

In the process of trying to determine whether flensing use-wear could be differentiated from intense currying use-wear, it became necessary to examine all the factors that might influence the development of skin-working use-wear, and all the possible production sequences (*chaînes opératoires*). There were many factors that had not been studied by use-wear analysts, and many possible alternative production sequences. However, given the observations by Kamminga (1982) and others concerning the possibility of dramatically different types of wear being formed by working hides from different species of animals, I first decided to conduct a series of experiments to see if certain skin characteristics could be identified as having an effect on use-wear. The characteristics that I chose to investigate were thickness, adhering fat levels, difficulty in removing the interior membrane, and hair density. If it should prove possible to identify distinctive use-wear for any of these variables, it would make possible a number of important inferences on what kinds of skins were selected for processing, and perhaps what the goal of the skin processing was. For example, I hoped to determine whether furbearing animal skins produced use-wear that could be distinguished from ungulate skins.

From a more theoretical perspective, I hoped that the study of use-wear formed from work on animal skins with markedly different characteristics might provide some insight into the mechanism of wear formation. Use-wear on skin working tools can be extremely pronounced, even to the naked eye. However, the question of how such a soft material as skin can produce such extreme abrasive use-wear has remained an ongoing problem (although Knutsson 1988 has advanced some very cogent suggestions). Kamminga (1982) assumed that the extreme abrasion observed was due to dust and silt adhering to the animal skins and that these minute particles acted as abrasives. However, even when animal skins are kept scrupulously clean in dust-free environments, abrasion can be extreme. Thus, some other mechanism must be responsible for the wear observed. The experimental results from working skins with different characteristics might be one way of finding out what skin characteristics were most important in producing abrasive wear.

Finally, I hoped that if it was possible to identify use-wear associated with specific types of animal skins it might assist in developing more precise production sequences for the past. However, it must be noted that there are still many variables that remain to be investigated in much more thorough fashion in order to be able to realistically reconstruct prehistoric production sequences. There are many variations in the precise steps within production sequences that can substantially affect use-wear patterns.

Experimental design and procedures

In order to explore the question of whether various characteristics of hides had a significant effect on the nature of the use-wear produced on stone tools, it was necessary to monitor the use-wear effects of several variables while keeping other potential sources of variability relatively constant.

Variables

The characteristics that I thought would be most easily monitored and most likely responsible for potential use-wear differences were :

Hide thickness : I reasoned that the amount of force required to flense or curry hides would vary with hide thickness and in this fashion might affect use-wear characteristics. Specifically, thicker hides might require more force for softening procedures, thereby inducing greater edge fracturing, auto-abrasion, and perhaps greater heat in the tribological environment.

Fat and meat adhering to the hide : I reasoned that during the flensing operation the amount of material that had to be removed from a hide might bear a direct relationship to the amount of wear that accumulated on tools. Moreover, it appeared that fat might act as a lubricant that could impede the formation of wear. From previous work, I knew that animal species varied considerably in the amount of fat adhering to the skin and the ease with which this could be removed.

Difficulty of removing the interior membrane : From past experience, it was also evident that considerable work could be expended in trying to remove interior membranes for a successful tanning. Again, I reasoned that the more work was involved in this process, the more wear might be formed on tool edges. It also seemed that different wear tribological environments might be produced in the areas under the membrane, rather than the areas above it, where fat deposits could predominate as the major contact material. A tanning informant suggested that the ease of removing membranes in part depended on how old the hide was, i.e. how much time had elapsed between the skinning of the animal and this step in the hide processing. After two or three days from skinning, he said a knife was required. Whether this was true of all animal species is not clear.

Pore density : In order to determine whether there were any other important variables that I might have overlooked, I interviewed an experienced fur tanner in British Columbia about factors that affected preparation of skins for tanning. He informed me that the size and density of skin pores affected the "hardness" of the skin and made some very hard to prepare. Pore size is primarily determined by hair density and size. Specifically, he stated that very dense areas with little or no hair were very difficult to work, requiring a very sharp knife. These areas apparently became like hard cardboard after drying. African animals are particularly noted for having less hair and less fat as well. My informant added that fat on African animals can often be pushed off with a dull knife, although the meat still has to be cut off.

Other variables that should be examined in the future include the potential for different kinds of skins to form glue-like compounds under varying conditions of heat, pressure and moisture, as well as chemical or physical measures of the friction coefficients of different skins.

To cover a relatively large range of the above variables, I chose skins of moose, white-tailed deer, sheep and goat kid. I hope to include skins of beaver, racoon, coyote and a few other species in future work.

Sources of variability

The sources of variability that I wished to control and minimize included :

Raw material : Since I did not have abundant access to chert or flint materials, and because the chemical, physical and use-wear characteristics of cherts can vary considerably from one deposit to another, I chose to use vitreous rhyolite from the area that I am currently investigating in British Columbia. Most tools from the British Columbia Interior are made from this material. However, vitreous rhyolite has a number of characteristics that differentiate it from cherts and flints. First, it has a larger crystal size than most cherts and flints (c. 24 grains per mm). It is igneous in origin. And, probably most importantly, it appears to be a much softer lithic material that develops use-wear features much more readily than most cherts and flints. This was ascertained by using several scrapers made of rhyolite and chert in the same tasks. Where the wear on cherts was negligible after an hour or two, the wear on the vitreous basalt was usually moderate to pronounced. Thus, considerable caution must be exercised in using the descriptions of wear reported here to interpret wear on chert or flint tools.

Stages of wear development : In order to insure that all wear was comparable, I standardized the times that tools were to be used for. Tools could be used for as little as a half hour, but in general they were to be used for an hour, and exceptionally for two hours in order to monitor the development curve of the wear patterns. The focus on a one-hour use time eliminated the confusion that is generally caused by trying to compare tools used for 10 minutes in one context to tools used for several hours in another context or on another material.

Production sequences : Because of the enormous variability involved in whether skins were worked dried or fresh or re-soaked, whether they were ochred at particular stages, tanned with brains or bark, softened with stone tools, bone, wood or other materials, and a host of other possible procedures, I decided to restrict the use of stone tools to the two operations most likely to produce use-wear. These were : the flensing, or defleshing, of hides, and the softening of hides. Flensing included the removal of all adhering fat, meat and membrane from the *fresh* hide. Hides were then tanned with a traditional brain solution for several days and washed clean. Just as the hides began to become slightly firm when drying, stone tools were again used on them to break down the lignin fibers and to soften them. It is possible that once the lignin fibers dry, they undergo a slight permanent transformation that affects the character of the use-wear even if the hides are re-soaked. Ethnographically, the distinction between softening hides that had never been dried and hides that had been dried but re-soaked does not appear to have been critical. Nevertheless, Sylvia Albright (personal communication), who has considerable personal experience in working moose hides with the Tahltan (Albright, 1984), indicates that tanning and softening hides are *always* easier if they are fresh as opposed to being dried and re-soaked. Once hides have dried, they are always stiffer than fresh hides, and therefore women prefer to work them when they are fresh. Thus, we attempted to soften most hides prior to any drying. In my experience, extremely intense wear could be produced in the semi-dry tribological environment. Occasional variations on these procedures were tried out in order to monitor the effects of ethnographically documented variations that we suspected might have important effects on the use-wear, particularly of drying. There are a number of ethnographic observations indicating that defleshed skins were often, but not invariably, dried before tanning or currying (Robbe, 1975), and I wanted to determine if this might have an effect on use-wear formation.

Design characteristics of tools and their effectiveness

Flensers : Originally, we began with the notion that the typical upper Paleolithic end scraper could have been used in flensing activities. Several frustrating attempts with this tool form indicated that sharper edges might be required for flensing than the near right-angle edges of end scrapers. In many cases, unretouched, acute angled flakes made the most effective flensing tools, although, when stretched on a frame and with sufficient pressure, retouched edges with low edge angles (20-50 degrees) could also be effective. In all cases, however, a convex edge without sharp projections was essential to flensing without damaging the skin (see also Robbe, 1975). The question of what constitutes the most effective tool morphology for flensing is still unresolved in my view.

Softening tools : On the other hand, acute edges were definite liabilities in softening hides where high pressures were required to break down fibers, and where the skin was thinner and more susceptible to tearing and gashing than in the flensing operation. Any projections or sharp acute edges could easily ruin a skin. Thus, all edges had to be very even and either blunt or made with near right-angle edges.

Results

In order to examine the differential intensity of wear produced by the working of skins of different animals, I measured the frequency of fracture types, the general size of fractures and the extent of abrasion. These measures of intensity were generally made at 25x magnification.

In order to examine changes in the quality of wear characteristics, I attempted to describe the topography of the wear and the luster of the wear together with any other characteristics that seemed important.

Although observations were recorded at both low (25x) and high (110-220x) magnifications, the only microscope available for high magnification analysis did not have incident dark field illumination. Therefore, polishes could not be observed, and the analysis is of much more limited value than it might otherwise be. Nevertheless, a few results of potential interest did emerge from this high-power magnification study. Observations were rendered more difficult to interpret due to the particular fashion in which the rhyolitic material wore down. The rhyolite consisted of relatively large crystals (24 per mm), which appeared to break down into much smaller component grains (about 100-300 per mm). The component minerals of this rhyolite have a natural high, glassy luster (fig. 1 and 2). When the crystals are broken down into smaller grains, this luster is retained, creating a very granular, or « hummocky », appearance,

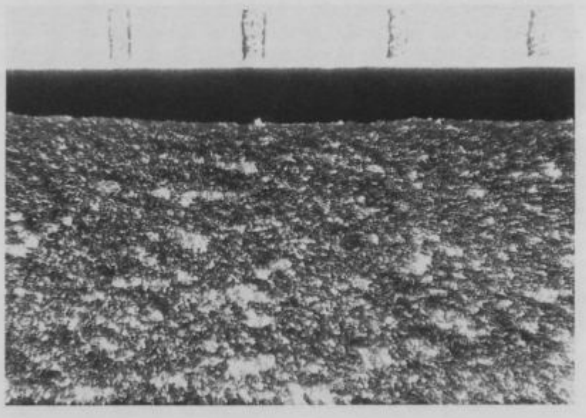

Fig. 1. Natural fracture surface of the rhyolite material used in experiments. Magnification = 25x ; scale at top is in mm.

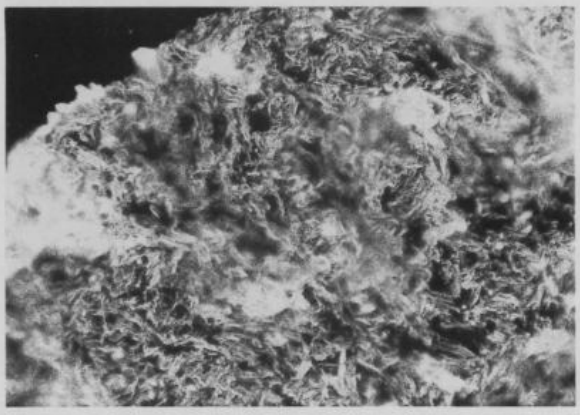

Fig. 2. Natural fracture surface of rhyolite used in experiments. Note natural glassy luster of component crystals. Magnification = 220x (brightfield).

with pinnacles and cavities (fig. 3). This luster creates highlights on the tops of the grains and a reflective, lace-like appearance at 110x magnification, or a frosted sugary appearance at 220x in most moist skin-working environments. With few exceptions, I found little distinctive variation in the quality of the luster that was detectable at higher brightfield magnification. On the other hand, topography varied from a fine granulated, sandpaper-like smoothed surface to extremely rugged and rough smoothing. This may prove to be more diagnostic of certain skin characteristics.

Fig. 3. Highly abraded prominence on the edge of experimental tool no. 2 used for two hours to deflesh a fresh deer hide. Note the granular surface topography compared to figure 2, forming small hummocks and lace-like patterns. This granular topography appears to result from the disaggregation of larger crystals. The « dog's teat » shape of the prominence was typical of rounded prominences. Magnification = 220x (brightfield).

At lower magnifications, there was not much variability in the appearance of edge luster either. In general, the flensing tools used on wet hides appeared to have a more « greasy » luster (fig. 4), while those used for softening hides as they dried tended to have a slightly more mat luster (fig. 9), and the one tool used exclusively on a dry hide had the most distinctive, smoothed, flat, mat wear of the series (fig. 5-6).

Slightly more variability was observed in terms of the intensity of abrasive wear, although the sample sizes at this stage of research are still very small, and results may be misleading. In flensing, deer produced the most wear, while goat and moose produced the least (fig. 7, table 1). For currying, sheep produced the most wear, while tools used on the remaining three types of animals

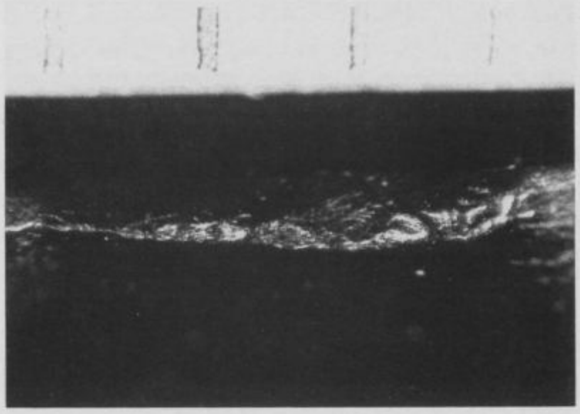

Fig. 4. Greasy reflective luster of edges typical of flensing fresh hides (tool no. 2 used for two hours on a deer hide). Compare this luster to the luster in figures 5 and 9. Magnification = 25x ; scale at top is in mm.

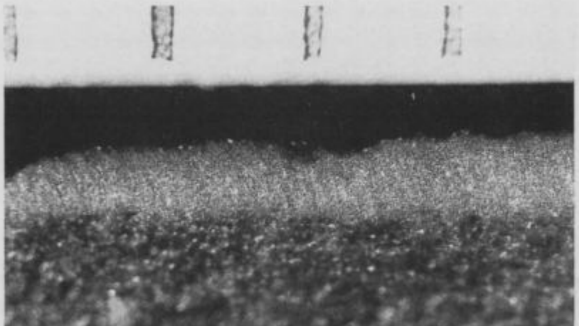

Fig. 5. Extremely mat, dull luster resulting from defleshing a dry deer hide (tool no. 5 used for one hour). Compare this luster to the luster in figures 4 and 9. Note the clear linear tears and linear trends and the coarsely abraded aspect of the surface. Magnification = 25x ; scale is in mm.

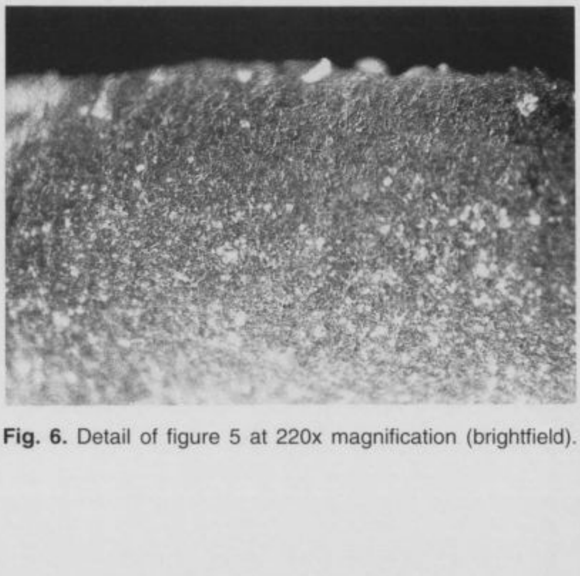

Fig. 6. Detail of figure 5 at 220x magnification (brightfield).

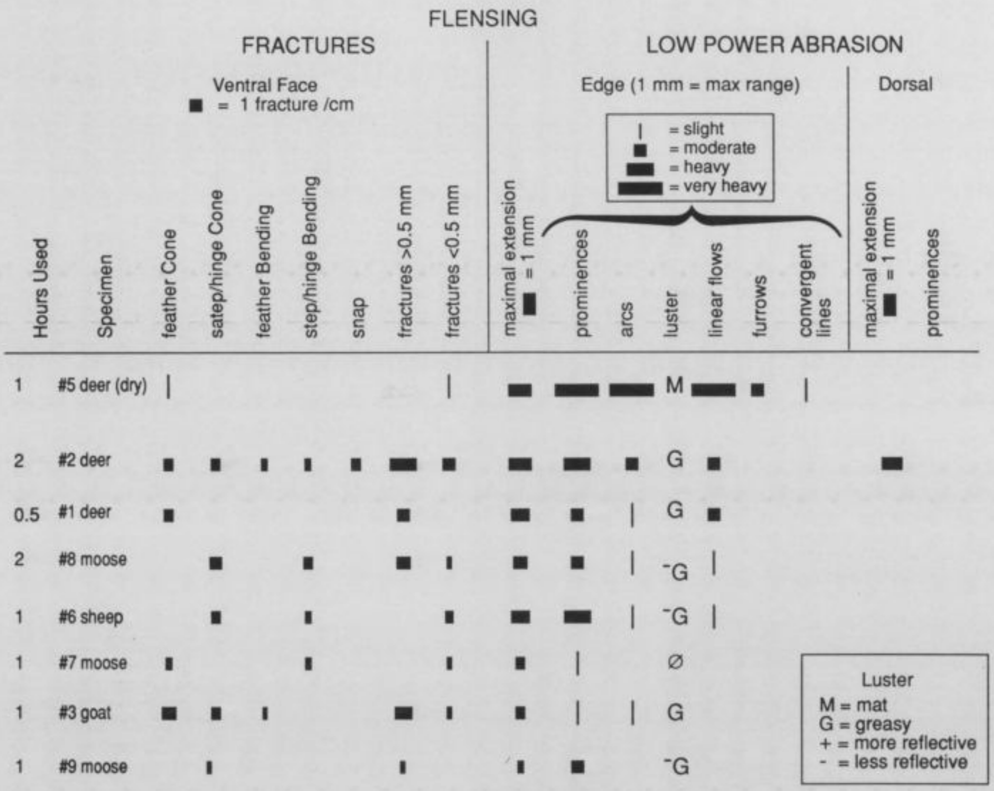

Fig. 7. Relative nature and intensity of flensing wear patterns, arranged according to the most intensively worn tools at the top to the least at the bottom.

Hours Used	Specimen	Topography	Luster	Magnification
1	#5 dry deer	ground flat	mat	110
		ground flat	mat	220
.5	#1 deer	smoothed, micro-hummocks	reflective lace	110
		hummocky	frosted	220
2	#2 deer	smoothed, micro-hummocks	reflective lace	110
		hummocky	frosted	220
2	#8 moose	smoothed, micro-hummocks	reflective lace	110
		hummocky, some smoothing	frosted	220
1	#6 sheep	slight smoothing, rounded edge tips	reflective lace	110
		hummocky	frosted	220
1	#3 goat	slight edge rounding	micro black lace some reflective lace	110
		smoothed and some hummocks	micro black lace & frosted	220
1	#9 moose	smoothed, hummocky	reflective lace, larger lattices from grain top abrasion	110
		hummocky, roughly smoothed	frosted, abraded grain top lattices	220
1	#7 moose	roughly smoothed with some finer smoothing	some reflective micro-lace	110
		roughly smoothed & hummocky	some reflective micro-lace & frosting	220

Table 1. High Resolution (110-220x) Flensing Wear Characteristics.

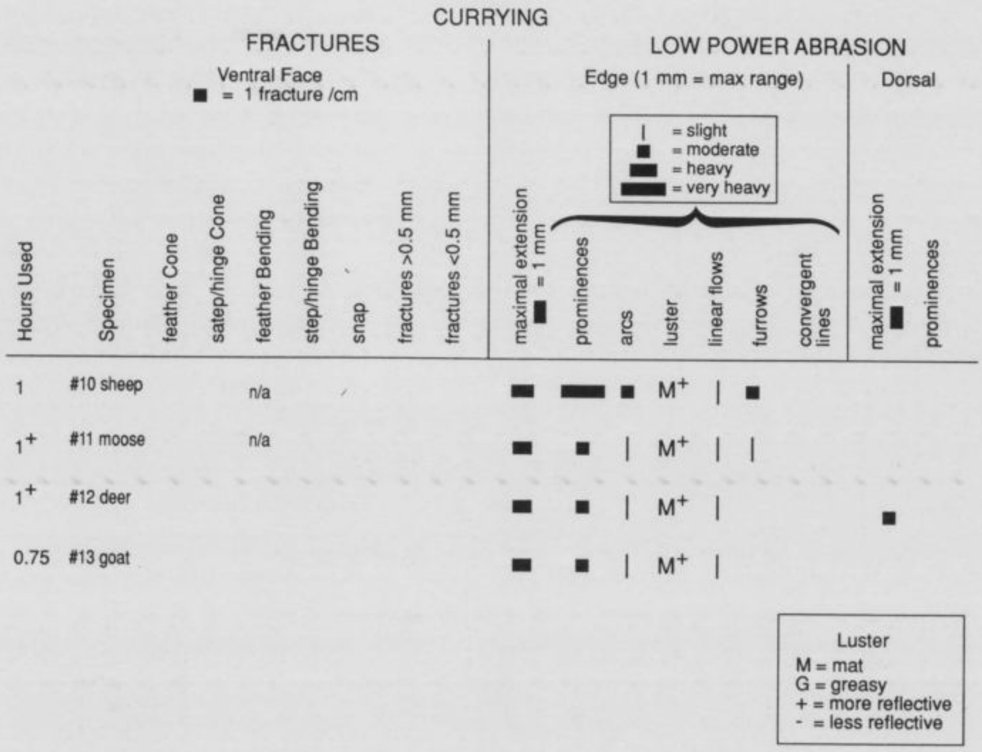

Fig. 8. Relative nature and intensity of currying use-wear patterns, arranged according to the most intensively worn tools at the top, and the least at the bottom.

Hours Used	Specimen	Topography	Luster	Magnification	Other
1	#10 sheep	smoothed	dull lacey	110	
		hummocky	frosted	220	
1+	#11 moose	smoothed sand papery	dull lacey	110	surface tears exposing underlying crystals
		smoothed sand papery	frosted	220	
1+	#12 deer	like sand paper, some smoothing	dull lacey	110	highly fractured and irregular edge
		hummocky some smoothing	frosted	220	
.75	#13 goat	roughly smoothed	reflective & dull micro-lace	110	
		roughly smoothed some sand paper resemblance	dull lacy, frosted	220	

Table 2. High Resolution (110-220x) Currying Wear Characteristics.

were about the same (fig. 8, table 2). There is some variability between tools used on the same animal or skin in terms of their wear characteristics, and the source of this variability cannot currently be accounted for, but clearly more experiments need to be undertaken before these descriptions can be accepted as representing general trends. With this caveat in mind, it is possible to examine the relative rank of species derived from these wear characteristics and the relative rank of species skin characteristics as derived from the list of independent variables (table 3).

In general, the order of the variables is relatively mixed. However, a few observations can be made when the extremes are examined. The order of species in hair density seems to correspond reasonably well with the intensity of wear associated with flensing abrasive wear development at low magnification, and, since goat has the most distinctive (lowest) hair density, the extreme position of goat in the description of currying wear may also be related to hair density. On the other hand, goat is also the thinnest-skinned species represented, and the relatively reduced wear on

Skin Thickness moose (2.5-3 mm) deer (1.6 mm) sheep (1.5 mm) goat (1.1 mm)	*Currying (hi & lo magnification)* sheep (most intensive abrasion) moose deer goat (least intensive abrasion)
Hair Density Highest: deer/moose sheep Lowest: goat	*Flensing (lo magnification)* deer (most developed abrasion) sheep / moose moose goat / moose (least developed abrasion)
Fat Removed (in g/m) deer (237) moose (210) sheep (128) goat (14)	*Flensing (hi magnification)* deer (finer smoothing) sheep / moose goat : (darker luster) moose (rougher smoothing)
Difficulty of Removing Membrane Most Difficult: deer moose goat Least Difficult: sheep	

Table 3. Rank Ordering of Species by Wear and Skin Characteristics.

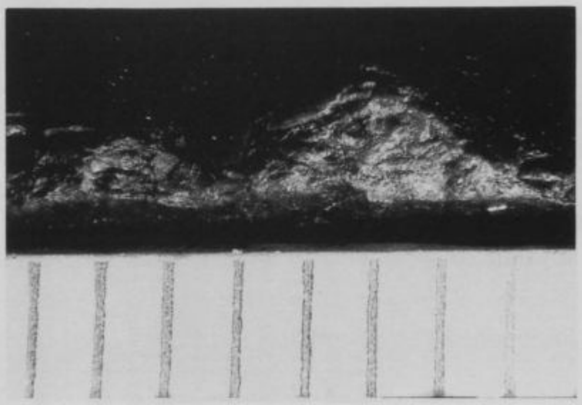

Fig. 9. The semi-mat or dulled greasy luster typical of tools used to soften semi-dried skins (tool no. 12 used for a little over one hour to soften a deer hide). Note the intense degree of internal fracturing on these prominences. Magnification = 12x.

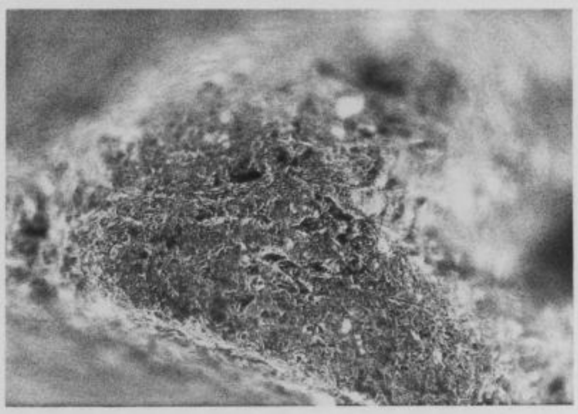

Fig. 10. An abraded edge prominence on tool no. 11 used to soften a moose hide for over one hour. Note the coarser nature of the topography compared to flensing wear (fig. 3), and particularly the internal cracks visible on the surface of the prominence. No such internal fracturing was observed on tools used for flensing. Magnification = 110x (brightfield).

tools used to curry goats may also be due to this factor.

In terms of use-wear observed on flensing tools at high magnifications, goat and moose were the most distinctive in luster (goat) and topographic roughness (moose), the other types of skin producing relatively similar types of wear. The distinctive, blacker, luster associated with goat could be related to fat content, hair density or skin thickness, while the rough wear topography associated with moose could be related to hide thickness or hair density. It is interesting that some topographical roughness (and internal fracturing) was also associated with moose, as well as deer and goat, in the high magnification analysis of currying use-wear (fig. 9-10). From these indicators, topographic roughness and internal fracturing on abraded surfaces may be one of the more useful criteria for inferring the types of skin worked.

I could detect no evident association between fracture types or frequencies and the independent variables. It is possible that a much larger sample, controlled for edge angle, will reveal basic underlying patterns, although the variability between tools used in the same context indicates to me that edge morphology may play an important and problematical role.

Thus, while the above results incorporate considerable variability between tools used on the same animal skin, there is nevertheless some preliminary indication that skin thickness and pore size may have a noticeable effect on use-wear characteristics. Because the intensity of wear development is also strongly affected by the length of time a tool is used, distinguishing these effects will be further complicated by variable periods of use of tools and should be addressed in future studies.

General observations

The most dramatic difference that I observed was between wears on tools used to flense fresh *versus* dry hides. Wear from fresh hides had a greasy luster at lower magnification, while at higher brightfield magnification they had a typical reflective lacey (110x) or hummocky frosted (220) appearance (fig. 3). Prominences along the working edge were rounded like a dog's teat (fig. 3) with granular surfaces. In contrast, wear from flensing dry hides was almost like wear from a fine grit grinding wheel. Grains and crystals seem to have been truncated and resembled coarsely cut quartzite or conglomerate (fig. 5, 6). The luster of edges used on dry hide at lower magnification was very mat, and there were numerous furrows, tears and linear features. Similar characteristics and distinctions have been noted before by others (Knutsson, 1988 ; Plisson, 1985), and it is gratifying to observe some consistency in results despite differences in lithic raw material. In accord with these observations, the wear characteristics from currying semi-dry hides is intermediate between dry hide wear and fresh hide wear. Some of the wear associated with the currying of specific animal hides may turn out to be distinctive, such as the tearing away of superfically abraded grains to reveal underlying crystals of tools used on moose hides, or intensive fracturing of edges from currying deer hides.

I observed clear indications of occasional massive fracturing along the dorsal edge of many skin working tools. Although the idea that working materials as soft as skin can produce significant amounts of fracturing seems counter-intuitive, there now appear to be enough independent observations of this phenomenon for it to be seriously considered (*ibid*). In the present case, sections of worn edge were sometimes interrupted by much fresher fractured edges (although, once hafted, the experimental tools were never resharpened). Moreover, during currying, several unusually large flakes (5 and 7 mm long) were also observed spontaneously separating from the dorsal and ventral faces along the edge of two endscrapers. Portions of the dorsal edge and face also exhibited extremely intense fracturing associated with heavily worn prominences. This intense fracturing appears far more extreme than would ordinarily occur from resharpening, where the most intense fracturing is expected to occur in the *deepest* edge recesses, near bulbs of percussion rather than on prominences.

In terms of the mechanism of wear formation, abrasion appears to be the major operating factor. Abrasion may be caused by micrograins adhering to tool surfaces, even fresh tool surfaces, due to electrostatic forces. Abrasion may also be due to auto-abrasion from fragments created by the fracturing of fragile edge sections ; or, alternatively, abrasion may be initiated by glue-like substances that increasingly bond to grains on the surface of the tool as heat and pressure build up and as humidity decreases. There is considerable difference between the wears from working fresh *versus* dry hide, and we still do not have an adequate understanding of what causes these differences. Heat may account for some of the spontaneous spalling or fracturing effects (Robbe, 1975 notes a considerable buildup of heat in Eskimo skin working, even using large metal scraping tools).

The present preliminary results provide some reason for hope in making important distinctions concerning past behavior, including the identification of different stages in the production sequence of hide garments, the production of different kinds of hide garments, the use of different types of animal skins, and socio-economic differentiation involving the production and use of hide garments. The results to date have been tantalizing and promising, and justify further determination to carry out the experiments required to base provisional interpretations on sound inferences.

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