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A Functional Analysis of the Lithic Material From Burrone Scierra I (Calabria, Italy)

Maureen A. Hays
University of Tennessee, Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Maureen A. Hays entitled "A Functional Analysis of the Lithic Material From Burrone Scierra I (Calabria, Italy)." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Jan F. Simek, Major Professor

We have read this thesis and recommend its acceptance:

Charles Faulkner, Andrew Kramer

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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A FUNCTIONAL ANALYSIS OF THE LITHIC MATERIAL FROM BURRONE SCIERRA I (CALABRIA, ITALY)

A Thesis
Presented for the
Master of Arts
Degree
University of Tennessee, Knoxville

Maureen A. Hays
August 1992

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Date June 28, 1992

This thesis is dedicated to my parents

Dennis and Eileen Hays.

They introduced me to archaeology

and supported me all the way.

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ABSTRACT

The purpose of this research is to investigate several aspects of function within Mousterian assemblages by performing an analysis of artifacts from Burrone Scierra I, a site on the Ionian coast of Calabria, Italy. This research focuses on the relationship between function and the edge angle, tool size, raw material, technology and typology. Another intent of this study is to examine what spatial integrity remained at the site. The study assemblage is a surface collection from a plow zone context. Because the collection under investigation is from plow zone context the methods employed are those developed for low-power microwear analysis.

Results of the investigation reveal that several distinct activities were taking place at the Burrone Scierra I site. These activities include cutting, scraping, graving and boring on materials defined as hard, medium or soft. Two distinct activity areas are identified.

It is concluded that a relationship exists between function and edge angle and tool size, while there is little to no relationship between function and technology and typology. Some spatial integrity is maintained even within

plow zone context allowing for the definition of activity areas. Therefore, in the future microwear analysts should not shy away from assemblages that have been obtained from plow zone contexts.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Chipped stone artifacts play a very critical role in the interpretation of prehistory. For nearly 2.5 million years the utilization of a stone tool technology has allowed humans to manipulate their environment in ways which allowed for the making of clothes and the building of shelters for protection from the elements, and the hunting of game needed for survival. Due to temporal as well as preservational conditions stone implements have been in abundance throughout prehistory and compose much of the archaeological record. In fact, if there is poor bone preservation in the areas of investigation, chipped stone artifacts are often the only remaining record of prehistoric hunters and gatherers (Barton 1990; Chase and Dibble 1987; Odell 1988). For this reason a great emphasis has been placed on stone tool analysis and interpretation. In the past century lithic studies have gone through an evolution in analysis techniques, and as a result archaeologists can, with more confidence, infer behavioral patterns based on the analysis of the lithic component at a site.

There are various means by which lithic artifacts are studied. Depending upon the interests and objectives of the analyst the study can take several turns. Some studies focus on defining cultural chronologies and typologies, some focus on analyses of technological stages in the manufacture and production of the stone implements, others concern themselves with the identification of style, and lastly some analysts concern themselves with the investigation of function. Each of these techniques will be addressed briefly.

Typological studies focus on classifying artifacts and placing them into categories. Dunnell (1971) states that "class, as a unit of meaning, can be thought of as a conceptual box created by its boundaries. The boundaries are established by stating the criteria which are required, the necessary and sufficient conditions, to be included within the box or class" (p.45). A type is defined as "a paradigmatic class of discrete objects defined by modes. Types are not groups of objects, but classes whose significata consist of sets of modes stating the necessary and sufficient conditions of membership. Since these conditions are modes and modes are cultural, types are cultural" (p. 158). These modes may be things such as edge

shape and the retouch pattern along the edges of the piece. The combination of these modes then makes up the types such as end-scraper or burins. Bordes study (1950) is a fine example of just such a typology (Figure 1). These types are then in turn used to measure variability in an assemblage by noting the presence, absence, and percentage of certain types within the assemblage. Variability in Mousterian assemblages is usually measured in just such a way (Bordes 1950, 1961, 1972, 1973; Bordes and de Sonneville-Bordes 1970). The concept of variability in Mousterian assemblages will be discussed in detail in chapter 2.

While typological studies are concerned with forming culture chronologies, technological studies focus on identifying the various stages of manufacture from acquisition of the raw material, through the various stages of production, to the ultimate discard of the stone artifact. Geneste (1985, 1989) addresses the methods involved in technological analyses. Geneste's "chaine d'operatoire" defines technological stages from 1 to 26 (Table 1). These stages place artifacts in various technological categories based on modes such as amount of cortex, type of flake, and whether retouch is present. This allows the analyst to interpret

Number	Bordesian Type
Levallois Tools	
1.	Typical Levallois Flakes
2.	Atypical Levallois Flakes
3.	Levallois Points
4.	Retouched Levallois Points
5.	Pseudo-Levallois Points
6.	Mousterian Points
7.	Elongated Mousterian Points
8.	Limaces
Side-Scrapers	
9.	Single Straight
10.	Single Convex
11.	Single Concave
12.	Double Straight
13.	Double Straight/Convex
14.	Double Straight/Concave
15.	Double Convex
16.	Double Concave
17	Double Concave-Convex
18	Convergent Straight
19.	Convergent Convex
20.	Convergent Concave
21.	Asymmetrical
22.	Transverse Straight
23.	Transverse Convex
24.	Transverse Concave
25.	Side-Scraper on the Ventral Surface
26.	With Abrupt Retouch
27.	With Thinned Back
28.	Bifacially Retouched
29.	With Alternate Retouch
Upper Paleolithic Tools	
30.	Typical End-Scraper
31.	Atypical End-Scraper
32.	Typical Burin
33.	Atypical Burin
34.	Typical Borer
35.	Atypical Borer
36.	Typical Backed Knive
37.	Atypical Backed Knive
38.	Naturally Backed Knive
39.	Mousterian Raclette
40	Truncated Piece Blade or Flake
41.	Mousterian Tranchet
42.	Notch
43.	Denticulate
44.	Alternate Retouched Beaks
45.	Piece Retouched on the Ventral Surface

Number	Bordesian Type
Miscellaneous Retouched Flakes	
46.	Abrupt Thick Retouch
47.	Alternate Thick Retouch
48.	Abrupt Thin Retouch
49.	Alternate Thin Retouch
50.	Bifacially Retouched Piece
51.	Tayac Point
52.	Notched Triangle
53.	Pseudo-Microburin
54.	End Notched Piece
55.	Hachoir
56.	Rabots (Plane)
57.	Aterian Tanged Point
58.	Tanged Piece
59.	Chopper
60.	Inverse Chopper
61.	Chopping-Tool
62.	Miscellaneous
63.	Bifacial Foliates (Blattspitzen)

Figure 1. Bordesian Tool Typology (after Bordes 1950).

Table 1. Technological Typology (after Geneste 1985).

Reference Type	Descripteurs Technologiques	Phase
0	block of raw material tested or untested	
1	cortical flake, test flake, (more than 50% cortex)	0 Acquisition
2	flake with residual cortex (less than 50%), or cortex on the platform	
3	naturally backed knife	1 Beginning the Shape
4	flake, ordinary point, or core rejuvination flake	
5	ordinary blade	
6	atypical Levallois flake, or pseudo Levallois flake, or flake with offset platform	
7	Levallois flake	2 A
8	Levallois blade	
9	Levallois point	
10	pseudo Levallois point	Production of Supports
11	disk core	
12	miscellaneous core	
13	Levallois flake or point core	
14	Levallois blade core	2 B
15	backed Levallois flake	
16	edge of core, crested blade or flake	
17	core fragment	
18	Kombewa core on flake	
19	thinned flakewith abrupt retouch	
20	Kombewa flake	2 C
21	indeterminent flake fragment without cortex	
22	bifacial thinning flake	3 Transformation of Supports Residues and Miscellaneous
23	retouch flake	
24	debris larger than 30 mm with or without cortex	
25	debris smaller than 30 mm with or without cortex	
26	small flake, whole or fragmented, smaller than 30 mm	

where along the "chain of production" the artifact lies based on where the artifact falls within this classification.

Style is quite an elusive term to archaeologists due to the nature of the concept. To define style is to imply that what was taking place in the mind of the prehistoric person at the time that the implement was fashioned can be known. Therefore, in order to select the attributes that define style one generally screens out any attribute that may be ascribed to technology or function. Attributes that cannot be explained as being linked to production or function are then attributed to style (Barton 1990; Sackett 1973). In any event, stylistic analyses must be approached with much caution lest we delve into the realm of fiction writing and story telling.

Functional analyses are critical to the study of prehistory. By understanding how stone implements were used prehistorically we begin to understand how humans manipulated their environment for survival. Once those functions are determined they may be examined spatially to define activity areas within the site and to compare activities between sites. Not only can functional studies shed light on where

activities were taking place but they can also begin to bring to the archaeologist an understanding of what materials were being exploited. Was the site being used to butcher animals? to process vegetal materials? to work bone? Functional analyses are linked directly to economic activities that took place prehistorically. Functional studies may also glean knowledge on prehistoric decision making and choice (Odell 1977). By investigating the relationship between function and raw material; function and size and edge angle of the artifact; function and technology; and function and typology; we can begin to understand what choices were being made and begin to interpret why these choices were made.

The objective of functional analyses moves away from ordering variability towards interpreting variability. While typologies strive to order variability based on morphological attributes, functional analyses attempt to use attributes that are the result of utilization to interpret the functional role of the stone implement. The use of experimentally defined functional attributes in an analysis is not always the norm. For example, stone implements are frequently classified using functionally loaded names such as 'side-scraper' and often the analyst assigns functional

designations to implements devoid of performing any analysis that examines attributes associated with function. Binford and Binford (1966) in performing their infamous "functional" analysis of a limited sample of Mousterian assemblages, one from France and two from the Near East, assigned certain tools a priori to functional classes designed using Bordesian tool types. After performing a factor analysis on these classes, variability within Mousterian assemblages was interpreted as being a result of function. Though Mousterian variability may indeed be linked to function, the Binfords' analyses did nothing to substantiate that claim because they did not examine attributes that are indicative of function, and they essentially reaffirmed Bordes' original groupings. Caution must be used when considering the functional possibilities of an assemblage that has been typed using morphological typenames with functional overtones.

Caution must be employed so that the new functional classes are not solely based on the old types. This would only reconfirm what has already been said using functionally loaded type names by default. For example, just because something has been named a "Mousterian point" does not mean that its purpose was to be projected. A Mousterian point

not only has a point but also two edges that can be used for cutting or scraping and studies show that "Mousterian points" have been used for just such a purpose (Shea 1988, 1989). Several investigators have seen that form does not necessarily correspond with function (Ahler 1971; Odell 1982; Tringham 1974). It has also been noted by Dibble (1984, 1987a, 1987b) and Chase and Dibble (1987) that as many as twenty different typological classes of side-scrapers may not be related to style at all but rather simply to the reduction of the pieces through resharpening.

Typological studies have their role in lithic analysis, but that role is not to act as a substitute for functional analyses that examine attributes that are the direct result of utilization. Attributes that reflect various kinematics, (cutting, scraping, graving and boring) and those attributes that may give evidence to the type of material worked, are critical in understanding past behaviors. By using an attribute approach we may be able to deduce which attributes co-vary and this may shed some light on variability that exists in Mousterian assemblages (Fish 1979). Techniques have been developed and expanded upon over the last three decades that address the issue of tool function. These techniques have produced two "camps" of proponents, those of

high-power microscopic analyses and those proponents of low-power microscopic analyses. Both methods rely heavily on experimental data simulated to replicate prehistoric activities and the analogies that can then be drawn from the data produced.

High-power microscopic analyses use magnifications between 300x and 500x or more and are very appropriate methods of analyses under many circumstances. However, because the attributes that these methods assess are very sensitive to post-depositional damage (Keeley 1980) these methods are not considered appropriate for this study. Post-depositional damage, especially damage that artifacts are subjected to within the plow zone, can all but obliterate the defining attributes high-power microscopic analysis relies upon for its interpretation of function.

Low-power microscopic analyses use magnifications between 10x and 100x. Although the attributes that this method assesses are also sensitive to post depositional damage, experiments have been conducted to isolate such damage so that it may be screened out of the analysis and not be misinterpreted as utilization damage (Mallouf 1982; Odell 1985).

It was the purpose of this thesis to address the concept of function by performing an analysis of a Mousterian assemblage from Burrone Scierra I, a site on the Ionian coast of Calabria, Italy. The study assemblage from Burrone Scierra I, Calabria, Italy , is a surface collection from plow zone context. Therefore it was decided that the best method of functional analysis would be low-power microscopic approach. Methods used included low-power microwear analysis epitomized by the work of Ruth Tringham (Tringham et al. 1974) and firmly upheld by George Odell (1975, 1977, 1988). Attributes that could be identified as functionally specific according to the literature were assessed. These attributes were then combined and used to identify the various functional groupings at the site as well as to identify the number of different "tools" present in the assemblage.

In this study the edge or utilized portion of the edge was the basic unit of analysis. A low-power microscopic analysis of the attribute patterns definitive of function was performed on the assemblage from Burrone Scierra. The fundamental objectives of this study were to discover the range of activities carried on at the site and the areas where they took place. This study also examined the

relationships between the following: technology, typology, raw material, tool size, and edge angle.

One very critical objective for this study is to determine the functional integrity maintained within plow-zone assemblages. Should microwear studies even be attempted on such collections? It was discovered that relationships between these various states did exist and therefore functional studies of assemblages within the plow zone should not be overlooked. Not only can functions be assigned to individual implements, but the activity areas within the site also maintain some integrity. From this, adaptational as well as economic patterns may be deduced and broader questions about culture change and process during the Mousterian of southern Italy may be addressed.

CHAPTER II

OVERVIEW OF THE MOUSTERIAN

The Middle Paleolithic is a chronological time period defined by subdividing cultural traditions throughout the Pleistocene based mainly on stone tool technologies. For ease of identification and discussion let us say that the Middle Paleolithic is a period that took place during the Riss and early Wurm glacial periods (125,000-35,000 B.P.) (Gamble 1986). It is defined by and equated with the artifact complex named the Mousterian in Europe and the Near East.

The Mousterian complex is commonly identified as a flake technology (as opposed to a blade technology) in association with various percentages of side scrapers and other tool types. In Europe the Mousterian technology is generally associated with *Homo sapiens neandertalensis* skeletal remains. However, this is not the only technology that Neandertals have been associated with. They have also been found with what has been defined as the first Upper Paleolithic technology, the Chatelperronian, at Saint-Cesaire and Arcy-sur-Cure (Leveque and Vandermeersch 1980) in France. To complicate matters further, Neandertals are

not the only hominids associated with the Mousterian complex. In the Near East at Qafzeh and Skhul anatomically modern humans have been associated with Mousterian implements (Bar Yosef et al. 1986; Jelinek 1982, 1990; Marks 1990; Stringer et al. 1989).

The Mousterian is not only distinguished by its stone tool technology but by other cultural characteristics as well. Oddly enough, though the Mousterian tradition employs a very complex tool technology there is little evidence for the manufacture and use of bone tools (Klein 1989; White 1982). At Cueva Morin (Freeman 1978) there is some evidence for the very beginnings of bone tool working. It would appear that the bone worked at this site was worked in a similar fashion to that of stone. The bone was retouched along the edges like stone tools. Binford (1981) has dismissed the retouching on these bone tools as canid gnawing along the edges. Other evidence for bone working has been found at La Grotte Vaufry (Rigaud 1989) as well as at Bilzingsleben (Mania 1986).

There is some evidence for wood tools, but they have only been found at a handful of sites because of the perishable nature of the material. An example of this was found at a site in Germany called Lehringen, when a 2.4 m

long spear was recovered in amongst the rib bones of an elephant (Movius 1950). Some of the best evidence for the manufacture of wooden tools comes from microwear studies (Anderson 1979, 1990; Beyries 1989). These studies indicate that a great deal of wood working was being done by the people of the Middle Paleolithic.

Unlike for the Upper Paleolithic, there is very little evidence for art or personal ornamentation during the Mousterian, and the evidence that we do have is somewhat inconclusive. Though no parietal art is associated with Mousterian complexes the same raw materials used by the succeeding cave artists have been found in the Mousterian levels at Pech de l'Aze. One hundred fragments of the black mineral manganese dioxide and red ocher were discovered in the cave, and most of the fragments were polished or worn flat from wear on one side from use (Bordes 1972). From this evidence one might infer that the Mousterian people were producing art forms on perishable materials such as wood or possibly the pigments were used as body paints for personal ornamentation. Another interpretation of the presence of these pigments could be for their use as abrasives in tanning hides. Other evidence for body ornamentation is scarce. Only a few animal teeth that may

be perforated for suspension around the neck have been found. Dibble and Chase (1987) have questioned these ornaments and have proposed that the punctures may have been made by carnivore action.

It is also during this period that we see the first evidence for intentional burial of the dead. Excavated graves and the arrangement of the graves and bodies within them shows planning and forethought. An investment of time and energy in the preparation of the grave, the body and in some cases grave goods sees its beginning in the Mousterian. There were several types of burial practices. Simple singular burials like that at Le Moustier were common. The burial at Le Moustier contained a single individual whose bones had been defleshed and then bundled together and later placed in a pit feature along with tools of the Mousterian of Acheulean Tradition (Peyrony 1930). At Tekshish Tash (Movius 1953) a burial of a young child laid out in anatomical position was discovered. There were rocks placed in a circular pattern around the burial pit along with eight pairs of ibex horns placed around the body. Besides the singular burials there were also group burials. These group burials sometimes involved multiple individuals buried together in the same grave, and at La Ferrassie there were

multiple individuals buried in separate graves. This complex included several pit graves all at the same level (Peyrony 1934). It is difficult to determine whether evidence of this kind testifies to a simple reverence for the dead or reveals something as complex as a belief in an afterlife. This point is, however, inconsequential. What is of consequence is that there was a cultural tradition for the burial of the dead and this tradition like that of the Mousterian tool technology was taught and practiced throughout the time period.

The Mousterian technology changed little over a period of over 90,000 years. This lack of change can be interpreted in many ways. One argument might be that people of the Mousterian were less innovative and less advanced than later peoples of the Upper Paleolithic (White 1982). Before the discoveries at St. Cesaire it was also argued that the Mousterian people were incapable of making the "more advanced" blade tools that characterize the Upper Paleolithic. This same lack of change over 90,000 years has been used in support of arguments for a strong inherited tradition that served its purpose and needed to undergo no change because it was completely efficient for the purposes for which it was intended (Fish 1979).

Though there was little technological change during the Mousterian that does not mean that there was no variation within the assemblages. That variability exists within Mousterian assemblages is not questioned. Based on excavations at Pech de l'Aze between 1948 and 1969 and at Combe Grenal between 1953 and 1966, Francois Bordes (1950, 1961, 1972, 1973) was able to distinguish five variants of the Mousterian. Bordes observed that these variants could occur at any Mousterian site in several combinations. These variants as they were defined by Bordes (1961, 1972) are as follows:

<u>Charentian:</u>

<u>Quina Mousterian-</u> characteristically having a great number of transverse scrapers and only a slight Levallois index, also having Quina retouch created by repeated heavy blows to the flake.

<u>Ferrassie Mousterian-</u> characteristically having a high proportion of side-scrapers and a high Levallois index.

<u>Typical Mousterian-</u> characteristically having a variable amount of points and side-scrapers.

<u>Denticulate Mousterian-</u> characteristically dominated by denticulate and notched tools.

Mousterian of Acheulean Tradition- characteristically represented by having the presence of bifacial hand axes but they are more round and thinner and have fine retouch.

Type A- earlier variety; hand axes are common.

Type B- later than A chronologically; hand axes are rarer and of the backed knife form. Contains a percentage of Upper Paleolithic type blade tools.

The assemblages were described based on the percentage of occurrence of a fixed range of types and then were classified on this basis. Bordes observed that these variants could occur at any Mousterian site in any combination and that there was no chronological patterning that existed among them except for the fact that Mousterian of Acheulean Tradition Type B is always found on the top of a given sequence. Bordes also found that there were no links between climatic conditions and variation by showing the contemporaneity of sites occupying different microenvironments. Chase (1986) has also found that both faunal and lithic data appear to be independent of climate as well as appearing to be independent of one another. Based on these findings Bordes (1950) interpreted Mousterian

variability as being representative of variation in ethnic groups occupying the landscape contemporaneously (Bordes and de Sonneville-Bordes 1970). There seems to be a fundamental problem with Bordes' interpretation. Bordes would suggest that distinct groups roamed the landscape at the same time but either never came into contact with one another, or if the did come in contact they maintained their distinct cultural traditions and were in no way influenced by the groups contacted. The Binfords sought another interpretation of the variability seen in Mousterian assemblages.

The Binfords (Binford and Binford 1966; Binford 1973) questioned whether archaeologists were dealing with different groups of people or whether the five variants of the Mousterian might represent the manifestation of several different activities carried out by the same cultural tradition. The Binfords analyzed assemblages from France and the Near East by factor analysis using Bordes' typology for the individual pieces to see if Bordes' variants could be equated or subdivided into functional groups. The result was again five separate groupings loosely corresponding to those that Bordes defined which the Binfords interpreted as being functional. They deduced the existence of different

types of sites with functional definitions.

Mellars (1970, 1973) has championed a partly chronological interpretation of Mousterian variability. He argues that Typical Mousterian and Denticulate Mousterian are not chronological because they appear throughout the Mousterian. However, Ferrassie, Quina and Mousterian of Acheulean Tradition A and B represent chronological variants that always appear in the same order. This seems to work when sites are viewed individually. When comparing between sites and matching contemporary stratigraphies this argument loses some of its strength (Fish 1979). At each site though, the variants are found in similar patterns when compared chronologically, Quina and Mousterian of Acheulean Tradition are found as contemporaries.

Mousterian variability exists. The means by which that variation is analyzed, however, and its resulting interpretation are in question. More than likely Mousterian variability is the result of the combination of several different factors. It is quite plausible that Mousterian variability is the result of the interrelation of functional and stylistic variables (Fish 1979; Rolland 1977, 1981; Sackett 1973). Along with function and style contributing to variability in Mousterian assemblages there may be other

factors as well. In assemblages outside of France, specifically the Pontinian variant of southern Italy, factors such as resource availability may contribute to the definition of this variant (Kuhn 1990).

"The Pontinian Mousterian is defined as a Mousterian of the Charentian type but possibly closer to the Quina type... the Levallois debitage is always present; the facetting index is quite high; side-scrapers are present in large amounts; little evidence for the Upper Paleolithic group, denticulated flakes and naturally backed knives; the Quina retouch attains moderately high values" (Piperno and Segre 1982:211). The Pontinian was defined by Blanc (1937) at the site of Canale Mussolini/Canale delle Acque Alte. Besides the traits listed above a critical trait of the Pontinian is in the size of the artifacts. None of the pieces in a Pontinian assemblage are larger than approximately 3 cm. There has been argument as to whether the Pontinian is a separate Mousterian type or, as it has been suggested by others, the Pontinian is the result of resource stress (Kuhn 1990).

The Pontinian Mousterian has been the focus of much Middle Paleolithic research in Italy. The geographical region of interest has been concentrated in west central

Italy (Kuhn 1990). Earliest research was begun in the 1930's by Blanc (1937) and Segre (Blanc and Segre 1953). This work defined the Pontinian Mousterian and provided association of a Neandertal skull from Grotta Guattari with a Pontinian assemblage. The work during this period uncovered nearly a hundred caves and rock shelters in the area but only a few of them contained Paleolithic materials. Work was undertaken during the 1960s and the 1970s, but it began again vigorously in the 1980s with research teams from the University of Amsterdam and the University of Rome. Most recently Steven Kuhn (1990) at the University of New Mexico has undertaken the analysis of several sites on the Latium coast of Southern Italy.

Though much research has been conducted in Southern Italy, most of it has been on the western coast (Blanc 1937; Blanc and Segre 1953; Kuhn 1990). Also the studies that have been carried out are of a traditional sort, i.e., typological studies and investigations of technology and how they relate to raw material and faunal profiles. In this regard the collection under investigation here will be analyzed in a unique manner. There have been no functional studies performed on Pontinian assemblages.

For that matter there have been very few functional analyses on Mousterian assemblages in general except for those done by Beyries (1989) and Anderson (1979, 1990) and Shea (1988, 1989, 1990). These studies will be discussed in detail in Chapter IV. Functional studies of the Mousterian will contribute to an understanding of behavior in the Middle Paleolithic. Functional analyses may also aid in deciphering Mousterian variability. But, in order to investigate previous functional studies as well as the present one the terms "function", "use", and "wear" need to be defined as they are understood by microwear analysts.

CHAPTER III

FUNCTIONAL THEORY

There are two main debates when it comes to the concept of function in microwear analysis. The first debate focuses on the definition of the terms "function", "use" and "wear" and how they apply to what we do as microwear analysts. The second debate surrounds the purpose of the attributes that are collected in a functional study. The attributes define function but should that be enough? Is it the responsibility of the archaeologist to then interpret those patterns? In the end these two arguments are linked because while the attributes, what we call wear, are the direct result of use, function is the result of the interpretation of those attributes.

The first debate centers around the definition of terms and the need to standardize usage of these terms. At the Ho Ho Conference (Hayden 1977) the terms function, use and wear were discussed. Although this was mostly a semantic debate, there was a general consensus reached on the definitions of these terms as well as their role in microwear research. These definitions were most succinctly summed by Faulkner:

> "wear is what you see on a stone tool. It is the evidence of the next thing,- use,- but it is what you actually look at on the edge of the stone tool. Use, of course, is a kind of behavior: you can't look at use, this is some kind of activity. Purpose, of course, is the goal or the objective of the task to be performed. Function has a much larger meaning since we know that stone tools have idiotechnic, sociotechnic, or technomic functions. I would agree with Ruth Tringham that ultimately we are doing functional analysis. But what do we actually study? We are studying wear. I think perhaps this is the best way to characterize the kind of studies we do, although obviously what we are ultimately trying to abstract is function" (cited in Hayden 1979:63).

In defining the terms function, use and wear, Faulkner also states his position on the second debate revolving around the purpose of microwear analysis. Faulkner states that what, "we are ultimately trying to abstract is function" (1979:63). In other words the role of microwear analysis is to examine the attributes of wear on the edges of the tools. The use of these tools is an activity that took place prehistorically that we do not see. Finally we as archaeologists make an interpretation that is function. Odell (1977) has a broader definition of function that entails the simple definition of function as the interpretation of prehistoric use (as Faulkner has defined it). Odell also broadened the definition of function to include "an assessment of the articulation of these pieces with other elements of the cultural repertoire" (Odell

1977:91). However when it comes to the purpose of microwear analysis, Odell agrees with Faulkner that the main objective is not only to define the attributes but also to draw an analogy from the experimental data to make an interpretation of the functions, the range of activities, that were taking place at the site under investigation.

Dunnell (1971, 1975) takes quite a different stance on the role of functional analysis. He feels that the collection of the wear attributes that are the result of use is the main objective of microwear analysis. Dunnell states:

> "For example, we might be able to state that a given assemblage is referable to 18 functional classes or prehistoric uses. The meaning of the classes is precisely equivalent to the wear characteristics defining them; this in turn permits one to assess whether or not the same classes are represented in another assemblage in the same or different proportions and so on. Calling such classes axes or arrowheads serves no useful purpose, save perhaps to make the investigator comfortable" (1975:54).

In other words, it is enough to collect the attributes or combinations of attributes that in and of themselves are definitive of a particular prehistoric use. Therefore the uses at the site are defined and can be compared between areas at the site or between sites. It is of no interest to Dunnell to give artifacts class names such as knife, arrowhead, or axes that are names for tools used currently.

Thus, Dunnell's model allows for the distinguishing of use but not for the application of interpretive names to the implements analyzed.

Odell feels differently. He states that:

> "...function relates to people, whereas wear, as employed by Dunnell, does not. Since people adopt to natural environmental and social situations, one simply cannot introduce the human element into the equation without recognizing at some point, that, for example, wear pattern q represents chopping and we do have axes at the site" (1982:27).

Wear, as stated by Dunnell, is a mechanical process and the direct result of the fracturing properties of the raw material contacting the material being worked. It must be ultimately linked to the people performing the action because as stated earlier "since these conditions are modes and modes are cultural, (functional) types are cultural" (Dunnell 1971:158). For the study of the assemblage from Burrone Scierra I, interpretations were extrapolated only to the level of defining the prehistoric function. Combinations of attributes that were the result of prehistoric uses were assessed and then analogies were drawn from the experimental data available in order to define the function at hand. What name to call these implements was left to the Bordesian Typology. The implements studied were not renamed based on their functional designation.

CHAPTER IV

MICROWEAR: THE CURRENT STATUS OF RESEARCH

The publication of Semenov's (1964) work entitled Prehistoric Technology launched a plethora of microwear studies that not only used but also refined the methods of analysis Semenov developed. At the same time other new methods encompassed a wide variety of tool types and materials. These studies fall into one of three categories: 1) those that conduct experimental studies to define the attributes most effected by utilization and therefore definitive of function (Derrico 1986; Grace, Grahm and Newcomer 1985; Stafford and Stafford 1984; Tringham et al. 1974), 2) those studies that produce experimental collections and then apply them to archaeological assemblages drawing analogies between the edge wear produced experimentally and that produced prehistorically (Ahler 1971; Brink 1978; Donahue 1988; Dumont 1988; Frison 1968; Keeley 1978, 1980; Odell 1977, 1988; Semenov 1964; Shea 1988, 1989, 1990; Vaughan 1985; Wilmsen 1968), and 3) this study that use the experimental work of others and apply it to a prehistoric collection and then too, draw conclusions based on analogy.

At present, a debate exists over the type of method that should be employed in the field of microwear analysis. This debate concerns whether a low-power magnification or a high-power magnification should be used to search for wear damage and which of these two methods produces the most reliable, quantifiable and verifiable data. The high-power approach, often referred to as the "Keeley method" after the work done by Lawrence Keeley (1974, 1978, 1980, 1988) uses magnification of 300-500x or more in the identification of use wear. Though the high-power approach does evaluate utilization damage in the form of micro flake scar patterns, this method relies heavily on the identification of microscopic polishes produced by utilization (Keeley 1974, 1978, 1980; Semenov 1964; Vaughan 1985).

Through the use of blind tests (Bamforth 1986, 1988; Bamforth, Burns, and Woodman 1990) the high power method has proved to be quite reliable. Newcomer et al. (1986), however, would disagree. They contend that the blind tests were unsuccessful and that the analyses were not capable, with any degree of reliability, of consistently and accurately identifying the function of the experimental tool based on the polishes that had formed. They feel that work on the nature of the formation of polishes urgently needs to

be done and more objective methods of quantifying polishes need to be developed.

There are some basic drawbacks to the high-power approach. The high-power technique is time consuming as well as costly and involves extra preparation of the artifacts with chemical coatings to make the polishes more vivid (Keeley 1980). There is also a measure of subjectivity to the high-power technique. The polishes though qualifiable have not been adequately quantified (Newcomer et al. 1986). Each analyst through experimentation comes to "know" what polishes look like as they are identified with specific functions. The analysts can then with some degree of reliability identify these polishes in an archaeological collection, but these polishes are described as being "sickle sheen", "hide polish", "high polish", or "low polish". These terms are very subjective and not defined by any combination of defined attributes.

On the other side of the debate lies the low-power approach to microwear analysis epitomized by the work of Ruth Tringham (et al. 1974) and George Odell (1977, 1985, 1988). The low-power technique has also proved in blind tests to be a reliable method for examining the functional uses of stone implements (Odell and Odell-Vereechen 1980).

This technique microscopically scans a utilized edge of an implement at a magnification between 10 and 20x and then assesses the damage patterns at a magnification between 20 and 40x. It has been noted that scarring usually appears before any other type of wear; in addition, scarring seems to be effected less by post depositional processes than micropolishes (Odell 1974). This scaring, the tiny chips removed from the edge of a tool under the pressure caused by utilization, is not only important in and of itself, but also in defining the function for which that implement was used. Note that it defines only the last function that occurred or that occurring on the hardest material, because tasks preformed on hard materials tend to obliterate previously existing signs of damage.

In 1972 an experimental program was begun by Ruth Tringham at Harvard University to address the issue of function. Through experiments using blades and flakes made of English chalk flint various activities were performed using different materials. The damage was then assessed using the low-power method and functionally specific patterns of damage were defined. Odell (1977:112) states that the "most diagnostic discriminators among the various activities represented by the experiments were: the shape of

the scar, the size of the scar, the definition of the scar along the interior border, and the distribution of the scars along the edge of the implement". Once these attributes are defined, one progresses to more complex structures by combining these attributes to form patterns that define specific activities.

When more experiments are conducted they augment and corroborate the already existing body of data. The use of experimental collections generated by others is justified because in general most flints and cherts fracture similarly (Greiser and Sheets 1977; Keeley 1980; Odell 1977, 1975). Odell has stated that, "no one has empirically tested this statement, but the author's work with flint from a lime quarry in England and a beach on the coast of Denmark, plus glacially transported nodules found in the Netherlands, indicates that the damage patterns from utilization on all conchoidally fracturing rocks are so similar that they can be treated identically for the purposes of microwear analysis" (1977:100). Greiser and Sheets (1977) also observe that materials group together as far as their fracturing patterns go mainly by their grain size. All cherts are going to fracture similarly and on the other hand more granular materials like quartzites will have another

fracture pattern. "The isotropic and microcrystalline materials are reduced through microscarring, whereas the attrition process for more granular materials is one of grain removal and/or wearing down of individual grains" (Greiser and Sheets 1977:292). For the purposes of this thesis the bulk of the functionally defining data will be drawn from the experimental literature and applied to the assemblage being analyzed because of similarity in processes involved. Another reason for using existing experimental data is that local materials from the Burrone Scierra region were not available for experimentation.

Thus far, the methods of both high-power and low-power microwear analysis have been discussed. Lastly I would like to discuss the work in microwear analysis that has been done specifically on Mousterian assemblages. John Shea (1988, 1989, 1990) has conducted low-power (10x-120x) microwear analyses on Mousterian assemblages from Kebara Cave (Mount Carmel, Israel). He interpreted the presence of large hinge and step fractures on the top of pointed tools as the result of the implement being projected into an animal and making contact with bone. Shea also identified feather and step fractures on the edge of points at the base that he interpreted as signs of hafting. He concluded that these

implements were projectile points and that this evidence "contradicts recent hypotheses that technologically-assisted hunting (ie., with projectiles) was a subsistence strategy practiced only by the anatomically-modern hominid of the Late Pleistocene" (1988:1). Besides his work with projectile points, other material from Kebara was analyzed as well. Shea found that the vast majority of the assemblage was used for working wood or for butchering game. A very small proportion of wear was interpreted as being the result of either working hides or vegetal material.

Sylvie Beyries (1989) conducted an examination of the Mousterian materials from couche VIII at La Grotte Vaufrey. She employed the methods of high-power microwear analysis and concluded that the vast majority of the implements were used in woodworking. She also identified the presence of hafting on some categories of tools, points or convergent side scrapers. She, too, saw only a very small percentage of implements as being used on other materials such as bone and vegetal materials.

Patricia Anderson-Gerfaud (1990) conducted microwear studies on various Mousterian assemblages from France employing several high-power techniques. She concluded that the majority of the tools from the Middle Paleolithic were

used for wood working and that this may attest to a complex wooden tool industry during the Mousterian that has not been preserved in the archaeological record. She also suggested that the most abundant tools in Mousterian assemblages being wood working tools may in fact be a result of preservation. Anderson-Gerfaud (1990) suggested that the wear preserved in Mousterian assemblages is woodworking polish that is less sensitive to post depositional processes.

This may indeed be the case. The wear that high-power techniques assess may be too sensitive to post depositional processes. If this is so, the microwear preserved in the archaeological record may be wear that is interpreted as the result of wood working. Because woodworking wear preserves better than any other kind, this wear biases the sample.

The pieces not showing wear at all may have originally showed wear but it has been obliterated by the processes of deposition. On the other hand it may be suggested that certain wear polishes produced by post depositional processes, whatever they may be, are being misinterpreted as wear that is seen in experiments as wood working wear. This bias may also be a result of the fact that more damage producing processes such as the working of hard materials, like wood, obliterate less damage producing activities such

as the working of soft materials, like meat and plant materials. Depending on raw material availability and the reworking and reuse of tools, the evidence for activities working with soft materials would be obscured by those activities that are more damage producing.

CHAPTER V

AREA OF INVESTIGATION AND REFERENCE COLLECTION

The site of Burrone Scierra I is located on the Ionian coast of Calabria, Italy (Figure 2). It is an open air lithic scatter discovered in 1977 and then systematically surface collected in 1977 and 1979. Artifacts were removed from an active plow zone, and this was taken into consideration in the analysis. Since Burrone Scierra I is an open-air site, there was no bone preservation. However, there were numerous retouched as well as non-retouched stone tools exhibiting various reduction techniques including the Levallois technique.

Unfortunately, little is known about the Mousterian in Calabria, Italy. Other regions of Italy have been discussed briefly in Chapter II. As for Calabria, there was some work conducted in the late 1800's by Patroni (1897 in Ammerman n.d.) at the site of Torre Talao. Two other sites excavated in the area include one near Archi and another near the Ionian coast. At the site near Archi a child's mandible was discovered and attributed to Homo sapiens neandertalensis (Ammerman n.d.). Because there have been so few sites excavated in the area, sites like Burrone Scierra I become

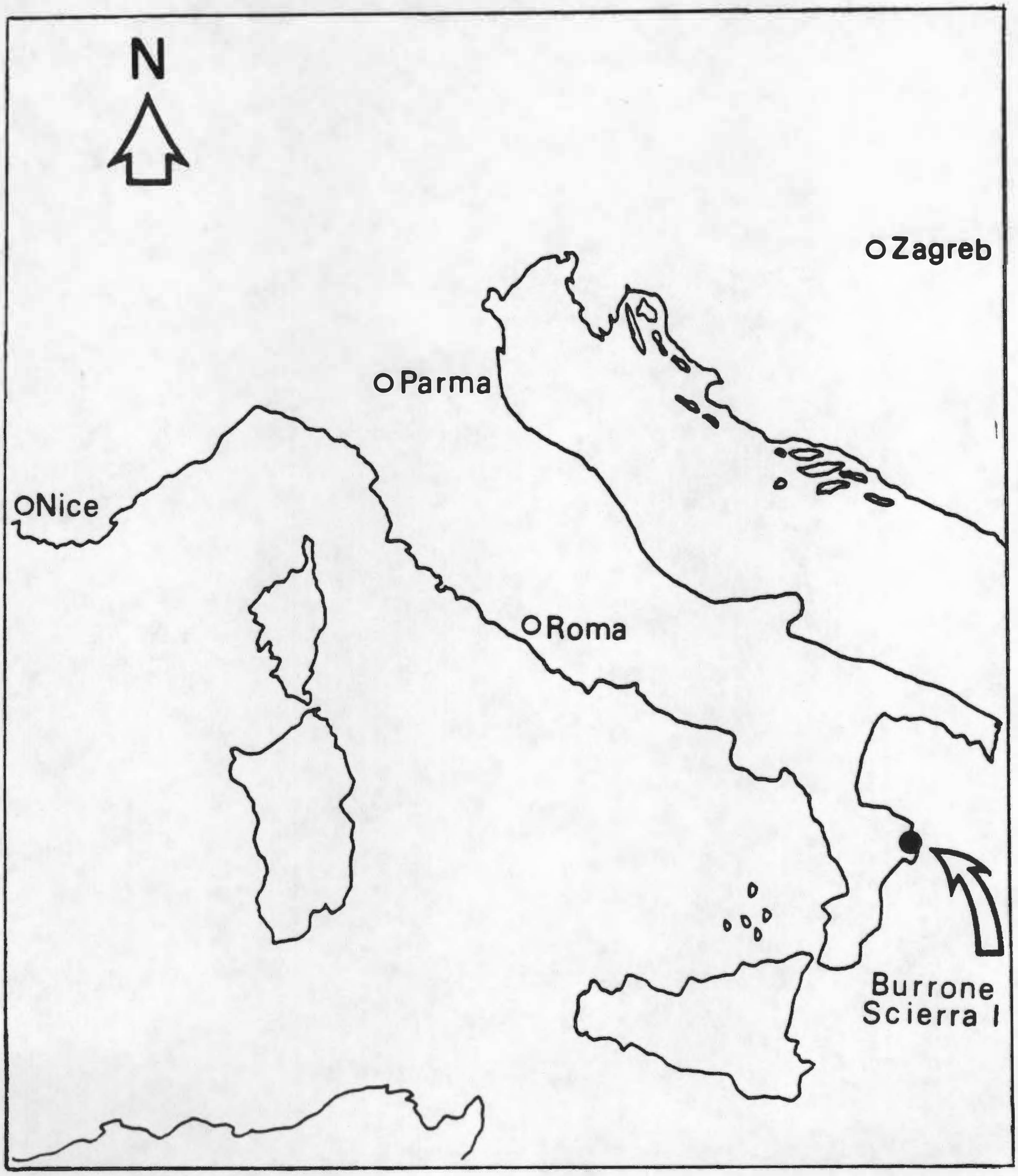

Figure 2. Map Showing the Location of Burrone Scierra I (Calabria, Italy) (Simek and Ammerman 1990).

even more important. Due to modern agriculture many open air sites are threatened by plowing, but these can still yield important data on function and subsistence (Ammerman 1985; Odell 1985; Odell and Cowan 1987).

Very little is known about the lithic raw material sources in Italy (Kuhn 1990; Simek and Ammerman 1990). It would appear that there are very few sources of high quality nodular and tabular flints. These are found in limestone in the mountainous areas. Near Rome, about 150 km to the north west of Burrone Scierra I, the size of the lithic raw materials increases as a rough function of distance from the coast (Kuhn 1990). From 0-5 km small pebbles are found that originate from recent beach deposits; 5-25 km from the coast larger pebbles are found originating from older beach deposits; 25-35 km at the foot of the mountains there are larger pebbles as well as cobbles carried by rivers. It is not until 40-100 km from the coast that primary sources of nodular and tabular flints are found in the mountain ranges (Kuhn 1990). If conditions on the coast near Rome can be used as a general indicator of resource availability for coastal southern Italy, then there was limited availability of lithic resource materials. The Burrone Scierra I assemblages might reflect resource stress in its near-coast

context. The site of Burrone Scierra I is very far to the south on the Italian Peninsula, and the assemblage seems to show stress associated characteristics because all of the lithic material is under 3 cm. in size.

An assessment of the raw materials by Simek and Ammerman (1990) has defined ten raw materials at the site. Although the source locations are unknown they have speculated that five cherts types were acquired in the site vicinity as well as three types of quartzite; one category was defined as exotic materials, and the tenth category was unidentifiable due to heavy weathering. Reevaluation of the raw materials in the Burrone Scierra I assemblage showed that there were a total of nineteen raw materials. Because there has been little to no raw material investigations in Italy (Kuhn 1990) it was impossible to pin-point the exact locations from which the chert was gathered, nor was it possible to use a reference collection of known chert types to define the types present at the site. For this reason attributes of color, grain size, inclusions, banding, and when present, cortex were used to distinguish the nineteen material types used for the analysis.

The raw material colors were defined using the Munsell color chart. Colors ranged from white for the quartz to a

dark yellowish brown (10YR4/4) quartzite to a dusky red (10R3/4) to a very dark gray (2.5YR3/0). The grain size and fineness of the cherts ranged from very fine "exotic" cherts that were sometimes represented by as few as one or two pieces to a coarse grained quartzite that was more abundant. There were also cherts that seemed to range in grain size from very fine to quite coarse. The coarse chert was the dominant chert in the assemblage (Table 2).

Only a few of these raw materials dominate the assemblage from Burrone Scierra I. In fact, fourteen of the nineteen raw materials are "exotic" materials. These materials are only represented by a few pieces in each instance. In many cases only whole or partial "tools" are represented with no debitage being present. This would seem to indicate that the tools were produced elsewhere.

The assemblage consists of 572 used edges and 1073 unused pieces ranging from simple debitage to Bordesian tool types that showed no evidence of use. These pieces are distributed throughout the raw material types.

Table 2. Raw Materials from Burrone Scierra and Corresponding Munsell Colors.

Number	Munsell Number	Raw Material Color	Grain Characteristics
1	10YR8/6 to 10YR7/4	Pale Yellowish Orange to Grayish Orange	fine grained no inclusions
2	10R4/4 to 10R3/4	Weak Red to Dark Reddish Brown	fine grained no inclusions
3	5YR4/4 to 5YR3/4	Moderate Brown	fine grained no inclusions
4	5YR5/6	Light Brown	fine grained no inclusions
5	10R3/4 to 10R3/2	Dusky Red	fine grained no inclusions
6	7.5YR5/4	Strong Brown	fine grained no inclusions
7	10R3/2	Grayish Red	fine grained with inclusions
8	5YR5/6 to 5YR4/4	Light Brown to Moderate Brown	fine grained no inclusions
9	2.5YR5/6 to 7.5YR6/6	Red to Reddish Yellow	fine grained no inclusions
10	10R3/3	Dusky Red	quartzite burned beyond recognition
11		White Quartzite	coarse grained with black inclusions
12	10YR5/8	Yellowish Brown Quartzite	fine grained no inclusions very homogeneous
13	10YR4/4	Dark Yellowish Brown Quartzite	medium grained no inclusions very homogeneous
14	2.5YR5/2	Grayish Brown	fine grained with inclusions
15	2.5YR5/2	Grayish Brown Banded	fine grained with inclusions
16	2.5YR3/0	Very Dark Gray	fine grained no inclusions
17		White Patinated Beyond Recognition	fine grained
18		White Patinated Beyond Recognition	coarse grained
19	10YR7/4 to 10YR5/8	Very Pale Brown to Yellowish Brown	fine to coarse grained some banding

CHAPTER VI

ATTRIBUTE DEFINITIONS

Through experimentation certain attributes have been found to be definitive of use activities. From the low-power microwear literature (Brink 1978; Frison 1968; Keller 1979; Odell 1975, 1977, 1988; Odell and Odell-Vereechen 1980; Tringham et al. 1974; Wilmsen 1968) a series of attributes that best define the use of stone implements can be defined. These attributes are size, edge angle, edge shape, scar type, scar size, scar location along the utilized edge, and scar pattern. Along with these attributes the fragmentation of the piece and the function location as well as the Bordesian type and the technology were collected. Before defining function, however, it would be in order to discuss the measure of the attributes listed above.

Size. Size was measured by weight in grams, using a digital scale with accuracy to the tenth of a gram. Weight was used as an indication of size due to the fragmentary nature of most of the pieces in the collection.

Edge Angle. Edge angle was measured at the very edge of the implement using a protractor with a straight edge

attached to the center point allowing it to move freely. With this device the edge angle of the piece was measured in degrees. The edge angles were then combined into five categories: 0-40 degrees, 40-60 degrees, 60-80 degrees, 80-100 degrees, and 100-360 degrees.

Edge Shape. Edge shape was recorded as being straight, convex, concave, or a point. This was determined using Bordes (1979) method of placing the edge of the implement up against a straight edge and recording its relation to the artifact's edge.

Scar Type. Scar type (Figure 3) was described as being one of four states (Crabtree 1972):

A feathered scar was defined as a scar produced by the force of the instituted blow traveling through the rock mass, gradually moving closer to the rock surface until the flake detaches. The distal end of the feather scar has a smooth, gradual transition between the scar and the rock surface. There is no ridge or lip at the distal end of the feather scar.

A stepped scar was defined as a scar resulting when the flake detaches in a right angle break at the distal end of the flake. The detached step flake has a blocky distal end with approximately a 90 degree angle between the ventral

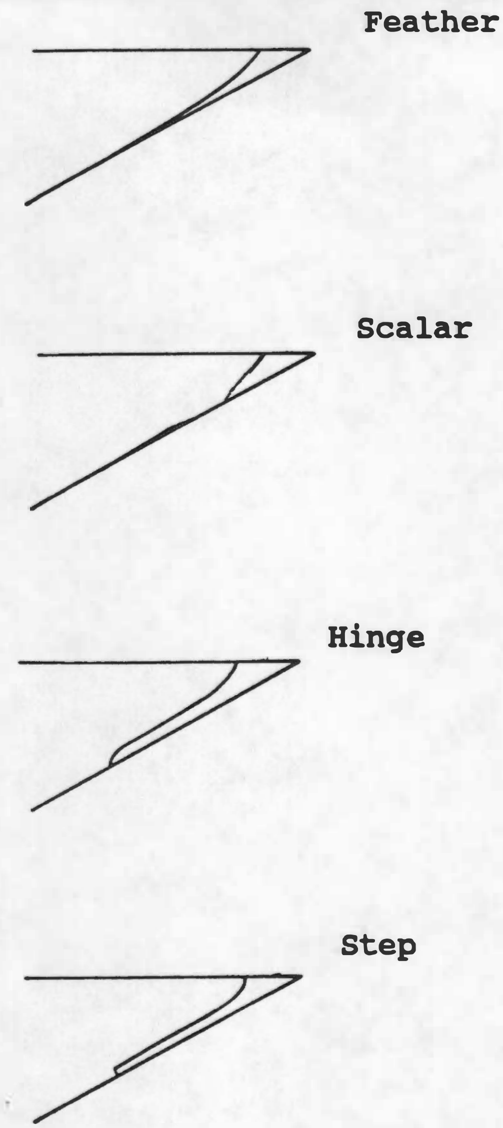

Figure 3. Illustration of Scar Types (Cotterell and Kamminga 1977).

surface and the blocky end.

A scalar scar was defined as when the force by which the flake is detached is stronger than for feathering and the resulting termination is more abrupt but not abrupt enough to form a right angle as with the step scar. The scar is deeper than the feather scar.

A hinged scar is one where the flake is detached at a right angle but the force turns back producing a lip on the distal end of the scar.

Scar Size. Scar size was defined as being small (only seen clearly under 40x magnification or above), medium (only seen clearly under 20x magnification or above), and large (seen clearly with the naked eye). This method is used because it is considerably faster than trying to measure each and every one of the multitude of scars (Odell 1988).

Scar Location. Scar location was defined as being either located on the ventral face of the implement, the dorsal surface of the implement, or both the ventral and dorsal surface of the implement.

Scar Pattern. Scar pattern was recorded as being continuous, discontinuous, altering, or random. Continuous scars follow a pattern nearly touching over a portion of the edge. Discontinuous scars begin, stop, and begin again

within a functional unit. Alternating scars are continuous but portions go from ventral to dorsal and then back again. Random scars show no real pattern but are sporadically located across the implement.

Fragmentation. Fragmentation was recorded as being one of ten categories. Indeterminate was recorded for unidentifiable fragments. Distal portion was recorded for the terminus end of the implement only. Medial/Distal was recorded for pieces that obviously had a middle section and a distal section but were missing the bulbar end. Medial was recorded for a piece having no distal terminus and no bulbar end. Medial/Proximal was recorded for pieces that had a striking platform and a middle section but were missing the distal terminus. Proximal was recorded for the pieces that only had the bulbar end. Whole was recorded for pieces having proximal, medial, and distal portions. Lateral was recorded for pieces that were broken down the long axis of the implement. Chunk was recorded for pieces with no clear orientation that were almost as thick as they were wide and long. Core, or its appropriate fragment, was recorded for those pieces that showed obvious scar removals for core use.

Function Location. Function location was recorded on a six polar coordinate grid and the use damage within each of these units or the appropriate combination of those units was observed and recorded. This six polar grid was adapted from Odell (1977) but was modified to include various combinations of the grid coordinates for a more precise identification of the utilization damaged area.

Plow Damage. Plow damage falls into several of the above categories. The damage that was screened out in this investigation was that damage defined by Mallouf (1982). Plow damage manifests itself in random, non patterned scars about the entire artifact. Often the scars have a V shape. Fresh scars without patina were immediately screened out of the analysis.

Functional Categories. Certain attributes have been chosen because they define a particular aspect of use. These attributes were identified using the literature on experimentation in low-power microwear. Groups of attributes (scar size, scar type, scar location, and functional location) were formed to make an interpretation of the functions taking place at the site. Other attributes (weight, raw material, and edge angle) were collected to examine their relationship with varying functional

categories.

Edge angle has been experimentally associated with motion: cutting generally uses angles below 40 degrees, sawing between 45 and 55 degrees, scraping between 60 and 75 degrees, graving between 90 and 180 degrees, and boring at 360 degrees (Brink 1978; Derrico 1986; Fish 1979; Frison 1968; Keeley 1980; Odell 1977; Odell and Odell-Vereechen 1980; Tringham et al. 1974; Wylie 1975).

Edge shape is associated with motion as well: straight edges tend to be used for cutting and scraping, convex and concave edges tend to be used for scraping, and points as projectiles or for boring (Frison 1968).

Scar size and shape are directly associated with the kind of material worked: feather scars are generally associated with the working of soft material such as meat and vegetable materials, while scalar scars are associated with the working of medium materials such as hides and soft woods, while step scars are associated with the working of hard materials such as bone, antler, and hard or dry wood (Keeley 1980; Lawrence 1977; Odell 1977; Odell and Odell-Vereechen 1980; Stafford and Stafford 1984; Tringham et al. 1974).

The location of the scars is definitive of the motion involved in the activity: location on either the ventral or the dorsal face is indicative of scraping because with scraping, pressure is exerted on only one face of the implement. Thus, scars are removed only from the side opposite of that receiving the pressure. Scars located on both the ventral and dorsal face of an implement are indicative of cutting. This is because a transverse motion pressure is exerted on both faces of the implement with the result being that scars are removed from both faces (Keeley 1980; Odell 1977; Odell and Odell-Vereechen 1980; Stafford and Stafford 1984; Tringham et al 1974).

Scar pattern has proved to be an indicator of whether the wear being observed was caused by a culturally associated activity or a post depositional process. If the pattern is even, uneven, or alternating it is indicative of a cultural activity. If the pattern is completely random and located all over the piece then the wear is most likely the result of post depositional processes (Ammerman 1985; Fiorillo 1984; Flenniken and Haggarty 1979; Gero 1978; Keeley 1980; Keller 1979; Mallouf 1982; Odell 1977, 1985; Stafford and Stafford 1984; Tringham et al. 1974). The combination of these attributes forms the various patterns

reflective of different motions; cutting, scraping, boring, graving and stabbing. These combinations are also indicative of different materials or at the very least of varying degrees of hardness in materials worked. After having reviewed the literature and completed the analysis of the Burrone Scierra I assemblage it was only possible to characterize the material worked as soft, medium or hard. I did not feel that making functional identifications on archaeological assemblage using low-power microwear techniques allowed for the determination of the material worked beyond the general categories listed above.
The means by which the above attributes were combined and then later used to interpret function at the site are listed in Table 3.

As stated earlier a debate exists between the proponents of high-power microscopic methods and those of low-power microscopic methods as to which more accurately identifies use wear damage. Though the high-power approach may in the long run prove to be more accurate, the limitations of this method render it inadequate for the purposes of this thesis. That it is time consuming and costly are two considerations, but the factor that renders it less useful to the impending research is the fact that

Table 3. Attribute Combinations Defining Function.

Function	Material	Functional Location	Edge Shape	Scar Type	Scar Size	Scar Location	Edge Angle
cutting	soft	any	straight	feather	any	ventral and dorsal	any
			convex	scalar	small	ventral and dorsal	any
cutting	medium	any	straight	scalar	medium	ventral and dorsal	any
			convex	scalar	large	ventral and dorsal	any
cutting	hard	any	straight	step	any	ventral and dorsal	any
			straight	hinge	any	ventral and dorsal	any
			convex	step	any	ventral and dorsal	any
			convex	hinge	any	ventral and dorsal	any
scraping	soft	any	straight	feather	any	ventral or dorsal	any
			straight	scalar	small	ventral or dorsal	any
			convex	feather	any	ventral or dorsal	any
			convex	scalar	small	ventral or dorsal	any
			concave	feather	any	ventral or dorsal	any
			concave	scalar	small	ventral or dorsal	any
scraping	medium	any	straight	scalar	medium	ventral or dorsal	any
			straight	scalar	large	ventral or dorsal	any
			convex	scalar	medium	ventral or dorsal	any
			convex	scalar	large	ventral or dorsal	any
			concave	scalar	medium	ventral or dorsal	any
			concave	scalar	large	ventral or dorsal	any
scraping	hard	any	straight	hinge	any	ventral or dorsal	any
			straight	step	any	ventral or dorsal	any
			convex	hinge	any	ventral or dorsal	any
			convex	step	any	ventral or dorsal	any
			concave	hinge	any	ventral or dorsal	any
			concave	step	any	ventral or dorsal	any
graving	soft	1	point	feather	any	ventral and dorsal	80-100
			point	scalar	small	ventral and dorsal	80-100
graving	medium	1	point	scalar	medium	ventral and dorsal	80-100
			point	scalar	large	ventral and dorsal	80-100
graving	hard	1	point	hinge	any	ventral and dorsal	80-100
			point	step	any	ventral and dorsal	80-100
boring	soft	1	point	feather	any	ventral and dorsal	100-360
			point	scalar	small	ventral and dorsal	100-360
boring	medium	1	point	scalar	medium	ventral amd dorsal	100-360
			point	scalar	large	ventral and dorsal	100-360
boring	hard	1	point	hinge	any	ventral and dorsal	100-360
			point	step	any	ventral and dorsal	100-360

the collection to be analyzed must be in pristine condition. Because the Burrone Scierra assemblage is a plow zone surface collection and highly patinated (the processes involved in the formation of patina erode the micro surface of the implement [Keeley 1980]), it is highly likely that many polishes have been destroyed or altered to such an extent that they are no longer functionally definitive. Damage scars are more resistent to post depositional processes, and therefore the low-power method will be employed (Keeley 1980; Odell 1977).

CHAPTER VII

METHODS

After determining that the low-power approach to functional analysis was the most appropriate method for Burrone Scierra I, the literature was reviewed for proper protocol (Odell 1977, 1980; Tringham et al. 1974; Wilmsen 1968). In general, magnifications between 10x and 100x were used. At those magnifications scar type and pattern were readily discernable and therefore no chemical coatings were needed for enhancement of the utilization scars.

For this particular study a Wild-Leitz stereoscopic microscope with incident lighting and a zoom lens with magnification capabilities from 12.5x to 80x was employed to assess the microwear patterns. Due to the small size of the assemblage, sampling was not needed and 100% of the collection was viewed. All artifact surfaces were observed not just those that were suspected of damage or those where the damage could be seen macroscopically. Each artifact was initially scanned at low magnification to identify where scars were located, and then the type of scar and pattern were assessed at magnifications from 12.5 x to 80x depending upon the size of the scars. Pieces were oriented on a six

unit polar coordinate grid and the use damage within each of these units or the appropriate combination of those units was observed and recorded. This six polar unit grid was adapted from Odell (1977) but was modified to include various combinations of the grid coordinates for a more precise identification of the utilization damaged area. The pieces were oriented with their ventral surface down and their proximal end toward the observer. When a piece was blocky and did not possess a clear ventral or dorsal surface it was placed with the flattest side down and the longest axis stretching between distal and proximal poles (after Odell 1977, 1988). The presence of attributes (Figure 4) was recorded on data sheets (Figure 5), and later a computer data base was created using the Paradox data base program.

After the data base was created and edited, frequencies of various attribute combinations definitive of function were collected to determine what activities were taking place at Burrone Scierra as well as what materials were being worked prehistorically. These attribute combinations were first observed over the site as a whole in order to gain a general understanding of what activities were taking place at the site. These same attribute combinations were then examined over space. The latter data

Year
7 1977
9 1979
Artifact Number
Site Artifact Number
X
Y
Bordesian Type
Technological Type
Raw Material
Weight in grams
Functional Location
0 absent
1
2
3
4
5
6

7 1+2
8 2+3
9 3+4
10 4+5
11 5+6
12 6+1
13 1+2+3
14 2+3+4
15 3+4+5
16 4+5+6
17 5+6+7
18 6+1+2
19 1+2+3+4
20 2+3+4+5
21 3+4+5+6
22 4+5+6+1
23 5+6+1+2
24 6+1+2+3
25 1+2+3+4+5
26 2+3+4+5+6
27 3+4+5+6+1
28 4+5+6+1+2
29 5+6+1+2+3
30 6+1+2+3+4
31 1+2+3+4+5+6
Edge Angle
0 absent
1 0-40 degrees
2 40-60 degrees
3 60-80 degrees
4 80-100 degrees
5 100-360 degrees

Edge Shape
0 absent
1 straight
2 convex
3 concave
4 point
Feather sm v
0 absent
1 present
Feather md v
0 absent
1 present
Feather lg v
0 absent
1 present
Feather sm d
0 absent
1 present
Feather md d
0 absent
1 present
Feather lg d
0 absent
1 present
Scalar sm v
0 absent
1 present
Scalar md v
0 absent
1 present
Scalar lg v
0 absent
1 present
Scalar sm d
0 absent
1 present
Scalar md d
0 absent
1 present
Scalar lg d
0 absent
1 present
Hinge sm v
0 absent
1 present
Hinge md v
0 absent
1 present
Hinge lg v
0 absent
1 present

Hinge sm d
0 absent
1 present
Hinge md d
0 absent
1 present
Hinge lg d
0 absent
1 present
Step sm v
0 absent
1 present
Step md v
0 absent
1 present
Step lg v
0 absent
1 present
Step sm d
0 absent
1 present
Step md d
0 absent
1 present
Step lg d
0 absent
1 present
Indeterminate
0 absent
1 ventral
2 dorsal
3 ventral/dorsal
Fragment
0 indeterminate
1 distal
2 medial/distal
3 medial
4 medial/proximal
5 proximal
6 chunk
7 whole
8 lateral
9 core

Figure 4. Decoding Sheet.

indet.																				
hinge ld																				
hinge md																				
hinge sd																				
hinge lv																				
hinge mv																				
hinge sv																				
scalar ld																				
scalar md																				
scalar sd																				
scalar lv																				
scalar mv																				
scalar sv																				
step ld																				
step md																				
step sd																				
step lv																				
step mv																				
step sv																				
feather ld																				
feather md																				
feather sd																				
feather lv																				
feather mv																				
feather sv																				
edge shape																				
edge angle																				
func unit																				
weight																				
material																				
technology																				
bordesian																				
Y																				
X																				
site #																				
#																				
year																				

Figure 5. Data Recording Sheet.

allowed for potential activity areas across the site to be examined.

Though these data in and of themselves produced some interesting results, I also wanted to examine how certain attributes covaried with specific functions. Frequencies for the covariation of function with edge angle, size, raw material, typology and technology were examined. Frequencies for the covariation of the material worked with edge angle, size, raw material, typology and technology were also assessed.

These counts of presumably covarying attributes were then subjected to statistical tests to determine the significance of their independence or dependence. Chi-square as a test-for-independence was performed to examine whether function was independent of edge angle, size, raw material, typology, and technology. Chi-square tests were also performed to evaluate the independence of material used with the same attributes as were tested with function.

Counts of the attribute combinations intuitively reveal a lot about the activities at the Burrone Scierra site and about how various previously stated attributes covaried. However, I wanted to know if there was a statistically significant relationship between those variables. In other

words can easily identified attributes such as edge angle, size or technology predict with some degree of confidence the function of the implement as well as the material on which the implement was used? Are the variables dependent or are they independent?

The chi-square statistic tests the hypothesis of independence of variables (Zar 1984). The test uses observed and expected frequencies to test the null hypothesis that the row and the column variables are independent. The alternate hypothesis is that the row and the column variables are dependent. Thus, it could then be determined if, for example, edge angle is independent of function. From this it might be determined that one attribute may be a predictor of another.

CHAPTER VIII

RESULTS AND INTERPRETATIONS

This chapter will discuss the results of the low-power microwear analysis of the assemblage from Burrone Scierra I. The analysis proceeded in several steps, each of which will be described along with its results and interpretations. In the first phase the attributes were observed and recorded following the methods described in Chapter VIII. Attributes were then grouped as defined in Chapter VII, and function was interpreted from those groupings allowing for a functional designation to be given to each piece. The second phase of analysis centered on the spatial distribution of the various functional classes across the site. The third phase of the analysis concentrated on identifying the relationships between the functional classes and artifact size, edge angle, raw material, technology, and typology. After initial counts were gathered, the Chi-square test of independence was performed to examine the interrelatedness of the classes.

After the data were collected and recorded the attributes that were definitive of use were combined to allow for the interpretation of function and the creation of

functional classes. These raw counts (Table 4) showed that at Burrone Scierra I, 34.8% of the edges exhibited some form of wear. This is quite a high percentage of pieces to show evidence of use (Odell 1985). It is not surprising however, due to the nature and location of the raw materials in the site area (as discussed in Chapter VI). Because raw materials were not available immediately near the site, it would follow that there would be less debitage because the initial reduction of the material was taking place at the source. Also, because raw material was scarce, pieces that would generally be discarded as waste at sites where raw material was plentiful were, at Burrone Scierra, being used. Thus, a higher percentage of the pieces at the site would show evidence of use. Raw material availability could also explain why most of the tools at Burrone Scierra I were under 3 cm. in length. Through use, resharpening, and reuse, tools were utilized until they were too small for the human hand to hold and use efficiently.

Of the pieces that evidenced use wear allowing the interpretation of motion, 35% were cutting tools, 59% were scraping tools, 2.8% were graving tools and 2.9% were boring tools. The fact that only 35% of the tools at the site showed evidence for wear indicative of cutting and 59% of

Table 4. Function and Material Worked.

Function	Material	Count	Weight	Proportion
cutting	soft	31	33.4	5.4
cutting	medium	128	236.1	22.36
cutting	hard	9	36.3	1.6
cutting	indet.	33	117.3	5.8
scraping	soft	18	32.7	3.1
scraping	medium	116	362.4	20.3
scraping	hard	156	614.7	27.3
scraping	indet.	48	362.3	8.4
graving	soft	0	0	0
graving	medium	8	22.9	1.4
graving	hard	8	21.9	1.4
boring	soft	0	0	0
boring	medium	11	18.2	1.9
boring	hard	6	14.5	1.0
cutting	all	201	423.1	35.1
scraping	all	338	1372.1	59.1
graving	all	16	44.8	2.8
boring	all	17	32.7	2.9
all	soft	49	66.1	8.6
all	medium	263	639.6	46.0
all	hard	179	687.4	31.3
all	indet.	81	479.6	14.2
used		572	1872.7	34.8
unused		1073	1639.1	65.2

the tools were used in a transverse motion indicates that scraping was the predominate activity taking place at the site.

This is even more pronounced when one takes into account that cutting tools are generally expedient tools (Stafford and Stafford 1984; Wilmsen 1968). When a cutting edge dulls the tool is generally discarded and a fresh edge is used to continue the work because a fresh unretouched edge is the sharpest cutting edge. Thus a profile for a site that had equal amounts of cutting and scraping taking place should have more cutting tools. To consider cutting and scraping at a one to one ratio would, in that case, derive a false estimate of how much cutting was taking place at the site. In this instance with scraping (59%) and cutting (35%) scraping is by far the dominant activity represented at the site using microwear analysis. However, it should be noted that microwear only allows for the interpretation of the last event to take place. Consequently if, after cutting, the piece was retouched and used for scraping then the result would be that very few cutting tools would be interpreted through microwear analysis. When the attributes that indicate the material worked were analyzed it was seen that the working of medium, not hard materials,

was dominant. This contradicts the studies done by Anderson (1979, 1990) and Beyries (1989). Soft materials accounted for 8.6% of the materials worked. Medium materials accounted for 46%, hard materials were represented by 31.3% of the materials, while 14.2% of the material could not be identified. This would suggest that wood and bone working was frequent, but the working of medium materials such as hides was the dominate activity. This also contributes to the fact that scraping tools are the predominant type of tool at the site.

When considering the combination of motion with material worked, cutting medium materials (22.4%), scraping medium materials (20.3%) and scraping hard materials (27.3%) were the dominate functions. All of the graving and boring tools combined only make up 5.8% of the assemblage and therefore were quite inconsequential with regards to interpreting site function.

Over all, the high proportions of tools used for cutting medium materials, scraping medium materials, and scraping hard materials indicate that this site might be interpreted as a wood working and hide processing camp. It was suggested by Anderson (1990) that the presence of wood working tools may indicate that there was a complex wood

tool industry. This combined with the many scraping and cutting tools used on medium materials lends support to the hide processing scenario.

Spatial Analysis

The next stage of analysis involved investigating the spatial distribution of functional classes across the site by square. This allowed for the examination of possible activity areas across the site. Using the SURFER Program, density data was entered for each of the 180 five by five meter squares that made up the boundaries of the Burrone Scierra I site. In turn, counts for each of the various motion and materials worked classes were entered and distribution maps were made for each of the classes.

The density distribution map for the total lithics throughout the site (Figure 6) indicates that there were high concentrations of material within the 25E,35N square as well as the 35E,30N square. When the total lithic weight (Figure 7) is plotted it matches exactly with the total lithic count distribution. However, when the average lithic weight (Figure 8) is plotted it indicates that the lightest materials were clustering in the area of the most dense lithic concentrations. Because most of the lithic material was in this same area it would be logical that most of the

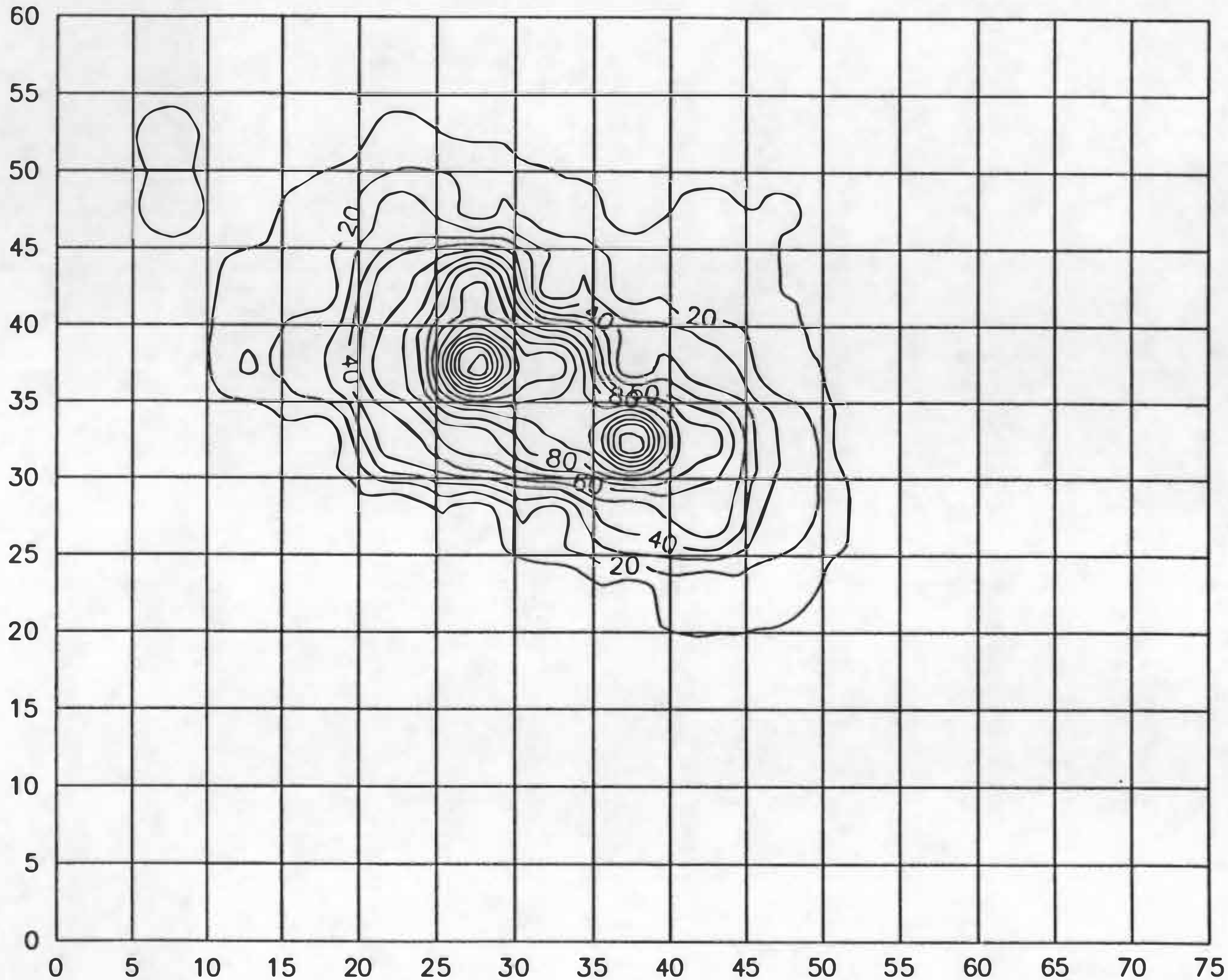

Figure 6. Distribution of Total Lithic Count.

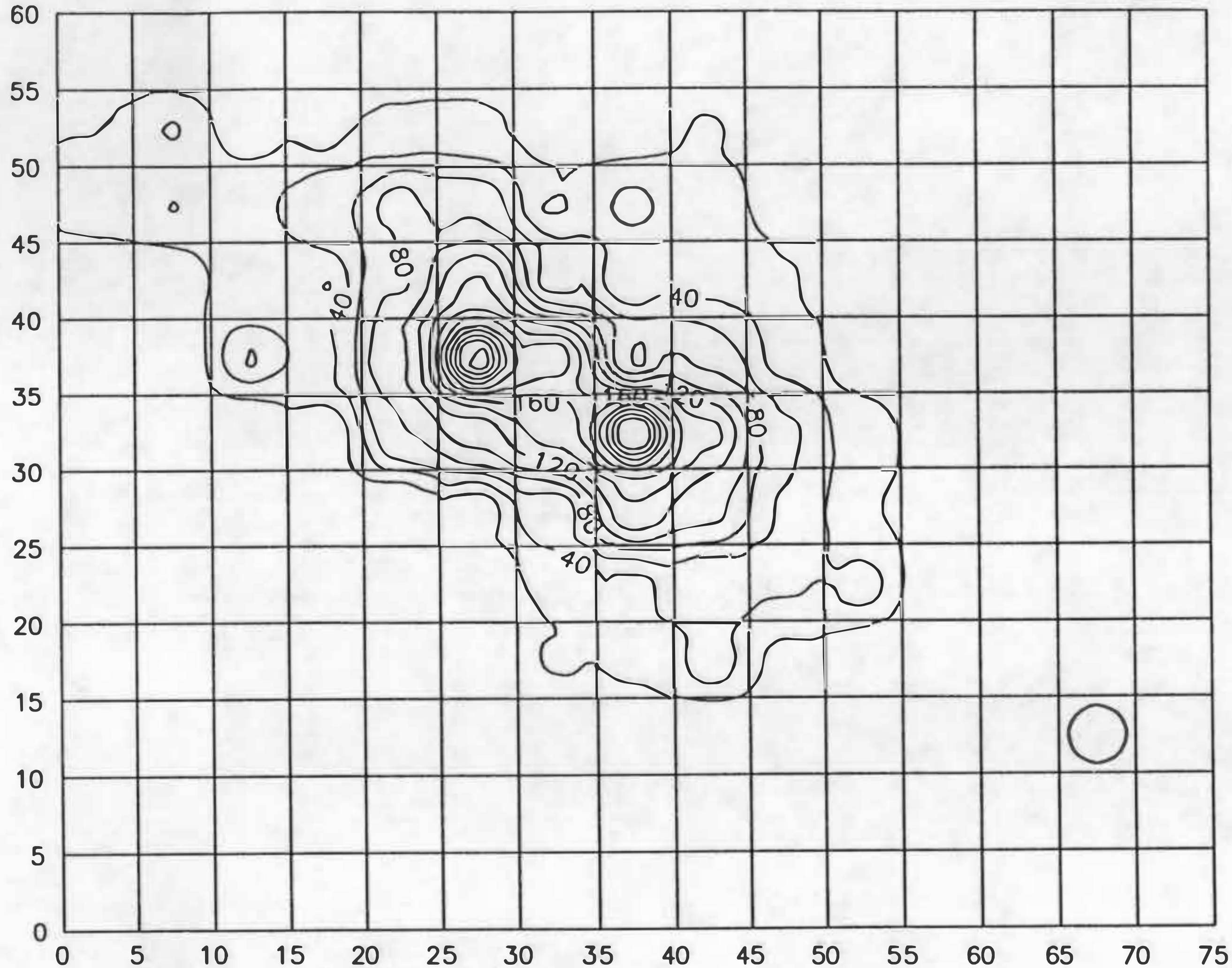

Figure 7. Distribution of Total Lithic Weight in Grams.

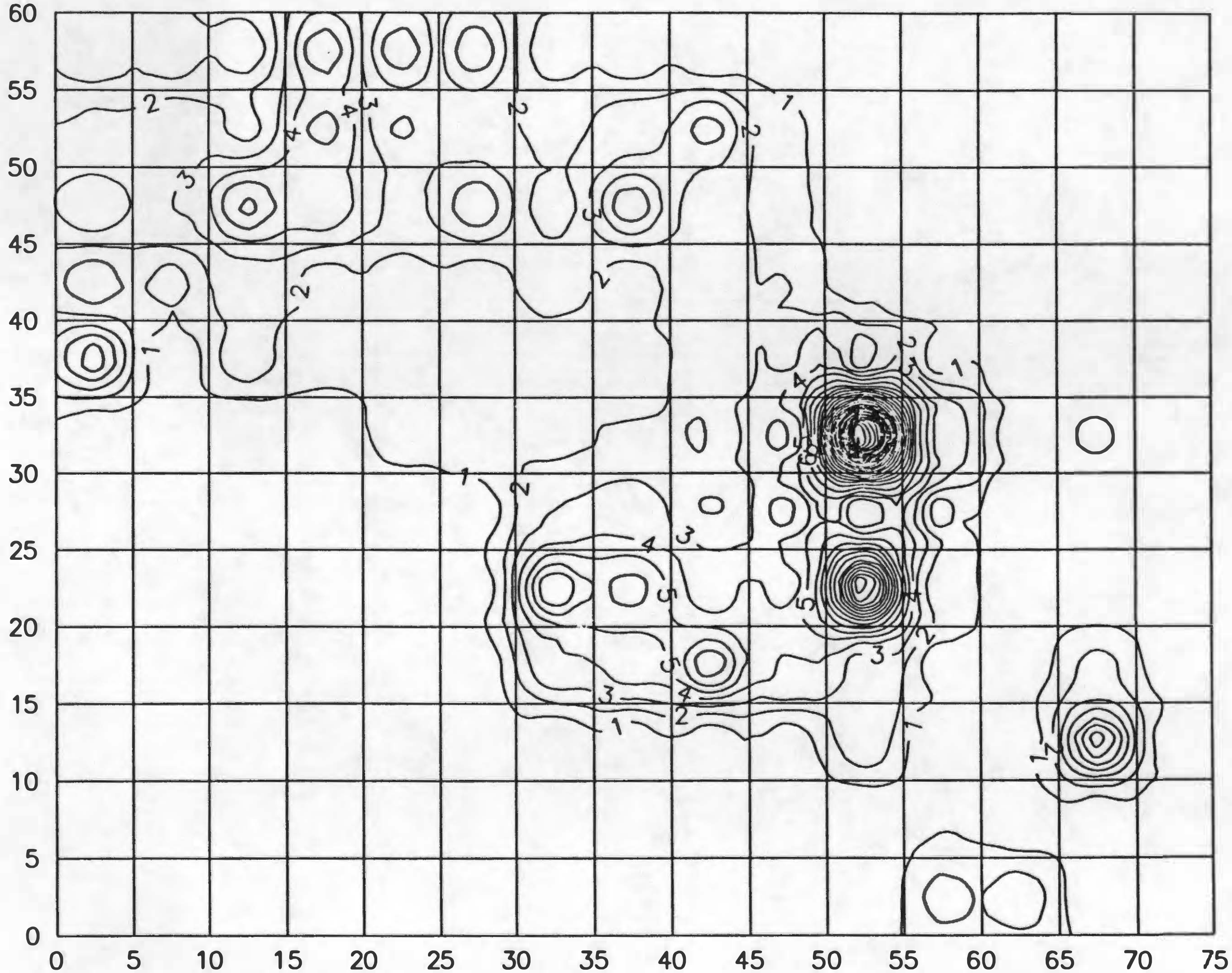

Figure 8. Distribution of Average Lithic Weight.

debitage would also be in the same area. If this was an area of concentrated activity where tools were being used and resharpened then there would be a great deal of debitage as well as tools. Generally the very small pieces of debitage weigh less that the larger finished pieces. Therefore, with a concentration of smaller pieces of debitage the average weight of the pieces in this area is reduced. When the unused pieces (Figure 9) are plotted they match the total lithic distribution, as expected. However, when the distribution of the used pieces (Figure 10) are plotted there is a slightly different distribution.

Plots of the tools for the Burrone Scierra I site indicate a slightly different pattern than the unused pieces. It appears that the tools fall out mostly in the 25E,35N and 35E,30N squares but there is an extension of the 25E,35N square to include the adjacent squares 25E,40N and 30E,35N. When these two clusters are analyzed there are great similarities. There are 25 cutting tools in each of the areas and approximately the same amount of scraping tools, 28 and 32. However, one cluster has a predominance of tools used on medium material while the other is dominated by tools that had worked hard materials. Quite interestingly, this may indicate that some spatial integrity

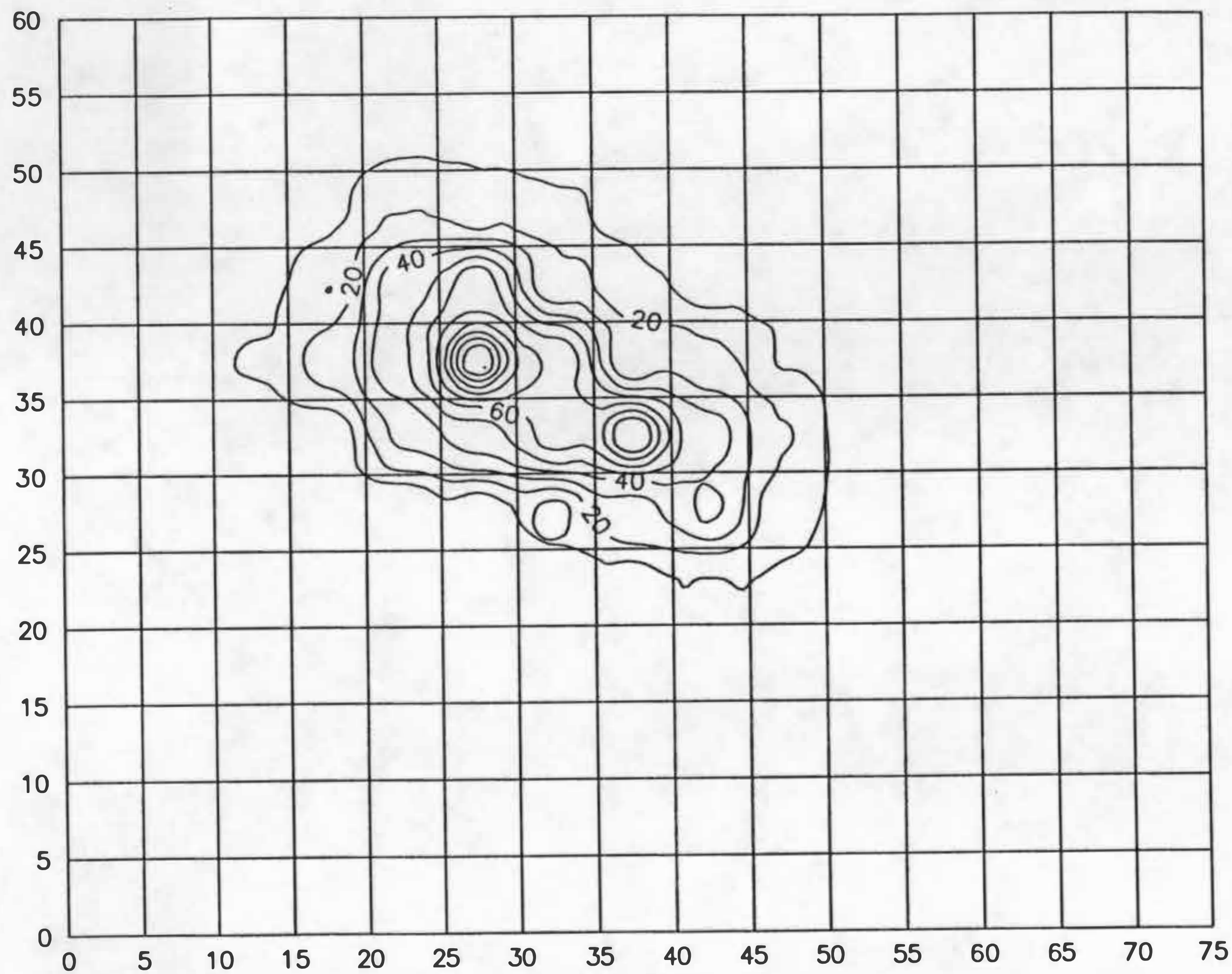

Figure 9. Distribution of Unused Lithic Material.

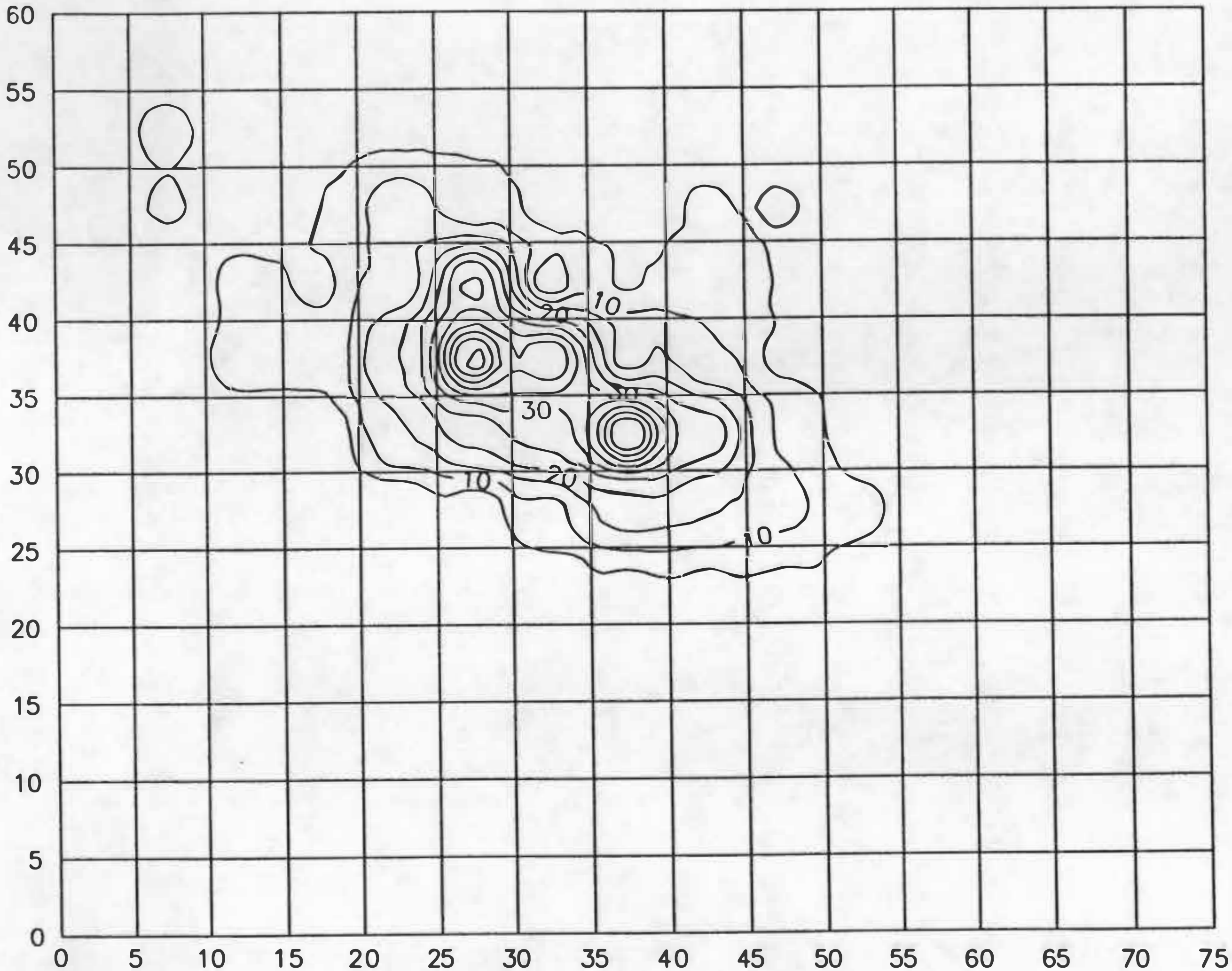

Figure 10. Distribution of Used Artifacts.

was maintained for activity areas even within the plow zone. One area may have been used to work wood while the other was used to process hides.

Maps for cutting tools (Figure 11) and for scraping tools (Figure 12) mainly fall out in the same pattern for the distribution for all tools across the site. It is interesting to note, though, that the distribution maps for the few graving tools (Figure 13) and boring tools (Figure 14) fall into the same cluster as do the wood working tools.

When viewing the maps produced for the distributions of materials worked, soft, medium and hard materials generally cluster around the main two clusters that were defined earlier for the total lithic distribution. The map for the soft materials (Figure 15) follows this pattern as well. The maps showing the distribution of medium materials worked (Figure 16) and hard material worked (Figure 17) show a clear clustering pattern. This indicates that hard materials were being worked in a separate place than medium materials and this may signify that wood (hard material) was being worked in one area of the site while hides (medium material) were being worked in another area of the site. Indeterminate materials (Figure 18) did not cluster but were distributed throughout the site.

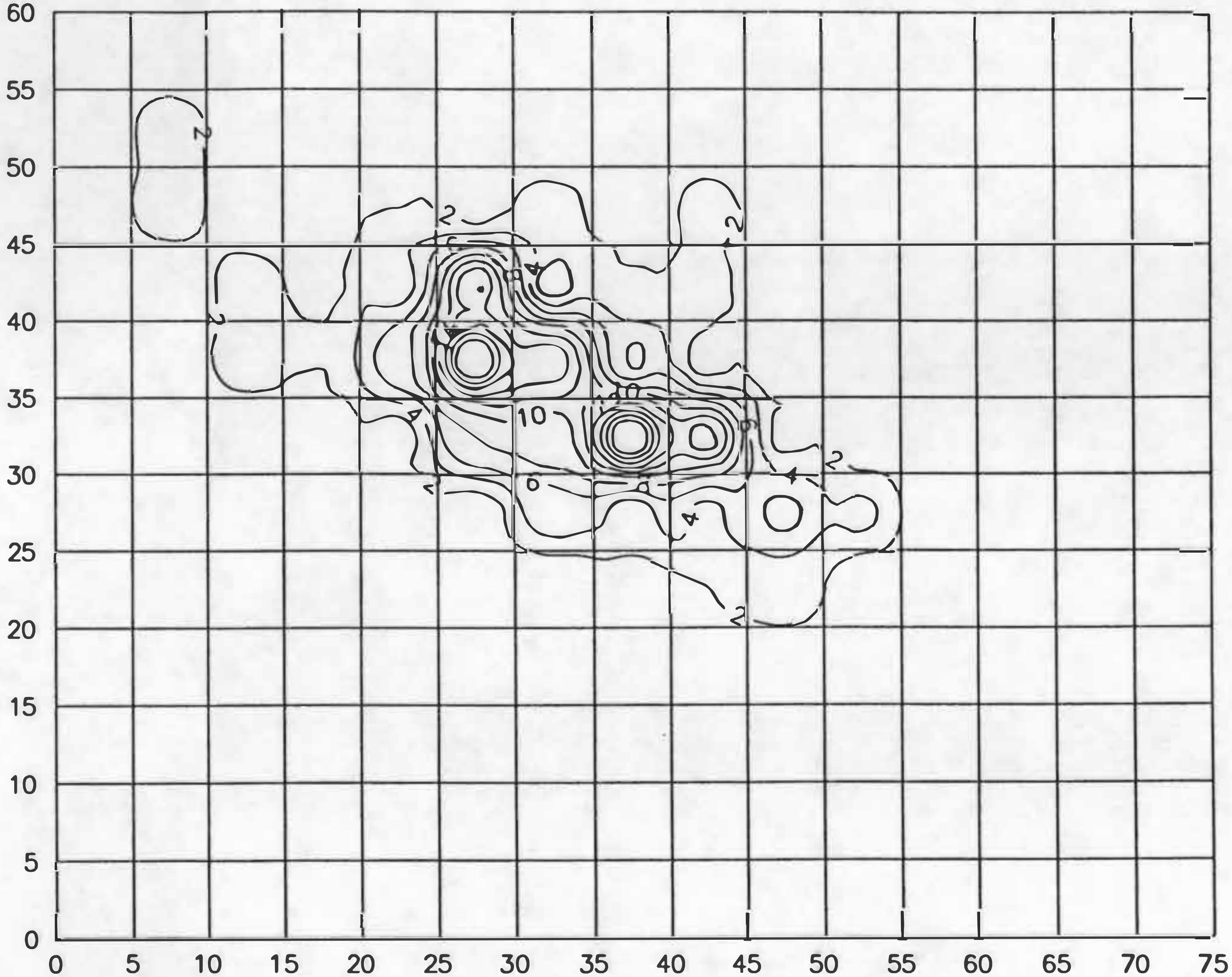

Figure 11. Distribution of Cutting Tools.

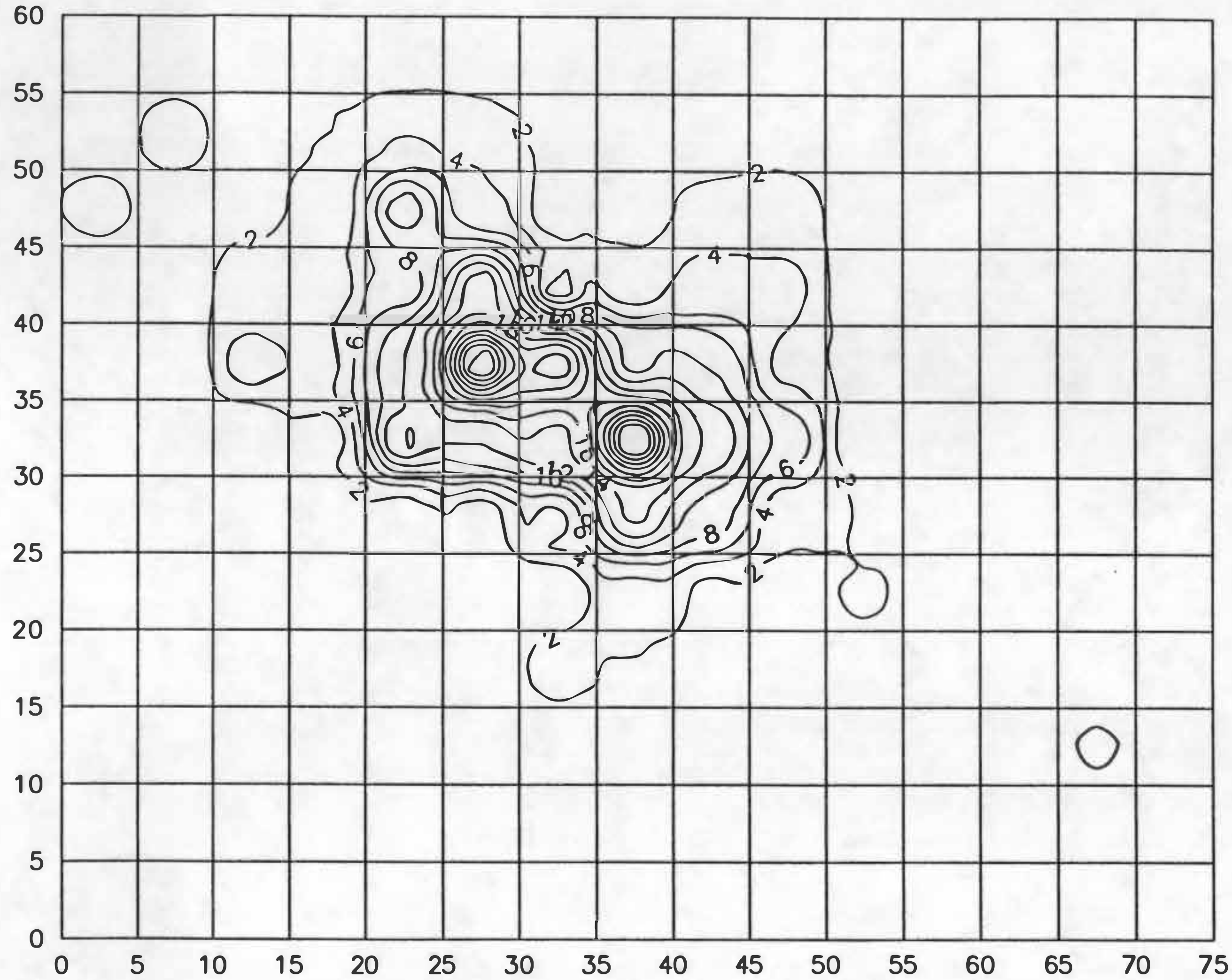

Figure 12. Distribution of Scraping Tools.

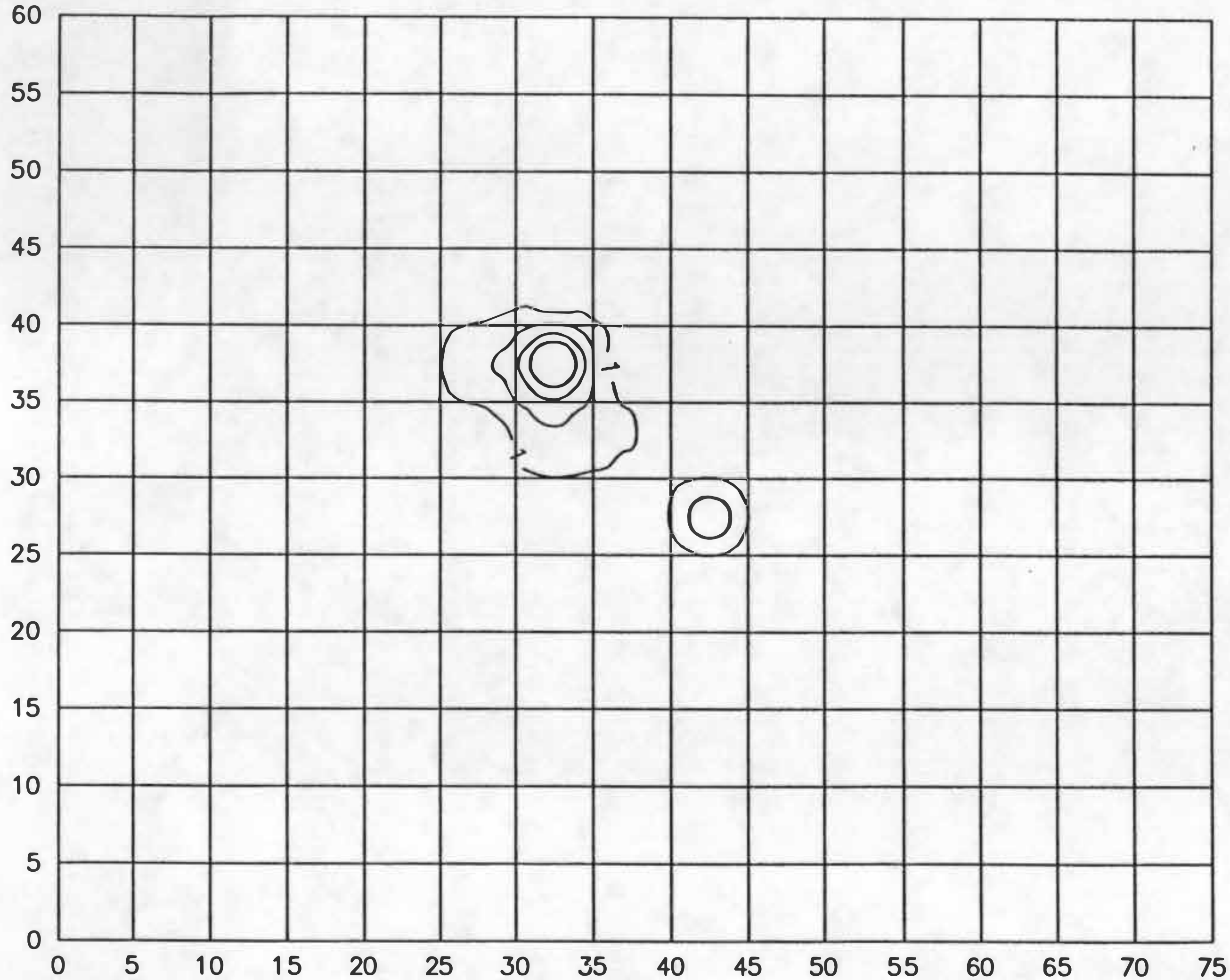

Figure 13. Distribution of Graving Tools.

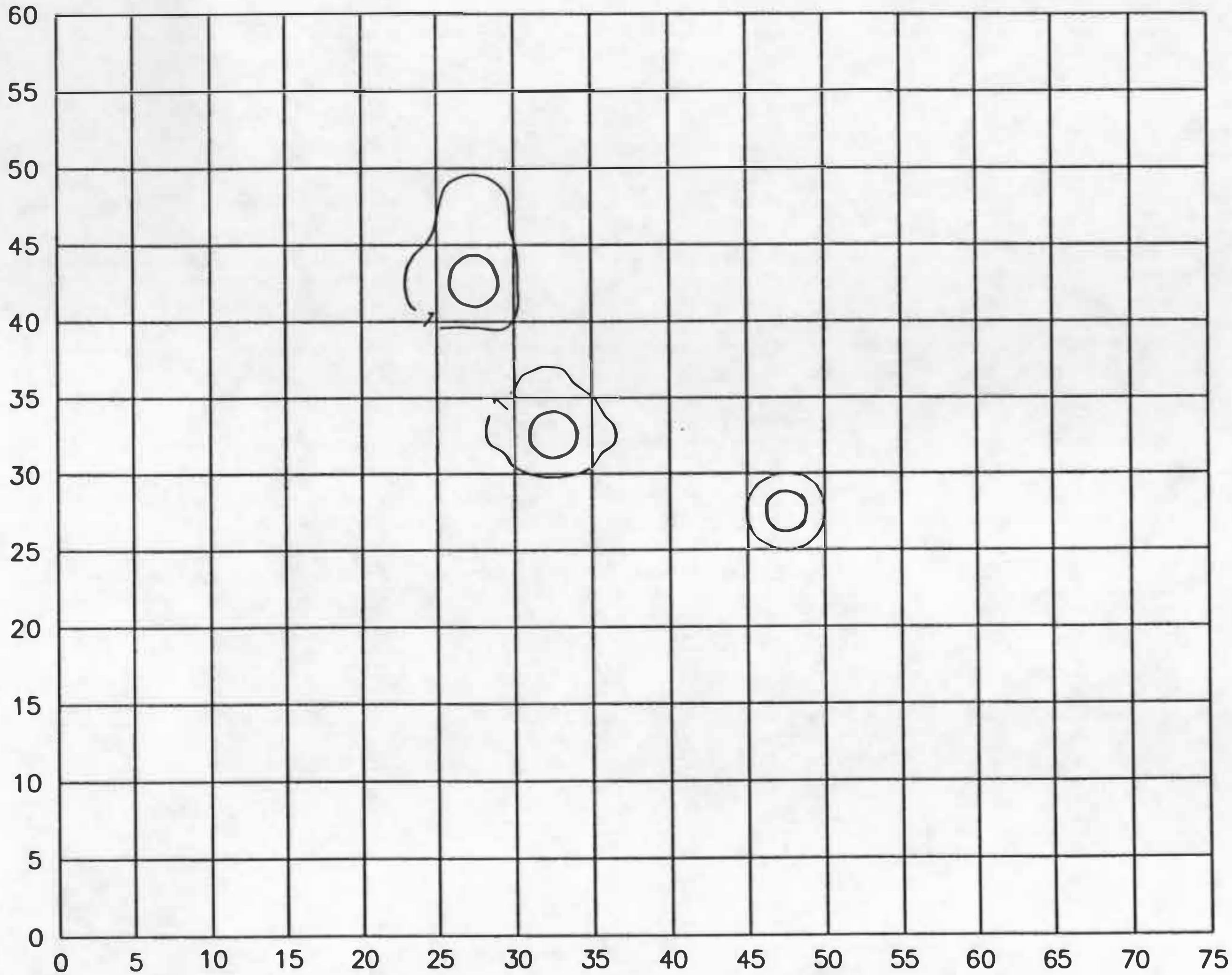

Figure 14. Distribution of Boring Tools.

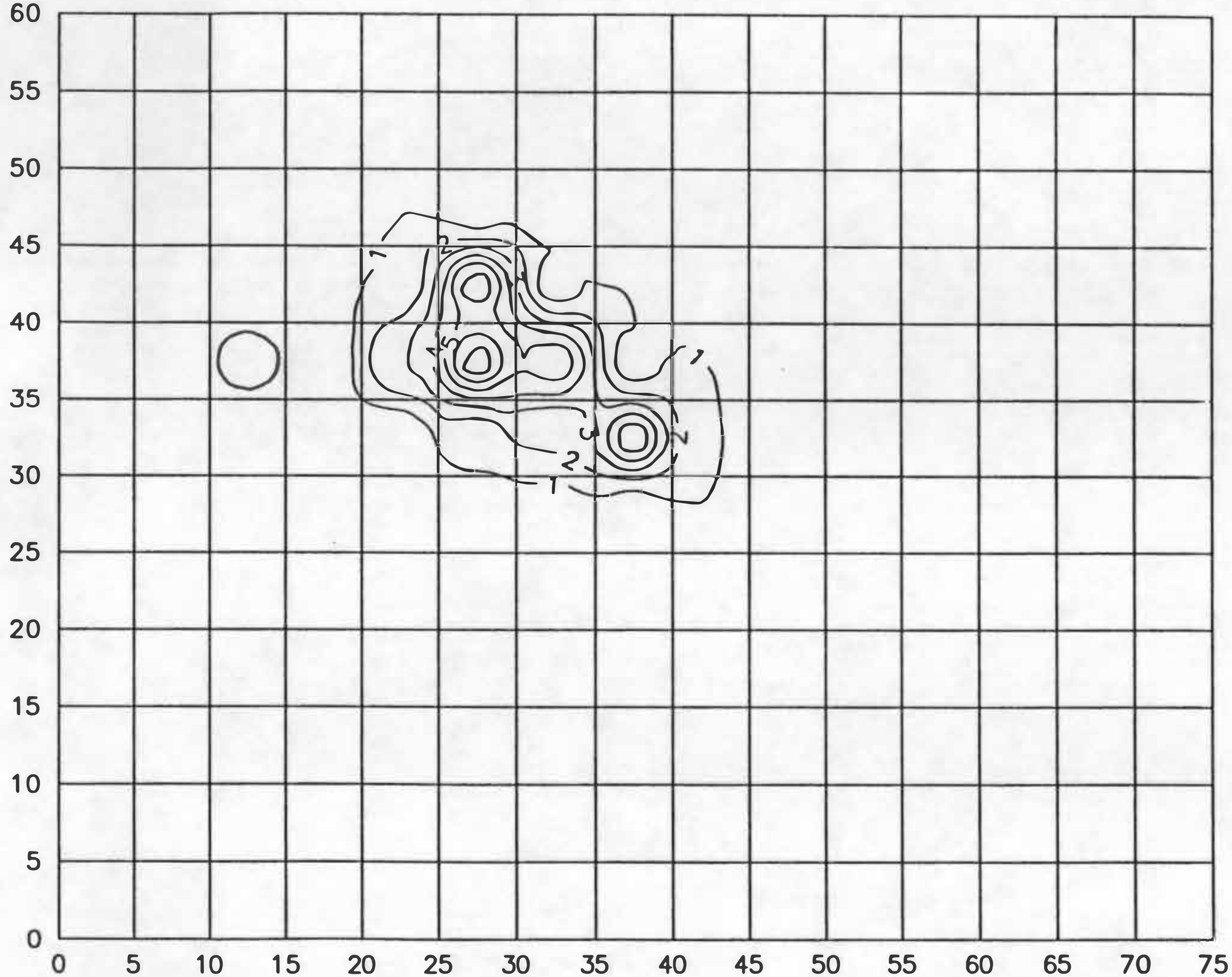

Figure 15. Distribution of Tools Used on Soft Material.

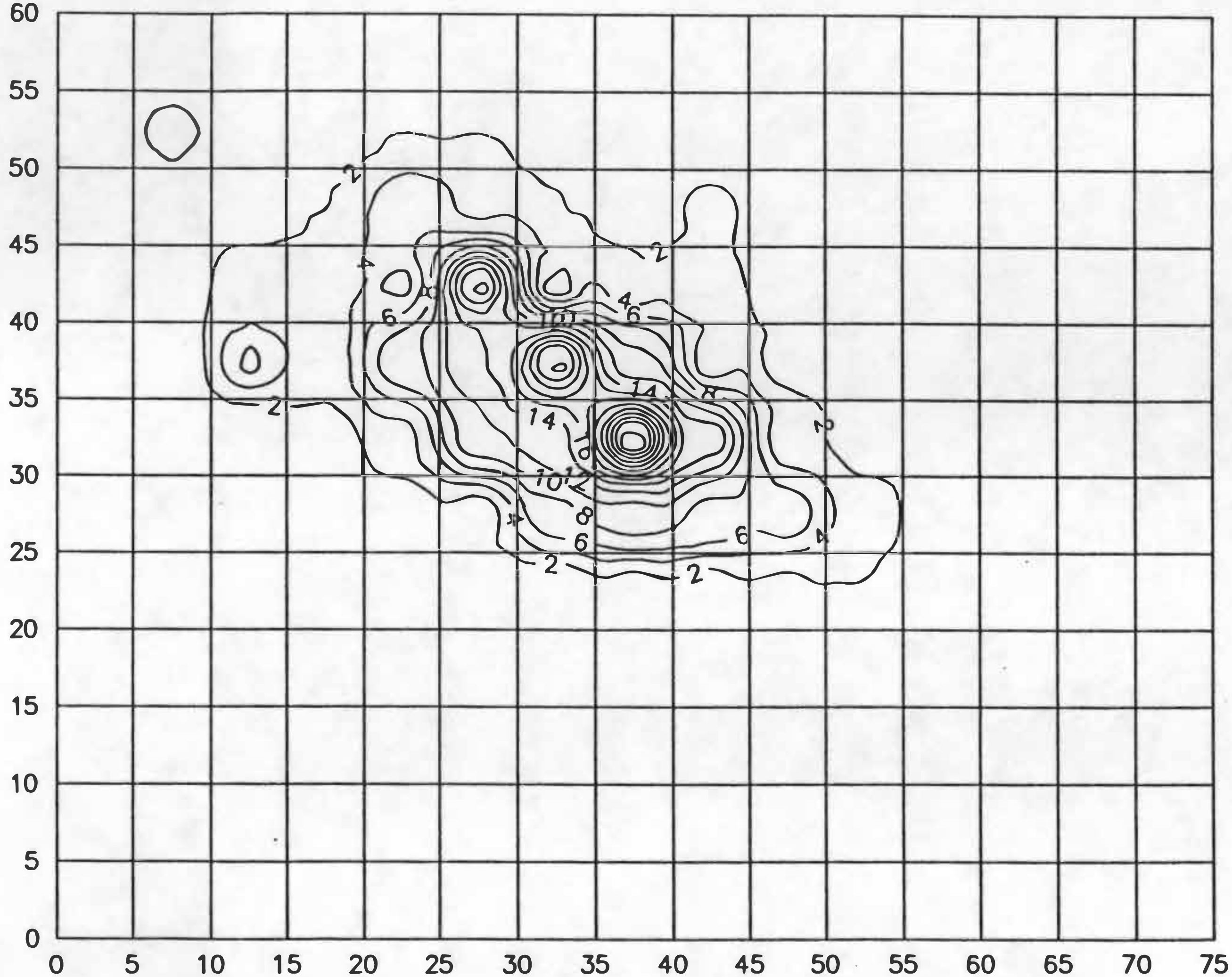

Figure 16. Distribution of Tools Used on Medium Material.

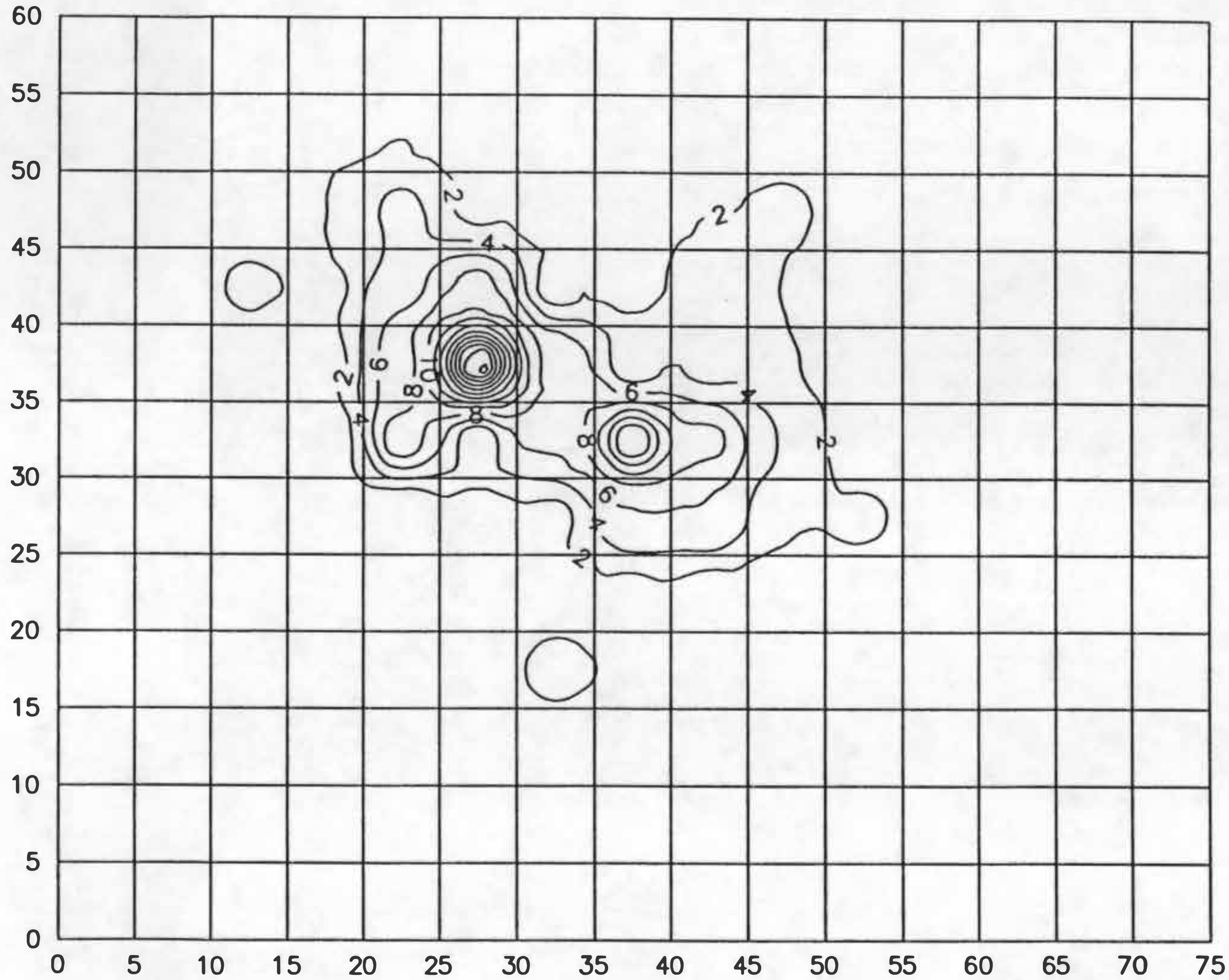

Figure 17. Distribution of Tools Used on Hard Material.

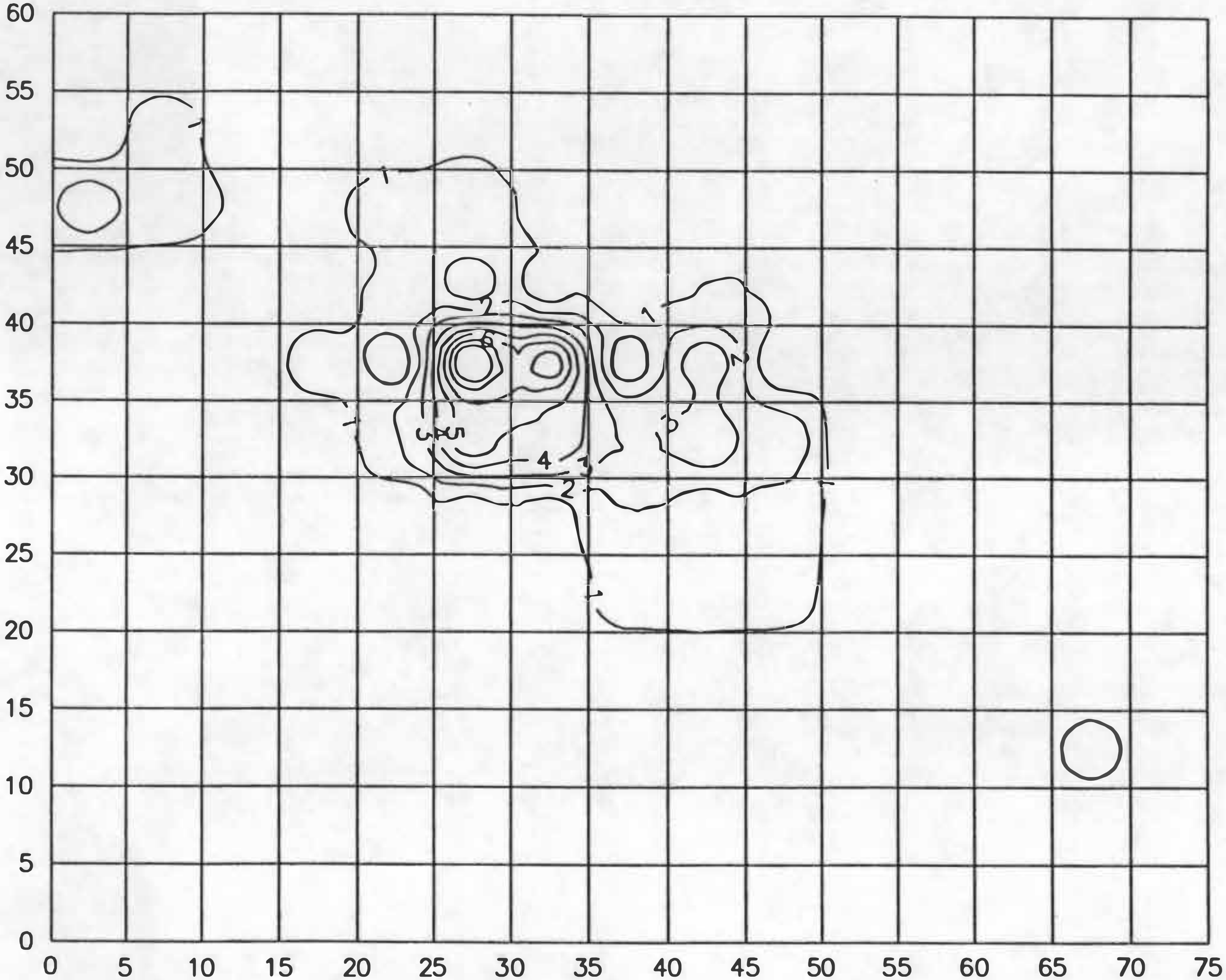

Figure 18. Distribution of Tools Used on Indeterminate Material.

Interrelation of Variables

The next stage of analysis involved investigating the dependence of certain variables within the data set. The relation of functional classes and material worked with edge angle, size, raw material, technology and typology was analyzed first by looking at raw counts and then through simple statistical means.

When the relation between function and material worked with edge angle (Table 5) was explored it was discovered that 24.5% of the tools fell into the edge angle category 0-40 degrees, 37.9% fell into the 40-60 degree category, 31.8% were in the 60-80 degree area, 2.8% were in the 80-100 degree range, while only 3.0% of the tools had edge angles between 100 and 360 degrees. There was definitely a domination by the edge angles below 80 degrees. The relation between edge angle and motion showed that 55.7% of the cutting tools fell into the 40-60 degree area, while 41.3% were in the range of 40-60 degrees, and only 3.0% of the cutting tools fell into the category between 60 and 80 degrees. Scraping, on the other hand, showed a different pattern. 8.3% of the scraping tools fell into the 0-40 degree range while 39.6% fell into the 40-60 degree range and 52.1% of the scraping tools were in the 60-80 degree

Table 5. Function and Material Worked by Angle.

Angle in Degrees		0-40		40-60		60-80		80-100		100-360	
Function	Material	Count	Weight	Count	Weight	Count	Weight	Count	Weight	Count	Weight
cutting	soft	23	15.7	8	17.7	0	0	0	0	0	0
cutting	medium	65	101.7	61	126.1	2	8.3	0	0	0	0
cutting	hard	2	5.2	5	27.4	2	3.7	0	0	0	0
cutting	indet.	22	70.4	9	34.5	2	12.4	0	0	0	0
scraping	soft	4	2.8	7	7.7	7	22.2	0	0	0	0
scraping	medium	18	15.7	74	234.7	24	112.0	0	0	0	0
scraping	hard	1	2.0	30	89.6	125	523.1	0	0	0	0
scraping	indet.	5	11.8	23	184.9	20	165.6	0	0	0	0
graving	soft	0	0	0	0	0	0	0	0	0	0
graving	medium	0	0	0	0	0	0	8	22.9	0	0
graving	hard	0	0	0	0	0	0	8	21.9	0	0
boring	soft	0	0	0	0	0	0	0	0	0	0
boring	medium	0	0	0	0	0	0	0	0	11	18.2
boring	hard	0	0	0	0	0	0	0	0	6	14.5
cutting	all	112	193.0	83	205.7	6	24.4	0	0	0	0
scraping	all	28	32.3	134	516.9	176	822.9	0	0	0	0
graving	all	0	0	0	0	0	0	16	44.8	0	0
boring	all	0	0	0	0	0	0	0	0	17	32.7
all	soft	27	18.5	15	25.4	7	22.2	0	0	0	0
all	medium	83	117.4	135	360.8	26	120.3	8	22.9	11	18.2
all	hard	3	7.2	35	117.0	127	526.8	8	21.9	6	14.5
all	indet.	27	82.2	32	219.4	22	178.0	0	0	0	0
used		140	225.3	217	722.6	182	847.3	16	44.8	17	32.7

category. Boring and graving tools combined accounted for 100% of the tools within the 80-360 range.

When these relationships were investigated statistically using the Chi-square test for independence, the graving and boring tools were left out of the analysis because of the small samples and the fact that the interesting relationships lay in the areas of scraping and cutting. The Chi-square test for independence (Table 6) is quite significant with a Chi-square value of 199.226. This value is interpreted to mean that there is a great deal of dependence between the edge angle and motion. It should be noted that cutting tools in the 0-40 degree range are over represented while scraping tools are under represented. The pattern is reversed for the 60-80 degree angle range. It can be stated, then, with a great deal of confidence that as edge angle increases (up to 80 degrees), scraping tools will be more highly represented. When edge angle is small there is a higher degree of confidence that it will be a cutting tool. This may be used in the absence of a true functional analysis of attributes to predict the range of motions at a site.

When material worked and its relation to edge angle are investigated similar results appear. Soft materials fall in

Table 6. Chi-Square Test for Independence Between Function and Edge Angle.

HO: Function and edge angle are independent.

Chi-Square Value 199.226
Degrees of Freedom 2
Probability 0.000

Therefore reject the null hypothesis of independence and accept that function and edge angle are dependent.

Function		Angle in Degrees			Total
		0-40	40-60	60-80	
Cutting	(observed)	112	83	6	338
	(expected)	52.208	80.922	67.870	
Scraping	(observed)	28	134	176	201
	(expected)	87.792	136.080	114.130	
Total		140	217	182	539

the lower edge angle range. Of the tools used on soft material 55% fall within the 0-40 degree range, while 57.6% of the tools used on medium material fall within the 40-60 degree category, and 76.9% of the tools used on hard material fall within the 60-80 degree range.

Chi-square tests performed on edge angle and material worked (Table 7) indicated that there was a strong relation between the two. As edge angle increases there is a better chance that the material worked will be harder and as edge angle decreases there is more of a likelihood that the material worked will be softer. This, like the test for scraping and cutting, suggests that edge angle is a fairly good predictor of material worked because hard materials were worked with large edge angles and soft materials were worked with smaller edge angles.

Size was broken into weight categories by gram; <1 gram, >=1<2 grams and so forth. When the relationship between motion and size (Table 8) was examined it was found that the majority of the tools weighed less than 2 grams. As the pieces got larger there were fewer cutting tools. The greatest number of cutting tools fell in the <1 gram range (43%). Scraping tools, however, increased until the >=2<3 gram category and then decreased.

Table 7. Chi-Square Test for Independence Between Material Worked and Edge Angle.

HO: Material worked and edge angle are independent.

Chi-Square Value 222.224
Degrees of Freedom 4
Probability 0.000

Therefore reject the null hypothesis of independence and accept that material worked and edge angle are dependent.

Material Worked		Angle in Degrees			Total
		0-40	40-60	60-80	
Soft	(observed)	27	15	7	49
	(expected)	12.090	19.793	17.118	
Medium	(observed)	83	135	26	244
	(expected)	60.201	98.559	85.240	
Hard	(observed)	3	35	127	165
	(expected)	40.710	66.648	57.642	
Total		113	185	160	458

Table 8. Function and Material Worked by Size.

Weight in grams		<1		>=1 <2		>=2 <3		>=3 <4	
Function	Material	Count	Weight	Count	Weight	Count	Weight	Count	Weight
cutting	soft	22	13.7	7	13.1	1	2.7	1	3.9
cutting	medium	60	35.2	29	39.2	10	23.9	10	33.2
cutting	hard	1	.4	1	1.4	4	10.5	0	0
cutting	indet.	4	2.6	8	13.0	5	14.1	2	7.8
scraping	soft	6	2.8	5	6.8	4	8.9	0	0
scraping	medium	27	16.6	28	42.0	22	48.7	9	32.5
scraping	hard	14	11.1	19	27.4	325	78.8	35	121.1
scraping	indet.	3	2.2	53	7.1	50	12.9	5	17.5
graving	soft	0	0	0	0	0	0	0	0
graving	medium	3	2.2	1	1.7	1	2.1	0	0
graving	hard	2	1.5	2	2.2	0	0	1	3.6
boring	soft	0	0	0	0	0	0	0	0
boring	medium	6	2.9	3	4.1	0	0	0	0
boring	hard	1	.9	1	1.8	2	4.7	1	3.1
cutting	all	87	51.9	45	66.7	20	51.2	13	44.9
scraping	all	50	32.7	57	83.3	63	149.3	49	171.1
graving	all	5	3.7	3	3.9	1	2.1	1	3.6
boring	all	7	3.8	4	5.9	2	4.7	1	3.1
all	soft	28	16.5	12	19.9	5	11.6	1	3.9
all	medium	96	56.9	61	87.0	33	74.7	19	65.7
all	hard	18	13.9	23	32.8	38	94.0	37	127.8
all	indet.	7	4.8	13	20.1	10	27.0	7	25.3
used		149	92.1	109	159.8	86	207.3	64	222.7
unused		690	234.3	175	244.8	76	185.1	43	148.6

Table 8. (continued)

Weight in grams		>=4 <5		>=5 <6		>=6 <7		>=7	
Function	Material	Count	Weight	Count	Weight	Count	Weight	Count	Weight
cutting	soft	0	0	0	0	0	0	0	0
cutting	medium	8	35.0	3	15.0	3	19.0	5	35.6
cutting	hard	0	0	0	0	0	0	3	24.0
cutting	indet.	7	30.5	3	16.6	3	18.5	1	14.2
scraping	soft	2	9.1	1	5.1	0	0	0	0
scraping	medium	6	26.4	2	10.5	7	46.8	15	138.9
scraping	hard	15	66.1	14	75.9	6	39.0	21	195.3
scraping	indet.	3	14.2	2	11.8	0	0	25	296.6
graving	soft	0	0	0	0	0	0	0	0
graving	medium	1	4.6	1	5.2	0	0	1	7.1
graving	hard	2	9.4	1	5.2	0	0	0	0
boring	soft	0	0	0	0	0	0	0	0
boring	medium	0	0	2	11.2	0	0	0	0
boring	hard	1	4.0	0	0	0	0	0	0
cutting	all	15	65.5	6	31.6	6	37.5	9	73.8
scraping	all	26	115.8	19	103.3	13	85.8	61	630.8
graving	all	3	14.0	2	10.4	0	0	1	7.1
boring	all	1	4.0	2	11.2	0	0	0	0
all	soft	2	9.1	1	5.1	0	0	0	0
all	medium	15	66.0	8	41.9	10	65.8	21	181.6
all	hard	18	79.5	15	81.1	6	39.0	24	219.3
all	indet.	10	44.7	5	28.4	3	18.5	26	310.8
used		45	199.3	29	156.5	19	123.3	71	711.7
unused		26	112.7	16	88.3	11	69.7	36	555.6

The Chi-square test of independence was conducted on the weight data (Table 9). For the majority of pieces below 4 grams, there is a substantial trend; as size increases the number of cutting tools decreases. Conversely, when size increases there are more scraping tools. This same pattern holds true for the observed and expected values for the chi-square test of the independence between size and material worked (Table 10). There is a strong relationship between the material worked and the size of the tool. As the size of the tool increases there is a greater possibility that the material worked will be harder. As the size of the tool decreases there is a better chance that the material will be softer.

Function and material worked correlated with raw material (Table 11) showed little of interest. The assemblage is so completely dominated by a few raw materials that the other materials become very insignificant in contrast. The Chi-square tests were not conducted on these variables because the test itself would be inconclusive due to the fact that there were so many empty squares in the matrix.

The relation between technology and function was investigated and there was little to no patterning present.

Table 9. Chi-Square Test for Independence Between Function and Size.

HO: Function and size are independent.

Chi-Square Value 75.563
Degrees of Freedom 7
Probability 0.000

Therefore reject the null hypothesis of independence and accept that function and size are dependent.

Material Worked		Size in Grams								Total
		<1	>=1<2	>=2<3	>=3<4	>=4<5	>=5<6	>=6<7	>=7	
Cutting	(observed)	87	45	20	13	15	6	6	9	201
	(expected)	51.089	38.037	30.952	23.121	15.289	9.323	7.085	26.104	
Scraping	(observed)	50	57	63	49	26	19	13	61	338
	(expected)	85.911	63.963	52.048	38.879	25.711	15.677	11.915	43.896	
Total		137	102	83	62	41	25	19	70	539

Table 10. Chi-Square Test for Independence Between Material Worked and Size.

HO: Material worked and size are independent.

Chi-Square Value 95.199
Degrees of Freedom 14
Probability 0.000

Therefore reject the null hypothesis of independence and accept that material worked and size are dependent.

Material Worked		Size in Grams								Total
		<1	>=1<2	>=2<3	>=3<4	>=4<5	>=5<6	>=6<7	>=7	
Soft	(observed)	28	12	5	1	2	1	0	0	179
	(expected)	14.171	9.580	7.584	5.688	3.493	2.395	1.597	4.491	
Medium	(observed)	96	61	33	19	15	8	10	21	263
	(expected)	76.061	51.422	40.709	30.532	18.747	12.855	8.570	24.104	
Hard	(observed)	18	23	38	37	18	15	6	24	49
	(expected)	51.768	34.998	27.707	20.780	12.760	8.749	5.833	16.405	
Total		142	96	76	57	35	24	16	45	491

Table 11. Function and Material Worked by Raw Material.

Raw Material		1		2		3		4		5	
Function	Material	Count	Weight	Count	Weight	Count	Weight	Count	Weight	Count	Weight
cutting	soft	2	2.6	0	0	0	0	0	0	0	0
cutting	medium	3	8.1	2	1.2	2	10.0	2	7.6	1	3.9
cutting	hard	3	17.7	0	0	1	.4	0	0	0	0
cutting	indet.	0	0	0	0	0	0	0	0	0	0
scraping	soft	0	0	1	5.1	0	0	0	0	1	2.2
scraping	medium	2	12.8	1	.8	0	0	0	0	0	0
scraping	hard	2	10.6	4	12.3	4	18.5	0	0	2	7.8
scraping	indet.	0	0	0	0	0	0	0	0	0	0
graving	soft	0	0	0	0	0	0	0	0	0	0
graving	medium	0	0	0	0	0	0	0	0	0	0
graving	hard	0	0	0	0	0	0	0	0	0	0
boring	soft	0	0	0	0	0	0	0	0	0	0
boring	medium	0	0	1	.6	0	0	0	0	0	0
boring	hard	1	2.7	0	0	0	0	0	0	1	2.3
cutting	all	8	28.4	2	1.2	3	10.4	2	7.6	1	3.9
scraping	all	4	23.4	6	18.2	4	18.5	0	0	3	10.0
graving	all	0	0	0	0	0	0	0	0	0	0
boring	all	1	2.7	1	.6	0	0	0	0	1	2.3
all	soft	2	2.6	1	5.1	0	0	0	0	1	2.2
all	medium	5	20.9	4	2.6	2	10.0	2	7.6	1	3.9
all	hard	6	31.0	4	12.3	5	18.9	0	0	3	10.1
all	indet.	0	0	0	0	0	0	0	0	0	0
used		13	54.5	9	20.0	7	28.9	2	7.6	5	16.2
unused		0	0	0	0	0	0	0	0	1	3.8

Table 11. (continued)

Raw Material		6		7		8		9		10	
Function	Material	Count	Weight	Count	Weight	Count	Weight	Count	Weight	Count	Weight
cutting	soft	0	0	0	0	0	0	0	0	0	0
cutting	medium	1	4.0	0	0	1	.2	1	.8	0	0
cutting	hard	1	1.4	0	0	0	0	0	0	0	0
cutting	indet.	0	0	0	0	0	0	0	0	1	.8
scraping	soft	0	0	0	0	0	0	0	0	0	0
scraping	medium	0	0	0	0	0	0	0	0	0	0
scraping	hard	0	0	1	7.0	2	6.2	0	0	0	0
scraping	indet.	0	0	0	0	0	0	0	0	0	0
graving	soft	0	0	0	0	0	0	0	0	0	0
graving	medium	0	0	0	0	0	0	0	0	0	0
graving	hard	0	0	0	0	0	0	0	0	0	0
boring	soft	0	0	0	0	0	0	0	0	0	0
boring	medium	0	0	0	0	0	0	0	0	0	0
boring	hard	1	.2	0	0	0	0	0	0	0	0
cutting	all	2	5.4	0	0	1	.2	1	.8	1	.8
scraping	all	0	0	1	7.0	2	6.2	0	0	0	0
graving	all	0	0	0	0	0	0	0	0	0	0
boring	all	1	.2	0	0	0	0	0	0	0	0
all	soft	0	0	0	0	0	0	0	0	0	0
all	medium	1	4.0	0	0	1	.2	1	.8	0	0
all	hard	2	1.6	1	7.0	2	6.2	0	0	0	0
all	indet.	0	0	0	0	0	0	0	0	1	.8
used		3	5.6	1	7.0	3	6.4	1	.8	1	.8
unused		0	0	0	0	4	2.8	0	0	2	3.5

Table 11. (continued)

Raw Material		11		12		13		14		15	
Function	Material	Count	Weight	Count	Weight	Count	Weight	Count	Weight	Count	Weight
cutting	soft	0	0	0	0	0	0	2	3.4	2	2.4
cutting	medium	0	0	0	0	0	0	5	6.6	16	43.2
cutting	hard	0	0	0	0	0	0	1	2.5	0	0
cutting	indet.	0	0	3	4.8	27	108.3	0	0	0	0
scraping	soft	0	0	0	0	0	0	1	1.1	0	0
scraping	medium	0	0	0	0	0	0	5	11.7	18	64.9
scraping	hard	0	0	0	0	0	0	7	36.3	29	133.3
scraping	indet.	1	.7	0	0	39	328.4	1	2.8	1	8.8
graving	soft	0	0	0	0	0	0	0	0	0	0
graving	medium	0	0	0	0	1	.7	0	0	1	5.2
graving	hard	0	0	0	0	0	0	2	4.2	1	5.2
boring	soft	0	0	0	0	0	0	0	0	0	0
boring	medium	0	0	0	0	0	0	1	.3	4	12.5
boring	hard	0	0	0	0	0	0	0	0	2	8.4
cutting	all	0	0	3	4.8	27	108.3	8	12.5	18	45.6
scraping	all	1	.7	0	0	39	328.4	14	51.9	48	207.0
graving	all	0	0	0	0	1	.7	2	4.2	2	10.4
boring	all	0	0	0	0	0	0	1	.3	6	20.9
all	soft	0	0	0	0	0	0	3	4.5	2	2.4
all	medium	0	0	0	0	1	.7	11	18.6	39	125.8
all	hard	0	0	0	0	0	0	10	43.0	32	146.9
all	indet.	1	.7	3	4.8	66	436.7	1	2.8	1	8.8
used		1	.7	3	4.8	67	437.4	25	68.9	74	283.9
unused		18	79.9	9	7.3	126	267.7	17	18.6	43	148.6

Table 11. (continued)

Raw Material		16		17		18		19	
Function	Material	Count	Weight	Count	Weight	Count	Weight	Count	Weight
cutting	soft	0	0	12	3.3	0	0	13	21.7
cutting	medium	0	0	29	41.4	2	1.4	63	107.7
cutting	hard	0	0	1	2.0	0	0	2	12.3
cutting	indet.	0	0	0	0	2	3.4	0	0
scraping	soft	0	0	3	1.8	0	0	12	22.5
scraping	medium	3	14.0	36	90.0	0	0	51	168.2
scraping	hard	5	25.7	46	142.0	0	0	54	215.0
scraping	indet.	3	15.7	1	2.5	1	.6	1	2.8
graving	soft	0	0	0	0	0	0	0	0
graving	medium	0	0	0	0	0	0	6	17.0
graving	hard	0	0	1	.8	0	0	4	11.7
boring	soft	0	0	0	0	0	0	0	0
boring	medium	0	0	1	.5	0	0	4	4.3
boring	hard	1	.9	0	0	0	0	0	0
cutting	all	0	0	41	46.7	4	4.8	78	141.7
scraping	all	11	55.4	86	236.3	1	.6	118	408.5
graving	all	0	0	1	.8	0	0	10	28.7
boring	all	1	.9	1	.5	0	0	4	4.3
all	soft	0	0	15	5.1	0	0	25	44.2
all	medium	3	14.0	66	131.9	2	1.4	124	297.2
all	hard	6	26.6	48	144.8	0	0	60	239.0
all	indet.	3	15.7	1	2.5	3	4.0	1	2.8
used		12	56.3	130	284.3	5	5.4	210	583.2
unused		2	3.6	297	215.7	28	21.2	526	866.4

Of the 572 used pieces in the collection, 519 (90.7%) were classified by their technology (Table 12). The majority of the used pieces were made on flakes or ordinary points or on flakes smaller than 30mm. Flakes or ordinary points accounted for 106 (20.4%) of the used pieces and 6.4% of the total assemblage. Flakes smaller than 30mm accounted for 165 (31.8%) implements and 10% of the total assemblage. Together these two classes make up over 50% of the pieces interpreted as showing evidence of function and 16.8% of the total assemblage. The other portion of the used pieces in the collection are distributed between the other twenty-four technological classes. As for the relation of these technological classes to function there is no discernable pattern. Each of the functional classes (i.e. cutting soft material, scraping hard material etc.) has a number of technological classes associated with it and there is overlap in technological classes between functional classes.

Unlike technology, typology shows some interesting relationships with function. When the Burrone Scierra assemblage was analyzed, 407 of the pieces were ascribed to Bordesian types. Of these, 335 were used and 72 showed no signs of utilization. This would indicate that pieces fashioned in typological tool forms were then generally put

Table 12. Function and Material Worked by Technology.

Type	Cutting				Scraping				Graving		Boring	
	soft	medium	hard	indt.	soft	medium	hard	indt.	medium	hard	medium	hard
1		2		4	3	1	4					
2		7		5		15	23	3	3	2		1
3		5				3	7	1				1
4	1	24	3	8	4	28	42	8	1		1	1
5	1	10		5		5	21	6	1	1		1
6	1			3		7	6	6				
7		8	1	3		12	3	5	1			
8												
9						3	2					
10												
11												
12						1	1	1				
13												
14												
15												
16							1					
17											2	
18								2				
19								2				
20												
21						4	4					
22												
23												
24		1				1						
25		1				1	1			1	1	
26	5	59		8	1	41	23	13	2	4	8	1

to use. Bordesian type designations were assigned to 335 (58.6%) of the 572 used implements (Table 13). Though 82% of the formally typed tools were used, they make up only 58.6% of the utilized pieces in the collection. Thus, if one only looks at the formally typed tools for a functional analysis, a good portion of the utilized material in the assemblage will go unexamined.

Relationships between Bordesian types and functional types were observed. In the scraper category (#9-29 and 30-31), there were 143 formally typed side scrapers and end scrapers. However, there were 338 pieces that were interpreted as showing usewear ascribed to scraping. Of the 143 formally typed scrapers, 130 were interpreted as being used for scraping while 9 showed evidence for cutting, 3 for graving and 1 for boring. Consequently, the Bordesian scraper types are good predictors that the implement was used to scrape.

Pieces ascribed to the point types (#3-8) had various interpreted functions. Of the 40 points, 12 were interpreted as being used for cutting, 27 for scraping and one for graving. There were only 9 pieces typed as knives (#36-38) and of these only one showed evidence for cutting. The other 8 showed signs of scraping. None of the burins

Table 13. Function and Material Worked by Bordesian Type.

Type	Cutting				Scraping				Graving		Boring	
	soft	medium	hard	indt.	soft	medium	hard	indt.	medium	hard	medium	hard
1		7	1	3				2	1			
2				1								
3												
4												
5												
6					2	6		4				
7						1	1					
8								2				
9		2			4	5	4	1				
10					1	1	1					
11						4	10	1				1
12						3	3	1				
13		1				2	2			1		
14				2			2					
15					1	1	7					
16									1	1		
17						1	7	9				
18		1				2						
19	1				1	4	4	2				
20												
21			2				2					
22							3					
23						1	5					
24							4					1
25												
26												
27												
28												
29												
30												
31					2	2	5					
32						1						
33												
34	4	4					2	1			1	1
35					1	1	2	1		1		
36					1		1					
37							6					
38		1										
39												

Table 13. (continued)

Type	Cutting				Scraping				Graving		Boring	
	soft	medium	hard	indt.	soft	medium	hard	indt.	medium	hard	medium	hard
40		1				2	2		1			1
41												
42	1	2				12	9	1				
43	2					2	2	7				
44												
45	1	7	1				3		1	1		
46							6					
47					1							
48	1	1		1	1		2					
49				2								
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												
61												
62		1										
63												
99	6	10		3	6	18	15	1	2	2	2	

(#32-33) showed signs of graving while only two of the 18 borers showed indications of boring activities. Of the other significantly represented types there were 25 notches (#42). Three of these showed signs of cutting while 22 showed indications of use for scraping. Denticulates were represented by 13 pieces. Of these 13 pieces; 2 were used for cutting and 11 were used for scraping. Consequently, aside from the scraper class (#9-29 and 30-31), the Bordesian typology is a poor indicator of function.

CHAPTER IX

CONCLUSIONS

The intent of this thesis was to investigate several aspects of function within a Mousterian assemblage from southern Italy that had not previously been functionally analyzed. These investigations focused on the relationship between function and the edge angle, size, raw material, technology and typology of the assemblage. Another intent of this study was to examine the remaining spatial integrity of the activity areas (if there were any) at Burrone Scierra I. The Burrone Scierra I assemblage presented several methodological problems in that it was a surface collection from a plow-zone context. Plow damage and heavy patination have in the past been two of the microwear analyst's nightmares and a hinderance to investigations (Mallouf 1982; Odell 1985). For this reason, it was determined that the methods developed for low-power microwear were the most adequate means of analysis and would allow for a functional interpretation to be made while screening out the damage produced by the plow. Because plow-zone assemblages present these challenges, microwear analysts have shied away from attempting investigations on such assemblages. There has

been little work done on plow-zone assemblages and consequently any work done on these assemblages contributes to the larger body of archaeological literature. From this particular study it was determined that though there may have been some misinterpretation of plow damage as usewear, for the most part, plow damage did not completely obliterate usewear attributes and therefore function could be interpreted. Spatial patterning of these functions indicated that two different activities were taking place in separate areas of the site. This information along with the fact that there are two separate clusters of lithic material at the site allowed for the conclusion that some spatial integrity was maintained within the plow zone.

Using the methods developed for low-power microwear analysis by Ruth Tringham (1974) and George Odell (1977) the assemblage for Burrone Scierra I was analyzed to investigate the attributes that would allow for the interpretation of function. Once these attributes were recorded, the earlier stated relationships were investigated. The relation of function with edge angle, size and typology proved to be significant. The relationship between raw material and function and technology and function did not. Larger edge angles were associated with more intense functions such as

scraping, while smaller more delicate angles were associated with cutting. The sharpest edge that can be used is a fresh unretouched edge. As a tool dulls and is retouched its edge angle becomes larger. The tool may become less efficient as a cutting tool and either discarded, or in resource poor areas reworked into a scraping tool. Since what we as micro-analysts see is only the evidence of the last activity that the tool was used for, much of the evidence for cutting may be obliterated if the tool was indeed reused as a scraper.

The relation between function and size was significant as well. Larger tools are used for scraping while smaller tools are used for cutting.

The relation between function and typology was investigated in order to see if functionally loaded type names, such as backed knife and side scraper, had anything to do with and the actual interpreted function based on attributes identified using microwear techniques. One significant relationship did exist. Most of the pieces typed as scrapers were indeed used for scraping purposes. However, not all were. A small percentage was used to cut and others were used to grave and bore. With points, knives, borers, gravers, notches and denticulates, varying

proportions of the artifacts from each type were interpreted as cutting, scraping, graving and boring tools. Thus, if typological classes are used for functional analyses a large proportion of implements will be misclassified, and a large number of used pieces will go unnoticed because they do not fit into a formal type. This is one on the many drawbacks of the Binford's work with function and Mousterian variability.

It was also significant that through low-power analysis, several functions on several different materials were identified for a Mousterian assemblage. Previous investigations (Anderson 1979, 1990; Beyries 1989) using high-power microwear methods found that woodworking was the dominant activity at Mousterian sites. This may be due to post deposition processes being misinterpreted as evidence for wood working. This, however, remains to be proven. At the Burrone Scierra I site wood working is not the only activity taking place nor is it the dominant activity.

Raw material and technology showed little to no patterning in relationship to function. I believe this is due in part to the dominance of one or two categories in each instance. This dominance probably represents proximity to the resource. The site was located in a resource poor

area; thus, any useable raw materials were utilized.

Investigations of the spatial patterning at the Burrone Scierra site proved to be significant. Because the assemblage was from a plow-zone context it was not expected that there would be much integrity to activity areas remaining at the site. When the patterning was investigated and function was looked at across the site there was significant clustering of materials being worked in two separate areas of the site. One area was dominated by medium materials and the other was dominated by the working of hard materials. Each of these areas had an equal number of cutting and scraping tools. The area where hard materials were being worked had the presence of boring and graving tools. These areas are interpreted as being wood (hard material) and hide (medium materials) processing areas. Regardless of their interpretations, the implications for the spatial analysis is that within a plow-zone context, some spatial integrity can remain to the activity areas, and this can be identified through microwear analyses.

At a minimum, the significance of this thesis is that it contributes to the body of data for the Mousterian in Italy. Raw material availability indicates that Mousterian

people may have been acquiring their materials and then carrying them great distances to the Burrone Scierra I site. They then utilized these materials until the functional life of the tool was exhausted. Functional analyses of these utilized tools indicate that several activities were taking place at Burrone Scierra I. Other than woodworking, previously identified at Mousterian sites by Anderson (1979, 1990) and Beyries (1989), microwear interpreted as hide working is identified at Burrone Scierra I. Due to the fact that only two activities are identified at Burrone Scierra I this site is not interpreted as a habitation site. Rather, it is interpreted as a temporary work camp for hide processing, wood working and general retooling of implements.

This thesis also strengthens the body of literature on microwear analysis by applying methods and data from the experimental literature in a low-power functional analysis of a plow-zone assemblage. In so doing this work establishes that assemblages from plow-zone contexts and surface collections should not *a priori* be ignored in microwear studies. Functions can be interpreted for the implements from plow zone context, and activity areas may still be defined based on these functional designations.

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