TABLE 8.03. FREQUENCIES OF UNIFACES AND BIFACES AT MOCCASIN CONFLUENCE IN TEST PITS 1-3 BY TEST PIT 2 LEVELS.

Level	Unifaces	Bifaces	Level	Unifaces	Bifaces
1	0	0	19	2	3
2	0	0	San 20	0	2
3	0	0	Geron-21	1	0
4	0	0	imo 22	0	3
5	0	0	23	0	0
6	0	0	24	0	2
7	0	0	25	0	1
8	0	0	26	0	0
9	0	2	27	0	0
Rnd 10	1	1	28	0	0
Rock11	2	2	29	0	0
12	0	1	30	0	0
13	2	1	31	0	0
Clr 14	0	0	32	0	0
Fork15	0	1	33	0	0
16	1	0	34	0	0
16.5	0	4	35	0	0
17	0	2	36	0	0
18	1	2	37	0	0
			38	1	0
			39	0	0

After 5000 B.P. the Clear Fork phase is characterized by more numerous, large sites, with a distinctly different artifact inventory. A more focal subsistence pattern (Weir 1976) is attributed to more abundant resources, rather than technological innovation, a hypothesis supported by the climatic analysis in chapter 5.

In Test Pit 4, there is a dramatic increase in the number of bifaces for the Clear Fork levels. Three of the bifaces recovered from these levels appear to be manufacturing discards, given the breakage patterns. They appear to be what are commonly called "blanks." Lithic raw materials were close to the site, and reduction of these materials could have been a primary activity, although it most likely would have been in conjunction with food collecting.

Test Pits 1, 2, and 3 generally show a decline in the number of unifaces and bifaces for the Clear Fork levels (Table 8.03). This seems to correspond with the lithic debris concentrations, and perhaps indicates a change in site function within the overall subsistence pattern.

The Round Rock phase (4200-2600 B.P.), corresponding to the Colorado Subpluvial, marks a change to a more mesic, warm environment for the region (see chapter 5). Weir (ibid.) suggests that this prompted a more focal subsistence pattern, as resources flourished. We would expect that under these conditions the tool assemblages would be less diverse and more specialized.

There are indications of change in the manufacture and use of tools. In Test Pit 4 there are fewer bifaces for the Round Rock levels, while Test Pits 1, 2, and 3 show an increase in bifaces and unifaces from the previous phase. The change in the character of the artifact assemblage may be due to a change in site function in response to environmental changes or organizational restructuring. In general, there is a higher ratio of debris to tools in Test Pits 1, 2, and 3, possibly indicating an increase in tool manufacturing. Assuming that wood was a more prominent feature of the landscape during this mesic period, and that the wooden artifacts were an integral part of the cultural inventory, it follows that woodworking would appear as a more prominent feature of tool function. Woodworking dictates the use of sharp tools, and we would assume that the tools used in woodworking would exhibit extensive resharpening. There were a large number of tools exhibiting stepping found in the wear pattern studies, suggesting use on a hard surface, such as wood (see below).

The tool and debitage assemblage from Moccasin Confluence for the Archaic presents a picture of adaptation involving changes in tool use for resource exploitation, and also in the manufacture and maintenance of tools. There was a decreasing emphasis on tools and an increasing reliance on utilized flakes, "tools of convenience," for vegetable processing or butchering.

CONCLUSIONS

The morphological analysis of the tool assemblage from Test Pits 1, 2, 3, and 4 indicates a change in adaptation from the earlier phases through the later phases of the Archaic that correlates with changes in environment. The frequencies of tool types shifted within the site through time suggesting changes in site-specific activities. In general, style and form are the result of a "mental template" of a flint knapper, and also the response of the cultural and technological system to environment. As there are climatic shifts, there is a resulting impact on available resources. Such environmental stimulation will eventually influence the style and form of tools.

USE-WEAR ANALYSIS OF BIFACES AND UNIFACES (Price)

A functional analysis of bifacial and unifacial artifacts from Moccasin Confluence (41 BC 71) was undertaken to establish the types of activities predominant at the site through time. Both macroscopic and microscopic observations were made on working edges of the assemblage, based on the concepts and techniques suggested by Keeley (1980); Hayden and Kamminga (1979); and Ahler (1979). These included the analysis of wear patterns such as edge damage (nibbling, step and hinge fractures) as well as polish.

The actual recording of the observations can be complex. Short of literally counting fracture scars and designating the dominant form of damage on one or both aspects, observations can become almost arbitrary. This is a particular problem if the observer is inexperienced, or does not have the time for extensive replicative experiments. Following the recommendations of many researchers, considerable time was spent preparing and examining each specimen. Semenov (1973), for instance, advises close attention to details such as the orientation of striations, the cross sections of the utilized edges, and the extent of polish, even noting whether the polish is present in the hollows of fracture scars as well as on the ridges.

With regard to the interpretation of wear patterns, various attendees of the first Conference on Lithic Use-Wear, held in 1977, have pointed to several sources of edge damage other than "use" that could confound interpretation, e.g. manufacture, mechanical transport (downslope movement), eolian polish, excavation damage, and "bag" damage. There was even a report of debitage trampling by moccasined feet that produced modification remarkably similar to "established morphological categories." It was also noted that raw material was a factor in edge damage resulting from use, and that high magnification equipment is not uniformly available to all researchers.

These factors are particularly important when attempting to distinguish grades of wear polish, the occurrence of which has been related to use on such disparate contact materials as wood, bone, meat, and hide. Keeley (1980) pointed out that differences in illumination with microscopes can create "serious observation differences."

In view of these admitted difficulties in microscopic data collection and interpretation, several researchers have proposed that other morphological attributes of lithic tools may be more "objective" and more readily obtainable to complement and supplement the microscopic observations. Edge angle, for example, has been included in various schemes of functional analysis (Wilmsen 1968; Odell 1979) and has been shown to be an important factor in distinguishing motions required for certain tasks (e.g., cutting and scraping Keeley 1980). Weight of the artifact was found to be a useful diagnostic attribute in the work of Cantwell (1979) on the settlement system of the midwest Havana tradition. It was found that there was a significant difference in weight between two groups of scrapers divided into categories on the basis of wear pattern alone. Thickness, too, would logically be a factor in determining use, especially in such activities as chopping and adzing, and has been recorded as an integral attribute (albeit not a determining one) in an analysis of hardwood scrapers by Hester et al. (1973). These three variables, then—

edge angle, weight, and thickness—will be related to types of edge damage in an attempt to establish values of what Cantwell (1979) has called "diagnostic criteria" for this collection.

The Sample

The sample consisted of 40 unifaces and bifaces selected from those documented above. Selection of the sample was based on the relative "completeness" of the artifacts. Each artifact was placed flat side down and the most pointed side toward the top of the page on a grid of eight equally spaced radii, and a measure of edge angle, as well as observations of wear, were made for each edge segment bounded by two radii. Measures for weight (g) and thickness (mm) were also recorded, and each edge segment was examined with a stereoscopic microscope for evidence of microwear (Table 8.04).

Wear

Observations were recorded for each edge segment as to the presence of, or absence of, polish, nibbling, or stepping. Stepping was observed as large and invasive step and hinge fractures. These three wear characteristics were taken to indicate use on progressively harder materials: polish for use on succulents or other vegetable matter; nibbling for use on medium-hard materials, such as soft woods, bone, or antler; and stepping for use on hardwoods, or activities requiring greater force. Table 8.05 shows the relative frequency of their occurrence on artifacts from the various chronological periods. With two exceptions, the pattern remains basically the same through all periods. Stepping is infrequent except in the Middle Archaic, where it represents 64% of the total observations. The Paleoindian period is notable for lowest incidence of stepping, only 21%.

TABLE 8.05. PERCENTAGE OF WEAR BY PERIOD

	Paleo-Indian	Early Archaic	Middle Archaic	Late Archaic
Polish	24	18	13	18
Nibbling	55*	47	*23	45*
Stepping	21	35	64*	27
Number of Tools	29	146	31	22

TABLE 8.04. TOTALS BY LEVEL OF UNIFACES AND BIFACES AT MOCCASIN CONFLUENCE IN TEST PITS 1-3 USING TEST PIT 2 LEVELS

Phase (Weir 1976)	Level*	Unifaces	Bifaces	Level Depth from Surface* (cm)
	1	0	0	5.00
	2	0	0	10.00
	3	0	0	15.00
	4	0	0	20.00
	5	0	0	25.00
	6	0	1	30.00
	7	0	3	35.00
	8	0	1	38.00
	9	0	1	40.00
Round	10	2	1	44.40
Rock	11	2	2	46.60
	12	1	2	47.60
	13	2	1	52.20
Clear	14	0	0	58.00
Fork	15	0	0	62.40
	16	1	0	67.80
	16.5	0	4	73.80
	17	0	0	78.05
	18	1	2	82.45
	19	2	4	85.65
San	20	1	3	90.25
Geronimo	21	0	0	94.85
	22	0	2	100.45
	23	0	1	104.45
	24	0	2	111.65
	25	0	1	117.85
	26	0	0	120.85
	27	0	0	123.35
	28	0	0	128.60
	29	0	0	132.35
	30	0	0	139.55
	31	0	0	143.95
	32	0	0	153.75
	33	0	0	163.75
	34	0	0	171.15
	35	0	0	180.35
	36	0	0	190.35
	37	0	0	198.95
	38	1	0	208.75
	39	0	1	218.75

*Levels and level depths are based on Test Pit 2.

The climate during the Middle Archaic has been characterized as predominately warm and moist (Gunn, Sims, La Rocca, Chapter 5) and would have contributed to the propagation of a woodland type of environment in the central Texas region. The high proportion of stepping may reflect increased exploitation of woodland resources. The ratios of the other periods probably represent a successful economic strategy that persisted among the inhabitants of the site during less moist intervals.

Weight

The mean weight of the entire sample was determined to be 86.2 g (standard deviation 73.6, range 279). When weight was tested between the three types of edge wear with a two-tailed t-test, no significant difference was found between the means of wear categories. These results could be explained by the rather disparate nature of the collection, as indicated by the wide standard deviation. There is a slight tendency for weight of stepped pieces to be heavier that reinforces the use hypothesis. The fact that differences in thickness are significant (see below) must be taken as an indicator of which variable is important to heavy use.

Thickness

Calculation of the mean for the 40 measurements of thickness gave a value of 18.32 mm. The standard deviation was 8, and the range 35. The mean for the occurrence of polish was 15.6 mm; that of nibbling, 15.8 mm; and stepping 18.7 mm. A significant t-test indicated a difference between the mean thickness of artifacts with stepping, and those with polish and nibbling. The mean thickness for artifacts with polish and nibbling were almost identical. It would seem that thickness is not a discriminating variable for activities where force is not a factor. The significant association of thickness with stepping, however, adds a meaningful dimension to the Middle Archaic, apparently woodland assemblage.

Edge Angle

Measurements for edge angle were taken in all eight segments of each artifact with a contact goniometer. The mean value for all the observations was 66.5° (standard deviation 11.3); and the values range from 40° to over 90°. A t- test on the edge angles between polish and nibbling was not significant. However, tests for differences between the mean edge angle on artifacts with polish and that of stepping, and the mean of those with nibbling and that of stepping were significant at the .005 level. These results, along with those for the other variables, indicate that, statistically, weight, thickness and edge angle can not be used to discriminate between activities resulting solely in polish and nibbling.

If, however, the values for polishing and nibbling are pooled and compared with the values associated with stepping, significant levels are found for thickness (.01) and edge angle (.001). The combination of polish and nibbling into one category was suggested by Keeley's (1980) report of wear damage resulting from experimental replication. Thin, low edge angled scrapers exhibited polish and microscopic fracture scars; thicker, high edge angled scrapers exhibited polish and large, shallow fracture scars.

The test for differences between means for weight did not reach the criterion value. It does not seem to be a diagnostic attribute, at least not for this sample.

It is interesting to note that with regard to edge angle, the mean for stepping (71.9°) is close to those found by Cantwell (1979) in the analysis of the hardwood "Havana" scrapers (70.7°) and by Hayden and Kamminga (1979) in their report on Australian woodworking tools (70.0°).

It is worth noting that weight, thickness, and edge angle show a clear progression toward better discrimination of use, which is in accord with the original hypothesis of the study. The failure of weight to perform as an indicator is probably due to its indiscriminate characterization of the whole mass of the artifact. As can be seen in Figure 8.05A thickness discriminates only stepping. Edge angle, on the other hand, shows three distinct frequency peaks for each type of use-wear (Figure 8.05B). This suggests a two-staged blank production process for various intended uses. In the first stage a blank of appropriate thickness was prepared. In the second stage the edge angle was adjusted to the prospective use.

We propose, then, that these results support the idea that the morphological characteristics of thickness and edge angle can be used as supplementary indicators of tool function along with use-wear on contact surfaces. In conjunction with other data concerning available resources, these characteristics could help determine use. Furthermore, the frequency signature, the distributions of the thickness and edge angle attributes against types of use, can be used as ecological indicators and probably produce information on the cultural origins of groups on a given occupation level.

CONCLUSIONS (Price, Gunn)

It is proposed that the Archaic cultural system existed in a homeostatic balance with its environment, in spite of structural and functional changes brought about by climatic shifts. Foods being exploited changed through time, but within a marginal, or optimal, environment food was available. In our tool analysis studies the importance of hunting must not be overemphasized. Plant food sources certainly were an integral and even more reliable part of the prehistoric peoples diet.

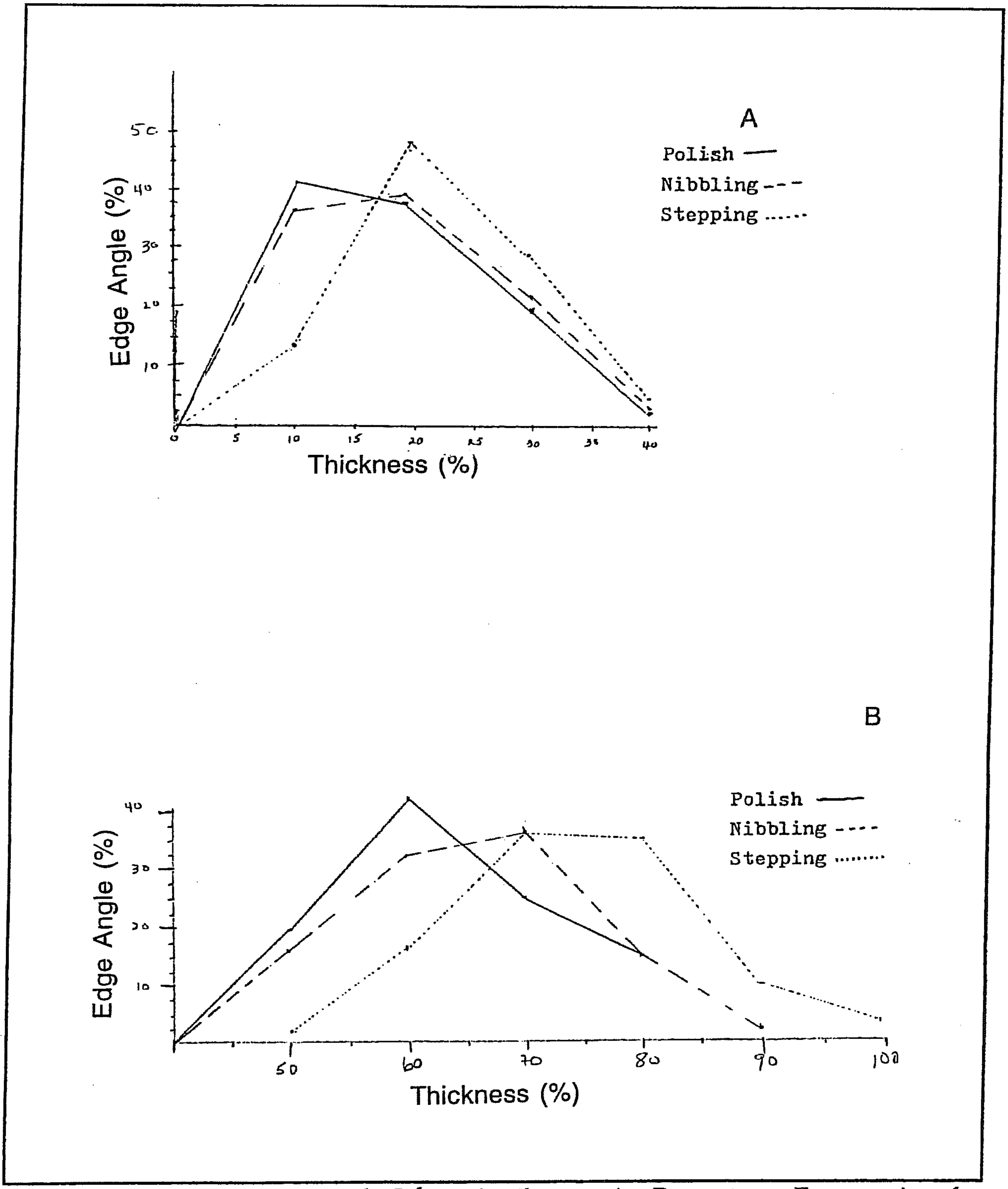

Figure 8.05. Edge Wear and Other Attributes: A. Percentage Frequencies for Thickness Measurements for Observed Polish (n=43), Nibbling (n=101), and Stepping (n=84), B. Percentage Frequencies for Edge Angle for Polish (n=28), Nibbling (n=99), and Stepping (n=84).

A comparative study of other sites and assemblages in this area of Texas indicated reoccurring patterns in tool assemblages and proposed site attributes. However, the reports on the Enchanted Rock area (Assad and Potter 1979) and the Fall Creek site (Jackson 1938) were mainly surface survey reports. The evidence from test pits at 41 BC 71 and 41 GL 21 are promising and more extensive excavations could ultimately contribute much to our understanding of environmental change, and its impact on culture in central Texas.

CHAPTER 9—FLAKE MORPHOLOGY AND CULTURE CHANGE (Gunn, Probst, Syverson)

This chapter reports on the study of culture change as evidenced by lithic technology, specifically through the analysis of platformed flakes, at Moccasin Confluence. Unlike points and tools, flakes are found in all levels and, therefore, provide a continuous, high resolution monitor of cultural change.

OBSERVATIONS AND METHODOLOGY

Platformed flakes were targeted for study because they contain the most diagnostic attributes of the various technological modes and accurately represent the amount of lithic-related activity at the site. Platformed flakes are, literally, a "blow-by-blow" description of a site's lithic history. The number of broken or "shattered" pieces has a random component that depends on the number of fragments into which a flake breaks. The total amounts of lithic debris including shatter ("chips") are discussed in Kerr (chapter 6).

The flakes came from the levels of Test Pits 2, 4, and 6. Each level had an assigned field number (FN). Flakes were washed and sorted into platformed and nonplatformed classes. Platformed flakes were measured and observed on 32 variables. The information recorded from each flake was then keyed into computer readable format. The results were evaluated, and the information obtained is the subject of this report.

Test Pit 6 contained 385 flakes from 12 levels. All platformed flakes from the test pit were processed. In Test Pit 2, 564 flakes were sampled from levels 1 through 39. If less than 50 flakes were recovered from a level, all were processed. If more than 50 flakes were recovered, they were sequenced from largest to smallest and a random sample of 50 flakes was drawn by reference to a table of random numbers. Two-hundred flakes were processed from the lower levels (19-41) of Test Pit 4, the Paleoindian and the early half of the Early Archaic period. All of the levels contained less than 50 flakes.

Figure 9.01a shows the flake manufacturing process and describes the flake terminology used in this report (Gunn and Mahula 1977b; Gunn 1982d). Figure 9.01b illustrates the morphological characteristics of a platformed flake. Each of these components must be recognized before a flake can be evaluated.

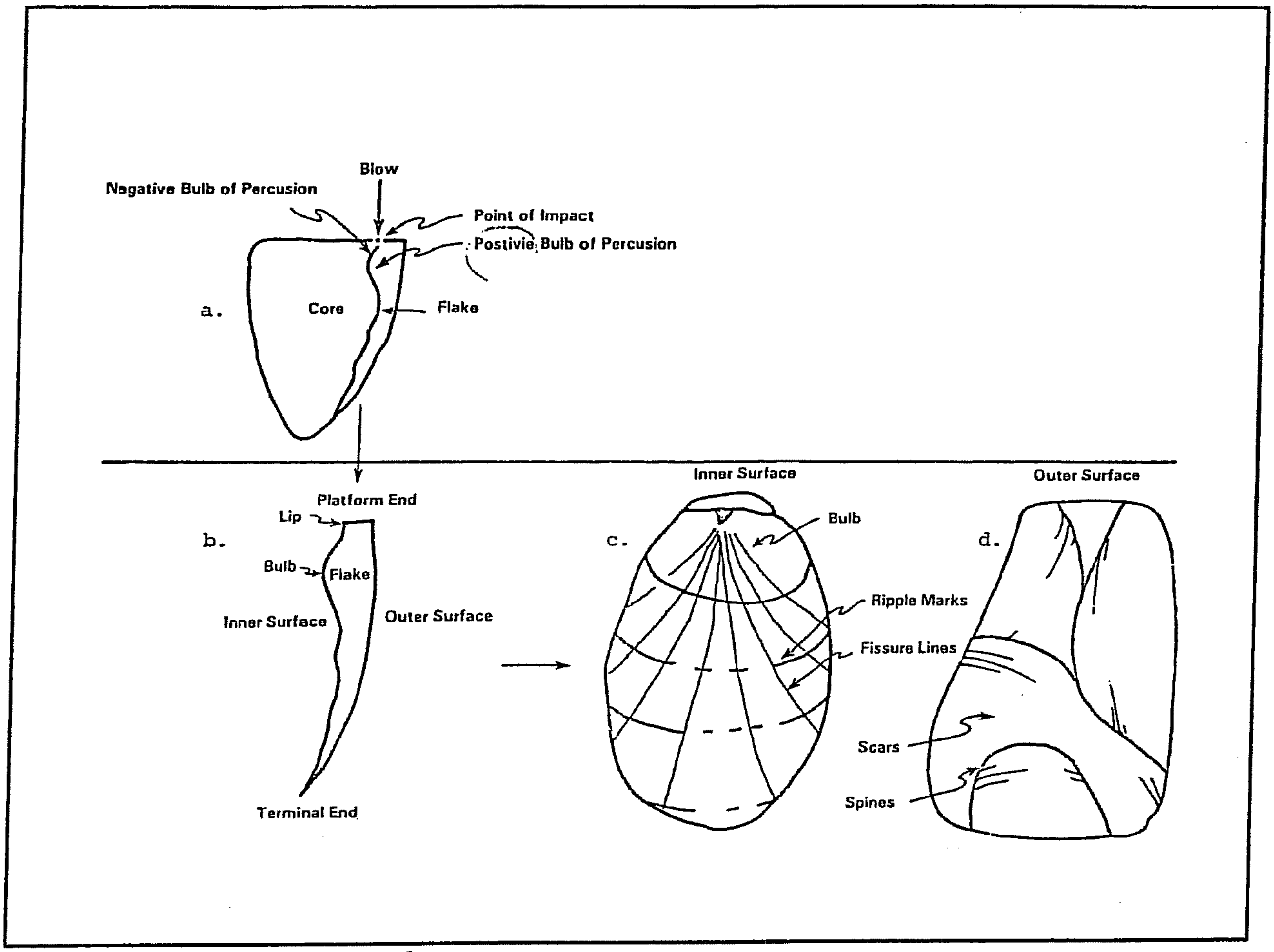

Figure 9.01. Flake Terminology.

Fifteen participants in the anthropology laboratory course (ANT 4403), at UTSA in the fall of 1982, assisted in the analysis. Each was assigned a coder number. These numbers were recorded on each form as the individual completed the 32 observations and measurements. Test and reviews were conducted by the instructor and lab supervisor to reduce reporting error.

The individual characteristics of each flake were recorded on a flake technology/morphology form (Figure 9.02). The variables of each flake were recorded in the following manner:

1. Time—time at which the observations began.

2. FN—permanent field specimen number assigned by level. This number along with the artifact sequence number and site number, 41 BC 71, was inked onto each flake.

3. Sequence Number—a unique number assigned to each flake within a level.

LBJ PARK PROJECT

Flake Technology/Morphology-JG-6OCT82
Zero=missing data, Blank=not observed

Codes	Units	Field	Columns
		Time _ _:_ _	1-4
		FN# _ _ _ _	5-8
		Sequence # _ _	9-10
1=flake 2=blade 3=bif Lo 4=bif Wi		Technotype _	11
1=translucent 2=edge trans. 3= opaque		Translucence _	12
1=tan 2=grey 3=white 4=black 5=red 6=yellow 7=brown		Color _	13
1=absent 2=present		Mottling _	14
1=light 2=medium 3=dark 4=very dark		Value _	15
1=very fine 2=fine 3=medium 4=coarse		Grain _	16
1=none 2=slight 3=prominent		Lip _	17
1=flat 2=triangular		Platform Shape _	18
1=none 2=facet 3=ground 4=hvy ground		Platform Preper _	19
1=flaked 2=bitpat 3=1/2pat 4=pat 5=bitcort 6=1/2cort 7=cortex		Outer Surface _	20
1=feathered 2=hinged 3=runoff 4=flat 5=outhang 6=inhang 7=outdent 8=indent 9=truncation		Termination _	21
1=none 2=nibbled 3=scalled 4=stepped 5=notched		Altered _	22
1=none 2=reddened 3=potlided 4=crazed		Fired _	23
	mm	Length _ _	24-25
	mm	Width _ _	26-27
	mm	Platform Width _ _	28-29
	mm	Platform Thickness _ _	30-31
	.1mm	Bulbar Thickness _ _._	32-34
	.1mm	Length Thickness _ _._	35-37
	.1mm	Width Thickness _ _._	38-40
	.1mm	Terminal Thick _ _._	41-43
	.1grams	Weight _ _ _._	44-47
	log mm	1st Ray _	48
		2nd Ray _	49
		3rd Ray _	50
		4th Ray _	51
		5th Ray _	52
		6th Ray _	53
		7th Ray _	54
		8th Ray _	55
		9th Ray _	56
		10th Ray _	57
		Test Pit _	58
		Depth _ _ _	59-61
		Level _ _	62-63
		Coder _ _	64-65
		Inspector _	66
		Time _ _:_ _	67-70

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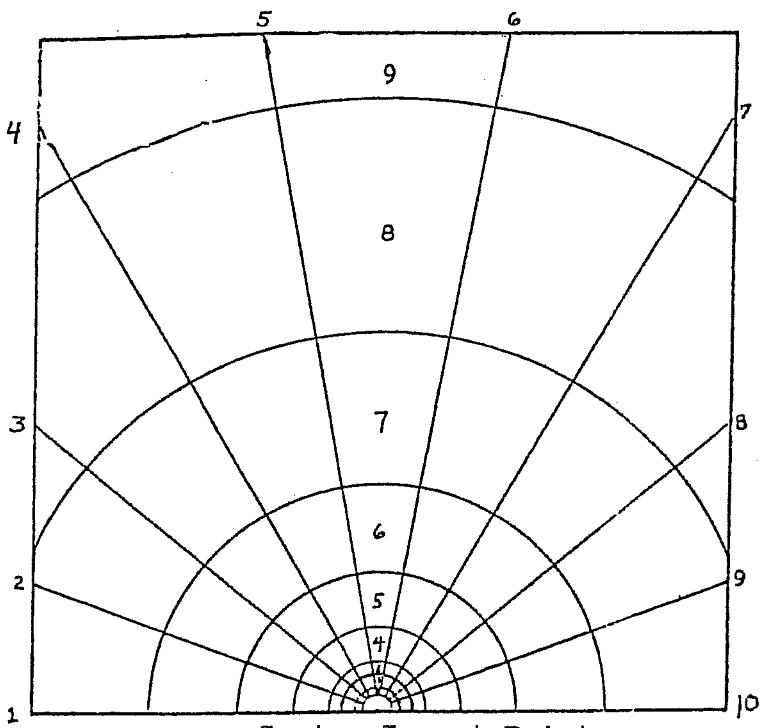

Center Impact Point
Inner Face Down

Figure 9.02.

4. Technotype—The technological mode by which flakes are removed from the parent material; 1=flake, 2=blade, 3=biface long, 4=biface wide.

5. Translucence—A variable representing the light transmitting characteristic of the material; 1=translucent, 2=edge translucent, 3=opaque

6. Color—A rating of the color of the material; 1=tan, 2=gray, 3=white, 4=black, 5=red, 6=yellow, 7=brown.

7. Mottling—Significant color variation in the material; 1=absent, 2=present.

8. Value—A rating of four states intended to measure the gray scale of the material; 1=light, 2=medium, 3=dark, 4=very dark.

9. Grain—A rating of the material texture; 1=very fine, 2=fine, 3=medium, 4=coarse.

10. Lip—A rating describing the character of the lip on the inner edge of the platform; 1=none, 2=slight, 3=prominent.

11. Platform shape—A variable describing the profile of the platform (Figure 9.03c); 1=flat, 2=triangular.

12. Platform Preparation—The extent and kind of special modification used to prepare the platform for further work; 1=none, 2=faceted, 3=ground, 4=heavy ground. (Faceting indicates a retouching of the platform in order to alter the shape. Grinding is accomplished by rubbing a coarse grained rock across the platform. A ground platform is usually detected by drawing a fingernail across the platform. If the fingernail is shaved, or catches, no grinding has been done.)

13. Outer Surface—A description of the outer surface of the flake; 1=flaked, 2=bit patinated, 3=1/2 patinated, 4=patinated, 5=bit cortex, 6=1/2 cortex, 7=cortex. (Outer surface shows primary, secondary, or tertiary nature of the flake.)

14. Termination—A description of the terminal end of the flake; 1=feathered, 2=hinged, 3=runoff, 4=flat, 5=outhang, 6=inhang, 7=outdent, 8=indent, 9=truncation. (Figure 9.04d illustrates the various terminations.)

15. Altered—The presence or absence of alteration or retouching; 1-none, 2=nibbled, 3=scaled, 4=stepped, 5=notched.

16. Fired—A rating of the degree of heat alteration; 1=none, 2=reddening, 3=potlidded, 4=crazed.

17. Length—A measurement taken perpendicular to the platform (mm).

18. Width—A measurement taken parallel to the platform (mm).

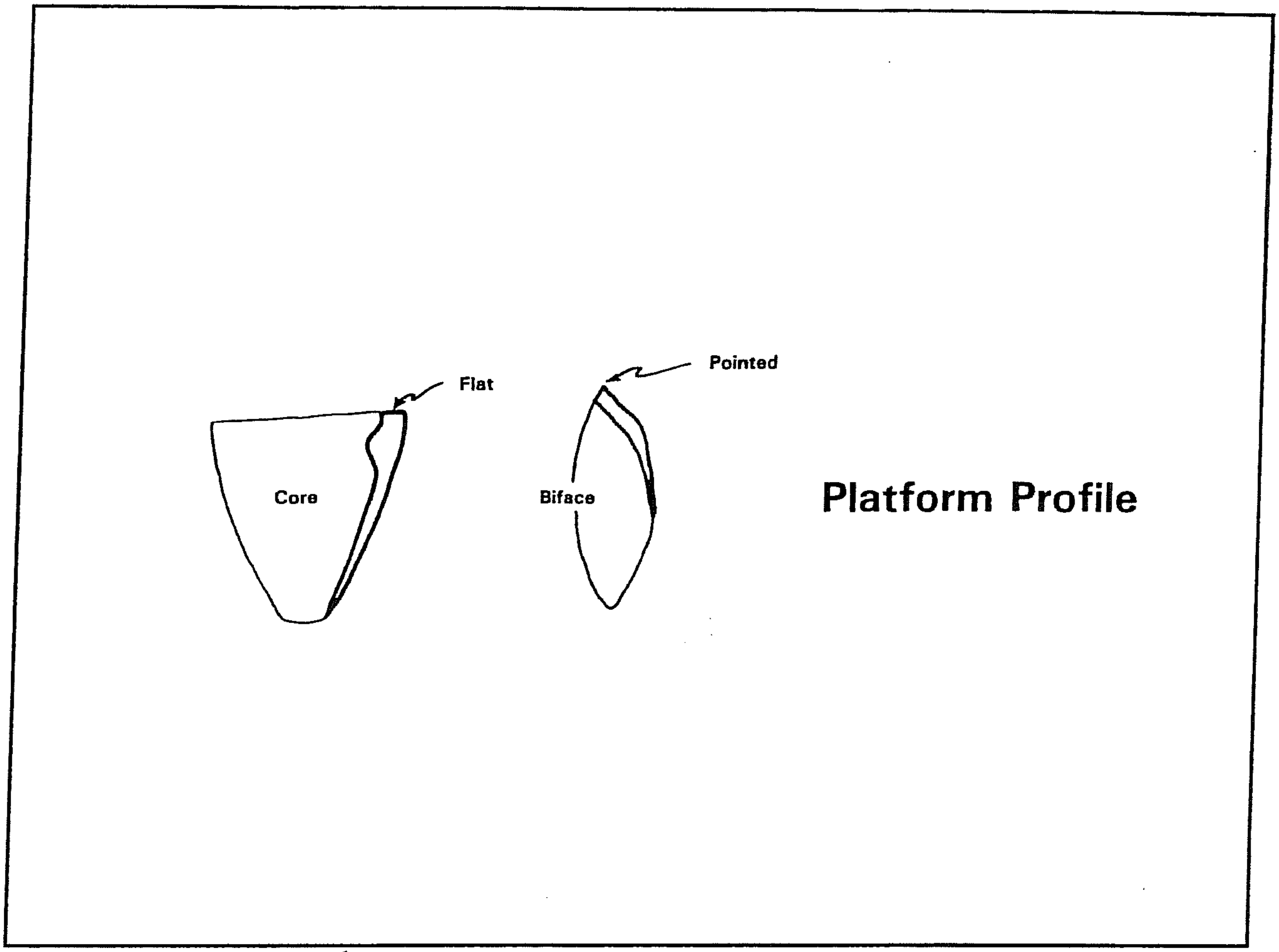

Figure 9.03. Platform Shapes.

19. Platform Width—A measurement taken across the platform, parallel to width (mm).

20. Platform Thickness—A measurement taken from the lip to the outer edge of the platform (mm).

21. Bulbar Thickness—A measurement taken from the most salient point on the bulb of percussion to the outer surface (.1 mm).

22. Length Thickness—A measure taken with the assistance of vernier calipers, by allowing the platform and terminal ends to touch one arm, and the highest point on the outer surface to touch the other (.1 mm).

23. Width Thickness—A measurement made approximately halfway down and perpendicular to the length (.1 mm).

24. Terminal Thickness—A measurement taken at the terminal end of the flake (.1 mm).

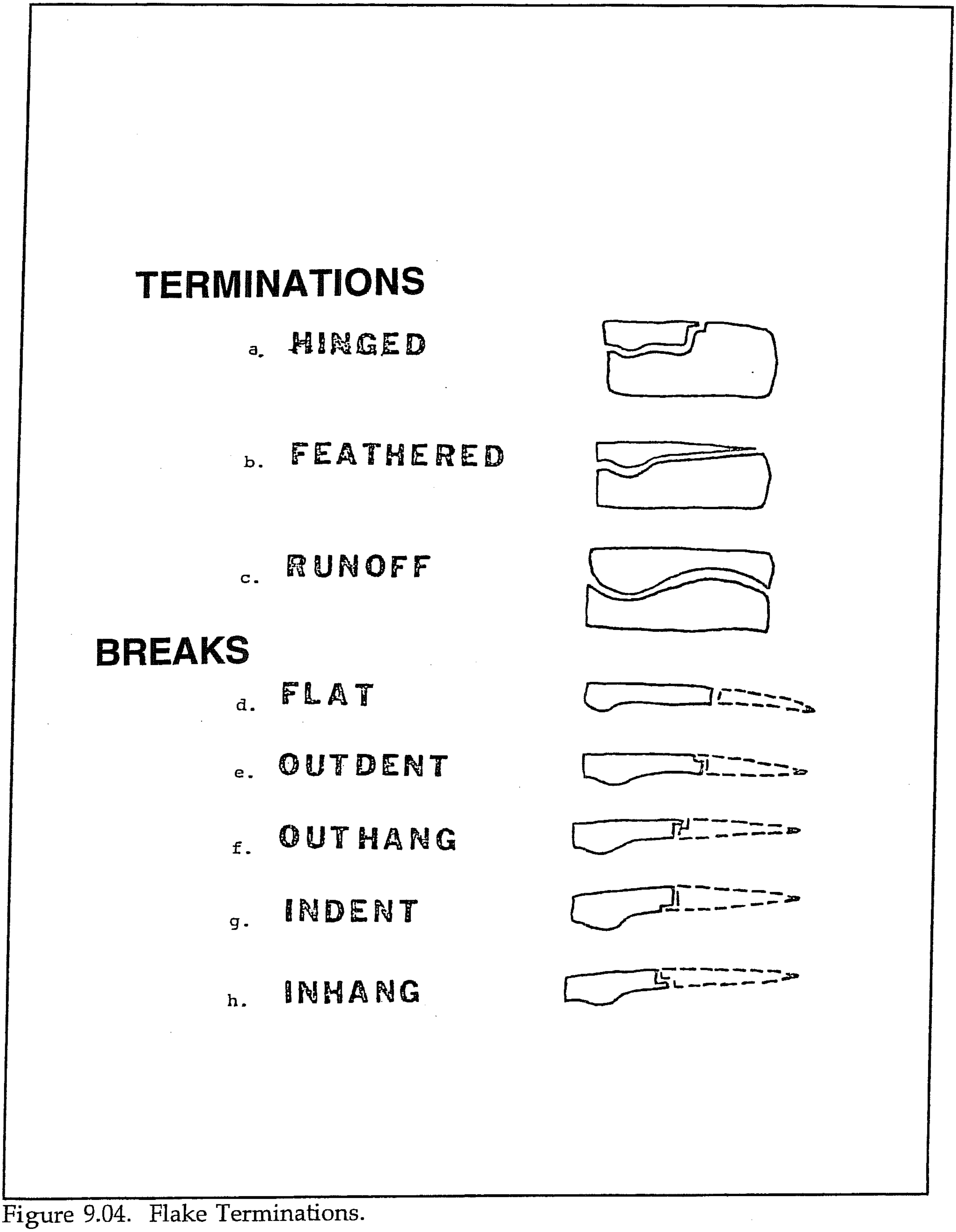

Figure 9.04. Flake Terminations.

25. Weight—A measurement of the weight of a flake on a balance scale (0.1 g).

26. First to Tenth Ray Length—A system of 10 polar coordinates designed to represent the shape of the flake. The point of impact at the platform end of the flake is centered at the origin, inner face down, while a pencil line is drawn around the flake. Measurements (log scale) are taken on the 10 rays.

27. Test Pit—Identifies by number the test pit from which the material was recovered.

28. Depth—The depth, in centimeters, of the unit/level from which the artifact was recovered.

29. Level—A sequential listing of the excavated levels from top to bottom.

30. Coder—A unique number assigned to an individual coder.

31. Inspector—The number of the lab supervisor/instructor who has received and confirmed the recorded information.

32. Time—Time at which flake observations were completed.

As each level was completed, the sheets for all flakes in that level were entered into a computer. A principal components analysis was calculated for interval variables and contingency tables for the nominal variables.

ANALYSIS

Three trends were identified in the data by correlating variables with level numbers:

1. Technology versus Level—the change in flake type and manufacturing suggest shifts through time.

2. Size versus Level—the width of flakes changed through time.

3. Quality of Material versus Level—Grain and translucence changed through time.

The remainder of this report will deal with these three trends, paying particular attention to variation during the Archaic period. The information gathered from Test Pit 6, located on the sandy knoll above the confluence, will be examined first. The sediments on the sandy knoll were temporally limited to the Middle and Late Archaic, based on point typology. Test Pit 6 is of interest because it records a transition from Middle to Late Archaic that involved several dimensions of material and technique. It shows that flake morphology is a valuable adjunct to diagnostics as an indicator of cultural change. There was a negligible amount of material in levels 1 and 2, so they were combined with level 3. Level 12 was added to level 11 for the same reason.

The overall trends in the Test Pit 6 assemblage (Table 9.01) are as follows.

Components I and VI pertain to the size and material of the flakes.

Component I represents the general size of flakes. Only translucence of the material shows any relationship to size. Larger flakes are sometimes made of more opaque materials. Opaqueness is frequently associated with poorer quality materials, with coarse grain, because opaqueness is caused by nonsiliceous inclusions such as clay, carbonates, etc. This is an almost normal observation in flake assemblages. Larger flakes and decortication flakes, in particular, are usually of coarse grain.

Component VI is concerned with material. More opaque and grainy material occurs in the older, Middle Archaic, levels. Finer grained and more translucent material is in the Late Archaic. If we assume Binford's (1978, 1980) logistical model as an explanation for material quality, this pattern conforms with the semisedentary to nomadic transition thought to have occurred in the Middle to Late Archaic. The more mobile Late Archaic bison hunters would have had more access to high quality material because of greater mobility and access to more chert resources.

Components II-V pertain to core and bifacing technology.

Component II has a loading greater than 0.4 for the variable Level and is therefore related to time. Rays 3-6 (flake length) of the polar coordinate grid appear on the component. There is a tendency for flakes to be longer in the older levels, as well as exhibiting heavy grinding on the platform. It suggests that Middle Archaic bifacing technology tended to produce longer flakes, probably a product of attempts at biface thinning, which requires that flakes proceed past the halfway line from both sides in order to thin the middle of the biface. A higher degree of platform preparation (heavy grinding) would be expected on such bifacing flakes.

Components III and IV evolve around the lipping on flakes, a phenomenon normally associated with bifacing. Component III shows that lipping on the platform is related to the platform width of the flakes, Rays 1-2 and 10. An inverse relationship to weight indicates that flakes with wider platforms and prominent lips are lighter, i.e., very thin. While unlipped flakes have narrow platforms and tend to be heavier, i.e., core flakes.

Taken together, Components II and III represent two modes of biface production. One is thinning as discussed in Component II which produces long narrow flakes. The other, Component III, is not so well defined in the literature but is readily observable in assemblages of bifacing flakes. The process involves short wide flakes that transcend a ridge near the edge of the biface. A beveled edge is characteristic of such a flake but could be produced in a number of other operations. The principal components analysis demonstrates that they are two statistically independent and definable processes in the assemblage.

TABLE 9.01. UNROTATED PRINCIPAL COMPONENTS ANALYSIS OF TEST PIT 6 FLAKE MORPHOLOGY

Components	I	II	III	IV	V	VI
Variables						
Level	.2	.5*	.3	.0	-.0	.4*
Translucence	.4*	-.3	.1	-.1	-.3	.5*
Value	-.3	-.3	.1	-.1	.1	.2
Grain	.3	-.0	.2	-.2	-.2	.7*
Lip	.1	.2	.4*	.4*	.3	.1
Platform Shape	-.2	-.3	.2	.3	.4*	.2
Platform Preparation	.0	.4*	.1	.2	.5*	.1
Use Alteration	.2	.2	-.3	-.2	.1	-.2
Fire Alteration	-.0	.0	.1	-.1	.5*	.3
Length	.8*	.2	-.3	.1	.0	.0
Width	.9*	.1	-.0	-.1	-.1	.0
Platform Width	.5*	-.1	.4*	.1	-.0	-.0
Platform Thickness	.7*	-.3	.1	.2	.0	-.1
Bulbar Thickness	.9*	-.3	-.1	.2	-.0	.0
Length Thickness	.9*	-.2	-.2	.2	.0	.1
Width Thickness	.8*	-.3	-.3	.3	.0	.1
Terminal Thickness	.6*	-.1	-.1	-.2	-.0	.2
Weight	.7*	-.2	-.4*	.5*	.1	.1
Ray Length 1	.5*	-.1	.5*	.2	-.1	-.3
Ray Length 2	.6*	.1	.5*	.1	-.3	-.2
Ray Length 3	.6*	.4*	.3	.0	-.3	-.1
Ray Length 4	.7*	.5*	.1	-.1	-.3	-.0
Ray Length 5	.7*	.5*	-.2	-.1	-.0	-.0
Ray Length 6	.8*	.4*	-.3	-.1	.1	.0
Ray Length 7	.7*	.2	-.1	-.4*	.3	-.0
Ray Length 8 .	.7*	-.1	.1	-.5*	.3	-.1
Ray Length 9	.6*	-.3	.3	-.4*	.3	-.2
Ray Length 10	.6*	-.4*	.4*	-.0	.2	-.1

* Indicates important loadings

Component IV indicates that small, unlipped flakes tend to vector to the right. There is probably a tendency for right-handed knappers to vector bifacing flakes to the right. Larger lipped flakes, however, tend not to go to the right. These are probably core flakes.

Component V indicates that platforms with triangular profiles, such as bifacing flakes, usually have platform preparation (grinding). They also are more frequently severely fire altered. The ray loadings are not important by usual standards but appear to have a pattern. Rays 2-4 move in the opposite direction of Rays 7-9. Thus, platform prepared flakes tend to be shorter on the right and longer on the left. In other words there is a tendency for platform prepared flakes to vector to the left. It also implies that flakes with unprepared platforms vector to the right. The process of lithic production that is responsible for this pattern is as yet undefined. Oddly enough, the more preparation and vectoring to the left, the more frequently the flakes are found to be of heat altered chert. This may indicate a special function that was carried out near fires.

These six processes characterized lithic technology in the Late and Middle Archaic on the knoll. Two processes relate to material. Larger flakes are made of opaque, coarse material (Component I). There is a distinct shift from coarse, in the Middle Archaic, to fine-grained materials in the Late Archaic (Component VI). The remaining four processes concern aspects of lithic technology. The Middle Archaic flint knappers produced long and narrow flakes, while the Late Archaic artisans made relatively short and narrow pieces (Component II). Since the dimensions of flakes are associated with platform preparation, it is likely that these characterize the shift from a bifacing to a core flaking mode of production. Lipping figures prominently but is only slightly not related to time. Lipped flakes tend to have wide platforms and are light weight (Component III). Unlipped flakes also tend to be light and to vector to the right (Component IV). And flakes with triangular shaped, prepared platforms are frequently fire altered (Component VI).

Statistical verification of the trends in bifacing, material and size suggested by the principal components analysis were sought as follows. In Table 9.02, technotypes "flakes" and "blades" were combined into one category, core. The "biface long" and "biface wide" flake types were combined into the category, biface. In this way categories were grouped according to overall technological type rather than technological subtypes.

There is an approximately 2:1 ratio of core to biface technology in levels 3- 6, the Late Archaic levels. The core to biface ratio in levels 7 and 9 changes significantly, but not consistently, toward bifacing. Levels 10 and 11 complete the transition with a shift to biface technology. The chi- squared values are highly significant at less than .001.

TABLE 9.02. COLUMN PERCENTAGES AND CONTINGENCY TABLE ANALYSIS OF TECHNOLOGY BY LEVELS IN TEST PIT 6

	Level								
Technology	3	4	5	6	7	8	9	10	11
Core	68	69	67	69	50	90	65	25	35
Biface	32	31	33	31	50	10	35	75	65
Chi-Square (X2)=45 p<.001									

In Table 9.03, the two fine-grained categories, very fine and fine, are combined into a single category of fine. Medium and coarse grain are combined into coarse. Levels 3-8 contain 75% or more fine grained flakes while levels 9-11 are less than 75% fine grained flakes. The logistic model of Late Archaic procurement of higher quality chert is supported by statistical analysis.

TABLE 9.03. COLUMN PERCENTAGES AND CONTINGENCY TABLE ANALYSIS OF GRAIN BY LEVEL IN TEST PIT 6

	Level								
Grain	3	4	5	6	7	8	9	10	11
Fine	85	90	88	75	81	85	73	55	71
Coarse	15	10	12	25	19	15	27	45	29

Chi-Square (X2)=22 p=.004

Figure 9.05 shows the deviation of each level flake width from the grand mean flake width for Test Pit 6. There are two distinctive groups of flakes in relation to width. Width is taken to be an indicator of bifacing (wide) and core flaking (narrow). Levels 3-8 fall in the negative range of standardized level means. Levels 9-11 range into the positive deviations. These differences generate an analysis of variance significance level of p=.001. The extraordinary shift between levels 8 and 9 suggests a marked change in technology, and probably pinpoints the change from Middle to Late Archaic.

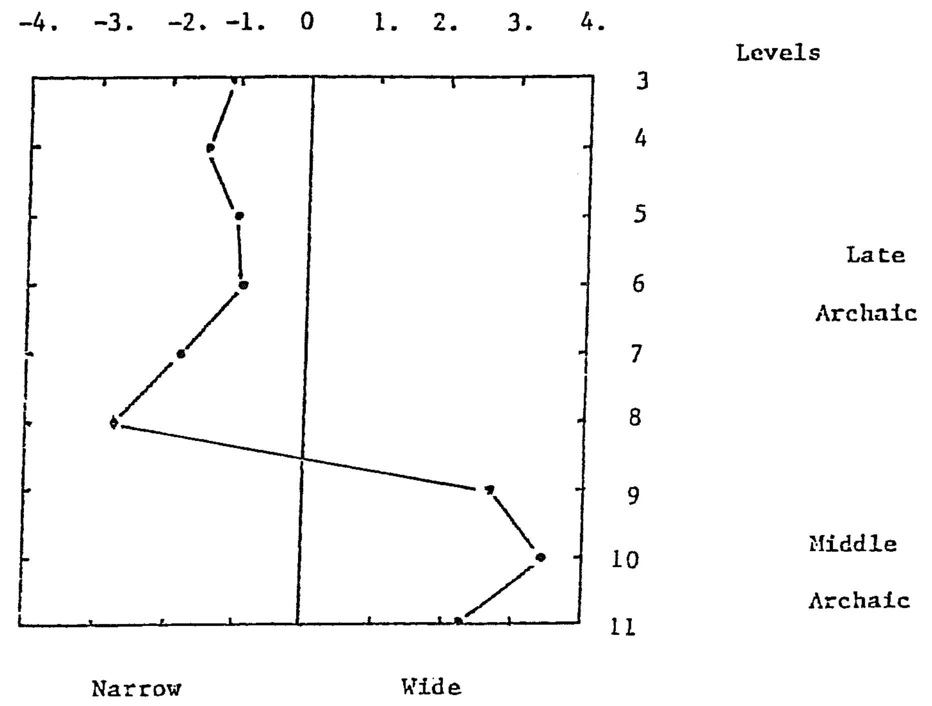

Figure 9.05. Mean Flake Width Range of Variation in Test Pit 6.

Test Pit 6 Summary

All evidence from Test Pit 6 indicates a major cultural transition between levels 8 and 9. Increases in the numbers of bifacing flakes, increases in the size of flakes, and the presence of more coarse material all at the same time leads us to believe that this is where the Late and Middle Archaic meet.

Based on three diagnostics, Kerr (chapter 6) placed the transition at level 10. But the distinct characteristics of the larger number of flakes indicate a more reliable placement of level 8. We are not suggesting that flake morphology can replace points as time markers. They can, however, in conjunction with a point chronology, provide a much more resolved definition of period boundaries. The points "ball-park" the dates, while flake morphology provides specific temporal definitions.

In levels 3-8 there is a trend to smaller flakes. Some bifacing flakes are present, but the majority of the flakes are core flakes exhibiting flat platforms. The material is generally translucent and fine grained.

Test Pits 2 and 4 Summary

Test Pits 2 and 4 are located in the confluence about 42 meters apart. Test Pit 2 is 40 m further upstream along Williams Creek and nearer the bank of the creek. The dominant technology, as represented by the percentage of bifacing flakes, and the percentage of fine-grained flakes are shown in Table 9.04 for all test pits at Moccasin Confluence. The sharp and consistent drop in bifacing technology observed in Test Pit 6 from the Middle to the Late Archaic does not appear in Test Pit 2. This suggests two things: the Late Archaic was not entirely dominated by a core flaking technology and that there was functional differentiation between areas of the site during the Late Archaic or a possible postdepositional disturbance (see Labadie, chapter 10).

There is an increase in the use of fine-grained cherts during the Late Archaic in Test Pit 2. As has been noted before, this suggests an increase in mobility and a solution to the logistical problems of nomads. It also compares favorably, and thus affirms, the similar shift to the use of fine- grained cherts as was posited for the late sequence in Test Pit 6. Various findings associating bison hunting with the Late Archaic, including bison bone from this site (Hafernik, Appendix A) are consistent with nomadic lifeways. The course grained character of lithics in the Middle Archaic levels is, likewise, indicative of a more settled lifeway.

The multiple classification analyses for three test pits are illustrated in Figure 9.06. In comparable levels the trends found in Test Pit 6 are not entirely replicated in Test Pit 2. Test Pit 2 flake widths show considerably more oscillation between narrow to wide within both the Late and Middle Archaic. Wider flakes tend to dominate in the Early Archaic levels. Test Pit 2 may have material from the Late Prehistoric but no diagnostics were found.

TABLE 9.04. PERCENTAGE OF BIFACING FLAKES AND FINE-GRAINED FLAKES FROM TEST PITS 2, 4, AND 6 (bif = biface)

		Test Pit 2		Test Pit 4		Test Pit 6	
Period	Level	%bif	%fine	%bif	%fine	%bif	%fine
	3	67	100			32	80
	4	56	88			30	90
	5	80	95			33	88
Late	6	75	80			31	75
Archaic	7	67	88			50	81
	8	59	61			10	85
	9	80	60			35	73
Middle	10	76	76			75	55
Archaic	11	76	83			65	71
	12	74	78				
	13	80	78				
	14	71	79				
	15	72	85				
	16	96	68				
	17	62	78				
	18	72	74				
Early	19	83	85	61	83		
Archaic	20	89	91	54	54		
	21	52	73	46	64		
	22	79	90	65	53		
	23	72	70	47	80		
	24	46	27	33	53		
	25	60	52	27	27		
	26	67	33	30	80		
	27	89	44	27	55		
	28	^	^	67	83		
	29	50	75	50	79		
	30	^	^	56	78		
	31	^	^	50	70		
	32	44	67	15	54		
Paleo-	33	^	^	21	71		
Indian	34	56	63	^	^		
	35	^	^				
	36	44	72				
	37	15	69	Combined			
	38	^	^				
	39	50	30				
	40	^	^				
Chi-Square(X2)		86	97	21	21	45	22
p		<.001	<.001	.11	.10	<.001	.004

Lower Levels

Both Test Pits 2 and 4 were analyzed for the Paleoindian and Early Archaic periods. Sparse frequencies of lithics in Test Pit 4 below level 33 reflect the relative unimportance of the north side of the site in earlier times. The levels below 33 in

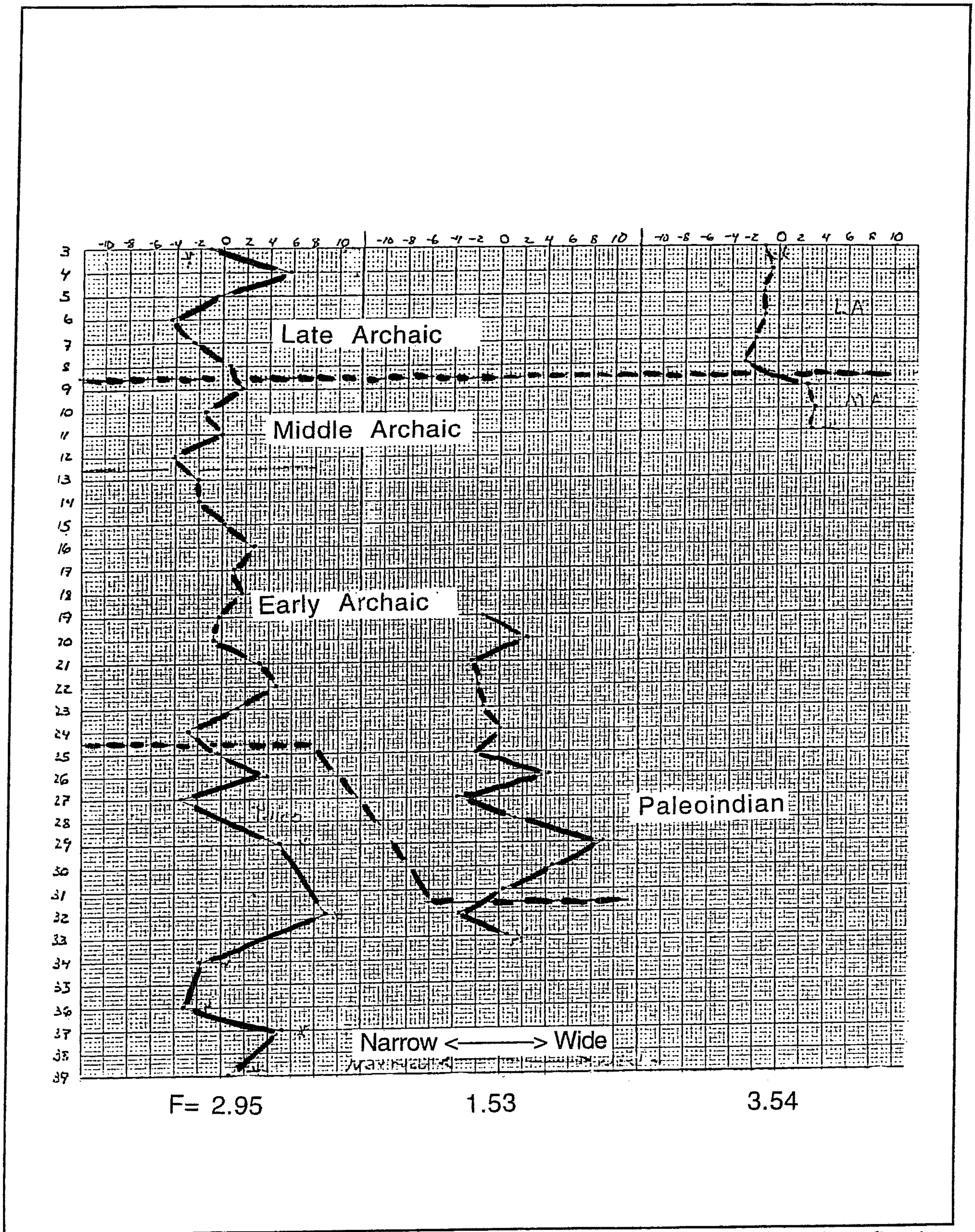

Figure 9.06. Flake Width Mean Departure F-Values for Multiple Classification Analysis.

Test Pit 4 were summed into level 33 to increase the numbers because of inadequate frequencies for statistical analysis.

Both test pits show significant periods of wide flakes during the Paleoindian and Early Archaic. It is possible that the peaks of wide flakes correlate. However, the sparse diagnostics found during the excavation appear to indicate that they do not.

Flaking through the Early Archaic period appears to represent medium width flakes rather than the extremes. This is perhaps another generalized aspect of the varied Early Archaic tool kit (Weir 1976; Gunn and Weir 1976). However, an alternative is suggested by studies of Indian activities during the Historic period. The ethnic composition of the Edwards Plateau changed on an annual basis depending on the severity of the winter which effected the movement of bison and those pursuing them (Gunn and Frkuska 1982). It is, therefore, not unlikely that these near-mean values represent frequent visits by various groups during the Middle Holocene.

Returning again to the idea that grain indexes mobility, Figure 9.07 illustrates the percentage of fine-grained material for all levels analyzed in Test Pits 2, 4, and 6. Test Pit 2 shows a marked tendency toward less fine grained material and more coarse grained material during the Late Paleoindian period. Diagnostics indicate that the Paleoindian period begins about level 24 in Test Pit 2. Finer grained materials again dominate the assemblage until the Middle Archaic/Late Archaic interval. The Middle Archaic period has been thought for some time as an interval of sedentary lifeways (Weir 1976). However, the idea that Late Paleoindians were at least semisedentary is recent. Morse (1975) first suggested it in the Mississippi River Valley when he discovered a Dalton cemetery. The vast numbers of points at the Wilson-Leonard site (Young 1983) in central Texas accompanied by a burial suggests that sedentism may have extended to the Balcones Fault zone. The flake material from Moccasin Confluence appears to support a similar conclusion. The reason for this period of intense Late Paleoindian occupation are discussed in Gunn (1983b).

CONCLUSIONS

1. Flake morphology refined definition between test pit levels of the transition between the Middle and Late Archaic periods over that which was possible by diagnostics alone. Indications from material and core-bifacing studies support similar conclusions.

2. It seems likely that during the Middle Holocene (Early Archaic) the site was visited by a range of groups that homogenized the flake assemblage. Prewitt (1981) arrived at similar conclusions from the number of point types in the Middle Holocene (Early Archaic).

3. If the frequency of fine-grained flakes can be taken as an indicator of mobility, mobility was reduced during the Late Paleoindian period.

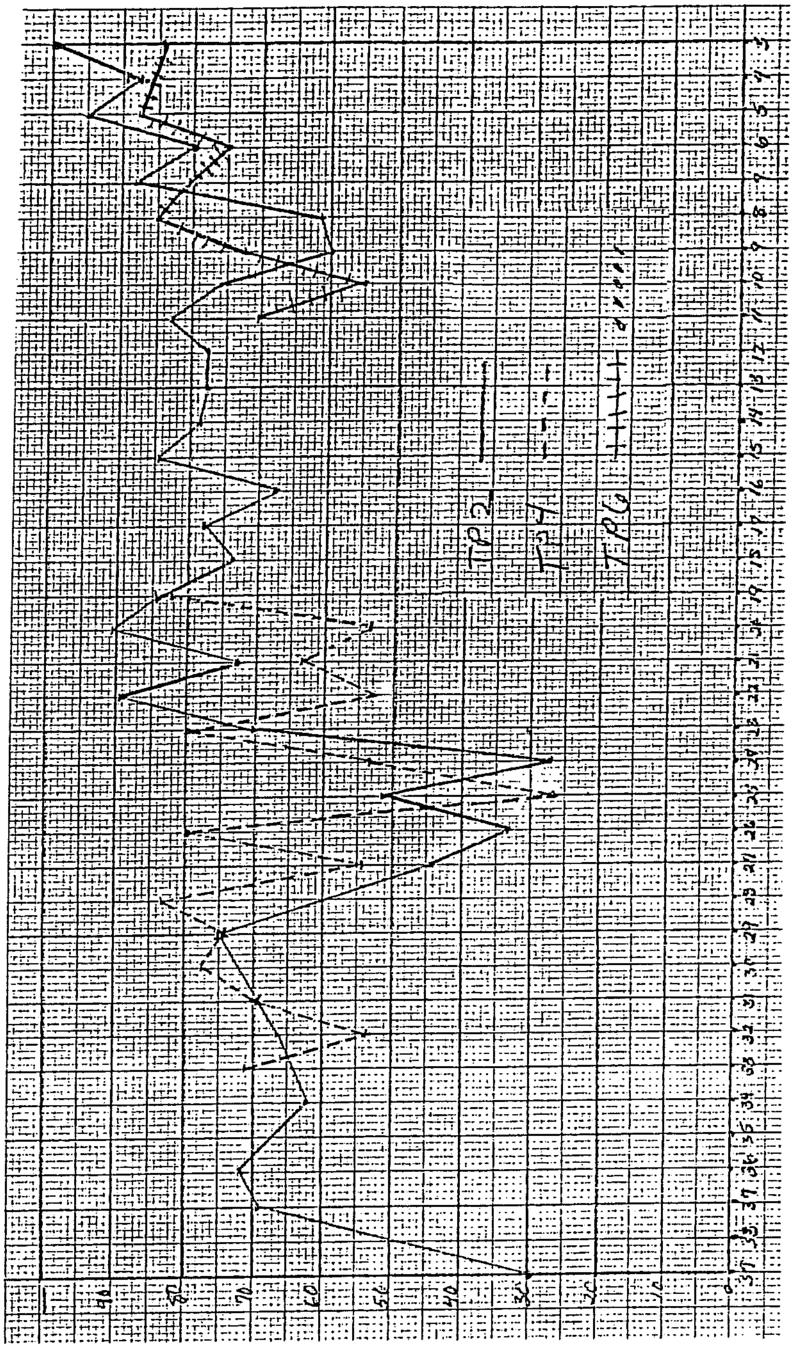

Figure 9.07. Percentage of Fine Grained Material from Test Pits 2, 4, and 6.

CHAPTER 10—FUNCTIONAL STUDIES OF FLAKES AT MOCCASIN CONFLUENCE AND HOP HILL (Labadie, Craig, Gunn)

INTRODUCTION (Gunn)

This chapter surveys the use of flakes as tools and the changes in the patterns of those uses at Moccasin Confluence and Hop Hill. The results indicate relationships between climate and culture.

The amount and kind of use is measured by the observable wear on the flakes. Wear can be observed macroscopically, without the use of microscopes, as well as microscopically. Microscopic observations fall into two general categories because of the increasing difficulty of observing wear patterns under progressively higher powers. Below about 80 power magnification (80X) observations are not difficult with a binocular microscope and can be done without substantial preparation of specimens and problems of interpretation. Above 80X, problems of specimen preparation, time of interpretation, and difficulty of observation complicate the observation process. Increasing the detail of observation requires proportionally more sophisticated interpretive aids such as experimental replication of the use of specific lithic materials on equally specific target materials.

The studies conducted for this project include observations made macroscopically, and microscopically at high and low magnification. However, since this is the first study of wear patterns in the LBJ Park, area there was a major emphasis on macroscopic and low power studies because of the preliminary nature of the effort. More sophisticated studies should follow now that the generalities of site wear patterns are understood.

LITHIC USE AT MOCCASIN CONFLUENCE AS A FUNCTION OF BIOLOGICAL VARIATION IN THE ENVIRONMENT (Labadie)

Stone tools and lithic debris are often all that remain to indicate the presence of prehistoric humans. The reduction of stone to functional tools allowed early people to exploit a variety of biotic resources that, in their natural state, were otherwise unusable. Knives, choppers, and scrapers composed the early tool kits and enabled humans to pursue and process a diversified diet. Biotic diversity, tempered by cultural norms for preferred resources, may have served as limiting factors for the variety and size of the tool kits.

This study assumes that tool kits for a nonsedentary group may have been limited further by their highly mobile lifestyle. Caching tools would have been possible for groups that could depend on returning to the same location year after year. It is believed that large or heavy tools (choppers, hammerstones) were not, as a matter of routine, transported from campsite to campsite, especially in areas where lithic resources were known, or plentiful. On-site manufacture of tools produced lithic debris, as did the resharpening of dulled tools. Detached flakes usually have sharp edges of varying thickness, edge angle, and length. Depending on the task at hand, these flakes could function as *ad hoc* or expeditious tools without any secondary modification. It could, therefore, be expected that highly mobile groups would use flakes and chips for augmenting simple, portable tool kits. By contrast, semisedentary groups could be expected to utilize debris to a less intense degree while having a more task-specialized and complicated tool kit comprising in part, heavier tools.

In this study the hypothesis will be examined that lithic traditions for the manufacture of chipped stone tools have a directional meaning relative to the changing habitat and inhabitants of the region. Several investigators (Hester 1971; Gunn and Mahula 1977a; Thoms, Montgomery, and Portney 1981; and Lukowski 1983) have previously addressed this issue. The Plains lithic tradition is thought of as primarily a core-flaking technology because of a nomadic lifeway favoring simple, generalized, and light tools. This lifeway was highly mobile because it involved the hunting of migratory animals. The Eastern Woodlands lithic tradition is posited to have a larger component of a bifacing technology, assumed to be a cultural response to the biotic diversity typical in a woodland biome, and thus, sedentism and a higher incidence of potentially heavier bifacial tools (Gunn 1982d). These two lithic traditions are spatially separated by an ecotonal boundary, with the Plains tradition generally found to the west (grassland biome) and the Woodland tradition to the east (forest biome). Climatic conditions are primarily responsible for decreasing biotic diversity, as well as density, from east to west, and the transition from one biome to the other has shifted substantially over the 10,000-year history of this site (see chapter 5).

Furthermore, it may be assumed that a bifacing technology inherently produces a greater amount of debitage than the core technique. This is because the products from chipping from a core are targeted for use, while they are waste products from a biface. In the context of use-wear analysis then, we expect to see a higher ratio of used lithic pieces during periods when core production is favored. Periods of high percentages of use of lithic pieces, then, should correlate with dry intervals. Periods of low use percentages should correlate with moister periods.

To test this idea the unmodified (no intentional secondary modification after initial removal) flakes and chips (total=5754) were examined both macroscopically and microscopically for evidence of use-wear edge alteration. In many cases use-related edge alteration was eliminated principally on the basis of the size or technotype of platformed flakes. This report presents the results of a computer-generated analysis of the differences and similarities found among the four cultural periods represented at Moccasin Confluence using wear and lithic frequencies as criteria for comparison. These data are supplemented by a similar analysis from Hop Hill.

USE-WEAR ANALYSIS OF FLAKES AT MOCCASIN CONFLUENCE (Labadie)

Artifact recovery strategy at Moccasin Confluence provided a high resolution recovery of cultural remains. Excavation in 5 or 10 cm levels within homogeneous strata was supplemented by the use of microstratigraphic excavation techniques in cultural levels. In the cultural levels all artifacts were mapped in place, providing detailed recording of discrete occupation floors. Screening was through 1/4- or 1/8-inch mesh, with some limited water screening performed in Williams Creek. This practice was soon abandoned because of frequent sightings of moccasins in the creek.

The analysis of lithic use wear at 41 BC 71 involved the application of one research design to two divisions of the tool assemblage. All lithic debitage, platformed flakes and nonplatformed chips, were placed into one of the following categories:

1. Utilized—evidence of edge alteration due to abrasion during use;

2. Modified—evidence of edge alteration produced by purposeful retouch;

3. Unmodified—no evidence of edge alteration after manufacture.

The unmodified and utilized categories will be discussed in this chapter. Modified flakes, tools, and tool fragments are discussed by Mock and Price (chapter 8).

In order to elicit behavioral information from the debitage at Moccasin Confluence a two-pronged approach was used. The first phase explored replicative experimentation with tools and materials. From this a basic understanding of the mechanics of platform preparation, and the flaking process itself was gained. Flakes removed from cores in this phase of the analysis were not modified. The objective of the experiment was to produce flakes of a uniform size and shape. The second phase involved the use of these flakes in a replicative edge damage experiment. These flakes formed the basis for a comparative collection, against which the artifacts from Moccasin Confluence could be examined. This experimental data was integrated with data gleaned from several sources (Shafer and Holloway 1977; Gibson and Gunn 1982; Keeley 1980; Hayden 1977; Odell 1980), to form a comparative collection.

Contact materials were for the replicative edge damage study that would provide similar flake edge damage to what is encountered at Moccasin Confluence. The task was complicated by the fact that the site had been occupied periodically over the last 10,000 years. That time encompassed many varied environments (chapter 5). Against this backdrop of vast potential adaptive variability was a desire to keep the number of contact material classes manageable. The number of material classes was narrowed by archival research (Schuetz 1960, 1963) and several trips to view the comparative collections at the Witte Museum, San Antonio, Texas. At the Witte Museum, the curator allowed perishable assemblages to be examined. Most of the materials were from dry cave sites in the Trans-Pecos region (Shumla, Damp, and Centipede Caves) that were dated to the Archaic and/or Paleoindian periods. Assemblages examined included a woven pouch with flake inside (Figure 10.01, see also Martin 1933), as well as, sandals, matting, cordage, basketry, bundles of unprocessed plant fibers, pointed and shaped sticks and tree branches. Bone artifacts included awls, drills, and probable cutting tools. Sotol (*Dasylirion* sp.), lechuguilla (*Agave lecheguilla*), yucca (*Yucca* sp.), and sacahuisti grass dominated the preferred plant construction materials. The species of wood and animal bone were not determined. The wood, however, is believed to be typical hardwood (possibly live oak or mesquite).

Additional artifacts from Hinds Cave, Val Verde County, Texas, were microscopically examined. These artifacts were unique in that they still retained organic residue on the working surfaces from the materials worked thousands of years ago (Hayden 1977). Sotol and lechuguilla fibers have been identified among the organic debris preserved on the artifacts. These fibers were processed using artifacts in a cutting and/or slicing motion with polish and smoothing of the edges as a result of contact with plant material (Shafer and Holloway 1977; Hayden 1977). Nibbling was obliquely oriented relative to the working edge on several of the specimens.

METHODOLOGY

An Olympus stereomicroscope was used to isolate wear patterns because of its ability to produce what is, essentially, a 3-D image (high depth of field relative to the specimen size). The depth of field allowed by the stereomicroscope is an asset in this type of study. The use of maximum magnification is a liability, as above 80X the depth of field becomes a substantial problem. Part of the objective was to identify specific microwear polishes, i.e. as being from bone, wood, plants. For theoretical and practical reasons this study was construed to be a first pass, low resolution endeavor. Determinations of use were limited to wear damage produced by contact with either hard (step and hinge scars) or soft (polish) materials. Contact with materials of intermediate hardness and/or softness was characterized by nibbling and scaling of the working edges.

All flakes and chips from all levels of Test Pits 2 and 6 were examined macroscopically for edge alteration. A flake that showed anything other than a relatively straight edge (usually a by-product of manufacture) was suspected to have related damage. Once selected, these flakes and chips were examined microscopically at low (40X or lower) power magnification. This examination was intended to determine if the damage was the result of nonuse related damage

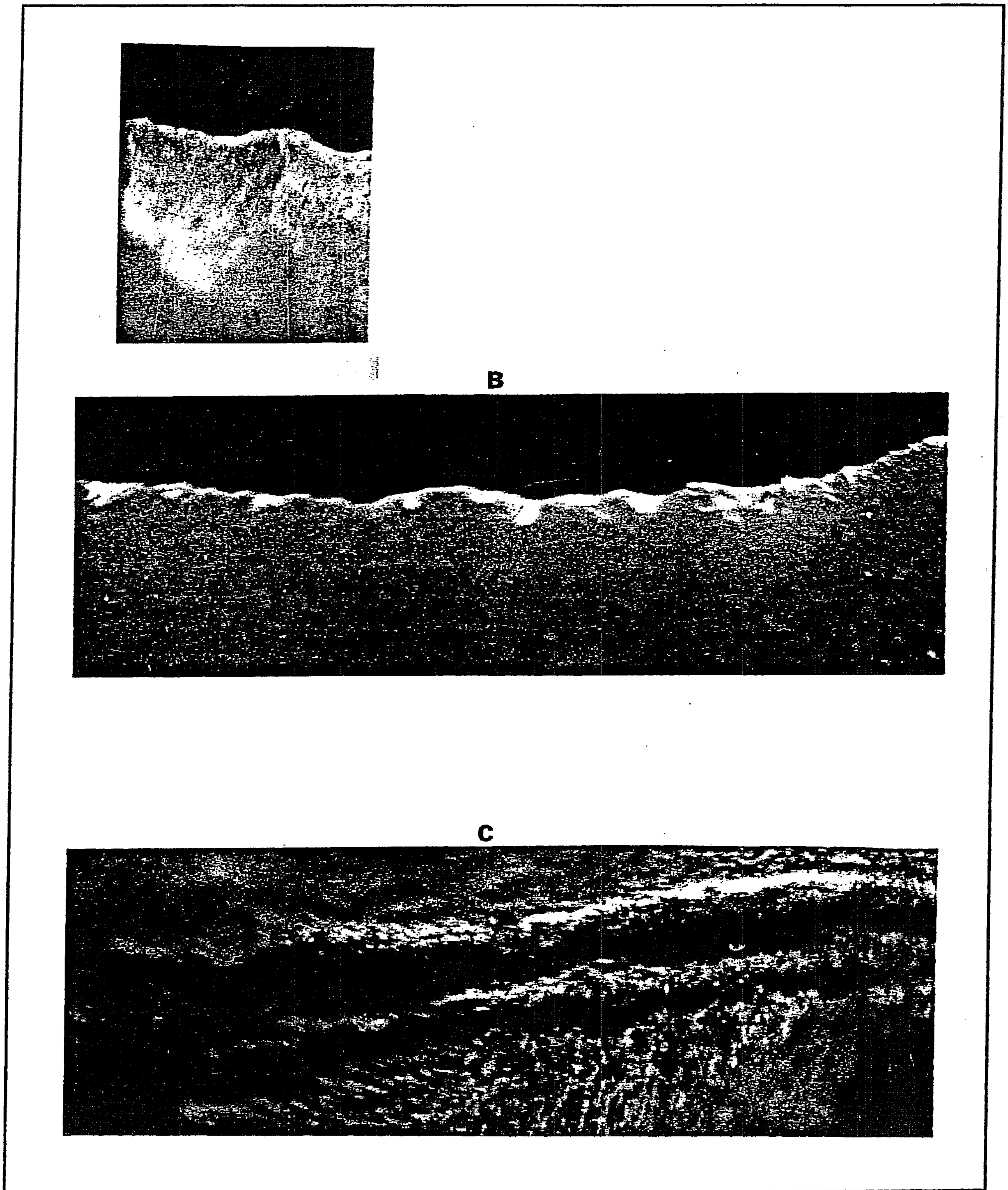

Figure 10.01. Edge-wear Scar Patterns and Organic Residue: A. Scaled Flake Scars, B. Nibbled Edge with Randomly Oriented Flake Scars, C. Sotol Fibers on an Artifact from Hinds Cave.

incurred during manufacture or after deposition. Great care was taken in this determination, particularly on edges that were nibbled or scaled.

In many cases nibbling appeared on edges with prominent hackling. These projections along the terminus of the edge, at times, showed a random pattern of breakage. This was interpreted as the product of postdepositional damage from trowels, screening and bag damage. If there was symmetry or definable patterning to the breakage of a hackled edge, it was interpreted (subject to several other qualifications, i.e., type of breakage initiation) as damage resulting from use.

Flakes or chips with otherwise straight edges, without prominent hackling, that displayed nibbling, scaling, or step and hinge termination flake scars were also examined at low power magnification. The object was to eliminate flakes and/or chips with nonuse-wear related damage. As part of the background replicative experiments, a group of flakes and/or chips were placed on a concrete or dirt floor and walked on, then examined under the microscope at low magnification. Edges typically displayed randomly located and spaced unifacial removals. If the removal was in the area of a former projection along the edge it often produced a "C-" or "D-" (Odell 1979) shaped nibble or scale. Usually there was no symmetry to the location of the scars, but in a few cases, symmetry was present and may be attributable to the evenness of the pressure exerted along the edge as it was stepped on while resting on the floor (this occurred on both dirt and concrete).

In many cases, use-related edge alteration was confidently ruled out based principally on size and technotype of platformed flakes. In some levels of Test Pit 2 (Early Archaic and Paleoindian) some biface-wide flakes and beveling flakes (associated with the retouch of a dulled, bifacial edge) were so small that up to five flakes could be placed on a penny without totally obscuring the face of the coin. Examination of wear on these flakes concentrated on the outer surface near the platform. Frequently these areas had step- and/or hinge-terminated flake scars.

Platform wear on resharpening flake platforms is an area of study with much potential, especially in a case where tools were carefully resharpened, maintained, and carried away for use at other sites. However, these scars could be the product of original manufacture or retouch maintenance instead of the result of use-related damage that dulled the edge and necessitated retouch and beveling to return the edge to its original sharpness. If platform preparation was required prior to retouching of the dulled edge, use damage (already present) would be obliterated by grinding. Nonuse-related patterning would be produced on the prominent scar ridges that were already smoothed by use. The amount of experimental replication necessary to discriminate between these three "theoretical planes of edge damage" was judged to be beyond the scope of the project, and the effort was left for later studies.

In cases where polish was suspected, the artifact was rewashed with vinegar and water (or in some cases hot soapy water or methyl alcohol). Polish, somewhat surprisingly, was rarely isolated, and was never associated with areas of the flake that pertain to hafting, e.g. spurs, haft edges, etc.

RESULTS

Test Pit 6

Test Pit 6 is located further from Williams Creek than any of the other test pits, and likewise is at the highest elevation (see Figure 3.01). The 1-m2 test unit was excavated to 115 cm by 10 cm levels, and all matrix was screened through 1/4-inch mesh. A hand-operated post hole digger was then used to dig a test probe down to 160 cm. No artifacts were found in the test probe.

Based on diagnostics, levels 1-9 of Test Pit 6 were dated to the Late Archaic, and levels 10-12 to the Middle Archaic (chapter 6). Since no points or other diagnostic materials were found in the test probe, the lower temporal boundary could not be confidently established.

Discussion

Each flake and chip that was not deliberately modified after manufacture was examined for use-related damage. Table 10.01 shows descriptive statistics per period. The percentages of pieces attributable to the three modes of utilization remain about the same except that polishing appears in the Late Archaic. This implies extended use of the tools, a trait that would be logically consistent with more nomadic lifeways. There is, contrary to the hypothesis, more unmodified debitage in the Late Archaic. As we shall see, this probably reflects a special use status for the top of the knoll.

TABLE 10.01 LATE AND MIDDLE ARCHAIC USE-WEAR OBSERVATIONS IN TEST PIT 6

	Polish	Nibbling	Stepping	Unmodified	Total
Late Archaic	5 (4%)	116 (88%)	11 (8%)	791 [86%]	923
Middle Archaic	0 (-)	52 (91%)	5 (9%)	189 [77%]	246
Total	5 (3%)	168 (89%)	16 (8%)	980 [84%]	1169

Note: Row Percentages of utilization mode () and unmodified [].

Of the 1169 pieces of chert in Test Pit 6, overall percentage of utilization was 16%. Comparison of the difference in the frequencies for utilized pieces between the Middle and Late Archaic levels (Table 10.02) shows an interesting trend through time. The 16% figure is representative of the expected rate of utilization for most levels. The Middle Archaic values all exceed 16% indicating an increase in utilization. The Late Archaic levels fall below the expected value, suggesting that the assemblage is more dominated by lithic production. These findings did not conform to the proposed model of higher frequencies for utilized flakes in the Late Archaic.

TABLE 10.02. PERCENTAGE OF UTILIZATION BY LEVEL FOR TEST PIT 6

	Middle Archaic				Late Archaic							
Level	12	11	10	9	8	7	6	5	4	3	2	1
Percentage of Utilization	22	24	41	30	13	16	10	12	19	14	60	0

Overall utilization rate = 16%

Further, used as a chronological criterion, high utilization in level 9 suggests that it should be included with the Middle Archaic, rather than the Late Archaic, as was determined by the point chronology. Level 2 need not be considered an exception to this as only five flakes were recovered. The phase values in Table 10.01 were calculated to reflect this decision, e.g. using levels 9-12 for the Middle Archaic and Levels 1-8 for the Late Archaic.

As is shown in Table 10.03, during both the Late and Middle Archaic the platformed flakes were consistently preferred over chips for use as expedient tools. This probably reflects the more robust character of the platform end of flakes. It also suggests that the flake morphology study (chapter 9) gathered most of the important variation in the flakes that were used as tools.

TABLE 10.03. PERCENTAGE OF FLAKES AND CHIPS UTILIZED BY LEVEL IN TEST PIT 6

	Middle Archaic				Late Archaic						
Level	12	11	10	9	8	7	6	5	4	3	2
Percentage of Flakes	25	45	33	33	34	15	12	14	25	18	100
Percentage of Chips	18	12	26	18	12	13	7	10	12	10	29

Most utilized flakes had use-related wear characterized by nibbling and scaling on one or both lateral edges; platform end alteration was infrequent. The edge angles rarely exceeded 20%, with the mode of use (slicing, chopping, etc.) usually undefinable. Few edges had flake scars oriented perpendicular to the edge; most scars were obliquely oriented with no preference noted for terminal-to-platform or platform-to-terminal mode of use. Because of the lack of artifacts with identifiable polish (Figure 10.02), it is believed that the majority of the flakes and chips were utilized for short duration functions that required a sharp, low-angle working edge.

Test Pit 2

Test Pit 2 consisted of 39 levels divided into two periods, Archaic (Late 1-8, Middle 9-12, and Early 13-24) and Paleoindian (25-39). Late Paleoindian is considered to be from 25-33 for the purposes of this analysis, but there is, as yet, no radiometric or typological evidence to support such a separation relative to standard Paleoindian chronology (see Kerr, chapter 6, for discussion). Most of the levels were excavated in 5 or 10 cm arbitrary levels, although several cultural floors were excavated using the microstratigraphic "rock bottom" excavation technique (Mahula 1977), which allowed for the "in-place" mapping, photographing, and recording of artifacts.

Discussion

The results of the microwear analysis of the 5753 flakes and chips recovered from Test Pit 2 produced results quite different from those in Test Pit 6 (Tables 10.04 and 10.05). The overall utilization rate was 3.4%, which is considerably lower than the 16% at Test Pit 6. As was the case with Test Pit 6, the most common type of edge damage was nibbling and scaling of the lateral edges (75%). Terminal modification was rare. Damage characterized by step and hinge termination flake scars accounted for 23% of the utilization, and polish was confidently identified in 2% of the cases (Table 10.06).

The frequencies of classes of wear vary from period to period. Eliminating the Paleoindian sample as too small, the important difference seems to be a shift to nibbling during the Late Archaic. The reduced appearance of stepping in Late Archaic is what would be predicted by our model because of a reduction in forest biome components in the vegetation. The relatively high incidence of stepping during the Early Archaic is not what would be expected by our simple model if Early Archaic peoples were nomads in an arid environment. Further examination of the model is needed to explain this case.

The mean frequency per level is highest during the early part of the Late Archaic (Figure 10.03), and in the Middle Archaic possibly reflecting more intense occupation. Wear occurs more frequently in the Late Archaic than in either the Middle or Early Archaic.

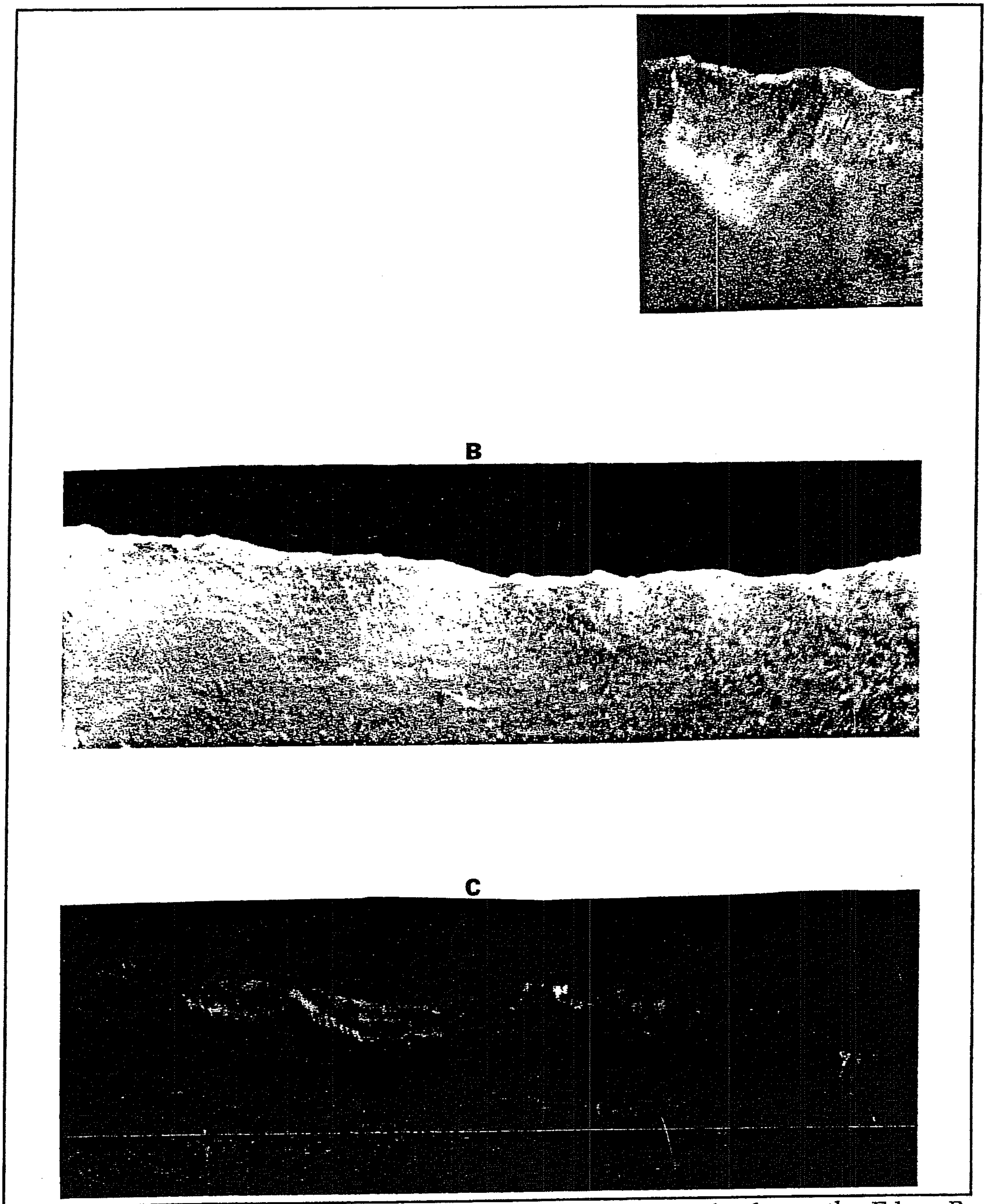

Figure 10.02. Edgewear Scar Patterns: A. Flake Scars Perpendicular to the Edge. B. Polished Edge with Smoothed Scar Ridges. C. Scaled and Hinged Flake Scars.

TABLE 10.04. TEST PIT 2 PLATFORMED FLAKE UTILIZATION FREQUENCIES

Test Pit/ FN/Sequence	Polish	Nibble	Step/Hinge	Unmodified	Total
2-301-2	0	0	1	5	6
2-302-3	0	1	0	3	4
2-303-4	0	2	1	11	14
2-304-5	0	1	1	20	22
2-305-6	0	14	5	157	176
2-306-7	0	7	0	199	206
2-307-8	0	6	0	37	43
2-500-9	0	6	0	51	57
2-503-10	0	9	1	228	238
2-515-11	0	0	3	96	99
2-528-12	1	1	3	132	137
2-542-13	0	2	1	167	170
2-547-14	0	6	2	94	102
2-552-15	0	2	0	43	45
2-558-16	0	4	2	45	51
2-563-16.5	0	6	1	50	57
2-568-17	0	4	1	45	50
2-571-18	0	0	0	60	60
2-573-19	0	1	0	56	57
2-575-20	0	1	0	35	36
2-579-21	0	1	0	29	30
2-581-22	0	0	0	41	41
2-585-23	0	1	1	26	28
2-587-24	0	0	1	11	12
2-590-25	0	0	0	3	3
2-599-27	0	0	0	3	3
2-602-28	0	0	0	8	8
2-606-29	0	0	0	4	4
2-609-30	0	0	0	3	3
2-615-31	0	0	0	6	6
2-621-32	0	0	0	9	9
2-629-33	0	0	0	6	6
2-630-34	0	0	0	8	8
2-631-35	0	0	0	23	23
2-632-36	0	0	0	2	2
2-637-37	0	0	0	1	1
2-644-38	0	1	0	6	7
2-647-39	0	0	0	3	3
Total	1	76	24	1750	1851

TABLE 10.05. TEST PIT 2 CHIP UTILIZATION FREQUENCIES

Test Pit/ FN/Sequence	Polish	Nibble	Step/Hinge	Unmodified	Total
2-301-2	0	3	0	12	15
2-302-3	0	1	0	1	2
2-303-4	0	7	3	59	69
2-304-5	0	1	1	29	31
2-305-6	0	6	1	398	405
2-306-7	0	6	2	689	697
2-307-8	0	16	2	81	99
2-500-9	0	12	4	110	126
2-503-10	0	1	0	373	374
2-515-11	0	0	0	155	155
2-528-12	1	0	1	283	285
2-542-13	0	3	1	402	406
2-547-14	0	6	1	169	176
2-552-15	0	1	3	95	99
2-558-16	0	2	1	145	148
2-563-16.5	0	3	0	82	85
2-568-17	0	1	1	97	98
2-571-18	0	0	0	99	99
2-573-19	0	0	1	49	50
2-575-20	0	1	0	75	76
2-579-21	0	0	0	77	77
2-581-22	0	1	1	104	106
2-585-23	0	0	0	29	29
2-587-24	0	0	0	61	61
2-590-25	0	0	0	32	32
2-594-26	0	0	0	2	2
2-599-27	0	0	0	5	5
2-602-28	0	0	0	28	28
2-606-29	0	0	0	4	4
2-609-30	1	0	0	4	5
2-615-31	0	0	0	3	3
2-621-32	0	0	0	4	4
2-629-33	0	0	0	5	5
2-630-34	0	0	0	5	5
2-631-35	0	0	0	20	20
2-632-36	0	0	0	9	9
2-637-37	0	0	0	2	2
2-644-38	0	0	0	7	7
2-647-39	0	0	0	3	3
Total	2	71	22	3807	3902

TABLE 10.06. PALEOINDIAN TO LATE ARCHAIC USE-WEAR OBSERVATIONS IN TEST PIT 2

	Polish	Nibbling	Stepping	Unmodified	Total
Late Archaic	0 (-)	71 (81%)	17 (19%)	1701 [95%]	1789
Middle Archaic	2 (5%)	29 (67%)	12 (28%)	1428 [97%]	1471
Early Archaic	0 (-)	46 (73%)	17 (27%)	2186 [97%]	2249
Paleoindian	1 (50%)	1 (50%)	0 (-)	242 [99%]	244
Total	3 (2%)	147 (75%)	46 (23%)	5557 [97%]	5753

Note: Row Percentages of utilization modes () and unmodified [].

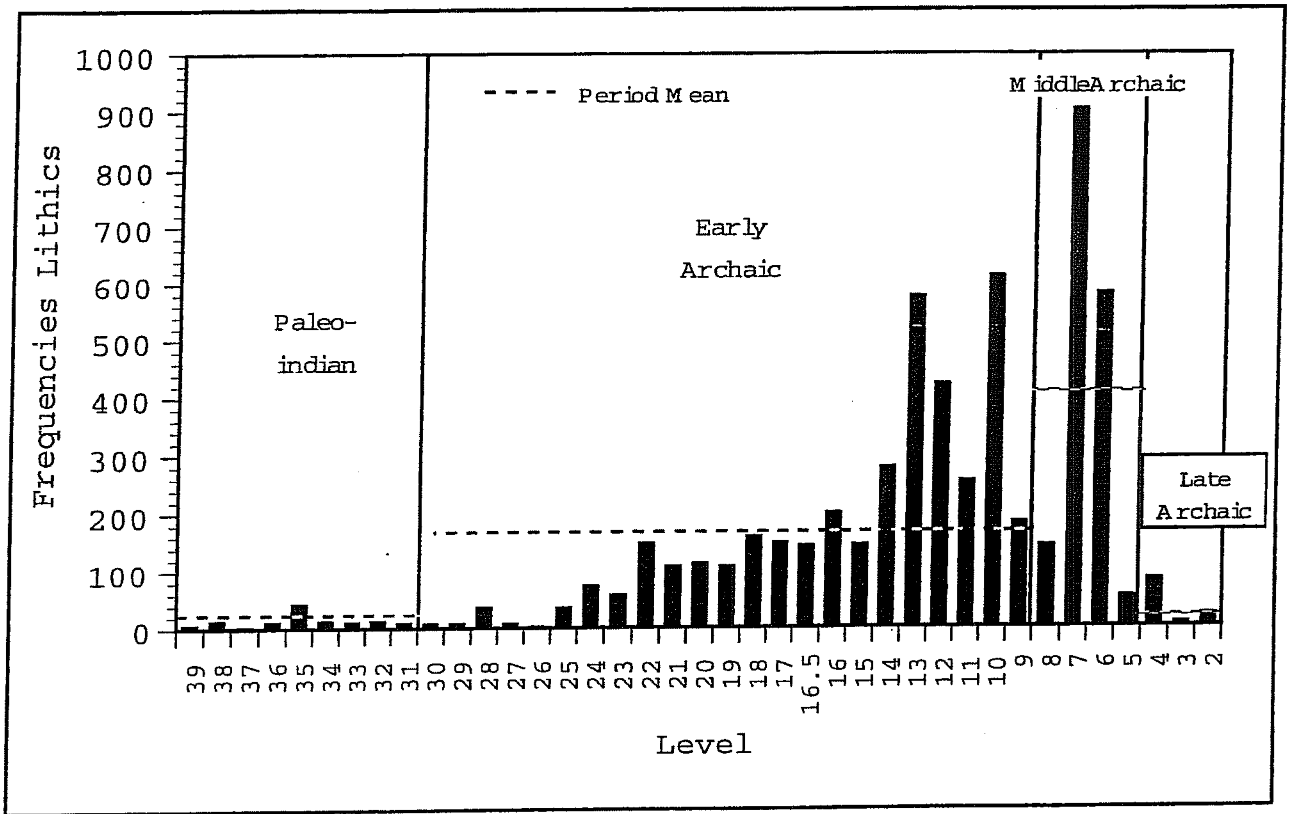

Figure 10.03. Total Lithics by Level, PER X = period Mean Frequency Per Level.

The percentage of utilization of debris in each period was computed (see Table 10.6, inverse of unmodified debris). The utilization of debris steadily increased from Paleoindian to Late Archaic. In general this trend indicates that the site was used less as a lithic workshop, and more as a lithic "use shop." It is not inconceivable that this trend was fostered by the increased difficulty of obtaining good lithics as 10,000 years of exploitation made good quality cryptocrystalline rocks more difficult to obtain. Whatever the reason, a fundamental change in the philosophy of lithic use developed. Within periods there are some fluctuations about the period mean utilization score (Figure 10.04).

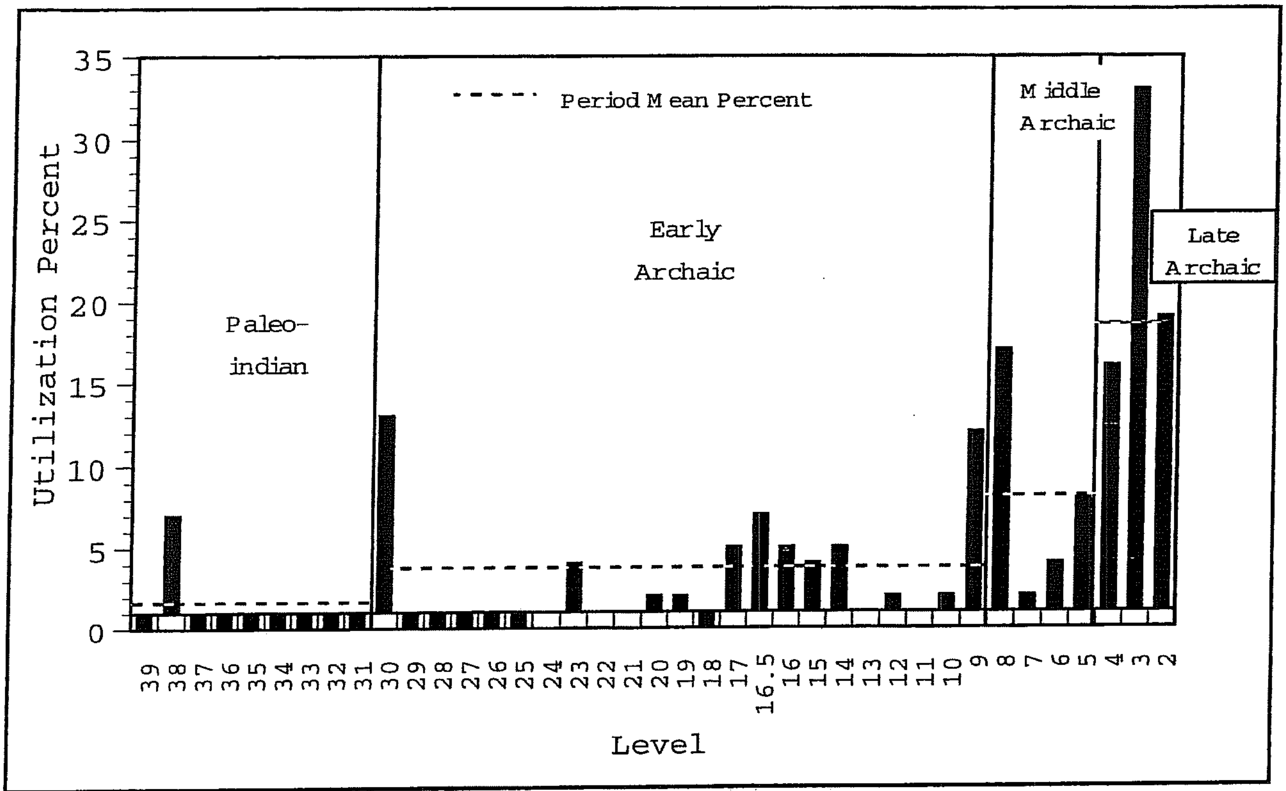

Figure 10.04. Intensity of Occupation, Percent of Lithics Used as Tools.

Comparison of the Late Archaic components in Test Pit 6 (levels 1-8) and Test Pit 2 (levels 1-8) showed a reversal in the use trend noted earlier. Late Archaic use in Test Pit 6 is consistently below the 16% expected value. In Test Pit 2 use is consistently above the expected 3.4% value (see Figure 10.04). This probably indicates internal differentiation of use areas within the site.

The Middle Archaic components in Test Pit 6 (levels 9-12) are consistently above the 16% utilization rate. The Middle Archaic component in Test Pit 2 (levels 9-12) also shows this utilization rate above the expected value 3.4% (see Figure 10.04). A consistent pattern of use seems to have occurred over the currently known areas of the site during the Middle Archaic.

The Early Archaic component in Test Pit 2 begins at level 13 and extends to level 24. Almost all of the levels have a utilization rate below the expected 3.4%. Most of the flakes and chips are very small, with biface-wide and beveling flakes as the dominant technotypes for platformed flakes. Flakes with the potential (width, length, and edge angle) for use as expeditious tools are almost wholly absent. During the Early Archaic and Paleoindian periods, the use of flakes and chips in subsistence activities is minimal. From the types of platform flakes present, it is clear that during both periods the retouching and resharpening of tools dominates over manufacture.

Summary

From the data collected on the 6922 flakes and chips recovered from Test Pits 2 and 6, the use of flakes and chips without secondary modification can be demonstrated. Overwhelmingly, sharp, low edge-angled, platformed flakes were the preferred choice through all time periods in both test pits.

In Test Pit 6 a definite pattern exists from the Late and Middle Archaic. During the Late Archaic the Test Pit 6 area functioned more as a manufacturing locus, while the Middle Archaic shows more evidence of being an area in which both manufacture and use of stone tools were practiced.

Test Pit 2 has an overall utilization rate much lower (3.4%) than is seen in Test Pit 6 (16%). In overall perspective, then, more manufacturing was done by the stream than away from it. The elevated location of Test Pit 6 may have been preferred for resource processing.

The Paleoindian components in Test Pit 2 (levels 25-39) show little evidence for the use of platformed flakes and chips in subsistence activities. Most of the material examined were the by-products of tool rejuvenation. This is consistent with Binford's (1980) logistic model as applied to Paleoindians. That is, the far-ranging Paleoindian preferred to carry high quality, workable flint with them, rather than chance local materials. The continuation of this tradition into the Early Archaic is consistent with similar findings cited in the literature for the southern Plains and the Southeast (Mahula 1982).

One major question raised by the analysis involves the context of materials in Test Pit 2. There is an elevational difference between Test Pits 2 and 6 of approximately 3.8 m. Whether this is a sufficient gradient to allow for sheetwash between these two areas is a significant question which needs to be addressed by geomorphological investigations. If, during the Early Archaic period, when the climate was characterized as hot and dry, there would, in all likelihood, have been less surface vegetation to slow runoff, thus increasing the potential for erosion. The first materials eroded downhill would be the smallest. This may account for the near absence of flakes and/or chips that have the potential for use.

USE WEAR ANALYSIS AT HOP HILL, 41 GL 21 (Gunn, Craig)

At Hop Hill (41 GL 21) the lithics from a 1-m2 (E101-N102) excavated in the summer of 1982 were examined for signs of microwear. This area of the site was in a buried gully that was apparently used as a trash pit or perhaps a natural cooking pit during the Late Archaic (see chapter 3). The purpose of this analysis was to determine the frequency of use of the flakes and/or chips through time. The analysis was conducted on all lithic debris recovered from E101-N102. Lithic debris was defined as platformed flakes and nonplatformed chips, that had not been purposely retouched.

The debris was examined with the same methodology discussed for Moccasin Confluence.

The debris was divided into four categories: (1) None, no apparent evidence of microwear; (2) Polish, caused by contact with soft materials; (3) Nibbling and Scaling, caused by contact with an intermediate material such as leather, or short term contact with a hard material such as wood or bone; and (4) Step and Hinge fractures, caused by contact with hard materials.

Twenty levels were excavated in E101-N102 (Table 10.07) with a total of 3735 pieces of lithic debris found, of these only 2% showed signs of wear. In all of the levels there were large amounts of potlidded, crazed, or otherwise thermally altered debris. This alteration made the identification of wear difficult.

As judged by point chronology, the levels represent three phases: the San Marcos (2600-2250 B.P. corrected radiocarbon), Uvalde (2250-1750 B.P.) and Twin Sisters (1400-1750 B.P.) (Prewitt 1981). Each phase will be discussed in detail below.

The San Marcos phase at Hop Hill is not well defined because only a minimum of prehistoric activity was apparent, and no diagnostic points were found. The periodization is inferred from stratigraphic position relative to the Uvalde phase. There was no apparent utilization on any of the 99 pieces of lithic debris. This suggests that the area was used only as a lithic procurement station.

The Uvalde phase at Hop Hill was defined by Castroville points. During this time there was a decrease in effective moisture (chapter 5), and the drying may have forced the prehistoric inhabitants to broaden their subsistence base into upland areas such as Hop Hill. This is supported by an increase in density of lithic debris, and therefore increased occupation of the site during the Uvalde phase. In the Uvalde phase there are 1225 pieces of lithic debris. Out of this number 1.6% of the pieces showed signs of use wear. Of those pieces utilized, 80% showed signs of stepping and/or hinging. Increased occupation and broadening of activities is suggested.

In the Twin Sisters phase there are 2411 pieces of lithic debris. Of this assemblage 3% exhibit utilization. The phase was defined by the presence of Ensor points. Of the pieces utilized, 85% showed signs of nibbling and/or scaling, and 15% showed signs of stepping and/or hinging. The percentage of debris utilized almost doubles that of earlier levels. This increase might, again, be interpreted as an increase in occupation and use of the site for a broader range of activities.

In summary, the amount of debris indicates an increase of activity at Hop Hill during the Late Archaic. The utilization of lithic debris doubled through the period. The progression of increase in amount of debris and use of debris suggests an increasing range of activities, specifically workshop and occupation. The change in relationship between nibbling/scaling and step/hinge variables through the Uvalde and Twin Sisters phases, points to a change in site function, perhaps in response to changing environmental conditions.

TABLE 10.07. HOP HILL UTILIZED FLAKE & CHIP FREQUENCY AND PERCENTAGE

Phases	FN/Sequence	Flakes A-U	Flakes T	Flakes %	Chips A-U	Chips T	Chips %	Total Debris	Total % Utilized
Twin Sisters	1035-1	2	29	7	1	201	1	230	1
	1037-2	15	75	20	13	627	1	702	3
	1038-3	3	83	4	5	258	2	341	2
	1040-4	4	88	5	5	280	2	368	2
	1043-5	5	38	13	3	135	2	173	5
	1044-6	4	36	11	2	125	2	161	4
	1045-6.5	2	59	3	3	91	3	150	3
	1047-7	4	62	6	5	224	2	286	3
Uvalde	1053-8	2	47	4	0	185	0	232	1
	1056-9	1	52	2	2	108	2	160	2
	1063-10	1	66	2	0	183	0	249	0.4
	1071-11	1	23	4	1	61	2	84	2
	1073-12	0	29	0	0	72	0	101	0
	1082-13	1	37	3	0	66	0	103	1
	1111-14	2	26	4	1	79	1	105	3
	1113-15	2	43	5	1	148	1	191	2
San Marcos	1117-16	0	18	0	0	46	0	64	0
	1123-17	0	2	0	0	14	0	16	0
	1124-18	0	0	0	0	19	0	19	0
	1125-19	0	0	0	0	0	0	0	0

% indicates percentage
A-U - Amount Utilized
T - Total

The concept, central to Primary Forest Efficiency (Caldwell 1958), that techniques developed within a period of broad spectrum resource exploitation will become intensified toward the end of that episode, can be applied in this case as a vehicle for interpretation. It is worth noting that the lithic frequencies and use indicate a coordinated burst of activity at Hop Hill and in the Test Pit 4 area at Moccasin Confluence.

Intensive occupation at Hop Hill ends with the Twin Sisters phase, which supports the inference of some sort of cultural trauma during or before the following Driftwood phase. This corresponds approximately the A.D. 536 event that produced worldwide climatic and population changes (Baillie 1994).

CONCLUSIONS (Gunn, Labadie)

The rather cursory discussion of lithic use-wear presented in this chapter demonstrates dramatically the potential of such studies to discover the character of past lifeways. At the beginning of this study, we proposed that when the frequency of utilized flakes exceeds the period means, it indicates dry climatic and/or biotic intervals. During these periods the region would be favored by Plains people adapted to drier conditions, nomads who are conservative with their carefully selected lithics. The increase in the percentage of utilization early in the Late Archaic correlates with the onset of drier conditions during the San Marcos phase.

The less-than-expected use of lithics during the Middle Archaic indicates a less nomadic people who were less selective of materials and, more inclined to a bifacing technology to produce the heavier tools necessary for life in the woodlands. The evidence from Test Pit 2 supports this model, while that of Test Pit 6 does not. Intrasite patterning is likely a factor to be considered in future interpretations.

A steady increase in the use of lithics from Paleoindian to Late Archaic marks a basic shift of lithic use philosophy over time. The earlier groups apparently preferred to use tools in the formal sense, leaving only resharpening flakes as residue. During the later periods emphasis shifts to the use of flakes as expeditious tools.

There is a marked increase in the proportion of lithics used at the beginning of each period in the chronology (see Figure 10.04). This probably represents the immigration of people from other regions, most usually east Texas, which is noted by Prewitt (1981), at the beginning of each period. It is logical that new arrivals in a region would be unfamiliar with local lithic resources, and they would therefore be more careful to curate and utilize what they brought with them, probably on hunting expeditions. As local resources were discovered and utilized and they settled into the local niche as residents, less emphasis would be placed on curation and utilization and more on local production. Also, at the beginning of each period, and therefore at the beginning of the optimization of the efficiency process, new arrivals would, of necessity, be more mobile than during more sedentary times after they familiarized themselves with a broad spectrum of local resources. These data constitute the best evidence that central Texas ecology acted repeatedly as a cultural "anvil," first enticing and then crushing cultural structures. The archaeology suggests a parallel case to that of Labrador (Fitzhugh 1972) discussed in chapter 1. In this perspective the use of lithics as tools can be seen as a part of the Broad Ecotone adaptation processes that draw in cultural groups during optimum conditions, necessitate adaptation to local conditions, and then place them under severe stress during periods of radical climatic change (Gunn and Prewitt 1983).

CHAPTER 11—OCCUPATION FLOORS AND FIRE AREAS AT MOCCASIN CONFLUENCE (Meskill, Gunn)

INTRODUCTION

As is amply demonstrated in Kerr (1983), occupation floor patterns are a growing interest among archaeologists of the south-central United States. Such excavations yield examples of stratigraphically unmixed behavior patterns of prehistoric peoples. These units of analysis can be used to study the information content of prehistoric technological systems as Kerr did, to isolate associations of typological diagnostics as Prewitt (1981) and Goodyear (1974) demonstrate, and to delineate use-wear patterns (Gunn 1982f; Johnson 1982). While no large areas were opened at Moccasin Confluence, a 1 by 3 m excavation revealed enough of the occupation floors to justify a preliminary study. This chapter can serve as a guide for future research and also demonstrates the integrity of the floors at the site.

A METHOD FOR HEARTH DEFINITION

There is more than adequate ethnographic, ethnohistoric and archaeological evidence that activities in a camp lifestyle are centered around hearths (Yellen 1977, Binford 1983, Leroi-Gourhan and Brezillon 1966). Therefore, the definition of a fireplace is the first priority in the study of occupation floor patterns and activities. Charcoal is generally used in archaeological sites to locate prehistoric hearths. The scarcity of charcoal at Moccasin Confluence (probably due to the alluvial/colluvial character of the site) posed a problem for the identification of fire-related areas. Following Gunn (1982f), a model was developed to spatially define the location of fires at the site without the benefit of charcoal. In each test pit and level targeted for study, data was compiled on the quantity and condition of fire-altered materials recovered. Field observations, visual documentation, mapped floors, and photographs were integrated to identify hearths and related occupation floor features. Analysis of these traces of ancient life suggested certain possibilities for interpretation. "Interpretation" is used here as museum science uses it, visualization of a scene from some basic facts or an outline.

The search for interpretive clues focused on the patterning of physical features: shape, repetition, and size of rock patterns. Also, the rocks themselves were observed and studied. These structural elements became valuable diagnostic tools.

The amount of fire-altered lithics was used to locate fires. Fire-altered material was determined by visual examination in the laboratory; assumptions were conservative. Lithics, including tools, flakes, chips, and fire spalls from chert nodules, bone, burned limestone, the small amounts of charcoal collected, and any other pertinent materials were selected for their burned condition, then counted and weighed. Totals for each category were recorded by level.

Reddening of lithic materials (limestone, chert) and the "dishwatery" appearance normally associated with heat alteration of chert were considered inadequate criteria for location of fires. These attributes were viewed as ambiguous with respect to the placement of hearths, since intentional thermal alteration can affect these changes. Prehistoric artisans presumably placed blanks and cores under campfires in sand or soil (Crabtree and Butler 1964), then removed the material after heating for further modification. The possibility of transfer of these materials from the immediate area of heating eliminates color change as a reliable indicator of fire position.

Primary indicators of fire were crazing and potlidding. In the absence of charcoal, these conditions were viewed as being the most direct evidence of fire. Accidental exposure to fire was assumed as items may have been dropped into a fire, or a fire built over them after they were discarded. Although poor control of intentional heating can cause these characteristics (Patterson 1979), it is a less likely and certainly a less frequent occurrence. Should potlidding and crazing both be present, the item is categorized as crazed. Crazing is taken to signal direct contact with fire, while potlidded items are viewed as being on the periphery of the fire.

Fire spalls, large, firecracked fragments of flint, were interpreted as fractured boiling stones. They might be found inside or outside the fire. Fracturing occurred during heating (inside the fire) or when taken from the fire and placed in water and exposed to an abrupt temperature change. When removed from the boiling container they would probably be discarded outside the fire. Burned limestone, probably also used as boiling stones, would have been discarded outside the fire for the same reason.

Wilson and Davis (1978) assert that burned, blackened, and calcimined bone results when bone pieces are thrown or spat into the fire as a means of efficient garbage disposal and are not the by-products of cooking. Cooking could cause a small amount of leaching, or charring of ends, if exposed when roasting. And bone buried beneath a fire would be charred and blackened due to the reducing environment (Wilson and Davis 1978). Charred and blackened bone, then, is seen as being inside the fire.

The totals of burned materials for the occupation floors from Test Pits 1, 2, and 3 are shown in Table 11.01. The crazing and potlidding ratios are presented on occupation floor maps as pie diagrams above each square, "C" indicating crazed and "PL" potlidded. Evidence of a hearth for the later Archaic floors is determined by the presence of 20 g or more of burned material. On lower floors the square with the greatest weight of burned material indicates a hearth area.

TABLE 11.01. MOCCASIN CONFLUENCE FIRE-RELATED MATERIALS FROM OCCUPATION FLOORS

	Test_Pit_1				Test_Pit_2				Test_Pit_3			
Floor	Lithic		Bone	Sum	Lithic		Bone	Sum	Lithic		Bone	Sum
	Cnt	Wt	Wt	Wt	Cnt	Wt	Wt	Wt	Cnt	Wt	Wt	Wt
8	265	45*	2.6	48	40	18	2.0	20	124	23	.4	23
10					335	80	1.5	82	76	35	2.3	37
11	143	51	1.1	52	62	30	2.2	32	86	0	0	0
12	116	68	7.0	75	139	30	1.1	31	99	40	.2	40
15	55	25	.9	26	41	11	3.2	14	80	52*	1.5	54
25	0	0	.1	.1	7	8	.2	8	1	1	.5	2
27	1	1	1.7	3	4	5	0	5	21	20	.5	21
29	2	25**	.1	25	1	0	0	0	5	1	.8	2
31	0	o	.6	1	2	1	.4	1	4	0	1.4	1
33	1	0	1.0	1	4	1	1.5	3	1	0	3.9	4
36	1	0	0	0	2	2	.9	3				

* A lithic piece weighing over 30 g was excluded
** Includes 24.5 g flake
Cnt = Count, Wt = Weight
Note: Weights are in grams, rounded off for lithic weight and summed weight.

METHOD FOR INTERPRETATION OF OCCUPATION FLOORS

At Moccasin Confluence there was a wealth of features peripheral to hearths. Probably most of the Middle Archaic activity was at the midden across Williams Creek. The area excavated at 41 BC 71 provided uncluttered examples of midden producing activity where there was less accumulation of the dense jumble of debris usually associated with burned rock middens. This greatly facilitated interpretation.

Test Pits 1, 2, and 3 were excavated in 40 levels/microstrata. It would have been neither useful nor possible to interpret all possible occupation floors. Eleven floors were selected for intensive study and interpretation. Generally, selected floors contained large numbers of artifacts that were mapped and photographed in detail. Some occupation floors with few artifacts were not mapped, but were included in the interpretation because of important diagnostic artifacts. Study of these floors considered on totals of burned materials and other statistical data, notations from the field, and inferred subsistence patterns. Since there was no evidence to indicate otherwise, the interpretations based on these data assume very little or no depositional or postdepositional disturbance.

Floors with substantial amounts of cultural material were excavated with the greatest care. The technique of "rock bottom excavation" (Gunn and Mahula 1977a; Gunn 1982f), i.e. excavation with a control face to the bottom of rocks in horizontal association, hypothetically enables the excavator to expose a consistent cultural level. The occupation floor thus exposed is then mapped and photographed. The vertical location of the floors can be seen in Figure 5.03. Horizontal proveniencing of diagnostics on an occupation floor is at one centimeter resolution, other artifacts are provenienced to one meter.

The initial step in interpretation was spatial ordering of observed features of mapped floors. Photographs provided the clearest evidence of patterns, upon which functional assessments were recorded. Statistical data were used to support these interpretations. Such data act, at times, as an activity indicator, and at other times as a corrective to interpretation. Gunn's (1982e) concept of an "episode," as related to functional discreteness, supported the diagnosis. Historical and archaeological references (see discussion of acorn utilization below) to methods of food preparation were investigated, and inferences drawn.

A system of rock patterns, first noted in the field by the primary author, and further defined from photographs during laboratory analysis, suggested the interpretation of the midden floors. Patterns of repeated interconnecting circular forms seemed the logical result of a single activity episodes. An unusually explicit example appears in Figure 11.01. Investigation of historical references (Turner 1977a) to the forms observed suggested that the patterns might be associated with stone boiling. Kroeber (1932:276) describes a Patwin acorn boiling episode this way:

> Acorn soup or gruel, YIWIT, required three baskets to cook well. The hot stones were picked up with two sticks and first dipped into the acorns. They were removed from this with two paddles, TS'IWIK, of oak, a foot and a half long, with blades the size of a palm. Then the gruel was carefully poured into another basket so as to leave behind the fragments of rock that had become detached.

Note the indication of multiple boiling containers. This procedure is consistent with the rock patterning observed on the midden floors at Moccasin Confluence. Circular or ovate rock groups, perhaps used as support for baskets or boundaries for skin "bowls," are seen adjacent to hearth areas in which the stones could have been heated. The use of rock patterns is particularly applicable to the Middle Archaic midden floors. Using the data, a systematic search was made of each floor for circles and ovals, seen as voids on living floors and immediately accessible to fire, where they would be expected if the stone rings were put to such a use.

Additional support for the interior of stone rings being discrete functional zones is found in the fact that they were apparently cleared of debris before use. The general absence of materials within the circles is supplemented by the fact that provenienced artifacts were often on the periphery or outside of the circular rock forms.

Examination of the occupation floors in the Eagle Hill II report (Gunn and Brown 1982) at similar time depth and the Hop Hill report (Gunn and Mahula 1977a) seem to suggest the presence of these forms (see southeast section, Occupation Plane 2.13, Gunn 1982f:328). The interpretation of the stone rings as features associated with stone-boiling and acorn processing (Turner 1977a), suggests the occurrence of such activities at Moccasin Confluence.

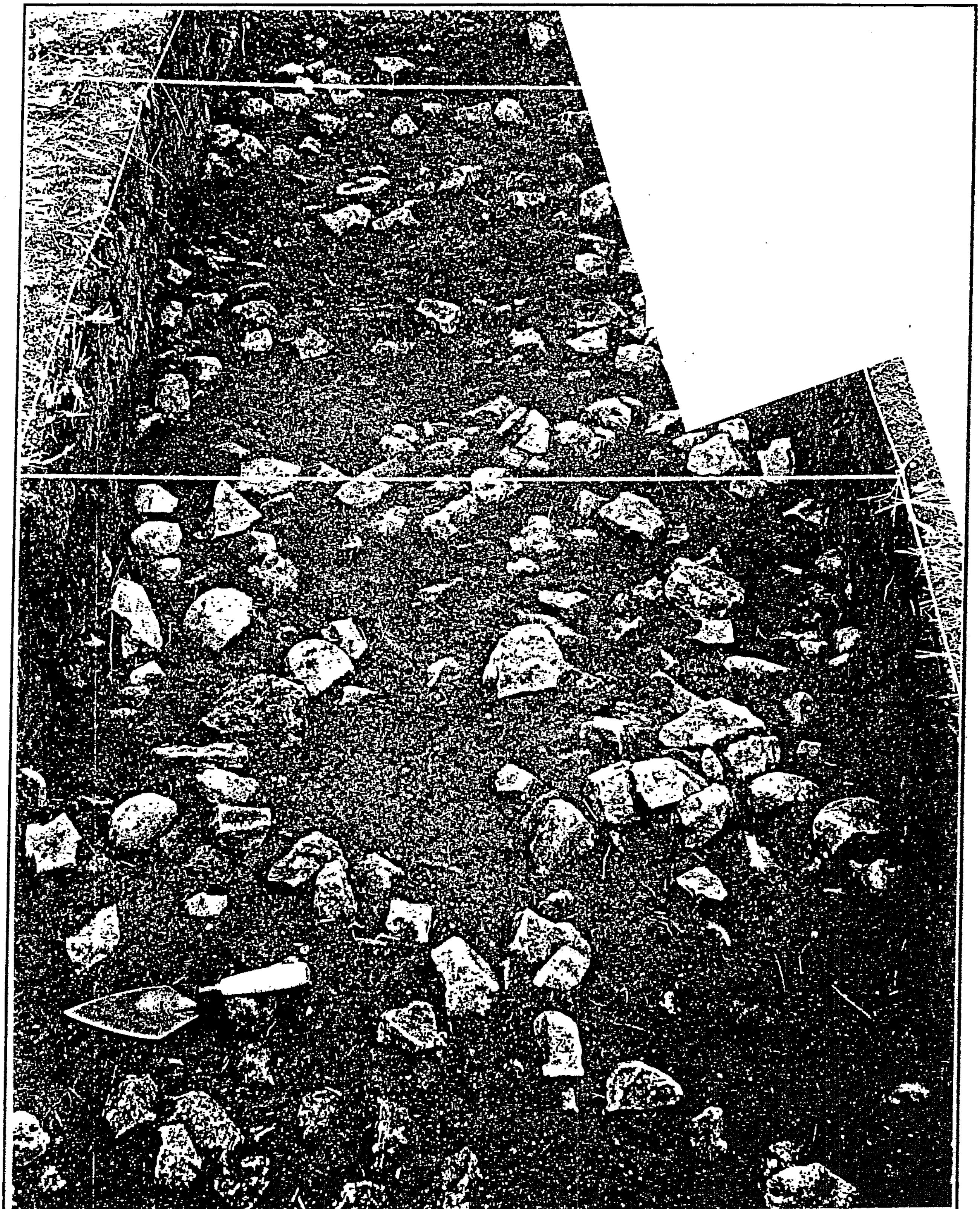

Figure 11.01. Occupation Floor 8, View East.

ROCK SIZE THROUGH TIME

An informative overview of the use of rocks during the 10,000 year occupation interval of the site can be seen in Table 11.02. The circumferences of rocks mapped on occupation floors we measured and divided by the number of rocks per square to get the average circumference for a floor. It was assumed that the size selection of rocks, and possibly shape, was a product of a culturally determined, mental template. This selection would have been influenced by availability, but the primary consideration would have been which rocks best suited the current preferred mode of food preparation.

TABLE 11.02. OCCUPATION FLOOR AVERAGE CIRCUMFERENCE OF ROCKS

Test Pit 1			Test Pit 2			Test Pit 3		
Unit FN*	N. of Rocks	Cir.	Unit FN*	N. of Rocks	Cir.	Unit FN*	N. of Rocks	Cir.
1-257-8	24	17	2-306-7	21	26			
1-258-9	28	18	2-307-8	22	19	3-338-5	24	22
1-259-10	44	17	2-500-9	16	25	3-345-6	19	18
			2-503-10	62	20	3-501-7	50	21
						3-507-8	36	21
1-504-11	39	19	2-515-11	40	16	3-524-9	24	18
1-511-12	stain		2-528-12	9	21	3-529-10	31	17
1-517-13	7	14	2-542-13	5	18	3-544-11	8	24
						3-544-12	8	23
1-504-14	6	18	2-552-15	3	24			
			2-568-17	6	27			
			2-571-18	5	25			
			2-594-26	23	20			
1-627-26	17	24				3-648-27	19	25
			2-615-31	5	41	3-662-30	7	27

*Unit FN = Test Pit-Field Number-Level, N. = Number, Cir. = Average Circumference

The table shows that large counts of rocks near the surface clearly indicate the presence of midden floors. Below the midden floors rocks become generally larger and remain so, with the exception of Occupation Floor 26. Visual examination of the occupation floor maps supports the figures in Table 11.02 and suggests a clear change in rock size and shape preference during the Late Paleoindian period. Though not temporally documented, a similar pattern of change was noted by Gunn and Mahula (1977a) at Hop Hill.

The presence of smaller rocks in Test Pit 1, nearer the stream, through all levels is probably a function of slope. The bank of Williams Creeks begins to slope at Test Pit 1 and it probably represents broken and discarded or rolled rocks.

OCCUPATION FLOOR INTERPRETATIONS

The following sections detail interpretations of targeted occupation floors.

Occupation Floor 8

This midden floor is dated to the Late Archaic, based on the presence of a Castroville point from the central unit (Figure 11.02). Evidence of a hearth, based on the analysis method, is present in all three pits. The pie diagram (see Figure 11.02) for this floor points to Test Pit 3 as being the most likely hearth area with a higher proportion of crazed (C) than potlidded (PL) material. However, Test Pit 1 also has a relatively high proportion of crazing and the weight and count of fire-altered materials were greater there.

Circular forms in Test Pit 3 (evident in the lower part of the photograph, see Figure 11.01) are adjacent to a mass of large rocks at the juncture with Test Pit 2, conforming to the pattern associated with stone boiling. A broken mano from Test Pit 3 and a second mano (tentatively identified in the photograph), suggest the grinding of some plant or nut resources indigenous to the area. A likely position for the "cook" would be in the void just below the east edge of Test Pit 3. Prehistoric women, we assume, were tending the fire and boiling meals in baskets, or perhaps roasting nuts or meat as additions to the boiled food. Tools and fragments of white-tailed deer bone in Test Pit 1 suggest the presence of meat, and that it was being severed from the bone and cut up to the west of the fire. An expended tabular core and a burned cortex flake found in the southwest quadrant of Test Pit 2 suggest a possible minor workshop area. Flint knapping may have been the product of immediate need. Use-wear figures show a high proportion of utilization relative to other floors. Twenty-three flakes and chips show signs of nibbling (plant-animal processing), and two show step wear (use on harder substance such as bone or wood).

The edge of an ovate form at the east edge of Test Pit 1 suggests a satellite hearth described in Weir's (1976) Hearth Type 5 category, where a large hearth, three to eight feet in diameter, is surrounded by satellite hearths. These subsidiary hearths are 12-36 inches across and consist of only a few burned rocks located three to ten feet from the parent hearths (ibid.). The parent hearth type might have been used for the roasting of large game, and the satellite hearths may represent stone-boiling activities. Also recovered in Test Pit 1 were 14 very small pieces of rolled quartzite and a nut fragment, possibly pecan.

Occupation Floor 10

Weight and count of burned material in Test Pit 2 are the highest of all the units analyzed on this occupation floor, a strong indication of a hearth (Figure 11.03).

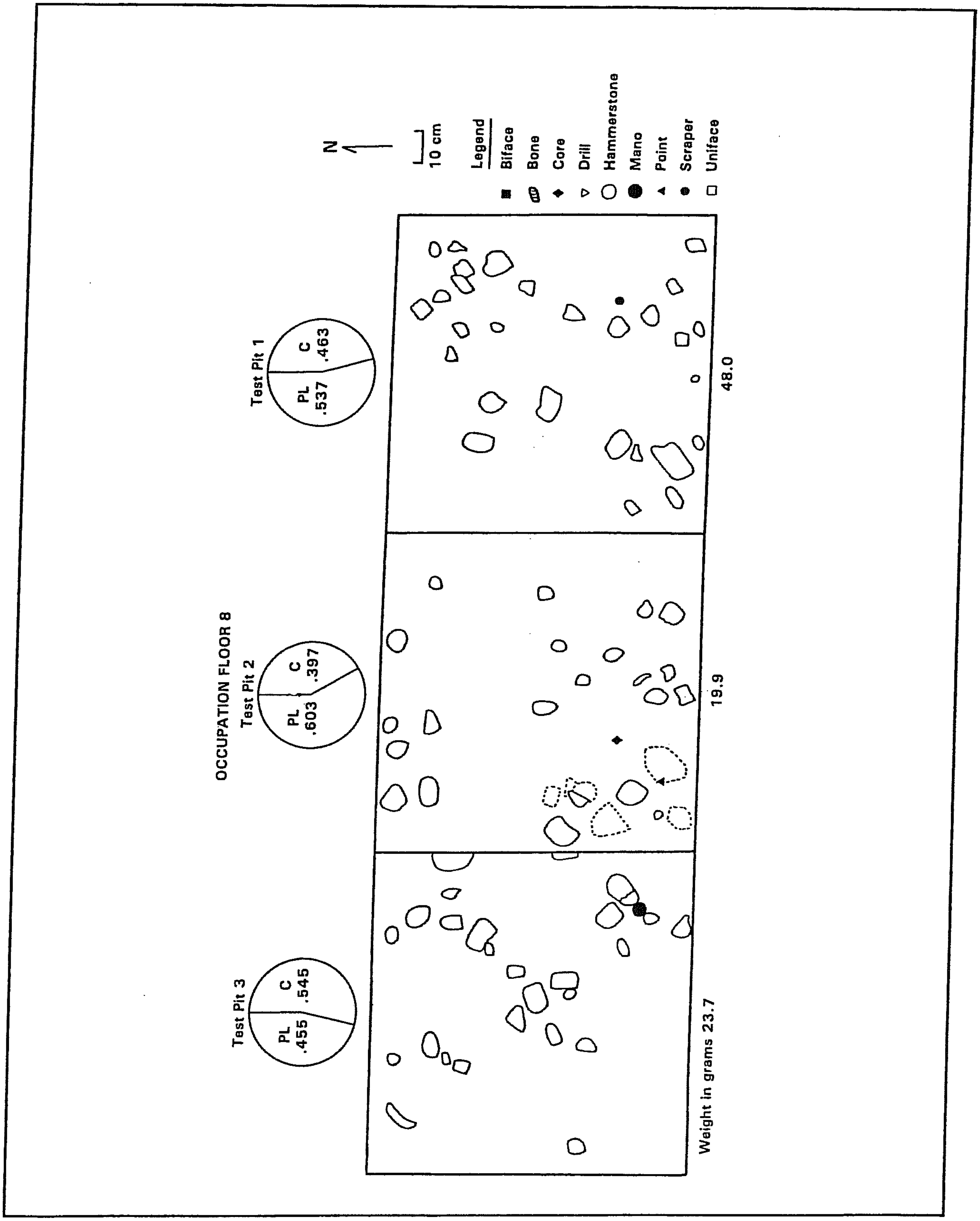

Figure 11.02. Occupation Floor 8.

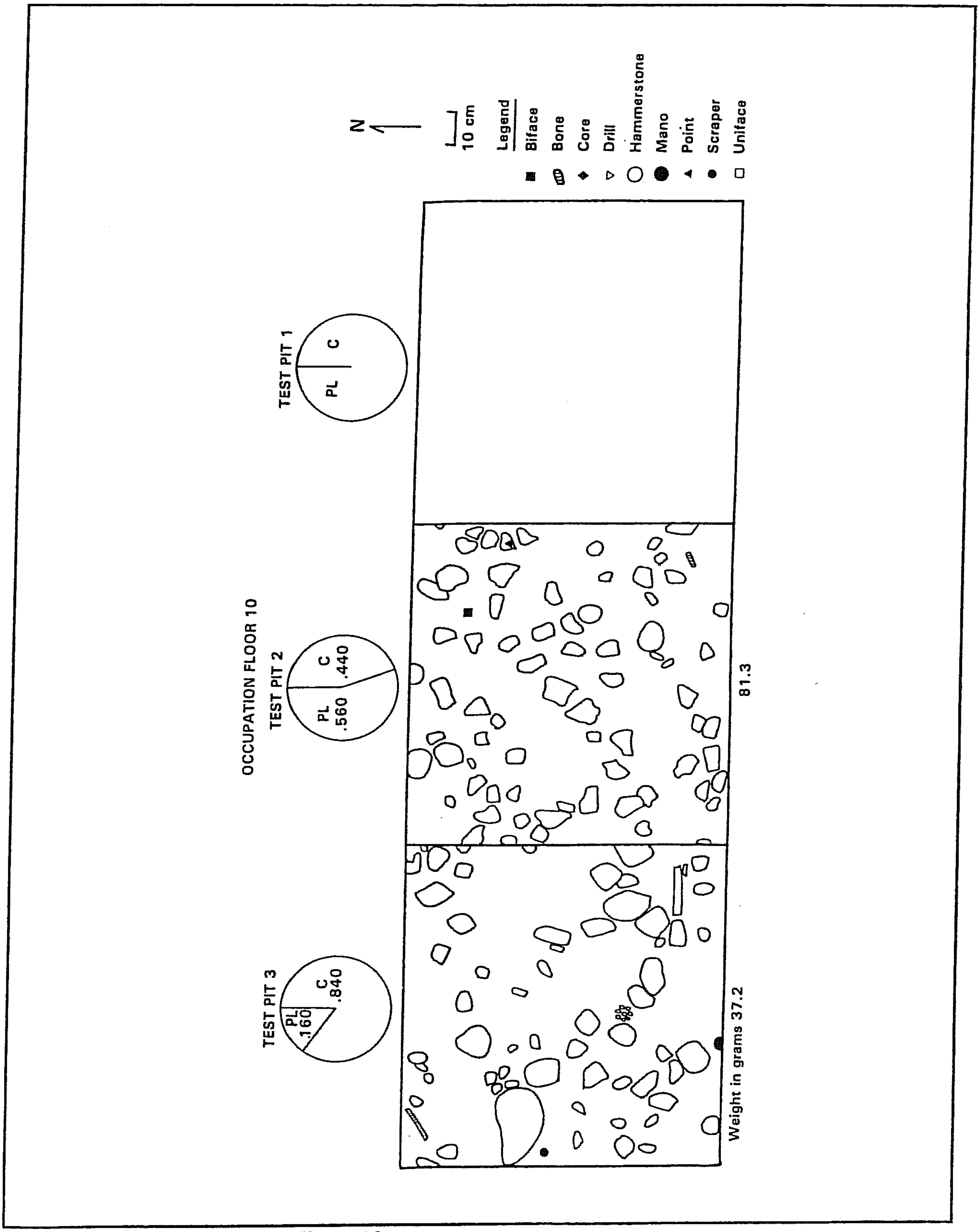

Figure 11.03. Occupation Floor 10.

This is, however, inconsistent with the higher proportion of crazing to potlidding in Test Pit 3. Four discrete patterns radiate from the hearth area in the southeast quadrant of Test Pit 3, the same position suggested on the earlier midden floor, Occupation Floor 8 (see Figure 11.02). The stone-boiling analytical device is again applicable. An incident of some interest is suggested in the northwest area of the unit. A metate, a discoid denticulated scraper and a large piece of bone appear together outside the aboriginal "firepot." A woman, leaning over, grinding plant food or nuts, scraping meat off bone, and adding these ingredients to the baskets or skins is easily imaginable from the disposition of these artifacts and features. The relationship is inferred from Iroquois and Algonquin use of acorns, as reported by Parker (1910) and Merriam (1918). A broken mano is in the south wall of the unit.

A triangular point, a Taylor or Baird, was recovered from Test Pit 2. Evidence of a hearth is strong in this pit: of 612 flakes and chips recovered, 335 were burned. Ten lithic pieces exhibit nibbling, and one has step fractures. The number of burned chips is extremely high relative to the count of burned flakes—a pattern seen repeatedly through this period. A severely burned biface was situated in the northeast quadrant of Test Pit 1, possibly indicating a subsidiary hearth.

Occupation Floor 11

A Bell point from Test Pit 2 (Figure 11.04) marks this floor as a possible Early Archaic occupation. Circular patterning of rocks, observed in the field and more clearly observable in the photograph (Figure 11.05), precipitated the pursuit of the rock pattern study. Attempts to account for the forms observed led to the stone boiling concept. Note the placement of tools on the periphery of the circle (see Figure 11.04).

The crazing proportion is highest in Test Pit 1, which is consistent with the high count of burned material. However, the greatest weight of burned material is in Test Pit 3, where crazing is over 50%. Perhaps the dense, more random rock scatters represent destroyed hearths. Test Pit 1 yielded one of the rare traces of charcoal. This unit is located at the top of the embankment sloping toward Williams Creek to the east, and may indicate that earlier occupations were to the west.

A biface and a scraper on the east side of Test Pit 2 suggest a cutting and scraping episode. Use-wear analysis shows only three utilized flakes, all evidencing step wear. These flakes may have been damaged in the same task as the core tool found in the west end of the unit. The marked shift from utilized flakes in Occupation Floor 8 to tools in Occupation Floor 11 is characteristic of the whole sequence as is discussed in Labadie's use-wear analysis (chapter 10). Paleoindian and Early Archaic peoples favored formal tools while later Archaic residents relied on flakes as tools. A rather enigmatic yellow rock found at the bottom of Test Pit 2 could be a hammerstone. Outside the circular pattern of rocks, in the north portion of Test Pit 1, a crescent scraper (see Figure 8.03, FN 506) was found. The large amount of lithic debris in this area suggests that some prehistoric flint knapper might have sat on the edge of the slope, resharpening his tools.

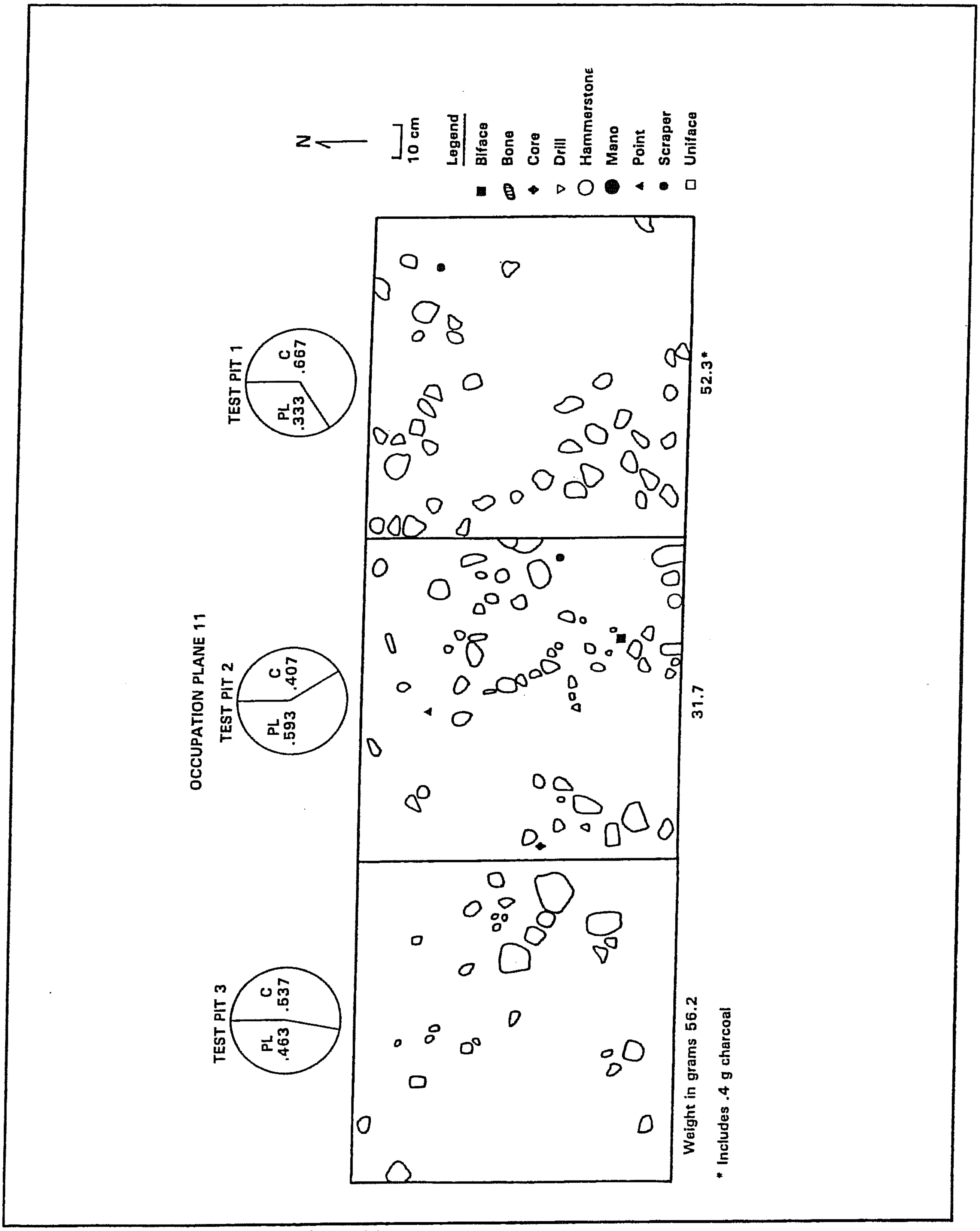

Figure 11.04. Occupation Floor 11.

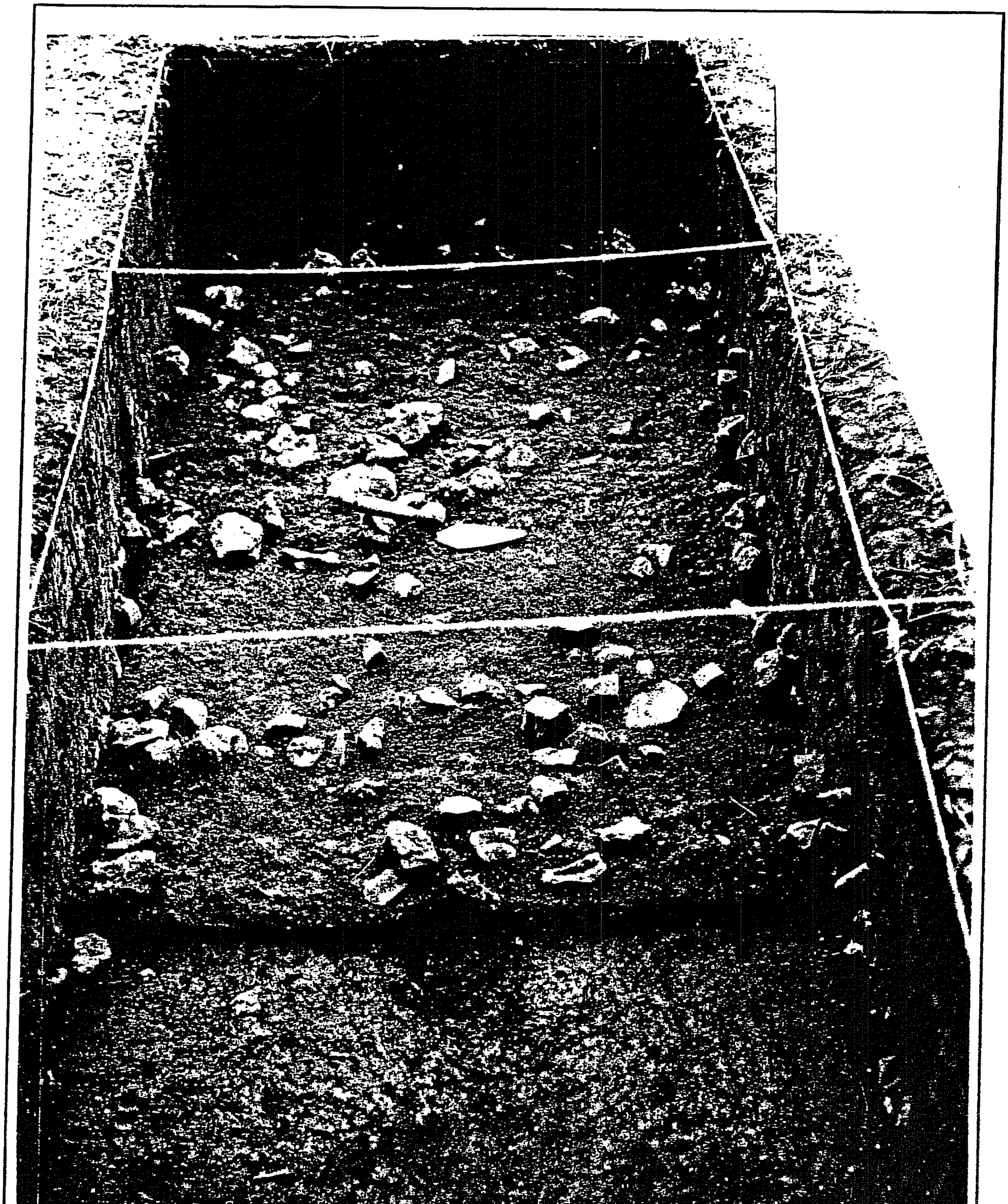

Figure 11.05. Occupation Floor 11, View West.

In Test Pit 3 a concentration of terrestrial snails was noted in the northeast quadrant.

Occupation Floor 12

This occupation floor provokes particular interest, with four points, a Montell, a Martindale, a Bulverde, and an untyped point, having been recovered from Test Pit 1, in close context with a drill positioned on the upper right of Test Pit 2 (Figure 11.06). The tooth of a large herbivore, apparently that of a small bison, was also located in this pit. The Martindale is noted as having an apparent impact fracture at the tip. A probable post mold between Test Pits 1 and 2 suggests some sort of shelter or structure (shaded area, Figures 11.06). It is 15 cm in diameter, 25 cm deep and a rock was found at the bottom, perhaps to stabilize the post.

Another interpretation suggests the roasting or steaming of the meat on the spot and a single, but contemporaneous, hide-working episode in the vicinity of Test Pit 2. The Bulverde point on the left is potlidded, but the bone beneath it was not burned, nor were the other points. The counts of burned material were high in all three pits, and the weight greatest in Test Pit 1. The crazing relationship, taken alone, would have pointed to Test Pit 3 as the most likely hearth area. The proportion of crazed materials was highest in Test Pit 3, and possible boiling stones and fragments were found, indicating a hearth, or a disposal of hearth-related debris. A biface, a scraper fragment, and the basal fragment of a point were also recovered.

Burned materials were frequent in Test Pits 2 and 3, and the concentration of rocks in the westernmost area of the pit suggests a hearth. A complement of tools, two uniface cutting tools and a scraper, were recovered next to the concentration of rock. The cobbles are distinguished by their consistent size, a characteristic not noted on any other floor.

Labadie's use-wear analysis for Test Pit 2 (chapter 10) shows hard wear, with four artifacts exhibiting step fractures, one with polish and only one piece evidencing nibbling. Subsistence on this floor seems to be oriented towards the exploitation of animal, rather than plant, resources.

Occupation Floor 15

This floor represents an Early Archaic occupation (Figure 11.07). The amount of lithic materials has decreased as compared to the upper levels. The relative lack of artifactual materials in this level prompted the use of 5 cm levels sloped with the strata. The floor maps reveal a minimum of visual information. A rodent bone was found in Test Pit 2 and two probable deer teeth in Test Pit 3, while an exhausted core was found in Test Pit 1.

A trace of charcoal, a fire spall, and a fairly large quantity of bone, some of it burned, came from Test Pit 2. The proportion of crazing to potlidding is high in Test Pit 2,

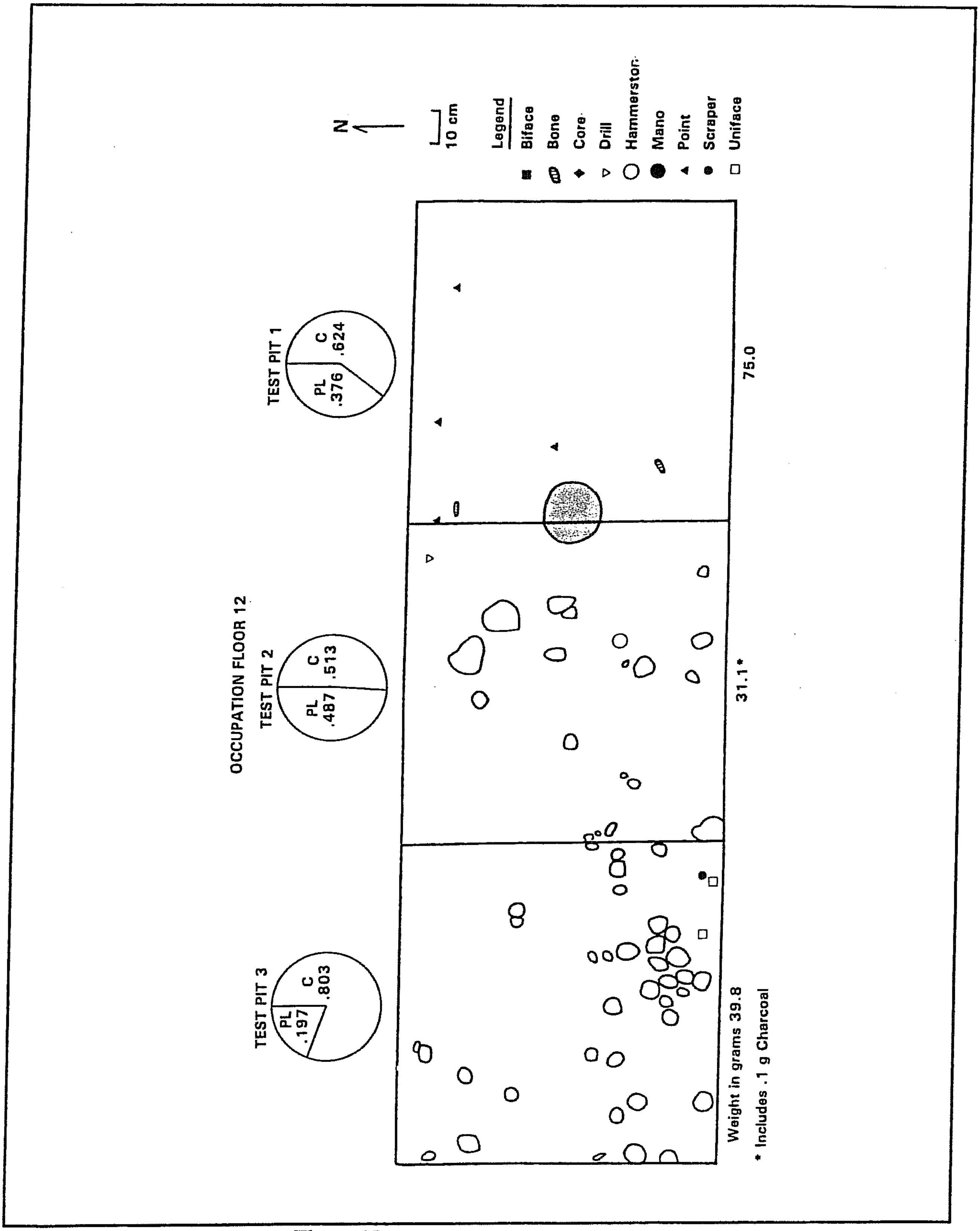

Figure 11.06. Occupation Floor 12.

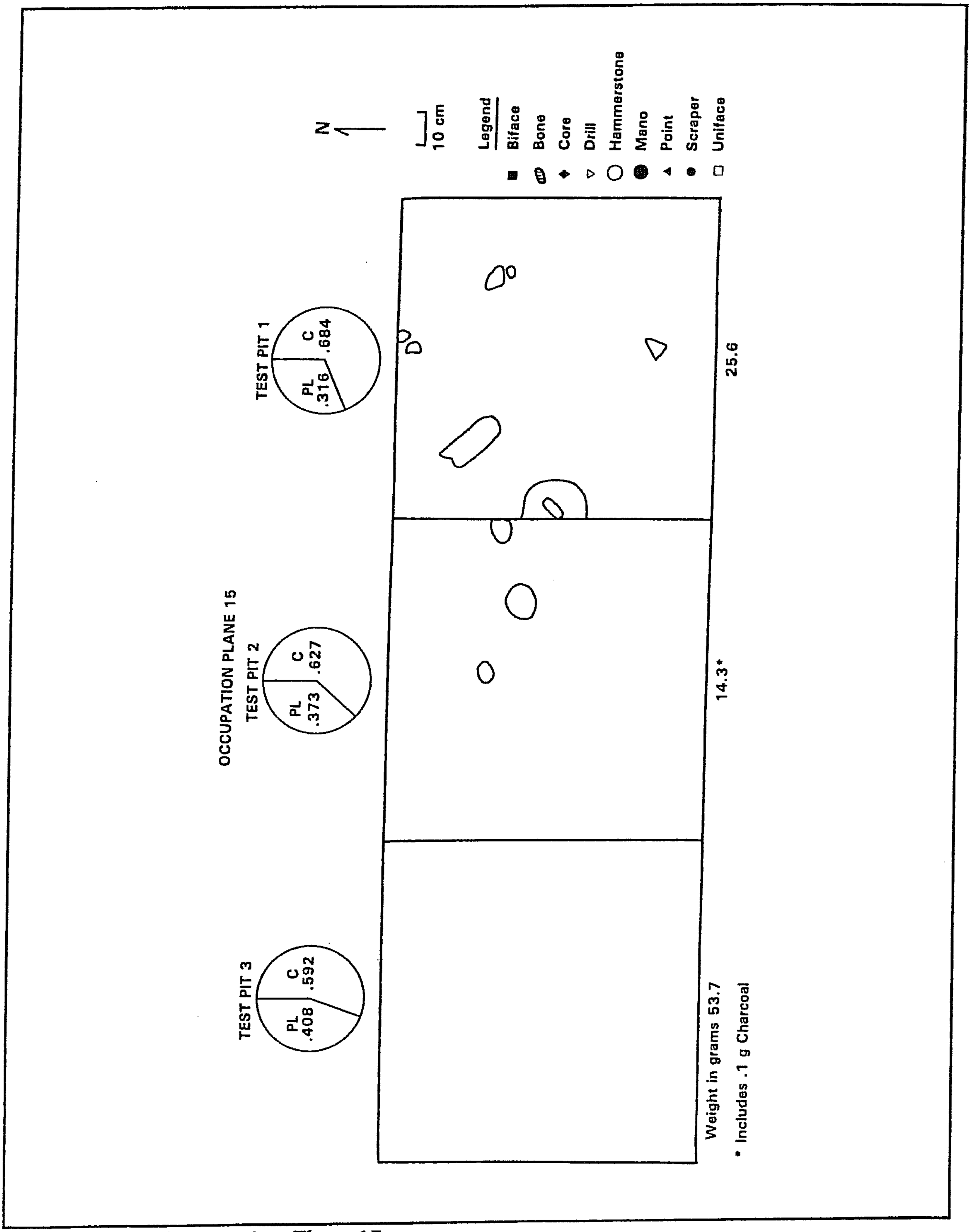

Figure 11.07. Occupation Floor 15.

although the amounts of burned material are rather low. Three flakes and chips show signs of soft wear (nibbling), and three chips evidence harder wear (step fracturing). The weight and count of burned material is highest in Test Pit 3, where a crazed, unidentified point, a point fragment, and a beveled tool were found. Aquatic shell appears on the occupation floor.

Occupation Floor 25

A possible Plainview point marks this as the first Paleoindian floor. The Paleoindian levels were generally excavated in 5 or 10 cm levels, lacking the midden structure necessary for the rapid microstratigraphic excavation appropriate to a testing operation. The diagnoses are, therefore, more generalized, but certain qualitative suggestions can still be made.

Perhaps some generally applicable remarks would be helpful. The amount of lithic materials recovered from these lowest levels was greatly reduced compared to the upper levels. Any large weights are derived from the presence of either a large flake or fire spalls. The percentage of burned material for these floors is high relative to the total amounts, and the recovery of bone is greater relative to lithic material. The burned/not burned relationship for bone is also higher. The proportion of crazing to potlidding becomes ineffective as a diagnostic devise because of the small amounts of lithics. Rocks mapped on the floors are large, with but one exception, in Test Pit 2, level 26. The matrix was screened through 1/4-inch mesh screen, with the exception of the southwest quadrant of Test Pit 2, which was screened through 1/8-inch mesh as a control. Indications are of short-term occupation, camping by the water, cooking game, moving on, making this site in essence, a Paleoindian stop-over spot.

Test Pit 2 exhibits the best evidence for a hearth feature. Notations made in the field report a large number of flat rocks in this unit, and a possible Plainview point was located here. Five fractured chert nodules may be associated with stone boiling.

Test Pit 1 yielded an edge-ground Nolan point and a biface, but no burned chips or flakes, and only one piece of burned bone. Test Pit 3 had only one crazed chip, and five pieces of bone, all burned.

Occupation Floor 27

This floor was selected for analysis because of a mapped (Figure 11.08) and photographed (Figure 11.09) feature, recognizable as a hearth in Test Pit 1. The amount of burned flint and bone in association with this feature is quite low, a seeming anomaly within our analytical model. A strict analytical examination of these units would probably not have pointed to the existence of this feature, and this points again to the validity of visual observation as an additional analytical tool. The discrete pattern and low material count reflect a short-term occupation, possibly

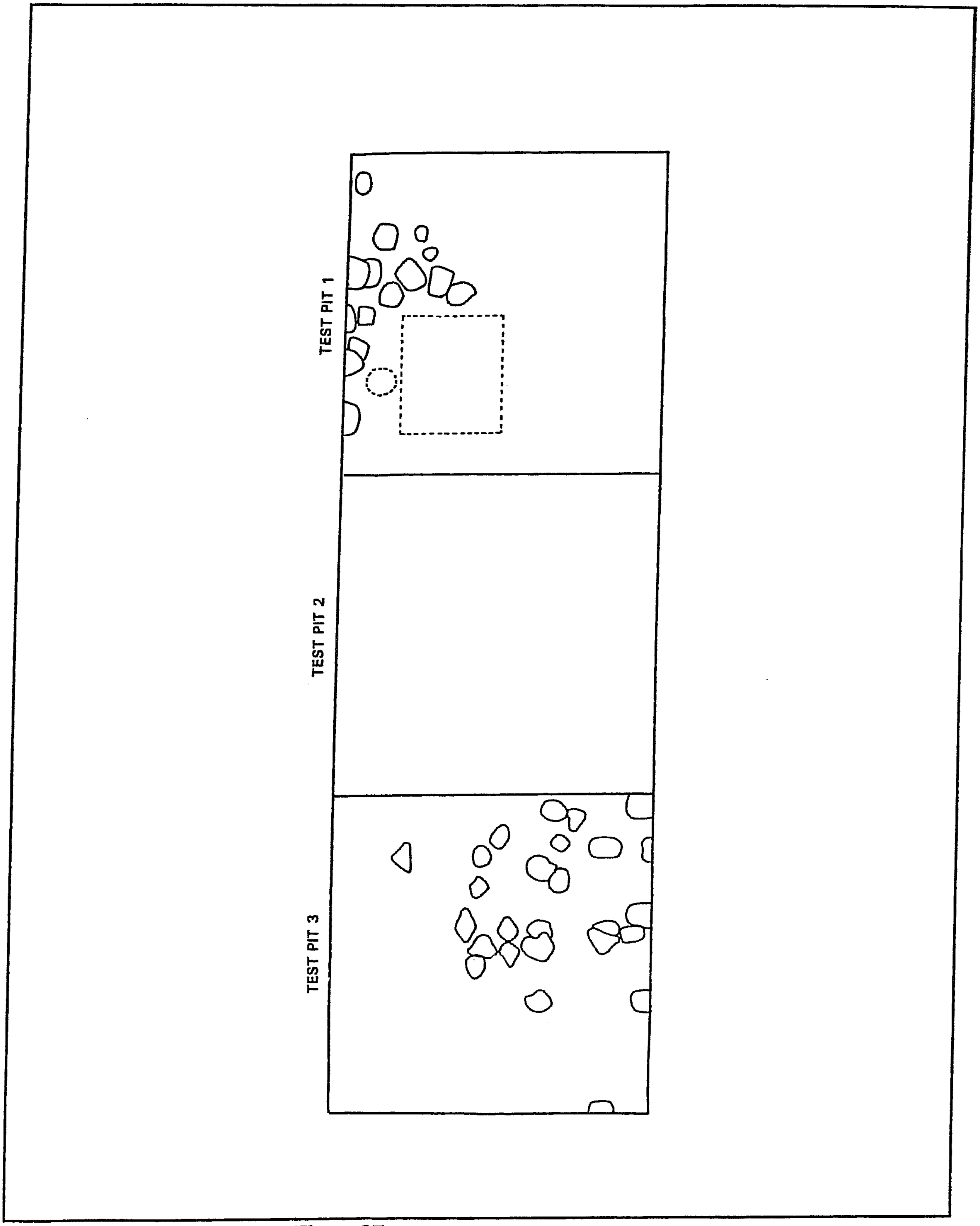

Figure 11.08. Occupation Floor 27.

Figure 11.09. Occupation Floor 27, View East.

just an overnight stay. The area within the dotted lines in Test Pit 1 (see Figure 11.08) was excavated as an arbitrary level with a shovel.

The lithic debris from Test Pit 3 contains the highest count of fire-altered flakes and chips from any of the excavated Paleoindian levels. Three fire spalls, two quite large, and both aquatic and terrestrial snails are present. The somewhat dispersed nature of the rocks could indicate a disturbed hearth. Rocks in the two features in Test Pits 1 and 3 are very similar in size and shape. A point of interest: on the level above, in Test Pit 2, a hackberry seed was found.

Occupation Floor 29

An Angostura point was recovered from this Paleoindian floor in Test Pit 1, the unit closest to Williams Creek. The high weight of fire-altered materials would probably mark it as a hearth area. The amount for the weight of fire-altered material is somewhat skewed, however, by the presence of a large (24.5 g) crazed flake. Two chert fragments of moderate size and a piece of charred bone were also found.

Only one burned lithic piece came from Test Pit 2. Test Pit 3 yielded five crazed and potlidded flakes and chips and ten fragments of bone, four charred.

Occupation Floor 31

This Paleoindian floor shows a pronounced difference from the upper levels. It contains (Figure 11.10) a rectangular, or square-shaped feature, which suggests a different cultural pattern. The cultural pattern of this period may have differed from that of later periods, but it is unknown whether this also reflects different subsistence strategies. The rock partially exposed in Test Pit 2 appears to be the result of an intentional disruption of the pattern. This flat rock was possibly removed from the corner of the fireplace and then used as a metate. A large (43.6 g) potlidded chip was present as well as rolled quartz pebbles. The placement of the feature is to the north and no material was recovered from the southwest quadrant.

Notations made on Test Pit 1 indicate that large pieces of flat rock were present at the bottom of the level, perhaps indicating the presence of associated hearthstones. Two very large fire spalls and one piece of charred bone were recovered.

Occupation Floor 33

An Andice-like tip in Test Pit 1 was recovered from Occupation Floor 33. The weight of burned bone, with fire spalls eliminated, now exceeds that of the remaining lithic material. Almost 4 g of bone came from Test Pit 3 alone. The scarcity of lithic materials suggests a short stay at the site, probably just a visit to exploit the faunal resources of Moccasin Confluence.

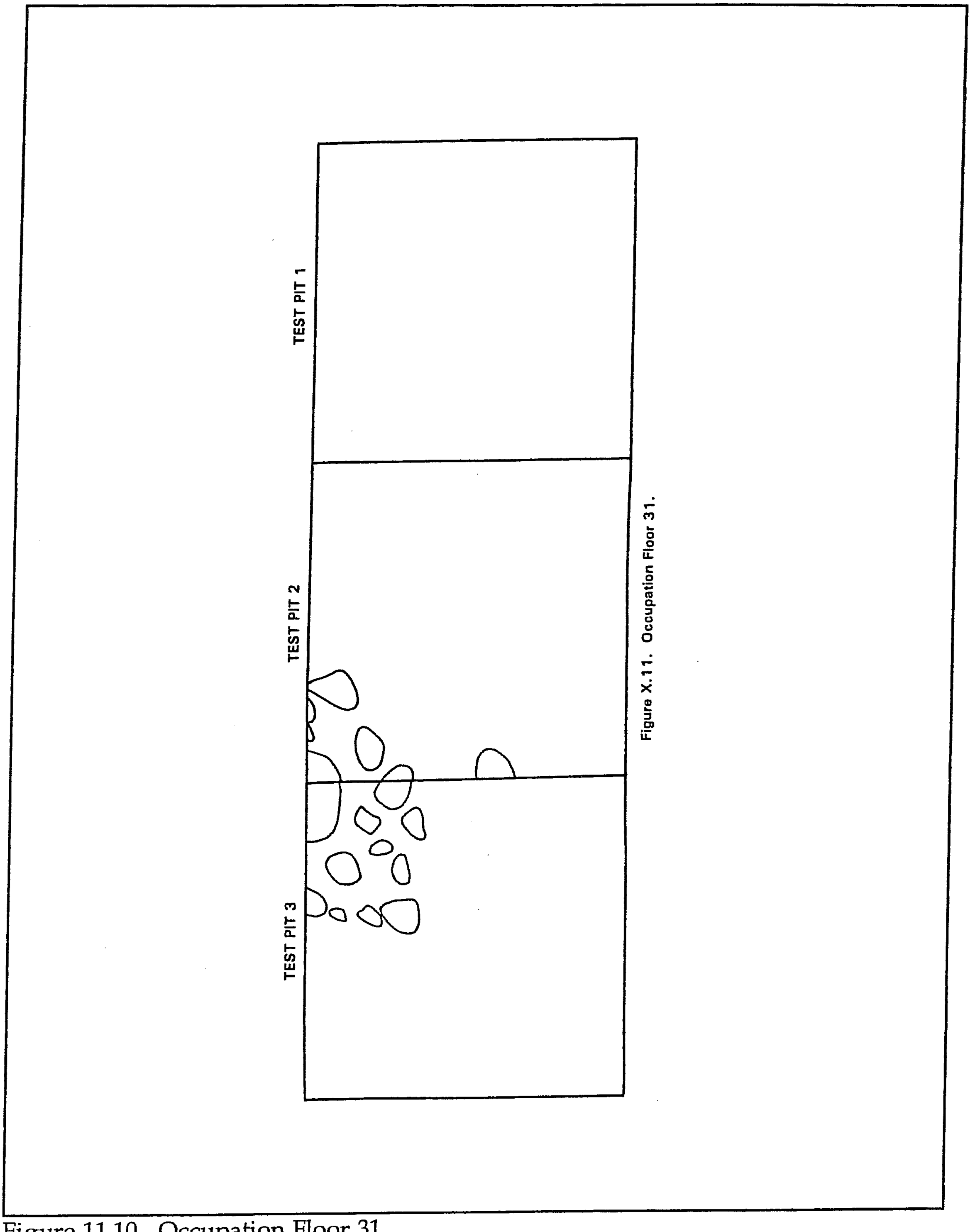

Figure 11.10. Occupation Floor 31.

Occupation Floor 36

A possible Paleoindian point fragment was recovered from Test Pit 2, as were terminal tool fragments. The point fragment was a medial section, heavily patinated and, was located in the southwest quadrant with a trimmed flake. Notations from the field indicate the presence of burned rock. Charred bone was noted below the point fragment. This would suggest the presence of a hearth. Test Pit 1 yielded a single potlid. Test Pit 3 was not excavated down to this level.

DISCUSSION

The circular patterns of rock noted on midden floors appears repeatedly. Gunn (1977b:223) stated that a systematic hypothesis of midden structure would aid in delineating their functional character. It is suggested that the rock patterning observed at Moccasin Confluence could be such a structure, and could serve as a generalizable interpretive devise.

The patterns of repeated, interconnecting circles seen in the photographs (Figures. 11.01 and 11.04) of the midden floors were suggested to be the product of multiple and simultaneous activities, and also to be the result of a specific function, that of stone boiling. The observations from the limited area opened in the 1982 excavations relative to the size of the site is suggestive as a glimpse of the scope of such activity. As an hypothesis we propose the mass processing of an indigenous resource such as that frequently reported in the ethnographic record.

In addition to the discussion of acorn utilization by Kroeber (1932), mentioned in the early paragraphs of this chapter, a look at historical observations of acorn utilization also provide some interesting insights into the presumed aboriginal subsistence patterns at Moccasin Confluence.

The acorn has been used almost universally for sustenance. Spatially, the utilization of this resource in the Old World extended from Iberia in the West to New Guinea in the east (Gifford 1936). In the New World, at the time of European contact, acorns formed a substantial part of the diet of Indians from California to the Eastern Woodlands.

Ethnographic reports point to the widespread practice of boiling acorns to remove the tannic acid, before final processing. In the eastern woodlands Gifford (1936) reports that boiling of whole acorns was the common method of leaching. In some areas in California the acorns were first ground, and then the meal was boiled in a basket by the stone boiling method.

To the native Indians of California, the acorn was the staff of life (Merriam 1918). Of high nutritive value, and often the principal component of the diet, the effect of the acorn as a staple food is attested to by a population of over 300,000 individuals at the time of European contact.

The acorn also played an important role in the subsistence patterns of the Iroquois, the Algonquins, and the Hurons in the eastern woodlands (Merriam 1918). Although, "their former employment remains only a memory," the Iroquois use of acorns was recorded by Parker (1910). They would boil the acorns in wood ash (lye) as a means to leach the bitter tannic acid and render the acorns palatable. The nuts were then roasted and ground and, after several washings, cooked with meat to make a soup or pudding. The fact that acorns have been found in Hopewellian mounds and refuse pits (Streuver 1962) shows something of the age of the custom.

Merriam's (1918) observation of a ceremony for the dead points to the abundance and importance, of the acorn. He reports two cooking and five leaching places in active operation for several days. He counted 50 baskets, containing one to two bushels each, of freshly cooked acorn mush, and at least 50 loaves of acorn bread. He also reports the use of acorns for bread and oil by the Algonquins in the east. A Jesuit account of buying 500 bushels of acorns from an Algonquin tribe illustrates the abundance and importance of the acorn to these people. Also noted was the establishment of acorn camps, to which the groups returned each season.

Newcomb (1961) cites usage by such Texas tribes as the Comanche, the Tonkawa, the Caddo and the Bidais. The possibility of such occurrences during the prehistoric period are almost certain in the central Texas region at the time of the ubiquitous burned rock middens. The system of rock patterning observed on the midden floors at Moccasin Confluence may reflect activities associated with boiling and/or leaching in baskets, skins, or trays. The location is near oak groves (see chapter 5) and water, the two essential ingredients. The midden exhibits a large quantity of burned rock, and the association of acorn processing and the development of these middens is logical.

In addition to ethnographic support for the acorn hypothesis, archaeologists have pointed out further logical support from prehistoric sites themselves. Hester (1973) notes the proximity of major sites to oak groves. Weir (1976) and Turner (1977a) have associated the presence of middens with acorn utilization for various reasons. The presence of deer bone, which subsist in part on acorns, further supports this conclusion.

Presumably, then, communal gatherings were held to process large crops of acorns in the fall. Women and children might have collected acorns on the ground, and the men often reportedly assisted in obtaining acorns by climbing trees (Driver 1961). Skins or waterproof baskets were on or inside the rock features. Large amounts of limestone rocks were being heated nearby to be used as boiling stones or possibly leaching agents, as suggested by Turner (1977a). Sodium ash could also be used to leach the tannic acid from the acorns to make them more palatable (Driver 1961). The skins or baskets were filled with water from the nearby creek, and then the acorns were placed in the water. Boiling stones and a leaching agent (possibly the same, Turner 1977a) were added. The acorns were simultaneously cooked and leached of their tannic acid. The limestone rocks were then discarded, and an accumulation of these could create an aboriginal dump as suggested by Hester (1971). The dense midden structure around Test Pit 4 at Moccasin Confluence might represent just such a "dump." The procedure described above would have been repeated until the entire crop was processed.

CONCLUSIONS

Two distinctive periods of rock use are apparent in the Moccasin Confluence levels. The first is associated with the midden. The midden floors date from the Late Archaic to the later phases of the Early Archaic. Amounts of lithic artifacts are high, as is the proportion of crazed and potlidded chips to those not fire altered. Information from visual observation is interpreted in relation to possible subsistence patterns. Evidence from spatial patterning, observations noted, and artifacts collected indicate reliance on some sort of plant resource, which we suggest to be acorns. The utilization of faunal resources seems centered on the exploitation of white- tailed deer, based on the assemblage of bone recovered. Gunn (1983a) and Weir (1976) propose a model relating the moist period, the Colorado subpluvial (chapter 5) when these middens were under development, to the movement of people from the east following the encroachment of oak woodlands.

An older pattern appears on Occupation Floor 12, the end of the Early Archaic. The indications of the presence of large herbivores (bison), the introduction of different diagnostic artifacts, and a difference in the spatial ordering and consistency of rock size probably indicates a different character of the local and regional biotic system, as well as a cultural change.

No clear pattern emerges through the remaining Early Archaic period. Lithic material is much less evident. There is still evidence of hearths, although analysis of more floors is needed to deduce the overriding patterns for this period.

Occupation Floor 25 begins the Paleoindian occupation. The amount of lithic materials drops sharply when compared to later periods. The percentage of burned pieces is high relative to the totals, and rocks mapped are large. A very distinctive pattern, the square hearth, appears on Occupation Floor 31. Diagnostics suggest a Plains influence on these Paleoindian floors. Throughout the floors was a consistently high proportion of burned chips to crazed and potlidded flakes.

In conclusion, influence from the east and west is evident. Prehistoric peoples from both areas followed the shifting ecotone to arrive at the Moccasin Confluence area. A reliance on the local fauna was noted, and a possible dependence on acorns for subsistence was suggested. Further intensive recovery of micro and macro faunal and floral remains are needed to confirm the specific character of the activities being performed at the site as suggested by this preliminary analysis.

CHAPTER 12—SETTLEMENT PATTERNS IN THE LOWER FREDERICKSBURG BASIN (Gunn)

INTRODUCTION

With the exception of the 1976 excavation season at Hop Hill, efforts during succeeding periods of the project have included a focus on understanding the settlement pattern in the LBJ State Historical Park and the surrounding area. In 1978 a survey was made along a 20 km (13 mile) strip south of the Pedernales River. The strip extends from the river to the uplands toward the south. The study area was centered on the park and, through questioning of residents, 13 sites in the area neighboring the park were located. In 1982 all of the sites in the park east of Hop Hill were tested. Both of these exercises contributed to what is now understood about the arrangement and distribution of archaeological sites within the park and the park vicinity. Limited inferences can be made about the functional relationship between sites in the park and those in the park environs, using the location and content of these sites. This chapter reports on these findings. The results can be taken as ideas for further testing during future work in the Fredericksburg area at large. This chapter also focuses on, and makes use of, much of the research reported in previous chapters.

PHYSIOGRAPHY OF THE PARK ENVIRON

Figure 12.01 is a map of the Pedernales River, a tributary of the Colorado River. Fredericksburg, Texas, in the western portion of the valley, is the largest town in the valley and as of 1980 incorporated a population of 5536 persons. Johnson City at the east end of the valley has 932 inhabitants. Fredericksburg was settled in 1846 by German emigrants and is notable for peaceful relations with the Comanches. Johnson City was established later by Anglo settlers and is the town in which Lyndon B. Johnson was educated. The LBJ Ranch is between the two towns near the community of Stonewall, and on the north side of the river. The Lyndon B. Johnson State Historical Park is opposite the ranch on the south side of the river. Williams Creek marks the eastern end of the park. The study area was selected to center on the park and extends from Rocky Creek in the east and South Grape Creek in the west. The study area is between the towns of Rocky Creek, and Luckenbach, Texas.

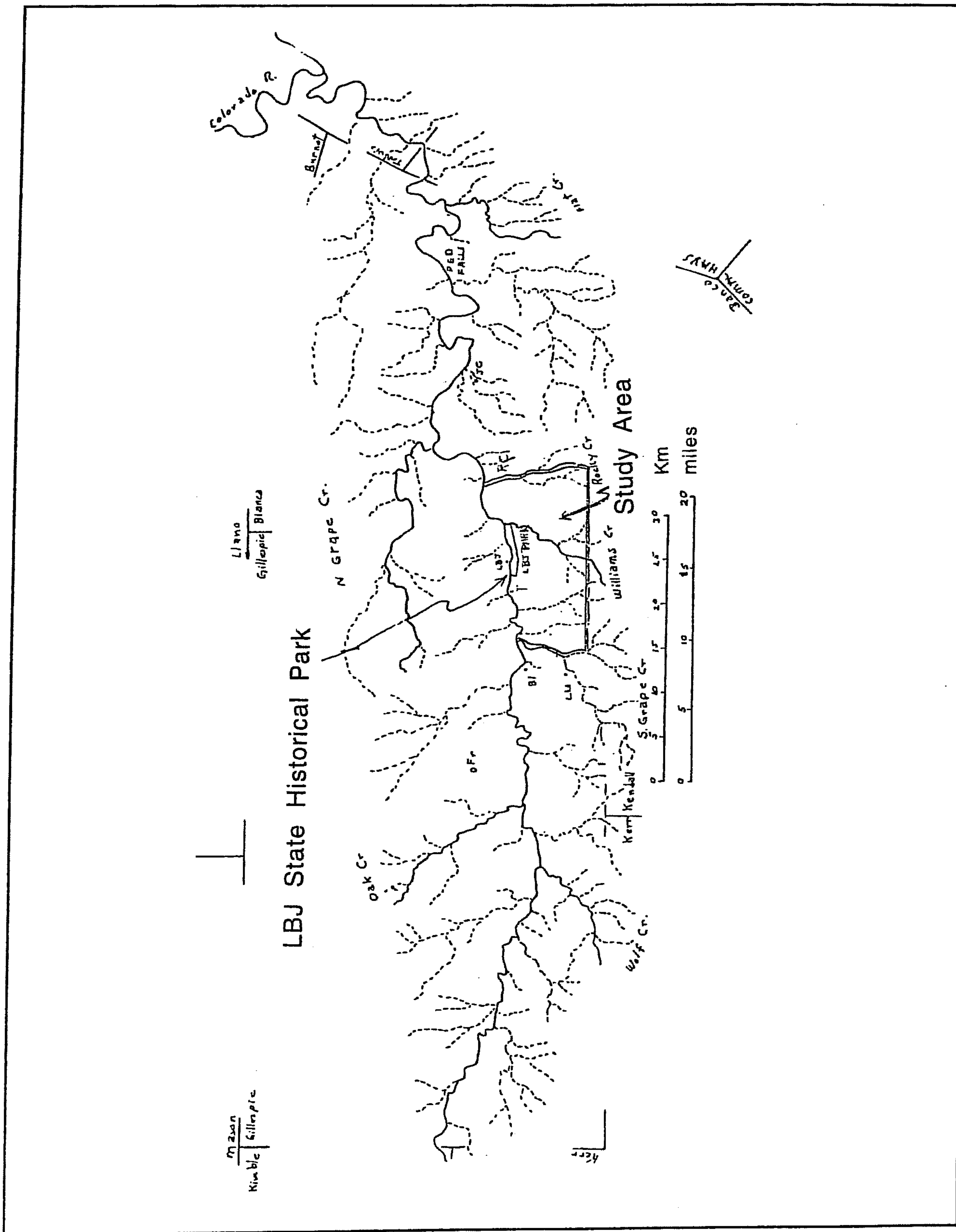

Figure 12.01. Pedernales River Valley.

A remnant of resistant Pre-Cambrian rock extends from the Central Mineral Region of Texas south to the Pedernales River between Rocky Creek and Johnson City (Renfro, Feray, and King 1973, see geology in chapter 5). This creates an upland and a choke between Rocky Creek and Johnson City that gives the upper Pedernales Valley its basin shape. The Fredericksburg basin is a rich agricultural region. It is particularly noted for the excellent quality of its peaches, a commodity for which Stonewall is famous. Residents attribute the quality of the peaches to the minerals contributed by the central mineral region which the Pedernales River, in part, drains.

In the east at Rocky Creek the elevation is 1300 feet above mean sea level (amsl). At Grape Creek the elevation is 1460 feet amsl, a gradient of 12 feet per mile. Above the floodplain to the south the countryside rises to about 1500-1600 feet amsl (Figure 12.02). The highest point in the study area is 1831 feet on the Mayer property. We were privileged to visit this place in the company of Mr. and Mrs. Mayer, and it affords a spectacular view of the entire study area as well as evidence of prehistoric occupation.

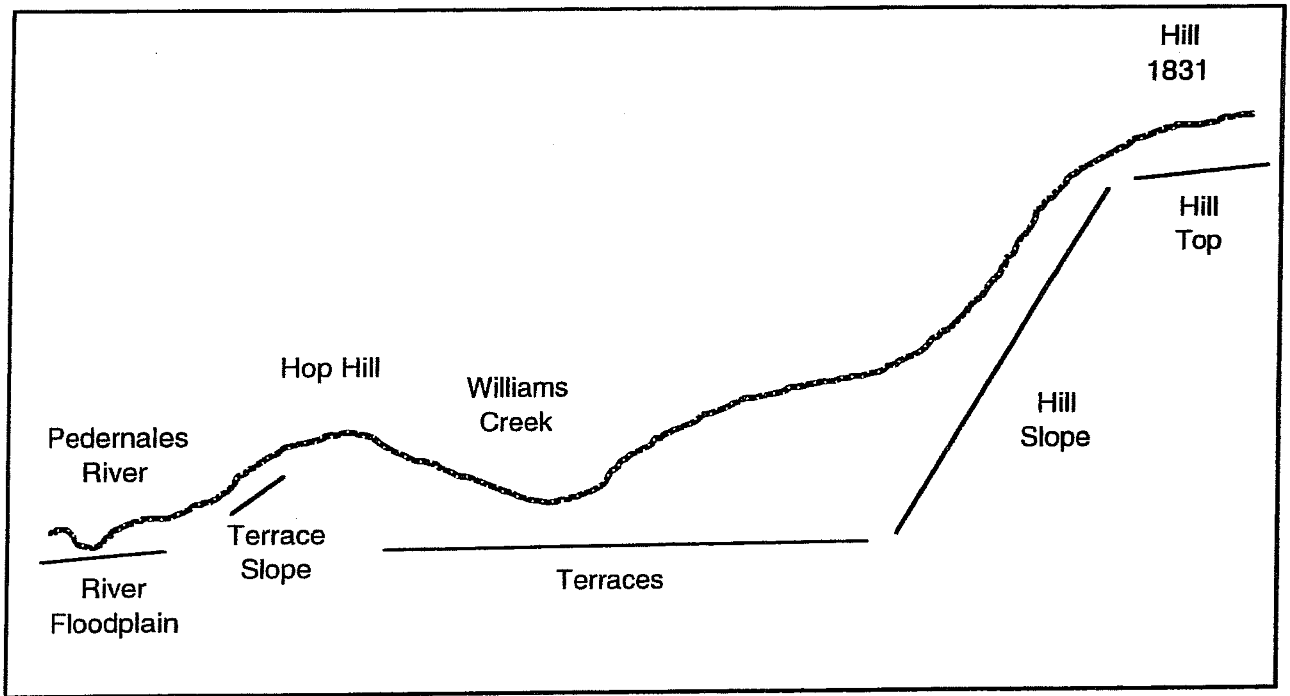

Figure 12.02. Transect of the Study Area, Hop Hill to Hill 1831.

Occasional low spots or swamps are found in the lower terraces and floodplain. In dry years they are farmed. In wetter years they fill with water and provide habitat for migratory birds.

Geomorphic Observations

A few observations can be added to those made by Brown in chapter 5 on the geomorphology of the study area. The river floodplain deposits appear to be underlain by a gravel bed as can be observed near the Grape Creek Highway 290 bridge. The gravels are covered by up to three meters of alluvial sediments and soils. An erosional incision near the park headquarters shows this very well. The terraces are overlain by a red soil, the Luckenbach-Pedernales- Heatly Association (Figure 12.03) under which is generally a caliche zone or limestone bedrock. This applies to everything from the terrace margin (see Figure 12.02) immediately adjacent to the river, as at Hop Hill, to the break in topography at the hill slope. Modern land use consists of farming the sandy loams of the river floodplain and lower terraces. Grain crops are grown in the higher terraces. The bulk of the terraces and hills are grazing land.

Hydrologic Observations

The year 1978, when the environs were surveyed, was very dry. One person reported that up to the time of the survey (late June) they receive 30 inches of rain in good years. That year there were only 6 inches of rain by June. The archaeological crews lost no days to rain during the summer. Creeks that normally flow through the summer were reduced to holes of standing water and one individual thought the Pedernales River would stop flowing by mid July at the study area. Mr. Althaus, who showed us his land immediately upstream from Johnson City, indicated that a spring in the Pedernales River water course on his property never ceases to flow; it becomes the headwaters of the Pedernales River during dry years. This suggests that the area upstream from Johnson City, i.e., the Stonewall area, may be a particularly sensitive area to moist and dry conditions since anyone living there in prehistoric dry intervals would have had limited, if any, access to water. (Before the 1952 flood, which scoured out much of the valley, there was a mound near the Althaus spring that contained Paleoindian points.)

Springs at the heads of Rocky Creek, Williams Creek, Three Mile Creek, and South Grape Creek infrequently cease to flow; so they are also indicators of aridity of the climate. F. Mayer, who lives at the head of Williams Creek, has reopened the springs on his place with a bulldozer and found that even in dry years there is plenty of subsurface water. G. Lindig reports that the now dry gullies east and west of Hop Hill (41 GL 21) in the park flowed most of the year up to the 1920s. Now only the one to the east flows and only in moist years. Lindig's grandfather settled the land in the 1850s.

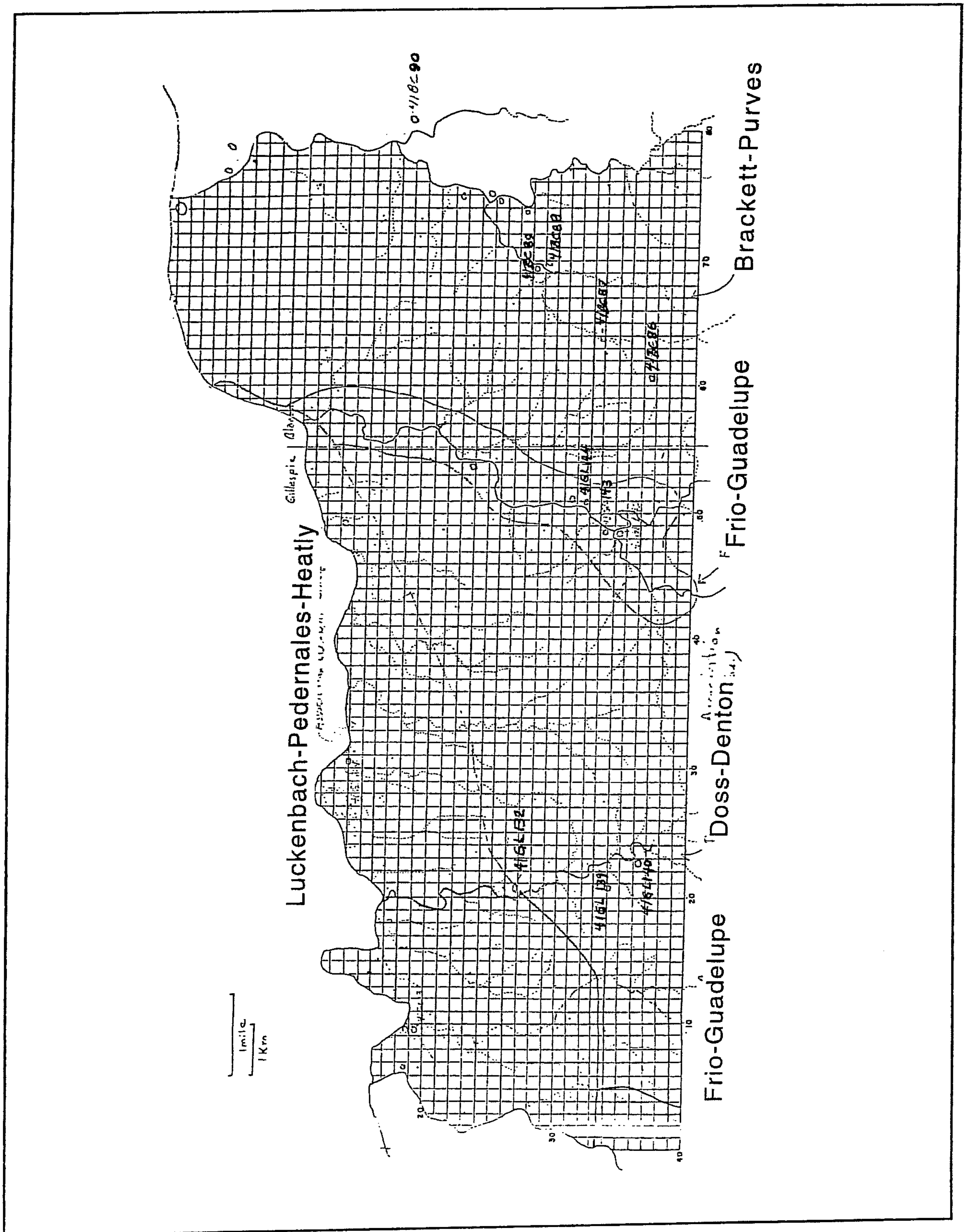

Figure 12.03. Study Area Soil Associations.

Vegetation

The present-day vegetation is generally composed of live oak and mesquite which appears in decreasing frequency all the way to the hill tops. Several residents reported that about 100 years ago there was only grass outside the floodplains of permanent streams. Vegetation along the Pedernales River tributaries was dominated by hackberry and elm. Hickory groves were reported close to the river.

Whitworth reported that his grandfather burned off some part of his land each year, perhaps half, as a pest control measure. Burning off the land reduced the tick and locust problems in that and subsequent years. An additional effect was to reduce the brush and tree vegetation.

We have not determined if the Indian populations of the area burned off land during proto- and prehistoric times. The Comanches only occupied the area briefly before the coming of the Germans, from perhaps the latter decades of the 1700s (John 1975; Gunn and Frkuska 1982). Comanches were not friendly with the Apaches or Tonkawas they were displacing, so it is unlikely they would have acquired and passed on their customs. However, the Germans were quite well acquainted with the Comanches, exchanging treaties and goods with them (Turner 1977b). It would be interesting to know if the land burning technology was developed by the settlers or passed from the natives and, therefore, a custom of long standing. The earliest German settlers were not farmers by trade. They had left Europe because of upheaval over religious beliefs, and were also isolated from other European settlements in Texas until about 1849, the beginning of the gold rush. The German settlers were, therefore, inclined to adopt whatever was useful from the Indian culture.

F. Merz, a lifelong resident of the Williams Creek area, reported that watercress grew in that stream early in the 1920s, but since then the grazing of sheep, which eat the watercress, has reduced its frequency.

Wildlife

The tributaries of the Pedernales River in the Stonewall area are not polluted by modern economic activities except that there is an increase of sediment load from farming activities. This seems to have started in 1917 in the terraces, and the effects are evident in the upper levels of Test Pits 1, 2, and 3 at Moccasin Confluence. Nevertheless, all of the streams we observed contained fish, catfish, perch, bass, and sucker. These were observed far up into the hill slopes.

Cottontail rabbit and jackrabbit, red squirrel, armadillo, raccoon, and fox were observed by the survey crews. Various kinds of small rodents, snakes, and lizards were also seen in numbers. Some of the hilltops have rattlesnake dens that are visited on occasion by the residents.

Wild turkey, buzzards, various hawks, kill-dee, cardinals, mockingbirds, etc., were present, and migratory ducks were mentioned by the residents.

White-tailed deer are present throughout the study area. They are seen much more frequently in the more rugged terrain of the Rocky Creek drainage in the eastern part of the study zone, the uplift of Pre-Cambrian rock. G. Lindig (a third-generation resident of the area) says there were no deer in the 1930s and corn could be grown then. The deer have become so numerous since that it is difficult or impossible to grow corn. There is money to be made from deer leases.

The 1982 field season was the third in a series of moist summers. The quantities of wildlife, particularly deer, rabbits, and armadillos appear to have increased by about fourfold on the strength of two moist summers. This can be taken as indicative of the significant responsiveness of wildlife to environmental conditions.

SURVEY METHODOLOGY

In 1978 an informant survey was conducted in the park environ by students of The University of Texas at San Antonio, Summer Field Course in Archaeology. Informants, usually land owners, were sought by driving the roads in the study area and visiting the farm and ranch houses wherever they were encountered. The amount of area sampled depended on who was at home when the surveyors drove by. However, residents were generally very cooperative and in some cases, when they were missed, they sought us out to report on sites. The areas for which owners were found are mapped on Figure 12.04. Thirty-nine percent of the 250 m^2 squares in the study area received coverage in this manner. Various forms were filled out for each informant and site reported. The locations, which at present qualify as sites, were reported to Texas Archeological Research Laboratory in Austin and assigned state numbers. Table 12.01 lists the sites, that were assigned the names of the land owners, the drainage, physiographic context, elevation, and the most characteristic artifacts of each site. The sites are ordered from the Pedernales River by drainage.

PRESENT DAY SETTLEMENT PATTERN

The floodplain of the Pedernales River is very wide toward the west and narrows considerably toward the east. Within the floodplain, farmers grow peaches, cotton, sorghum, corn, etc., on plots of ground from a few acres to hundreds of acres. Residents of Stonewall pride themselves on living in the peach growing capital of Texas and hold an annual Peach Jamboree and Rodeo in honor of peach growing. At progressively higher altitudes the uplands are dominated by larger and larger ranches ranging up to 2000-3000 acres. Cattle, sheep, and goats are raised. Also, lands are leased to deer hunters from adjacent urban areas, a practice that contributes substantially to local incomes.

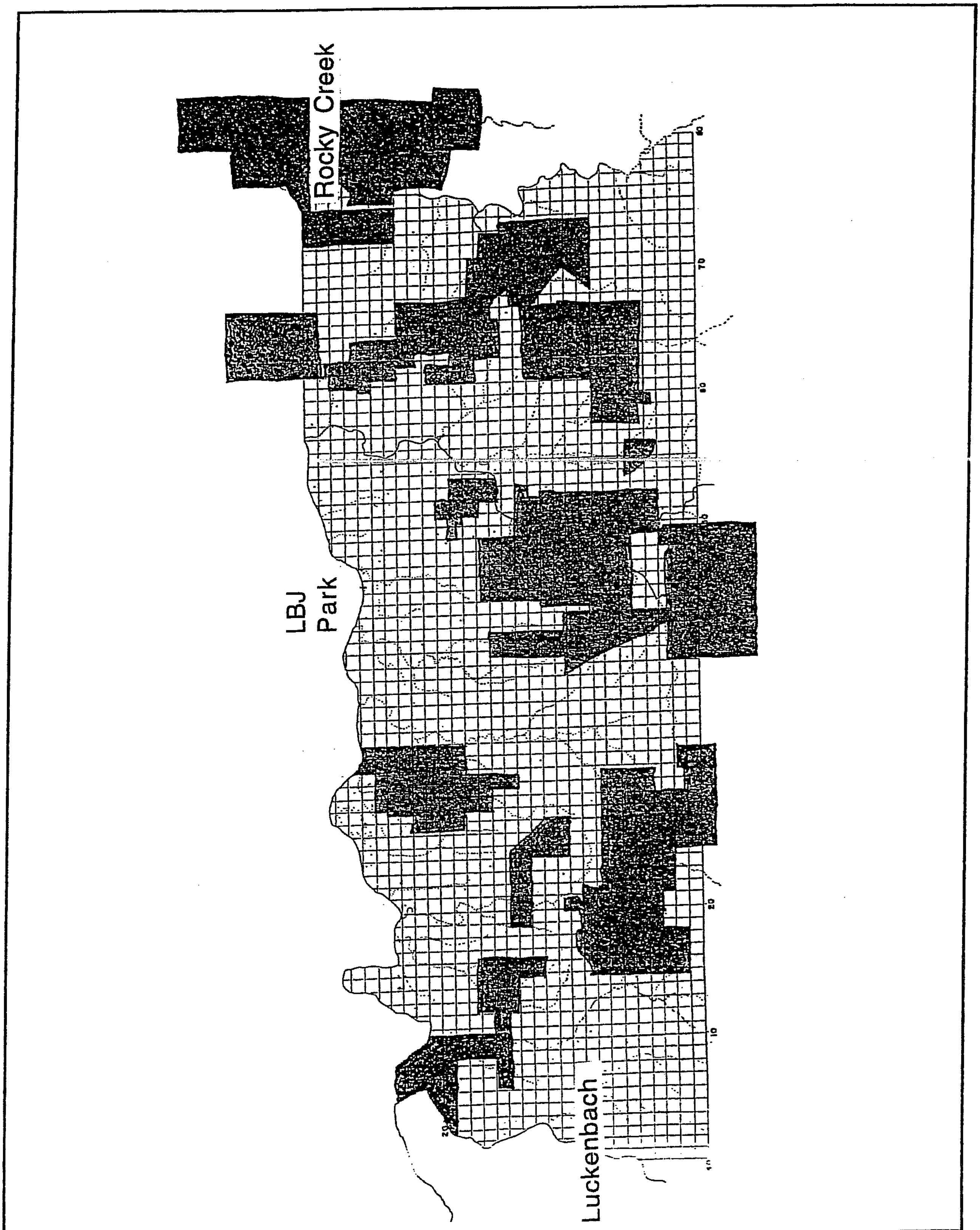

Figure 12.04. Properties on which Landowners were Contacted.

TABLE 12.01. SITES REPORTED BY INFORMANTS IN THE PARK AREA

Site Name	State Number	Artifacts	Elevation	Physiography
Rocky Creek				
W. Lindig	41 BC 90	burned rock	1380	terrace, small bluff over creek
Lange #1	41 BC 89	burned rock	1460	terrace, West rock Fork floodplain
Lange #2	41 BC 88	points	1490	terrace, foot of hill slope
Mayer #2	41 BC 87	flakes	1560	hill slope valley, narrow
Mayer #1	41 BC 86	flakes	1831	hill top, highest in study area
Williams Creek				
Moccasin Confluence	41 BC 71	burned rock	1380	alluvial, confluence with Pedernales River
-----	41 BC 63	burned rock	1380	alluvial, confluence with Pedernales River
Basse	41 GL 144	burned rock	1460	terrace, Williams Creek floodplain
Merz #2	41 GL 143	cores	1460	terrace, Williams Creek floodplain, confluence
Merz #1	41 GL 142	manos	1480	terrace, foot of hill slope
Three Mile Creek				
Weinheimer	41 GL 138	burned rock	1500	terrace, edge of farmlands
Kusenberger #1	41 GL 139	burned rock	1580	terrace, foot of hill slope
Kusenberger #2	41 GL 140	burned rock	1560	hill slope valley, wide
Pedernales River				
Moccasin Confluence	see above			
Hop Hill	41 GL 21	choppers	1430	terrace margin
Burg	41 GL 141	choppers	1450	floodplain
Pickett	41 GL 137	choppers	1480	terrace margin

The Williams Creek floodplain provides an avenue for agriculture leading away from the Pedernales River. Its rich and mature floodplain allows the practice of farming up to the town of Albert which is on the southern margin of the study zone. The farming is associated with the Frio-Guadalupe soil association (see Figure 12.03).

Collectors in the Study Area

Usually residents of the study area are interested in "arrowheads" or points and collect them from their own land. This occurs usually after plowing and rains. J. Porter reported that the best time for finding points on unplowed land is at the end of the winter before the grass begins to grow. Residents consistently reported that points were found regularly up to about 20 years ago. After that time they become much harder to find. Once a serious interest in collecting developed, surface finds disappeared rapidly. This reflects the thinness of the terrace soils over the bedrock and the consequent shallowness of the sites.

Several collectors allowed us to look at collections from their property and in some cases outlines of points were made. Ida Feldstead has lived in the vicinity of the Hye Post Office (eastern sector of the study area) all of her life (83 years as of 1978) and has collected points off the floodplain for about 45 years. Her collections are mostly from east of Stonewall and in the Pedernales River floodplain. She has about 2000 points, some of which were collected in other parts of the United States.

Warren Smith does not live in the study area. However, he dug a site on the W. Lindig property and retains most of the collection labeled with an "L" for Lindig.

Collectors and Prehistoric Occupation Density

Aside from knowing the location of sites on their own land, land-owners usually are aware of the best places to collect in the area. People in the study area generally recognize a site on the F. Merz property as the best place to collect. Apparently the same rich soils that attract modern farmers to settle away from the Pedernales River along Williams Creek also attracted prehistoric interest. The Hop Hill locality is also widely recognized. As mentioned above, I. Feldstead collected near Hye, Texas, and W. Smith in the Rocky Creek area. We were not able to locate any collectors who frequented the area west of Stonewall in the Three Mile and Grape Creek drainages. Our surveying seemed to confirm a lack of significant sites. However, the pattern has to be qualified with one observation. C. Weinheimer never found a point on his place in the Three Mile Creek drainage west of Stonewall until a few years ago when he had a water reservoir constructed. In the construction process a substantial site was unearthed. Victor Nixon from Fredericksburg reported heavy collecting of artifacts from about Blumenthal (west of the study zone, Figure 12.01) to Harper (west of Fredericksburg).

J. Ohlenburg (District Conservationist, Fredericksburg) has worked all over west Texas and thinks that the concentration of artifacts in the Fredericksburg area is greater than any he has seen elsewhere.

The pattern of occupation as seen from collector's eyes, then, is one of intense occupation around Fredericksburg and the Williams-Rocky Creek areas with little between the two concentrations. In the intervening area are Three Mile and Grape Creeks that are low lying and may have been unattractive for more permanent occupation for that reason, or the sites may be buried under the floodplains.

Prehistoric and Modern Occupation Density

One very interesting fact came out of the survey interviews. Persons occupying terrace land for the purpose of subsistence in areas in which sites occurred frequently showed us at least two sites on their property. This includes people who were very helpful and willing to spend any amount of time showing us around. Those who did not, often spoke of minor or destroyed sites. It is likely that prehistoric sites occur in a ratio of 2:1 to modern property holdings. The reason for this relationship must have something to do with the amount of land present-day property owners acquire along streams, since most sites occur along semipermanent tributaries. Also, when the great variation in the size of farms and ranches in the study zone is considered, it suggests that the frequency of sites on properties is related to carrying capacity in the same way that modern economy dictates the distribution and size of farms and ranches.

At this time I can offer no explanation for the concentration of sites around Fredericksburg. It should be made a matter of study. However, the attraction to the lower basin around Williams and Rocky Creek may have been the convergence of the river with the Pre-Cambrian uplands. This convergence produced a profusion of habitats in a narrow space, all of which was well watered during moist climatic episodes. As is typical the world over, a variety of resources next to water attracts human occupation. Since the area is above the only permanent spring at Johnson City, however, it must have been occupied by relatively sedentary people on a periodic basis depending on climate.

SETTLEMENT PATTERN AND SITE FUNCTION IN THE PARK AND ITS ENVIRONS

The settlement pattern in the park is known in great detail because of surveys performed by the Texas Parks and Wildlife Department in 1975 and 1977 (reported in the previous research sections of chapter 2), and testing of all of the sites found in the eastern half of the park during 1982 are reported in previous chapters. Moccasin Confluence at the juncture of Williams Creek and the Pedernales River has all the marks of long-term occupation by many cultures. The intensity of occupation indicates base camp or semipermanent status. During the Late Archaic this intensity of occupation was supplemented by an even more intense occupation of Hop Hill, a probable bison overlook site. Various other sites in the terrace margin and terrace slopes near Moccasin Confluence appear to be lithic workshop stations, based on the appearance of the lithics. An occasional piece of ground stone indicates other activities, as do occasional chopping tools.

Characteristic tools from the sites in the park environ likewise suggest some possible site functions. Choppers were found in great numbers at Hop Hill (Gunn and Ivey 1977), and the sites revealed by the survey along the Pedernales River (see Table 12.01) are reported to be characterized by bifaces and choppers. The heavy nature of the choppers suggests that they were being used to work wood in the riparian zone. Sites in the terraces typically contain middens of burned rock. Current wisdom associates middens with nut and deer processing, a not unreasonable, but yet to be substantiated, inference. However, as Larson (1980) points out, deer are most frequent at the edge of the riparian zone as are the most productive oaks and hickories. It is therefore likely that if the middens were being used for deer and nuts, they would be located just where they were located.

Perhaps the most interesting site, with respect to function, is the Merz #1 site (41 GL 142 shown on Figure 12.C4). F. Merz reports that he has collected a bucketful of manos (and metates) from the field every year since it was first plowed in 1917. He has fenced his yard with these manos and metates. The site is located at the break in topography between the terraces and the hill slopes. Presumably the hills would always have been more prone to grassy vegetation than the rest of the topographic features in the basin. Indians observed ethnohistorically in the western United States typically awaited the coming of may/ricegrass seed in the late spring with great interest since they were usually running short of food and the maygrass was the second most important edible plant product after pine nuts (Thomas 1973:164; Steward 1938:104). Harvest sometimes began as early as May (Steward 1938:96). Since the manos appear in such great profusion at a well-watered place at the juncture of the lowlands and highlands, it is likely that they were there for some sort of grass or weed-related seed collecting, perhaps the maygrass. At 41 GL 142 such seed processing was carried out in great numbers. Manos and metates appear less frequently in terrace and floodplain sites. One metate seems to be the norm.

From the information collected from within and without the park, a seasonal round of activities can be inferred for the prehistoric inhabitants of the park. They would have preferred to live at Moccasin Confluence most of the time. However, they would have retired up Williams Creek in the spring to collect and process seeds into cakes, perhaps storing enough flour or cakes to last the year. The later summer would have involved maturing native fruits, berries, and wild vegetables. In the fall they would have worked the middle ground between the hills and river for nuts and deer. All parts of the year they would have supplemented their diet with small game, root crops, cactus, etc.

As yet we know little about the time structure of these activities. Widespread burned rock middens in the study area suggest that between 2000- 3000 years ago the year-round activities would most have resembled those outlined in the previous paragraph. During the Paleoindian period about 10,000 years ago and in the last 1000 years those activities would have been supplemented or replaced by big game hunting, bison in most cases. Further research in the sites away from the river would be necessary to discover times when the differing approaches to diet and survival were taken.

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APPENDIX A—ANALYSIS OF FAUNAL MATERIAL (Hafernik, Gunn, Kerr)

In general, one does not expect open sites to be conducive to the preservation of bone, and therefore not expect to recover great quantities of bone from an open site such as Moccasin Confluence. However, the test excavations did recover a modest amount of bone. Although not substantial, the bones do permit a preliminary assessment of subsistence practices of the prehistoric inhabitants of the site. This assessment will be a valuable guide to future excavations and analysis. While few conclusions can be drawn because of the minimal size of the sample, a few observations can be made with respect to the existing literature on man-fauna relationships in the area.

One-hundred sixty pieces of bone were recovered. The fragments were identified, counted, and weighed. Identification was made as to type of animal, and those fragments were counted and recorded by cultural period (Table A-1). Few fragments were identifiable to order, genera and species, although we favor the attitude of the late John Guilday, that all bone is identifiable though to different degrees. Knowing that a bone is of a large or small mammal can be a useful bit of evidence if properly treated.

TABLE A-1. FREQUENCIES OF BONE FRAGMENTS PER PERIOD

	White-tail Deer	Bison	Small Mammal	Reptile	Unid.	Total
Late Archaic	3	1	0	1	32	37
Middle Archaic	4	1	0	0	14	19
Early Archaic	10	1	5	1	44	60
Paleoindian	2	0	1	0	41	44
Total	19	3	6	2	131	161

The total amount of bone from each test unit was weighed to provide an estimate of yield per level. The condition of the bones, types of fracture, and evidence of burning, was noted since such data can shed light on subsistence activities, such as butchering and food preparation practices.

OBSERVATIONS

Test Pit 1-3

Test Pits 1, 2, and 3 form a 1 x 3 m block. Test Pit 1 is the closest to Williams Creek, and Test Pit 3 the farthest. Percentage of bone weights per level for TP 1-3 are illustrated in Figure A-1. The level numbers are for TP 2. The percentage was developed from the level with the highest total weight, level 10 with 69 g. The weight of each level was divided by 69 to arrive at a representative vertical distribution of total weights from all three test pits. The Late Archaic occupies approximately the first 35 cm from the surface. Of the faunal material recovered from these levels very little was identifiable with certainty. A distal end of a right deer tibia was found in Test Pit 3. The tibia had a break 64 mm from the medial malleobis, which resembled a spiral fracture. The weight was 26.4 g. Other fragments, in Test Pit 2, appeared to be from white-tailed deer and small mammals. These showed signs of being subjected to heat. Test Pit 1 produced mostly crushed fragments which prevented positive identification. The bone fragments appeared to be from a medium-sized animal, possibly white- tailed deer.

The Middle Archaic levels (9, 10, 11, 12) contained numerous bone fragments in all three test pits. The fragments could not be positively identified but they were from a long bone and had features resembling those of monopole spiral fractures (Bonnichsen 1973). A portion of the fragments exhibited the fire stages: charred, blued, and calcined. The condition of the bone material suggests burning of refuse rather than preparation of food.

The Early Archaic levels (13 throught 24) produced several identifiable specimens. Test Pit 1 contained two fragments of partial astragalus from white-tailed deer. Also there was a Labyrinthic tooth probably from a white- tailed deer. Test Pit 2 yielded a large fragment of a white-tailed deer vertebra that included a partial spinous process. From this test unit came a possible bison tooth, weighing 3.4 g and measuring 30 mm in length. At this time depth the tooth may be *Bison antiquus* (E. Johnson, personal communication). It showed no signs of having been subjected to heat. Test Pit 3 contained a virtually complete right astragalus and a complete right terminal phalange identified as coming from white-tailed deer. Along with the identifiable bone there were numerous fragments, from all three test units that were crushed and showed signs of having been subjected to heat.

The majority of identifiable fragments from the Paleoindian levels (25 through 36) appear to be from rodents and small mammals. Test Pit 1 produced the distal end of a humerous of a woodrat with an entepicondylar foramen. A large flat bone, possibly a scapula or pelvis, was recovered from Test Pit 2. Test Pit 3 produced only framents that could not be identified. Most of the fragments from all three units showed signs of being subjected to heat.

Test Pit 4

Test Pit 4 was located on a rock midden approximately 42 m northwest of Test Pits 1, 2, and 3. It contained artifacts from the Late Archaic to the Paleoindian period. Bone weights per level are shown in Figure A-1. The bone fragments from the Late Archaic levels (1 through 4) were not identifiable. It is notable, however, that the exterior of the fragments exhibited a darkened color postulated to result from association with the organically stained midden.

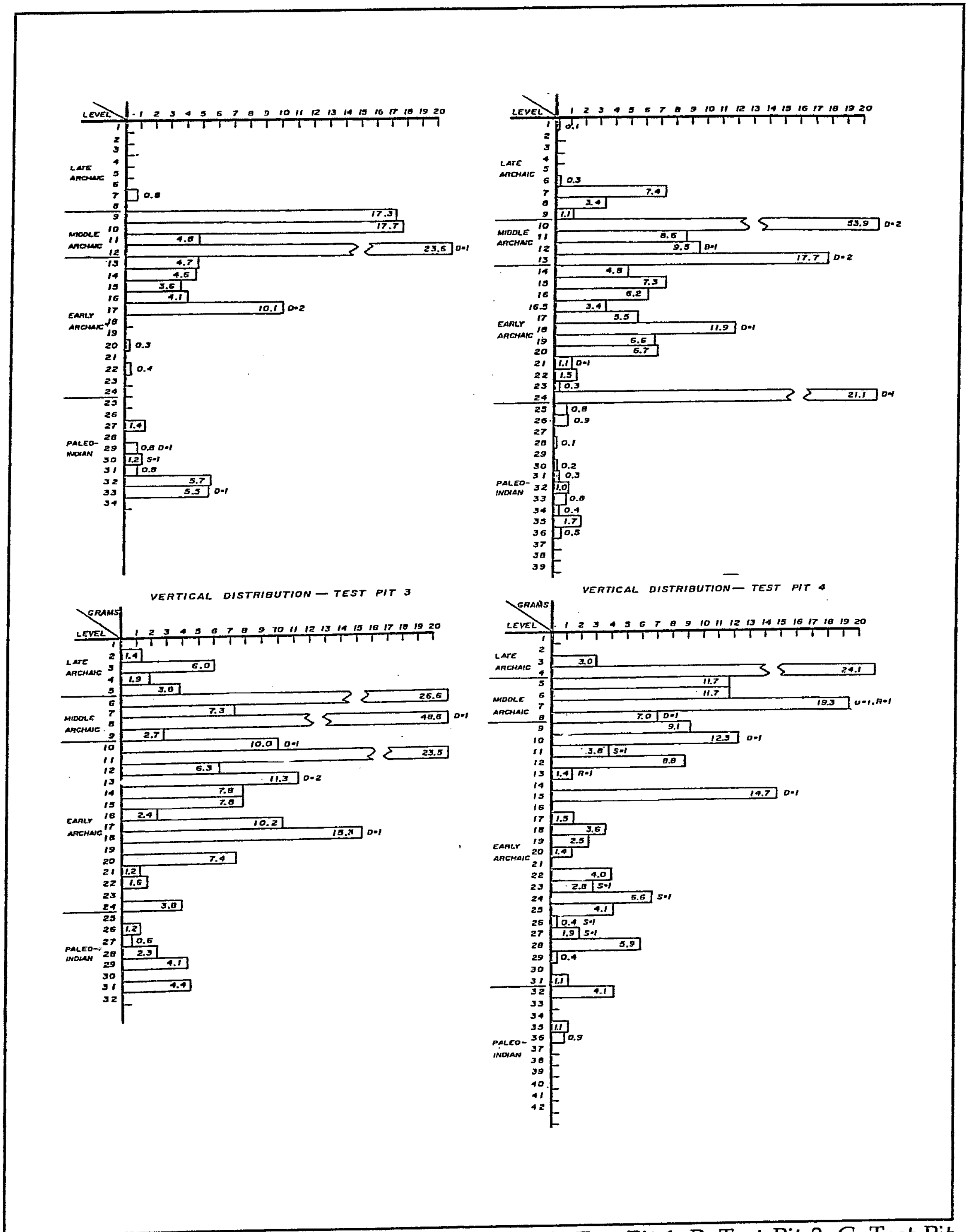

Figure A-1. Vertical Bone Weight Distributions: A. Test Pit 1, B. Test Pit 2, C. Test Pit 3, D. Test Pit 4.

The fragments from the Middle Archaic levels (5 through 8) also appeared darkened due to the midden. Though few of the fragments were identifiable, there were two fragments of a herbivore's tooth, probably a white-tailed deer. Also, found was a femur resembling that of a cotton rat. Some of the bone fragments had been subjected to heat.

The Early Archaic levels (9 through 31) yielded several identifiable bone fragments. There was a proximal end of a right radius probably from a deer, exhibiting a spiral fracture approximately 32 mm from the head. Also recovered was a herbivore tooth, probably white-tailed deer. There were several rodent bones as well that showed minor signs of being subjected to heat. One bone fragment is distinguished by thicker walls which suggest a large animal the size of a bison.

The Paleoindian levels produced only fragments that were unidentifiable. A few of these showed signs of having been heated.

Test Pit 6

Test Pit 6 was located on a knoll across the road from the other test units (Figure 3.01). In this unit the greater weight is concentrated in the Late Archaic levels (1 through 9, Figure A-2). Several fragments were identified as deer bones. First is the proximal end of a right femur that includes the slightly crushed lesser trochanter. It had been broken at the neck and the greater trochanter was missing. The femur was split down the axis. The second fragment is the distal end of a left tibia with a break resembling a spiral fracture approximately 35 mm proximal to the medial malleolus. Third is the distal end of a phalange broken approximately 40 mm from the end. Also recovered was a partial vertebra, primarily the spinous process that included the anterior zygapophyses. In addition, a partial vertebra of a reptile, probably a snake, was recovered. And, perhaps of most interest, the proximal end of a phalange of a bison also came from this test unit.

The Middle Archaic levels (9 through 12) of Test Pit 6 produced only fragments, none of which could be identified. It is significant that none of the skeletal material showed signs of having been burned.

Table A-1 shows the counts of bones that were felt to be securely identified. Probably the most significant observation is that the three bison bones were recovered in the Middle and Late Archaic levels. Qualitatively this supports the hypothesis that the Late Archaic activities were more bison-related (Prewitt 1981). The presense of white-tail deer is continuous through the sequence. A rough correction for the number of levels in each period suggests an emphasis on deer in the Middle and Early Archaic: P=.20, EA=.83, MA=1.00, EA=.38. (The higher the index the greater the emphasis on deer per unit.) Future research should be focused on quantifying this potentially interesting relationship. The interplay of deer and bison is to be expected on the prairie-forest ecotone because of their complementary feeding habits, bison prefering the prairie grasses and deer woodland brouse. That this complementarity can be detected in archaeological sites has been demonstrated by Bryson and Baerreis (cited in Bryson and Murray 1977:31-44).

CONCLUSIONS

The skeletal material recovered, although not substantial of itself, suggests future avenues of research at Moccasin Confluence. Although the site was probably used as a camp by hunting parties, the limited range of skelletal elements indicate it was not used as a butchering site. The problem of preservation is relevant and needs to be dealt with in future research.

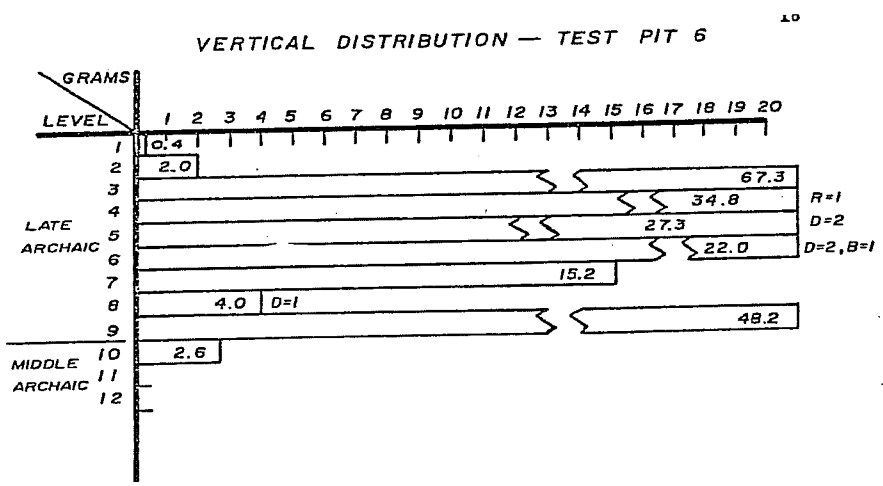

Figure A-2. Bone Weights in Test Pit 6.

The fact that the skeletal remains were in such small broken pieces suggests that the inhabitants were crushing the bones, probably to recover the marrow, and then burning the remaining fragments as refuse or fuel.

Indications from the literature are that there was a shift of emphasis from deer to bison from the Middle to Late Archaic. The potential to test this hypothesis appears to be present at Moccasin Confluence. It will be of interest to determine if deer-bison behave in a parallel manner to the relationships demonstrated on the central Plains by Bryson and Barreis (1968).

The five 1-m2 test pits analyzed from Moccasin Confluence Site produced a limited collection of faunal material but one clearly indicative of the potential of the site for additional research relevant to the prehistoric lifeways of the Edwards Plateau.

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APPENDIX B—HOP HILL HUMAN SKELETAL REMAINS (Hafernik)

During the 1978 season at Hop Hill a left mastoid process of a human was discovered at the bottom of a test pit in what eventually was found to be an old stream or spring channel under the site.

During the 1982 Hop Hill excavation more of this same individual was uncovered. The identified skeletal material included:

1. The distal end of a right humerus. The humerus included the nutrient foramen. The bone also showed some signs of animal gnawing. This portion of the humerus was 127 mm long and weighed 18.9 g.

2. The mid-section of a tibia was recovered. Side determination of the fragment was impossible due to the small size. The tibia measured 46 mm and weighed 9.4 g.

3. The proximal end of a right ulna was found. The fragment was crushed so as not to include the semilunar notch or the olecranon fosa. However, part of the radial notch was preserved. It was broken distally at the nutrient foramen. The ulna was 66 mm long and weighed 8.6 g. The ulna and the humerus were recovered partially articulated. The articulation might have been more complete at the time of burial. However, observations in the field suggest that the individual was interred as a bundle burial.

4. The remaining fragments were primarily small and inconclusive. Many of them were small pieces of ribs. Only one of these was complete enough to include the head, coastal groove, and articular surface. Small crumbly fragments of the basiler portion of the occipital bone at the foramen magnum, and the transverse spinous process of a lumbar vertebra were also recovered. The pieces were so badly preserved as to make these identifications problematical.

The materials were all recovered at a depth of 110 cm in two of six square meters of excavation. A large flat rock over part of the bone suggests that it may have been buried in the upper end of the gully under some sort of cairn.

The skeletal remains are presently assumed to be of an adult female. The bones are the gracile, slim bones of a female. The individual was over the age of approximately 17-20 years old as indicated by the total fusion of the epiphesis of the proximal end of the ulna. This rules out the possibility that it was a subadult and therefore a gracile young male. The individual was probably of small, petite stature.

The observations on the human skeletal analysis were made under the guidance and supervision of Al B. Wesolowsky, UTSA-CAR, and Dr. Harry J. Shafer, Texas A&M University.

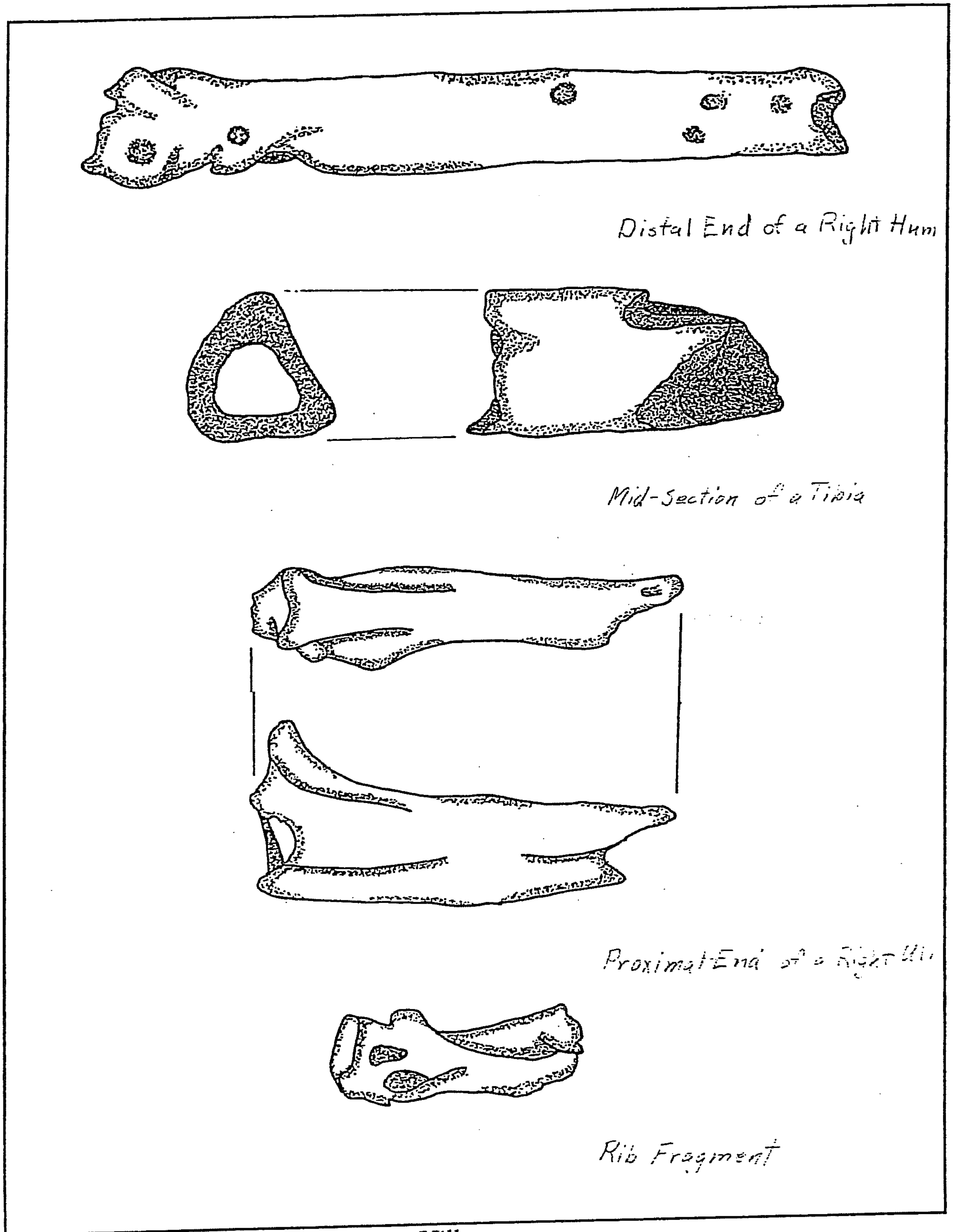


Figure B-1. Human Bone from Hop Hill.

APPENDIX C—MEASUREMENTS OF POINTS

RUN NAME LBJ PROJECTILE POINTS, 1978 & 1982
VARIABLE LIST FN SEQ VEC1 TO VEC20
INPUT FORMAT FIXED (F4.0,F1.0,20F3.0)
READ INPUT DATA

88	37	21	14	10	9	8	11	15	15	11	8	9	9	8	11	15	11	10	7	7
486	38	20	14	14	13	12	11	11	11	11	12	13	13	12	11	11	16	20	15	15
232	37	20	16	17	8	8	9	10	10	9	8	8	8	8	9	10	16	12	9	11
233	35	21	19	22	26	27	21	19	19	13	12	12	8	8	8	10	17	15	14	14
234	35	17	12	10	10	10	10	11	11	10	10	10	10	10	10	11	18	21	21	21
344	37	18	15	16	10	10	10	11	11	10	10	10	10	10	10	11	16	18	18	18
405	60	30	20	20	22	21	15	17	17	15	19	16	12	14	15	17	14	11	10	11
407	37	22	16	17	10	10	10	11	11	10	10	10	10	10	10	11	16	22	23	22
408	51	28	21	20	20	11	11	12	12	11	11	17	13	11	11	12	16	19	18	18
433	32	21	17	19	20	19	18	11	11	12	11	10	8	8	8	11	13	9	9	9
442	36	17	15	16	13	12	11	10	10	11	12	13	13	12	11	10	14	18	15	16
471	53	20	15	13	9	9	10	11	11	10	9	9	9	9	10	11	11	9	7	8
508	63	30	19	18	18	12	12	13	13	12	12	16	11	12	12	13	12	10	5	6
510	44	24	17	17	16	16	17	11	11	17	16	16	16	16	17	11	7	5	5	5
513	55	29	16	15	8	8	8	10	10	8	8	8	8	8	8	10	12	11	8	8
514	51	24	16	15	16	12	10	14	14	10	13	12	9	9	10	14	14	10	9	10
517	25	13	13	13	9	9	9	10	10	9	9	9	9	9	9	10	14	22	21	21
522	55	34	29	28	29	29	28	12	12	17	17	17	12	11	12	12	18	18	17	18
537	60	28	21	21	22	22	21	8	8	17	16	15	11	12	13	8	13	11	11	11
555	34	19	15	15	10	10	10	11	11	10	11	13	11	11	10	11	15	19	18	18
559	40	24	17	15	15	15	16	17	17	16	15	15	15	15	16	17	17	17	16	17
564	29	15	12	10	8	8	8	9	9	8	8	8	8	8	8	9	13	13	13	13
576	49	18	12	9	6	6	6	7	7	6	6	6	6	6	6	7	12	9	8	8
583	44	18	14	14	9	9	10	11	11	10	9	9	9	9	10	11	15	11	10	10
584	33	19	14	15	9	9	8	10	8	9	10	12	10	10	9	8	14	17	17	17
591	46	24	17	12	7	7	8	9	9	8	7	7	7	7	8	9	11	8	7	7
608	60	24	18	18	13	14	19	19	19	19	14	13	13	15	19	19	10	9	8	9
623	27	16	12	11	10	10	10	11	11	10	10	10	10	10	10	11	19	18	18	18
654	64	22	12	9	9	9	9	9	9	9	9	9	9	9	9	9	12	14	13	14
970	23	17	16	19	21	22	24	11	11	16	14	13	9	9	10	11	13	12	12	12
972	22	13	11	8	7	7	6	7	7	6	7	7	7	7	6	7	13	11	11	11
10072	26	14	9	9	11	11	11	11	11	11	11	11	11	11	11	11	12	10	10	10
10161	63	34	23	22	22	22	14	17	17	14	18	17	13	13	14	17	18	16	8	9
1030	30	19	15	19	12	13	14	18	18	14	13	12	12	13	14	18	12	10	10	10
1042	50	20	15	14	8	8	11	12	12	11	8	8	8	8	11	12	9	7	6	7
1048	41	21	15	17	12	12	13	18	13	11	11	11	11	11	11	13	17	13	11	12
1081	46	26	21	24	15	16	19	19	19	19	21	19	16	18	19	19	14	12	11	11
1127	49	18	13	11	9	5	11	13	13	11	8	9	9	8	11	13	9	7	7	7
1243	30	18	14	13	12	12	11	12	12	11	12	12	12	12	11	12	16	22	26	25
593	65	22	14	12	12	12	13	14	14	13	12	12	12	12	13	14	18	12	10	9
610	50	20	14	12	12	12	12	13	13	12	12	12	12	12	12	13	16	20	21	21

980	57	25	16	13	9	9	10	10	10	10	9	9	9	9	10	10	14	17	14	14
432	14	11	9	6	7	7	9	11	11	9	7	7	7	7	9	11	9	7	7	7
416	58	18	13	12	11	12	12	14	14	12	12	11	11	12	12	14	27	27	26	27
550	42	23	14	11	9	8	8	8	8	8	8	9	9	8	8	8	13	16	13	13

APPENDIX D—RECOVERY FORMS

LBJ PROJECT PHASE IV JUNE 82

CENTER FOR ARCHAEOLOGICAL RESEARCH - U.T.S.A.

SHOVEL TEST RECORD
Data Recovery and Prompting Device

1	1 - 2	0 5	Record Number
2	3 - 8	_ _ _ _ _ _	FN #

Before Excavation

3	9 - 13	_ _._ _ _	Substratum (m)
4	14 - 19	_ _ _ _ _ _._	East (m) SW Corner
5	20 - 25	_ _ _ _ _._	North (m) SW Croner
			Size of unit (cm)^2
6	26 - 28	_ _ _	Level type (1=natural, 2=arbitrary,3=cultu
7	29	_	Slope (dip, degrees, 0=horizontal)
8	30 - 32	_ _ _	Direction of slope (strike, degrees)
9	33 - 35	_ _ _	Hue (number)
10	36 - 38	_ _._	Hue (Alpha: 1=y, 2-yr,3=r,4=g,5=n,6=bg,7=b
11	39	_	Value
12	40 - 43	_._ _ _	Chroma
13	44 - 45	_ _	
	44		
14	46 - 47	_ _	Texture

1=clay
2=sandy clay
3=silty clay
4=sandy clay loan
5=clay loam
6=silty clay loan
7=sandy loan
8=loan
9=silt loan
10=loamy sandy
11=silt
12=sand

15	48	_	Consolidation (1=usual,2=unusual

After Excavation

16	49	_	Charcoal flecks (=absent,2=present)
17	50	_	Aquatic shell frags (=absent,2=present)
18	51	_	Land snail frags (=absent, 2=present)
19	52	_	Chipped stone (=absent,2=present)
20	53	_	Burned rock (=absent,2=present)
21	54 - 55	_ _	Recorder
22	56	_	Mapped (1=no,2=yes)
23	57	_	Flagged (1=no, 2=yes)
24	58	_	Depth to Top on Transit Shot Format (1=no, 2=yes)
25	59 - 60	_ _	Inspector
26	61 - 62	_ _	Day
27	63 - 64	_ _	Month
28	65 - 66	_ _	Year

_______________ Excavator _______________ Photo #s

_______________ Excavator _______________ Photo #s

Excavator _______________ Photo #s

LBJ PROJECT PHASE IV JUN82

Center for Archaeological Research-U.T.S.A.

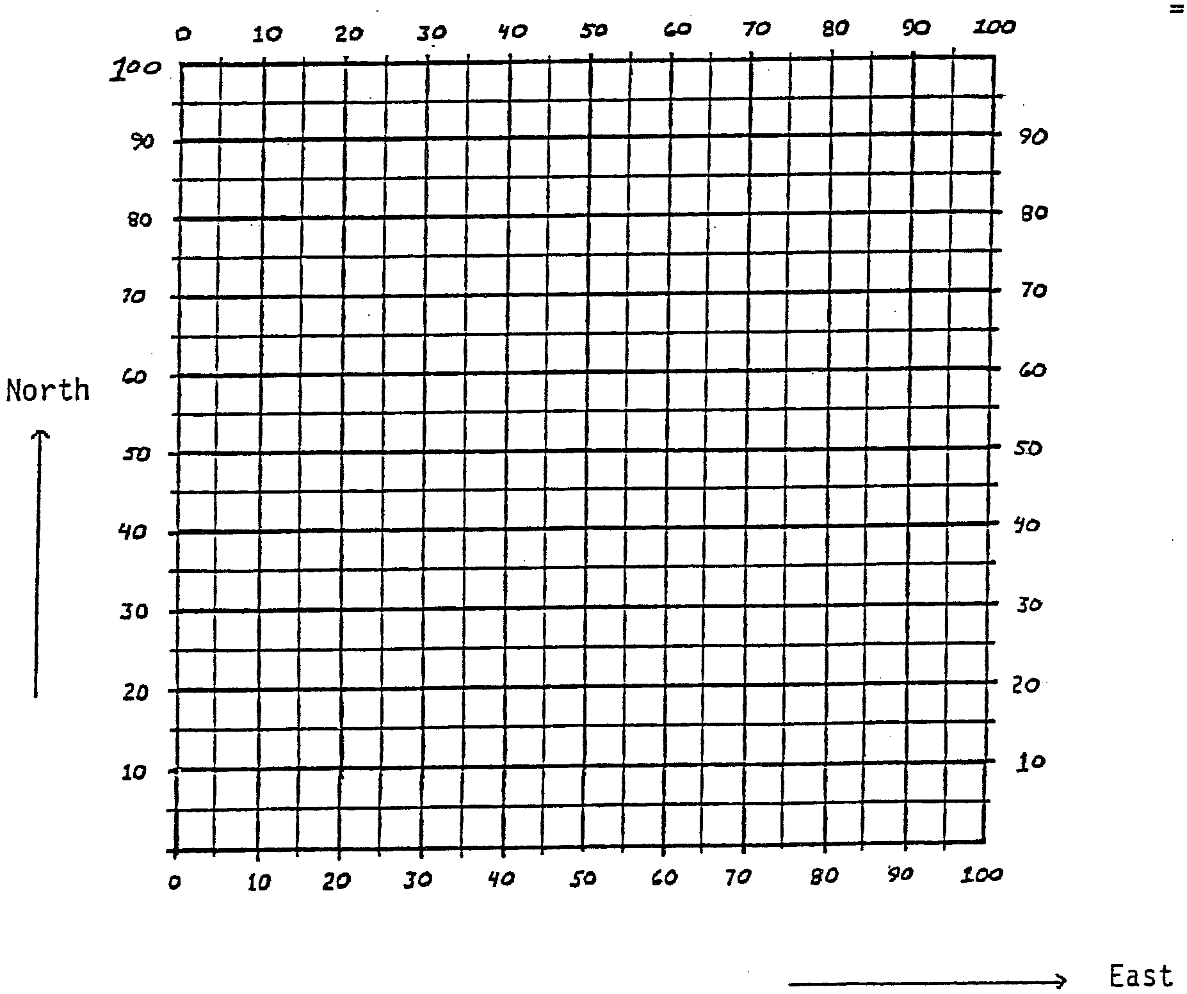
UNIT MAPPING RECORD

1	1- 2	0 4	Record #
2	3- 8	_ _ _ _ _ _	FN
3	9-10	_ _	Number of Depth measurements
4	11-15	_ _ . _ _ _	Substratum
5	16-18	_ _ _	Plan photo number
6	19-20	_ _	Inspected (Inspector #)
7	21-23	_ _ _	Scale (5 mm = x)
8	24-25	_ _	Coder
9	26-27	_ _	Day
10	28-29	_ _	Year

☐ = 5 mm^2 =

LEGEND

. =
o = flake
x = chip
* = burned chip
# = charcoal
=
=



EAST Measuremen

LBJ Project
SITE SURVEY PACKAGE
Site:

Reporter:

Comments:

Point Types, List I

30:71 _ *Perdiz*
31:72 _ *Scallorn*
32:73 _ *Cliffton*
33:74 _ *Fairland*
34:75 _ *Ensor*
35:76 _ *Marcos*
36:77 _ *Castroville*
37:78 _ *Marshall*
38:79 _ *Frio*
39:80 _ *Uvalde*
40:81 _ *Pedernales*
41:82 _ *Darl*
42:83 _ *Lange*
43:84 _ *Bulverde*
44:85 _ *Travis*
45:86 _ *Bell*
46:87 _ *Martindale*
47:88 _ *Plainview*
48:89 _ *Angostura*
49:90 _ *Golondrina*
50:91 _ Other (__________)*
51:92 _ Other (__________)*
52:93 _ Other (__________)*
53:94 _ Other (__________)*
54:95 _ Other (__________)*

Cores, Tools, Flakes, etc.

55:96 _ Hammerstone
56:97 _ Chunk
57:98 _ Core
58:99 _ Core Fragment
59:100 _ Primary Flake
60:101 _ Secondary Flake
61:102 _ Interior Flake
62:103 _ Final Trimming Flake
63:104 _ Retouched Flake
64:105 _ Heat Spall
65:106 _ Blade
66:107 _ Retouched Blade
67:108 _ Quarry Blank
68:109 _ Chopper
69:110 _ Biface
70:111 _ Side Scraper
71:112 _ End Scraper
72:113 _ Other Scraper
73:114 _ Uniface
74:115 _ Perforator
75:116 _ Graver
76:117 _ Burin
77:118 _ Burin Spall
78:119 _ Denticulate
79:120 _ *Clear Fork* tool
80:121 _ *Guadalupe* tool
81:122 _ Metate
82:123 _ Mano
83:124 _ Ceramics
84:125 _ Glass, Worked
85:126 _ Mussel Shell
86:127 _ Snail Shell
87:128 _ Non-human Bone
88:129 _ Charcoal
89:130 _ Other (__________)
90:131 _ Other (__________)
91:132 _ Other (__________)
92:133 _ Other (__________)
93:134 _ Other (__________)
94:135 _ Other (__________)
95:136 _ Other (__________)

* *Additional Point Types*

91 = *Langtry*
92 = *Edwards*
93 = *Side Notched*
94 = *Gower*
95 = *Early Side Notched*

LOCATIONAL DETAILS: Distinctive nearby features, including nature of nearest water source.

SITE CHARACTERISTICS: Associations of artifacts with features, distribution of artifact types through site, no. and type of artifact concentrations and content (describe each).

CONDITION OF SITE: Type and extent of disturbance plus notes on how site content and artifact distribution may have been affected.

PRELIMINARY FIELD EVALUATION: Ideas regarding site function, occupation, character of deposits, etc.

RECOMMENDATIONS:

ACTIVITIES OF RECORDER: What was done and how.

PHOTOGRAPHIC RECORDS (roll, exposure #'s)

B&W:

Color:

Collection Bags____________________

Recorder____________________

Table ___. Soil zones descriptions for

Zone	Munsel Color	Texture	Structure	Comment
___	___	___	___	
___	___	___	___	
___	___	___	___	
___	___	___	___	
___	___	___	___	
___	___	___	___	
___	___	___	___	

Culturally the site is evidenced on the surface

Subsurface cultural deposites

In the sattlment pattern