APPENDIX G

USE-WEAR ANALYSIS OF THE LITHIC TOOLS FROM THE PUNCHEON RUN SITE

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THE PUNCHEON RUN SITE

By

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I. INTRODUCTION

Lithic specialists, in determining the function of stone tools from the past, usually examine the following research questions: (1) Is there any correlation between the form and function of tools? (2) Is there any relationship among form, use, and culture? (3) Is there any association between tool users and a site? (4) What kind of behavior can be distinguished by examining edge-damage? Simply put, these questions seek to determine what people did by the kind of tools they used.

Two methods are generally followed to accomplish these goals. The most common and traditional way to determine function of tools is through the typological studies. Such an approach involves examination of tool's morphology, or shape. Endless sequences of diverse shapes and forms have been proposed to identify functions (cf. Bordes 1968, 1972; Oakley 1968; Watson 1968).

The methodology of studying prehistoric stone tool functions has improved significantly since the introduction of the microscopic approach. This second method examines discrete edge damage morphologies and use-wear patterns caused by distinct uses of stone tools (see Cook and Dumont [1987] for a brief overview; cf. Grace [1989] on the study of tool functions using the use-wear approach exclusively). This new approach proved something that might seem obvious to many researchers (although many still have doubts): a tool's function cannot be determined simply from its shape[1] or the quality of raw material used to manufacture it. Furthermore, this approach has not only clearly shown that form does not determine function in any direct way, but that similar wear patterns cannot always be attributed to the same use. Function is best determined from a comparative analysis of edge damage and use-wear patterns. Additionally, the use-wear approach allows for detection of unexpected functions that could have not been identified otherwise (Hudler 1997; Lozny 1999). With such an assumption, it seems logical that a comparison of traces on ethnographic tools with the archaeological artifacts could give a clue as to how they were used in the past (Gould et al. 1971)[2]; however, there are problems with such inferences. For instance, the use of certain functional terms based on tool morphology, like scrapers (cf. Grace 1989), could be confusing, for tools of various forms could have been used for scraping. By applying the typological (morphological) approach, we limit our observations to those tools that fit our imagination as scrapers. Also, several prehistoric tool types, such as handaxes, are unknown to modern indigenous peoples (Grace 1989).

Thus edge analysis seems to be a important step in identifying the functions of ancient stone tools. This method also involves a specific morphological approach, except that it is not the tool's morphology (shape/form) that is studied, but the morphology of the tool's edge, or its selected fragments. One of the earlier practitioners of the detailed study of tool edges in the United States, Edwin O. Wilmsen (1968), studied the edge angles of tools and identified the three major groups of angles and their associations with task-specific activities: cutting (edges of 26- to 35-degree angles), hide scraping/heavy cutting (edges of 46- to 55-degree angles), and bone- and woodworking (edges of 66- to 75-degree angles).

White and Thomas (1972) also presented a very interesting classification of activities determined through the analysis of edge morphology. They simply interviewed the indigenous people of New Guinea and asked them to classify their tools by how would they use them and for what task. Their selection was tested

[1]For a very illustrative, although not always relevant, presentation of arguments between the traditional (typological) and new (use-wear) approaches toward determining tool function, see the discussion between François Bordes (1969) and Sergei Semenov (1970).

[2]Several interesting studies have been reported on analysis of edge damage on historically used chert tools, such as various grater teeth (Crock and Bartone 1982; Walker 1980).

statistically, and it appeared that tools of certain edge angles were preferred for specific tasks (the New Guineans were not told of the relation between the edge angle and task preference). The authors also speculated on the possibility of preferential selection of raw material for specific tasks.

Another example of the application of edge angle analysis in determining function involves an assemblage of scrapers from the American Midwest examined by Cantwell (1979). The author has established that the mean edge angles for task-specific activities were as follows: wood scraping tools, 61 degrees; and hide scraping, 70 degrees.

Since Semenov's (1964) studies, the emphasis in use-wear analysis has been on the use of microscopy, although some scholars have experimented with both microscopic and edge angle approaches (Broadbent 1979). Actually, microscopy was used by Broadbent and his associates to record changes in the edge appearance after a series of uses. The authors noticed that the edge stabilizes at certain angles; for instance, woodworking tools with original edges less than 55 degrees stabilized at 70-80 degrees. Those tools with original edges greater than 80 degrees sustained little wear. On the other hand, scraping hide with tool edges greater than 70 degrees turned out to be impractical, since the edges were not sharp enough. Scraping was successful with the edges angled at about 50 to 60 degrees. The most interesting epistemology from this study is that the use of tools of the same quality raw material to process diverse objects might produce similar wears, but it does not create the same edge angles. For instance, heavy hide scraping might look like short bone work, since eight to 10 minutes of work on hard materials will generate identifiable traces, while work on soft materials will not leave any traces within the same time. Therefore the authors suggested that the edge morphology is the best clue to a tool's function. An interesting issue pointed out by the authors was resharpening of used tool edges, in which case the edge damage represents the last use/modification. This is also a problem for microscopic studies.

Table G-1 summarizes the results of examining edge angles and their association with task-specific activity. No information on raw material types is included, since the cited authors were inconsistent in identifying this variable.

Table G-1: Some Posited Connections Between Edge Angle and Activity

Edge Angle*	Suggested Activity	Reference
26-35	cutting	Wilmsen 1968
46-55	scraping/heavy cutting	Wilmsen 1968
66-75	wood/bone working	Wilmsen 1968
61 (mean)	wood scraping	Cantwell 1979
70 (mean)	hide scraping	Cantwell 1979
55-65	soft materials	Broadbent 1979
70-85	hard materials	Broadbent 1979

* *degrees*

All referenced studies show that the edge angle may be considered a significant morphological attribute that may be used to identify tool functions. These authors failed, however, to identify various wear types and their combinations, such as polish, striations, or fracture patterns.

Tringham et al. (1974) have attempted to bridge the gap and analyze both edge damage and wear patterns to determine the relationship between them. The idea was to test whether tools of different raw materials will exhibit different or similar wear patterns when they are used to perform the same task on the same material. Three variables were controlled: direction of use, pressure, and contact angle. This well-controlled study set the standard for further attempts, especially in the area of experimentally created use patterns and edge damages. Tringham's followers have emphasized the distinction between fracturing created by retouch and use. Analysis of the size and shape of scars stemmed from this approach. Using a low-powered magnification, the followers of this approach (Kamminga 1982; Odell 1977) were interested in identifying discrete fracture patterns that could be attributed to a specific tool function. Kamminga (1982) described six types of fractures: bending fractures, feather fractures, hinge fractures, retroflexed hinge fractures, step fractures, and clefts. He also quantified the size of fractures. Such time-consuming and painstaking effort has been further modified by Tomenchuk (1983) and Akoshima (1987). Kamminga's (1982) study demonstrated that tool selection (or edge selection) by prehistoric peoples would have been quite important in carrying out many tasks.

Keeley (1980) redirected Semenov's work into high-powered magnification studies (100x to 400x magnification). His approach centered around the various degrees of polishes caused by different materials. He recognized distinctive polishes produced by bone, wood, hide, and other materials. Keeley's approach, however, is significant also because of his emphasis on generating experimental polishes using the same quality material as archaeological artifacts (some have claimed this condition to be unnecessary: cf. Vaughan [1985]).

Irene Levy Sala (1986) reviewed the microscopic approach to polish analysis and discussed several experimental observations. The aims and scopes of microwear studies have been limited to the reconstruction of activities at a particular site. Moreover, the lack of systematic testing (Keeley 1974:323) and experimental studies has created a specific lack of confidence in identifying the use (function) of stone implements. Enough studies have been done to show that the microscopic study of tool edges is a better way to identify tool function than a simple morphological approach, but use-wear analysis still awaits its theory, and methodology can always be improved (Ahler 1971; Tringham et al. 1974:footnote 17).

Use-wear analysts are interested primarily in identifying the function of prehistoric tools, and they therefore study intentional (controlled) edge modifications. The ultimate goal of this approach is to assess what kind of wear could have been generated by what type of activity (motion) and resistance. Simply put, use-wear analysis involves a systematic study of specific consequences to determine their causes. Theoretically, it may seem that use-wear analysis involves an inductive type of research, namely a study of meticulously collected details to reach general conclusions. The premise behind such an approach is that a specific activity generates a distinctive type of use-wear, or that different wear types are controlled by specific variables, including type of motion, quality of raw material worked, duration of tool use, etc. Accordingly, if we can identify an edge, which has been intentionally modified, we might also be able to recognize a set of distinctive variables that contributed to the final "look" of the edge, and therefore reach a conclusion on the tool's function.

For several reasons, however, identifying this "specific" type of activity (motion) or material worked may not always be possible. The ambiguity may be caused by several factors. For instance, under certain conditions no recognizable traces may be conceived of short-term use. Also, a variety of materials worked may produce very similar use-wear patterns, e.g., shaving of hard wood or antler. Furthermore, the same tool could have been used to accomplish various tasks (scraping/cutting/butchering) simultaneously or at different times. A previously generated pattern of use-wear would therefore be obliterated by the subsequent use of the tool.

The approach to use-wear analysis taken in this study of the Puncheon Run Site relies on microscopic determination of patterns of use-wear and their comparative analysis with experimentally replicated wear. Edge angles were also recorded, as a control. Overall, the approach involves two steps: (1) identification of discrete patterns of edge modification, and (2) comparative analysis of the identified wear. The objective is to distinguish between intentional (controlled) and unintentional (random) traces of edge modification. Both methods involve assumptions or interpretations, so the approach can be considered "hypothetical-deductive" rather than strictly inductive. No method of studying use-wear ensures correct identification of tool functions, so all identifications have to be accepted as approximations rather then well-established facts.

II. PROJECT METHODOLOGY, METHODS, AND STAGES OF ANALYSIS

A. METHODOLOGY

The main principle of the functional analysis of the Puncheon Run collection is based on an assumption that microscopic analysis will provide recognizable patterns of use-wear, which can be further matched with the experimentally made patterns, thus determining a tool's function. This method differs from the traditional approach, which principally involves an analysis of a set of tool morphological traits. The advantage of the microscopic approach over the morphological assessment lies in the ability to identify a variety of tools (activities/motions) within an assemblage where no formal tools (types) are present, or where the formal tool typologies are misleading about the tool's actual use. The microscopic approach was combined with the study of edge angles and inspection of visible edge damage to create a systematic study of the tool edges. Although the proposed study involves a method related to microscopic determination of intentional edge damages, the chief question is: What was the tool's function?

B. METHODS

Use-wear analysis can be performed on any set of stone artifacts, and its application is not limited to specific conditions of preservation. The method can be applied as either a low- or high-level magnification technique. Certain disagreement exists among scholars as to which technique is more accurate and produces more reliable results. The precision of both techniques has been checked by many blind tests, however, and it seems that both procedures are very similar in quality of their results (Odell 1996) and therefore should not be viewed as opposing but as supplementary procedures.

One of the most common approaches to use-wear analysis is an attempt to identify various degrees of polishes, which is essential in the high-power microwear approach (Brink 1978; Keeley 1980). The equipment used in this study had two separate adjustable lamps allowing for manipulation of light angle. Both lamps were controlled by a dimmer, and the light path through the microscope was also adjustable to allow different levels of light (Plate G-1). Even with such measures, however, the nature of polish descriptions is very subjective, and the relative brightness of a polish depends on such things as the type of microscope used, filters employed, and differences in lightning conditions. The author has performed some experiments with the quantification of polish identification, using computer analysis of the image, but this investigation relied on the normal, subjective technique.

Doubts about the accuracy of all known techniques for determining tool function, including microwear analysis, have led some experts to develop a multi-variant approach. The method involves the systematic recording of the functionally diagnostic attributes of a tool, using a standardized vocabulary, so that the descriptions can be replicated by other analysts. Correlations among the variables allow some of the possible functions to be eliminated until the most probable is isolated. The function can therefore be postulated with

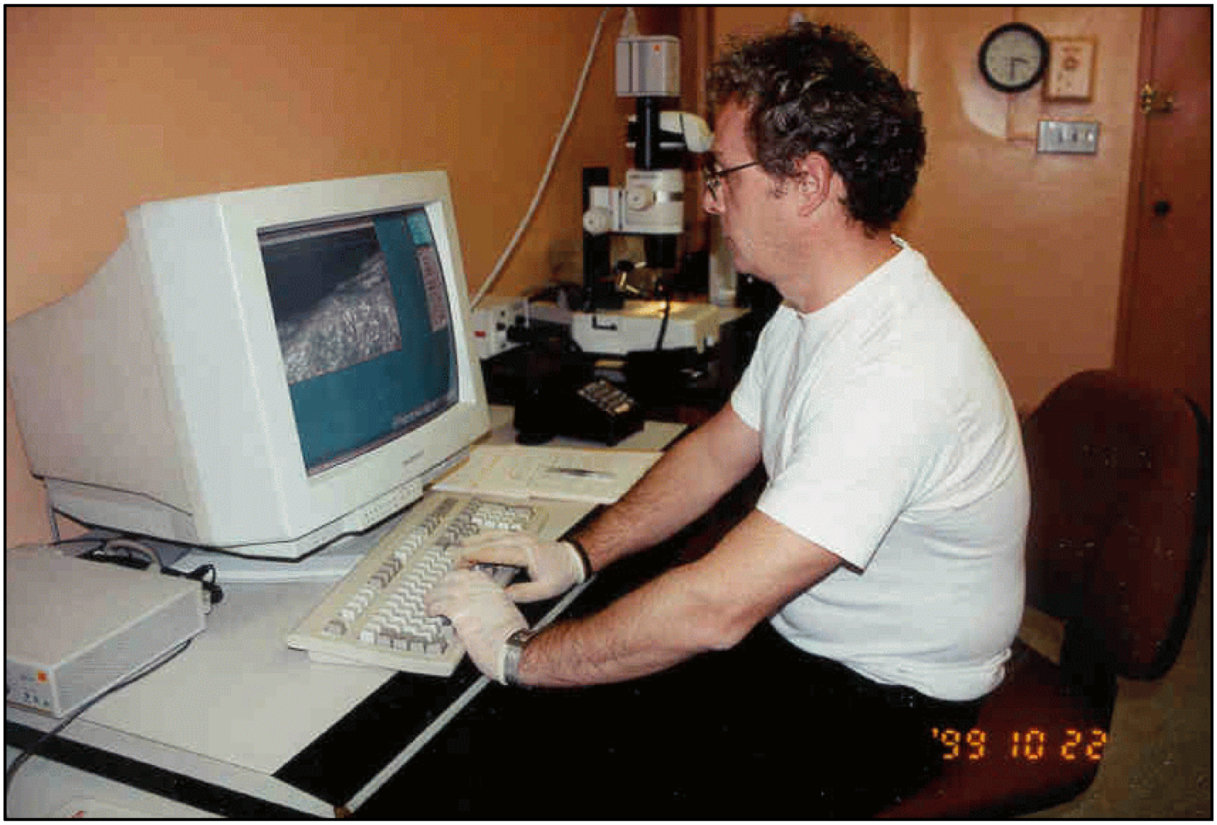

Plate G-1: Analyst with Computer and Microscope

some confidence. This new approach does not rely entirely on just one attribute, such as the quality of polish and its various descriptions (Anderson-Gerfaud 1981; Gendel and Pirnay 1982; Keeley 1980; Moss 1983b; Vaughan 1981). Analysts use characteristics other than polish in their functional reconstructions. Gendel and Pirnay (1982), in addition to numerous qualities of polish, discuss edge morphology, use damage, and the orientation of striations (although their presentation is not systematic). The point is that there is not a single diagnostic feature, but a set of features that has to be considered. If we can identify similar sets, than the probability of recognizing tool function improves.

The method used in the present study produces standardized descriptions of three variables: striations, polish, and fractures. Each variable is described by using the same terms. A function is then proposed according to agreements between sets of observations. Additionally, observations on archaeological artifacts are matched with experimentally generated use-wear, where time, the quality of raw material, and type of motion were considered the most significant controlling factors. The approach was multi-dimensional, considering sets of data rather than a single variable.

The applied method involved microscopic examination of artifacts at magnification grades ranging between 10X and 100X. An essential element of this approach to use-wear analysis is the comparative analysis, which compares a controlling sample of use-wear patterns generated on flakes produced from the same raw material as the examined sample. The quality of such an approach, however, should not be overestimated. The materials used in the experiments were not exactly the same as those used by prehistoric tool makers, and the time spent on generating specific use-wear patterns remains highly experimental. The conclusions are speculative and suggest possible types of motions and materials used.

The objective of the present study was accomplished by a three-step approach:

- location of functional unit;
- identification of motion; and
- identification of worked material.

The first step of the functional analysis was to determine the existence of edge modification. This was accomplished through the examination of each artifact under a microscope using a 6-8X magnification level. After detecting a modified area, both dorsal and ventral sides of the edge were examined to estimate the extent of the working edge (the location of wear, also called a functional unit [Odell 1996:37]). Ideally, a working edge (functional unit) should contain specific evidence of a discrete activity. It should be kept in mind, however, that a tool may exhibit evidence of more than one functional unit, and in that case functional determination becomes extremely difficult. Once an area containing edge modifications was recorded, the edge was further examined for presence of attributes that may suggest a specific type of activity/motion (scraping, shaving, drilling, cutting, butchering, etc.). The use-wear analysis was performed at different levels of magnification, ranging between 10X and 100X. Subsequently, tool function was assumed by applying a comparative method and matching the observed traits of edge modification with experimentally made patterns of use-wear. All edges that exhibited the assumed intentional use-wear were scanned at 10X to 50X and saved in digital format (see Attachment). No other variables, such as chert identification or heat alteration, were recorded.

C. STAGES OF ANALYSIS

1. Preliminary Stage

The preliminary stage consisted of three phases.

a. Phase 1 - Selecting Tools for Use-wear Analysis

One hundred specimens were selected. The specimens were chosen from the areas of most interest in the interpretation of the Puncheon Run Site, especially the Metate block, Feature 30 block, and Buried Plowzone area. The sample included both formal and informal tools. Two types of tools that seemed to be of particular interest, small-stemmed "pebble points" and formal endscrapers, were over-represented. In order to simplify the analysis, all of the selected specimens were chert, jasper, or rhyolite. Quartz and quartzite, which are very hard rocks, more often show no use-wear than cryptocrystalline materials, and when they do show wear it can be distinctly different. All artifacts were washed and their surfaces wiped with a cotton bud dipped in alcohol. Alcohol cleaning is necessary for removing deposits, such as finger grease, that are produced by handling. The use of cotton buds may sometimes produce false striations when grease is present, appearing as linear, unidirectional features; a rotational wiping avoids this confusion. All residues must be removed prior to microscopic evaluation.

b. Phase 2 - Selecting Raw Materials to Generate Experimental Use-wear (according to the selected tools)

This selection was carried out after the prehistoric tools had been selected. All raw materials were selected from a sample of local raw materials provided by the excavators and also collected separately by the author.

c. Phase 3 - Generating Experimental Edges (knapping)

The knapping and selection of edges were performed in consultation with Dr. William Parry, Department of Anthropology, Hunter College, New York.[3]

2. Data Collection

Data collection consisted of two phases, Phases 4 and 5 in the sequence of the analysis.

a. Phase 4 - Generating Experimental Use-Wear

Experimental use-wear was generated using a variety of materials, including fish, meat pieces, hide, wood, bone, and antler. All materials were treated with experimentally generated edges. Several factors were controlled and observed, and all data were recorded on specially prepared coding sheets:

- type of resistance (quality of material worked, such as soft/hard/wet/dry, meat/fish/wood/hide/ grass, etc.)
- time (the time each activity required)
- type of motion (quality of motion performed on specific material, such as butchering, scraping, fleshing, cutting, etc., was recorded; each type of motion was characterized by the time spent on performing activity and type of resistance)
- other (analysts usually forget to note other factors that could modify the experimentally generated pattern of use-wear; experience suggests that wooden boards used to put a piece of meat to be butchered, or a stone slab used for the same reason, generate specific microflaking patterns that should also be observed and described; after all, prehistoric people could have also used boards or slabs, etc.)

b. Phase 5 - Microscopic Observations of Experimental and Prehistoric Use-Wear; Laboratory Method

Microscopic studies were performed at the AMICA Laboratory of the Department of Anthropology, Hunter College.[4] All artifacts were placed on a transparent specimen slide. Transparency of the slide allows for better manipulation of contrast between the photographed specimen and the background. Plasticine was not used to mount the specimens, as some analysts suggest (Grace 1989), since the observations concerned both sides of the examined tool.

The equipment used to perform use-wear analysis included a Leica MZ APO Stereo Zoom Microscope with 5-400 magnification capability (Plate G-2). All images were processed using a Leica Quantiment 600 High Resolution Image Analysis System (Plate G-3) to enhance details, to improve visual contrast, and to perform numerous gray/color levels analyses and measurement protocols. An Image Archiving Workstation was used to save all images onto a recordable compact disk. All images were printed using a HP LaserJet 5000 PS printer, which allows 1200 dpi outputs.

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[3] I would like to thank Dr. William Parry for the advice and direction he has given me on numerous occasions in regard to lithic studies in general and use-wear analysis in particular.

[4] I would like to thank Dr. Tim Bromage and Ms. Haviva Goldman of the Department of Anthropology, Hunter College, for their help and assistance during this study.

3. Final Stage

The final stage, Phases 6 and 7, consisted of analytical elaboration of the collected data and their interpretation.

a. Phase 6 - Analysis and Cross-examination of Experimental and Prehistoric Wear Types

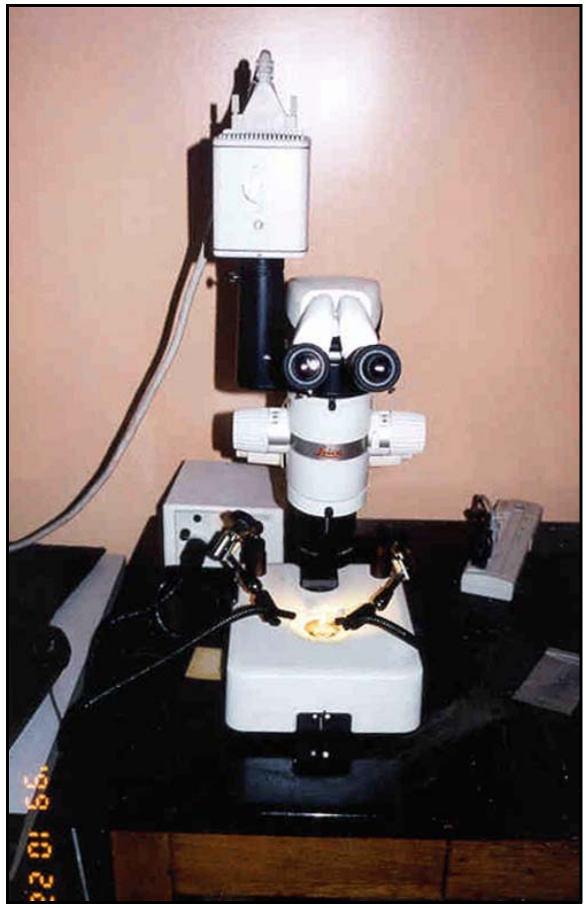

Plate G-2: Leica MZ APO Stereo Zoom Microscope Used in Study

This analysis involved cross-examination of descriptive data and images generated during Phases 4 and 5. All observations were recorded on specially prepared coding sheets. All artifacts were drawn (outlined) to indicate areas with potential use-wear and position of any observed features, and photographed areas. All additional information was recorded by filling in a coding sheet, which allowed very systematic recording of the observed features and kept observations consistent. The coding sheets contained primary data for further manipulation.

The reference number of a tool and its type has been recorded. If multiple functional units have been observed, each unit has been assigned a different alpha-numeric code. A set of several variables was observed and recorded:

Striations — scratches or grooves in the polish. Their orientation to the working edge is recorded according to their length (long, short), appearance (parallel, perpendicular, or oblique), and location (whole edge, portion).

Polish — defined as a visible alteration of the natural surface that increases its reflectivity. It is recorded according to appearance (matte/bright), location (edge, fractures), visibility (gloss, medium, weak), and limits (large areas, margins). A working edge may represent a combination of polish distribution, visibility, and appearance.

Fractures — evidence of the edge topography modifications. Four variables were recorded: characteristics of distribution (regular or random), topography of location (unifacial/bifacial), size (small, medium, large), and scar termination (step, feather, hinge, and snap). Overall, morphology of fractures may indicate how they originated; snap fractures, for instance, occur when the edge brakes off under bending stress. Step or hinge scar terminations are most likely caused by direct percussion on the edge and may indicate that the edge was created by either the use of percussion or because of unintended edge damage (trampling). Bifacial edges will exhibit such fractures. Fractures have to be interpreted before recording to classify them as results of intentional edge-wear or damage produced by natural forces. The approach taken in this study relies on observations made by Odell and Odell-Vereecken (1981) and Tringham et al. (1974), who pointed to the pattering of edge damage as most distinguishing factor between natural and human-made fractures. The assumption is that, in general, random patterns will be characteristic for unintentional damage, while regular patterns characterize intended behaviors (use). Obviously, it is not an absolute rule, as other analysts have pointed out (Grace

1989; Kamminga 1982; Odell and Odell-Vereecken 1981; Shea 1991). Also, the use of a tool on soft materials such as meat often produces no edge damage (if there are no bones and the meat is not processed on a wooden board) besides several randomly spaced fractures. Some hard materials may also produce minor edge-wear if the edge is robust or retouched. Therefore, in this study the mere presence of fractures was not considered potential evidence of use-wear. Instead, the study focused on several guiding criteria. Patterning of fractures (a consecutive pattern may indicate use-wear and a random pattern most likely does not); placement of fractures (the location of patterned fractures on just one edge will most likely be due to use); and other morphological features, such as size and termination, may add to the final conclusion, along with other corroborative features, such as the presence of polish, striations, and/or rounding.

Other variables — appearance of the working edge as symmetrical and asymmetrical, and heat alteration presence/absence, or possible. The appearance of the working edge can be essential in final determination of the tool's function, and heat treatment may eventually explain the appearance of certain use-wear, mostly polish.

Notes — the Notes field is used to record any other observations that are not included in reference to the identified variables, such as heavy or light edge rounding.

b. Phase 7 - Development of Conclusions and Critical Evaluation of the Study

The final phase was completed with the submission of the written report.

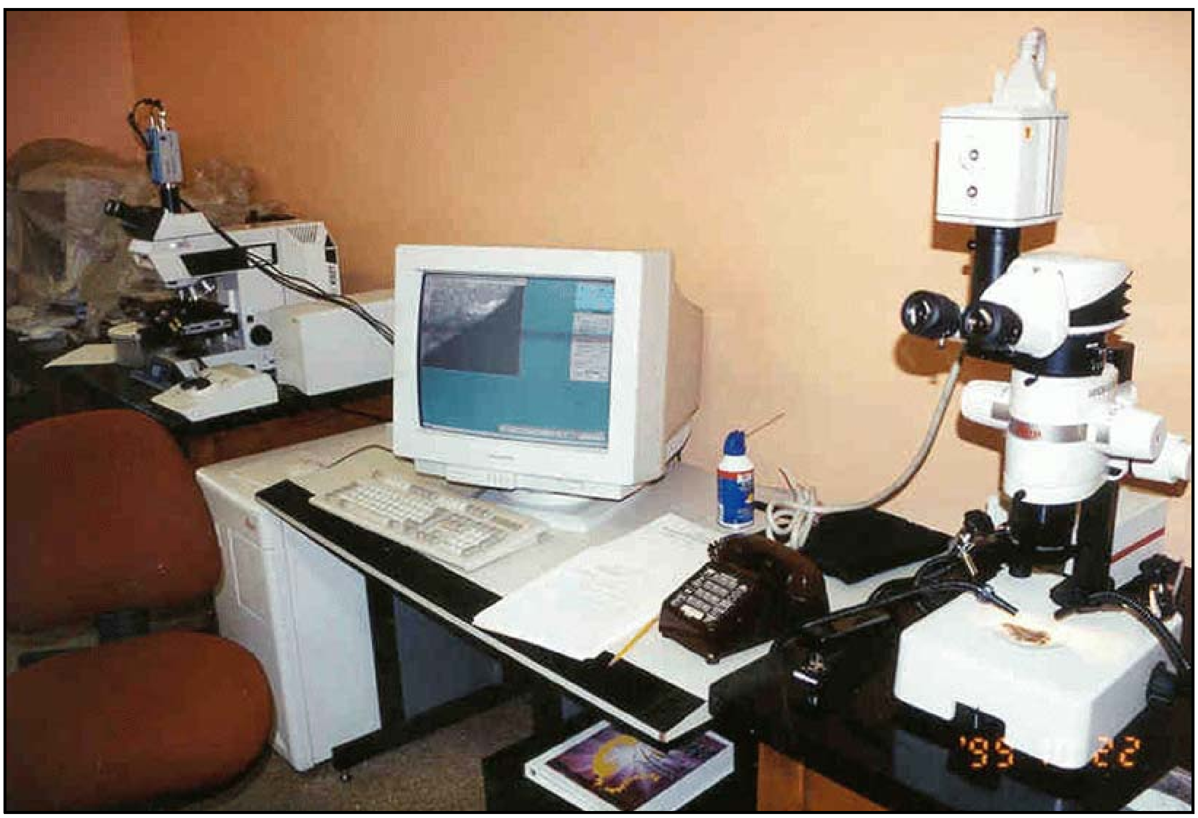

Plate G-3: Microscope and Computer

D. EXPERIMENTAL STAGE

One way to test prehistoric use-wear is through experimental use of various tools. Most use-wear specialists use their own comparative collections (Keeley 1976, 1977a, 1977b; Newcomer and Keeley 1979; Tringham et al. 1974).

Four specimens of each raw material (limited to chert and jasper) were prepared for the experiments. In order to isolate raw material as the sole variable, factors such as the cutting angle, length of stroke, angle of stroke, and worked material were controlled. The following variables were observed.

1. Fractures

The presence of fractures helps to interpret which edges of a tool may have been utilized. The number of fractures can often indicate the hardness of the worked material, depending on the susceptibility of the edge to wear. Fracture types can help to interpret the motion of the tool. For example, unifacial fractures can indicate unidirectional movement. Snap fractures can indicate a longitudinal motion, as they often occur when cutting or sawing with an unretouched edge. Step fractures are often associated with a percussive motion on the edge, as with adzing or chopping.

Edge rounding also helps in the recognition of worked edges. It can also indicate the motion of the tool; for instance, rounding on an endscraper indicates transverse scraping motion. Schutt (1982) suggested that rounding can be described as unilateral and bilateral. Rounding on one surface would indicate unidirectional motion, and when it occurs on both sides a bidirectional motion is inferred. Vaughan (1985) suggested that transverse motion will produce greater rounding on the surface in contact with the material worked (but if the contact angle is close to 90 degrees, the rounding will be equal on both sides). Longitudinal motions produce equal rounding on both faces of the edge.

Rounding also helps to eliminate possible materials worked. For instance, a longitudinal motion on a soft to medium material, such as sawing fresh wood, will most likely produce only light rounding, whereas heavy rounding will indicate a harder material, such as bone. Rounding has been seen as one of the characteristics of use on hide (Keeley 1980). The amount of rounding may be related to the presence of grit and dirt on the hide rather than the hide itself.

2. Levels of Polish

The polish distribution was recorded because of the possible correlation with topographical features, such as ridges or fractures. If the ridges and fractures are polished, the ridged topography may create the illusion of a different level of polish although the tool was used on the same material. Polish distribution can also indicate possible motions. Two types of polish distribution have been coded, marginal and larger areas. The polish covering larger areas indicates that the edge was not in direct contact with the material worked. Such distribution may further indicate that the edge has not been used to cut but rather to scrape or groove. Another distribution occurs when the edge is used to cut soft materials, and the surface is rubbed against the material. Such mixed distribution is usually associated with cutting and grooving. Edge polish may also be limited to margins along an edge. This type of distribution can be produced by a number of activities and is functionally discriminatory; however, asymmetrically distributed polish along the edge may indicate specific types of activity or different activities performed or materials worked. Also, relationships between such variables as the spatial distribution of the polish on the tool, edge-wear, and morphological attributes such as edge angle can indicate use on materials of a particular hardness. Correlation among these variables can eliminate some materials. For example, if the working edge with polish has an acute angle and shows little edge-wear, then harder material can be eliminated and soft, fresh wood might be a possibility.

Gloss, that is, polish visible to the naked eye, helps to isolate the working edge, and indicates use on either a hard material that produces a well developed polish quickly, or a softer material used for considerable length of time, such as with sickle gloss.

3. Striations

Striations are linear features, either in the form of lines of polish (Grace 1989) or grooves. The range of striations is a continuum rather than precise types associated with specific activity. The main diagnostic value of both variables is as indicators of the direction of the motion of the tool, and it is therefore important to notice their orientations.

III. DATA PRESENTATION

One hundred artifacts were selected for microscopic studies. All observations were recorded on specially designed coding sheets and are summarized below in Table G-2. Images of the edges may be found in Attachment A.

Table G-2: Summary of Microscopic Observations

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
utilized flake, chert	30-35	STP B-9D/B BPZ	short, parallel striations covering whole edge; bright, located on edge and within fractures, glossy and medium polish limited to margins; regular, bifacial, small and medium, step and feather terminated fractures	cutting, possibly grass?	50d x50	97/51/43
middle stage biface, jasper	65-70	STP C-15/A BPZ	no use-wear		no picture	97/51/48
projectile point, jasper	30	191/B/4 BPZ	matte, located on edge, weak polish, limited to margins; some fractures	used as pp	47d x40	97/58/83
			matte, located on edge, medium and weak polish limited to margins; some regular, bifacial and small in size feather terminated fractures	used as pp	47v x40	
			bright, located on edge, glossy and medium polish, limited to large areas and margins	piercing; used as pp	47t x63	
projectile point, jasper	50-55 30-35	196/A/1 BPZ	some weak, limited to margins polish; regular, unifacial and bifacial, small, medium, and big fractures, step and hinge terminated	tip broken on impact; probably used as pp after tip broke off	36d x40 36v x63	97/58/39
			some matte, weak polish limited to margins; regular, unifacial and bifacial, small and medium fractures, step terminated		36v x63	

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
			matte, located on edge, medium and weak polish limited to margins; regular, bifacial, small and medium, step and feather terminated fractures		38v x50	
utilized flake/ block shatter, jasper	65-70	256/B/4 BPZ	matte, located on edge, weak polish limited to margins; random, unifacial, small and medium, feather terminated fractures	limited scraping of soft materials	34d x16	98/2/46
			matte, located on edge and fractures, medium polish limited to margins; regular, unifacial, small and medium, feather terminated fractures		34v x50	
projectile point, frgm., rhyolite	75-80	257/C/4 BPZ	matte, located on edge, medium and weak polish limited to margins; regular, unifacial, small, feather terminated	limited use, possible scraping	64d x50	98/2/40
utilized flake, chert	45-50	266/B/2 BPZ	matte, edge polish, weak, limited to margins; random, bifacial, small fractures	inconclusive	23d x32	98/2/78
			regular, unifacial, small, medium, and big fractures, feather and hinge terminated		23v x63	
utilized flake, chert	65-70	266/B/2 BPZ	matte, located on edge, weak polish, limited to margins; random, unifacial, small fractures	possible limited scraping of soft materials	35v x16	98/2/78
utilized flake, jasper	75-80	266/B/2 BPZ	regularly distributed, unifacial fractures, small, medium, and big, feather terminated	scraping	11d x20	98/2/78
			short and long, perpendicul. striations covering whole edge; some matte polish located on edge and limited to margins		11v x32	
early stage biface, jasper	≈75	277 (wall scraping) BPZ	short and long, perpendicul. striations covering whole edge; bright, located on edge and within fractures, medium, and weak polish, limited to margins; random, unifacial, small, feather terminated fractures	scraping hard materials	37v x50 38v1 x100	98/2/443
projectile point frgm., jasper	65-75	371/B/2 BPZ	long, perpendicul. striations, covering whole edge; matte, located on edge and within fractures, medium polish; regular, unifacial, small and medium, feather terminated fractures	scraping medium/hard materials	62d x40	98/2/419
early stage biface, chert	≈45 ≈45 35-45	384/A/1 BPZ	matte, located on edge, weak polish, limited to margins	limited cutting	46d x63	98/2/424
			regular, bifacial, small and medium, step and feather terminated fractures		46v x63	

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
late stage biface, jasper	40-45	269/B/2 COB	matte, located on edge and fractures, medium and weak polish, limited to margins; random, unifacial, small and medium in size, step and feather terminated fractures	scraping/ cutting	48d x25	98/2/134
			matte, located on edge, weak polish, limited to margins; some inconclusive fractures	scrapping/ cutting	48d1 x50	
			matte, located on edge, medium and weak polish, limited to margins; regular, unifacial, small and medium, feather terminated fractures	scraping/ cutting	48v x50	
			matte, located on edge, weak polish limited to margins		48v1 x32	
biface frgm., chert	60-65	Feature 60 SILO	some weak polish		49d x40	98/2/1344
			matte, located on edge and fractures, weak polish, limited to margins; random, unifacial, small and medium, step and feather terminated fractures	inconclusive butchering? Wedge?	49v x25	
utilized flake, chert	45-50	200/A/1 Locus 2	regular, unifacial, small, medium, and big fractures, step and feather terminated	scraping hard materials	19d x50	97/59/4
			short and long striations, perpendicular, covering portion of the edge; bright, located on edge and fractures polish; regular, unifacial, small and medium fractures		19v	
utilized flake, jasper	55-60 35-45 50-60	203/A/1 Locus 2	edge 1 - matte, locate on edge and limited to margins polish; regular, unifacial, small and medium, feather terminated fractures	edge 1 - scraping	31d1 x25 31d2 x25 31d3 x40	97/59/9
			edge 2 - matte, located on edge and fractures weak polish limited to margins; random, unifacial, small and medium, step and feather terminated fractures	edge 2 - inconclusive		
			edge 3 - weak polish	edge 3 - inconclusive		

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
			edge 1 - short, perpendicul. striations; bright, located on edge, weak polish, limited to margins; unifacial, small, feather terminated fractures edge 2 -matte, located on edge and limited to margins polish; small feather terminated fractures edge 3 - matte, located on edge and limited to margins polish; random, small fractures		31v1 x40 31v2 x25 31v3 x50	
utilized flake, chert	45	214/A/1 Locus 2	bright, edge and fracture polish, medium and weak, covering large areas; regular bifacial, small, feather terminated fractures	possible cutting? (limited use)	18d x100	97/59/12
			regular, unifacial and bifacial, small feather terminated fractures		18v x50	
utilized flake, chert	45	214/A/1 Locus 2	matte, located on edge, weak polish, limited to margins; regular, bifacial, small and medium fractures, step and feather terminated	cutting/ butchering	27d x25	97/59/12
			some weak polish limited to margins; regular, bifacial, small and medium fractures, feather terminated		27v x25 27v1 x25	
utilized flake, jasper	1. 45-50 2. 75	217/A/1 Locus 2	edge 1- random, bifacial, small and medium in size, feather terminated fractures edge 2- short, perpendicul. striations covering whole edge; bright polish on edge	edge 1 - cutting/ fleshing edge 2 - scraping medium/hard materials	17d x40 17d1 x63	97/59/12
			edge 1- bright polish on edge and limited to margins; regular, bifacial, small and medium in size, feather terminated fractures; edge 2 - regular, unifacial, small and medium, feather terminated fractures		17v x40	
utilized flake, jasper	65-75	217/B/2 Locus 2	short, perpendicul. striations, covering whole edge; bright, located on edge, glossy and medium polish covering larger areas; regular, unifacial, small fractures	scraping hard materials (hard wood/bone)	16d x80 16d1 x100	97/59/21
			regular, unifacial, medium in size, and feather terminated fractures		16v x40	

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
utilized flake, jasper	45	Feature 30 211/A/1 F30 Block	bright, located on edge and fractures, medium polish, limited to margin; regular, bifacial, small, medium feather terminated fractures	cutting	33d x50	97/55/505
			bright polish		33d1 x100	
			bright, located on edge and fractures, medium polish, limited to margin; regular, bifacial, small, medium, feather terminated fractures	cutting	33v x50	
utilized flake, jasper	55-60	Feature 30 211/A/1 F30 Block	bright, located on edge and fractures, glossy and medium polish limited to margins; regular, bifacial, medium and big, step and feather terminated fractures		39d x50	97/55/505
			as above		39d1 x50	
			bright, located on edge and fractures, medium polish, limited to margin	cutting	39v x50	
projectile point/ knife, rhyolite	35-45	Feature 30 315/C/3 F30 Block	matte, located on edge, weak polish limited to margins; random, bifacial small, feather terminated fractures	haft area shows different polish	42d x80	98/2/498
			matte, located on edge, medium and weak polish, limited to margins; regular, bifacial, small, feather terminated fractures		42d1 x50	
			matte, located on edge, medium, weak polish, limited on margins; regular bifacial, small, feather terminated scars	cutting	42v x50	
			matte, located on edge, medium and weak polish, limited to margins; regular, bifacial, small, feather terminated fractures		42v1 x50	
utilized flake, chert	55-60	Feature 30 318/A/1 F30 Block	some short, perpendicul. striations located on portion of the edge; matte, located on edge, weak polish, limited to margins; random, unifacial, small fractures	wood shaving?	25d x100	98/2/154
			matte, weak polish located on edge and limited to margins		25v x50	
late stage biface, rhyolite	35-40	Feature 30 318/A/3 F30 Block	some weak polish and small fractures	inconclusive	43d x100	98/2/757
			some polish and small fractures	inconclusive	43v x100	
			matte polish	basal grinding	43b x50	
utilized flake, chert	40-45	Feature 30 319/A/1 F30 Block	matte, located on edge, weak polish, limited to margins; random, unifacial, small fractures with feather terminations		28d x50	98/2/157
			bright located on edge and fractures medium and weak polish, limited to margins	scraping medium/hard material	28v x50	

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
endscraper, hafted, chert	60-65	Feature 30 320/A/3 F30 Block	bright located on edge, glossy polish, covering large areas	scraping hide	15d x100	98/2/193
			regular, unifacial, small and medium size fractures	scraping	15v x25	
biface frgm., chert	45	Feature 30 368/B/2 F30 Block	bright/located on edge and fractures, medium and weak polish, limited to margins; regular, bifacial, small and medium, feather terminated fractures	cutting; short usage	40d x100	98/2/456
			bright, located on edge, weak polish limited to margin; some fractures	cutting; short usage	40v x100	
utilized flake, chert	55-60	Feature 37 380/A/4 F30 Block	matte, located on edge, weak polish, limited to margins; some short striations, perpendicul. covering portion of the tool	scraping	41d x100	98/2/475
			matte located on edge, weak polish, limited to margins; random, unifacial, small, feather terminated fractures	scraping	41v x32	
utilized flake, jasper	40-45	Feature 37 380/A/7 F30 Block	matte, edge, weak polish limited to margins	inconclusive	20d	98/2/486
utilized flake, jasper	45-55	Feature 37 380/B/5 F30 Block	some bright located on ridges weak polish; limited to margins; regular, unifacial, medium in size, step and feather terminated fractures	wood shaving, carving?	22d x16	98/2/475
			bright, located on edge and ridges weak polish limited to margins; regular, unifacial, small and medium, feather terminated fractures	as above	22v x32	
endscraper, hafted, chert	60-65	Feature 37 440/A/8 F30 Block	bright, glossy and medium polish located on edge and fractures, limited to margins	scraping hide	26d x50	98/2/1043
			bright, located on edge glossy polish limited to margins	haft area	26db x50	
			bright, located on edge, glossy and medium polish, limited to margins	haft area	26db1 x50	
			matte, located on edge, weak polish, limited to margins	ventral side; scraping	26va x50	
			bright, located on edge glossy and medium polish, limited to margins	haft area	26vb x50	
			bright located on edge, glossy and medium polish limited to margins	haft area	26vb1 x50	
utilized flake, chert	60-65	Feature 37 468/A/1 F30 Block	bright, located on edge, weak polish, limited to margins; some random, unifacial, small fractures	probably short usage scraping	21d x100	98/2/1271
			bright located on fracture ridges polish		21v x25	
			regular, unifacial, small and medium feather terminated fractures	carving? Fresh wood		

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
endscraper, frgm., chert	60-65	Feature 37 471/A/1 F30 Block	bright, located on edge, glossy and medium polish, limited to margins; random, unifacial, small feather terminated scars	scraping	30 x25 edge	98/2/1281
			as above	scraping	30a x16	
			bright, located on edge, medium polish limited to margins	scraping	30d x63	
			bright, located on edge, glossy polish, limited to margin	scraping	30v x63	
			as above	scraping	30v1 x40	
utilized flake, jasper	45	Feature 37 472/A/1 F30 Block	bright, located on fractures, glossy and medium polish, limited to margins; regular, bifacial, small, feather terminated fractures	cutting/ butchering	32d x40	98/2/1347
			as above	cutting/ butchering	32d1 x80	
			bright, located on edge and fractures, medium polish, limited to margins; regular, bifacial, small and medium, feather terminated fractures	cutting/ butchering/ fleshing	32v x100	
			as above	cutting/ butchering	32v1 x100	
projectile point, jasper	30	Feature 37 472/B/2 F30 Block	bright, located on edge, glossy and medium polish, limited to margins; regular, bifacial, small and medium size fractures, feather terminated	piercing; used as pp	44d x100	98/2/1352
			as above	as above	44v x100	
			bright, located on edge, medium polish, limited to margins; some fractures	used to perforate	44t x100	
hafted endscraper, chert	70	Feature 37 473/A/3 F30 Block	bright, located on edge, glossy and medium polish, limited to margins	scraping soft materials	45d x100	98/2/1379
			some weak polish; regular, unifacial, small size fractures, feather terminated	haft area	45d2 x40	
			bright, located on edge and fractures, medium polish, limited to margins; regular, unifacial, small, medium size fractures, feather terminated	haft area	45d3 x50	
			some weak polish; regular, unifacial, small and medium in size, step and feather terminated fractures	scraping soft or medium hard material	45v x32	
			some weak located on edge polish; regular, unifacial, small and medium in size, step and feather terminated fractures	haft area	45v2 x32	

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
			matte, located on edge, weak polish limited to margins; randomly distributed, unifacial, small size fractures	transitional area between the haft and functional unit	45v3 x40	
endscraper, hafted, chert	60-65	Feature 37 473/ A/2 F30 Block	bright, glossy polish covering large areas	scraping hide?	12d x40	98/2/1377
			bright, glossy polish covering large areas	scraping hide	12d1 x100	
			weak limited to margins polish; regular, unifacial, small fractures with feather terminations		12v x12.5	
utilized flake, chert	60-65	Feature 38 453/A/1 F30 Block	short striations in oblique angle; some bright, weak polish limited to margins; regular, unifacial, small and medium, feather terminated fractures	scraping medium hard material	24d x62	98/2/1156
			bright located on ridges, weak polish, limited to margins	as above	24v x100	
projectile point, chert (nonlocal?)	25-30	331/B/3 MET	matte, located on edge, medium polish, covering large areas and margins; random distributed, bifacial, small and medium in size, step and feather terminated fractures	piercing, used as pp	66t x40	98/2/213
projectile point, jasper	15-20	353/B/3 MET	matte and bright, located on edge and fractures, medium and weak polish, limited to large areas; regular, bifacial, small and medium, step and feather terminated fractures	piercing; used as pp	67t x50	98/2/315
projectile point (broken tip), jasper	65-70 broken tip	356/B/3 Feature 36 MET	matte, located on edge and fractures, medium and weak polish, limited to large areas and margins; regular, unifacial, small feather terminated scars	reused as scraper	83d x50	98/2/849
projectile point (broken tip), jasper	60-65	356/B/3 Feature 36, MET	matte, located on edge, weak polish, limited to margins; random, unifacial, medium, hinge terminated scars	limited use probably as scraper	84d x100	98/2/849
early stage biface, jasper	55-60 65-70	362/B/2 Feature 36 MET	bright, located on edge and fractures, medium and weak polish, limited to margins; regular, unifacial, small and medium, step and feather terminated fractures	scraping (wood shaving?), limited use	68d x100	98/2/346
			short, perpendic., striations located on whole edge; matte, located on edge and fractures, medium and weak polish, limited to margins; regular, unifacial, small and medium, step and feather terminated fractures	scraping (wood?)	68v x25 68v1 x63	
			as above, well visible striations and polish	scraping (wood?)	68v1 x63	

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
projectile point, jasper	20	362/B/3 Feature 36 MET	matte, located on edge and fractures, medium and weak polish, limited to large areas and margins; regular, unifacial, small and medium in size, feather terminated fractures	piercing; used as pp; limited scraping possible	91t x100	98/2/953
utilized flake, chert	50-55	370/B/4 F. 36 MET	bright polish on located on edge, glossy and medium, limited to margins	carving; wood working?	6d x50	98/2/946
			bright edge weak polish, limited to margins		6v x32	
projectile point, chert	20	374/B/3 MET	matte, located on edge and fractures, weak polish, limited to margins and big areas; regular, bifacial, small and medium, step and feather terminated fractures	piercing; used as projectile point	73t x25	98/2/510
			matte and bright, located on edge, medium and weak polish limited to large areas and margins	wear due to hafting	73b x50	
projectile point, jasper	20	382/B/2 MET	matte, located on edge, medium and weak polish, limited to margins; regular, bifacial, small, medium, and big, step and feather terminated fractures	piercing; used as pp	71t x40	98/2/470
			matte, located on edge, medium and weak polish, limited to margins	base; haft-wear	71b x50	
early stage biface, chert	65-70	382/B/3 MET	regular, unifacial, small in size, feather terminated fractures	inconclusive	65d x25	98/2/476
projectile point, chert	20	387/B/3 MET	matte, located on edge and fractures, medium and weak polish limited to large areas and margins; random, bifacial, small and medium, step and feather terminated scars	piercing; used as pp	85d x40	98/2/911
utilized flake, jasper	45	388/B/2 MET	possible short perpendicul. striations; matte and bright polish located on edges and fractures, medium and limited to margins; some regular fractures, unifacial, small with feather termination	cutting/ scraping soft, medium hard material	8d x80	98/2/489
			some matte polish located on edge, weak, and limited to margins		8v x100	
late stage biface, jasper	60-65	391/A/1 MET	matte, located on edge and fractures, medium polish, limited to margins	scraping soft material (hide)	72d x63 72d1 x100	98/2/506
			matte, located on edge and fractures, medium and weak polish, limited to margins	scraping soft material (hide)	72v x40	
projectile point, jasper	15-20	391/A/1 MET	matte, located on edge, medium and weak polish limited to margins; some random, unifacial, small, feather terminated fractures	base, haft- wear, wooden shaft	70b x40	98/2/506

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
			matte, located on edge and fractures, medium and weak polish, limited to margins; random, bifacial fractures, small and medium, step and feather terminated	piercing; used as pp	70t x25	
utilized flake, jasper	35-40	396/B/2 F. 96 MET	bright, glossy polish limited to margins; some parallel striations located on portion of the edge	cutting grass	9d x100	98/2/525
			as above		9v x100	
late stage biface, jasper	55-60	402/A/1 MET	matte, located on edge, medium and weak polish, limited to margins	scraping	75d x100	98/2/548
			bright, located on edge, weak polish, limited to margins; some random fractures	haft wear	75d2 x32 75d3 x32	
			bright, located on edge, glossy and medium polish, limited to margins	scraping different materials	75d1 x40 75d4 x40	
			matte and bright, located on edge and fractures, medium and weak polish, limited to margins; regular, unifacial, small, feather terminated fractures	scraping	75v x40 75v1 x32	
projectile point, broken, chert	20 intact	403/B/2 MET	matte, located on edge, medium and weak polish limited to margins	base; haft-wear	74b x32	98/2/543
	75 broken		some weak polish; regular, bifacial, medium and big step terminated fractures	has not been used as pp after the tip broke off	74t x20	
utilized flake, chert	60-65	404/B/2 MET	short, perpendicul., striations; bright, located on edge and fractures, medium polish limited to margins; random, unifacial, small scars; polish fractures	scraping?	2d x80	98/2/545
			some marginal polish	scraping	3v x16	
late stage biface, jasper	45	405/B/2 MET	matte, located on edge, medium and weak polish, limited to large areas; random, bifacial, small and medium, step and feather terminated scars	limited scraping?	76d x25	98/2/602
			matte, located on edge, medium and weak polish, limited to margins; random, bifacial, small, feather terminated scars	limited scraping	76d1 x100	
projectile point (broken), jasper	75-80	405/B/2 MET	matte, located on edge, weak polish, limited to margins; regular, unifacial, small, feather terminated scars	possible limited scraping	77d x40	98/2/602
			as above (different light)	as above	77d1 x40	
			matte, located on edge and fractures weak polish, limited to margins; regular, bifacial, small, and medium, step and feather terminated scars	this wear is related to use as pp	77d2 x50	

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
endscraper, chert	60-65	405/B/3 MET	bright, located on edge and fractures, glossy and medium polish, limited to margins; random, unifacial, small, step terminated scars, fractures	scraping	3d x32 3d1 x16 3d2 x16 3d3 x50	98/2/635
projectile point, chert	30	407/B/2 MET	n.a.	piercing; used as pp	no pictures	98/2/604
projectile point, jasper	15-20	407/B/3 MET	matte, located on edge, weak polish limited to margins; random, bifacial, small and feather terminated fractures	piercing; used as pp	69t x25	98/2/432
utilized flake, chert	75-80	409/B/3 MET	bright marginal polish	scraping?	4d x25	98/2/685
projectile point, chert	25	419/A/1 MET	matte, located on edge and fractures, medium polish, limited to margins; random, bifacial, small, feather terminated scars	piercing; used as pp	79d x63	98/2/666
projectile point, jasper	20	421/B/4 MET	matte, located on edge, weak polish limited to margins; regular, bifacial, small and feather terminated scars	piercing; used as pp	80t x40	98/2/781
projectile point, jasper	15-20	423/A/1 MET	matte, located on edge and fractures, medium and weak polish, limited to large area; polish along the edges	piercing; used as pp	81t x40	98/2/787
utilized flake, jasper	30-35	423/B/3 MET	bright, located on edge, medium, limited to margins polish; regular, unifacial and bifacial fractures, small and medium with feather terminations	cutting?	14d x32	98/2/796
			some bright polish located on fractures and limited to margins; regular, unifacial fractures, small and medium, with step and feather terminations	could be trampling or scraping/ cutting hard material (dry wood?)	14d1 x50	
			bright, located on edge polish, medium limited to margins		14v x100	
			bright, located on edge medium polish; random, unifacial and small fractures with feather terminations	scraping?	14v1 x100	
utilized flake, chert	60-65	425/B/3 MET	polish regular, unifacial fractures; small with feather terminations matte edge polish	scraping?	5d x40 5d1 x100 5d2 x12.5 5d3 x50	98/2/811
			matte edge polish on the margins; random, unifacial, small and medium fractures		5v x50	
projectile point, jasper	20-25	426/A/1 MET	matte, located on edge and fractures, medium and weak polish, limited to large areas and margins	piercing; used as pp	82t x40	98/2/818
projectile point (broken), jasper	70-75	429/A/1 MET	matte, located on edge and fractures, medium and weak polish limited to large areas and margins	scraping	86d x32	98/2/912

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
			as above	as above	86d1 x63	
			bright, located on edge and fractures, glossy and medium polish, limited to margins; regular, unifacial, small, feather terminated scars	different use than shown on images 86d and 86d1	86d2 x63	
			as above	as above	86d3 x100	
			matte, located on edge, medium and weak polish, limited to larger areas	haft wear	86b x50	
projectile point (broken), jasper	60	430/A/2 MET	bright, located on edge and fractures, glossy and medium polish, limited to margins; random, unifacial, small and medium, feather terminated scars	scraping	87v x63	98/2/913
			matte, located on edge and fractures, medium and weak polish, limited to margins	scraping; limited use	87v1 x63	
projectile point, chert	15	430/B/2 MET	fine edge retouch; weak polish	piercing; used as pp	no picture	98/2/924
bipolar core, chert		430/B/3 MET	no use-wear		no picture	98/2/925
bipolar core, jasper		431/B/3 MET	no use-wear		no picture	98/2/921
early stage biface, chert		437/B/2 MET	no use-wear		no picture	98/2/942
biface frgm., jasper	35-40	439/B/3 MET	matte, located on edge and fractures, medium and weak polish, limited to margins; regular, bifacial, small, medium in size step and feather terminated scars	short use cutting?	92d 100x	98/2/990
			matte, located on edge and fractures, medium and weak polish limited to margins; regular, bifacial, small and medium, step and feather terminated scars	limited cutting?	92v 63x	
early stage biface, jasper	50-55	441/B/3 MET	long, perpendic. striations, located on edge portion; matte and some bright polish, located on edge and fractures, medium and weak, limited to large areas; regular, unifacial, small and medium, step and feather terminated scars	hard wood/bone scraping	93d 16x	98/2/994
			bright marginal polish; as above	as above	93d1 16x	
			well visible marginal polish and perpendicul., striations	as above	93d2 40x	
projectile point, broken, jasper	20	441/B/5 MET	matte, located on edge and fractures, medium and weak polish, limited to margins; regular, bifacial, small and medium, step, feather, and snap fractures	piercing; used as pp; tip snapped off; point continued to be used as pp	94t 63x	98/2/1000

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
			matte, located on edge and fractures, medium and weak polish, limited to margins; regular, unifacial and bifacial, small, medium, and big, step, feather, and hinge terminated scars	haft wear	94b 40x	
projectile point (broken), jasper	60-65	442/B/4 MET	long, perpendicul., limited to edge portion striations; matte, located on edge, weak polish, limited to margins; regular, unifacial, small and medium in size, feather terminated scars	limited scraping	95d 100x	98/2/1004
			different light; better visible polish and striations	as above	95d1 63x	
			as above; different mag.	As above	95d2 40x	
projectile point (broken), chert	≈45; broken ≈90	449/B/2 MET	no use-wear other than marginal polish	piercing; has not been used since tip broke off	no image	98/2/1027
biface frgm., chert	75	451/A/1 MET	random, unifacial, small and medium, step and feather terminated scars	possible use; scraping?	97d 40x	98/2/450
projectile point (broken), chert	70-75	451/A/1 MET	matte, located on edge and fractures, medium and weak polish, limited to margins; regular, unifacial, small and medium, feather terminated scars	scraping	98d 40x	98/2/1150
			regular, unifacial, small and medium, feather terminated scars	scraping	98d1 50x	
projectile point (broken), chert	70-75	455/A/1 MET	short, perpendicul. striations, located on edge portion; matte, located on edge and fractures, medium and weak polish limited to margins; regular, unifacial, small and medium, feather terminated scars	scraping	99d 63x	98/2/1160
			well visible marginal polish		99d1 100x	
projectile point, chert	15-20	459/A/1 MET	matte, located on edge, medium and weak polish, limited to margins; regular, bifacial, small, medium, and big, step, feather and hinge terminated scars	piercing; used as pp	100t 25x	98/2/1186
early stage biface, chert	55-60	465/B/2 MET	matte, located on edge, medium and weak polish, limited to margins	scraping	1d, 50x	98/2/1263
			bright, located on edge, medium polish, limited to margins; random, unifacial, small fractures; some striations	scraping	1v, 50x	
flake, chert		465/B/2 MET	no use-wear		7d,7v	98/2/1263
projectile point, chert	15-20	Block 2 Locus 3	broken tip, some weak edge polish	piercing; limited use as pp	no picture	97/55/22

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
projectile point, chert	20	Block 2 Locus 3	matte, located on edge and fractures, medium polish limited to margins; regular, bifacial, small, feather terminated fractures	piercing; used as pp	57t x50	97/55/167
projectile point (broken tip), chert	75	Block 2 Locus 3	short, perpendicul. striations; some matte, located on edge, medium and weak polish, limited to margins; some random distributed, bifacial, medium in size and feather terminated fractures	used as pp; possible some tip scraping	58t x63	97/55/167
projectile point, chert	20-25	Block 6 Locus 3	matte, located on edge, medium and weak polish	piercing; used as pp	55t x63	97/55/62
projectile point (broken tip),	30	Feature 3B Block 6, Locus 3	matte, located on edge and fractures, medium polish, limited to margins; regular, bifacial, small, feather terminated fractures	fractures obliterated by polish	59d x63	97/55/397
jasper			matte, located on edge, medium and weak polish, limited to margins; regular, bifacial, small in size, feather terminated fractures		59v x63	
late stage biface, jasper	45	57/Ap1/1 Locus 3	matte, located on edge and fractures, medium and weak polish, limited to margins	limited cutting	53d and 53d1 x32	97/55/1
			random, bifacial, small and medium, step and feather terminated fractures	cutting?	53v x32	
endscraper, hafted, jasper	65-70	67/B/2 Locus 3	some oblique striations; matte located on edge, medium polish covering large areas	scraping hide	13d x40	97/55/95
			bright, located on edge and fractures medium polish limited to margins; regular, unifacial, small fractures; this wear appears on both sides and is probably related to a hafting device	haft	13d1 x20	
			bright, located on edge and fractures medium polish, limited to margins	scraping dry hide	13v x40	
flake core, chert	45-50	85/B/3 Locus 3	short, perpendicul. striations located partially; bright, located on edge medium and weak polish, limited to large areas; regular, bifacial, small, feather terminated fractures	scraping/ butchering/ cutting	56d x40	97/55/142
			short, perpendicul. striations located on portions; matte, located on edge and fractures medium and weak polish, limited to margins; regular, bifacial, small, feather terminated fractures	cutting over scraping?	56d1 x100	
			as above	as above	56d2 x100	
			matte, located on edge, medium and weak polish, limited to margins; regular, bifacial, small, feather terminated fractures	cutting/ butchering	56v x63	

Table G-2 (continued)

Tool Type	Edge Angle*	Unit/Str/ Level	Type of Wear	Suggested Activity	Image No. Magn. X	Cat. No.
			matte, located on edge and fractures, medium and weak, limited to large areas and margins; regular, bifacial, small, feather terminated scars	cutting/ butchering	56v1 x50	
utilized flake, jasper	65	165/B/3 Locus 3	bright, located on edge and fractures, medium and weak polish, limited to margins; regular, bifacial, small and medium, feather terminated fractures		60d x63	97/55/469
			matte, located on edge and fractures, medium and weak polish limited to margins; regular, bifacial, medium and big, step and feather terminated fractures	butchering/ scraping?	60 x10	
			bright, located on edge, medium and weak polish, limited to margins; regular, unifacial, small and medium in size, feather fractures		60v x63	
			bright, located on edge and fractures, medium polish, limited to large areas; regular, unifacial, medium, and feather terminated fractures	limited scraping?	60d1 x63	
endscraper, chert	75	205/A/1 Locus 3	bright, located on edge and fractures, medium and weak polish limited to margins; regular, bifacial, small and medium, feather terminated fractures	scraping	29d x100	97/55/483
			bright located on edge and fractures, glossy and medium polish limited to margins; regular, bifacial, small and medium, step and feather terminated fractures	scraping	29v x100	
projectile point, jasper	20-25	327/B/2 Locus 3	matte, located on edge and fractures, medium polish, limited to large areas and margins; regular, bifacial, small and medium, feather terminated fractures	piercing; used as pp	61t x32	98/2/178
utilized flake, chert	40-45	327/B/2 Locus 3	bright polish located on edge and in fractures, medium and weak, locally limited to margins and covering larger areas; random, unifacial, small fractures with feather terminations	scraping?	10d x100 10d1 x100 10d2 x40	98/2/178
			weak polish limited to margins; random, unifacial, small fractures		10v x100	
projectile point	60-65	349/B/3 Locus 3	some polish and some fractures	inconclusive	63d x50	98/2/298
(broken), chert			bright, located on edge, medium and weak polish, limited to margins	inconclusive; limited use	63v x63	

* degrees

IV. CHARACTERISTICS OF THE ASSEMBLAGE

All of the 100 specimens selected were chert, jasper, or rhyolite. There was no attempt to choose one of these materials over another, and the numbers roughly reflect the presence of the materials in the total tool assemblage from Puncheon Run. Traces of various use-wear were recorded on 94 specimens. Six specimens did not show any patterns of edge damage; these consisted of four chert and two jasper tools, so that the sample of tools with edge-wear consisted of 46 chert, 45 jasper, and three rhyolite.

The tools exhibiting use-wear consisted of 63 formal tools (Table G-3), such as projectile points and endscrapers, and 31 informal tools, such as utilized flakes. The sample for analysis was chosen to represent the range of tool types at the site, so the ratio of formal to informal tools is not, in itself, significant.

Table G-3: Tools Selected for Analysis

		Area							
Material	**Tool Form**	**BPZ**	**Silo**	**COB**	**Locus 2**	**MET**	**F30**	**Other Locus 3**	**Total**
chert	proj. point	.	.	.	.	11	.	5	16
	endscraper	.	.	.	.	1	5	1	7
	biface	1	1	.	.	4	1	.	7
	core	.	.	.	.	1	.	1	2
	utilized flake	4	.	.	3	5	5	1	18
jasper	proj. point	3	.	.	.	15	1	2	21
	endscraper	.	.	.	.	.	.	1	1
	biface	2	.	1	.	7	.	1	11
	core	.	.	.	.	1	.	.	1
	utilized flake	2	.	.	3	3	5	1	14
rhyolite	proj. point	1	.	.	.	.	1	.	2
	biface	.	.	.	.	.	1	.	1
Total		13	1	1	6	47	19	13	100

V. ANALYTICAL QUESTIONS

A. HOW DOES EDGE ANGLE CORRELATE WITH RAW MATERIAL TYPE?

Although only 94 tools were examined, 105 different edge angles were recorded, because some tools had more than one edge. There was no correlation between raw material and edge angle, or between raw material and use-wear. It seems that chert and jasper were treated in essentially the same way and used for the same purposes. Table G-4 lists all of the identified edge angles.

Table G-4: Functional Units by Edge Angle and Raw Material

Edge Angle*	Chert	Jasper	Rhyolite	Total
15	1			1
15-20	2	4		6
20	4	4		8
20-25	1	2		3
25	1			1
25-30	1			1
30	1	3		4
30-35	1	2		3
35-40		2	1	3
35-45	1	1	1	3
40-45	2	2		4
45-50	3	1		4
45	6	5		11
45-55		1		1
50-55	1	2		3
50-60		1		1
55-60	4	4		8
60		1		1
60-65	11	3		14
65		1		1
65-70	2	5		7
70	1			1
65-75		2		2
70-75	2	1		3
75	4	2		6
75-80	1	2	1	4
80	1			1
Total	51	51	3	105
	(46 tools)	(45 tools)		

* degrees

B. HOW DOES EDGE ANGLE CORRELATE WITH USE?

Figure G-1 and Table G-5 show the grouping of edge angles in the chert and jasper tools. The angles clearly cluster into three groups, 15-35, 40-50, and 55-85 degrees. Comparison with Table G-6 shows that the first cluster of edge angles, ranging from 15 to 35 degrees, may represent cutting edges, the second group (40-50 degrees) heavy cutting/scraping, and the third (55-85 degrees) scraping and heavy scraping. Scraping appears to have been the most common activity at Puncheon Run. Table G-5 shows that the edge angle range 40-50 degrees is the least represented (N=24), the second is the range 15-35 degrees (N=29), and the most common is the range 55-85 degrees (N=54).

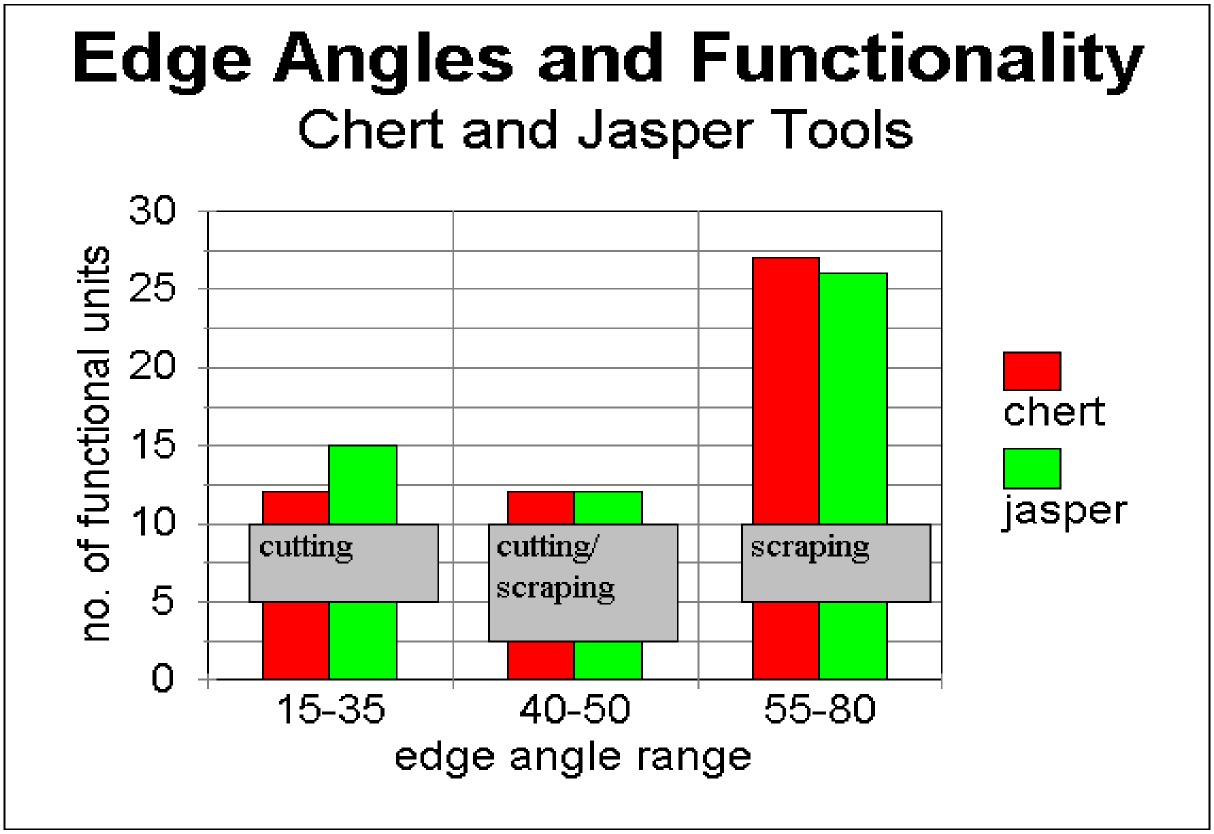

Figure G-1: Edge Angles and Function, Chert and Jasper Tools

VI. DISCUSSION

The study showed that there was some relationship between tool function and morphology, that is, all of the formal scrapers had been used to scrape, and most of the projectile points exhibited wear compatible with such use. However, the correspondence was not exact. Particularly interesting was the discovery that several projectile points with broken tips had been used as scrapers. This behavioral phenomenon was recorded on both chert and jasper points. Fourteen specimens (seven chert and seven jasper) were examined, all found in Locus 3, mostly around the Metate block. The chert points-turned-scrapers clustered in Block 2, Locus 3-Metate, and three of them in Locus 3, Metate, Feature 37. Three of the jasper points-turned-scrapers clustered in Locus 3, Metate, Feature 36, and four in Locus 3, Metate.

A number of bifaces identified morphologically as "unfinished," that is, early-stage, middle-stage, or late-stage, showed evidence of use as tools, some as knives and some as scrapers.

Several interesting clusters of tools were also identified. A concentration of three utilized flakes, two chert and one jasper, was located at Unit 266 (Locus 1); all had probably been used to scrape. Another concentration of four expedient tools was found in Locus 2 (Unit 214, two chert tools; Unit 217, two jasper tools). The chert tools had been used to cut, and of the jasper tools, one had been used to cut/scrape and the other to scrape. A concentration of three expedient tools (one chert and two jasper utilized flakes) was recorded in Locus 3 (Unit 380, Feature 37), consisting of two jasper cutting tools and one chert scraping tool.

Table G-5: Frequency of Edge Angles by Raw Material

Edge Angle Range*	Chert	Jasper	Rhyolite	Total
15-35	12	15	2	29
40-50	12	12		24
55-85	27	26	1	54
Total	51	53	3	107

* degrees

Table G-6: Edge Angle and Suggested Use

	Edge Angle*			
Activity	**15-35**	**40-50**	**55-85**	**Total**
cutting				
generalized	2	8	3	13
cutting/butchering	.	3	1	4
cutting grass	1	1	.	2
woodworking	.	.	5	5
cutting/scraping				
generalized	.	1	.	1
scraping/butchering	.	1	1	2
hard material	.	1	.	1
scraping				
generalized	.	2	25	27
hide	.	.	3	3
soft material	.	.	3	3
hard material	.	2	6	8
piercing; used as pp	24	2	3	29
inconclusive	1	4	4	9
Total	28	25	52	107

* degrees

The study also demonstrated some difference in tool function between the studied areas of the site. Table G-7 lists the possible tool functions from Locus 1. Of the 14 specimens from Locus 1 that were examined, 13 exhibited patterns of use-wear. Among them were seven formal tools and six informal tools. Seven were made of jasper, five of chert, and one was made of rhyolite. A wide range of uses was represented, with no clear clustering.

The examined tools from Locus 2 are shown in Table G-8. The assemblage was composed of six tools, all of them expedient. Three of them were jasper and three were chert tools. Suggested functions are scraping (N=3) and cutting (N=2), primarily on hard materials. One tool exhibited mixed scraping/cutting use-wear patterns.

Table G-7: Functions Suggested for Tools from Locus 1

Spec. #	Cat. #	Unit/Strat/ Level	Raw Material	Suggested Function	Material	Morphological Type
11	98/2/78	266/B/2	jasper	scraping		utilized flake
23	98/2/78	266/B/2	chert	inconclusive		utilized flake
34	98/2/46	256/B/4	jasper	scraping (limited)	soft	utilized block shatter
35	98/2/78	266/B/2	chert	scraping (limited)	soft	utilized flake
36	97/58/39	196/A/1	jasper	piercing		projectile point
37	98/2/443	277 (wall scraping)	jasper	scraping	hard	early stage biface
38	98/2/26	254/B/2	chert	cutting (limited)		utilized flake
46	98/2/424	384/A/1	chert	cutting (limited)		early stage biface
47	97/58/83	191/B/4	jasper	piercing		projectile point
48	98/2/134	269/B/2	jasper	cutting/scraping		late stage biface
49	98/2/1344	Feature 60	chert	butchering?		biface fragment
50	97/51/43	STP B-9D/B	chert	cutting	grass	utilized flake
51	97/51/48	STP C-15/A	jasper	no use-wear		middle stage biface
62	98/2/419	371/B/2	jasper	scraping	medium/hard	projectile point frgm.
64	98/2/40	257/C/4	rhyolite	scraping?		projectile point

Table G-8: Functions Suggested for Tools from Locus 2

Spec. #	Cat. #	Unit/Strat/ Level	Raw Material	Suggested Function	Material	Morphological Type
16	97/59/22	217/B/2	jasper	scraping	hard	utilized flake
17	97/59/21	217/A/1	jasper	cutting/scraping	medium/hard	utilized flake
18	97/59/12	214/A/1	chert	cutting/butchering		utilized flake
19	97/59/4	200/A/1	chert	scraping	hard	utilized flake
27	97/59/12	214/A/1	chert	cutting		utilized flake
31	97/59/9	203/A/1	jasper	scraping		utilized flake

Locus 3 was sampled most extensively and produced the most interesting results. The results are presented in Tables G-9, G-10, and G-11, which present the Metate block, the Feature 30 block, and the remainder of the Locus, respectively.

Table G-9: Functions Suggested for Artifacts from the Metate Block

Spec. #	Cat. #	Provenience	Raw Material	Suggested Function	Material	Morphological Type
66	98/2/213	331/B/3	chert	piercing		projectile point
67	98/2/315	353/B/3	jasper	piercing		projectile point
83	98/2/849	356/B/3/ Feature 36	jasper	scraping		projectile point (broken)
84	98/2/849	356/B/3/ Feature 36	jasper	scraping		projectile point (broken)
68	98/2/346	362/B/2/ Feature 36	jasper	scraping	wood?	early stage biface
91	98/2/953	362/B/3/ Feature 36	jasper	piercing		projectile point
6	98/2/946	370/B/4/ Feature 36	chert	sawing	wood	utilized flake
73	98/2/510	374/B/3	chert	piercing		projectile point
71	98/2/470	382/B/2	jasper	piercing		projectile point
65	98/2/476	382/B/3	chert	inconclusive		early stage biface
85	98/2/911	387/B/3	chert	piercing		projectile point
8	98/2/489	388/B/2	jasper	cutting/scrapin g	medium	utilized flake
70	98/2/506	391/A/1	jasper	piercing		projectile point
72	98/2/506	391/A/1	jasper	scraping	hide	late stage biface
9	98/2/525	396/B/2/ Feature 96	jasper	cutting	grass	utilized flake
75	98/2/548	402/A/1	jasper	scraping		late stage biface
74	98/2/543	403/B/2	chert	scraping?		projectile point (broken)
2	98/2/545	404/B/2	chert	scraping		utilized flake
76	98/2/602	405/B/2	jasper	scraping (limited)		late stage biface
77	98/2/602	405/B/2	jasper	scraping		projectile point (broken)
3	98/2/635	405/B/3	chert	scraping		endscraper
78	98/2/604	407/B/2	chert	piercing		projectile point
69	98/2/432	407/B/3	jasper	piercing		projectile point
4	98/2/685	409/B/3	chert	scraping?		utilized flake
79	98/2/666	419/A/1	chert	piercing		projectile point
80	98/2/781	421/B/4	jasper	piercing		projectile point
81	98/2/787	423/A/1	jasper	piercing		projectile point
14	98/2/96	423/B/3	jasper	scraping	wood?	utilized flake
5	98/2/811	425/B/3	chert	scraping		utilized flake
82	98/2/818	426/A/1	jasper	piercing		projectile point
86	98/2/912	429/A/1	jasper	scraping		projectile point (broken)
87	98/2/913	430/A/2	jasper	scraping (limited)		projectile point (broken)
52	98/2/924	430/B/2	chert	piercing		projectile point

Table G-9 (continued)

Spec. #	Cat. #	Provenience	Raw Material	Suggested Function	Material	Morphological Type
89	98/2/925	430/B/3	chert	no use-wear		bipolar core
88	98/2/921	431/B/3	jasper	no use-wear		bipolar core
90	98/2/942	437/B/2	chert	no use-wear		early stage biface
92	98/2/990	439/B/3	jasper	cutting (limited)		biface frgm.
93	98/2/994	441/B/3	jasper	scraping	hard wood/ bone	early stage biface
94	98/2/1000	441/B/5	jasper	piercing		projectile point (broken)
96	98/2/1027	449/B/2	chert	piercing		projectile point (broken)
97	98/2/1150	451/A/1	chert	scraping?		biface fragment
98	98/2/	451/A/1	chert	scraping		projectile point (broken)
99	98/2/1160	455/A/1	chert	scraping		projectile point (broken)
100	98/2/1186	459/A/1	chert	piercing		projectile point
7	98/2/1263	465/B/2	chert	no use-wear		flake
1	98/2/1263	465/B/2	chert	scraping		early stage biface

Table G-10: Functions Suggested for Artifacts from the Feature 30 Block

Spec. #	Cat. #	Provenience	Raw Material	Suggested Function	Material	Morphological Type
33	97/55/505	211/A/1	jasper	cutting		utilized flake
39	97/55/505	211/A/1	jasper	cutting		utilized flake
42	98/2/498	315/ Feature 30/C/3	rhyolite	cutting		proj. point/knife
25	98/2/154	318/A/1	chert	scraping	wood?	utilized flake
43	98/2/757	318/ Feature 30/A/3	rhyolite	inconclusive		late-stage biface
28	98/2/157	319/A/1	chert	scraping	medium	utilized flake
15	98/2/193	320/ Feature 30/A/3	chert	scraping	hide	hafted endscraper
40	98/2/456	368/B/2	chert	cutting		biface fragment
22	98/2/475	380/B/5/ Feature 37	jasper	wood sawing		utilized flake
41	98/2/475	380/B/5/ Feature 37	chert	scraping	wood?	utilized flake
20	98/2/486	380/B/8/ Feature 37	jasper	inconclusive		utilized flake
26	98/2/1043	440/ Feature 37/A/6	chert	scraping	hide?	hafted endscraper
24	98/2/1156	453/ Feature 38/A/1	chert	scraping	medium	utilized flake
21	98/2/1271	468/ Feature 37/A/1	chert	scraping?	wood?	utilized flake

Table G-10 (continued)

Spec. #	Cat. #	Provenience	Raw Material	Suggested Function	Material	Morphological Type
30	98/2/1281	471/ Feature 37/A/1	chert	scraping		endscraper frgmnt
32	98/2/1347	472/ Feature 37/A/1	jasper	cutting/butcheri ng		utilized flake
44	98/2/1352	472/ Feature 37/B/2	jasper	piercing		projectile point
12	98/2/1377	473/ Feature 37/A/1	chert	scraping	hide	hafted endscraper
45	98/2/1379	473/ Feature 37/A/2	chert	scraping	soft materials	hafted endscraper

Table G-11: Functions Suggested for Artifacts from Locus 3 (other than Metate and Feature 30 blocks)

Spec. #	Cat. #	Provenience	Raw Material	Suggested Function	Material	Morphological Type
54	97/55/22	Block 2	chert	piercing		projectile point (broken)
57	97/55/167	Block 2	chert	piercing		projectile point
58	97/55/167	Block 2	chert	scraping?		projectile point (broken)
55	97/55/62	Block 6	chert	piercing		projectile point
59	97/55/397	Block 6, Feat. 3B/A/1	jasper	scraping?		projectile point (broken)
53	97/55/1	57/A/1	jasper	cutting		late stage biface
13	97/55/95	67/B/2	jasper	scraping	hide	hafted endscraper
56	97/55/142	85/B/3	chert	cutting/butchering		flake core
60	97/55/469	165/B/3	jasper	scraping/butchering		utilized flake
29	97/55/483	205/A/1	chert	scraping		endscraper
10	98/2/178	327/B/2	chert	scraping		utilized flake
61	98/2/178	327/B/2	jasper	piercing		projectile point
63	98/2/298	349/B/3	chert	inconclusive		projectile point (broken)

The assemblage consists of 72 specimens. Four of them did not exhibit any use-wear, bringing the total number of tools to 68. There are 37 chert tools and 31 jasper tools. Among them, 51 are formal tools and 17 are informal tools. The formal tools have been mostly used for piercing (N=21), scraping (N=25), and cutting (N=3); the uses of two could not be determined. Informal tools were used for cutting (N=1), cutting/butchering (N=2), scraping (N=11), and sawing wood (N=2); one was inconclusive. The chert tool assemblage contains 27 formal and 10 informal tools, and the jasper tool assemblage contains 24 formal and seven informal tools. Chert formal tools have been used for piercing (N=11), scraping (N=13), cutting (N=1), and inconclusive (N=2), and informal tools have been used for scraping (N=9), and sawing wood tool (N=1). Jasper formal tools have been used for scraping (N=11), piercing (N=10), cutting (N=3), and informal tools have been used for scraping (N=2), cutting (N=3), sawing wood (N=1), and inconclusive (N=1).

Overall, the activity areas were broadly similar; however, the use-wear analysis confirmed differences between the Feature 30 and Metate blocks that had been observed in the forms of the tools. The small-stemmed projectile points known as "pebble points," most of which were found in the Metate block, showed evidence of having been used to pierce soft objects, that is, they were probably used as projectiles. Some of them also showed use as scrapers, particularly the ones that had had their tips broken off. The formal scrapers, most of which were found around Feature 30, showed use as scrapers, probably on hide. The rest of Locus 3 resembled the Metate block more than the Feature 30 block.

VII. EXPERIMENTAL REPLICATION

A. INTRODUCTION

Because there is no universally accepted body of data that use-wear studies might rely upon, an integral part of the method used in this study is the testing of functional interpretations by experimental replication. This can be done by checking the observed wear traces on the tool being analyzed against existing experimentally created traces; however, the wear observed on prehistoric tools is almost never identical to any particular type of experimental wear.

Features observed experimentally include direction of motion, angle, grip, pressure, and hardness. Standard classifications of hardness include the class of hard materials, such as bone and antler, and soft, such as meat and skin. Interestingly, fish and grass produce a surprising amount of resistance (cf. Tringham et al. 1974:figures 18c, 21b). The mode of action is indicated by the distribution of the microflake scars on both sides of the flake, and along the flake's edge. The nature of the worked material is indicated by the morphological features of the micro-scars. Regardless the hardness of the material worked, the first microflakes detached were feather terminated, whereas the subsequent scars varied from hinge terminated to step terminated (only hard materials; cf. Tringham et al. 1974).

Types of wear observed by Tringham et al. (1974), according to activity, include the following categories.

- *Cutting* (one-way movement). Patterns of microflaking depend on the angle of the tool's edge to the working material. Distribution of scars is uneven but not random. There are no specific scar shapes. Abrasion is slow to develop and is formed on both sides of the edge. Parallel striations occur when the tool is held at a 90-degree angle to the worked material.
- *Sawing* (two-way movement). Abrasion is similar to cutting, but the pattern of scars is more regular.
- *Scraping/shaving/planing* (one-way movement). Only one surface receives pressure from the worked material, and microflakes develop on one edge. The scars are regular in shape and size and appear on the edge opposite to the surface that touches the edge. The working edge usually develops perpendicular striations.
- *Boring* (highly localized wear). The damage consists of microflakes, polish, and striations. The last two appear over much of the flake surface.

Materials include the following categories.

- *Soft materials* (skin, flesh). No matter what species, these materials produce only feather terminated scars. Fish produce better defined scars than mammal flesh or skin.
- *Hard materials* (antler and bones). Step terminated scars obliterate feather terminated scars. Abrasion is in the form of a dull polish on the edge and scars, while antler produces more striations.

- *Medium worked materials* (hard and soft wood, both seasoned and fresh). No matter what species, wood generates a variety of feather terminated scars; hard woods might produce step scars. Also, seasoned wood causes heavier abrasion and fractures than fresh wood. Abrasion is not heavy.

It is easier to say what might not happen; for instance, step scars will not be produced by scraping skins or cutting meat (unless the experiment is performed on a wooden board).

B. EXPERIMENTAL REPLICATION FOR PUNCHEON RUN SITE

The experimental use-wear patterns made for the Puncheon Run Site are shown in Table G-12. Observations that have been made by other analysts regarding the quality of use-wear as compared with unused samples are shown in Table G-13.

Table G-12: Puncheon Run Experimental Use-Wear Patterns

Raw Material	Edge Angle *	Motion/Material/Time	Wear Traces
chert	45-55	scraping/seasoned wood/10 min.	medium bifacial matte and bright polish, limited margins; regular step and feather terminated fractures; striations
chert	45-55	scraping fresh wood/15 min.	matte polish limited to margins; regular microflaking; some striations
chert	45	fleshing fish/10 min.	matte and bright bifacial polish limited to margins and larger areas, rounded edges; regular bifacial fractures
chert	45-55	butchering/30 min.	matte heavy polish on margins; regular bifacial microflaking
chert	35-45	sawing fresh wood/30 min.	bifacial polish, striations; bifacial microflaking
chert	55-60	scraping dry hide/30 min.	heavy matte and bright polish; striations; some microflaking
chert	35-45	cutting grass/3 hrs.	gloss; well rounded fractures
jasper	45-55	scraping seasoned wood/10 min.	heavy marginal polish; striations; regular microflaking
jasper	45-55	scraping fresh wood/15 min.	marginal matte and bright polish; short striations; regular microflaking
jasper	45-55	fleshing fish/10 min.	bifacial marginal polish; rounded edges; regular microflaking with scars feather terminated
jasper	45-55	butchering/30 min.	matte and bright polish; some scars
jasper	35-45	sawing fresh wood/30 min.	bifacial matte and marginal polish also covering larger areas
jasper	65-70	scraping hide/30 min.	heavy bright polish, rounded edges; some edge microflaking
jasper	45-50	cutting grass/3 hrs.	heavy gloss

* degrees

Table G-13: Comparative Experimental Samples

Material	Activity/Time	Quality of Wear	Reference
Obsidian	unused	none; small, regular scars	Greiser and Sheets 1979
Obsidian	cutting wood (seasoned oak) 1.4 min.	dull scar ridges; edge crushing; regular scars with feather terminations; use-wear well visible at 25-50x mag.	Greiser and Sheets 1979
Obsidian	cutting wood (seasoned oak) 16.6 min.	well rounded edge; regular microflaking	Greiser and Sheets 1979
Sandstone	unused	snap fractures; sharp scar edges	Greiser and Sheets 1979
Sandstone	cutting wood (seasoned oak) 1.4 min.	slight rounding; no microflaking	Greiser and Sheets 1979
Sandstone	cutting wood (seasoned oak) 16.6 min.	slight polish; slightly faceted edge	Greiser and Sheets 1979
Quartzite	cutting wood (seasoned oak) 1.4 min.	rounded edges	Greiser and Sheets 1979
Quartzite	cutting wood (seasoned oak) 16.6 min.	high polish	Greiser and Sheets 1979
Chert	unused	random size and shape fractures	Greiser and Sheets 1979
Chert	cutting wood (seasoned oak) 1.4 min.	regular edge; step fractures	Greiser and Sheets 1979
Chert	cutting wood (seasoned oak) 16.6 min.	rounded and well polished edge	Greiser and Sheets 1979
Chalcedony	cutting wood (seasoned oak) 1.4 min.	crushing	Greiser and Sheets 1979
Chalcedony	cutting wood (seasoned oak) 16.6 min.	crushing	Greiser and Sheets 1979
Silicified limestone	unused	random scars	Greiser and Sheets 1979
Silicified limestone	cutting wood (seasoned oak) 1.4 min.	smooth edge	Greiser and Sheets 1979
Silicified limestone	cutting wood (seasoned oak) 16.6 min.	smoothing and polish; rounded edge	Greiser and Sheets 1979
Flint	whittling wood	bifacial snap fractures; polish over larger areas and on edge	Grace 1989
Flint	scraping bone, 6 min.	ventral fractures; polish over larger areas and along the edge	Grace 1989
Flint	scraping wood, 6 min.	bifacial polish randomly distributed fractures	Grace 1989
Flint	grooving horn, 5 min.	polish	Grace 1989
Flint	scrape antler, 5 min.	polish	Grace 1989
Flint	scrape hide, 15 min.	polish	Grace 1989
Flint	grooving soaked antler, 7 min.	heavy polish	Grace 1989
Flint	boring horn, 4 min.	polish; circular striations	Grace 1989
Flint	making holes in bark	limited polish	Grace 1989
Flint	scraping bone, 7 min.	heavy polish	Grace 1989
Flint	piercing hide, 9 min.	some polish	Grace 1989

Table G-13 (continued)

Material	Activity/Time	Quality of Wear	Reference
Flint	scraping fresh yew branches, 30 min.	polish, microflaking	Grace 1989
Flint	grooving shell, 7 min.	heavy polish; edge microflaking	Grace 1989
Flint	adzing ash, 20 min.	step fractures, polish	Grace 1989
Flint	whittling pine, 17 min.	marginal polish; edge microflaking	Grace 1989
Chert	carving bone, 5 min.	polish	Keeley 1980
Chert	carving wood, 5 min.	polish	Keeley 1980
Chert	chopping meat	polish	Keeley 1980
Chert	sawing wood	polish	Keeley 1980
Chert	drilling wood	polish	Keeley 1980
Chert	scraping dry hide, 25 min.	polish	Keeley 1980
Chert	scraping fresh hide, 5 min.	polish	Keeley 1980
Chert	cutting meat, 10 min.	polish	Keeley 1980
Chert	cutting corn, 3 hrs	polish	Keeley 1980

C. ELEMENTS OF THE ANALYSIS

The major problem with assessing the validity of any use-wear analysis is to determine the reliability of the inferences. This study has relied on experimental tools and experimentally generated (controlled) use patterns. The method has been discussed by Keeley (1976, 1977a, 1977b), Newcomer and Keeley (1979), and Tringham et al. (1974). The tools made for this study were mostly expedient-type utilized flakes. The tools were of two classes of raw material, chert and jasper, collected at the site. All flakes were generated by direct percussion knapping with a quartzite hammerstone. Occasionally platforms were slightly prepared. All materials used by these tools were organic (meat, wood, bone, plants). One flake of each material was always left unused for control purposes.

The tools were used for tasks related to a range of activities observed in ethnographic record or inferred from archaeological evidence. The basic actions of scraping, slicing, sawing, boring, chopping, carving, and cutting are represented. All tools were unhafted and held in a bare hand. One tool was used to perform only one activity, with no multiple uses of the same tool. Use of the tool was recorded by drawings, notes, and photographs. The photographs show the positions of the hands and the material worked. The notes were taken after the task was finished (type of material worked, how the tool was held, duration of activity, edge damage visible to the naked eye, other). Line drawings were made of the dorsal and ventral sides, and the area used was indicated. Indicated areas were inspected microscopically.

1. Location of a Used Edge

In order to determine the use of an edge, three features have been looked for: (1) polish, (2) striations, and (3) fractures. As many experiments have shown (Newcomer and Keeley 1979; Odell 1975; Tringham et al. 1974), most used edges have at least two of these features. As observed, utilization in the form of striations of microflaking does not form well on steep, retouched edges. Therefore, Newcomer and Keeley (1979:199) accepts polish as the most likely evidence of possible use.

2. Inferring the Method of Use

The objective of use-wear analysis is the determination of the method of use of a tool. No clear-cut identification is possible, however, and the use is inferred through analysis of several types of evidence. This type of inference is highly subjective as it mostly relies upon the analyst's experience. Other types of evidence usually considered (Newcomer and Keeley 1979) include general shape of the edge, type and placement of utilization, distribution and orientation of striations, location and extent of polish. Semenov (1964:16-21) proposed certain "standard" forms of traces, but this is "ideal" evidence, which might develop differently on different materials.

3. Inferring the Material Used

The main principle is that various materials produce distinct wears. Newcomer and Keeley's (1979:figures 3, 4) experiments show that materials of diverse hardness produce distinguishable polish (see also Keeley 1976, 1977a, 1977b; he used 200X magnification and incident lightning). It is therefore important to use raw materials as similar as possible to those used by the prehistoric tool-makers being studied, as in this study.

4. Recording Edge Damage

Statistical modeling (Grace 1989; Shea 1991) suggests that polishes caused by various materials do not clearly separate out, and that, for instance, some wood polishes cannot be distinguished from antler or are at least quite similar. Such observations have been reported by several authors (Anderson-Gerfaud 1981; Gendel and Pirnay 1982; Kelley and Newcomer 1977; Moss 1983a; Vaughan 1981). Grace (1989:figure 21) reports that 20 to 30 minutes of work on wood produces polish qualitatively equivalent to three to 12 minutes of work on antler, and also that wood polishes, which were clearly separated from antler, were on tools used for between five and 15 minutes. These findings indicate that time of work is a significant factor to be considered in use-wear analysis (Grace 1989:figures 20-24). Other variables, such as edge morphology, also have an effect on the quality of polish.

Because of the complexity of inferring a tool function and material used, three groups of edge damage were recorded during this study, striations, polish, and fractures (Newcomer and Keeley 1979; Odell 1975), along with their particular locations and specific characteristics.

Some analysts have experimented with various raw materials trying to establish whether there was a significant preference in terms of what raw material would fit what specific task. A preliminary assumption was that material toughness and resiliency might affect the usefulness of certain materials for specific tasks. Each activity was timed and the number of strokes and cuts was counted. Experiments show (Greiser and Sheets 1979) that isotropic and microcrystalline materials are reduced through micro-scarring, whereas the attrition process of more granular material removes or wears down individual grains. Two factors, hardness and toughness, contribute to such mechanics.

Analysts observing different wear patterns on tools from an archaeological assemblage might conclude that those patterns are generated by different activities. From a petrological point of view, the variation of wear on archaeological specimens might be due to different qualities (physical characteristics) of raw material. The experiment carried out as part of this study employed materials collected at Puncheon Run, qualitatively similar to the tools examined for use-wear. No significant differences were observed.

Greiser and Sheets (1979:295) suggest that stone tool users consciously selected various types of raw materials for specific uses and that the selection was based on more that just one reason. The authors seem to believe that functional demand influenced such selections. Archaeologically, such correlation might be visible in statistical significance between classes of raw materials and tools. Even though only cryptocrystalline tools were examined microscopically, the Puncheon Run assemblage may provide a good sample for testing of such hypothesis. Because of the abundance of locally available raw materials, human preference in selecting raw materials for task-specific activities could be recognized statistically. Nonetheless, the preference could have been given to flaking attributes of a raw material rather than a tool function. Such a statement may be true, and therefore the reasons for preferential selection of raw materials should be examined carefully. On the other hand, in the case of Puncheon Run, no quartz scrapers have been found even though quartz is dominant in the area. A possible explanation might be that because of the physical attributes of quartz, people specifically selected chert/jasper to make scrapers. If this was the case, the selection was intended according to tool function rather than the quality of raw material.

5. Interpretations and Objective Measurement of Microwear Variation

Microwear interpretations always contain a subjective component in the recognition of microwear as a use-wear (functionality and wear patterns; cf. Shea 1992). The recognition system is not perfect, and it should be improved through more systematic studies and tests (van Gijn 1990; Grace 1989; Newcomer et al. 1986; Shea 1992; Tomenchuk 1985). Minimizing the subjectivity is the most challenging methodological effort.

6. Trampling and Unintentional Edge Damage

One of the problems with use-wear studies is how to deal with post-depositional effects. It has been minimized by many analysts, who claim that it is relatively easy to distinguish between true use-wear and modifications produced by post-depositional processes, such as trampling, soil movement, water, etc. (Keeley 1980). Some analysts point out, however, that quality of polishes produced intentionally and by post-depositional processes could be the same (Grace 1989; Levi Sala 1986). Various post-depositional occurrences might also contribute to certain edge damage (Shea 1992). Theoretically, it is possible that post-depositional modifications will somehow generate a pattern of edge damage, or modify one edge or even remove the edges.

Water action (Tringham et al. 1974) produces random scars along the entire edge with no localizations. Unintentionally modified edges will have no standard size or shape, and random orientation. Trampling (Tringham et al. 1974) causes random edge damage usually distributed on one edge. The scars have no fixed orientation or size.

VIII. CONCLUSIONS

A. USE-WEAR ANALYSIS APPLIED TO PUNCHEON RUN

Use-wear analysis is an interpretive technique and is not designed to make deterministic statements. The evidence of use-wear identified by one analyst might be easily questioned by another. The approach to use-wear analysis employed in this study does not rely on using any single variable as diagnostic of a tool use, but depends instead on the cumulative evidence from all the variables that leads to a logically consistent functional reconstruction. The evidence from use-wear varies on different tools, and interpretation can only be made to the level that the evidence allows.

The direction of use is interpreted by the morphological attributes that can indicate either a transverse, a longitudinal, or a rotational motion. A transverse motion is one at right angles to the working edge, and a longitudinal motion is parallel to the edge; a rotational motion involves either a continuous or backward and forward movements. The morphological attributes of a scraper suggest a transverse motion; those of a lateral edge of a flake suggest a longitudinal motion. Polish distribution also suggests motion, so bifacial polish with little edge-wear indicates a longitudinal motion as both surfaces were in contact with the worked material and the lack of edge damage testifies against a transverse motion. The orientation of striations is an obvious indication of movement.

Motion of use is determined through a combination of variables, such as edge morphology, polish distribution, edge-wear, and linear features or striations. It is established through eliminating motions until only one is consistent with the observations. The following definitions of motion have been applied:

- *cutting*. A uni- or bi-directional longitudinal motion with the edge parallel to the direction of use and approximately vertical to the worked material; both surfaces are in contact with the worked material.
- *sawing*. A bi-directional longitudinal motion with the edge parallel to the direction of use and approximately at right angles to the worked material.
- *grooving*. Insertion of the tool into the worked material to create a groove. It may be uni-directional or bi-directional motion, and can be longitudinal or transverse; the contact angle varies.
- *scraping*. A transverse action that can be uni- or bi-directional. If uni-directional, it can be away or toward the user.
- *whittling*. Uni-directional motion often in an angle to the worked material; it must involve the removal of slivers of material to differentiate it from the motion of scraping.
- *chopping*. A percussive motion of use, transverse to the working edge, where both surfaces are in equal contact with the worked material; the contact angle is approximately 90 degrees.
- *adzing*. A percussive motion, transverse to the worked edge, where one surface is in more contact that the other. The motion is intended for shaping material rather than for separating it, as in chopping. The contact angle is approximately 45 degrees.
- *piercing*. A rotational or transverse motion designed to penetrate material. The motion is transverse when a soft material is penetrated by pushing the tool through. For example, piercing hide may involve no rotational motion.
- *boring*. A rotational motion involving backward and forward movement designed to penetrate material. Boring can only apply to a resistant material of at least medium hardness, so that fresh hide cannot be said to have been bored.
- *drilling*. A rotational motion involving backward and forward movement designed to penetrate material. It is distinguished form boring and piercing since a mechanical device is employed and the tool must be hafted rather than hand-held. The difference here is in the intention rather than in the motion.

Hardness of worked material is divided initially into three categories, soft, medium, and hard. From many experiments involving hundreds of tools used by a number of people, the following classification has been derived.

- *soft materials* - meat, plants, woody plants, bark, fresh soft wood, fresh hide.
- *medium materials* - other wood, fish, soaked antler, dry hide, soft stone, horn.
- *hard materials* - dry antler, bone, shell, stone.

Wood used in this study refers to soft woods, such as pine, rather than to hard woods. These harder woods may produce edge-wear more characteristic of a hard material.

The main variables that can indicate the relative hardness of the worked material are edge-wear, edge morphology, and invasiveness, all of which indicate a penetration that is related to the hardness of the material. An inference about the motion of the tools also sets limits to the hardness of the worked material. For example, if the motion of a tool has been interpreted as being grooving or drilling, then at least a medium material must be involved. Cutting in association with a thin edge with little or no wear limits the worked material to being soft. Further, more detailed identification of the worked material is possible if the motion of the tool and hardness of the worked material have been determined. Such identification is possible through the elimination of materials within the same hardness.

B. INTERPRETATION OF PUNCHEON RUN ASSEMBLAGE

Functional analysis of the Puncheon Run lithic collection approached through the use-wear analysis helps to answer some of the key questions presented in the Archaeological Treatment Plan for the Puncheon Run Prehistoric Site. The analysis contributes data for further discussion of issues such as subsistence strategies, dietary habits, and perhaps gender roles.

Functional determination of tools is ambiguous and should not be limited to a simply morphological approach. This suggestion refers to many formal tools (for example, projectile points, which could have been used as knives), and informal tools, used for scraping, shaving, cutting, or other activities. Ethnographic data may help in identifying certain types of tools; however, it should be noted that ethnoarchaeological indications must be approached carefully, for although they characterize the present, they may not always exemplify the past (cf. Odell 1996).

Functional determination based on use-wear analysis follows a general empirical observation that any intentional use of a stone tool generates a specific pattern of wear. Most patterns are grouped into four classes (Shea 1991), microfractures, striations, polish, and edge-dulling. It is possible, however, that a tool may exhibit more than one discrete pattern of use-wear, or that certain patterns could have been obliterated by the later use of the same edge. For this study, distinctions have not been made among the following types of wear patterns.

- *Striations* - linear evidence of motion of various lengths and shapes, caused by hard particles (for instance, silica) embedded in the worked material.
- *Decays* (chemical alterations) - certain dissolution of chert due to acidic content of the material worked.
- *Polish* - different levels of obliteration of a natural texture of the worked material, which usually develops along the working edge and on fracture scars.
- *Fractures* - caused by a systematic use of a tool; for instance, battering fractures, which result from a systematic use of an edge as a chopping tool.
- *Other fractures* - resulting also from unintentional (random) causes, such as trampling.

The following functional tool groups could be identified through the microscopic analysis of various types of use-wear patterns.

- *Cutting tools*. These are soft-material cutting (butchering) tools. The working edge is symmetrical with well-polished areas covering a larger portion of the working edge (most unretouched flakes or blades could have been used as expedient knives). Cutting tools worked on hard materials (wood, bones, antler) will exhibit polish and some striations mostly on certain portions of the edge. Striations usually run parallel to the working edge. Retouched flakes and some types of burins could have been used for this type of work.

- *Shaving tools*. These have asymmetrical working edges and exhibit mostly striations running in an oblique angle to the working edge. Striations are grouped in one portion of the tool. Unretouched and retouched flakes, and formal tools, could have been used for this activity.
- *Scraping tools.* These show asymmetrical working edges mostly concave or convex in shape (formal scrapers). Tools used on soft materials exhibit some polish and short striations perpendicular or in an oblique angle to the working edge. Tools used on hard materials show longer striations, which could be accompanied by well-articulated fractures.
- *Perforators and drills*. These show polish, fractures, and striations on the working edge.
- *Burins*. These were used to make grooves on hard materials (bones, antler) and exhibit long striations running perpendicular to the working edge.
- *Chopping tools*. These most likely exhibit heavy edge fracturing, usually visible with an unaided eye.
- *Hammers*. These exhibit heavy battering visible with an unaided eye.
- *Flakes or blades.* These were used to cut grasses for a long time will show polish (gloss) also visible with an unaided eye.

Two types of functional variables are discussed below, observed phenomena and interpretive states. *Observed phenomena* were limited to descriptions of abrasion observed under a microscope. Abrasion was determined by examining edge rounding. Light abrasion is shown by visible margins of the edge, and heavy abrasion is suggested by obliterated outline of the edge. Specific abrasion was characterized by qualities of polish (bright, matte), striations (regular, irregular; short, long; parallel, perpendicular, diagonal). Analysis of edge fracturing normally include several variables, but commonly only three are observed: scar termination (feather, hinge, step, and snap fracture), scar size, and scar distribution (Odell 1996:37-38). *Interpretive states* depend on correlation between observed use-wear and wear produced experimentally.

The use-wear analysis of the assemblage from the site was oriented toward examining the two obvious variables of tool motion (activity) and the worked material and its resistivity. The analysis revealed traces of possible discrete activities.

The quality of all worked materials was generally identified according to the following three groups (Odell 1996): soft (animal - hide, flesh, vegetal - grass, leaves), moderate (wood), and hard (bone, antler, stone, etc.). The last group could also contain abrasion made while using a stone tool to dig or modify earth. Prehension, a special category of use-wear, was not determined for the analyzed assemblage.

The following general patterns of use-wear were used for comparative analysis of the analyzed assemblage.

- *Butchering*. Butchering generates abrasion limited to matte polish and well-rounded edges. Striations may not be present, or may not be visible using low magnification microscopy. Edge fracturing is bifacial. Polish is limited to the margin of the working edge. As described by Odell (1996), experimental butchering of a dog produced discrete wear. The abrasion was limited to matte polish, and developing edge rounding visible under low magnification. Fracturing was bifacial but its type varied with specific task and edge thickness. Odell (1996) reports snap fractures on thin edges, and step and hinge fractures - on medium and thick edges. Hinge and step fractures were characteristic for a butchering tool, which contacted bone frequently (see Odell 1996:figures 4.6a and 4.6b, also description of butchering a dog and a goat; Odell also noted feathers terminated fractures). It is interesting to note that not all tools used in the experiment of butchering a goat exhibited wear. The reason, as Odell puts it, could have been limited duration of use (five tools used instead of one), or frequency of fractures, which obliterated other use-wear.
- *Hide Scraping and Fish Fleshing*. This experiment produced a wear characterized by well-rounded edges, bright polish, and striations perpendicular to the working edge. In this activity, fracturing was

obliterated by abrasion, and almost did not show. The amount of polish and density of striations depend on time involved in the tool use.

- *Fresh Meat and Hide Cutting*. Hide cutting developed some polish limited to the margin of the working edge, whereas meat cutting produced tiny bifacial, feather fractured scars.
- *Leather Working*. Drilling developed mostly polish and striations. Microflaking included step and feather bifacial fractures.
- *Bone Working*. The use-wear on tools applied to scraping meat off the bone consisted of dorsal step and hinge fractures, and some feather scars. The ventral sides were polished. Bone graving produces edge fracturing and polish.
- *Antler Working*. The use-wear is similar to bone working traces and consists of bifacial hinge fractures and polish. The edges are rounded and exhibit bright polish and striations.
- *Woodworking*. Use-wear patterns exhibit bright polish and step of feather type of bifacial fracturing. Characteristic is a different pattern of scars on both sides of the working edge (caused by shaving, graving, and chopping motions). A significant addition to this type of experimentation has been made by Odell (1996), who observed that his results did not show differences between tools used on seasoned and fresh wood.
- *Grass Cutting*. The use-wear consisted of bright silica gloss near the margin. Fracturing is bifacial.

Certain data allow for speculation that specific tools have been primarily used to do one type of work. Actual ethnographic evidence confirms, for instance, that hafted endscrapers have mostly been used for hide scraping, and some could have been used to process other organic materials (Binneman 1999; Williamson 1999). As pointed out by Shea (1992), however, several analyses of assemblages from the Old World have shown only loose relationships between the forms of tools and the materials they appeared to have been used to work (Andserson-Gerfaud 1990; Beyries 1987; Plisson 1988; Shea 1991).

The next logical question that arises is: who did this work? Other ethnographic data confirm that hide scraping has been mostly conducted by women, who both made and used scrapers (see the Ethiopian case of Konso people, presented by Brandt [1999]). Looking at archaeological and ethnographic records, it seems that scrapers are perhaps the easiest to identify using both morphological and microscopic methods. They have been mostly used to work with soft materials, but some of them could have also been used as knives.

One of the most interesting questions about patterns of use is about a possible correlation between a raw material type and the tool's function (Greiser and Sheets 1979). It is feasible to assume that the knowledge of raw material properties could have led to a selection of specific raw materials for certain functions. A selection is visible as percentage distribution of raw material across the Puncheon Run Site. Three qualities must have been especially valued by the aboriginal people: brittleness, availability of the material, and control of flaking. The question relating to use-wear is whether certain wear patterns are distinct because of the type of raw material.

C. CONCLUSIONS

It seems that the applied method generates more objective assertions about the examined sample. The use of a multi-dimensional approach is a better solution to the problem, as any interpretations are made from a variety of attributes rather than concentrating on polish appearance. With the multi-dimensional approach, in order to interpret an edge as used, there has to be corroborative evidence of morphology and edge-wear with polish, all of which have to be consistent with a particular motion of use.

The study also demonstrates that form does not determine function. In many cases (except the formal scrapers), the function could have been determined only through the microscopic observations. One of the most interesting inferences is that several broken points have been reused to scrape or process soft and medium-hard materials. Because of the sampling bias, however, it is not possible to assume whether this phenomenon is related exclusively to the Metate block.

The Puncheon Run data suggest scraping/fleshing as the most common identifiable activity. Not much evidence of cutting was found, and only one good example of a grass cutting device. Activities were mostly directed toward processing food and general domestic activities. From such distribution of activities a specific type of subsistence may be suggested. For instance, no clear evidence of harvesting plants could suggest less reliance on a fiber-based diet. Yet the ratio of expedient tools to formal tools suggests a more sedentary or semi-sedentary lifestyle. Such a conclusion could also be supported by environmental factors, such as the local abundance of foodstuffs and raw material.

Heavily biased sampling of artifacts does not permit detailed elaborations on the relation among tool forms, their use, and culture. The artifacts were selected mostly from the two clusters of artifacts labeled as Feature 30 and Metate. In both areas, however, scraping/fleshing and cutting dominate. This may suggest that both areas have been occupied by culturally similar populations, or that the groups were not drastically different. Interestingly, a high ratio of projectile points present in the Metate block as compared with the second area indicates a possible qualitative difference. Most of these points exhibit wear characteristic for use as projectile points, but many of those with broken tips have been reused as scrapers.

Finally, the relation between tool users and the site can be somehow determined from the activities suggested for the F30 and Metate blocks. In both cases, domestic and food processing activities prevail.

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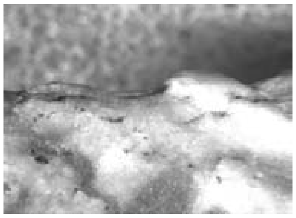
ATTACHMENT A

IMAGES OF USE-WEAR



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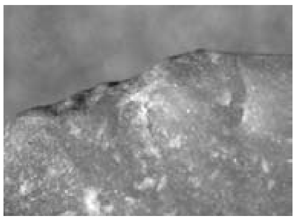


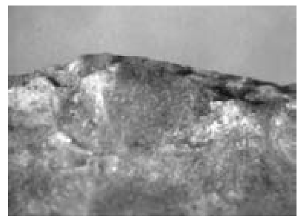
Specimen 1, Image 1v

Specimen 2, Image 2d, x80

Specimen 2, Image 2v, x80

Specimen 3, Image 3d1, x32

Specimen 3, Image 3d x 32



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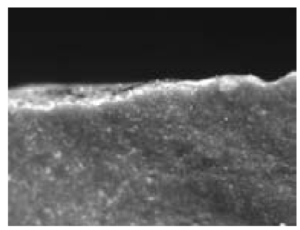
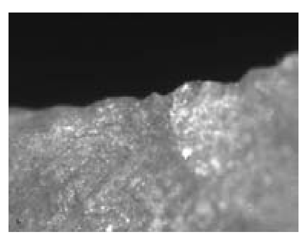


Specimen 4, Image 4d, x25

Specimen 5, Image 5d, x40



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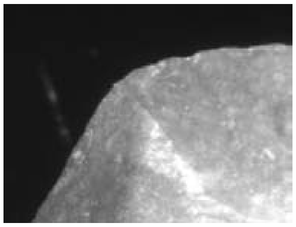

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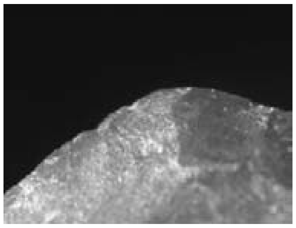

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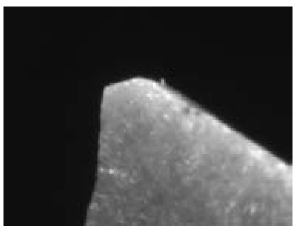
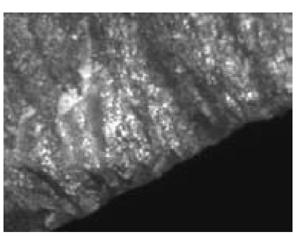


Specimen 6, Image 6d x50

Specimen 6, Image 6v x32



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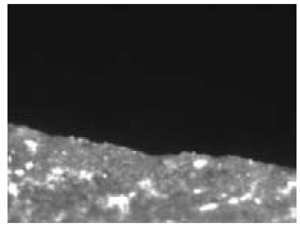

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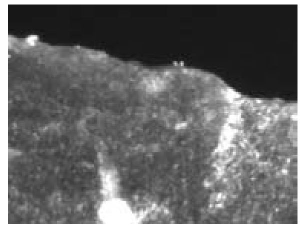

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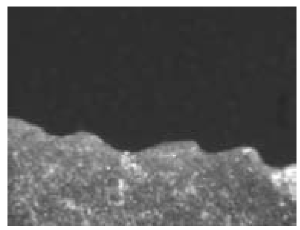

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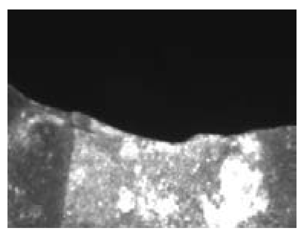

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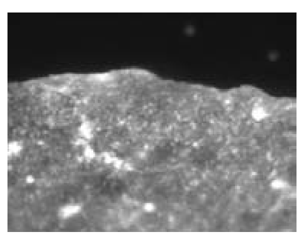
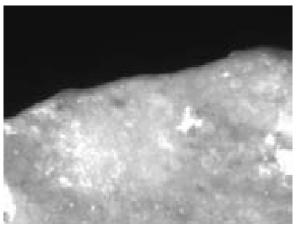


Specimen 10, image 10v x100

Specimen 11, image 11d x20

Specimen 11, image 11v x32



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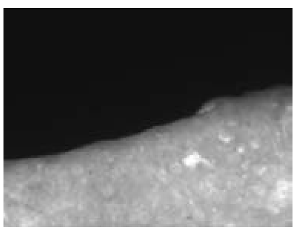
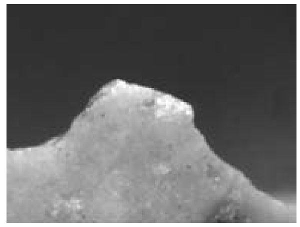


Specimen 12, image 12d1 x100

Specimen 12, image 12vx12.5



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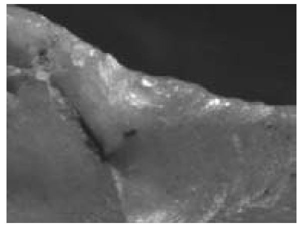

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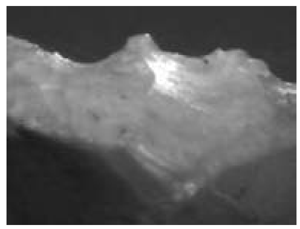

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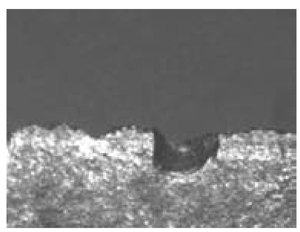

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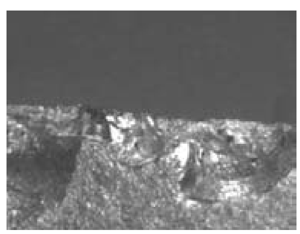

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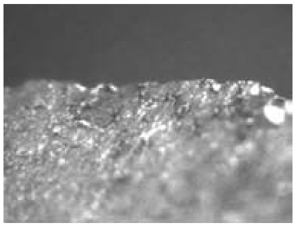

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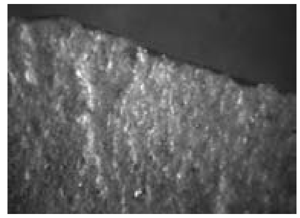

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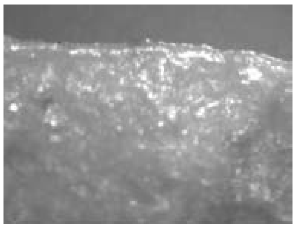

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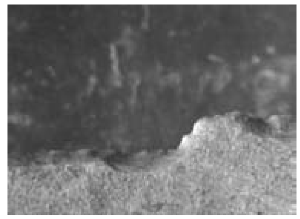

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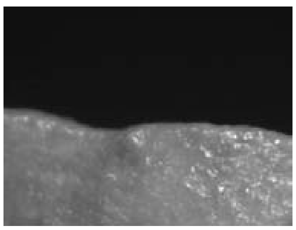
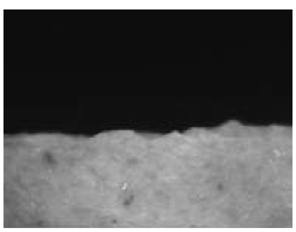


Specimen 15, image 15d1 x50

Specimen 17, image 17d x40



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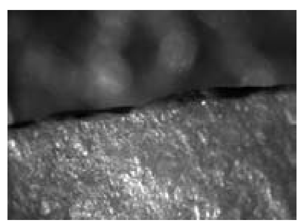

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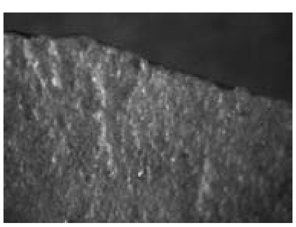

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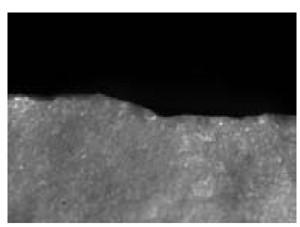

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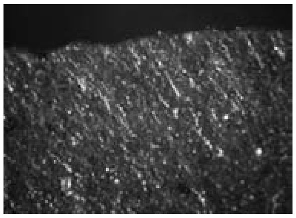

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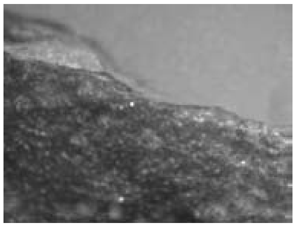

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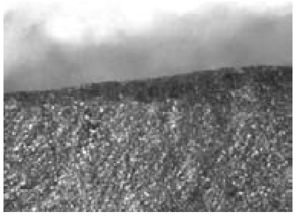

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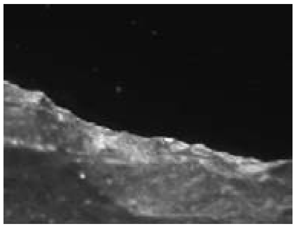

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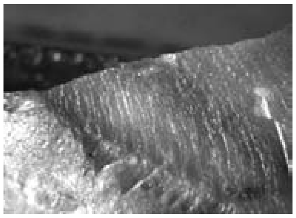

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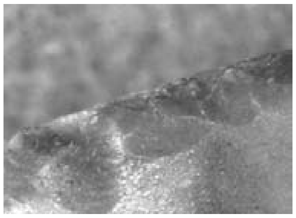

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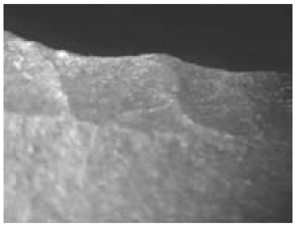

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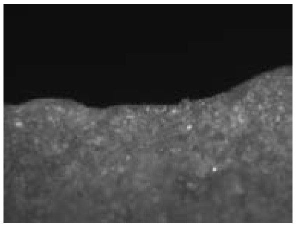
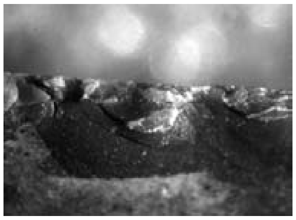


Specimen 20, image 20d

Specimen 23, image 23d x32



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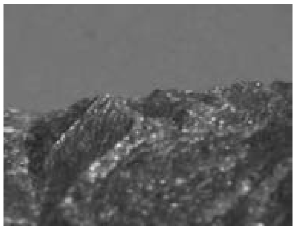

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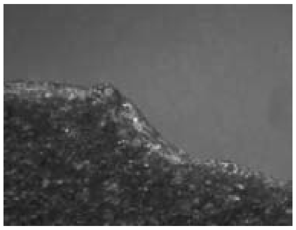

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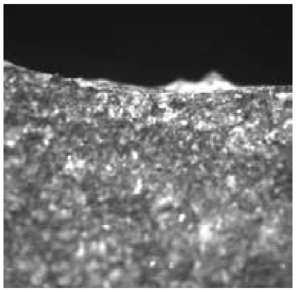

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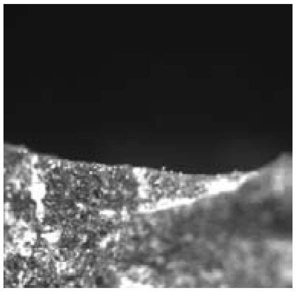

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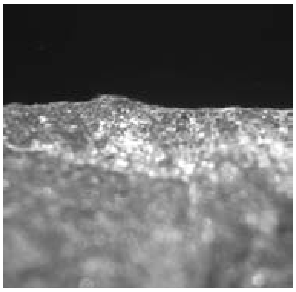

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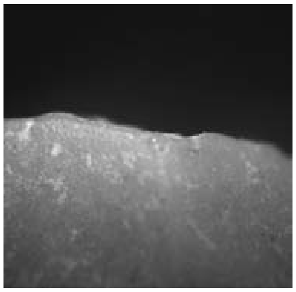

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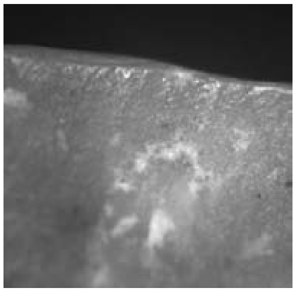
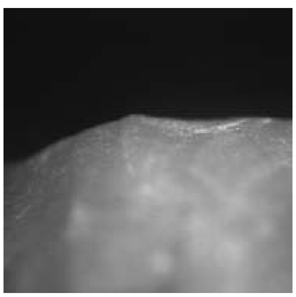


Specimen 26, image 26db1 x50

Specimen 26, image 26va x50



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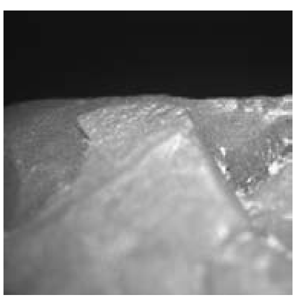

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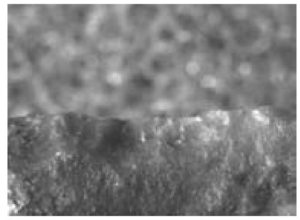

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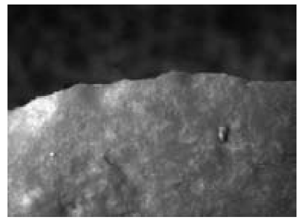

Specimen 27, image 27v x25

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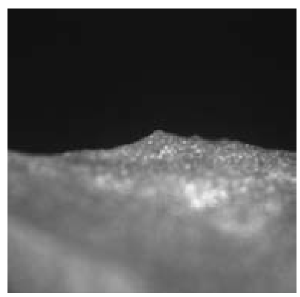

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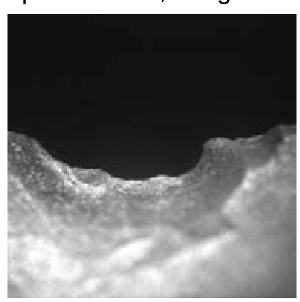
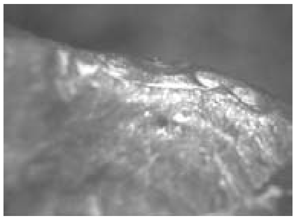
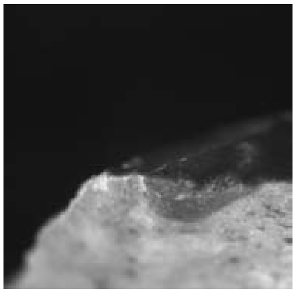


Specimen 28, image 28v x50

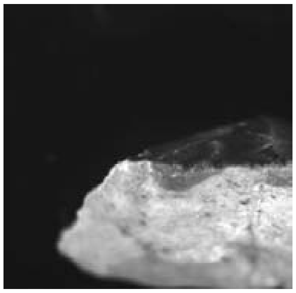
Specimen 29, image 29d x100



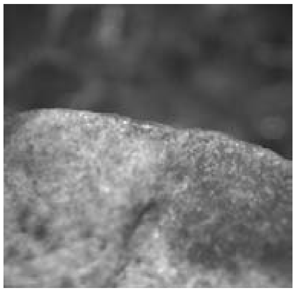
Specimen 29, image 29v x100



Specimen 30, image 30 x25

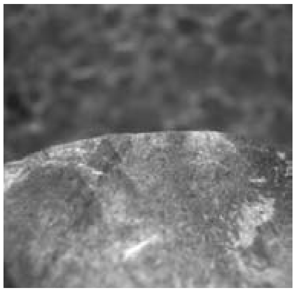


Specimen 30, image 30a x16



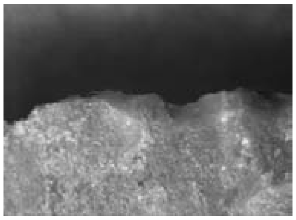
Specimen 30, image 30d x63

Specimen 30, image 30v x63



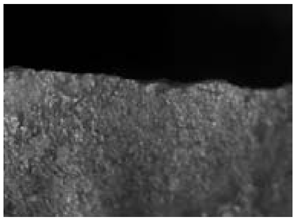
Specimen 30, image 30v1 x40

Specimen 31, image 31d1 x25

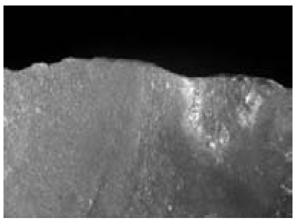


Specimen 31, image 31d2 x25

Specimen 31, image 31d3 x40

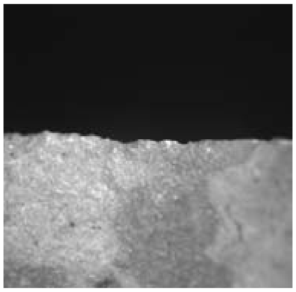


Specimen 31, image 31v1 x40

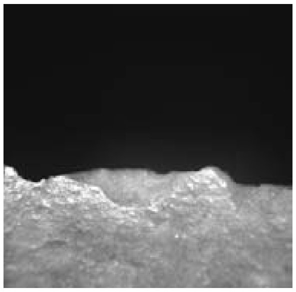


Specimen 31, image 31v2 x25

Specimen 31, image 31v3 x50

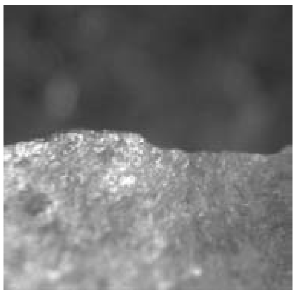


Specimen 32, image 32d x40

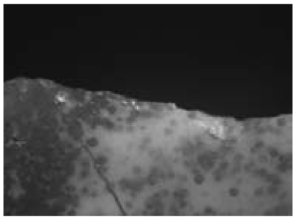


Specimen 32, image 32d1 x80

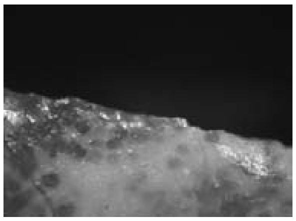
Specimen 32, image 32v x100



Specimen 32, image 32v1 x100

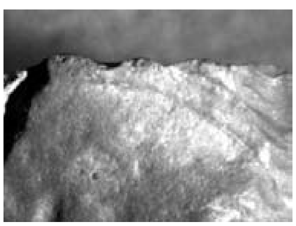


Specimen 33, image 33d x50

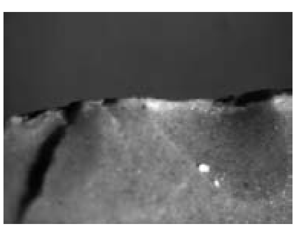


Specimen 33, image 33d1 x100

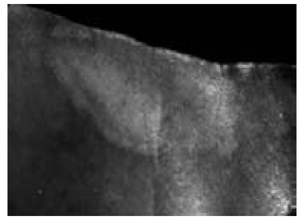
Specimen 33, image 33v x50



Specimen 34, image 34d x16



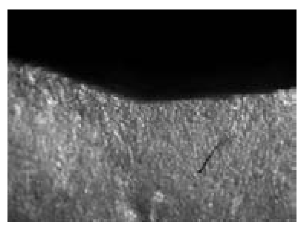
Specimen 34, image 34v x50



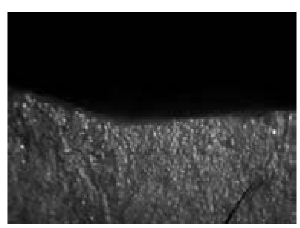
Specimen 35, image 35v x16

Specimen 36, image 36d x40

Specimen 36, image 36v x63



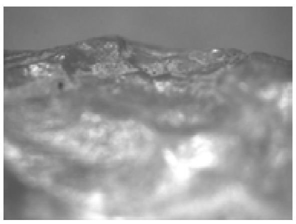
Specimen 37, image 37v x50



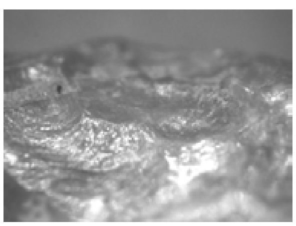
Specimen 37, image 37v1 x100

Specimen 38, image 38d x50

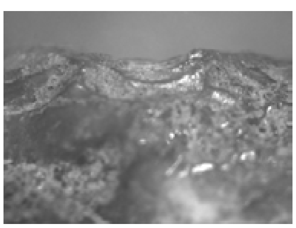
Specimen 38, image 38v x50



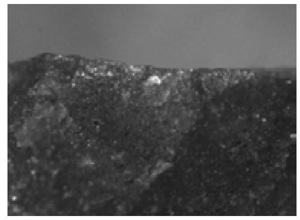
Specimen 39, image 39d x50



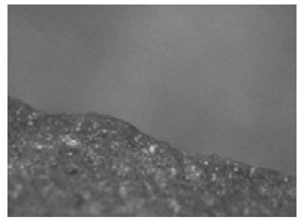
Specimen 39, image 39d1 x50



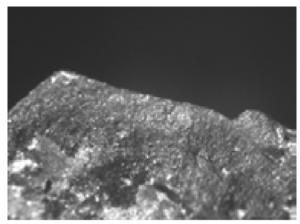
Specimen 39, image 39v x50



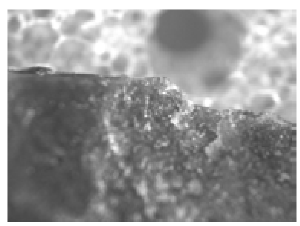
Specimen 40, image 40d x100



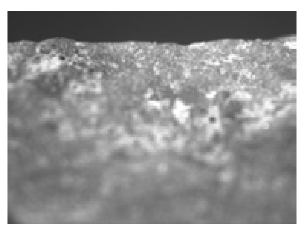
Specimen 40, image 40v x100



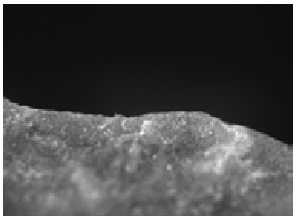
Specimen 41, image 41d x100



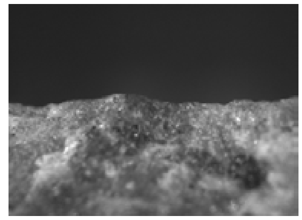
Specimen 41, image 41v x32



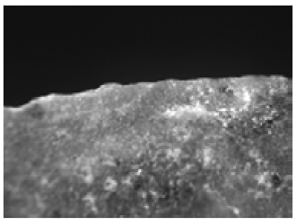
Specimen 42, image 42d x80



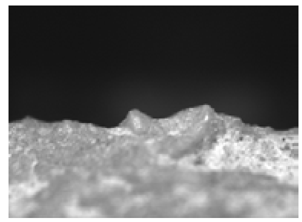
Specimen 42, image 42d1 x50



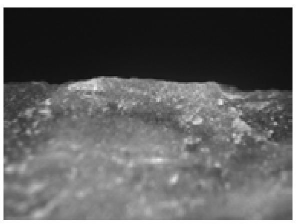
Specimen 43, image 43v x100



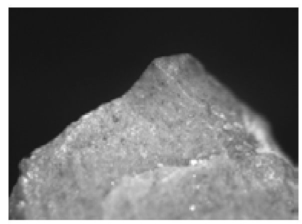
Specimen 42, image 42v x50



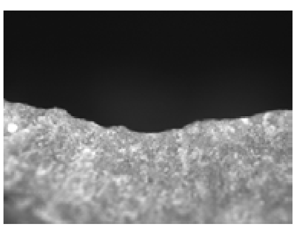
Specimen 44, image 44d x100



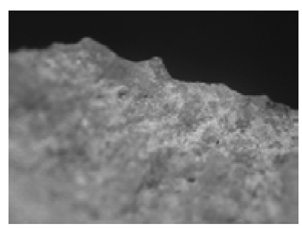
Specimen 42, image 42v1 x50



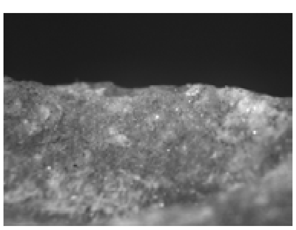
Specimen 44, image 44t x100



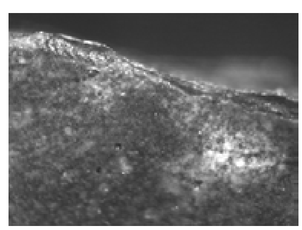
Specimen 43, image 43b x50



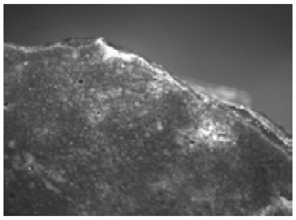
Specimen 44, image 44v x100



Specimen 43, image 43d x100

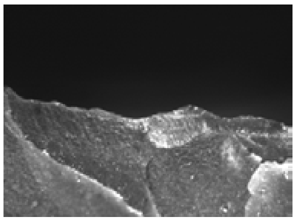


Specimen 45, image 45d x100



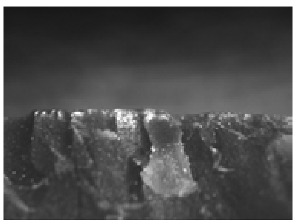
Specimen 45, image 45d1 x100

Specimen 45, image 45v3 x40

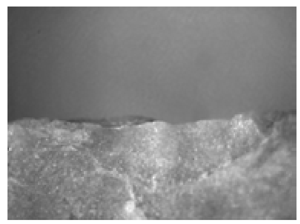


Specimen 45, image 45d2 x100

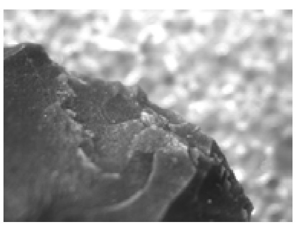
Specimen 46, image 46d x63



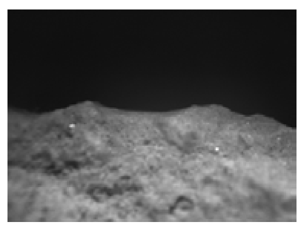
Specimen 45, image 45d3 x50



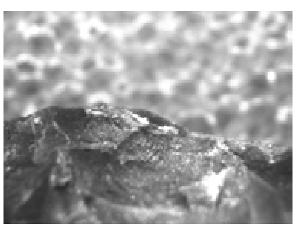
Specimen 46, image 46v x63



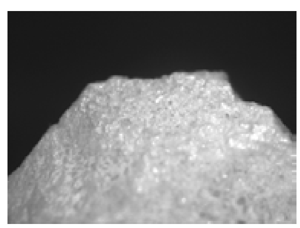
Specimen 45, image 45v x32



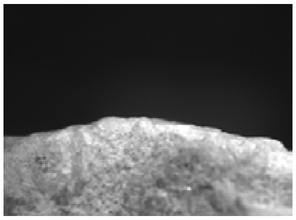
Specimen 47, image 47d x40



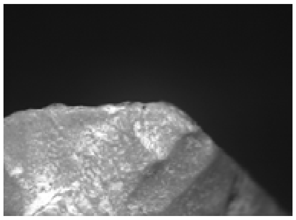
Specimen 45, image 45v2 x32



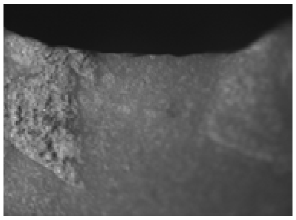
Specimen 47, image 47t x63



Specimen 47, image 47v x40

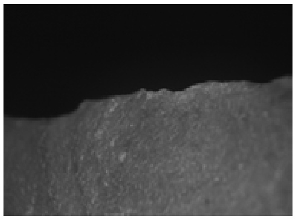


Specimen 48, image 48d x25

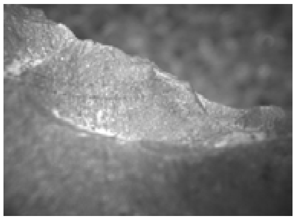


Specimen 48, image 48d1 x50

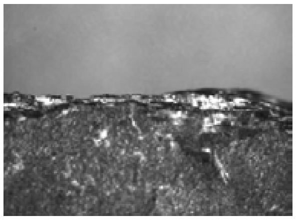
Specimen 48, image 48v1 x32



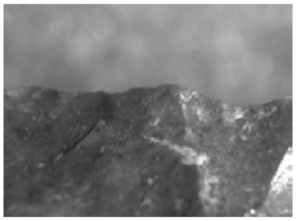
Specimen 49, image 49d x40



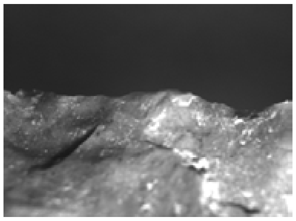
Specimen 49, image 49v x25



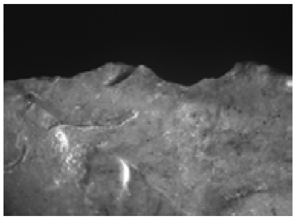
Specimen 50, image 50d x50



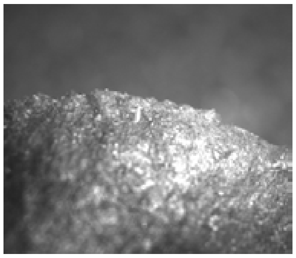
Specimen 53, image 53d x32



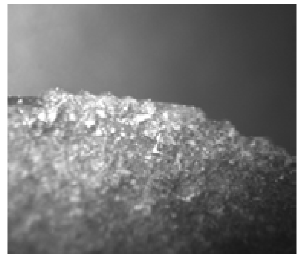
Specimen 53, image 53d1 x32



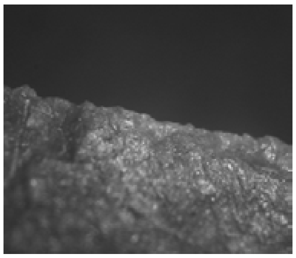
Specimen 53, image 53v x32



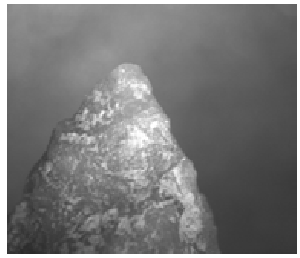
Specimen 56, image 56d x40



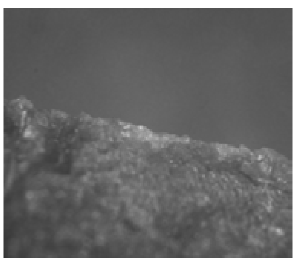
Specimen 56, image 56v1 x50



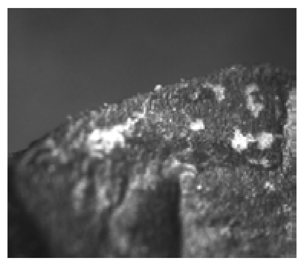
Specimen 56, image 56d1 x100



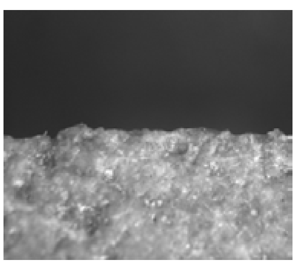
Specimen 57, image 57t x50



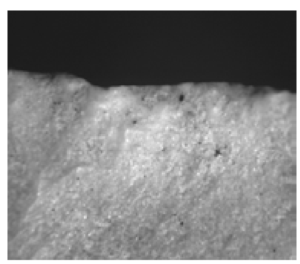
Specimen 56, image 56d2 x100
(different light)



Specimen 58, image 58t x63

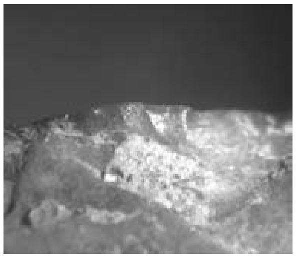


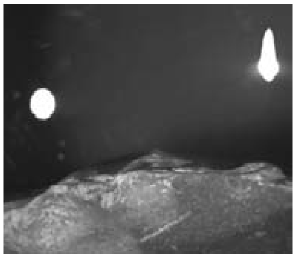
Specimen 56, image 56v x53

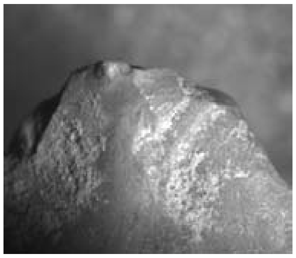


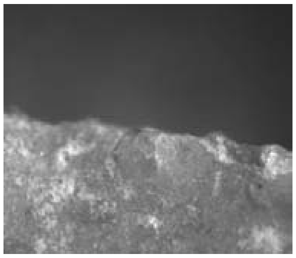
Specimen 59, image 59d x63


Specimen 59, image 59v x63


Specimen 60, image 60v x63


Specimen 60, image 60 x10


Specimen 61, image 61t x32

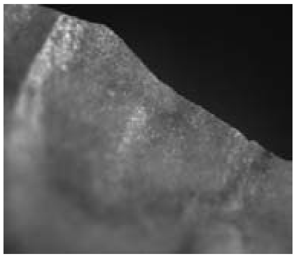

Specimen 60, image 60d x63


Specimen 62, image 62d x40

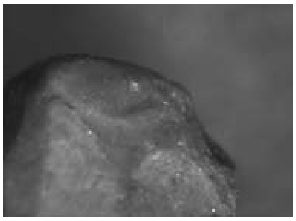

Specimen 60, image 60d1 x63


Specimen 63, image 63v x50

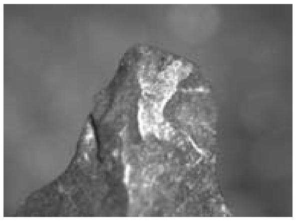
Specimen 64, image 64d x50



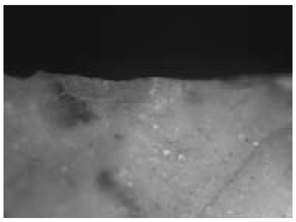
Specimen 65, image 65d x25



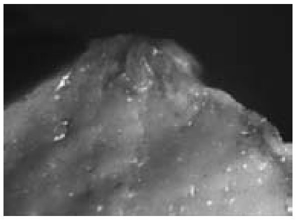
Specimen 66, image 66t x40



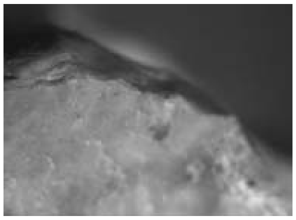
Specimen 67, image 67t x50



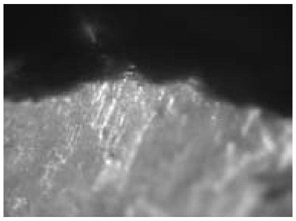
Specimen 68, image 68d x100



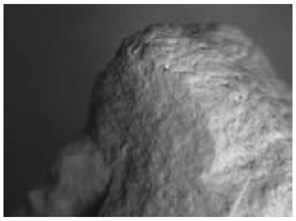
Specimen 68, image 68d1 x32



Specimen 68, image 68v x25

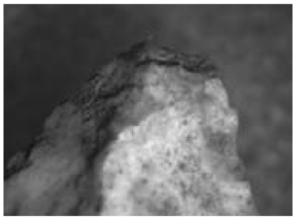


Specimen 68, image 68v1 x63

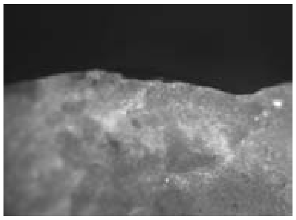


Specimen 69, image 69t x25

Specimen 70, image 70b x40

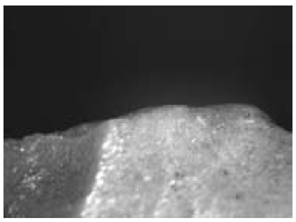


Specimen 70, image 70t x25



Specimen 71, image 71b x50

Specimen 71, image 71t x40

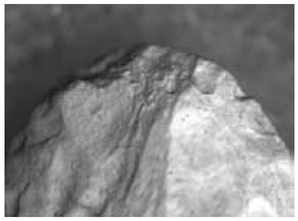


Specimen 72, image 72d x63

Specimen 72, image 72d1 x100

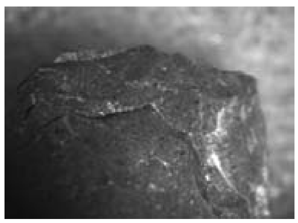
Specimen 72, image 72v x40

Specimen 73, image 73b x50



Specimen 73, image 73t x25

Specimen 74, image 74b x32



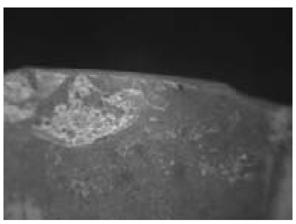
Specimen 74, image 74t x20

Specimen 75, image 75d x100

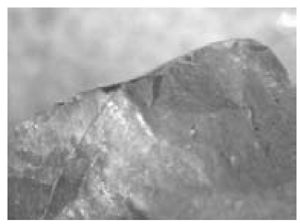
Specimen 75, image 75v x40

Specimen 75, image 75d1 x40

Specimen 75, image 75v1 x32



Specimen 75, image 75d2 x32

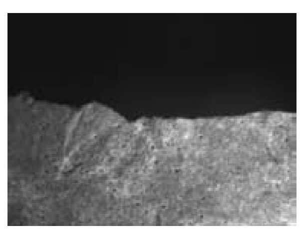


Specimen 76, image 76d x25

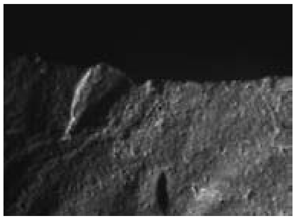
Specimen 75, image 75d3 x32

Specimen 76, image 76d1 x100

Specimen 75, image 75d4 x40

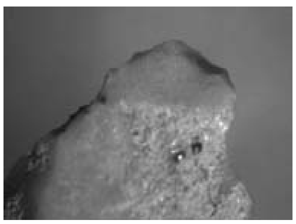


Specimen 77, image 77d x40



Specimen 77, image 77d1 x40

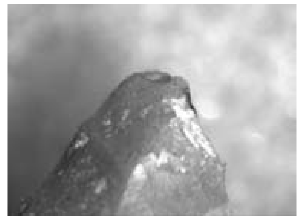
Specimen 77, image 77d2 x50



Specimen 79, image 79t x63

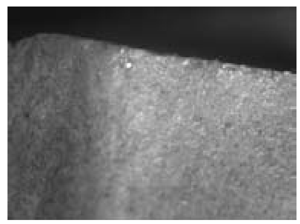
Specimen 80, image 80t x40

Specimen 80, image 80t1 x63

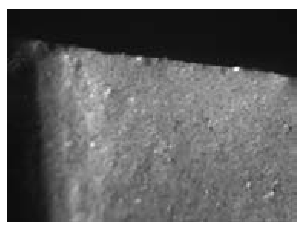


Specimen 81, image 81t x40

Specimen 82, image 82t x40



Specimen 83, image 83d x50

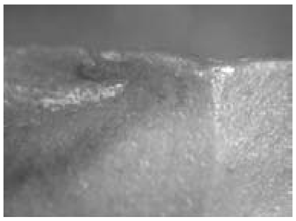


Specimen 83, image 83d1 x50
(different light)

Specimen 84, image 84d x100

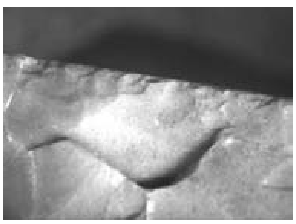
Specimen 85, image 85d x40

Specimen 86, image 86d3 x100

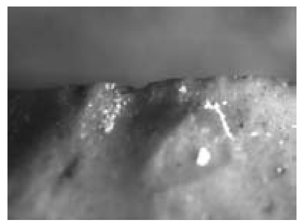


Specimen 86, image 86b x50

Specimen 87, image 87v x63



Specimen 86, image 86d x40

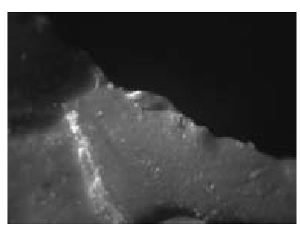


Specimen 91, image 91t x100

Specimen 86, image 86d1 x63

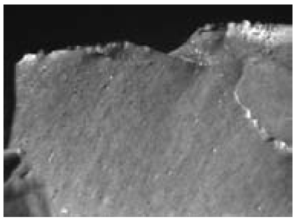
Specimen 92, image 92d x100

Specimen 86, image 86d2 x63

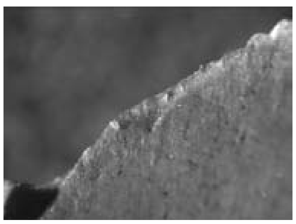


Specimen 92, image 92v x63

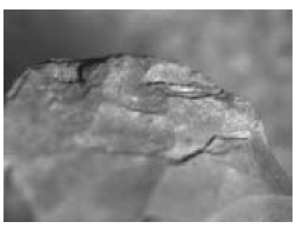
Specimen 93, image 93d x16



Specimen 93, image 93d1 x16

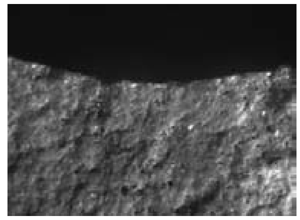


Specimen 93, image 93d2 x40

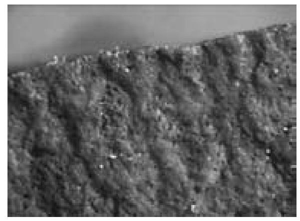


Specimen 94, image 94b x40

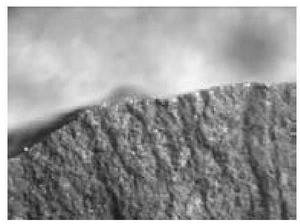
Specimen 94, image 94t x63



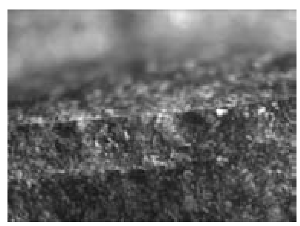
Specimen 95, image 95d x100



Specimen 95, image 95d1 x63

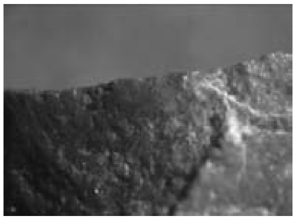


Specimen 95, image 95d2 x40

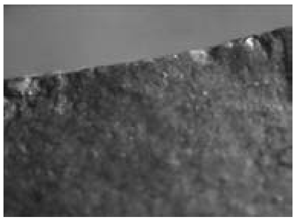


Specimen 97, image 97d x40

Specimen 98, image 98d x40



Specimen 98, image 98d1 x50



Specimen 99, image 99d x63

Specimen 99, image 99d1 x100

Specimen 100, image 100t x25