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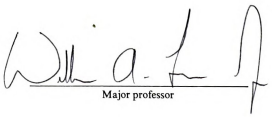
TECHNOMORPHOLOGY, TOOL USE AND SITE FUNCTION
IN THE ITALIAN UPPER PALEOLITHIC

presented by

Randolph Edmund Donahue

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TECHNOMORPHOLOGY, TOOL USE AND SITE FUNCTION IN THE ITALIAN UPPER PALEOLITHIC

By

Randolph Edmund Donahue

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ABSTRACT

TECHNOMORPHOLOGY, TOOL USE AND SITE FUNCTION IN THE ITALIAN UPPER PALEOLITHIC

By

Randolph Edmund Donahue

This study is derived from research at the Upper Paleolithic sites at Petriolo where the fundamental assumption of a co-relationship between tool use and tool technomorphology was applied. This assumption is found throughout the Paleolithic literature when formal stone tool types are used for economic and behavioral studies. This assumption is no longer considered necessary because microwear analysis can adequately test it.

Microwear analysis is the microscopic examination of wear patterns on the edges of stone tools that differ according to the material being worked by the stone. Microwear analysis is applied to level 4a of Paglicci Cave to test relationships hypothesized between tool technomorphology and tool use. Although somewhat hampered by small samples, numerous significant findings result, including: 1) mixed/polygonal burins were generally used as bladelet cores; 2) ogival endscrapers were used for their long lateral edges while the small front is relatively insignificant; 3) the remaining endscrapers are

used only for scraping hide; 4) points are generally found to have been used as knives, mostly for butchering; 5) the converging end of points may sometimes be a hafting element; 6) laterally backed tools fall into two use groups, (meat) knives and armatures, which can be differentiated according to the distribution of dimensional characteristics; and 7) microburins resulted from the manufacture of the functional class of armatures, and not from the manufacture of backed tools in general.

The results of this study indicate that there is substantial conformity between Laplacian techno-morphological types and tool use. When there is nonconformity, often there are other technomorphological characteristics that are found to correspond with use. The general conclusion reached is that there is a strong likelihood that a functional classification of tool types is possible for the late Upper Paleolithic.

These results are applied in a study of site function for level 4a of Paglicci Cave. The assemblage is hypothesized to have resulted from a hunting camp based on the overall activities performed. Various sources of data are analyzed which support this hypothesis of hunting camp over the alternative of residential base camp. General similarities of this assemblage with numerous other lowland cave site assemblages leads the author to speculate that many of these sites may be special function sites and not residential base camps.

To the memory of

B. Mark Lynch

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I wish to thank my guidance committee: William Lovis, Joseph Chartkoff, Lawrence Robbins and Lawrence Keeley for their long term support and the direction they provided during my training. Their maintenance of high standards for my work has made the results of this research so much more satisfactory. I must especially thank them for the speed with which they read and commented on sections of the thesis.

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I wish to gratefully acknowledge the warmth that the Cinelli family has shown me through both good times and not so good times. They will always have my deepest affection. Norm and Eileen Sauer have provided so much moral support that it was obvious that they weren't going to let me not finish. To my parents, for all their support, their patience (even when it seemed so very short) and their love, I can give little but a manuscript and my love in return. Finally, to Daniela Burroni who had a little less patience and much criticism, but who assisted me when I needed help (especially with the figures) and always gave me her love, now perhaps I have a little more time to share with her now that this dissertation is finished.

B. Mark Lynch was a fellow student, a scholar and a teacher, with whom I collaborated on my first publication. His sudden death at such a young age came as a shock to all who knew him.

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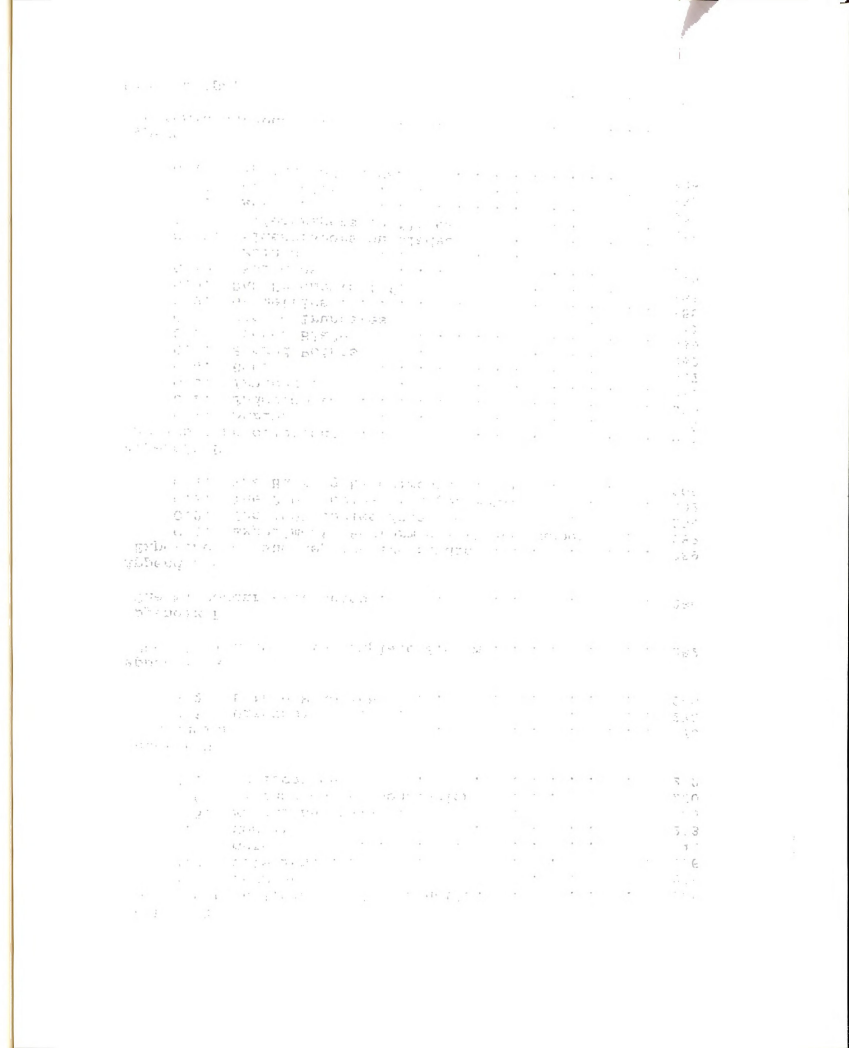
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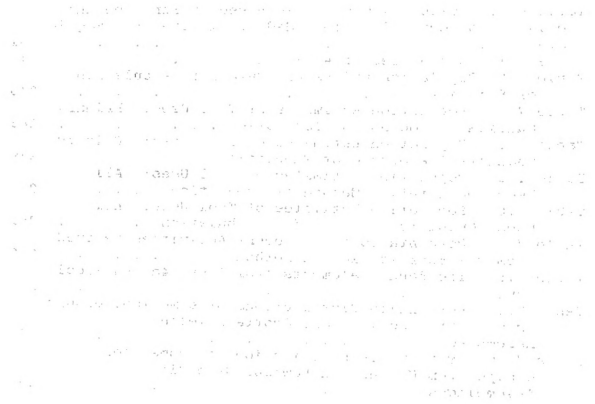
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CHAPTER 1

INTRODUCTION

1.1. The Research Problem

This research stems from a project addressing Paleolithic subsistence and settlement patterns in the Ombrone drainage system of southern Tuscany. The project was initiated in 1976 under the direction of J. Chartkoff in the Farma Valley (see Chartkoff and Chartkoff 1976; Chartkoff and Donahue 1981). Following the formulation of a research design to test two competing models of Upper Pleistocene subsistence-settlement systems in central Italy, the project began a major site survey and the excavation of two sites; Petriolo II and Petriolo III North. It became apparent that certain assumptions, not specific to this project, but common to most economically-oriented Paleolithic studies, had to be evaluated before accurate interpretations could be made of the sites and of the region.

As in most Italian Paleolithic open-air sites, those in the Farma Valley did not contain faunal remains. Methods other than economically informative faunal analysis were therefore called upon. One of these was the spatial analysis of tool types for intra-site activity patterning.

Another was the study of frequency variations of tool types between sites for inter-site comparison and the interpretation of site function (Binford 1978a). It was a basic assumption of the research that different tool types, defined on the basis of morphological and technical attributes, could be used to differentiate activities of economic importance.

This is a classic implicit and explicit starting point for the stone tool analyses of Paleolithic economic studies. Researchers persist in interpreting artifact types which are defined by technical and morphological (technomorphological[1]) attributes as having functioned in certain specific ways. This assumption is the focal point of the research problem: Is there a co-relationship between tool function and tool technomorphology, and if so, can we identify and use it for inferring tool use?

Although this assumption is used by those associated with the "New Archaeology" movement, it did not begin with the application of anthropological archaeology in European

---

[1]The recently developed typologies for Paleolithic stone tools are derived from (and only from) technical and morphological characteristics of the stone tools as clearly presented by Laplace (1964):

> It [The Laplace analytical typology] is based on the idea of primary types, which are purely typological concepts, defined by exclusively morphological and technical terms, which are united according to their technical and morphological characteristics into typological groups.

In order to accommodate this specific approach to tool definition, I will use the term technomorphology.

Paleolithic studies. Instead, as the brief history of Paleolithic stone tool research in Chapter 2 indicates, there had been a long tradition of functional interpretation of stone tools until such research was persuasively stopped by the French Traditional school in the early part of this century because it was considered either unscientific, illogical or unsystematic!

To understand stone tool use would dramatically assist in understanding past human economic behavior. To be able to organize or classify tools according to function allows for the discussion of the activities which occurred at a site, to understand the spatial organization and structure of sites and to differentiate types of sites on the basis of what the occupants were doing at them. There is little question that the ability to specify tool uses would be an achievement not matched since the development of radio-isotopic dating techniques.

For the determination of tool use one must have either direct or indirect evidence on the tools themselves, or resort to analogy with ethnographically documented stone tools to infer tool function. With an analogous approach one must first group or organize tools into identifiable types in order to compare them with their counterparts. This organizational procedure must almost certainly be based upon technomorphological attributes.

A functional interpretation of a tool type by analogy consists of a number of a priori assumptions. First, the technomorphological types are functionally specific (even if "general-purpose"). Second, the functions of these types are properly identified through analogy. Third, the actual tools, even if their type is functionally specific and correctly identified, were used in that specific manner and not in some other way. It should be noted that many recent studies which use technomorphological types and make functional interpretations do not make explicit how function was derived (eg., Freeman 1966).

For many years the assumption remained untested because adequate techniques for testing and evaluating it did not exist. With the development (Semenov 1964) and refinement (Keeley 1980) of microwear analysis, an adequate technique has become available. Microwear analysis is the study of microscopic attributes on the edges of stone tools which result from the use of those tools. Microwear attributes, as observed through experimentation, differ according to the material the tool was used on and how the tool was used. Microwear analysis is a technique for inferring tool use directly from the stone tools. These patterns of use can then be compared with the technology and morphology of the stone tools.

1.2. The Theoretical Orientation

Archaeology has long been considered the science of past human cultures. However, archaeologists recognize that although our objectives include the description and explanation of the past, we do not, we cannot, observe that past. We can only observe cultural and natural processes in the present. We explain the past from inferences derived from observations we make in the present.

The explanation of the past from the observations we make in the present is the task of all historical sciences. The methodology is crucial. Archaeologists are just now learning that methodology, but it was one taught in historical geology more than a century ago by Charles Lyell. He argued that geologists had failed to construct a science of geology because they had not developed the procedures for inferring an unobservable past from a surrounding present and had therefore indulged in unproven reverie and speculation (Gould 1983:123).

Lyell, in Principles of Geology (1830-33), presented this methodology. It consists of two of the four components of his theory of uniformitarianism. As presented by Gould (1977:150-51):

> (1) Natural laws are constant (uniform) in space and time. As John Stuart Mill showed this is not a statement about the world; it is an a priori claim of method that scientists must make in order to proceed with any analysis of the past. If the past is capricious, if God violates natural law at will, then science cannot unravel history.

> (2) Processes now operating to mould the earth's surface should be invoked to explain the events of the past (uniformity of process through time). Only present processes can be directly observed. Therefore we are better off if we can explain past events as a result of processes still acting. This again is not an argument about the world, it is a statement about scientific procedure.

If archaeology is to succeed in its scientific endeavors, then it too will have to operate as a historical science. There are two difficulties to overcome: 1) In order to understand the past, we must infer from our knowledge on how the world operates now; 2) It is necessary that we make uniformitarian assumptions if we are to justify using our understanding of the present to understand the past. The assumptions must be warranted, but they will permit us to relate what we observe in the present for explaining the past.

The method by which this is done is not difficult, but it is challenging. We must study the causal relationships between dynamic aspects of culture and the static remains that they produce in the observable present. We can do this through the use of controlled experimentation on the non-human aspects of culture and through carefully designed research and observation of human behavior. We must be certain that the relationships we see are causal and not correlative or coincidental.

This is the reason why we must observe this relationship in the present. It is only in the present that we can observe both the causal agent and the result.

We can then use the uniformitarian assumption that the causal relationship which is valid in the present is also valid for the past. We thus bridge the living, dynamic, but unobservable past with the static, observable archaeological remains of the present (Binford 1981:22).

These causal relationships found today become the instruments and the observational language for the archaeologists in the future for the study of past processes. It is the development of this observational language that Binford (1981:25) refers to as middle-range theory building (not the same as middle-range theory as used in sociology; see Raab and Goodyear 1984) and Schiffer (1976) refers to as behavioral archaeology. We seek to develop instruments, derived independent of the archaeological record, which will assist us in making unambiguous observations on the archaeological record that measure properties of past cultural dynamics.

> What we are seeking through middle-range research are accurate means of identification, and good instruments for measuring specified properties of past cultural systems. We are seeking reliable cognitive devices; we are looking for "Rosetta stones" that permit the accurate conversion from observation on statics to statement about dynamics. We are seeking to build a paradigmatic frame of reference for giving meaning to selected characteristics of the archaeological record through a theoretically grounded body of research (Binford 1981:25).
>
> The reason that middle-range research must be basically actualistic is that only in the present can we observe the bear and the footprint together, the coincidence of the dynamic and the static derivatives. In more mature disciplines, where a

> relatively sound methodology and a sophisticated observational language exist, it may be possible to use inferred conditions about the past as premises for further inferences if the initial premises serving as the basis of the original inference are securely documented and "verified" at the middle-range level of research (Binford 1981:29).

Our ability to test hypotheses concerning general theory is dependent on our ability to measure past processes with the available archaeological data. Middle-range theory provides the means for bridging the relationships between the archaeological data and the dynamic past which we wish to understand. Without the development of this observational language, without the instruments by which we operationalize the archaeological data, we will be unable to test general theory and thus to produce a truly scientific archaeology. As Lyell put it in referring to the substantial amount of speculation which existed in geology on the eve of his publication, "We see the ancient spirit of speculation revived and a desire to cut, rather than patiently untie, the Gordian Knot" (Lyell 1880-1883 in Gould 1983:123).

The recent research in faunal analysis exemplifies the methodology outlined above. Studies have been made of living human populations and of non-human factors that effect the composition and variation of the faunal remains at a site (Behrensmeyer and Hill 1980; Binford 1978; Klein 1984). Such studies have now produced the means for recognizing some of the dynamic causes for their

characteristics in the archaeological setting. We can now provide meaningful comments about past processes on the basis of those instruments which have been developed. We can now test some hypotheses concerning past processes because the meaningful, non-observable variables of the past are measurable through the use of these new instruments.

Faunal remains are too limiting in the kinds of information they can provide. Faunal analysis permits us to understand only a small part of economic behavior. Perhaps of greater importance is that many Paleolithic sites do not contain faunal remains. This is typical of Paleolithic open-air sites. Economic studies thus face the dilemma that they are often without faunal remains, or when present, lack the ability to recognize many activities and exploited resources through faunal analysis. We must continue to increase our observational language through middle-range research.

One such area of middle-range research, the potential for a host of new instruments, directly and indirectly, is microwear analysis. Microwear analysis is a fully experimental and replicative technique for the analysis of the causes for the wear microscopically observed on the edges of stone tools. The technique is founded on basic theories of surface polishing which confirm that different

abrasional surfaces will produce different patterns of wear.

Microwear analysis is first performed in the present under experimentally controlled conditions. This permits the determination of the material causes for the different polishes on stone tools manufactured of specific raw materials. These microwears can be described and defined.

The research is replicable. The results produced by one experimenter can be tested and then confirmed or challenged by another experimenter. This is perhaps one of its greatest strengths. Microwear analysis is a technique that has been repeatedly replicated with many different kinds of materials, and the results, with only minor deviations, have consistently shown to be the same (Keeley 1980; Vaughan 1981; Moss 1983). There are few, if any, techniques in archaeological research that have been tested in experimentally controlled conditions as often as microwear analysis.

Microwear analysis is thus derived from an independent body of theory. It has been experimentally tested by controlling the dynamic processes that produce the microwear and examining the resulting static attributes of that process. As such microwear analysis is becoming one of the instruments providing information about human activities of the Stone Age.

This thesis is directed toward testing propositions concerning the implied relationship between use and technomorphology of stone tools of the Upper Paleolithic. The analysis is performed for a single level of Grotta Paglicci, a cave site in southern Italy. It is considered a necessary first step in that the relationships resulting from this analysis must be tested at other sites and for other industries of the Upper Paleolithic. Generalizations, even for the cave as a whole, cannot be appropriately made because only one level is examined. However, the implications can be substantial.

If the propositions are accepted, we can begin to justify our inference of function from types derived from technomorphological attributes. One might need only to sample a few artifacts for microwear analysis from a site to confirm such patterning, and then could infer a similar use for all tools of the same type.

If there is no evidence for a co-relationship between technomorphology and use, then techniques such as microwear analysis will be necessary to ascertain tool use. Afterwards one can attempt to derive activities from the spatial organization of the studied tools. Such a result--the rejection of the use of the functional assumption--implies that those studies which have previously interpreted activities or even the function of a site from

the distribution (spatial or frequency) of technological types would be unacceptable in light of the new findings.

It was the intent of this research to provide a first step in determining if there existed co-relations between the technomorphological dimension of stone tools and their functional or use dimension. It was clear at the end of the analysis of the lithics from level 4a of Grotta Paglicci that the resulting microwear analysis implied certain meaningful economic behavior which could be hypothesized and tested. Rather than stop at that point it became my intent to demonstrate that the development of instruments for archaeological interpretation is critical. With the use of the faunal remains from the site the inference of site use as derived from the microwear analysis is tested. Only because the inference resulting from the faunal remains is "securely documented and verified at the middle-range level of research" (Binford 1981:29) is it possible to test this inference of site use.

1.3. Tool Function Versus Tool Use

There has been substantial disagreement, both explicit and implicit, over whether to refer to our subject matter as the study of tool use or of tool function (Hayden 1979). In many studies the terms are considered synonyms and therefore used interchangeably. Others argue that it is tool function that we study and that we refer to ourselves as functional analysts (Moss 1982). One problem with the

term function is that it is heavily over-used in archaeology and it is found in reference to many things other than just tools, eg., sites (Binford 1980).

In addition, the concept of tool function, as used with current typologies, contains an implication that the tool, or better the tool type, has a specific purpose or a special use, even if that use is "general purpose." Typologies of tool function have types based on technical and morphological attributes in which the types are assumed to have been designed for a specific use, task or activity. Tool function is therefore the work a tool is designed to do.

This takes the concept of tool function beyond a simple notion of how a tool is used. Microwear analysts study microwear patterns on stone tools and interpret how those tools were used. Tool use is the work a tool actually performed. To use the term function for what microwear analysts do, the interpretation of tool use, will only create additional confusion.

Consider the following contemporary example of the distinction between tool use and tool function. A screwdriver is a tool designed to be used for turning screws. A screwdriver can be used for other things for which the tool was not designed. If a screwdriver is used only for prying open paint cans, then a correct use-analysis would indicate that the tool was used as a lever.

Its function, that is, its intended use, is to turn screws. This is the function of all screwdrivers. Microwear analysts can interpret the use of a stone tool. It is a leap in logic to interpret what a tool was designed to do.

The distinction of tool use and tool function has behavioral implications. Having a functionally meaningful set of technically and morphologically defined types tells the archaeologist, not how tools were used, but how they were designed to be used. Under normal situations one would expect the use of the tools to be equivalent to their function. If not, then one has a situation in the past where the behavior of the original population does not conform to prior held expectations.

How does one make the logical step from use to function? It is suggested that one must first demonstrate that a homogeneous class of tools defined by a specific set of attributes which distinguish the class from others has a statistically meaningful correlation to a specific use or aspect of use; either motion or material being worked. This would need to be done for numerous sites because of the possibility that use and function do not correspond at a single site. If a relationship is repeatedly demonstrated, then one has the basis for declaring a technomorphological tool type to be functionally meaningful.

Tool function can be the theoretical bridge linking stone tool use and stone tool technomorphology. If technomorphological types did not have a designed use, that is, function, then it is unlikely that dependable relationships can be found between technomorphological types and use. On the other hand, if tools were manufactured in certain standard ways because they were meant to perform certain tasks or functions then there is a theoretical starting point for predicting tool use through technical and morphological characteristics.

The derivation of tool function requires two things. First there must be an attribute based, technically meaningful, descriptive classification system for stone tools. Second, there must be an equally powerful classification system based on microwear attributes which are meaningful in terms of use. In Chapters 3 and 4 classification systems are presented that are considered adequate for these requirements.

CHAPTER 2

THE HISTORY OF PALEOLITHIC RESEARCH AND STONE TOOL ANALYSIS

2.1. Objective

The study of Paleolithic stone tools has been heavily influenced by various dominating themes, models and theories of the discipline. One can discuss stone tool studies outside the history of Paleolithic archaeological theory (and the history of the parent discipline, geology) as has been done extremely well by Vaughan (1981) in his review of stone tool functional studies. However, such an approach fails to present the impact of theory on prehistoric research.

Both, general histories of archaeology (e.g., Daniel 1976) and those specific to the Paleolithic (e.g., Grayson 1983; Sackett 1981), provide little information concerning changing directions and emphases in stone tool research. The ensuing discussion attempts to incorporate stone tool studies, such as reported by Vaughan, within the context of the history of archaeological theory. The goal is to present some possible explanations for the directions of stone tool research. It is suggested that major transitions appear to occur with the collapse of a major theory, model or paradigm in the Kuhnian sense (Kuhn 1970).

CHAPTER 4

THE HISTORY OF PALEOLITHIC RESEARCH AND STONE TOOL ANALYSIS

Four historical periods encapsulate the primary theoretical themes present in Paleolithic stone tool research. These include: (Period I) Pre-1860, when research was directed toward proving that chipped flints were ancient tools; (Period II) 1860-1915, when the field saw a diversity of analyses being performed, (Period III) 1915-1950, during which the field was confined to analyses that would assist in the interpretation of Paleolithic traditions, industries and their relative chronology, and finally (Period IV) Post-1950, when new refined methods of systematics and chronometric dating techniques entered the discipline.

2.2. Period I; Pre-1860

The first period begins during the Renaissance. A time of enlightenment in which even stone tools were recognized by some scholars for what they were; the remains of ancient peoples. Yet, the last fifty years of this first period is marked by substantial disagreement over the interpretation of chipped flints. Why this regression of understanding stone tools? I suggest that the acceptance of an inaccurate theory required disavowment of the true meaning of these archaeological objects.

This history begins with Nicolaus Steno (1638-1686) who provided the basis for distinguishing materials that formed within solids versus those that were formed and then covered by earth (Steno 1916; orig. 1669). It provides a

crucial step in the understanding of stone tools since prior to Steno all materials from the ground were classified as belonging to the same group of "odd things in rocks" (Gould 1983:78). After Steno, stone tools were recognized, along with fossils, as things which were previously formed and then covered over (Steno 1916).

Naturalists in the seventeenth and eighteenth centuries recognized these stone objects as a variety of things, but one of these was stone tools. Their method for recognizing these objects as stone tools was based on a method we still see used today; the use of historical documentation, e.g., Aldrovandi (1522-1607) reciting Pliny (Clarke 1978:4), and through analogy with modern tools and stone tools from primitive cultures (Dugdale 1656; Plot 1686; Lhwyd 1713):

> ...I doubt not but you have often seen of those Arrow-Heads they ascribe to Elfs or Fairies: They are just the same chip'd Flints the Natives of New England head their Arrows with at this Day; and there are also several Stone Hatchets found in this Kingdom, not unlike those of the Americans. I never heard of these Arrow-heads nor Hatchets in Wales; and therefore would gladly be informed whether you have ever heard of their being found in England. These Elf Arrow-heads have not been used as Amulets above thirty or forty Years; but the use of the rest is immemorial: Whence I gather they were not invented for Charms, but were once used in shooting here, as they are still in America (Lhwyd 1713:99-100).

M. Mercati (1541-1593), Superintendent of the Vatican Botanical Gardens also kept a collection of fossils and minerals. His background in classics and his knowledge of primitive cultures from reports and materials being sent to

the Vatican by early missionaries made him aware of an age of stone that preceded the use of metals. He presented an organized scheme for artifacts, in which iron replaced the use of stone:

> Ceraunia is plentiful in Italy, where it is popularly called 'Sagitta' (arrow), since it is carved in the shape of a triangular weapon, made of flint, slender, and hard. Two opinions are held in regard to this. Most men believe that it is deposited by lightning. Those who study history think that before the use of iron it was beaten out of the hardest flints, to be used for the madness of war. For very early man used sections of flint as knives (Heizer 1962:65 translated from the original; Mercati 1717).

In England, by the early 18th century there was sufficiently strong opinion that these were once the tools of humans that J. Woodward (1728) ridiculed those who had interpreted these objects as anything but the results of human manufacture. In France, the idea that these chipped stones were tools and not celestial objects was furthered by a number of French Jesuits including Montfaucon in 1685, Lafitau in 1724 and Mahudel in 1730. They compared the findings of stone tools in France with those used by American Indians (Cheynier 1936:10-14). The result of these studies in France led a three-age system to be proposed in 1758 by A. Y. Goguet. Yet, a hundred years later little further understanding, in fact, greater animosity toward such interpretations, had developed.

The three-age system of Stone, Bronze and Iron was first formally applied at the Danish National Museum in

1819 and published in 1836 by C. Thomsen. Its eventual acceptance as a model of prehistory is significant because it provided temporal meaning to artifact technology. The Stone Age, the earliest of the three Ages was fully accepted. At about the same time a Frenchman, J. Boucher de Perthes (1841), was excavating stone tools in the Somme Valley near the town of Abbeville, yet he was failing to receive recognition for his finds from the scientific community. Why was his interpretation that these were ancient tools made of stone denied? The reason appears to lie in the formation of geological theory.

The intervening years between Mercati and Thomsen saw major accomplishments in the understanding of geological formations. By the end of the eighteenth century, J. Hutton (1795) had interpreted the formation of stratigraphy (successfully), claiming that it results from processes similar to those which we see today. Hutton's theory of uniformitarianism was, however, in competition with that of another geologist; the reknown paleontologist, Georges Cuvier. Cuvier's theory of catastrophism became the more accepted theory because of the nature of the empirical data itself. Stratigraphic layers appear to be the result of major catastrophes.

W. Smith (1769-1839), a canal excavation engineer in England had been studying the fossils found in various stratigraphic beds, and as a result could recognize beds in

different localities as being the same on the basis of their distinctive fossil remains (Smith 1816). Catastrophists used this information to argue that each major catastrophe led to the extinction of many species of organisms and required a new creation to produce those species found in higher strata. Humans were one result of the last creation.

G. Lyell's Principles of Geology (1830-33) did not immediately lead to the rejection and falsification of catastrophism. Instead, there is a substantial time period over which the scientific community modified its views to fall in line with uniformitarianism. Lyell's immediate success was to demonstrate that the earth was very ancient, which was also accepted by catastrophists (Gould 1977:151). Catastrophism remained the predominant theory for the formation of the earth for some time after Lyell's publication.

The rejection of Boucher de Perthes' finds, particularly by French geologists, was a result of the general acceptance of catastrophism. Boucher de Perthes was finding stone tools in association with extinct fauna; fauna already recognized as having roamed the earth prior to the last diluvium or catastrophe. As alluded by Daniel (1976:59), an acceptance of the validity of Boucher de Perthes finds would be a direct challenge to the theory of catastrophism.

It was therefore the endeavor of those working at that time in what today are recognized as Paleolithic deposits to spend their efforts on demonstrating that the stones being recovered were tools manufactured and used by ancient people. This was not the problem in Denmark. The stone tools in Denmark were coming from Neolithic sites in association with domesticated animal remains. Their age was recognized as immediately preceding the Bronze Age. This did not contradict current geological theory. It made humans ancient, but not of antidiluvian times.

In places such as Denmark, therefore, it was for this reason that the basic analytical study of stone tools was begun prior to the acceptance of Paleolithic remains. Stone tools were being studied in Denmark by S. Nillson (1868; orig. 1838-43), who, through systematic studies produced a descriptive classification organized by function. His method included the study of wear which from examination, he argued, one could conclude with certainty how the tools were used (Olausson 1980:48). He also presented the comparative method (Daniel 1976:48). This is the comparison of prehistoric artifacts with formally and functionally identical objects used by modern peoples as a means to identify the artifacts.

The catalyst for the acceptance of Paleolithic remains began at Brixham Cave in 1858 (Gruber 1965). Excavated by three amateur geologists, they discovered in an undisturbed

stratigraphic layer, stone artifacts with extinct fauna. Falconer, one of the three geologists, visited Boucher de Perthes's site in France and suggested that other geologists should see it. The site was then visited by the reknowned geologists, J. Evans and J. Prestwich, who acknowledged its validity.

Evans and Prestwich convinced Boucher de Perthes that papers should be read to the Royal Society of London which was accomplished in 1859 (Evans 1860; Prestwich 1860, 1861). Numerous other English scholars visited Abbeville between the first visit and the reporting of the site. Many of these also gave reports to various Societies, the most significant being Lyell (1860), who had consistently denied that humans were of great antiquity. He now readily admitted that the extinct beasts and humans were contemporaneous. The year 1859 thus marks the acceptance of ancient, stone tool using humans.

2.3. Period II; 1860-1915

> A new field is opened for antiquarian research, and those who work in it will doubtless find their labours amply repaid (Evans 1860:307).

The years following 1859 saw a rapid expansion of legitimate Paleolithic research beyond the well known ravaging of sites for "goodies" to place in personal collections and museums. This was a time when research was extremely diverse, there being such a great variety of archaeological remains to study. There were, in general,

two dominant themes. The first of these was paleethnological, in that it asked significant questions concerning culture history or asked anthropologically oriented types of questions which were thought answerable through comparative ethnography (Sackett 1981:85).

This approach was well represented in Italy where it became formalized as an aspect of prehistory. The International Congress of Anthropology and Prehistoric Archeology was founded at Spezzia in 1865. At the Congress, the term "paleo-ethnology" was proposed as an alternative for prehistory (Daniel 1976:89). The Italians abbreviated the term to paletnologia (paleethnology). Although used for only a short time in most of Europe, it continues to be used in Italy and France, but with a much altered meaning.

In 1871 the Congress met again in Bologna, stimulated by recent findings of lake dwellings not only in Switzerland but also in northern and central Italy. It was from this meeting that Strobel, Pigorini and Chierici established the Bullettino Paletnologia Italiana in 1875. A clearly humanistic approach to the study of prehistory, this school withstood the initial attacks by natural science oriented scholars in the early twentieth century, but was pushed slowly into researching the latter stages of prehistory.

In artifact analysis this paleethnological approach is best documented by the analysis of stone tool function, predominantly by ethnographic comparison. Jacques Boucher de Perthes (1847-65), having succeeded in convincing the world of the validity of his finds, had begun to define them in functional terms using modern tools and weapons for analogy. The approach was similar to that of S. Nillson some 20 years earlier. Many of these same French terms are still used today although their meaning and defining characteristics have completely changed.

John Lubbock in 1865 incorporated an extensive amount of analogy from "modern savages" of Oceania, North America and South America in order to interpret the manufacture and use of stone tools. For example he provides discussion and comparative figures of Eskimo scrapers and Upper Paleolithic endscrapers (Lubbock 1875:95-96 and figs. 103-107; orig. 1865). John Evans (1872) developed a comprehensive classification of stone tools based on analogy with ethnographically recorded stone tools and with modern counterparts. This classification is also predominantly functional.

The second theme found in Europe at this time was one that attempted to order the archaeological record into meaningful chronological phases or epochs (Sackett 1981:85). During this period of Paleolithic archaeology there were two approaches to differentiating and organizing

these sequences. One, typefied by the work of E. Lartet (1862) in France, was to use the faunal assemblages from the (cave) sites and differentiate the periods according to the predominant species. There resulted the Ages of: Woolly Mammoth and Woolly Rhinoceros, Reindeer and Bison.

This approach was later challenged by G. de Mortillet, who argued that archaeological periods must be defined on the basis of archaeological remains (de Mortillet 1883). He introduced many of the names of the traditions which we use today, eg., Mousterian and Magdalenian. In order to differentiate assemblages, de Mortillet developed the "principle of classification by relative rudeness" (Dawkins 1874:353). Artifacts were depicted as representative of an epoch, but there is little evidence that de Mortillet had a knowledge of the variability of industries or an understanding of typological systematics.

De Mortillet's field and analytical methods were extremely poor. As a result, he failed to differentiate Perigordian and Aurignacian assemblages and instead viewed them as representative of a single tradition. This left him vulnerable to attack by his detracters. H. Breuil (1905) challenged Mortillet's scheme in 1905 and within ten years (Breuil 1913) had succeeded in replacing it with his own scheme. With this replacement came the acceptance of other ideas of Breuil and of his contemporaries, especially

D. Peyrony, leading to the end of this formative period of Paleolithic research.

2.4. Period III; 1915-1950

That which has become known to us as the "traditional approach" to Paleolithic archaeology was begun by the famous French prehistorians H. Breuil and D. Peyrony. They emphasized the study of the empirical content of the archaeological record with a primary objective of constructing schemes of space-time systematics. This approach had an overwhelming impact on Paleolithic archaeological research because of its assumptions, methods and goals.

One of the first objectives of this approach was to narrow the scope of Paleolithic studies by declaring that paleethnological research was merely speculation and therefore it was not appropriate for scientific research. As Sackett (1981:87) describes they invoked the principle of "unripe time;" ie., that the writing of culture history had to be postponed to some future time when the data would allow interpretations concerning culture and behavior.

They emphasized two aspects of archaeological research. The first of these was the typology of the artifacts. The second was the study of the structure of the sites and, in particular, the stratigraphic sequence. The two are closely associated because of the underlying assumptions of the research and of the analytic methods employed.

Study of the archaeological record duplicated the paleontological approaches employed to analyze the contents of stratigraphic units and to systematize the fossil record. For paleontologists, formal type-fossil directeurs provided the relational information to cross-correlate different geological sites as well as to define the beds containing similar specimens. Archaeologists used analogous index type-fossils in order to group assemblages into specific industries and traditions.

However, unlike the fossil remains of organisms, archaeological tools used as type-fossils were not inherently defined. What was and what was not an archaeological type-fossil varied considerably. Peyrony, for example, preferred rigidly defined artifact types to use as type-fossils capable of specific stratigraphic interpretation. On the other hand, Bourlon et al. (1912) used morphological traits in order to produce more general type-fossils. The result was numerous regional and local schemes of assemblage ordering that were not comparable[2].

It was noted earlier that a ruling theoretical paradigm directed (or misdirected) geologists from accepting antidiluvian stone tools in the first half of the nineteenth century. Another paradigm directed European

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[2]This was also the situation in Italy until 1964 when Laplace applied his typological system to a large number of Italian sites (Laplace 1964b). The resulting success led to the adoption of this typology for Upper Paleolithic stone tools throughout Italy.

Paleolithic research for the first half of this century, one which accepted the paleontological model and its premises as valid for Paleolithic archaeology. Two basic assumptions were inplicit in this research direction. First, that a one to one correlation could be expected between cultural and natural strata. Second, like a paleontological complex, a cultural complex should be more or less invariant in its composition. Cultural entities recognized by archaeological systematics were regarded as "natural" categories, which were inherently discontinuous and did not modify their form from one context to another. The problem of such a theoretical framework is presented by Sackett:

> A major problem with the use of an organic model of evolution is that when systematic variation occurs within a given tradition in a given region it must be assigned temporal significance so as to reflect a linear succession of industries. A correlate to this is that when different industries "interstratify" within a given regional sequence then they must be accounted for in terms of two distinct traditions. Therefore all significant variability observable in the archaeological record must be significant in phylogenetic terms, variability from any other source, such as variations in activities, was, by definition, excluded from systematics (Sackett 1981:93).

The impact of this movement was felt elsewhere in Europe. In Italy there emerged out of the natural sciences (geology, and specifically, paleontology), a scientific approach to replace the humanistic one. Led by reknowned scholars such as A. Mochi, G. A. Blanc and N. Puccioni, and centered at Florence, they incorporated many scientific

disciplines into the pursuit of Paleolithic archaeology. Bitter disputes arose between the schools of Rome and Florence (Palma di Cesnola n.d.:2-3). Humanistic scholars were eventually edged out of the early periods of the Stone Age and into the Neolithic and later periods of prehistory. More recently, the factions have closed ranks and research is often unified under the original label of paletnologia.

This trend was also followed in England, but with Childe's publications in the 1920s and 1930s, the trend was replaced with one emphasizing the study of prehistory as culture history (Daniel 1976).

During this time there appeared studies relating technology and typology, such as an analysis of thick endscrapers by Bourlon et al. (1912), and numerous experimental studies of technology, including: Rutot (1908), Pfeiffer (1912), Moir (1912, 1914, 1926), Clarke (1914) and Sturge (1914). Many of these studies were attempts to differentiate chipped flints of natural and of human production.

Studies of how stone tools were used, which were common toward the end of the nineteenth century, became more infrequent. Those performed often consisted of interpretations based on features of the tools thought related to use. These studies were in turn performed by archaeologists known for their understanding of technology. D. Peyrony and H. Noone (1938) noted the recurrence of fine

scarring on microburin facet edges and suggested that the scarring could be the result of use as lateral barbs on hunting weapons. In 1949, D. Peyrony interpreted the polish and rounded edges of certain Upper Paleolithic instruments as the result of working hard materials.

These studies are criticized by Vaughan (1981) because they fail to build up an experimental base to demonstrate the validity of their interpretations. Although true, these studies present inferences of tool use derived from detailed examinations of the artifacts themselves. There is a greater awareness that there might be information concerning use on the tools. Most likely this results from an increased awareness and understanding of how flint is modified. The typologists, because of this understanding, attempted to collect empirical information directly from the tools rather than apply analogy based on general similarities with ethnographic and modern specimens.

2.5. Period IV; 1950 - Present

The 1950's saw a trend toward more scientific approaches to the analysis of stone tools and assemblages. Recognition of the complexity of stratified sites has led to highly refined excavation techniques. All artifacts are collected at the sites. Typological systems are developed such that it is the relative frequency of stone tool types that become the criteria for distinguishing different industries. Such quantitatively tending typological

methods were initiated by F. Bordes (1950). These advances have allowed for greater precision in differentiating assemblages. These typologies, including those of Bordes (1950, 1961), de Sonneville-Bordes and Perrot (1954-56), Laplace (1964) and Tixier (1963), are based on measurable attributes of the tools which reflect technical and morphological variation. As such, these typologies have a strong theoretical base. One example of such a system which is incorporated into this study, the Laplace analytical typology, is discussed in Chapter 3.

Paleoanthropological theories and their associated archaeological models have been far less prone to change than analytical methods and techniques. The same organic view of culture as developed in the early part of the century was, and still is, maintained. This results in the inability to provide explanations for interassemblage variation except by proclaiming that different ethnic or cultural populations produced them. Most research reports present the characteristics of the assemblages being studied and a comparison with other assemblages, but there seldom is an attempt to provide explanations for the results.

The 1960s saw the reemergence of use-wear studies of stone tools in European Paleolithic research, beginning with the translated edition of Prehistoric Technology by S. Semenov (1964). The failure by Semenov to provide detailed

methodological information, however led to a ten year hiatus of high magnification studies. Keeley, for his dissertation research, was able to overcome many of the difficulties faced by use-wear analysts (See Hayden 1979). He presented the method for preparing specimens and viewing them with a light-incident microscope at magnifications centering around 200x. Most important, he emphasized the need for experimental research prior to archaeological study. Finally, he demonstrated the validity of such research through blind-testing (Keeley 1980). Since Keeley's research there has been much recent research as recently documented by Vaughan (1981). These will not be presented here although their analyses and results will be discussed and incorporated into the description of microwears in Chapter 4.

Although little impact has yet been made on European Paleolithic research by these microwear studies, functional interpretation pervades the recent literature. This is often the result of liberal transgressions taken in the name of anthropology by "New Archaeologists" entering European Paleolithic studies. Much of this recent literature presents some of the most thought-provoking and challenging essays--a result of providing human behavior as one explanation for inter-assemblage variation--although they use methods for interpreting stone tool function that were used in the eighteenth and nineteenth centuries.

In terms of modern behavioral approaches to the analysis of Paleolithic assemblages one must start with Binford and Binford's now classic study of Mousterian inter-assemblage variation (1966). Few other articles have produced such a stir of debate, reaction and controversy. Yet, even if one accepts the basic method of factor analysis (Harmon 1967) used to derive their site activity factors, there is still much to criticize.

In order to derive factors that are meaningful with regard to activities, the Binfords were required to present the artifacts as functionally meaningful. Each tool type, or group of types, based on the Bordes classification system was given a specific function. The basis for such interpretations were given as:

> ...a priori judgments as to the mechanical task for which the implements would have been utilized. When we felt our judgment was shaky or that there was ambiguity in the morphology of the tool, an alternative suggestion is offered (Binford and Binford 1966:243-45).

Vaughan (1981) is extremely harsh on the Binfords' interpretation of factors; criticism which is misdirected as there is no breach in the Binfords' logic at this point. The variables they use are the functional interpretations of tool types. The interpretation of the factors on which the functional tool types load are activities or tasks; what one might expect from groupings of tool types defined by function. One should note that in their various publications they describe their method of interpreting the

factors in three different ways (Binford and Binford 1966:243, 1966:267; S. Binford 1968:51)! On the other hand, Vaughan pays little attention to the most critical aspect of their method, and that which makes the entire research questionable; that the a priori assumptions of mechanical tasks (tool function) based on tool morphology are valid. It is no complement to the "New Archaeologists" that many of them quickly accepted the functional interpretations of the Mousterian facies as fact, although it was stated at the outset that this was but a preliminary analysis.

Freeman (1966) deserves an equivalent critique for his analysis of Middle Paleolithic assemblages in Spain. In this study the resulting groupings of artifact types from a factor analysis were interpreted as representing different tool kits which performed different tasks. Underlying this argument is that the tool types have different functions. But the only reference to this underlying assumption is a brief line stating that:

> Now, if it is assumed that Mousterian stone artifacts are nothing more than tools, then they must have been appropriate to the performance of a number of specific tasks which were somehow similar even in extremely different environments (Freeman 1966:232).

Whallon (1973) in the first of his three part study of the spatial analysis of Paleolithic occupation areas uses the same argument, but with a different tack; he argues that spatial patterning of tool types should exist and

reflect the locations of different activities that require different toolkits:

> We refer to the implication that artifacts, classified into separate tool types, should be differentially distributed on prehistoric occupation floors as a result of their differential utilization in the various separate activities carried out by human groups at each location used or inhabited (Whallon 1973:115).

Whallon in the following paragraph explicitly states the required assumption. "A necessary assumption for Binford's argument is that these tool types are defined by a typology which measures primarily 'function'" (1973:116). He makes the claim that a test of this assumption is that at least some of the tool types will exhibit significant spatial patterning and mutual association with other tools on some occupation floors (1973:119). While I don't disagree with this claim it must be noted that his finding of the significant spatial patterning of three stone tool types in his second article (Whallon 1974) in and of itself fails to justify the assumption because by chance alone one would expect some types to display spatial regularities.

In a reappraisal of spatial analysis Whallon (1978) suggests that there are problems with his approach. Specifically he suggests that: current models, which incorporate the concepts of toolkit and activity area, are too simple; available analytical methods are inadequate; and the assumption that traditional techno-morphological types represent functional classes, even at a

rudimentary level such as cutting, scraping and piercing, is basically false.

Although in this article Whallon appears to recognize the deficiencies of his approach, his comments on how he will continue research at the sites at Havelte indicate this is not completely true. On the basis of his original success with his approach at the site of Guila Naquitz where excellent spatial patterning was found for the debris of worked materials, he suggests that one might find better evidence for activity areas by looking at the patterning of tool by-products at Havelte. These by-products include tool fragments such as spalls from retouched working edges, borer tips, slivers from cutting edges and spalls from scraping edges (Whallon 1978:34). However, this only transfers the assumption that one can infer function from technomorphologically defined tools to technomorphologically defined fragments of tools. If there are not strong correlations between tool technomorphology and function, then it is unlikely that there will be any between types of tool fragments and function unless demonstrated through experimental use-wear studies.

Keeley (1982) also points out that Whallon's assumption of spatial patterning may be correct, but that he has over-simplified the expected patterning because of hafting behavior, and that hafted and non-hafted tools can occur simultaneously at a site.

That what Whallon wants to accomplish is within our grasp is seen from the multi-dimensional approach used to study the lithic remains at the site of Meer (Cahen et al. 1979). The investigation of the concept of toolkits followed numerous lines of research including microwear analysis, refit analysis and spatial patterning (paleotopography). The research at Meer revealed the existence of activity areas, such as a hide scraping area and a bone and antler working area. These economically meaningful results are derived from knowledge of tool use and by not assuming that final spatial distribution of stone tools necessarily represent the activity area of their use or that tools found in spatial association are necessarily activity related.

For European Paleolithic research in general, the "New Archaeology" does not represent new goals as much as it represents a revival of attempts to understand the broad spectrum of culture and behavior which was being studied prior to the twentieth century. It has improved theory, and it has developed a large array of sophisticated analytical techniques for studying the past. The methods employed for studying that past however, have often made the same errors that led to the eventual end of paleoanthropological and culture historical studies. There is little reason for us to still be making many of the same tentative assumptions that were used more than a century

ago, especially since we have the ability to test these assumptions.

The recent approaches toward interpreting the past by studying the processes that produce the archaeological present (eg., Binford 1981; Keeley 1980) attempt to correct our weak scientific foundation for explaining the past. They are building the observational language required for a truly scientific anthropological Paleolithic archaeology.

CHAPTER 3

THE LAPLACE CLASSIFICATION SYSTEM

3.1. Introduction

The French paleethnologist Georges Laplace found fault with the various typological approaches that were being used in France during the 1950s and early 1960s. The descriptive techniques of the Traditional French school, which described type-fossils for ordering assemblages in a paleontological approach, were still in use. However, the impact of Bordes (1950) study, if not immediate, certified that these other approaches were no longer adequate for assemblage ordering.

The geographic method, which recognized some of the faults of the morphological descriptive method, tried to correct them by placing geographic and temporal boundaries on type-fossils. This, however, was eventually seen as unscientific because the strictness of the definition of the stone tools based on their own formal characteristics was lost. It attempted to bound the type as one would find a cultural unit bounded in space and time. Types in this system were associated to an abstract concept whose validity for the Paleolithic was not certain. Industry, as it is used in Paleolithic archaeology, is not meant to

correspond to a unit of cultural organization. Instead they represent technological complexes, and how these might relate to units of culture as identified by ethnographers is yet to be understood (see Laville et al. 1980:15-16).

The "statistical" or "analytical" methods of artifact classification are based on exact typological definitions as applied to entire assemblages. They provide a quantitative measure of the composition of an industry by defining all tools. Such "statistical" approaches include those of Bordes (1950, 1961), de Sonneville Bordes and Perrot (1954-56), Tixier (1963), the recent work of Perles (1976), and also that of Laplace (1964).

According to Laplace, one of the weaknesses of the other systems is that they have incorporated within their schemes many of the traditional types whose terminology is derived from: a supposed function, a purely morphological attribute, relative sizes, archaeological periods, stages or industries, geographic regions and sites, and personal names. Another basic problem is that there is little or no structure to these typologies, instead they present a long list of types where their relationship to one another is not defined by the system, but only within their definitions.

The typological system of Laplace (1964), an analytical typology as he refers to it, is based, at its most fundamental level, on 85 primary types. These types are

defined exclusively by descriptive technical attributes of which many are theoretically and experimentally linked to technology. These primary types are united according to similar technical and morphological attributes into fourteen typological groups and these groups combined into five families or families of groups (Table 3.1).

There is thus a hierarchical structure to the Laplace system, one of four levels (the class level, set between the group and the primary type, is little used). All taxons at all levels are defined in this strict manner. The attributes used in the definitions and descriptions of the tool types are presented in Appendix A.

The Laplace classification system provides one additional thing which other systems fail to do. In individual tool descriptions, or when patterning is found among tools below the level of primary type, the Laplace system incorporates the same attribute set for describing all characteristics of the tools including those which do not define the primary type. This is a definite advantage for microwear analysts who are studying the relationship between tool use and tool technmorphology or using technomorphology as a sampling criterion. One is thus capable of studying the relationship of use to techno-morphology at four levels of tool nomenclature, and in addition with specific combinations of attributes including individual technomorphological attributes.

Table 3.1

The Structure of the Laplace Classification System

Level of Nomenclature		
Family	Group	Primary Types
Burins	Burins	B1-B9
Endscrapers	Endscrapers	G1-G9
Differentiated abrupt retouch tools (RAD)	Truncates	T1-T3
	Becs	Bc1-Bc2
	Backed points	PD1-PD7
	Backed blades	LD1-LD6
	Backed truncates	DT1-DT8
	Geometrics	Gm1-Gm9
Foliates	Foliates	F1-F10
Substrates	Points	P1-P5
	Scrapers on blades	L1-L3
	Scrapers on flakes	R1-R5
	Abrupts	A1-A2
	Denticulates	D1-D8

Note: Classes and detailed descriptions of types are presented later in this chapter.

For example, one could study use among the group of endscrapers, or of the class of thin frontal endscrapers, or of the primary type of circular, thin and frontal endscrapers (G5). Finally, one could study use of endscrapers defined by aspects of suggested secondary types, such as those with frontal lateral notches (Galiberti and Giannoni 1980-81), or even to individual attributes such as the use of flat retouch at the end opposite the endscraper front. All of this information is recorded in a structured and systematic way by the Laplace system.

3.2. The Laplace System in Italy

The Laplace system became used in Italy as a result of his successful analysis of numerous Italian Upper Paleolithic assemblages (Laplace 1964b). Prior to that time there were numerous regional typological systems. Because of incongruent types and inconsistent terminology there was tremendous difficulty to perform comparative research of assemblages. Laplace's analysis of a large number of assemblages from various geographic regions demonstrated that his classification system with some basic statistical procedures could order assemblages into various industries.

Laplace first published his classification system in 1964. He has revised it twice since then, once in 1968 and again in 1971. It is the 1964 version of the system that

is commonly used in Italy although the other versions are occasionally presented. The use of numerous versions does add complications for those interested in regional comparisons, but it has not been a severe distraction from the overall success of the typology. It is the 1964 version that is used for the analysis of the Upper Paleolithic stone tools from Paglicci Cave.

3.3. The Typology

The types are presented below according to their descriptive characteristics. Figures are provided to assist in the understanding of each type. For more detailed information concerning the definition of types, see Laplace (1964a).

The family of burins contains three classes which are further subdvided into nine primary types (Figure 3.1). The classes include: 1) simple burins, formed only by burin spalls; 2) burins on fractures and 3) burins formed by retouch and spalls. The nine primary types are:

B1: A simple burin with a single burin face;

B2: A simple burin with two opposing lateral burin faces;

B3: A simple burin with one lateral and one transversal burin face;

B4: A simple burin with retouch intersecting the burin face;

B5: A burin on a fracture or break;

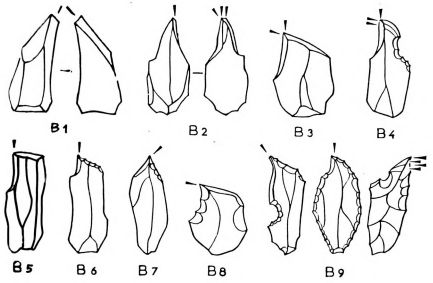


Figure 3.1. The group of burins.

B6: A burin with a lateral burin face and transversal retouch;

B7: A burin with a lateral burin face and opposing lateral retouch;

B8: A burin with a transversal burin face and lateral retouch;

B9: A burin with retouch and a burin face arrested by retouch.

Later editions of the typology switched the labels for B6 and B7 in order to make them consistent with the positions of their sister types B2 and B3.

Two technical attributes are incorporated in the description and analysis of burins. These are the profile morphology and the profile direction which are described in Appendix A.

The family of endscrapers, like the burins, contains but one group of the same name. Endscrapers have a convex front, and a profound amplitude of retouch and either a simple or raised mode of retouch. There are nine primary types in three classes: the thin endscrapers with a large front, the nosed endscrapers and the carinate or thick endscrapers (Figure 3.2). The nine endscrapers are:

G1: Thin and long endscraper;

G2: Thin and long endscraper with (profound) lateral retouch;

G3: Thin and short endscraper;

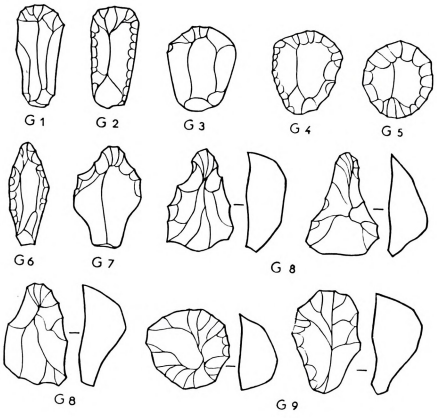


Figure 3.2. The group of endscrapers.

G4: Thin and short endscraper with (profound) lateral retouch;

G5: Thin and circular front endscraper;

G6: Thin, ogival and nosed endscraper;

G7: Thin and nosed endscraper;

G8: Carinate and nosed endscraper;

G9: Carinate endscraper.

The family of differentiated abrupt retouch tools (RAD) includes six groups. All groups are characterized by the distinctive placement of abrupt mode of retouch.

The first group is the simplest and is labeled the group of truncates. They have an abrupt mode of retouch on a transversal end. There are two classes, those with marginal retouch and those with profound retouch, and there are three primary types (Figure 3.3):

T1: Truncate of marginal retouch;

T2: Normal truncate of profound retouch;

T3: Oblique truncate of profound retouch.

The group of becs (beaked tools) consists of two distinct classes of one type each (Figure 3.3). Both classes have a pointed end as a result of the converging retouch. The becs are:

Bc1: Bec on a truncate (a lateral notch is placed near the truncated end);

Bc2: Bec on a backed point (laterally opposing abrupt retouch).

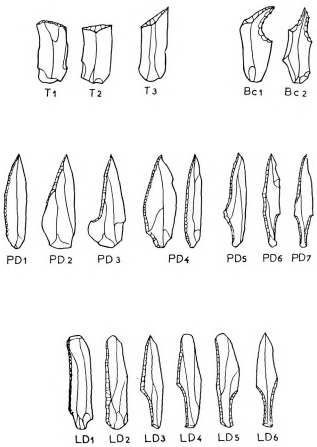


Figure 3.3. The groups of truncates, becs, backed points and backed blades.

The group of backed points consists of three classes: those with marginal retouch, those with profound retouch and those with a notch or cran[3] (Figure 3.3). Backed points must have abrupt retouch at the point otherwise they are backed blades. The seven primary types are:

PD1: Backed point of marginal retouch;

PD2: Backed point partially of profound retouch;

PD3: Backed point with a cran;

PD4: Backed point with profound retouch;

PD5: Backed point with an adjacent cran;

PD6: Backed point with an opposite cran;

PD7: Backed point with a tang.

The group of backed blades consists of the same classes as backed points. Backed blades have abrupt retouch on only one lateral edge unless associated with a cran. They are differentiated from backed points by their not having abrupt retouch at the point of the blade (Figure 3.3). The six primary types are:

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[3]The term used by Laplace is cran, which translates from the French as "notch," and refers to the concavity formed by the very invasive abrupt retouch along a part of one edge. Given that notch is such a vague term used in association to many other tools, I prefer to stay with the French term, cran, In addition, to be a cran, the resulting tongue must be relatively long. Americanists will notice that crans are another way of viewing the production of shoulders, such as on shouldered points. When there are crans on both lateral edges the modification is refered to as a soie which is the same French term used for the tang or tongue of a knife or sword.

LD1: Backed blade of marginal retouch;

LD2: Backed blade of profound retouch;

LD3: Blade with a cran;

LD4: Backed blade with an adjacent cran;

LD5: Backed blade with an opposite cran;

LD6: Blade with a tang.

The group of backed truncates (proto-geometrics) is characterized by abrupt retouch on one lateral edge and having at least one truncated edge. The group consists of three classes: backed and truncated blades, backed blades with trihedral points and backed points with truncated bases (Figure 3.4). The eight primary types are:

DT1: Backed blade with normal truncate;

DT2: Backed blade with double normal truncate;

DT3: Backed blade with acute angle, oblique truncate;

DT4: Backed blade with obtuse angle, oblique truncate;

DT5: Backed blade with double irregular truncate;

DT6: Backed blade with trihedral point and truncated base;

DT7: Backed point with base normally truncated;

DT8: Backed point with base obliquely truncated;

DT9: Backed point with truncated base.

The group of geometrics consists of three classes: segments, triangles and trapezoids. Geometrics are characterized by abrupt retouch on two or more edges and are distinguished by the following forms (Figure 3.4):

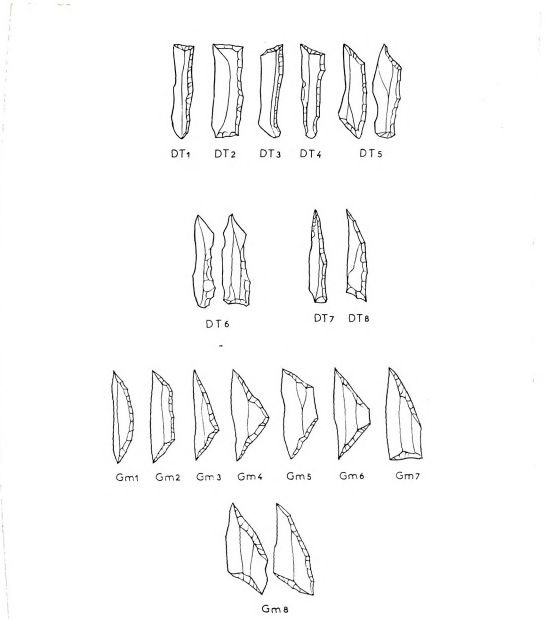


Figure 3.4. The groups of backed truncates and geometrics.

Gm1: Circle segment (lunate);

Gm2: Trapezoidal segment;

Gm3: Scalene triangle;

Gm4: Isoceles triangle;

Gm5: Scalene trapezoid;

Gm6: Isoceles trapezoid;

Gm7: Rectangular trapezoid;

Gm8: Rhomboid.

The family of foliates is characterized by tools with a flat mode of retouch. Flat retouch not only modifies the edge, but it also modifies, by thinning, the faces. The family consists of a single group which contains five classes: Pieces with a flat face, bifacially retouched pieces, flat retouched pieces with a tang, geometrics of flat retouch and scrapers. There are ten primary types (Figure 3.5):

F1: A truncate of flat retouch;

F2: An assymmetrical (lopsided) point of flat retouch;

F3: A straight point of flat retouch;

F4: An ogive of flat retouch;

F5: A bifacially flat retouch piece;

F6: A flat retouch piece with a truncated base;

F7: A flat retouch piece with a stem;

F8: A flat retouch piece with a cran;

F9: A flat retouch geometric;

F10: A flat retouch scraper.

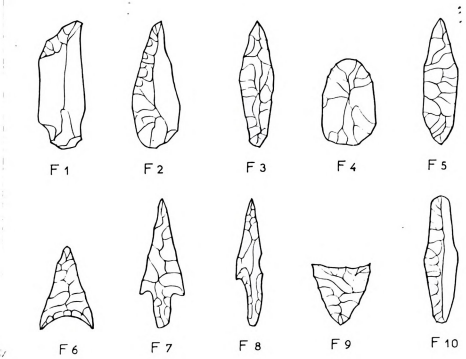


Figure 3.5. The group of foliates.

The substrate family consists of five groups which are generally retouched tools that do not fall into the previous well-defined categories. The first group in the family is the group of points. It is characterized by the production of a point on a flake or blade by simple or raised retouch on both lateral edges. There are three classes: with marginal retouch, with profound retouch and carinate. There are five types (Figure 3.5):

P1: Thin point with marginal retouch;

P2: Thin straight point with profound retouch;

P3: Thin, assymmetrical (lopsided) point;

P4: Thin, shouldered point;

P5: Carinate point.

The group of (side)scrapers on blades is characterized by simple or raised retouch on one or both lateral edges of a blade (Figure 3.6). It consists of three classes with one type each of the same label:

L1: Thin scraper on a blade with marginal retouch;

L2: Thin scraper on a blade with profound retouch;

L3: Carinate scraper on a blade.

The group of scrapers on flakes is characterized by simple or raised retouch on one or more edges (Figure 3.6). It consists of three classes: marginal, profound and carinate:

R1: Thin scraper with marginal retouch;

R2: Thin scraper with profound lateral retouch;

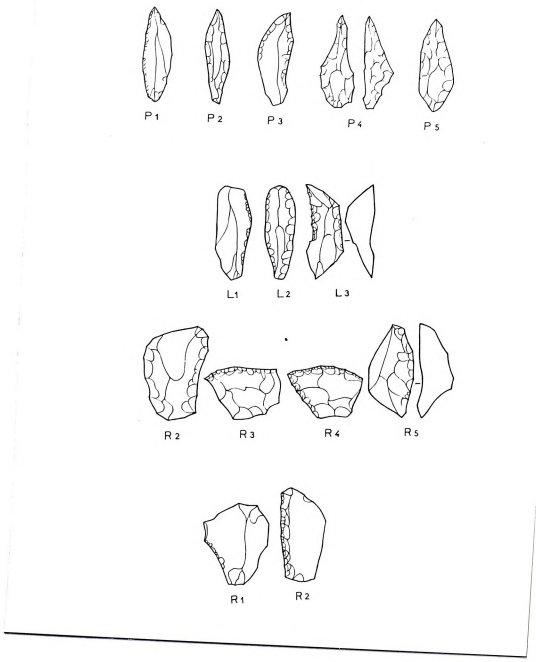


Figure 3.6. The groups of points, (side)scrapers on blades and scrapers on flakes.

R3: Thin scraper with profound transversal retouch;

R4: Thin scraper with profound lateral and transversal retouch;

R5: Carinate scraper.

The group of abrupts is characterized by abrupt retouch along one or more edges. It consists of two classes of one type each (Figure 3.7):

A1: Abrupt with marginal retouch;

A2: Abrupt with profound retouch.

The group of denticulates is characterized by the production of a notch or a series of notches which produce a toothed edge. They are produced with simple or raised retouch. The group consists of two classes; thin and carinate. There are eight primary types (Figure 3.7):

D1: Thin notch;

D2: Thin denticulate scraper;

D3: Thin denticulate point;

D4: Thin denticulate endscraper;

D5: Carinate notch;

D6: Carinate denticulate scraper;

D7: Carinate denticulate point;

D8: Carinate denticulate endscraper.

Outside the formal and statistical classification scheme of Laplace there also occur other groups and primary types. Some groups in the family of <u>divers</u>, include the

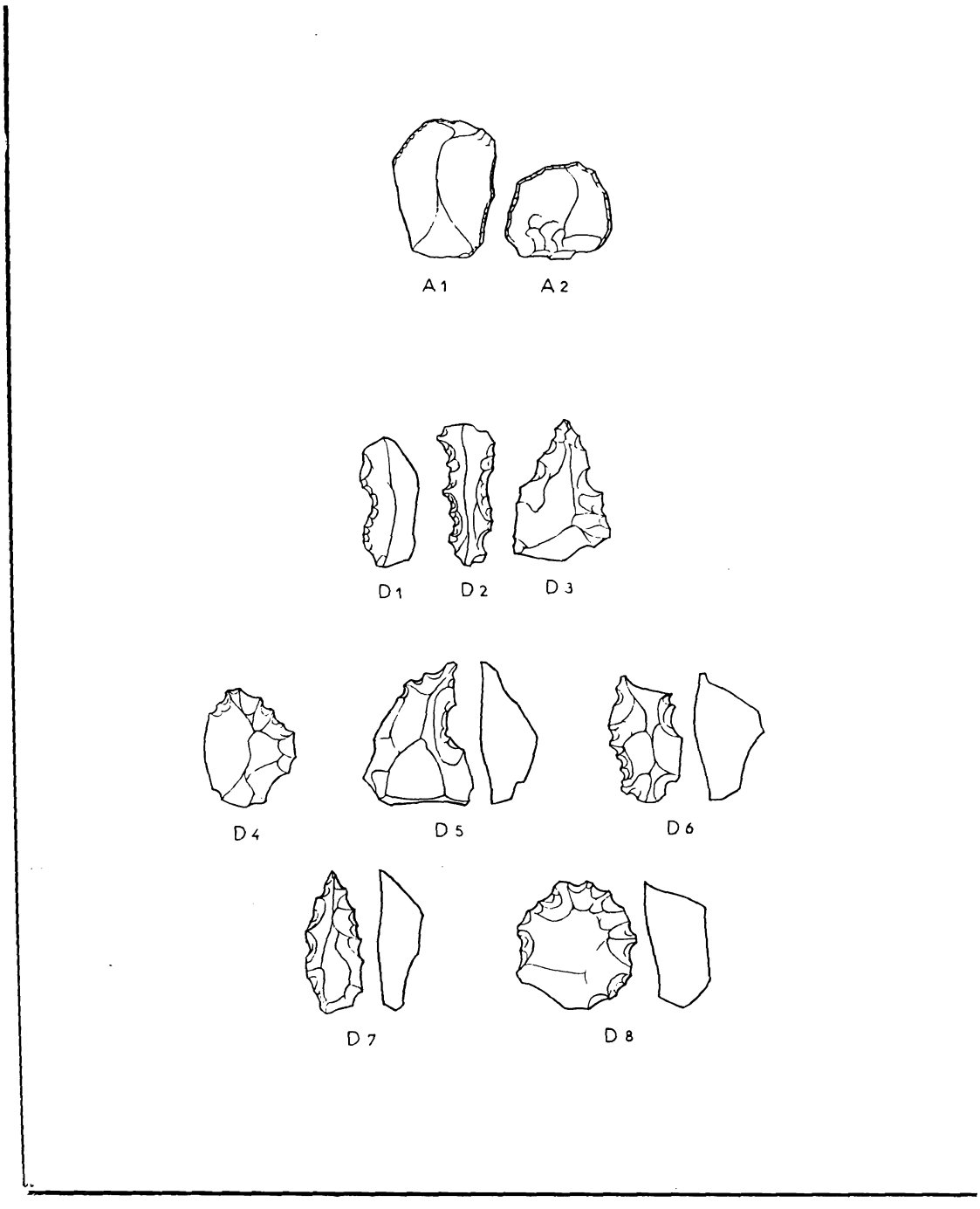


Figure 3.7. The groups of abrupts and denticulates.

pièce esquillée (splintered flakes) and the microburins. These are labeled "E" and "m" respectively.

Because of the increasing evidence of the importance of unretouched tools that have edge modification (often thought to be edge damage) many typologists and analysts have added primary types for this "inframarginal" retouch category. These include: T0, P0, L0, R0, A0 and D0. Analysts do not include these primary types in statistical summaries or indices of families or groups, although they will be studied, classified and tabulated.

The Laplace tool types as can be seen from their definitions do not include any inferred functions. This is typical of all commonly used European Paleolithic stone tool typologies (see footnote 1, page 2). However, as is mentioned in Chapter 2, many of the descriptive labels of these systems are derived from Boucher de Perthes's system in which function was inferred. It is thus easy to make the mistake of assuming inferred functions for tool types in these systems if one is unfamiliar with the attributes used to define the types.

CHAPTER 4

A CLASSIFICATION SYSTEM FOR MICROWEARS

As presented in the first chapter there is a substantial need for the development of a classification system for tool use. It was argued that approaches which incorporate ethnographic analogy or analogy with modern technology are inadequate for such a classification system because we cannot verify the functional equivalence, and as also pointed out, cannot be certain that those tools were used in accordance to their functions. A meaningful typology for tool use depends on our ability to derive information about use from the actual tools.

4.1. Goals and Objectives

The goal is to develop a classification system of stone tools that can be a building block for the study of Paleolithic economic behavior. In order to do this it must be based on observable attributes and yet meaningful to tool use. Although we desire to discuss tool use what we observe and classify are wear patterns on the stone tool edges that can result from tool use. Because these wear patterns can only be discriminated with a microscope they will be referred to as microwears. It is these microwears that can then be used to infer tool use.

CHAPTER 4

There is a variety of stone materials on which microwear traces can be found, but most experimental studies with the same results as here are performed with fine grain silicates such as flint, chert or jasper (Keeley 1980; Moss 1983; Vaughan 1981). The field of the classification system is thus limited to fine-grain silicates with the understanding that the field may have to be reduced, or may actually be expanded, as experimental research continues.

The classification system is hierarchically structured. This is unique to systems currently used by microwear analysts. Linear schemes tend to categorize microwears at the most specific level deemed discernable through experimentation. Because often only a few attributes are discernable not all microwears can be characterized at such a precise level.

When currently confronted with this difficulty the microwear analyst must decide whether to discard it from the analytical process, to add a new, general category or guess and place it in one of the specific categories. To discard sampled tools is to complicate already complex statistical sampling procedures. Failure to differentiate requires an additional category to be produced. If additional categories are formed, their inclusion, exclusion or combination with other categories would still have to be decided at a later stage in the analysis.

Because methodological problems arise when adding new categories as a result of the inability to distinguish microwear patterns, forced categorization is more likely to occur. Such a situation would lower the accuracy of the classification procedure in order to maintain a high level of precision or specificity.

The hierarchical classification system resolves this difficulty by providing various levels of precision. A microwear that cannot be classified at the most precise level, may still be classifiable at another level. Accuracy, the ability to correctly identify a microwear, should be maintained. Because many research problems will not require extreme precision, one can improve accuracy by operating at a less precise level in the hierarchy.

Consider the study performed by Odell and Odell-Vereecken (1980). In this low magnification use-wear study Odell analyzed stone tools used by the co-author. He interpreted their uses at two levels. One in which he gave some general characteristics of the material worked (e.g., hard, soft) and also a finer, more precise level where he actually attempted to interpret the specific material worked (e.g., meat, carrots). At the more general level he resulted in 61.3 percent accuracy while at the more precise level he had only a 38.7 percent accuracy. Precision without accuracy is clearly meaningless.

Another aspect of this system, unlike those in current

use, is the labeling of the categories. It has become the common practice of microwear analysts to give material names to the microwears especially polish types, e.g., hide polish, meat polish, wood polish, etc. This has been done because experiments show that such microwear patterns result from the use of those specific materials, or put another way, of materials with those specific characteristics.

The labels presented here avoid that practice, although according to theory that which defines the unit has primacy over the label (Dunnell 1971:58). There is an attempt here to separate and distinguish the two steps involved in the study of microwears. The first step is observation and recognition. By characterizing the various attributes of the microwear the analyst is able to classify it. The second step is that of interpretation or inference; when the analyst makes an inference as to the material that caused the microwear.

Why distinguish these two steps? Most microwear analysts recognize the two step process (e.g., Keeley 1980:23). It is important that the steps are distinguished because first, they represent two distinctly different sources for error. It is possible to make incorrect observations on the microwear such that it causes a misidentification of the microwear category.

At the interpretive stage additional sources of error are likely. This is the case when one has incorrectly inferred a material as the cause of a microwear which was actually produced by another material. For example, it has recently been suggested by Vaughan and Anderson (Keeley, personal communcation) that bone and antler can produce an identical microwear. In this case one could hypothesize that the wear pattern observed is that of antler, when it had actually been produced by bone.

Another example is the experimental test performed by Keeley and Newcomer (Keeley 1980). In experiment 15 Keeley describes a microwear that is bright and smooth, and has numerous shallow and deep striations, which he then mistakenly identifies as produced by hide. Although these attributes are not typical of bone which actually produced the microwear, they certainly are not characteristic of hide. Labeling the microwears with neutral names may not correct such errors of interpretation, but it will allow others to recognize that the error does not result from an inability to observe and discern the attributes that characterize the microwears.

Finally, however, there is another reason for desiring not to place material labels on the microwear patterns. Microwear analysts are studying the effects on stone tools by different materials continually. There is no reason why

we should assume that the materials in these new studies will continue to produce new and distinct microwears. The likelyhood is that we will begin to find materials that produce the same kinds of wear as those already identified.

Such cases have already begun to appear. Keeley (personal communication) has discovered that the cutting of fresh elephant hide produces the same kind of microwear as the cutting of the dry hides of most other mammals. By using material names for microwear labels situations can arise such as the finding of fifty blades with dry hide polish in association with the remains of elephants. By claiming dry hide we are already making the inference that they were drying and then preparing elephant hides for who know's what in a place where the butchering of elephants took place. The error is either not recognized or the microwear analyst has to explain that although it is dry hide polish (a microwear) it will not be interpreted as resulting from dry hide (a material).

Rather than backstepping, it is suggested that it is best to categorize the polish in neutral terms and then state the interpretation. In most current situations the inference follows naturally from the observation thanks to substantial experimentation (Keeley 1980; Vaughan 1981; Moss 1983). In the example above, because more than one interpretation is possible, independent sources of information are included in making the inference from a

neutral classification based on observed attributes. "Fifty blades with H1M microwear were found. This polish can be produced experimentally from dried mammal skins and from the fresh hide of a few kinds of mammals including elephants. Because a large quantity of elephant remains were found in association with the blades the wear is interpreted as resulting from the cutting of fresh elephant hide[4]." The importance of using a multi-dimensional approach to the interpretation of a site is also emphasized by this point. One line of evidence can be extremely misleading.

4.2. The Attributes

The attributes selected for the classification system are ones that have consistently shown to be relevant in the microwear patterns produced during experimentation by materials that would have likely been worked in the Paleolithic. As such these attributes may not be sufficient or even adequate for differentiating microwear patterns produced by materials manipulated during the Neolithic, Bronze Age or other periods and places.

The attributes themselves can be organized into three independent categories: fractures, striations and polish of the stone's surface. Some of the attributes measure tool direction or motion rather than the material being worked.

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[4]It has recently been brought to my attention that Akoshima (1982) has also argued for and developed a neutral classification system.

All attributes and the attribute states are presented in Appendix B.

4.3. The Classification System

The classification system consists of four hierarchical levels which have been labeled from general to specific: family, group, class and type. At this time there are a total of 12 types, but the system has been designed such that new types and new categories at all levels, can be added as meaningful additions become necessary or are desired. The classification system operates in a more or less nomethetic approach, that is, the appearance or non-appearance of a single attribute state does not determine the classification of a microwear. For this reason microwears will be discussed in general terms--the attribute states presented, more or less, characterize that category.

Alphanumeric characters are used for labeling the taxa. For the level of family capital letters are used as labels. Labels for the level of group use the letter of its family and a number. For the level of class a capital letter is used. A number is used at the level of type with the class label in the same way as the group label includes family (see Table 4.1). Added to this information is a second alphabetic character for direction of motion. A third alphabetic character can be added for the angle of attack of the tool (Table 4.2). In order to simplify the

Table 4.1

Classification of Microwears

Family	Group	Class	Type
Y (Characterized by materials that yield to the tool)	Y1 (Yielding and non-reflective)	H (Hide)	H1 (Dry hide)
			H2 (Fresh hide)
		M (Meat)	M1 (Meat & hide)
			M2 (Meat)
	Y2 (Yielding & reflective)	P (Plant)	P1 (Soft plant)
			P2 (Woody plant)
		W (Wood)	W1 (Soft wood)
			W2 (Hard wood)
R (Characterized by materials that resist penetration by the tool.	R1 (Same as R)	B (Bone & antler)	B1 (Smooth antler)
			B2 (Rough antler)
			B3 (Bone)
		S (Shell)	S1 (Shell)

Table 4.2

Categories of Motion and Angle of Attack

Indicators of Motion	Indicators of Angle of Attack H: High angle	L: Low angle	U: Undet.
P: Parallel to the edge	PH	PL	P
S: Perpendicular to the edge	SH	SL	S
O: Oblique to the edge	OH	OL	O
I: Impacting with the edge	IH	IL	I
M: Multiple directions	MH	ML	M
U: Undetermined	UH	UL	U

Indicator of Motion	Key	Hex	Dec	Oct	Bin
P: Jump to the outer	2H		50		F
S: Jump out of the cave	9H		9E		A
O: Go to the west	0H		00		0
I: Jump back with the Cup of	IS		1B		I
M: Motionless observation	1E		30		M
U: Wandering mind	0Z		1E		U

memorization of labels, character codes are generally the first letter of the experimentally worked material or direction which originally produced those microwears.

It must be noted that the structure and the labels of this classification system are developed by the author. However, the descriptions of the microwears for the type follow very much what has been demonstrated by many other microwear analysts as well (see microwear categories as presented by (Keeley 1980; Moss 1983; Vaughan 1982). Their descriptions and comments about microwear characteristics and the materials that produce them are incorporated here. When disagreements exist these are explained. Some of the experimental research associated with the development of this classification system are presented in Appendix C.

4.4. The Microwears

4.4.1. Family of Y (Yielding) Microwears

The family of Y microwears is typically characterized by small fractures, often of bending initiations. Polishes tend to develop on the edges and up the faces (but within two millimeters of the edge) as well as in both high and low contours in the microtopography of the tool's surface. This microwear pattern results experimentally from the working of yielding or soft materials.

There are two groups of microwears in this family, each containing classes and types. The first of these is the Y1 group distinctive for the low-reflectivity of the polish.

This group of microwears is characterized by fracture patterning of the family and by a variety of polishes or abrasions that are typically dull or non-contrasting relative to the original surface. While the texture in this group varies, it is never smooth as characterized by the other group in this family.

Within the Y1 group there are two classes, the first of these is the H class labeled after hide for which the characteristic attributes were first recognized. Fractures are mainly bending initiations with various terminations, but rarely snap terminations. The striations are usually numerous and they vary in type. One type of striation, a linear depression, which is found on the edge is very characteristic of this class of microwear. The polish is usually dull and has a matt texture. Edges and nearby arrises usually show extreme rounding. A type of micro-pit, fairly large and almost hemispherical, is found occasionally in association with this polish. There are two types of H microwear.

The H1 type of microwear usually has numerous small fractures with bending initiations. The fractures have no distinguishing termination type. Step terminations are common with an associated scraping motion and snap terminations are not found. The microwear is characterized by a high frequency of striations and a variety of types including: narrow and deep, shallow and diffuse, and

linear depressions. Linear depressions are found in areas of greatest abrasion, the edge. The polish is distributed up the face and usually at all topographic contour levels. It is extremely matt in texture and dull in reflectivity. It is characterized by an undulating or rough microtopography which appears to result from extreme reduction of surfaces, especially the rounding of edges and arrises. In association with highly worn areas are occasional micropits, fairly large in size (discernable at 100x) and hemispherical in shape. This microwear pattern is reproduced in experiments in which dry hide is worked (Photomicrographs 3 and 4).

The H2 type of microwear has many of the same characteristics as H1. Fracture and striation patterns do not differ. Polish characteristics however can vary, sometimes substantially. The polish differs in that it is often less matt, sometimes with a somewhat lustrous, greasy-like surface texture. It also can have a rough microtopography although the undulating surface may or may not occur. The rounding of edges and reduction of surfaces appears lessened as well. Pitting patterns as above also occur. This microwear is reproduced in experiments with tools working a greasy, but dried hide. It can also be reproduced by the working of fresh hide after the flesh has been removed (Photomicrographs 5 and 6).

The second class in the low-reflectivity group is the class M. This class differs from the H class in that its fractures are typically very small, striations are rare, the polish is not dull, but neither is it bright. There is a textural sheen to the surface. Surface and edge reduction, while varies, is rarely as much as seen in the H class. Also, the polish contains no pitting.

The first of the microwear types of this class is the M1 type. It is characterized by small fractures usually with bending initiations, and various terminations with the exception of snaps. The striations are infrequent and include various types, but not the linear depressions. The polish is typically non-contrasting with the original surface, but at times can be more reflective. The polish has a textural sheen to it, while the microtopography is extremely rough. The abrasion, the edge rounding, can vary substantially. It appears positively correlated to the roughening of the surface. There is no pitting associated with this polish. This polish has been reproduced in experiments on the effect of working very fresh hide; in skinning, in the fleshing of hide and in general butchering where mostly meat, but also hide is being cut (Photomicrograph 7).

The M2 microwear is characterized by extremely small fractures, typically with bending initiations and feathered terminations. Striations are rare. The polish varies in

reflectivity, but tends to be slightly more reflective than the original surface. This may be a result in the change in texture which has a sheen, almost a greasy like aspect to the surface of the stone. The edge and faces are modified in this fashion as well as both high and low topographic contours. The microtopography of the flint surface is usually unchanged, but can be slightly roughened from extended wear as indicated by mild rounding of the edge. Typically there is very little rounding of the edge. No pitting is associated with this microwear. This microwear is experimentally associated with meat cutting and butchering (Photomicrographs 8 and 9)[5].

The second group in this family is the Y2 group characterized by polishes of high-reflectivity. Besides this very bright polish, the group is also characterized by a very smooth polish and moderate to substantial rounding. Polish can extend up the face and effect all or most

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[5]It has been suggested by one analyst (Vaughan 1981) that this kind of microwear polish develops as a first stage for many microwears. It should be noted however that one must take into account the fracture patterning as well as the polish formation. Even so, with paying attention to only the polish one will discover that other microwear polishes will tend to develop their own distinctive patterns on the edge by the time that the M2-like polish will develop on the faces. M2 polish develops along the face, as much as 2mm away from the edge, while developing along the edge as well. Although Moss (1983) suggests that this microwear is most intense at 2mm away from the edge, I have found it most intense on the edge and decreasing in intensity as distance increases from the edge.

contours of the microtopography. Fracture and striation characteristics vary.

The only class of the Y2 group is the P class consisting of the above characteristics.

The first type in this class is the P1 type characterized by small fractures of various initiations and terminations. Bending initiations usually predominate. Striations are infrequent. They are somewhat unique because it often appears that the polish fills them in somewhat. The polish is very bright and very smooth, both the texture and the microtopography. It is argued whether the smoothness of the microtopography of this polish is the result of a "filling in" of the lower contours with a silicate gel, an intense abrasion of the higher contours or a combination of the two. Nonetheless, the resulting polish appears almost layered on the surface of the tool. The polish often extends far back from the edge. The edge itself is often extremely rounded, extremely abraded, and does not neccesarily have this smooth polish on its surface. The polish also contains micropits, the shape of comets with their tails parallel to striations. This polish is experimentally reproduced by the cutting of plant fiber such as hemp or jute and reported for the sickling of wheat and wild grasses (Photomicrograph 10). Its extensiveness and extreme brightness causes it to often be visible without the aid of magnification.

The P2 microwear is characterized by small to medium size fractures of various initiations and terminations. The striations, infrequent, are typically narrow, but there is also a distinct kind which is broad and shallow. The polish is very smooth and bright. It has a doming or undulating microtopography. The edge is moderately rounded. The polish is found on the edge and onthe face near the edge, going back as much as one to two millimeters. The lowest contours of the microtopography are rarely affected, but moderate and high ones are affected. There is no pitting yet recorded in association with this microwear. The microwear has been experimentally reproduced with the working of very soft wood and woody plants (Photomicrograph 11).

4.4.2. Family of R (Resistant) Microwears

The second family of microwears is the R family and contains but one group, R1. The family and the group are characterized by two basic features. First, extensive and large fractures along the working edge. Second, the very small areas where the polish develops; the polishes are not difficult to see as they are bright, but instead of being dispersed (fairly evenly distributed) on the edges and nearby faces, they are spotty or patchy and found only on the higher contours of the microtopography. The extreme amount of fracturing of the edge often increases the effect of the spotty appearance of the polish. The basic

characteristics of this microwear family is associated with highly resistant or hard materials.

The first microwear class in the R1 group is the W class. The fractures are large and vary in types of terminations and initiations. Striations are infrequent, but not uncommon. The polish is extremely bright, texturally smooth and tends to dome or undulate in microtopography. The polish tends to be on the edge or on the faces near the edge. It can extend farther back, however. Related to this, it tends to be found at high and medium, but not the lowest contours of microtopography. Edge rounding can be substantial. There are a two types of W microwear. They differ in the extensiveness of the polish and the size of fractures.

The W1 type is very similar to P2. It tends to have slightly larger fractures, typically of medium size. The polish is less extensive going only a short distance up the face from the edge. The lowest contours for the most part are also unaffected. This microwear type has been reproduced experimentally with the working of medium hardness wood (Photomicrgraph 12).

The W2 type has many of the same attributes including infrequent striations which are typically narrow, but there is also a distinctive broad and shallow striation. The polish is very bright and smooth, and appears to dome microtopographically. It also has no pitting. It differs

from W1 microwears in that the polish rarely extends beyond the edge or the interface of edge and face. It usually appears only on projections, thus only on the higher contours of the microtopography. The fracturing is extensive along the edge, and usually consisting of fairly large fractures as well. The polish has been reproduced experimentally through the working of very hard (and usually dried) wood. It is suggested that the working of driftwood (an Arctic phenomenon) would produce this microwear as well.

The second class of the R1 group is the B class which consists of three types. The class is a complex one and one in some state of confusion as will be discussed later.

The B1 type of microwear is characterized by medium to large fractures of various initiations and terminations. Striations are extremely rare, but when recorded are narrow and shallow. The polish is bright and the texture is very smooth. It has an undulating microtopography. The combination of these three characteristics has led Keeley (1980) to describe the polish as having the appearance of a melting snowbank. The polish can spread slightly more than the other microwears in the group, but typically stays near the edge and on the high and middle contours of the microtopography. There is seldom, if any, micropitting associated with this microwear. The microwear is experimentally reproduced by the working of antler. Fresh

and soaked antler produces less fracturing of the edge and greater dispersion of polish than does dry antler (Photomicrograph 13).

The B2 type of microwear has the same fracture and striation characteristics, but the polish differs. It is rough rather than smooth although its brightness remains unaltered. No other major differences have been recorded. Keeley (1980) has recorded the appearance of this polish from experiments on sawing antler (Photomicrograph 14).

The B3 type of microwear is characterized by large fractures and of high frequency along the edge. Fractures can have various terminations and initiations mainly dependent on motion. The polish consists of numerous deep, narrow striations that are found running in parallel tracks. The polish is bright, the texture is rough and not smooth. The polish is found only on the edge and usually only on projections of the edge. It is never found up the face and is found only on the highest contours of the microtopography (Photomicrograph 15). The polish, if bathed in hydrochloric acid, often produces micropits. These micropits are very tiny and are thought to be produced by the dissolution of apatite by the HCl bath. The microwear has been reproduced by the working of bone. This microwear is often found in association with polish resulting from autoabrasion; fine grains of flint abrading

the surface of the tool. This can cause the B3 polish to be even less visible.

The class of B microwears consists of those that have been reproduced in experiments on antler and bone. It has been argued that either of these materials can produce the polishes described and thus the material cause for archaeological specimens cannot be discerned. Future experiments may indicate other ways to do so. Interpretations of these three polishes may, for the moment, be best considered not capable of allowing a more precise interpretation than hard animal tissue even though the specific microwear type is distinguishable.

The S class of microwear contains but one type, S1. This microwear is characterized by substantial abrasion on the edges and often numerous striations. Fracturing of the edge is substantial. The polish is bright and rough, but also rough in topography giving it a rather geometric design. Keeley has suggested that the polished surface is actually micro-cracked (Keeley: personal communication). The largest amount of research done on it so far is by R. Yerkes (1983). This microwear is associated with the working of shell (Photomicrograph 16).

4.5. Categories of Motion and Angle of Attack

In order to have a classification of microwears which is meaningful to tool use there is more information required than simply the material being worked. The other

major aspect of tool use is the method of employment of the tool on the object. This aspect of tool use consists of two factors. The first is the motion of the tool, or more exactly the working edge, against the object. The second is the angle at which the tool is maintained while it is being used against the object.

The question of how a tool is used is an interesting one. At first, one thinks that there are few ways. Yet, as one begins to remember the terminology we have developed for this question of "how?", the numbers increase dramatically. There is cutting, slicing, sawing, scraping, grating, planing, drilling, engraving, piercing, wedging, adzing, axing or chopping, digging or hoeing, etc. These terms, however, often reflect more than just the motion and angle of attack of a tool, they also are terms specific to a material. We hoe soil, but we adze wood. The motions and the angles of attack do not differ greatly, instead the terms reflect the material being worked.

In each of the two aspects of method of use, there are only the dimensions of space one can move one object relative to another. By considering mixed motions, differing angles, one can produce an unlimited set of use methods, but these are beyond our techniques to accurately interpret.

The attributes used for interpreting these two factors are mechanically produced. They consist mainly of

attributes of fractures and striations. The attributes used are presented in Appendix B. There are two confounding factors that can influence the behavior of some of these attributes. These are the material being worked, mainly the hardness of the material, and the spine plane angle of the tool. These factors can tend to increase or decrease the apparent force of impact of edges against materials. Occasionally they can influence the interpretation of the direction of movement as well.

4.5.1. The Motion of Use

The motion of use of a prehistoric stone tool can only be inferred. This is no different than inferring the material that was worked. However, because the dominant attribute used in inferring direction of use is the striation whose linear morphology is parallel to the direction of movement the inference seems less difficult to make.

Microwear patterns relevant to the motion of a tool have been subdivided into five categories (Table 4.2, page 70). They are labeled with a capital letter corresponding, when possible, to the direction of the most important directional attribute, the striation. Because the direction of a striation is also the direction of the tool, this seems a successful means for denoting direction of use. Direction is oriented in relation to the edge.

The first category of microwears that indicate direction of use is the P (parallel) category. Striations and "comet-pit tails" are oriented parallel to the edge. Fractures tend to be oblique, not perpendicular, to the edge. Fractures are found on both faces, often alternating. Fracture characteristics, especially with the R family of microwears, often include bending initiations and snap terminations. If the movement was unidirectional then polish develops on faces of fracture scars that face that direction. These characteristics are experimentally reproduced by a tool motion parallel to the edge.

The S category consists of striations and "comet-pit tails" oriented perpendicular to the edge. Fractures are also perpendicular to the edge and are often unifacial. These characteristics are experimentally reproduced by a tool motion perpendicular to the edge.

The O category consists of striations and comet-pit tails oriented obliquely to the edge. Fracture directions often vary. Often polish is better developed on one face of fracture scars than on the opposite face. The fracture ridge above these polished surfaces is approximately perpendicular to the oblique striations. This microwear pattern is associated experimentally with motions oblique to the edge. An example of such a motion is the whittling stroke.

The I category consists of striations and comet-pit tails parallel to impact fractures. These may occur perpendicular to an edge or parallel to the bisect of a pointed end. This microwear pattern results from movement directly toward the object. Inferences for use vary from projectiles to chopping to wedging.

The M category consists of striations and comet-pit tails oriented in numerous directions. Fracture patterns vary. Such patterns are reproduced in experiments by multiple motions of the tool. Post-depositional causes for such striation patterns should be considered.

The U category indicates that no microwear pattern is available which will allow for the inference of a direction of use.

One final comment concerning the microwear of drilling. Drilling will produce an S category of wear on one edge and an S category of wear on the opposite edge. The motion of drilling therefore must be inferred on the basis of the technical features of the tool and the combination of these S categories of motion on opposite edges.

4.5.2. The Angle of Attack

This aspect of how a tool is used is perhaps the most difficult to infer. There are only three categories of attack based on two definable microwear patterns. Each category is labeled with a capital letter (Table 4.2).

The category H contains polish mainly on the edge and is equally distributed on the two faces. This pattern is seen when the tool is held perpendicular or at a high angle to the object being worked.

The category L contains polish predominant on the edge and one face. The fracturing of the edge is also unifacial. This wear pattern is associated with tools held at a low angle to the material being worked. This category can be underestimated if the tool were flipped over and used in the same manner.

The last category, U, encompasses those tools with an undefinable angle of attack. Because this is a common category because of the difficulty of ascertaining the angle of attack, this label is assumed and is not required; for example, instead of H2SU, H2S is adequate.

4.6. Other Causes of Flint Surface Modification

There are many other factors that effect the surface of a flint. Some of these are microwears in that they modify the flint itself, but these are seen as being produced by natural causes. Others are deposits on the flint surface such as from some metal alloys and from baths of mineral rich water. Finally there are those produced by the many processes labeled under the heading of patination. Because these different non-use produced alterations of flint surfaces have been discussed by numerous other authors (Anderson-Gerfaud 1981; Keeley 1980; Vaughan 1981; Moss

1983), and they will not be repeated here (Photomicrographs 17-19).

There is little doubt that there are now other microwears being discovered and recorded which could be incorporated into this typological system. It is hoped that this will eventually be done. Finally, although these microwears have been organized on the basis of similarity of characteristics it is hoped that the underlying causes for their similarity and dissimilarity can be discovered so that a theoretical foundation can be laid and built upon. Whether or not this system will survive such progress is uncertain, and of little import if the result is improved scientific method and greater interpretive performance.

4.7. Microwear and Retouch: A Discussion

Before leaving this chapter it is an appropriate point to discuss some implications derived from experimental research and from some basic axioms. Certain deduced theorems will play an active role in the interpretation of some tools from Paglicci Cave.

Three definitions of important concepts are first presented in a somewhat simplified version: 1) Edge--the intersection of two planes to form a line; specifically, the line formed by the intersection of the ventral face and the dorsal face of a stone tool; 2) Arris--a ridge approximately perpendicular to an edge which typically results from a fracture on that edge; 3) Retouch--the

modification of the edge of a stone tool by reduction through the deliberate production of fractures; 4) Microwear--the microscopic wear characteristics on or near the edge of a stone tool which result from the use of that tool (Figure 4.1).

Two axioms are now presented which set the underlying assumptions for the derived theorems. 1) Microwears are a surficial phenomenon; they develop on the surface of the silicate (flint) and not within the flint; ie., one cannot fracture the polished surface and still have microwear underneath the removal. 2) Any edge or face of a stone tool that comes into substantial non-stationary contact with another object (such as an object being modified) will develop microwear characteristics including patterns of: polished surfaces, fractures, striations and the rounding of edges and arrises.

The following theorems are deduced directly from the previous axioms. The first theorem, important to microwear analysis and the reconstruction of tool histories related to use, and fundamental to most of the theorems following it, that it is given the designation of the Law of Precedence. This law states that: If a microwear exists on an edge and the surfaces forming that edge of a stone tool then that edge and its defining surfaces existed prior to the development of that microwear (Figure 4.2a).

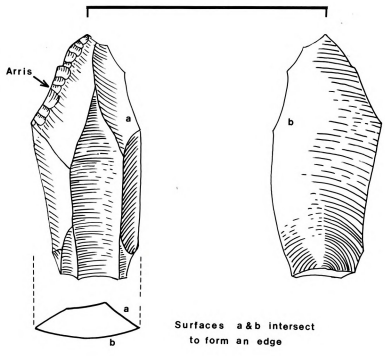


Figure 4.1. Some technical aspects of a flake.

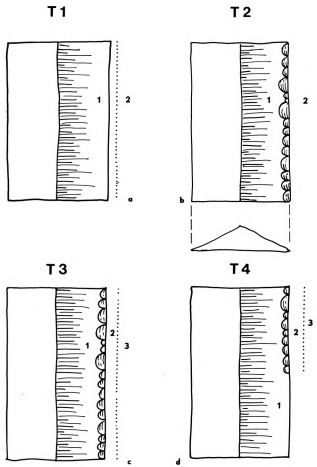


Figure 4.2. Visual representations of theorems 1-4. Small numbers denote the sequential order of the involved processes.

Theorem 2 applies the same relationship to an edge and retouch as the Law of Precedence does for an edge and microwear. It states that, if retouch originates along the edge of a tool then that edge and the two surfaces that created that edge, must have existed prior to the production of the retouch (Figure 4.2b).

Theorem 3 states that, if a microwear exists on a retouched edge then that retouch preceded the microwear (and by logical deduction the use that produced that microwear). It follows that a retouched edge and face is also a surface and thus also falls under the Law of Precedence (Figure 4.2c).

Theorem 4 states that, if a microwear exists on a retouched portion of an edge then that edge preceded the microwear. This is true even if portions of the edge exist unretouched and without microwear. This theorem incorporates the temporal relationship between Theorems 2 and 3 where it follows that if the edge precedes the retouch and the retouch precedes the microwear then the edge precedes the microwear (Figure 4.2d).

Theorem 5 states that, if an arris exists on an edge and face, and a microwear is produced on that edge, then that arris will also have (at least partially) that microwear. Once again the arris is a part of the surface thus it falls under the Law of Precedence. It should be noted that the most obvious aspect of the microwear on an

arris is the rounding of the arris near the edge with less rounding as the arris continues up the face. It should also be noted that this theorem does not negate the possiblity for other causes of rounding or of producing a microwear on an arris (Figure 4.3a).

Theorem 6 states that, if a microwear extends along an edge to the ridge of an arris and that arris has no microwear (the ridge is sharp along its length) then the microwear precedes the arris and, by definition, the fracture that produced the arris. This theorem prepares for the following theorem. There can be extreme difficulty with a deep concavity or even a snap fracture in determining if it occurred before or after the use of an edge. The analysis of the bordering arris clarifies this relationship (Figure 4.3b).

Theorem 7 states that, if an edge is partially retouched and a microwear extends only along the unretouched part of the edge, abruptly ending at the first arris of the retouch (Theorem 6) then the microwear precedes the retouch. This theorem clarifies when retouch follows the use of an edge (Figure 4.4a).

Theorem 8 states that, if an edge has two distinct areas of retouch and microwear extends only along one area of retouch and abruptly ends at the first arris of the second area of retouch, then the retouch with microwear precedes the microwear and the microwear precedes the

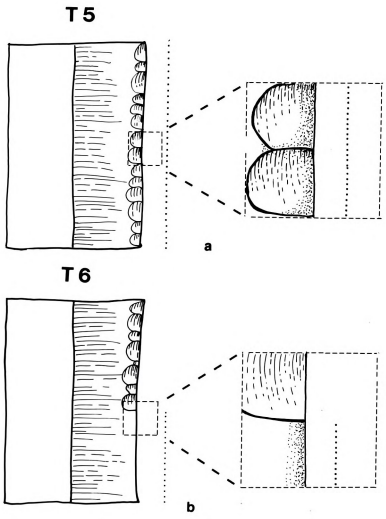


Figure 4.3. Visual representations of theorems 5 and 6.

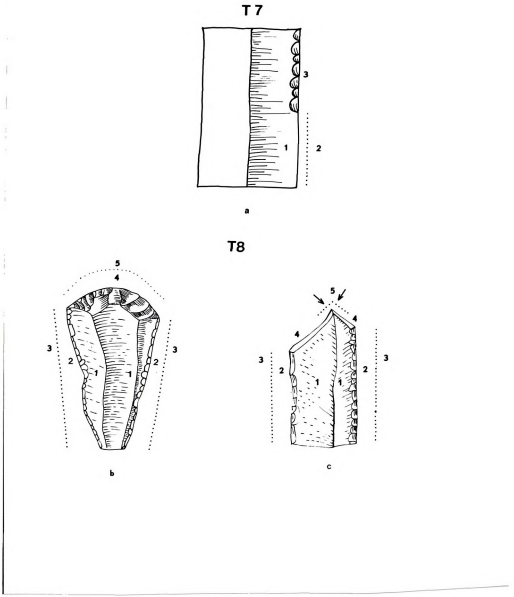


Figure 4.4. Visual representations of theorems 7 and 8.

retouch without microwear. Numerous theorems are combined here to produce a complex statement about the use and modification of a tool (Figure 4.3b and 4.3c).

The application of these theorems during the analysis of the stone tools will clarify there value in lithic analysis and in understanding site dynamics. If stone tools went through numerous stages of use and modification these theorems will help unravel that history.

CHAPTER 5

PAGLICCI CAVE

Apuglia is a long narrow region along the east coast of Italy located south of Molise and north of Calabria. Extending 400km along the Adriatic Sea, the region consists of both the heel and the spur of Italy's familiar boot-like outline. It is in the far northern area of Apuglia, the spur of the boot, the Province of Foggia, where lies Paglicci Cave (Figure 5.1).

5.1. Environmental Context

Foggia contains two of the most unique topographic features of southern Italy. The Gargano Promontory, a large plateau, rises abruptly out of the Adriatic Sea in the east and above the Tavoliere Plain in horizontal gradations along its southwestern edge. It is this plain which is its second most remarkable feature. The Tavoliere Plain circumscribes the western half of the promontory and is circumscribed itself by the foothills of the Appennine Mountains. Large and seemingly featureless, the Tavoliere Plain extends over an area of 5000 square kilometers.

Paglicci Cave lies above the Tavoliere Plain at the western end of the southern face of the Gargano Promontory in the municipality of Rignano Garganico. Named for the

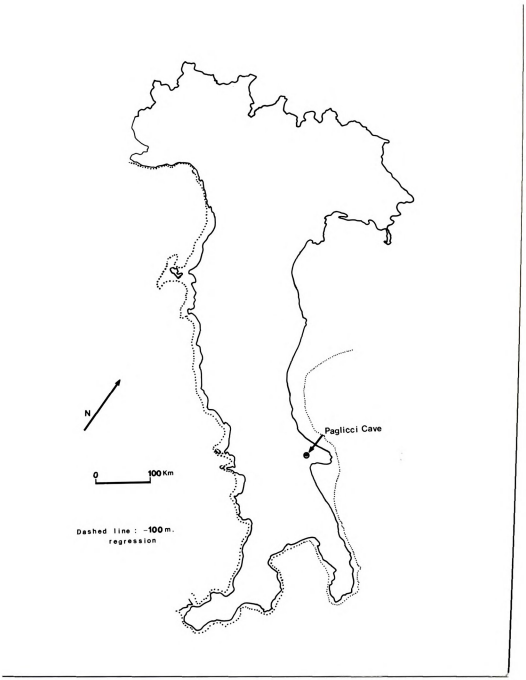


Figure 5.1. Peninsular Italy.

nearby farmstead of Paglicci, it lies just inside the canyon of Settepenne, at an elevation of about 150m. Opening to the southwest, it overlooks both the canyon and the plain (Figure 5.2).

The cave, consequently, lies at the confines of two very different environments. Below the cave is the Tavoliere Plain. Its soil, consisting of Plaisancian sands and Pleistocene clays, is quite shallow, usually less than one meter thick (Houston 1967:404). Below the soil is a bedrock of Cretaceous limestone. The plain is well known for its Neolithic sites in locations where light sands predominate (Jarman et al. 1982:163). The heavy clay soils, inadequately drained by the small rivers of the plain, produce both marshy conditions and, due to low summer rainfall, hard, compact soils. The plain was the winter grazing area of a major transhumant pastoral strategy which is hypothesized to have had its origins in the Bronze Age (Houston 1967:531; Barker 1980). Drainage systems and irrigation networks, mostly constructed in the 1930s, give the plain a crucial role in the agricultural economy of this region.

The Gargano Promontory consists of a series of horizontal beds of Mesozoic limestones rising to heights over 1000m. This pattern is most clearly seen along the western edge where three distinct horizontal grades occur at elevations of about 200, 600 and 900 meters. The soft

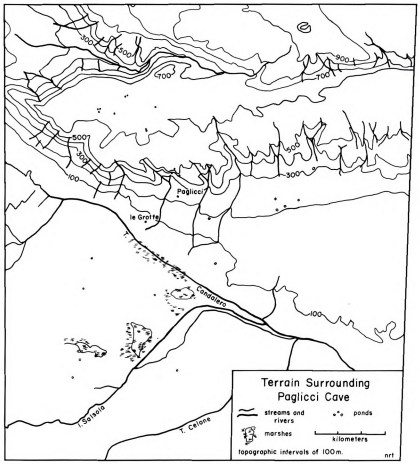


Figure 5.2. The terrain surrounding Paglicci Cave. The cave is located between the farms of Paglicci and le Grotte.

limestone of the plateau is carved by numerous dolines and karstic formations. Small valleys and canyons are also common. The promontory extends eastward into the Adriatic Sea where high bluffs have been carved by marine and aeolean processes. Lack of a coastal plain along this eastern edge precludes travel except by boat. In general, travel within the Gargano Promontory is extremely difficult.

On the southern face of the promontory, especially along the lowest limestone grade above the plain, are a series of steep scarps. These large, eroded gullies or canyons continue to be eroded during the rainy season (October to February) when large quantities of water rush down the denuded limestone slopes. Most of the year these canyons remain completely dry.

The climate of the region is much like that of North Africa. The Appennine Mountains block much of the moisture ladened winds from the west thus the region receives only about 200mm of rainfall, far less than its west coast counterparts (Houston 1967:417). The mountains of the Gargano Promontory receive a slightly greater amount of precipitation. The rainfall is also highly seasonal on the plain, with a dry summer season of five months and the bulk of precipitation occurring during the late fall and winter. With the added effect of the temperature on the plain, the summers are extremely hot (14-25° C.) and dry; the winters

tend to be very cool (2-10° C.) and damp. The Gargano Promontory, because of the higher altitude, maintains slightly milder summers and colder winters.

There is virtually no indigenous vegetation on the Tavoliere plain today, it being totally under cultivation. The mountains of the Gargano Promontory still maintain much natural vegetation characterized by Mediterranean evergreen, mixed deciduous oak and beech forests (Houston 1967:420, 529). Along the south face, where Paglicci Cave is located, little vegetation exists on the hillsides and limestone grades. Used for olive cultivation, the area is host to some wild grasses, shrubs and stunted evergreens. The macchia is minimal due to the extent of olive cultivation. The soil is extremely shallow in this area and there is an abundance of bare limestone blocks. Thus today, the viewer from the plain below is presented a rocky and denuded landscape.

Paleoclimatic research reveals that Pleistocene conditions of the local environment would have varied considerably, depending upon stadial and interstadial conditions. While considerable research still needs to be done in this regard, it is thought that the plain underwent the greatest changes and would have remained open, without forest, during most of the Upper Pleistocene, hosting either prairie or steppe vegetation depending on the climatic conditions. Toward the end of the Pleistocene the

plain would have become more forested (Sala 1983). The Gargano Promontory probably maintained an appearance similar to that of today throughout the Upper Pleistocene, especially during stadials when cooler, dryer conditions kept vegetation to a minimum.

The global climatic phases of stadials and interstadials would have had a regional impact. The glacial advances, although not expanding into peninsular Italy, would have locked up large quantities of ice causing sea levels to be lowered dramatically. It is estimated that sea levels dropped as much as 100m at the apex of stadial conditions (Butzer 1971:217; Houston 1967:63). The result would have made the entire northern half of the Adriatic Sea a large plain and created a wide coastal plain along the southern half of the Italian coast. During stadial climatic conditions the coastal lowlands would have maintained prairie and steppe habitats. While favoring those species that would have made use of the Tavoliere Plain, it would have also allowed facile movement north and south along the coast rather than around the western end of the Gargano Promontory (see Figure 5.1).

5.2. The Cave

The cavity of Paglicci Cave consists of a spacious front chamber or atrium with the walls expanding downward, and from which one descends through a gallery into some large interior chambers (Figure 5.3). The current entrance

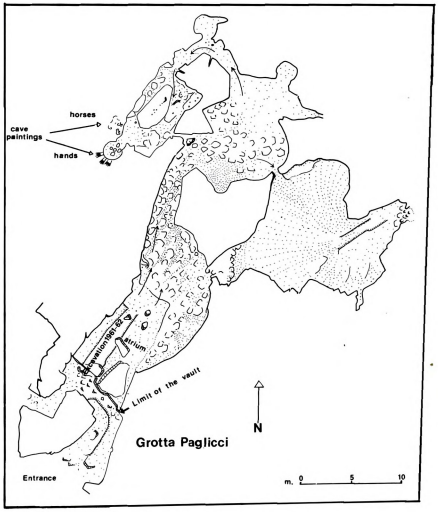


Figure 5.3. Paglicci Cave.

is quite narrow and rather unimpressive, the result of a recent collapse. Large blocks of downfall and the existence of uncovered vertical walls outside the entrance indicate that the atrium extended perhaps five to ten meters during the Upper Pleistocene. Mezzena (personal communication) suggests it may have extended twenty or more meters during its occupation in the Middle Pleistocene.

The fill of the cave is found almost completely within the atrium, extending about ten meters into the interior. The deposit then slopes downward into the interior part of the cavity where it appears to level off with the deepest known strata.

5.3. History of Research

Paglicci Cave was first brought to the attention of archaeologists by R. Battaglia in 1955. It was severely damaged by clandestine operations in the late 1950s with the blasting of the site with dynamite; the cause for the most recent collapse of the entrance. It was subsequently excavated by the Museo Civico di Storia Naturale di Verona under the direction of F. Zorzi and assisted by F. Mezzena between 1961 and 1963 (Mezzena and Palma di Cesnola 1967). This first sondage was located in the atrium adjacent to the left wall (Figure 5.3). The research was suspended at a depth of about six meters below the original floor.

After a seven year hiatus the research was resumed in 1970 by the Istituto di Antropologia e Paleontologia Umana

of the University of Siena under the direction of A. Palma di Cesnola with the collaboration of F. Mezzena. In 1970 and 1971 the sondage was continued with the objective of exploring the depth of the deposit in the atrium (Palma di Cesnola 1975). At about eight meters below the original floor the excavation was again suspended still without reaching the bedrock floor of the cave. At about the same time a sondage tested the deposit outside the cave and revealed a stratified deposit of earlier cultural remains (Mezzena and Palma di Cesnola 1971).

In 1972 excavations inside the cave were expanded to include the central rear area of the atrium. This is the current area of excavation which is again cutting through the entire stratigraphic sequence. The principal aim is to gather new data for the paleoenvironmental reconstruction and absolute chronology of the various climatic periods (Bartolomei et al. 1977).

5.4. Stratigraphy and Chronology

The excavations at Paglicci Cave, have to date, encountered 22 strata without reaching the limestone bedrock of the cave floor. These 22 strata were excavated in non-arbitrary levels (over 66 recognized to date), characterized by dense floors of faunal remains, carbon lenses or horizontal series of hearths. The soil in the front chamber is a fine loose sediment that varies in shades from light gray to dark brown. The soil often

contains a large quantity of angular breccia and limestone chips that, sometimes, will form a distinct natural floor themselves (Mezzena and Palma di Cesnola 1967). In addition there are often large limestone blocks of downfall from the ceiling or walls of the cave (Figure 5.4). The excavation of these sediments is very easy, although downfall is often a major obstacle. The sedimentological analysis has not yet been completed (Palma di Cesnola, personal communication).

The large quantity of carbon, found scattered in the strata and as part of hearth debris, along with the large quantity of burnt bone provide an ample amount of material for carbon 14 dating. There are currently twenty C14 dates for strata 21 to 18b and 10 to 3-2 (Palma di Cesnola 1977:304). Carbon 14 dates are currently lacking for the middle strata of the deposit; those from 18a to 11.

5.5. Faunal Remains and Paleoclimatic Reconstruction

The microfaunal remains in the deposit of Paglicci Cave are being studied by G. Bartolomei. Numerous species have been recorded including: Microtus agrestis, M. arvalis and M. nivalis; along with: Apodemus silvaticus, Elyomis, Glis, Arvicola, etc. Strata 21-18 are dominated by Microtus agrestis and M. arvalis indicating a subhumid continental climate. In stratum 18 there is a rise in M. nivalis and Apodemus sylvaticus indicating a slight warming trend. No

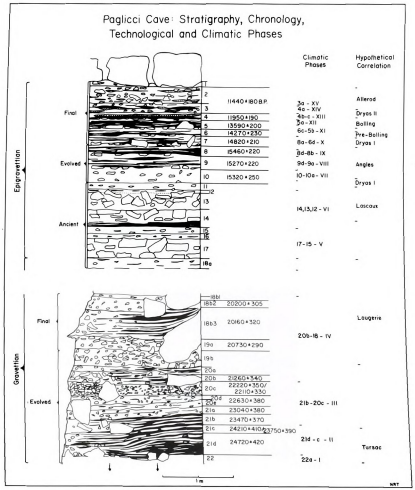


Figure 5.4. The stratigraphy, chronology, and technological and climatic phases.

information is currently available for strata 17-13. In stratum 12 there is again the dominance of M. agrestis and M. arvalis. Within strata 10-6 there is evidence of rapid climatic change with Microtus descending to 5% and Pitymis savii rising to 70% indicating a trend toward a steppe habitat. P. savii remains dominant through stratum 2 but with some increase in Apodemus and Arvicola (Bartolomei et al. 1977:305).

The macrofaunal remains were recently studied by B. Sala (1983). Species common to almost all levels are: Equus caballus (horse), Equus (Asinus) hydruntinus (ass), Bos primigenius (wild cattle), Cervus elaphus (red deer), Capreolus capreolus (roe deer), Capra ibex (wild goat), Rupicapra rupicapra (chamois) and Sus scrofa (wild boar).

The distributions of faunal remains are presented in Figure 5.5. In the analysis by Sala (1983) an attempt was made to correlate the varying distributions of these species which formed a series of oscillations with the stadial and interstadial phases known for western Europe. The results of this study produced a very good correlation between faunal remains and the western European paleoclimatic sequence. Cold climate species, especially Capra ibex and Marmot marmot, but also horse were found in highest relative frequencies in strata carbon 14 dated to stadial conditions while other species became more frequent during interstadial periods. Toward the end of the

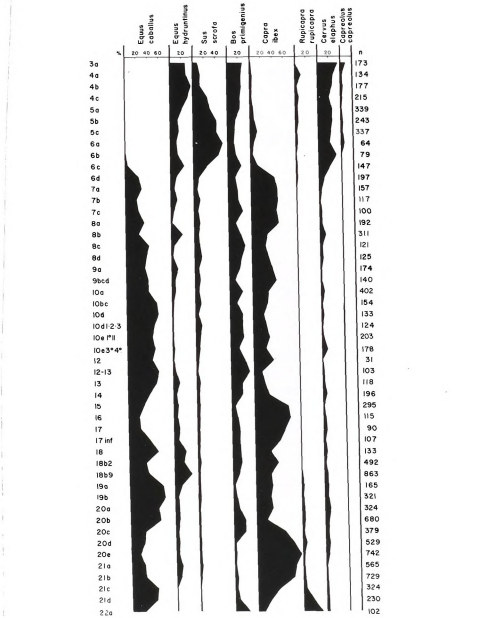


Figure 5.5. The distribution of faunal remains.

Pleistocene one sees a replacement of horse with red deer and a substantial increase in wild boar and chamois indicating a change to more temperate, humid and wooded conditions. This pattern also emerges from the analysis of the microfaunal remains as well (Bartolomei et al. 1977).

5.6. Technology and Industries

The industries discovered in the strata from 22 to 18b belong to the Gravettian Tradition. They have been ordered by Palma di Cesnola into the following phases on the basis of stone tool typology and typometrics of the assemblages (Martini 1976; Palma di Cesnola 1975; Bartolomei et al. 1977).

The Evolved Gravettian of backed points occupies stratum 22 and is characterized numerous and various types of backed points. The Evolved Gravettian of the Font Robert Point occupies stratum 21. As yet only one classic example of this point type has been recorded. The Evolved Gravettian of Backed Truncates occupies stratum 20 to level 19b. It is characterized by numerous backed truncates in the assemblage. The Final Gravettian of Angled Backed Points is contained in strata 19a and 18b. It is characterized by angled forms of backed points not unlike the Creswellian points of England (Palma di Cesnola and Bietti 1983). See Figure 5.4.

The Epigravettian (the industry that in Italy corresponds chronologically with the Solutrean-Magdalenian

and European Azilian) includes the strata from 17 to the top of the stratigraphic sequence. The Epigravettian subdivides into three principal horizons (Ancient, Evolved and Final); each containing various phases and subphases (Mezzena and Palma di Cesnola 1967).

The Initial Epigravettian of level 18a is followed by the Ancient Epigravettian of Foliates of stratum 17, which contains numerous tools with the flat retouch of the Solutrean style. The Ancient Epigravettian of Crans (tanged tools) occupies strata 16 to 10. Three subphases are recognized; one of abundant tanged tools in levels 16-15, another in strata 14-12 where the tanged tools are rarer, and a terminal subphase in strata 11-10. Evolved Epigravettian is found in strata 9 and 8. The Final Epigravettian of Truncates and Backed Truncates occupies strata 7-5. It is characterized by numerous truncated blades and backed and truncated bladelets and microliths. The Final Epigravettian of Geometrics occupies levels 4-2. It contains a high frequency of geometric microliths, especially those of the lunate form (Palma di Cesnola and Galiberti 1983).

5.7. Art

Paglicci Cave has provided numerous manifestations of art, both wall and mobile forms. In 1961 a series of pictures on the walls of a small interior room was discovered. Two horses, one of which is in a vertical

position, and the profile of the back of a third larger horse are represented. There are also some negative and positive outlines of human hands (Zorzi 1962).

While there are not yet precise dates for this artwork, the styles compare favorably with those of the most ancient of the Franco-Cantabrian parietal art. Recently, a limestone fragment was recovered in the atrium of the cave (probably fallen from above) depicting on one smooth face the posterior part of a horse. Its style is similar to that of the Solutreo-Magdalenian of Lascaux. The fragment originates from a level (the bottom of stratum 14) of the Ancient Epigravettian a cran.

Graffitti (finger lines and linear scratches) have been discovered near the mouth of the cave. These are high up on the left wall, and on the surface of a large block of downfall which was part of the lintel of the entrance. These are calculated to be from an epoch of about 15,000 years ago.

The mobile art is represented on stone and bone, principally by: a profile of a wild goat realized in an archaic style and covered by a geometric "chevron" motif; a scene of the hunt with horse and deer running below a cloud of arrows (or darts), a bird sitting on eggs in a nest while a nearby snake lies in wait, some heads of wild cattle and deer, figures of birds, etc. (Figure 5.6). Apart from the drawing of the wild goat, which belongs to

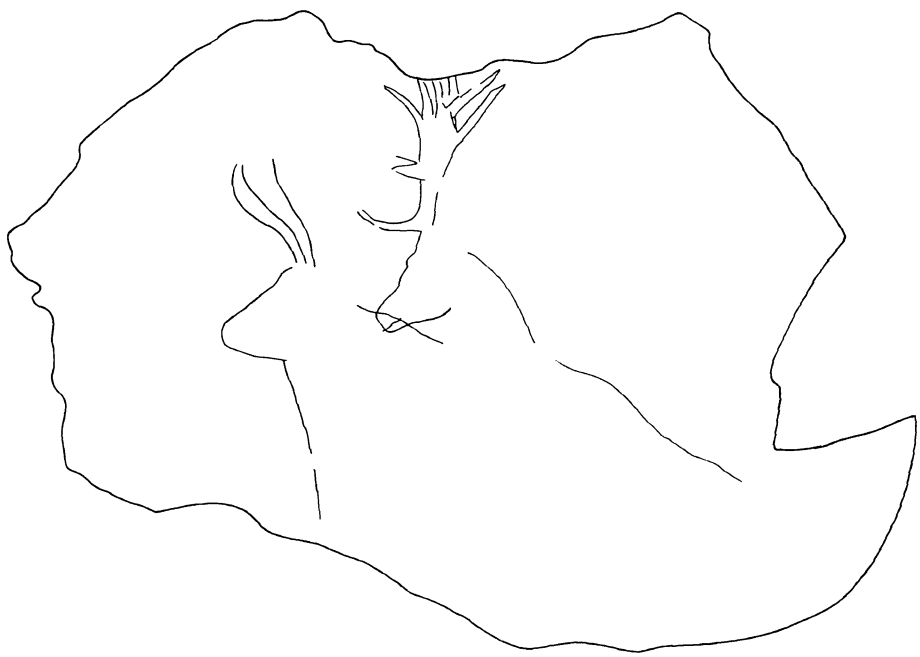


Figure 5.6. Mobile art from Paglicci Cave.

the Gravettian, almost all the other objects of mobilary art, which are in a developed naturalistic style (approaching that of the height of the French Magdalenian), derive from the levels of the Evolved Epigravettian (strata 9-8). To these, add graffitti with various geometric motifs on stone or on the cortex of flint, most of which were discovered in the levels of the Final Epigravettian (Mezzena 1976; Mezzena and Palma di Cesnola 1973).

5.8. Human Remains

The excavations in the deposit of the atrium have recovered a substantial quantity of human remains. One complete skeleton, interred with an assemblage of stone and bone tools, ornaments (jewelery) of shells and drilled deer canines, and covered with red ocher, was discovered in 1971 at the surface of the Gravettian stratum 22 (Mezzena and Palma di Cesnola 1972; Figure 5.7). A second burial (which is yet to be excavated) was located the same year in stratum 21. In addition, single elements of human skeletons including mandibles, cranial fragments and long bones, have been recovered from almost all of the Gravettian levels.

Recorded in the Final Epigravettian deposit (stratum 5) is the recovery of a partial burial (pelvis and leg bones) and of two humeri positioned on a large stone slab (Zorzi 1962). Other bone fragments were collected sporadically in other strata of the same Final Epigravettian deposit.

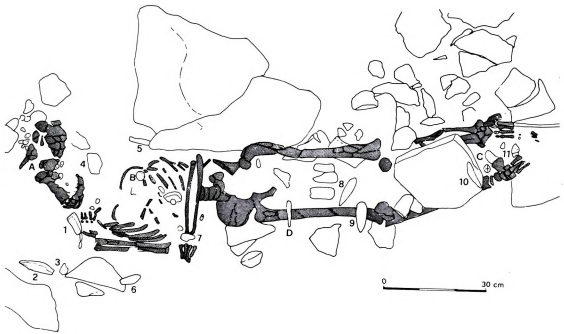


Figure 5.7. Skeletal remains from Paglicci Cave.

Analysis accomplished to date (Borgognini et al. 1980; Corrain 1965; Mallegni and Parenti 1974) has revealed the presence at Paglicci Cave of a type of Homo sapiens sapiens with attenuate characteristics. The individual buried just above stratum 22, has a narrow face and high eye orbits, characteristics even today considered to be Mediterranean features.

5.8. The Deposit Outside the Cave

The sondage placed outside the mouth of the cave in 1970 discovered four additional strata of cultural remains, a total of seven meters, before bedrock was reached (Mezzena and Palma di Cesnola 1971). See Figure 5.8. The lower two strata contained Acheulian industries of the Lower Paleolithic. It included the recovery of handaxes and flake tools. The technological characteristics of the industry indicate that it may represent the Evolved Acheulian, an older and rarer form of the Acheulian than is commonly found in Italy (Radmilli 1975). Recovered with the artifacts are fossilized faunal remains including Equus caballus, Cervus elaphus, Lepus europaeus, Capra sp. and numerous microfaunal remains.

The upper two strata contained Middle Paleolithic remains identified as belonging to the Italian Laquinoid Mousterian (similar in numerous respects to the La Quina Mousterian). The faunal remains from these strata are not

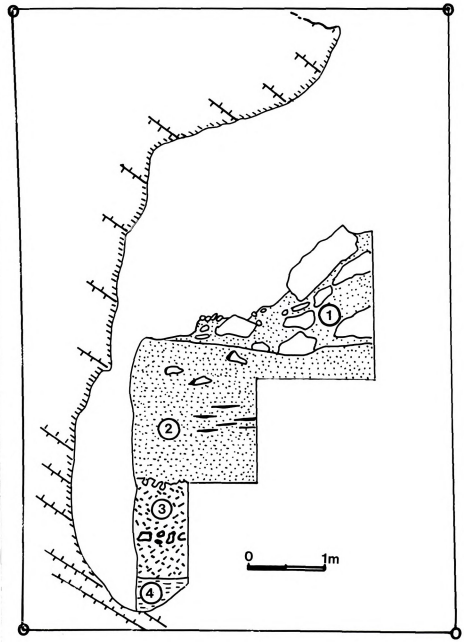


Figure 5.8. The deposit outside the cave. Layers 1 and 2 are Middle Paleolithic deposits, and layers 3 and 4 are Lower Paleolithic deposits.

fossilized and are most fragile. The large mammals represented here include Bos taurus and Cervus elaphus.

5.9. Discussion

Paglicci Cave adds significant information to the reconstruction of the Italian Paleolithic. As recognized by Barker (1980) and others, Paglicci Cave is now the source for the chronology of the Italian industries. By having helped establish the chronological sequence of the Italian Paleolithic, researchers are now able to spend more time in better documenting the minor variations that occur regionally in peninsular Italy: the Adriatic coast, the Tyrrhenian coast, and Liguria which follows the southeast France sequence.

The superb technological analysis performed by A. Palma di Cesnola (e.g., 1975) and A. Galiberti (e.g., 1979) on the stone material from Paglicci Cave provides not only an understanding of its own distinctiveness, but also indicates that southern Italy was not isolated from the rest of western Europe. The assemblages reveal evidence of the diffusion of technology indicating communication with regions outside Italy. These include specific tool types such as the Font Robert point, and specific technological techniques such as flat retouch. Diffusionary processes are indicated because of the temporal congruency of these technological patterns. It is primarily due to the fine stratigraphic and chronological control at Paglicci Cave

that makes this so apparent.

The Paglicci Cave art independently corroborates these interpretations. Although it cannot be said to be directly related to that of southwest France, it is evident that similar patterns in the evolution of artistic style occur coevally in both places.

Although still at a preliminary stage of analysis, the paleoenvironmental reconstruction for the site and its territory is proving valuable. Rarely have such independent sources of information as cave sediments, microfauna, macrofauna and radiocarbon dates for chronological comparison with the global climatic sequence shown to correspond so well. Palynological analysis has just begun for the site, but the few levels so far completed also show good comparative results (Galiberti: personal communication).

The cave is also providing an abundance of hominid remains. If this continues as the excavation progresses, a long chronological sequence of Upper Pleistocene hominids will be recovered for analysis. Such data may provide insights into the chronological changes and variability within the Homo sapiens species.

Paglicci Cave is a classic example of an Italian Mediterranean Paleolithic site. Its long sequence of carbon 14 dates correlated with faunal remains and paleoclimatic sequences provides substantial information

for local climatic conditions during the late Pleistocene. The careful excavation and dating of the stone tool industries make it the index site for the east coast of the Italian Peninsula where other sites use Paglicci Cave for chronologically correlating their assemblages. These characteristics, along with its panoramic view of the landscape, the substantial artwork, burials, thick deposits of faunal remains and large quantities of stone tools has led to informal interpretations that Paglicci Cave must have been a permanent or semi-permanent base camp occupied through the late Pleistocene.

CHAPTER 6

THE ANALYSIS OF TECHNOLOGY AND TOOL USE OF LEVEL 4A

6.1. Background

Level 4a is the loose sandy upper deposit of stratum four. It is approximately five to seven centimeters thick tapering off toward the back of the atrium. Along with levels 4b and 4c, it has been dated to 11,950±190 B.P. This corresponds to the Dryas II (Middle Dryas) paleoclimatic phase considered to be a cool phase within the overall warming trend of the very late Upper Pleistocene. Changes in the relative frequency of faunal remains of a number of species, as presented by Sala (1983) and discussed earlier, tend to support this interpretation. Sala suggests that the region at the time of occupation of level 4a had a temperate climate.

6.1.1. The Artifact Sample

Of the original deposit of level 4a, approximately nineteen square meters had been excavated by F. Zorzi in the early 1960s. Zorzi failed to differentiate the level from other levels of the stratum. The area of the level which was neither excavated by Zorzi nor destroyed by clandestini was excavated by A. Palma di Cesnola and F. Mezzena in the 1970s. This area, located in the center of

the atrium, measures approximately 6.75 square meters. It is subdivided lengthwise into three provenience units of about 1.5 meters square. The 174 tools analyzed in this study come from this second episode of excavation.

A comparison of the recovered tool type percentages from the two excavation episodes shows a fairly close similarity in the distribution of technological groups (Table 6.1). Major differences occur between some of the backed tool groups. It is suggested that these differences result from differences in the excavation recovery techniques (Palma di Cesnola, personal communication). The later excavation recovered a higher percentage of microliths which in turn reduces, relatively, the percentages of other tool groups. The tools from the earlier excavation are classified by A. Palma di Cesnola (Mezzena and Palma di Cesnola 1967) while those from the recent excavation are classified by A. Galiberti (1979).

For the microwear analysis it became evident that not all of the 448 stone tools could be studied, and therefore a sampling procedure was designed. The tools are statistically stratified according to primary type and spatial provenience. Five artifacts from each classificatory stratum are randomly sampled. When there are less than five in a stratum all tools within it were sampled. Occasionally the classification of the microwear for a specimen is impossible because of cortex, patination,

Table 6.1

Comparison of Stratum 4 and Level 4a, Paglicci Cave

Tool Type		Stratum 4	Level 4a
B	Burins	8.2%	6.5%
G	Endscrapers	17.2	13.2
T	Truncates	10.0	7.1
Bc	Becs	1.6	2.5
PD	Backed Points	8.9	3.8
LD	Backed Blades	4.1	2.7
DT	Backed Truncates	4.7	7.1
Gm	Geometrics	0.2	5.1
Δf	Backed Fragments	12.2	29.5
F	Foliates	0.0	1.1
P	Points	2.4	1.6
L	Sidescrapers (blades)	19.4	8.5
R	Sidescrapers (flakes)	4.9	2.7
A	Abrupts	0.0	3.1
D	Denticulates	5.7	5.6
Total		99.5%	100.1
		N = 1250	N = 448

or recent damage. These are considered as unsampled. The sample sizes presented in the tables in this chapter and in Figure 6.1 thus represent those classifiable and interpretable, and not those actually studied. In general, the classification and interpretation of the microwears were not difficult.

This sampling scheme permitted every primary type within each spatial unit to be sampled. This allows study of spatial variation and technological variation of tool use. In a number of instances additional samples are drawn to test hypotheses developed during the original phase of research. It must be noted that although attempts are made to gather a representative sample of the population, the sample is by no means a random sample of level 4a itself.

6.1.2. Method of Specimen Preparation and Data Recording

The sampled specimens are prepared for the microwear analysis by first washing them in water with a non-abrasive, ammonia based soap. Artifacts are viewed microscopically (50 to 400 maginification) at this time with no difficulties in observing microwears on the tools. In the early part of the study the specimens were bathed for ten minutes each in 12 percent HCl and 20 percent H_2O_2 followed if necessary by bathing for thirty minutes in three sequential solutions of acetone. The solution of HCl is used in microwear studies to remove inorganic materials from the flint surface. The H_2O_2 is used to remove organic

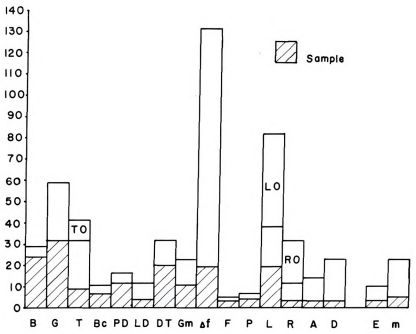


Figure 6.1. Distribution of tool groups from level 4a.

materials. Acetone removes the clear nail polish used to protect the provience codes written on the tools with india ink. The smaller tools often have nail polish on their edges. Examination of tools after these baths show that they have no effect on the tools and microwears except to remove the nail polish. It was decided part way through the research program to end these chemical baths unless nail polish was to be removed. This saved time, but at the cost of losing experimental control because experimental specimens are cleaned with the chemical solutions.

Each specimen is observed on both faces of all edges. Ventral surfaces and dorsal ridges are often viewed to be certain that microwear patterns were not produced by an effect not related to use. Records are maintained describing the microwears along any given edge of a tool with figures providing locational information. The microwears are classified and the use of the tool, or each aspect of the tool, is interpreted. Photomicrographs are also taken to record what is being observed. Finally, specimens are observed on two and often three separate occasions so as to check the original interpretation.

6.1.3. Technology and Use

In addition to the 448 stone tools there are pièce esquillée (splintered pieces), microburins and cores. There are a large quantity of flakes, bladelets and fragments of flint debitage almost all of which measure

less than two centimeters in length (Table 6.2). Typically unretouched flints are considered debitage and are not analyzed as tools, however at the University of Siena, using the Laplace (1964a) classification system, these tools are classified using a zero primary type designation, e.g., T0, L0 and R0. Ten artifacts from the debitage bags were examined, but they were badly damaged with flint on flint abrasion, possibly resulting from storing and transporting the debitage in large plastic bags.

Before studying the artifacts from level 4a, the Laplace primary types were evaluated in terms of hypothesized tool function. One or more hypotheses was given for each tool type (Table 6.3). Although it was not expected that the use of these tools would follow these hypothesized functions it was decided to explicitly state my expectations.

6.2. Burins

6.2.1. Analysis

There are twenty-nine burins recovered from level 4a. All primary types except B4 and B8 are represented (Table 6.4). Many of these are composite tools, often double burins. The most common type of burin is the burin on a fracture (B5) representing 37.5 percent of the total.

The burins are extremely varied in size and shape, yet there is one distinctive pattern within this variability. Many of the B5 burins and other primary types are found on

Table 6.2

The Debitage from Level 4a

Debitage Type	Excavation Unit External	Medial	Internal	Total
Cores	4	1	1	6
Blades and Flakes ≥ 20mm	154	152	19	325
Blades and Flakes < 20mm	660	1076	266	2002
Total	818	1229	286	2333

Table 6.3

Hypothesized Functions of Laplace Tool Types

Tool Type	Hypothesized Function
B	Graving hard materials
G1 - G7	Scraping hide
G8 - G9	Scraping wood
T	Scraping hard materials or end is not used
Bc	Boring hard and soft materials
PD	Projectile points
LD	Backed knives
DT	Projectile armatures
Gm	Projectile armatures
F	Various
P	Projectile (spear) points
L	Knives
R1 - R3, R5	Knives
R4	Projectile Points
A	Various
D1, D5	Scraping cylindrical objects
D2, D6	Sawing hard materials
D3, D7	Projectile points
D4	Hide scraping
D8	Wood scraping
E	Bipolar knapping, wedging

Table 6.4

Population and Sample Sizes of Burins

Pop. / Sample	Excavation Unit: External	Medial	Internal	Total
B1	2 / 2	3 / 3	0 / 0	5 / 5
B2	1 / 1	1 / 1	0 / 0	2 / 2
B3	2 / 2	2 / 1	0 / 0	4 / 3
B5	7 / 7	4 / 2	1 / 1	12 / 10
B6	1 / 1	2 / 2	0 / 0	3 / 3
B7	2 / 0	0 / 0	0 / 0	2 / 0
B9	0 / 0	1 / 1	0 / 0	1 / 1
Total	15 / 13	13 / 10	1 / 1	29 / 24

thick flakes with numerous long spall fractures on one end giving it a polygonal face and convex edge. They appear similar to small bladelet cores and, in fact, are described by the name, bulini nucleoformi (core-shape burins). Often they are technologically characterized by a polygonal shape and a mixed direction (see Appendix A for shape and direction attributes). These burins are often composite tools, especially double burins. The other burins in the collection are typically thinner with just one or two spall fractures forming the burin edge. Often these have lateral retouch.

The spatial distribution of the primary types shows a general trend of fewer burins toward the back of the atrium; a pattern of all tool groups. There is no distinctive pattern concerning their distribution otherwise.

A total of twenty-four of the burins are sampled for microwear study. Four categories for the role of the burin edge resulted: used, undetermined (but appear to have been used), unused and used for the manufacture of bladelets (Table 6.5; Figures 6.2 and 6.3).

Those burins interpreted as having been used for the manufacture of bladelets are the most numerous, totaling sixteen. They have a distinct microwear pattern that does not fit into any of the microwear patterns which are related to tool use. Instead, the burin edge often has

Table 6.5

Distribution of Use Categories of Burin Facets

Type	Blade Prod.	Used Burin Edge Bone/Ant.	Used Burin Edge Wood	Undet.	Unused	Total
B1	5					5
B2	2					2
B3	1		1	1		3
B5	7	2			1	10
B6	1	1	1			3
B9				1		1
Total	16	3	2	2	1	24

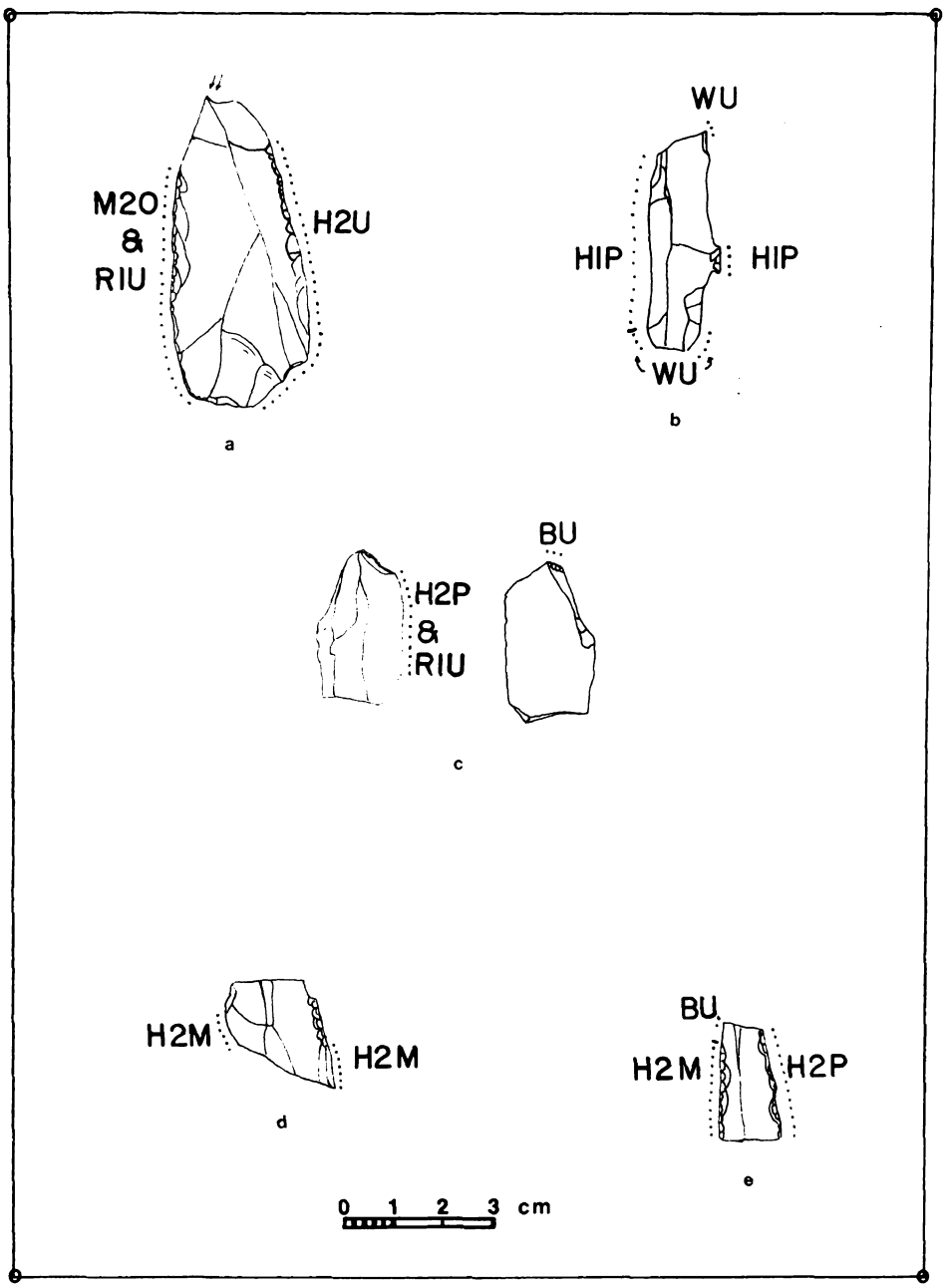


Figure 6.3. Some non-nucleoform burins from level 4a.

substantial abrasion, with small striations parallel, and sometimes perpendicular, to the edge, numerous step fractures on the face of the edge where the spalls (bladelets) are removed, and distinctive, very wide and long striations that are perpendicular to the edge. These striations are usually associated with bright polishes (Photomicrograph 20). These microwear patterns are reproduced experimentally by the preparation and removal of bladelets from a core with the use of a small stone. No other microwear patterns appear on these edges; evidence that these are not working edges. Not surprisingly, there is a significant relationship between the polygonal mixed burins and the burins interpreted as bladelet cores (Table 6.6).

The remaining burins are quite different from this first group, if for no other reason than they are substantially thinner. Their burin edges are often simple; produced by just one or two burin spall fractures (Figure 6.3). Four burins have classifiable microwears on the burin edge or on a nearby facet. These microwears are in the R1- family and are classified as either B- or W- microwears (there are two of each; see Photomicrograph 21). The sample is too small to differentiate or correlate the specific use of the burin with technolgical features. In addition there is one burin which appears to have some microwear, but because of poor visibilty, it is impossible

Table 6.6

Test for Independence Between Use and Form of Burins

Microwear Interpretation	Other Burins	"Nucleoform" Burins	Total
Blade Production	1 a	15 b	16
Other Uses	7 c	1 d	8
Total	8	16	N = 24

H_0: Use and technology are independent.

H_1: Use and technology are not independent.

Fisher's exact test is used to test for independence since some cell frequencies are very small (see Blalock 1960:221-225). The rejection level is set at a probability level of .05. Reject the null hypothesis (independence) if $P < 0.05$. Method: Calculate the probability of obtaining exactly these frequencies and all others of lower frequency in cell a while maintaining the values in the marginals.

P_0 = Probability of cell a = 0.

$$P_0 = \frac{(c_0 + d_0)!\ (b_0 + d_0)!}{N!\ d_0!} = .0000013597$$

P_1= Probability of cell a = 1.

$$P_1 = \frac{b_0\ c_0}{(a_0 + 1)(d_0 + 1)} P_0 = .000174$$

$P = P_0 + P_1 = .000175$

$P < 0.05$: Reject H_0.

to classify. The other three burins have burin edges without evidence of use.

The burins not related to blade production have an additional pattern of use. The lateral edges not removed by the burin spalls often have microwears that fall within the Y1- group. Three of these tools appear to have microwear resulting from butchering and four from hide working (Figure 6.3). In every case either Theorem 7 or 8 can be invoked indicating that the lateral microwear preceded the burin spalls. Two explanations can be hypothesized for the lateral microwears given that they resulted before the last spalling of the burin. The first is that the lateral edges of these tools were used (on meat, fresh hide and dry hide) as indicated by the microwears, prior to the manufacture of the burin edge on the end of the tool.

The second hypothesis is that the microwears result from the handling of the tool. These tools often show intensive microwear along their lateral edges. Handling is not considered capable of producing much microwear, especially in the typical short use-life of a stone tool. However, burins, like some other end-used tools can be resharpened often, thus extending the use-life substantially. It is thought that microwear from handling might develop more intensively because of this extended

use-life. Each spalling stage of the burin removes the microwear on all but the remaining original lateral edge.

Currently this second hypothesis is less acceptable. No burin shows any evidence of more than one spalling stage, the intensity of the microwear is typical of sidescrapers which is much more intense than any handling or hafting microwear produced experimentally, and finally, edges that could have been used, but not likely held, display these microwears as well. As will be discussed further, this pattern of lateral edge microwears on end-used tools is also seen on endscrapers.

It should also be noted that this microwear development on the lateral edges of this second use-group of burins provides independent support for differentiating them from those used for bladelet production (Table 6.7).

6.2.2. Summary

It was originally hypothesized that burins were used for graving or chiseling hard materials such as bone, antler and wood. This analysis indicates that for level 4a there are at least two well defined use-groups. One group is used for the manufacture of blades. It is technomorphologically distinct, in that they are formed on thick flakes, have a mixed direction and polygonal shape and have numerous long spall fractures. They differ from the blade cores found in level 4a only in that they are usually manufactured on thick flakes rather than on nodules.

Table 6.7

Test for Independence Between the Uses of the Burin Edge and Lateral Edge(s)

Burin edge Interpretation	Lateral Edge Interpretation Used	Unused	Total
Blade Production	1 a	15 b	16
Other Uses	6 c	2 d	8
Total	7	17	N = 24

H_0: Use of lateral edge is independent of use of burin edge.

H_1: They are not independent.

Fisher's exact test is used to test for independence since some cell frequencies are very small (see Blalock 1960:221-225). The rejection level is set at a probability level of .05. Reject the null hypothesis (independence) if $P < 0.05$. Method: Calculate the probability of obtaining exactly these frequencies and all others of lower frequency in cell a while maintaining the values in the marginals.

P_0 = Probability of cell a = 0.

$$P_0 = \frac{(c_0 + d_0)!\ (b_0 + d_0)!}{N!\ d_0!} = .0000231144$$

P_1= Probability of cell a = 1.

$$P_1 = \frac{b_0\ c_0}{(a_0 + 1)(d_0 + 1)} P_0 = .0012944086$$

$P = P_0 + P_1 = .00132$

$P < 0.05$: Reject H_0.

The second use-group fits the original hypothesis of being used for graving hard materials. In some cases the use of the burin edge is not determinable. Surprisingly many of these burins are manufactured on blades and flakes with lateral microwear produced prior to the last spalling of the burin. This suggests that the lateral edges were used before the manufacture and use of the burin edge.

Finally, in a few cases the burin edge shows evidence of not being used at all. In these cases the burin is not a well designed instrument and usually falls into the Laplacian type of "burin on a fracture." It is likely that these may not have been originally intended to be used, and possibly not even deliberately manufactured. This suggests that for purposes of functional interpretation, techno-morphological types should be conservatively assessed and classified.

6.3. Endscrapers

Laplace distinguishes nine primary types of endscrapers and seven of these are represented in the collection of fifty-nine endscrapers from the 1972 excavation of level 4a. The majority of the endscrapers fall within the first three types (Table 6.8). Spatially, the endscrapers are found predominantly toward the front of the atrium with only two being recovered from the most interior section of the excavation. Using the described sampling procedure, a total of 32 endscrapers are studied for microwear patterns.

Table 6.8

Population and Sample Sizes of Endscrapers

Pop. / Sample	Excavation Unit: External	Medial	Internal	Total
G1	13 / 5	2 / 0	0 / 0	15 / 5
G2	8 / 5	2 / 2	0 / 0	10 / 7
G3	7 / 5	5 / 5	0 / 0	12 / 10
G4	1 / 1	0 / 0	0 / 0	1 / 1
G6	1 / 1	2 / 2	0 / 0	3 / 3
G7	2 / 2	1 / 1	1 / 1	4 / 4
G9	1 / 1	1 / 0	0 / 0	2 / 1
_G	9 / 0	2 / 0	1 / 1	12 / 1
Total	42 / 20	15 / 10	2 / 2	59 / 32

6.3.1. Analysis of the Fronts

Prior to the analysis it was hypothesized that the fronts of endscrapers were used for scraping hides. This is based on numerous studies of: Upper Paleolithic endscrapers (Keeley 1980; Moss 1983); prehistoric North American endscrapers (Ahler 1979); ethnographically documented hide working endscrapers (Hayden 1979); and ethnographic descriptions of the tools used for scraping hides by North American Indians (e.g., Murdock 1892). Of northern latitudinal studies, ethnographic and archaeological, only Dumont's (1985) analysis of Star Carr materials have results suggesting that endscrapers had a major alternative use (bone scraping).

The microwear of the fronts of the thirty-two sampled endscrapers indicates that most were used for scraping hide in various conditions, and also some with fronts which are only extensions of lateral edges. The latter group will be discussed later. The preceding group, with independently used fronts, number twenty-six and are all interpreted as used for scraping hide. Of these, eight are interpreted as used on fresh hide and another eight on dry hide (Table 6.9; Figures 6.4 and 6.5; Photomicrograph 22).

There are ten endscrapers with fronts having a microwear characteristic of both fresh and dry hide (Figure 6.6). These edges vary between a matt and a rough texture, numerous to few striations perpendicular to the edge and

Table 6.9

Use of Endscraper Fronts

Type	Fresh Hide	Dry Hide	Undet. Hide	Continuation of Lateral Edge	Total
G1	2	3			5
G2	1	1	2	2	6
G3	3	4	5		12
G4	1				1
G6				3	3
G7			3	1	4
G9	1				1
Total	8	8	10	6	32

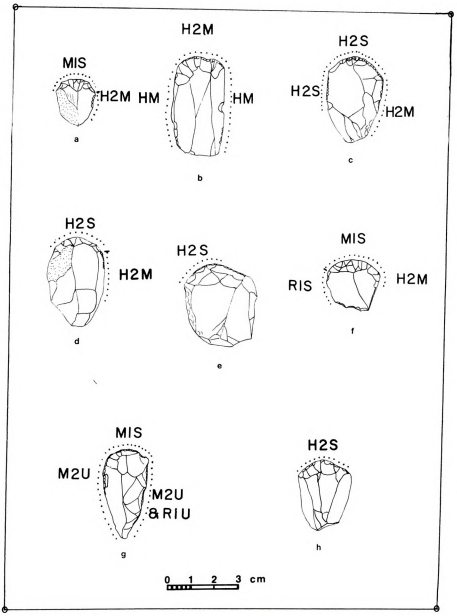


Figure 6.4. Endscrapers used for scraping fresh hide.

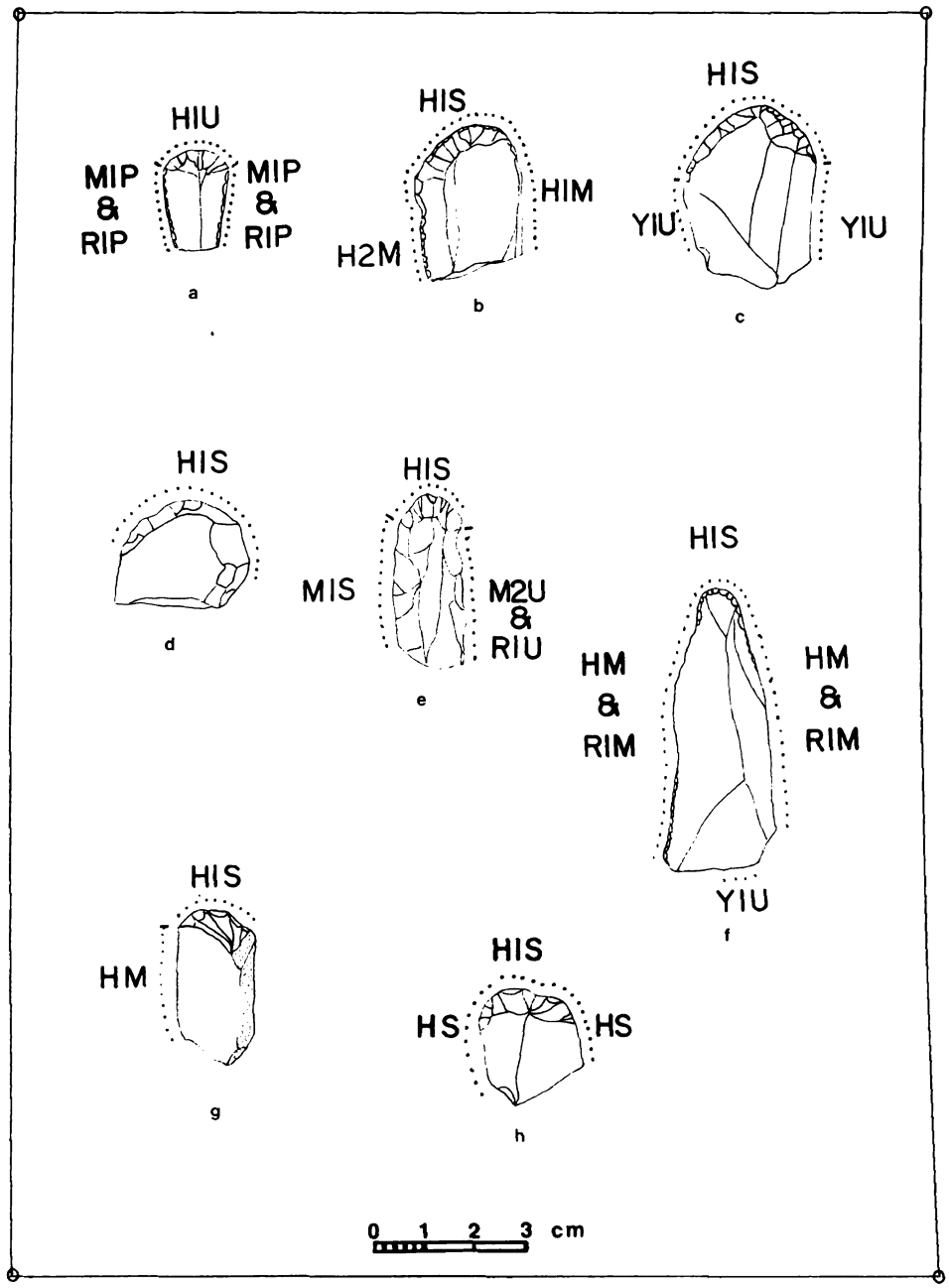


Figure 6.5. Endscrapers used for scraping dry hide.

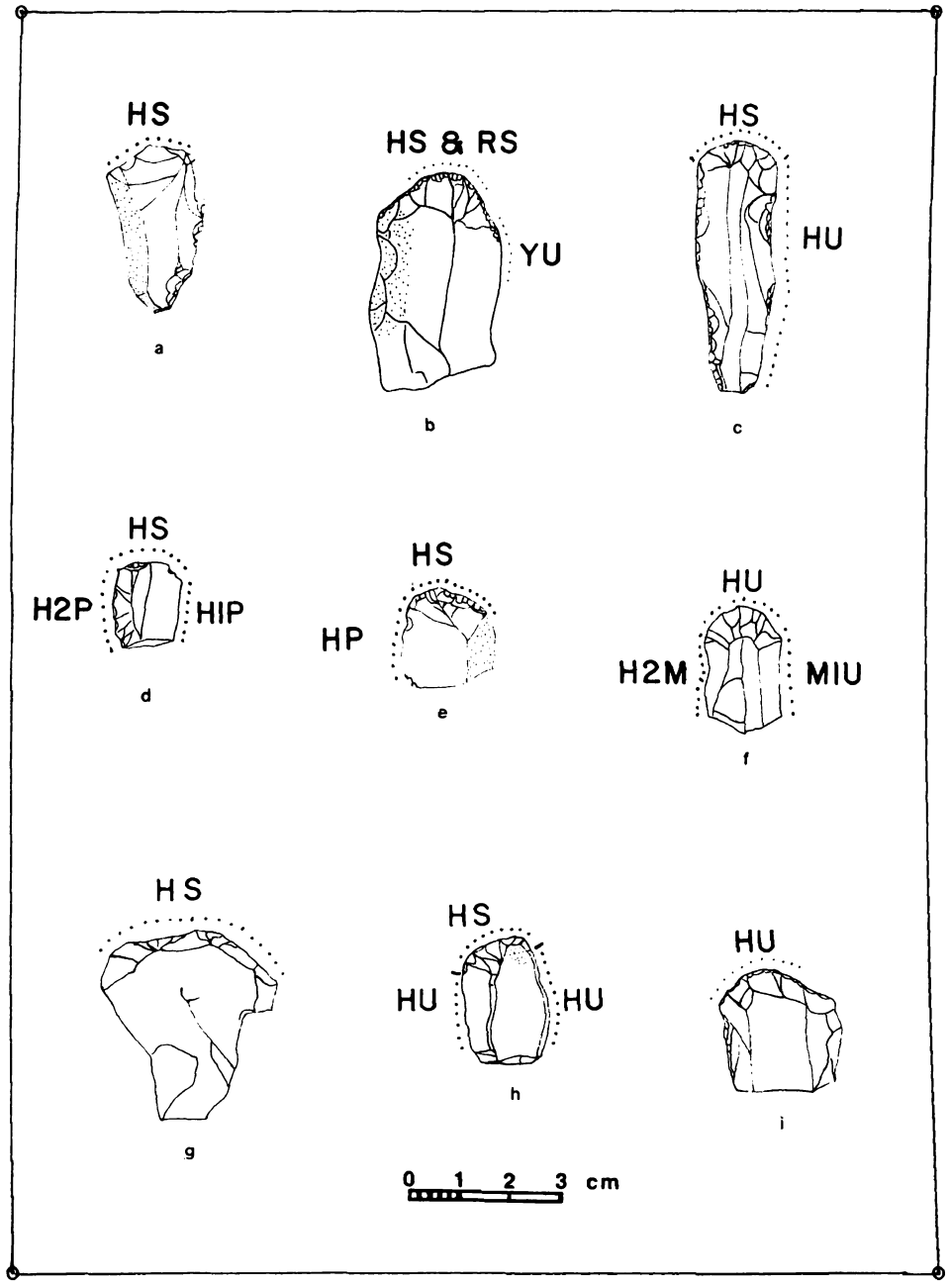


Figure 6.6. Endscrapers used for scraping hide of undetermined condition.

moderate to heavy rounding. The microwear may be the result of scraping greasy dry hides, but this is not confidently demonstrated. This suggests that the dichotomy of fresh and dry hide may be an oversimplification and that greater variability along a continuum exists.

In numerous cases these fronts show evidence of reuse cycles (retouch and use, retouch and use, etc.). This is evident from more intense microwear on portions of the front that had not received retouch in the final retouch cycle (for example, Appendix D, SE 14 and see Theorem 8), and when microwear is seen fairly intense on retouch scars and arrises not removed by later retouch (e.g., Appendix D, SE 36). While this should not be surprising, it is important to note that these tools could have been used for an extensive amount of time before disposal. This has some (potentially) confounding effect on the ability to interpret the lateral edge microwear patterns that are seen.

It was assumed that there would be no technomorphological differences between endscrapers whose fronts were used for fresh hide scraping and those used for dry hide scraping. It is therefore a surprise to find that the fresh and dry hide endscrapers appear to differentiate according to the convexity of the contour morphology of their fronts (compare Figures 6.4 and 6.5). This was first noted while attempting to illustrate the quantitative

differences between frontally used endscrapers and endscrapers not used independently on the front.

These tools differentiate according to a frontal measurement technique (Movius et al. 1968) which assumes that the front can be characterized as a circle segment defined by the radius and the degrees of arc. The curvature of the front is matched to a segment of a circle with a known radius. This is followed by measuring the degrees of arc contained in that segment (Figure 6.7). The distribution of endscrapers in the dimensions defined by these two variables is seen in Figure 6.8. It appears that fresh hide scrapers can be characterized as having relatively flatter faces than the dry hide scrapers.

Various explanations can be provided for this patterning, including: 1) observational error, in that some observations are incorrect and thus negate the observed patterning; 2) sampling error, in that the observed patterning exists in the sample, but that the sample does not reflect the population; 3) the statistical patterning exists but it is not meaningful; and 4) selective processes for technological and morphological characteristics in the use of fronts. Further independent research will be necessary to evaluate these hypotheses.

The remaining six endscrapers have fronts which are not independently used edges but are a continuation of lateral edges. The tools appear to have been used for meat

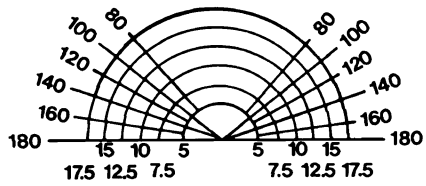
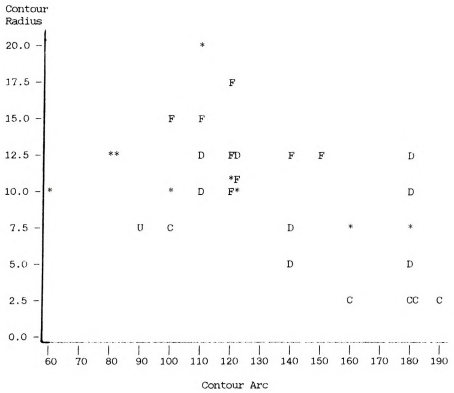


Figure 6.7. Technique used for measuring the contour arc and radius of endscraper fronts.



LEGEND

D Dry hide
F Fresh Hide
C Continuation of lateral edge
U Unused front
* Undetermined hide

Figure 6.8. Distribution of frontal use types according to frontal measures.

butchering and for various categories of hide working. These six tools have the microwear of the lateral edges extend, with no break, on to the lateral aspects of the retouched front (Figure 6.9). According to Theorem 3 therefore, it is clear that the use of the lateral edges of these tools followed the modification of the front. This is chronologically very different from what is seen on many of the frontally used endscrapers.

Unlike the fronts of the frontally used endscrapers which tend to be well-formed, distinctive and quite large, the remaining endscrapers clearly differ in that their fronts are often very small or protrude greatly relative to the width of the fronts ie., chord (e.g., SM 349). See Figure 6.10 for how the chord and protrusion (the maximum perpendicular from the chord to the edge of the front) are measured. In Figure 6.11 endscrapers are distributed according to their chord and protrusion. These predominantly laterally used endscrapers are set apart here as well as in Figure 6.8.

These visually distinct tools are not always typologically distinquished from other endscrapers. However, all tools classified as ogival endscrapers (G6) are found to fall in this use category (Table 6.9). Two other endscrapers, SE 1 and SE 20, appear to be functionally similar, but their fronts appear to have been used to some degree independent of the lateral edges.

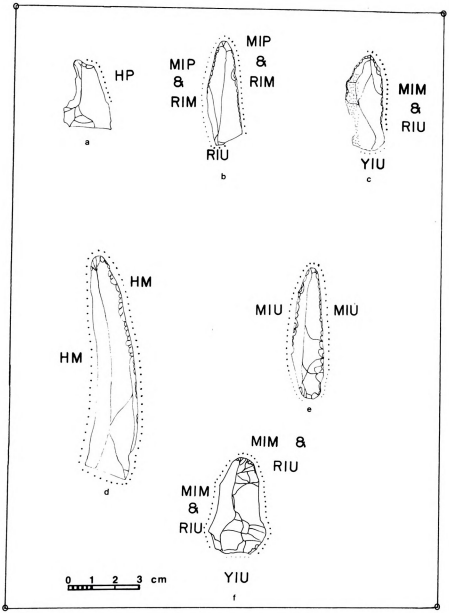


Figure 6.9. Endscrapers with predominantly used lateral edges.

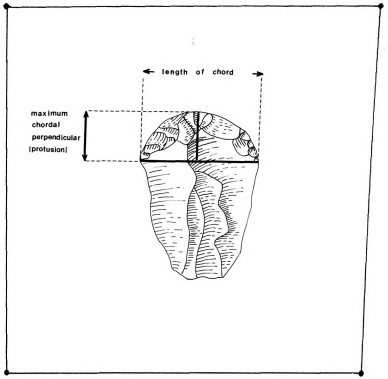


Figure 6.10. Measuring technique for chord and protrusion.

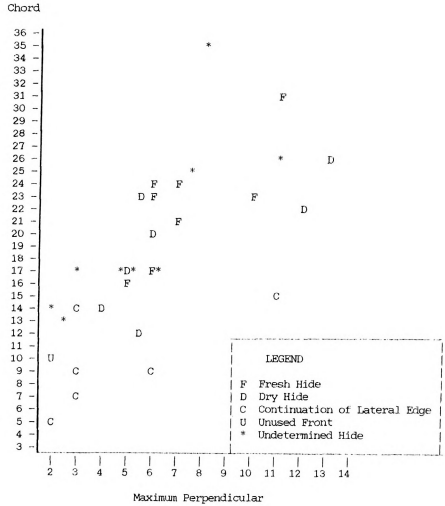


Figure 6.11. Distribution of endscrapers according to chord and protrusion of front.

6.3.2. Analysis of Lateral Edges

The lateral edges of the endscrapers prove to be far more complex than the fronts. As seen previously some endscrapers have lateral margins as their main working edges. Since their characteristics have already been noted, emphasis here is placed on the front working endscrapers which have microwears on their lateral margins.

Microwears are visible on 31 of 52 lateral edges of frontally used endscrapers. These microwears are interpreted as caused predominantly by hide (fresh or indeterminate) working and meat butchering (Table 6.10). Evidence for dry hide is surprisingly infrequent, with only two edges showing such use. The microwears are often well developed and frequently the edges are even more rounded than the endscraper fronts (Photomicrograph 24). Finally, when both lateral edges show evidence of microwear, they are generally the same microwear indicative of the same use. Of thirteen bilaterally used tools only three exceptions occur, and two of these microwears are similar enough as to have been produced by the same use.

One question that arises is the temporal relationship of the lateral microwear to the frontal microwear; which was produced first? Some endscrapers show evidence that the lateral margins were used after the last modification of the front, such as SE 1 and SE 20. This evidence is the continuation of the microwear along the lateral edge on to

Table 6.10

Lateral Edge Use on Front-Used Endscrapers

Type	Fresh Hide	Dry Hide	Undet. Hide	Depilate Hide	Butcher Meat	Bone/ Antler	Total
G1	3	1	4	2			10
G2	2		1		3		6
G3	4	1	6		1	1	13
G9					2		2
Total	9	2	11	2	6	1	31

the retouched front (see Theorem 3). In these two cases since the frontal microwear and lateral microwears are found together on the retouched front, it is likely that the microwears were produced about the same time, although not necessarily. As previously noted these two artifacts probably fit more closely with the lateral edge working endscrapers.

In another situation, endscrapers show evidence of the working end extending onto the lateral edge as if the lateral edge is an extension of the front; e.g., SE 8 (Figure 6.5d). In this sense the "use front" is larger than the technomorphological front of the endscraper.

Other endscrapers display good evidence that the lateral microwear developed before the last use of the front; e.g., SE 17, SE 29a, SE 31 and SM 331 (Figures 6.5e, 6.5a, 6.4a, 6.4d respectively, and see Appendix D). In these cases the lateral microwear is immediately abrupted by the frontal retouch. According to Theorem 7, the lateral microwear must have preceded the frontal retouch which in turn preceded the frontal microwear. This does not mean that substantial time must have passed between the episodes of use that produced the two microwears. Instead it is possible that they developed during the same activity period, but that lateral microwear did not occur after the last frontal retouch episode. However, it is also possible that substantial time might have passed, such as when a

used blade discarded during one occupation episode of the site is scavanged and used for hide scraping during a later occupation episode.

One question that cannot be ignored is whether or not these lateral edge microwears were produced by use or by handling and hafting during use of the front. Lateral microwear on end-used tools has been reported by other use-wear analysts (Keeley 1982; Odell 1980:412). In these cases the microwear has either been produced during experimentation, or interpreted to have been produced prehistorically by haft or manual wear during use.

Comparison of the microwear on these tools with that described by Keeley indicates that the microwears described here are generally more extensively and intensively developed along the edge than seen on those studied by Keeley. Nonetheless a model can be proposed to explain these differences. This model operates on the assumption that if raw material is scarce, more intensive use of the stone tools occurs. For end used tools such as endscrapers and burins the working edges, at least in theory, can be resharpened for reuse numerous times. It is suggested that the extended temporal use of the front would allow manual or haft produced microwears to develop more fully along the lateral edges. It is suggested that retouching the front eventually abrupts this lateral microwear. The final result would be an front-used tool with microwear on the

frontal retouch which abrupts a well developed microwear on the lateral margins. See Figure 6.12.

In experiments to test this model endscrapers are manufactured and hafted to an antler handle using dry hide to bind them. Each tool is used for scraping dry hide. When the working edge becomes dull the tool is retouched and the hide scraping then continues. The tools are used for up to three hours of actual scraping. The bindings of the haft hold very well and rarely require rebinding. Retouching the tool while it is bound is more difficult, partly due to the difficulty of being able to grasp the tool adequately. In addition, when the front is reduced to near the binding, it becomes difficult to percussion retouch the lateral aspects of the front because the binding interfers with the direction of the blow. It is uncertain if an expert knapper would face the same problem. Finally, retouch never extends to the binding itself because of the interference. This causes a short length of about two to four millimeters of the lateral edges to be unaffected by the binding and by the retouch (Figure 6.13).

The resulting microwear produced by the hafting of the endscrapers follows closely the description of microwears described by Keeley (1982) for hafted tools. The microwear is very mild and it is barely recognizable as a microwear produced by dry hide. It is found either sporadically along the edge or fairly localized. This is not the

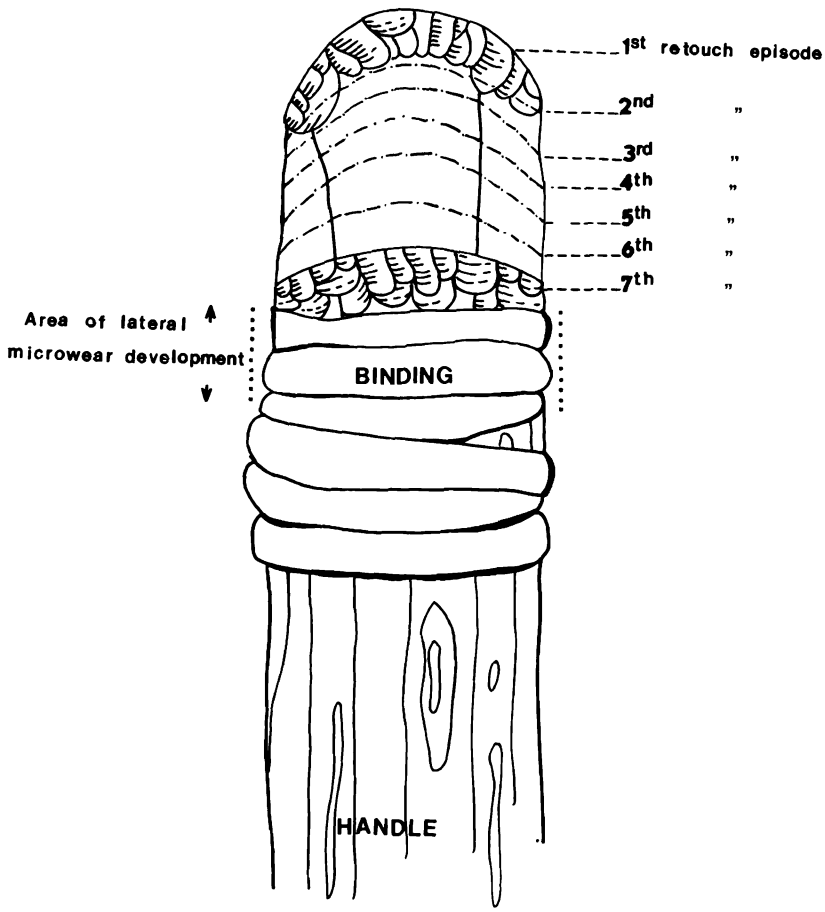


Figure 6.12. Model of how hafting can produce intensive lateral microwear.

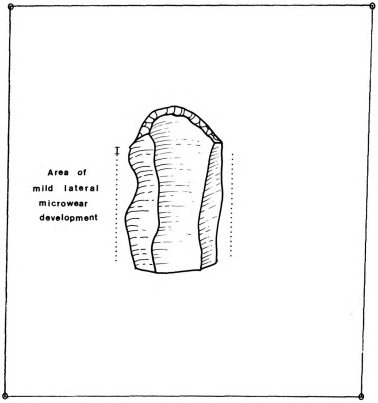


Figure 6.13. Generalized results from the hafting experiments.

pattern seen of the tools from Paglicci Cave where the lateral microwear is extremely well developed, often having produced substantial rounding of the edge. The results thus indicate that the microwear on the lateral edges of the archaeological specimens is unlikely to have been produced by hafting (and by extension, handling). In addition, no archaeological specimen has a gap between the lateral microwear and the retouched front (except SE 18 whose microwear was hypothesized to have resulted from handling prior to these experiments). This would be expected often if the tools were hafted and used as hide scraping endscrapers.

In a second set of experiments to test whether or not microwear from hafting can disrupt or confound the interpretation of a microwear which is produced by the use of the edge. In this experiment a blade is used for cutting plants until a well-developed microwear and a moderately rounded edge results (Photomicrograph 11). The tool is then retouched to form an endscraper and used for three thirty minute episodes. At the end of each use episode it is unbound and microscopically examined.

It is not until after the last use episode of the tool that the lateral edges show modification which result from the haft. Approximately 50% of the bright P1M microwear is removed. The P1M microwear is now often interupted along the edge, and when visible it is much narrower line of

polish (Photomicrograph 25). Interestingly its removal occurs mainly at the most projecting aspects of the microtopography. Although one can still recognize that there is a bright microwear on the edge, it is difficult to recognize it as resulting from plant.

The preliminary results of this experimental research suggests that microwear caused by hafting can modify previosly formed microwears and therefore cause misinterpretation of the lateral edge use. Although the experiment has only been performed for microwear resulting from plant use, it is plausible to suggest that a heavily used butchering tool, for example, could have its lateral margins effected enough to suggest that the original use was hide working and not meat butchering. Further testing, however, is required.

6.3.3. Summary

The results of this research indicate that there are two major use categories of endscrapers from level 4a of Paglicci Cave. The first of these is typically long and narrow with a small, occasionally protruding, front. Technomorphologically they are often defined as Laplace's primary type G6 (ogival endscrapers) and include look-alikes in the other primary types. These tools show consistent use of lateral edges for butchering and hide working which always followed the modification of the front.

The second category consists of all other endscrapers from level 4a which have large, well developed fronts. They consistently have evidence of use for hide scraping on their front. This fits the hypothesized function of endscrapers. There appears to be some technomorphological distinction between fresh hide and dry hide scraping fronts, but this needs further testing.

Lateral microwears on these front-used endscrapers may be from hafting or handling, but the intensive microwears appear to result from lateral edge use prior to the (last) modification of the front. Experiments suggest however that the microwears seen on these lateral edges may have been modified by hafting or handling during the use of the front which can lead to misidentification of the microwear and thus cause misinterpretation of the original use.

Only one carinate endscraper is studied and it does not differ by use from the other endscrapers although technologically it is not significantly different from the others. Thus the use of carinate endscrapers at Paglicci Cave cannot confirm or support the findings by Keeley (personal communication) that these can be bladelet cores.

6.4. Differentiated Abrupt Retouch Tools

The family of differentiated abrupt retouch tools includes: truncates, becs, backed points, backed blades, backed and truncated tools and geometrics. The abrupt retouch which characterizes these tools is located on

distinct parts of the tool, thus producing very different forms. This distinguishes them from the group of abrupts in the family of substrates.

6.4.1. Truncates

The group of truncates is characterized by abrupt retouch on the (usually distal) end of a blade or occasionally of a flake. Note that a truncate is not just a fractured or snapped blade and that it is not the same as an endscraper. There are thirty-two truncates recovered from level 4a, and an additional ten T0s which have fractured ends with minute damage, not adequate to be referred to as retouch. Ten of the truncates (including T0s) are composites found on other tool types. The truncates are manufactured on various sizes of blades, but not on the small bladelets characteristic of all other RAD groups except becs. Most have a profound and not a marginal retouch on the end. There are a few T3 types with the end angled 45 to 75 degrees relative to the axis of the blade, but most of the truncates have ends perpendicular to the axis of the blade (Table 6.11).

The truncated end of these tools was originally hypothesized to potentially serve many different functions. These include: the shortening of a blade (for example if it is curved; ie., the ventral face is concave, one may wish to remove the curved section); to strengthen the end if it is thin and could easily fracture; to produce

Table 6.11

Population and Sample Sizes of Truncates

Pop. Sample	Excavation Unit External	Medial	Internal	Total
T1	3 / 0	0 / 0	0 / 0	3 / 0
T2	6 / 2	5 / 0	1 / 0	12 / 2
T3	10 / 5	5 / 0	2 / 0	17 / 5
T0	9 / 2	0 / 0	1 / 0	10 / 2
Total	28 / 9	10 / 0	4 / 0	42 / 9

a backed surface so that the tool is more accommodating to grasp; to produce a corner that can be used for cutting or graving; and finally, the only hypothesis as a working edge itself, is its use as a scraper for hard materials such as bone.

The data support the general contention that the truncated ends are not working edges although this is based on a small sample (Figure 6.14). Table 6.12 shows that only one tool has a truncated end thought possibly used. This is further supported by the well developed microwears found on the lateral edges indicating that these are the primary working edges (Table 6.13).

There is also no association between primary type and microwear type. Lateral edges in the sample are predominantly used for meat butchering. The BP microwear found on one tool is located on the corners of the tool and was probably used for bone graving. It is perhaps best to functionally categorize truncates as equivalent to unretouched blades (L0) or sidescrapers on blades; e.g., L1, L2 (Photomicrographs 23, 34 and 35).

6.4.2. Becs

Becs (beaked tools) are characterized by a projection at the end of the tool produced by either a truncate and an adjacent lateral notch (Bc1) or by two opposing lateral notches (Bc2). There are eleven becs recovered from level 4a. Of these only one is a Bc2. Seven becs are studied

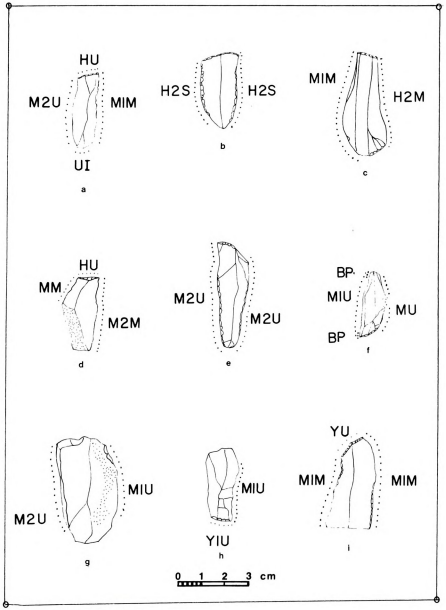


Figure 6.14. Truncates from level 4a.

Table 6.12

Use of Truncated Ends

	T0	T2	T3	Total
Used	1 ?	0	0	1 ?
Unused	1	2	5	8
Total	2	2	5	9

Table 6.13

Lateral Edge Use of Truncates

	Fresh Hide	Butcher Meat	Bone/ Antler	Total
T0	2	2	0	4
T2	0	3	0	3
T3	3	7	2	12
Total	5	12	2	19

for microwear including the single Bc2 (Table 6.14). It was hypothesized that becs were used rotationally for drilling or boring hard or soft materials. As the analysis reveals only two becs and a possible third bec were used as drills; one on hide and two on wood. Some becs show much bone microwear near the projection but the evidence suggests that they were being using for butchering meat and disarticulating (jointing) bone as the lateral edges also have bone and meat microwears (Figure 6.15).

Lateral edge use, unlike that of burins and endscrapers, tended to complement the use of the point. Wood was whittled by the lateral edges of the becs also thought to have been used to bore wood (Photomicrograph 26). On the other hand, many showed the lateral edge use to be the dominant feature. Two tools have heavy meat and bone microwears suggesting butchering. Another, made on a small bladelet, has a nicely developed meat cutting microwear. This tool is technomorphologically very similar to the longer PD's and DT's, and this is how they are thought to have been used as well. It is noted that the butchering tools show good evidence for multiple episodes of tool use. That is, unretouched surfaces often have qualitatively much more microwear development than retouched surfaces indicating that the tools were retouched between use episodes at least once during their use-lives.

Table 6.14

Population and Sample Sizes of Becs

Pop. / Sample	Excavation Unit: External	Medial	Internal	Total
Bc1	7 / 6	3 / 0	0 / 0	10 / 6
Bc2	1 / 1	0 / 0	0 / 0	1 / 1
Total	8 / 7	3 / 0	0 / 0	11 / 7

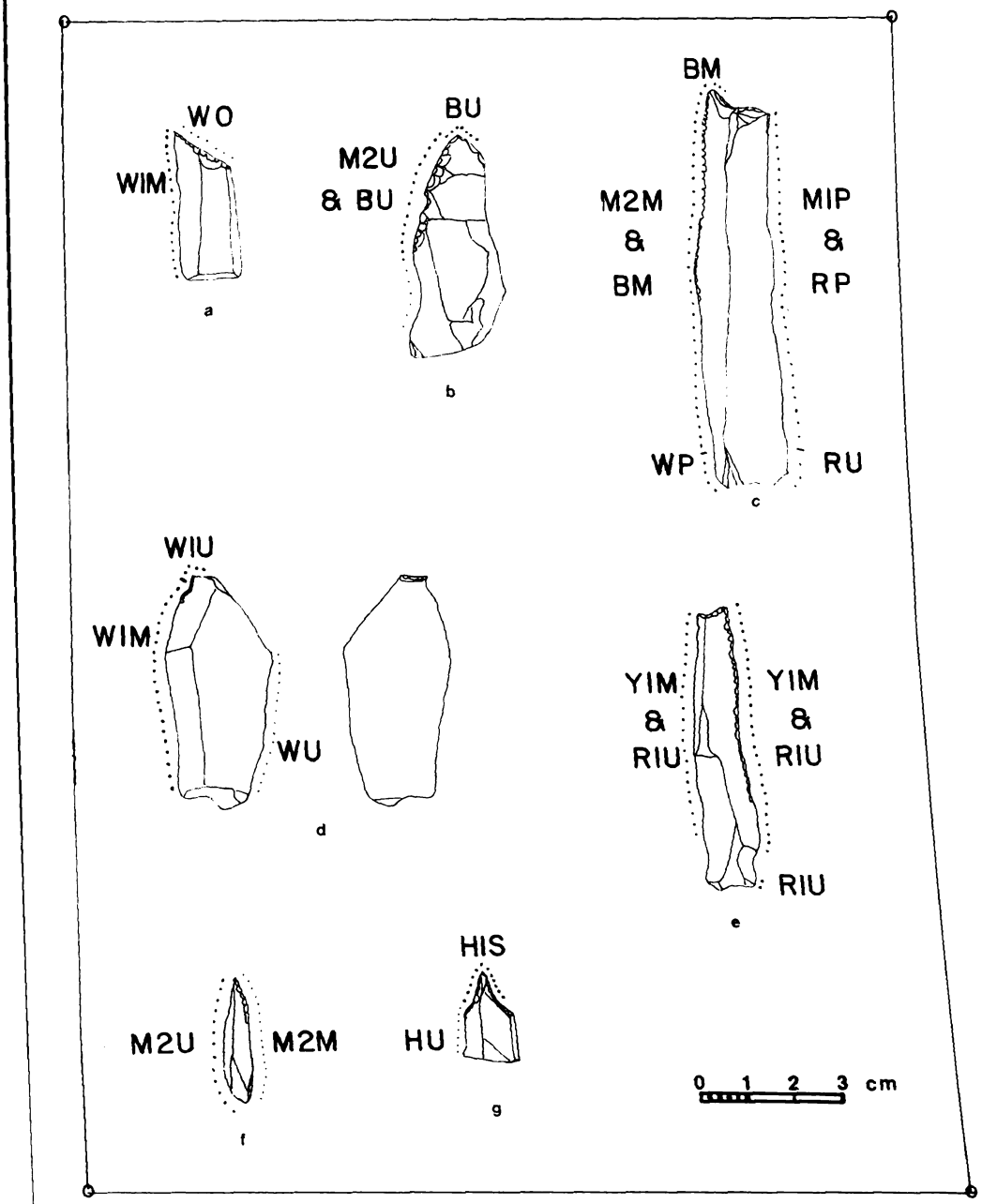


Figure 6.15. Becs from level 4a.

It is interesting that only two of the becs meet the strict "classical" definition of becs as defined by Laplace (1964a). In only two cases is the evidence for use as borers good. This suggests that the correlation between the technomorphologically defined group of tool, bec, and the use motion of boring can be positively very strong as long as the group definition is strictly adhered to.

6.4.3. Backed Points

There are seventeen backed points (PDs) in the level 4a assemblage of which twelve have classifiable microwears. The backed points are manufactured on small blades or bladelets of which all measure less than 50mm. There are no crans from this level and most of the backed points are PD2 and PD4 primary types (Table 6.15). Of the PD4 primary type, there occurs one distinctive secondary type given the name, Punta Sauveterre. It is bipointed and mildly biconvex formed by abrupt retouch circumscribing the tool (Figure 6.16, g-j). In level 4a it is a microlith in that it ranges from 12 to 16mm long, and less than 4mm in either dimension of width or thickness.

The microwears vary considerably within the technomorphological group with M- and M2- microwears predominant. There also occur R- microwears as well. Fortunately there are often overlapping attributes indicating that similar uses produced the different microwears. For example the Sauveterre points in the

Table 6.15

Population and Sample Sizes of Backed Points

Pop. / Sample	Excavation Unit: External	Medial	Internal	Total
PD2	2 / 2	3 / 2	0 / 0	5 / 4
PD3	0 / 0	1 / 0	0 / 0	1 / 0
PD4	6 / 5	3 / 1	2 / 2	11 / 8
Total	8 / 7	7 / 3	2 / 2	17 / 12

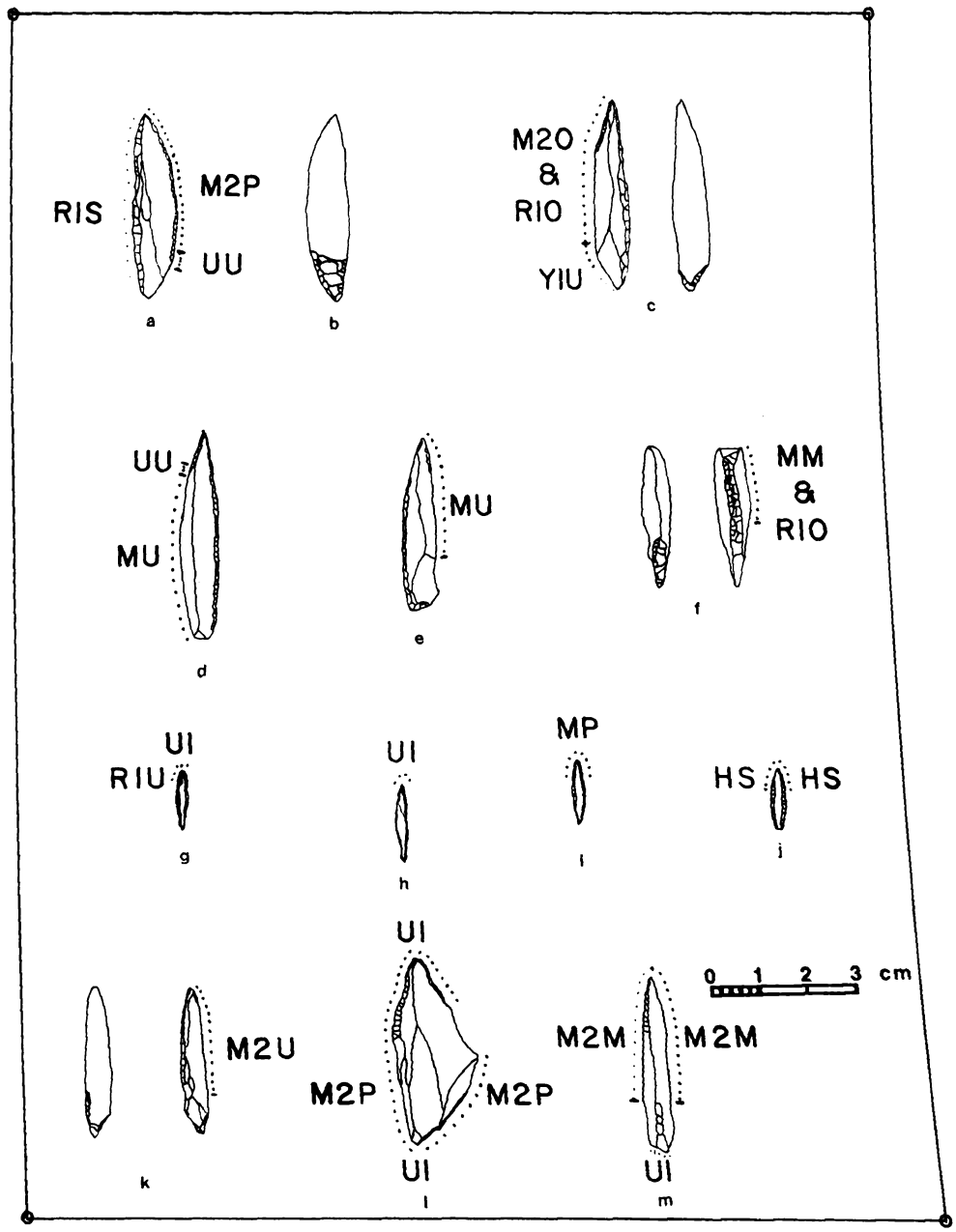


Figure 6.16. Backed points from level 4a.

sample have classifiable microwears of MI, H1S, R1U and RU, yet all but the H1S microwear are interpretable as having resulted from use as projectile points.

The Sauveterre point with the H1S microwear (on both lateral edges; Figure 6.16j) is interpreted as having been used in a rotating fashion (boring) in order to pierce dry hide. The small size of this tool is such that it would require hafting in order to have been used. Although possibly designed to be used for piercing hide, it is equally likely that a form of expedient behavior is represented where the point of a projectile is being used for a task not originally designed for that tool. Arrows, for example, are known ethnographically to be employed by hunter-gatherers as expedient tools.

The other backed points, all substantially larger than the Sauveterre points, have an M- or M2- microwear, but at a much increased level of intensity and showing different directions of use. Six are interpreted as having been used for cutting meat, fresh hide or both (Photomicrograph 27). The remaining two tools are interpreted as having been used as projectile points, based on the relatively less developed nature of the microwear, small impact fractures at one or both ends and striations parallel to the axis of the tools. There is a strong chance that these two tools are also "meat knives," but just with less microwear development. This is based on the technomorphological

similarity these tools have with many of the other backed tools interpreted as being used as meat knives, and that microwears seen on tools consistently interpreted as projectile armatures are much less developed than seen on these two tools.

There is no pattern of use with specific primary types or with spatial provenience. The Sauveterre point shows some evidence in this study as being functionally specific, and there is an indication that the larger backed points are, in general, knives (for meat) and not projectile points (Table 6.16). Backed edges of these tools do not show evidence of having been used. Additional aspects of the backed points will be presented in the general discussion of RAD tools.

6.4.4. Backed Blades

There are twelve backed blades (LDs) of which five have classifiable microwears (Table 6.17; Figure 6.17). Like the backed points they are all made on bladelets and there are no shouldered or tanged forms among them. Most of these are simple in form, usually LD2 with abrupt retouch along a single straight lateral edge. A few of the backed blades are microlithic in size and except for lacking a truncated end, are very similar to the small backed truncates (the microlithic DTs) to be discussed later.

Many of the LDs have extraneous microwear, mainly damage of flint on flint, especially those from the middle

Table 6.16

Technomorphological Types and Uses of Backed Points

Type	Projectile Armature	Meat Knife	Hide Boring	Total
PD2	1 ?	3	0	4
PD4 Sauveterre	3	0	1	4
PD4 Other	1 ?	3	0	4
Total	5	6	1	12

Table 6.17

Population and Sample Sizes of Backed Blades

Pop. Sample	Excavation Unit: External	Medial	Internal	Total
LD2	6/4	4/0	1/1	11/5
LD3	0/0	1/0	0/0	1/0
Total	6/4	5/0	1/1	12/5

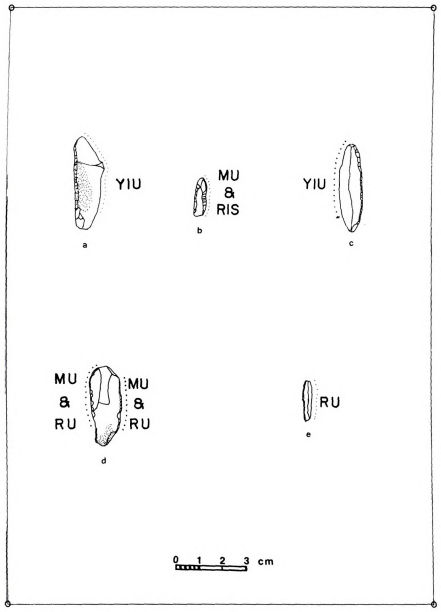


Figure 6.17. Backed blades from level 4a.

section of the excavation, which is distracting enough to inhibit attempts to classify and interpret microwears produced by use. It is thought that this silicate damage occurred post-depositionally.

The five interpreted instruments have microwears within the Y1- group, some of which belonging to the M- class. These microwears are seen at two distinct levels of intensity which corresponded to the two size categories represented. The microlithic LDs have faint microwear traces on them and are interpreted as projectile armatures. The longer LDs have well developed microwears, and are interpreted as backed meat knives. Their microwears, including intensity, match that found among many of the longer PDs. In one case, specimen SI 122 (Figure 6.17d), the microwear is seen on both lateral edges. The backed edge in this case is only partial, thus part of this edge is also sharp. No spatial patterning and no patterning among primary types concerning use can be recognized because of the small population and sample.

6.4.5. Backed Truncates

There are thirty-two backed truncates (DTs) from level 4a. These, like the PDs and LDs, are all made on bladelets. They do, however, vary substantially in length; from less than 10mm to more than 40mm. All primary types except DT7 are represented in the population and sample

(Table 6.18). No DTs are recovered from the internal section of the excavation.

There appears to be no relationship between primary type and microwears. The microwears are always found on the sharp, non-backed lateral edge. They almost all belong to the Y family with most classified as M class and M2 type microwears. There is one tool that appears unused, its edge shows no rounding, virtually no fracturing and no polish. It is referred to in Italian as a gauncio because the abrupt retouch ends in a hook on the edge (Figure 6.181). It is thought by the technologists to represent an unfinished abrupt retouched tool, and the lack of microwear supporting an unused interpretation also supports this "unfinished" claim.

The microwears of the remaining tools occur at two levels of intensity, one extremely mild and the other of moderate intensity, and these seem related to techno-morphological characteristics (Table 6.19). This first group consists solely of microlithic forms, all under 20mm and less than 5mm in width and thickness. These are interpreted as having been used as projectile armatures. In one case, specimen SE 240, there are substantial microwear and technomorphological similarities to the Sauveterre points except that it is wider (Figure 6.18e). The retouch on one lateral edge suggests that the knapper had extreme difficulty in attempting to further retouch

Table 6.18

Population and Sample sizes of Backed Truncates

Pop. / Sample	Excavation Unit: External	Medial	Internal	Total
DT1	2 / 2	1 / 0	0 / 0	3 / 2
DT2	2 / 2	0 / 0	0 / 0	2 / 2
DT3	1 / 1	1 / 0	0 / 0	2 / 1
DT4	1 / 1	2 / 2	0 / 0	3 / 3
DT5	1 / 1	1 / 0	0 / 0	2 / 1
DT6	1 / 1	0 / 0	0 / 0	1 / 1
DT8	1 / 1	1 / 1	0 / 0	2 / 2
ΔDT	11 / 6	6 / 2	0 / 0	17 / 8
Total	20 / 15	12 / 5	0 / 0	32 / 20

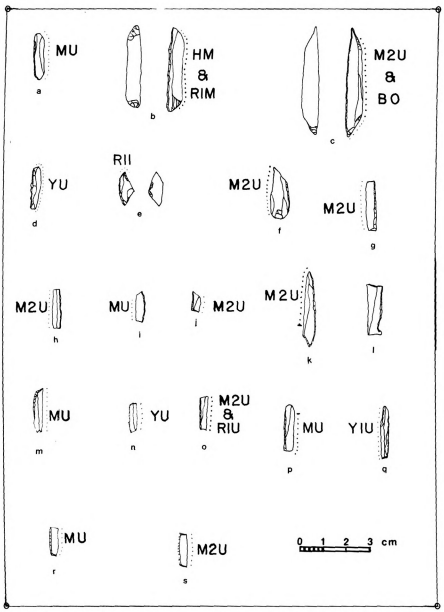


Figure 6.18. Backed truncates from level 4a.

Table 6.19

Relationship Between Tool Length and Intensity of Microwear on Backed Truncates

	Intensity of Microwear		
	Moderately Developed "Backed Knives"	Mildly Developed "Armatures"	Total
Long	4	0	4
Short	0	14	14
Total	4	14	18

this edge. The impact fractures and striations parallel to the axis indicates that it belongs to the same use group as the Sauveterre points, thus it is inferred to be a projectile point.

The second group consists of much longer tools, except for specimen SE 250, a DT6, the triangular form of the distal end is the result of a snap. The fractured edge has no microwear even at the vertex (an arris) where it meets the cutting edge which has substantial microwear. Theorem 6 thus applies and it is argued that the snap occurred at the end of its use (Figure 6.18f). The original tool was therefore longer, thus fitting the technomorphological pattern of the other tools in this use category. These tools are interpreted as being used for cutting meat, and in one case, for cutting hide.

6.4.6. Geometrics

There are twenty-three geometrics recovered from level 4a and these are all microlithic in size except for one. This one and one other instrument are the only two that are not Gm1s (lunates). Nine of the sampled Gms, all Gm1, have classifiable microwears (Table 6.20). The microwears are all of the Y1- group, mostly of the M- class with a few recognized as M2-. The microwear is extremely mild and found along the unretouched edge, but sometimes appearing to extend onto a part of the backed edge (Figure 6.19).

Table 6.20

Population and Sample Sizes of Geometrics

Pop. / Sample	Excavation Unit: External	Medial	Internal	Total
Gm1	7/5	11/4	3/0	21/9
Gm2	1/0	0/0	0/0	1/0
Gm6	1/0	0/0	0/0	1/0
Total	9/5	11/4	3/0	23/9

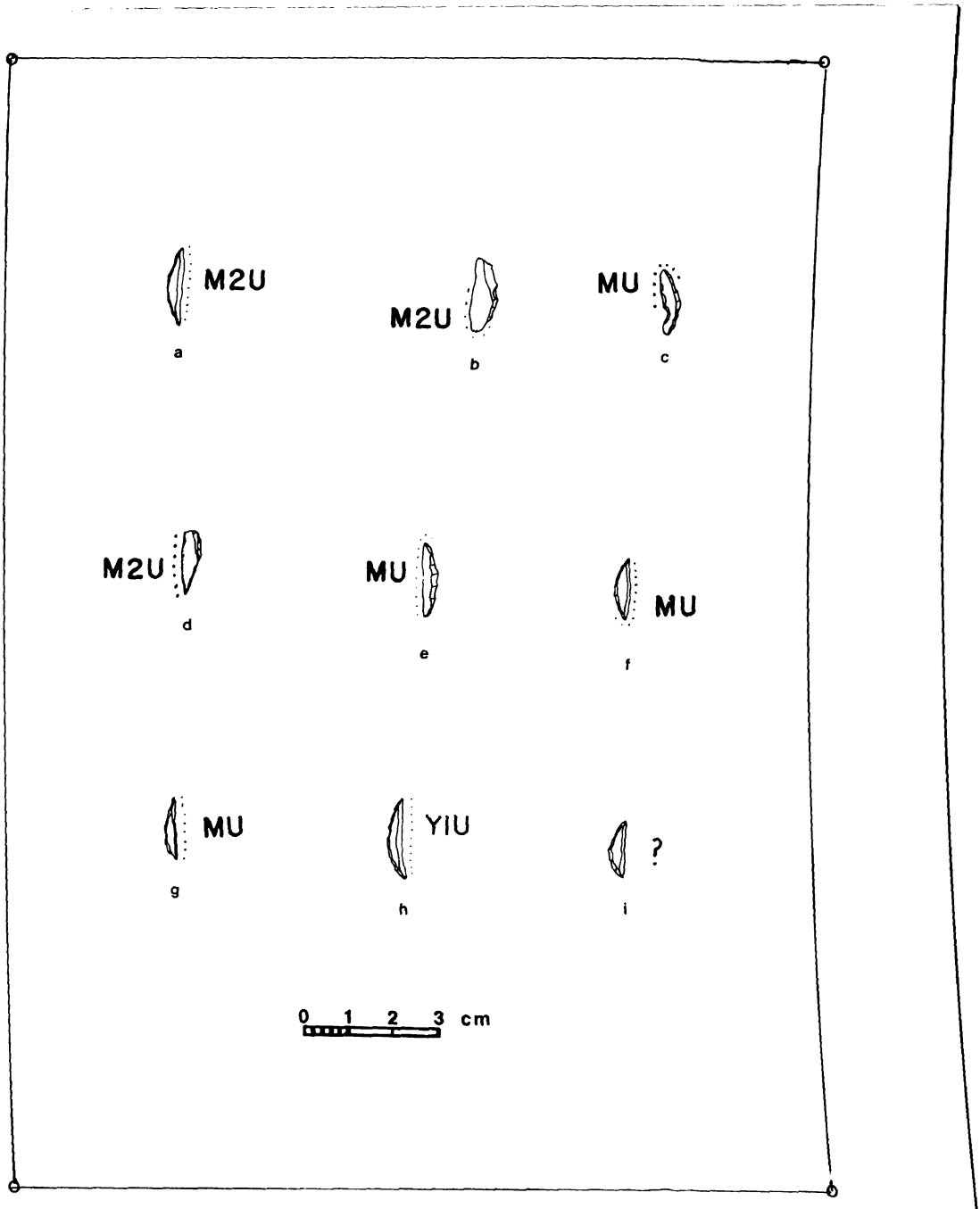


Figure 6.19. Geometrics from level 4a.

These tools are inferred to be projectile armatures, probably lateral barbs, but possibly projectile points.

A sample of the Gms is compared with a sample of the microlithic DTs to test if substantial differences occur that might imply different uses or different intensities of use between the two groups. While differences do occur (more fractures in one group, more rounding of the cutting edge in the other) the differences are negligible and do not negate their interpretations. In general, the microwear on microliths is far less intense than that found on any other technomorphological or use group.

6.4.7. Discussion of Backed Tools

One of the patterns noted in the study of the uses of the instruments is that most of the tools interpreted as armatures are short relative to the length of those interpreted as backed knives. In fact, if the two PDs inferred to be projectile points are deleted from the sample, then all armatures would be relatively short. Figure 6.20 shows that the two use classes do differ according to length. However, nine of the DTs presented have only one end truncated the other end being fractured. These tools could therefore be fragments of longer tools. Technologically, they are classified as fragments (ΔDT).

Since length appears to be a meaningful yet problematic measure, are there other dimensional measures equally diagnostic, but not so problematic? Both width and

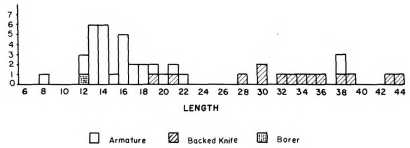


Figure 6.20. Distribution of armatures and backed knives by length (mm).

thickness seem to be useful especially when combined (Figure 6.21). Even when projectile points are included in this diagram they all fit the pattern for armatures except two. (This consistent pattern of "exceptions" for these two tools explains why I suggest my interpretation may be wrong.)

The hypothesis that width and thickness together can be used to distinguish the two use classes is tested on a sample of the backed tool fragments (Δf). This unofficial Laplace category of instruments within the RAD family includes backed fragments which cannot be classified into specific groups and are thus categorized separately. In level 4a there are 132 backed tool fragments of which twenty are sampled for microwear analysis (Figure 6.22).

Microwears resulting from the analysis on this sample lead to the inference of the two use groups of armatures and backed (meat) knives, and one group of unused (unfinished) tools. The distribution of the two use groups in the two-dimensional graph with axes of width and thickness supports the above hypothesis that these measures are significant for differentiating use, and possibly functionally meaningful, classes (Figure 6.23).

It is to be noted that there is a distinct difference in the dimension of length for each of the use groups for the fragments as well (Figure 6.24). It appears that tools which are truly fragments are backed knives while those

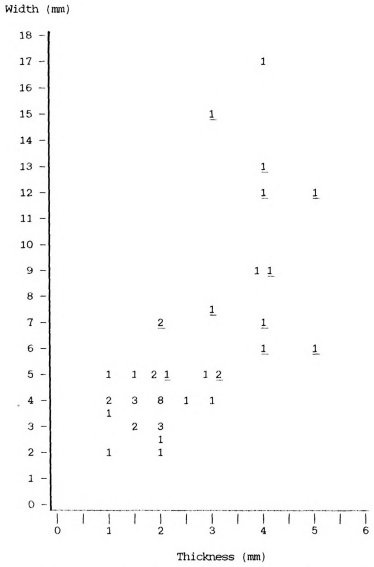


Figure 6.21. Scatter plot of armatures and backed knives excluding backed tool fragments.

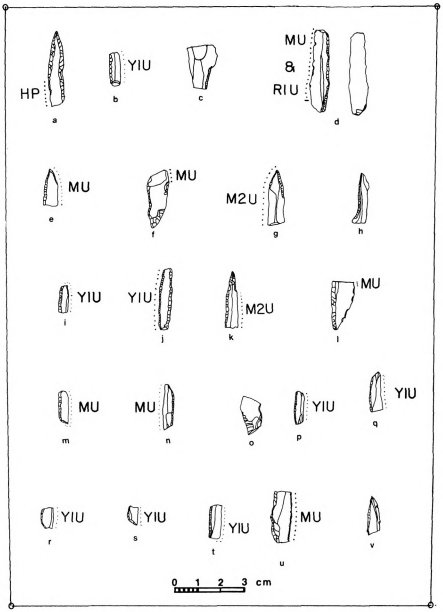
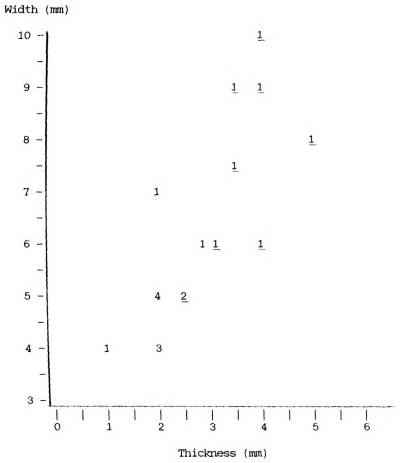


Figure 6.22. Fragments of backed tools from level 4a.



Numbers represent frequency of specimens with those dimensions.
Underlined numbers indicate backed knives, all others are armatures.

Figure 6.23. Scatter plot of sampled backed tool fragments.

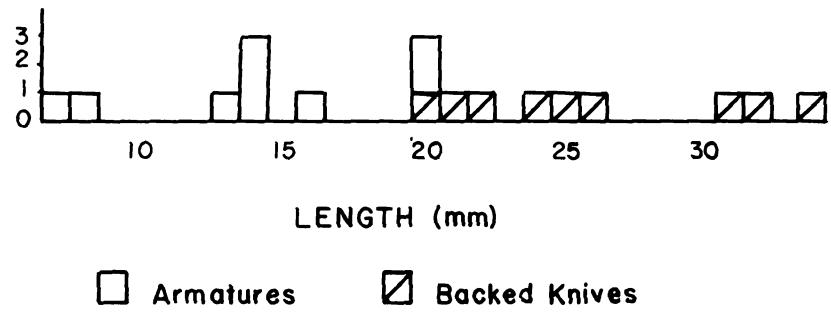


Figure 6.24. Frequency distribution of sampled backed tool fragments.

interpreted as armatures are probably not "fragments," but instead are whole tools. In addition, armatures appear limited in length, both in this sample and in the samples from the different RAD groups. This length limit appears to be approximately 20mm for level 4a.

According to this information it is now possible to predict for level 4a the use of a backed tool as an armature. The criteria include the following:

1. Width is 5.0mm or less.
2. Thickness is 3.0mm or less.
3. Length is 20mm or less.
4. Deletion of all gauncio forms.

The backed tools that are greater than 5mm in width or 3mm in thickness and are not gauncios can be predicted to be backed meat knives or their fragments.

Whether or not the dichotomy of size for these two use groups actually occurs in other levels at this site or at other sites is uncertain. It is generally known that through the Italian Epigravettian chronologically there is a general decrease in the overall size of tools in the assemblage (Barker 1980). This pattern appears to hold true for the backed tools of assemblages I have viewed. This suggests that if a size dichotomy occurs which differentiates the use of these tools as described above, it may occur at different dimensions for other levels of Paglicci Cave and for other sites.

There are other kinds of evidence to support this dichotomy. One of these regards the manufacturers' concern for length. The armatures very rarely include the proximal end of a bladelet. On the other hand those tools interpreted as knives almost always include the proximal end of the bladelet. A substantial amount of effort is often expended in order to modify the proximal ends of these tools in preparation for their use. The simpler option of removing the proximal end is rarely seen. Thus it appears that the retainment of the maximum possible length for the knives is sought even though originally manufactured on bladelets.

The backed knives have, in general, the same microwears as the armatures, however they differ significantly in terms of the development of the microwear, the intensity of the fracturing and the amount of rounding of the edge. The microwears always fall within the Y1 group with an occasional additional R1 group microwear. These Y1 group microwears are almost always of the M class or M2 type with only one exception. The tools thus appear to be almost always used for the cutting of flesh, either meat or fresh hide, except in one case where dry hide seems to have been the material cut. This is the reason for referring to them as backed meat knives.

The location of the microwear on these tools, most noticeably the edge rounding, occurs almost always from one

end of the tool along the non-abrupt retouched edge to about 10mm from the opposite end. At this point the edge is extremely sharp and shows no evidence of use. Occasionally intense fracturing of the tool exists near this transition point. This pattern of showing no sign of use near one end of backed tools is considered evidence for hafting of the tool. It is so characteristic that it is possible to infer that many of the fragments are pieces of backed knives even though they only have a few millimeters of microwear along their length near the fractured end (e.g., Figure 6.22: a, f and l).

Technomorphological characteristics of the hafted ends of backed knives vary considerably. A hafted end may have no additional retouch except lateral backing, or it may have distinct modification of edges and faces. They can also be exact duplicates of the projecting or distal end of a backed knife. In general the pattern is one of narrowing the width of the tool. This can be a complex procedure, especially because of the difficulty of retouching the tool near the bulb of percussion.

Backed knives appear to come in not only end hafted forms, but also back hafted forms. The best evidence for this is specimen SE 245, a DT3 (Figure 6.18b). It has flat retouch at both ends to produce a cutting edge from the back corner at one end, along the unretouched lateral edge and around to the other end's back corner. The microwear

on this tool is an intense class HP which suggests the cutting of dry hide or greasy dried hide. The rounding of the edge begins abruptly at the proximal end, 4mm from the back. It extends to the distal end where it slowly lessens in intensity until about 3mm from the backed edge where the edge is again very sharp. The simplest explanation for the microwear location is to suggest back hafting as neither end hafting nor manual use adequately explain the distribution of the microwear. Other tools from this level may be back-hafted as well, but the evidence is less clear.

6.4.8. Summary

In summarizing about the family of differentiated abrupt retouch tools it can be stated that truncates appear to fall into the use category of sidescrapers (to be discussed). Becs also appear to fit this category when strict technomorphological definitions are not adhered to, but when they are, they match their hypothesized function of tools for boring. Becs (at least in one case) can be of the same use category as backed (meat knives).

Among the laterally backed tools, there appear to be two general use classes. First, the armatures, often characterized by their microlithic form, and which can probably be subdivided into points and lateral barbs. Second, backed meat knives, tools characterized by the fact that they are manufactured on small blades (bladelets), yet maintaining as great a length as possible unless fractured.

This is unlike the armatures which almost always show evidence of having been shortened. There may also be more specialized types in this use group as well, such as the back-hafted, hide working DT3, SE 245, but this will require further study.

Backed points have been controversial tools for some time in that it is debated whether they are projectile points or knives. This study tends to support the contention that the larger ones are indeed knives, but that they are also, on occasion, projectile points.

The two use categories of laterally backed tools presented here do not correlate with the Laplacian technological types even though all geometrics fall into the armature category. This appears to be mainly the understandable determination by Laplace of avoiding tool length as a criterion for the typological system. It is important to recognize, as this study implies, that relative length and not absolute length is a significant criterion for distinguishing functionally meaningful types. That these functional types can be distinguished by means of technological and morphological features and measures appears possible based on this analysis.

Finally, it appears that these backed tools, whether backed meat knives or armatures, are closely associated with either the killing or the butchering of game. That this is reasonable as a hypothesis beyond this level and

beyond Paglicci Cave is found in the amount of preparation necessary to manufacture these tools. They are carefully retouched and then evidently always hafted on a shaft or handle most likely with a prepared resin. That one would go to such length for a tool that would become dull rapidly while whittling wood or cutting hide when a simple flake could do the task seems unlikely. That such preparation would go into tools of extreme importance (arrows) or tools that could last through hours of meat cutting, therefore representing perhaps days of use, is far more likely.

6.5. Foliates

Foliates are a technologically distinct family of tools because of their characteristc flat retouch that is probably produced by pressure flaking. The population of foliates is very low from this level of Paglicci Cave. This is to be expected as they are most numerous in Ancient Epigravettian assemblages, dating about 19,000 B.P. and closely corresponding to the Solutrean, when that technique reached its peak in southwest France and northern Spain. Three foliates are sampled for microwear analysis from the population of five, two F10s and three foliate fragments. The results indicate that there are two tools with microwears indicative of meat cutting and butchering and a third tool with microwear indicative of plant cutting or wood working (Figure 6.25; Photomicrographs 28 and 29). These tools are further described in Appendix D.

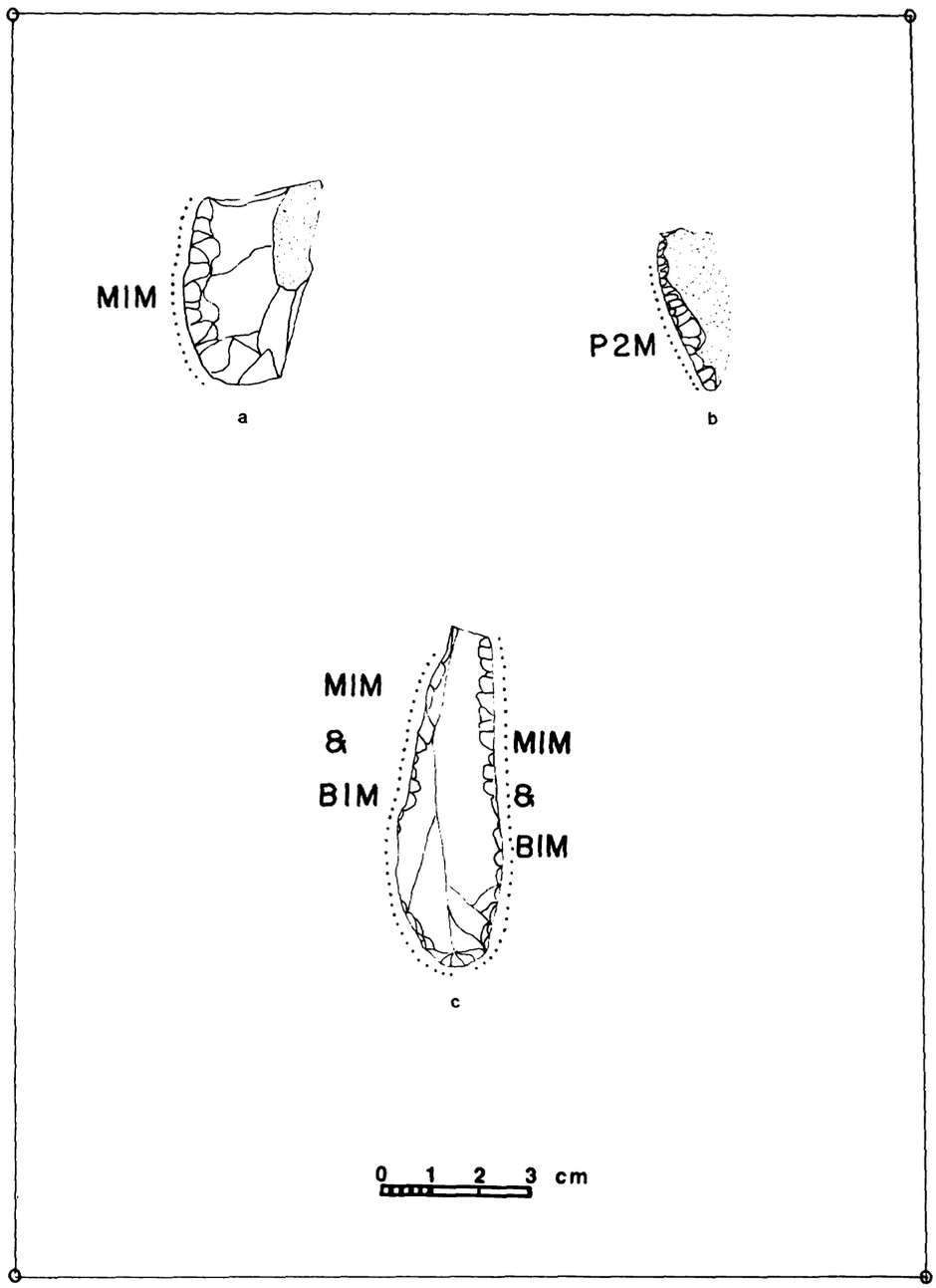


Figure 6.25. Foliates from level 4a.

No generalizations can be made concerning specific uses of foliates based on this small sample, but some overall comments can be made. Although these tools are technologically distinct from other tools, morphologically they fall into many similar categories, and in fact, go by those names (e.g., foliate sidescraper, foliate point, foliate geometric, etc.). For the development of a functional typology it would probably be best to group foliates with their morphological "cousins" rather than attempt to analyze them as an independent branch. This suggestion is supported by the similarity seen between the foliate SE 129 and the point SE 126 which show similar use, and appear to belong to a distinct functional group of tools. This will be discussed with the group of points.

6.6. Substrates

The substrate family includes a large variety of tool groups, often having little common relationship with one another in the family except for being tools that don't fit in the previously defined groups. They generally have simple retouch and little mophological shaping of the tool.

6.6.1. Points

The group of points include tools with simple or raised retouch on the lateral edges causing them to converge at one end to form a point. There are seven points recovered from Level 4a and of these four are studied (Table 6.21). Originally hypothesized to be the pojectile points (of

Table 6.21

Population and Sample Sizes of Points

Pop. / Sample	Excavation Unit: External	Medial	Internal	Total
P1	3 / 3	1 / 0	0 / 0	4 / 3
P2	0 / 0	2 / 0	0 / 0	2 / 0
P5	1 / 1	0 / 0	0 / 0	1 / 1
Total	4 / 4	3 / 0	0 / 0	7 / 4

spears), I found that this hypothesis to be incorrect, and instead, found that the tools studied here are knives. From this level of Paglicci Cave they are mainly used for the butchering and processing of meat (Figure 6.26). Three of the four tools appear to have been used for butchering and a fourth for fresh hide working. There is some evidence on two tools for some woodworking, but this may result from bone, autoabrasion or hafting.

One tool, SE 126, is very similar morphologically and in use to foliate SE 129. They both have a wide flat proximal end with this part of the tool having intensive microwear, evidently from butchering (Photomicrograph 30). The pointed half of the tool, although there is some microwear, is less intense and appears to have been the handled part, or perhaps a hafting element. These tools appear to be stemmed[6] butchering tools.

A review of similar points from other levels of Paglicci Cave indicates that this technomorphological type continues through the Epigravettian into the Gravettian; one even being found in the famous Paglicci burial of level 21d. The microwear on these tools have the same pattern of intense microwear on the broad flat part of the tool and

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[6]The Laplace system refers to these as Pointe à épaulement which translates as shouldered points. This one here is a P5 (a carinate point) because of it is relatively thick. Carinate has priority over other features. The thickness of this and the other shouldered points I viewed is generally greater than other points. This is often at the stemmed end, suggesting the need for greater strength.

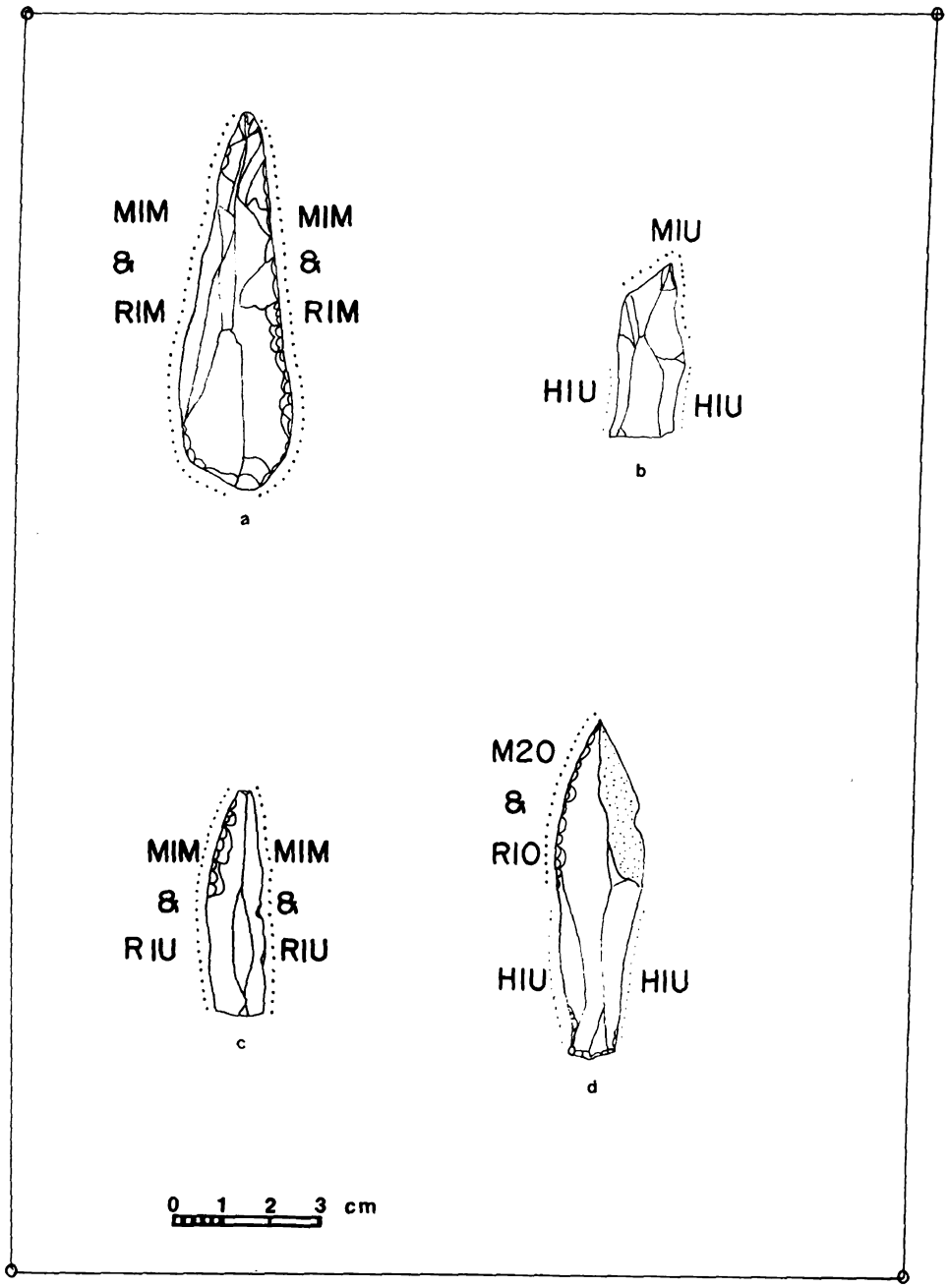


Figure 6.26. Points from level 4a.

little microwear on the contracting stem. In a number of these cases there was a distinct transition from used edge to unused edge making a much stronger case than made by the specimens of level 4a that these tools were indeed hafted.

This contracting stem is a technomorphological feature of some composite tools besides points including the endscraper-point and the double point. In each case it can be argued that the contracting stem (or one on a bi-pointed tool) functions as a hafting element for the tool. Thus the endscraper-point (if previous analysis holds for endscrapers) is a hidescraper with a contracting stem hafting element. The point and foliate specimens discussed here are two (butchering) knives with contracting stem hafting elements. Recognizing the profound simple or raised retouch on converging lateral edges as a potential hafting element may not only assist in understanding tool function better, but also improve the definition of industries since the hafting element can be a meaningful technomorphological attribute whose frequency varies through industries and traditions.

6.6.2. Sidescrapers on Blades

The sidescrapers discussed here include the primary type L0 although in a technological sense these are only unretouched blades. The term is maintained although some alternative such as "simple retouch and unretouched blades" may be more appropriate.

The microwear studied sample of sidescrapers are selected from a population of eighty-two sidescrapers on blades, and include unretouched blades and fragments that might be sidescrapers or points (L-P). See Table 6.22. The lateral edges of seventeen sidescrapers have microwears interpreted as resulting from meat cutting or butchering and two are from fresh hide working. (Table 6.23; Figures 6.27 and 6.28; Photomicrographs 31-33).

The dominance of butchering and processing of soft animal tissue suggests that the blades are specifically reserved and used for these tasks. This would be an important result if valid. However sidescrapers have a long straight edge and as such could be used for a variety of uses. Since they require no additional preparation after the production of the blade (as indicated in the use of the LOs), their relative value (measured in production time) is lower than the hafted backed knives.
There is also evidence of retouch and reuse of these tools suggesting an extended use-life.

Two sidescrapers and one truncate, SE 73, SE 75 and SM 384 are interesting in that they are technomorphologically complex, yet very similar. All have one splintered end and their lateral retouch is often very nearly denticulated and is located on the ventral face. Two are found to have been used for fresh hide working and the other is not interpretable because of the condition of the material.

Table 6.22

Population and Sample Sizes for Sidescrapers on Blades

Pop. / Sample	Excavation Unit: External	Medial	Internal	Total
L1	14 / 5	10 / 1	1 / 1	25 / 7
L2	5 / 4	4 / 2	0 / 0	9 / 6
L0	24 / 4	18 / 2	1 / 0	43 / 6
L - P	4 / 0	1 / 0	0 / 0	5 / 0
Total	47 / 13	33 / 5	2 / 1	82 / 19

Table 6.23

Relationship Between Tool Use and Technological Type

Type	Meat Butchering	Hide Working	Total
L0	6	0	6
L1	6	1	7
L2	5	1	6
Total	17	2	19

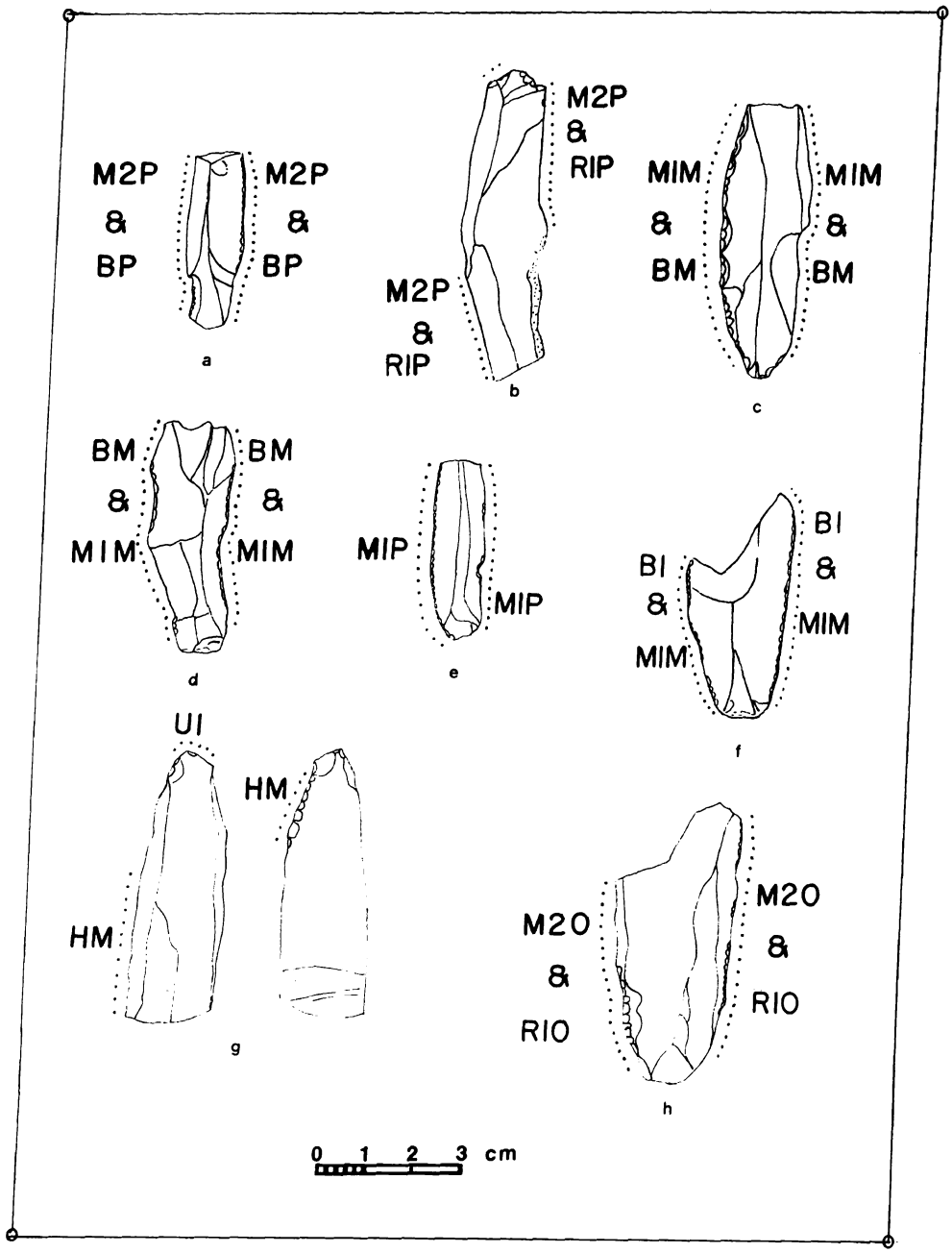


Figure 6.27. Sidescrapers on blades from level 4a.

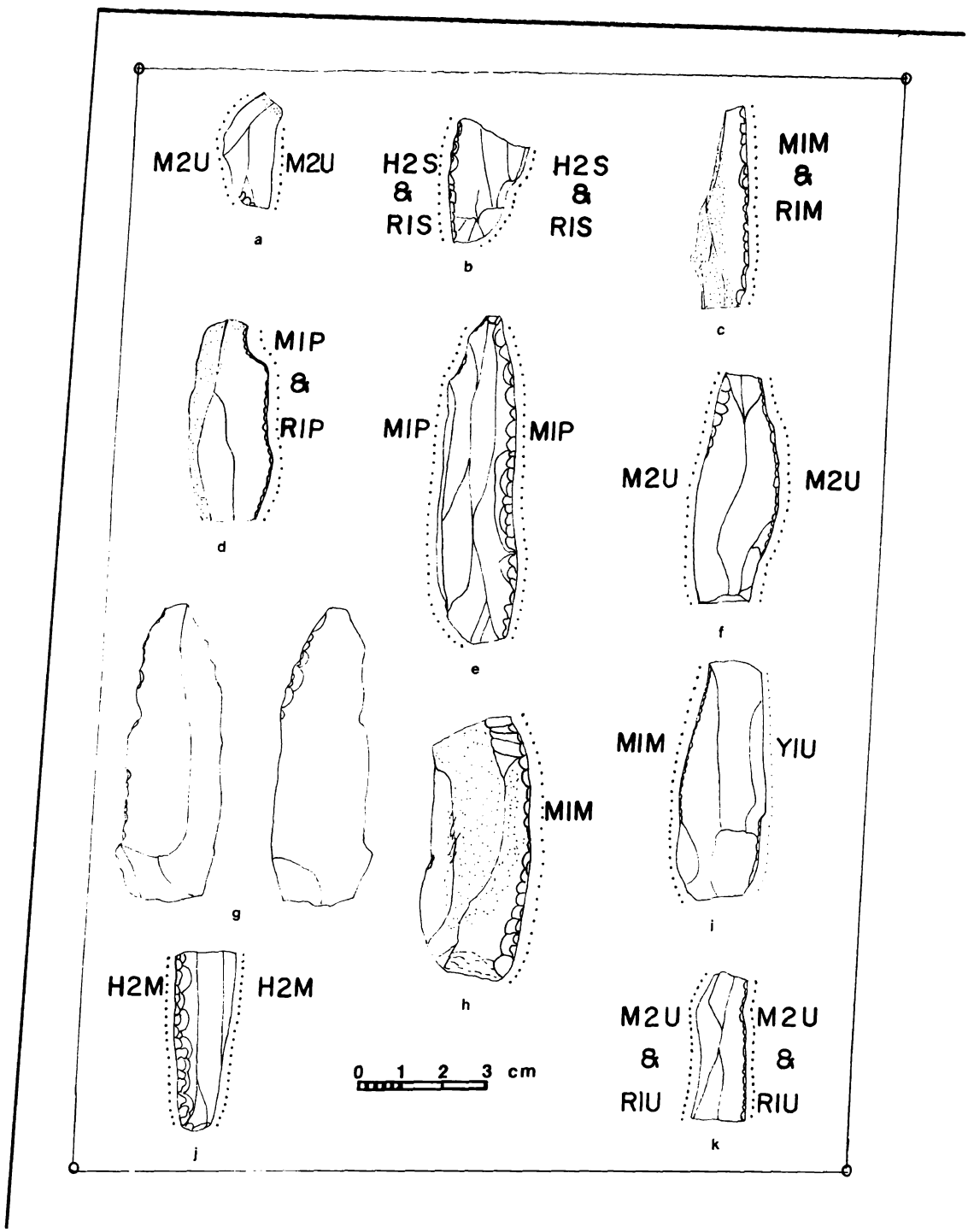


Figure 6.28. Sidescrapers on blades.

The similarities of these tools suggest a meaningful functional type distinct from other sidescrapers. As to use, it is interesting to note a comment presented by others stating that the removal of flesh from a hide is more easily accomplished with a denticulated edge (Keeley 1980).

The consistency of the microwears found on opposite edges of the blades, and the predominance of meat over hide in blade use supports the claim that the lateral edge interpretations of endscrapers are likely to have been misidentified as suggested by the experimental studies.

6.6.3. Scrapers on Flakes

There are only seven technomorphologically proper (side)scrapers on flakes, none being in good condition, but the number increases to thirty-two with the addition of unretouched flakes and scraper fragments (R-L; Table 6.24). Only three scrapers sampled, all ROs, have interpretable microwears. They all have evidence of being used for meat butchering (Figure 6.29). One of the butchering tools has substantial evidence for contact with bone suggesting that it may have also been used for jointing.

Little can be said about the sample in reference to the population concerning use. However, this group of tools represents the first of three groups which are very poorly represented from this level of the site. The poor representation of this group suggests that there was

Table 6.24

Population of Scrapers on Flakes

	Excavation Unit			
	External	Medial	Internal	Total
R1	1	1	0	2
R2	2	0	1	3
R3	0	1	0	1
R4	1	0	0	1
R0	10	3	1	14
R - L	9	1	1	11
Total	23	6	3	32

Note: From the sample of tools studied, which did not include fragments (R - L), microwears were interpretable from only 3 R0s.

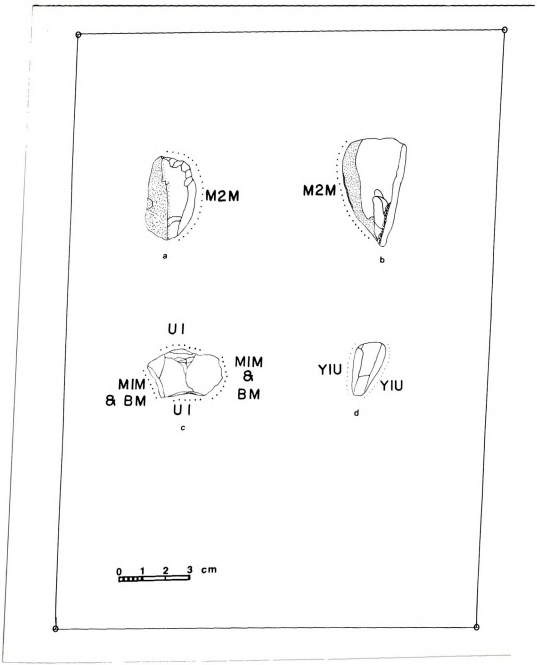


Figure 6.29. Scrapers on flakes from level 4a.

extreme selection in the importing of flint to the site. Even the best blade technology is going to produce substantial quantities of flakes and yet here there are few retouched flakes and not many unretouched flakes of any size even in the debitage collection.

6.6.4. Abrupts

There are only fourteen abrupts reportedly recovered from this level and although all of these are studied only one has interpretable microwear (Table 6.25; Figure 6.30). This A1 primary type tool appears to have been used for meat cutting along a non-modified edge.

That most of the abrupts do not have microwears suggests that at least for this level abrupts are tools that were not often used, and may not have been intentionally manufactured. Abrupts, formed by pressure flaking directed away from the flake, are often found in high frequencies where pressure occurs through disturbance such as trampling. It is suggested that, given the poor form of many of these abrupts, that they fall into this category of not being deliberately produced. It is also suggested that given their extremely low frequency in this level the natural and human processes that would tend to cause unintentionally produced abrupts was not much of a factor here.

Finally, once again their low frequencies suggest care in the selection of high quality flint being brought to the

Table 6.25

Population of Abrupts

	Excavation Unit			
	External	Medial	Internal	Total
A1	3	3	2	8
A2	5	1	0	6
Total	8	4	2	14

Note: Of those studied only one abrupt (an A2) has identifiable microwear.

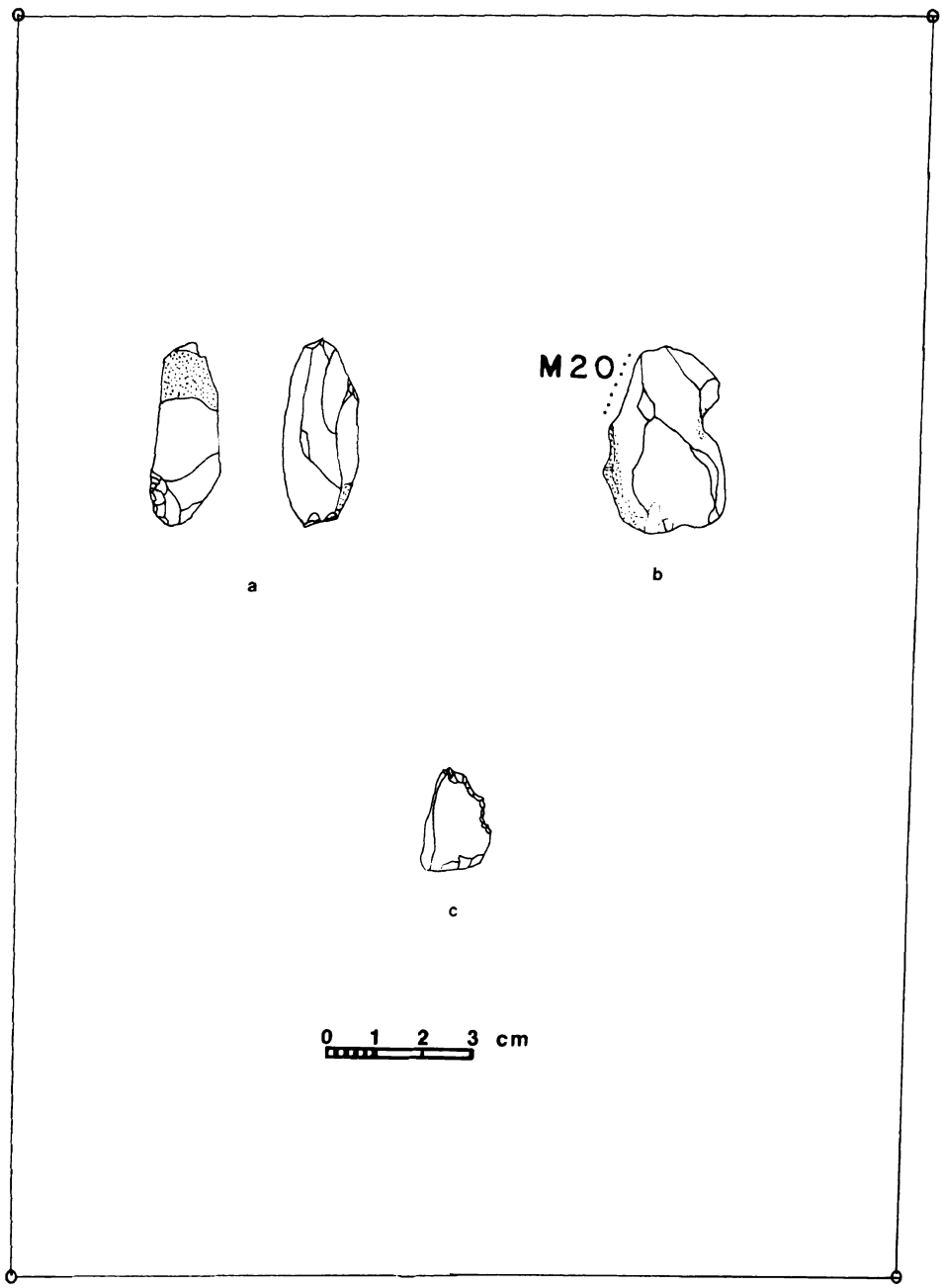


Figure 6.30. Abrupts from level 4a.

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site. Like the sidescrapers on flakes, only well-formed and large tools occur in any significant frequency.

6.6.5. Denticulates

There are twenty-five denticulates recovered from level 4a. The studied sample results in three denticulates with distinguishable microwears (Table 6.26). As far as denticulates are normally described these are extremely poor representatives, yet they are typical of the denticulates of level 4a (Figure 6.31). One is a spina; a denticulate formed by two near adjacent notches forming a spine on the edge. This spine shows no microwear although on another edge of the tool there is evidence of meat butchering. The other two tools both have denticulate edges produced by the use of the tool and not by deliberate modification. This is indicated by the microwear. One is a thin blade used for butchering. The other has extensive BS microwear on it and appears to have been used for working bone although the microwear may have developed through butchering (jointing).

The few tools discussed here are inadequate for generalizing about denticulates, however it appears that unless denticulates are well-modified by profound retouch, then it is likely that their modification may result from use.

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Table 6.26

Population and Sample Sizes of Denticulates

Pop. Sample	Excavation Unit: External	Medial	Internal	Total
D1	7 / 0	5 / 0	0 / 0	12 / 0
D2	6 / 2	2 / 1	1 / 0	9 / 3
D4	0 / 0	1 / 0	0 / 0	1 / 0
D5	2 / 0	0 / 0	0 / 0	1 / 0
D8	1 / 0	0 / 0	0 / 0	1 / 0
Total	16 / 2	8 / 1	1 / 0	25 / 3

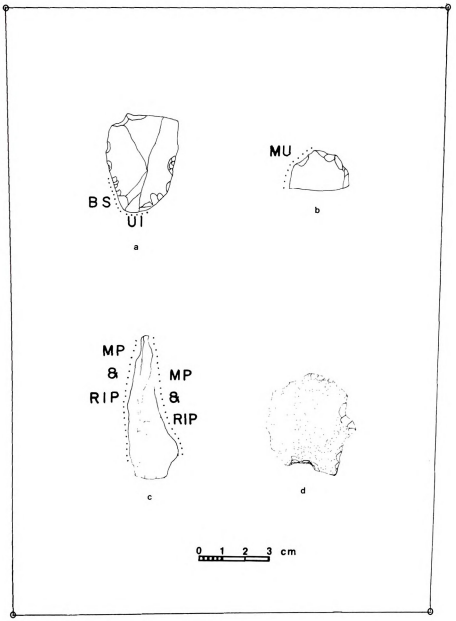


Figure 6.31. Denticulates from level 4a.

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6.6.6. Summary

The family of substrates as previously mentioned include a diverse collection of tool types. It is the case for level 4a that these tools have a predominance of microwears resulting from butchering.

The points, hypothesized to be projectile points, are found to be knives. In fact, the tear drop shaped point variety appears to be a knife with the stem of the point being a hafting element.

The scrapers on blades show a predominance of heavy butchering use as indicated by the associated microwears interpreted as being produced by meat and bone. Blades have long cutting edges usable for many cutting activities, However, for level 4a it is apparent that meat cutting was an important activity which may be the reason for the predominance of butchering evidence on the blades. However, it could also be that long blades are a very useful butchering tool and are, in general, preferentially used for that task. It is also evident that the retouching (simple mode) of these tools is a way of resharpening used and dull tools, and not just a means to modify an edge.

The flake scrapers are not numerous and are of poor quality. Those studied are interpreted as having microwears produced by meat cutting. Many of the broken flakes may have been blades and not flakes, but have been put in this category for conservative reasons.

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The abrupts rarely show evidence of use suggesting that many may have been produced naturally. Even so they are quite rare for this level.

The denticulates, like flake scrapers and abrupts, are relatively rare and often of very poor quality. When a used edge is mildly denticulated it is highly possible that it results from use and not from deliberate retouch. In other cases they can occur from natural processes like abrupts. A conservative point of view is therefore important for the technologist when evaluating potential denticulates.

6.7. Other Tools

6.7.1. Splintered Flakes

Splintered tools are not a Laplacian group, however they have distinct characteristics and their modification, known to be from impact, is often assumed to result from bipolar knapping techniques and not formal retouch procedures.

The sample of splintered flakes here are derived from a total population of nine. They are surprising because three of the four studied have well developed microwears on their lateral edges indicating wood whittling or scraping (Figure 6.32; Photomicrograph 36). It is uncertain why this should be or what the relationship of this use is with the splintered ends. In their cases no microwears are

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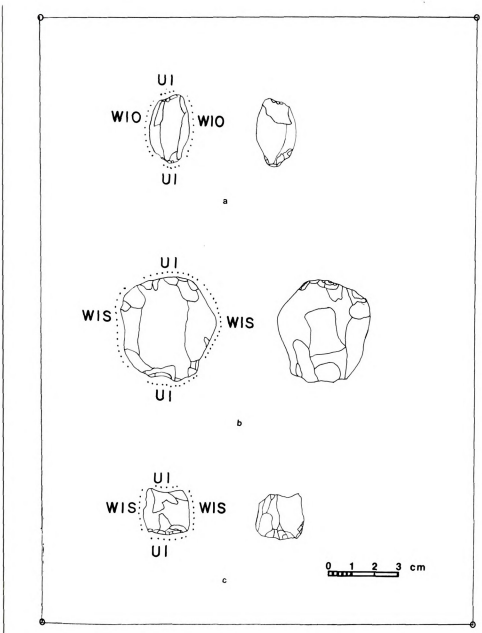


Figure 6.32. Splintered flakes from level 4a.

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visible except the impact fractures and some crushing on the edge.

6.7.2. Microburins

Thirty-four microburins are in the collection from this level. No microwear is found on any of the five microburins examined. This is to be expected given our current understanding that microburins are the waste that is produced from the snapping of a bladelet at a prepared notch in the manufacture of microlithic tools such as geometrics. No microwear would therefore be expected. Given that they are all on bladelet fragments and that the use group of backed knives are rarely shortened, but instead have their length maintained, it can be proposed that microburins only result from the manufacture of armatures.

6.8 Conclusion

6.8.1. Technomorphology and Use

In concluding this chapter it is perhaps best to begin with the hypotheses concerning the relationship between technomorphological types and use that are presented at the beginning of this chapter. If the hypotheses are supported throughout the typological system then it would be clear that there is a strong relationship between techno-morphology and use; the relationship that is the focus of this thesis. Even if the original hypotheses are replaced by some other equally well defined use the overall argument

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of a strong relationship between technomorphological type and tool use would be supported, and this in turn would support the attempts (and not necessarily the methods or conclusions) of those who on the basis of technomorphological types have made functional interpretations of stone tools.

Table 6.27 shows that there the results are mixed concerning the hypotheses. Often the microwear analysis supports the original hypothesis; e.g., thin endscrapers (G1-G5). In other cases the original hypothesis is refuted, but replaced with another equally specific use; e.g., points (P). These findings are offset by the inability of the research to support, and in some cases to reject, numerous other hypotheses. Finally, in most cases the analytical results show that there are at least two different uses for each of the technomorphological groupings presented in the hypotheses. Fortunately, in almost all of these cases there are clear technomorphological characteristics that can distinguish the two use groups.

Returning then to the original question of this thesis, "Do functional interpretations operate successfully?" one must respond that with the Laplace system, they probably do not. However, one must quickly add that it appears possible that they can. There are strong relationships between technology and use which would allow development of

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Table 6.27

Implications of Research on Hypothesized Tool Functions

Tool Type	Hypothesized Function	Results of Analysis of Use
B	Graving hard materials	Graving hard materials Cores for bladelets
G1-G7	Scraping hide	Scraping hide (Flesh working) knives
G8-G9	Scraping wood	Sample too small
T	Scraping hard materials or not used	Truncate is not used; lateral edges are knives
Bc	Boring hard and soft materials	Boring, but questionably typed ones are knives
PD	Projectile points	Projectile points and (meat) knives
LD	Backed knives	Projectile armatures and (meat) knives
DT	Projectile armatures	Projectile armatures and (meat) knives
Gm	Projectile armatures	Projectile armatures
F	Various	Sample too small

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Table 6.27 (cont'd.)

Tool Type	Hypothesized Function	Results of Analysis of Use
P	Projectile points	(Meat) knives
L	Knives	(Meat) knives
R1-R3, and R5	Knives	Sample too small
R4	Projectile Points	Sample too small
A	Various	Sample small, but many are unused
D1, D5	Scraping cylindrical objects	Sample small; some are unused, others are undet.
D2, D6	Sawing hard materials	Sample too small
D3, D7	Projectile points	Sample too small
D4	Hide scraping	Sample too small
D8	Wood scraping	Sample too small
E	Bipolar knapping, wedging	Sample too small
m	microlith technology	Unused; supports microlith technology

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a classification system based upon technological and morphological attributes that would be functionally meaningful. An incomplete example of how one might organize such a system, based on the findings of level 4a, is presented in Table 6.28.

The development of a functional typology confirmed by microwear studies will require far more research over a broad region. Even then, it may turn out that such systems will have applicability only for short temporal units in very small regions because of variations in both human behavior and environmental conditions that can influence the accuracy of a functional classification system. These problems require further study. For example the special nature of Paglicci Cave alone may have a significant impact on the relationship between stone tool technomorphology with tool use seen for level 4a. This will be considered more closely in the next chapter.

Nonetheless it appears from this study that functional typologies are a possibility because of the numerous strong relationships between technomorphological attributes with tool use. It appears that the standardization of tool manufacturing techniques and of the technomorphology of the tools in the late Upper Paleolithic is related to how these tools were to be used.

Table 6.28

Categories of Tools Based on Function and Derived from Generalizations Made from Level 4a, Paglicci Cave

Techmorphonological Type or Defining Characteristics	Hypothesized Function
Thick, multi-faceted (usually polygonal and mix) burins	Bladelet cores
All other well-modified burins*	Gravers
G1-G5 and G7-G9 endscrapers with large, well-formed fronts#	Hide scrapers
G6 and other small-front, generally long endscrapers	Multi-purpose knives
Truncates	Multi-purpose knives
Becs; conservatively defined Bc1 and Bc2 types	Borers
Other, usually long becs	Multi-purpose knives
Sauveterre backed point	Projectile points; armatures for projectiles

*Keeley (personal communication) has suggested that some dihedral burins (equivalent to B1) from France and Belgium are also used as hafting elements and also for boring.

#Keeley (n.d.) has recently reported that thick keeled or carinate endscrapers (G8 and G9) reported from the Pyrenee Mountain area from Magdalenian sites are bladelet cores.

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Technomorphological Type or Defining Characteristics	Hypothesized Function
Microliths including PDs, LDs DTs and Gms; typically short, narrow and thin; with length less than four times the width.	Projectile armatures
Backed tools (PDs, LDs, DTs and possibly some becs) which are manufactured on bladelets, but are generally longer, wider and thicker than microliths. Their length is usually more than four times their width and they have at least one non-abrupt retouch (cutting) edge.	Special-purpose (Meat?) knives
Foliates	Inadequately studied
Points	Multi-purpose knives
Sidescrapers on blades	Multi-purpose knives
Sidescrapers on flakes with possible exception the type R5	Multi-purpose knives
Abrupts	Multi-purpose knives
Denticulates	Inadequately studied
Splintered pieces	Inadequately studied
Microburins	Armature manufacturing debris

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6.8.2. Implications for Interpretation

That such a strong relationship is seen between technomorphological types and use groups suggests that many measures and indices used for the distinguishing of traditions, industries and phases may require reevaluation by technologists. Although virtually no phase of an industry, let alone an industry or tradition, is based on a single index of tool types, it is apparent that the meaning that some artifact types, measures or indices have may be more economic than technological. For example, the ratio of burins to endscrapers, when no nucleoforms are present, says more about relative amounts of graving hard materials versus hide working that is performed at a site than it does about different technologies.

6.8.3. Implications for Sampling Procedures

The method for taking samples for microwear analysis can be influenced dramatically by these results as well. As we can begin to grasp the technological bases for the different uses of tools, that is the development of functional types, then those types can be used for defining the strata by which one will want to sample other collections. Since the object for statistical purposes should be to maintain as much homogeneity within strata and allow for clear differences between strata one can begin to sample within previously defined functional types which one would expect to be fairly homogeneous. To find small

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discrepancies would not be surprising, but to find substantial discrepancies would suggest further refinement of the functional system be made as well as a careful review of non-systematic causes for such discrepancies.

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CHAPTER 7

MICROWEAR ANALYSIS AND SITE FUNCTION

7.1. Introduction

A large sample of the artifacts excavated from level 4a has now been analyzed for microwears. As such there should be some ability to explore the behavioral and economic implications of the results.

During the microwear analysis, it became obvious that there was a predominance of tools interpreted as used on meat, on fresh hide, or on both. It was thought possible that this was a result of the sampling procedure and that when results were tabulated this pattern would not stand. Nonetheless, in a preliminary statement (Donahue 1984), it was suggested that the occupation might be unique, and rather than being a "base camp", it was some kind of special function site, probably a hunting camp and observation post. This chapter is directed toward the examination of that proposition.

The approach taken to examine this proposition is one that is felt very necessary for the testing of behavioral hypotheses and propositions concerning archaeological site formation (Binford 1978; Schiffer 1976). It is suggested that numerous independent dimensions of the archaeological

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record must be examined which are relevant to the hypothesis. Each dimension that supports the hypothesis further strengthens it. Those that don't support it must be adequately explained if the hypothesis is not to be rejected outright. This multi-dimensional approach to hypothesis testing is not new in archaeology (Clarke 1954), but it is being formalized within research designs and the results of its applications are demonstrating the interpretive power of the approach (e.g., Cahen et al. 1979).

In addition to this multi-dimensional line of inquiry, the study follows the dialogue presented in Chapter 1. It applies instruments (e.g., faunal analysis) able to interpret behavioral hypotheses or propositions (e.g., site function) in the present and which are considered warranted to use the uniformitarian assumption. Thus they are capable of testing such hypotheses concerning the past. In addition, faunal analysis can be used to begin evaluation of the applicability of microwear analysis as a new instrument for the interpretation of site function.

7.2. Site Function

Many classification systems have been developed for organizing archaeological sites according to economic criteria. Site function systematics developed by L. R. Binford (1978) have enjoyed much success. It is suggested that this is because they are derived from the study of

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present hunter-gatherers and their sites, thus it has empirical support, and because it is organized within a theoretical framework which provides models of how and why hunter-gatherers produce the various types of sites.

Binford organizes hunter-gatherer subsistence-settlement strategies along a continuum with collecters at one end and foragers at the other. Collectors, who maintain a logistical organization, occupy a residential base camp and send out special task groups to bring resources back to the base camp. Because resources can be distant from the base camp, or because the task requires much time to perform, task-groups can be gone for days at a time from the base camp. The archaeological results of such a strategy are the production of both residential base camps and special function sites, including: field camps, stations and caches, with numerous subcategories of these all with different characteristics (Binford 1980:10). Different site functions can also occur at the same location producing additional variability as noted by Binford (1980:12), "There is still an additional source of variability, since ... in some situations one might be able to use the field camp as an observation point, in others it may equally serve as a hunting stand." A logistical organization is therefore characterized by substantial inter-site variability.

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Hunter-gatherers operating within a foraging strategy move their entire group to resources as those resources become available during the annual cycle. The archaeological results of such a strategy are the production of only two types of sites: the residential base camp; and the location, where resource extractive activities occur (Binford 1980:9).

Site function is an important concept in archaeology for two reasons. First, it is based on models of human behavior derived from ethnoarchaeological data. It has a strong theoretical foundation, evidence that it is a meaningful way to organize modern hunter-gatherers, and it has archaeological consequences that make it possible to operationalize it for the study of prehistoric hunter-gatherers. That it is applicable to modern hunter-gatherers does not mean that it is necessarily applicable to Paleolithic hunter-gatherers. Instead, it is a return to the premise that it is best to first consider processes known to act in the present in order to explain features that resulted from past processes (Gould 1977).

Second, it is a means for classifying and organizing sites on the basis (almost totally) of economic activities rather than temporal, industrial or cultural affiliation. As such it allows for the comparison of economically similar but culturally or regionally dissimilar sites, as

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Currently, most attempts at inferring site function are performed with faunal analysis. Microwear analysis appears to be one technique exceptionally qualified as a complementary method for inferring site function. Its basic unit of data is the microwear, a result of the interaction of two physical objects, thus the atemporal laws of physics and mechanics apply. The microwears are reproducible in the laboratory and capable of being studied under experimentally controlled conditions. In addition, much of the information it provides is specifically economic. It tells us what the people did with their stone tools; what materials were manipulated and how they were manipulated. Finally, the information is carried on stone, thus it often survives conditions which bone will not.

Can microwear analysis assist in inferring site function? No standard approach has yet been devised to tabulate microwear results for an assemblage, let alone use such results to differentiate types of sites such as hunting camps and residential basecamps. The following example therefore is only to present that such an application of microwear analysis appears feasible. It is one more aspect of microwear analysis which needs further research, and which holds future promise.

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7.3. Method

Many difficulties arise from attempts to quantify microwear results. One would like to be able to transform measures of microwear into measures of economic activities. However, numerous problems and confounding factors must be overcome including: 1) rates of microwear and rounding differ for different materials; 2) different kinds of flint, and silicates in general, vary in their rate of rounding and microwear development; 3) the inclusion of foreign matter, such as dirt, into materials being worked can greatly effect the rate of microwear; 4) edge angle, edge length and fracturing rates effect the rate of rounding and microwear development; and 5) retouch as a means for rejuvenating a worn edge, that is, a retouched edge may have been used once or twenty times.

These problems are not resolved here. Instead, tool use is viewed as an aspect of an activity and operationalized at a most general, "robust," level. This is very different from those who want to claim the ability to estimate the number of deer butchered or the number of fish eaten (see Odell 1980). This is of special concern here since the sample itself is not as statistically representative for the population as one would prefer, although this is a problem of archaeological sites generally, and cave sites specifically. By operating in this manner it also reduces the problem of inaccuracy

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recognized in microwear studies. With the relatively high rate of error suspected in microwear analysis one wants to maintain the most general level of specificity or precision that is still meaningful to the research goals.

Table 7.1 presents one method of organizing activity information one might associate with stone age hunter-gatherers that could be derived from microwear through the study of stone tools. These economically meaningful categories are organized so that many are directly corresponding to the taxa presented in the classification of microwears (Table 4.1). In this hierarchical organization general activities do not provide as much information as specific activities or tasks, but nonetheless they should provide a fundamental impression of the relative intensities of kinds of activities found at sites; information still very valuable for economic analysis. In terms of methodology, therefore, it is suggested that researchers attempt to infer represented activities to only the specificity required by the research problem.

The method for this study therefore is first, to interpret the tools, based on the microwear findings, as elements used in economically meaningful activities. The activity categories should be fairly general so as not to infer beyond the precision of the microwear study. Fortunately, it is thought that general categories are

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Table 7.1

Categories of Activities

Level 1 General Activity	Level 2 Specific Activity	Level 3 Task
Game Processing	Hide Removal	
	Butchering and disarticulation	
	Meat cutting	
Hide Working	Fresh hide working	
	Dry hide working	Dry hide scraping
		Hide depilating
		Hide tailoring
Tool and Ornament Manufacturing	Bone/Antler working	
	Wood/Plant working	
Hunting		
Stone processing	Stone quarrying	
	Stone reduction	
	Tool blank manufacturing	
	Stone tool manufacturing and rehafting	

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quite adequate for the reseach problem since the activities that should be predominant are those involved in game processing. The second step is to use the sample for each stratum as an estimate for the population of that stratum. Population estimates are then calculated for each activity within each stratum which are then summed to give a total of each activity group.

In order to simplify the calculations and to include artifact types not represented in the sample, the sampling strata will be collapsed spatially and from the techno-morphological primary types to groups. Only when certain specific primary or secondary types show use patterns very different from other types in the group are they presented separately. The use groups in the strata are briefly summarized below.

Burins are found to fall into two use groups. The first are multi-faceted polygonal burins which are bladelet cores. The second group consists of graving or chiseling instruments used on wood or bone. The lateral edges of these burins had often been used prior to the manufacture of the burin edge.

Endscrapers were consistently used for scraping hide, although it is difficult to discern whether it was dry or fresh hide. Again, like the used burins, the lateral edges were often used prior to the manufacture of the scraping front. One type of endscraper, the ogival endscrapers are

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found to have been used like blades and have been separated from the others for the calculations to follow.

The substrate family include: points, scrapers on blades and flakes, abrupts and denticulates. These plus the truncations and many becs have microwear on their lateral edges mainly from the cutting of meat, some hide cutting and little else. Some becs are primarily used for boring, however. Denticulates and abrupts, in contrast to the others, are frequently found to be unused.

Backed tools, including: backed blades, backed points, backed truncates and geometrics, when microwear evidence is interpretable, show two distinct uses. Some of the longer of these tools, all made on bladelets, are knives. However, most of these tools appear to be armatures, either projectile points or lateral barbs. With the inclusion of most "backed fragments", the functional class of armatures represents 29.2% of the tools in the assemblage.

Of the other lithic remains, their are 34 microburins which result from the manufacture of armatures. There are also pièce esquillée most of those sampled show the lateral edges with well developed microwears produced by the working of wood.

The method of calculating the population estimates from the samples is slightly complicated by composite tools. So that over-representation does not occur for secondary uses of tools the composites are included only within their

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first primary type category for both population and sample. Sampled tools without any definable microwears (excluding unused) are considered as not having been sampled. The following equation is used for calculating the proportion:

$$R_i = \frac{P_i - Cp_i}{S_i - Cs_i}$$

where: P_i is the population of each stratum (collapsed or otherwise); S_i is the sample of each collapsed stratum; and C is the frequency of the non-defining composites. The resulting r_i is the ratio of the population to the sample for each stratum i (Table 7.2). The sum of each use for each stratum is multiplied by R_i to obtain the estimated population of that use for each stratum.

The calculation of use or on individual tools in order to obtain summary statements about activities is extremely difficult. Simplifying assumptions are used here. The most discrete unit of measure is the use-edge. The intensity of the microwear, the edge rounding and the length of the edge will be ignored.

Four approaches to summing the data are taken which differ as to how to count multiple independently used edges into the study. The first method analyzes the primary use (last use or most predominant use) in a qualitative manner. In this case the primary use alone is counted once per artifact no matter how many edges show that use. The

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Table 7.2

Population and Sample Data for Calculation of R Indices

Stratum	Population	Population Composites	Sample	Sample Composites	R-Index
B	29	7	24	6	1.22
G	56	2	28		1.96
G6	3		3		1.00
T	42	10	9		3.56
Bc	11	1	7		1.57
PD sauv.	5		4		1.25
PD	12		8		1.50
LD	12		4		3.00
DT	32		20		1.60
Gm	23		9		2.56
PD-LD	11		4		2.75
PD-DT	15		6		2.50
PD-LD-DT	73		3		24.33
DT-Gm	9		3		3.00
Δf other	24		3		9.00
F	5		3		1.67
P	7		4		1.75
L	82		19		4.32
R	32		3		10.67
A	14		3		4.67
D	23		4		5.25
E	10		3		3.33
Total	530	20	174	6	

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second method is the quantitative aspect of this approach where all independent used edges with the primary use are counted. The third approach is to use a qualitative approach to record primary and secondary uses. Each different use is counted once per artifact. The fourth approach is to quantify the third by counting every independently used edge.

The result of any one of these tabulations is the production of a matrix of elements with m uses (columns) and n sample strata (rows). Tables 7.3 to 7.6 provide this information along with the population/sample index.

Each row of elements is multiplied by its associated population/sample index, R_i, producing the expected population of uses for each stratum. Each column (use) is summed giving t_j, the expected total of that use for the assemblage of level 4a. The formula for this procedure is presented below;

$$t_j = \sum_{i=1}^{n} (R_i \cdot a_{ij})$$

which is performed for each use or general activity (j). The percentages of the totals are calculated in order to provide comparative information between tabulation methods. This is presented in Table 7.7. As can be seen from this table there is little variation in the final figures for the different uses. Finally, the mean is calculated for

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Table 7.3

Population Estimates of Tool Uses:
Primary Qualitative Method of Tabulation

	Hide	Butch-ering	Bone/ Antler	Wood/ Plant	Arma-tures	Cores	No Use
B			4	2		13	1
G	53	2					
G6		3					
T	7	25					
Bc	2	6		3			
PD sauv.	1				4		
PD		11			3		
LD		9			3		
DT	2	5			24		2
Gm					23		
PD-LD		3			6		3
PD-DT	3	13			5		
PD-LD-DT		24			49		
DT-Gm					9		
∆f other		9			18		
F		3		2			
P		7					
L	9	73					
R		32					
A		5					9
D		16	5				5
E				10			
Total	77	246	9	17	144	13	20

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Total

Table 7.4

Population Estimates of Tool Uses:
Primary Quantitative Method of Tabulation

	Hide	Butch-ering	Bone/ Antler	Wood/ Plant	Arma-tures	Cores	No Use
B			4	5	20	1	
G	63	4					
G6		5					
T	14	50					
Bc	2	11		3			
PD sauv.	1				4		
PD		11			3		
LD		12			3		
DT	2	5			24		2
Gm					23		
PD-LD		3			6		3
PD-DT	3	13			5		
PD-LD-DT		24			49		
DT-Gm					9		
Af other		9			18		
F		5		2			
P		11					
L	17	130					
R		43					
A		5					9
D		16	5				5
E				20			
Total	101	357	9	30	144	20	20

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L	
R	
A	
D	
E	
Total	

Table 7.5

Population Estimates of Tool Uses:
All Uses Qualitative Method of Tabulation

	Hide	Butch-ering	Bone/ Antler	Wood/ Plant	Arma-tures	Cores	No Use
B	11	4	4	2		15	1
G	53	8	2				
G6		3					
T	7	25	4				
Bc	2	6		3			
PD sauv.	1				4		
PD		11			3		
LD		9			3		
DT	2	5			24		2
Gm					23		
PD-LD		3			6		3
PD-DT	3	13			5		
PD-LD-DT		24			49		
DT-Gm					9		
Af other		9			18		
F		3		2			
P		7					
L	9	73					
R		32					
A		5					9
D		16	5				5
E				10			
Total	88	256	15	21	144	15	20

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D	
E	
Total	

Table 7.6

Population Estimates of Tool Uses:
All Uses Quantitative Method of Tabulation

	Hide	Butch-ering	Bone/ Antler	Wood/ Plant	Arma-tures	Cores	No Use
B	10	5	4	5	21	1	
G	100	18	2				
G6		5					
T	14	50	7				
Bc	2	11		8			
PD sauv.	1				4		
PD		11			3		
LD		12			3		
DT	2	5			24		2
Gm					23		
PD-LD		3			6		3
PD-DT	3	13			5		
PD-LD-DT		24			49		
DT-Gm					9		
Af other		9			18		
F		5		2			
P		11		4			
L	17	130					
R		43					
A		5					9
D		16	5				5
E				20			
Total	148	376	18	39	144	21	20

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Table 7.7

Percentages of Different Activities Derived from the Four Tabulation Methods

	Hide	Butch-ering	Bone/ Antler	Wood/ Plant
Primary Use; Qualitative Measure	22.1	70.5	2.6	4.9
Primary Use; Quantitative Measure	20.3	71.8	1.8	6.0
All Uses; Qualitative Measure	23.2	67.4	3.9	5.5
All Uses; Quantitative Measure	25.5	64.7	3.1	6.7
Average (Mean)	22.8%	68.6%	2.9%	5.8%

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7.4. Results

In summary, the tool edges used on various kinds of materials, breaks down to 69% on meat or very fresh hide, 23% on hide in various states, and less than 10% for wood, plant, bone and antler. These statistics exclude the microliths used for armatures on projectiles which are associated with hunting activities.

The results of the analysis suggest that the predominant activity at the site was the butchering of animals (Figure 7.1). Another major activity was the processing of hides. The microwear evidence shows little working of antler, wood or bone. These are the "hard" materials from which other kinds of tools might have been manufactured.

From study of the technology as well as the microwears it is apparent that the retooling of weapons used in hunting was an important activity at the site. This evidence includes numerous bladelet cores recovered which are labeled as burins, a fairly high frequency of microburins which are used in the production of armatures, and the overwhelming dominance, technologically, of the microlithic backed tools, of which most are interpreted as armatures which were discarded at the site.

Fig

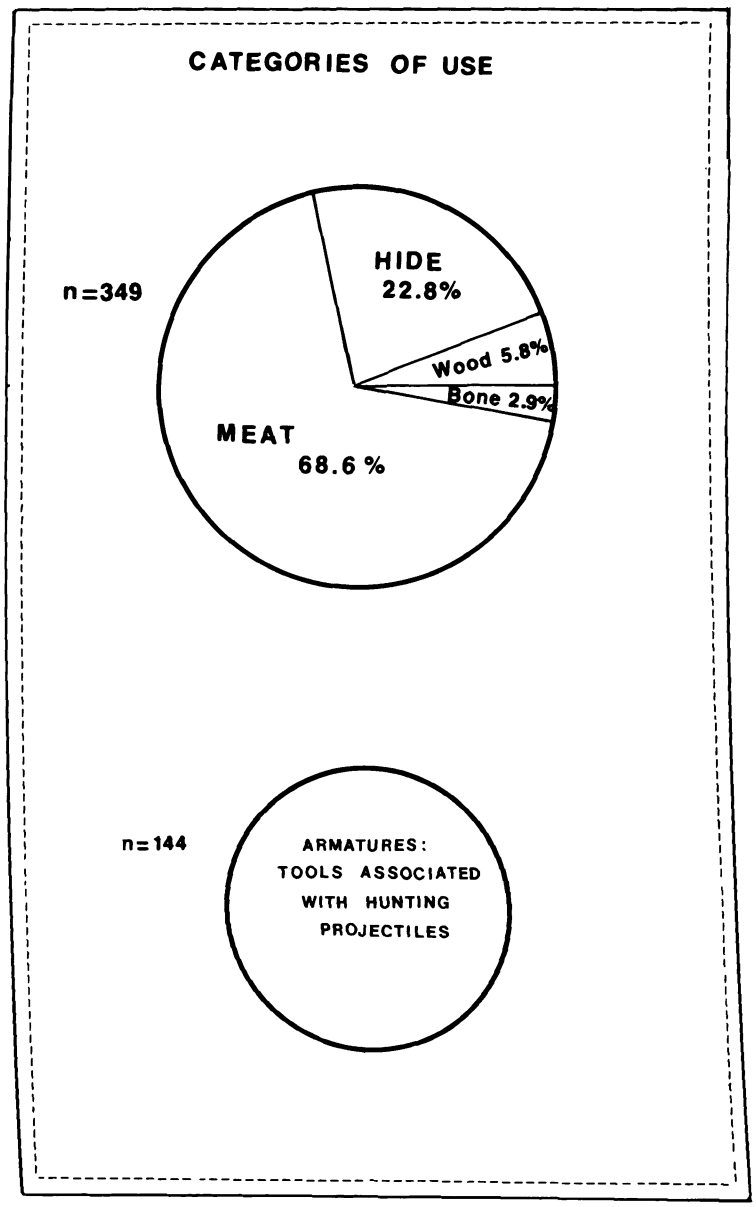


Figure 7.1. Categories of tool use for level 4a.

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It appears that this is a very specialized site. One would expect numerous and various activities to occur at a base camp. Here there are few major activities. Given the predominance of butchering, well represented hide working and substantial retooling of weapons level 4a can best be interpreted as a hunting camp.

However, is it possible that the material requirements of Upper Paleolithic populations in this region were so few that activities other than meat and hide processing are rare or practically insignificant? Or in an opposing view, were conditions so severe that total labor expenditure had to be directed toward these activities?

7.5. Faunal Analysis

As previously mentioned, it was during the microwear analysis that it began to be apparent that the assemblage was the remains of a somewhat specialized occupation. The tabulation of this data supports that observation, but it cannot be used as a test of that hypothesis for two reasons. First, it is not independent of the data that originally inspired the hypothesis, and second, microwear analysis is an untested instrument for studying site function. When the technique can be shown to measure site function by being evaluated with previously validated instruments it will then be usable as a means to test such hypotheses. What is needed now is faunal analysis which can test the hypothesis that this was a hunting camp.

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Major advances have been made in the analyses of faunal remains. Through taphonomic studies (e.g., Behrensmeyer and Hill 1980) archaeologists better understand the non-cultural causes for assemblage characteristics of faunal remains while through studies of ethnographic studies of human behavior there is greater understanding of the cultural causes for their assemblage characteristics.

One of the processes of cultural behavior that leaves very characteristic patterns in the assemblage is known as the Schlepp effect (B. Smith: personal communication). The Schlepp effect results from the differential discard patterns of faunal bone elements during butchering. Prior to transportation to a habitation or settlement site hunters will discard the least useful elements of the carcass, which are generally those elements that have a low meat to weight ratio.

From the Schlepp effect one would expect to find a far different composition of faunal elements at a hunting camp than at a residential base camp. A hunting camp would tend to contain discarded parts of the animals such as distal leg bones and cranial bones, mainly because of low meat content while a habitation site would tend to have bones associated with large quantities of meat such as ribs, proximal leg bones, scapulae, etc. An analysis of the faunal remains from level 4a therefore should help to confirm or disconfirm the hypothesis that favors the

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identification of that occupation as a hunting camp instead of a base camp.

The faunal assemblage for level 4a is small. B. Sala identified 125 specimens of seven species representing an identification rate of about 49%. The percentage breakdown of species is: 25% each of Equus sp. (most identified as Equus hydruntinus); Bos primigenius, and Cervus elaphus; 10% each of Sus scrofa and Rupicapra rupicapra; and less than 3% each of Capra ibex and Capreolus capreolus. I restudied the faunal remains for collecting information concerning the bone elements (Table 7.8). The recovered elements represent almost totally distal skeletal elements, individual teeth and mandible fragments (Figure 7.2).

Taphonomic factors cannot adequately explain the resulting distribution. The cave contains numerous levels where other elements are recovered including ribs, vertebrae, scapulae and femurs. The recovery of well preserved fox bones from the level indicate that post-depositional factors are not a major cause of this distribution. There is also no evidence of carnivores effecting the assemblage through gnawing and splintering of bone. Trampling is ruled out because of the recovery of numerous soft bones and the recovery of few dense bones from non-distal body parts.

The faunal remains tend to support the hunting camp hypothesis. The recovery of lower leg bones suggests that

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Table 7.8

The Faunal elements from Level 4a, Paglicci Cave

Taxon	Element	Side	Portion	Freq.
I. Head and Teeth				
Equus	Tooth			9
Bos	Tooth			17
Cervus	Tooth			11
Sus	Mandible			4
Mammal sp.	Tooth			51
II. Body				
Mammal sp.	Vertebra			2
Mammal sp.	Caudal			2
Mammal sp.	Costa			1
III. Proximal Leg				
Equus	Humerus	right	distal	1
IV. Distal Leg				
Equus	Radius	left	distal	1
Equus	Metapodial	N/A	distal	1
Equus	Metapodial	(MII or MV)	medial	1
Equus	Metacarpus	left	distal	1
Equus	Calcaneous	left	whole	1
Equus	Calcaneous	right	whole	1
Equus	Calcaneous	right	whole	1
Equus	Phalange (hoof)		whole	1
Bos	Metacarpus	left	proximal	1
Bos	Metapodial	N/A	distal	3
Bos	Scapho cuboide	left	whole	1
Bos	Scapho cuboide	right	whole	1
Bos	Phalange	N/A	proximal	1
Cervus	Radius & epiphesis	right	distal	1
Cervus	Astragalus	right	distal	1
Cervus	Astragalus	left	whole	1
Mammal sp.	Metapodial	N/A	distal	2
Mammal sp.	Astragalus	right	whole	1
Mammal sp.	Carpal Tarsal Sesamoid			29
Total				148

Note: Cranial and post-cranial remains of fox are also recovered.

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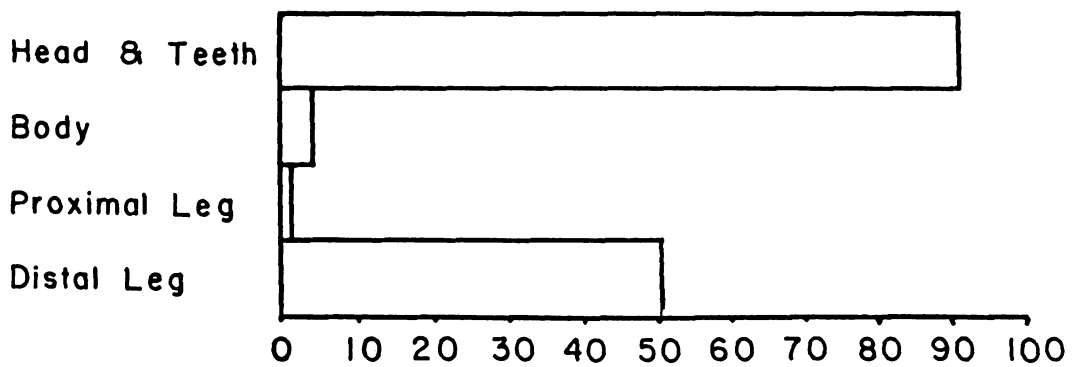


Figure 7.2. Frequency distribution of bone elements by body portion.

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these were discarded because they have little associated meat. The marrow in the discarded long bones and metapodials was retrieved, however. Jaws may have been dismembered in order to retrieve tongues. The remaining missing bones are those typically associated with large quantities of meat, implying that these parts along with the hides are being taken elsewhere.

The final question to be considered is whether or not what is recovered represents a specialized activity area of the site itself. The centralized position of the trench, and the recovery of materials indicative of weapon maintenance, rule out a butchering area or secondary dump as explanations. A marrow processing area would certainly include many other long bones than just the few distal ones recorded, and exclude many of the ones that were recovered. Finally, a maintenance area or living area of a base camp would not contain the faunal remains considered the first to be discarded.

7.6. Discussion and Conclusion

Supporting evidence for this inference of a hunting camp can be found from a number of sources. On the basis of the faunal remains there is absolutely no evidence for more than a single individual of each species represented. The total quantity of meat represented by such numbers could not have fed even a small band for a long period of time, let alone a season, or more.

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The stone tool technology and microwear indicate that there is conservation of flint. The sources for the flint come from the other side of the Gargano Promontory, about 20km. The debitage, consisting of many tertiary retouch flakes, many bladelet cores (if nucleoform burins are included), no large blade cores, few primary and secondary flakes, yet many large and well-formed blades among the tools suggest that blades and retouched tools, and the small bladelet cores were the form the flint was in when it was brought to the site. It is speculated that this is to be expected of a temporary occupation, where only a small amount of stone is brought in preparation for use. If a base camp was located this far from the flint source it is argued that large prepared blade cores or nodules would also have been imported.

The position of the cave has already been mentioned, but it is in an excellent position to be an observation post for hunters observing game that would be on the Tavoliere Plain, or moving up and down the canyon. It is also well located for expeditions to the rocky crags and outcrops along this edge of the Gargano Promontory.

The atrium of the cave itself also supports this argument. The atrium expands outward as one moves down through the strata. While very large at the current entrance level of the cave, level 4a is found about 2.5m higher. At this height there is only about a two to three

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meter wide area of standing room (above 1.5m) along the length of the atrium. It is uncertain if the original entrance was much larger, but nonetheless the atrium would have been far too small for a band of hunter-gatherers.

7.7. Implications

The implications of this finding has a major impact on the appropriate subsistence-settlement strategy model with which to address the late Upper Paleolithic of peninsular Italy. If the data supported the hypothesis that the site was a residential base camp then both the foraging strategy and the collecting strategy models would still be applicable here. Instead, the hypothesis that the site was a hunting camp (type of field camp), supports the collecting strategy model (logistical organization) over the foraging strategy model.

I suggest that this is counter to current theory, models and data for peninsular Italy which generally support a foraging strategy model. A quick review of this support is appropriate. In the presentation of European Paleolithic research in Chapter 2 it is noted that little change in theory has ensued since the third period (1915-1950). During this period there was (and there still is) the use of an organic model of culture derived from paleontology. One expects to find assemblages belonging to the same cultural complex to be homogeneous, with little or no difference between them. Although coming from a very

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different direction than Binford's foraging model, both models propose that archaeological assemblages within a space-time boundary would likely be extremely similar. In other words, there would be little inter-site variability.

Taking Paglicci Cave and Grotta Polesini as examples for mid-Adriatic and mid-Tyrrenean lowlands respectively, it is noted that as one moves through the strata, there is substantial homogeneity in the artifact type distributions (Table 7.9). It is admitted that these data, do not distinquish the numerous complex levels that exist and that they are palimpsets of occupational episodes, thereby homogenizing some variability. Nonetheless, this pattern of little inter-assemblage variability within sites is characteristic of most lowland cave sites in peninsular Italy. This similarity between assemblages, within and often between sites, thus supports the argument that the sites were produced by groups actively engaged in a foraging subsistence-settlement strategy.

Further support comes from the faunal remains at these sites. Although there is often a high percentage of a single species taken in one level, it appears that there is rarely evidence for selective hunting. Instead it appears that they incorporate a foraging strategy in which whatever game they come across they then take. This would help explain the strong correlation seen between percentages of

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Table 7.9

Percentile Distributions of some Tool Groups from Grotta Paglicci and Grotta Polesini Assemblages

Paglicci Cave (Zorzi excavation)

Stratum	Burins	Endscrapers	PD,LD,DT,Gm,Δf	Denticulates
9	12.5	16.5	28.1	6.4
8	12.5	19.5	26.9	6.3
7	9.0	21.4	33.7	4.6
6	5.8	20.1	30.0	6.9
5	4.5	21.6	29.8	4.6
4	8.2	17.2	31.1	5.7
3	16.6	13.5	23.2	10.7
2	16.1	14.6	19.7	18.0

Recent excavations indicate that backed fragments and geometrics are substantially under-represented here, especially in levels 4, 3 and 2.

Grotta Polesini

Stratum	Burins	Endscrapers	PD,LD,DT,Gm,Δf	Denticulates
12-11	5.7	21.3	52.1	0.8
10-9	5.4	25.4	47.7	0.8
8-7	5.7	24.9	50.0	1.1
6-5	7.8	26.0	44.2	1.6
4-3	6.9	26.6	45.5	1.6
2-1	10.8	31.0	34.6	2.7

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species based on animal bone frequencies and paleoclimatic conditions (see Figures 5.4 and 5.5).

In terms of technomorphology, upland cave sites do seem to differ from the lowland cave sites. This has been noted by Barker (1980) and by Pollnac and Ammerman (1973). This can be explained within the foraging model by different resources being exploited, different technology resulting from the differences or variations in flint, or from the impact of seasonal climatic and environmental variation. In this regard it is to be noted that the most accepted model for settlement pattern (beyond permanent residential base camps) is a transhumant model in which hunter-gatherers occupied the coastal plains during the winter and moved into the mountains during the summer (Barker 1980). This model has no impact on the subsistence-settlement strategy models because either a collecting strategy or a foraging strategy could have operated within a transhumant settlement system.

Thus there has been reason for use of a foraging strategy model for describing late Upper Paleolithic hunter-gatherers of peninsular Italy. However, there are now numerous reasons to reevaluate this view.

The microwear analysis of level 4a indicates that there was an overwhelming predominance of meat processing at the site. Tool manufacturing and most maintenance activities involving wood, bone or antler account for less than ten

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percent of the uses of the tools. The hundreds of microliths and numerous microburins indicate that the retooling of weapons was also very important. These data suggest that the site was a hunting camp, as all the predominant activities are associated with the retooling of weapons to kill animals, the butchering of these animals and the processing of their hides. The faunal remains indicate that the site was used for preliminary processing of game prior to its transportation to a residential base camp based upon many head and distal leg bone elements and few body and proximal leg elements. There is evidence that the site by this time is relatively small with little floor space. Finally, the site is an excellent observation post for viewing game on the Tavoliere Plain or in the Settepenne Canyon.

From a technomorphological viewpoint of the artifacts, level 4a of Paglicci Cave is not unique. Not only do many of the other levels of Paglicci Cave have very similar artifact type distributions as discussed , but so do most of the lowland cave sites found throughout peninsular Italy. These assemblages are substantially different from most upland cave sites (Table 7.10).

By regarding here as functionally meaningful those technomorphological types found to be fairly functionally meaningful for level 4a of Paglicci Cave (Table 6.28), it can be suggested that upland sites differ strongly from

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Table 7.10

Percentile Distributions of some Tool Groups from Upland and Lowland Cave Site Assemblages

Lowland Cave Sites

Site & level	Burins	End-scrapers	PD, LD, DT, Gm & Δf	Denticulates
Abri Mochi A	7.4	7.0	70.6	3.8
Grotta Campane	3.7	20.8	54.3	4.1
Grotta Polesini 8-7	5.7	24.9	50.0	1.1
Grotta Paglicci 4a	6.5	13.2	48.2	5.6
Grotta Jolanda	6.5	18.9	36.4	3.4
Gr. Mezzogiorno 23-21	9.6	26.4	31.2	1.6
Gr. del Cavallo BIIa	3.6	12.7	37.5	13.1
Grotta Santa Croce	20.4	25.9	7.0	n.d.

Upland Cave Sites

Site & level	Burins	End-scrapers	PD, LD, DT, Gm & Δf	Denticulates
Rip. Maurizio 11-8	26.8	10.9	6.	26.3
Rip. Maurizio 7-3	45.0	4.7	2.	11.2
Gr. di Ciccio Felice	24.0	6.7	7.7	15.4
Gr. Achille Graziani	9.5	7.5	21.0	12.9
Gr. di Ortucchio	9.6	7.1	18.0	18.5
Gr. Maritza	26.5	12.0	42.0	6.0

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lowland sites according to: less emphasis on working hide (fewer endscrapers); a substantial decrease in the retooling of weapons and manufacture of armatures (substantial decrease in backed tools); and an increase in tool and ornament manufacture (more burins). There are also often many more denticulates which may also support this last contention.

However, this is not simply a finding of two distinct types of sites found in two equally distinct environments. In the lowlands there are occasional assemblages with artifact distributions quite similar to the upland pattern, such as Grotta Santa Croce, and there are also cave sites in the uplands, like Grotta Maritza, which have artifact assemblages similar to lowland sites. In the case of Grotta Maritza there also is the very high percentage of backed tools, associated with hunting activities, and resulting from their manufacture and their replacement by retooling of weapons at the site. There is also, as seen for level 4a of Grotta Paglicci, a low percentage of waste flakes (Barker 1980:115).

Barker (1980) has noted that while most upland cave sites tend to have fairly diverse faunal assemblages (besides horse and red deer they also have cattle, chamois, ibex and pig), Grotta Maritza has a faunal assemblage predominated by horse and red deer, even though it is not far from other, more typical, upland sites. Barker argues

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on the basis of location data that Grotta Maritza is not a habitation site, but it is a kill site:

> ...Grotta Maritza could have been a specialized kill site, with a special toolkit taken from the home base for the purpose. The most logical time to use a site like Grotta Maritza (which is in fact hidden in the rocks, directly above and within a spear's throw of the basin floor) would have been at the end of the summer, when the animals would have been coming down from the hills into the Ortucchio valley and passing round the margins of the lake on their way west to the lowlands. If they wanted to avoid human base camps on the eastern side of the lake, they would have had to pass directly below the Grotta Maritza (Barker 1980:137).

Barker suggests that the other cave sites in the region are habitation sites. I could concur, given the techno-morphology which is what would seem more "characteristic" of a residential base camp. I would also speculate that these mountain residential sites were occupied for a much shorter time and by smaller groups than lowland residential sites. Thus the caves provided a kind of expedient housing.

This is not the first presentation for arguing that caves may not have been important residential base camps. Binford (1978:492) in a comparative ethnographic study of a wide range of societies notes that caves are not used as residential base camps by modern or historically documented hunter-gatherers in temperate and colder latitutudes. That this appears associated with climatic conditions suggests that during the Pleistocene even more southernly latitude groups might have behaved in the same manner.

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What are some of the reasons and attitudes about the use of caves by modern hunter-gatherers? Binford (1978b:489) reports that:

> Archaeologists, particularly those interested in the Paleolithic, tend to view caves and rockshelters as centers of operation. Such a use of these natural facilities is a joke for the Eskimo. When questioned about the potential of such natural facilities for use as "residential locations," they proceeded to cite a truly fascinating list of negative traits that rendered these places useless, in their eyes, as potential residential locations. In winter, they were damp. For the most part because of topography, they are distributed away from fuel...the caves are lacking the solid ice needed in winter to supply water in any quantity. They are also more common along precipitous rockfaces, which are more in restricted valley systems where the good game trails are. "Animals are not dumb, they go around and stay away from Eskimo camps."

Many of the problems of caves as viewed by the Eskimo would have been problems with the caves in peninsular Italy during the Pleistocene. Inadequate sources of firewood and water, dampness inside the cave, and disturbance of game by the group are reasons why these sites may not have been used as residential base camps. Binford continues with a discussion of Paleolithic archaeologists reporting evidence for tents in caves, which is considered by the Eskimo as foolish since the reason to camp in a cave is to avoid having to pack a tent. The discussion continues with the special value rockshelters and caves have for the logistically organized groups because they don't have to unpack their sleds while in transit. Finally the discussion turns to how caves and rockshelters are used:

> Because the locations of these natural facilities do not change, and because the locations of certain activities are topographically specialized, the same caves and rockshelters are used repeatedly for essentially the same purpose, that is, as natural shelters for hunting parties exploiting the surrounding area during specified seasons or for specific game....Redundancy is the property most likely to characterize the separate episodes of use in such settings unless there is a major change in the environment that could affect the distribution of game and their normal movements (Binford 1978b:490).

The strongest point for suggesting that a foraging strategy was the best model for hunter-gatherers of Paleolithic peninsular Italy was the lack of inter-assemblage variability. But this was based on the assumption that cave sites were residential base camps. With the evidence from level 4a of Paglicci Cave and the supporting evidence from Grotta Maritza, it can be speculated that these were generally not residential base camps, but mostly hunting camps. This can explain the inter-assemblage variability--the redundancy of assemblages--among many lowland cave sites.

If the lowland cave sites were generally not used for residential base camps, then where are the base camps? I suggest that we have substantial evidence for their existence in the numerous recorded findings of large assemblages found on river and stream terraces throughout peninsular Italy (e.g., along the Merse and Farma Rivers alone: Buoncompagni et al. 1971; Chartkoff and Chartkoff 1976; Schiaffino 1960; Stoduti 1973). Often these sites

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are nothing more than agriculturally disturbed assemblages whose structural characteristics are lost. However, the search and excavation of such sites in peninsular Italy is far behind cave research and it may be that those sites found structurally intact, such as Petriolo III South (Donahue et al. n.d.), can help test this tentative proposition.

This chapter, through the analysis of level 4a of Paglicci Cave, attempts to demonstrate the potential that microwear analysis has for inferring site function. Although much research needs to be done to operationalize it, it is apparent that such an application is possible. But it also equally demonstrates the value of combining analytical techniques towards the resolution of behavioral questions in archaeology. Microwear analysis, technolgical and typological study of the assemblage, faunal analysis, location and contextual information and site structure, are combined to provide a much fuller understanding and a much more complete interpretation of level 4a of Paglicci Cave than could any of these techniques alone. It is through the development of these and other instruments that we will be able to improve, with greater speed and precision, our knowledge and understanding of the past.

CHAPTER 8

CONCLUSION

8.1. Discussion

This thesis presents a large and diverse quantity of material relevant to microwear analysis and European Paleolithic archaeology. In so doing it provides numerous insights and speculations into theory, method and substance concerning these areas of study. Because of the extent of this coverage, it is considered appropriate to review the direction of thought that is taken and the accomplishments (real or imagined by the author) of this study.

The original idea for this study is derived from research at the Petriolo sites where the fundamental assumption of a correspondence between tool techno-morphology and tool use was applied. This assumption is found throughout the Paleolithic literature when the discussion enters topics of economy or behavior. This assumption is no longer considered necessary because the method of microwear analysis can adequately test it.

Microwear analysis is placed in its respected role in archaeological theory. Although it is historically not a new technique, Keeley (1980) has refined both its technical and methodological aspects and demonstrated how to apply

the technique toward the study of fundamental archaeological questions (Cahen et al. 1979). Here, microwear analysis is placed in the theoretical framework of middle-range theory. It is developed specifically for archaeology, but its theoretical foundation comes from the natural and experimental sciences of physics and mechanics. Its assumptions are seen as fully warranted for application to the study of past processes. In this sense, it similarily follows the study of prehistoric technology, where through experimentation and the application of models of fracture dynamics we have come to better understand the techniques of knapping and retouch by prehistoric peoples (e.g., Speth 1975).

A careful distinction is made between the terms of use and function. Use is defined as the actual application to which a tool is put, while function is the application for which a tool is designed. Thus while it is likely that a tool's use and function can be similar, it is not obligatory. Differentiating these terms facilitates the development of a classification system for tools based on function since it identifies a potential source of nonconformity. It also provides behavioral information since the recovery of tools not used for the tasks they are designed suggests that the activities performed were those not expected by the tools's manufacturers.

A historical discussion of Paleolithic stone tool research reveals how the study of Paleolithic materials was heavily influenced by overriding theories or models. Although such paradigms might have been of value at their inception, often it was only until such misleading paradigms were satisfactorily dismissed that progress in the study of Paleolithic archaeology continued. This was the case with the theory of catastrophism and with the acceptance of a paleontological model for the evolution of cultural industries. It is argued that this model is still a disruptive force in the study of Paleolithic archaeology.

Information concerning the method of the Laplace classification system for Upper Paleolithic stone tools is also presented. This is the first detailed documentation of the system in the English language. As such it may help clarify the complex notational system and make more easily available the thousands of publications in Spain, France and Italy that use the Laplace system.

A formal classification system for microwears is devised. Employing labels not inherently associated to materials, it thereby eliminates the potential confusion that can result if future research discovers additional materials that produce similar microwears.

The value of a hierarchically structured taxonomic system for microwears is clarified by a discussion on the relationship between precision and accuracy. With such a

structure the microwear analyst need not stretch taxonomic definitions in order to classify microwears that do not meet criteria at the most precise level of the taxonomic system. After classification, interpetations of microwears, although closely linked to the taxons, can be formulated with greater or lesser precision if other information is available.

In addition, the hierachically structured system has taxons that are meaningful to approximately equivalent levels of "activity." For example, if one has a B1U microwear interpreted as produced by antler one can say that it was used for antler working or in an antler working activity. If one has a R1U microwear one cannot claim that it was produced by a single specific material, but because all the materials likely to produce that microwear would be those associated with ornament or tool manufacturing, one is still capable of presenting useful behavioral and economic information. Thus there are levels of interpretation that can be meaningful to a given research problem that are also very accurate.

From this research a set of experimental studies is added to the growing body of experimental rsearch in microwear analysis. Two different types of experiments are performed, one which is replicative, in which tools are used in order to perform tasks as might have been done in the past, and second, classical experimentation is

performed where variables are to some degree controlled in order to assess their impact on the resulting microwear. The experiments can also be grouped in a different, equally meaningful manner: those experiments performed to determine if one can replicate microwears discussed by other microwear analysts, and those experiments performed to test specific hypotheses or models about microwear formations.

The relationship between microwear and edge fracturing is also developed. Derived from this are organizing principles that allow for the temporal ordering of tool "use-lives" as indicated by the relative placement of microwears and modified (retouched) surfaces.

The application of microwear analysis to level 4a of Paglicci Cave is performed in order to test the relationships hypothesized for tool technomorphology and tool use. Although somewhat hampered by small samples, numerous significant findings result, including: 1) discovery of a type of burin that was used as a bladelet core while other burin types are generally used for graving; 2) one type of endscraper is used for its long lateral edges and its small front is relatively insignificant in terms of use; 3) the remaining endscrapers are used for scraping hide; 4) hide scraping endscrapers and the burins used for graving are found to have been used on their lateral edges prior to these uses; 5) points are generally found to have been used as knives, mostly for

butchering, as are most sidescrapers, although it is uncertain if this is a truly functional category; 6) the converging end of points may sometimes be a hafting element; 7) truncates appear to fit the same pattern as non-truncated blades and scrapers; 8) laterally backed tools fall into two use groups, (meat) knives and armatures, which can be differentiated according to technomorphological characteristics; 9) microburins resulted from the manufacture of the functional class of armatures, and not from the manufacture of backed tools in general; 10) denticulates and abrupts often may not have resulted from deliberate retouch; 11) splintered flakes were consistently used for wood working, but the functional implications of this are unclear.

The results of this study indicate, somewhat unexpectedly, that there is substantial conformity between Laplacian technomorphological types and tool use. In addition and very importantly, often when there is nonconformity, there are other technomorphological characteristics that can be found to correspond to the variations of use. The general conclusion one must reach from these results is that there is a strong likelihood that a functional classification of tool types that employs technomorphological attributes as defining criteria is possible for the late Upper Paleolithic.

These results are applied in a study of site function for level 4a of Paglicci Cave. The assemblage, hypothesized to have resulted from a hunting camp, is tested using a multi-dimensional approach. Rather than depend just on the lithics or the microwear analysis, all dimensions of the archaeological record that can provide information concerning this proposition is studied. These dimensions include the microwear analysis, the technology of the assemblage, interpretations of site activities, faunal analysis, study of the site location and evaluating the spatial structure of the cave's interior. The overall evidence tends to support the proposition that the site is not a residential base camp but is instead a hunting camp.

The method for tabulating the microwear data is of importance here since no one has developed a means for assessing overall assemblages. The tools, sampled by technomorphological categories are interpreted according to their use. The proportion of each use for each sampling stratum serves to estimate use for the proportion of the population of each sampling stratum. The population estimate of each use is summed across all sampling strata to provide a total count for each use. The percentage of each use can then be calculated from the whole. Importantly, because the proposition of site function requires only broad categories of activities (e.g., butchering, hide working, tool and ornament manufacturing),

the precision of the microwear interpretations can be kept general, allowing for an arguably high level of accuracy.

The results of this research combined with the technomorphological research of sites throughout Italy and the paleoeconomic study of central Italy by Barker (1980) permits some speculative comments to be made concerning Italian cave sites in general. It is suggested that many of the assemblages result from occupations that used the caves as special function sites; often, specifically for hunting camps.

This argument is based on ethnographic data as well as Paleolithic research, and it challenges the long held assumption that caves during the Paleolithic were residential base camps occupied from a single season to year-round. Although there is much support for this speculative argument, it will be only through the study of numerous additional sites, including open-air sites which are hypothesized as likely candidates for residential base camps, that we will be able to test it. Thus, the open-air sites that produced the need for research concerning the relationship between tool use and technomorphology may be the sites which lead us toward new ideas and a better understanding of the Paleolithic.

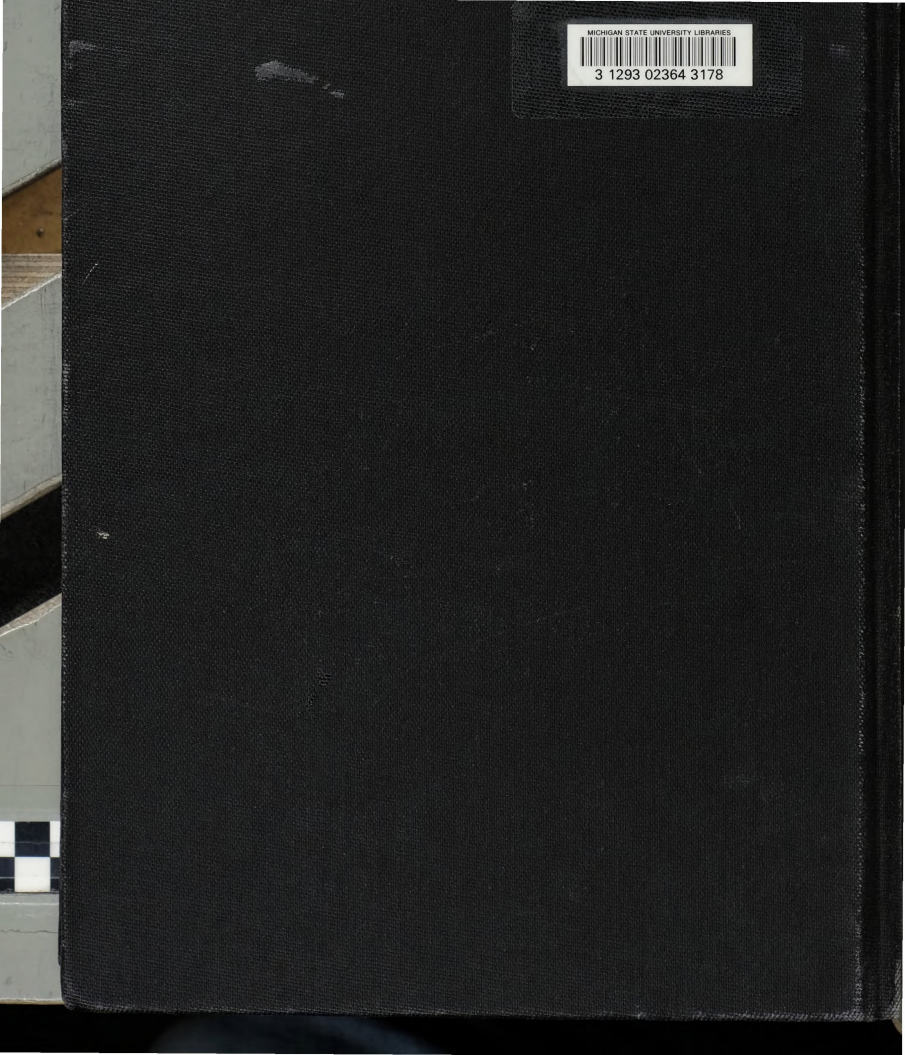
8.2. Future Research

This study suggests numerous directions for future research. Without doubt one of the most interesting

research problems presented in the thesis is the use of caves in the Upper Paleolithic. At this time there is the means to test the hypotheses concerning site function. It requires the study of additional lowland cave assemblages, those that fit the recognized assemblage patterning and some that are uniquely different. Upland cave sites should also be tested; Barker's hypothesis concerning Grotta Maritza, for example, as well as determining if many of these cave sites served as temporary residential base camps. Equally important is to collect good comparable information from open-air sites. The data from these sites ought to be statistically reliable, a current potential weakness of many assemblages. The research need be multivariate, and include faunal analysis, the study of lithic technomorphology, microwear analysis, and spatial analysis. Numerous hypotheses can be formulated and tested with these techniques to assist in interpreting site function.

At the same time such research provides the large comparative data base needed for developing a functional typology based upon technomophological types. Already numerous patterns have been discovered between use and technomorphology. Testing these hypotheses and building upon them is now called for. As an integral part in these studies, microwear analysis will play a greater, not a lesser, role in the study of Paleolithic archaeology.

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Volume II

APPENDICES

APPENDIX A

THE ATTRIBUTES OF THE LAPLACE SYSTEM

The following is a brief description of the attributes used in the Laplace typology. It is suggested that the original work (Laplace 1964a) be reviewed before attempting to use this system.

Mode of retouch:
1) (S) Simple--The spine plane angle is substantially increased
2) (A) Abrupt--The spine plane angle is near 90 degrees; "backing"
3) (P) Flat--The retouch barely modifies the spine plane angle
4) (SE) Raised--Simple retouch on carinate flakes
5) (E) Impact (Siena)--Fractures that splinter the edge

Amplitude of retouch:
1) (mm) Inframarginal (Siena)--Tiny, non-retouch fractures
2) (m) Marginal--Retouch that does not modify the form of the edge
3) (p) Profound--Retouch that modifies the form of the edge

Direction:
1) (d) Direct (dorsal)--Retouch on the dorsal face
2) (i) Inverse (ventral)--Retouch on the ventral face
3) (a) Alternate--Retouch that alternates between faces along the edge
4) (b) Bifacial--Retouch that appears coincidentally on both faces
5) (bip) Bipolar (Siena)--"Backing" that occurs along both faces

Delineation:
1) (cont) Continuous--Continuous retouch along an edge
2) (dent) Denticulate--Retouch that creates teeth along an edge

Orientation:
1) (lat) Lateral
  1a) (dext) Right lateral
  1b) (sen) Left lateral
2) (trav) Transversal
  2a) (prox) Proximal--Bulbar end
  2b) (dist) Distal

Form:
1) (dir) Straight
2) (conv) Convex
3) (conc) Concave
4) (sin) Sinuous

Localization:
1) For lateral edges:
  1a) (prox) Proximal
  1b) (med) Medial
  1c) (dist) Distal
2) For transversal edges:
  2a) (dext) Right
  2b) (med) Medial
  2c) (sen) Left

For burins only (Figure A.1):

Profile morphology: The form of the burin edge
1) (rect) rectilinear--straight
2) (sigm) Sigmoid--sinuous
3) (poly) Polygonal--thick convex

Inclination: The angle the burin spall makes with the ventral face
1) (norm) Normal--Greater than 45 degrees
2) (plan) Flat--Less than 45 degrees
3) (mixt) Mixed--The numerous spalls cause the angle to vary
  3a) (prism) Prismatic
  3b) (car) Carinate

The Laplace Notation

Laplace developed a notational device for presenting a description for all retouched edges of a tool. This is therefore a much more complete picture of the characteristics of a tool than that gained from the type definition.

The notational description of a tool begins with its primary type classification, such as G3, followed by the notations for the position and the form of this primary edge:

G3 prox conv.

Because often a primary characteristic is required in the type definition it is not necessary to give that

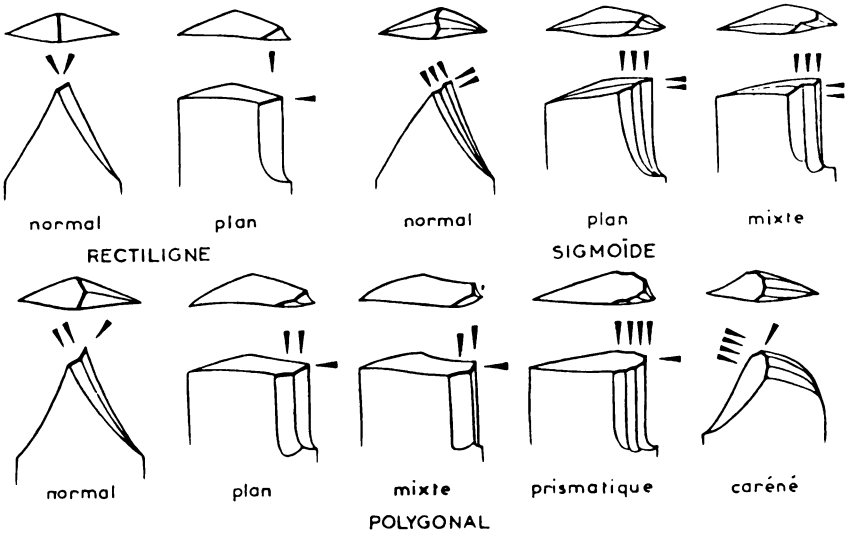


Figure A.1. Morphology and direction of the burin edge.

information. For example all endscrapers must be convex in form, thus:

G3 prox,

is the same as the previous statement.

Attributes of the retouch technique that define the primary type then follow and are placed within brackets. Three attributes always required are the mode, the amplitude and the direction of the retouch:

G1 prox [Spd].

All other retouch, referred to as complementary retouch, is separated from the primary characteristics by a slash. These secondary characteristics are also described according to retouch technique, position, form, etc.:

G1 prox [Spd]/ Smd sen sin.

In order to present the positional relationship of two areas of of retouch there is a specific set of notation which describes the articulation of the various areas of retouch. These are:

- Continuation of different retouch along a single edge
-- Two areas of retouch along a single edge separated by an unretouched area
= Two coincidental retouch types
+ The retouch is on an adjacent edge
* The retouch is on an opposite edge (normally a centered point is used).

Other notation includes:

( ) Signifies that their is a tendency toward this attribute.
___ (underline) Signifies that the tool is on a blade.

Some examples:

G3 dist [Spd]/+ Smd dext - Spd

B3 norm rect/ Apd dext

T3 [Apd]

PD4 sen rect [Ap bip - Apd]/ Ppi bilat prox.

Additional examples can be found in Laplace (1964a).

APPENDIX B

THE MICROWEAR ATTRIBUTES

This appendix contains a description of the attributes used for characterizing the microwears, coded for statistical use, they are found in descriptive format in both Chapter 4, the description of the classification system, and in the detailed description of the stone tools in Appendix D.

Fractures

Fracture Size; effected by hardness, force and edge angle:
1) Minute (very small)
2) Small
3) Medium
4) Large
5) Extremely large

Fracture initiations:
1) Cone or point--indicates a strong compressive force
2) Bending--indicates a strong bending force

Fracture terminations:
1) Feather--indicates a strong compressive force
2) Step--indicates a secondary bending force, flaw or insufficient pressure
3) Hinge--indicates some bending force
4) Snap--occur only with bending initiations. Indicates strong bending force or a tensile force perpendicular to the edge (see Hayden 1979:135).

Fracture directions:
1) Perpendicular to the edge
2) Oblique to the edge
3) Mixed

Striations

Frequency of striations:
1) None
2) Very few
3) Common
4) Dense (innumerable)

Striation morphology:
1) Deep and narrow (less than 2mc)
2) Broad and Deep
3) Broad and shallow
4) Abraded line--only tops of topographic features effected
5) Linear depressions--more like troughs than striations

Position of striations:
1) Edge
2) Edge and face near edge
3) Face
4) All over tool

Direction of striations:
1) Perpendicular to the edge
2) Parallel to the edge
3) Oblique to the edge
4) Mixed

Polish

Polish location:
1) Edge
2) Edge/Face
3) Face

Vertical distribution of polish:
1) Peaks of microtopography
2) High and middle contours
3) All contour levels

Reflectivity:
1) Dull
2) Slightly bright to no contrast
3) Bright
4) Very bright

Microtopography:
1) Flat or smooth
2) Doming
3) Convoluted or undulating
4) Rough

Texture:
1) Smooth
2) Convoluted
3) Greasy or satiny luster
4) Rough
5) Matt

Abrasion (rounding):
1) Very mild
2) Mild
3) Moderate
4) Intense or heavy

Pitting:
1) Tiny and common
2) Medium size and comet-shaped
3) Large and hemispherical

APPENDIX C

EXPERIMENTAL AND REPLICATIVE STUDIES

The experiments are performed over a two year period. Most of the experiments are performed to confirm that the patterns of microwear found by other microwear analysts are also found here. Various other experiments are performed in order to test specific hypotheses concerning the relationship of microwear development to use, technology or morphology of the tools.

Experiments were performed on red jasper which is found in central Italy, and on three varieties of fine grain flint, all found on the eastern side of the Gargano Promontory. Red jasper is the predominant material found at Petriolo and the flints are all found archaeologically at Paglicci Cave.

C.1. Experiments Performed with Red Jasper

X-1

In this experiment a jasper flake is retouched into an endscraper and used for the scraping of dry hide. The tool is used for a total of 30 minutes in two scraping episodes. The tool is then washed in soap and water, and bathed in a 12 percent solution of HCl and a 20 percent solution of KOH. Under microscopic examination at 200x magnification the edge is moderately rounded and has an extremely matt texture. The polished surface is dull relative to the original surface. There are numerous and various types of striations perpendicular to the edge, both on the edge and on the faces near the edge. There are also some small hemispherical pits seen near or on the edge. Interestingly, at low magnification, and even at a macroscopic level, the polished surface area appears to be a lighter, duller and more matt surface than the unpolished surface. It is uncertain why this is so visible, but it is suggested that the red color of the stone provides substantial natural contrast so polished surfaces are much more visible.

X-2

In this experiment an unretouched flake of jasper is used to whittle the bark off a branch from a honey locust tree. The tool is used for 30 minutes with the ventral face toward the branch. The tool is then cleaned in the manner described above.

The microwear from this experiment shows a small amount of polish on the ventral face and edge, while the dorsal face has numerous small fracture scars of point initiation and various terminations. The polish is very bright and smooth. It gently curves, and sometimes appears to dome on the surface. There are some pits as well, but these appear to result from profound areas in the microtopography not yet affected by the microwear.

X-41

In this experiment a piece of fresh deer hide is scraped for 30 minutes with an endscraper. The tool is cleaned after use in the above described manner.

The microwear of the tool is extremely pronounced. The edge and arrises from retouching the front are all well rounded. The surfaces of the jasper tool near the front are all rough in microtopography and greasy in appearance. A few striations are visible, mostly the wide and shallow type. The polish is fairly bright and there is substantial contrast between affected and non-affected surfaces.

X-15

This experiment is an attempt to grave deer antler with a jasper burin. The tool is used for a total of thirty minutes. After cleaning in the above described manner, it is examined microscopically. The microwear on the burin edge is bright and fairly smooth. Where it is fairly well developed, it has a slightly pock-marked appearance giving it a "melting snow bank" appearance. The edge is mildly rounded and no striations are visible.

X-39

In this experiment deer bone is graved with a jasper burin for 30 minutes total. The tool is cleaned as described above. The microwear at 200x magnification is bright, but it has a rough, almost a matt, texture to it. There are tiny pits in the microwear and striations in parallel tracks that are in the direction of the tool's movement. The polish is viewed at ten minute intervals of use, and at each viewing the polish becomes more and more developed, brighter and more distinct, but it does not tend to expand beyound a small area of a single projecting ridge where it is first noted.

X-32

In this experiment an unretouched flake of jasper is used to cut deer meat for 30 minutes. The tool struck bone occasionally during use, but is never used to cut against the bone. The tool is cleaned in the above described manner.

The microwear on the tool is very faint, but it is evident that some modifications of the original surface has

taken place. The edge is very mildly rounded with fracture scars and a relatively bright line of polish on the edge. The faces near the edge have a slight sheen to them and appear somewhat greasy, but they are not. The texture is no longer grainy, but other than the sheen there is no real texturally describable characteristics.

Ex-15

The purpose of this experiment is to characterize the developmental process of dry hide polish. The jasper flake is retouched to form a convex edge with profound and simple retouch (an endscraper). The chord of the edge is 6mm and its perpendicular is 1.5mm. The longest retouch scars have point initiations and feather terminations. The shorter scars have point initiations and step terminations. The edge is covered by numerous particles of jasper resulting from the retouching. The tool is washed and lightly brushed which removes only some of this particulate matter.

The tool is used for scraping dry hide for five minutes. The tool is bathed in soapy water and in HCl and KOH for 10 minutes each.

The used edge displays mild rounding through an attritional process that does not involve fracturing. No fracturing of the edge is apparent. There is a mildly developed topography of rounded mounds on the edge and dorsal face. All loose particulate matter has been removed which gives the stone a clean, brushed look relative to part of this edge that is retouched, but not used. There is at least one striation visible which is on the edge and perpendicular to it. There is a slightly matt appearance to the texture of the jasper which is not terribly different from the original surface. The brightness is not altered to any extent either. Linear undulations known to occur with this material are not yet apparent but the mounding of the microtopography is probably the initial aspects of this characteristic. The predominant characteristic at this time is edge rounding.

The tool is again used for scraping dry hide for five minutes, thus for a total of ten minutes. The tool is cleaned and prepared for examination as above.

The tool displays a few striations similar to that found previously. The edge itself is not noticeably more rounded than before. The matt appearance of the texture has increased substantially and is easily differentiated from original surface characteristics. A greater length of the convex edge has also been affected which probably results from shifting the hide from a hard table to my lap.

The tool is again used for scraping dry hide for five minutes. The tool performs poorly, without doubt because the tool is dull. The tool is cleaned and prepared for examination as described above.

The tool displays all of the above characteristics with slightly greater intensity and sightly more polish distributed over the surfaces. Striations are more numerous as well, vary in type and all are found perpendicular to the edge.

The tool is used again for five minutes, thereby totaling the time of use to 20 minutes. Cardboard is used as a backing which allows for increased force to be applied, but it is obvious that the tool is virtually uneffective in working the hide because of its dullness. Cleaning and preparation for examination follow as presented above.

Examination of the tool shows the edge to be extremely rounded with a well developed matt surface texture. There are some small step fractures on the dorsal face thought to have resulted from use, but this is not certain since there are step fractures from the retouch as well. The ventral face which is the leading face in the scraping motion does not have any fractures.

Ex-16

The corner of a retouched flake is used to cut dry hide. The edge angle is 60 degrees. The retouched edge is sinuous, and almost denticulated, although irrelevant to the use area of the tool which is a small corner area. The dry hide is to be cut on a flat hard surface with another piece of hide underneath it. The edge of the tool is very sharp and clean of particles for the first 3mm of the edge. A quartzite vein intersects the edge which has some particles and then the remaining part of the edge is again particle free. There are no scars along the ventral edge, but there is one large and four small feather termination scars along the dorsal face.

The tool is used for five minutes for cutting strips of 2mm thick dry hide. The tool appears to be as effective for cutting the hide at the end of the 5 minute period as at the beginning.

The tool is cleaned and prepared with a water and soap solution and baths of HCl and hydrogen peroxide.

At a magnification of 200x it is evident that there is some rounding of the edge for about 5mm from the corner. The very small retouch scars described earlier have all but disappeared from abrasive action. The previously minute arrises are worn smooth. The texture of the rounded area is mostly matt, but still somewhat grainy. There is also a fine line of bright polish along the edge which was thought to result from contact with the wood underneath the second piece of hide, but now is better understood to probably have resulted from auto-abrasion.

The tool is again used for five minutes. It is now dragging and requires some small amount of force to cut the

hide, but not very much. After use the tool is cleaned as described above.

The tool microscopically (200x) shows no edge fracturing, striations or undulations. The brighter polish found only on the edge still exists. It is bright with tiny striations and is very smooth and rounded.

The tool is used another five minutes and it continues to cut well with only a little force. The tool is cleaned as above.

The bright polish on the edge still exists; either it is not being removed or it continues to be produced along with the matt textured microwear that is predominant. No striations are noted. The matt appearance, although obvious, is not as extreme as found when scraping hide. The edge appears to have a micro-sine wave to it when looking at the ventral face. This is caused by numerous tiny bending fractures that have been abraded smooth.

Exp-17

The purpose of this experiment is to study the effect of dry hide on an unretouched tool used for cutting.

After manufacture the tool is used as the tool in experiment 16 for five minutes. Through the five minute period it became increasingly difficult to cut the hide. After use the tool is cleaned with soap and water and then bathed in HCl and hydrogen peroxide.

The edge at 200x magnification displays mild rounding of the edge. There is textural change to the area that has been in contact with the hide, but not distinctly different. There is no bright microwear along the edge itself, supporting the hypothesis that this bright line of microwear is caused by autoabrasion from silicate particles.

The tool is used for another 5 minutes in the same manner. It becomes increasingly more difficult to cut with, and requires additional force to be applied in order to perform the task. The tool is cleaned in the same manner as above.

Microscopic examination shows that the edge is moderately rounded and the texture of the stone in the cutting area is distinctly matt. No striations are noted but these are often more visible at lower magnifications. In addition to the other characteristics, tiny fractures are removed from the edge by use, and a mild sine wave edge contour is beginning to form.

Exp-18

The purpose of this experiment is to recover information concerning microwear produced by cutting a cylinder (branch) of wood with an unretouched edge.

The tool comes from the same core as ex-17 and has a very sharp straight edge. The edge angle is approximately

50 degrees. The tool is used with a sawing motion across the grain of a fresh limb of pine. The tool is used for a period of 30 minutes and cuts to a depth of 7mm around the entire limb. It can be noted that the thickness of the tool interferes with the sawing substantially at this depth into the wood. The tool is cleaned in HCl and Hydrogen peroxide.

Microscopic examination of the tool at 200x magnification reveals a fine line of very bright polish along the edge. Some polish formation has begun at the edge/face interface, where characteristics of the wood polish are more easily discerned. It is, besides very bright, very smooth with a slightly doming appearance. It is developed on the higher areas of the microtopography. There is virtually no edge damage although substantial pressure has been applied. The sine wave contour of the edge resulting from hide cutting has not developed here.

It is evident that the tool can be used for substantially more cutting before it is dull. It is suspected that the polish development is relatively slow because of the substantial moisture of the wood.

C.2. The 1000 Series Experiments

The following experiments all numbered in the 1000s are performed to confirm that the microwear patterns being seen for the red jasper are also being found on the flint.

Ex-1001

The tool is retouched to form a fairly steep, mildly convex edge on a lateral edge of the blade. The edge is mildly denticulated as a result of poor retouch technique. There is also a substantial amount of particulate matter along the retouched edge resulting from retouching.

The tool is used for whittling a piece of antler that was soaked for 24 hours in water. This gives it the apparent hardness of medium to soft wood. The whittling is found to proceed very well once no attempt is made to remove large shavings, but instead apply light pressure to remove tiny shreds. This could be done extremely rapidly. The tool is used for a constant five minutes whittling with the ventral surface always face down.

The tool is cleaned and prepared for observation by washing in soap and water and bathing it in HCl and H_2O_2 (hydrogen peroxide).

The microscopic observations show a well developed microwear that is bright and convoluted. The microwear is very well developed on the ventral surface near the edge. It is also well up the dorsal face, but it is much poorer in development. Some of this polish formation has a greasy luster, but it is fairly bright; typical of what Vaughan

(1981) describes as the first stage of polish formation. The appearance of the microwear is very similar to that as described by Keeley (1980) as like a "melting snow bank." Although there are no striations, there are very smooth linear undulations that are oblique to the edge and may prove valuable for determining the direction of use on archaeological specimens. The edge is moderately rounded.

Ex-1002

The purpose of this experiment is to characterize microwear on flint produced by scraping (graving) bone.

The tool is used for ten minutes with a back and forth scraping motion of the burin edge along the length of a long bone. A groove quickly develops into the bone 2.5mm wide--the width of the burin edge--and reaches a final depth of about 2.0mm.

The tool is cleaned with non-abrasive, ammonia-based soap and water and is placed in baths of HCl and H_2O_2.

Microscopically, the burin edge has a smooth, bright polish with tiny pits. There are also numerous striations perpendicular to the working edge running in parallel tracks. The microwear is on the edge and on the high points on the faces, and on the facet edges near the burin edge. It is thought that much of this microwear is not what is recognized by Keeley as bone microwear but instead it is the closely associated autoabrasion microwear resulting from contact with particles of flint.

The tool is used for another ten minutes in the same manner. It is also cleaned as previosly described. The resulting microwear is very similar to what has previously been seen. The polish has a slightly greater distribution than before and greater intensity, but these are not significantly different from the previous examination. For the most part the microwear has stayed only upon the most projecting parts of the edges and related components. None of the rough texture microwear is found on this tool that has been found by others and myself as resulting from bone.

Ex-1003

The purpose of this experiment is to present characteristics resulting from bone cutting. This triangular shaped tool is unifacially retouched to provide a straight edge. It is used to saw bone for ten minutes. The bone is very fresh and still has some tendons and flesh connected to it. Although fresh, the bone is very hard and only a small cut (groove) is being produced. Meanwhile it is obvious that the handaxe is fracturing along the working edge.

The tool is cleaned in the previously described manner.

The resulting microwear is characterized first by substantial bending initiations fractures along the edge of the tool. Along only the edge and some facial projections

there is a bright polish, often appearing as an interrupted bright line. On projections the polish is more intense, but still not well developed. Often the polish appears smooth, thus suggesting that it comes from autoabrasion. There are a few striations along the edge, always approximately parallel to it, and never in the smooth polish. In addition to this smooth polish, at less protruding areas along and near the edge, the tool has a greasy appearance to it, not unlike meat produced microwear. This microwear is not associated with any noticeable textural or microtopographic changes of the surface, however.

Ex-1004

The purpose of this experiment is to present a well developed bone microwear resulting from sawing. This long, fine-grained blade has a straight edge, but it is slightly curved when looking straight on. This proves to have a major effect on the edge-wear. The tool is not retouched. It is used for sawing bone for fifteen minutes, by which time it has become fairly difficult to use. The tool is problematic because the curving edge does not allow for easy cutting, and it becomes obvious that substantial fracturing of the edge is occurring.

The tool is prepared for viewing by the cleaning method described above.

The edge has a distinct, macroscopically visible, denticulate edge produced by the sawing of bone. The fractures that form this denticulated edge are large bending initiation fractures up to 0.5mm in wide. Because of the substantial edge fracturing there is very little visible microwear. It appears best on the "teeth" of the denticulated edge. There are two types of polish. The predominant one is very smooth and bright, with occasional tiny pits that are barely visible even at 400x magnification. The second type of microwear is bright, but rough in texture, and it has numerous fine striations in parallel tracks associated with it. While the first microwear type is probably the result of autoabrasion, the second is most likely to be the commonly described bone polish.

Ex-1005

The purpose of this experiment is to produce microwear from the scraping of dry hide. A fine grain flint flake is retouched to form an endscraper. The tool is used for 20 minutes on a piece of dry cow hide (leather). The tool appears to be more difficult to use by the end of this period.

The tool is washed in soap and water, and then bathed in HCl and hydrogen peroxide.

The tool is microscopically examined and displays a moderately rounded front with some bright polish on it. The remainder of the tool has a rather non-contrasting and extremely matt textured polish. There are numerous striations perpendicular to the edge. The striations are generally wide and shallow, but there are also deep, narrow ones as well. It is now recognized that the bright smooth polish on the edge probably results from autoabrasion.

Ex-1007

The purpose of this experiment is to characterize meat produced microwear. An unretouched flake is used to cut strips of boneless beef. The meat is extremely greasy and it is cut for one hour with special care taken so as not to cut anything but meat. Again, no contact is made with any other material except the meat. The tool is cleaned in the manner described previously.

The microwear on the tool is barely noticeable. The evidence includes a very fine, bright line of microwear along the length of the working edge. The line is not wide enough to describe except that it appears very smooth and it is very bright. In addition, the faces of the tool near the edge are not grainy, but are somewhat greasy looking with a very mild sheen. The edge is slightly rounded, but to call it mildly rounded would be to overstate it. There are a few tiny bending initiation, feather termination fracture scars, some of which interrupt the line of brighter polish seen along the edge. No striations are visible.

Ex-1008

The purpose of this experiment is to produce a microwear resulting from plant fiber. The tool, with a retouched lateral edge, is used to cut up a burlap bag. It is used for 15 minutes. The tool is washed with soap and water and then bathed in HCl and hydrogen peroxide.

The microwear on the tool is extremely bright and smooth, but it has a large number of striations parallel to the edge. The microwear extends a short distance up the face, especially on the arrises. The microwear does not dome as much as seen from working wood, but it is slightly more fluid looking, effecting all but the lowest of microtopographic elevations. It is evident however that the microwear is not flat. The edge is mildly to moderately rounded and some rounding of the arrises has occurred. There are some edge fractures probably resulting from use, but these may result from the earlier retouching of the tool. No comet shaped pits are recognized.

Ex-1009

The purpose of this experiment is to produce a more extensive microwear polish from plant than what has been

produced by cutting jute. A straight, steeply retouched edge is used to scrape burlap. There is little attempt to shred the burlap as much as to produce an extensive area of plant microwear. The tool is used for 30 minutes. At the end of this time it is cleaned in the manner described above.

The microwear is more extensive than any other microwear experimentally produced, going well up the dorsal face, but the edge itself is only mildly to moderately rounded. The microwear is very bright and very smooth although the smoothness is not obvious because of numerous striations running perpendicular to the edge. The microwear effects virtually all microtopographic levels although only the higher areas have a very well developed microwear. Again no comet shaped pits are recognized.

Ex-1010

The purpose of this experiment is to characterize microwear from whittling soft wood. An unretouched blade is used for whittling a branch of fresh pine. The tool is always held such that the ventral surface is facing the wood. The tool is used for twenty minutes, by the end of which time the tool has become moderately difficult to use.

The tool is washed with soap and water and then bathed in HCl and hydrogen peroxide.

The edge has numerous small fractures which appear to be mostly of bending initiations and feathered terminations on the ventral surface, and point initiations and feathered terminations on the dorsal face. The microwear on the ventral face goes up the edge a small distance, but it is only recognizable as wood polish near the edge. It is very bright, very smooth and the polish appears to dome on the surface of the flint. Polish appears to start with convoluted patterns smoothing or doming at high points on the microtopography and then seems to spread over larger areas and into lower areas of the microtopography. Even interior surfaces of fracture scars on the ventral surface are effected. The microwear is never flat, but always undulating or doming, and it contains holes or pits without polish. No striations are seen on this tool. The edge is mildly to moderately rounded.

A slight variation in polish intensity is consistently seen within the fracture scars. The polish is slightly more intense on the face of a scar that faces the direction of movement by the tool. This can be explained by the whittling motion that draws the tool across the object being worked at the same time it is scraping down the object. Since polish development appears to correlate with intensity of contact, it makes sense that polish would develop most intensely on such facing surfaces.

Ex-1011

The purpose of this experiment is to characterize microwear produced by the working of fresh hide by various methods. The tool used in this experiment has a retouched convex front and unretouched lateral edges. The main part used is one of the lateral edges with a scraping, almost whittling kind of motion in order to remove the flesh still attached to the hide. The tool is used for 45 minutes. It is not easy to use because the grease from the flesh makes it slippery to grasp. Little force is used and the tool is almost always in contact with flesh and not hide. By the end of use the tool seems dull. In addition to the lateral edge, the front of the endscraper is also used with a scraping motion.

After use the tool is washed with soap and water and bathed in hydrogen peroxide and HCl.

The tool has a very mildly rounded edge along the most heavily used part. It is characterized mainly by the appearance of a fine bright line along the edge and gleamy ventral and dorsal surfaces near the edge. These surfaces still appear as if they have grease on them, but further cleaning indicates that this is a characteristic of the stone's surface. The grainy appearance of flint's texture is no longer noticeable, but the surface is not smooth, nor does the microtopography appear modified. There are a few very small fractures along the edge mainly on the dorsal face. No striations are seen and no rounding of the fracture scars along the edge. This would be interpreted as microwear produced by meat if it were an archaeological find.

The front of the endscraper has very noticeable polish on its dorsal face but again no microtopographic change.

Ex-1012

This tool is very similar to Ex-1011 and is used in the same manner for 30 minutes. Occasionally a cutting motion is used in attempting to remove flesh. The dorsal face of this tool faced the hide. The front of the tool is also used in low angle scraping. The tool is cleaned as described above.

The microscopic characteristics of this tool is identical to that of Ex-1011. It has a fine bright line along the edge with only a minute amount of measurable rounding. The dorsal and ventral surfaces near the edge have lost their graininess and are greasy in appearance with a mild sheen. No striations are evident.

Ex-1013

This tool is similar to the previous tools used in this activity of removing meat from fresh hide. This tool is shorter than the other two which permits one of its unretouched lateral edges to be used with a high scraping

angle. The front of the tool is again used at a low scraping angle. The tool is used for thirty minutes. Cleaning of the tool follows the procedure discussed with Ex-1011.

The microwear on this tool, although used in a slightly modified manner matches the microwear resulting from the previous two experiments. The edge is only mildly rounded and has a bright line running its length. The surfaces are gleamy with a greasy appearance. The front of the tool is slightly more rounded, however. Its dorsal face has a very greasy appearance to it as does the ventral face which also has some mild roughening of the microtopography. Because greater pressure is used with this tool, and a lesser amount of flesh remains on the hide, it is hypothesized that the microwear characteristics from contacting fresh hide, and not just contacting meat, is beginning to appear.

Ex-1014

This tool is an endscraper whose front is used to scrape fresh hide at a low angle. Substantial pressure is applied unlike with the previously used specimens. This is possible because the retouched front is substantially thicker than the thin lateral edges of the other tools. The tool is used for 20 minutes by which time most of the remaining meat fibers have been removed from the hide except for around the margins. The hide is still flexible and very greasy, however.

The tool is cleaned as discussed above twice. It was apparent after the first cleaning that numerous fibers of flesh had been lodged in the distal parts of the step termination fractures produced by the retouch.

The edge of the endscraper is noticeably more rounded than on the other tools. In addition there is no bright line of microwear although some of the dorsal ridges display bright areas of microwear. The dorsal and ventral faces near the edge are slightly brighter than non-affected areas of the tool, and they also have a greasy texture and a rough microtopography. There are a few striations perpendicular to the edge; their types are not noted. There also are a few fractures on both ventral and dorsal faces suspected of resulting from use of the tool, but this is not certain. They are generally step termination fractures.

Ex-1015

In this experiment an attempt is made to study the cause for the bright microwear seen associated with other microwears. It is thought to result from flint autoabrasion. This experiment is performed three times with varying amounts of pressure being applied. One piece of flint is rubbed in a circular motion over the surface of another. The tool is cleaned in the standard manner of

soap and water followed by baths in HCl and hydrogen peroxide. The resulting microwear appears to be of two types. The first type is bright, texturally smooth, and rough or undulating in microtopography, and when over an adequate area appears somewhat similar to smooth antler or wood. This polish however sits on top of higher peaks of the microtopography and thus never seems to cover a large area. The second microwear is slightly less bright and appears to have flattened the microtopography. It appears smooth in texture. Numerous thin short striations are seen with this microwear and they follow the line of movement. It appears that the first microwear results from a small force being exerted while the other results from a substantially greater force being applied.

It is suspected that the fine bright polish found on high points and on the edge of meat knives and other tools results from autoabrasion with flint and is characterized by the first form of this microwear. Although often there is substantial force applied in these tasks, the material being worked probably acts as a cushion, thus variation one and not variation two is formed.

Ex-1020

This tool is used on a piece of dry cow hide that has been previously scraped (when fresh) and allowed to dry for 30 days. The hide is very stiff and hard, yet very greasy. The endscraper used for this task is fairly large which makes holding it by hand less difficult than with other endscrapers. After a few minutes of lightly scraping the hide, substantial force is applied for approximately forty minutes.

The tool is cleaned with soap and water and then bathed in HCl and hydrogen peroxide.

Microscopic examination of the tool reveals that the ventral surface is slightly bright and has a rough texture with mild microtopographic changes. Fairly large circular pits are also seen near and on the edge. There are also a few step scars. There are numerous striations which are of the wide and shallow and the narrow and deep types. There also seem to be linear depressions, but these are difficult to discern. The edge is moderately rounded and in some areas is much more matt than rough. There are also occasional areas of a bright polish, seen only on the edge and on projections of the arrises on the dorsal face. The microwear goes well up the dorsal face. Numerous fractures are seen on the dorsal face, but I cannot be certain that they are from use. Arrises on the dorsal face are only very mildly rounded.

In comparison with other reports of hide polish this microwear compares well with what Keeley describes as greasy dry hide. In his case grease was added to dry hide while here grease is a natural lubricant from the hide.

The source of the lubricant therefore doesn't appear to be important. In comparison, the microwear characteristics of greasy dry hide appear to be somewhere between those produced by fresh hide and dry hide.

Continued work with this piece of hide, especially for depilation experiments, was foiled by a villainous bitch (of the canine variety) which merrily absconded into the woods with the hide.

Ex-1025

This experiment is performed in order to replicate microwear produced by shell working. A flint drill is manufactured with abrupt retouch along two converging lateral edges. Four seashells have holes bored into them. Three seashells fragmented in the process. It is noted that while substantial force can be used during the early parts of drilling, once the tool is about to break through the shell only very light force can be applied, otherwise the shell shatters.

The tool is cleaned with soap and water and then bathed in HCl and H_2O_2.

Microscpically this is the most difficult tool to study because of the tremendous damage of the edge resulting from the retouch and from the abrasion produced by working shell. The polish is found on only the small tips of projections. It is bright and has a rough texture to it. Small, narrow striations are occasionally seen. There is some rounding of the edges but it is mild. Some fracturing of the edge probably results from the use of the tool, but these cannot be differentiated from those caused by retouching.

C.3. The 2000 Series of Experiments

The decision to perform the following experiments results in part from the fresh hide working activity performed with a number of tools described previously. In all previous experiments it has been the objective of the to characterize the microwears produced on a certain stone by a certain material worked in a specific manner. It is evident at this point that the microwears are closely following that which has been recorded by others. However, it is equally evident that the patterns being produced may not be very useful for interpreting the methods of working archaeological materials because I am attempting to produce microwears, and they were attempting to produce or manufacture material objects. Because of this the following few experiments are performed with the objective of completing a specific task, such as the manufacture of an antler harpoon. These tasks will be done with numerous stone tools selected from unmodified flakes and blades. The tools will be modified only to the degree necessary to

do the task at hand. When the tool is felt to be performing inadequately it is not retouched, but set aside for later examination.

Ex-2001

The purpose of this experiment is to manufacture a harpoon from a branch of antler using only stone tools. All stone tools used are flint.

The process by which the harpoon is manufactured begins with a branch segment of red deer antler that has been soaked for 24 hours. Burins manufactured on fine grain flint are used to grave two parallel grooves in the antler approximately 20mm apart. When the grooves reach the central matrix of the antler a flint is used to wedge into the grooves and pry the splinter out. The antler splinter is then lightly scraped to smooth the surfaces. A lightly etched outline of the desired form is then engraved on the splinter. Large sections of the splinter to be removed are then sawed off. The final shaping is then done by lightly shaving the tool with a scraping motion, with a whittling motion, or both.

The total manufacturing process required nine hours and eighteen tools. The amount of time necessary to manufacture the harpoon is high partly because this is the first attempt to manufacture a tool in this way. With experience it can probably be done in a fourth of the time. The number of tools used is a maximum. Many are not well worn when "discarded", and often there are additional useable edges or the used edge is retouchable and therefore reuseable. In addition some tasks in the manufacturing are very specific and do not require much use of a tool.

Most of the tools are studied for microwears. They are cleaned according to methods outlined above. The microwears, when well developed, are consistently what has been described as smooth antler polish. It is bright, with a very smooth texture and a convoluted microtopography. The polish is on both high and moderate levels of the microtopography. Rarely are striations seen, but interestingly, they are often in mixed directions even on the same tool. Fracture scars are of a medium size with bending intiations on the tools used for sawing, while tools not used for sawing often have much smaller fratures with point initiations. Edges are never more than moderately rounded and most often they are only lightly rounded. Polishes are usually found about equally up the face on both ventral and dorsal faces. This probably results from changing the tool position in the hand causing both faces to be next to the antler at different times.

The tool used for wedging the splinter has no recognizable microwear resulting from the task, however it is used for a very short period of time .

Ex-2002

The purpose of this experiment is to produce microwears resulting from the manufacture of a bone needle with only the use of stone tools. A fresh long bone of lamb is used for this experiment. The groove and splinter technique is again used to produce a long thin splinter of bone about 5mm wide. This step requires substantially more time than the antler did, probably because the bone, even though fresh, is still much harder than soaked antler. A sawing action is used with a tool at one end of the splinter to prepare it for removal. This part of the bone is later snapped by hand. This makes removal of the splinter easier. The bone is then partially shaped using a whittling and scraping motion that produces very fine shavings of bone. Prior to final shaping a small unretouched tool with a snapped end is used like a burin to grave a tiny eye at the wider end. A graving motion is used since that is the only way to produce a hole without being so wide as to break the tool. Graving is done on both faces with the tiny grooves intersecting in the middle. The final shaping is then accomplished by continued scraping. The task requires only 5 hours of work, but requires nineteen tools to complete. It is also felt that had this been done before the harpoon it would have taken as many hours to complete.

The tools are cleaned as previously described for other tools.

Microwear examination of these tools indicates that a mildly developed bone microwear often occurs in association with a well developed, very smooth and bright silica polish. The bone microwear is generally found on projecting areas of the faces while the silica microwear is most often on the edge itself. Numerous striations are seen, often in parallel tracks, and usually oblique to the edge, but ranging from parallel to perpendicular relative to the edge. The edge is mildly rounded and fractures are numerous on the tools used in the earlier parts of the task and are very tiny on the tools used in the final shaving of the tool. Fractures are usually found on both faces.

Given the even distribution of microwear and fractures on both faces and the multiple direction of striations on the tools in the previous experiment and this one, it is apparent that once concern is directed toward what is being modified instead of how one is producing microwear on the tool, then the tools have a much greater variability in how they are held and in the directions of the tools' motions than previosly recognized. This suggests there can be difficulty in interpreting these factors of tool use in archaeological specimens.

Ex-2003

This experiment is performed to study the resulting microwears from the butchering of kid goats. Only three blades and one endscraper are brought for the butchering of three kids. The tools are too dull to use after having cut the hide and the connecting tissue between skin and flesh of the animals. Thus the tools are considered representative of the skinning process of butchering.

The skinning of the animals requires short cutting strokes and took about 20 minutes per animal. After the removal of one skin it is laid on a wood surface and rapidly scraped to removed flesh (connecting tissue) from it. A fairly heavy scraping motion is used and the skin is rapidly cleaned in about 30 minutes.

Tools are washed in soap and water and then bathed in HCl and KOH.

The microscopic examination of these polishes shows them to be typical of meat and fresh hide polish, or fresh hide polish alone, with a rough microtopography, and a mildly contrasting and greasy appearing polish. The surfaces of the skinning knives has just begun to roughen while the endscraper has a well developed rough surface. Numerous striations are seen on the endscraper, only a couple are seen on the knives. The endscraper has a well rounded front, and the knives have mild rounding or a little more. Occasionally, a bright line of polish appears on the edges of the knives. Although it was thought that the knives had contacted the hide very seldom, the microwear was much like that resulting from fresh hide working.

C.4. The Hafting Experiments

The following experiments are performed to test the hypothesis that the lateral microwear seen on endscrapers and burins results from hafting and not from use of these edges.

Ex-h1

An endscraper is manufactured on fine grain flint. Its non-front end is wrapped in a small piece of hide and then inserted into a partly hollowed antler section. The hide provides greater contact surfaces and softens the pressure of contact areas of the antler against the tool, thus decreasing fracturing. A 5mm wide piece of wet hide is wrapped tightly around both the antler and endscraper covering almost the entire lateral edges of the endscraper.

The tool is used for twenty minutes to scrape dry hide. The haft holds surprisingly well even with the added force one is able to apply because of better leverage and a better grip than with hand-held endscrapers. It is obvious

that it is far more "productive" in scraping the dry hide with a hafted instrument. There is also no apparent dulling of the tool. By the end of the scraping period the tool still seems quite sharp and useable.

The following day the tool is used for another 20 minute episode of scraping dry hide. The tool continues to be extremely effective, and there appears little evidence for thinking the tool is dull. In addition, the haft holds very well with almost no free motion of the tool in the haft.

The tool is again used for 20 minutes, now totaling about one hour of use from the same edge for scraping hide. By the end of this episode it is noted that the tool is significantly looser in the haft than previously; there is about 2-3mm of free movement at the front. This free movement is not enough to disrupt the use of the tool, however. The tool is now noticeably less efficient to use than previously, although with just a little more force it still scrapes quite well.

The tool is used for one more 20 minute episode. It still performs surprisingly well. It does so partly because substantial force can be applied comfortably with the use of the haft. There is now about 5mm of free movement of the endscraper front and it is thought that this is enough to impede its use.

The tool is unhafted and washed in soap and water and bathed in HCl and hydrogen peroxide.

The front of the tool microscopically shows moderate to moderately heavy rounding. The surface is matt and sometimes rough. There are numerous and varied types of striations and there are micropits. The polish is not dull, but it is slightly brighter than the original surface.

The lateral edges have many small fracture scars on the ventral and dorsal surfaces in an almost alternating pattern that also produces a somewhat sinuous appearance to the edges, microscopically. The edges have just begun to round, but it is very mild. It is heaviest nearer the front. The polish is also mild, being slightly matt in texture.

The results of this experiment indicate that when hafted an endscraper can be used for a longer period of time without needing to be retouched. It also shows that hafting can produce a very mild microwear over a use period of about an hour or more. However, there is evidence to suggest that hafting cannot produce the extreme rounding seen on some lateral edges of endscrapers.

The only possibility for hafting to produce extensive lateral rounding for the endscraper front to be retouched many times to rejuvenate the scraping edge. This is tested in the next experiment.

Ex-h2

In this experiment a similar procedure is followed as above except that when the tool becomes dull it is retouched. The tool is manufactured on fine grain flint and hafted as in the previous experiment. The tool is used for scraping dry hide for 20 minutes. The tool is slightly loose in the haft after this episode, but after sitting an hour it becomes firmer in the haft. It is thought this is because the hide strap used for the haft continued to dry and tighten. The tool is used for another ten minutes after which the tool seemed somewhat dull.

The tool's front is retouched using a small stone with a percussion technique. The retouch flakes are carefully collected for later examination. The tool is then used for thirty minutes. The tool is now somewhat loose in the haft but not so seriously as to effect the ability to use the tool. The tool is used again for thirty minutes. It is now dull and is resharpened for a second time. The retouch this time is more difficult to perform and an overhanging ridge onthe front from the step fracturing results. This interfers with the next episode of use. After ten minutes of use the experiment is stopped.

The tool is cleaned according to the previously described procedures. The tool has been used for a total of about one hour. The front has a very well developed matt microwear with substantial rounding on the higher parts of arrises not affected by the last retouch episode. The lateral edges have virtually no polish development and only a few fractures resulting from the haft.

The fractures removed from the front of the tool by retouch have a very well rounded edge located on the dorsal proximal aspect of the flakes. The matt texture and rounding is adequately represented to recognize it as resulting from dry hide scraping. This supports the suggestion by Keeley (1982) that one way to locate activity areas is to study microwear on retouch flakes and analyze their spatial distribution, rather than on studying tools which may have been hafted, curated and disposed in another location.

Ex-h3

A third endscraper is manufactured for the same proceure as outlined above. It is used on dry hide for 20 minutes when it starts to become somewhat loose. It is continued to be used for an additional 15 minutes. The tool is then retouched and used for an additional fifteen minutes. The tool seems dull soon again, probably because not all of the previous dull edge was removed in the retouch process. The tool is retouched again and used for twenty minutes. Somewhat dull, the tool is retouched a third time and used for fifteen minutes. The following day the tool is continued to be used for 30 minutes when it is

retouched and used for two more 30 minute episodes with one intervening episode of retouch.

The tool is then cleaned in the above manner. Technologically, two notches occur in the last retouch episode on the lateral sides of the front. They result from attempts to retouch the entire front but the knapping stone is not able to strike the most lateral areas of the front because the hide binding interfers with the blow.

The microscopic examination of the front indicates that the tool has a well developed matt polish with moderate rounding of the edge. The lateral edges have virtually no rounding, very few fractures and just a tiny amount of a matt polish on the surfaces. The tool is used for a total of 2 hours, 55 minutes and yet the haft has produced no appreciable microwear.

It is concluded that although microwear from hafting might be capable of developing after a long period of use of the front, there is no evidence that the substantial rounding seen on the lateral edges of archaeological examples could have been produced by the haft alone.

Ex-h4

The purpose of this experiment is to test if microwear from hafting can disrupt or confound the interpretation of a microwear which is previously produced by the use of the edge. A blade is used for shredding jute to produce a well-developed PM (plant) microwear with a mildly to moderately rounded edge (Photomicrograph 11). This requires about 90 minutes of use. The tool is then retouched to form an endscraper and is used for three thirty minute episodes. At the end of each use episode it is unbound, cleaned in the above manner, but with KOH replacing the H_2O_2, and microscopically examined.

It is not until after the last use episode of the tool that the lateral edges show modification which result from the haft. Approximately 50% of the bright P1M microwear is removed. The P1M microwear is now often interupted along the edge, and when visible it is a much narrower line of polish (Photomicrograph 25). Interestingly its removal occurs mainly at the most projecting aspects of the microtopography. Although one can still recognize that there is a bright microwear on the edge, it is difficult to recognize it as resulting from plant.

The results of this experiment suggest that microwear caused by hafting can modify previously formed microwears and therefore can cause misinterpretations of lateral edge use. Although the experiment has only been performed for microwear resulting from plant use, it is plausible to suggest that a heavily used butchering tool, for example, could have its lateral margins affected enough to suggest that the original use was hide working and not meat butchering.

APPENDIX D

ARTIFACT DESCRIPTIONS

C.1. Burins

PA SE 4a 42
B1 mix pol * T2 dist rect [S(A)pd]/+ Spd sen - Smd

The burin edge has much silica damage on the edge. The "dorsal" face has many step scars while the opposite face has none. Large striations on this face are perpendicular to the edge. The microwear is interpreted as produced by bladelet manufacture.

The lateral edge has a Y1P microwear which has characteristics of M1P and of H2P. Striations are mostly parallel to the edge. In addition there is an occasional R1U microwear. This edge is interpreted as being used mainly for butchering although it may have been only used on fresh hide.

The truncate is more typical of an endscraper (simple retouch and convex form) and appears to have the same microwear pattern (Y1P) on its edge as above. Probably fresh hide produced it (Figure D.1a).

PA SE 4a 48
B1 mix pol dist/* SEpd - Spd conv

The tool is thought to be an endscraper fragment but there is no evidence of use on that retouched edge. The burin edge has a "flattened" surface area on the "platform". There are also striations perpendicular to the edge. The edge is somewhat rounded from abrasion. Microwear patterns indicate that this is a bladelet core (Figure D.1b; Photomicrograph 20).

PA SE 4a 108
B3 norm rect/ Apd parz dex - Smmd * Smmd

The burin edge and the proximal corners of this tool have a WU microwear. The edges are moderately rounded. These edges are interpreted as used on wood.

The left lateral edge and the remains of the retouched right lateral edge have an H1P microwear. They are extremely rounded, matt and have many striations in mostly

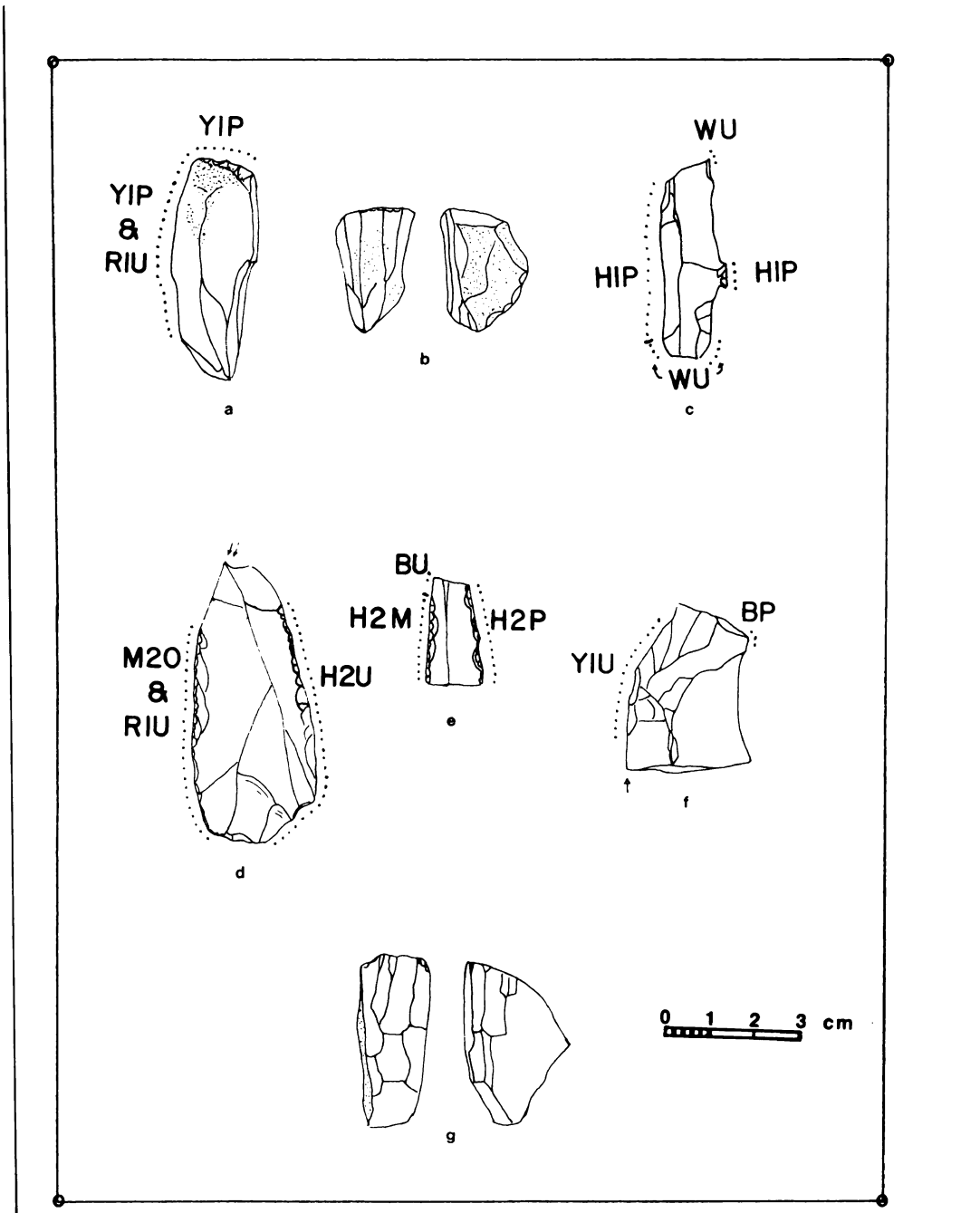


Figure D.1. Sampled burins from level 4a.

parallel directions. They are interpreted as used for hide working (Figure D.1c; Photomicrograph 21).

PA SE 4a 44
B3 norm pol dist/ Spd somm sen * Smd

The burin edge is not microscopically visible and therefore it cannot be determined if it was used. The left lateral edge has a well developed M2O microwear with some R1U microwear. The edge is mildly to moderately rounded. This edge is interpreted as having cut meat.

The opposite edge is slightly rougher with some rounding and is classified as H2U. It is interpreted as used for butchering and fresh hide working with the use of the burin edge as undeterminable. The lateral edge microwears extend along the proximal edge to near the platform. Both microwears stop distally where burin spalls end thus the spalls were removed after the development of these microwears (Figure D.1d).

PA SE 4a 61
B5 mix pol prox/--Smmi trav + Smd sen * S(P)pd

There is a bright, smooth, finely pitted polish seen on the burin facets. It appears to be a BU microwear. Faint striations are visible oblique to the edge. The microwear is hypothesized as produced by either bone or antler.

The lateral retouched edges are substantially rounded with a rough and somewhat matt microwear well developed on the edges and up the faces. Striations are parallel on the right side and mixed on the left. The microwears are H2P and H2M respectively. The lateral edges are interpreted as used for cutting (working) greasy dry hide (Figure D.1e).

PA SE 4a 46
B5 norm rect--T2-3 dist rect [Apd bip parz]/Spd sen conv

There is no microwear on the burin edge. At the proximal end of the same edge another spall fracture has no microwear. The retouched edge has a mildly developed microwear that is difficult to discern more precisely than Y1U. It probably results from butchering because of an occasional greasy appearance. The distal right corner where there is "Ap bip" retouch is a small area of BP microwear. It is interpreted as resulting from antler or bone incising (Figure D.1f).

PA SE 4a 47
B5 mix pol dist su colpo adottato

No microwear is seen on this tool. There are some areas of abrasion on the edge from a hard object (Figure D.1g).

PA SE 4a 45
B6 norm rect [T3 conc Apd dist]/+ Smma dex * Smmd parz

The burin edge has only a faint microwear that appears to be of a BU class. Most of the microwear is located on the ventral facet edge. There are some striations. It is interpreted as used on bone or antler.

The right lateral edge has a very rough, dull to bright microwear with numerous striations. It is an H2P microwear. It is interpreted as used for cutting hide. The microwear ends with the truncate and is thus probably used prior to manufacture of the burin. Some R1U microwear is also seen on this edge. Therefore it might be from meat butchering, or from bone or antler working (Figure D.2a).

PA SE 4a 43
B5 mix pol * B5 mix pol

There is much fracturing and some abrasion on these edges, of which all can be accounted for by blade production (Figure D.2b).

PA SE 4a 49
B2 mix pol dist * B5 mix pol

There is a rough abrasion along the edge. Numerous small striations occur oblique to the edge. There are many step scars. This is not a use-wear but results from bladelet production. The opposite edge is similar, but with much silicate damage. The tool is interpreted as a blade core (Figure D.2c).

PA SE 4a 160
B5(?) norm rect prox/+ Spd sin

No microwear is seen on the burin edge. Distal halves of lateral edges are well rounded with a matt and rough texture. Striations are numerous and both perpendicular and parallel to the edges. The microwear is a H2M type. It was probably used for cutting or working greasy dry

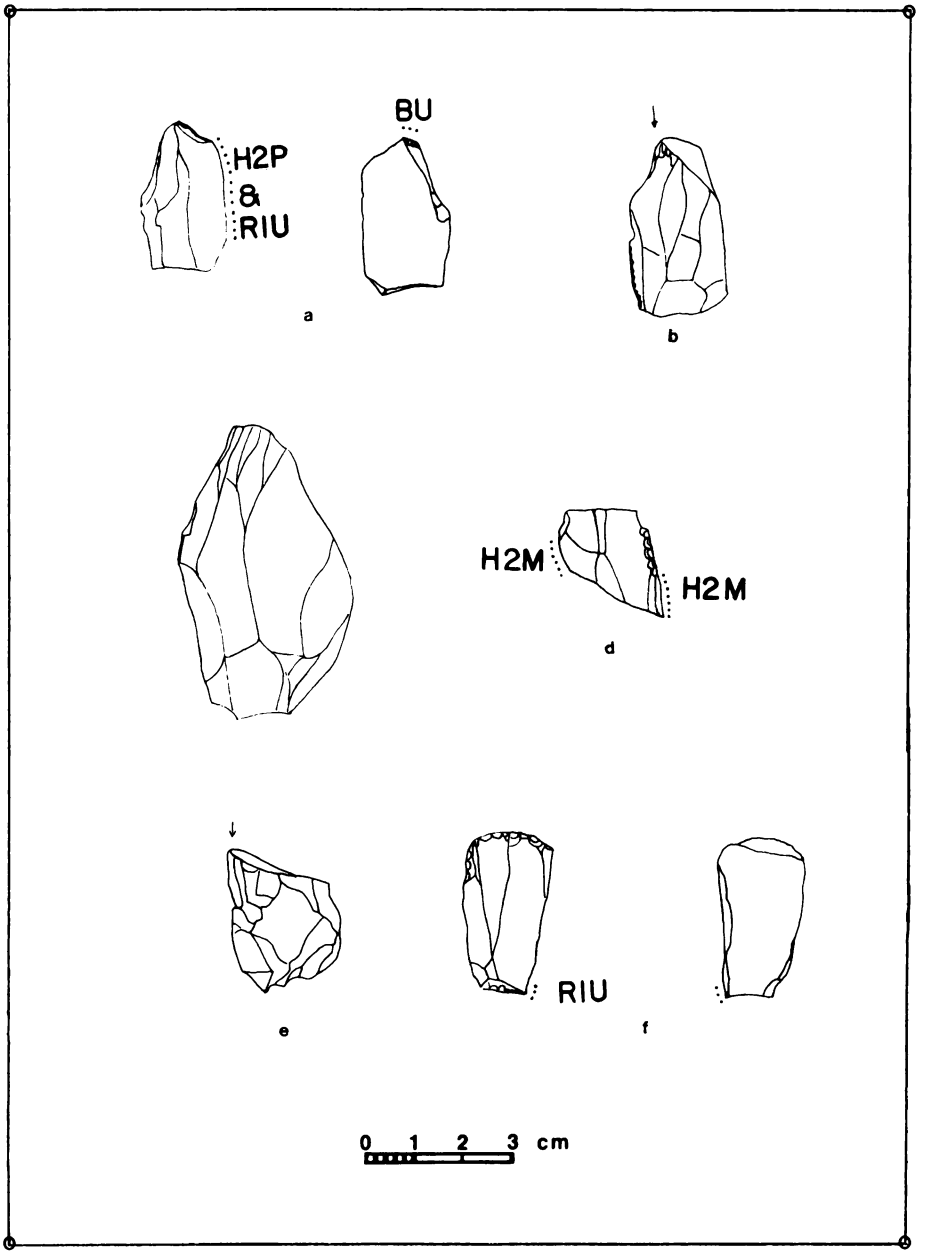


Figure D.2. Sampled burins from level 4a.

hide. No microwear appears on the retouch of the left edge. It was therefore retouched after the development of the microwear (Figure D.2d).

PA SI 4a 104
B5 mix pol dist

There is extensive abrasion on the platform face with many striations and silica damage. It is interpreted as a blade core (Figure D.2e).

PA SM 4a 319
B6 norm pol [Apd parz px] - B9 norm rect [Apd parz prox + Apd parz sen] G1 [Sp(m)d]/ Apd parz sen

The left burin face has no visible microwear. The right face has a bright microwear on the ventral facet edge near the corner. It is a R1U microwear. It is hypothesized to be produced by graving wood because of its somewhat smooth and very bright appearance (Figure D.2f).

PA SM 4a 322
B5 mix pol/ Smi parz sen

There is much silicate damage on the edge. There is no evidence of use. It is hypothesized as used for bladelet manufacturing.

PA SM 4a 330
B1 mix pol * B3 mix pol

There is no evidence of use. There is silicate damage and abrasion along the edge and striations perpendicular to the edge on the platform. It is hypothesized as a blade core.

PA SM 4a 315
B2 mix pol * B1 mix pol/ Sp

There is no evidence of use on either edge. Some abrasion and silica damage occur as above. It is hypothesized to be a blade core.

The laterally retouched margin is patenated and therefore is not visible.

PA SM 4a 318
B1 mix pol * G1?

The large platform shows the same pattern as the other burins of this type. There is no evidence of use on either edge. It is interpreted as a blade core.

PA SM 4a 326
B6 Norm rect [Apd prox] * B5? mix pol

No use is evident. A few striations related to bladelet production are seen on the platform.

C.2. Endscrapers

PA SE 4a 16
G1 prox [Apd]

The front of this endscraper has a well developed H1S microwear characterized by many striations of various types perpendicular to the edge which is substantially rounded. It is interpreted to be the result of dry hide scraping. The dorsal face of the tool overhangs the edge; a pattern I've seen when tools are retouched numerous times. The dorsal face has evidence of originally being modified by a simple mode of retouch. The abrupt retouch here is actually produced the same way as simple retouch but because of the step termination fractures it appears to be abrupt retouch.

Both lateral edges are extremely rounded and have Y1U microwears, but the material makes more precise classification of the microwear impossible. They are hypothesized as used for hide working (Figure D.3a).

PA SE 4a 11
G1 dist [Spd - Apd]/ Sma dex - Smb * Sm(mm)a

The front has a H2S microwear. Parts of the edge are well rounded, but many of the projections have a rough and greasy aspect to them. There are a few striations perpendicular to the edge. This edge is interpreted as being used for scraping greasy, fresh hide.

The right edge has a H2M microwear extensively developed. The texture is rough, but sometimes matt, and it is quite dull although less so at the proximal end. There are also some large micropits along the edge. Striations are seen in mixed directions. It is interpreted as having been used for fresh hide working.

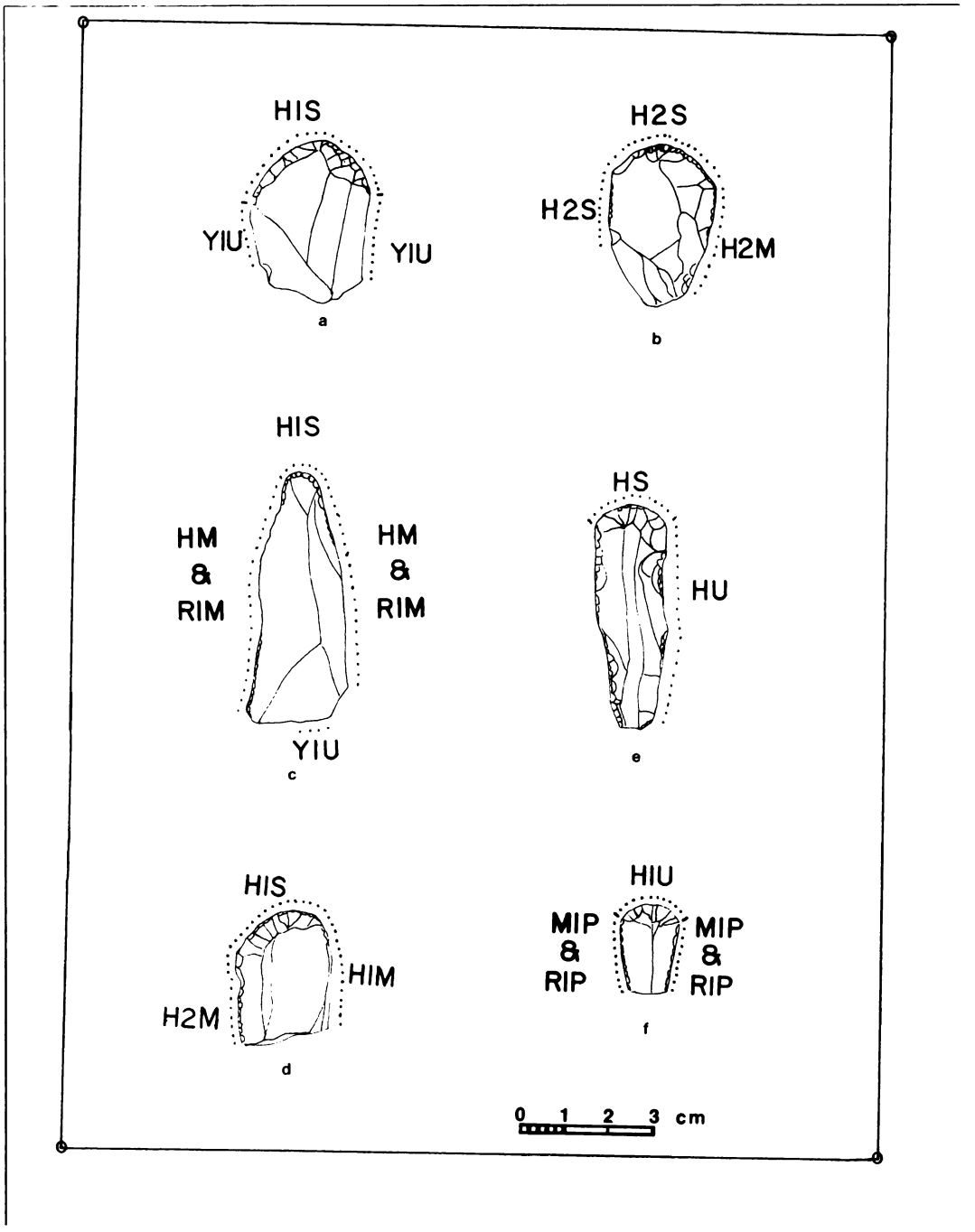


Figure D.3. Sampled endscrapers from level 4a.

The left edge has a H2S microwear on the distal half of the edge. It has both a matt and a rough texture and is somewhat bright to non-contrasting. The microwear is moderately to heavily developed. This edge is interpreted as having scraped greasy fresh hide (Figure D.3b).

PA SE 4a 20
G1 (G2) dist [S(A)pd + Spd parz dex]/ Smma - Api dex + TO parz + Smma

The front has a H1S microwear with an extremely rounded edge. Striations are frequent and perpendicular to the edge. The texture is matt and non-contrasting to the unpolished surface. Polish and abrasion extend far up the dorsal face. The edge is thought to have been used for dry hide scraping, but perhaps for depilating like the lateral edges.

The lateral edges have a HM microwear. There is substantial edge rounding and the polish is matt and dull. There are numerous striations mostly perpendicular to the edge, but also parallel and oblique. A bright R1M microwear exists along the edge on high points. It has fine striations and tiny pits. This microwear is difficult to interpret as it has characteristics of both butchering (striking bone) and of dry hide working. This could also be related to hide depilation. The right half of the proximal end also has some microwear. It is the same general pattern, but not well developed (Figure D.3c).

PA SE 4a 9
G1 prox obl [Spd]/ Smd - Smmd bilat

The front of this tool has a H1S microwear along some areas where it is extremely rounded and very little on other parts of the edge. The microwear is extremely matt and dull. There are numerous striations and they are perpendicular to the edge. The front was used for dry hide scraping. It was probably partially retouched just prior to disposal which explains the variation of the edge wear.

The right lateral edge has an H1M microwear that is well developed. Textural changes go well back from the edge. There is some pitting and the numerous striations are both parallel and perpendicular to the edge. The edge is interpreted as used for working dry hide, possibly cutting it.

The left edge has a H2M microwear varying to a M1M microwear. It is somewhat greasy. The polish extends well up the face. Striations are in various directions. It is thought to have been used for working fresh hide or for butchering (Figure D.3d).

Pa SE 4a 22
G2 prox [Spd sublam + Spd bilat]/* T2 dis conc [Apd]

The front of this endscraper has a HS microwear. It is rough and slightly brighter than the original surface. It extends fairly far back on the ventral face. The edge is sometimes bright, well-rounded and has a matt texture. Many deep wide striations occur on the edge and are perpendicular to the edge. It is interpreted as having been used for scraping hide, but I am uncertain of the condition of the hide.

The left edge is somewhat rounded but is not classifiable because of much silica damage.

The right edge has a HU microwear. It is rounded and matt, but there is also occasional greasy aspects to the edge. There are striations perpendicular and oblique to the edge. It is suggested that the edge was used for hide working but it might be from handling (Figure D.3e).

PA SE 4a 29a
G2 prox [S(P)pd + Spd dex * Smd - Smb]

There is a H1U microwear on the front. It is only spotty, and it appears that the tool was retouched just prior to discard which removed most of the worn edge. The microwear is extremely matt and non-contrasting in brightness. No striations are visible. The edge was probably used on dry hide.

The left lateral edge is complex, but it is mainly a M1P microwear. It is occasionally matt but mostly greasy. It is slightly bright and extends up the faces. There is also an R1P microwear along the edge which is somewhat spotty. It is bright and has many tiny striations which are parallel to the edge. It also has tiny pits. It is thought that the edge was used for butchering.

The right lateral edge is the same as the left edge. It is occasionally well rounded. The snapped distal end has no microwear whatsoever (Figure D.3f).

PA SE 4a 19
G2 dist obl [Spd + Sp(m)d dex]/ Smd sen - Smmd * Smd

The front of this endscraper has a mild M1P microwear that is more intense along the right distal edge. It is greasy and extends up the faces. On the immediate edge there is a bright line of R1M microwear. The microwear extends the length of the lateral edge, decreasing in intensity toward the proximal end. Striations are occasionally perpendicular to the edge. The opposite edge

has the same characteristics but less developed. The proximal left corner has some additional R1U microwear on high points. The tool is interpreted as used on fresh hide and meat or possibly as a flesher. The R1U microwear could be the result of bone. The proximal end is thought to have been hafted where the retouch begins (Figure D.4a).

PA SE 4a 17
G2 dist [Spd sublam + Spd dex * Spd - Spi enc]

The front of the endscraper has a H1S microwear. It is well rounded and has many striations perpendicular to the edge. The microwear is matt to rough in texture, and dull to no contrast in brightness. Some large pits are on the edge. Polish extends up the dorsal face. It is interpreted as used for scraping dry hide (Figure D.4b; Photomicrograph 22).

The right edge has a M2U microwear. It is extremely greasy appearing and the edge is only slightly rounded. The microwear extends up both faces. A somewhat continuous bright line, R1U microwear, appears directly on the edge. It is interpreted as having been used for cutting meat.

The left lateral edge is very similar to the right lateral edge except that it has more extensive rounding, a slightly rougher and occasionally matt texture suggesting a M1S microwear. Striations perpendicular to the edge are also seen. It is interpreted as having been used on fresh hide as well as meat (butchering). The front retouch abruptly stops the lateral microwear. The ventral retouch appears to have occurred prior to the microwear.

PA SE 4a 26
G2 dist [Ppd sublam] * T1 rect [Pmdors parz]/ Smmd bilat

The front has an HU microwear. It is very rounded, matt, and dull to non-contrasting. Much of the edge is not rounded and has a somewhat greasy appearance. The dorsal face is also affected, but there is not much rounding of the arrises. It is interpreted as used for hide scraping; uncertain if the hide's condition was dry or greasy.

The right lateral edge is very greasy in appearance and has some rounding. It is classified as a M1U microwear. There are many alternating scars. Microwear extends far back on both faces. There is some rounding of scar ridges, but there are no striations. It is thought to have been used for cutting meat and, possibly, fresh hide.

The left edge has a H2M microwear. The edge is extremely rounded and it is often matt and dull. The dorsal face is extremely greasy appearing at midsection.

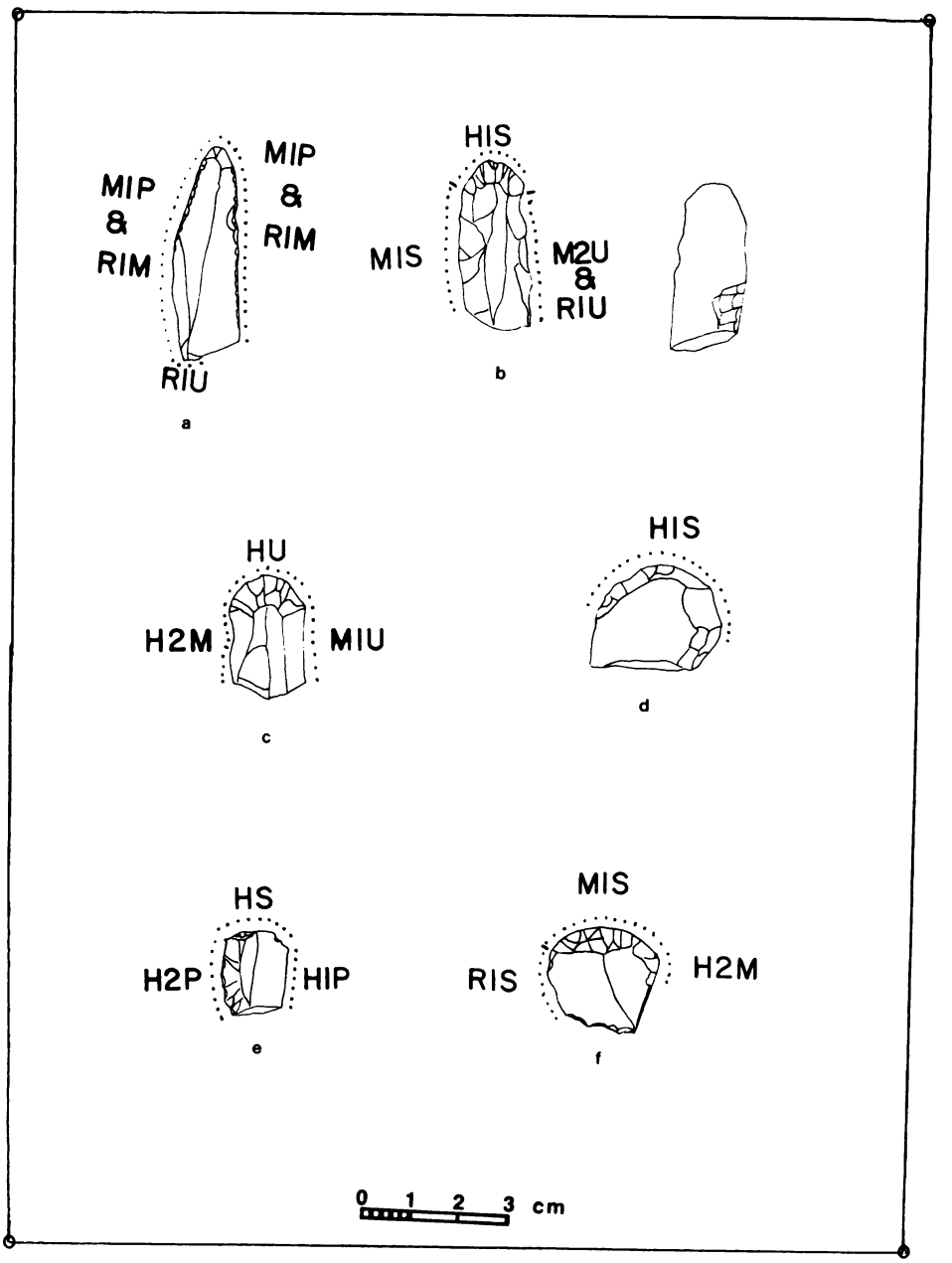


Figure D.4. Sampled endscrapers from level 4a.

It is thought to have been used on greasy hide, but it could result from use on meat and dry hide (Figure D.4c).

PA SE 4a 8
G3 dist [Ppd]/+ Smmi dex - Spi

The front of this tool has a H1S microwear. It is extremely rounded and has a matt texture. It is dull to non-contrasting except on the dorsal face where it is slightly bright and slightly greasy in appearance. Striations are perpendicular to the edge. The microwear extends along the edge and continues on to the right lateral edge as if it were a single working edge. The proximal aspects of the lateral edges have no microwear. The tool is thought to have been used for scraping dry hide (Figure D.4d).

PA SE 4a 36
G3 prox [Spd] * T1 rect [Pmi]/ S(P)md dex * Smmd

The front has a HS microwear. It is mildly rounded with a matt to rough texture which sometimes appears greasy, particularly on the dorsal face. Some arrises have more rounding than the edge, implying that it had been retouched not long before disposal. It is interpreted as having been used for scraping hide.

The right lateral edge has a H1P microwear. It is rounded, matt and dull with many of the scars oblique and striations parallel to the edge. The edge is microscopically saw-toothed with the teeth well rounded. It is thought to have been used for cutting dry hide.

The left edge has a H2P microwear. It is extremely greasy looking with some rounding. There are many scars and few striations. It has a rough and sometimes matt appearance. Polish extends onto ventral and dorsal faces, and it is fairly bright. It is thought to have been used for cutting fresh hide (Figure D.4e).

PA SE 4a 24
G3 prox [S(P)pd]/ Spd sen parz * Smmd

The front has a M1S microwear. There is some rounding and numerous scars on the dorsal face. The polish is greasy in appearance with a rough microtopography. There are a few striations perpendicular to the edge. It is interpreted as used on fresh hide.

The left edge has a distinct R1M microwear that appears to be the result of working antler or bone, but the microwear could also have been produced by a haft.

The right lateral edge has a H2M microwear. It has alternating fractures, a rounded edge and a bright, rough and greasy polish. Striations are parallel and perpendicular to the edge. This edge is interpreted as being used for fresh hide working; probably cutting hide (Figure D.4f).

PA SE 4a 31
G3 dist obl [S(P)pd]/ Smd dex

The front of this endscraper has a M1S microwear. There is mild rounding, but the microwear is well developed. It has no contrast to the original surface, and it is rough and greasy in appearance. There are a few striations perpendicular to the edge. The microwear does not extend far on the ventral face, but does so on the dorsal face. There are also many step scars on the dorsal face. It is thought it was used for scraping fresh hide.

The right lateral edge has a H2M microwear. There are numerous oblique fractures on the ventral face. There is extreme rounding on the dorsal face. The polish is rough and sometimes matt, but shows little contrast. There is a greasy aspect to this edge also. It is thought that this edge was used for cutting and working fresh hide (Figure D.5a; Photomicrograph 24).

PA SE 4a 30
G3 dist obl [Spd] * T1 conv [Pmdors parz]/ Smd parz dex * Smmd

The front of this endscraper has a HS microwear. The front is extremely rounded with numerous perpendicular striations. The polish is matt and without contrast. It has a slightly greasy appearance on the dorsal face. The microwear extends around to the left edge as well. The edge is interpreted as having been used for scraping hide. The condition of the hide is uncertain.

The left lateral edge has a HP microwear. Scars are generally oblique to the edge. The edge is moderately rounded with a rough to matt texture. It is thought to have been used for cutting hide (Figure D.5b).

PA SE 4a 5
G6 dist [Spd parz] * T2 conv [Spd parz]/ Smmd bilat

Only the right part of the front has a M1M microwear and this extends along the entire right side and is the same as the left lateral edge. The edge is well rounded, bright and rough. There are many striations in mixed

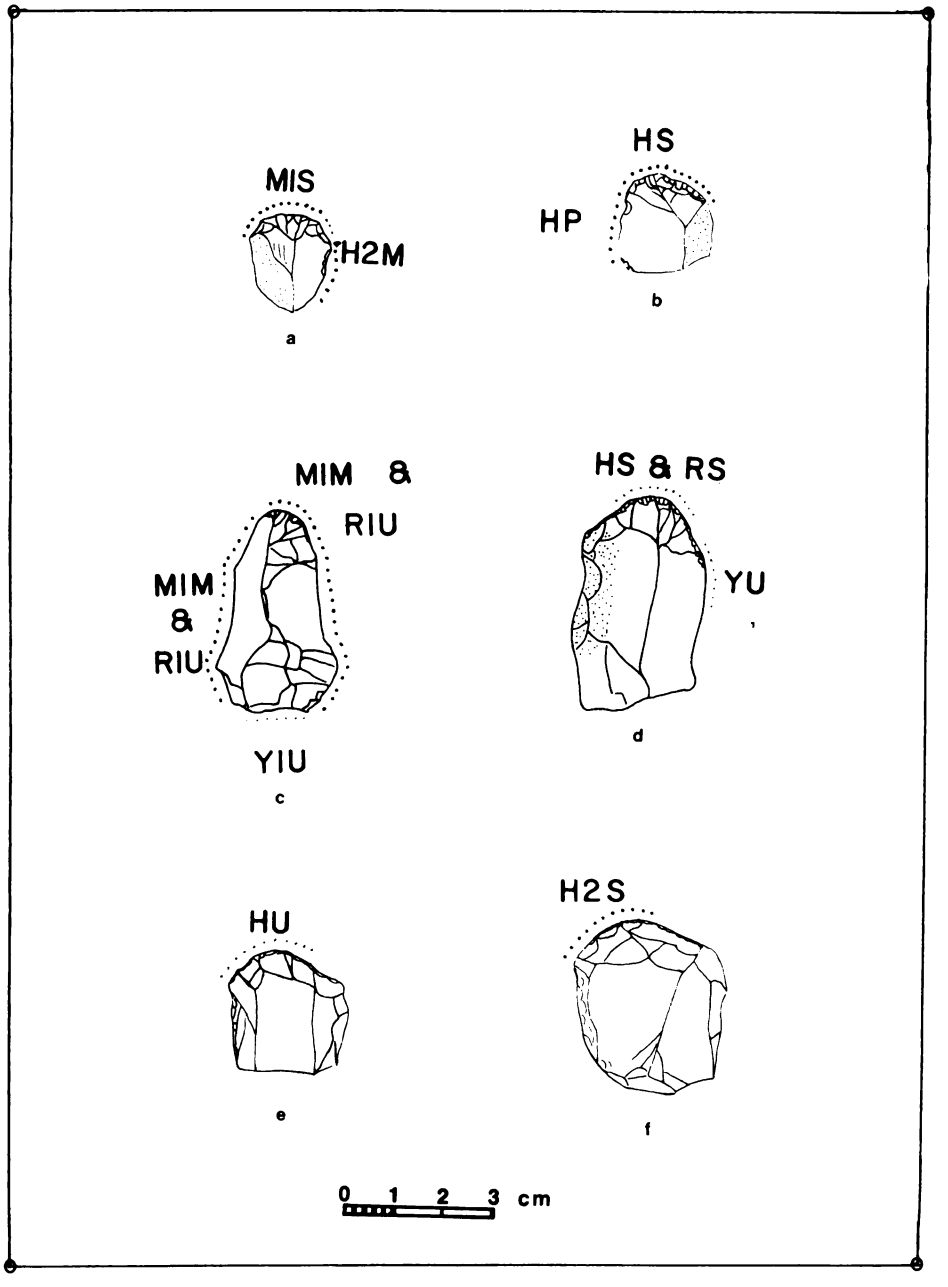


Figure D.5. Sampled endscrapers from level 4a.

directions. The polish varies between a matt and a greasy texture. A bright smooth R1U microwear appears on the edge. The edge is thought to have been used for cutting meat or working fresh hide. The smooth polish seen on the opposite edge appears to have been produced by silicate damage.

The truncated end has a faint microwear that appears to be of the Y1U group but it cannot be discerned further. It may not be a working edge (Figure D.5c).

PA SE 4a 18
G7 dist [Spd sublam] TO sect [Smmd]/ Smmd bilat

The front of this tool has a HS microwear and a small amount of an RS microwear. The polish is typically rough and it is moderately rounded. Projections tend to have a bright smooth microwear with some tiny pitting. This is interpreted as resulting from the scraping of greasy hide. It must be noted that in experiments an R1-like microwear is often produced on the edge, especially in the early stages of the use of an end scraper. It is recognized that it is auto-abrasion; microwear produced by fine fragments of flint that were removed from the edge and caught in the hide. It seems to occur most often when the same area of a hide is worked fairly intensely.

The right lateral edge has a faint YU microwear. It is thought that this might result from handiling or hafting. The left edge is cortex (Figure D.5d).

PA SE 4a 27
G7 dist dej [Spd - Apd]/ Spd bilat

The front of this endscraper has a HU microwear. It is not developed directly on the edge and there is little rounding. However, the dorsal face has well-developed microwear that is rough and slightly greasy. It is interpreted as having been used for scraping hide. It was retouched just prior to disposal thus removing the microwear that had formed directly on the edge.

The lateral edges have a faint microwear which is not adequately developed to allow classification. It probably results from hafting or handling (Figure D.5e).

PA SE 4a 14
G4 dist obl [Spd + Apd dex - Spd parz * Spd]

The microwear, a H2S type, is found only on the left side of the front. The edge is mildly rounded, the microwear is non-contrasting and sometimes greasy looking.

It was probably used for scraping fresh or greasy hide. The right side of the front appears to have been retouched after the use of the edge whereas the left side was not (Figure D.5f).

PA SE 4a 13
G9 prox [Spd]/ SEpd sen * Smd parz

The front has a M1S microwear. The polish extends up the dorsal face and there is little rounding of the edge. Striations are perpendicular to the edge. It is interpreted as having been used for scraping fresh hide.

The left lateral edge has a M2U microwear. It is extremely greasy in appearance and also goes far up the face. There is only mild rounding of the edge. The edge is interpreted as used for meat cutting.

The right edge is similar except there is a bright line of R1U microwear along the edge. This edge is also interpreted as having been used on meat, possibly striking bone as well (Figure D.6a).

PA SI 4a 106
G1-3 (G7) dist dej [Spd - S(A)pd]/ Smi dent dex * Smmd

The front has an H1S microwear. The polish is matt. Wide, shallow striations are perpendicular to the edge. It is interpreted as having been used for dry hide scraping.

The left and right margins have an HS microwear. The edges are well rounded, more so than the front. The texture is usually matt, but sometimes it is greasy and rough. Striations are perpendicular to the edge. The ventral face usually appears matt while the dorsal face usually appears greasy and rough. These edges are interpreted as having been used for scraping hide, but the condition of the hide is uncertain. The proximal ends of both lateral edges have no microwear (Figure D.6b).

PA SI 4a 105
G7 dist dej [Spd]/ Sma dex * Spa parz - Smmd

The front of this tool has no microwear on it, there is no evidence of use.

The right lateral margin has a HP microwear. The edge is slightly rounded. Striations are parallel to the edge. It is interpreted as having been used for cutting hide (Figure D.6c).

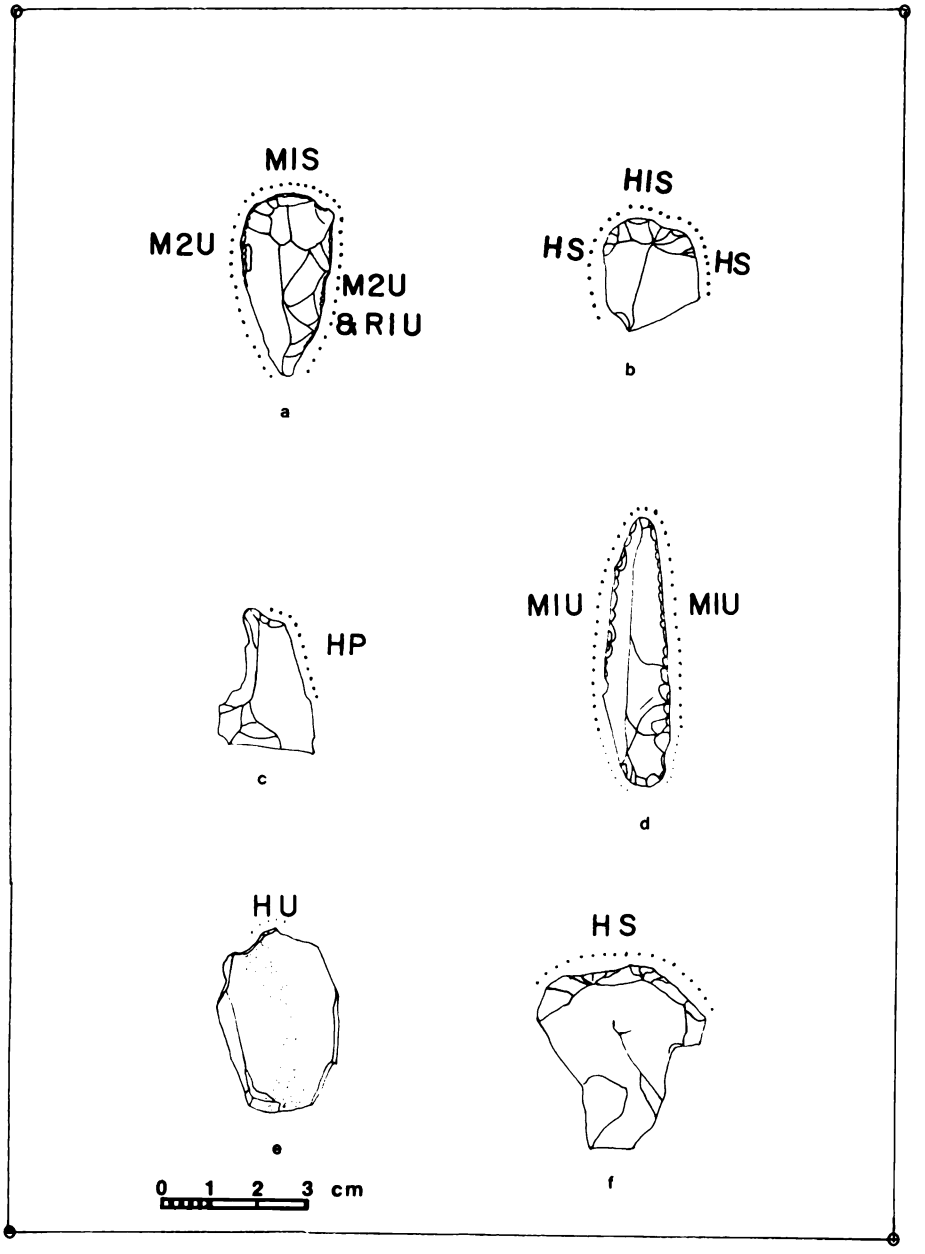


Figure D.6. Sampled endscrapers from level 4a.

Pa SM 4a 334
G6 dist [Spd]/+ Spd dex - Ppd * Spd - Smd

The front of this endscraper has a M1U microwear, but it is thought to be just the extension of the working lateral edges. The polish is rough and greasy, and the edge has moderate rounding.

The left and right lateral edges have an M1U microwear. The edges, where not last retouched, are well rounded. The microwear is occasionally matt, but more often it is somewhat bright and extremely greasy in appearance. The proximal 12mm of the edge has less extensive microwear, but not substantially less. The tool is thought to have been used on fresh hide or meat, perhaps as a flesher. The polish is sometimes not much different from SM 337, a tool thought to be used for depilatng hide (Figure D.6d).

PA SM 4a 341
G7 dist [Apd]/ Smmd parz sen

The front of this tool has a very minute amount of microwear. It appears to be HU. The microwear is not well enough developed to allow for an interpretation beyond hide working (Figure D.6e).

PA SM 4a 327
G3 (G7) dist [Spd sublam]/+ Smmd sen * Smmd parz dex prox

The front of this tool has an HS microwear. It is mildly to moderately rounded with the medial part of the edge having the most wear. The material makes the microwear difficult to characterize, but it was certainly caused by hide although I am uncertain if it was fresh or dry hide.

The lateral edges are scarred and occasionally rounded, but nothing consistent or recognizable can be seen. Again the material does not allow for easy viewing. The microwear may result from handling or hafting (Figure D.6f).

PA SM 4a 342
G3 dist obl [Spd sublam]/ Smmd parz bilat

The front has an HS microwear. It is mildly to moderately rounded. Polish extends well up the face but only mildly rounds the arrises. The ventral face is also little affected. There are few striations and no pits. It is interpreted as having been used for scraping hide.

The right lateral edge has a HU microwear as does the left lateral edge. The right edge has much fracturing and mild rounding. The left edge is slightly more rounded and less fractured. It is substantially rounded at the proximal corner. The left edge is also steeper than the right edge. The microwear was probably produced by hide but I am uncertain how or the condition of the hide (Figure D.7a).

PA SM 4a 335
G3 dist [Spd sublam]/ Smma bilat

The front has a H2S microwear. It is moderately rounded and contains numerous fractures. The microwear is rough and greasy appearing. It is slightly bright. An occasional matt texture appears on projections. Striations are perpendicular to the edge. It is thought to have been caused by greasy hide scraping.

The lateral edges have substantial fracturing, but there is neither a directional tendency nor is there a classifiable microwear. It could be the result of hafting or holding. Microwear extends along the entire edge and the dorsal ridges also show some rounding (Figure D.7b).

PA SM 4a 339
G3 dist dej [Spd - Apd]/ Smd dex -- Spi enc

The front has a HS microwear. It is well rounded on the projections and quite matt. The right side is more rounded but has a greasier and rougher texture than the left side. It is thought to have been used on hide; uncertain if dry or greasy (Figure D.7c).

PA SM 4a 337
G2 (G6) prox [Spd + Apd - Spd sublam * Spd parz prox]/ Smmd dex + Smmi dist - Apd parz

All edges of this tool are extremely well rounded. There are many striations in all directions, but most are perpendicular to the edge. The microwear is fairly bright, but there are numerous pits similar to that found with H1 microwears. The polish is generally matt or rough, but along the edge there appears a bright smooth polish, a R1 that is somewhat similar to W class microwear. I was unable to interpret the cause or causes that led to the production of these microwears. Keeley (personal communication) has suggested that it might be from

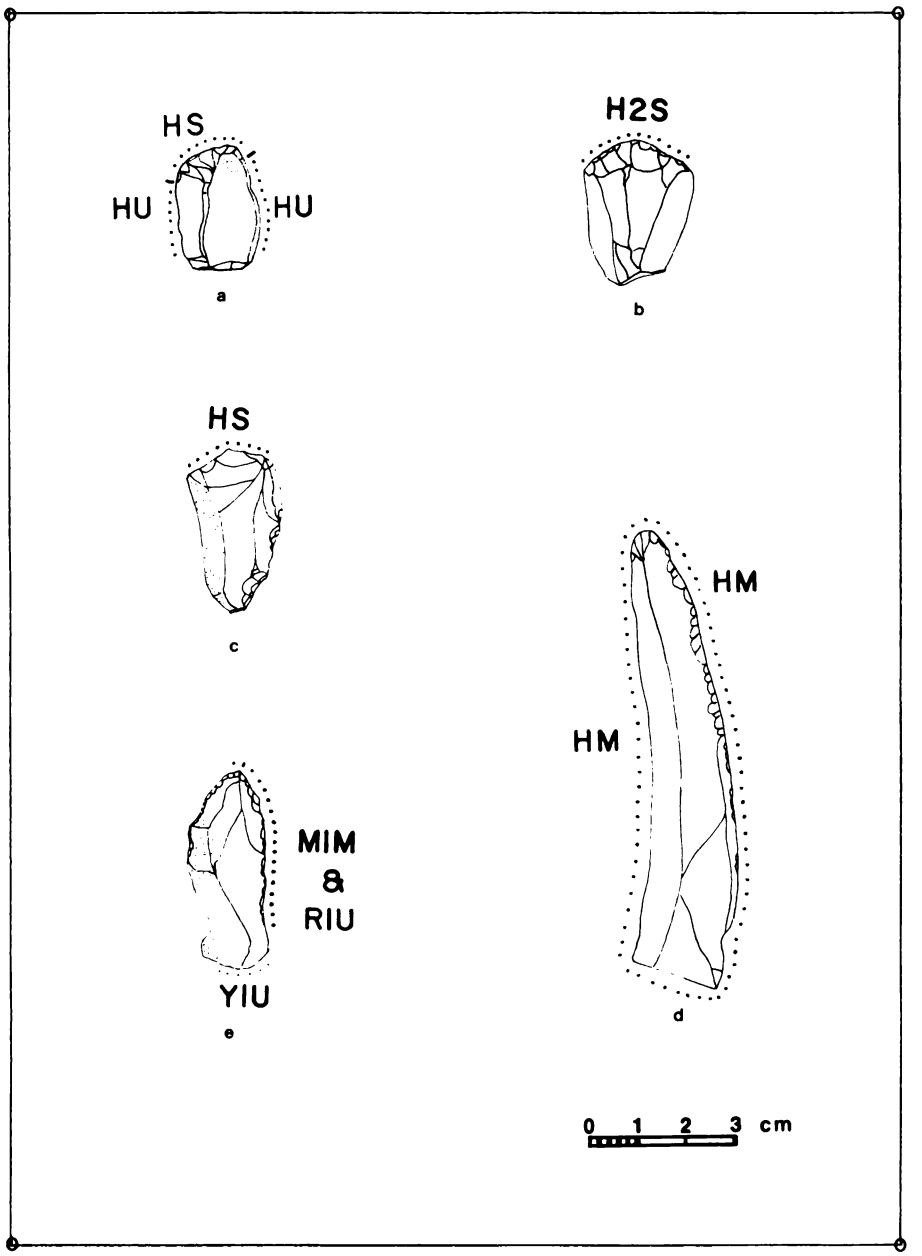


Figure D.7. Sampled endscrapers from level 4a.

depilating hide. This will require testing. Again all edges show this microwear thus it could also be from some natural cause (Figure D.7d).

PA SM 4a 349
G6 prox [S(A)pd sublam] * T2 conv [S(A)pi parz]/+ Smd sen

The front of this tool is not the working edge but a continuation of the right lateral edge. This edge has a M1M microwear. The polish is rough and greasy and is very intense until about 5mm from the proximal end. The edge is well rounded and has striations perpendicular to the edge. There is also an R1 microwear on the projections of the edge. The tool is thought to have been used on fresh hide; possibly for fleshing.

The truncated edge has some mild rounding, but it cannot be classified better than Y1U. No interpretation is possible (Figure D.7e).

PA SM 4a 343
G3 dist [Spd cont (dent) sublam]/ Am(p)d parz dex - Amd * Smd - Smma

The front of this tool has a H1S microwear. It is well rounded and has a matt texture although it is somewhat bright. It is thought to have been used for scraping dry hide.

The left lateral margin has a HM microwear. It has many fractures in multiple directions. The proximal end is moderately rounded while the remainder of the edge is only mildly rounded. The polish is bright but not well developed. This edge appears to have been used for working hide; its condition being unclear (Figure D.8a).

PA SM 4a 331
G2 dist [Spd + Spd parz sen]/ Sm(mm)a parz dex

The front of this tool has a H2S microwear. It is mildly to moderately rounded. The polish is slightly matt, but not dull. The ridges on the dorsal face are very rounded. There is much edge fracturing, but there are few striations and no pits. The polish is often greasy appearing. This edge was probably used on greasy hide.

The right lateral edge has a H2M microwear. It has much fracturing on the ventral face which is often oblique in both directions. It ends 10mm from the proximal end of the tool. The retouch of the front continues along the lateral edge. Here the edge is only mildly damaged. Just beyond the retouched area substantial fracturing begins.

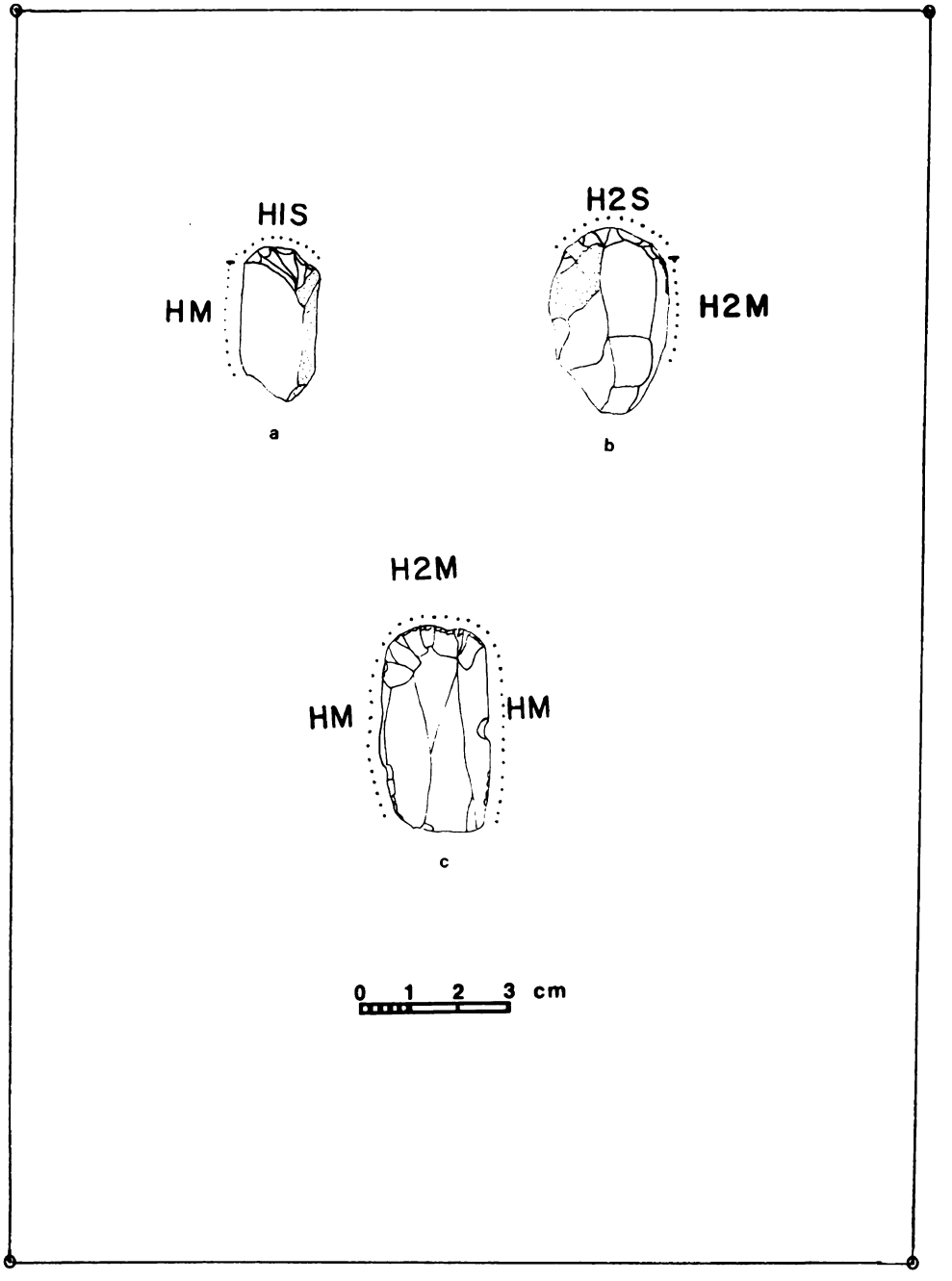


Figure D.8. Sampled endscrapers from level 4a.

It is hypothesized that the lateral edge of this tool was used prior to the manufacture of the front and that either the polish and fracturing occurred less on the retouched edge or the retouch removed some fracturing midway through use. The edge was used either for the scraping or cutting of fresh hide (Figure D.8b).

PA SE 4a 1
G1 dist [Spd lam]/Smma dex * Smmd

The front of the tool has a H2M microwear with a slightly matt to a rough texture. The polish on the ventral face has a slightly greasy appearance and is non-contrasting to slightly bright relative to the unworn surface. There are many fine, shallow striations on the ventral face that are parallel to the edge. The dorsal face has an extremely greasy appearance to it. The concavity in the center of the edge has little wear. This edge appears to have been used for working greasy hides, but much of the microwear is hypothesized to result from the front being an extension of the use of the corners and lateral edges of this tool.

The two lateral edges have an HM microwear which is matt, but non-contrasting. The edges are extremely rounded and have oblique striations and fractures. Many well rounded fracture scars are seen on the ventral face. These edges appear to have been used for hide working (Figure D.8c).

C.3. Truncates

PA SE 4a 56
T3 [Apd]

The truncated end has no microwear except near the corners suggesting that this edge was not used, but instead the microwear resulted from lateral edge use and the truncate was made prior to the use of these edges. The left lateral edge has a M1M microwear. It is greasy, rough and somewhat bright. The edge is mildly to moderately rounded. The edge is interpreted as used for meat butchering. The right lateral edge has a H2M microwear. It is more matt than greasy and the rounding of the edge is more intense. There are numerous striations; broad and deep and also linear depressions near the distal end. This edge is interpreted as used for working fresh hide (Figure D.9a; Photomicrograph 23).

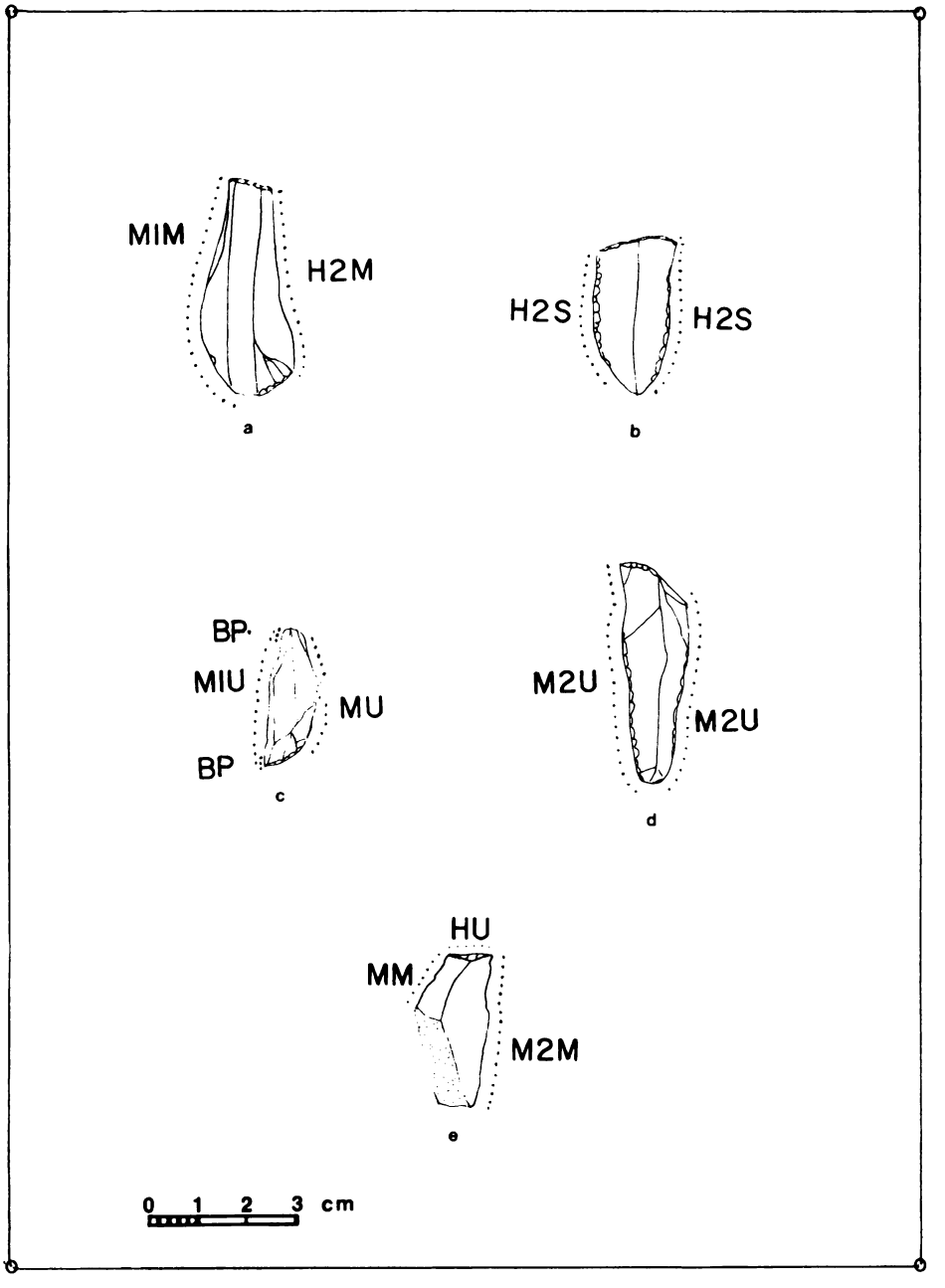


Figure D.9. Sampled truncates from level 4a.

PA SE 4a 57
T0 [Ammd]/+ Smd bilat

The truncated distal end has no microwear except for a small amount on the right side which is probably associated with the use of the right lateral edge. The right and left lateral edges have a H2S microwear which is most intense at the convex part of each edge. The striations vary in type, and are perpendicular and oblique to the edge. It is interpreted as used for fresh hide scraping (Figure D.9b).

PA SE 4a 63
T3 prox rect [Apd]

The proximal truncated edge has no microwear. The right lateral edge has a MU microwear. There are numerous fractures but very little rounding of the edge. It is hypothesized to have been used for cutting meat. The left lateral edge, in general, has a heavily developed M1U microwear. The texture is very rough, non-contrasting and very greasy looking. It is interpreted as used for cutting meat. The distal and proximal ends of this lateral edge have a bright rough microwear on the projecting surfaces. There are numerous fine striations and tiny pits. This is a BP microwear. The M1U microwear is also visible in these areas. The BP microwear is thought to have been produced by bone, either by graving or during the cutting of meat off of bone. These corner microwears are found on the scars of spall fractures, thus the use of meat occurred after the production of the spalls (Figure D.9c).

PA SI 4a 108
T3 dist rect [Apd]/ Smd cont (dent) dex * Smd sin

No microwear is seen on the distal truncated end. There is an intensive M2U microwear on both lateral edges. It is greasy and somewhat rough in appearance. There is also some edge rounding. It is hypothesized to have been used for meat cutting (Figure D.9d).

PA SI 4a 109
T2 dist sin [Apd]/+ Sm(mm)b sen * Sm(mm)a - Pmi prox

The distal truncated end has a mild HU microwear. There is some rounding of the edge especially on the projections. It is suspected that the microwear is not from use, but from handling. The right lateral edge has a well developed M2M microwear. It is very greasy

appearing. The left edge has a mild MM microwear that is visible on the non-cortex aspect of the edge. Both edges are hypothesized to have been used for meat cutting (Figure D.9e).

PA SE 4a 113
T0 dist rect [Ammi]/ Pmd parz bilat

The truncated distal edge appears slightly matt along the edge and greasy on the dorsal face. The edge is substantially rounded, but there are no visible striations. This suggests a HU microwear. It could have been produced from use with a scraping motion, from the holding of the tool, or from the use of the lateral edges since the microwear is more developed near the corners.

The right lateral edge has an intense M1M microwear on its distal third of the edge. There is much rounding and a few striations. The ventral face also has substantial microwear. The microwear is hypothesized to result from meat butchering although it may result from the working of fresh hide.

The left lateral edge has a mild M2U microwear except for substantial edge fracturing mainly on the ventral face. It is hypothesized to have been used for meat cutting. The proximal end has some impact fractures and no polish (UI microwear). It is hypothesized to be associated with hafting (Figure D.10a).

PA SM 4a 356
T3 dist sin [S(A)pd parz]/+ Smmd parz sen

The truncated end has no microwear. The left lateral edge has a well developed M2U microwear. It is rough and greasy in appearance and the edges are only mildly rounded. There is a bright microwear on the edge itself but its characteristics cannot be discerned. The fractures are small. It is hypothesized that the edge was used for cutting meat (Figure D.10b; Photomicrographs 34 and 35).

PA SM 4a 360
T2 (T3) prox conv [Apd]/+ Amd sen - Smmd

The proximal truncated edge has a mild Y1U microwear. It is thought to be from handling. The left lateral edge has much silicate damage which inhibits classification of any microwear. The right lateral edge is mildly rounded and has a well developed M1U microwear. The edge is much

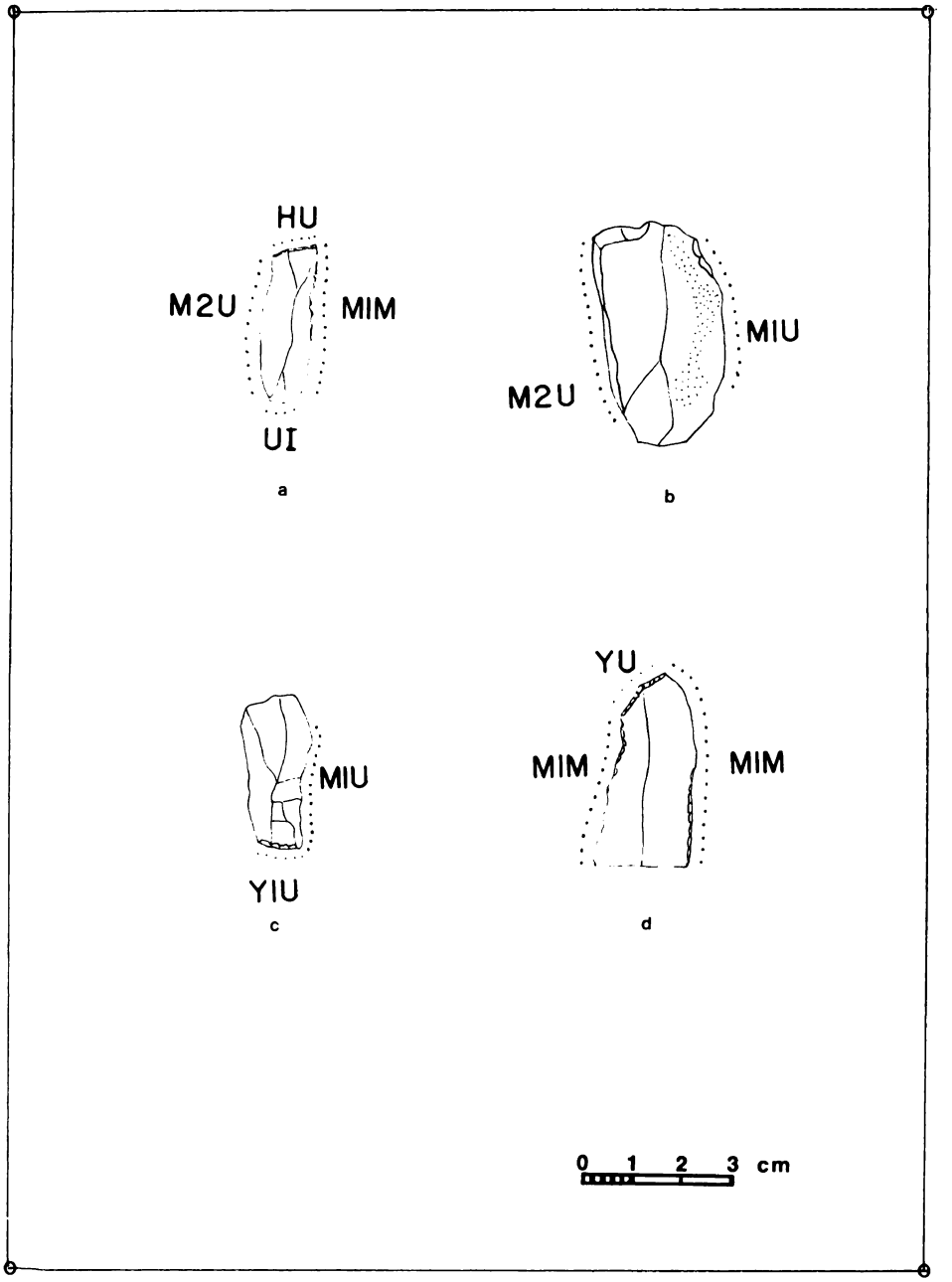


Figure D.10. Sampled truncates from level 4a.

fractured. It is hypothesized to have been used for meat butchering (Figure D.10c).

PA SM 4a 384
T3 dist sin [Apd dent]/ Emi dist - Sma dext - Smmi prox * Smd - Smmi prox

The truncated distal end has a faint YU microwear. It is hypothesized to result from handling. The right and left lateral edges have a M1M microwear. There is mild to moderate rounding, a rough microtopography and a greasy textural appearance. It is more like a H2M microwear toward the proximal ends. Striations are perpendicular and parallel to the edge. The tool is thought to have been used for fresh hide processing such as fleshing, but it may have been used for butchering (Figure D.10d). Note: this tool, with ventral, almost denticulate, lateral retouch, is technologically very similar to two sidescrapers, SE 73 and SE 76.

C.4. Becs

PA SE 4a 71
Bc1 dist [Apd trav conc + Sp(m)d sen]/ Smma sen * Smi - Smma - Sma

The projection has a matt, sometimes slightly greasy microwear which is not dull but is non-contrasting. It effects low and high microtopography and up the face. There are shallow linear depressions parallel to the edge. Edge fractures are oblique and also occur on the distal aspect. Striations on the distal aspect of the projection are multidirectional. On the ventral face there are areas with a BM microwear; bright with many fine, parallel-track striations; again, multidirectional relative to the edge. Although there is some evidence that the projection was used for drilling it is hypothesized to be an extension of the lateral edges.

The left lateral edge, with M1M and BM microwear, is mildly rounded with many bending fractures, although other fracture types are apparent. The BM micorwear is bright and rough and located along the entire midsection of the blade on protruding microtopographic features. Occasional striations are apparent, mainly narrow and deep, and are multidirectional. Along the edge, and the face near the edge, the greasy appearing M1M microwear is apparent. The proximal end of the left edge has a well developed WP microwear as well as a matt and rough microwear. The striations are deep and narrow and parallel to the edge. The microwear is smooth with small pits. The microwear on

the ventral aspect of the edge has a doming effect. This edge is hypothesized to have been used for butchering. The proximal end may have been working wood or results from hafting.

The right lateral edge is very similar with M1P and RP microwears slightly less developed than seen on the left edge. The proximal end also has substantially bright microwear which is classified as RU (Figure D.11a).

PA SE 4a 74
Bc1 (?) prox [Apd trav + S(P)pd]

The retouched part of the lateral edge has a well developed M2U microwear in combination with a BU microwear. The first is rough, greasy and non-contrasting. All microtopographic elevations are affected and the microwear goes well up the face. The edge shows only mild rounding. There are many scars with step terminations on the dorsal face. They are perpendicular to the edge and overlap in a micro-scalarform manner. The BU microwear is bright and is found discontinuously along the edge. The microwear is most intense on the retouched portion of the edge. Some microwear extends onto the unretouched part of the edge, however it is not nearly as intense and it is difficult to identify. The proximal end also has some BU microwear, but no evidence of any other associated microwear. The tool is hypothesized to have been used for meat butchering. Substantial contact with bone is indicated, perhaps resulting from jointing (Figure D.11b).

PA SE 4a 75
Bc1 dist [Spi +Apd sen]/ Smmi sen * Smma

The microwear on the left lateral edge of this tool appears to be a W1M microwear. It is very bright and smooth with some pitting near the edge and on the faces near the edge. There is also a doming effect to the microwear. There are many striations, mostly perpendicular to the edge, but also some parallel and oblique ones. The rounding is moderate or greater. There are numerous step scars, sometimes found oblique to the edge. On the ventral face there are many bending scars with feather terminations. It is thought to have been used for whittling soft wood or perhaps working fibrous plant. The distal aspect of the projection has a W1U microwear although not nearly as intensely developed as found on the microwear on the lateral edge. This microwear occurs only on the projection, and does not extend onto other parts of the distal edge. No directional evidence is noted. The right

lateral edge has some WU microwear which cannot be clearly discerned because of material quality (Figure D.11c).

PA SE 4a 77
Bc2 prox [Pd3d * PD3d]/ Smd sen

The lateral edges that form the projection have a H1S microwear. The heavily rounded edges are rough and occasionally matt and dull. Striations are perpendicular to the edge and are deep and broad. The microwear appears to result from perforating hide. There is also some bright microwear occurring along these edges and it is suspected to be auto-abrasion. The microwear on the left edge extends 7mm from the point. The right lateral edge, which is retouched, has a small amount of HU microwear. It is hypothesized that this is not from use, but from hafting or handling the tool during use (Figure D.12a).

PA SE 4a 72
Bc1 prox [Apd trav + Smd dex]/ Smma parz dex

The lateral edge that forms the point of the bec has a W1M microwear. It is very bright and smooth and has a doming effect. There are a few striations parallel and perpendicular to the edge and a few medium size (comet shaped?) pits. Fractures are predominantly on the dorsal face and are usually of the bending initiation type. The point has a well developed microwear extending 3.5mm from the tip. Edge fracturing continues an additional 2.5mm. The point is hypothesized to have been used for drilling wood, but the lack of good evidence on the truncated end makes it less certain. The remainder of the lateral edge has a W1M microwear extending along its entire length. It is moderately developed and has similar polish characteristics as that outlined above. It is hypothesized to have been used for whittling wood (Photomicrograph 26). The truncated edge has a minute amount of W0 microwear along its edge, but surprisingly, none is seen near the point (Figure D.12b).

PA SE 4a 79
Bc1 (?) dist [Apd conc * Sma dex] *
T0 prox conc [Smb = Epi]/ Smma sen

Both lateral edges have a Y1M microwear along most of their length. The microwear tends to be rough, somewhat bright and the edges are substantially rounded. Striations are perpendicular and parallel to the edge. The microwear is well distributed on all levels of the microtopography.

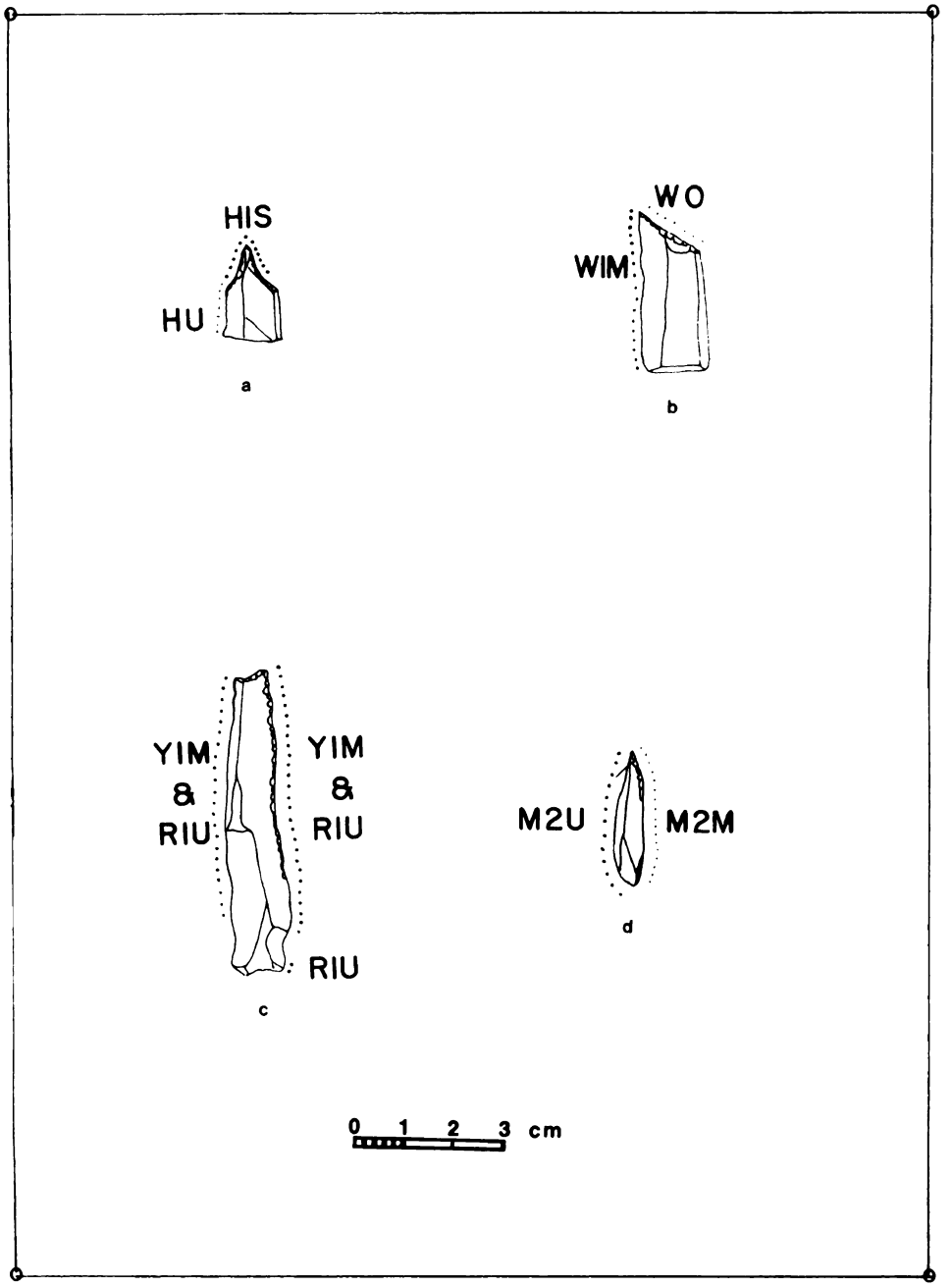


Figure D.12. Sampled becs from level 4a.

There is also a brighter R1U microwear located along the edge as well. The retouch arrises are well rounded, and the original surface not removed by retouch has much more microwear development than the retouched surface. This suggests the retouch occurred between at least two use episodes. At the proximal end of the lateral edges there is very little microwear except on the protrusion on the right proximal corner which has a R1U microwear. The tool is thought to have been used for butchering and the proximal end was hafted. The tool compares very well with SE 71 (Figure D.12c).

PA SE 4a 298
Bc1 prox [Apd dex + Spa sen parz]/ Smd parz dex dist * Smmd parz

The right lateral edge has a mildly developed M2M microwear which is greasy and slightly bright in appearance. It also extends up the face. There are very tiny fractures scattered along the edge with most being oblique to the edge. It is hypothesized to have been used for meat cutting. The left edge has a well developed M2U microwear especially where retouch did not remove the original edge. It appears well up the face. There is much edge damage on both faces including bending and conic initiations and feather terminations. The edge is mildly rounded. This edge is hypothesized to have been used for meat cutting. There is no evidence for rotational use of the point (Figure D.12d).

C.5. Backed Points

PA Se 4a 235
PD4 doppia dext react [Apd]/* Spd dist - Smmb - Spi prox

The distal and medial localizations of the left edge have a well-developed M2U microwear. The polish is greasy, slightly rough and slightly bright. The edge is mild to well-rounded. There are many tiny scars oblique to the edge and with feather terminations. Occasional hard polish (R1O) is seen along the edge with associated oblique-mixed directions striations (Photomicrograph 27).

Along the proximal end of this edge for 9.6mm from the end, noted in a second series of observations, there is a Y1U microwear, which is much more matt in texture and very dull relative to the rest of the edge. Rounding is mild to moderate.

The backed edge appears to have a very faint YU microwear, but it is too faint to be certain. The dorsal ridges show no rounding from the proximal to distal ends.

The tool is thought to have been used for cutting meat with the left lateral edge. The proximal end was hafted; possibly bound with dry hide. The cutting edge is maintained along the entire left lateral edge. The retouch at the distal end was performed prior to use and which converges with the right edge to produce a strengthened point. Medial fractures show differential wear, probably a result of fracturing during use. Ventral retouch thins the bulbar surface. The backed edge shows inadequate evidence for use (Figure D.13a).

PA SE 4a 236
PD4 dop sen rect [Ap bip * Apd sublam -
Ap bip sublam dist]/ Ppi bilat prox - Smd dext

The right lateral edge has a mildly developed M2P microwear, but with no microwear at the proximal end and little at the distal end. Striations are found near the distal end and are parallel to the edge. There is a small fracture, possibly an impact fracture, at the point which occurred after the retouch.

Edge fractures occur on the ventral face 9.4 to 12.1mm from the proximal end. Flat retouch begins at 9.0mm. There is a mild but distinct change of the microwear at the edge between medial and proximal parts. Some deep fractures also occur on the flat retouched part of the edge. Some R1S microwear occurs on the backed edge. There are, in addition, associated striations perpendicular to the edge. It is suspected that this is related to the manufacture of the backed edge.

The mild polish, the small impact fracture and parallel striations suggest that the tool was used as a projectile point. It was probably end hafted as evident by the distinct change in microwear. The flat retouch appears to have been performed to remove the bulb on the ventral face. This was the hafted end (Figure D.13b).

PA SE 4a 237
PD2 prox sen [Apd]/* Spi prox on burin spall

This retouched burin spall has a moderately well developed MM microwear. The microtopography appears somewhat rough, but the microwear is non-contrasting and greasy appearing. The edge is moderately rounded. The microwear is slightly brighter and better developed at the convex part of edge. Also there is R10 microwear along the edge. Numerous parallel striations occur oblique to the edge. Microwear does not exist at the proximal retouched end which is extremely sharp. The microwear begins 13.5mm

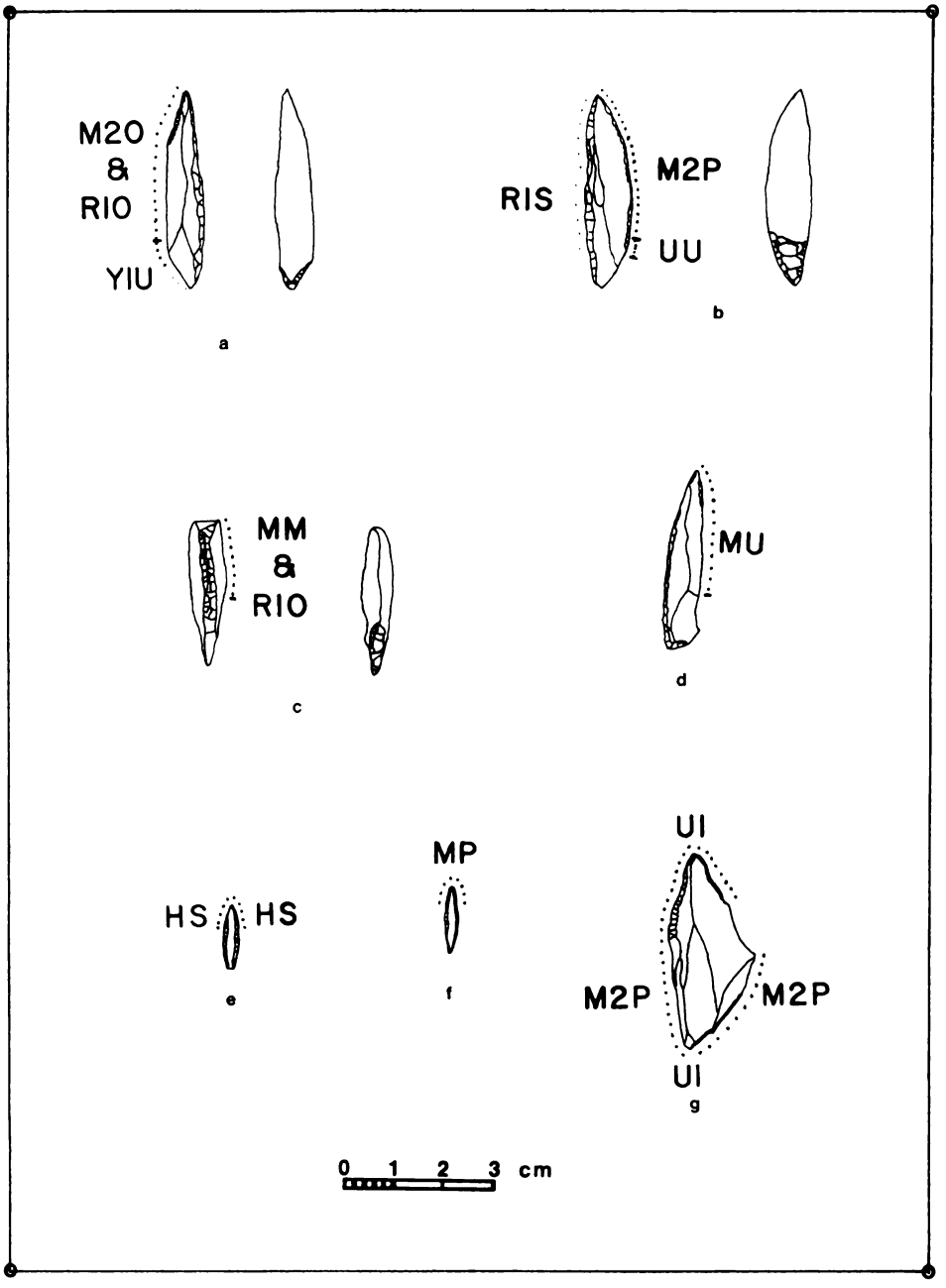


Figure D.13. Sampled backed points from level 4a.

from the proximal end. Other edges occasionally show very mild rounding but it is indistinct.

The tool was used for either cutting meat or very fresh hide. The proximal end was hafted with the edge covered up to 13.5mm from the end. The point is thus the hafted end on this tool. It is interesting to note that when first observed macroscopically it was thought that the tool was a drill because of its shortness, its triangular cross-section and its heavily modified point. As it turns out this was a completely wrong hypothesis (Figure D.13c).

PA SE 4a 238
PD4 dist sen conv [Apd - A(S)pd prox]/* Smd parz dist

This tool has a "sheen" along the distal and medial localizations of the right edge. The edge is moderately rounded until 10.8mm from the proximal end where it is sharp. The microwear is of class MU. The tool was used on meat or fresh hide, probably for cutting. The tool was hafted at the proximal end (Figure D.13d).

PA SE 4a 241
PD4 dop bitrav [Apd] punta Sauveterre

The material is of too coarse a grain to interpret. This tool is technomorphologically a "punta Sauveterre" and is most likely a projectile point.

PA SE 4a 242
PD4 dop bilat [Apd dex * Ap bip - Apd] punta Sauveterre

The distal half of both edges contain an HS microwear. It is matt and dull but also rough and greasy with moderate rounding of the edges. Much textural change occurs here. There is also much edge damage. The point is well rounded. Striations are seen perpendicular to the edge. There are no fractures (impact type) at the point and those on the lateral edges are perpendicular and not oblique to the edge. The tool is interpreted as used for boring hide with a rotational movement (Figure D.13e).

PA SE 4a 243
PD4 dop bitrav [Apd] punta Sauveterre

The proximal end has fractures oblique to the edge angled away from the point. There is no rounding but a very mild sheen exists along a portion of the edges. Some striations on the dorsal face occur which run parallel to the edges. The polish is virtually nondiscernable, but all

attributes taken into consideration suggest that it is an MI microwear. It was probably a projectile point (Figure D.13f).

PA Se 4a 244
PD2 dop bilat [Apd dex prox * Apd sen dist]/ S(A)md dex dist * Smmi sen prox

The tool has a M2P microwear on both lateral edges except for the medial area of the right edge where there is a large snap fracture. Edges are mildly rounded. The edges (not including the snap) have much small fracturing.

Both ends of the tool have small impact fractures; the proximal end has the larger of the two. There are a few striations parallel to the edge (axis) at this end.

The tool was definitely associated with meat, but it is uncertain how it was used. The impact fractures and the parallel striations suggest a projectile point but the microwear seems too intense for this use. How it was hafted and which end was hafted is also uncertain (Figure D.13g).

PA SM 4a 487
PD2 prox dex conv [Apd sublam]/* Amd prox parz - Smmi Smd lam

A well-developed MU occurs along the unretouched right edge. The edge is mildly to moderately rounded. The microwear is greasy and rough with an occasional tendency to become matt.

The proximal end has less rounding than the remainder of the edge, a length of 8.5mm. At 8.5mm there is some (relatively) intense fracturing. The back ridge is very sharp and straight until 11.3mm away from the proximal end when it is very rough and jagged (This could be from knapping preparation and not hafting).

The tool was used for cutting meat (and hide). The less intensely worn proximal end was probably hafted, probably protected (wrapped) to a distance of at least 8.5mm.

The proximal end has some ventral face retouch, recorded as simple in mode, but it does flatten the bulb. The retouch on the dorsal face at the proximal end extends 7.4mm, ending slightly before intense fracturing located between 8.5 and 11mm from the end (Figure D.14a).

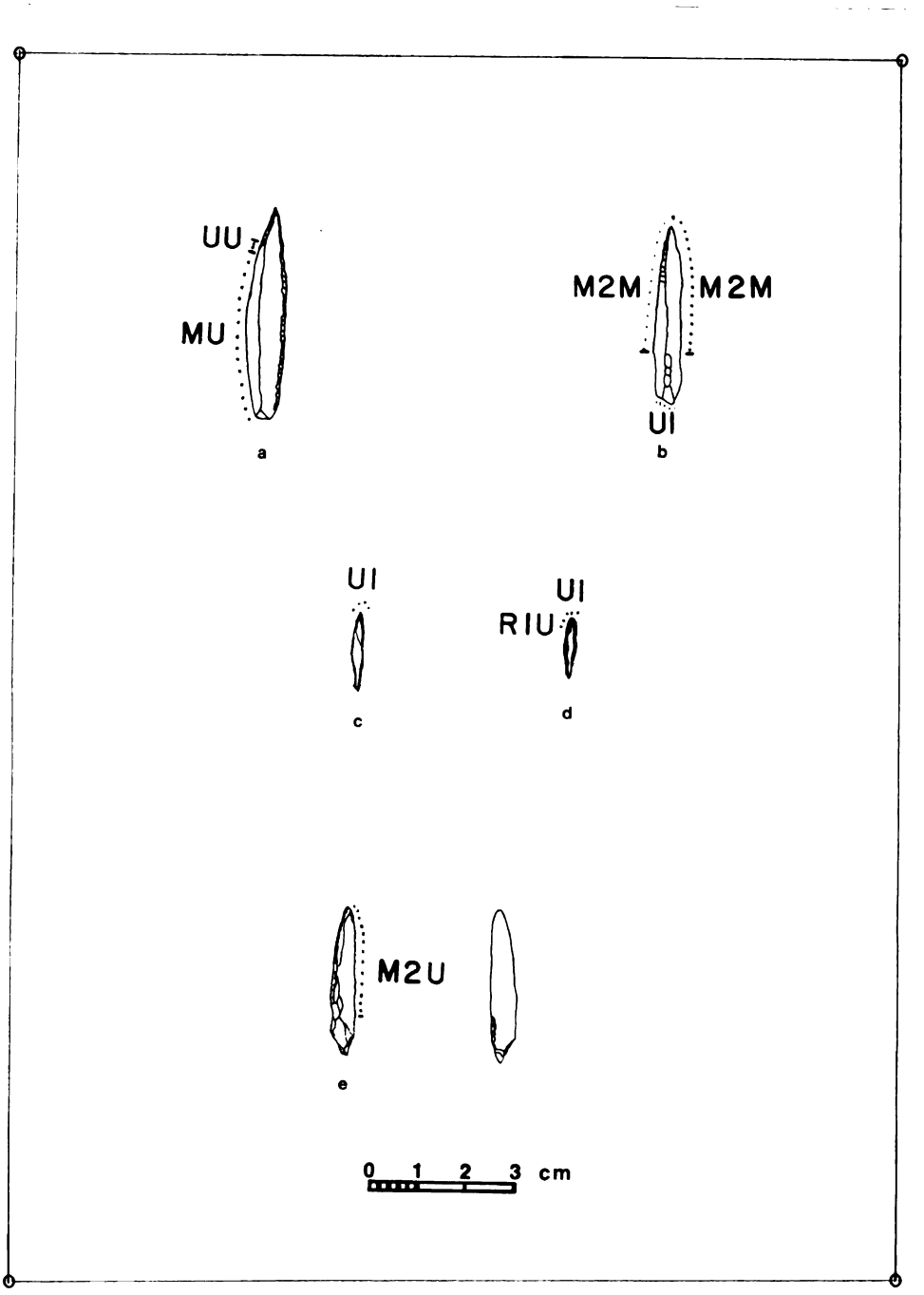


Figure D.14. Sampled backed points from level 4a.

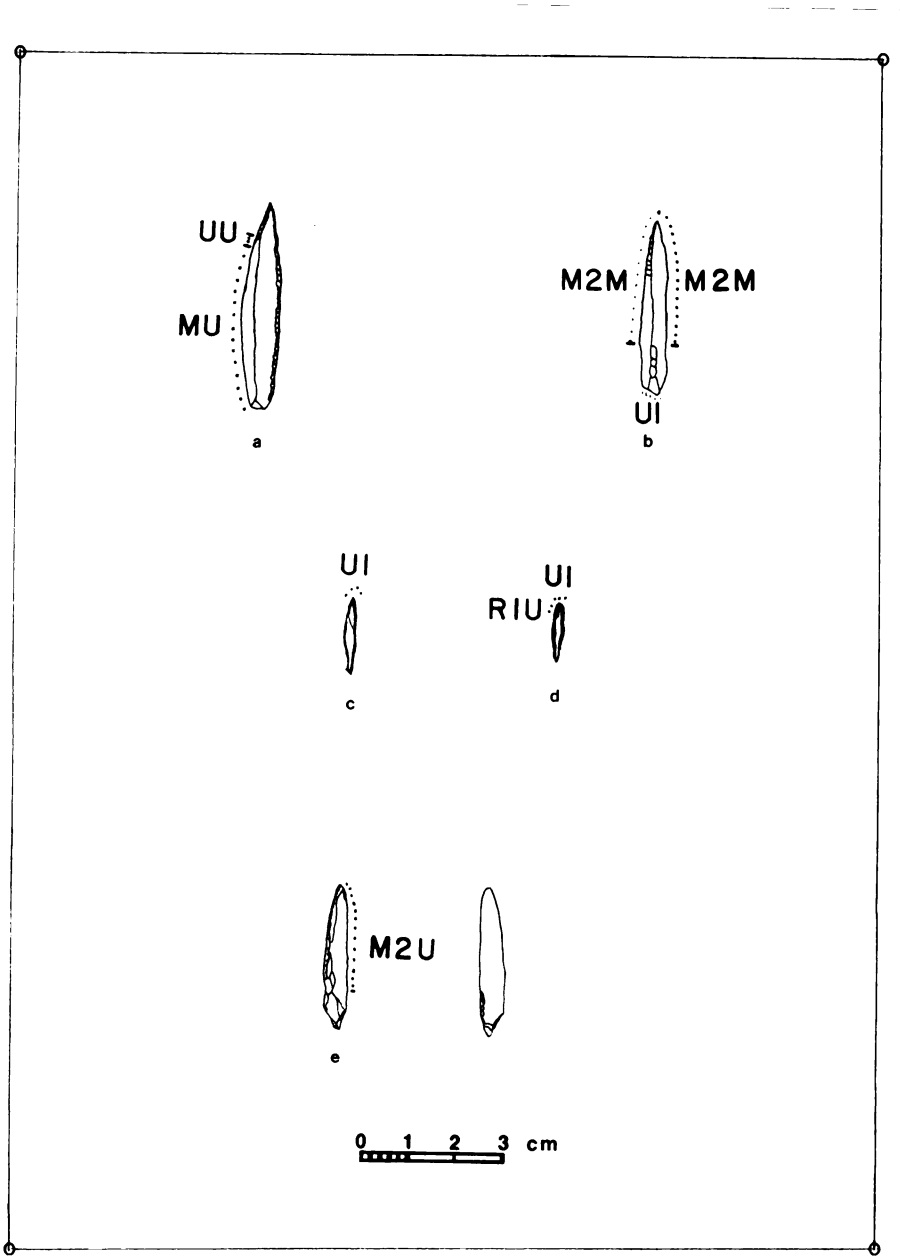


Figure D.14. Sampled backed points from level 4a.

PA SM 4a 491
PD2 dist sen conv [Ap bip]/-- Spdors parz prox *
Spd parz dist - Smmb - Emb prox

This backed point has a very well developed microwear of M2M type. The polish is rough and somewhat bright with a greasy sheen. There is little rounding but much tiny fracturing. The microwear tends to have a flow that is both perpendicular and parallel to the edge. There is some microwear on a second edge of this triangular shaped tool, but it is much less developed and could be manual wear.

Very little microwear occurs at the proximal end. It appears to be rough, not unlike a greasy dry hide microwear. This exists until 10.2mm from the end. In this proximal area the dorsal ridge is sharp, afterwards it is mildly rounded.

The tool is interpreted as an end hafted meat knife. The proximal end has both abrupt retouch and splintering (impact fractures). It is thought this is related to attempts at thinning the proximal end (Figure D.14b).

PA SM 4a 464
PD4 bilat [Apd] punta Sauveterre

Some bright RU microwears occur at the proximal(?) end, but nothing else is visible. At the distal end there are a few scars on the ventral face at the point. It is very "chewed-up". On one lateral edge just one to two millimeters from the point there is substantial R1U microwear. A large impact fracture is on the dorsal face of the point. There is a slight sheen along the edges of this half of the tool but it is not discernable. The fracture and other microwear suggest impact damage. It was probably a projectile point (Figure D.14c).

PA SI 4a 119
PD4 doppio bilat [Apd * Apd sublam] punta sauveterre

The distal(?) end has a fractured (snapped) point (UI microwear). There are a few fractures, but no rounding. The end is chewed up. The ventral surface of the proximal end is roughened and striated. An RU microwear occurs near the point. There are a few lateral edge fractures but they are angled toward the distal end.

The tools is interpreted as a projectile point. The distal(?) end is hypothesized as the piercing end (Figure D.14d).

PA SI 4a 110
PD4 (PD5) sen dist sin [Apd sublam]/* Sma parz prox

The right lateral edge has an M2U microwear. The edge is mildly rounded with a greasy aspect to it. The distal point has tiny fractures. The proximal end has no microwear for 9.7mm of its length. This correlates fairly closely with tiny ventral fractures (retouch). The tool is hypothesized as used for meat cutting. The proximal end was probably hafted and covered for 9.7mm of its length (Figure D.14e).

C.6. Backed Blades

PA SE 4a 265
LD2 dex conv [Apd]/* Smma

Originally it was thought that the material was too coarse to observe anything. In the 1984 review I was able to discern a Y1U microwear and rounding along most of the length of the left edge until 9.3mm from the proximal end. The rounding is moderate and could have resulted from hide as well as meat. The tool is interpreted as a meat cutting or hide working tool, with the proximal end hafted for 9.3mm (Figure D.15a).

PA SE 4a 266
LD2 sen rect [A(S)pd]/* Spd - Amd

Originally it was thought that this is a WU microwear because of bright areas along edge. Further study reveals that it is a MU microwear with occasional R1S microwear spots along the edge. The MU microwear is best seen on the ventral face near the edge. The rounding is mild. There are numerous fine fractures dorsally and a few ventrally. Striations are seen perpendicular to the edge.

It is probably a mild meat produced microwear and, probably, from some bone. It is thought that this is an armature for a projectile. The motion evidence indicates that this is not so. Therefore, although called an armature, it is definitely not strongly supported (Figure D.15b).

PA SE 4a 268
LD2 sen rect [Apd]/* Smma

A Y1U microwear exists along the edge, but it is very mild. There is much fracturing along the unretouched edge,

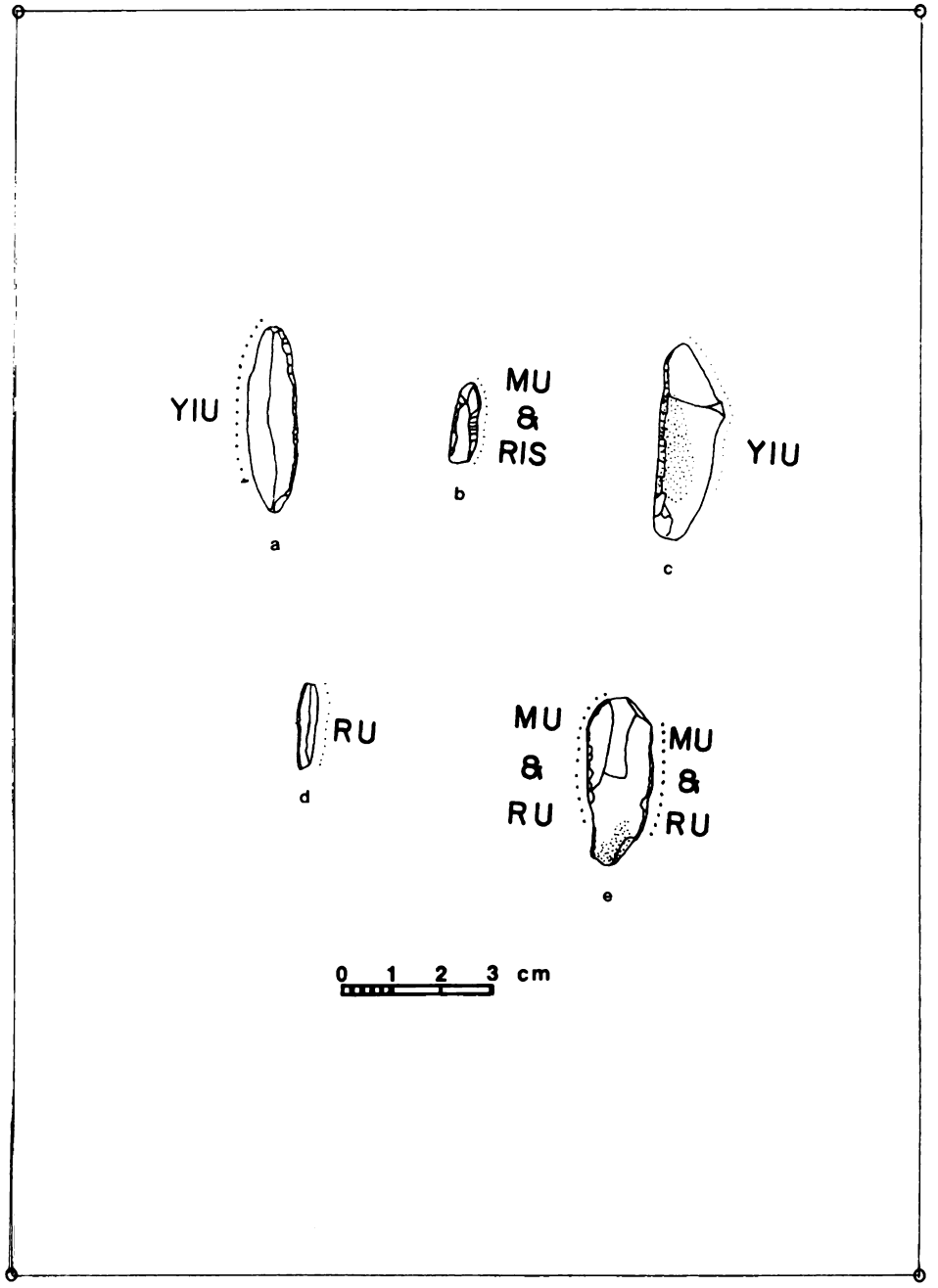


Figure D.15. Sampled backed blades from level 4a.

however. The point of the tool is fractured and this is followed by some rounding. The fracturing at the edge goes the entire length except for 10mm of the proximal end. This end is thick because the bulb of percussion has not been thinned.

The tool is probably a knife but it could be a projectile point based on the mildness of the microwear. It was hafted at the proximal end (Figure D.15c).

PA SE 4a 286
LD2 sen conv [Apd - Amd]/* Smma

There is a substantial amount of alternating fractures on the right edge. Spots of a bright rough polish (RU) are seen. A second review of this piece suggests that there is also some MU microwear. The tool cannot be interpreted (Figure D.15d).

PA SI 4a 122
LD2 sen conv [Apd parz dist]/- Smd - Smmd * Smd

Both lateral margins have an MU microwear with spots of a BU microwear. The concave edge of the distal right margin shows substantial rounding and is somewhat like an H2U and an M1U microwear. Fracturing is also fairly intense. The microwears imply a butchering activity perhaps even some jointing. There appears to be contact with meat, hide and bone. There is no clear evidence for hafting (Figure D.15e).

C.7. Backed Truncates

PA SE 4a 239
DT5 [PD2 prox Apd * Ap(m)d sen * PD2 dist Apd]/
Smma parz dex

The edge is not very rounded but has a bright sheen along the edge that is likely to be the fine bright line associated with M2- microwear. (See Vaughan 1981). It also occurs on the distal and proximal retouched ends of the tool. M2O microwear is less apparent on the ends than on the central portion of the edge.

One spot of BO microwear does occur as well as striations oblique to the edge and angled toward the distal end. Rounding is less extensive on this tool than others, but the M2O microwear is better developed.

There is some evidence of hafting in that no microwear occurs for 6.0mm from the proximal end. The tool is 4.0mm wide at this point. The tool is hypothesized as used for

cutting meat. There is a good possibility that the tool was back hafted instead of end hafted, but neither can be inferred (Figure D.16a).

PA SE 4a 245
DT3 [Sp dors - T3 prox Spi + Apd]/ Ppi dex dist - Smmb

The right edge of this tool is extremely rounded and very matt, but with a slight sheen along the ventral face of the edge. The texture is sometimes rough. There occur, on the edge, large pits. There are also deep and wide, and also narrow striations, usually parallel to the edge, but occasionally perpendicular. There is at the distal end some R1M, possible WM, microwear, but this is uncertain. The HM microwear appears more like H2M, e.g., greasier, less matt, and rougher near the ends. The edge rounding gradually ends distally while at the proximal end it abruptly stops.

The tool appears to be used for dry hide cutting but may have been used on a somewhat fresh hide. It also appears to have been back hafted which is the best way to explain the microwear distribution (Figure D.16b).

PA SE 4a 254
DT2 [T2 prox Apd + Apd parz sen + T2 Apd]

There is no microwear on this tool, only a few miscellaneous fractures. It was probably not used (Figure D.16c).

PA SE 4a 250
DT6 [Apd dex]/ Smmi parz sen

The microwear on the left edge of this tool is rough and greasy, but not well developed. It is an M2U microwear. The snapped end has no microwear. The microwear is probably the result of meat cutting but it is not developed enough to make a good interpretation. The tool probably broke during use which would explain the freshness of the snapped edge. The snap is what defines this type of backed truncate suggesting that if more are seen as this one then the type may be erroneous and result from the accidental breakage of other tool types (Figure D.16d).

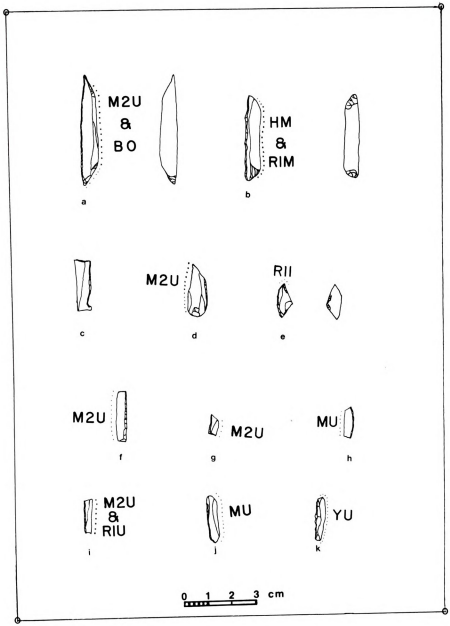


Figure D.16. Sampled back truncates from level 4a.

PA SE 4a 240
DT8(?) [PD3 prox * Ap(m)d sen]/ Sma dex

There is much scarring at the distal end. There is a small area of R1U microwear near the point as well. Also there is some possible WU microwear on the opposite point. The damage at the point of the tool implies impact damage. There is no other evidence to confirm it other than the technomorphological similarity of this tool to the Sauveterre points.

The bulge on the right edge was attempted to be reduced by the manufacturer through retouch, but an overhang of the edge made it impossible. It is thought that this tool was being manufactured into a punta sauveterre which could not be narrowed as much as is typical for this variety of backed tool (Figure D.16e).

Note: The use of the small DT's and Gms is found to carry the same microwear characteristics except for minor variations. These include tiny fractures along the unretouched edge with a faint but detectable MU microwear. There are rarely striations. Only the variation beyond that of this microwear pattern and that of its location will be given for the following DTs and Gms.

PA SE 4a 248
DT (1,2,5,6,7) [T2 prox Apd + Ap bip dex]

There is a M2U microwear with many scars on the ventral face with various terminations. Interpretation: Microwear is from meat contact and the tool is probably an armature (Figure D.16f).

PA SE 4a 251
DT (3,5,6,8) [T3 dist conv Apd + Apd sen]

There is a faint M2U microwear on the cutting edge. It is interpreted as an armature (Figure D.16g).

PA SE 4a 252
DT (3,5,6,8) [T3 dist Apd + Apd dex] Smmi sen

There is a very mild sheen characteristic of MU along the unretouched edge. The dorsal face also shows some microwear. It is interpreted as an armature (Figure D.16h).

PA SE 4a 261
DT (1,2,5,6,7) [T2 prox Apd + Apd sen]

There is some M2U microwear with some R microwear on the unretouched edge. The fracturing is fairly intense. The tool is interpreted as an armature (Figure D.16i).

PA SE 4a 249
DT4 [T3 prox Apd + Apd parz sen]/ Smmi dex dist

Only the textural variation of the edge differs from non-use. There is also a fine line of bright microwear scattered along the edge. It is probably an armature (Figure D.16j).

PA SE 4a 255
DT1 [T2 prox Api + Apd sen]/ Smmd dex

The microwear is convoluted and fairly bright. It is somewhat up the face and there are many small scars. The tool is interpreted as an armature. The microwear curves around corners implying that the tool was back hafted and the contact was with a soft material (Figure D.16k).

PA SE 4a 253
DT (1,2,5,6,7) [T2 prox Apd + Apd dex]/ Smmi sen

There is a mildly developed M2U microwear; rough, slightly greasy and with many tiny fractures often oblique and on both faces. It is interpreted as an armature (Figure D.17a).

PA SE 4a 256
DT (4,5) [T3 prox Apd + Apd dex]/ Spd parz sen dist

There is a mildly developed Y1U microwear with a bright line along the edge. There are numerous tiny fractures mostly on the ventral face. Most microwear and damage is near the distal end. The tool is interpreted as an armature (Figure D.17b).

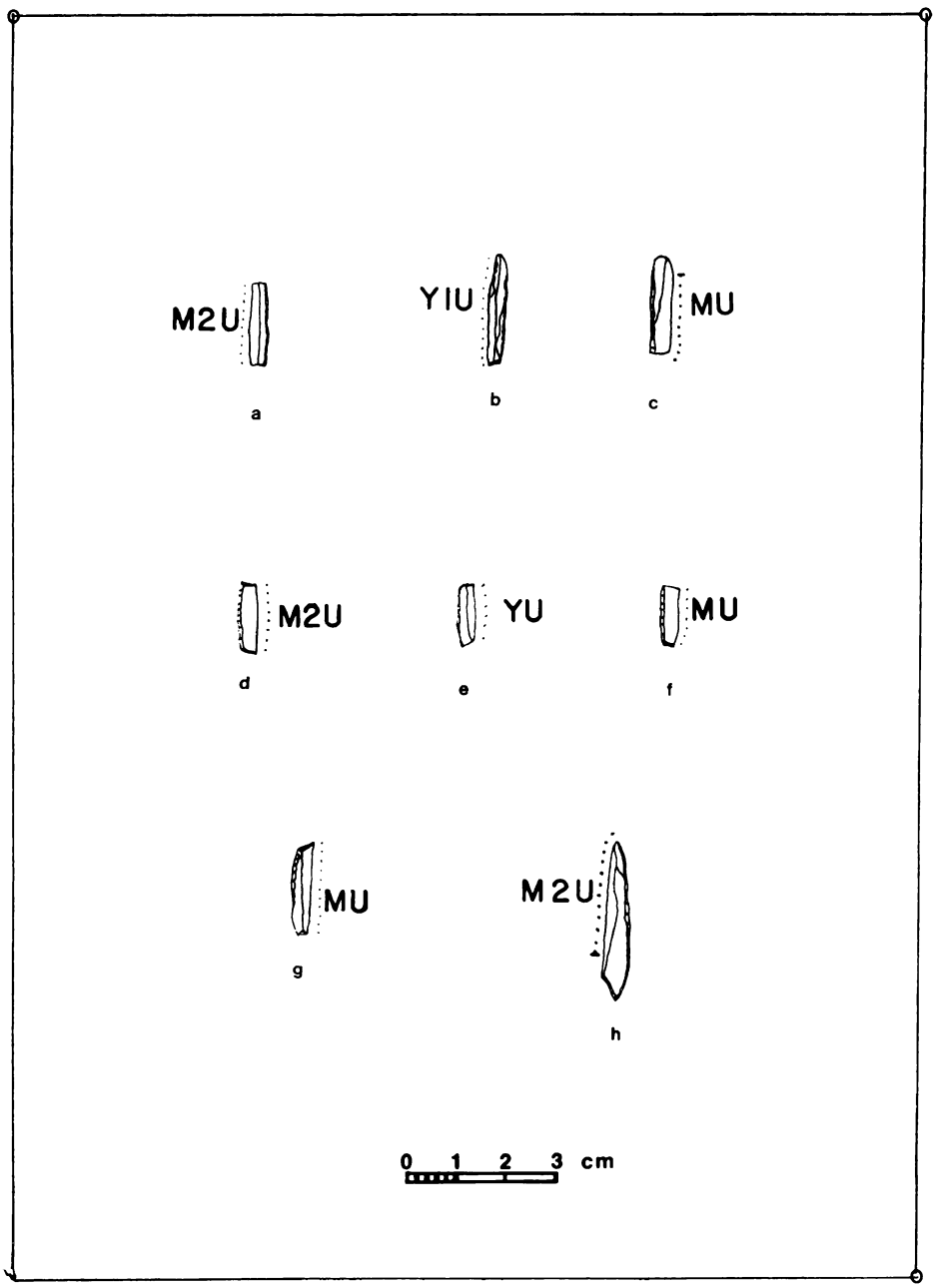


Figure D.17. Sampled backed truncates from level 4a.

PA SE 4a 257
DT2 [T2 prox Apd + Apd dex + T2 Apd]

The edge has a fine line of bright polish which is very faint. The fracturing and other microwear is typical. It is probably an armature.

PA SE 4a 259
DT1 [T2 prox Apd + Apd sen]/ Smmi dex

There is a bright, rough or convoluted, microwear directly on the edge. It is continuous, and it is on both projections and indentations. There are many tiny fractures, mainly on the ventral face. They appear perpendicular to the edge. A MU microwear is more intense on the dorsal face and it is somewhat lustrous. There is mild rounding of the edge. It was probably produced by meat and possibly some bone. The tool is hypothesized to be an armature. The microwear does not extend over the last 3.9mm of the distal end. The proximal corner is slightly rounded. This suggests that the tool was angled to the shaft like a barb and not set parallel to it (Figure D.17c).

PA SM 4a 524
DT (3,5,6,8) [Ap bip + Apd trav]/ Smmi parz

There is a M2U microwear of mild development along the unretouched edge. There is also some mild fracturing most of which is on the ventral face. The tool is hypothesized to be an armature (Figure D.17d).

PA SM 4a 532
DT4 [Apd sen + Apd parz dist] Smmd parz dex

There is a slight sheen which is not well developed. It is characteristic of a YU microwear. There are numerous tiny fractures. It is interpreted as an armature (Figure D.17e).

PA SM 4a 536
DT (4,5) [Apd prox + Apd sen]/ Smmi parz dex

This tool has a mild MU microwear. There are many tiny fractures. It is interpreted as an armature (Figure D.17f).

PA SM 4a 520
DT4 [S(A)pd dex parz + Apd prox]/ Smd dex

The microwear is somewhat more than mildly developed. There are numerous rounded projections. The backed edge is sharp while the cutting edge is mildly to moderately rounded. It is a MU microwear. It is interpreted as an armature (Figure D.17g).

PA SM 4a 508
DT8 [PD3 sen prox * Apd sublam dex]/ Smmi parz sen

There is some flint damage on the tool. The fracturing and rounding of the edge and the greasy microwear indicate an M2U microwear. The proximal end has no microwear and the dorsal ridge is not effected at all for the proximal 10.0mm length of the tool.

The amount of microwear indicates that this tool is a knife for cutting meat and not a projectile point (Figure D.17h).

C.8. Geometrics

The following geometrics, like many backed truncates, show a very consistent microwear pattern which is indicative of meat being the cause of the microwear when fully developed. Some differences in location of the microwear do occur.

PA SE 4a 299
Gm1 sen [Apd sublam]

The microwear which is mainly along the unretouched edge is an M2U type. It is more intense distally. The edge is not rounded. The proximal end has much microwear which also appears to partially extend onto the backed edge. It is interpreted as a projectile armature; either a lateral barb or a point (Figure D.18a).

PA SE 4a 340
Gm1 dex [Apd parz]

There is a mildly developed M2U microwear on the proximal 3/5 of the unretouched edge. It is interpreted as an armature (Figure D.18b).

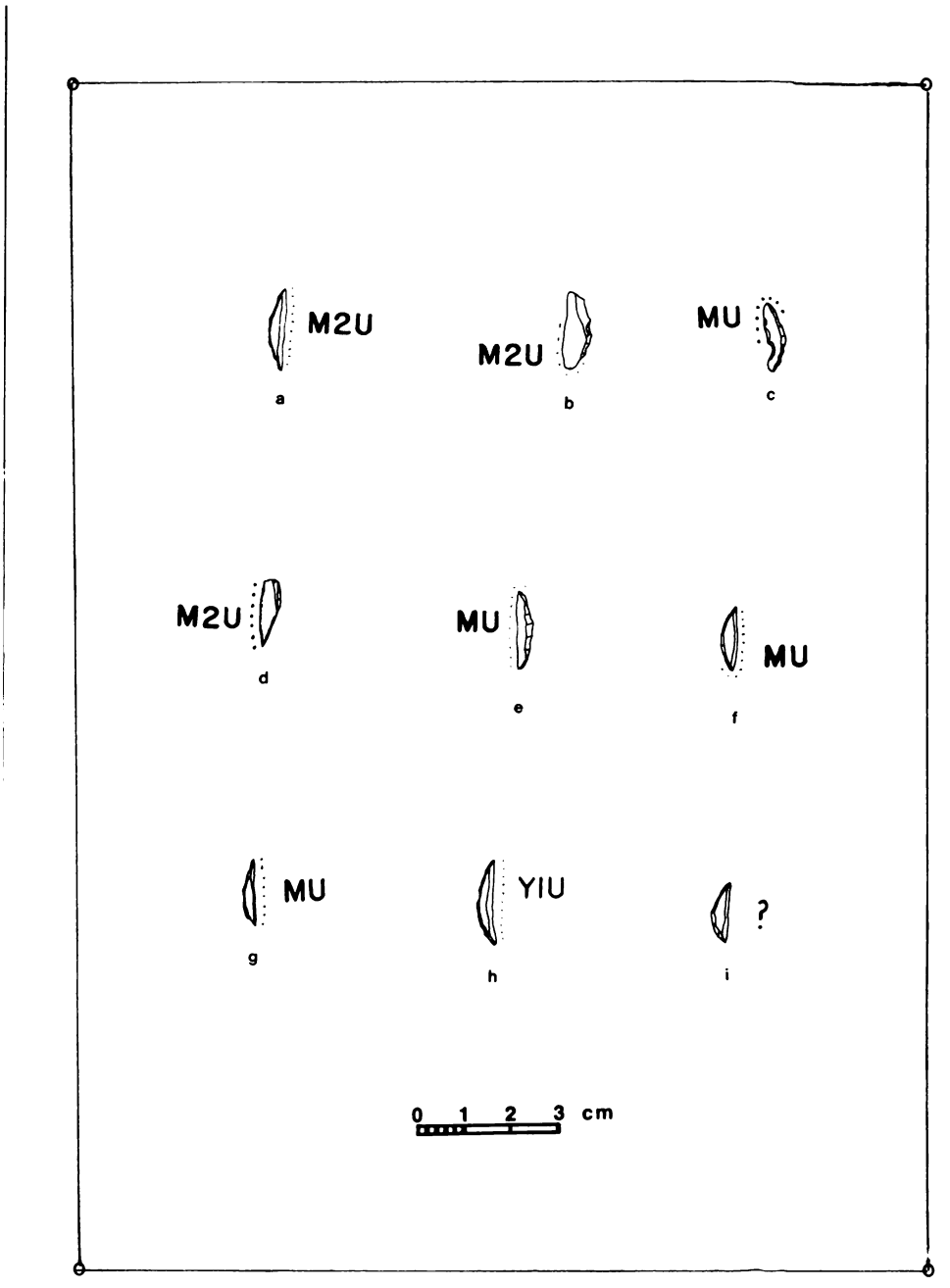


Figure D.18. Sampled geometrics from level 4a.

PA SE 4a 344
Gm1 sen [Apd - Smd]

There is some MU microwear on the unretouched edge, but there is also flint on flint damage. The interpretation is uncertain but the minimal amount of microwear suggests that the tool is an armature if used at all.

PA SE 4a 305
Gm1 dex [Apd]/* Spd enc - Smmd

There is microwear along the left edge and it is intense at the distal end. It continues around the edge onto part of the backed edge. There is much fracturing. Some of the microwear may be flint on flint. The tool is interpreted as an armature. It is one of very few armatures that appears to have the sharp cutting edge retouched although this could be use damage (Figure D.18c).

PA SE 4a 309
Gm1 dex [Apd sublam]/ Smd

The M2U microwear is fairly intense at the proximal end. The point area is fairly rounded and the polish goes up the arisses of the face. This could be a fragment of a larger backed tool, but it is doubtful. It is probably an armature (Figure D.18d).

PA SM 4a 497
Gm1 dex [Apd]

There is MU microwear and possibly silicate damage on this tool. The distal end is mildly rounded while the rounding is less along the rest of the edge. There is some bright polish, probably R1U microwear, but it could be silicate damage. It is interpreted as an armature (Figure D.18e).

PA SM 4a 451
Gm1 sen [Apd sublam]

There is a mild MU microwear on the edge with very mild rounding. The tool is interpreted as an armature (Figure D.18f).

PA SM 4a 467
Gm1 sen [Apd sublem]

There is mild rounding and a very mild MU microwear on this tool. It is interpreted as an armature (Figure D.18g).

PA SM 4a 493
Gm1 dex [Apd]/* Smmi parz

The edge has very little rounding and much fine fracturing. The Y1U microwear is very mild. Although it is not certain, it is probably an armature (Figure D.18h).

PA SM 4a 459
Gm1 (Gm4) sen [Apd]

Because of the material, the microwear is not classifiable. The rounding of the edge is mild (Figure D.18i).

C.9. RAD Fragments (Δf)

PA SE 4a 296
PD1 - LD1 dex sin [A(S)md sublam]/* Spi prox - Smmb

This tool has a moderately rounded edge with many small and large fractures. The ventral face near the proximal end which is retouched is chewed up but not rounded. There is no rounding for 4.5mm from the end. The microwear is MU with some R1U. The tool was probably used for butchering. There was contact with meat and possibly hide, and also with bone (Figure D.19a).

PA SE 4a 297
PD(3,5) - LD(3,4) sen [Apd parz]/* Smmd parz

All of the edges are sharp, but there is much fracturing. The lateral edge may have been used but there is no indication. It was probably not used (Figure D.19b).

PA SE 4a 300
PD1 - LD1 sen rect [A(S)md]/ Smmd parz

This tool follows the same pattern as the small DTs. There is very mild rounding with a Y1U microwear. It is probably an armature (Figure D.19c).

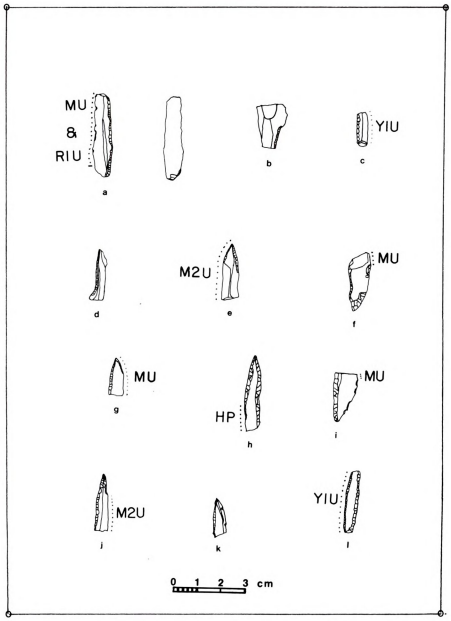


Figure D.19. Sampled backed tool fragments from level 4a.

PA SE 4a 308
PD5 - LD(3,4) sen [Apd sublam parz]/* Smmd parz

The edge has mild rounding, but much fracturing. The damage may have occurred after use. The microwear is Y1U and the tool is probably an armature (Figure D.19d).

PA SE 4a 207
PD - DT dex conv [Apd sublam parz dist]/* Sma dist

The edge is mildly to moderately rounded all the way to the point with a M2U microwear. The fractured edge is very sharp. The backed edge is retouched only at the point. The remainder of this edge does have some MU microwear and fractures, but it is very mild. Although possibly a projectile point, the microwear development is more indicative of substantial cutting and thus the tool was probably a meat knife. The opposite edge was used for cutting as well or may have been maually worn (Figure D.19e).

PA SE 4a 215
PD - DT dex rect [Apa]/* Spd dist - Smmi - Smd - Smmi

This distal end of a bladelet has a minute amount of crushing at the point. There is virtually no microwear along the edge until mild-moderate rounding of an MU microwear occurs. It is a distinct change from the remaining edge. Minute edge fractures occur along the ventral face and go to the end of the tool. There is no microwear on the snapped edge. Snap may be from impact. There is substantial edge damage on dorsal face at 14.0 to 19.9mm from the end. The backed edge is very sharp. This distal blade fragment is the hafted end of a backed knife used for cutting meat or fresh hide. The large fractures are thought to result from pressure of the haft's binding (Figure D.19f).

PD SE 4a 231
PD - DT dex prox rect [Ap bip]/* Smb prox - Smmb

There is MU microwear, some edge fracturing and mild rounding of the simple retouched edge. The snapped end is sharp, but with a few (spontaneous?) fractures. The tool is probably the front section of a meat cutting knife, but it could possibly be a projectile point (Figure D.19g).

PA SM 4a 468
PD - DT dex sin [Apd prox - Ap bip - Apd]/*
Ppd parz dist -- Smd - Amd

This tool is not carefully studied. It appears to have an MU microwear with some R1 microwear. The tool is probably a meat knife, but it is not certain.

PA SM 4a 472
PD - DT dex sin [Apd]/* Apd parz dist Ppd - Smma

There is no microwear on the distal 20.7mm of the simple retouched (left) edge. From this spot to the fractured end (10.1mm in length), the edge is extremely rounded and somewhat matt with an HP microwear. Striations are approximately parallel to the edge. Tiny fractures occur on the ventral face corresponding with the edge rounding and microwear. The tool was used for cutting hide. It was end hafted with this being the hafting element. There is a slight overlap of the retouch and the rounding of the edge indicating that the retouch preceded the use of the tool (Figure D.19h).

PA SM 4a 484
PD - DT sen rect [Ap bip prox - Apd]/* Smma

There are no microwears along almost the entire unretouched edge, but there is substantial fracturing. At less than 1.5mm from the snap at the distal end there is intensive MU microwear. It is suggested that this is the hafted end of a backed knife used on meat or fresh hide. The spine plane angle is quite thin which thus caused greater fracturing than normal along the hafting element (Figure D.19i).

PA SM 4a 488
PD - DT sen conv [Amd - Apd sublam dist]/*
Apd parz dist = Pmdors dist - Smmd

The lateral unretouched edge has a moderately well developed M2U microwear. This microwear does not extend onto the retouched portion of the edge. The exact point where the microwear ends is not clear (not recorded). The snapped edge does not have microwear. No microwear exists on the drill-like end of the tool. The tool is interpreted as used for cutting meat prior to the snap at the end. The retouched end was a hafting element (Figure D.19j).

PA Sm 4a 500
PD - DT dext conv [Apd]/* Smmd parz prox

There is no evidence of use on most of the edge. Tiny fractures occur near the snap, but acetone residue requires additional cleaning here. No interpretation is currently possible because the tool is not adequately cleaned. If the pattern continues, however, this is the hafted end of a backed tool and a little microwear may be evident near the snap (Figure D.19k).

PA SI 4a 112
PD - LD - DT dex rect [Apbip]/* Smd prox - S(A)md

The cutting edge, which is retouched, is mildly rounded. There is substantial silica damage as well. The ends of this edge are both sharp, not showing any wear. The backed edge is also very sharp. The microwear is Y1U with moderate rounding but few and small fractures. The tool was well used on a soft material as indicated by the microwear pattern. There is no evidence of end hafting, but also no evidence of use on either end. The tool might have been back hafted. Also the ends are snapped which may have occurred during use. The tool was used for cutting on soft material (Figure D.19l).

PA SI 4a 113
PD - LD - DT dex rect [Apd]/* Smmd parz

There is mild rounding on the edge and the arrises of fracture scars on the ventral face. There is also a somewhat lustrous MU microwear along both faces. The proximal edge is sharp, as is the distal edge. The rounding is probably caused by meat. The tool was probably back hafted and was probably an armature (Figure D.20a).

PA SI 4a 115
PD - LD - DT dex sin [Apd]

There is very mild rounding along the unretouched edge. There are also numerous small fractures. At the distal end the edge is fairly sharp, but it is more so on the proximal edge except at the back corner. The tool, like SI 113, is probably an armature (Figure D.20b).

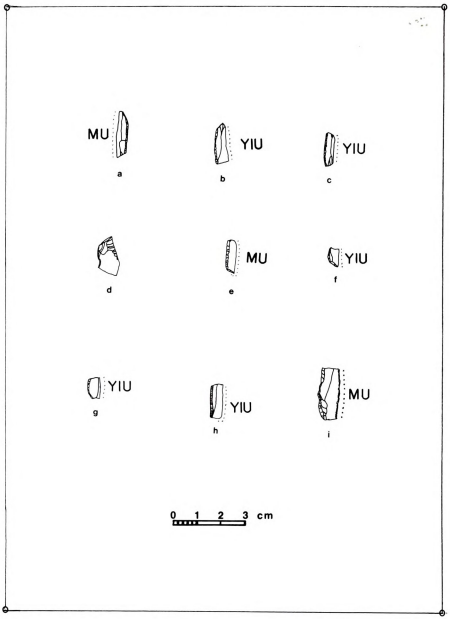


Figure D.20. Sampled backed tool fragments from level 4a.

PA SE 4a 260
DT(4,5) - Gm2 [Apd sublam sen rect + T3 d dist]/
Smmd parz dex

This tool is similar to all other "4x2mm" DTs that are studied. It has mild edge rounding and mild fracturing along the unretouched edge. The retouched end is slightly rounded. The snapped end is very sharp. The tool is hypothesized as having been an armature (Figure D.20c).

PA SE 4a 271
DT(4,5) Gm2(?) [T3 bip prox + Ap bip dex sin]/
Ppd sublam parz sen prox

This thick proximal fragment has much fracturing perpendicular to the edge. The snapped end varies but it is normally sharp. The corner where the cutting edge intersects it, is also very sharp. The fragment is hypothesized as being the hafting element of a meat cutting tool, but there is not an adequate amount of information to prove or disprove it (Figure D.20d).

PA SE 4a 324
DT(4,5) Gm2 [T3 Apd prox + Apd sublam sen rect]/
Smmi parz dex

This tool has MU microwear and a mildly rounded edge with much tiny fracturing. One end is very sharp while the other is sharp except for rounding at the cutting edge corner. The tool is thought to be an armature (Figure D.20e).

PA SE 4a 332
DT(4,5) - Gm2 [T3 d prox + Ap bip sen conv]/ Smmi

The edge of this tool is mildly rounded with a Y1U microwear, while both ends of it are very sharp. It is hypothesized to be an armature (Figure D.20f).

PA SE 4a 194
PD - LD - DT - Gm sen rect [Apd]/* Smmd parz

There is a mild Y1U microwear along the edge. The rounding is also mild. Fracture scars occur, some without microwear. It is interpreted as an armature (Figure D.20g).

PA SE 4a 205
PD - LD - DT - Gm sen rect [Apd - Apm]/* Smmi

This is typical of a 4x2mm DT. There is mild Y1U microwear along the edge. Both ends are sharp but one has some rounding where it meets the cutting edge. It is interpreted as an armature (Figure D.20h).

PA SE 4a 214
PD - LD - DT - Gm sen rect [Ap bip - Apd]/* Sm(mm)d

The microwear is well developed on the cutting edge on both the edge and the face. The MU microwear is bright, greasy and rough. Both ends are sharp and have no rounding at corners. This is thought to be a cutting tool used on meat or fresh hide. It is broken at both ends (Figure D.20i).

C.10. Foliates

PA SE 4a 130
F(1-2-10) sen conv [Ppd lam]/+ Smd parz

Much of the dorsal face has cortex, but the flat retouch removes it from the working edge. The left edge is extremely rounded and there is an extremely well developed, very bright and smooth microwear beginning just off the rounded edge and extending well up the face. There are many striations associated with the polish and they are mostly oriented perpendicular to the edge, although they are also found parallel to the edge. Fractures are typically oblique to the edge. The microwear is a P2M and it is thought to result from plant processing or from soft wood working (Photomicrographs 28 and 29). The edge itself is extremely matt in appearance with numerous and various striations and occasional hemispherical pits. It is unknown if this results from the use which produced the P2M microwear, but it appears to be a H1S microwear. Both microwears are found on the exact same length of the working edge which is most of the entire length except the tip and 6.5mm of the distal end. This end is suspected of being hafted. The opposing edge is not modified, but forms a natural back to the working edge. The tool is tentatively hypothesized as used for plant processing (Figure D.21a).

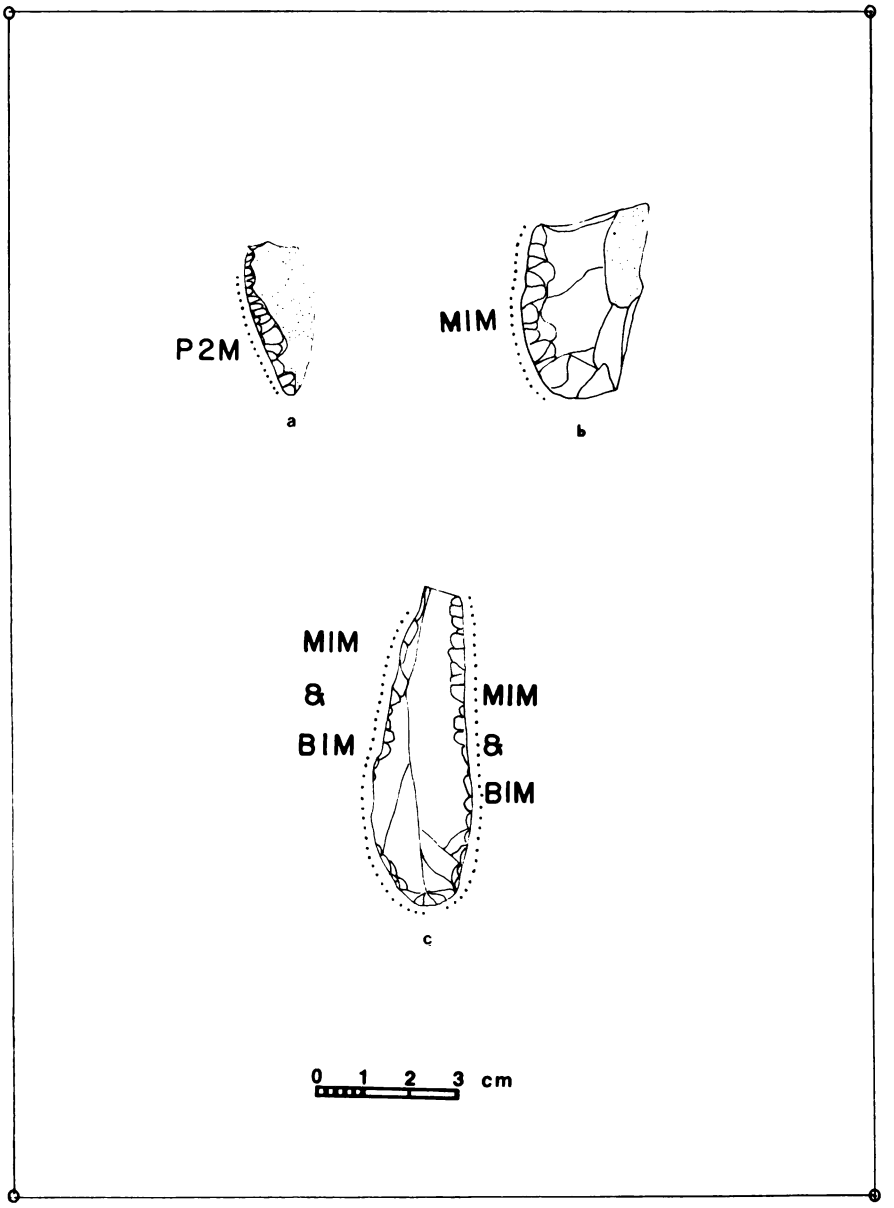


Figure D.21. Sampled foliates from level 4a.

PA SE 4a 134
F10 sen conv [Ppd]/* Smma parz + T0 (?) dist

A M1M microwear is seen along the retouched edge with some R1M microwear directly along the edge. The edge is moderately rounded and the surface appears greasy and rough. The very bright microwear cannot be characterized. Striations are seen perpendicular and oblique to the edge. The opposite edge at the distal end has a mild Y1U microwear which may be from handling or use. The working edge is thought to result from meat butchering, but may have been used for fresh hide working (Figure D.21b).

PA SE 4a 129
F3-10 dex sin [Ppd lam]/* Smd sen prox - Spd

The microwear consists of two distinct types. There is a well developed M1M (almost H2M) microwear which is most distinct along the lateral edges near the proximal end and extending onto the proximal edge. It is least developed near the distal, narrowed end of the tool. The second microwear is a well developed B3M which is found on projections of the edge's microtopography. The microwear is probably produced by bone and not wood because of its extremely localized nature on these projections and tiny parallel-track striations seen which are parallel and oblique to the edge. The tool is thought to be a butchering knife with the wide end being the working edge. The tool may have been hafted and broke the at point where the handle began, the inserted end now missing. The tool is almost a duplicate both in form and use as point SE 126. Finally, there is some silica damage at the distal left lateral edge (Figure D.21c; B1M should read B3M).

C.11 Points

PA SE 4a 92
P1 (?) dex dist [Spd prox - Smmd - Spd - Smd]

This is almost a naturally formed pointed blade with only a small amount of retouch at the converging end. There is a M1U microwear on the distal ends of both lateral edges. It is moderately rounded with a rough, greasy and sometimes matt microwear. It is hypothesized to have been used for butchering or fresh hide working. The proximal ends of the lateral edges have a mildly developed H1U microwear which is dull and matt. The two microwears do not merge but are separated from one another by unworn areas of the tools. It is possible that this is wear

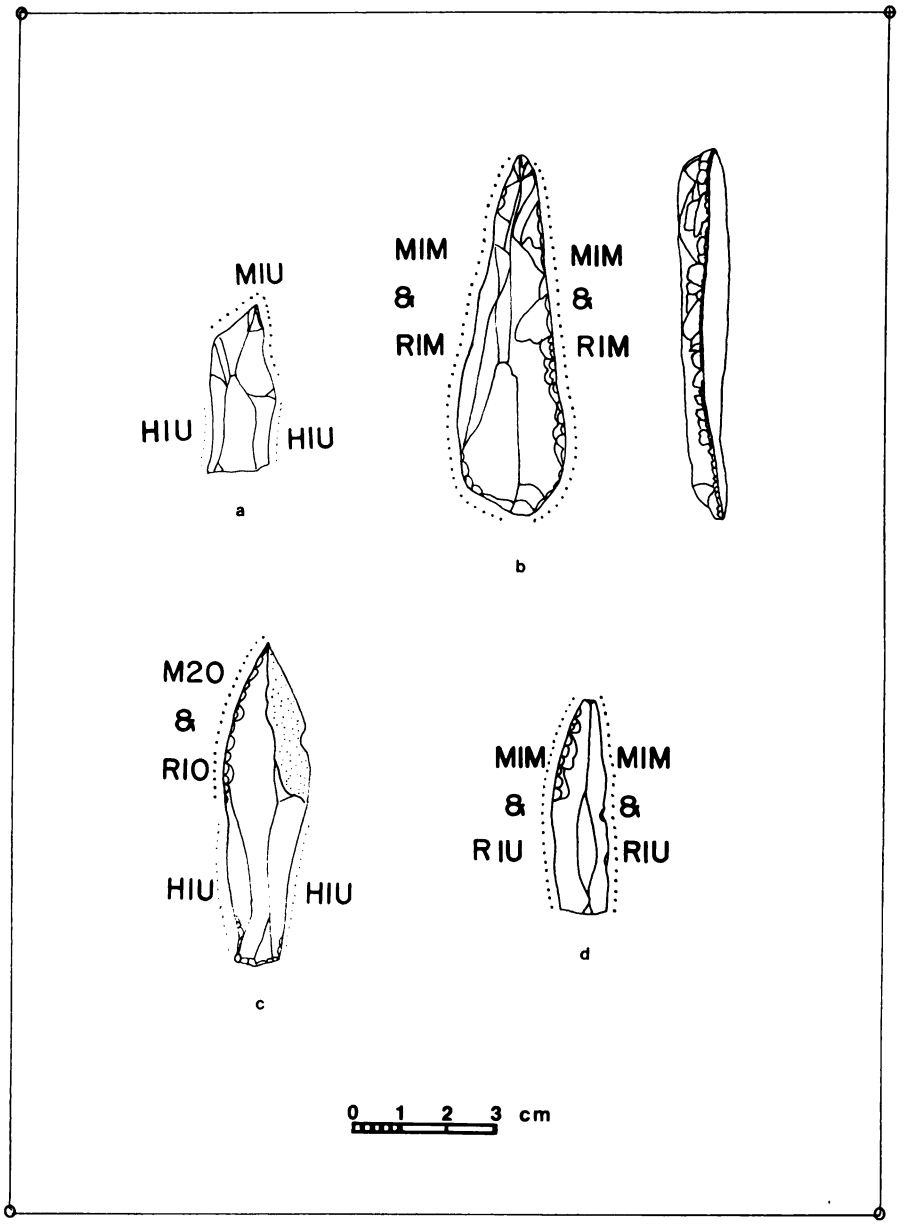


Figure D.22. Sampled points from level 4a.

resulting from hafting or handling of the tool (Figure D.22a).

PA SE 4a 126
P5 dej bilat dist [SEpd]/ Pmd dex - Ppd * Spd sen +
Smi prox

This point is very similar to foliate SE 129. The microwears are of two types. A M1M microwear rare at the distal end of the tool appears to gradually increase in development until it is very intense along the proximal end of the tool. A second microwear, R1M, shows the same distribution but is found only on protruding aspects of the edge. At the proximal end this microwear gets very intense and takes on the appearance of a W1U microwear. However, this is not certain. A fracture on the ventral face at the proximal edge, and caused by impact occurs without microwear development suggesting it occurred after use. Striations are mostly parallel to the lateral edges. There is some soil damage on the bulb of the ventral face which does not extend beyond this protrusion. It is suggested that the tool was used for butchering. It may also have been used for some wood working (Figure D.22b; Photomicrograph 30).

PA SE 4a 127
P1 sen dist [Spd prox - Smmd - Spd - Smd]

The distal half of this tool has a well developed M2O microwear on one lateral edge, the other having cortex. At the widest point there begins to appear a faint R1O microwear which also appears on the opposite edge. The distal portion of this edge is not visible because of cortex. Moving toward the proximal half of the tool, the R1O microwear becomes predominant on this second edge. Toward the proximal end of the tool a H1U microwear occurs. It appears that this may be related to hafting and that the tool was used for butchering. Prior to that it may have been used on wood (Figure D.22c).

PA SE 4a 128
P1 sen dist [Smd parz]/ - Smmd * Smmd parz

There are M1M and R1U microwears on this tool. The edge is moderately rounded along the retouched edge except for one small unretouched area where heavy rounding occurs. This suggests use, retouch and reuse. The microwear is rough, slightly bright and occasionally greasy. The entire length has microwear on both lateral

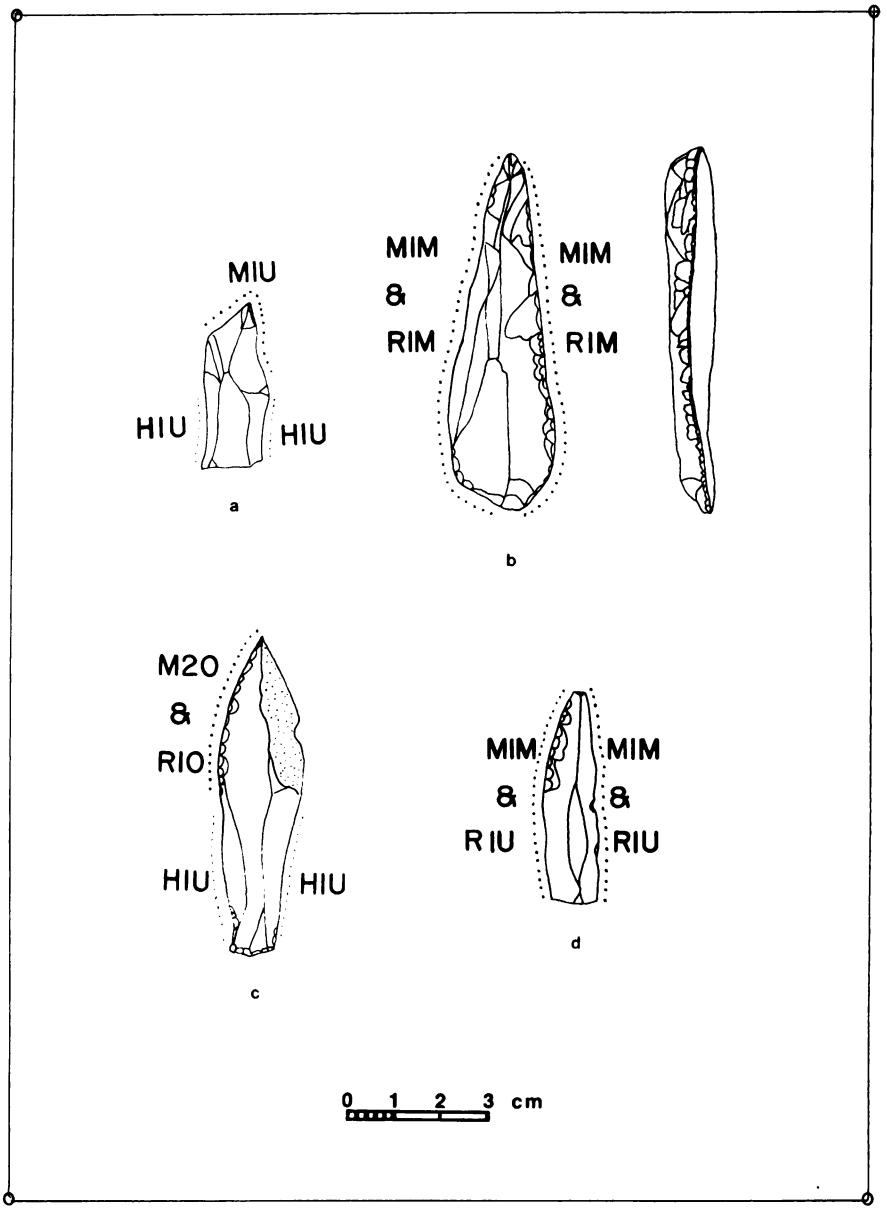


Figure D.22. Sampled points from level 4a.

edges, but not the proximal edge. Some silica damage is seen on the ventral face. It is hypothesized to have been used for butchering (Figure D.22d).

C.12. Sidescrapers on blades

PA SE 4a 101
L0 bilat sin [Smmd dex * Smm(m)d]/ Amd parz sen

There is a substantial amount of a bright rough BM microwear on projections of the lateral edges which is interpreted as resulting from bone. The edges are moderately rounded. On the edges there is also a very greasy appearing M1M microwear. Striations on the edges are perpendicular and parallel to the edge. There is much fracturing on the edges; the scars being minute, deep and feathered. The tool is hypothesized as having been used for meat butchering with much bone contact, possibly the result of jointing (Figure D.23a).

PA SE 4a 109
L0 bilat rect sin [Smmd parz dex * Smmi]

There is a M1P microwear which is bright and greasy with tiny fractures along the mildly rounded lateral edges. The microwear is better developed on the projections but it is not different in character. Striations are parallel to the edge. The tool is interpreted as used for meat cutting (Figure D.23b).

PA SE 4a 73
L1 (L2) dex conv [Sm(p)d cont (dent) parz dist]/
+ Epi dist + Smmd

The HM microwear found on the lateral edges of this tool varies from rough and greasy to dull and matt. It is most intense along the proximal half of the left edge. The striations vary in type and are mostly perpendicular to the edge although they also occur parallel to the edge. The tool is interpreted as used for hide working, possibly fleshing, but this is uncertain (Figure D.23c).

PA SE 4a 81
L2 sen conv [Spd]/* Smma parz

The lateral edges have M1M and scattered BM microwears. The M1M microwear is rough and greasy in appearance, and the edge is moderately rounded. There are

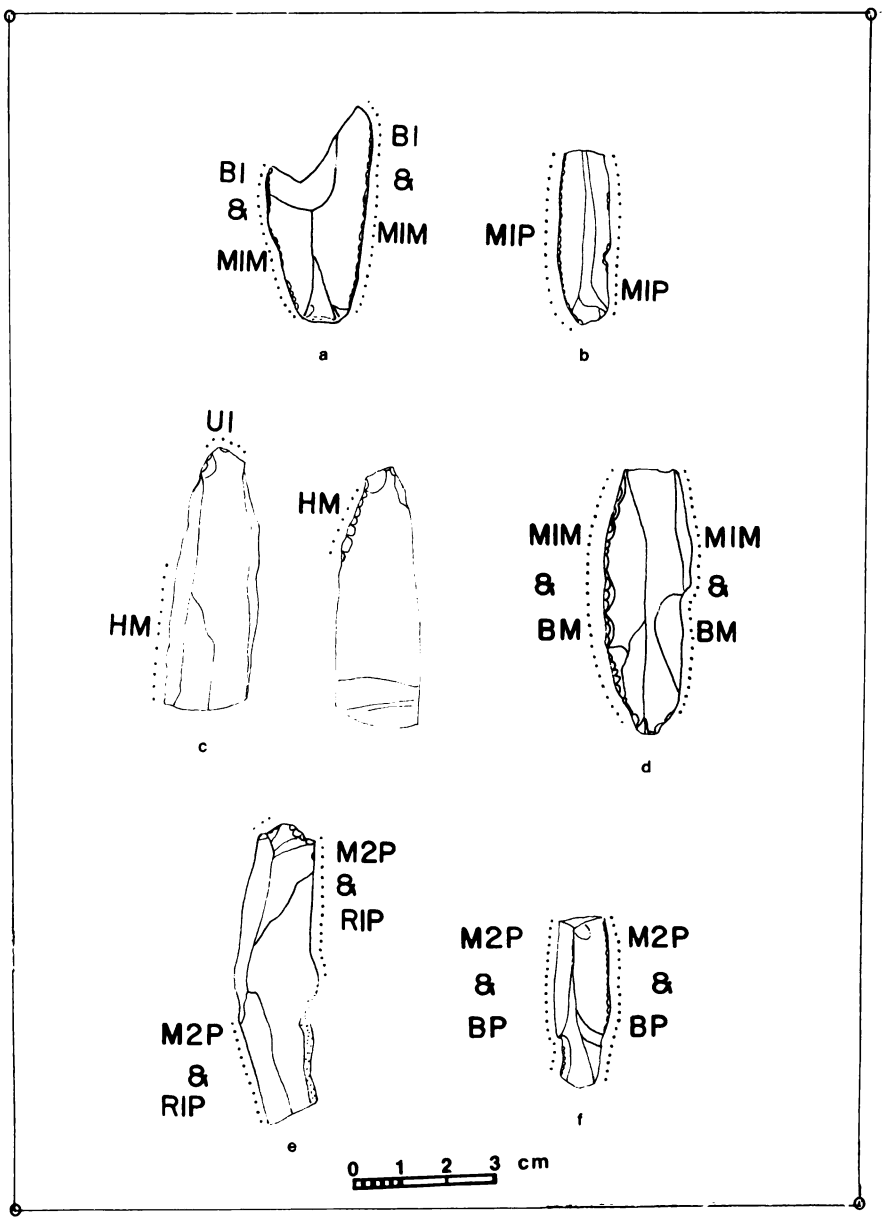


Figure D.23. Sampled scrapers on blades from level 4a.

scattered areas of bright, smooth and finely pitted microwear toward the distal end. Striations associated with this microwear are usually perpendicular to the edge. Toward the proximal end the microwear is more matt, less greasy and has a more rounded edge. The dorsal face is greasy appearing and the BM microwear is seen on some arrises with striations parallel to the working edge. The tool is interpreted as used for meat butchering (Figure D.23d; Photomicrograph 31).

PA SE 4a 88
L0 bilat sin [Smmd parz dex * Smma parz]/ Spd enc dist

Many parts of the lateral edges are not visible because of the material of the stone. Those edges visible have a well developed M2P microwear and some scattered R1P microwear. The edge is only mildly rounded, but there are many small fractures, usually obliquely oriented to the edge. The tool is interpreted as used for meat butchering (Figure D.23e; Photomicrograph 32).

PA SE 4a 98
L0 bilat sin rect [Smmd dex * Smmb parz]

The lateral edges of this tool have M2P and BP microwears. The edge is slightly rounded and fairly bright with a greasy hue on the faces near the edge. On the edge there are numerous bright rough microwears with parallel-track striations parallel to the edge. The tool is interpreted as having been used for meat butchering (Figure D.23f).

PA SE 4a 80
L1 bilat conv sin [Smma dex * Smmd - Smd enc]/
Smmd den dist

The lateral edges have a M2O microwear which is greasy, rough and somewhat bright. There is also a R1O microwear on some protrusions along the lateral edges. This tends to be bright and rough. Fractures and striations are obliquely oriented to the edge. The tool is hypothesized to have been used for meat butchering (Figure D.24a).

PA SE 4a 95
L1 dex sin [Smd]/* Smma

The lateral edges of this tool have a M2U microwear with occasional ares of an RU microwear. The edges are

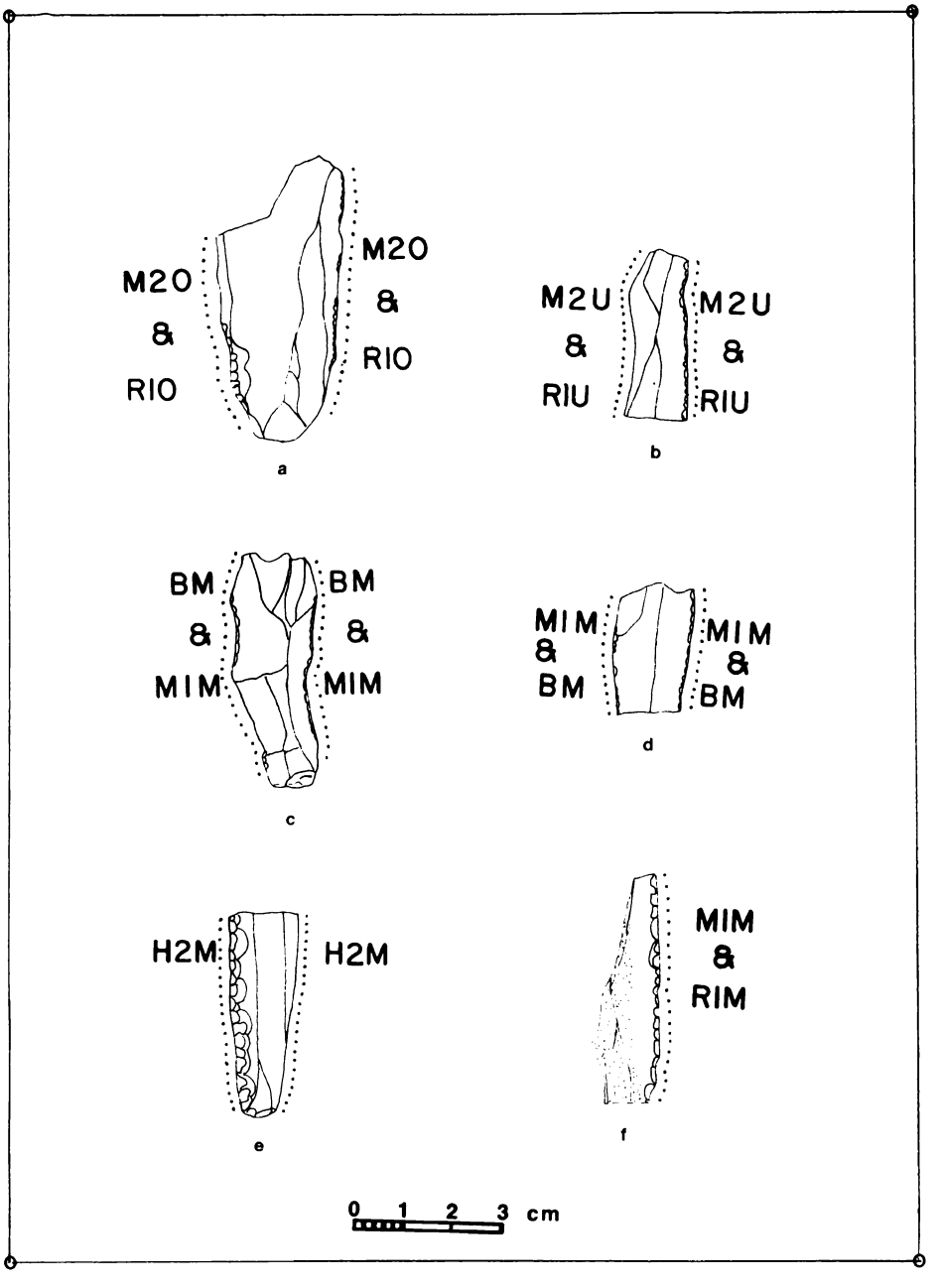


Figure D.24. Sampled scrapers on blades from level 4a.

extremely greasy in appearance and mild to moderately rounded. The tool is interpreted as having been used for cutting meat (Figure D.24b).

PA SE 4a 97
L1 bilat sin conc [Smd parz dex * Smd parz - Smmi]/
Smmd dex + Amd parz dist

The microwear is bright and rough and has fine striations perpendicular and parallel to the edge. Slightly back of the edge the microwear is greasy and somewhat rough. It appears to result from a BM and M1M microwears. The tool is hypothesized as having been used for meat butchering (Figure D.24c).

PA SE 4a 111
L1 sen rect [Smd]/- Amd parz * Smmd - Smd - Smmd

The lateral edges have the same pattern consisting of two microwears. A M2M microwear is found along the edge with occasional areas of a BM microwear. This microwear contains striations parallel and perpendicular to the edge. The tool is interpreted as used for meat butchering (Figure D.24d).

PA SE 4a 114
L2 sen rect [Spd]/* Smmd -- Smmd

The distal portion of the right lateral edge has a H2M microwear. It is rough and greasy with many striations perpendicular and parallel to the edge. This edge is very rounded. The left edge has a M1M microwear and some areas with a R1M microwear. Near the proximal end the microwear is more matt and there is also intense BU microwear. It is hypothesized that this is associated with hafting. The tool is hypothesized to have been used for butchering, but possibly for working fresh hide also (Figure D.24e).

PA SE 4a 84
L2 dex rect [Spd - Smd - Spd]

The one cutting edge has a M1M microwear with a substantial greasy appearance on the edge and face near the edge. At the mid-distal area there is extreme rounding, and a rough, somewhat bright H2M microwear with parallel and perpendicular striations. A very bright R1M microwear occasionally occurs on the edge and arrises. The tremendous rounding suggests much hide working although

other characteristics suggest the hypothesis that the tool was used for butchering (Figure D.24f).

PA SE 4a 117
L2 sen conv [Spd]/* Sm(mm)d

A H2S microwear is found on both lateral edges. It is slightly bright and rough to matt in texture. Some areas of bright R1S microwear are also found. Both microwear types have striations perpendicular to the edge. The tool is intepreted as used for fresh hide working, possibly for fleshing (Figure D.25a).

PA SI 4a 121
L1 (?) sen [Smd parz]/ Smmd bilat

Both lateral edges have a M2U microwear. It is very greasy in appearance but there is some mild to moderate rounding. There are also numerous small fractures. It is hypothesized to have been used for meat cutting (Figure D.25b).

PA SM 4a 350
L1 bilat sin [Smd]

The edges are not easily visible but the lateral edges appear greasy and sometimes rough. Edges are mildly rounded. The microwear is M2U, probably resulting from meat cutting (Figure D.25c).

PA SM 4a 389
L2 (F10) dex sin [S(P)pd parz]/- Smmd - S(P)md *
Smmd - Smma dist + Smmd

This tool has a M1P microwear on both lateral edges. Striations are parallel to the edge. The tool is hypothesized to have been used for butchering meat (Figure D.25d).

PA SM 4a 393
L0 dex sin [Smma]

This tool has a M1P microwear and an occasional R1P microwear on the right lateral edge. The M1P microwear is generally rough and greasy appearing while the R1P is

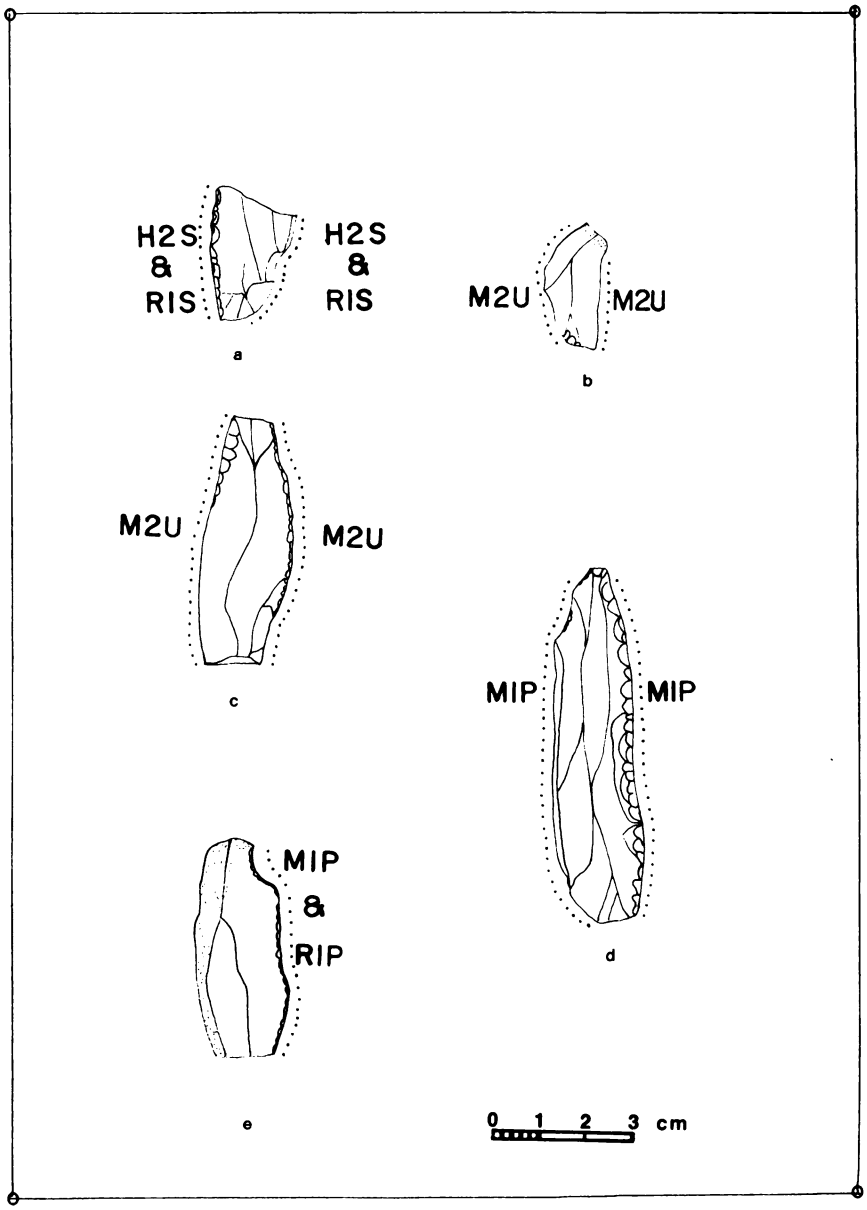


Figure D.25. Sampled scrapers on blades from level 4a.

bright and located only on protruding points along the edge. The tool is hypothesized to have been used for butchering meat (Figure D.25e).

PA SM 4a 376
L0 lat trav [Smma sen sin + Smmd dist]/ Amd parz dex prox

The left lateral edge has a well developed M1M microwear. It is greasy and rough with striations parallel and perpendicular to the edge. The opposite edge appears to have been used in the same manner but it is not clear. The tool is interpreted as having been used for butchering although it may also have been used for fresh hide working (Figure D.26a).

PA SM 4a 380
L2 (F10) dex conv [S(P)pd parz]/ Sm(mm)d parz dex *
Smmd - Smma

The microwear on the retouched edge is very similar to the left edge of SM 376. It is a M1M microwear which is rough and greasy. The edge is moderately rounded and striations are both parallel and perpendicular to the edge. The opposite edge is difficult to see. The tool is interpreted as used for butchering (Figure D.26b).

C.13. Sidescrapers on flakes

PA SE 4a 139
R0 sen conv [Smma parz]

The right lateral edge has a well developed, very greasy appearing and somewhat rough M2M microwear. There is little rounding. The edge is hypothesized as used for meat cutting (Figure D.27a).

PA SE 4a 135
R0 conv rect [Smma dex * Smmd parz]

This tool is very similar to SE 139. The left lateral edge has a well developed, very greasy M2M microwear. There is little rounding. It is hypothesized to have been used for meat cutting (Figure D.27b).

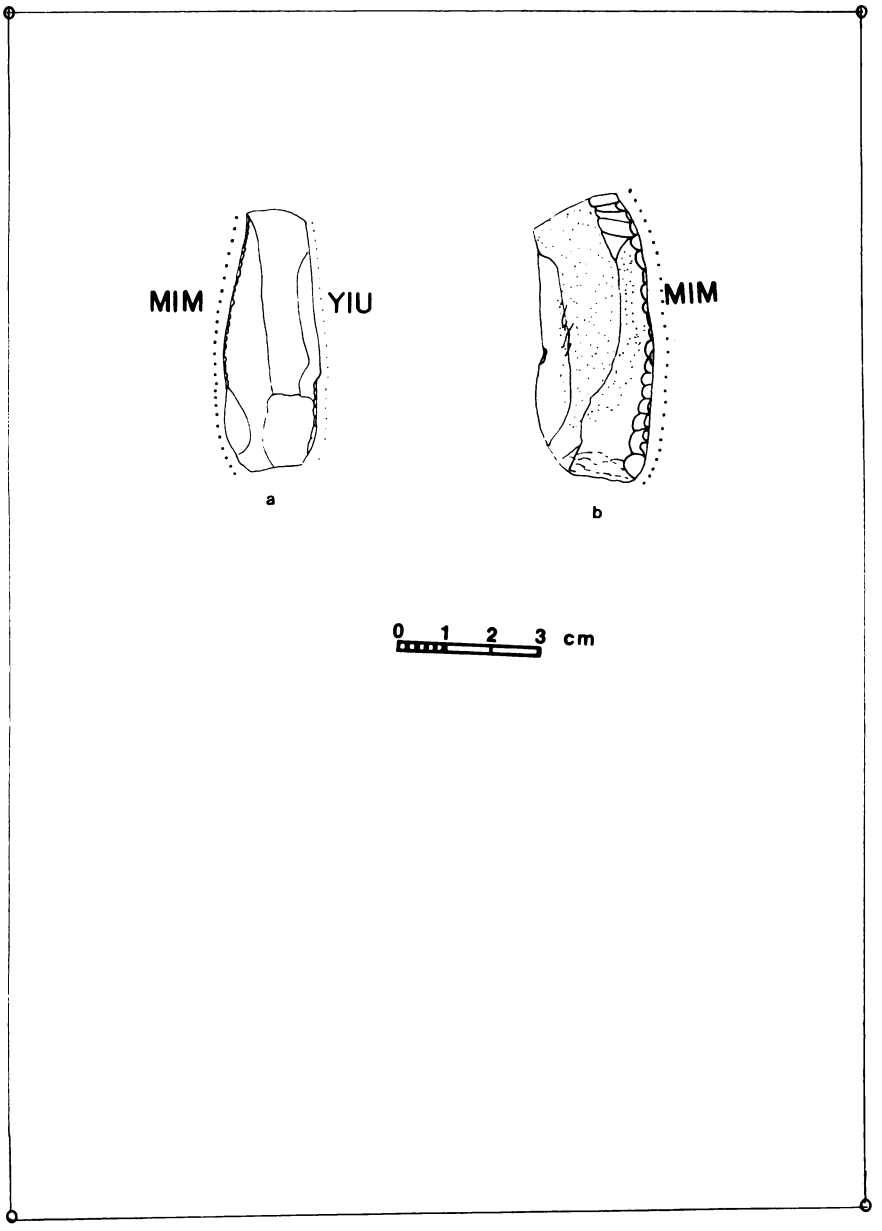


Figure D.26. Sampled scrapers on blades from level 4a.

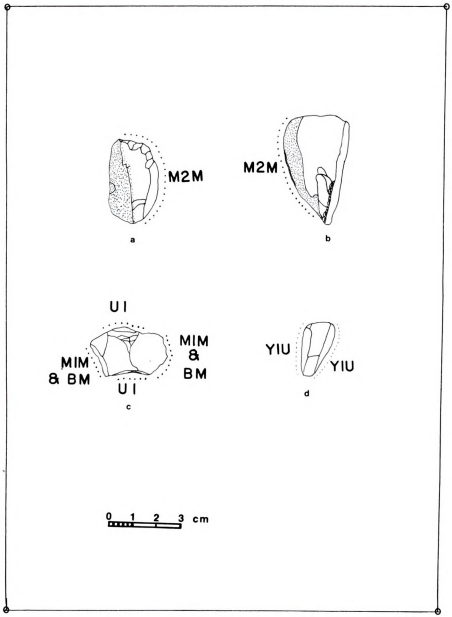


Figure D.27. Sampled scrapers on flakes from level 4a.

PA SI 4a 125
RO lat trav [Smma dex conc + Smma dist conc +
Smma rect - Ami + Ami]/ Epb prox

This flake has M1M and BM microwears on both lateral edges. The BM microwear is intense and there is much edge fracturing. There are also some impact fractures at the proximal end. The tool is thought to have been used for jointing and other butchering activities (Figure D.27c).

PA SM 4a 408
RO bilat conv [Smma]/+ Smmd dist

This small flake has microwear along the edge but it also has much silicate damage that renders classification of the microwear impossible (Figure D.27d).

C.14. Abrupts

PA SE 4a 177
A1 dex [Amd parz]/* Smmd rect

This is the only abrupt studied that has classifiable microwear. There is a M20 microwear on the distal left edge of the tool. It is greasy in appearance and extends well up the face. There are numerous tiny fractures oblique to the edge. It is hypothesized that the tool was used for meat cutting (Figure D.28a).

C.15. Denticulates

PA SE 4a 167
D2 trav prox [Smi]/+ Smmi dex

There is some MU microwear on the left distal aspect of this tool fragment. It is moderately rounded and has a slightly greasy and rough texture to it. It is hypothesized to have been used for cutting meat (Figure D.28b).

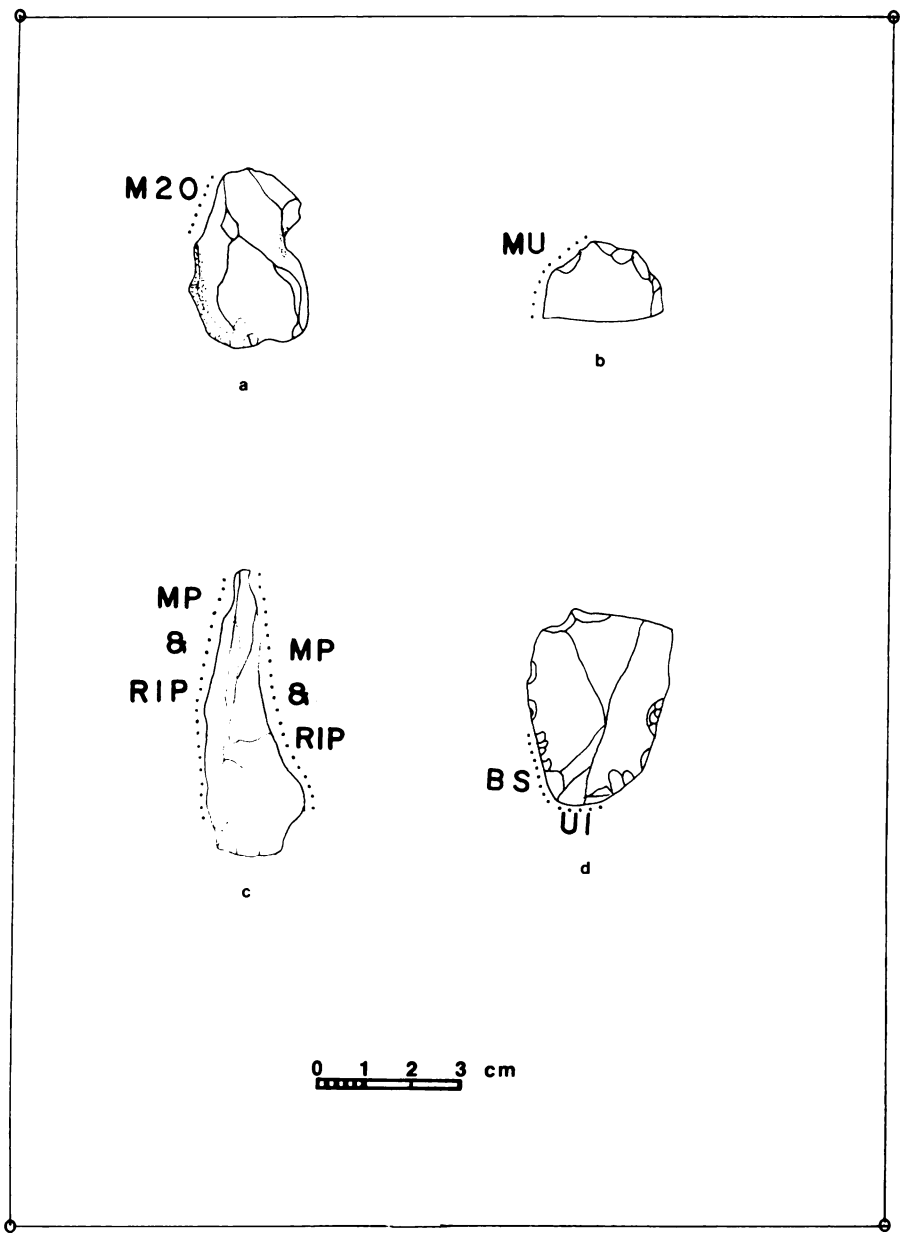


Figure D.28. Some sampled abrupts and denticulates from level 4a.

PA SE 4a 166
D2 trav dist "a spina" [Spd] * T3 prox conv [Spb - Spd]/
Smb sen * Smd

This composite tool has a BS microwear on the proximal end of the left lateral edge. There is much fracturing and some silicate "autoabrasion" in addition to the bright, rough, striated and pitted microwear. Striations are perpendicular to the edge. The proximal end has impact fractures (UI microwear) with much silica damage. It was probably pounded by, or wedged into, a hard object. The tool was probably used on bone, possibly for jointing during the butchering process, but this is uncertain (Figure D.28c).

PA SM 4a 383
D2 sen dist [Spd parz]/- Smmd parz * Smmi parz

This denticulate has a MP and a R1P microwear on both lateral edges. The tool is interpreted as used for butchering. The marginally denticulated edge is probably the result of use (cutting on bone) and is not deliberate retouch (Figure D.28d).

C.16. Splintered flakes

PA SI 4a 130
E1 [Epi * Em(p)b]

The impact fractured ends of this tool have no visible microwears and are therefore labeled UI. The lateral edges have very well developed W10 microwears. Striations are oblique and perpendicular to the edge. The tool is interpreted as used for working (whittling) wood (Figure D.29a; Photomicrograph 36).

PA SI 4a 129
E1 [Epb * Epb]/+ Sma * Sma

This tool has the exact pattern of SI 130 except the striations are more consistently perpendicular. Thus the lateral edges are classified as (W1S). The left edge is more developed than the right edge. The distal and proximal ends (UI) both have impact fractures, but no evidence of the material which produced them.
The tool is hypothesized to have been used for scraping or whittling wood (Figure D.29b).

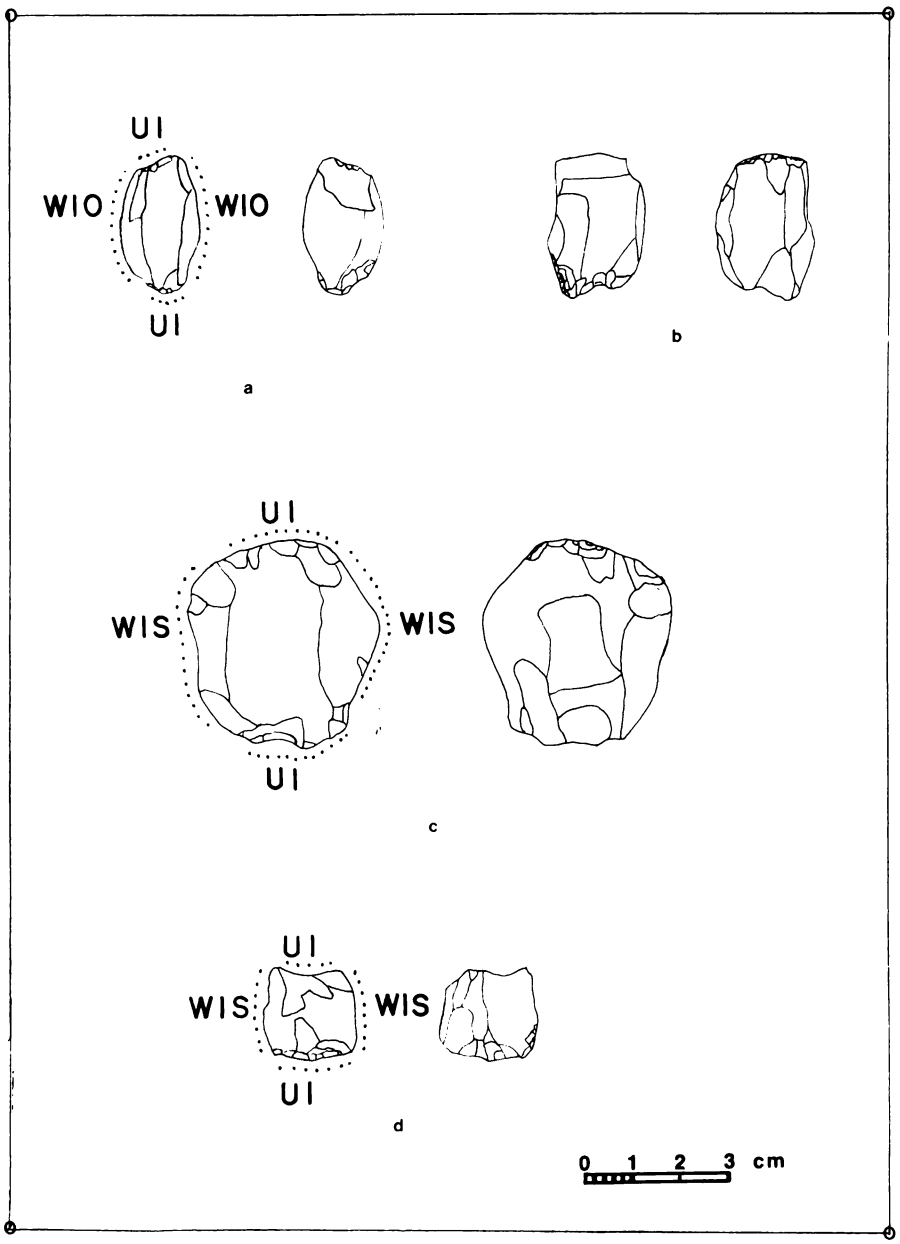


Figure D.29. Sampled splintered flakes from level 4a.

PA SM 4a 509
E1 prox sin [Epi]/+ Smmd dex

Once again the same pattern as the other splintered flakes. Impact fractures are found on the distal and proximal ends (UI) and well developed W1S microwear is found on the lateral edges. It is hypothesized to have been used for whittling or scraping wood (Figure D.29c).

APPENDIX E

PHOTOMICROGRAPHS

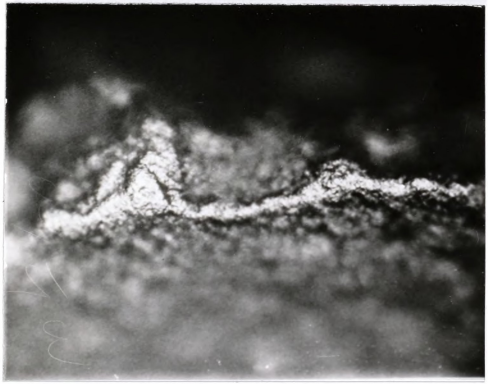
Pm.	Specimen	Description
1	Ex-1011	Unused surface of flint
2	Ex-1011	Unused edge of same flint; edge on view
3	Ex-h2	H1 microwear from scraping dry hide
4	Ex-1020	H1 microwear from scraping greasy dry hide
5	Ex-1020	H2 microwear from scraping greasy hide
6	Ex-2003d	H2 microwear from scraping fresh hide
7	Ex-2003a	M1 microwear from skinning kid goat
8	Ex-1007	M2 microwear from meat cutting
9	Ex-2003c	M2 microwear from meat cutting
10	Ex-1009	P1 microwear from working burlap (jute)
11	Ex-h4	P2 microwear from working jute cord
12	Ex-1010	W1 microwear from working pine
13	Ex-2001	B1 microwear from scraping antler
14	Ex-2001	B2 microwear from sawing antler
15	Ex-1002	B3 microwear from graving bone
16	Ex-1025	S1 microwear from boring shell
17	SE 128	Glass or ceramic produced microwear
18	SE 305	Metal smear on specimen from striking microscope
19	Ex-1015	Flint on flint abrasion
20	SE 48	Blade manufacture platform on burin
21	SE 108	WU microwear on burin edge
22	SE 17	Edge on view of H1S microwear on endscraper front
23	SE 56	Lateral edge of truncate with H2M microwear
24	SE 31	Used lateral edge of endscraper; H2M type
25	Ex-h4	Abraded P2U microwear by haft wear on lateral edge of endscraper
26	SE 72	W1M microwear on lateral edge of a bec
27	SE 235	M2U microwear on a backed point
28	SE 130	P2M/W1M microwear on a foliate scraper
29	SE 130	Edge on view of above foliate; note the extreme rounding
30	SE 126	M1M microwear on point for butchering
31	SE 81	BM (bone) microwear on blade; butchering
32	SE 88	M2P microwear on blade for butchering
33	SE 114	R1M microwear resulting from butchering
34	SM 356	M2U microwear on lateral edge of truncate
35	SM 356	Same displaying the edge rounding
36	SI 130	W1O microwear on lateral edge of a splintered tool



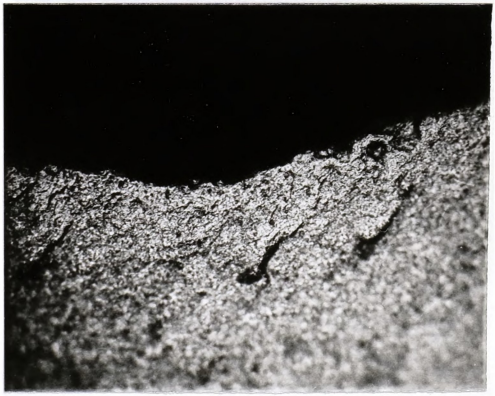
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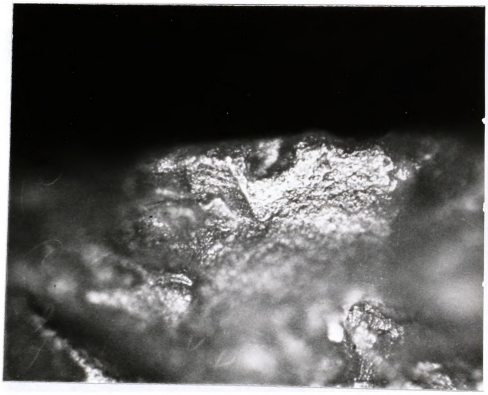
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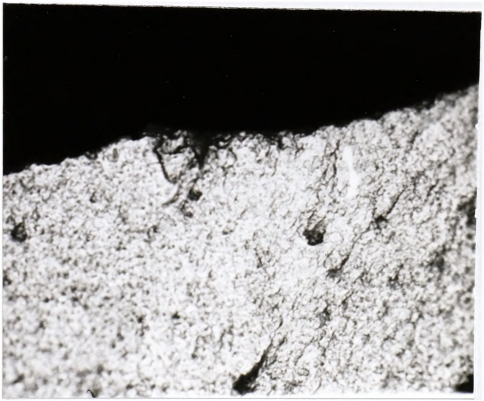
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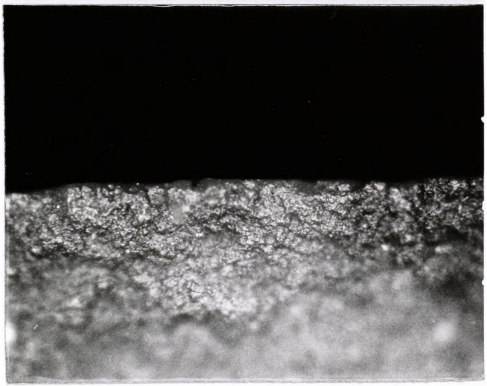
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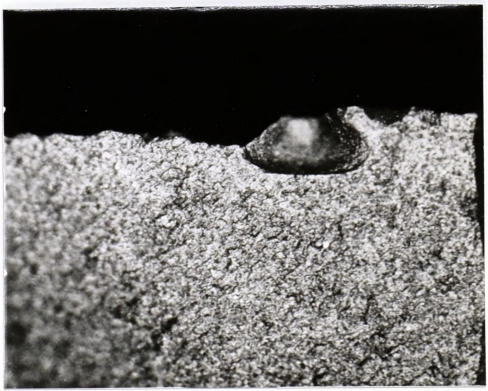
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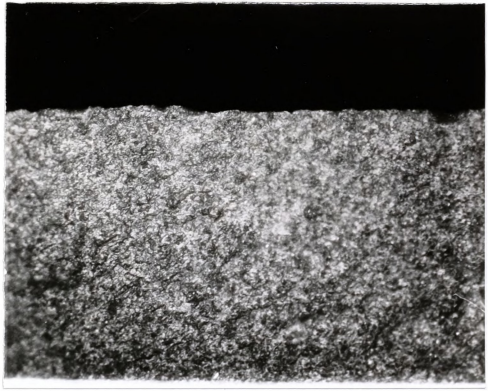
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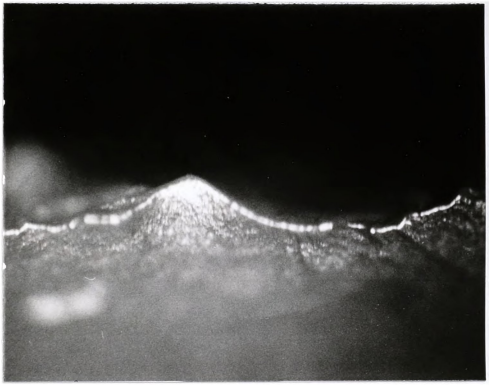
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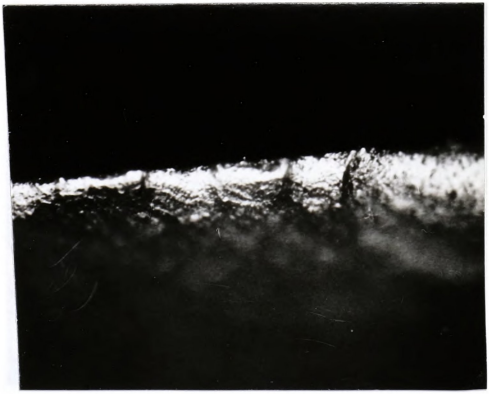
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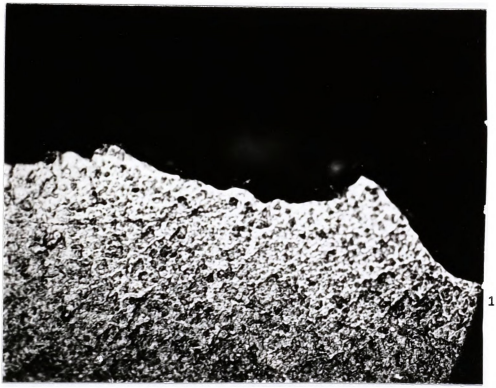
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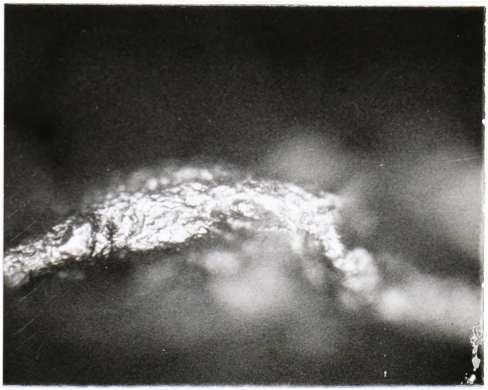
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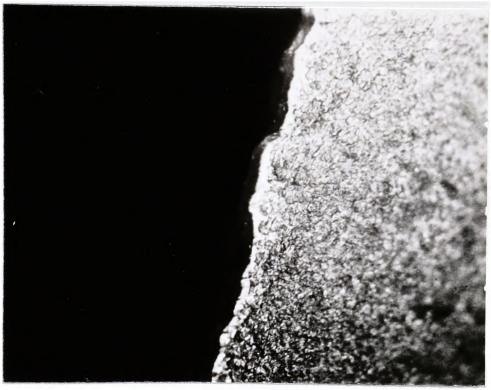
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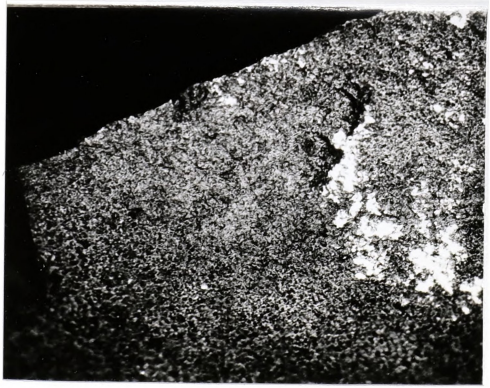
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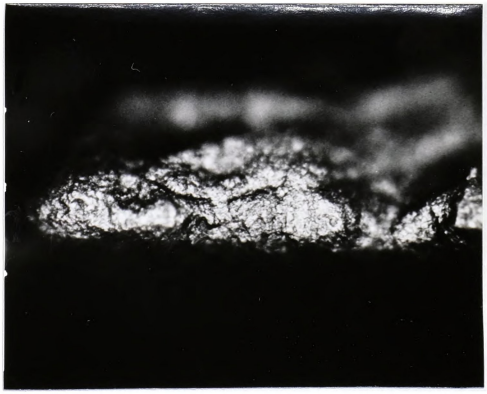
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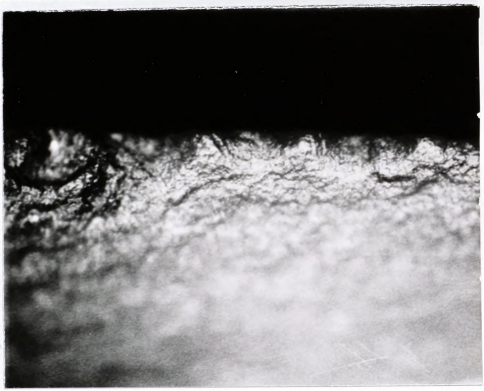
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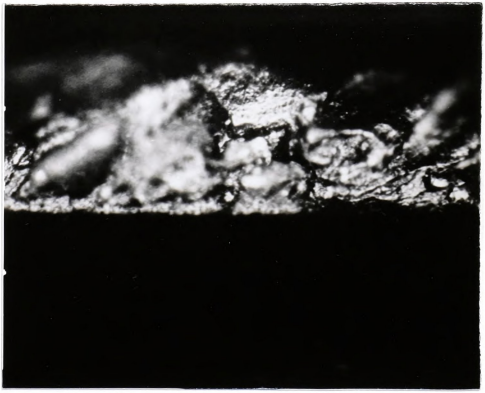
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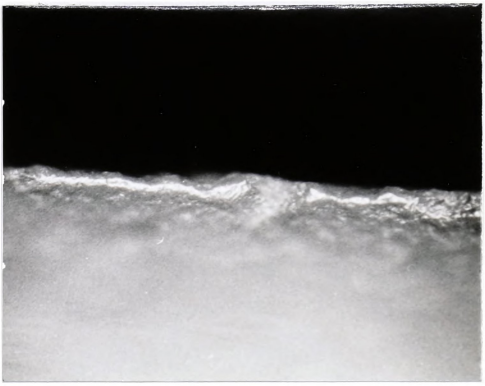
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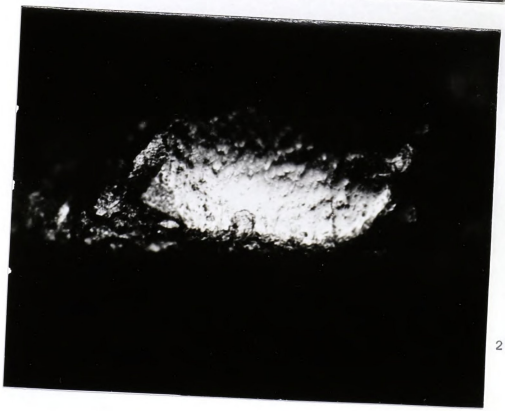
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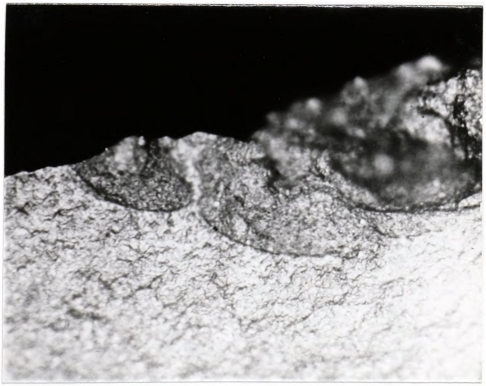
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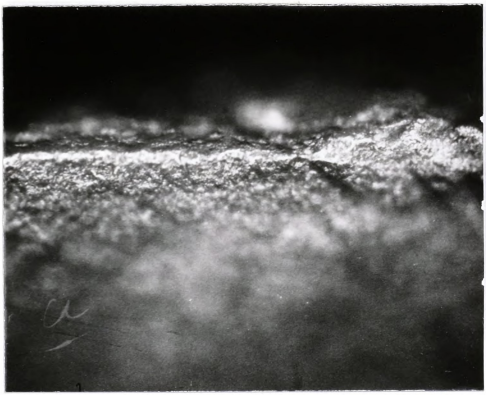
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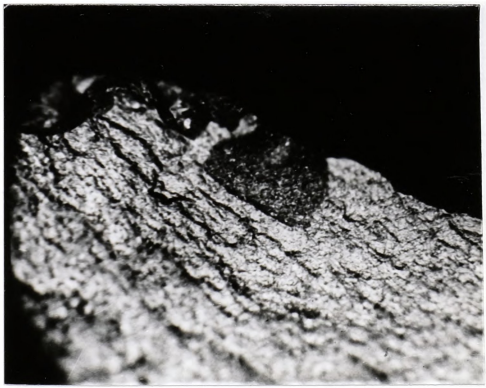
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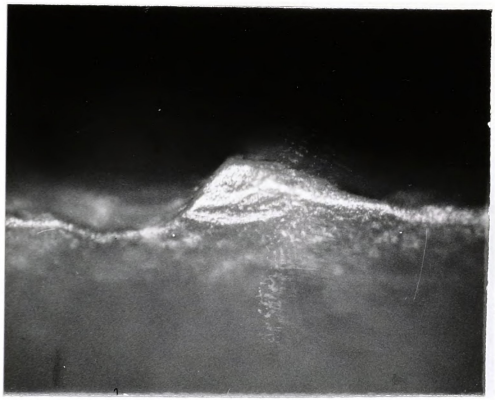
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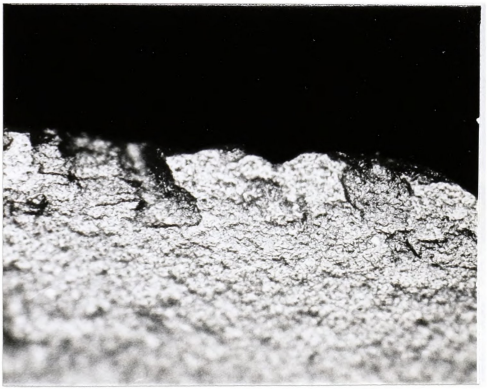
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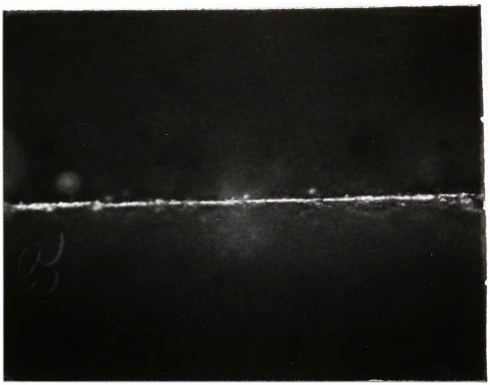
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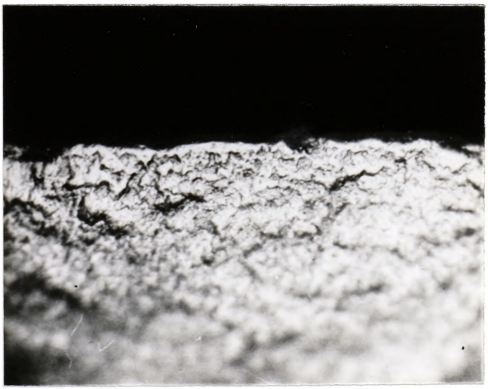
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