Lithic Technology

Center for Archaeological Research

The University of Texas at San Antonio

San Antonio, Texas 78285

Editor's Notes

Thomas R. Hester

I want to thank the many readers who have submitted papers to the journal in recent months. The processing of these manuscripts is moving along, thanks to a number of hard-working reviewers, and we now actually have a backlog of manuscripts for the next several issues. Indeed, manuscripts have accumulated more rapidly than the rate of subscriptions. If we could recruit additional subscribers, the number of pages could be increased per issue--and we could then get more papers in to print more promptly.

Because of space and production problems, the paper by Hugo Nami on his experiments with stone tools from Tierra del Fuego will have to be delayed until the December issue (Vol. 13, No. 3). Indeed, with our backlog and pending a review of the journal's finances in November, I will refrain from listing (as I have in previous issues) those papers slated for December. Suffice it to say that we will have a full issue at that time.

Please note, on the inside rear wrapper, that it is time to subscribe to Vol. 14 for 1985. If you have not yet paid for 1984 (Vol. 13), I hope you will do that at this time. We still have earlier issues of the journal available and you can use the form at the back to order any that you might be missing.

Lithic Technology is published three times yearly (April, August, and December). Subscription rate for this volume is $10.00, postage included. Subscriptions and inquiries should be addressed to Dorothy Galin at the address above.

Manuscripts, prepared according to *American Antiquity* style, should be sent to the Editor. Please send the original and two copies. Tables, line drawings and photographic illustrations should be in a format suitable for publication.

Papers

Functional Variability Within an Assemblage of Endscrapers

Peter E. Siegel
Department of Anthropology
State University of New York
at Binghamton
Binghamton, NY 13901

Abstract

In light of the issue concerning artifact form and function archaeologists recently have been interested in examining patterns of use-wear within and across morphologically discrete types. To this end, assemblages and morphologically distinct artifact types have been shown to display varying degrees of functional specificity. Further, it has been found that the results of analyses pertaining to specific morphological types for a given assemblage cannot be generalized for the same morphological types across assemblages (either spatially and/or temporally).

In this study, a low-magnification microwear analysis is conducted on an assemblage of 67 late prehistoric/early historic, Northwest Alaskan Inupiat Eskimo endscrapers. Based upon ethnographic observations and considerations of edge angles, Eskimo endscrapers traditionally have been associated with hide working activities. Through the microwear analysis I have documented a wider range of functional variation in these endscrapers than hide processing. Other materials on which the scrapers were used include wood, bone, and antler. It is suggested here that ethnographic literature should be used with caution when evaluating variation in tool use.

Introduction

Archaeologists often consider particular artifact classes to be functionally specific. The Stockton point controversy (Nance 1971; Hester and Heizer 1973) reflects the growing dissatisfaction among archaeologists for such facile assumptions (Ahler 1971; Wylie 1975; Odell 1981). Investigators are finding that within any given tool form there may be a wide range of functional variation represented.

Ahler (1971) in a study of 114 projectile points recovered from a rockshelter in Missouri, documents a considerable range of activities for which the points were used. Keeley (1980:6-7) suggests that Ahler did not conduct a diverse enough series of projection experiments in order to recognize the full range of projectile damage that might be present within an assemblage. Nevertheless, it is likely that many of the wear characteristics reported by Ahler (1971:40-51) are in fact the result of non-projectile activities. The Stockton point controversy reflects a similar concern for the relationship between artifact form and function (Nance 1971; Hester and Heizer 1973).

Odell (1981) performed a microwear analysis on a Dutch Mesolithic assemblage consisting of a range of morphological types (knives, side-scrapers, axes, borers, endscrapers, burins, and microlithic points). He finds that there is a range of functional specificity across the various tool forms. The microlithic points and burins exhibit functionally narrow ranges of damage patterns, and therefore the forms and functions are identical for these two artifact classes (Odell 1981:333). The remaining artifact classes, however, internally display a wide range of functional variability (Odell 1981:333-335). Odell (1981:337) indicates that in terms of the form/function issue the results of any given study cannot be generalized to other, culturally unrealted artifact assemblages. Therefore, the forms and functions of microlithic points and burins can only be considered interchangeable among Dutch Mesolithic assemblages. This relationship must still be demonstrated, rather than assumed, for other (either in time or space) assemblages.

Dumont (1983) conducted a microwear analysis on a sample of the lithic artifacts recovered from the Mesolithic site of Star Carr. The morphological types examined by Dumont include scrapers, marginally retouched blades and flakes, awls, burins, backed blades, microliths, and cores. In terms of the scrapers, Dumont (1983:137) indicates that form and function kinesthetically may be applied interchangeably, which is contrary to Odell's (1981:335) assessment of the Bergumermeer scrapers. In other words, Dumont finds that the Star Carr scrapers were indeed used only in scraping activities, whereas Odell finds that the Bergumermeer "scrapers" were used in a variety of other activities, as well as scraping. With regard to worked materials, Dumont (1983:132) finds that polishes resulting from hide, bone, antler, and wood are represented on the scrapers that he examined. As will be seen later, these results compare favorably with the present study.

In the present study, a functional analysis of an assemblage of late prehistoric/early historic Northwest Alaska Inupiat Eskimo endscrapers is conducted. Many investigators consider Eskimo endscrapers to have been used solely in hide scraping activities (e.g., Ford 1959:192; Stanford 1973:178; Nissen and Dittemore 1974:67). The basis for this assumption apparently is derived from the ethnographic literature where hide processing activities are presented (see Murdoch 1892:294-295; Nelson 1899:112-118). I tested the notion that Alaskan endscrapers were used solely for hide working activities by performing a microwear analysis of two sets of tools. The first was a collection of 67 endscrapers recovered during the 1981 S.U.N.Y.-Binghamton field season in Barrow, Alaska (see Dekin *et al.* 1981). The raw material of these scrapers is comprised of a fine-grained blue gray chert, derived from the Ikpikpuk formation. Further, a small portion of the scrapers consist of red, and others of black chert. The tools are unifacially worked and are steeply retouched along the distal edges (Fig. 1). The bulbar side of each tool is free of any retouch.

In addition to these tools, through the courtesy of the Lowie Museum, at the University of California, Berkeley I have re-analyzed the socketed scrapers originally discussed by Nissen and Dittemore (1974). They conducted a microwear analysis of nine socketed scrapers recovered from northern Alaska. Eight of these tools are derived from the ethnographic context, and the ninth is archaeologically derived. Nissen and Dittemore (1974) argue that all nine of these scrapers were used in hide working activities. The basis for this supposition is derived from Wilmsen's (1968) discussion of the functional implications of scraper edge angles, and the ethnographic documentation for the use of endscrapers in hide working activities (see Murdoch 1892).

Edge Wear Analysis

A low-magnification microscope set-up was employed in this study. A Leitz Wetzlar Stereoscopic microscope with inter-changeable objectives was used, with the examination of wear traces ranging from 25X to 100X.

Keeley (1974, 1980) has indicated that in order to validly retrieve the maximal amount of use-wear data one needs to incorporate a high-magnification set-up in a microwear analysis. Keeley contends that the various types of polishes that different activities and worked materials produce provide the best functional information. These polishes can only be distinguished at high magnifications (at least 200X). Tringham *et al.* (1974) and Odell and Odell-Vereecken (1980) have demonstrated, however, that the examination of scarring and abrasion at low magnifications yield results comparable to viewing polishes at high magnifications. An advantage of the low-magnification system is that more specimens may be examined over a given amount of time than with a high-magnification set-up.

The variables selected for analysis are a combination of abrasive and fracture wear types. Several investigators have indicated that fracture patterns may not be responding solely to use but from manufacturing damage as well, especially in the context of retouching (Newcomer 1976; Brink 1978:115-117; Hayden 1979:210; Keeley 1980:27). However, other investigators maintain that patterns of fracture types may be associated with particular activities and/or worked materials, which are distinguishable from the flake scars produced during manufacture (Gould *et al.* 1971:159-160; Tringham 1972:145; Tringham *et al.* 1974:187-188; Odell 1977:150-151, 300-301, 1981:324). I have chosen to focus upon the examination of fracture and abrasive wear patterns because of the demonstrated reliability of these variables as functional indicators, and because the rate at which specimens may be examined using the low-magnification approach is much quicker than the high-magnification approach (see Odell and Odell-Vereecken 1980).

The variables, as originally presented by Odell (1977:584-587), have been somewhat modified for this study. The abrasion variable was originally combined by Odell with polish and striations (Odell 1977:585). Polish, as a variable, was deleted from this analysis. In the present study it was not felt that different kinds of polishes could be distinguished using a low-magnification set-up (see also Keeley 1980:9). If we examine polishes using the low-power set-up then we are likely to bias our study to the recognition of polishes that can only be observed at this magnification and angle of illumination. It is important to monitor the degree of abrasive wear present on a tool, as well as the orientation of striations. For this reason abrasion and striations were separated as two distinct variables in the present study. An aspect of the present analysis that deviates from Tringham *et al.* (1974) and Odell's (1977) is with respect to the portion of each tool examined.

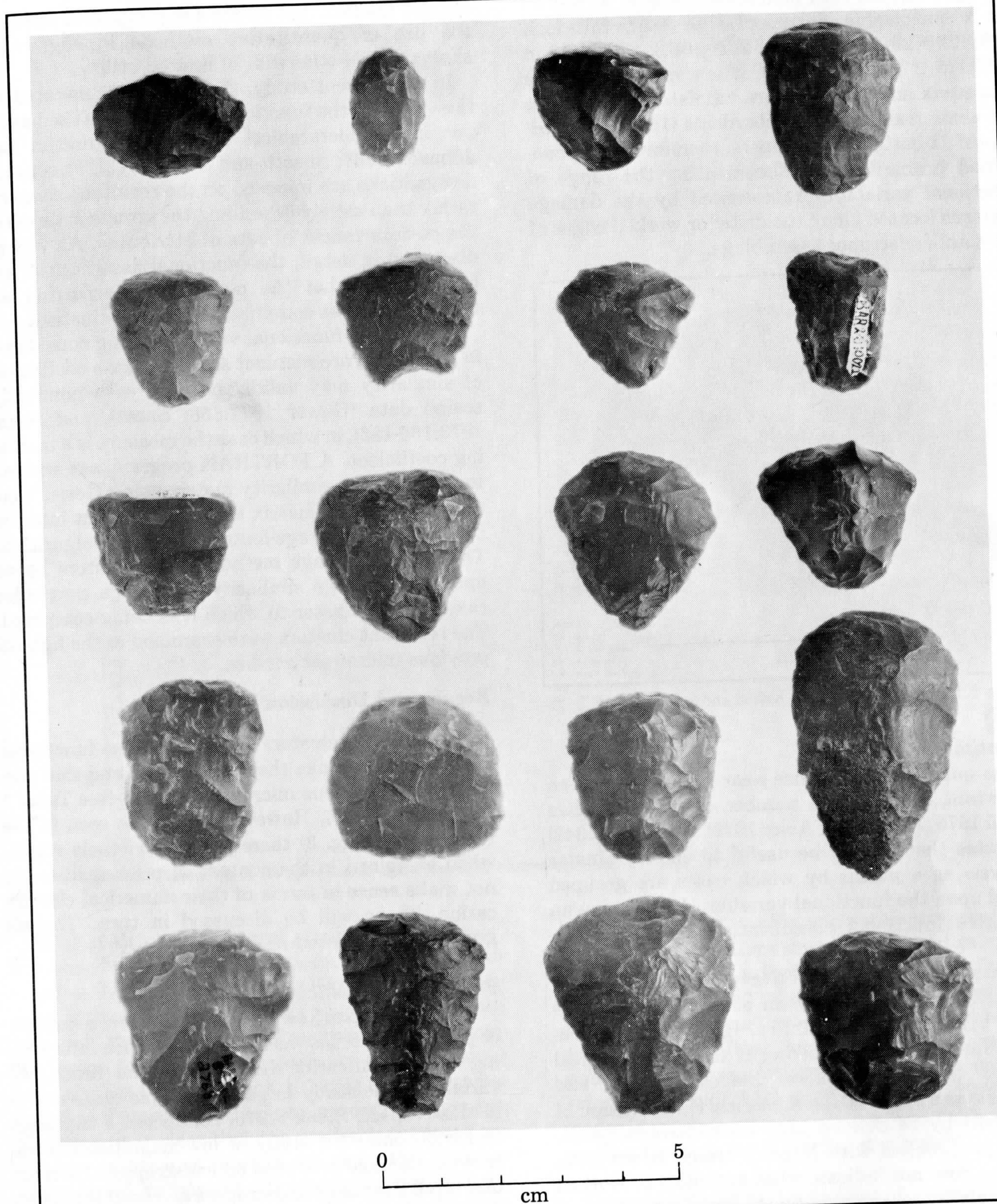

Figure 1. Sample of the endscrapers recovered from the Utkiavik site in Barrow, Alaska.

Since Tringham *et al.* (1974) are concerned with the types of damage that may be present on all parts of a tool, they divide each tool into polar coordinates, examining each polar coordinate in terms of the defined variables. In this way various types of prehension and hafting in addition to utilization damage may be monitored.

Based upon a number of hafts and hafted scrapers found during the 1981 field season (Fig. 2), as well as the ethnographic documentation (e.g., Murdoch 1892:295-298, Figures 289-296,298; Nelson 1899:116-117, Plate XLIX), it is apparent that the Utqiaqvik endscrapers were consistently hafted in the same manner. As in Hayden's (1979:208) analysis of 22 hafted skin scrapers, therefore, I was concerned primarily with documenting the range of functional variability represented by the damage patterns located along the distal or worked edges of the total endscraper assemblage.

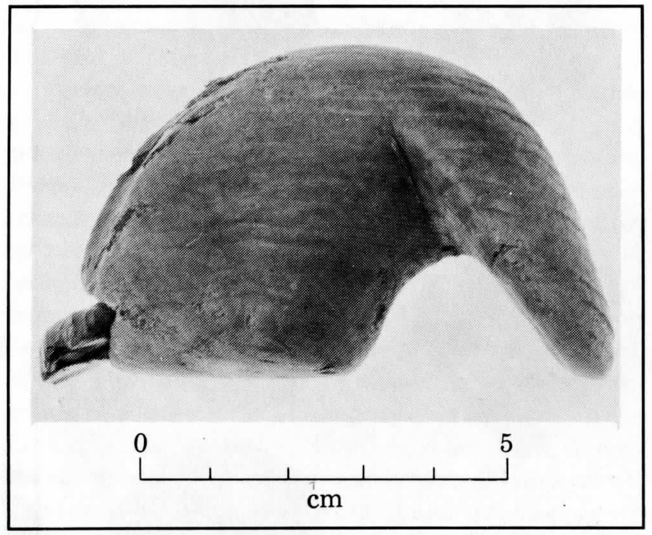

Figure 2. Example of one of the hafted endscrapers.

Quantitative Analysis

The quantification of use-wear data has been an important concern in a number of recent studies (Odell 1975, 1979, 1982; Ahler 1979). Odell (1979:342) indicates that it may be useful to employ cluster analysis as a means by which cases are grouped based upon the functional variables. In this way an objective functional classification may be generated.

Nance (1977) employs an average linkage clustering routine to classify an assemblage of stone tools by functional attributes. He is able to document functional cross-cutting of the morphological groups (scrapers, bifaces, blades, burins, and gravers) as a result of the numerical classification of the tools by 24 defined edge wear characteristics. A major problem with Nance's study, however, is that he does not indicate what activities or worked materials are represented by the individual clusters. In a sense, we are offered only one half of a numerically based edge wear analysis. In other words, an assemblage is classified by the functionally defined variables, and groups of tools are presented. But, what do the groups mean? That is the important last step in any numerical taxonomy. Therefore, except for the fact that Nance's study is an example of the use of quantitative methods in edge wear analysis, it is otherwise of limited utility.

In the present study, the raw data generated by the values of the functional variables are used as input into a hierarchical clustering algorithm (see Johnson 1967; Sneath and Sokal 1973). Functional designations are imposed on the resultant clusters, rather than merely describing the groups in terms of the co-occurrences of sets of attributes. As will be discussed in detail, the functional designations are based upon what the particular co-occurring attributes are that comprise each of the clusters.

Most of the functional variables being considered in this study are nominal scale. Gower's coefficient of similarity may validly be used with nominally scaled data (Gower 1971:858; Sneath and Sokal 1973:135-136), in which case the measure is a matching coefficient. A FORTRAN program was written to generate the similarity matrix using Gower's coefficient, and the matrix was used as input into the BMDP (1981) average-linkage clustering algorithm. The average-linkage method forms clusters based upon the average similarity between a particular case and the cluster to which it is being compared. The resultant clusters were examined in the light of previous microwear studies.

Results and Discussion

There are six clusters (based upon the functional variables) that make theoretical sense and that correspond to previous microwear studies (see Table 1 for the raw data). However, as can be seen in the dendrogram (Fig. 3) there are several tools which, when examined in the context of prior studies, do not make sense in terms of their numerical classification. These will be discussed in turn. The six groups are presented in Table 2.

Functional Classification

In addition to my own experimentation, a number of published studies were referenced when interpreting the classification based upon the functional variables. One study in particular was quite useful in this respect. Brink (1978) conducted a thorough and well-controlled study of low-magnification microwear damage produced on endscrapers. He manufactured a series of endscrapers and used them on a variety of materials. Brink presents verbal descriptions of the resultant wear patterns and invaluable photomicrographic documentation of the worked edges. Many of the photographs are of the same working edge but display various degrees of wear, thus monitoring the sequential process by which the damage formation occurs.

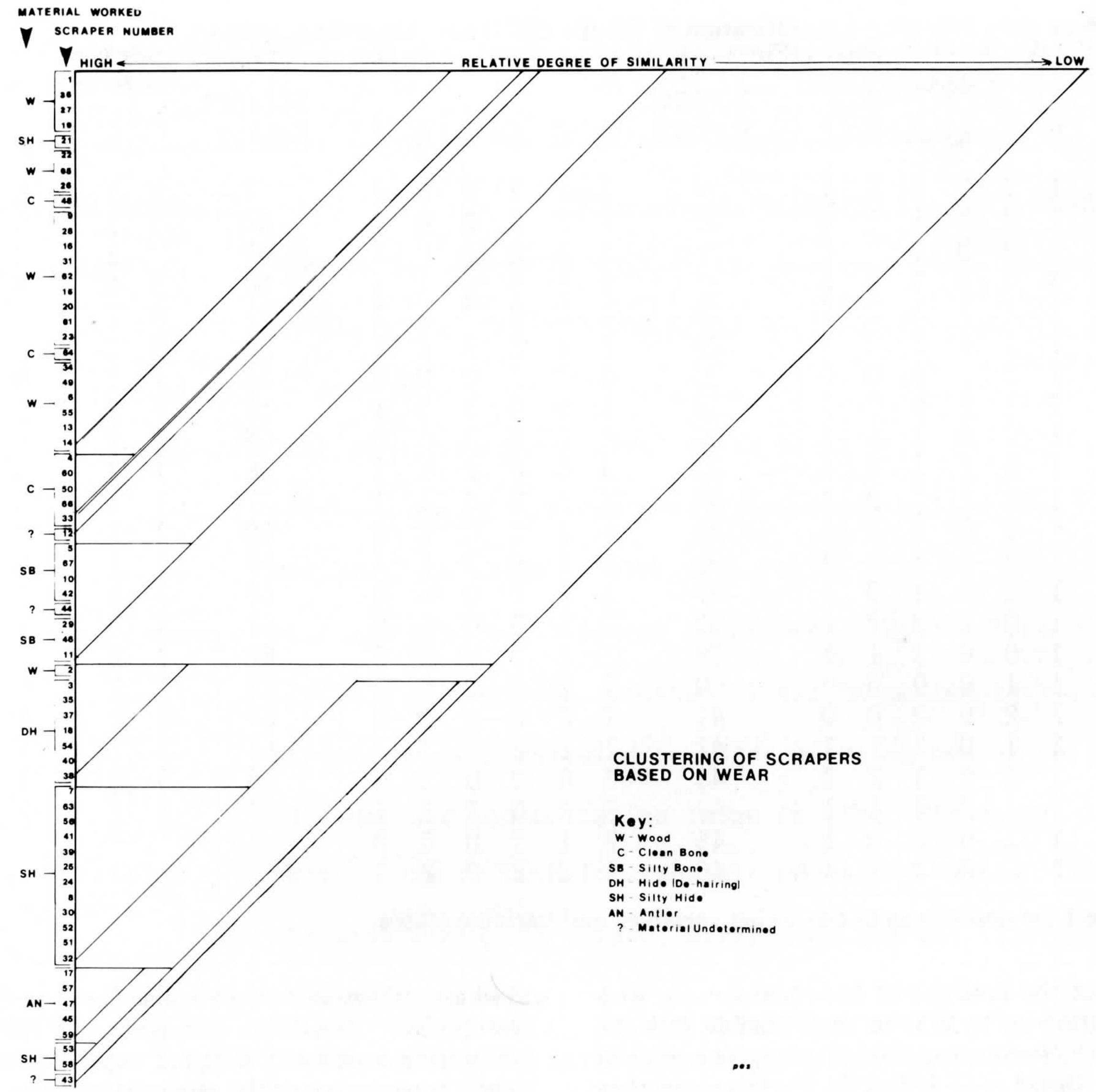

Figure 3. Clustering of scrapers based upon the wear characteristics.

Most of Brink's functional attributions, however, are based solely upon striations, polishes, and/or relative degrees of rounding. Except for one use-wear category (clean bone scraping) Brink does not rely upon the examination of microscarring. The major reason for this is the appearance of spontaneous retouch that both he (Brink 1978:59) and Newcomer (1976) document in the tool production process. However, it is clear that the predominant locations of the spontaneous retouch are along the distal or disto-lateral margins of a flake (Newcomer 1976:64; Brink 1978:59). Therefore, if we are examining scar patterns as an indicator of tool use, then we are on safe ground as long as we do not base our attributions on the fine retouch that may be present on the distal or disto-lateral margins of flake removals.

From the functional variables six basic groups of scrapers are defined: wood, clean bone, silty bone, hide de-hairing, silty hide, and antler scrapers (Table 2). In several situations the tools cross-cut categories and this provides a tentative basis for defining a seventh category of multi-use scrapers. The distinguishing characteristics of each group will now be discussed. Definitions for the terms such as abrasion, scar sizes, striations, etc., may be found in Tringham *et al.* (1974) and Odell (1975, 1977). The reader is encouraged to refer closely to Table 2 while reading through the following discussion.

Group 1: Wood Scrapers (Fig. 4). Working with the Western Desert aborigines in Australia, Gould *et al.* (1971) document similar wear patterns resulting from wood working activities as presented in Table 2. After observing the Australian aborigines using chert endscrapers for scraping wood and examining the resultant wear patterns,

Table 1. Raw data following a modification of Odell's (1977) variable coding system[a].

Scraper Number	A	B	C	D	E	F
1	1	1	0	3	1	1
2	1	2	0	2	1	4
3	6	2	0	0	0	0
4	3	0	0	3	3	5
5	1	1	2	3	2	2
6	1	1	0	3	2	4
7	7	2	2	0	0	0
8	7	2	2	0	0	0
9	1	0	0	3	1	1
10	7	2	2	3	3	4
11	1	2	2	2	3	1
12	4	1	0	3	3	3
13	1	2	0	3	2	4
14	1	1	0	1	3	1
15	1	0	0	3	2	2
16	1	0	0	3	1	1
17	1	1	0	0	0	0
18	7	2	0	0	0	0
19	1	1	0	3	1	1
20	1	0	0	3	2	1
21	1	1	2	3	1	1
22	1	1	0	3	2	1
23	1	0	0	3	2	1
24	7	2	2	0	0	0
25	7	2	2	0	0	0
26	1	1	0	3	2	1
27	1	1	0	3	1	1
28	1	0	0	3	1	1
29	7	2	2	3	2	1
30	6	2	2	0	0	0
31	1	0	0	3	3	1
32	6	2	2	0	0	0
33	3	0	0	2	1	1
34	7	0	0	3	1	1
35	1	2	0	0	0	0
36	1	1	0	3	1	1
37	1	2	0	0	0	0
38	7	2	0	0	0	0
39	7	2	2	0	0	0
40	7	2	0	0	0	0
41	7	2	2	0	0	0
42	7	2	2	3	3	1
43	3	0	0	0	0	0
44	7	2	0	3	3	1
45	7	1	0	0	0	0
46	1	2	2	3	2	1
47	1	1	0	0	0	0
48	3	1	0	3	2	1
49	7	1	0	3	1	1
50	3	0	0	3	2	7
51	6	2	2	0	0	0
52	6	2	2	0	0	0
53	7	1	2	0	0	0
54	7	2	0	0	0	0
55	1	1	0	3	2	4
56	7	2	2	0	0	0
57	1	1	0	0	0	0
58	1	1	2	0	0	0
59	7	1	0	0	0	0
60	3	0	0	3	2	5
61	1	0	0	3	2	1
62	1	0	0	3	3	1
63	7	2	2	0	0	0
64	2	0	0	3	2	1
65	1	1	0	3	2	1
66	3	0	0	3	1	7
67	3	1	2	3	2	5

(A–F: VARIABLES)

[a]See Note 1 for definitions of the coded variables and variable states.

they report the presence of tiny (visible only with magnification up to 36X) to large (visible with the naked eye) "terminated flakes" along one edge of each tool (Gould *et al.* 1971:159). Furthermore, they indicate that these scars are frequently overlapping. As Hayden and Kamminga (1973:3) point out, it is unclear what Gould *et al.* mean by "terminated flakes," and suggest that they are flake scars with "abrupt terminations." From Gould *et al.*'s discussion and one photomicrograph (1971:160) it appears that the "terminated flakes" correspond to what generally has been referred to as step scars. Odell (1977:301) indicates that, on the basis of experimental wood scraping, flake scars are generally trapezoidal and scalar in shape and run into one another. Keeley (1980:38), in discussing scarring patterns on wood scrapers concurs that shallow, step scars are often produced.

Group 2: Clean Bone Scrapers (Fig. 5). On the basis of clean bone scraping experiments, Brink (1978:82) finds that microflaking is the most diagnostic wear pattern produced, taking the form of rectangular step scars *(ibid.*:84). In addition, he found that this class of scrapers is the only category in which utilization damage is also found on the ventral surface. Broadbent and Knutsson (1975:119) performing a series of scraping experiments using quartz scrapers report the same phenomenon of ventral and dorsal flaking when scraping bone. They attribute this pattern to the unyielding nature of bone as compared to wood or hide. This would not explain why the silty bone scrapers do not also exhibit ventral flaking, but perhaps the addition of silt particles creates a yielding surface against which the scraper is pushed. This seems unlikely in light of the fact that the silt particles are hard enough to abrade and gouge out bits of the scraper, as seen in Brink's (1978) silty bone scraping experiments. Odell (personal communication 1982) suggests that the grit may make the scraper slide over the material, maintaining a constant working angle, while if the scraper gets caught in the material (of clean bone), the working angle may momentarily change, thus producing damage to the other side. At this point, however, the problem remains unsolved.

Group 3: Silty Bone Scrapers (Fig. 6). According to a series of experiments conducted by Brink (1978), scraping silty bone with chert endscrapers

Table 2. Frequency of scrapers in each of the functionally defined groups. Wear characteristics for each category are also presented.

Wear Characteristics of Each Functional Category

Functional category	Wear characteristics	Frequency
Wood scrapers	Wear dorsal surface; edge abrasion absent or slight; scarring well-defined and small to large in size (Figure 4).	25
Clean bone scrapers	Wear on dorsal and ventral surfaces or only ventral; abrasion and striations absent; scarring well-defined and small to large in size (Figure 5).	5
Silty bone scrapers	Wear patterns on 1) dorsal or 2) one or both intermediate surfaces and dorsal; abrasion slight to medium to heavy; striations perpendicular to edge; scarring medium to well-defined and medium to large in size (Figure 6).	7
Hide de-hairing scrapers	Wear on one or both intermediate edges and ventral face; abrasion medium to severe; striations absent; scarring absent (Figure 7).	8
Silty hide scrapers	Wear on 1) both intermediate edges or 2) one or both intermediate edges and dorsal surface; abrasion heavy; striations perpendicular to edge; scarring absent (Figure 8).	14
Antler scrapers	Wear on 1) dorsal surface or 2) one or both of intermediate edges and dorsal; abrasion slight to severe; scarring absent (Figure 9).	5
TOTAL		64

produces a moderate amount of abrasion on the edge and dorsal surface in addition to striations running perpendicular to the edge. Brink suggests that the abrading and striating process in this situation is a result of the silt particles "gouging out bits of the tool surface in a linear fashion" (1978:89). He also indicates that microflaking is associated with the endscrapers used for scraping silty bone. Keeley (1980:45) mentions that variably sized step scars on the dorsal surface of tools result from bone scraping activities. However, he does not analytically separate clean from silty bone in his discussion. Due to the nature of Keeley's experimental program it is likely that a certain amount of silt or grit naturally entered the system: "As many of the experiments as was possible were conducted outdoors, on the ground, in case the amount of grit introduced between the implement edge and the worked material should be artificially reduced by experimenting indoors on clean floors or countertops" (Keeley 1980:15).

Group 4: Hide De-hairing Scrapers (Fig. 7). Semenov (1973) correctly discusses hide de-hairing as an activity separate from hide scraping. However, he is not very clear as to the nature of the wear patterns that result from hide dehairing. He does indicate, though, that "linear traces are scarcely detectable" (Semenov 1973:89) on the tools, which corresponds to the lack of striations observed on our scrapers. Furthermore, Semenov points out that the dehairing scrapers are blunted and smooth along the working edges, which would relate to the medium to severe abrasion that characterizes the scraper edges in our de-hairing category.

Brink (1978) conducted one hide de-hairing experiment and found that the working edge of the scraper gradually became very smooth with no flake utilization damage or striations occurring (Brink 1978:110-112). Brink finds that hide dehairing produces wear patterns virtually indistinguishable from hide de-fleshing. However, he points out that an endscraper is quite inefficient for the task of hide defleshing, whereas the tool is quite effective for dehairing. In light of this consideration, therefore, Brink (1978:112) is confident that in the analysis of archaeological specimens he is correctly assessing this particular wear type as the result of hide dehairing as opposed to hide defleshing. Keeley (1980:53), on the other hand, indicates that he is unable to discern any wear traces resulting from hide de-hairing, since the activity is so successful there is no time for damage to accrue. I would suggest that if Keeley had continued using the scraper as a dehairing implement on a number of hides he would have observed the same type of patterns that Brink (1978:110-112) describes.

Figure 4. Example of wood scraping wear. See Table 1 for a verbal description of the wear characteristics.

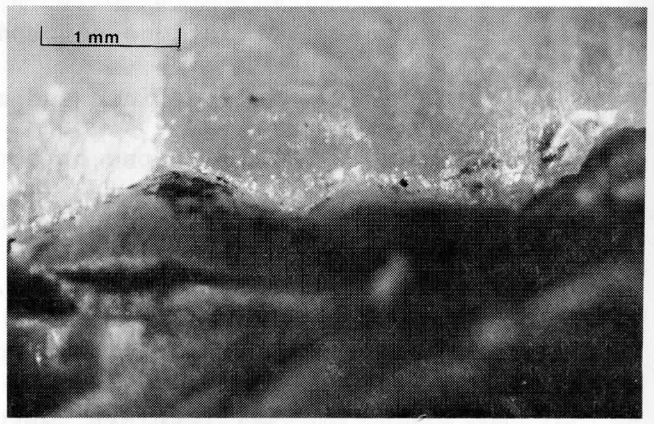

Figure 5. Example of clean bone scraping wear. See Table 1 for a verbal description of the wear characteristics.

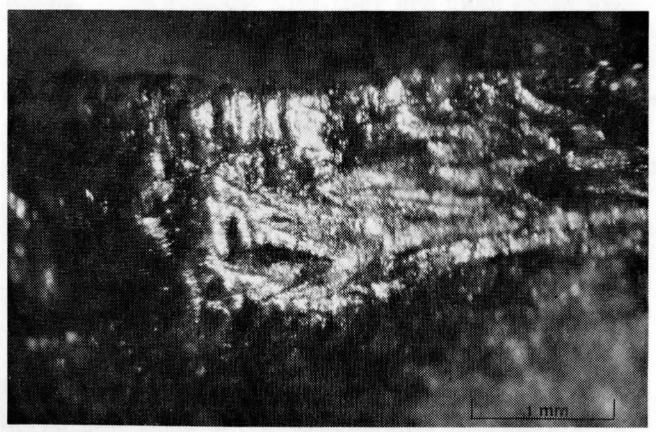

Figure 6. Example of silty bone scraping wear. See Table 1 for a verbal description of the wear characteristics.

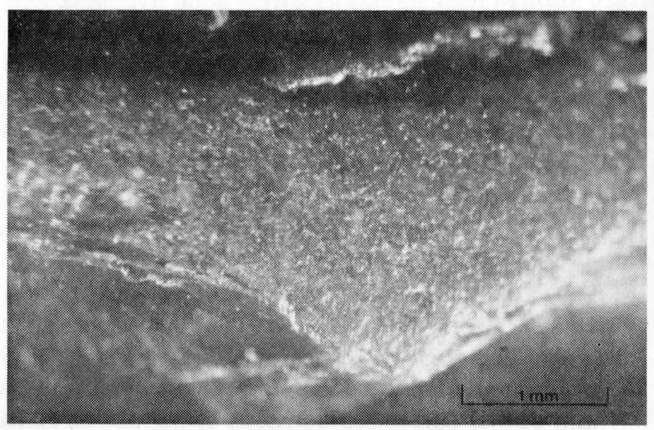

Figure 7. Examples of hide de-hairing wear. See Table 1 for a verbal description of the wear characteristics.

Group 5: Silty Hide Scrapers (Fig. 8). Brink's (1978) silty hide scraping experiments generated extreme abrasion along the working edges of his endscrapers — in some cases the edge was nearly eliminated, "making dorsal/ventral distinctions more difficult" (*ibid.*:108) — and there were striations perpendicular to the edges. Hayden (1979) documents a similar set of wear patterns for a number of ethnographically recorded hide scrapers. He found that the dorsal surface and the working edge are heavily abraded, while the ventral surface is relatively free from abrasion (Hayden 1979:316). Furthermore, Hayden observed striations perpendicular to the working edges of the scrapers (Hayden 1979:Fig. 9). Keeley also found that hide scraping produces rounded edges with striations perpendicular to the edges (*ibid.*:5).

Nissen and Dittemore (1974) examined nine Eskimo socketed scrapers, and on the basis of comparing their edge angles with those discussed by Wilmsen (1968) they indicate that the tools were being used for hide scraping and softening. Further, they cite the ethnographic literature for the use of endscrapers in hide processing activities (Nissen and Dittemore 1974:70-71). However, as indicated above, if the tools were being used for hide scraping, striations running perpendicular to the working edge definitely should be observed (especially at the 75X magnification that they were using; see also Semenov 1973:88; Brink 1978:108-109; Hayden 1979:213). From Nissen and Dittemore's (1974:69-70) descriptions of the wear patterns, it is likely that activities other than hide scraping are represented. They indicate that step flaking is present on the ventral surfaces of some of the tools, suggestive of bone scraping (see above and Brink 1978:84; Keeley 1980:45-46).

Apparently Nissen and Dittemore were predisposed to consider their scrapers as being used for some sort of hide working. When the wear traces that have been documented to result from hide scraping (i.e., striations perpendicular to the working edge) were not observed, Nissen and Dittemore (1974:71) offer a plausible but unlikely explanation for this phenomenon: "...the skins were left out in the snow during the winter and presumably little grit would be blowing through the air at this time of the year." It would seem more reasonable to consider alternative activities that would produce the observed wear patterns rather than fitting the data into an expected framework.

Group 6: Antler Scrapers (Fig. 9). Keeley (1980:56-57) and Brink (1978:72) indicate that because of its hardness, working dry antler is extremely unproductive and therefore it is probable that in the past, antler was only worked after it had been soaked in water for a period of time in order to soften it. Accordingly, Keeley and Brink conducted their respective sets of experiments using only soaked antler.

Brink (1978:75-77) finds that abrasion of the working edges of tools used for antler scraping is the principal form of resultant damage, while flake utilization scars and striations are absent. One potentially could confuse the wear damage resulting from antler scraping with that of hide de-hairing, but the location and degree of abrasive wear should be considered in this context. It is seen that abrasion associated with antler scraping is generally located only along the dorsal edge of the tool (see also Brink (1978:75), while abrasion resulting from hide dehairing is found on both intermediate surfaces in addition to the dorsal face.

Group 7: Multi-use Scrapers. When one compares the previous discussions of the functional categories with the actual dendrogram (Fig. 3) there seem to be certain discrepancies. Certain of the tools — specifically, numbers 21, 48, 64, and 2 — that have been assigned to particular categories in this discussion are not located with the associated functional cluster on the dendrogram.

The dendrogram is a graphical representation of the similarity matrix, which in this context (using nominal and ordinal scaled data) is derived from relative numbers of matches and mismatches in all possible non-redundant pair-wise comparisons. For most of the clusters the members found within them make sense in terms of the functional characterization of the particular clusters, and are internally consistent with respect to the experimental literature. However, there are the inconsistent tools mentioned above that in terms of their attributes are similar to particular clusters. When the actual variable state are examined these tools are placed within different functional categories than those produced by the numerically based clustering algorithm. These inconsistencies constitute "anomalies" which, as Gould (1980:139) stresses, "...cannot be dismissed as 'mere idiosyncrasies' or 'particularist exceptions'. They demand an explanation, and the explanation of these deviations or idiosyncrasies may prove more interesting than explanations for dominant patterns or 'behavior in the aggregate'."

One of the unresolved problems in microwear analysis is how to deal with tools that have been used in more than one activity. The "anomalous" scrapers mentioned above may have some bearing on this issue of multi-use tools. Numerically, on the basis of the defined attributes, the tools are placed in association with specific sets of scrapers. However, particular key variable states indicate that

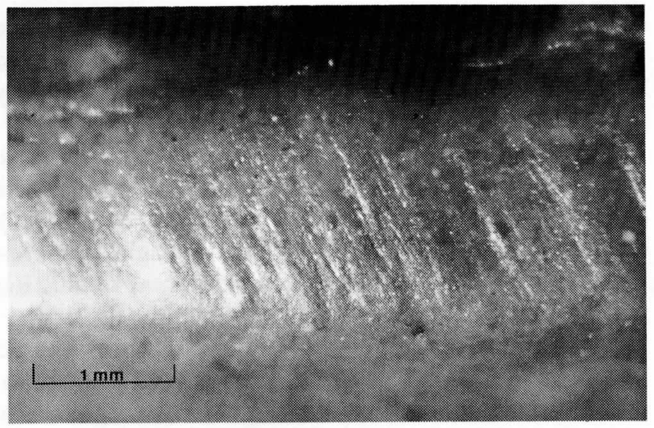

Figure 8. Example of silty hide scraping wear. See Table 1 for a verbal description of the wear characteristics.

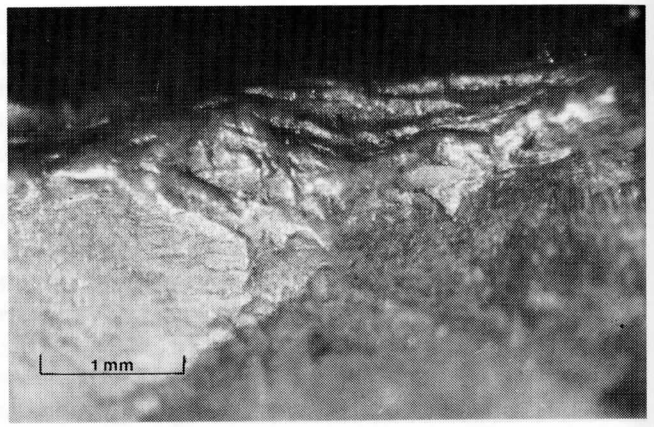

Figure 9. Example of antler scraping wear. See Table 1 for a verbal description of the wear characteristics.

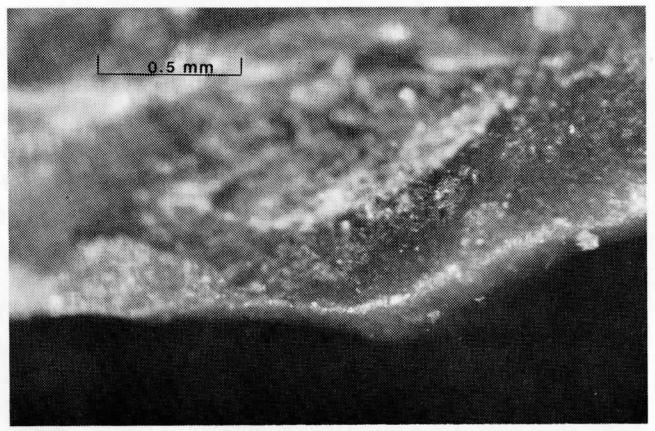

Figure 11. Clean bone scraping wear on socketed endscraper.

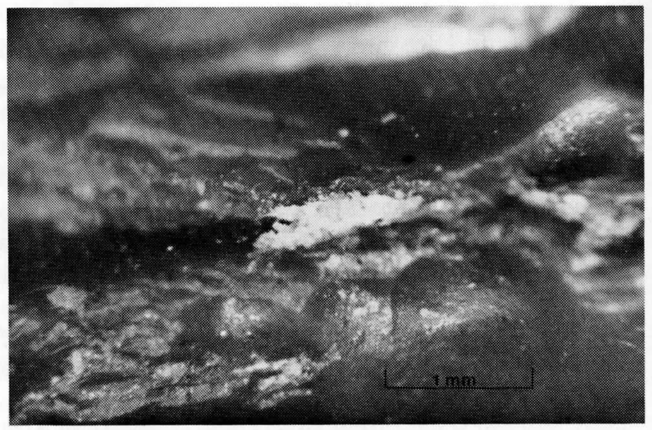

Figure 12. Clean bone scraping wear on socketed endscraper.

these "anomalous" scrapers were used for at least one other function different from that which the clustering algorithm demonstrates. By this method, at least two different activities for which a tool may have been used may be defined; one activity on the basis of the key variable state and, the other, on the basis of the tool's numerical placement in the clustering process. In other words, a key variable state might be important for defining a particular activity for which a tool was used. In addition, the edge wear attributes on the tool, when combined in the multivariate analysis, potentially are informative for other (different) activities. In light of this argument group 7 tentatively is comprised of multi-use scrapers, the validity of which may be tested by future experimental work.

This group consists of four members. Two of these tools were probably used for bone scraping, since there was flake utilization damage present on the ventral surface (tool numbers 48 and 64). Furthermore, both of the tools seem also to have been used for wood working, since the other variables numerically correspond most closely to that category. One of the other tools (Number 21) is considered to be a silty hide scraper on the basis of the abrasion along the distal edge in addition to the striations running perpendicular to the edge. The abrasion of this scraper is light and present only on the dorsal surface. Numerically, scraper 21 is also considered to have been used for wood working. On the basis of the flake utilization patterns, scraper 2 is considered to have been used for scraping wood. In terms of its numerical placement it is judged to have been used also in hide de-hairing activities.

Admittedly, this is only a tentative method by which one can deal with the problem of tools that have been used on a variety of materials, and experiments need to be conducted in order to test the validity of the approach. However, it may represent a useful way to consider multi-use tools.

Another problem with multi-use tools is that the analyst may only be observing the final episode of use. In other words, as a tool is incorporated into a different activity from that which it was previously used the more recent activity is likely to obliterate the initial wear patterns already present on the tool.

Furthermore, the tools are undoubtedly retouched in order to maintain sharp working edges. Therefore, the four artifacts comprising the category of multi-use scrapers presented in this study is likely to be a conservative estimate and limited to those items on which previous traces of use-wear had not been obliterated completely (either through a change in activity and/or by re-sharpening).

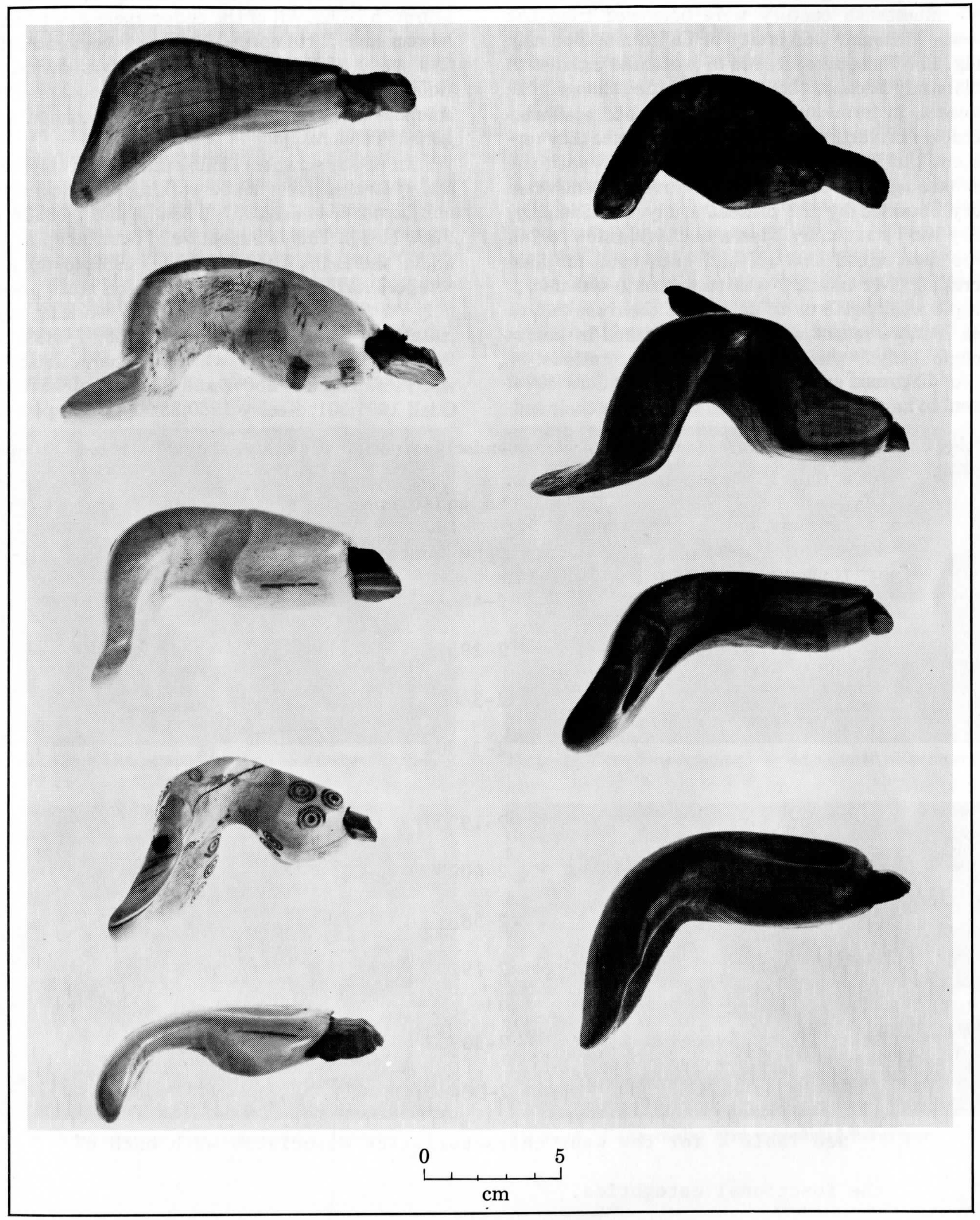

Figure 10. Nine socketed endscrapers originally examined by Nissen and Dittemore (1974). Courtesy of the Lowie Museum, University of California at Berkeley.

Ethnographic Endscrapers From Northwestern Alaska

In order to heighten our appreciation of ethnographic variability, endscrapers obtained by ethnographers working in Northwestern Alaska in the late nineteenth century were borrowed from the Lowie Museum, University of California, Berkeley (Fig. 10). These scrapers are of particular interest to this study because they represent the ethnographic present, in terms of the use of such socketed endscrapers in Northwest Alaska, and because they represent the best ethnographic comparison with the archaeological evidence for the late nineteenth century obtained by the present study. Additionally, they were studied by Nissen and Dittemore (1974), who determined that all had been used for hide scraping. My interest was to evaluate the microscopic wear patterns to determine their use and to see if more recent technical approaches in microscopic analysis yielded different interpretations.

As discussed earlier, Nissen and Dittemore (1974) seem to have been predisposed to consider their endscrapers to have been used solely in hide working activities. The basis for their preconceptions apparently is derived from Wilmsen's (1968, 1970) discussion of the functional implications of scraper edge angles, and the ethnographic documentation for the use of endscrapers in hide working activities (see Murdoch 1892). All of the endscrapers described by Nissen and Dittemore (1974) were re-examined in this study. Using the recording system devised by Odell (1977; see Methods section) the socketed endscrapers were divided into three functional categories (Table 3).

Four of the scrapers exhibit flaking on the dorsal and ventral surfaces of the working edges (catalogue numbers 2-48444, 2-2957, 2-38439, and 2-38364; see Figs. 11-14). This is indicative of bone scraping (see above and Brink 1978:84; Keeley 1980:45-46). Four scrapers have well-defined utilization scars present only on the dorsal surfaces of the working edges (catalogue numbers 2-19205, 2-4008, 2-5839, and 2-19204; Figs. 15-18), which is characteristic of wood scraping (see above and Gould *et al.* 1971:159; Odell 1977:301; Keeley 1980:38). Two scrapers display abrasion and edge rounding in addition to striations perpendicular to the working edges (catalogue numbers 2-30935, 2-38439; Figs. 19 and 20). As discussed above (and Brink 1978:108; Hayden 1979:316; Keeley 1980:51) this wear results from silty hide scraping. One of the silty hide scrapers (2-38439) was also used for bone scraping.

Nissen and Dittemore (1974:71) interpret the wear patterns on all of the endscrapers to be the result of some sort of hide working. They suggest that the absence of striations perpendicular to the working edge resulted from the skins being "...left out in the snow during winter and presumably little grit would be blowing through the air at this time of year." However, I was able to observe such microscopic wear traces (and others) and have determined several other (including multiple) patterns of wear. Why I was able to make such observations on these same specimens, since Nissen and Dittemore did not, is not clear. However, their interpretation of the negative evidence relies heavily on ethnographic analogy, which is highly normative and based on limited observation of actual scraper use. My analysis indicates considerable variation in scraper use (including multiple use), suggesting that simple ethnographic analogy may be an unreliable indicator of tool use, insofar as it unnecessarily reduces the interpreted variability in tool use. This is due to a limited range of observations and a lack of purposeful intent by the ethnographer to observe varying patterns of tool use.

From the present study, I have found that microscopic observations of scraper wear are a better indication of actual tool use than is ethnographic analogy, because they focus on the variability inherent in tool use with greater reliability. With our present technical capabilities of microscopic examination of stone tools, it would be erroneous for archaeologists to continue to use ethnographic analogy as an uncritical explanation for tool use, without explicit observation of relevant ethnographic specimens in a controlled comparison.

Table 3. Functional categories for the nine socketed endscrapers originally analyzed by Nissen and Dittemore (1974).

Functional category[a]	Socketed endscraper catalogue numbers	Figure number
Clean bone scrapers	2-48444	11
	2-2957	12
	2-38439	13
	2-38364	14
Wood scrapers	2-19205	15
	2-4008	16
	2-5839	17
	2-19204	18
Silty hide scrapers	2-30935	19
	2-38439	20

[a]See Table 2 for the wear characteristics associated with each of the functional categories.

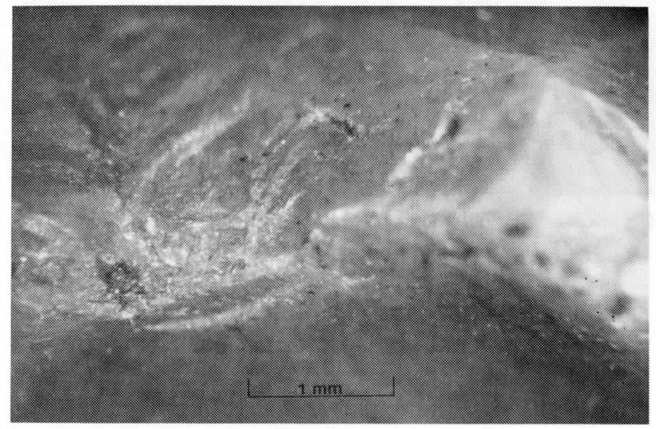

Figure 13. Clean bone scraping wear on socketed endscraper.

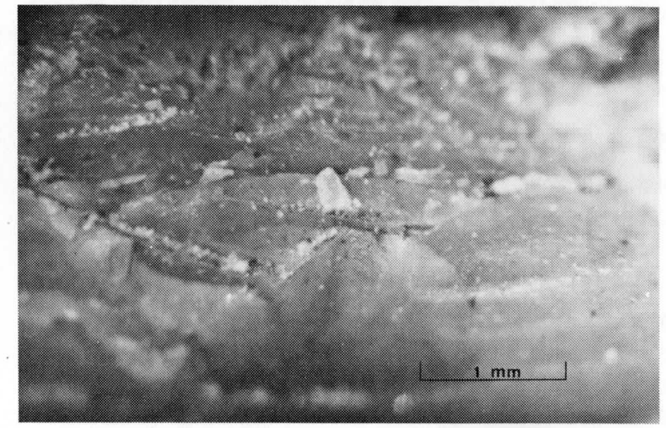

Figure 14. Clean bone scraping wear on socketed endscraper.

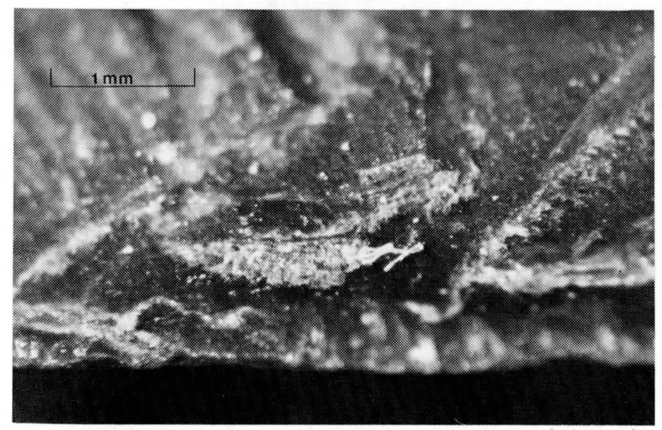

Figure 15. Wood scraping wear on socketed endscraper.

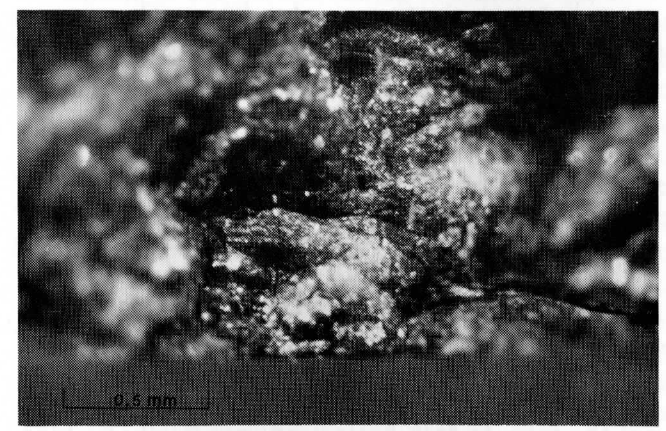

Figure 16. Wood scraping wear on socketed endscraper.

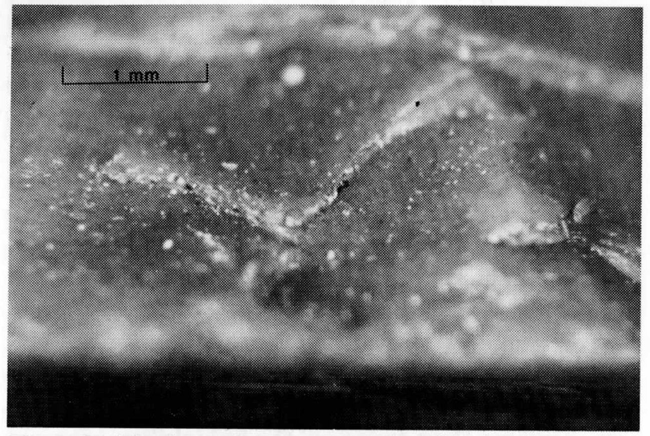

Figure 17. Wood scraping wear on socketed endscraper.

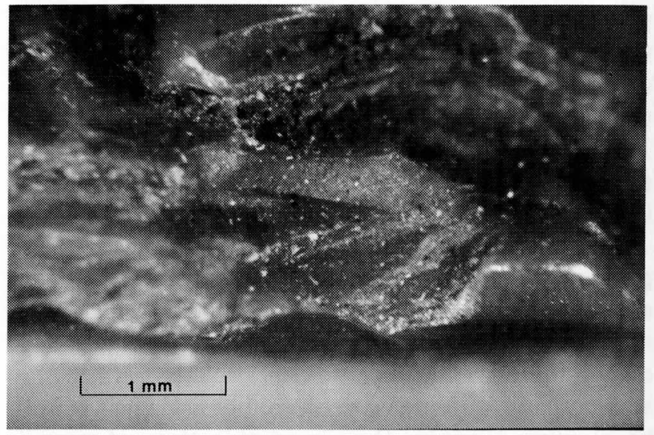

Figure 18. Wood scraping wear on socketed endscraper.

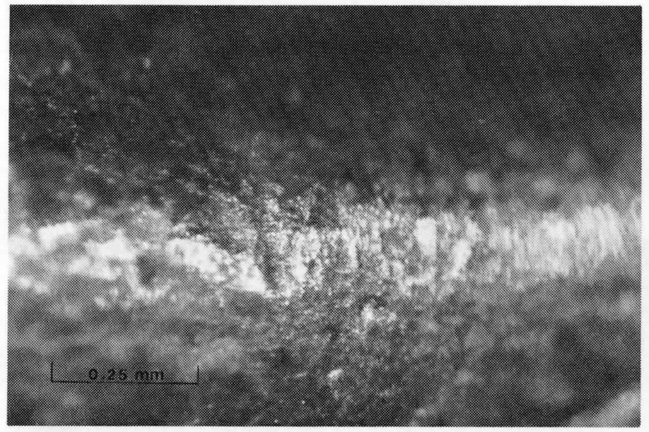

Figure 19. Silty hide scraping wear on socketed endscraper.

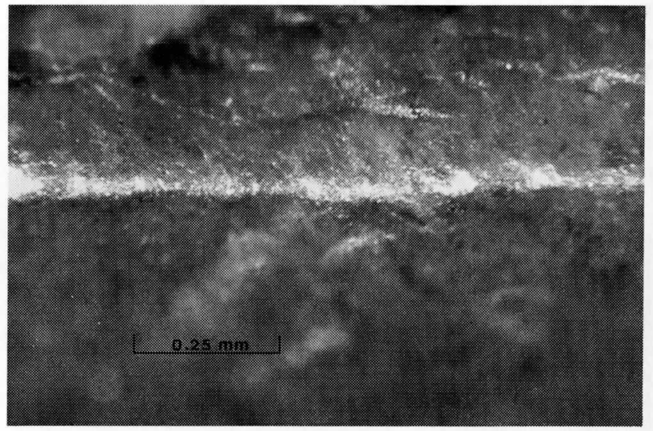

Figure 20. Silty hide scraping wear on socketed endscraper.

Summary and Conclusions

A functional classification was performed on the endscrapers recovered in 1981 from the Utgiagvik site, Barrow, Alaska. Based upon a series of functional attributes defined by Odell (1977) the scrapers were initially classified into six groups using an average-linkage clustering algorithm. Comparing these groups with previous microwear analyses (experimental and archaeological), several scrapers were found to be "anomalously" placed via the clustering process. Identifying these "anomalies" was suggested to be a potentially useful method in dealing with multi-use tools. Based upon this notion, a seventh, albeit tentative, group consisting of multi-use scrapers was defined.

As indicated earlier, I was concerned with testing the notion that the endscrapers, as a tool class, were used solely in hide working activities. The results of the microwear analysis certainly show that this is not the case. In fact, tools used specifically for hide scraping only constitute the second largest class of scrapers in the assemblage examined here. Wood scraping tools comprise the largest category.

These results corroborate Odell's (1981) findings that among endscrapers a considerable amount of functional variability is represented. However, the level at which functional variation is observed among the Eskimo endscrapers differs from that of the Dutch Mesolithic tools. Odell (1981:335) finds that a portion of the "endscrapers" were used in non-scraping activities. The Eskimo endscrapers were all used in scraping activities, but a range of worked materials is represented. In terms of Odell's (1981) argument (at the level of activity and not worked material) the Eskimo endscrapers, as a tool class, display a narrow range of functional variation, and therefore form or function may be applied to these tools interchangeably. However, in terms of Alaskan archaeology, endscrapers traditionally have been equated with hide processing activities (Murdoch 1892; Nelson 1899; Ford 1959; Stanford 1973; Nissen and Dittemore 1974). So, at this level of analysis (in terms of worked materials) we cannot safely make the equation between form and function for the endscrapers. Dumont (1983) in examining the scrapers recovered from Star Carr presents similar results to those noted here. He finds that the scrapers were in fact used solely for scraping activities, but on a range of worked materials, including hide, bone, wood, and antler (Dumont 1983:132-137).

In light of these results, it is argued here that only with extreme caution should the ethnographic record be used to interpret or explain the archaeological context. As seen in this paper, the uncritical reading of a single ethnographer (Murdoch) may potentially contribute to the misinterpretations of subsequent studies. One example of this phenomenon is seen in the conclusions generated by Nissen and Dittemore's (1974) microwear analysis of nine Eskimo scrapers. In the absence of hide-working wear patterns, these investigators nevertheless prefer to rely upon Murdoch's observations, and construct an elaborate explanation to account for the unusual edge wear as still being a result of hide scraping. As Wobst (1978) indicates, we must not be tyrannized or intimidated by "ethnographically perceived reality."

NOTES

1. With some modification the variables are presented by Odell (1977:584-587) are:

A. Side on which wear (damage) occurs.

0 = no wear
1 = dorsal surface
2 = ventral surface
3 = both surfaces
4 = intermediate edge; dorsal
5 = intermediate edge; ventral
6 = intermediate edge; both
7 = wear on one or both intermediate surfaces and ventral and/or dorsal surfaces

B. Abrasion.

0 = none
1 = slight edge roughening (projections slightly worn down, or abraded; abrasion does not extend far back from edge, nor does it alter edge angle much)
2 = medium/severe abrasion (edge moderately-to-greatly rounded; edge angle definitely altered)

C. Striations.

0 = none
1 = parallel to edge
2 = perpendicular to edge

D. Scar definition; along interior edge.

0 = none
1 = ill-defined (interior edge of scar; scar edge furthest away from edge of piece blends in with the stone surface so that it is very difficult to tell where the scar begins)
2 = medium-defined (one can tell where the interior edge of the scar is but the shape of the scar is not "imprinted" into the stone itself, so as to make un unmistakable clear-cut border)
3 = well-defined (border of interior edge of scar is unmistakably clear)

E. Scar size; scar of majority of representative scars. Although most determinations will be made at constant magnification, it is necessary to define this variable in terms of what one can see clearly under different magnifications. The alternative would be to actually measure the scars which would be too time consuming.

0 = none
1 = small (not easily visible under the magnification of 10X, though may easily be visible under 20X or greater)
2 = medium (not easily visible to naked eye, though quite easily visible under 10X magnification)
3 = large (easily visible with naked eye)

F. Scar distribution along edge.

0 = none
1 = even, run-together (i.e., touching one another); found wherever scarring occurs (on either or both surfaces)
2 = even, close (i.e., within one scar's distance of the next scar); found wherever scarring occurs
3 = even, wide (i.e., more than one scar's distance from next scar); found wherever scarring occurs
4 = uneven scarring and alternating sets of scars; found wherever scarring occurs
5 = even, run-together/close on dorsal surface; uneven on ventral
6 = even, wide on one surface; uneven on other
7 = even, wide on ventral; even, run-together/close on dorsal
8 = even, run-together/close on ventral; uneven on dorsal
9 = even, wide on dorsal; even, run-together/close on ventral

Acknowledgments

There are a number of individuals who have contributed immeasurably to this study. In terms of the logic and presentation of the arguments I am especially grateful for the critical comments of Al Dekin, Randy McGuire, and George Odell. Ron Menton, of the Mathematical Sciences Department at S.U.N.Y. - Binghamton, offered helpful advice regarding the multivariate analysis, and Bruce Wrighton took the photomicrographs. The Lowie Museum at the University of California, Berkeley generously loaned us the socketed endscrapers, which substantially increased the importance of the study, and the S.U.N.Y. - Binghamton Research Foundation provided insurance for these tools. The Department of Anthropology, S.U.N.Y. - Binghamton provided all of the facilities for the research. Financial support for the research was provided by the Research Foundation, S.U.N.Y. - Binghamton, under contract to the U.S. Department of Interior, National Park Service, with monies provided by the Bureau of Indian Affairs. I, of course, am responsible for the interpretations and conclusions.

References Cited

Ahler, S. A.
1971 Projectile Point Form and Function at Rodgers Shelter, Missouri. *Missouri Archaeological Society Research Series* 8.

1979 Functional Analysis of Nonobsidian Chipped Stone Artifacts: Terms, Variables, and Quantification. In *Lithic Use-Wear Analysis,* edited by B. Hayden, pp. 301-328. Academic Press, New York.

BMDP
1981 *Statistical Software.* Department of Biomathematics, UCLA, University of California Press.

Brink, J. W.
1978 An Experimental Study of Microwear Formation on Endscrapers. *National Museum of Man Mercury Series, Archeological Survey of Canada Paper* 83.

Broadbent, N. D. and K. Knutsson
1975 An Experimental Analysis of Quartz Scrapers. Results and Applications. *Fornvannen* 70:113-128.

Dekin, A. A., Jr. *et al.*
1981 *The 1981 Excavations at the Utquiaqvik Archaeological Site, Barrow, Alaska.* Department of Anthropology, State University of New York at Binghamton, Public Archaeology Facility. Submitted to the Bureau of Indian Affairs and the National Park Service, 540 West 5th Avenue, Anchorage, Alaska 99501.

Dumont, J. W.
1983 An Interim Report of the Star Carr Microwear Study. *Oxford Journal of Archaeology* 2:127-145.

Ford, J. A.
1959 Eskimo Prehistory in the Vicinity of Point Barrow, Alaska. *Anthropological Papers of the American Museum of Natural History* 47.

Gould, R. A.
1980 *Living Archaeology.* Cambridge University Press, New York.

Gould, R. A., D. A. Koster, and A. H. L. Sontz
1971 The Lithic Assemblage of Western Desert Aborigines of Australia. *American Antiquity* 36:149-169.

Gower, J. C.
1971 A General Coefficient of Similarity and Some of its Properties. *Biometrica* 27:857-874.

Hayden, B.
1979 Snap, Shatter, and Superfractures: Use-Wear of Stone Skin Scrapers. In *Lithic Use-Wear Analysis,* edited by B. Hayden, pp. 207-229. Academic Press, New York.

Hayden, B. and J. Kamminga
1973 Gould, Koster, and Sontz on 'Microwear': A Critical Review. *Newsletter of Lithic Technology* 2:3-8.

Hester, T. R. and R. F. Heizer
1973 Arrow Points or Knives? Comments on the Proposed Function of "Stockton Points". *American Antiquity* 38:220-221.

Johnson, S. C.
1967 Hierarchical Clustering Schemes. *Psychometrika* 32:241-254.

Keeley, H.
1974 Technique and Methodology in Microwear Studies: A Critical Review. *World Archaeology* 5:323-336.

1980 *Experimental Determination of Stone Tool Uses: A Microwear Analysis.* University of Chicago Press, Chicago.

Murdoch, J.
1892 Ethnological Results of the Point Barrow Expedition. *U.S. Bureau of American Ethnology, Ninth Annual Report.*

Nance, J. D.
1971 Functional Interpretations From Microscopic Analysis. *American Antiquity* 36:361-366.

1977 Numerical Taxonomy Studies of Microwear on the Los Tapiales Artifacts. *Proceedings American Philosophical Society* 121(3):264-273.

Nelson, E. W.
1899 The Eskimo About Bering Strait. *U.S. Bureau of American Ethnology, 18th Annual Report.*

Newcomer, M. H.
1976 Spontaneous Retouch. *Second International Symposium on Flint. Staringia* 3:62-64.

Nissen, K. and M. Dittemore
1974 Ethnographic Data and Wear Pattern Analysis: A Study of Socketed Eskimo Scrapers. *Tebiwa* 17:67-87.

Odell, G. H.
1975 Micro-Wear in Perspective: A Sympathetic Response to Lawrence H. Keeley. *World Archaeology* 7:226-240.

1977 The Application of Micro-Wear Analysis to the Lithic Component of an Entire Prehistoric Settlement: Methods, Problems, and Functional Reconstructions. Ph.D. dissertation, Department of Anthropology, Harvard University.

1979 A New and Improved System for the Retrieval of Functional Information from Microscopic Observations of Chipped Stone Tools. In *Lithic Use-Wear Analysis,* edited by B. Hayden, pp. 329-344. Academic Press, New York.

1981 The Morphological Express at Function Junction: Searching for Meaning in Lithic Tool Types. *Journal of Anthropological Research* 37:319-342.

1982 Emerging Directions in the Analysis of Prehistoric Stone Tool Use. *Reviews in Anthropology* 9:17-33.

Odell, G. H. and F. Odell-Vereecken
1980 Verifying the Reliability of Lithic Use Wear Assessments by "Blind Tests": The Low-Power Approach. *Journal of Field Archaeology* 7:87-120.

Semenov, S. A.
1973 *Prehistoric Technology: An Experimental Study of the Oldest Tools and Artefacts from Traces of Manufacture and Wear.* Translated by M. W. Thompson, Adams and Dart, Bath.

Sneath, P. H. A. and R. R. Sokal
1973 *Numerical Taxonomy: The Principles and Practice of Numerical Classification.* W. H. Freeman, San Francisco.

Stanford, D. J.
1973 The Origins of Thule Culture. Ph.D. dissertation, Department of Anthropology, University of New Mexico.

Tringham, R. E.
1972 The Function, Technology and Typology of the Chipped Stone Industry at Bylany. In *Die aktuelle Fragen der Bandkeramik.* Edited by J. Fritz, pp. 143-148. Szekesfehervar.

Tringham, R. E., G. Cooper, G. Odell, B. Voytek, and A. Whitman
1974 Experimentation in the Formation of Edge Damage: A New Approach to Lithic Analysis. *Journal of Field Archaeology* 1:171-196.

Wilmsen, E. N.
1968 Functional Analysis of Flaked Stone Artifacts. *American Antiquity* 33:156-161.

1970 Lithic Analysis and Cultural Inference: A Paleo-Indian Case. *Anthropological Papers of the University of Arizona* 16.

Wobst, M. H.
1978 The Archaeo-ethnology of Hunter-Gatherers of the Tyranny of the Ethnographic Record in Archaeology. *American Antiquity* 43:303-309.

Wylie, H. G.
1975 Tool Microwear and Functional Types from Hogup Cave, Utah. *Tebiwa* 17:1-31.