

limestone, sandstone, flint, concretions, shale, and chert. There was a high frequency of rose quartz, limestone, and stones that are noted as shale (smooth, shiny, fine-grained pebbles usually red, gray, and black). The evidence suggests that the rose quartz, the limestone (most abundant), and the shales are the most common pebbles found at the site. Limestone consists primarily of calcite. Some of the sediment on the Miocene lake bed may have been in an early stage of formation (Flint and Skinner 1974:A-32). The predominant texture of the limestone in our samples was coarse-grained through crystallization of the calcium carbonate elements or because they consisted largely of detrital shell fragments (Flint and Skinner 1974).

Table 15 also shows the frequency of material types in the total column. The deeper levels contain more types of pebble material. Apparently the earlier source area contained more variety of material.

TABLE 15. PEBBLE FREQUENCY AT EAGLE HILL

Material	Substrata							Total
	4.17	4.16	4.15	4.12	3.11	2.13	1.13	
Rose Quartz	21.8%	9.9%	15.3%	10.9%	3.8%	13.3%	30.2%	122
Smoky Quartz	9.4%	6.4%	5.6%	4.1%	1.0%	3.3%	19.0%	56
Clear Quartz	2.0%	2.3%	4.0%	1.4%	.5%	1.7%	3.2%	18
White Quartz	18.3%	7.6%	5.6%	5.5%	1.6%	8.3%	14.3%	78
Yellow Quartz	9.9%	7.6%	28.2%	6.8%	2.7%	5.0%	9.5%	87
Limestone	11.4%	24.4%	16.9%	20.5%	37.7%	41.7%	12.7%	203
Sandstone	0 %	0 %	1.6%	6.8%	1.0%	0 %	0 %	9
Flint	0 %	.6%	0 %	8.2%	2.1%	0 %	0 %	11
Concretions	6.9%	18.0%	5.6%	1.4%	17.4%	3.3%	0 %	87
Shales	20.3%	23.3%	13.7%	21.9%	31.7%	23.3%	11.1%	193
Chert	0 %	0 %	3.2%	12.3%	0 %	0 %	0 %	13
TOTAL (n)	202	172	124	73	183	60	63	877
TOTAL (% col.)	23.0%	19.6%	14.1%	8.3%	21.0%	6.8%	7.2%	

Table 16 summarizes the angularity of pebbles per level. The predominance of sharp pebbles indicates a relatively static erosive environment at Eagle Hill. There are few smooth pebbles in all of the seven substrata. Stream and riverine activity can account for uniform wearing away; however, given the sparse numbers (23) of smooth pebbles, it seems likely that the stones were worn smooth in the gizzards of birds. Some of the smoothed stones are unusually large and may have been imported by humans.

The results of this analysis indicate that colluvial deposition was active in the period of OP 3.11 and OP 4.17. As Figure 46 shows, there has been a general decline in the ability of the transporting agents to bring quantities of heavy materials into the site through time. This general trend is punctuated by a reversal during the OP 3.11 period. It is not entirely clear, but human

activity may have played some part in the OP 3.11 pebble concentration. However, the nature of the evidence suggests a large natural component to the OP 3.11 reversal and pertains to the erosion surface immediately below OP 3.12. Apparently OP 3.11 was directly on the erosion surface or at least our excavators dipped into the OP 3.11-3.12 intermediate area enough to pick up some of the deflated materials. While the numbers are not impressive, there is some indication of stronger erosive agents during OP 4.16 and OP 3.11 in the form of smoothed stones (Fig. 48).

TABLE 16. ANGULARITY OF PEBBLES AT EAGLE HILL

Angularity	Substrata							Total
	4.17	4.16	4.15	4.12	3.11	2.13	1.13	
Sharp	47.0%	21.5%	50.8%	42.5%	45.4%	48.3%	33.3%	359
Semi-sharp	28.2%	27.3%	25.8%	28.8%	24.6%	.3%	36.5%	243
Subangular	23.3%	47.1%	21.8%	24.7%	26.2%	21.7%	28.6%	252
Smooth	1.5%	4.1%	1.6%	4.1%	3.8%	0 %	1.6%	23
Total (n)	202	172	124	73	183	60	63	877
Total (% col.)	23.0%	19.6%	14.1%	8.3%	21.0%	6.8%	7.2%	

## G. GEOCHEMICAL ANALYSIS (Van Note)

### X-Ray Fluorescence Studies, Phase I

Soil samples from the HREC column levels that underwent screening and grain analysis were sent to Dr. Jerry Hoffer of The University of Texas at El Paso, Department of Geology, for chemical analysis by energy dispersive X-ray fluorescence (XRF).

#### Procedure

XRF method detects major, minor, and trace elements ranging from sodium (atomic number 10) to uranium (atomic number 92) in concentrations of parts per million. It also determines the relative intensities of the elements from sample to sample.

The following elements appeared in the analysis: Major--aluminum, potassium, calcium, titanium, iron; Minor--magnesium, phosphorus, chlorine, manganese; Trace--scandium, chromium, nickel, copper, germanium, rubidium, strontium, tungsten.

The data were coded and subjected to principal components analysis.

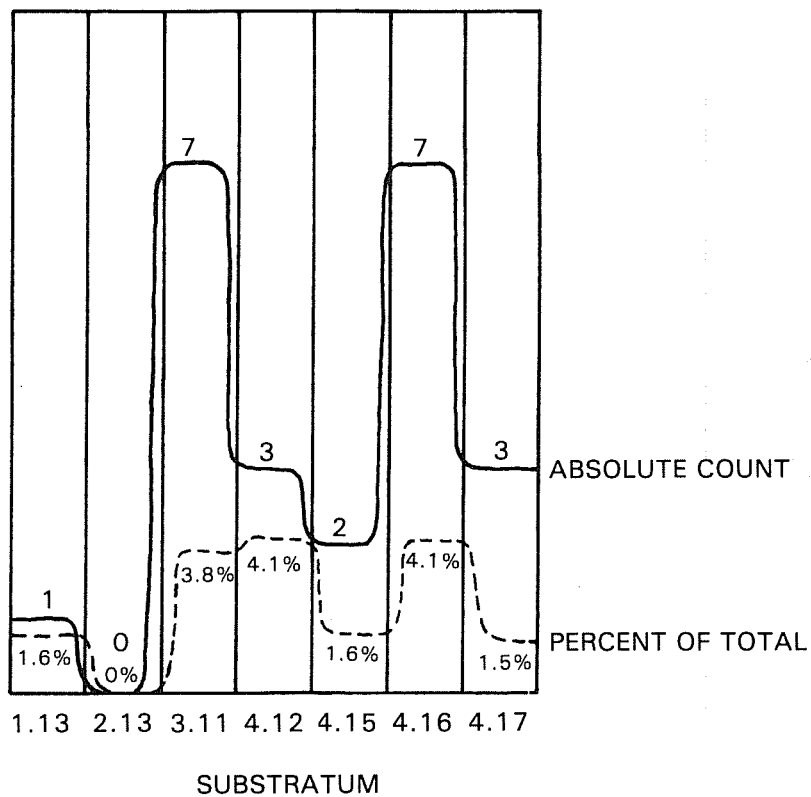


Figure 48. Occurrence of Smooth (Round) Pebbles per Occupation Plane. Numbers correspond to the number of pebbles found.

## Results

Analysis confirmed field observation on the nature of the sediments. The sandy upper levels proved to have a higher silicon content (Fig. 49,a). The high iron content of the lower substrata (Fig. 49,b) is a consistent characteristic of the site and apparently is a product of downward leaching of iron. Aluminum is also present in greater quantities in the lower levels reflecting a higher clay content.

Major Elements--Aluminum and iron were found to have a strong positive correlation with substratum indicating a tendency to increase toward the bottom of the column. Silicon, on the other hand, exhibited a strong negative correlation with substratum. Potassium and titanium remained fairly constant through time, but calcium showed a marked increase in OP 3.11 and OP 4.17 with twice the amounts of calcium in the other occupation planes. Since these are on or near deflation surfaces, there must be some tendency for calcium to accumulate at those surfaces in spite of intense leaching.

Minor Elements--Magnesium was reported in fairly constant amounts in all strata, except OP 2.13 and OP 3.11 where none was reported. Phosphorus was also present in fairly constant amounts, except in OP 2.13 and OP 4.16 where none was reported. Chlorine was detected only in substrata 1.13, 4.15, and 4.16. Manganese was present in all levels and showed a negative correlation with substratum revealing its tendency to decrease toward the top of the column.

Trace Elements--Scandium was present in small amounts in substrata 2.13, 4.12, and 4.17. Chromium was present in fairly constant, although small amounts in all substrata, except OP 1.13 and OP 3.11 where none was recorded. Nickel was found in substrata 1.13, 4.15, and 4.16. Copper was found only in OP 4.12 and OP 4.17. Germanium was present in all but the two lowest levels, OP 4.16 and OP 4.17, where none was detected and thus, was found to be negatively correlated to substratum. Rubidium was found in all levels and although it appeared to be unrelated to substratum, it showed strong positive correlations to aluminum and titanium. Strontium and tungsten were also detected in all levels. Strontium showed a positive correlation to substratum, while tungsten showed a negative correlation.

## Observations

Several groupings of factors with strong positive and negative correlations were determined from the varimax rotated factor matrix (Table 17). These seem to indicate compounds present and so is a possible alternative to X-ray diffraction. Groupings with a high substratum correlation probably indicate vertical translocation of elements after deposition or changes through time in the depositional environment.

The negative correlation of aluminum and iron with silicon would normally be positive and indicates the presence of free silicon in the samples (Don Lewis, personal communication). Rubidium (present in this analyses as a trace element) is always present in nature in compound form but, with this type of analysis and the limited number of cases, it is difficult here to tell with what other elements rubidium is combining. XRF also did not detect elements of lower atomic weights such as sodium which limits the analysis.

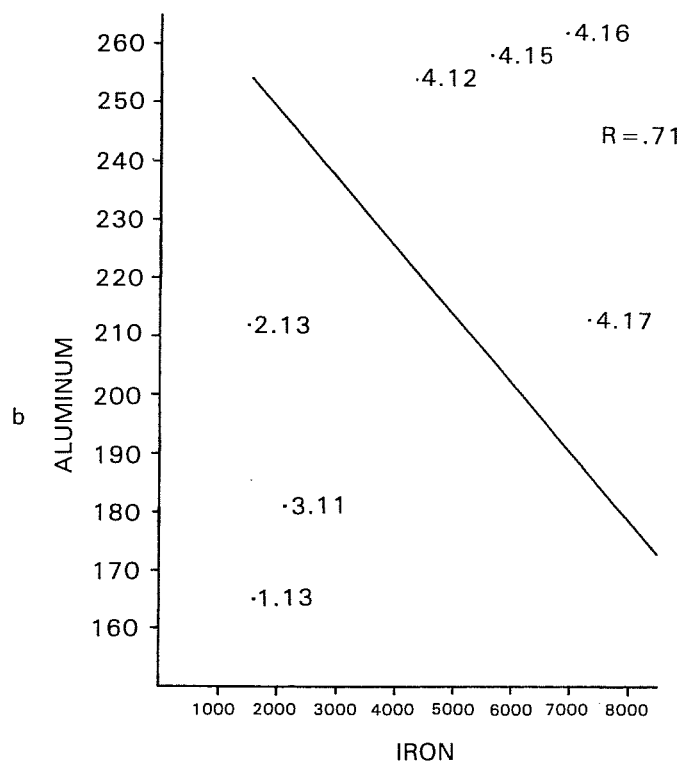
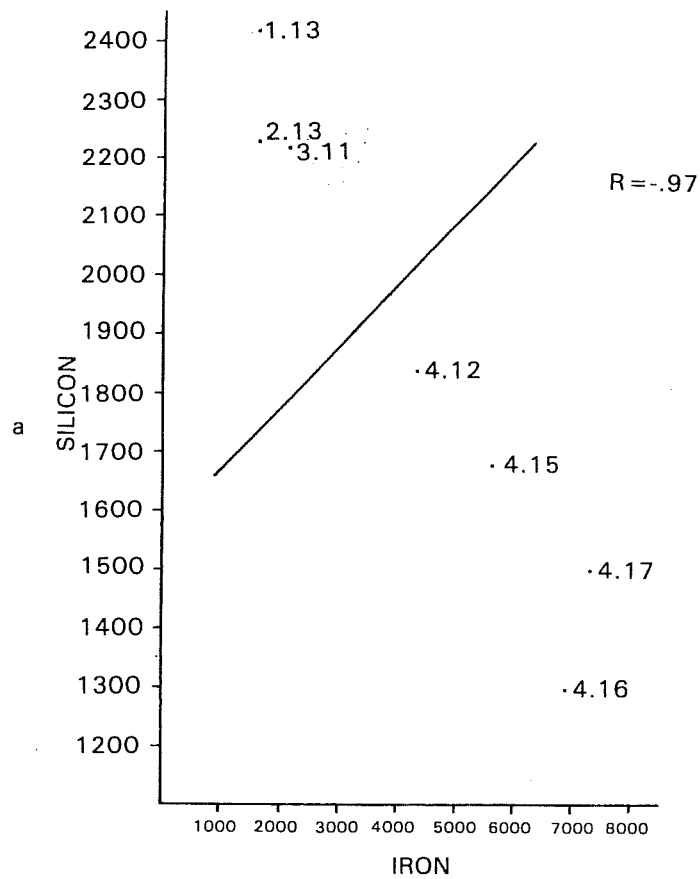


Figure 49. Quantities of Trace Elements Found by Substrata. a, iron and silicon; b, aluminum and iron.



TABLE 17. CORRELATIONS OF ELEMENTS FROM XRF DATA

## Positively correlated elements

Factor I	Factor II	Factor III	Factor IV	Factor V
Aluminum*	Iron*	Chlorine	Calcium*	Potassium
Iron*	Magnesium	Nickel	Copper	Phosphorus
Chromium*	Strontium*	Rubidium		Manganese
Rubidium*				Germanium

## Negatively correlated elements

Factor I	Factor II	Factor III	Factor IV	Factor V
Silicon*	Silicon*	Scandium	Titanium*	
Manganese*	Germanium*	Zinc		
Wolfram*				

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\*high substratum correlation

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X-Ray Fluorescence Studies, Phase II (Gunn)

Following Don Lewis's suggestions, it was decided to send only the silt and clay-sized particles for further X-ray fluorescence analysis. Samples were processed from occupation plane constant volume samples and sent to Dr. Jerry Hoffer for analysis.

## Procedure

Twenty grams of soil from each sample were placed in a clean plastic cup and soaked in 250 ml of distilled water for 24 hours. Each sample was stirred thoroughly with a glass rod and transferred into a graduated cylinder filled with distilled water to the 500 ml level. The cylinder was then vigorously shaken for 25 seconds sideways and 5 seconds upside down, and allowed to settle for 25 seconds. This gave particles larger than 100 microns time to settle. The top 300 ml of this mixture was decanted into a clean unused plastic cup and allowed to settle for another 24 hours. The water was then removed by pipette and the slurry transferred to a labeled glass vial for shipment. The coarse fraction was retained and transferred to an evaporating dish.

## Results

As expected, the removal of the larger particle sizes from the samples substantially reduced the silicon component and revealed the less abundant elements. The resulting data were analyzed in conjunction with other environmental and cultural indicators in section IV.





## H. FLORA AND FAUNA

### Flora (Sheehan)

#### Vegetation

The Eagle Hill site is situated between two widely recognized vegetation regions. To the north is the Gulf Slope section of the Oak-Pine forest (Braun 1950) or Oak-Hickory-Pine forest (Kuchler 1964). To the south is the westernmost extension of the Southeastern Evergreen forest (Braun 1950) or Southern Mixed forest (Kuchler 1964). The conspicuous distinction between these two forest types are controlled primarily by precipitation, 1140 mm per year in the Oak-Pine forest (Brown 1972).

On upland surfaces the Oak-Pine forest is characterized by open stands of short-leaf (yellow) pine (*Pinus echinata*) and several species of oak especially post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*), and southern red oak (*Q. falcata*). Hickories (*Carya* spp.) are important as well. Loblolly pine (*Pinus taeda*) is now common in this forest region, but in the aboriginal forests it occurred infrequently (Brown 1972).

Bottomland forests are characterized by trees common to alluvial soils throughout the South. Important among these are sweet gum (*Liquidambar styraciflua*), oak (*Quercus lyrata*, *Q. phellos*, *Q. prinus*), dogwood (*Cornus* spp.), redbud (*Cercis canadensis*), basswood (*Tilia americana*), and hackberry (*Celtis laevigata*).

Poorly drained sites support bald cypress (*Taxodium distichum*), willow oak (*Quercus laurifolia*), overcup oak (*Q. lyrata*), and water elm (*Planera aquatica*).

The Southeastern Evergreen forest in west central Louisiana is distinguished from the Oak-Pine forest by the presence of longleaf pine (*Pinus palustris*) and, in moister soils, by the presence of broad-leaved evergreen trees and shrubs. In many parts of the Southeastern Evergreen forest the longleaf pine of the aboriginal forest has been replaced by loblolly pine. This is usually attributed to the loblolly's more vigorous colonization of disturbed areas.

Associates of longleaf or loblolly pine on hills and in well-drained flatwoods are slash pine (*Pinus elliotii*), shortleaf pine, spruce pine (*Pinus glabra*), and turkey oak (*Quercus laevis*). In moister soils, longleaf and loblolly pine are associated with several oaks, hickories, sweet gum, sour gum (*Nyssa sylvatica*), red maple (*Acer rubrum*), ash (*Fraxinus* spp.), and holly (*Ilex opaca*) (Braun 1950).

In this forest region along sloughs occur swamp black gum (*Nyssa sylvatica* var. *biflora*), sweet bay (*Magnolia virginiana*), water oak (*Quercus laurifolia*), blackjack oak, gallberry (*Ilex glabra*), silverling (*Baccharis halimifolia*), and several shrubs of the heath family (Brown 1972). Swamps are often dominated by pond cypress (*Taxodium ascendens*).

#### Pollen Analysis

As mentioned previously, the Eagle Hill site is located in a zone of transition between two distinct vegetation types where rainfall is thought to be the

controlling factor. Because slight changes in climate will affect the position of the boundary ("tension zone") between two climatically controlled forest zones, a record of shifts in regional forests can serve as a record of regional shifts in climate. This situation is of particular interest in the reconstruction of vegetational and climatic history. Accordingly, samples of sediment from the High Resolution Environmental Column (HREC) from Eagle Hill were submitted to the palynological laboratory at the University of Indiana.

An initial series of seven samples from the HREC were selected for pollen analysis on the basis of sediment texture and color. Silty or clayey samples were chosen in preference to sandy ones and samples of gray or brown color selected in preference to those of red or yellow (Table 18).

All seven samples (five cubic centimeters each) were processed by the following method (modified from Faegri and Iversen 1974).

1. Carbonates were removed with cold 10% HCl.
2. Samples were screened to remove particles larger than 250 micrometers.
3. Samples were repeatedly water-rinsed, swirled, and decanted to remove heavy particles.
4. Remaining silicates were removed with hot 40% HF.
5. "Soft" organic matter was dissolved by acetolysis (10:1, acetic anhydride: conc.  $H_2SO_4$ ).
6. Samples were dehydrated, stained, and then suspended in tert-butyl alcohol. Drops of the pollen suspension were mounted in silicon oil on glass slides. Counts were made at 500 diameter magnification.

Very little pollen was recovered from the samples (Table 18). A second technique was used on samples 3.049, 3.052, and 4.088 similar to the first technique. This technique employed 5% sodium pyrophosphate to remove clay particles and a 7-micrometer-mesh monofilament nylon screen to eliminate small particles remaining after the chemical treatments (Cwynar, Burden, and McAndrews 1979). No additional pollen was extracted with this technique.

It is impossible to reconstruct a credible vegetational or climatic history for the Eagle Hill area using the sparse pollen data recovered. The quantity and variety of pollen in the individual counts is too small to allow confident speculation on the nature of past vegetation assemblages.

Nonetheless, a vague trend exists in the data. From sample 4.091 to 3.052 there is a decreasing importance of birch and an increasing importance of pine and herbs. From 3.052 to 1.031 there is a continued trend toward increasing pine values. In the Southeast, birch is a streamside tree. Pines are ubiquitous, but most common on well-drained sites. High proportions of herbs suggest an open type of forest. Thus, if the pollen data from the HREC were representative of changes in forest composition, the trend seen in them would suggest (1) a riverine environment contemporaneous with level 4.091, (2) an open, probably dry, pine woods contemporaneous with level 3.052, and (3) possibly a less open pine forest contemporaneous with level 1.031.

Future analyses of more suitable sediments from the Eagle Hill region will be necessary before the trend suggested by this study can be verified.

TABLE 18. EAGLE HILL (HREC) MICROFOSSILS, SELECTED LEVELS

Sample Number	<i>Pinus</i> (pine)	<i>Fagus</i> (beech)	<i>Quercus</i> (oak)	<i>Betula</i> (birch)	<i>Myrica</i> (bayberry)	<i>Ambrosia</i> (ragweed)	<i>Tubuliflorae</i> (daisy tribe)	<i>Gramineae</i> (grass)	<i>Chenopodiaceae-Amaranthaceae</i>	Monolete Fern Spores	Pollen Sum (excludes spores)
SS 1.031	6	-	-	-	-	-	1	-	-	-	7
SS 1.046	-	-	-	-	-	-	-	-	-	3	0
SS 3.049	2	1	-	-	-	-	2	-	-	-	5
SS 3.052	3	-	-	-	1	1	19	3	-	-	27
SS 4.085	-	1	1	-	1	-	-	-	-	-	3
SS 4.088	-	-	-	1	-	-	-	-	1	-	2
SS 4.091	1	-	-	6	-	-	-	-	-	-	7

#### Fauna (Gunn)

We were aware from the beginning of the project that the likelihood of finding faunal remains were slight. Only occasionally, minute fragments of aquatic shells were found in the uppermost levels of the site. Our one hope was that rodent teeth would survive the acid soils. Also, humans might act as agents to concentrate teeth in recoverable quantities. Rodents can be identified by their teeth, and they are a good climatic indicator. Careful examination of several samples revealed no teeth, and the effort was abandoned.

#### I. CHEMICAL ANALYSIS OF CERAMICS AND LITHICS FROM THE EAGLE HILL II SITE (Brown)

While a large part of traditional archaeological research has been aimed at the site and its contents as a discrete spatial unit for comparison to other such units, many recent studies have attempted to view the site as a node of activity within a regional framework. Settlement pattern, regional ecology, and studies such as the catchment area analysis in this report have stressed the dynamic relationship of the inhabitants of the site with their environment. Perhaps the earliest and most common example of the interest in external activity patterns has been the analysis of introduced materials, such as trade goods

from known areas. It was also recognized quite early that certain kinds of raw materials, most notably cherts, could be identified, and grade or movement patterns hypothesized.

The use of raw materials as indicators of trade routes and group movements has expanded almost exponentially within the last several decades, coinciding with the increased availability of, and improved techniques in materials analysis. New data have been gathered to help answer old problems, and new kinds of questions have begun to be asked.

In planning for the analysis of materials from the Eagle Hill site, it was thought that material provenience studies might have particular relevance, because of apparent changes through time in various raw materials in parts of Louisiana. In particular, the early Paleo-Indian period seems to be represented by a disproportionate number of projectile points manufactured from exotic cherts (Gagliano and Gregory 1965), many of which are from sources easily identified on the basis of macroscopic characteristics.

Unfortunately, excavation at the Eagle Hill site yielded no macroscopically obvious diagnostic indicators of known raw material apparent in basic raw material types. Certain kinds of cherts, represented primarily as finished artifacts, were rare and quite distinct from other types present. Other siliceous stone artifacts were similar to opals occurring in sediments of the immediate area. Between these two extremes was a wide range of colors, textures, and qualities of stone with little clear indication of whether the vast majority of lithic debitage is local, regional, or extra-regional. The article by Jolly in this report approaches this question from the point of view of observable characteristics and frequencies; the following section explores these hypotheses further using data from chemical and mineralogical analysis of lithic materials from the site.

Although the site consists primarily of lithic debitage, within which are apparent differences in procurement options through time, the ceramics are also represented in the upper substrata at the site. Equally significant questions can be asked of the ceramic raw material data and their relationship to aboriginal procurement behaviors. Although the presence of local or exotic ceramic raw materials cannot be hypothesized on the basis of visual characteristics, there is a wide range of variation in ceramic pastes at the site. Some of this variation is easily explicable in terms of technological differences, but certainly some of it may be due to differences in clay sources.

The basic data for this section consists of mineralogical and chemical analyses of samples of lithic and ceramic materials, discussed in separated sections below. The mineralogical analyses were primarily conducted at the Geology Department at The University of Texas at Austin, while the chemical analysis was conducted both in Austin and at the Nuclear Science Center at Texas A&M University, aided by Melinda Urbantke. The Nuclear Science Center provided additional funding for part of this study.

### Ceramics

As mentioned in the chapter on ceramic analysis, the sherds collected at the site exhibit a considerable range of technological variation. Such variation could clearly mask otherwise visible differences in raw material usage. In some cases, what is apparently technological variation might not be due to

clay preparation, but to initial differences in raw material sources. The numerous sandy paste sherds are a good example. Are they naturally sandy clays or do they represent added aplastic materials?

The numerous sandy clays of this upland area suggest that many of these ceramics may have been made at the site or in the nearby area. Short of an analysis of the ceramic paste materials, it would be very difficult to approach such a question in any but the most cursory fashion. One observation made in the field was relevant to this question; beneath the site was a good source of plastic clay, which might be an excellent ceramic raw material. In addition, the possibility could not be ignored that the great number of fired clay balls found in the ceramic levels might be waste from the ceramic manufacturing process.

One of the more preliminary kinds of questions which can be asked is the nature of variation present in local clays. Are they totally homogeneous throughout the area, do they vary randomly from one meter to the next, or is there some consistent gradient of variation? In order to attempt an answer to this question, a number of local clay samples were collected from in and around the site and from clay exposures at some distance from the site. Table 19 gives a brief description of these samples and their general location in relation to the site.

TABLE 19. CLAY SOURCE PROVENIENCE DATA

<u>Sample</u>	<u>Material Type</u>	<u>Location</u>
C1	Gray Sandy Clay	Upper profile, gully 50 m E of Area A
C2	Gray Sandy Clay	Upper profile, gully 50 m E of Area A
C3	Orange Mottled Brown Sandy Clay	Lower IIB2t, Area A
C4	Dark Red Mottled Gray Clay	Upper IIIB2t, Area A
C5	Gray Clay w/Some Red Mottles	Mid IIIB2t, Area A
C6	Gray Clay	Lower IIIB2t, Area A
C7	Grayish Brown Fine Sand	Mixed I and II soil from backdirt
C8	Light Gray Sandy Clay	Upper profile, gully west of Area A
C9	Light Gray Sandy Clay	Lower profile, gully west of Area A
C10	Loose Brownish Gray Sand	Eagle Hill I, 0.5 km N of 16 SA 50
C12	Brown Sandy Clay	Perimeter Rd Bridge, 1.5 km NW of 16 SA 50
C13	Light Gray Sandy Clay	Perimeter Rd Bridge, 1.5 km NW of 16 SA 50
C15	Whitish Gray Sandy Clay	Eagle Hill III, 0.7 km NW of 16 SA 50 just below lithic sample IIIW-1
C17	Red Clayey Sand	Eagle Hill I, 0.5 km N of 16 SA 50
C19	Light Gray Clay	Lowest point in gully 100 m NNW of Area A

Rather than immediately submit all of the source clays and a number of ceramic samples to neutron activation analysis, a somewhat expensive technique; the potential source clays were first analyzed by X-ray diffraction and X-ray fluorescence to make a preliminary assessment of the variation. Utilizing the methods available at The University of Texas at Austin, these techniques are not as powerful discriminators as neutron activation analysis nor are they absolutely quantitative. Only relative amounts of various easily recognizable minerals and elements can be determined. In addition, these methods are both destructive and require a relatively large sample. For X-ray fluorescence, for example, the four gram minimum sample size would eliminate all but a few of the largest sherds from the analysis and necessitate the destruction of large portions of each of those for the analysis. For this reason, only the source clays were included in the initial analysis.

The first step in this analysis was the X-ray diffraction analysis of a sample of these clays in order to determine their basic mineralogy. Five samples from the site (C1, C2, C3, C4, and C5) were selected for this analysis; five grams of each of these were dissolved in deionized water and a pipette sample collected from near the surface after twenty minutes settling time. This allows for the settling-out of sands and other large mineral fragments, which might obscure the clay mineral peaks. The pipette samples were then placed on a clean glass slide and allowed to dry. The dried sample was run through the general clay range on an X-ray diffractometer and the resulting mineral peaks identified. These samples all proved to be primarily montmorillonite with a small amount of kaolinite present. The relationship between these two clay mineral groups was very consistent among the samples, the major variation being the total amount of clay present in the different sediments.

At this time a number of clay samples were selected for X-ray fluorescence analysis. Preparation for this analysis included grinding the sample and mixing a carefully weighed amount with a small amount of Bakelite. This mixture was pressed into a small pellet under pressure and cured at approximately 110 to 120°C. In all, thirteen of the clay samples collected were analyzed by this technique. These were C1, C2, C3, C4, C5, C6, C8, C9, C10, C13, C15, C17, and C19. The relative amounts of eight elements were recorded using this procedure. These elements are Titanium, Barium, Vanadium, Chromium, Samarium, Manganese, Iron, and Zirconium. Table 20 shows some of the approximate relationships of the elements identified. Values shown are simply chart divisions with no absolute basis, but given the similar matrices and similar clusters of elements, they could be considered quantitative in a relative sense.

Several conclusions are indicated by the results of the X-ray fluorescence study. In the first place, there are quite recognizable differences between the clays of the area. But most important, these differences are not random, but are related to the spatial separation of the various strata. In general, those clays which are farther apart show the greatest differences. Figure 50 illustrates a cluster tree diagram for the sampled source clays based on these XRF peaks. This cluster analysis, which uses the Biomedical Computer Program BMDP2M (Dixon and Brown 1977), groups those samples which have the closest values for all elements (based on an Euclidean distance measure of normalized data) into clusters two at a time, treating each newly formed cluster as a single case for further clusters.

TABLE 20. XRF CLAY SAMPLE PEAKS

Sample	TI	BA	V	CR	SM	MN	FE	ZR
C1	28	18	18	27	24	31	56	47
C2	28	19	18	27	23	35	80	40
C3	29	18	18	28	23	31	74	47
C4	29	18	19	30	24	32	69	49
C5	29	17	19	29	21	31	94	46
C6	27	19	18	26	22	34	56	43
C8	29	18	19	30	24	30	71	43
C9	31	30	20	24	24	32	71	44
C10	16	18	15	29	24	29	10	40
C13	26	18	19	25	21	33	85	37
C15	17	19	19	25	21	33	94	38
C17	18	16	17	28	27	29	77	33
C19	29	16	18	26	21	42	100	36

The first two and therefore the strongest groups in this analysis are formed between the upper strata of clays from the site. Samples C4 and C1 and samples C8 and C3 first form two separate clusters and one step removed from one single cluster, which includes all of the samples from the upper 30 to 50 cm of Miocene clay surrounding the site. Two lower samples, C6 and C2, which are 50 or more meters apart, but stratigraphically equivalent, group at the third cluster step. Sample C5 which is intermediate to C6 and C4 stratigraphically, behaves as one would expect a transitional sample to behave, joining the cluster at an intermediate step.

One of the more interesting clays from the site is C9, a gray sandy clay that is the most chemically distinct of all of the samples and which joins the cluster tree last of all. As is obvious from the data, it has extreme values for both barium and chromium. This sample, although apparently stratigraphically equivalent to C6 and C2, appears somewhat different and its distinctiveness may indicate the presence of another strata. Sample C19, at a depth of several meters below C9, shows more similarities to the rest of the clays from the site than to C9. It is somewhat different, however, and samples C13 and C15, which are both more than a half kilometer distant (from the site and from each other), join the upper site clay cluster first. These two, which are texturally similar and probably also stratigraphically equivalent to one another, form a cluster with each at the fifth cluster step. Samples C17 and C10, both from the top of Eagle Hill, are quite distinct (one is a red clayey sand while the other is a loose brown sand) and group at such a low level that it is probably not significant.

Five of these clay source samples were selected for more detailed study in neutron activation analysis. These included two from beneath the site (C4 and C6), one from the gully to the east of the site (C2), one from the deepest part of the gully to the west of the site (C19), and another (C12) from a series of eroded gullies near the perimeter road, one kilometer northwest of the site. One of these samples, C19, was drilled twice to examine the amount of variability present in a single clay source; the two samples were taken less than

a foot apart at the bottom of the gully. These five clays were thought to potentially represent a large portion of the variation present in the clays of the immediate surrounding area.

In addition to these five clay samples, several other sediment samples were included in the analysis. Two soil samples from the constant volume sample and from the High Resolution Environmental Column in E3019 N1002 were included, one from substratum 2.13 and the other from substratum 4.12. These were primarily included as a test of the origin of the site's clay balls, two of which (one each from substrata 2.13 and 4.12) were also analyzed. These sediment samples also provided a check on the possible effects that burial in these sediments might have on trace element chemistry. One further sample, collected from the excavation backdirt (C7), is a mixed fine sand that probably approximates the Plio-Pleistocene colluvium that covers the area and which may have served as an aboriginal source of tempering material. This sample should approximate the samples from both 2.13 and 4.12, but not precisely, being a mixture of the sediments from several different substrata.

Contrasted to these local sediment samples were fifteen ceramic samples thought to represent the major technological types present at the site. These samples were selected subjectively; all of the sherds were spread out on a table and divided into groups based on visible characteristics such as color, thickness, apparent temper, etc. One of the larger and more representative sherds of each of these groups was then selected for analysis. Two sherds were sampled twice to assess the variability in trace elements from one end of the sherd to the other. The proveniences of the sampled sherds are shown in Table 21.

Sampling of all of the ceramic and clay sources was done by drilling a small amount from one edge after first cleaning the surface with a burring tool. In order to minimize drill contamination, drill bits and burrs were of tungsten carbide; in any case, tungsten was ignored in the analysis because of this. Large inclusions of organic material or obvious tempering were avoided in drilling, but in the case of the sherds, the samples were too large and the temper too fine and evenly distributed to avoid the inclusion of some tempering material.

Samples were then weighed and placed in a plastic container which was then sealed and subjected to neutron irradiation at the Nuclear Science Center at Texas A&M University for three different time periods: two minutes, two hours, and 14 hours. Fifty milligram samples were used in the two minute run, while 100 milligram samples were used for both the two hour and 14 hour runs. Collect times for the various runs were five minutes for the two minute run, 15 minutes for the two hour run, and 20 minutes for the 14 hour run. Gamma ray emissions during this period were counted and analyzed by the computer at the Nuclear Science Center, which produced a printout of the various elements recognized in parts per million. These data were subsequently keypunched for analysis by The University of Texas at Austin.

In total, more than 60 elements were recognized in some or all of the ceramic samples in amounts varying from fractions of a part per million for rare earths like lanthanum or europium to several percent of the total composition for more common elements like iron or magnesium. In order to reduce the data set to a more useful and workable size, the printouts were scanned for possible sources



of error in peak recognition. Elements with extremely high recorded errors or which had possible unrecorded peaks were excluded from the initial analysis. This eliminated the possibility that an element present in a given sample might have simply been missed either in counting or in computer peak analysis. Additionally, elements such as tungsten, from the drill bits, and argon present in the air in the sample container, were eliminated from the analysis. The remaining 11 elements were present in some quantity in every one of the 28 samples (a 29th sample, an empty vial, was also run, but, other than argon and less than 30 PPM sodium from salt, almost nothing was present, and this sample was not included in further analysis).

TABLE 21. CERAMIC SAMPLE PROVENIENCE

Sample	North	East	Substratum	Temper	Comments
8	3018	1001	3.11	grit	
12	3019	1001	2.13	grit	
16	3020	1002	2.13	grit	not <i>in situ</i> , decorated
20	3018	1002	3.11	grit	
25	3020	1002	3.11	grit	
27	3021	1000	2.21	grit	coarse tempered
28	3020	1002	3.11	grit/sand	2 samples drilled
40	3018	1002	1.12	none visible	
53	3018	999	2.21	sand	
55	3017	999	3.11	grit	
64	3019	1000	2.31	grit	2 samples drilled
76	3019	999	2.31	grit	
79	3017	1000	2.31	grit	
90	3021	1002	2.31	sand	
97	3020	1000	2.13	grit	decorated

Even with only 11 elements left in the analysis, the attempt to make sense of the data by hand yielded little information. This attempt did seem to indicate that there were a number of differences between the clay sources and most of the ceramics, and that one small group of sherds seemed to differ considerably from the rest. To verify these preliminary observations, the data were subjected to a cluster analysis, using the same BMDP2M procedure as above. This cluster, presented in Figure 51, clearly separates these hypothesized groupings.

In this analysis, the clay ball from substratum 2.13 (CB21) clusters first with the soil sample from substratum 4.12. Significantly, the next two samples to group together (64-1 and 64-2) are two separate drillings from the same sherd. The other double drilling (28-1 and 28-2) does not cluster as near the top of the analysis, but these two samples also group with one another before they are grouped with any other sherd. Other early and strong groupings occur between sherds 64 and 79 and between 8 and 20. A good group also forms between the various soil samples and the clay ball from substratum 2.13. The clay ball from substratum 4.12 eventually joins this group, but not until there is a considerable increase in cluster distance.

S  
A C C C C C C C C C C C C C  
M 1 3 8 4 5 6 2 1 1 1 1 1 9  
P 5 3 9 7 0  
L  
E

AMALG.  
DISTANCE

1.105  
1.366  
1.470  
1.566  
1.811  
1.996  
2.015  
2.981  
3.718  
4.085  
4.086  
4.399

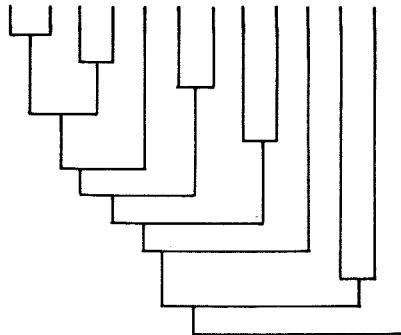


Figure 50. X-Ray Fluorescence Cluster Tree.

S S C S C C  
A 2 2 6 6 C 4 2 C 1 1  
M 8 8 4 4 C B . . 8 9 9  
P 5 1 2 7 9 2 - - 4 7 - - 2 C C C 1 C 2 1 1 4 - 5 9 1 -  
L 3 2 5 6 0 7 2 1 0 9 1 2 8 0 2 4 6 2 7 1 2 3 1 1 5 7 6 2  
E

AMALG.  
DISTANCE

.946  
.955  
.983  
1.036  
1.082  
1.148  
1.416  
1.454  
1.299  
1.526  
1.568  
1.730  
1.867  
1.906  
1.913  
1.937  
2.061  
2.267  
2.189  
2.342  
2.819  
2.838  
3.770  
4.015  
4.108  
5.143  
5.905

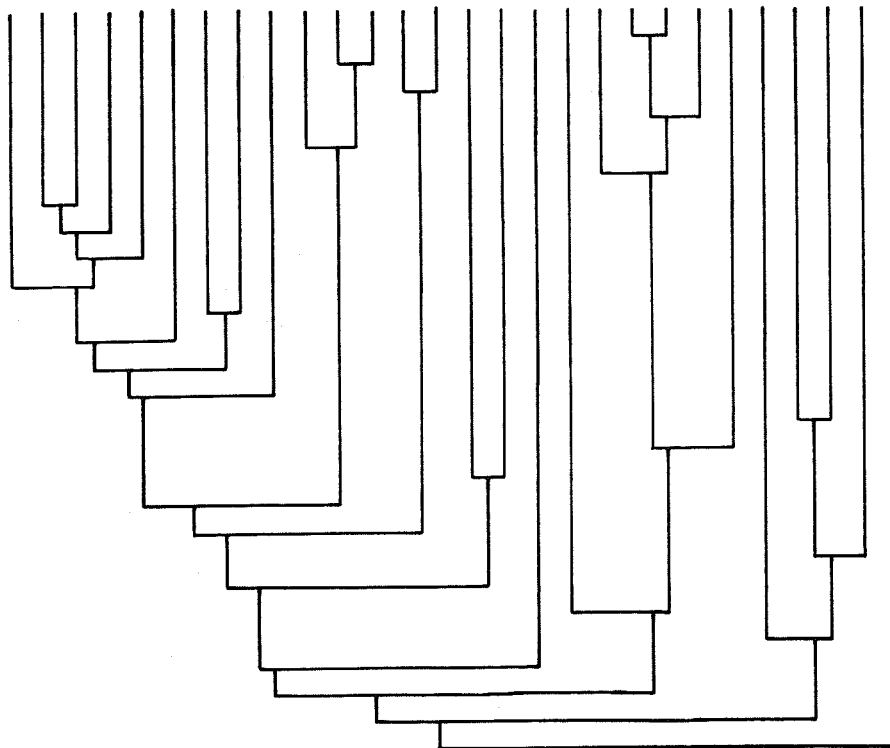


Figure 51. Ceramic and Clay Source Cluster Tree.

On the left side of this diagram, a cluster is formed that includes most of the sherds from the site, with the exclusion of the two small groups already mentioned and three sherds which do not join the main group of sherds until after almost everything in the analysis has joined. These three sherds, which do not form a very distinct cluster in themselves, are clearly distinct from everything else at the site. Two of these three are decorated, the only decorated sherds included in the neutron activation analysis. These two (16 and 97) both have incised horizontal lines and are included in the *Coles Creek* ceramic classification discussed in a later chapter of this report. These two are quite distinct from one another and are not clearly related to many other sherds from the site. Number 16 has a red paste with numerous large inclusions that appear to be clay grit temper. Most of the horizontal parallel incised sherds from the site are of this paste, but there are no undecorated sherds that have a paste similar to this.

The other incised sherd is the single unique example of a somewhat irregularly incised sherd found in a rodent burrow in substratum 2.13; it cannot, therefore, be clearly tied to any vertical provenience. Upon close inspection, however, it does have a number of similarities in paste characteristics with sample 55, with which it clusters first. Although they are probably not the same vessel, it seems likely that they may have been made from a similar clay source and perhaps have even been made by the same potter. The reason for suspecting that they are not the same vessel is the size and color distribution of clay grit particles in the exterior vessel wall; on the other hand, sample 55, which seems to be related to two other sherds from the site, is also somewhat distinct in paste and temper characteristics from most of the other sherds at the site.

It appears that there are four distinct groups of sherds present in the sample, which in turn fall into two larger groups distinguishing between the three unique sherds discussed above and all the other specimens. The main group of eight sherds contains a number of visually distinct sherds that could not possibly have come from any less than five or six different vessels. For the most part these sherds have a sandy paste, although they vary in grain size and amount. Thickness of these specimens varies considerably, also, ranging from 4.4 mm in 53 to 11.8 mm in 27 (the thick, coarsely tempered sherd discussed on page 265). Sherds 64 and 79 are quite similar specimens of a thin high-fired ware and could potentially be from the same vessel; they may also be related to the crosshatch incised specimen discussed on page 265. The other group, composed of 8 and 20 is not particularly visually distinct; they do not appear to have come from the same vessel, but this possibility cannot be ruled out.

Although one major group of sediment samples and fired clay balls is formed in the early stages, these do not in turn group well with any of the nearby clay samples. Samples C7, S2.13, and S4.12 group with each other, but do not group at all with C4, the clay sample from the top of stratum 5, only 30 cm below substratum 4.12. In fact, the only clay sample that joins these sediment samples at all is C12 (from one kilometer distant) which joins so low in the tree as to not form a very significant bond. The implications of this for the clay balls are not totally clear, but they do not appear to be related to the Miocene clays of the lower strata of the site. Actually, they appear to be closely related to the sediment samples that contain relatively small clay fractions. If they are indeed formed from fired argillic clays, the implication

is that they were exposed by erosional truncation or bioturbative movements if they were fired when near the surface.

While none of the clay source samples form very strong groups, samples C4 and C2 are the best approximation of a cluster. These two clays, suggested as different units in the XRF analysis and separated by almost a 100 m horizontal distance, may be part of the same original depositional unit, a unit subsequently altered by soil-forming processes. Sample C6, located only some 30 cm below C4, does not cluster with anything much less with its closest neighbor. A scan of the original data set shows that C6 and C4 are actually very close in all of their trace element compositions, with the exception of sodium, where the difference is so extreme as to prevent their forming a cluster. In fact, sample C6, with 8774 PPM sodium (compared to 3373 PPM for C4), has the highest sodium content of any ceramic or clay sample in the analysis. This difference seems to be due to downward leaching of sodium through the sediment.

Perhaps most disappointing of the clay sample groupings is that of the two separate drillings from C19, the clay from the lowest part of the gully to the west of the site. This clay, located three or more meters below the other clay samples in the neutron activation analysis, would not necessarily be expected to group with other samples from the site. Unfortunately, the two samples do not really even come close to grouping with one another. In this case, an analysis of the actual data shows again that many of the values are nearly identical, with two significant exceptions (titanium and magnesium), which are divergent enough to prevent a cluster.

The most obvious conclusion from this cluster pattern is that the ceramics found at the site were not made from any of the clays collected in the site area. Although it might be that clay preparation procedures have totally disguised these clays, it is unlikely because the main cluster of ceramics represents a technologically very diverse group that appears to represent a variety of added materials. Yet, despite this diversity of added materials, sherds from the main group cluster with each other before clustering with any of the clays.

One further analytical approach was taken to examine the ceramic groupings. Discriminant analysis was used to study the strength and direction of the groupings. This technique evaluates the discriminating power of variables for cases placed into known groups and attempts reclassification based on discriminant functions created from those variables (Nie *et al.* 1975). For this analysis, all of the sherds were placed in one group and all of the clays in another. Table 22 shows the various samples and the probability of their being as far from the group centroid (assuming normal distribution) as they actually are. Although a number of samples have probabilities below 30% or 40%, this includes samples from both extremes. The discriminant scores for each sample are included so that those which lie outside the range of either group can be distinguished from those which lie between. The two samples which lie closest to the middle ground between the groups are C4 and 20, but also in the middle are samples 8, 25, 53, and 64-2. No other clay lies between. This suggests that perhaps the two smaller groups, especially the one containing 8 and 20 may have been made from clays similar to the local ones.

Although none of the sherds could be clearly identified with clay samples from the area, it is suggested that four distinct clay sources are represented, none

of which came from the immediate area around the site. The small group containing 8 and 20 may represent a clay source near the site, however. The larger group and the small group containing numbers 64 and 79 do show some similarities to the area clays; it may be that these sherds were all manufactured from similar, but unsampled upland clays from the general area. The small cluster including one plain and two decorated sherds, because of its distance from the local clays, may actually have been imported from some distance. The tentative hypothesis that these sherds come from floodplain ceremonial centers is offered here.

TABLE 22. DISCRIMINANT ANALYSIS SCORES

<u>Sample</u>	<u>Probability</u>	<u>Discriminant Score</u>
53	.2714	-1.7660
28-1	.4278	-2.0728
C6	.8268	4.2101
C4	.2481	3.2739
16	.5233	-3.5040
20	.2028	-1.5922
64-2	.2415	-1.6946
90	.8262	-2.6461
12	.1072	-4.4765
C2	.4209	5.2338
27	.0660	-4.7045
55	.1072	-4.4768
CB41	.8209	4.2026
79	.4186	-3.6746
40	.7352	-2.5275
C7	.2789	5.5117
C19-2	.0612	6.3007
76	.9797	-2.8403
28-2	.6911	-3.2631
C12	.6046	3.9110
8	.2164	-1.6296
S2.13	.8280	4.6462
CB21	.6986	4.0417
97	.6241	-3.3558
C19-1	.5823	3.8788
64-1	.8198	-2.6380
S4.12	.3569	3.5076
25	.3123	-1.8554

Clay Group Discriminant Function = 4.42898

Ceramic Group Discriminant Function = -2.86576

### Lithics

The amount of obvious variation present in the excavated lithics from the site was enormously greater than that found in the ceramics. Stone tools and the

debitage from tool maintenance (and perhaps manufacture) ranged from translucent, very fine-grained cryptocrystalline cherts to grainy quartzites. That some of this material was imported into the site was suggested by the high percentage of formal tools made on extremely rare types. Yet, as mentioned above, much of the debitage at the site bears some resemblance to the locally occurring opaline silicates. The probability that the aboriginal groups inhabiting the site selected for high quality cryptocrystalline cherts for many of their tools cannot be doubted. Yet, at the same time, tools with perhaps equal functional utility were manufactured from materials not as easily manipulated. In fact, neither of the two most obvious early diagnostic indicators, the spurred end scraper or the lanceolate projectile point found in the lowest level, is made from what could be termed a high quality chert.

The section by Jolly (page 290) detailed the variation through time in the usage of various visually distinct lithic types from the site. He hypothesizes that the changes in the frequencies of occurrence of various raw materials should reflect changes in the subsistence pattern of the site's occupants. Given that chert sources do not generally move around, this hypothesis seems obvious enough. Several problems remain, however. Without some idea of the actual direction and distance to the chert sources, it is difficult to equate a change in range with a change in subsistence patterns. Some changes in range may actually reflect differential preferences in procurement areas for identical resources between different bands utilizing the same site as a temporary encampment. Conversely, since many similar lithic sources are correlated with east-west trending geological formations that can contain different subsistence resources depending on elevation and precipitation (which also tends to occur on an east-west gradient), there is the possibility that identical lithic resources could be obtained from different areas following substantial changes in range and subsistence strategies.

The following section was undertaken primarily as a test of the hypothesis that the aboriginal inhabitants of the Eagle Hill area utilized the widely distributed local opaline silicate resources, perhaps even selecting this particular locality over others because of the presence of serviceable stone in a region that does not have extensive natural chert deposits. At the same time, it can be considered a partial test of some of the categories of stone described and utilized by Jolly. Although no attempt will be made to verify or negate that hypothesis here, it is hoped that some of the data presented will be useful in operationalizing the model so that it can be tested.

The characterization of the upland area of west central Louisiana as a chertless region is not strictly true. Extensive gravel deposits occur 40 km to the south in the Quaternary Williana Formation, and gravels also occur in the Pleistocene terraces of both the Sabine and Red Rivers (Welch 1942). In the central upland areas to the north of the Williana contact, however, there are few concentrated sources of siliceous stone. Petrified wood and opals are the primary naturally occurring stones, varying considerably in their serviceability as lithic tool raw materials.

The distance to usable stone is not so great that it would be out of any given group's ordinary range. A source of adequate stone could hardly be more than a couple of days walk from any spot in the Eagle Hill area. But the possibility should be considered that a long trek undertaken solely for tool

manufacture might be less attractive to an aboriginal uplander than the difficulties involved in finding and working locally available stones. As is implied in Jolly's hypothesis, the aboriginal perception of these difficulties is probably strongly correlated with their ordinary subsistence range.

In order to determine the possibility of the presence of local stone types at the site, a chemical analysis of debitage samples from the site and some locally collected opals was undertaken. For comparison, debitage samples from several adjacent prehistoric sites and chert source samples from several distant areas were also included. The debitage from the site was part of the type collection identified by Jolly. Dr. Frank Servello, of the University of Southwestern Louisiana, pointed out the location of several nearby opal sources used in the analysis and provided the debitage samples from surrounding sites. An additional sample, from Dowden Creek, was furnished by John Guy, a local avocational archaeologist. The samples from central Texas were collected by the author at various times while the samples from Arkansas were provided by Mark A. Mathis of the North Carolina Department of Cultural Resources. Table 23 gives the provenience of all of the samples used in the analysis.

Because of the small amounts of many trace elements contained in cherts, X-ray fluorescence is not generally sensitive to chemical variation in lithic samples (G. Karl Hoops, The University of Texas at Austin Geology Department, personal communication). Therefore, in contrast to the ceramic samples, no preliminary chemical analyses were conducted on the lithics from the Eagle Hill site. Thin section analyses, however, confirmed that the locally collected materials were indeed opals (E. Garner, personal communication). Lithic samples selected for neutron activation analysis underwent much the same procedures as for the ceramic samples with the following exceptions. Because of the hardness of the lithic samples, they were not drilled; a small bit of each sample was placed in a heavy plastic bag and crushed to a fine powder. Three separate runs, equivalent in length to the ceramic runs were conducted, each with a 100 milligram sample of crushed stone. Count time for the shortest run (five minutes for the lithics) was 10 minutes; for the two hour run count time was 30 minutes; while for the 14 hour run count time was 20 minutes.

Cursory examination of the data set from the neutron activation analysis showed that only a few of the 60 elements contained values for most of the samples examined, and none of the elements were recorded present in every sample. However, comparison of the zero values showed that the presence or absence of certain elements seemed to be correlated with some of the more obvious known groups of samples. For example, the local samples contained small amounts of certain elements not present in the other samples. It appears that the presence or absence of certain elements within the lithic sample may be a useful diagnostic indicator. Therefore, the first analytical method chosen was a discriminant analysis of the known groups within the lithic sample in order to determine the best discriminating elements which could then be used for further analysis.

In the primary discriminant analysis, the debitage from 16 SA 50 and surrounding sites was compared to the locally collected source materials, with the exotic materials left ungrouped. None of the samples were misclassified, and there was little if any ambiguity between the groups. Only four samples (DTM-2, WO-1, IWO, and GO-1) had discriminant scores that placed them between the two groups,

TABLE 23. LITHIC SAMPLE PROVENIENCE DATA

## 16 SA 50 DEBITAGE

<u>Sample</u>	<u>Material Type</u>	<u>East</u>	<u>North</u>	<u>Substratum</u>
BLM-1	Black Mottled	3018	998	2.13
BrO-1	Brown Opaque	3020	998	4.12
CH-1	Chalcedony	3017	1001	2.13
DT-1	Dark Tan	3020	998	4.12
DT-2	Dark Tan	3020	997	4.17
DTM-1	Dark Tan Mottled	3020	997	4.17
DTM-2	Dark Tan Mottled	3017	1001	2.13
GO-1	Gray Opaque	3020	998	4.12
LTM-1	Light Tan Mottled	3017	1001	2.13
LTM-2	Light Tan Mottled	3018	998	2.13
WO-1	White Opaque	3020	998	4.12
WO-2	White Opaque	3017	997	4.17

## COMPARATIVE DEBITAGE SAMPLES

<u>Sample</u>	<u>Material Type</u>	<u>Location</u>
IBLM	Black Mottled	Eagle Hill I, 0.5 km N of 16 SA 50
IGO	Gray Opaque	Eagle Hill I, 0.5 km N of 16 SA 50
IIIBL	Black Mottled	Eagle Hill III, 0.5 km NW of 16 SA 50
IIILTM	Light Tan Mottled	Eagle Hill III, 0.5 km NW of 16 SA 50

## COMPARATIVE SOURCE SAMPLES

<u>Sample</u>	<u>Material Type</u>	<u>Location</u>
IIIE-1	Opal, Light Tan Mottled	Eagle Hill III
IIIW-1	Opal, Black Mottled	Eagle Hill III
IIIW-2	Opal, Black Mottled	Eagle Hill III, not same cobble as IIIW-1
PR-1	Opal, Black Mottled	Perimeter Road Bridge, 1 km NW of 16 SA 50
DC-1	Opal, Black Mottled	Dowden Creek, 7.5 km SSW of 16 SA 50
DC-2	Opal, Black Mottled	Dowden Creek, 7.5 km SSW of 16 SA 50, same cobble as DC-1
PW-1	Petrified Wood	Mill Creek, 9 km W of 16 SA 50
NF79-1	Gray Opaque	Andice Road, near Georgetown, central Texas
NF79-2	Gray Opaque	Andice Road, near Georgetown, central Texas, same cobble as NF79-1
NF80-1	Gray Opaque	Andice Road, central Texas, 5 km SE of NF79
NF80-2	Gray Opaque	Andice Road, central Texas, 5 km SE of NF79, not same cobble as NF80-1
PF-1	Gray Opaque	Pedernales Falls, near Johnson City, central Texas
PITKIN	Black Opaque	Pitkin Chert, north central Arkansas
EVRTON	Brown Mottled	Everton Chert Breccia, north central Arkansas



but the actual distance from the group centroid was relatively small; only two of these, WO-1, with a probability of distance from the centroid of 0.0413 and DTM-2, with a probability of distance from the centroid of 0.1346, were below 0.35 probability. Most interesting, however, was the fact that all of the ungrouped exotic chert samples grouped with the debitage from the site. Two of these, NF80-2 and PITKIN had discriminant scores between the two groups, but still much closer to the debitage than the local materials.

Discriminant analyses were conducted using several of the known chert groupings as bases. The best discriminating variables from all of these analyses were then subsequently used in a cluster analysis of the lithic samples. The resulting cluster tree is shown in Figure 52. As is apparent from this tree, the local samples do not cluster well with the debitage samples, and no separate clusters are formed between individual local samples. The closest of these local materials to the main sample clusters are the two Dowden Creek samples, one of which actually enters the larger cluster immediately before the last of the debitage samples to cluster; the black mottled sample from Eagle Hill III joins the cluster. The rest enter at a considerable distance.

The debitage from 16 SA 50 forms two main clusters, one of which (on the left side of the tree) contains most of the debitage samples from the site. This cluster also contains most of the higher order (stronger) clusters formed; the first five samples to join are in this cluster. The other centrally located cluster mixes central Texas source samples with debitage from the site and surrounding areas. Actually, only two debitage samples from the site, CH-1 and WO-2, are included in the higher orders of this cluster; DT-2 does not join until much lower down in the analysis. The other two debitage samples included here are from the surrounding sites, IWO from the top of Eagle Hill and IIIITM from the site surrounding the gully where three of the opal samples were collected.

The strongest cluster in the mixed central Texas and debitage cluster is between CH-1 and one of the Georgetown samples, NF80-1. Although this particular debitage sample is excellent quality chert, certainly worth importing, it not only does not closely resemble the central Texas samples, but it is one of the most prevalent debitage types at the site (see Jolly, page 290). Thus it is difficult to argue that this group of samples is imported into the site from central Texas. The other 16 SA 50 sample in this cluster, WO-2, is linked first to a visually similar sample, IWO, and then, at a lower level, into the main group.

Little can be said with respect to the meaning of the links formed within the other main cluster. The two distinct dark tan mottled samples, DTM-1 and DTM-2, group with one another before joining to any other samples, although the two light tan mottled specimens, which join at the next lower level, are each grouped with another sample first. On the whole, however, there is no obvious grouping in terms of either visual types, local-area-region designations, or excavation substrata.

Since the majority of the debitage samples identified and tested are potentially regional (either regional, local/regional or regional/area), it is somewhat difficult to postulate significant groupings along these lines. It



is interesting to note, however, that both of the local samples tested, CH-1 and DT-2, group with the mixed central Texas-local debitage cluster. On the other hand, two regional samples are also included in this cluster.

More specific conclusions regarding the relation of the local debitage to area chert resources will have to await further analysis of the local chert gravel deposits. One conclusion seems warranted, though: none of the debitage samples studied shows any relationship to the local opal samples. Although visually similar in some cases, they are chemically quite distinct from these local source materials. It is perhaps possible that either the IIIBLM or IBLM samples, which do not group well with the main debitage clusters, might be local opals; but none of the site debitage shows any evidence of being such. In addition, it is possible that there are at least two major chert sources represented at the site, one which corresponds to the central Texas debitage group and the other corresponding to the main debitage group. The similarities of the former group to central Texas cherts is noted, but there is insufficient evidence as yet to understand the possible relationship.

### Conclusions

An analysis to understand some of the potential relationships existing between artifacts excavated from 16 SA 50 and their possible sources through chemical analyses has been presented. Although no unquestionable source has been identified, the similarities between one of the small group of sherds (8 and 20) suggest that they may have been made in the general area of the site. The failure to identify other discrete source areas is unfortunate, but general areas of origin can be hypothesized for further testing with a more extensive collection of source samples. The larger group of sherds, for example, may come from a Miocene upland area similar to the environment of Eagle Hill, while the smaller unusual group may come from sites on the Sabine or Red River floodplain.

Difficulties with the analysis of the chert sample trace elements were anticipated because of the extreme variability in their chemistry, even within the same cobble. The scattered nature of the chert outcrops in this part of Louisiana naturally makes the identification of a discrete source difficult. The fact that there are two distinct groups of chert from the site, one of which clusters with central Texas cherts suggests possibilities for further analysis. And, in itself, the evidence against the utilization of local silicates is significant and somewhat surprising. Analysis of a larger sample of material from the site should provide more data on this.

### III. CULTURAL CONTEXT AND FORMAL CONTENT

#### A. EAGLE HILL ENVIRONMENT, LITHICS, AND DYNAMIC UTILIZATION ANALYSIS (Gunn)

##### Introduction

The study of Eagle Hill fell naturally and comfortably into two parts, because of a 6000-year hiatus between the upper and lower strata in the site. The missing interval is significant not only stratigraphically, but also environmentally and culturally. A Paleo-Indian or lithic period is associated with the lower stratum, while the upper stratum is clearly inhabited by ceramic period people. The following sections are organized accordingly. The site is on a ridge, exposed and highly vulnerable to the elements. Marginal habitats, such as Peason Ridge, are sensitive barometers to climate, demography, and probably many other data. As we shall see, properly treated lithics are no exception.

##### The Eagle Hill Literature Search Problem

The assemblage of artifacts recovered by excavation from the Eagle Hill site was substantially different from what had been anticipated. The report of the test excavations (Servello n.d.) and previously described sites from the region, such as the John Pearce site (Webb, Shiner, and Roberts 1971) and the Whatley site (Thomas and Campbell 1978), strongly foretold a Paleo-Indian occupation with large numbers of formal tools, such as points, scrapers, burins, and drills. Our careful excavation of 30 m<sup>3</sup> of sediments resulted in only enough tools to confirm a Paleo-Indian component at the bottom of the site and a long chronology ranging from the lithic period nearly to the present. Of the thousands of artifacts recovered, over two dozen could conclusively be identified as formal tools. The remainder were flakes and ceramic fragments.

This turn of events altered the literature search from a rather routine examination on the background of regional lithic and ceramic development to an in-depth examination of the literature from a completely different point of view. Our initial tactic would have been to compare tools recovered from Eagle Hill with those found at other sites, determine proportions of tool kits, and infer functions in a standard manner. Full realization of the type of assemblage we were dealing with required a reworking of the original plan. The questions to be resolved became a matter of why the atypical assemblage was at the site and how to make use of the nonstandard data to interpret prehistoric lifeways on top of Peason Ridge. The composition of the assemblage can be explained as a combination of the habitat in which the site is located and the resources available at the location.

The assemblage of flakes and how to make use of it for cultural interpretations complicated the literature review process. We assumed that the flakes we recovered were products of refabricating the types of tools found at other regional Paleo-Indian sites. Our analysis is, therefore, one step removed from the normal examination of formal tools, and our literature search had to be more demanding in order to show the genesis, development, and utilization of

the envisaged tools from which they came. This combination of circumstances, expecting formal tools and finding only flakes, forced a reorganization of our view of flakes, which we feel may be quite productive. The study of formal tools is, in fact, a study of end products of utilization, the part that was no longer useful to the prehistoric artisan. On the other hand, the study of flakes removed from the still useful tool is an examination of the tool use system in its dynamic aspect. We will return to the idea of "dynamic utilization analysis" presently.

### Environmental Control of Peason Ridge Occupation

It seems that the predominant flake composition of the Eagle Hill assemblage is a product of its location in the regional environment. The site is high and sometimes dry on Peason Ridge. Periods of dryness are a part of both the seasonal cycle and the long term climatic cycles. During seasons or periods of high precipitation and/or low evapotranspiration, the sands of Peason Ridge act as an aquifer. The sands portion out water through springs and streams until it is expended. During periods of low precipitation/high evapotranspiration springs and streams are absent and, no doubt, the ridge is quite dry. Human occupation will be encouraged or discouraged by the availability of water. Sites would only be able to assume permanent status if water was available year round. There is no evidence of permanent occupation. It seems likely that water was never permanent.

In support of this position, local, long term, periodic dryness can be inferred from the 16 SA 50 sediments. The Eagle Hill site is a peculiar sediment trap, which appears to have partially resisted erosion for at least 100,000 years. A few meters in any direction, however, the beds are eroded down to the Miocene lake deposits. The timing of the erosive periods can be determined from the depositional/erosional sequence in the site. There is a developed Pleistocene soil with the A horizon removed (Soil Horizon III), an early Holocene soil with the A horizon removed (Soil Horizon IIB), and a late Holocene soil (Soil Horizon I) with an A and B horizon.

The rhythm of Holocene climatic change on the Gulf Coastal Plain was extensively researched in section II, and the results correlate logically with the Eagle Hill upland erosional/depositional sequence. The pivotal interval is the Hypsithermal (4500 to 7500 B.P.). The middle Holocene is characterized by net aggradation in the river bottoms of the Southeast. Sedimentation in one part of the system implies erosion in another. Given the biotic evidence for the middle Holocene in the Southeast, it seems reasonable to assume that the dry and probably unstable climate resulted in impoverished upland vegetation and degradation of upland soils, including that on Eagle Hill.

By contrast, the early and late Holocene periods before and after 4500 to 7500 B.P. were generally cooler and wetter, although there were exceptional intervals. We would expect stable, verdant vegetation during these periods in the uplands and net aggradation in topography subject to colluviation. This is, in fact, the situation at Eagle Hill.

The late Holocene sequence is of special interest relative to the sensitivity of the interaction between the cultural and climatic sequences. Existing deposits start during the cool interval between 1000 and 1300 years ago (A.D. 700-900). This period is marked by a heavy occupation of the site, which supports the inference of a well-watered environment. There is, however, a great concentration of artifacts on Soil Horizon I/II interface, nearly twice as many as any other substructure. One might expect that these artifacts were a result of early Holocene occupation and were deflated from the now eroded Soil Horizon IIA. An intensive analysis of debitage from the test excavation (Servello n.d.), however, indicated that the flakes were more closely related to the late Holocene specimens than to the early Holocene assemblage. If we follow the reasoning that Peason Ridge was occupied during moist periods, the period 3400-3900 B.P. is not represented in extant and radiometrically dated horizons at Eagle Hill. This time period variously termed "Late Archaic" in the Southeast and "Middle Archaic" in Texas, is normally well represented in archaeological sites. It seems probable, therefore, that artifacts deflated onto the I/II interface are the remains of a Middle Archaic Eagle Hill occupation. There are two diagnostics to support this contention. Sedimentologically, the inference must be made that there was an erosional episode within the late Holocene.

The literature supports a rather consistent set of cultural-demographic-climatic relationships across the Southeast for contrastive wet and dry periods. The middle Holocene/Middle Archaic is dry and so low-profile culturally that it is practically untraceable in most regions. The dry and unstable climate apparently precluded large populations. The general lack of cultural development in spheres other than subsistence-oriented activities suggest a nomadic lifeway probably restrained by scarce resources. The exceptions which prove the rule are persistently stable "resource oasis" such as the Tennessee Valley (Lewis and Lewis 1961) and the climatically exempted coastal regions (Gagliano 1977). In the immediate region of Eagle Hill, the Whatley site with its ideal microhabitat, natural weir, etc., may be such a place.

Cooler and/or wetter times appear to support populations characterized by growth, progressive stability, and increasing cultural complexity. This phenomenon can be read in the archaeological record as occupation of the uplands, presumably forced by overutilization of lowland habitats. The occupation of upland habitats during the late Holocene is documented in Florida/Georgia (Brose and Percy 1978), the upper Tombigbee River (Blakeman 1975a), and in the lower Mississippi Valley (Gagliano 1977; Haag 1965; Webb 1951). A similar trend appears to be developing in central and south Texas. The environment of Texas is quite sensitive to climatic change (Gunn *et al.* 1982), and the research by Gerstle, Kelly, and Assad (1978) shows there was a retreat to the lowlands during the inferred hot period between 2000 and 3400 years ago (1400 B.C. to A.D. 1). Peason Ridge would have been only slightly less affected by this trend because of its more easterly location.

The early Holocene appears to have experienced a similar set of cultural/climatic levels. Clovis populations were sparse either because they were a pioneer culture or because they lived during the relatively warm Two Creek interval. The presence of mammoth in Arizona suggests the former. In contrast, the Dalton occupation of the Southeast, appears to have experienced a

population explosion. Nearly 300 Dalton localities were reported in the eastern Arkansas region as early as 1973 (Schiffer 1975). The high frequency of Dalton period sites is accompanied by pioneer occupation of the uplands, so that the earliest artifact-bearing levels in most upland sites, such as Stanfield-Worley Rockshelter are of Dalton age (Goodyear 1982).

Should this very manageable relationship between climate, population, and occupation of upland habitats stand the test of future research, we can expect to infer that occupation and climate on Peason Ridge are very much in concert, and that we are probably able to account for all of the significant periods of habitation at Eagle Hill by climatic change. Low occupation frequencies during the middle Holocene would be matched by equally low sediment rates or erosion. There would be no sediment record and no cultural record to be made. Moisture early and late Holocene occupations would be duly recorded by sediments.

The likelihood that there was no middle Holocene occupation on Peason Ridge is supported by the lack of ground stone on the I/II deflated interface. Ground stone is the hallmark of the Middle Archaic. A metate was found in the ceramic age occupation, but there were no ground stone artifacts in the deflated horizon below.

#### Environmental Control of Recovered Lithic Technology

In a somewhat different sense, environment is also likely to be the reason for the lack of formal tools at the site. Three factors seem to be relevant. First, the site is removed from sources of high quality cryptocrystallines. Second, it is likely that there was a locally available, low grade source of siliceous materials. The likely product of this combination of circumstances, according to current efforts at a logistical theory for hunters and gatherers, is careful curation and refabrication of prized materials obtained from a distance (Goodyear 1982; Binford 1978). Less valued local materials, used for whatever purposes, were treated in a cavalier fashion. The net result for Eagle Hill is an assemblage in which local, discarded materials are frequent and only flakes remain of the more valued materials that were used, re-sharpened, and carried on to the next camp.

The fact that no valued material was ever cached at Eagle Hill can further be interpreted to mean that when hunters and/or collectors came to Peason Ridge they had no destination in mind as a part of a regular annual subsistence cycle. Under such a set of assumptions, items so cached would most likely never be retrieved and therefore would be wasted.

It is interesting to note that the assemblage is of a relatively consistent local/exotic composition over a period of ten millenia. Therefore, the site served the same basic function whether the operational base camp was a hunting or an agricultural village. This interesting prospect allows for a certain continuity in our analysis, which would be lost in a more ideally suited locality where function changes with the subsistence base and cultural evolution. In other words, the environmental situation acts as an information filter which allows us to examine adaptive solutions of people with vastly different world views under relatively controlled conditions. It is a good laboratory for the study of culture process rather than culture change.

### Lithic Period Background Research

As a result of the surprise assemblage recovered at Eagle Hill, we found ourselves returning from the field with a great deal of carefully collected information on platformed flakes, but few tools. We were unwilling, however, to give up the effort to achieve a meaningful distributional analysis of activities on our painstakingly excavated occupation horizons. This led to a re-examination of the problem of lithic use and wear analysis and resulted in a somewhat altered model and approach to the problem.

The concept to which we turned can perhaps best be termed "Dynamic Series Utilization Analysis." As is illustrated in Figure 53, the manufacture of artifacts can be divided into four basic stages. This is the commonly accepted generalized scheme for the use of lithics and accounts for most of the contingencies we might expect at Eagle Hill. Naturally, exceptions are likely to occur, but we can assume with some safety that Eagle Hill is a satellite camp because of its environmental situation. Lithic activity will consist mostly of refabrication, and one would expect discard. The reason for the expected lack of discard was discussed earlier as a probable effect of being unsure of destinations when on Peason Ridge. Essential tools were apparently brought to the ridge in a youthful, good condition and virtually always survived the activities so that only debitage remains. It is worth noting that when tools were found they were always solitary items, losses not caches. This conservative attitude toward lithics may have been encouraged by limited access to good lithics in Louisiana.

<u>Location</u>	<u>Stages</u>	<u>Activity</u>
	Enter System	
Quarry	1. Prefabrication	Testing and Preforming
Base, Satellite	2. Fabrication	Shaping
Satellite, Base, Field	3. Refabrication	Resharpener and Reshaping
Satellite, Field, Base	4. Discard	Failure to Refabricate
	Exit System	

Figure 53. *Stages of Lithic Tool Manufacture and Maintenance Relative to a Satellite Camp such as Eagle Hill.*

As a result of this strategy, we will be examining a stage in the life of a tool, which is obscured by the standard reduction models. This stage is best illustrated in Figure 54. The fabrication stage of an artifact is a product of some



sort of norm which accounts for the fact that a tool, if it is to have a long and useful life, must have within its structure the potential for a certain amount of refabrication. This "dynamic potential" falls within the acceptable range of variation for the tool.

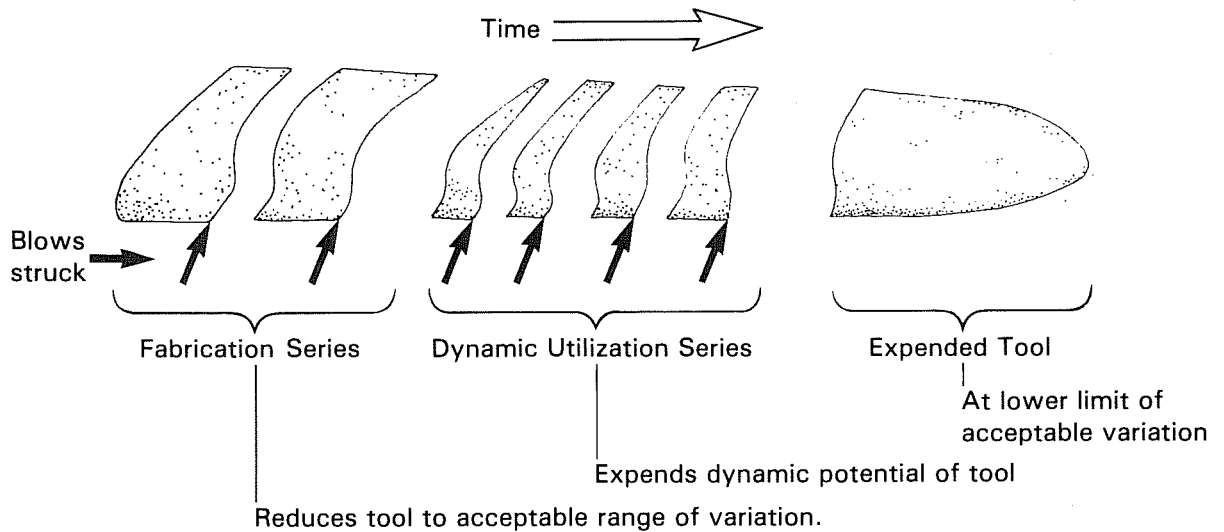


Figure 54. *Dynamic Potential Lithic Tool Utilization Series Model.*

In this model, the refabrication stage becomes a long period in terms of number of steps during which the dynamic potential of the artifact is used up. This dynamic utilization series consists of a number of flakes upon which the evidence of utilization appears. It can appear on the platform edge, the spines, or wherever else the tool contacts the subject material during utilization.

Eventually the tool is refabricated to the point that it no longer exists within the acceptable range of variation for its form. It can no longer be refabricated or it no longer offers the necessary purchase for holding or hafting. At this point, it has to be discarded or recycled to another tool form.

Given the circumstances of an apparent Paleo-Indian site whose neighbors possess sophisticated formal tools, it seems that the flakes recovered from Eagle Hill represent, at least in part, the dynamic utilization series component of the tool life series. The use of this model implied two actions on our part. First, we should do a more thorough than usual examination of the origin and evolution of formal tools in North America, especially relative to environments, in order to understand the likely genesis of our flakes. Second, it implied an attempt to use some of the new lithic use-wear analysis techniques on the flakes to verify that this system of lithic function was operative at Eagle Hill.

### Area Scale Lithic Period Chronology

In the following sections, literature relevant to the lithic period stratum at Eagle Hill will be reviewed. In order to focus this discussion directly on the problem it seemed advisable to formulate a chronology and spatial structure for the relevant areas, regions, and time periods of North America. Table 24 shows this general schema. North America is divided into three areal traditions (Fig. 55) defined by well-known general characteristics of the area. Phases are assigned within each tradition. The terms Pre-Clovis and Proto-Clovis are suggested to account for some new information that is appearing in the archaeological literature.

TABLE 24. AREA SCALE, LITHIC PERIOD CHRONOLOGY

Area/Tradition		Llano	Enterline	Cumberland
Period	Date			
Sedentary	4500-500 B.P.			
Ground Stone	7500-4500 B.P.		Middle Archaic	Middle Archaic
	11,500-7500 B.P.	Plano	Kirk Late Paleo	Serrated points Serrated points
		Folsom Clovis	Mid Paleo Clovis	Kirk Dalton Clovis Fluted bifaces
Lithic	15,000-12,000 B.P.	Proto-Clovis	Proto-Clovis	----- Mousterioid industry
	??????-15,000 B.P.	Pre-Clovis		Pre-Clovis Various possibilities

Enterline Tradition--Areally the Enterline tradition extends over the present northeastern United States. It is intended to mark those regions usually accepted as being periglacial and park tundra during the declining stages of the last glaciation. Naturally there is an element of the Enterline fluting technique and associated tool types intended. However, the Enterline tradition encompasses all apparently Clovis-related cultural manifestations in the area including antecedents.

Llano Tradition--The Llano tradition is conceived of as a similar broad scale concept which encompasses Clovis-related manifestations on the High Plains. Adjacent regions of the Southwest are also a part of the Llano tradition. It again includes antecedents and descendents. The Llano tradition seems to be characteristically big-game oriented, and its demise seems to be rather abruptly marked by the Hypsithermal. The northwestern Louisiana uplands appear to be a

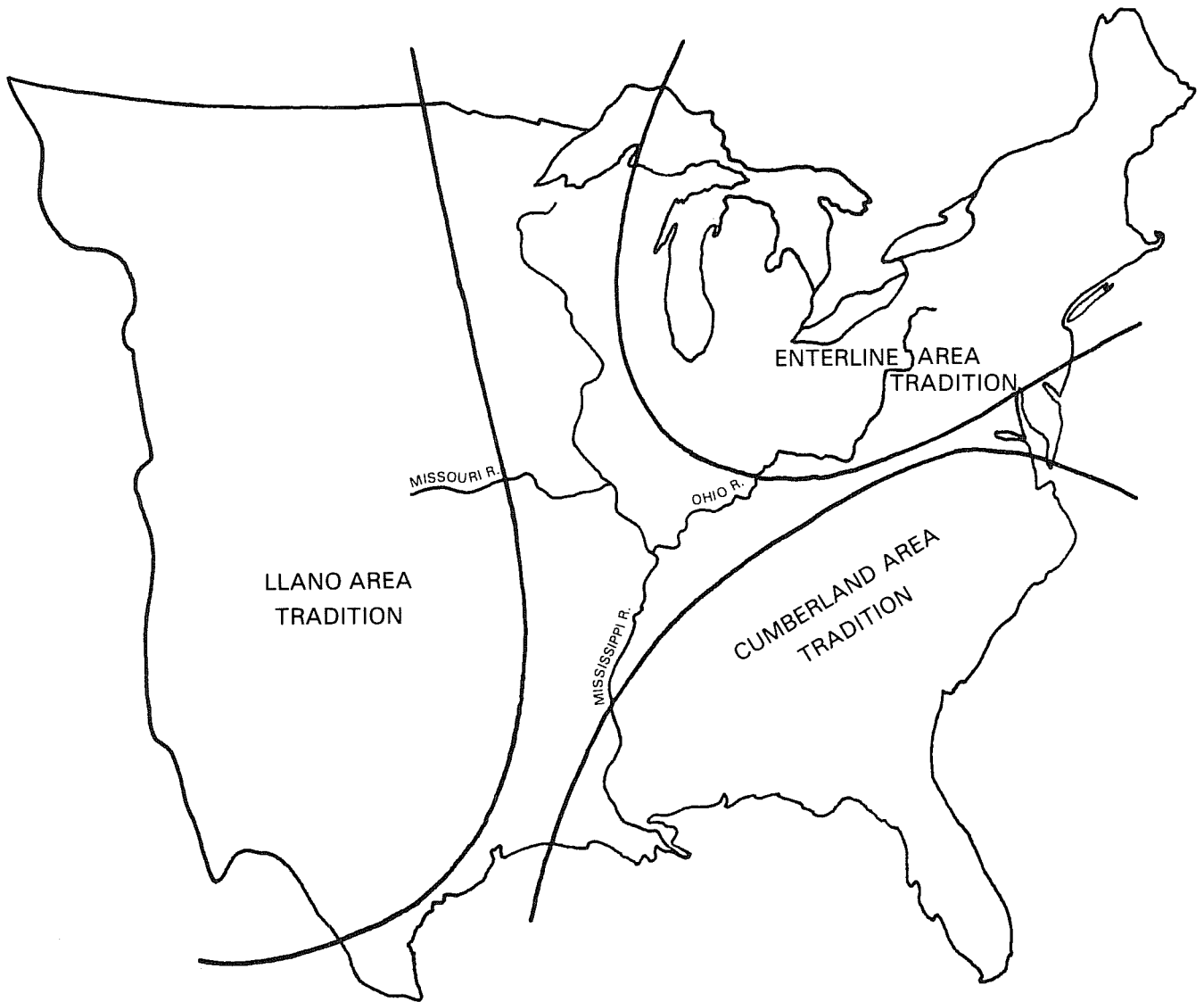


Figure 55. *North American Areas Relevant to the Literature Search.*

part of the Llano tradition during some periods (Gagliano and Gregory 1965; Haag 1965).

Cumberland Tradition--The Cumberland tradition appears to have been the first secure riverine adaptation by Clovis pioneers (Muller 1978). It is perhaps the first securely post-Pleistocene tradition in the New World (Fitting 1974). The Cumberland tradition is taken to include the Early Archaic of the Southeast, because of the technological continuity with the Paleo-Indian period. The northwestern Louisiana uplands appear at times to have also been a part of this tradition.

Pre-Clovis--The term is used to imply cultures before and not related to Clovis. So little is understood of Pre-Clovis culture that it hardly warrants mentioning. However, a growing body of evidence suggests that it does exist. In fact, Gagliano (1977) has made a convincing argument for a very ancient inhabitant of Mississippi. We are quite sure that whatever Pre-Clovis was, it is not represented at Eagle Hill. A Clovis-Llano tradition tool kit was discovered in the lowest stratum immediately above the culturally sterile Miocene lake sediments at Eagle Hill.

Proto-Clovis--Proto-Clovis is taken to mean antecedent and related to Clovis. Again there is firm evidence that the lowest stratum at Eagle Hill postdates Proto-Clovis. There is a growing and convincing body of evidence that is beginning to define Proto-Clovis culture. Two sites have been discovered in recent years, which do not contain lanceolate projectile points, but predate Clovis. Interestingly enough, they are located in glacial-margin areas of the northern United States. The Shriver site (Reagan *et al.* 1978) in northwest Missouri and Meadowcroft Rockshelter, western Pennsylvania (Adovasio *et al.* 1978), contain culture bearing levels below Clovis-related materials. Comparable tool kits containing trianguloid flakes (Mungai knives), bladelets, bifacing flakes, etc., suggest a Mousterioid industry and a logical antecedent to the fluted point tradition. Both of the sites date to about 15,000-13,000 B.P. and are within 200 miles of the ice front. Recent glaciological models of the life history of the Wisconsin ice sheet suggest an ice free corridor would have been present at that time. A rapid rise in sea levels about 16,000 B.P. supports this argument (Gagliano 1977).

Clovis--The Clovis phase is well dated and clearly identified in the Plains ca. 11,000 years ago. To date, evidence indicates a dedicated mammoth-hunting culture in the Llano area. The standardized tool kit, especially fluted points, suggests that fluting was probably experimentally developed somewhere in the periglacial homeland and adapted to the Plains environment at an advanced state of application. Fitting's (1974) classic study of cultural adaptation in eastern North America traces a torturous and probable long period of development of fluted points in the East, a position which is supported by the great diversity of points (Kraft 1973) at the Plenge site. Radiometric dates are unfortunately not available to support such a process, and chronological control is not very good in the East.

Hester and Grady (1977) found little evidence for territoriality during Clovis times on the Llano Estacado, instead there was considerable evidence for Clovis hunters of the Plains leading a spectacular wandering existence. Elephants are thought to have migrated from the Gulf Coastal Plain to the glacial fronts on an

annual round (Churcher 1978). Even if this migratory cycle was limited by half, as is indicated by two variants of mammoth (Eileen Johnson, personal communication), the migratory movements were still formidable, when compared to later Plains inhabitants. Not until the reintroduction of the horse in historic times were movements again so extensive. As evidence, consider that *Clovis* points made from material collected in the Texas Panhandle have been found washing out of the beaches near Beaumont, Texas (Long 1977). Such transport is not unusual for Clovis materials and suggests that Plains bearers of Clovis culture were indeed well traveled. This wandering seems to have ceased with Folsom people. Hester and Grady (1977) found rather definite evidence for territoriality on the Llano Estacado during the Folsom occupation.

Fitting (1974) thinks that Clovis period people settled rapidly into a more vegetable-oriented existence in the Cumberland area. His analysis stems from the proportions of hunting to gathering tools in respective northern and southern assemblages. It is supported by an apparent preference for islands of rich riverine resources. Clovis-related artifacts are frequently reported from the Tennessee Valley, eastern Arkansas-Mississippi Valley (Morse and Goodyear 1973), and the Mississippi Delta (Gagliano 1977).

During subsequent phases and subphases the contrast between Llano and Cumberland area lifeways became more pronounced. Naturally, the location of Eagle Hill on the border between two highly contrastive culture areas makes it of utmost interest to the archaeological community.

## B. LITHIC PERIOD (Mahula)

### Enterline Tradition

#### Introduction

In this discussion, the Northeast includes all lands east of the Mississippi River and north of Maryland, Virginia, West Virginia, and Kentucky. The northern boundary will tentatively be considered the southern boundary of the Valdres ice advance. It must be pointed out, however, that the southern boundary is extremely tenuous since cultural influences from the Southeast blur distinctions between archaeological assemblages in the Northeast and Southeast. The southern margin of the Valdres ice is considered (Willey 1966) to have run from southern Maine, across New York and southwestern Ontario, dipping southward around Lake Michigan, and turning northward again through central Wisconsin and southern Minnesota at approximately 11,000 years ago. With the discovery of the Debert site (MacDonald 1968) in Nova Scotia, well dated at approximately 10,600 years ago (Stuckenrath 1965), and the Holcombe Beach site (Fitting, DeVisscher, and Walha 1966), however, some rethinking of glacial chronology and retreat ensued. Borns (1966) proposes, after analysis of the chronological and geological position of the Debert site, that all of the continental ice had dissipated from northern Nova Scotia at the time of occupation. He thinks the margin of the Valdres age ice cap was less than 60 miles to the southwest with continuous snow as little as five miles to the north in the Cobequid Mountains. The site is underlain by a layer of aeolian sand deposited by southwestern winds under periglacial conditions from the surface of the wasting continental ice in the Debert River valley. All artifacts were either on or just within the

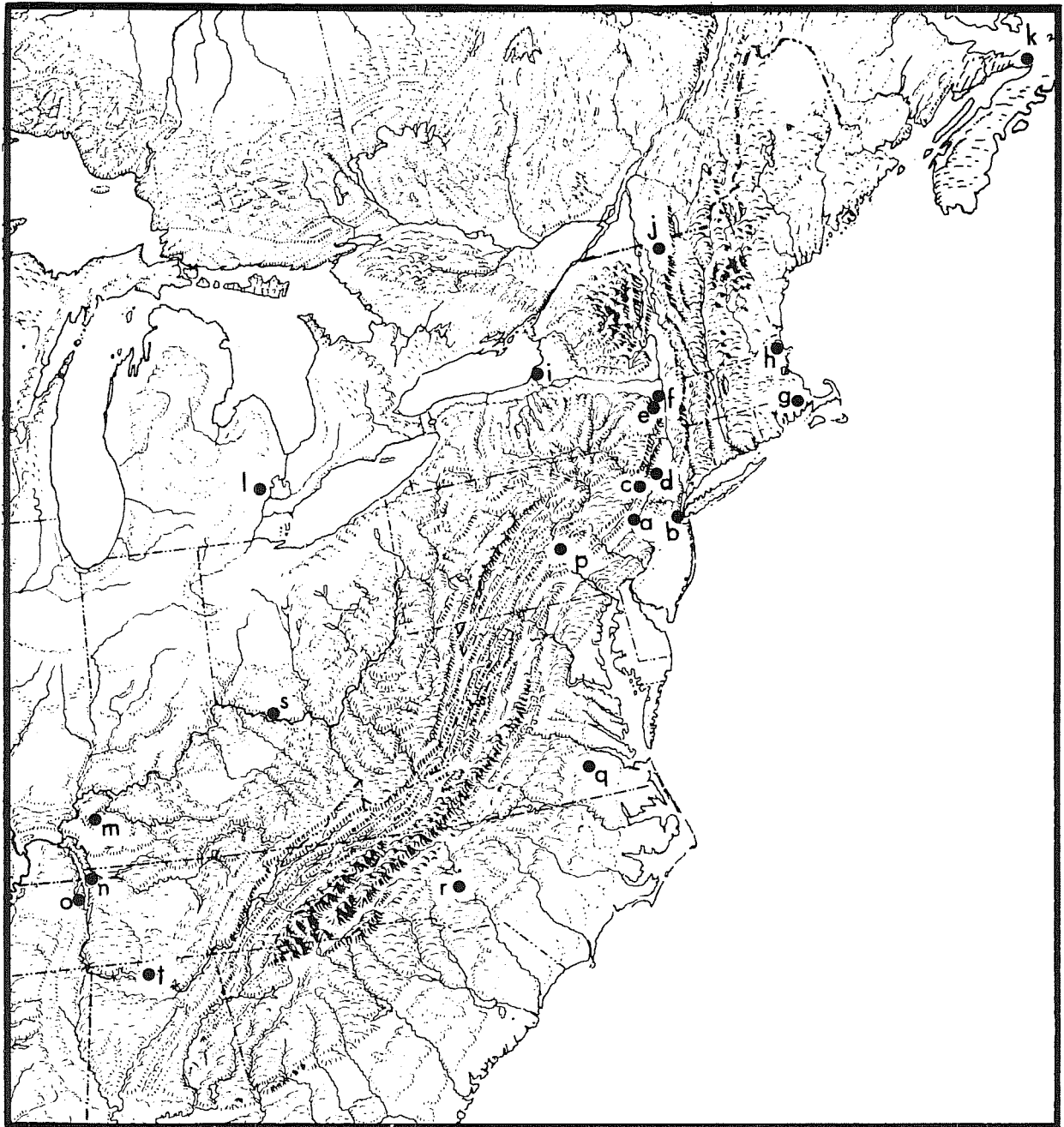
aeolian sand suggesting that occupation followed the beginning of the modification process. Debert inhabitants existed in an extremely cold, periglacial environment. Relative sea levels in the area, considering geologic uplifting and eustatic changes, were 100-200 feet lower than at present which would have considerably widened the land corridor from New Brunswick into Nova Scotia. This fact could prove significant to possible migrations of Paleo-Indians and perhaps offer a clue as to why they camped at Debert (Byers 1966: 53-55). In addition, there had been a minor oscillation from warmer to colder climate just prior to the occupation of Debert resulting in a tundra condition of continual permafrost. This climate lasted only a very short time, however, and with continual wasting of the ice masses and concomitant elevations in sea level, the character of the locality was soon altered. Distributions of major known early hunter sites in the Northeast illustrate known cultural limits of the region (Fig. 56). The foregoing notwithstanding, however, a pre-Valders occupation of more northerly regions is not an impossibility (Willey 1966; MacDonald 1971; Byers 1966).

In discussing man's earliest entry into the eastern regions of the continent, Fitting (1969, 1974) proposes that early man entering the New World would have had several options open to him. To the northeast, the ice front was bordered by a periglacial zone of treeless to park tundra. It consisted of a ground cover of grasses, sedges, lichens, and willows in the open areas interspersed with scattered clumps of spruce, fir, larch, and birch. Tree stands were densest along waterways and low drainage areas. The entire zone would have been characterized by poorly drained soils. Permafrost was possibly more than 300 m thick with seasonal thaws reaching only 10-60 cm (Ritchie and Funk 1973; Strahler 1969:251-269). An environment of this sort would have been suited to grazing mammals, such as the barren ground caribou and mammoth, and would have supported a small population of hunters (Ritchie 1969:212; Ritchie and Funk 1973:6-7).

Interdigitating to the south with the park tundra environment would have been a taiga or open cold woodland biome dominated by spruce, fir, jack pine, white pine, and a few deciduous species which would have been the haven for browsing mammals such as the mastodon, woodland caribou, woodland muskox, moose-elk, and some still extant species like deer, elk, moose, bear, and wolf. This environment would have had a high carrying capacity for game and was probably the principal milieu of the early Paleo-Indian hunter over most of the Northeast (Butzer 1964:138; Ritchie and Funk 1973:6-7).

Fringing this bountiful woodland to the south was a needleleaf (or boreal) forest composed of relatively few species of conifers including spruce fir and pine. This type of closed canopy evergreen forest has a low carrying capacity for game and would have been a rather inhospitable and a less productive environment for hunters.

Further to the south, grading into the southeast region, existed a temperate summergreen deciduous forest, characteristic of a humid continental climate, with a southward progression of a predominantly oak forest grading into richer forests of oak, beech, hickory, chestnut, birch, walnut, maple, basswood, elm, ash, and others (Strahler 1969:267; Ritchie 1969:213-214; Ritchie and Funk 1973:8). This area, laden with mast foods, would have held the highest carrying capacity for animals and man.



- |                              |                         |                    |
|------------------------------|-------------------------|--------------------|
| a. Plenge (NJ)               | h. Bull Brook (MA)      | o. Nuckolls (TN)   |
| b. Port Mobil (NY)           | i. Potts (NY)           | p. Shoop (PA)      |
| c. Zierdt (NJ)               | j. Reagan (VT)          | q. Williamson (VA) |
| d. Dutchess Quarry Cave (NY) | k. Debert (Nova Scotia) | r. Hardaway (NC)   |
| e. West Athens Hills (NY)    | l. Holcombe Beach (MI)  | s. Adams Co. (OH)  |
| f. Kings Road (NY)           | m. Parrish (KY)         | t. Quad (AL)       |
| g. Wapanucket 8 (MA)         | n. Wells Crater (TN)    |                    |

Figure 56. *Sites in the Enterline Area.* From Kraft (1973:58).

The most likely choice for early man from these options would have been to follow the periglacial front eastward along the edge of the retreating ice front (Fitting 1974; Dragoo 1976). The Shriver site and Meadowcroft Rock-shelter would be examples of early settlements.

Many no doubt did choose the periglacial environment--as distributions of fluted point sites across the Northeast indicate. Although extremely cold and moist, this familiar environment apparently attracted the ice age hunters who probably wandered in small bands upward along the major river valleys, where they kept principally to the elevated terraces, probably because of higher water levels at this time (Byers 1966; Jennings 1978).

Although the periglacial environment would have probably been a first choice for new explorers, its supportive character would have soon begun to alter. As the ice masses retreated, early hunters would have been forced to continually follow the glacial front northward. The periglacial zone would soon have deteriorated, due to changes in drainage systems with attendant changes in plant and animal associations, and the accompanying increase in periods of darkness with increases in latitude (Strahler 1969:256).

In general, deglaciation of the Northeast followed the autogenic succession patterns observed in the evolution of present day biomes. Although Davis (1969) has noted that the generally accepted progression of boreal forests northward following the maximum glaciation meets with some disconfirmation in the pollen record, most experts agree that, at least in general, the Northeast underwent just such a displacement of biotic zones. This, of course, still allows for considerable local variation due to highly specific combinations of drainage patterns, underlying geomorphic and resulting edaphic components, and local climatic patterns.

The pattern of autogenic succession in the Northeast following deglaciation is as follows. As the glacial masses dissipated leaving poorly drained depressions, bog succession invaded lowlands and shrinking lakes with a progression of sedges, rushes, and peat deposits followed by hygrophytic trees, such as spruce, followed in climax stages by mesophytes such as pine and fir. Most mountainous elevations and plateaus are characterized by closed canopy needle-leaf forests of mesophytes such as fir, pine, and mountain ash, which are dependent upon orographic rainfall, high humidities, and relatively flat temperature curves.

A northward movement of summergreen deciduous forests following glaciation would be dependent upon climatic change fostering humid continental climate which at the same time receives adequate precipitation in all months, and where there is a strong annual temperature cycle with a cold winter season and warm summer. As climatic regimes altered following deglaciation, probably by Middle Archaic times in the Northeast, the richer deciduous forest would have pushed northward fostering the expansion of the Archaic forest adaptation begun earlier in the Southeast. Temperate deciduous forests with a predomination of oak became established in the southern New England area around 8000 B.P. Later additions of beech, hickory, and chestnut with their attendant mast foods around 5000 B.P. set the stage for extensive occupation of the Northeast by Archaic peoples (Davis 1969; Ritchie and Funk 1973:37-39).



Following occupation of the periglacial region the attention of a hunting economy would have turned most naturally to the Plains and then to the parklike woodlands south of the boreal forests. Fitting (1968) proposes a wave of emigrants through this great belt of deciduous forest. In addition to being resource "rich," this area was not subject to great climatic fluctuations during the late Pleistocene and Holocene as was the Northeast. In fact, although the early hunter fluted point complexes were first discovered and defined in the Plains region, if sheer numbers of fluted points and accompanying tool types are any gauge, the heaviest Paleo-Indian occupation would have been in the East rather than the Great Plains.

### Paleo-Indian Complexes

Early man complexes in the Northeast are characterized by the fluted points discovered over the entire area and the general similarity in tool assemblages/types indicating a single, broad pattern of culture prevailing over the area. Some temporal and regional variations in the details of the typologies as a result of microenvironmental and lithic resource availability do, of course, exist. Byers (1966:36) characterizes this early fluted point tradition as belonging to the Llano complex as designated where first identified in the Great Plains. This complex is represented by a consistent group of unifacial tools composed of standardized end scrapers (most often spurred or "eared" which are almost a diagnostic trait); side scrapers, many also with graver spurs; bifacial and unifacial knives; single and multiple graters or perforating tools; and lanceolate projectile points with straight to concave bases usually trimmed by the removal of one or more longitudinal flakes from one or both faces. Characteristic types include *Clovis* and *Folsom* points with numerous subtypes in each category. Spokeshaves and side scrapers with one or more notched areas (also "strangulated" blades), probably used for processing wood or bone dart shafts, and flint wedges or *pièces esquillées* are also most consistently found in these early tool kits. Projectile points of similar general lanceolate form (such as *Plainview*) and lacking flutes are only associated with uniface artifacts similar to those of the Llano complex, so they must be considered as part of another tradition--probably a Late Paleo-Indian adaptation in the Northeast.

*Pièces esquillées*, as first recognized in North American assemblages at Debert, are described by MacDonald (1968) as being flakes (not necessarily blades or bladelike flakes) which evidence battering on opposite edges probably as a by-product of use as wedges for splintering bone, antler, or ivory. Experimental studies comparing flakes detached by bipolar flaking with those utilized as wedges for splitting wood demonstrated that *pièces esquillées* "can be as easily replicated by slotting and chiselling functions as they can by the bipolar technique of manufacture" (Cable and Most 1979:10). It is, of course, possible that *pièces esquillées* were bipolar cores and tools as well. MacDonald (1968:64) also suggests they could have served the dual purpose of wedge and burin, noting that in Old World sites as the incidence of *pièces esquillées* increases, the incidence of burins declines. It has been suggested that *pièces esquillées* are exhausted polyhedral cores. In many cases the discarded flake resembles (or is mistaken for) an exhausted polyhedral core suggesting an extensive blade industry.

Early Paleo-Indian assemblages are flake and not primarily blade industries (Byers 1966; Ritchie and Funk 1973). Tools are manufactured on lamellar flakes or reduced from bifacial preforms depending upon resource availability. It is primarily a uniface technology and a conservative one.

Lithic Materials--Another hallmark of Paleo-Indian industries is the use of exotic materials (usually heat treated) in the manufacture of tools. Heat treatment of stone, in order to improve workability, may well be another fundamental Paleo-Indian trait (Crabtree and Butler 1964). As these materials had to be curated from great distances they were generally used in an extremely economical fashion. Many theories have been offered to explain the cultural choices of these exotic materials. These range from purely functional to aesthetic and symbolic hypotheses. Goodyear (1979) hypothesizes that the preference for fine-grained cryptocrystalline materials was the result of a mobile adaptive pattern necessitating a portable and a flexible technology which could be instantly worked, reworked, and refashioned to meet the contingencies of quickly fluctuating hunting resources. High quality, easily flaked material could be more easily converted into new tools when broken. Traveling hunters forced to be prepared for any contingency would need dependable and portable "gear." The importance of being prepared for any eventuality is demonstrated by the Nunamiut Eskimo practice of caching tools at known hunting and lookout spots in order to avoid being caught without necessary equipment (Binford 1978:174).

Exotics are found to some degree in nearly every recorded Paleo-Indian assemblage. High quality cryptocrystalline materials in the Northeast include blue black flint from upper Mercer County, Ohio, chalcedony from Licking County, Ohio, and jasper from southern Pennsylvania.

Prey Species--Due to poor preservation conditions (acid soils, etc.,) there has been little success in gaining evidence on faunal species exploited by early man in the Northeast. At Dutchess Quarry Cave (Funk, Walters, and Ehlers 1969), six caribou bones were found in a basal stratum with a *Cumberland* fluted point and remains of modern fauna. Collagen from the caribou bones was radio-carbon dated to 12,530 B.P. However, the extreme age of the site (older than mammoth kill sites on the Plains) and the relatively late Paleo-Indian fluted point type, casts some doubt on the reliability of the association. Since sites such as Debert, Holcombe Beach, and Bull Brook (Byers 1954) were apparently reoccupied on a seasonal basis for long periods of time, caribou would have probably been the only species which would have been available in enough quantity to support settlements of this size and concentration. Also, utilizing animals with well-known migratory habits would allow the establishment of a central hunting camp, as opposed to many scattered kill sites. Remains of mammoth and mastodon, its forest browsing cousin, have been found in the Northeast and would have been available in some numbers for exploitation by early man.

The first incontrovertible association of mastodon and *Clovis*-type lithics recently appeared in the literature (Graham *et al.* 1981). Although the mastodon may have been the primary motivators for movements of people, other available animals were probably utilized as well. In fact, the "idea of elephant hunters based on the western United States model is probably a gross exaggeration" (Ritchie 1969:103). It is more likely they would have followed a balanced hunting economy adjusted to local conditions.

Site Types--Ritchie and Funk (1973) describe three basic types of sites for the Paleo-Indian phase in the Northeast: major recurrent seasonal occupation camps, small temporary hunting camps such as in rockshelters in caves, and quarry workshops. Debert, Holcombe Beach, and Bull Brook are representative of the first type and point strongly to the recurrent occupation of a favorable locale for the purpose of caribou hunting. Binford (1978:169-178) describes the Nunamuit patterns of spring campsites where numerous families come together seasonally at a strategically placed locale for the purpose of intercepting large herds of caribou during spring migrations. The caribou move in herds of 100-1000 through migration routes at intervals of twenty minutes up to one day. Groups are able to move up from the base camp to dispatch the animals as they pass through the restricted area. Aside from choosing a strategic position along the migration route, camps are placed in or near a good stand of willows near a source of reliable water, ice, or spring overflow and protected to some degree from the wind. Binford (1978:169) also describes many small or solitary scouting campsites from which individual hunters scout and predict herd movements and harvest early meat. This type of camp corresponds to such sites as Dutchess Quarry Cave and the numerous small fluted point finds scattered over the area, often in rockshelters and caves. Quarry workshops are self-explanatory and are evidenced by sites such as Williamson (McCary 1951) and West Athens Hill (Ritchie and Funk 1973).

#### Representative Sites and Tool Kits

Debert--Lithic industries evidenced at Debert (MacDonald 1968, 1971) exhibit extreme economy of material. A notable aspect of technology is the use of irregular flakes with only minor modification by retouch. Extreme conservatism has probably precluded the preservation of complete bifacial cores. No blades are found on the site: 80% of the assemblage are unifacial, predominantly end scrapers (1600), most of them spurred. Six types of end scrapers were identified. The most common was a peculiar "eared" variety limited in the Northeast to Paleo-Indian assemblages. Other types included round bit, end of flake (no blades at Debert), and humped-back. Side scrapers occurred in myriad forms. One percent of the assemblage was spokeshaves. Bifaces included two types of bifacial drill: a basally fluted twist drill for hafting, and a wide-based, hand-held variety. Other tools in the bifacial category were *pièces esquillées* (15%), bifacial knives, and two large thin bifaces.

Plenge--The Plenge site (Kraft 1973) is the first extensive Paleo-Indian site to be discovered in New Jersey. It is located in an area of extremely rich lithic resources in the form of cobbles of shale, flint, jasper, and chalcedony deposited by terminal moraines. There was a long, intensive occupation of the site from Paleo-Indian to Early Archaic, probably due to the quantity of quality material. Numbers of fluted artifacts were found: knives, points, and preforms. Of the 49 points, 59.2% had a single flute on each side; 40.8% showed multiple flutes on each side. Three small, hafted knives similar to those from Debert were recovered; two were reworked from points, while one was made on a flake. Of the total inventory, 10.4% were bifacial knives of two different types--blunted knives on flakes and crude biface knives. Unifacial artifacts included side scrapers of varying design, with end scrapers making up the bulk of the assemblage. Of the end scrapers, 32.6% had graving spurs and probably many more were worn away. Thumbnail and steeply beveled

"keeled" or hump-backed scrapers were present along with end-of-blade scrapers and hinge fracture scrapers. Spokeshaves (concave scrapers) and "strangulated blades" uniaxially chipped, predominantly with a single concavity, accounted for 5.5% of the total inventory. Other tools included burins, graters (many hafted), beaks, denticulates, thick biface drills, perforators, and *pièces esquillées*. Although the latter are rare--Kraft (1973) suggests possibly they are not found as frequently at sites where lithic materials are abundant. Table 25 compares artifact types and lithic techniques at Plenge with other northeastern and some Plains Paleo-Indian sites.

Bull Brook--Fluted points recovered from Bull Brook resemble *Clovis* points and are similar to those found at Williamson and Shoop. They are believed to be representatives of the Enterline Chert industry. Finely chipped, needlelike uniface graters, some with more than one point are also found, along with examples of a bifacial "twist" drill and one "spokeshave shaped" instrument. Snub-nosed end scrapers with the bulb of percussion removed are characteristic. Other tools include side scrapers with graver spur on heels, thin side scrapers made from retouched blades, retouched blades, and *Enterline* side scrapers. Byers (1954) points to the similarity of the Bull Brook site assemblage with that of the Lindenmeier site. Again, others suggest these assemblages are flake rather than true blade industries. No polyhedral cores were recovered.

West Athens Hill--West Athens Hill (Ritchie and Funk 1973) is a quarry-campsite on the Hudson River. Most of the material at the site is Normanskill flint with small amounts of Pennsylvania jasper. Occupation probably dates back to early Anathermal with vegetation sparse along the rocky hill upon which the site rests. Large biface cores are absent. Bifaces recovered were grouped into four sets, each representing some stage in the production of projectile points and knives. Thirteen fluted points were excavated, all conforming to the *Clovis* fluted type. Unlike many other Paleo-Indian sites, side scrapers outnumber end scrapers. Side scrapers were made from almost any convenient flake, blank, or core, whatever its size or shape. Most conform to the "ear-shaped" category found at many eastern Paleo-Indian sites. Others were of a "turtleback" form. Unique was a massive, fist-sized "pulping plane" heavy tool with a roughly retouched edge. The great majority of end scrapers are of the classic triangular or trapezoidal form with the bulbous face unmodified. A small proportion are of irregular form. Two are double ended. Some have sharp or right-angled corners which, like spurs, could have been used for graving. Only one graver and only five examples of *pièces esquillées* were found in the collection. This lack of *pièces esquillées* at a site where lithic material is in abundance conforms to the pattern at the Plenge site. *Pièces esquillées* may well be a product of an extremely conservative lithic industry.

Shoop--Shoop is the type site of Witthoft's (1952) Enterline Chert industry. He proposes this to be the oldest cultural manifestation in America and describes it as a blade industry without microliths (see disagreement with this proposition in earlier section). Tools include pointed side scrapers with the tip or bit generally at the bulb end of the "blade," end scrapers, bladelets, flake knives, and uniface graters based on flakes. Tools are predominantly manufactured of Onodaga chert from an area 200 miles from the site.

TABLE 25. COMPARISON OF ARTIFACT TYPES AND LITHIC TECHNIQUES IN SOME NORTH AMERICAN FLUTED POINT INDUSTRIES

Artifact Types	Selected Attributes	Plenge site	Northeastern Sites										Western Sites				
			Bull Brook	Debert	Holcombe	Kings Road	Port Mobil	Potts	Reagen Late Paleo/ Early Archaic	Shoop	West Athens Hill	Williamson	Wells Creek Crater	Lindenmeier	Black Water Draw		
Fluted points	<i>Debert</i>	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
	<i>Clovis</i> -like	x	x	-	x	x	x	x	-	x	x	x	x	-	-	x	-
	<i>Folsom</i> -like	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Stubby	x	-	-	-	-	x	-	x	-	-	-	x	-	-	-	-
	Lanceolate	x	-	-	x	-	-	-	-	x	-	-	x	-	-	-	-
	<i>Plano</i> -like	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unfluted, Paleo	x	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	
Bifacial Knives	Large (over 10 cm)	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	x
	Small	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	x
	Concave based eared Fluted complete	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-
Drills	Bifacial chipping	x	x	x	-	-	-	-	-	-	-	-	x	-	-	-	-
	Unfluted on flake	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
	Unfluted expanding base	x	-	-	-	-	-	?	-	-	-	-	x	-	x	-	
	"Twist" drills	x	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-
<i>Pièces esquillées</i>		x	x	x	-	-	-	-	-	-	x	?	-	x	-	-	
Erid scrapers	Spurred	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	?
	Rounded bit	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Hump back	x	-	x	-	-	-	-	-	x	x	-	-	-	-	-	-
	"End of blade"	x	x	x	-	x	x	x	x	-	?	-	-	-	-	-	-
Side scrapers	Subtriangular	x	x	x	x	x	x	x	x	x	x	x	x	?	x	?	-
	Bulb at tip	x	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-
	Ridge-backed	x	x	x	-	-	-	-	x	x	x	x	x	-	x	x	-
	Form with graver spur	x	x	x	-	-	-	-	x	x	x	x	-	-	-	-	-
Flake perforators	x	?	x	x	-	-	-	-	-	-	x	-	?	?	-	-	
Stone Awls	?	x	x	-	-	-	-	-	-	-	x	-	-	-	-	-	
Gravers	x	x	x	x	-	x	x	x	x	x	-	-	-	-	x	-	
Chisel graters	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	
Spokeshaves	x	x	x	x	x	-	x	x	-	-	-	-	-	-	?	-	
Scraping planes	?	-	x	?	-	-	-	-	-	-	-	-	x	-	x	-	
Choppers	x	-	x	?	x	-	-	-	-	-	-	-	?	-	x	-	
Hammerstones	x	x	x	x	-	-	-	-	-	-	-	x	x	x	x	-	
Bone artifacts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	
Pigment	-	x	x	-	-	-	-	-	-	-	-	-	-	-	x	-	
Bifacial cores	x	-	-	x	-	-	-	-	-	-	-	-	-	x	?	-	
Flakes with bifacial striking platforms	?	?	x	?	-	-	-	?	-	-	?	-	-	x	x	-	
Polyhedral cores	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	
Elongated flakes	x	x	x	x	-	-	-	x	x	x	?	x	x	x	x	-	
Ground striking platforms	x	x	x	x	-	-	-	?	?	x	?	x	x	x	?	-	
Ground point margins	x	x	x	x	-	-	-	x	x	x	x	x	x	x	x	-	
Sample size		1017+	4000	4400	390+	371+	68	179	800+	1467+	2000+	2000+	?	?			

SOURCE: Modified from MacDonald 1968:144 and Kraft 1973.

## Late Paleo-Indian Developments

Traces of the Late Paleo-Indian period in the Northeast are very rare and sporadic and are probably best represented by sites such as the Reagan site (Ritchie 1953) in northwestern Vermont, the Brohm site (MacNeish 1952) on Thunder Bay on Lake Superior, and the Renier site (Mason and Irwin 1960) in northeastern Wisconsin. Stray finds of *Plano* points have been discovered as far north as New Brunswick in Canada. They are rare in the central Northeast, but are found frequently in the Ohio and Tennessee Valleys. Further to the south and east they appear to diminish, while *Dalton* points, a Late Paleo-Indian type from the Southeast, take over in complementary distribution (MacDonald 1971:37). A cultural trade-off seems to exist between the Plains and the Southeast during the Late Paleo-Indian period, with *Plano* points filtering slightly southeastward, and Dalton influences moving into the Plains, as evidenced by the presence of the *Meserve* point on the southern Plains.

The Reagan site in Vermont documents the end of the fluting tradition in the Northeast. Lanceolate projectile forms with parallel flaking are found in a typical Enterline Chert industry assemblage, although possibly a "less pure" expression (Byers 1954). One form of projectile point, a fluted lanceolate pentagonoid form, resembles the fluted lanceolate pentagonoid group from the Williamson site and is also classified as belonging to the Enterline Chert industry (Witthoft 1952). The rest of the assemblage is composed of typical eared and spurred end scrapers, side scrapers, flake knives, graters, and combinations thereof. A *Sandia*-reminiscent, weak-shouldered knife (?) was also recovered. The tool kit is in all other respects representative of those of the fluted point tradition. The Reagan site may actually be considered a late Middle to Late Paleo-Indian transition.

The Brohm site and the Renier sites are representative of a Plano occupation along the Northern Great Lakes between 10,000 and 8000 years ago. Apparently groups of Plains-adapted groups moved northeastward during warmer times and occupied lakeside environments in this area. Both sites were seemingly occupied for a limited time and not reoccupied again. There is no evidence of a Late Paleo-Indian to Archaic transition on the Great Lakes. The Plano occupation is represented at Renier by ripple-flaked, lanceolate points, *Eden* and *Scottsbluff* points, ripple-flaked scrapers, and other forms. Large ovate bifaces of quartzite were also found (Mason and Irwin 1960; MacDonald 1971).

The Brohm site on Thunder Bay yielded seven typical *Plainview* points and a series of large blades made of jaspery taconite. Two large triangular points and a long, round-based point with ripple flaking were also found along with a bifacially chipped drill (similar in form to Archaic and Woodland forms), several large knives or "daggers," and some square and ovoid thin bifaces. Fan-shaped, snub-nosed end scrapers almost identical to those from the Plainview site and *Folsom* points similar to those found at the Lindenmeier site were recovered, as well as other forms of ripple-flaked end scrapers, large side scrapers, and flake knives. Large, pointed or "pick-like" choppers and ovoid choppers completed the tool kit.

## Transitional and Early Archaic

There has been no clearly defined transition from the Late Paleo-Indian to the Archaic period in the Northeast. Since the region was subject to major shifts in environment, it was occupied and abandoned or at least subjected to extremely low population density as ecological conditions altered. "The Northeastern picture suggests rather a displacement of Plano industries only weakly represented at best, with Archaic industries from the South" (MacDonald 1971:38). As deciduous forests moved northward, already adapted Archaic cultures moved, or at least their influence moved, northward with the advancing forest line. There has been some suggestion of very late Plano to Early Archaic development at the Canadian Shield at about 7000 years ago as evidenced by the presence of generalized lanceolate forms in the Shield Early Archaic.

There has been an absence in the Northeast of well-dated Archaic cultures older than 5000 years ago. Recent discoveries made on Staten Island, New York, have produced the first Early Archaic expressions similar to those found in the Southeast. (All reported by Ritchie and Funk 1973:38.)

The Hollowell site revealed an Early Archaic assemblage previously unknown in the Northeast: 30 projectile points, most with bifurcated bases, conforming closely with the *Kanawha* type dated at 8210 B.P. at the St. Albans site, and an *Eva Notched* type. Also found were several large, ovate choppers, biface knives, small flake scrapers (some end and some side), utilized flakes, hammerstones, abrading stones, an adze fragment, and two bifacially chipped celts with ground bits.

Ward's Point revealed *Kanawha Stemmed*, *Kirk Stemmed*, and *LeCroy Bifurcated-Base* points, a biface knife, retouched flake side and end scrapers, a small retouched tool with three graving spurs, a drill fragment, about 75 choppers, anvilstones, abrading stones, and a possible bannerstone fragment. Two charcoal samples have been dated at between 7310 and 8300 B.P.

Richmond Hill has produced small corner-notched, ground-based *Palmer* points, *Kirk Corner-Notched* points, what appears to be a *Hardaway* point, retouched flake end and side scrapers, and choppers. A hearth sample yielded a date of 9410 B.P.

The Middle Archaic period is also hazy. However, late Middle to Late Archaic cultures in New York are well represented and will be discussed here for comparison. Diagnostics for the Lamoka culture include beveled adzes and certain bone and antler items: celts, adzes, chisels, worked beaver incisors, bone awls, antler flakers, drills, anvilstones, and hammerstones. Fishing was of primary importance as well as the hunting of white-tailed deer. The Lamoka culture is firmly dated at 4500 B.P. Sites are located on small lakes, which are in close relationship to present day topography. Paleocological data suggest conditions for support of the Lamoka lifeway existed at about 6000 B.P. Sheep Rock Shelter in Pennsylvania shows it was already established by 9000 B.P. where all faunal remains are modern. Archaic groups were apparently visiting the lower Hudson Valley between 6000 and 7000 B.P. as shown by the chronology at Sylvan Lake Shelter. A modern biome existed, but the bifurcated base and other early southeastern point types are lacking, and the lower level assemblages seem to be linked with northeastern developments of the Middle and Late Archaic periods (Ritchie and Funk 1973:38-41).

## The Llano Tradition

### Introduction

Early man's presence in North America has always best been known from sites on the Great Plains. Clovis sites, the oldest of the Big Game Hunting traditions have been well documented and well dated in this region with evidence as far back as 12,000 years ago. The early discovery of Plains Paleo-Indian adaptations and good conditions for preservation of faunal and other materials have caused this tradition to be better understood on the Plains than in eastern regions, where similar lithic traditions are at least as old if not older than to the west. Big Game Hunters or Paleo-Indians are characterized by distinctive lithic assemblages and most classically by the presence of stylized lanceolate projectile points and certain types of flake tools. Representative point types and accompanying cultural traditions are: *Clovis* (Early Paleo-Indian or Llano); *Folsom* and its related forms--*Plainview* and *Midland* (Middle Paleo-Indian); and *Agate Basin*, *Eden*, *Scottsbluff*, *Cody*, and *Angostura* (Late Paleo-Indian or Plano). Paleo-Indians occupied the High Plains from at least 12,000 B.P. to approximately 6000 years ago in some areas. *Clovis* points and most other Paleo-Indian points have a wide distribution throughout the High Plains, as well as into the desert regions of New Mexico and Arizona, where paleoclimatic conditions were substantially moister and cooler than at the present time (Fig. 57).

Clovis sites are primarily kill sites, such as Naco (Haury 1953), Domebo (Leonhardy 1966), and Murray Springs (Haynes and Hemmings 1968), where mammoth were hunted. Portions of disarticulated skeletons along with numbers of stone and bone tools have been found. Unfortunately, the lack of occupation camps has skewed the proportions and types of tools in tool kits, so that comprehensive analysis of tool kits has been difficult. Several stratified campsites have been discovered, however, and these have done much to clarify the picture of these early cultures. Lindenmeier and Blackwater Draw sites are prominent in this list.

Based especially on the Hell Gap sequence, *Plainview*, a projectile point found in rather limited distribution seems to be a transitional form between *Clovis* and Middle Paleo-Indian *Folsom* points, both in style of projectile point and prey species exploited--bison. *Plainview* points are similar in flaking and form, but are not a classic *Clovis* point. They are basally thinned, but do not carry the extent of fluting (Irwin 1971:47). At Hell Gap, the level below *Folsom*-related materials dates to at least 10,500 B.P.

Stratified, long occupied sites such as Blackwater Draw, Lindenmeier, and Hell Gap have supported each other and helped clarify the Paleo-Indian evolutionary sequence. The point sequence at Hell Gap goes from pre-*Folsom/Plainview* (?) through later *Plano* styles. Also at Hell Gap, *Folsom* points are followed by *Midland* points which resemble *Folsom* points, except they are unfluted. The suggestion has been made that a *Midland* point is a *Folsom* point which is too thin to flute. However, *Midland* points have been found in sites where no *Folsom* points were found. *Folsom* points have been dated at Lindenmeier at 10,830 B.P. *Agate Basin* points follow *Midland* points and are dated at about 10,000 years or possibly a little younger. *Agate Basin* points have a wide distribution far into Canada and along the Hudson Bay (Irwin 1971).



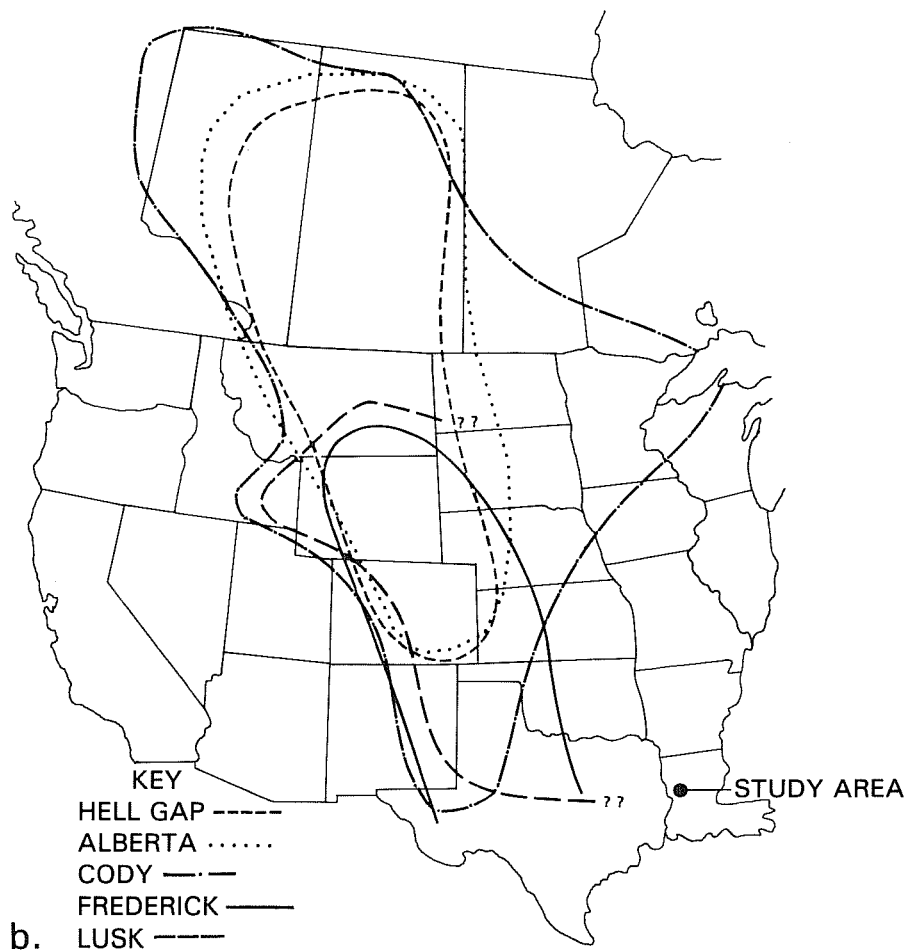
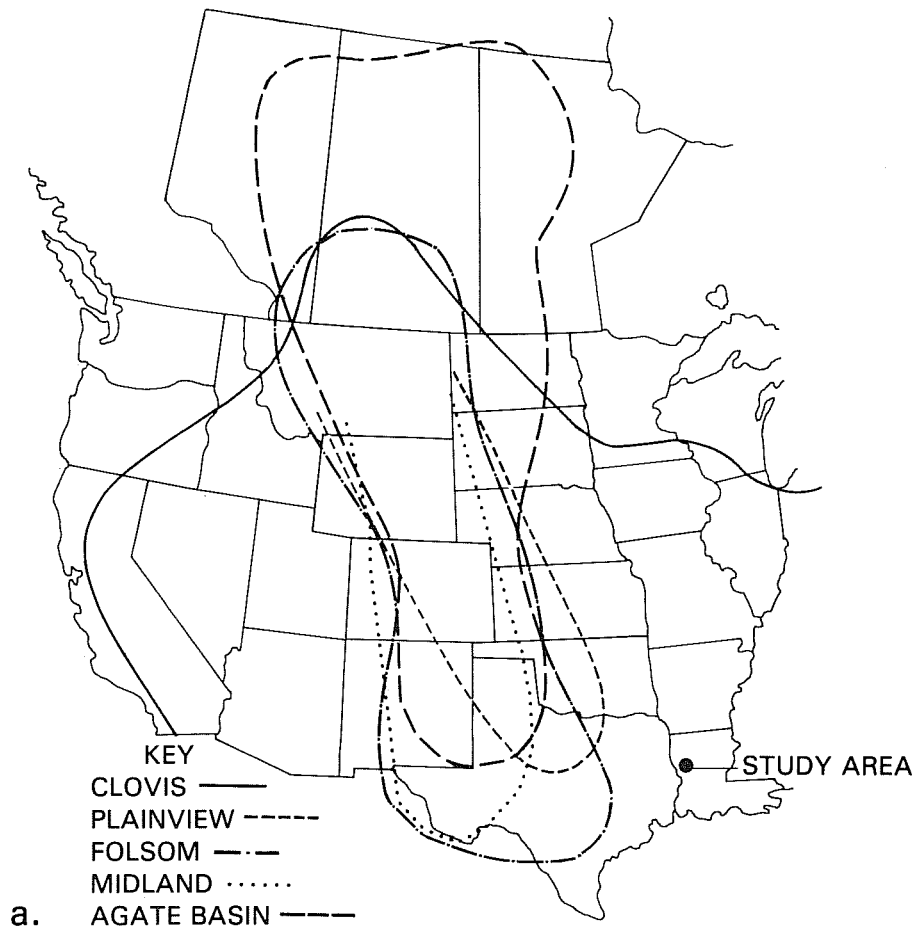


Figure 57. *Geographic Distribution of the Paleo-Indian Llano Tradition.*  
 a, 10,000-11,500 B.P.; b, 8000-10,000 (after Irwin 1971).

Agate Basin is followed by the Alberta complex. This complex is widespread to the north, but limited in the south. The Alberta complex is followed by the Cody complex, one of the most spectacular in terms of flintworking skill. This complex is also found far into Canada and extensive evidence for trade in flint is indicated. We have already mentioned distributions of Plano industries in the Northeast and Southeast. These distributions mark the northward and eastward movement of the Plano cultures. Another Late Paleo-Indian point which has long been involved in controversy is the *Angostura*. It is the last of the Late Paleo-Indian types and is often assigned to an Early Archaic horizon in some areas such as Texas. A date from the Greene site of 7930 B.P., however, (Monseth 1967) suggests it represents the last known Paleo-Indian hunters of the Plains. Following the Plano complexes are the Archaic traditions, tools gradually change with point styles moving toward notches. Different tool types and major changes in economy and settlement patterns transpire.

The origin of the earliest Plains cultures has long been of fascination to archaeologists. Many have commented on the similarity of certain aspects of the Clovis assemblage with Old World, Paleolithic cultures, thus proposing direct Old World origins for the Clovis hunters. Vance Haynes (1978) feels that the complex of traits suggests Old World origins; tool assemblages contain bifaces, scrapers, burins, blades, flake knives, etc. The bone technology of Clovis cultures includes bevel-based cylindrical points and foreshafts. Grave goods exhibit red ochre. Noting such Siberian sites as Malta, Afontova Gora II, Kokorevo, and Kostienki 1-5, he proposes origins from the Siberian Paleolithic during a time when the Arctic steppe biome existed on the Beringian Platform.

Two separate, but contemporary traditions, were in existence in Beringia before 11,000 B.P.: Diuktai, with leaf-shaped bifaces, wedge-shaped cores, and microblades; the other tradition contained flake tools, some bifaces, cylindrical bone points, and no microblades. "It is reasonable to postulate that Clovis developed from the one without microblades" (Haynes 1978:119).

Although an arid grassland today, the High Plains in former times was spotted with ponds, lakes, and marshes. In an effort to recreate the paleoecology of the Llano Estacado, Hester and Wendorf (1975) launched an interdisciplinary study and collected pollen, faunal, and archaeological data in order to develop a chronology for the Southern High Plains. Based on the results of their studies, they have divided the period from approximately 20,000 years ago into climatic episodes.

The first episode, the Tahoka pluvial, began sometime around 20,000 years ago and lasted at least until 13,500 B.P. and perhaps as long ago as 11,500 B.P. During this period, extensive woodlands or forests were contemporary with lakes and ponds both in the Llano area and in adjacent areas to the east. In the Llano area at this time were boreal forests dominated by pine and spruce and extending at least as far south as the southern edge of the Llano area and probably beyond. Summer temperatures were at least 10°F cooler than today, with winters no colder than today. This period was interrupted approximately midway by a brief drying trend with a short term expansion of grasses at the expense of forests, but then returned quickly to moister conditions.

The Tahoka pluvial was followed by a markedly dry episode--the Scharbauer interval. This dry period correlates (Haynes 1975) with the Two Creeks interstadial. Clearly, forests could not stand these dry conditions, and trees and forests of the Tahoka pluvial were no longer present. There is some indication that shortly after the onset of the Scharbauer interval, there was an increase in pine pollen and other indicators of cooler, moister times. This Blackwater subpluvial (?) would be approximately contemporary with Clovis-related materials and would suggest dates which cluster closely between 11,500 and 11,200 years ago. *Folsom* and *Midland* points appear after the Blackwater subpluvial (?) and toward the end of the Scharbauer interval.

The next climatic episode, the Lubbock subpluvial, is well validated by pollen and invertebrate fauna. An abrupt increase in pine and spruce pollen almost certainly reflects major changes in the vegetation in the Llano area and probably a reinvasion of boreal woodlands or forests over much of the High Plains landscape. Distributions of snails during this period indicate cool summer temperatures depressed by at least 10°F. An exact time range for the Lubbock subpluvial has not yet been established, but an average of four solid dates suggests a maximum range of 10,000 to 11,000 B.P., and possibly 10,300 to 10,500 B.P. as a more restricted range. Cultural materials associated with the Lubbock subpluvial are primarily *Folsom* related. Point finds indicate *Midland* and *Folsom* points succeeded *Clovis* points during the time interval immediately following the Blackwater subpluvial (?) and certainly replacing them by the time of the maximum aridity of the Scharbauer interval. *Folsom* points endured without *Midland* points into a period of major environmental changes represented by the Lubbock subpluvial. Finally, during the latter part of this period characterized by extensive boreal forests in the Llano area, or immediately thereafter, *Folsom* points were replaced by *Agate Basin* points, the first of a series of related projectile point types representing around 1000 years between 10,000 and 11,000 B.P.

Wendorf (1975:274) proposes that the forest expansion during the Lubbock subpluvial significantly reduced the mobility of bison that were concentrated in the few open park areas during this period, and the *Folsom* groups who hunted them would have been similarly restricted. A test of this hypothesis would determine if there were lower frequencies of lithic materials from distant sources rather than those located in more open grasslands. Hester and Grady's (1977) study of Clovis and *Folsom* settlement patterns in the Llano area supports Wendorf's hypothesis. Wendorf suggests, in addition, that the isolation of the Lubbock subpluvial could have been responsible for the explosion of *Plano* point styles and, with the retreat of the forest at the end of the Lubbock subpluvial a sudden widespread dispersal of previously isolated types throughout the region.

The Yellow House interval following the Lubbock subpluvial was, again, a period of increasing aridity and a decline of woodland elements. Another subpluvial around 8000 years ago is suggested by increases in pine pollen around this time. There are no direct archaeological associations, but this is evidently a period of a continuation of *Plano* point styles.

This Yellow House interval with its possibly short lived subpluvial(s) continued, evidently accompanied by *Plano* adaptations until the Altithermal at 6000 B.P., after which rising temperatures and aridity heralded new adaptations.

## Paleo-Indian Phases

Most of the artifactual material from the Plains region in the Paleo-Indian period comes from kill sites. With occupation data so limited, rather than describe the complex in general and recount artifact assemblages from several representative sites, all artifactual data will be incorporated into a description of Paleo-Indian tool complexes. Occupation data from Clovis sites come from Blackwater Draw (Hester and Wendorf 1975) and, data from Folsom sites from Blackwater Draw and Lindenmeier. The Hell Gap site is utilized to specify components of the Plano tool assemblages where extensive data on each complex is available (see Table 26).

TABLE 26. PLAINS CHRONOLOGY FOR THE PALEO-INDIAN PERIOD

Phase	Subphase	Date Radiocarbon B.P.
Post-Paleo-Indian phase	Lusk subphase	8000
	Frederick subphase	8500-8000
	Cody subphase	9000-8500
	Alberta subphase	10,000-9000
	Hell Gap subphase	10,000-9500
Plano phase	Agate Basin subphase	10,500-10,000
	Midland subphase	10,750-10,500
	Folsom subphase	11,000-10,750
Folsom phase	Plainview subphase	11,200-11,000
Clovis phase	Blackwater subphase	12,000-11,200

SOURCE: Adapted from Irwin (1971).

Clovis Phase--Identifying characteristics of the Llano complex have been described in some detail earlier so the following is a description of the complex in its Plains manifestation. Most tools of the Llano complex are manufactured on large flakes. Projectile points evidencing rather crude flake scars are primarily percussion flaked, and frequently exhibit impact fractures and resharpening. Some points are made on flakes, but most are produced from bifacial preforms. Tools include side scrapers, end scrapers (spurred), concave scrapers (spokeshaves), unifacial knives, flake knives, graters, burins, and various combinations thereof. Some of the tools are made on large primary flakes, some on bifacial thinning flakes, and others on bladelike flakes. Clovis blades are large and triangular in transverse section. Blade cores are rare, but in many cases these may in fact represent *pièces esquillées*. In addition to the lithic tools, bone tools also make up a large part of the assemblage. Bone awls, punches, scrapers, fleshers, points, cylindrical points, foreshafts, beads, and a shaft wrench have been recovered from Clovis sites. Haynes (1978) recounts caches of tools and raw materials associated with Clovis peoples. Hunter species were primarily mammoth, although in some instances associations with bison, horse, camel, bear, tapir, and rabbit have been noted.

Folsom Phase--The Folsom complex is more specialized. In comparing Clovis and Folsom phases at Blackwater Draw, of the 23 tool types identified as in the Folsom occupation, only nine types occur with more than 1% frequency, while the earlier Clovis phase had 15 types with more than 1%. During the Folsom phase less reliance was on bone tools and more on lithics. Flake scrapers, flake knives, and projectile points occur with greater frequency during the Folsom phase. Folsom people also rely less on core struck blades. Differences in choice of stone are evident as well. Although both industries depend on the highest quality cryptocrystallines, Clovis people relied predominantly on Alibates chert and less on Edward chert, while Folsom people reversed this preference. Folsom artifacts tend to be smaller than Clovis artifacts with less variation.

Plano Phase--Flaking techniques and tool types are derived from the Folsom phase. Plano industries were characterized by fluorescence in projectile point types. Parallel flaking on projectiles and some other tools are the prominent technological feature. Bison are still the primary prey. Each Hell Gap horizon will be briefly described below.

Goshen Subphase (Plainview)--This subphase is characterized by lanceolate projectile points with parallel to slightly convex or concave sides and concave bases, basally thinned. Scrapers include simple, convex-edged side scrapers and other side scraper forms; end scrapers with a lateral spur on beak; and small numbers of other end scraper types; spur perforators on small flakes; and utilized flakes. Bifaces include numerous biface pieces representing early stages in the manufacture of points and a single large, tear-shaped bifacial knife. This industry contains the highest incidence of true blades of any Paleo-Indian complex at Hell Gap. No radiocarbon date exists, but the stratigraphic position indicates a pre-Folsom culture about 11,000 B.P.

Folsom Subphase--Already described.

Midland Subphase--*Midland* points superficially resemble *Folsom* points--lanceolate with concave bases, but without flutes. Numerous convex side scrapers, double side scrapers, and certain other side scraper forms were recovered. Also in the scraper category were beaked and angle-edged end scrapers, spur perforators, and utilized flakes. Bifaces included denticulate forms of bifaces and another, single example of a teardrop-shaped bifacial knife. All are characteristic of the Folsom assemblage with the exception of the relatively large number of side scrapers. Dates based on radiocarbon samples are 10,440 and 10,740 B.P.

Agate Basin Subphase--The *Agate Basin* projectile point differs considerably from earlier periods. There is an emphasis on extreme thinness; long, slender, and lanceolate with convex edges reaching maximum width at the midpoint. The scraper category includes a large variety of single- and double-edged side scrapers, notched flakes, spur perforators, simple retouched flakes, utilized flakes, and end scrapers--principally of the beaked and angle-edged forms, but less prominent than previously. Also, interestingly, new tools appear: bone tools such as an eyed needle and a notched flattened implement. The biface category includes a very large form of a thin bifacial knife.

Hell Gap Subphase--The *Hell Gap* projectile point seems to be a stylistic development out of earlier forms through a shift in proportions and treatment of the lower hafting section. Proportions of other tools are reminiscent of the Agate Basin complex. Scrapers include various forms of side scrapers (side scrapers predominate) and end scrapers of angle-edged or beaked varieties (although in smaller numbers), spur perforators, utilized flakes, retouched flakes, and notched pieces. A most interesting innovation is the asymmetrical, one-shouldered bifacial knife, the "Hell Gap Knife." Dates are approximately 9500 to 10,000 B.P.

Alberta Subphase--Projectile points may represent, in part, a continuation of stylistic trends already noted above in the preceding period. There is a trend to constrict the lower section of the point and delineate a definable stem. Scrapers demonstrate a shift toward the increasing importance of end scrapers over side scrapers, and there is evidence of the growing popularity of the thin "raclette" scraper. No bifaces were recovered. Dates range between 8600 and 9000 B.P.

Cody Subphase--Both *Scottsbluff* and *Eden* points are customarily found together, both characterized by a long, narrow lanceolate outline with a relatively short stem set off from the blade by well-defined shoulders. The accompanying tool kit is distinguished by the growing importance of new types of end scrapers such as ground bit end scrapers; end scrapers on large, flat flakes; asymmetrical end scrapers; end scrapers retouched over the entirety of the ventral surface; and early forms of end scrapers (beaked and angle-edged varieties) no longer common. Side scrapers, although varied, are of secondary importance. Raclette scrapers continue to be important as are notched flakes, spur perforators, denticulates, and utilized and retouched flakes. Bifaces include several stemmed and shouldered bifacial pieces similar to what has been called *Scottsbluff* Type II. Also found is another bifacial knife form, which is asymmetrical and single shouldered, but distinct from the *Cody* knife form. The *Cody* subphase is dated to 8650 B.P.

Frederick Phase--This represents a radical shift from earlier occupations, especially in typology and character of the faunal remains. Projectile points seem unrelated to the slowly evolving tradition represented by the Agate Basin to *Cody* transition. Points have a lanceolate outline with concave base and no distinguishable shoulder or stem. The diagnostic is a specialized technique of oblique-paralleled pressure flaking. Scrapers include raclette scrapers; several types of side scrapers, although these are minimally important; spur perforators; notched flakes; and utilized and retouched flakes. The predominant scraper class is the end scraper, particularly the ventrally retouched, asymmetrical, and ground bit forms. Diagnostic bifaces are bifacial knives made on or similar in form to the *Frederick* projectile point.

### Settlement Technologies

Judge (1973), in his analysis of many aspects of Paleo-Indian cultures in New Mexico, has described the generalized Paleo-Indian pattern for site selection as being based upon (1) the proximity to a water source; (2) short travel time to hunting areas, which is usually a broad open area unobstructed by sharp topographical relief; and (3) an overlook or overview area. Within the generalized

pattern of the Paleo-Indian period, however, differences in site location occur. The Clovis period was represented in the survey by only one site and as a result was useless for comparative purposes. Folsom and Cody cultures were well represented and evidenced a distinctive trend. Folsom sites are located farther from present permanent water sources such as rivers and large streams and close to what were playa lakes in Folsom times. Playas were not only a source of water for man, but also for large grazing animals such as bison. For Folsom hunters water sources and hunting areas were practically the same. Folsom times must have been much moister to allow for this site patterning. Later Cody cultures were located next to permanent water sources and much farther from hunting areas.

Judge also suggests another developmental trend among Paleo-Indian technologies in New Mexico. Factor analysis of various categories of the transverse scraper (categories based upon the degree of lateral modification) suggested that variation between cultures in categories of this tool type could best be explained by the change from a generalized to a highly specialized artifact form. By analyzing wear patterns as well as retouch, Judge describes *Clovis* transverse scrapers as being included in a generalized group of end and side scrapers with the transverse scraper defined by certain characteristic lateral and end modification. Folsom peoples produced the transverse scraper as a unique category or type with consistent use patterns. Cody peoples, on the other hand, produced functionally specialized transverse scrapers. Judge proposes the tool specialization as a general trend of specialization in other elements of technology through time.

### Archaic Complexes

The Archaic period began much later on the Plains where the Big Game Hunting traditions of Paleo-Indian cultures continued until approximately 6000 B.P. and when climatic changes forced its demise. The transitional and Early Archaic period is poorly represented archaeologically. Due, no doubt, to the heat and aridity of the Altithermal from 5000 to 6000 B.P., few sites can be dated to this period. The Plains would have been an extremely inhospitable place, and the transition from Paleo-Indian to Archaic lifeways would have occurred more easily along southern and eastern margins of the Plains. Paleo-Indian to Archaic transitions are well documented in Texas and the Southeast where conditions other than parched grassland existed. Only after 5000 B.P. do Archaic sites again appear on the High Plains.

Although basically a local development from the Big Game Hunting tradition, the Plains Archaic was strongly influenced by diffusion from the Eastern Woodlands area, where the Archaic lifeway had been well established for thousands of years (Willey 1966). There was a general continuation of Paleo-Indian tool types, but with new additions. The McKean phase of Wyoming is a typical early Plains Archaic adaptation. Typical tools include the *McKean* point, a lanceolate point with an indented base, resembling Paleo-Indian styles but much more crudely fashioned, and other typical stemmed and notched Archaic types similar to the East and Desert forms. Other tools include milling stones and handstones. Occupation camps, cave sites, and bison kill sites are representative types. Faunal remains of bison, deer, birds, reptiles, and mussels have been recovered.

## The Cumberland Tradition

### Introduction

The southeastern culture area comprises all territory east of central Texas and south of the Ohio River. Archaeological research on early man in the Southeast is limited, but recent efforts at cultural resource management in conjunction with water management and conservation endeavors are yielding new information on Paleo-Indian lifeways. Research has primarily centered on the highly elaborated cultures of Woodland and Mississippian peoples, while neglecting interdisciplinary studies of early man's activities. This has been partly due to the scattered surface nature of early man sites, and partly due to the natural fascination of more fluorescent cultures.

Man's early entry into the Southeast is demonstrated by *Clovis* points and other variations of the fluted lanceolate point scattered across the area. The finds are predominantly along the major river valleys, especially the Mississippi and the Tennessee. Fluted points are found as far south as Florida (Bullen 1969; Gagliano 1977). Marine adaptations, at least by later Paleo-Indian times, were no doubt in effect, although much of the evidence has been lost along submerged coastal shelves. Gagliano (1977) has surveyed cultural resources along the western Gulf Coastal regions and located "pre-projectile point" possibilities such as evidence of pebble tool (Lively complex) industries on Avery Island off the Louisiana coast (Gagliano 1977:173). Some other tantalizing evidence of much earlier occupations on the Florida coast are noted. Several occurrences of mammoth bones exhibiting butchering marks ostensibly made, while the bone was still green have been reported (Bullen, Webb, and Waller 1970:205; Neill 1971:68), but no tools or other human associations have been found. A sloth bone was recovered along the Florida coast associated with a *Lerma*-like three-inch spear point with an estimated age of 12,000 to 14,000 years based upon similar type occurrences elsewhere. No incontrovertible evidence, however, has surfaced. Discovery of Paleo-Indian occupation along coastal areas is most dependent upon understanding the patterns of developing stream banks, beaches, margins of estuaries, and important ecotones. Earliest evidence of man in the central Gulf area is at Avery Island (Gagliano 1977), a protruding salt dome evidencing Late Paleo-Indian point types such as *San Patrice*, *Lerma*, and other lanceolate type points along with prepared cores, bladelets, flake end scrapers, flake side scrapers, and bifacial knives. Two other sites off the coast of Louisiana, the Bayou Grand Louis site and the Palmer site, yielded Paleo-Indian points such as *Cumberland*, *Angostura*, *Meserve*, *San Patrice* (Bayou Grand Louis), *Plainview*, and *San Patrice* (Palmer), along with unifacial scrapers, bladelets, and gougelike tools (Gagliano 1977). The Fish Creek site in Florida located in the eastern Gulf region produced *Suwannee* points (Gagliano 1977). Paleo-Indians along the southeastern coastal regions chose deltaic beaches, salt domes, and natural levees as occupation locations, because these sites would have been rich in resources such as plants, animals, fish, fowl, fruit, nuts, and berries.

Southeastern variants of the fluted point tradition include the *Cumberland*, *Quad*, *Suwannee*, *Hardaway*, and *Dalton*. *Cumberland* points appear predominantly in the Tennessee and Ohio Valley regions. They are relatively long, like the *Clovis*, but are frequently widest at the midsection and most often bear long *Folsom*-like flutes (Willey 1966). The *Cumberland* point is often called the eastern



version of the *Folsom* point due to its contemporaneity and stylistic similarity. *Folsom* points are extremely rare in the East with only a few noted occurrences. At the Williamson site (McCary 1951), a Paleo-Indian workshop-occupation site in Virginia, *Folsom* or *Folsom*-like points occur along with a fluted local variant (pentagonally shaped points) as part of a typical Paleo-Indian tool assemblage of end scrapers (many spurred or eared), side scrapers, large fluted bifacial knives, graters, and several crudely made bifacial knives. Willey (1966) suggests *Cumberland* points are in complementary distribution with Middle and Late Paleo-Indian industries of the Plains with Plains varieties occurring as far east as the Great Lakes region and north of the Ohio River, but becoming progressively less frequent further to the southeast. Evidence of Plains types is rare in the Southeast where *Cumberland*, *Suwannee*, and *Dalton* points become the dominant types during this time frame.

Gardner (1974), in his typologies of Flint Run complex projectile points, has proposed a three stage evolutionary model for classifying the varieties of fluted points found in the East, which parallels the three stages of development proposed for the Plains. Plains point complexes are represented by the Clovis root complex during Early Paleo-Indian times, giving rise to *Folsom* at Middle Paleo-Indian, and *Plano* during the Late Paleo-Indian. The late phase represents the beginning of regional variations. Gardner's stages are Clovis, Middle Paleo-Indian, and *Dalton*. In this sequence, there is some variation in point size (primarily length) from East to West, differences attributable to such factors as variations in raw materials, individual knappers, resharpening, and distance from the site. When tested along certain "diagnostic" variables (Gardner and Verrey 1979) and applied to eastern sites already discussed, principally length-width and width-thickness ratio, they are eminently classifiable into the Clovis and Middle Paleo-Indian typologies. The Shoop site is verified as an early, probably one time habitation camp with *Clovis* points; while the Williamson site has two components, Clovis and the visually recognizable Paleo-Indian. Gardner's scheme is pan-continental and aside from being extremely workable in classifying points of all localities, goes a long way in explaining both the universality of the *Clovis* point, and the complementary distributions of Middle Paleo-Indian (*Cumberland-Folsom* points), and *Plano* (*Scottsbluff*, *Eden*, *Meserve*, *Agate Basin*, *Dalton*, and *Hardaway*) points. In this scheme, *Clovis* points represent the pan-continental base; the Middle Paleo-Indian *Folsom* point, a continental-wide offspring of *Clovis*; and Late Paleo-Indian types as a period of regional diversification. Following this line of development to its logical conclusion, it is interesting to note the similarities of all regional cultures in the developmental sequence of notched and bifurcated base points.

Due to the similarity of style and technology across fluted point variations, as well as the similarity of component tools which comprise Paleo-Indian assemblages, many have suggested a similar Big Game Hunting adaptation for all carriers of the fluted point tradition. Gardner, however, suggests that these carriers of a basically Upper Paleolithic technology quickly became locally adapted to the hunting of plentiful smaller game such as deer, and although they were carriers of the lithic traditions of Big Game Hunters, they may not have been carriers of their adaptive strategies. Evidence in the Northeast appears to indicate exploitation of smaller game such as the caribou. Although larger Pleistocene fauna were certainly available to early inhabitants of the Southeast, there has been no evidence of their exploitation other than the

presence of a proven Paleo-Indian tool kit containing hunting tools such as end scrapers, side scrapers, knives, and other bone and hide-working tools. Historically, there does seem to be some symbolic element in the association of a highly stylized point typology and the predominant exploitation of a single prey species, for example, the *Solutrean Laurel Leaf* and the reindeer, the *Clovis* fluted point and the mammoth, the *Folsom* point and the bison, etc. Whether transference of style and technology automatically results in transference of adaptive strategy and possibly other symbolic units of the culture holds significance for analysis of archaeological materials. The old question of whether temporal or spatial distribution of a tool type (principally projectile points) can be taken to represent the distribution of a particular culture (i.e., entire cultural configurations) including that culture's adaptive strategies is still debated (Weir 1975). Whether similar subsistence patterns and other symbols accompany the similar style and technology of the fluted point complex waits to be discovered in the acid soils of the East where buried sites are most difficult to discover. Because of the condition of the soils and the surface nature of the finds, associations of faunal specimens and the earliest Paleo-Indian points have been missing. Late Paleo-Indian manifestations such as the Dalton, however, were exploiting white-tailed deer, while retaining to a great extent a classic Paleo-Indian tool kit. In addition, it is highly probable that Early Paleo-Indians were foragers as well as hunters. Nutshells, and possible nutstones, have been recovered from the Williamson site (Benthall and McCary 1973). Paleoenvironmental recreations suggest this based on the nature of flora and fauna in the Southeast during the hypothesized period of Paleo-Indian occupation.

Figure 58 illustrates proposed vegetation regions at late glacial period. Florida evidenced deciduous forest. The rest of the Southeast exhibited a type of pine savanna until approximately 11,000 years ago when an oak-hickory forest became established.

Carbone's (1976) recreation of paleoenvironmental conditions at the Thunderbird site in Virginia divides the ending glacial and subsequent approaching boreal periods into three episodes: Late Glacial (up to approximately 10,500 years ago), Preboreal (10,500-9300), and the Boreal (9300-8700). The Late Glacial was characterized by increased precipitation, lower temperatures, and a relatively open (pine savanna) boreal landscape. Average temperature was at least five degrees lower than at present, but with increased albedo and increased precipitation principally in the form of more extensive winter snowfall. Gardner (1974) suggests this period correlates with the Clovis occupation of the Thunderbird site, apparently the first human occupation of the Shenandoah Valley.

The Preboreal, an interim episode between Late Glacial and Boreal, experienced an expansion of forests, both coniferous and deciduous species, and a reduction of open habitats, the oncoming of a closed canopy forest environment. There appears to be an abrupt boundary between these two periods characterized by very rapid climatic change. Gardner (1974) and Verrey (1980) feel this corresponds approximately to Middle Paleo-Indian and Dalton subphases at the Thunderbird site.

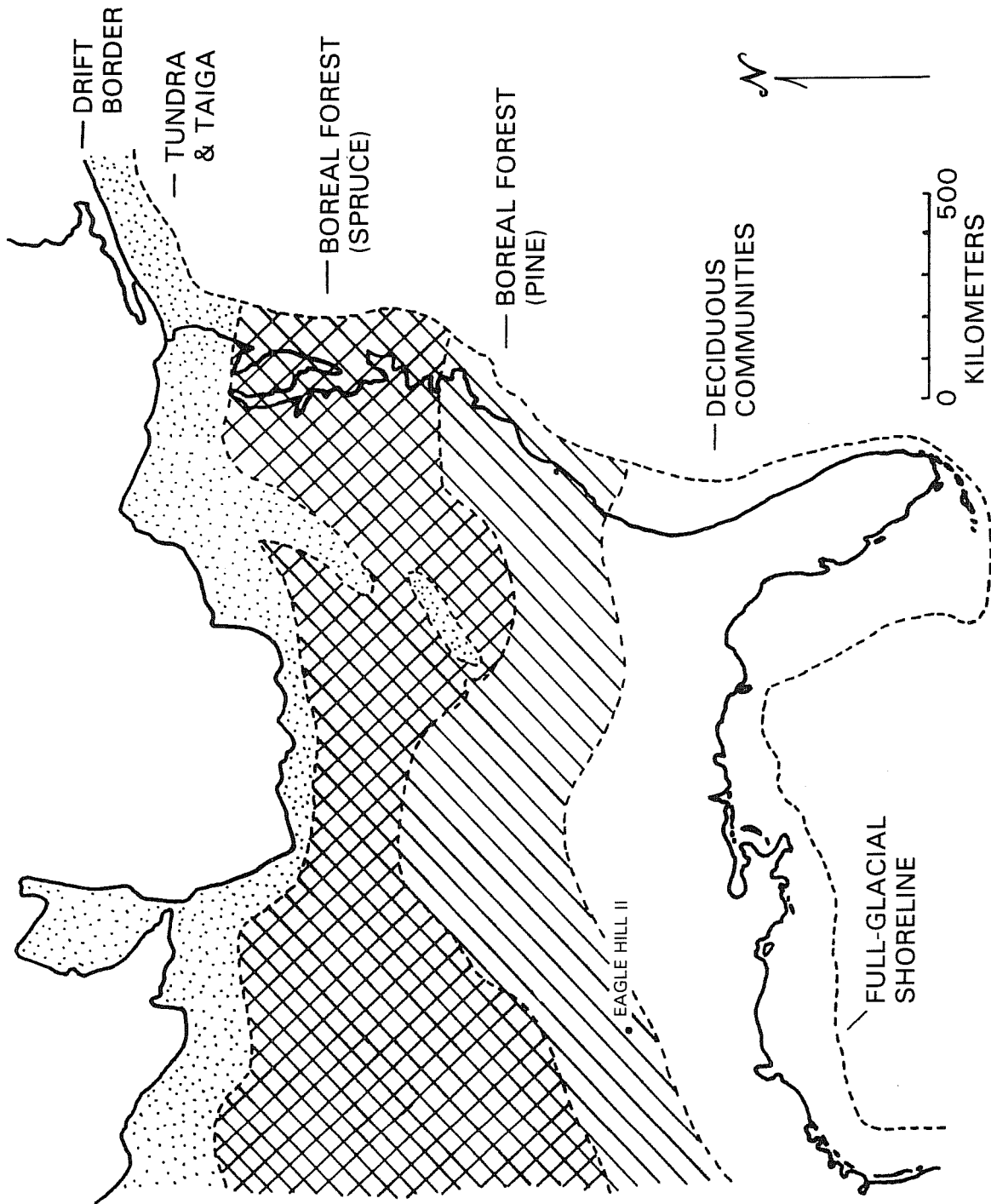


Figure 58. *Vegetation Regions of the Southeast.* From Whitehead (1982).

Characterized by a "continental" environment, the Boreal showed increases in average temperature with warmer summers and milder winters (the relatively "flat" temperature curve necessary for the maintenance of deciduous communities). This episode correlates with the notched point (Early Archaic) phases at the Thunderbird and Fifty sites (Gardner 1974; Verrey 1980). Both Verrey and Carbone suggest a decline in Clovis occupations (which had been along the major river valleys) as the boreal forests spread into Virginia at the beginning of the Preboreal.

Succeeding populations would be more limited and probably found specialty areas either rich in food or lithic resources. The upland pattern of Dalton sites could represent this situation. The Early Archaic correlates well with the Boreal episode. Changes in adaptation may be seen by the addition of more bifacial tools and the shift to notched projectile points as evidenced at the Thunderbird, Eva (Lewis and Lewis 1961), and Rose Island sites (Chapman 1975). Evidence at these and other Archaic sites in the Southeast seem to indicate that the major change in adaptation came with the Early to Middle Archaic transition rather than from Late Paleo-Indian to Early Archaic. Aside from a change in projectile point styles and the addition of a few more bifacial tools, the assemblages are remarkably similar. The Late Paleo-Indian to the Early Archaic appears to be more of a continuum. Following the Early Archaic, great environmental changes occurred that led to the Atlantic climatic episode and accompanying Middle and Late Archaic occupations (Verrey 1980:14). Middle Archaic cultures exhibit a significant switch to the exploitation of shellfish and other aquatic species and evidence a heavy foraging adaptation. The Eva site demonstrates this with the decrease in deer and the huge increase in shellfish. Specialized tools such as conoidal pestles, types of bone fishhooks, and large chert pounders were used to exploit aquatic resources.

### Paleo-Indian Complexes

The classic Paleo-Indian tool kit as described earlier applies to the Southeast as well. Classic southeastern sites such as Williamson and Quad are indicative of the Enterline Chert industry, although there are some new aspects. Bladelets occur along coastal sites at least during the Late Paleo-Indian period and possibly earlier. There also appears to be an increase in blades, core tools, choppers, and chisels. However, this may be due to the nature of the types of sites sampled and not to a "real" increase.

### Representative Sites and Tool Kits

Williamson--The Williamson site (McCary 1951) is located on the Appomattox River, Virginia. It is a camp-workshop that was probably occupied many times during the Early Paleo-Indian period. Thirty-three fluted points were found along with 174 snub-nosed end scrapers (predominantly of the eared or spurred variety), 24 side scrapers, 16 fluted basal fragments of bifacial knives, and a small number of gravers. McCary (1951) compares the site to the western Folsom site (see Gardner's hypothesis stated earlier). The large fluted bifacial knives are finely manufactured, while the six small bifacial varieties are crudely made using percussion only. Soday (1972) describes the Williamson

material as almost conforming to the Enterline Chert industry, but containing rougher fluted points, a snub-nosed blade (?), end scrapers, (many with graving spurs), side scrapers, bifacial flake knives, and possibly a few gravers. Scrapers in the Enterline Chert industry are characterized by having the bulb (often somewhat pronounced) at the tip of the scraper (bit), rather than at the distal end of the flake (Witthoft 1952).

Wells Creek Crater--Wells Creek Crater (Dragoo 1965) in Steward County, Tennessee, is a surface, quarry-workshop-occupation site. No stratigraphic information is available, but over 5000 Paleo-Indian tools have been recovered. The site yields the first direct evidence of large bifacial cores with ground margins and of large prepared platform cores designed to yield large preform flakes for unifacial tools. These cores are unique to fluted sites in the East. The flaking technique is similar to the Levallois technique. Lithic materials consist of nearby Fort Payne chert which is of high quality. Bifacial tools include a somewhat unusual disc scraper, biface knives, drills, preforms, and fluted points (nontyped). Other bifaces were a beaked side scraper and core tools. The unifaces included a great assortment of multifunctional tools: end scrapers--many on true blades, others on flakes--a large number spurred. Also recovered were unifacial flake end scrapers, free form end and side scrapers, unifacial knives, blade knives, flake knives, and unifacial side scrapers, some from polyhedral cores, some from bifacial cores. The flake scrapers were predominantly primary flakes which had been modified (unifacial core/flake or core fragment scrapers). Spokeshave scrapers were common, as were unifacial gravers, chisels, and utilized flakes. An interesting collection of large tools included unifacial choppers, large beaked flake scrapers, and picks. Core tools were in evidence as well. Tools made on percussion flaked polyhedral cores were large core spokeshaves, core denticulate-beaked tools, core scraper planes, and tabular core beaked tools. The basic set of tools includes, in addition to the fluted points, end scrapers (usually with spurs), a variety of side scrapers on blades and elongated flakes, bifacial and unifacial knives, spokeshaves, sharp-pointed and chisel-edged gravers, drills, utilized flakes, and an assortment of large cutting, scraping, and chopping tools rare or absent at most eastern and western sites.

Quad--The Quad site (Soday 1972; Cambron and Hulse 1960) is a surface site containing artifacts dating to both the Paleo-Indian and later Archaic periods. Paleo-Indian material was easily distinguishable from later industries by raw material, tool types, technology, and artifact patination. Paleo-Indian material was primarily of heavily patinated blue gray chert, rhyolite, or green jasper. The site is remarkable for its similarity to the Enterline Chert industry first identified at the Shoop site in eastern Pennsylvania. Artifacts included fluted points, thin and well ground (some typologically like *Clavis* and *Folsom* points), and end scrapers, many which were keeled and spurred. Two types of these end scrapers existed. One type was a long pointed scraper with both sides retouched and of the typical Enterline style with the bulb of percussion at the bit of the tool. The second type was made of short thick flakes often as broad as long. Both types were identified at the Shoop site as were other large scrapers, such as side scrapers that appeared to be notched (spokeshaves?) and manufactured on lamellar flakes. Gravers were in unusually high proportion at Quad, many with multiple (up to five) tips. Flake knives were found along with many combination tools such as knife-gravers, scraper-knives, and knife-graver-spokeshaves. A few drills and crude choppers averaging

four to five inches in length were also present in addition to what appears to be a fluted bifacial knife.

Thunderbird--The Thunderbird site (Gardner 1972, 1974) is part of the Flint Run complex found in the Shenandoah Valley. The Flint Run complex is composed of at least six types of sites: quarry, quarry reduction, base, base camp maintenance, outlying hunting sites, and isolated point finds. Thunderbird is a base camp maintenance site. It is a stratified site dating from Paleo-Indian through Early Archaic. Sites like Thunderbird and other base camps such as the Williams site (Gardner 1974, 1976) function in the same manner as the seasonal base camps exploiting rich seasonal resources as is known ethnographically among hunters and gatherers. In addition to the classic Paleo-Indian tools such as found at Williamson, crude bifaces and large blank flakes were recovered, evidently carried from the nearby quarry to the maintenance site. Materials represent the entire Paleo-Indian period through the Early Archaic. The primary change in artifact types is found in projectile point types moving from *Clovis* points, through Middle Paleo-Indian and *Dalton* points, into the notched and bifurcated point styles. The following chronology for the site is given: Clovis ca. 11,500-11,000 B.P., Middle Paleo-Indian ca. 11,000-10,500 B.P., Dalton ca. 10,500-10,000 B.P., Palmer ca. 10,000-9500 B.P., Kirk ca. 9500-9000 B.P., and Warren ca. 9000-8000 B.P.

Hardaway--The Hardaway site (Coe 1971) is another site marking the transition from Late Paleo-Indian to Early Archaic in North Carolina. The excavated sequence begins with the Hardaway blade (one like Quad) and *Hardaway-Dalton* points and proceeds through *Palmer Side* and *Corner Notched* styles, *Kirk Stemmed*, *Kirk Serrated*, *Stanley Stemmed*, and finally the bifurcates. The Palmer period was associated with a particular type of end scraper, which has long been associated with the Paleo-Indian points in the East, but whose terminal period was not previously known. At the Hardaway site, there appears to have been a primary association with only the Palmer period. Through time the use of hafted end scrapers increased considerably, while large heavy side scrapers decreased. The Kirk occupation signaled primarily a change in projectile point forms. These peoples continued to use scraper types that were known for the earlier periods, but there was a definite shift in emphasis to the cruder forms of end scrapers and the thin blade type of side scraper. Production of quarry blades began in Kirk times and increased in frequency through time. Chronology for the Hardaway site based on similar point styles from other areas such as the St. Albans site, the Habron Site, and Sheep Rock Shelter is (all dates B.P.): *Hardaway* 10,000, *Palmer Side-Notched* ca. 9900, *Kirk Corner-Notched* ca. 8930, *St. Albans* bifurcates ca. 8825, *LeCroy* bifurcates ca. 8250.

Stanfield-Worley--Stanfield-Worley Bluff Shelter (DeJarnette, Kurjack, and Cambron 1962) is a stratified multicomponent site in Colbert County, Alabama. The lowest cultural zone contained numerous uniface tools, side and end scrapers, graters, and spokeshaves as well as two major types of projectile points: *Dalton-Meserve* and the side-notched, basally ground *Big Sandy* points. Radio-carbon dates of 9640 and 8920 were secured for this zone. This association raises the possibility that Dalton represents a transitional Paleo-Indian tradition in the Southeast (MacDonald 1971). Goodyear (1982), who extensively researched the Dalton cultures and chronologies, feels that the association of *Dalton* and *Big Sandy* points may not be valid. Although these two point styles

were separated from overlying levels by wind-blown deposits, he feels there is the distinct possibility of mixing below this deposit and argues for an earlier date for *Dalton* points (10,500-9900 B.P.). *Dalton* points represent Late Paleo-Indian, while *Big Sandy* points were of an Early Archaic tradition.

Brand--The Brand site (Goodyear 1974) is a *Dalton* site located in northeast Arkansas. The site was a satellite camp which existed for specialized hunting and gathering. The *Dalton* tool kit mirrors those of the earlier Paleo-Indian assemblages with unifaces such as classic end scrapers (many spurred) and side scrapers, graters on flakes, true blades, retouched blades, bipolar cores, and *pièces esquillées*. An important addition, however, is a bifacially chipped stone adze that has been ground on the side margins to prevent haft damage in much the same manner that *Dalton* points are ground. In addition, there appears to be evidence that the *Dalton* point was used as a knife as well. The Brand site analysis shows that the different "types" of *Dalton* points may be merely the result of successive resharpening, rather than intentional differences in design (experimental resharpening was done by Goodyear).

There have been problems with assigning the *Dalton* point a time period. Many assign *Dalton* points to Paleo-Indian status based upon the technical and stylistic similarity of the points and other tools with the classic Paleo-Indian point and tool traditions. Also, *Dalton* is considered a southeastern variety of the *Meserve* point which is considered a Late Paleo-Indian point style on the Plains. Others consider *Dalton* points to be Early Archaic based on dates from such sites as Stanfield-Worley and Graham Cave but, as mentioned earlier, Goodyear questions the dating of *Dalton* as an Early Archaic point because of radiocarbon dates from such places as Stanfield-Worley. In addition, at Ice House Bottoms (Chapman 1973) and the Rose Island site (Chapman 1975) with Early Archaic components, none exhibit *Dalton* points. Goodyear (1974) assigns the interval of 10,500-9900 B.P. to the *Dalton* complex. *Dalton* peoples appear to have switched settlement patterns from earlier Paleo-Indian groups. They occupied uplands, caves, and rockshelters, in addition to river flood-plains. The *Dalton* adze must be a highly significant tool in understanding the *Dalton* lifeway due to its frequent occurrence throughout sites. Goodyear (1974) suggests that the presence of the *Dalton* adze could provide clues to functional differences between *Dalton* sites. He compares it to the *Clear Fork* gouge, a long-lived tool in the Late Paleo-Indian through Archaic periods in central Texas. Both apparently have something to do with exploiting an upland habitat.

In the Southeast, there is a well-documented transition from the Paleo-Indian to the Archaic. The largest jump, however, does not appear to occur from the Paleo-Indian to the Early Archaic, but rather from the Early to Middle Archaic. There appear to be continuities in tool types from Late Paleo-Indian to Early Archaic as evidenced by such sites as Eva and a series of Archaic sites dug by Jefferson Chapman in Tennessee. There is a documented point transitional (technostylistic) change from the Paleo-Indian *Dalton* to the side- and then, corner-notched point types, such as *Palmer* and *Kirk*. Other than this change, the rest of the tool kit remains essentially unchanged in the Early Archaic.

Eva--The Eva site components represent a gradual continuum due to adaptation to varying ecological conditions, to internal development, and to influence from

other cultural traditions (Lewis and Lewis 1961:13). Stratum Five or the earliest stage represents approximately 8000 to 6000 years ago. During the earliest occupation of the site, 10% more deer and mammals in general were exploited. This horizon is also characterized by more projectile points, blades, and choppers. Characteristic trapezoidal uniface scrapers, many with graving spurs, ovoid uniface scrapers, turtleback scrapers, circular biface scrapers, drills, anvilstones, nutstones, and large ovoid choppers occur. The Middle Archaic, however, evidenced a greatly increased exploitation of shellfish, an increase in bone fishhooks, and a decline in deer, either from a decline in deer populations or a preferred aquatic resource base. Early Archaic projectile points associated with the lowest levels are *Eva* and *Kirk Serrated*.

Rose Island--Rose Island (Chapman 1975) is a well-documented site having over 40,000 artifacts associated with the Early Archaic. Early Archaic assemblages at Rose Island span over 1100 years and are representative of four, perhaps five phases. Except for changes in the projectile point styles, little change is apparent in the assemblages over time. The Palmer phase is indefinite, based on radiocarbon dates from other sites; little time separates Palmer from Kirk material. Two radiocarbon dates for *Kirk Corner-Notched* points suggest an average date of 9270 B.P. Bipolar flaking, *pièces esquillées*, and associated pitted cobbles are present and continue to be present throughout the rest of the Early Archaic. Anvilstones occur and continue throughout as well. Other tools include end scrapers, side scrapers, a drill, a perforator, a graver, utilized flakes, hammerstones, and a possible grinding stone. There is the possible production of blades. A great similarity with earlier Paleo-Indian assemblages is apparent. The next stage, St. Albans, marks the beginning of the bifurcated base point. Ground stone increases as celts and a distinctive chopper/scrapper occurs. Stages in biface manufacture also appear. Radiocarbon dates for the St. Albans period average 8770 years ago. *LeCroy* points (ca. 8300) follow with a bifurcated base evolving into a bifurcated stem. The remainder of the assemblage remains unchanged. The Kanawha phase is the last phase of the bifurcated projectile point tradition, but is poorly represented at the site. A bipolar technique is still apparent, but the number of other tool types is small--comprised of one graver, a biface, and two side scrapers. A date of 8200 B.P. is estimated.

### Lithic Period Sites in Texas

The Eagle Hill II project area is at the junction between the Cumberland and the Llano tradition areas, and the archaeological literature is in two rather regionalized segments, Texas and Louisiana. Texas poses a mosaic of widely differing environmental zones. Because of its location on the plains/forest ecotone it provides an appropriate setting for studying both environmental and cultural factors involved in cultural change and diffusion.

Northwest Texas is in the High Plains region and is characterized as mixed grassland prairies and mesquite plains. Archaeological and cultural sequences are basically those described for the Plains. Although Paleo-Indian materials are found scattered throughout the state, the heaviest concentrations are probably to be found in this region.



Central Texas is marked by karst topography and is dissected by many rivers, streams, and broad uplands, which span the distance between streams. Typical plant association is a scrub forest of Mexican cedar, Texas oak, bear grass, and lecheguilla. It is rich in faunal resources with 57 species of mammals known from the region today. At all times, this area would have provided abundant resources for prehistoric man, especially along floodplains with rich resources of oak, hackberry, pecan, and other riverine floral and faunal species.

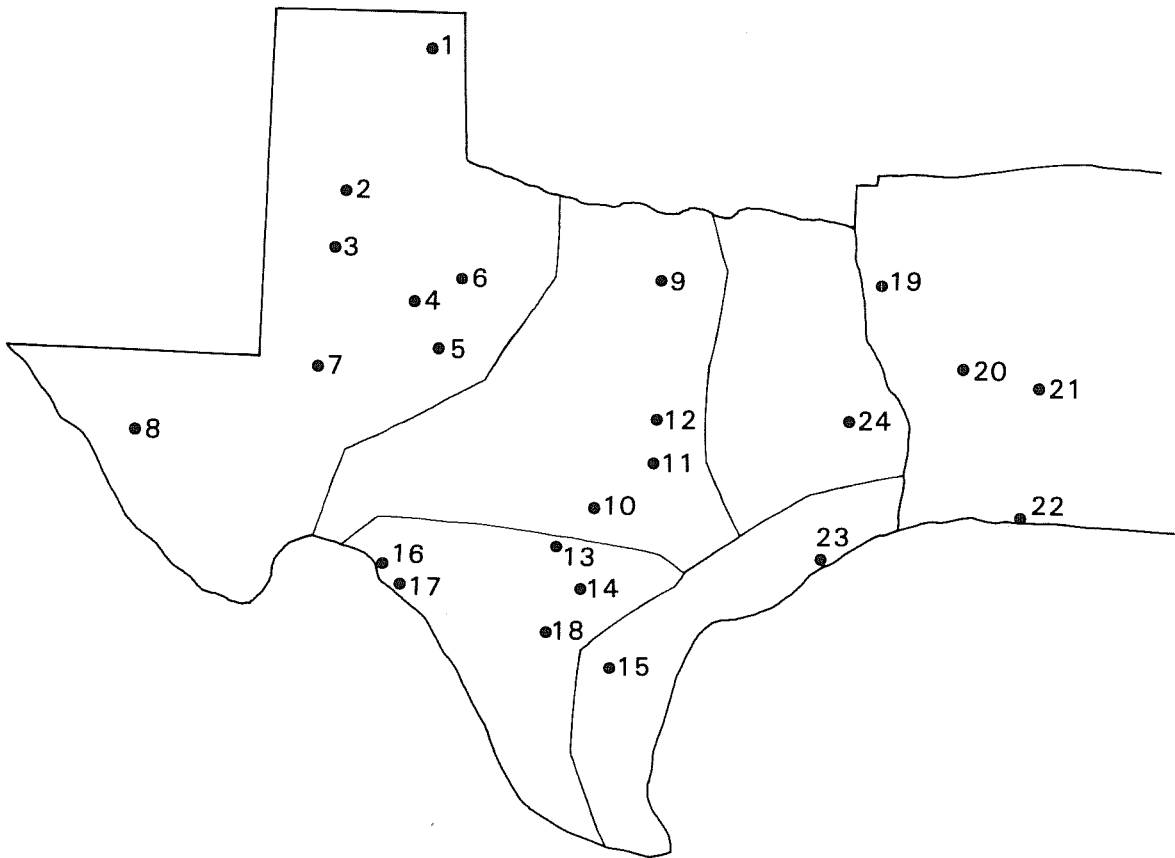
Closely related to the culture areas of the Southeast and lower Mississippi Valley, east Texas has the environmental characteristics of the mesic forests of the Southeast. Paleo-Indian evidence is scarce in east Texas, while the later cultures, with a well-developed forest efficiency adaptation, are well defined. Shafer (1975) considers Paleo-Indian lithic assemblages in east Texas to be a broader based hunting and gathering oriented strategy. By considering total assemblages and environment and not simply the presence of lanceolate points and the absence of milling stones, an unbiased assessment of adaptive tactics could be determined. Artifact components of early lithic assemblages in east Texas include several varieties of bifaces such as lanceolate projectile points (*Plainview*, *Angostura*, *Scottsbluff*, *Meserve*, *San Patrice*, and others), gouges, drills, choppers, hammerstones, grooved "Waco Sinkers," but no bones of extinct megafauna (Shafer 1975).

East Texas is extremely sensitive to climatic change with the grassland shifting east to west with fluctuating precipitation. As a continuation of the High Plains, at times, Plains hunters (primarily Plano peoples) moved into the forested areas of east Texas and southwestern Louisiana. Figure 59 lists and plots some of the lithic period sites in Texas.

#### Paleo-Indian Complexes

*Clovis* points are commonly found throughout Texas, but only one unequivocal site, the Miami site (Sellards 1938) has been reported. Cultures with *Folsom* points are better represented. In addition to scattered finds, several sites with *Folsom* points have been investigated. Among these are the Lubbock Lake site (Black 1974), the Adair-Steadman site (Tunnel 1975), and Bonfire Shelter (Dibble and Lorraine 1968). An occupation site, the Lubbock Lake site, established along an old river channel, yielded *Folsom* points along with bones of bison and bifacial knives, drills, beaked end scrapers, side scrapers (one notched or concave), graters, denticulates, and utilized flakes. Adair-Steadman is a surface site producing *Folsom* points, preforms, channel flakes, "typical" end and side scrapers, graters, and drills. Bonfire Shelter is a site of repeated bison jumps with three excavated bone beds. In the second or Bone Bed II, bison bones are found in association with a *Folsom* point. *Midland* points are likewise found. The indication of cooler and moister climate during *Folsom* times appears to be substantiated throughout Texas, with even the southern Pecos area of the state (a desertlike environment today) supporting pine forests during *Folsom* times.

The Late Paleo-Indian period in Texas is more complex. The *Plainview* point, excavated below the *Folsom* period at Hell Gap, appears in the Late Paleo-Indian period in Texas. *Plainview* sites are bison kill sites and date to 9200-8800 B.P.



- |                            |                      |
|----------------------------|----------------------|
| 1. Lipscomb                | 13. Friesenhahn Cave |
| 2. Plainview               | 14. Salado Creek     |
| 3. Lubbock Lake            | 15. Berclair Terrace |
| 4. Steadman                | 16. Bonfire Shelter  |
| 5. Lone Wolf Creek         | 17. Devil's Mouth    |
| 6. Biedleman Ranch         | 18. San Miguel Creek |
| 7. Kidland (Scharbauer)    | 19. John Pierce      |
| 8. Chispa Creek (Van Horn) | 20. Eagle Hill II    |
| 9. Lewisville              | 21. Whatley          |
| 10. Levi                   | 22. Avery Island     |
| 11. Stillhouse Hollow      | 23. Beaumont Beach   |
| 12. Horn Shelter           | 24. Wolfshead        |

Figure 59. *Lithic Period Sites in Texas and Louisiana.*

Like the Midland-Folsom problem, *Plainview* points, except for a more random flaking pattern, are practically mirrored by the *Golondrina* point. *Golondrina* points have been found in buried contexts without Plainview elements and are associated with certain other tools such as the *Clear Fork* gouge (bifacial variety). *Clear Fork* gouges are found in two forms, a bifacial variety found in Paleo-Indian assemblages, and a unifacial form found in Early and Middle Archaic assemblages. They are similar to the "Dalton Adzes" reported by Morse and Goodyear (1973).

The Cody complex is represented in Texas by surface finds of *Scottsbluff* points, primarily in the Panhandle Plains, east Texas, and along the coast. As described for the southeastern coast along the Gulf of Mexico, coastal regions in Texas reveal Late Paleo-Indian occupations. No doubt, Early Paleo-Indian sites are present along the now submerged margins of the continental shelf. The present coastline is now approximately 50 miles inland from the coastlines of Clovis and Folsom times.

The most common Late Paleo-Indian point in Texas is the *Angostura* point. This form is somewhat different, however, from its High Plains manifestations.

#### Archaic Complexes

The transitional period from Paleo-Indian to Early Archaic, the "Pre-Archaic" (Sollberger and Hester 1972), is represented by a series of distinctive tools: unifacial *Clear Fork* gouges, *Guadalupe* gouges, triangular dart points, *Bell* points, and the smaller *Gower* point. Other components of the Pre-Archaic assemblage are a continuation of typical Paleo-Indian scraper types, graters, and drills. Although the transition period may have been more abrupt in western and southern portions of the state, continuity from Late Paleo-Indian to Early Archaic appears to be more the case. Gouges were present in Paleo-Indian times. Stylistic elements are somewhat changed, but component tool types remain essentially the same.

Archaic sequences for the Plains and the southeastern forested regions are basically those described earlier for the "parent" regions. Central Texas, however, has a unique culture chronology because of its ecotonal situation between these two areas. Weir (1975), in his discussion of the central Texas Archaic, describes the earliest Archaic period (the San Geronimo phase) as being a sparse period during the Hypsithermal when resources would have been scarce. Groups of hunter/gatherers would have been smaller and wider ranging, in order to maximize scarce resources. Tools are essentially a continuation of the Pre-Archaic/Late Paleo-Indian. This Early Archaic pattern matches what has been noted for other transitions over the areas previously discussed. With the Middle Archaic, *Clear Fork* (5000-4000 B.P.) and *Round Rock* (4200-2600 B.P.) phases, however, a significant change occurs. The burned rock middens occur, although elements of the San Geronimo tool kit continue, with heavier emphasis on new resources. Weir, pointing to an increase of oak forests in previously open areas, postulated heavy dependence upon acorn and associated white-tailed deer beginning in the *Clear Fork* phase and flourishing into a forest efficient adaptation in the *Round Rock* phase. The *Clear Fork* gouge ceases to be used at the end of the *Clear Fork* phase.

## Lithic Period Sites in Louisiana

Previous archaeological investigation in Louisiana has been extremely limited with primary consideration, as in the Southeast in general, placed on Late Archaic and later cultures.

Scattered finds of Paleo-Indian points have been found almost exclusively in Tertiary and Quaternary uplands. Much of Louisiana is geologically too new to have been in existence during Paleo-Indian times. Gagliano (1977) has reported coastal finds of Late Paleo-Indian *San Patrice* and *Lerma* points along with bladelets, scrapers, and bifacial knives. Between 8000 and 9000 B.P., portions of Louisiana became an extension of the Plains with resultant influxes of Plano hunters. The *Angostura* and *Meserve* points, Plains equivalent of *Dalton*, are found along with eastern types such as *Quad*, *Dalton*, and the more localized *San Patrice* points. Webb, Shiner, and Roberts (1971) describe the *San Patrice* point as a late survival of the fluted, concave base points typical of Early Paleo-Indian styles. They feel it represents a Late Paleo-Indian manifestation centered in northwestern Louisiana which lasted no later than 8000 years ago. Two types of site locations have been described for the *San Patrice* culture, the margins of upland terraces overlooking streams and along small streams dissecting uplands, but away from major rivers and lakes. The *San Patrice* complex is basically a small tool complex and a unifacial industry manufactured of local materials (Webb, Shiner, and Roberts 1971). The artifact assemblage associated with *San Patrice* points at the John Pearce site (Webb, Shiner, and Roberts 1971) includes side-notched scrapers (*Albany* spokeshaves), side and end scrapers, lanceolate projectile points, small numbers of burins, drills, cores, graters, and retouched flakes.

Another Paleo-Indian point found in Louisiana, the *Pelican* point, is a pentagonal point reminiscent of the fluted pentagonal points from the Reagan and Williamson sites of the Northeast.

The Whatley site (Thomas and Campbell 1978) in north central Louisiana contained a Paleo-Indian level with *San Patrice* and *Meserve* points (Fig. 59). It also contained several end scrapers of the Enterline types (one spurred), three graters, a concave scraper, a unifacial knife, a wedge, and six notched and denticulate scrapers.

The Early Archaic in Louisiana is not well known. The Whatley site produced an Early Archaic level not significantly different from the Late Paleo-Indian level below. Paleo-Indian types continued with the addition of grooved axes, mortars, nutstones, and manos. Middle Archaic cultures in Louisiana are best represented by shell middens indicating the great change to a more aquatic or riverine orientation in Archaic cultures.

## Paleo-Indian Projectile Point Chronology in Western Louisiana (Wallace)

One of the most engaging questions in Louisiana archaeology is the late persistence of the Paleo-Indian transition. The Eagle Hill excavations shed a tiny ray of light on a large and complex problem. Llano tradition occupations

of Louisiana have long been recognized in both the Gulf Coastal Plains and the upland hills (Gagliano and Gregory 1965; Gagliano 1967b) primarily from projectile points found during survey and surface finds in private collections. Virtually all these finds are in the northwestern uplands of the state. Before recent work on the Mississippi Delta (Gagliano 1977) none had come from the younger coastal land. Most of the data obtained from surveys has been of little use, however, because of the imprecise dating of the finds. Of particular interest are *Plano* points originally called *Yuma*, but later renamed *Scottsbluff* (Davis 1953; Wormington 1957). No *Plano* sites, however, have been excavated. There is also a question as to whether the *Scottsbluff* points of east Texas and northwestern Louisiana are technological relatives of the classic High Plains forms or only morphologically similar pieces.

The persistence of the Paleo-Indian technology is exhibited by morphology and associations of *San Patrice* points in northwest Louisiana. *San Patrice* occupations have been dated as early as 8000 B.P. and as late as 6000 B.P. If the *San Patrice* occupation is not *Plano* then it must surely be an Archaic culture. However, morphological and associational analyses have shown a greater resemblance to *Plano* than to Archaic (Webb, Shiner, and Roberts 1971). Generally, the *San Patrice* occupation has been designated terminal Paleo-Indian.

Observation shows morphological similarity between *San Patrice* and other Paleo-Indian assemblages. The *San Patrice* point type is comprised of three varieties: *Hope*, *Goodwin*, and *St. John*. *San Patrice Hope* and *Meserve* points both have concave stems, edge ground concave bases, alternately beveled blades, and basal thinning by removal of short, flutelike longitudinal flakes. *San Patrice* points are shorter and relatively wider than *Meserve* points. *Meserve* points, however, appear more often to be reworked. The shoulders of *San Patrice* points are more prominent, while the shoulders of *Meserve* points are poorly defined. *San Patrice* point stems have small but distinct ears at 45 degree angles, while *Meserve* point ears are less well defined. Finally, beveling on a *San Patrice* point is generally on the left, while beveling of a *Meserve* point is on the right (Davis and Davis 1960).

*San Patrice* points were originally noted at the typesite in Louisiana (Webb 1948) and are also known from the Wolfshead (Duffield 1963), John Pearce (Webb, Shiner, and Roberts 1971), Whatley (Thomas and Campbell 1978), 16 GR 58 (Morehead and Guderjan n.d.), and Big Brushy (Guderjan and Morehead n.d.) sites, and at an unconfirmed Texas excavation (Morehead and Guderjan n.d.). Additionally, the *San Patrice* point can be found throughout Texas, Oklahoma, Louisiana, and Arkansas. This complex has also been found in the Forrest City area of eastern Arkansas (Webb, Shiner, and Roberts 1971). Occurrences elsewhere in Texas and as far north as Missouri show that the *San Patrice* assemblage ranges between the *Meserve* type to the west and the *Dalton* type to the east.

Several attempts have been made to establish the *San Patrice* assemblage as transitional. At Wolfshead, *San Patrice* and lanceolate, concave base points have been shown to precede side-notched and expanding stem corner-notched dart points (Duffield 1963), but tool complexes and associations cannot be accurately determined for the *San Patrice* assemblage, because the projectile points do not exactly fit Webb's 1948 definition. There is, however, a resemblance to *Paisano* and *Meserve* points (Suhm, Krieger, and Jelks 1954; Davis and Davis 1960; Ford and Webb 1956) which indicates a strong relationship between

*San Patrice* and *Meserve* points. At Wolfshead, the *San Patrice* culture has been assigned to the transition, because it possesses traits of both the Paleo-Indian and Archaic lifestyles. Typological, distributional, and associational data support this but, due to excavation methodology, the assemblage was not isolated.

At the John Pearce site (Webb, Shiner, and Roberts 1971) dated to 8000-6000 B.P., the *San Patrice* assemblage is assigned to the Paleo-Indian period, because grinding and milling tools do not appear in association with the tool assemblage. Technological and morphological observations such as edge angles on scrapers, etc., prove no relationship to Plains Paleo-Indian material, but they do indicate that the technology at the site is closer to Plano than previously thought (Irwin and Wormington 1970), because beaks, spurs on flakes, burins, and drills are common as in Plains technology.

A related and perhaps equally pivotal problem is the undated, questionably affiliated Scottsbluff-like component in the area. It is not entirely illogical that Plano cultures might have moved into the region as the Hypsithermal desiccated the Plains after 8000 years ago. A highly resolved examination of High Plains and Louisiana/east Texas specimens is certainly warranted. Opinions vary as to whether the morphologically similar types are technologically the same (Goodyear, personal communication) or different (Denis Stanford, personal communication).

The present chronology is so ill defined that *San Patrice* and *Scottsbluff* points could occupy any time slot in the post-Clovis period in any order. Other problems revolve around a scarcity of artifacts such as projectile points, the location of Paleo-Indian sites due to the geological age of alluvial floodplains in Louisiana, sketchy reports of most investigations, lack of stratigraphically well-controlled excavations, and the inconclusiveness of projectile point chronologies.

Lithic sites can be expected to be rare in Louisiana due to erosion-sedimentation, i.e., degradation of Pleistocene soils and aggradation of Holocene alluvial sediments. The alluvial valleys and delta plain of the Mississippi River date to no older than 3500 to 4000 B.P. (Saucier 1974). Most of the evidence of early man will be deflated and buried beneath the marshes of Louisiana or will be on the continental shelf covered by the Gulf of Mexico (Gagliano 1977). The more northern upland reaches of the state hold a great deal of potential, because of the presence of Pleistocene terraces and rare depositional curiosities such as Peason Ridge (see geomorphic report, this volume).

Most current data from the Paleo-Indian period results from surface artifacts retained in private collections. The *San Patrice* typesite has never been reported in detail (Webb 1948). Although the results of the Avery Island excavations are tantalizing, the mechanized excavation (Gagliano 1967a, 1970), for whatever reason, resulted in no great stratigraphic control, and the context of the archaeological finds can only be generally ascertained. The Whatley site (Thomas and Campbell 1978) near Alexandria and the John Pearce site (Webb, Shiner, and Roberts 1971) near Shreveport are the only thoroughly reported sites. The Whatley site is unfortunately undated. The John Pearce site dates suggest the late occurrence of *San Patrice* points. The excavation

of 16 GR 58 near Pollock is still in preparation. Interestingly enough, grinding and milling tools were found in levels with *San Patrice* points at 16 GR 58 (Morehead and Guderjan n.d.).

The Archaic tradition is defined as a generalized hunting and gathering economy and by stemmed projectile points. The Paleo-Indian period is defined solely upon a "specialized" hunting strategy and accompanying fluted points. Most sites indicate that Early Archaic stage peoples with such an economy appeared after the more specialized Paleo-Indian adaptations, but this evidence does not deny the possibility that this specialized economy was contemporary with the Archaic stage, nor does it imply that hunting was all the Paleo-Indians ever did to survive. Most Clovis sites represent big game or megafauna hunting activities, although the presumed consistent association of big game or herd animals has never been discovered, with one possible exception, or demonstrated east of Oklahoma. It has never been confirmed except in the environmentally similar grass prairies of the Plains regions of Arizona, New Mexico, Texas, Oklahoma, Colorado, and Wyoming, but then neither does the fluted point disappear with the extinction of these animals.

Fluted points persist even into a time when stemmed points predominate. They persist in California for some time after A.D. 1. Technologically similar points with basal thinning, but not true fluting, can be found in many areas such as in the Northeast on some *Copena* ceremonial points, in northern Alberta, and even in southern Texas (Bryan 1977). The concept of the Desert Archaic, for example, has been questioned, because of the associations of flaked stone tools with fluted points. This assemblage was regarded as being used by Desert Archaic people, but was assumed to have been made by Paleo-Indians. Even the wide distribution of Paleo-Indian points is represented by fluted and unfluted points. In the West, *Clovis* points are fluted, while in the East and Southeast these points are unfluted.

#### Paleo-Indian Technology and Demography in Northwestern Louisiana (Gunn)

Paleo-Indians, because of the substantial time depth of their occupation and the relative sparseness of their populations, have provided North American archaeologists with only infrequent insights into their daily lives. Where archaeological remains of Ice Age Americans have been located, lavish attention is paid to the thinly scattered shadows of distant lifeways. The result of this effort is an emerging picture of settlement patterns, subsistence, and technological preferences, and in some cases cultural forms which suggest burial customs and other more intangible and elusive habits. While these conjectural reconstructions of Paleo-Indian lifeways cannot be considered conclusive, they do provide the prospective researcher with a body of knowledge from which rather direct questions can be asked of prospective data sets prior to their recovery in archaeological excavation and analysis. This ability to anticipate results and prestructure research designs is particularly important in regions where little previous work has been done such as in west central Louisiana. In the following pages, a demographic model is developed for Paleo-Indians of Louisiana which draws upon the theory of Paleo-Indian lifeways as is currently understood by specialists in the field and upon the knowledge of archaeologists in surrounding areas such as east Texas, the Plains to the west, and of Louisiana and Arkansas

archaeologists to the east. The model explains some of the cultural changes that occurred during the Paleo-Indian period as a result of demographic succession, as well as culture changes, which probably reflect the influence of environmental change.

A study of Paleo-Indian point types from Louisiana taken from museum and private collections by Gagliano and Gregory (1965) provides some insights into the cultural chronology of the late Pleistocene of Louisiana. Four point types appeared as important components of the review. The quantities and characteristics of these types are presented in Table 27. Several lines of evidence place *Pelican* and *San Patrice* points later than *Clovis* points as a local variant of the Dalton/Meserve phenomenon. The *Scottsbluff* point, on the other hand, is well recognized and as yet is undated. Opinions differ as to its placement in the local chronology and whether it is a legitimate relative of the High Plains *Scottsbluff* type.

TABLE 27. PRIMARY PALEO-INDIAN POINT TYPES IN LOUISIANA

<u>Style</u>	<u>Frequency</u>	<u>Comments</u>
<i>Clovis</i>	18	Texas flints and Arkansas novaculites, widely distributed, uplands along Red River, percussion flaked
<i>Scottsbluff</i>	64	Texas flint (77%) and Texas locus, northwest Louisiana, percussion flaked
<i>Pelican</i>	17	Local material, good workmanship
<i>San Patrice</i>	72	Local, grainy chert

A careful examination of the materials and craftsmanship observed by Gagliano and Gregory (1965) shows a notable and usual progression from exotic to local cherts as well as a general increase in frequency with the exception of the *Pelican* type. Webb, Shiner, and Roberts (1971:20-23) report a remarkably Upper Paleolithic tool assemblage at the John Pearce site, a predominantly *San Patrice* point locality near Shreveport, Louisiana. Their analysis of debitage indicates an almost wholly flake-oriented lithic technology (Webb, Shiner, and Roberts 1971:25, 33). They report a late date (8000-6000 B.P.), for *San Patrice*, which is contemporary with the Plains *Scottsbluff* type. This contemporaneity, among other things, directly questions the opinion that the Louisiana *Scottsbluff* point is late and equivalent to the *Plains* point. For the sake of argument, the position that the Louisiana *Scottsbluff* point is earlier than the *San Patrice* point will be examined in the following section.



## Theory of Paleo-Indian Culture, Demography, and Culture Change for Western Louisiana

In the next section the rather typical Paleo-Indian lithics from Eagle Hill II will be described. The occupation floor on which they were found was dated by thermoluminescence to about 10,000 B.P. While it can be said that the date and tools fit comfortably into the late Folsom/Dalton periods defined from neighboring areas, there is reason to believe that western Louisiana and its immediate vicinity may offer the possibility of a late surviving Paleo-Indian tradition.

As yet there is little theory and only a modest amount of excavated and collected artifactual material through which one can view the context of the Eagle Hill finds. The following few paragraphs attempt to synthesize a plausible model of Paleo-Indian cultural development which explains known facts.

Irrespective of whether the bearers of "Clovis Culture" some 11,000 to 12,000 years ago were of western or eastern hemispheric origin the wide spread homogeneity of their technology marks them as a pioneer culture with the attendant attributes of high mobility. The full implications of this mobility, argued for decades (Martin 1973), has only recently become evident. Goodyear (1979) has begun to build a model of Early Paleo-Indian technology that accounts for heavy reliance on cryptocrystalline tools through mobility based on his experience with experimental replication of Clovis technology, extensive experience in the Southeast, and recent ethnographic studies by Binford (1978).

Goodyear's "logistical model," in essence, argues that the highly mobile Paleo-Indians frequently encountered opportunities to collect food under very unpredictable conditions. Perhaps the most unpredictable and critical of factors is the unlikely availability of good quality material from which to make tools, coincident with the encounter of an unexpected but preferred subsistence opportunity. This set of circumstances encouraged late Pleistocene hunters to manufacture tools from the most manageable and predictable of materials, specifically cryptocrystalline stones. Goodyear (1979) further argues that frequent re-touching and recycling is a logical outgrowth of this logistical system since preferred sources of the requisite material are only visited on scheduled occasions as a subsidiary activity of the annual subsistence round. Evidence for this is found in the ethnographic record among Eskimo cultures and Australian aboriginal groups.

Goodyear explains the movement away from exotic, fine-grained raw material to the exploitation of coarser, local cherts typical of southeastern cultural sequences as cultural change in the face of varying demographic conditions. As best as can be determined by the movement of flints away from their source, the Paleo-Indians must have traveled over territories at least 100 miles in lateral extent. As the land became more densely settled and movement restricted, a broader range of resources was exploited. This broader based, spatially restricted economy enhanced the predictability of resources, reduced accessibility to distant quarries of select material, and generally encouraged the use of locally available if not as workable material. This trend was no doubt

encouraged by the fading necessity to reshape and recover critical tools at points distant from raw materials.

While there may be alternative models, Goodyear's ideas provide a logical and plausible explanation of the elaborate treatment of fine-grained flints by Ice Age hunters and is readily seen as a complementary scheme to the bone quarrying ideas suggested by Bonnicksen, E. Johnson, Frison, and others. Bone quarrying is also thought to be an expedient measure by highly mobile hunters.

I might suggest, at this point, a refinement of the Goodyear (1979) model in view of the Gagliano and Gregory (1965) data discussed earlier. Let us assume, for the moment, that the order of occurrence of the points in time is sequential, and that they are correctly ordered as in Figure 60. Only the *Scottsbluff* specimens are in question as to order. Technological parallels drawn between *Folsom* preforms and parallel-flaked *Scottsbluff* points suggest a tenuous, but possible position between the *Clovis* point and the very Late Paleo-Indian *San Patrice* manifestation.

The technological trajectory outlined by this order is logical enough. *Clovis* and *Scottsbluff* points are both percussion flaked. Exotic flints grade into local cherts, workmanship begins at a high level with *Clovis* and *Scottsbluff* points and suffers a de-emphasis with the *San Patrice* point. The frequencies of the *Pelican* type, however, are a matter of some incongruence. Workmanship on the *Pelican* point is reported (Gagliano and Gregory 1965) as being "good" as one might expect in a culture transitional from one making *Scottsbluff* points. On the other hand, the material used for the *Pelican* points are local as might be foreseen for a type transitional to the *San Patrice* type. The frequency of *Pelican* points, however, are remarkably much lower than either of the adjacent categories.

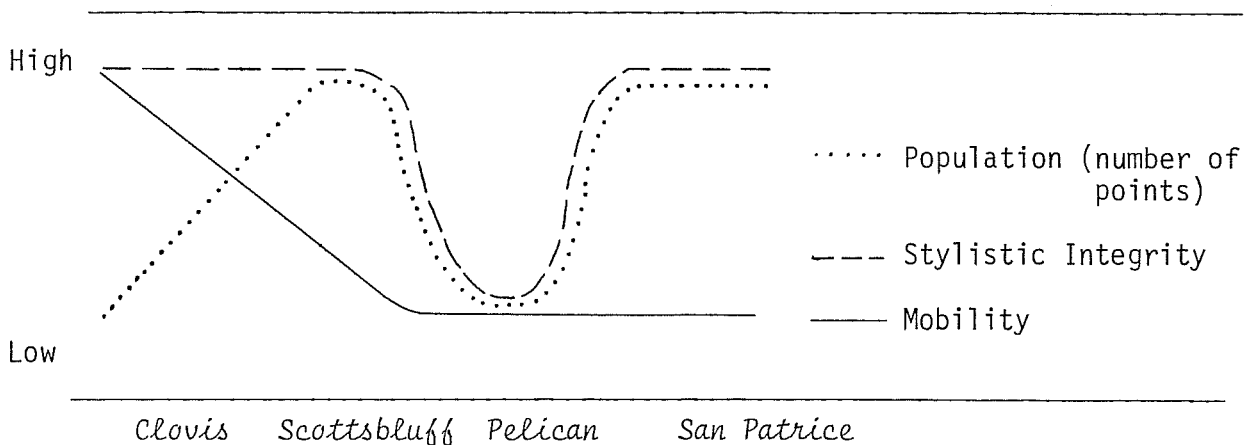


Figure 60. *Relationship between Demography, Climate, and Cultural Change in the Louisiana Area Based on Point Frequencies and Patterns of Manufacture.*

Without being overly optimistic in the absence of any sound chronometric data, it could be suggested that this low frequency of *Pelican* points intermediate between *Scottsbluff* and *San Patrice* represents a period of population decline and/or a short, intermediate period. If such is the case, a trajectory of

culture change in the Louisiana area as in Figure 60 may be suggested. Of primary interest is the fact that influences favoring cultural change are, in part, demographic and, in part, environmental. If "stylistic integrity" is defined by the duration and coherence of a culture as measured by a common pattern of procurement and manufacture, then we might assume that *Clovis* and *Scottsbluff* points with their common penchant for exotic material, percussion flaking, and general lanceolate form are a stylistic unit. Stylistic integrity then breaks down for a time and reappears as the well-represented *San Patrice* style. The *Pelican* series is represented as being low in stylistic integrity, because it shares the pattern of styles preceding and following it.

We might infer, in the case of *Clovis* and *Scottsbluff* points, that the differences between the styles is a function of demography. As the sparse *Clovis* hunters became more numerous their subsistence and technology changed to meet shifting demographic conditions. The subsequent radical change in style, however, possibly punctuated by an intermediate population decline, need not be explained in terms of culture responding to demography. More likely, an explanation might be sought in the realm of environmental or culturally induced change.

The find of an apparently Folsom-related component at Eagle Hill suggests that there was a Plains-related bridge, most likely between *Clovis* and *Scottsbluff* times. From Eagle Hill it is known that the Folsom phenomenon existed at 10,000 B.P. Nothing is known about the *Scottsbluff* component except that it existed on the Plains after 8000 B.P. and was very wide spread. The scarcity of chronological data as indicated by a possible 1000-1500 year gap either way from Eagle Hill serves to emphasize the great amount of work to be done in western Louisiana and east Texas before a meaningful early man chronology is manifested.

### Conclusions

In summary, with respect to Paleo-Indian tool kits and complexes, the *Clovis* tool kit appears to support a homogeneous, wide-ranging root culture with a very generalized technological base for a wide variety of adaptations. The variety of stone and bone implements was probably quite flexible in allowing *Clovis* hunters to exploit either the open environment of the Plains or the less hospitable environment of the far Northeast or the richer, more forested, "different" environment of the Southeast.

Folsom cultures, on the other hand, as indicated by differences in numbers and percentages of utilization of particular tool types, was a more highly specialized tool kit in terms of both stone and bone implements. In addition, *Folsom* tool types vary less than *Clovis* types. Judge's (1973) work with transverse scrapers indicates increasing specialization from *Clovis* to Folsom industries. To what extent the Middle Paleo-Indian industries of the East conform to this pattern is somewhat unclear due to the nature of Middle Paleo-Indian finds. But if Gardner and Verrey's (1979) classification scheme for Early and Middle Paleo-Indian points is valid, there is reason to assume that other elements of the technology are similar as well. A high degree of standardization is suggested for Middle Paleo-Indian times regardless of prey species.

Folsom peoples appear to have been highly specialized in an optimum environment. They had more freedom in site selection due to the greater availability of water and were highly specialized in bison exploitation. Judge (1973) suggests that the *Folsom* point consistency in size and shape was due to the practice of hafting them onto a bison rib foreshaft. This proposition appears to be consistent with the highly specialized nature of their technology and adaptation. Although it is probable that all of the Paleo-Indian hunters concentrated on other foods as well, it seems imminently more likely that Late Paleo-Indian peoples would have exploited a wider range of resources than Folsom peoples.

With the exception of some minor fluctuations such as the moist period associated with the Cochrane Readvance ca. 8000 B.P., Late Paleo-Indian cultures existed primarily in a time of increasing aridity. They would have been forced to choose less advantageous site locations to maximize certain resources: Plano peoples, the decreased water supplies on the Plains; Dalton peoples, the decreased areas of open land as forests continually encroached upon the landscape. Tool kits change little from components of earlier traditions except for an explosion of point types. In the Plains, tool kits show an increasing trend toward specialization with a continuing dependence on bison as a resource. Dalton peoples in the East were similarly highly specialized in the exploitation of white-tailed deer, although theirs and probably all eastern adaptations were always dependent upon a wider variety of forest resources. The Dalton tool kit continues, in most respects, the tradition of Middle Paleo-Indian assemblages, but adds the classic adze, possibly a good example of a high degree of increasing specialization in the exploitation of a changing environment.

The surprising find in this study has been the degree of continuity between Late Paleo-Indian/Early Archaic assemblages, not only in the East where it might be expected given an early trend toward developing a forest efficient adaptation, but in the Plains and Texas as well. The biggest change appears to occur from the Early to Middle Archaic periods. In the Southeast, a substantial change is noted with the appearance of shellfish and artifacts. Little is known in the Northeast of the transition to Early Archaic and from Early to Middle Archaic. What evidence does exist (Staten Island sites) shows remarkable continuity from Paleo-Indian tool types to earliest Archaic assemblages with the greatest changes occurring in the Middle Archaic Lamoka culture, which was highly dependent upon aquatic resources. In the Plains and Texas, "Pre-Archaic" and earlier Archaic assemblages continue with major components of Paleo-Indian tool kits. Bifacial *Clear Fork* gouges appear in the Late Paleo-Indian period and possibly earlier and switch to a unifacial form in the Early to Middle Archaic stages. Early assemblages along the Plains/eastern Woodland ecotones show continuation of trends in proportion and types of tools from Late Paleo-Indian through Early Archaic with only minor changes, primarily in point styles which are either significant in foretelling changes in adaptive strategies or not. Major changes in assemblages occur in Middle Archaic times with the addition of more ground stone tools, an increase in large tools such as core tools and large choppers, and an increase in bifacial tools in general.

One final note about the latter change is offered. Given what is known about Paleo-Indian groups, namely their mobility and their need and use of high quality cryptocrystalline materials (Goodyear 1982) as a portable, dependable, and

flexible technology, the change from unifacially oriented to bifacially oriented assemblages is not at all surprising, nor is the decline in "fine workmanship," and the use of more exotic materials. As their mobility was gradually reduced by major changes in climate, topography, plant and animal resources, and population pressures, the need for a more portable technology diminished. Another aspect of a portable technology of high quality materials is that it is naturally a conservative one. Materials were procured at great expense. Unifacial industries are, by definition, more conservative than bifacial ones. Finer workmanship, when continually reworking and resharpening tools, is conservative as well. Not only would the increase in bifaces, larger core tools, and choppers indicate a heavier dependence on plant resources, but also the decreasing need to conserve lithic materials. No doubt, it was a highly dynamic, multicausal system which was obtained during the change from unifacial to bifacial technologies. But loss of extensive mobility and of concomitant dependence upon high quality stone and not simply the need to exploit plant foods could have influenced Archaic peoples' choice of materials and technologies. Rather than a purely culturally biased "aesthetic" choice, their livelihood simply no longer depended upon it.

### C. TOOLS AND TECHNOLOGY

At Eagle Hill the inventory of formal tools and recognizable large flakes used as tools is small, but certainly existent. The sequence (Table 28 and Fig. 61) from the Paleo-Indian to the Historic period is standard in its composition. A relatively high frequency of tools gives way to less specialized forms until the Classic period of lower Mississippi Valley culture during the first millennium A.D. After the Classic period, formal tools again diminish.

The Paleo-Indian inventory consists of scrapers, burins, and beaks which appear only infrequently later. Gravers, notches, retouched flakes, and points are present throughout most of the period.

The OP 4.12 episode is the most distinctive assemblage. It is comprised of virtually no formal tools, but large edge-altered flakes are present. OP 4.12 is succeeded by an erosional episode that represents a significant gap in the archaeological record.

Each occupation plane (OP) after the erosional lapse is marked by a character of its own. OP 3.11 contains a few tools. However, it is mostly distinguished by a large number of edge-altered pieces. Also, bipolar cores appear in OP 3.11 and the subsequent plane. OP 3.11 has the highest index of occupation. Perhaps the large numbers of flakes indicate a brief interval of domestic activity on Peason Ridge. OP 2.13 is much like OP 3.11 except for a drastic reduction in the number of edge-altered pieces. Finally, OP 1.13 is marked by a reduction in frequency of occupation and a singularly unspectacular accumulation of lithic scatter.

Table 29 indicates the total number of classes of tools and their ratios with the number of platformed flakes. The number of platformed flakes represents the total amount of lithic-related activity at the site. A flake/tool ratio shows the relative emphasis on formal tools relative to less formal utilization of lithics. A thorough inspection of the Eagle Hill lithics leads one to

TABLE 28. FNs OF TOOLS RECOVERED FROM OCCUPATION PLANES AT 16 SA 50

Artifact	Substratum					Total
	4.17	4.12	3.11	2.13	1.13	
Points	3429			2965	1236	3
End scraper	2439		3081			2
Denticulate			1853	1405		2
Side scraper	3365 2737					2
Notch	2708 2737 3318 3399 3426		1765 1846	1322		6
Graver	2838 3388		1520	1154 1314 1365		6
Beak	2685 2779 2858 3403		1756 1779	1379		7
Burin/Spall	2876 3370 2554			1361		4
Retouched Flake	3218 3220	2091 3154	1611 1784	1171 1221	918 955 800	11
Biface Frag- ment	2814	2182 2204		1201		4
Edge-Altered Pieces	2706 2708 2718 2731 2861 2858 3016 3285 3372 3384 3403	1954 1958 2037 2034 2114 2179 2180 2215 3181 3205 3210	1510 1550 1591 1716 1726 1734 1742 1749 1767 1773 1782 1807 1817 1832 1844 1849 3041 3074 3105	1317 2982	836 818 800	46
Blade/ Bladelets	2439 3403	2029 2194	0221 1715 1720		744 61	9
Flake Core	2718 3318		1798			3
Microblade Core	2714				1043	2
Bipolar Core			1515 1810 1812	1170 1466		5
TOTAL						112

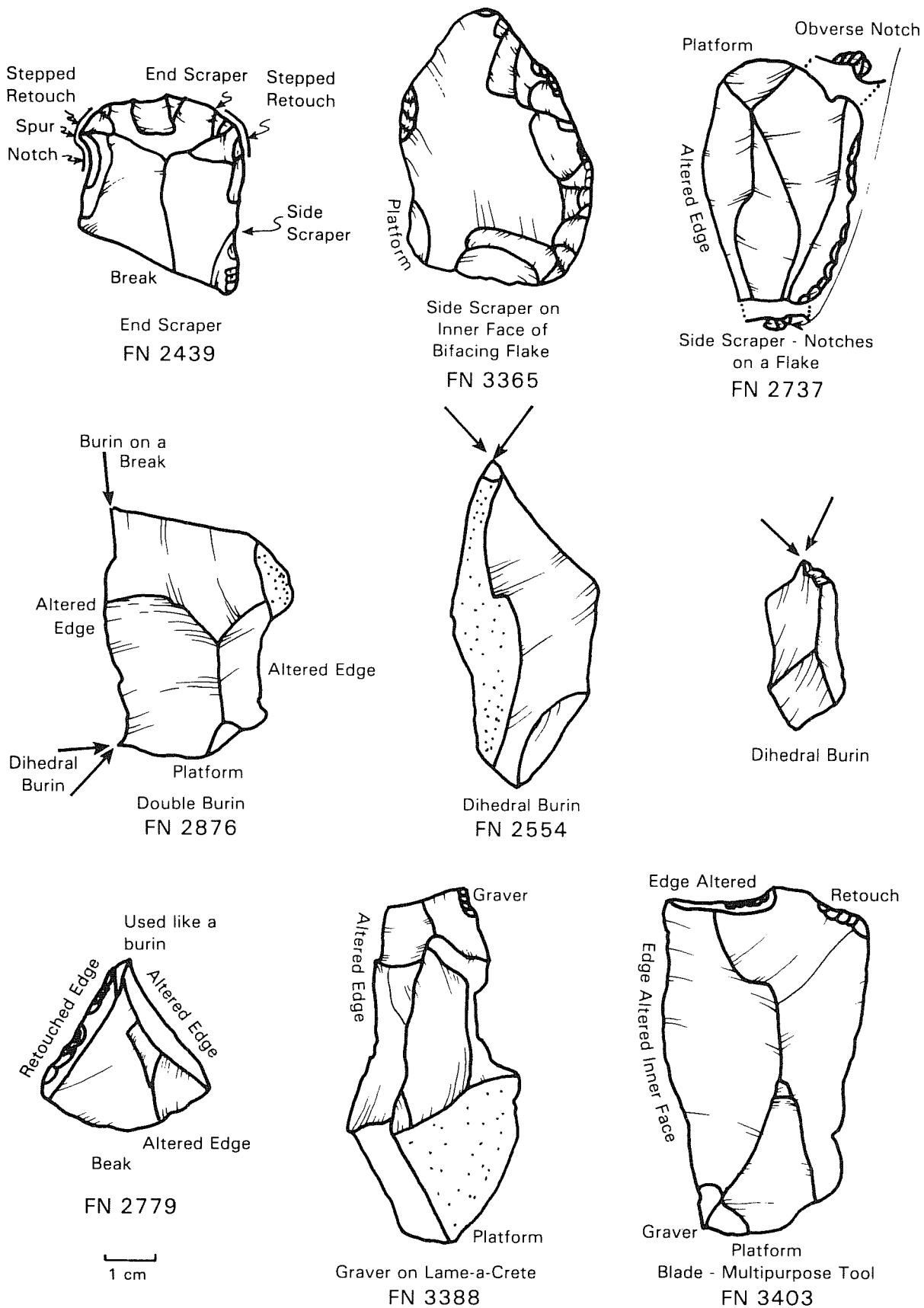


Figure 61. *Paleo-Indian Lithics from OP 4.17.*

TABLE 29. FLAKE TO TOOL RATIOS

Substratum	Artifact Formal Tools	Edge-altered Flakes	Cores	Total Plat- formed Flakes	Tool/Platformed Flake Ratio	Edge-Altered Flake/Plat- formed Flake Ratio	All Tools/Plat- formed Flake Ratio
1.13	4	3	1	139	.029	.022	.058
1.21	1	-	-	-	-	-	-
2.13	11	2	2	265	.042	.008	.057
2.14	1						
2.31	2						
3.11	9	19	4	300	.030	.063	.107
3.12	1						
3.21	2						
4.12	4	11	-	274	.015	.040	.055
4.17	21	11	4	141	.149	.078	.255



believe that any piece of silicious material carried to Peason Ridge was probably brought to be used. Large cores and core fragments, for instance, are universally edge altered. As Table 29 shows, when tool and toollike pieces are compared to platformed flakes, the Paleo-Indian assemblage is comprised of a full 25% of tools in contrast to 5 to 10% in later assemblages.

Some of the tools recovered are illustrated in Figures 61 to 63 and Plates 8 and 9. Aside from the sheer presence of formal tools on the Paleo-Indian floor (Fig. 61), the points provide some insight into the cultural chronology of the site.

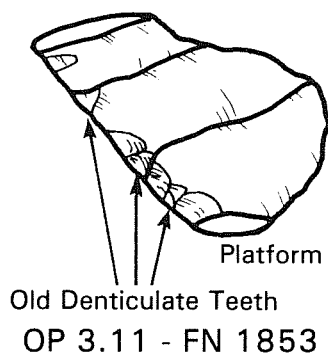
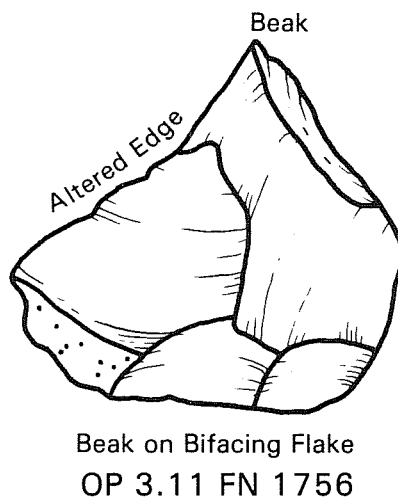
Lanceolate--The lanceolate (Plate 8) is made of a very tough, purple quartzite. The workmanship is clearly Paleo-Indian. Attempts at fluting failed, but it has the flat appearance of Paleo-Indian lanceolates. The artisan used the "diving flake" technique, which may have been more applicable to this unusual material. The shape, edge preparation, and flaking are reminiscent of Texas *Folsom* points (Thomas R. Hester, personal communication). The associated scrapers, burins, beaks, graters, etc. (Fig. 61), all point to a classic Paleo-Indian assemblage.

Corner Notch 1--A corner-notched point with a long blade and well-defined barbs was found in OP 3.12 of the Eagle Hill control column (Fig. 63,e; Plate 9,h). Typologically it is most like a *Williams* point (Suhm, Krieger, and Jelks 1962:259). It was apparently associated with the materials deflated onto the IB/IIB interface. The point could very well represent a Subboreal period occupation (2500 B.P.) on Peason Ridge which was subsequently deflated during the Roman Empire Climatic Optimum (see section on climate of the Gulf Coastal Plain, page 74). An engraver on a blade (Fig. 63,f; Plate 9,g) and a complete, although crudely made biface (Fig. 63,d; Plate 9) were found in the same level.

No points were directly associated with OP 3.11, but there were tools (Fig. 62). The small bipolar cores of this period may indicate the use of microlithic alternatives to points.

Corner Notch 2--A second corner-notched point similar to *Edgewood* was found in the OP 2.31 intermediate level in E3019-N999 (Fig. 63,b; Plate 9,e,f). It is made on pebble chert (note the pebble cortex on the reverse side). A couple of sherds from this level also appear to be similar to a style of the Marksville period. While two sherds of questionable integrity and a possible *Edgewood* point singly do not argue for a Marksville period occupation, in combination they do pose the possibility.

Small Gary--A small *Gary* point was found in the occupation plane immediately below OP 2.13 (Fig. 63,c and Plate 9,d). It suggests that by A.D. 935  $\pm$  70, local attempts were clearly underway to adopt bow and arrow technology. A more detailed discussion of the matter follows. The strangest biface in the site assemblage (Plate 9,c) is reminiscent of the barbed points succeeding the small *Gary* as arrow points. However, it is thick and poorly made, perhaps prototypical.



1 cm

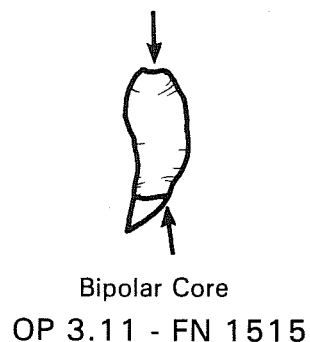
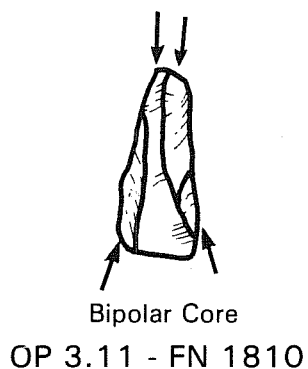
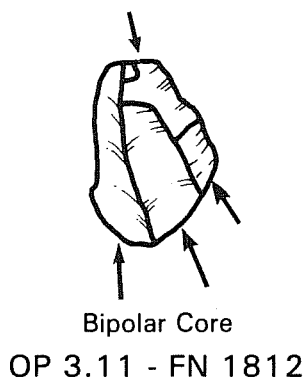


Figure 62. Tools, Resharpending Flake, and Bipolar Cores from OP 3.11, A.D. 820.



a obverse



Pressure Flaking Movement

FN 1431

b obverse

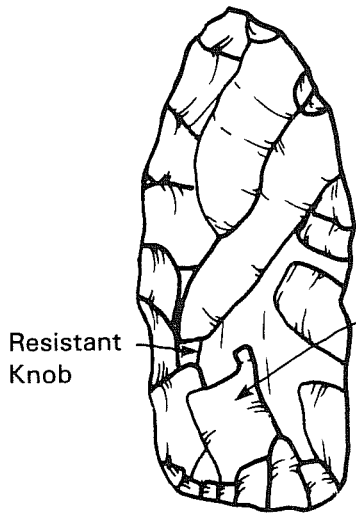


Cross section

FN 193

c obverse

1 cm

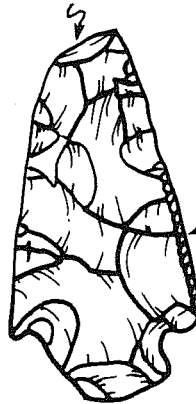


Resistant Knob

End Flake Attempt to Remove knob, Failed with Hinge Fracture

FN 1905  
d obverse

Snap Fracture



FN 242  
e obverse

Fine Retouch

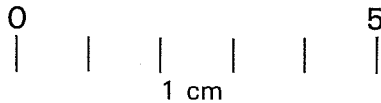
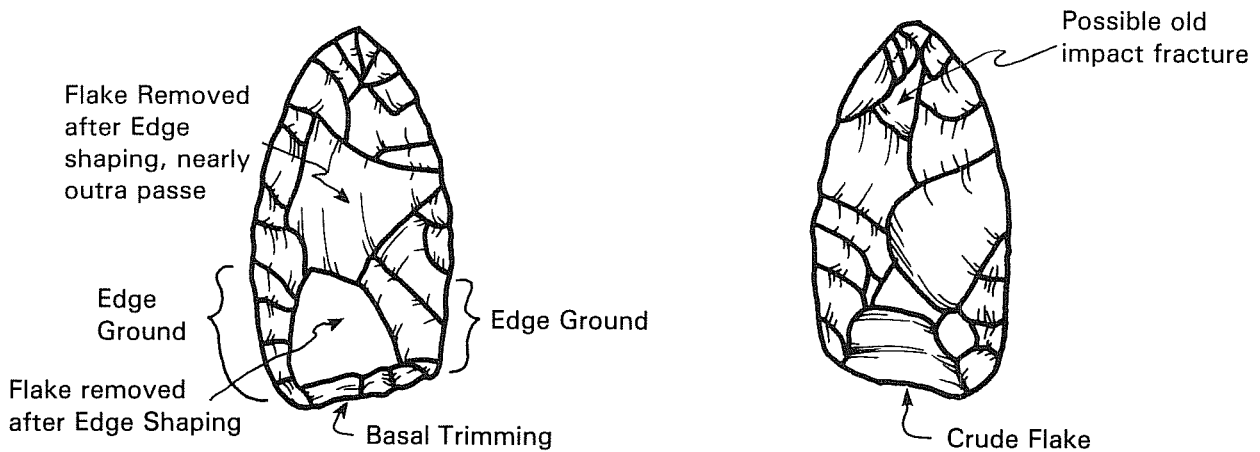
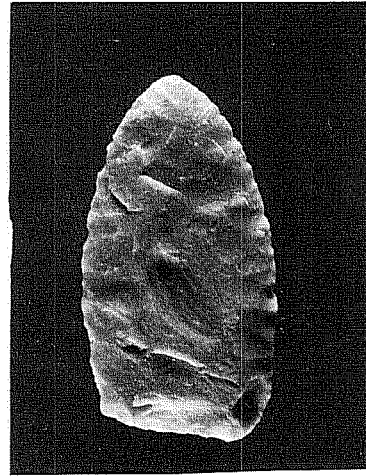
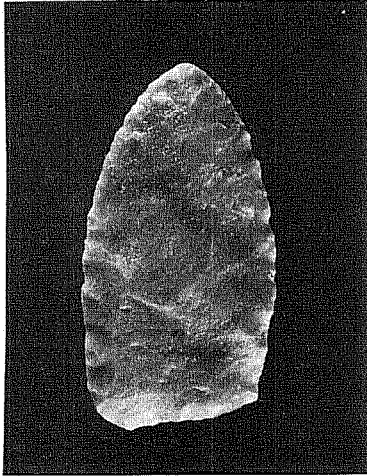
Engraver



Fine Retouch

Platform  
FN 1855  
f engraver

Figure 63. Late Holocene Artifacts.



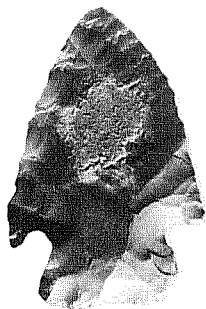
EAGLE HILL (16SA50)

FN 3429

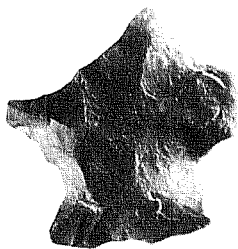
**Material:** Purple quartzite, material makes it difficult to see scar spines for drawing. No fissure lines so cannot determine sequence of flaking in all cases.

**Workmanship:** Generally very good. Basal trimming may be a different grade of workmanship. Point may have been broken near present base and reworked into shorter point by thinning and trimming base. Very slight possibility of impact fracture remnant near tip.

Joel Gunn-1 Sep 80



e reverse



b reverse



a



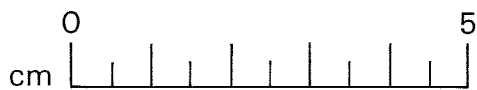
f obverse



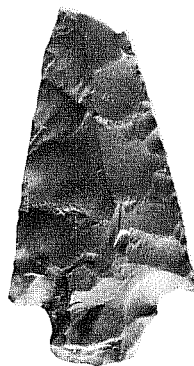
d obverse



c



i reverse



h reverse



g

Plate 9. *Late Holocene Artifacts.*

Friley--A *Friley* arrow point was found in the 1.21 intermediate level (Fig. 63,a; Plate 9,b). It indicates that by the time represented by the intermediate level OP 1.21, the inhabitants of Peason Ridge had made the technological transition to a refined bow and arrow technology. Unfortunately, OP 1.21 is not securely dated, perhaps after A.D. 935.

Base Fragment--The basal fragment of a possible *Cuney* point (Suhm, Krieger, and Jelks 1962:271) was found in OP 1.13. The *Cuney* arrow point (Plate 9,a) is associated with Caddoans of the Hasinai branch during the Historic period and dates between A.D. 1600 and 1800. If the dating is valid, OP 1.13 completes a very long if not full occupational history for Peason Ridge.

As was spelled out in the previous section we had hoped to define the tool kit using the resharpening and reshaping flakes of tools brought into and carried away from Peason Ridge. As the denticulate resharpening flake (Fig. 62) shows, we were able to do this to some degree by visual inspection. However, we were able to augment the tool sample only marginally with the unaided eye. Microscopic studies are discussed in the section Interpretation of Occupation Plane Patterns (page 316).

Most of the points were found in the exact top of the mound, especially in the control column. This is one of the first indications of the "dry feet phenomenon." As an escape from the surrounding swampy terrain, the site was probably most attractive during wet periods.

### Biface and Core Flake Technology

Several authors (Weir 1975; Gunn and Mahula 1977; Carter 1978) have suggested that there is an environmental relationship between biface flaking and core flaking technologies. It is thought that core flake technology is related more to the Plains, while bifacing is a Woodland-preferred technology. To my knowledge these are speculations for which there is no direct supporting evidence. The matter is complicated by the fact that there is no such thing as a purely bifacial technology or a pure core flaking technology. As a rule, assemblages contain elements of both.

A logical analysis of the two industries suggests that the presumed relationship is not altogether unlikely. The stone tools of mobile Plains groups probably serve as butchering tools and for related tasks. Core flaking and particularly blade core technology provides light tools and efficient use of raw materials that occasionally have to be carried. Woodland groups, on the other hand, make additional demands on their tool repertoire. Tasks related to woodworking, horticulture, etc., require more robust implements. Furthermore, Woodland groups are usually settled at least part of the year so that a heavier tool assemblage does not hamper nomadic movements. Larger and more robust tools are more easily made by bifacing. Therefore, Woodland groups preferring bifacing is not illogical.

As has been discussed in the perspective of long-term, Holocene climatic change, the west Louisiana/east Texas region is located in the unstable ecotone between the Plains and Woodlands. The location of Eagle Hill in this zone

indicates that it could be important in resolving the core-biface ecology problem. Both Hester (1971a:113) and Gunn and Mahula (1977:252) have observed shifts between the two technologies in south and central Texas. More recently Thoms, Montgomery, and Portnoy (1981) have attempted to test the model in south Texas with mixed results. In any case, no connections between technological shift and ecological change have been securely established or well defined.

It is also worth noting that any such analysis at Eagle Hill is likely to be one-sided relative to ecological changes. If our surmise is correct that the site would only have been occupied during wetter and cooler periods, it follows that the assemblages from the occupation planes should all be a product of Woodland style occupations. Thus, the following analysis does not provide conclusive proof of the techno-ecological relationships. It does provide a body of data on which future comparative research can be based.

Determining the bifacing component of an assemblage is a complicated problem, because the early stages (Fig. 64) yield biface flakes indistinguishable from core flakes. As the biface is thinned, the flakes begin to take on the characteristics of the typical bifacing flake. The most careful examination of a flake assemblage can only show the proportion of characteristic bifacing flakes to the corelike pieces produced early in the bifacing process and the true core flake specimens. Our counts of bifacing and nonbifacing flakes are an attempt to index the frequency of characteristic bifacing flakes against an indeterminate population of the other two types of flakes. The flake terminology illustrated in Figure 65 will be used in the following discussion. A comparison of Figures 64 and 65 shows the relatively arbitrary nature of most flake analyses.

Of the 1119 one-centimeter provenienced specimens identified as platformed flakes, 417 were determined to be bifacing flakes. Bifacing flakes were judged quite conservatively so that questionable specimens fell into the nonbifacing category. Attributes considered to be indicative of bifacing flakes were platforms with triangular profiles, strongly lipped platforms, ground platforms, and the broad, very flat slightly curved inner face and nonsalient bulbs of percussion (Table 30).

TABLE 30. FREQUENCIES OF PLATFORMED BIFACING TO NONBIFACING FLAKES BY OCCUPATION PLANES

Substratum	Total FNs*	Platformed Bifacing Flakes	Platformed Nonbifacing Flakes	Bifacing ÷ Nonbifacing Flakes	Total Plat- form Flakes
1.13	184	32(23%)	107(77%)	0.30	139
2.13	326	100(38%)	165(62%)	0.61	265
3.11	385	118(39%)	182(61%)	0.66	300
4.12	345	99(36%)	175(64%)	0.57	274
4.17	185	68(48%)	73(52%)	0.93	141
TOTAL	1425	417(37%)	702(63%)	0.59	1119

\* total number of pieces identifiable as tools, cores, or platformed flakes

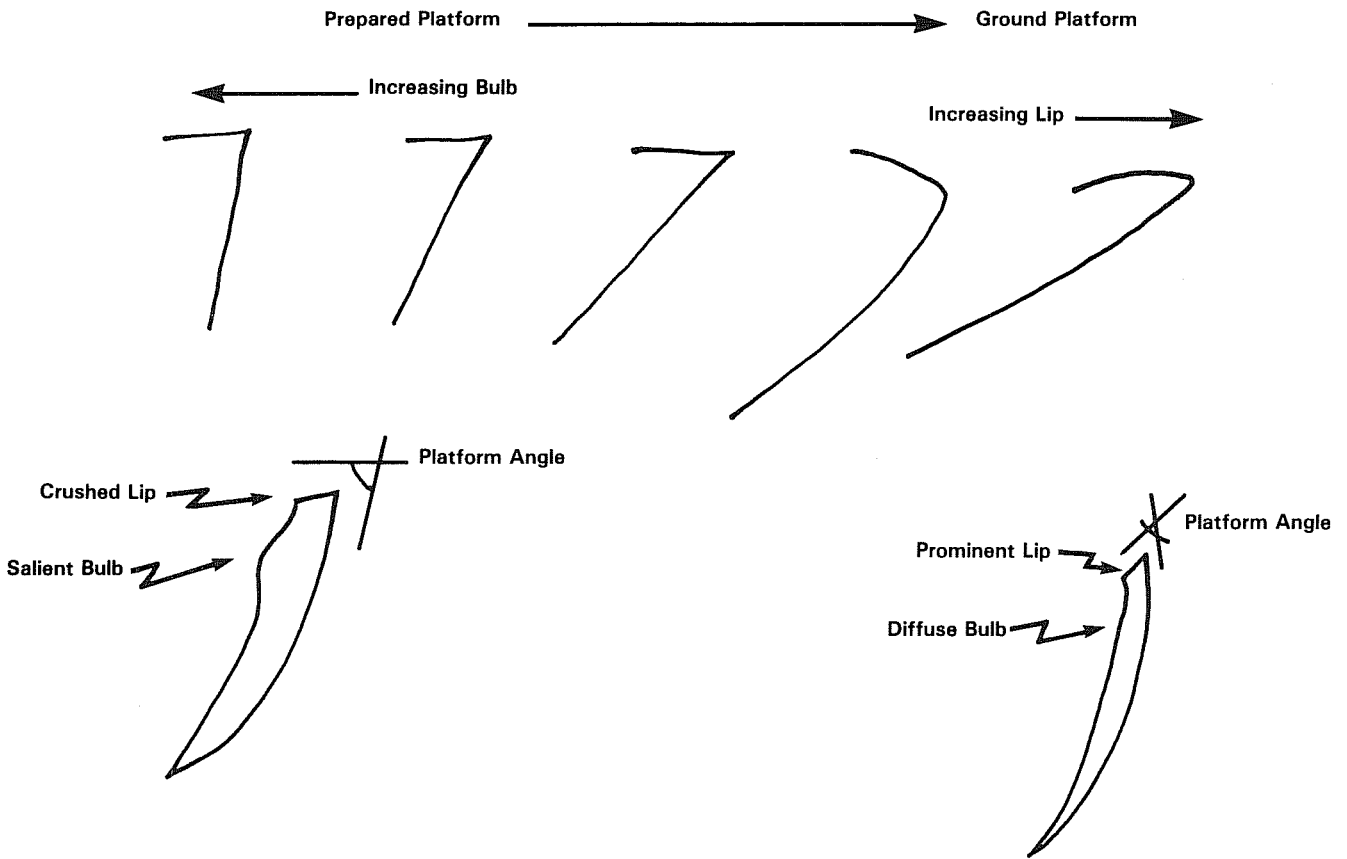
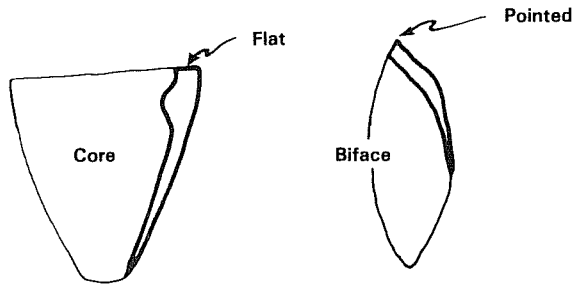
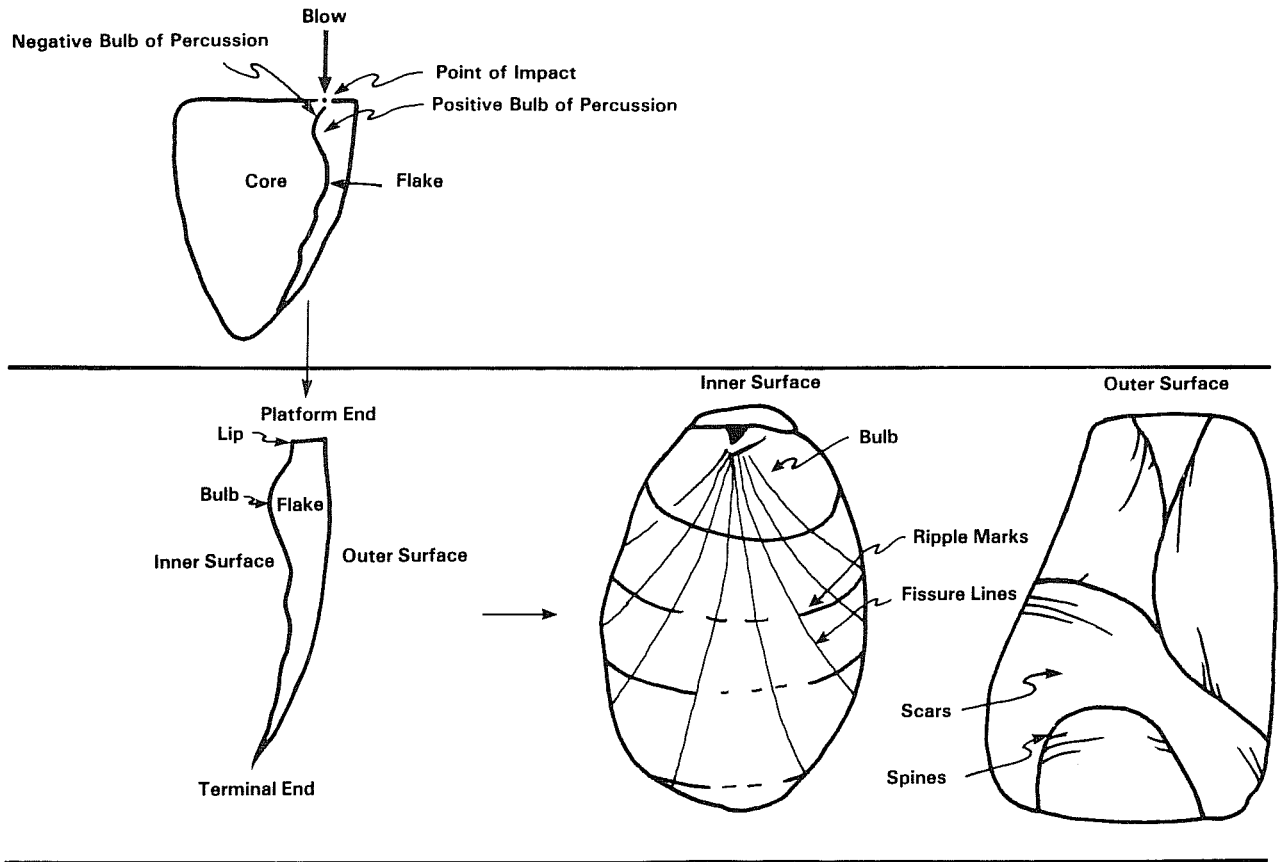


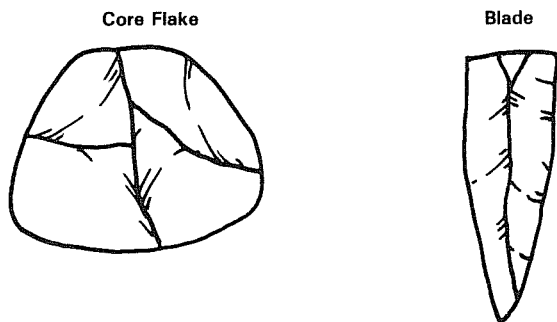
Figure 64. *Progressive Bifacialization of Flakes in the Biface Producing Process.* As the platform angle decreases, the platform must be ground to insure long flakes. The bulb becomes progressively more diffuse.



# FLAKE TERMINOLOGY



## Platform Profile



## Flakes & Blades

Figure 65. Flake Terminology.

As Table 30 shows, the middle three occupation planes are marked by a consistent relationship between bifacing and nonbifacing flakes. The lowest occupation associated with the Paleo-Indian component is different. It contains a very high proportion of bifacing flakes. The uppermost occupation plane is notable for a decided dip in the popularity of bifacing. This is a common characteristic of Late Prehistoric phase sites in Texas. It is contemporary with OP 1.13, but an explanation remains to be developed. In general, bow and arrow technology of the last millennium seems to have fostered an impoverished lithic technology, perhaps caused by low quantitative demands imposed by arrowhead making.

The frequencies of bifacing and nonbifacing flakes are shown by squares in Figure 66. In the right half of the illustration, the squares dominated by bifacing are shaded.

### Frequency of Habitation at Eagle Hill

Given that site function at Eagle Hill was probably consistent throughout time, the numbers of blows struck during the flaking process (platformed flakes) is a likely index of human activity at the site. This criterion indicates almost equal amounts of activity during Paleo-Indian occupation and the latest occupation. Likewise, approximately 250-300 platformed flakes in the middle three occupation planes indicate almost equal occupation frequencies during those times. The middle three occupation planes were utilized about twice as intensively as the early and late components.

### Points as a Functional System

American archaeologists have traditionally examined points from a morphological perspective. The primary intention has been to use points as diagnostic time markers, thus supplementing chronological information on site context. During the last decade several attempts have been made to reduce morphological types to systematic measurements in order to compare types numerically. Such an approach has the advantage of examining large numbers of points simultaneously and thus, escaping to some extent, the biasing interest of point typologists in exemplary specimens (Luchterhand 1970; Gunn and Prewitt 1975).

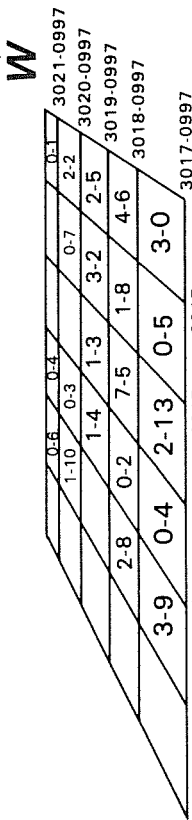
Benfer and Benfer (1981) examine the Gunn and Prewitt article in some detail. They suggest that the angular measurements used by Gunn and Prewitt are not heuristic and should be replaced by linear measures. Prewitt has been working on such a scheme for some time and now has a nonangular set of measures for several hundred points from the central Texas area.

The following analysis is directed toward two objectives. The first is to generate a "point space" for east Texas and Louisiana which will serve as an analytical background for the points excavated at Eagle Hill (16 SA 50) during the summer of 1980. "Point space" is more easily demonstrated than explained (see example at end of the Gunn and Prewitt article). A similar space was generated using principle components analysis by Gunn and Prewitt (1975). As a test of the Benfers' suggestion only linear measures will be used.

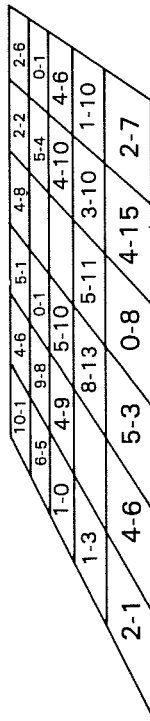
# EAGLE HILL (16SA50)

Occupation Floor Analysis - 1m Study

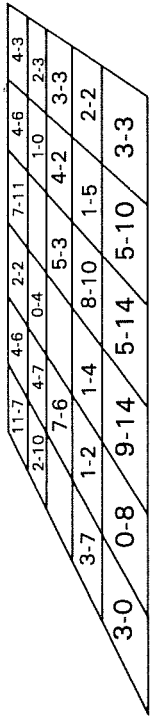
TOPIC: Bifacing and Non-Bifacing Flakes



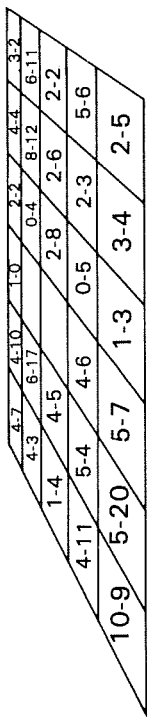
1.13



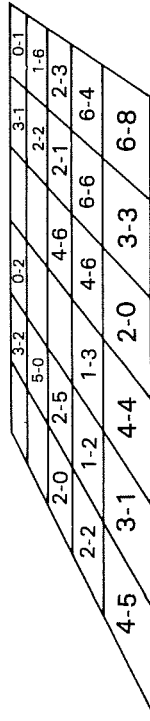
2.13



3.11



4.12



4.17

Occupation Floor

Figure 66. Bifacing Loci on the Occupation Planes.

The second objective is to develop a functional model for point morphology. In the past, measurements have been taken on points with no thought given to the rationale for those measurements, except that they describe the morphology of the point. In this effort measurement will be justified by function rather than morphology. The first task is the development of a functional model for the universe of point forms.

### Principles of Leverage and Prehistoric American Points

One of the first formally noted characteristics of the universe in which we live concerned leverage. Archimedes boasted, that given a place to stand, he could move the world with a lever. While our plans for this study are not so grandiose, it is not unreasonable to expect that some functional insight into the relative shapes of various points could be gained by examining their relationships in the context of the laws of leverage.

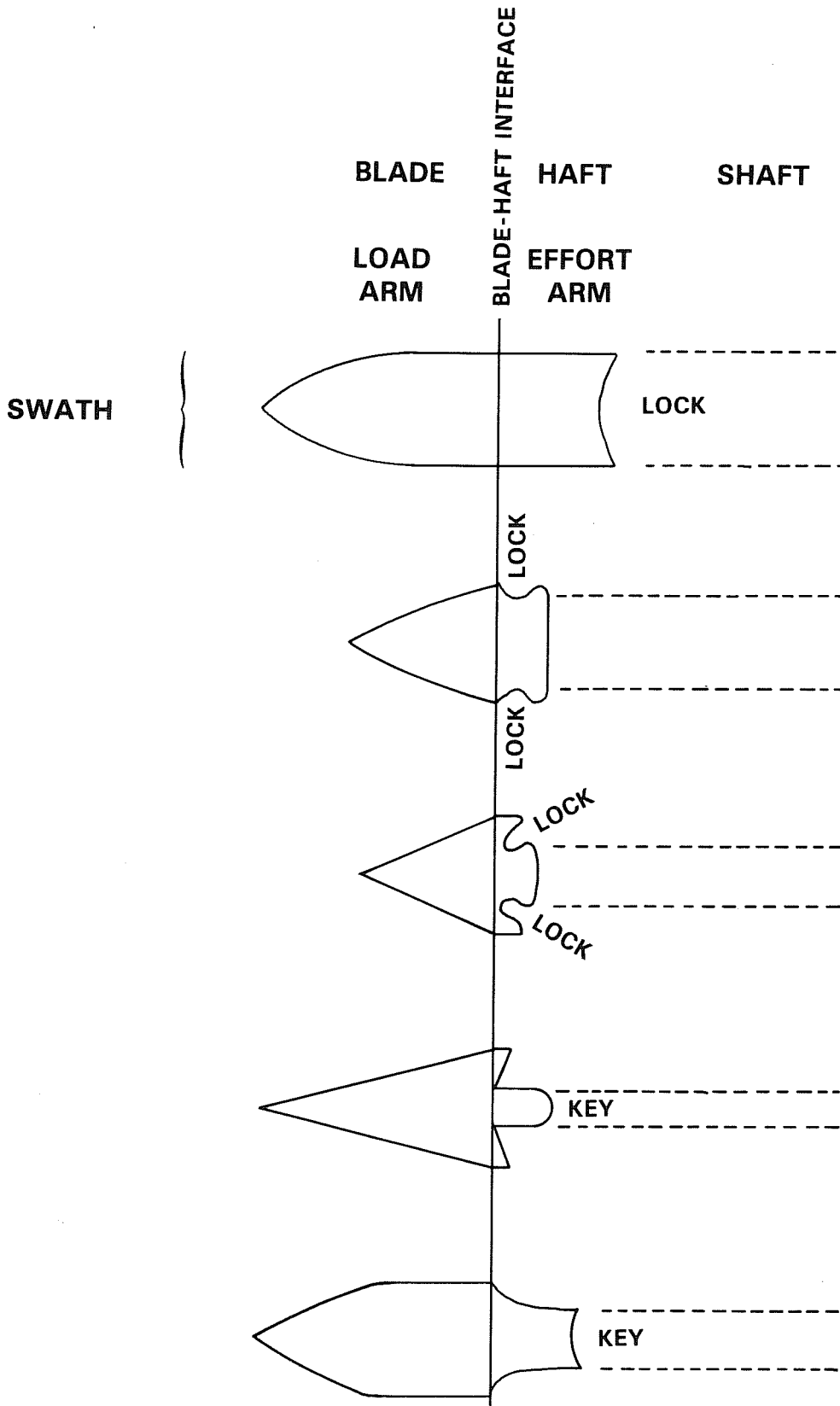
Normally levers are classified into three general types depending upon where the fulcrum engages the lever. The fulcrum of a first class lever is located near the middle or between the load which the lever is bearing and the source of energy which moves the load, perhaps a human. A crowbar is a good example. A second class lever locates the load between the fulcrum and the source of effort such as in a wheelbarrow. Finally, a third class lever locates the fulcrum and the effort at one end and the load at the other. A fishing pole or human forearm are examples of third class levers.

The relationship between the effort arm and the load arm of the lever can be described mathematically. The lever is said to be in equilibrium when the product of the length of the effort arm and the energy applied to it are equal to the product of the load and the length of the load arm. An equilibrium situation would be a seesaw with a box of sand suspended from one end. When a man applies enough downward force to hold the seesaw level, the leverages are in equilibrium.

Let us assume that the shapes of points are a system of leverages which perform functions for the user. It would be ideal if points were a simple lever like the seesaw. A preliminary examination of the problem, however, suggests that points are comprised of a complex system of leverages.

Points are generally thought to be hafted at the base into some sort of device, either a foreshaft or the shaft of a spear, dart, or arrow. Together the shaft and point are a third class lever. Singly, however, the relationship becomes that of a first class lever. The point does not sit on the end of the shaft as it would in a third class lever, but rather the shaft projects around the point so the two can be bound together. There is a fulcrum somewhere on the base, but here it will be treated as the interface between basal modification and the blade of the point. Basal modification includes edge grinding on lanceolates and on side corner and basal notches, tangs, etc.

Reflecting on the discussion of levers, the base is the effort arm of a point and the blade--the load arm. Such an identification allows an examination of various point styles in the context of the equilibrium potential of the various point forms. Figure 67 illustrates some well-known point styles consistently divided at the blade-haft interface. Lanceolates have a prominent effort



**Moments: product of force by its arm length**  
**Principle of Moments: equilibrium is established when the sum of the moments acting in one direction equal the sum of the moments acting in the other direction.**

Figure 67. Range of Variation in the Point Morphology Universe.

arm, perhaps one-fourth to one-third the length of the load arm. In contrast, notches have the effort arm embedded in the load arm, and it is proportionally so short that it is almost vestigial. The specimen illustrated is modeled after a *Catahoula* point (Thomas and Campbell 1977:175,e) with the base being one-fourth the length of the blade.

Function has either been inferred from wear patterns or conjectured from various morphological types. For instance, it is thought that the Paleo-Indian lanceolates were mounted in a foreshaft and used both as thrusting spears and sheath knives. Such a multiplicity of functions would certainly conform to Goodyear's (1981) logistic model for the Paleo-Indian. It would also imply a variety of lateral as well as frontal stresses on the tool and would suggest a stronger effort arm.

On the other hand, corner notched and barbed types of points occur later, probably under conditions of less mobility and more tool specialization. They are probably dart points. Function, as a specialized dart point implies less lateral stress, is supported by the shortening of the effort arm.

This perspective leads to some rather interesting conclusions about the *San Patrice* points recovered by Webb, Shiner, and Roberts (1971) from the John Pearce site. *San Patrice Hope* has a robust base and a small blade while the *San Patrice St. Johns* has a small base and a large blade. One might suspect that the *Hope* variety is a knife and the *St. Johns* variety a projectile. Notably the *Hope* variety specimens are resharpened to a nub, while the *St. Johns* variety appears to have been relatively untouched by such activities. This would be an interesting hypothesis to test with edge wear analysis.

#### Man and His Point

It would be very useful if, in addition to the leverage principal outlined above, there was some consistent function that crosscut all styles of points. As we have seen, the base varies with function and also with style, hafting technique, etc. The triangular shape of the blade is something of a constant, although it seems to vary not only with style, but also with resharpening and reshaping of the tip and edges.

In central Texas there is an interesting sequence of styles. The Late Archaic ends with a slim, stemmed point called *Darl*. During the early part of the Late Prehistoric and with the introduction of the bow and arrow, arrow points became a diminutive version of the *Darl* (*Scallorn*). After a period of time, the *Scallorn* is replaced by yet another form of arrow point, *Perdiz*. It is worth noting (Fig. 68) that in this sequence the maximum blade width is first reduced from that of the *Darl* to that of the *Scallorn* and again expanded to that of the *Darl*. A similar sequence probably occurs in Louisiana with the typical *Gary*, small *Gary*, and various arrow points such as *Colbert*, *Alba*, *Agee*, etc., all with exaggerated barbs.

This interesting observation led to the surmise that perhaps the blade width of projectiles and knives were a constant. It seems reasonable to expect that the human body has remained relatively constant over the late Quaternary, and that the strength of the human body as a delivery system imposed the ultimate limit on the penetrating characteristics of points. If we assume that hunters want to

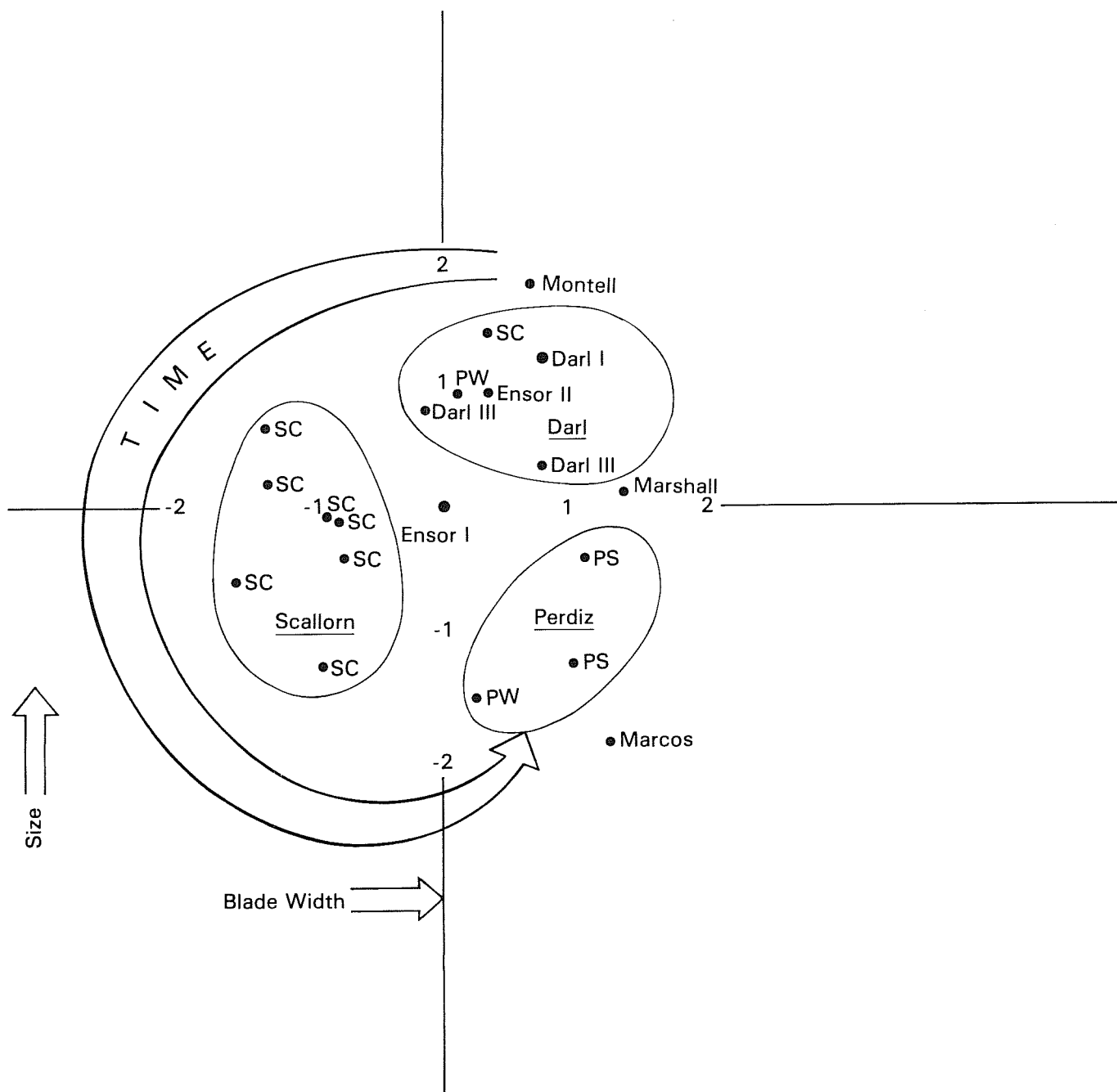


Figure 68. Through Time, the Darl-Scallorn-Perdiz Sequence Marked by a General Reduction in Size. Note that maximum blade width recovers to its former proportion in the case of the Perdiz points. Specimens are from the Loeve-Fox site (Prewitt 1974).

achieve as much damage with the impact of a missile as possible and within the limits of their strength, then we have a possible constant in the maximum blade width. The change from darts to arrows provides interesting insights into the equilibrium between man and his point. With the introduction of the bow, the lithic technology at hand was simply adapted to the end of the arrow by making it smaller. This, however, had the unfortunate effect of reducing the ultimate possible damage by penetration. In effect, the narrower blade width "wasted" a portion of the human potential. The solution was to broaden the maximum blade width by exaggerating the barbs.

For purposes of discussion we might call the maximum blade width "swath." In Figure 67 the points have been drawn so that the swath is constant. If we assume that the neck width is equal to the attached shaft, the shaft progresses from a large spearlike shaft for the Paleo-Indian specimen to dart-proportion shafts for the notched varieties to arrow shaft size for the *Perdiz* specimen. This provides something for the argument that swath is in equilibrium with human energy potential. It assumes that the force delivered by the bow and arrow and by the atlatl and dart are of similar magnitude. This remains to be determined.

Another test of the swath idea is to be found in measurements of various attributes of points. If swath is in equilibrium with human energy potential, then one would expect it to remain relatively constant across time and space while other attributes varied in response to changing function and style. Six attributes were measured on 49 points selected from site reports across central Texas to southwest Mississippi. The attributes will be discussed in detail later. It is sufficient to note that maximum blade width exhibited the lowest coefficient of variation of any attribute. For this analysis then, maximum blade width will be an indicator of the equilibrium of the economic and technological system rather than a technologically and stylistically controlled variable.

One further examination of Figure 67 shows that there are two basic styles of bases. They are designated as styles simply because there is no explanation as to why one would be functionally more advantageous than the other. The style illustrated in the upper three specimens provides a series of notches for hafting which will be referred to as the "lock" system. The other provides a tang which apparently interfaces with the shaft. This will be called the "key" system. The above concepts will be used in the following analysis of variability in point forms.

The curvature of the base will not be used. This diverges from standard typological dogma. In all of the analyses that have been run, the base depth has behaved as an almost completely independent variable. It is not related to the other attributes which apparently define the physical and stylistic system of points. Why curvature of the base should be so divergent is an interesting matter. It could be idiosyncratic, measured improperly, functionally insignificant, or all of the above. The matter warrants future consideration.

#### Attribute Analysis

In the previous section, a projectile point model was developed which indicated that the blade to haft ratio should vary with function. This section will



examine in part that model in a population of points selected from western Louisiana and adjoining regions. The idea of swath and hafting style will also be examined. All attributes are measured in millimeters taken only from complete or reconstructable specimens (Fig. 69). These attributes divide into three groups.

Swath--Swath is measured by maximum blade width, BLWD. Maximum blade width is measured perpendicularly to the axis of the tool wherever it may occur. It frequently corresponds to the blade-haft interface, although not always.

Blade--The length of the blade is measured by one attribute, blade length (BLLG). It is measured from the blade-haft interface to the tip parallel to the axis of the piece. Tips frequently have to be reconstructed.

Haft--Four measurements were required to describe the complex features of this part of a projectile point.

1. Base width (BSWD) measures the line drawn across the lowest part of the base from one extremity to the other. Convexity and concavity are ignored. The line is usually not perpendicular to the axis of the tool, but should not diverge from the perpendicular more than ten degrees.
2. Haft length (HALG) measures a line drawn from the right or left side of the piece to the interface of the blade and haft. It is parallel to the axis of the tool.
3. Neck width (NKWD) measures a line drawn across the narrowest dimension of the base. It need not be perpendicular to the axis of the piece, but should not vary more than ten degrees. It will usually cross between notches or lateral concavities. If the sides of the base are parallel, draw the line halfway up. If the base is a contracting stem, draw the line across the highest width before the base expands into the blade.
4. Neck length (NKLG) measures a line drawn from the right side of the base to the neck. The line should be parallel to the axis of the piece.

The sample selections were made so as to insure a relatively full range of morphological types in the area between central Texas and southwest Mississippi. That is not to say that all types are represented. If additional specimens were added to the sample, they would probably fit into this sample's range of variation.

Since the objective of the analysis was to examine the range of functional variation it seemed reasonable to utilize a method which would remove size from consideration. If a principle components analysis is performed, the first unrotated eigenvector normally extracts the variance generated by the size of the objects analyzed. The remaining vectors will then represent the shape of the objects. The unrotated principle components analysis for this sample is shown in Table 31.

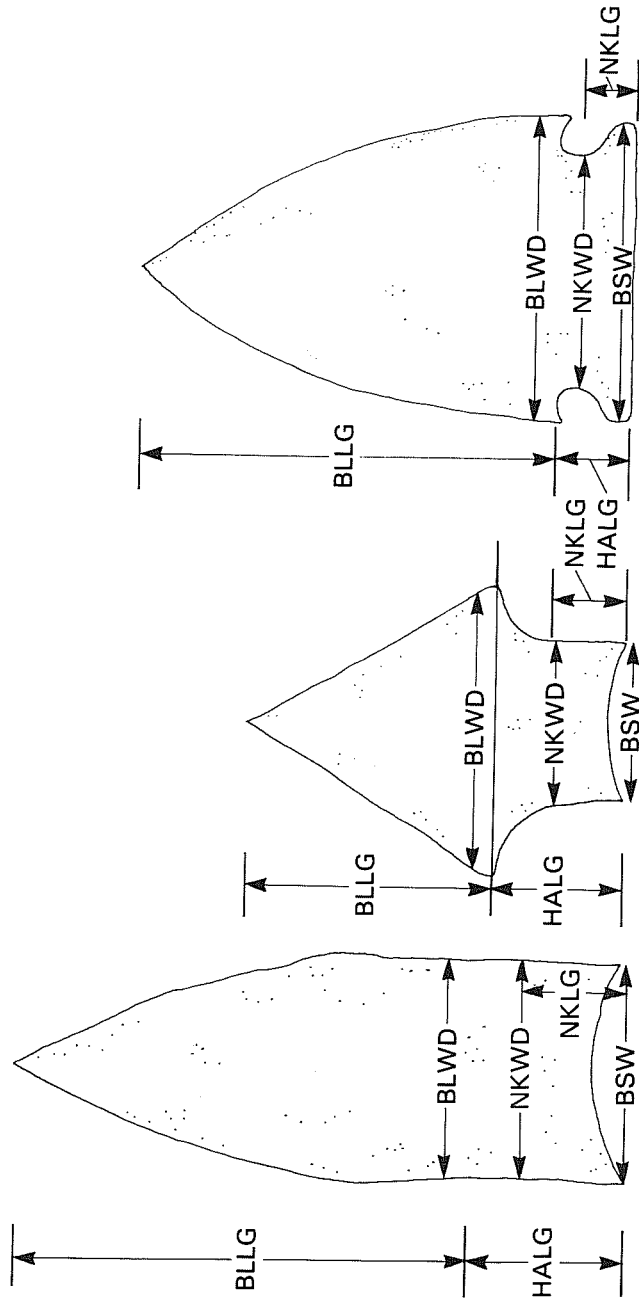


Figure 69. Attribute Measurements on Three Types.

As would be expected, Factor I loads for all of the variables. The loadings are very high and all positive, which is a sure indication of a size factor.

Factors II and III account for much smaller percentages of the total variation in the sample. Factors whose variation are accounted for in Factor III are usually suspect of being composed of random noise in the data. However, with small numbers of variables as in this study, small eigenvalues (less than 1.0) are frequently meaningful. As we shall see, Factor III makes perfectly good sense.

TABLE 31. UNROTATED PRINCIPLE COMPONENTS ANALYSIS OF MID-SOUTHERN PROJECTILE POINTS

Variable	Factor I Size	Factor II Leverage	Factor III Haft Style	Communality
Blade Width	.88	-.31*	.05/	.87
Blade Length	.76	-.45*	.41*	.95
Base Width	.86	-.08/	-.46*	.96
Haft Length	.86	.33*	.16/	.87
Neck Width	.93	-.01/	-.28/	.94
Neck Length	.76	.55*	.21/	.92
Eigenvalue	4.27	.73	.53	
% Variance	.71	.12	.09	.92

Note: n=49, \*= high loading, /= no loading

As is shown in Table 31, Factor I accounts for the size of the points in the sample and effectively removes the size factor from further consideration. Seventy-one percent of the variance is bound up in size. The remaining variance in Factors II and III describes that portion of the measurements which outline shape. Factor II indicates that blade length increases as the neck and haft length decrease. This is clearly the leverage factor expected. About 12% of the variance is concerned with leverage.

The third factor is primarily concerned with a relationship between blade length and base width. The meaning of this relationship is not immediately apparent but will become so. The relationship between the "lock" and "key" type hafts is one of narrowing base width. This for some reason is associated with the blade length. Key-type hafts are associated with longer, probably slimmer blades. It may be that key-type hafts are exclusively associated with projectile function. Testing that idea, however, is beyond the scope of this study, because it requires wear and fracture pattern analysis.

Exactly what the components analysis means in terms of specific specimens can be seen in Table 32 and Figure 70. In Table 32, loadings from Table 31 are used in conjunction with the means and standard deviations of six variables to

TABLE 32. VALUES USED TO CALCULATE FACTOR SCORES PLOTTED IN FIGURE 68

Factor scores for Factor II		Factor scores for Factor III	
([Measurement- $\bar{x}$ ]/s)	* Loading =	([Measurement- $\bar{x}$ ]/s)	* Loading =
1 ([Blade width-19.5]/7.7)	* (-.31) =	([Blade width-19.5]/7.7)	* (.05) =
2 ([Blade length-32.6]/17.6)	* (-.45) =	([Blade length-32.6]/17.6)	* (.41) =
3 ([Base width-13.2]/6.8)	* (-.08) =	([Base width-13.2]/6.8)	* (-.46) =
4 ([Haft length-8.5]/4.0)	* (.33) =	([Haft length-8.5]/4.0)	* (.16) =
5 ([Neck width-11.8]/6.2)	* (-.01) =	([Neck width-11.8]/6.2)	* (-.28) =
6 ([Neck length-5.7]/2.4)	* (.55) =	([Neck length-5.7]/2.4)	* (.21) =
Score = sum of lines 1-6	=	Score = sum of lines 1-6	=

Note: ( $\bar{x}$  = mean, s = standard deviation, \* = multiply, / = divide)

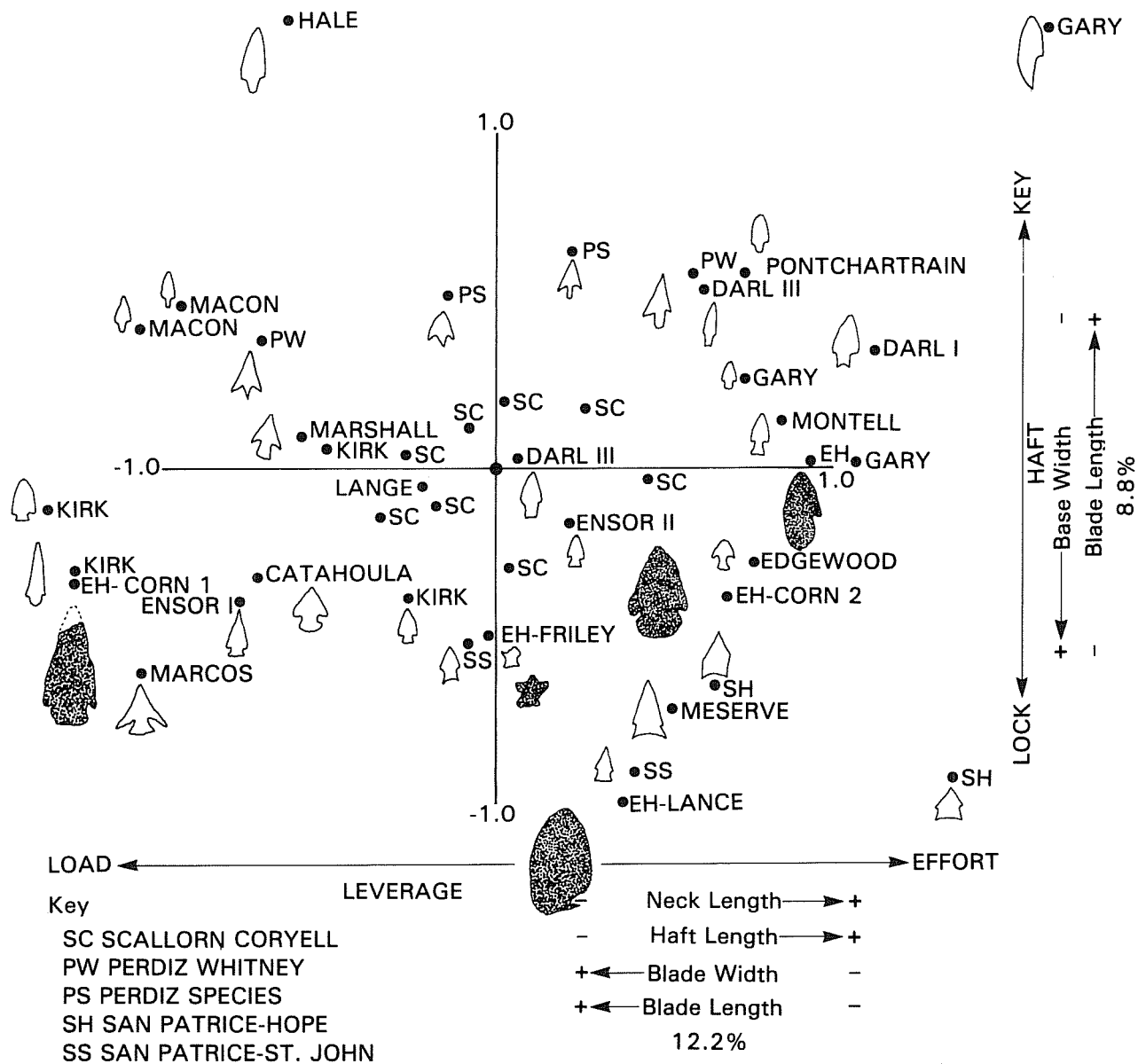


Figure 70. Factor Score Plot for the Mid-Southern Point Morphology Sample.

calculate a component score for each specimen on each component. Anyone interested in the location of their own specimens in the point space can do so by plugging in observations from the point to be plotted.

The score obtained from Factor II in Table 32 will be the horizontal coordinate in Figure 70. The score obtained from Factor III is the vertical coordinate in Figure 70.

Figure 70 displays the individual specimens in accordance with the relationships discussed for Factors II and III. The leverage component is displayed horizontally. Note that the points (*lanceolates, Edgewood, Friley, Darl, Pontchartrain*) to the right in Figure 70 have large hafts (effort arms) and small blades (load arms). In contrast, those to the left (*Kirk, Macon, Hale*) have small hafts and large blades. Examining the distribution vertically shows that those at the bottom have "lock" style hafts (*Friley, Kirk, Marcos*), while those at the top have "key" style hafts (*Pontchartrain, Perdiz, Macon, Hale*).

The "point space" represents the range of variation that native American peoples of the late Quaternary allowed in their mind in search of a workable combination of attributes for points. Also, the shear physics of point form is probably involved. From a temporal point of view, it might be suggested that these stylistic and technological wanderings began in the lower right hand corner of the plot and generally proceeded left and upward in that order. The five points from Eagle Hill that are plotted are, with one exception, all located in the lower right corner, although they represent over 10,000 years of prehistory. One might suspect that people who came to Peason Ridge were technologically and stylistically conservative. Whether this conservatism was functionally compelled by resources available on the ridge or because the region was stylistically out of the mainstream of the Mississippi Valley cannot be determined at this time. However, Gagliano (1967b) working from a completely different point of view concluded that the uplands flanking the lower Mississippi Valley were culturally stagnant between Paleo-Indian and Plaquemine times. It could very well be that the old ways of doing things, the Ice Age ways, survived a very long time on Peason Ridge.

#### D. CERAMIC PERIOD

##### Sedentary Period Analysis (Gunn)

We have adopted Muller's (1978) term "sedentary" for the last 3000 years, because the lower Mississippi River valley and related river systems in the Mid-South exhibited sedentary traits such as those during the Poverty Point period without the occurrence of ceramics. The absence of ceramics seems to cloud the literature on the lower Mississippi Valley and obscure obvious gestures toward civilization such as the Poverty Point mound complex, trade networks, and a general Olmec-like character and contemporaneity (Gibson 1974).

The discussion of the lithic period began on a continental scale, because the issues in that early period are continental issues. For instance, what caused the differentiation of Paleolithic culture in the New World, and how do conditions and cultural residues at Eagle Hill shed light on those problems?

The sedentary period raises a new set of issues at another scale. When life resumed on Peason Ridge after the Hypsithermal, the world of culture issues had shrunk. There is no longer a question about whether influences came from the Plains or from the Greater Southeast. Cultural pulses were coming from the river valleys where settlers were shifting to a cultivation of domestic plants for food or at least thinking about it. Direct evidence for earlier domestication is lacking. Perhaps like the Egyptians who were known to be tardy in their interest in agriculture, the inhabitants of the lower Mississippi Valley found their environment rich enough to delay the extra labor of farming. Peason Ridge was again holding deposits against erosion, presumably because of moister conditions and verdant vegetation. Peason Ridge again attracted human attention and the interaction of occupation refused; moisture and plants collected and held the residues of the new kind of visitor. Occasionally pottery was brought to Eagle Hill.

I use the word "pulses" when referring to cultural influences from the alluvial valleys, because there seems to be an up and down frequency to the occupation. There is little evidence for a Tchefuncte-Marksville period at the site. By contrast, the Coles Creek-Plaquemine period must have been a virtual clamor of human activity by normal Peason Ridge standards. If there ever was a domestic turn to occupation at Eagle Hill, it was during the Coles Creek period. The visitations continue throughout Plaquemine and then drop off. When Caddoan hunters visit the site, they again leave only sparse remains to witness their passage.

This peculiar trend of occupation seems to parallel what is generally thought of as population trends in the Southeast (Haag 1965). Perhaps people only came to Peason Ridge when resources of the alluvial valleys were being totally utilized. Klinger (1977) has outlined most of the current subsistence strategies and how they apply to the Mississippi Valley in the Arkansas region. He suggests that rather than merely exploiting the catchment around a camp, gatherers and hunters move on a vector which minimizes distance to all necessary resources. One route to travel, which takes a task group to nuts and white-tailed deer, is better than two trips, one for each resource. Seasonal vectors were only deflected to Peason Ridge when locales more accessible to the alluvium settlers were overexploited or restricted due to territorial boundaries. If such was the case, indicators of habitation frequencies on Peason Ridge may be very sensitive barometers of population density in the Sabine and Red River valleys.

This thought led to the following examination of the problem of population density variation in the lower Mississippi Valley. If population density and erosional/depositional episodes at Eagle Hill could be accounted for by a common forcing variable(s), it would provide a strong explanation for the cultural and sedimentological chronology of the late Holocene at the site.

#### Global Climate and Culture Chronology in the Lower Mississippi Valley

Since the 1930s, some researchers have thought that prehistoric cultural change in the lower Mississippi Valley was heavily influenced by environmental conditions (Gagliano 1967b). The perceived sources of influence were mostly alluvial

such as changes in meander belts and stream channels. More recently, Saucier (1974) has shown that human occupation of the Delta is also heavily influenced by gross shifts in the distributary pattern of delta channels.

In addition to environmentally induced culture change, archaeologists have perceived strong cultural influences from the upper Mississippi River valley system, the eastern or western Gulf Coastal Plain, and from along the Gulf Coast. In some cases, the local cultures appear to have been overrun by these influences while in others, they appear to have maintained their cultural integrity (Haag 1965; Gagliano 1967b).

Archaeologists perceived the effects of environment and external cultural influence in the lower Mississippi Valley (LMV) in an essentially local context without attributing ultimate causal mechanisms to the events which transpired. In this article, a more distant perspective on the progress of culture change in the lower Mississippi Valley will be developed. In the last decade, a considerable amount of information on global synchronous climatic changes and, in particular, climatic change in the Southeast has appeared. Likewise, culture change models have become increasingly sophisticated. According to Butzer (1980) most models, especially of more complex cultures, were evolutionary. However, as his analysis of the ups and downs of riverine Egyptian civilization shows, an ecological explanation for cyclic evolution and retrogression of civilized societies can be quite convincing. Two articles have been prepared on culture and climatic change in North America and Mesoamerica with favorable results (Gunn and Adams 1981; Folan *et al.* 1982).

### Cultural Geography

There are several cultural areas in North America pertinent to the progress of culture change in the lower Mississippi Valley. The key factors are restricted areas which are overtly or latently rich in resources. The alluvial floodplain and delta of the lower Mississippi Valley are particularly productive environments due to juxtaposition of alluvial soils, wetlands, forests, uplands, etc. The upper Mississippi River valley river system is an aggregate of potentially rich areas linked by river communication such as American Bottoms at St. Louis and the Middle Ohio Valley around Cincinnati. This complex will be referred to as the upper Mississippi Valley sphere (UMV). Another water-linked system is the Gulf Coast, the Gulf Coast sphere. The Tennessee River valley is also an exceptionally stable and rich resource zone of very long duration.

### Climatic Model

Rather complex models of climatic change have been developed (Gunn and Adams 1981; Folan *et al.* 1982; Gunn and Mahula 1977; Gunn *et al.* 1982) for the Southeast. While those models serve as background, a relatively simple system will serve this discussion. In an analysis of modern western hemisphere weather records of the 20th century (Sanchez and Kutzbach 1974) bands of temperature and moisture shift southward with global cooling. These quasi-stable bands divide the United States approximately into thirds. The two southern bands conform to the upper Mississippi Valley and the lower Mississippi Valley spheres. As will be explained later, the issue of climatic stability is



probably more directly related to this discussion than to temperature and moisture. However, moisture is the stabilizing agent in the atmospheric system. Climatic stability from year to year should be directly related to the Sanchez and Kutzbach analysis. The system is driven by the global energy budget, the sum of the heat reserved in the atmosphere, oceans, and land masses of the world, and is directly controlled by the jet stream which moves north as the energy budget increases and south as the world cools. Thus, during hot periods the "stability band" is over the upper Mississippi Valley sphere; during warm periods it is over the lower Mississippi Valley sphere and during cool times it is over the Gulf. Regions to the north of the stability band grow progressively less stable and more susceptible to perturbation as the band recedes southward.

During the late Holocene (5000-500 B.P.), a number of mutually reinforcing climatic chronologies have appeared which suggest marked movements in the global energy budget. As Table 33 shows there have been two warmer intervals and three colder periods. The level of the energy budget and the locations of the stability bands is also indicated. The table is adapted from glacial and tree line chronology (Denton and Karlén 1973), sea levels (Stapor and Tanner 1977), biosilicas (Robinson 1978), and mathematical projections (Gunn 1982a, 1982b).

TABLE 33. ENERGY BUDGET LEVELS FOR THE LATE HOLOCENE

Years A.D./B.C.	Years B.P.	Energy Budget	Location of Stability Band
1880	100	cool	Gulf
1250	700	warm	Lower Mississippi
900	1100	cool	Gulf
500	1500	hot	Upper Mississippi
500	2500	cool	Gulf
2000	4000		

#### Cultural Model

Butzer (1980) argues that although evolutionary models can explain developmental aspects of culture change, they cannot explain oscillation, especially of periods of retrogressive cultural change. It is the ecological aspect of culture change that accounts for the majority of the retrogressive movements.

Cleland (1976) has developed a subsistence adaptation model, the Focal-Diffuse Model, which has the interesting property of being conceptually reversible relative to cultural change. It is, in essence, a reworking of Caldwell's Primary Forest Efficiency concept which is evolutionary in principle. The Focal-Diffuse

Model, however, is defined as a continuum with focal economies (those depending upon few resources) at one end and diffuse economies (those dependent on a wide range of resources) at the other. Since the focal and diffuse economies directly imply certain social structures (under conditions of circumscribed resources, Carneiro 1970), it can serve both as an adaptive model and a cultural evolution model. A focal economy implies trade, ceremonialism, and/or legitimate force to organize and maintain the flow of specialized products in the economy. Such economies are usually associated with large populations and positive feedback demographic systems. Diffuse economies are usually organized with relatively equal access to resources by everyone. Populations are small and mobility acts as a negative feedback mechanism to population growth (Sahlins 1972).

Adaptively, the diffuse economy is very flexible. Since a wide range of resources is exploited, the diffuse economy is unaffected by climatic change. Focal economies, on the other hand, are likely to be disrupted by climatic change, since organization has to be restructured. If excessive adaptive demands are placed on the focal economy, it is likely to move toward the diffuse end of the spectrum making necessary social adjustments such as population reduction and loss of sedentary status.

#### Cultural Chronology

Examination of the last 5000 years has been selected for several reasons. Previous to 5000 years ago, cultures of the lower Mississippi Valley, with the possible exception of Dalton, are not especially visible to the archaeological record. This has to do with the alluvial floodplain developing after that date, but may also be related to a need for more work before anything definitive or even preliminary can be said. Also, after 5000 years B.P., native American cultures seem to have adapted to the lower Mississippi Valley and begun a general developmental, if not monotonic, move toward large populations and a complex society. The cultural periods are relatively well defined and serve as readily available units of analysis for a preliminary examination of the validity of the above model. Table 34 shows the cultural chronology, related cultural "power balance," and climatic information. This table is preliminary as a further literature search may well change some aspects of the entries. In general, the model seems to function as proposed, although there are some points that require more precise definition.

During the earliest cool period, Poverty Point is divided into two stages. Gagliano defined the Bayou Jasmine phase from a site in the delta, which dates to about 3700 years ago and contained many Poverty Point type clay objects and fiber-tempered sherds. This suggests that Poverty Point probably stems from some sort of circum-Gulf cultural phenomenon. Clay objects have been found along the Gulf Coast from Florida to Texas, and fiber-tempered pottery is known very early from Georgia, all in aquatically oriented situations. The later phase of Poverty Point appears as a movement from the delta-adapted, earlier phase into the alluvial floodplain.

Tchefuncte is a period of far ranging expansion up the alluvial valleys into east Texas and Arkansas. The expansion appears to be that of the local Poverty Point culture mobilized under its own power. It is noted as a donor system, although this does not imply that it penetrated the upper Mississippi Valley. This should be investigated.

TABLE 34. LOWER MISSISSIPPI VALLEY CULTURAL CHRONOLOGY

Influenced (ing) Sphere	LMV Mode	Period Name	Mid-Period Date	Global Climate/ Stability Band
East	Receiver	Moundville	700	cool/Gulf/LJAI
West	Donor	Plaquemine	800	warm/LMV/MCO
Upper Valley	Donor	Coles Creek	1100	warm/LMV/MCO
Gulf	Receiver	Troyville	1500	cool/Gulf/LIAI
Upper Valley	Receiver	Marksville	1800	hot/UMV/RECO
Upper Valley	Donor	Tchefuncte	2100	warm/LMV/RECO
Gulf	Receiver	Poverty Point	2700	cool/Gulf/Subboreal
Gulf	Receiver	Early Poverty Point	3700	cool/Gulf/Subboreal

The Marksville period is during the later, cooler part of the Roman Empire Climatic Optimum (RECO) and is a period when the lower Mississippi Valley was overrun by Hopewellian influence. The settlement pattern structure is suggestive of a conquered polity with an implanted, ruling elite. This may be stretching the evidence, but there is no doubt some sort of northern influence conforms to the model's projection.

Troyville falls during the earliest phase of the Little Ice Age. Adverse climate apparently destroyed the cultural hegemony on the north (Struever and Vickery 1973), and there is evidence that Troyville may be another imposed elite, perhaps from the coast of Mexico (Haag 1965). Again, the model correctly retrodicts the source of cultural influence.

Coles Creek and Plaquemine fall in the Medieval Climatic Optimum (MCO). Coles Creek marks the beginning of a period of local development which culminates in an aggressive donor surge to the west during the Plaquemine. Mississippian cultures to the north and Plaquemine seem to be in a stalemate as there is no intercourse between the two areas except at the borders (Haag 1965).

At the end of the Medieval Climatic Optimum, the Mississippian cultures to the north lose their coherence resulting in the complete collapse of Cahokia (Fowler 1952). The lower Mississippi Valley sphere loses the imperviousness it enjoyed during the Medieval Climatic Optimum and receives a cultural donation from the Moundville culture to the east.

## Conclusions

With the exception of the Moundville intrusion at the end of the sequence, the model seems to explain the sequence of cultural influences in the lower Mississippi Valley. The Moundville influence may be an expectable Gulf source or, if it is from the eastern sphere *per se*, it may reflect a successful adaptation to oscillating climate, which asserts itself when less resilient neighbors fall prey to climatic change.

It is interesting to ask why the model works as well as it does. Perhaps the lower Mississippi Valley is a basic transportation link for coastal goods when the volatile northern cultures are in a position to demand maritime products. The location amplifies the effects. Also, the resource richness of the delta region may have attracted more powerful culture purveyors.

It is often the case that models which work well at abstract levels of examination are less effective when closely scrutinized. This model is posed as an hypothesis for further testing. It does seem to complement similar climate/culture models developed for other areas of North America and Mesoamerica. Naturally the usual questions relative to climatic determinisms will eventually be raised. Climatic explanations of culture change (Gunn and Adams 1981) are only partial explanations. North America does have some of the most turbulent weather in the world: tornadoes, for instance, are an almost characteristically North American phenomenon. Tropical storms and hurricanes are not exclusive to North America, but they are not frequent in most parts of the world. They are directly controlled by the energy budget (Wendland 1977) and vastly affect moisture in the Southeast. Therefore, it is safe to suggest that North American cultures may be more susceptible to climatic change parameters than most of the rest of the world.

## Ceramic Analysis (Brown)

A significant portion of 16 SA 50 showed signs of occupation during later periods. In all, 162 sherds were collected. The following section is an analysis of the distribution of the sherds, their potential significance as cultural and temporal indicators, and some of their macroscopic technological properties. A later section is devoted to a more detailed physical and chemical analysis of both ceramics and lithics from the site.

All but one of the 162 sherds from 16 SA 50 were from the excavations in Area A, the truncated low natural mound that was the target of the most concentrated excavation effort. Area B, the smaller natural rise to the northeast and across the small drainage from Area A, yielded only one sherd. This single sherd was a fragment of a turpentine collecting cup of the type used before the turn of the century. It was found in Area B near the surface of the excavation unit in substratum 1.11. A single badly eroded fragment of fired clay from the bottom of this excavation unit was originally suspected of being a sherd, but subsequent examination showed it to be very poorly fired and morphologically indistinct from the fired clay balls in Area A. This was the only clay ball found in Area B.

Three of the 161 sherds recovered from Area A are also fragments of Historic period turpentine collecting cups. Although there was a turpentine crew camp several kilometers to the northeast (James Grafton, personal communication), there was no indication of historic settlement or long term activity in the immediate area of 16 SA 50. Recent military shell casing fragments were the only other historic materials found. The three historic sherds from Area A were all found near the ground surface, two from substratum 1.12 and the third from 1.13.

The 158 prehistoric sherds from the site were found just beneath the natural surface down to the upper portion of substratum 4.12. No ceramics were found in any of the levels beneath this. Figure 71 shows the vertical distribution of ceramics from each substratum and their percentage of frequency relative to the total ceramic sample.

Substratum

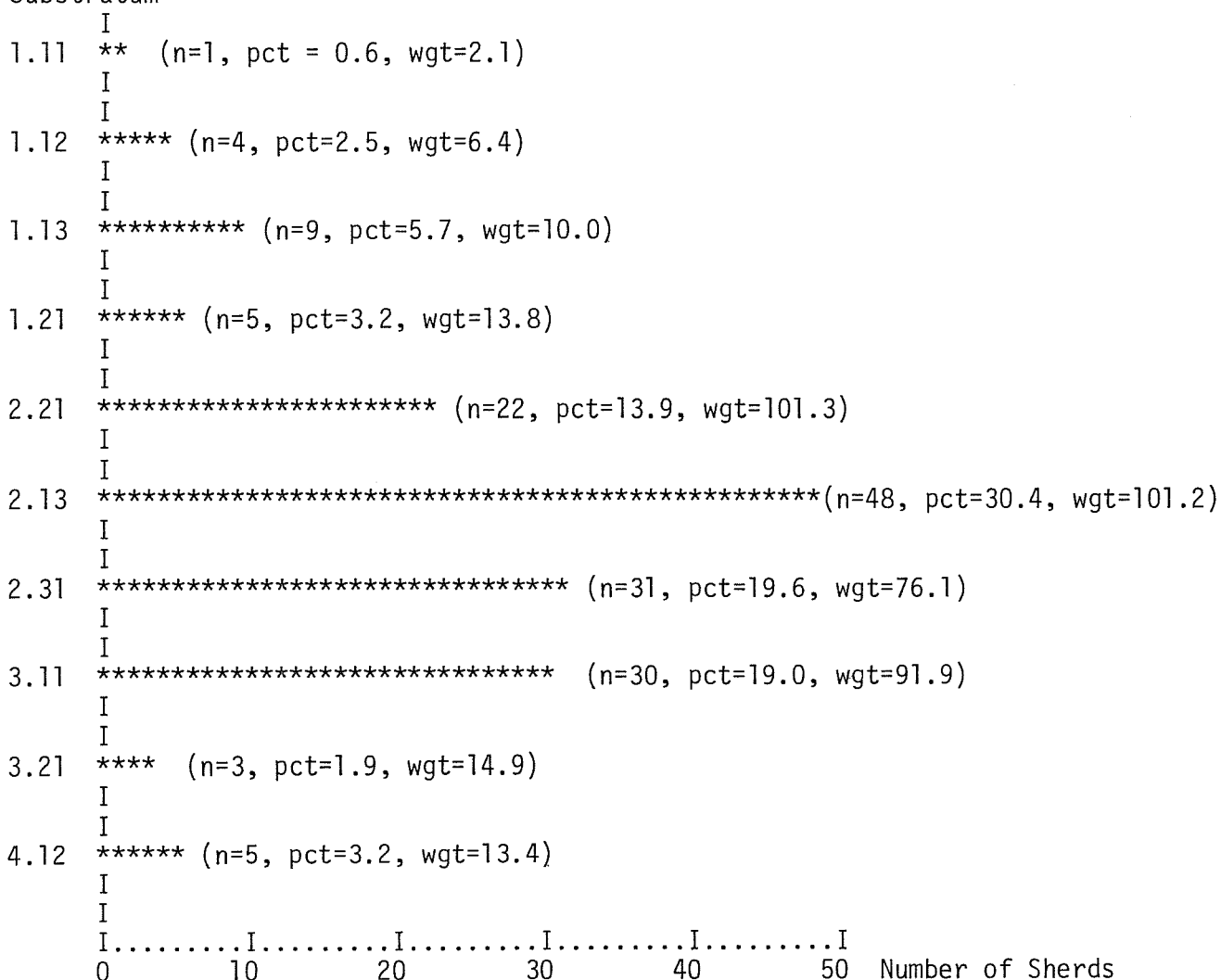


Figure 71. Vertical Distribution of Ceramics at 16 SA 50.

Note that most of the sherds were found between substratum 2.21 and 3.11 with small numbers occurring above and below. The relative paucity of ceramics below substratum 3.11 and the potential for vertical displacement of artifacts at the site suggest that these sherds may have been displaced downward from higher levels, a hypothesis supported by the occurrence of apparent preceramic artifacts in the lower levels. On the other hand, it is not at all clear whether the small ceramic sample in the upper substrata is due to upward displacement of artifacts into a sterile area by bioturbation or due to more recent occupations at the site by peoples who had little use for ceramics.

## Typology

Thirty-six of the 158 prehistoric sherds were decorated. Two basic styles of decoration were present at the site: incision and punctation. The two styles were not combined on a single sherd, although such combinations are not uncommon in many parts of Louisiana and east Texas (Price and Heartfield 1977). No engraved ceramics of any type were recovered from the site. Engraved ceramics, which are generally regarded as being associated with Caddoan cultures in this region, are found to the northeast on the Red River near Natchitoches and to the northwest along the Sabine River. The total ceramic sample is too small to make conclusive statements regarding the relationship between the ceramic period occupants and their Caddoan neighbors. The ceramics do suggest that the site was occupied earlier than the Caddoan development in the area or that the inhabitants might be related to coastal or inland Gulf Coastal Plain groups to the south.

Parallel Incised--This is the largest single group of decorated sherds--19 specimens. On all of the sherds, which are sufficiently large to make the determination, line orientation is horizontal. There are four decorated sherds; two other rims are plain. Depth, spacing, and definition (squareness of the incision) of the incised lines varies. All sherds, but one, have regular spacing. This single, irregularly incised sherd was found with a small cache of lithics (a rodent burrow?) on OP 2.13 of N3020 E1000; it is distinctly different from the other decorated sherds from the site. Several other sherds among the parallel-incised specimens clearly do not match other sherds in the decorated sample. On the basis of differences in line depth and spacing as well as morphological properties, there are at least five different vessels represented by these 19 sherds and perhaps a few more than this. Most of these sherds, however, may have come from the same one or two vessels, while the other three or four vessels are represented by only one or two specimens. Only two sherds in this group match one another; these are from adjacent substrata (2.13 and 2.31) in the same unit (N3018 E1002). The greater part of the parallel-incised sherds, forming only one or two vessels, are of a distinctive red paste with numerous small bits of clay grit showing in both the interior and exterior vessel walls; only a few small fragments of this paste are obvious among the undecorated sherds.

Horizontal parallel-incised motifs are quite common throughout the Caddo and lower Mississippi Valley area, often typed as varieties of *Coles Creek Incised* (Phillips 1970) or *Davis Incised* (Suhm and Jelks 1962). Along the coast the

similarities between *Coles Creek* and *Goose Creek Incised* have been noted (Aten and Bollich 1969). Because of the general lack of other Caddoan or coastal culture indicators at the site, it is probably best to view the specimens from the site as examples of *Coles Creek*. In comparison to the defined variants of *Coles Creek*, the majority of these sherds come closest to the definition of *Coles Creek hardy* (Phillips 1970:73), with some significant deviations. The most notable is that the incisions are neatly made with a blunt or slightly rounded tool. Two of these *hardy*-like sherds are illustrated in Figure 72,a,b. The USL test excavations identified *Coles Creek hardy* as being present, but it is unclear how close these specimens are to the defined variety.

Of the two remaining parallel-incised sherds, one has slightly overhanging lines (Fig. 72,c) and resembles more the classic *Coles Creek* variety of *Coles Creek Incised* than other sherds at 16 SA 50 (Phillips 1970:70). The other has closely spaced, extremely shallow incisions probably made on a dry paste. This latter specimen cannot be definitely typed, but is close to the *mott* variety of *Coles Creek Incised* (Phillips 1970:75). Both of these two latter varieties occur earlier in time than the *Coles Creek hardy* in the lower Mississippi Valley culture area; *Coles Creek* and *mott* varieties both date to the *Coles Creek* period between A.D. 750 and A.D. 1000 in the lower Mississippi Valley area. The possible *Coles Creek* variety sherd, occurring in OP 3.11 is one of the deeper parallel-incised specimens. The possible *mott* variety sherd, dated to the latter portion of the *Coles Creek* period, occurs in the next higher level at OP 2.31. The *hardy* variety is assigned to the early Mississippian period and could date between A.D. 1000 and A.D. 1200. Although the *hardy*-like sherds are scattered, the median of the distribution is in OP 2.31.

Horizontal Incised with Pendant Diagonals--These five sherds have diagonal incisions below (perhaps above in some cases) parallel, horizontally incised lines. Spacing and method of incision are similar, but at least two vessels present are based on paste differences. Also apparent from a consideration of general paste characteristics is the fact that neither of these two vessels could be part of the other decorated vessels. All of the sherds are badly eroded. One sherd has an abraded exterior surface on which the design is barely visible. The remaining four sherds, all apparently from the same vessel, have slightly abraded exterior surfaces and are extremely friable. Unlike any of the other incised sherds, these four sherds from a single vessel show broad, shallow incisions with small brush marks along their length. They also show a clearly displaced distribution; three are from the northern row of one-meter units in Area A in OP 4.12, while the fourth occurs in the same row in sub-stratum 2.31. Only a few other undecorated sherds might be part of this vessel, but none can be clearly associated with it. It is possible that it represents the earliest vessel made at or brought to the site, and that a single sherd was displaced upward from the floor where it was discarded. One of these sherds is illustrated in Figure 72,e.

A designation of *Mazique Incised mazique* (Phillips 1970:129) affords the best description of these sherds. They might equally well fit *Alligator Incised alligator* (Phillips 1970:39), especially since the larger group was incised on a relatively wet paste, a characteristic of *alligator*. The former, however, is probably the better choice given the rarity of the latter in the region.

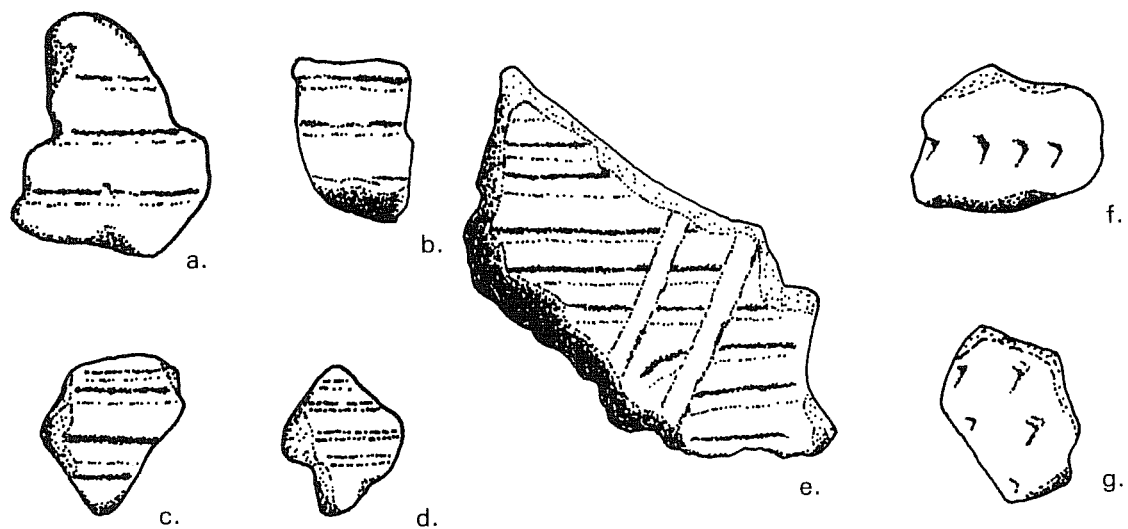


Figure 72. *Eagle Hill Ceramics*. a-d, parallel incised; e, cross-hatch incised; f-g, punctate.



*Mazique Incised mazique* is dated to the early Coles Creek period, while *alligator* variety of *Alligator Incised* is earlier, occurring in the Baytown period between A.C. 300 and A.D. 750.

Crosshatch Incised--These three sherds are distinguished by crossed diagonal incised lines on a thin and apparently well-fired vessel wall. Two and perhaps three of these sherds come from the same vessel, although they do not fit together. Because of their thinness and their distinctive tan pastes, it is apparent that they do not match any of the other decorated vessels, although they may match a number of similar undecorated sherds. In contrast to all the other incised sherds from the site, these three have distinctly wide, shallow, and rounded incisions. The largest is illustrated in Figure 72,e.

These unusual sherds cannot be typed. The broad U-shaped, diagonal lines show some similarities to the lower Mississippi Valley type *Sanson Incised* (Phillips 1970), but 16 SA 50 is far from the Tensas Basin where the type was first defined and to which it seems to be generally restricted. In addition, *Sanson Incised* does not appear to have diagonal lines trailed across opposing diagonals as these specimens do. The time range for these sherds is undetermined.

Punctate--Nine small sherds have fingernail punctate designs. None is large enough to allow examination of patterning, but they do appear to be oriented diagonally. Although there is some variation in thickness, color, and punctate size, the differences are not distinctive enough to indicate more than one vessel. All have very similar paste characteristics. If they are from the same vessel they show a scattered vertical distribution occurring from OP 1.13 down to OP 3.11. No more than two specimens are in any one level. The horizontal distribution is also rather scattered. Specimens occur in four one-meter squares along the N1002 row, three along the N1001 row, and a single specimen located in E3017 N998. Two of these sherds are illustrated in Figure 72,f,g.

A sherd of *Evansville Punctated wilkinson* (Phillips 1970:81) was identified from the USL test excavation. This identification could well fit these nine small sherds. On the other hand, they could fit equally well into the definition of *Evansville Punctated evansville* (Phillips 1970:78-79). Unfortunately, there are no clear means of distinguishing between the two. The former is dated to the Plaquemine phase of the Mississippi period (post A.D. 1000), while the latter is found from late Marksville and Coles Creek (approximately A.D. 100-A.D. 1000).

Plain Types--Although on the whole it is difficult to identify Plains ceramic types, one sherd at the site shows some similarities to *Williams Plain*, a type which occurs with some frequency in Oklahoma, but only rarely south along the Red River (Prentice Thomas, personal communication). This single sherd is in many ways the most unusual specimen at the site. Large, thick (11.8 mm), and heavy (55.9 grams), it contains large, rounded particles of clay grit. It is the basal corner of what may have been a very large vessel. It was found in OP 2.21 in E3021 N1000.

First defined in Oklahoma (Bell and Baerreis 1951), *Williams Plain* has been identified in east Texas (Webb *et al.* 1969) and along the Red River at the

Hanna site (Thomas, Campbell, and Ahler 1977). Because of the suggested early occurrence of this type in Oklahoma and the presence of only a single specimen among the ceramic collection from 16 SA 50 it is perhaps better to refer to this sherd as coarse-tempered plain rather than to identify it as an example of *Williams Plain*. It seems more likely that it represents some functional difference in ceramic use rather than cultural or temporal differences.

#### Vertical Distribution of Ceramic Types

Table 35 shows the vertical distribution of ceramic types from 16 SA 50. The sample size is too small and the distribution too scattered to demonstrate any valid statistical differences, and it is clear from simple observation that there is some vertical mixing. In fact, given the simple and only minimally diagnostic motifs found at the site, it would not be surprising to find all these types co-existing at the same time within the same group.

The radiocarbon dates from the ceramic levels at the site generally conform with the typological identifications suggested above. As noted elsewhere in this report, charcoal from OP 3.11 has been dated to A.D. 820 with a one sigma deviation of 70 years (uncorrected), a date which suggests an occupation of the site during the middle Coles Creek period. This agrees well with the presence of *Mazique Incised* and the tentative *Coles Creek* variety sherd. OP 2.13 has been dated to A.D. 935  $\pm$  80 years, a date falling near the end of the Coles Creek period. With a two sigma deviation this date could either overlap the earlier one, or fall well into the succeeding Plaquemine period. The remaining Coles Creek specimens, with a median of OP 2.13, would fit nicely into this time period. Depending upon the variety chosen, the *Evansville Punctated* could fit either period. On the whole, the dates generally confirm the typological and technological evidence, which suggests multiple, but not widely spaced occupations.

TABLE 35. DISTRIBUTION OF CERAMIC TYPES

Occupation Planes	<i>Coles Creek</i>	<i>Mazique Incised</i>	Crosshatch Incised	<i>Evansville Punctated</i>	Coarse- Tempered	TOTAL
1.11			1			1
1.12	1					1
1.13	1			1		2
1.21	1	1		2		4
2.21	4	1		1	1	7
2.13	5			1		6
2.31	4	1	2	2		9
3.11	1			2		3
3.21	1					1
4.21	1	2				3
TOTAL	19	5	3	9	1	37
MEDIAN	2.13	2.31	2.31	2.13	2.21	2.13

## Manufacture

There is a moderate amount of technological variation within the ceramic sample, but it is not distinctively different from other collections in the general area. This is especially noted in details of manufacture. The technological characteristics of the sample would be undistinguished in many Caddoan or Lower Mississippi Valley sites. There is, however, some technological variability between the two major culture areas as well as some technological change through time in the area. In addition to these concerns with culture history, there is the potential for asking behavioral questions of the data. For these reasons, manufacture and raw material-related variables were recorded. Those which relate to source materials and chemicals will be dealt with in a later section of this report. This section presents a summary of the information gained from an analysis of the manufacture-related variables.

Clay Preparation--Although the selection and preparation of clay raw materials will be discussed later, this section will examine some of the macroscopic properties of the ceramics. Clay selection and preparation are not random behaviors since not all clays are equally serviceable for ceramic manufacture. Factors affecting the procurement and treatment of raw materials are guided by cultural bias as well as functional necessity. Every ceramic item must fulfill its intended purpose, but within such limitations, there are numerous ways to utilize the raw material resources of a given locality.

In the Eagle Hill environ sands and sandy clays are common, so it is no surprise that many of the vessels would have a sandy paste rather than a silty one. The surface texture of 16 SA 50 sherds was classified as either predominantly silty, sandy, or coarse sandy: 93 were sandy, 61 were silty, and only four had a coarse sandy texture. Table 36 shows the vertical distribution of these textural characteristics. Sandy textures clearly predominate in substrata 2.13 and 2.31. Below substrata 2.31, silty texture reaches its highest percentages. The chi-square of a combined version of this table (in order to increase expected cell values) was 2.1903, a value not significant at the 0.05 level.

Aside from decorative technique, the identification of temper is probably the most commonly recorded technological variable in the region. Change in tempering material has both cultural and temporal significance. Sand-tempered pottery occurs southward toward the coast. There is a developmental trend showing change through time in the use of various tempering agents. There are, however, occasional difficulties in the identification of visible, aplastic materials as being natural or intentional. These difficulties were noted in the USL draft report on the test excavations (Servello n.d.).

Shepard (1965:161-162) discusses some of the problems involved in making the distinction between naturally occurring and intentionally added, nonplastic inclusions. The problem is compounded in the 16 SA 50 environ because of numerous varieties of sandy and fine sandy clays. These difficulties are especially apparent at 16 SA 50 where the more obviously, intentionally added nonplastics such as fiber, bone, or shell are totally absent. Nonplastic materials at the site are restricted to sand and particles of previously dried or fired clay. Although a few of the sandy paste sherds have a distribution of coarse-grained sand particles, which suggests that they are not naturally occurring

clays (Shepard 1965:161-162), this cannot be clearly ascertained for the majority of the sandy paste and clay grit sherds.

TABLE 36. TEXTURE BY SUBSTRATUM

Substratum	Silty	Fine Sandy	Coarse Sandy	Total
1.00*	8	11	0	19
2.21	8	12	2	22
2.13	16	31	1	48
2.31	10	20	1	31
3.11	14	16	0	30
4.00*	2	1	0	3
TOTAL	61	93	4	158

\*1.00 is the combined total of levels 1.11 through 1.21, and 4.00 is the combined total of levels 3.21 and 4.12.

To confront this question, the author gathered clay samples from the surrounding area and attempted ceramic vessel manufacture. Even with carefully controlled drying, none of the vessels survived to be fired. All developed fatal cracks in the drying stage, even when a small amount of sand tempering was added. A later mineralogical analysis of the raw clays and others collected from the area showed them to be composed almost entirely of montmorillonite clay minerals, expandable lattice clays not suitable for ceramic manufacture in their pure state. Although such a finding does not preclude the possibility of suitable ceramic clays nearby, it suggests that intentionally added, non-plastic materials should be expected.

Sherds were coded for the presence or absence of sand and/or clay grit in both the vessel wall and core. The two tempers were not mutually exclusive; some sherds had both sand and clay grit. Others had no recognizable temper. In all, 114 sherds had clay grit present, and 50 had coarse particles of sand. Because of the difficulty in distinguishing between finer sandy clays and ceramics tempered exclusively with the fine sand, these were excluded. The correlation, Spearman's R, between clay grit and sand temper is  $-.1541$ , significant to  $p = .003$  indicating a weak tendency for both not to occur on the same sherd. Table 37 shows the correlations between apparent temper and other distributional and technological variables. As is obvious, there is essentially no correlation with directional variables and low to moderate correlations with many of the other technological variables.

TABLE 37. TECHNOLOGICAL CORRELATIONS

	Sand Temper	Grit Temper
East	.0238 p= .329	.0284 p= .299
North	-.0856 p= .056	.0582 p= .139
Substratum	-.0649 p= .114	.2141 p= .001
Decoration	-.2074 p= .001	.2365 p= .001
Finish	-.1416 p= .005	.1991 p= .001
Size	.0494 p= .179	.2317 p= .001
Color	.0194 p= .360	-.1153 p= .017
Oxidation	.2033 p= .001	-.1909 p= .001

Some of the associated observations are so, for obvious reasons. A few deserve explanation. Decoration is the presence or absence of some decorative element. Therefore, the correlation indicates that more of the decorated sherds were grit tempered. Finish is an ordinal variable describing uneven, smooth, or burnished exterior surfaces; grit-tempered sherds in the sample are more likely to have a more carefully finished surface than the sand-tempered sherds. Color is a simple categorical, nominal variable dividing sherds into those with black or gray exterior surfaces versus those with red, tan, or buff exterior surfaces. In this case, the grit-tempered sherds show a slight tendency to be black or gray. Oxidation or core color, indicates that the grit-tempered sherds are less likely to have fully oxidized cores.

Perhaps the most interesting statistic of temper at the site is its vertical distribution. Tables 38 and 39 show the distribution of sand and clay grit by combined substrata above and below OP 2.13 (combinations made to achieve a valid statistical sample size). These clearly show increasing amounts of clay grit temper with depth (that is, a decrease in obvious clay grit through time). There is a distinct increase in sand temper only in OP 2.13.

On the whole, it is clear that the use of sand and grit temper is only partially related. While it is obvious that the use of grit temper diminishes through time, sand temper reaches a peak in the middle ceramic occupation.

This is in apparent contrast to the developmental sequence of temper in nearby east Texas, where sandy paste pottery is replaced by grog-tempered pottery with the onset of Coles Creek and early Caddoan assemblages (Shafer 1975:251).

TABLE 38. SAND TEMPER BY COMBINED SUBSTRATA

Substratum	Sand Temper		Total
	Absent	Present	
Above 2.13	30	11	41
Substratum 2.13	26	22	48
Below 2.13	52	17	69
TOTAL	108	50	158
Raw chi square = 6.473    p = .039			

TABLE 39. GRIT TEMPER BY COMBINED SUBSTRATA

Substratum	Grit Temper		Total
	Absent	Present	
Above 2.13	17	24	41
Substratum 2.13	16	32	48
Below 2.13	11	58	69
TOTAL	44	114	158
Raw chi square = 9.399    p = .009			

Shafer (1975) associates sandy paste pottery in this region with the Woodland tradition and Marksville ceramics. Sandy paste pottery is found locally in Sabine Parish at the Coral Snake Mound (Jensen 1968). Unfortunately, although the dating of the Marksville manifestations may be considered secure, other Marksville components in Louisiana and Mississippi are not so unquestionable and may continue much later in time (Phillips 1970:959-960). Despite its ultimate decline in the Caddo area, sandy paste pottery survives until historic times to the south along the coast (Shafer 1975; Patterson 1979). In the lower Mississippi Valley area, Phillips (1970:54-55) is dubious of the value of sandy paste as a diagnostic indicator, but is reluctant to dispense with his sandy paste variety of plainware, the *thomas* variety of *Baytown Plain*.

Whether one argues for or against intentional tempering it makes sense that ceramic pastes will be environmentally dependent to a large degree. The clays available in any given region dictate the ultimate paste characteristics. However, such environmental limitations do not fully explain changes through time at a particular site or broad areal changes as mentioned above for east Texas.

Any hypothesis concerning these changes in paste through time raises questions about locus of manufacture and whether the inclusions were intentional or not. These questions will be discussed in more detail later, but several suggestions can be made. The change in sand content in the paste may indicate a shift in the locus of ceramic manufacture either between the immediate site environ and some other locale or between two external manufacturing loci if none are made locally. Two mutually exclusive hypotheses can be formed concerning the clay grit. In the first of these, the decrease in the intentional addition of sherd fragments might indicate a return to a more nomadic lifestyle where sherd fragments are not readily available. The second hypothesis, which fits well with Weaver's (1963) suggestion that the clay temper is an accidental inclusion, states that with increasing sedentarism and a growing complexity of social organization, a specialist class of potters arises which manufactures ceramics with more care and precision than before. This latter hypothesis is more in keeping with the regional development of the Coles Creek and early Mississippian cultures, but such an extension into the project area cannot be made uncritically.

#### Vessel Construction and Firing

Because of the generally small size of the sherds, it is extremely difficult to determine manufacturing details. Although the ceramics were probably made by coiling, it is not clearly discernible in the sample. A few rectangular-shaped, horizontally oriented sherds are present in any case. However, exterior and interior scraping has essentially obliterated coil marks.

While the interiors of almost every sherd show some degree of scraping or smoothing, the exterior surface of every unabraded sherd shows a moderate degree of smoothing and, in cases, even burnishing. Of 141 sherds that had exterior surfaces unabraded by postdepositional processes, 50 were classified as uneven, 82 were smoothed, another nine were burnished. Table 40 shows the vertical distribution of these finishes. Although the chi-square for this table is not significant to the 0.05 level, there is a slight trend for unevenly smoothed surfaces to become more prevalent through time. The chi-square from a condensed version of the table is also not significant at the 0.05 level, but Kendall's Tau for the two ordinal variables is 0.1889, significant to  $p = .019$ , indicating that such a trend does exist.

Most of the sherds collected from 16 SA 50 are not highly oxidized; they were either fired at a low temperature or in a reducing atmosphere. Since most of the sherds from the site (115 of 144) have a tan or red core, the former seems the more likely. There is essentially no correlation between exterior color and core color, as Table 41 indicates. Neither color nor oxidation shows any strong correlation with locational variables, but there are some slight correlations with other technological variables. In the strongest of these,

black or gray sherds tend to have grit temper while, as noted in Table 41, oxidation shows some correlation with temper. Grit-tempered sherds are less likely to have fully oxidized cores. This latter correlation is potentially a factor of recognition, since higher firing may tend to obscure particles of obvious grit by fully oxidizing them.

TABLE 40. VARIATION IN FINISH CHARACTERISTICS WITH DEPTH

Substratum	Uneven	Smoothed	Burnished	Total
1.00*	10	6	1	17
2.21	7	13	1	21
2.13	15	22	3	40
2.31	10	18	0	28
3.11	6	18	4	28
4.00*	2	5	0	7
TOTAL	50	82	9	141

\*1.00 is the combined total of levels 1.11 through 1.21, and 4.00 is the combined totals of levels 3.21 and 4.12.

TABLE 41. EXTERIOR COLOR AND CORE COLOR

Core Color	Color		Total
	Black	Red	
Black	35	87	122
Red	4	17	21
TOTAL	39	104	143
Raw chi square = .4239			p = .515

For the most part, sherd size is too small to allow vessel form identification. Identifiable body parts are rare; the sample contains only six rim sherds and two basal fragments. Most of the sherds have a broad curvature suggesting larger vessels. Tightly curved sherds, as in bottle necks or miniature vessels, are absent. Also, no carinated bowl fragments were encountered. One large sherd has a hint of recurve and may be from a vessel with an outflaring neck. The single sherd of *Williams Plain* is from the basal edge of a large, outflaring, flat-based vessel.



## Ceramic Distribution

Initially, the vertical distribution of ceramics at 16 SA 50 was examined. Subsequent analyses of technological variables have emphasized differences in vertical distribution supporting the assertion that, despite bioturbational activities, the cultural remains at the site retain some part of their original stratification. This assertion is additionally supported by the sequence of radiocarbon dates which apparently verifies the typological conclusions concerning the temporal placement of cultures occupying the site.

The most obvious conclusion, which can be drawn from the vertical ceramic distribution, is that the central portion of the low natural mound known as Area A saw several occupations of approximately equal intensity. These occupations took place within a relatively restricted period of time separated by brief intervals lasting from a score of years to a century. It appears that there are definitely two such separate occupations centered at OP 2.13 and OP 3.11, although there may have been others contained in the intervening levels. The frequency of ceramics in these levels suggests that they derive from relatively long, sedentary occupation at the site. Such a sedentary occupation would require that the surrounding area be relatively wet, perhaps more so than at present.

Toward the upper portion of the site, there appears to be a discrete occupation plane visible in level 1.13. The evidence is not clear, but the levels above may have been displaced upward from the original level. The paucity of ceramics in this cultural substratum suggests a shorter period of occupation than in the cultural levels below. This may be an indication of a less populated upland area, perhaps during a slightly drier period. An interesting parallel to this later occupation can be drawn from the inland sites of the upper Texas coasts where pottery declines in the Late Prehistoric period (Patterson 1979: 109).

The horizontal distribution of ceramics at the site is shown in Figure 73 and Tables 42 and 43. The strata shown represent the specially excavated substrata, plus the two intermediate strata, which have the highest frequency of ceramics, 2.21 and 2.31; the other levels either have too few specimens or are clearly disturbed. Substrata 1.11 and 1.12, for example, have sherds in only one unit each, while in substrata 3.21 and 4.12, where sherds have apparently been displaced downward from substrata 3.11, the distribution parallels that of OP 3.11 almost exactly.

Little can be said about the upper high-resolution substrata, 1.13, because of the scarcity of ceramics. Only nine sherds were recovered from five units (Fig. 73). The distribution does not appear to be random; there is a marked concentration along the west wall. This concentration borders on both activity areas identified on this occupation plane (see Occupation Plane Analysis, page 324). An examination of the sherds from this substratum shows most to be extremely small. None appear to be from the same vessel.

Although level 2.21 was not a targeted occupation plane, it is illustrated (Table 42) because of the abundance of ceramics. Most of these ceramics may have originally come from the occupation plane identified as 2.12 in the



May 1980 test excavations, but there may be some mixing from other levels. In this level, 21 sherds were recovered from eight units. Most of the sherds in this unit are small with the notable exception of the large *Williams Plain* sherd, the largest at the site weighed 55.9 g. Two groups of three and two groups of two sherds may have come from four vessels, while the rest do not match any others. The distribution of sherds in this level generally matches the high density distribution of ceramics in OP 2.13, indicating possible vertical displacement, but there is no clear evidence either way.

TABLE 42. CERAMIC DISTRIBUTION IN OP 2.21

East						
North	3017	3018	3019	3020	3021	Total
1002				2	2	4
1001	3		6			9
1000					1	1
999	4		1			5
998	2					2
987						0
TOTAL	9	0	7	2	3	21

TABLE 43. CERAMIC DISTRIBUTION IN OP 2.31

East						
North	3017	3018	3019	3020	3121	Total
1002	2	5	2	2	6	17
1001			1		3	4
1000	7		1			8
999			2			2
998						0
997						0
TOTAL	9	5	6	2	9	31

The distribution of ceramics in OP 2.13 appears to be spread more evenly across the excavation unit than in any other substratum. There is a slight tendency for material to form a linear cluster running from the southwest of the excavation unit to the northeast corner. This clustering trend would be even more pronounced if it were determined that the material from OP 2.21 were displaced upward from this level. Several vessels are represented in the sample; ten sherds are from a thin, orange-colored, very sandy paste vessel; while seven others are from a well-smoothed, partially sandy reddish brown vessel which has broken into tiny fragments. There are also two groups of three and five groups of two sherds which may have come from seven other vessels. The most concentrated area of ceramics in this substratum is around the suggested trash dump (labelled activity area 3) and near the possible hearths (associated with activity areas 1 and 4).

Thirty-one sherds were found in ten units of level 2.31, all clustered toward the north of the excavation. Five sherds are possibly from a single, very thin, clay grit-tempered, blackish gray vessel. Three groups of three and one group each of four and two sherds are possibly from two other vessels. The distribution of sherds in this level parallels that of OP 3.11 and may represent upward displacement from that occupation plane.

The lowest targeted occupation plane, which clearly contains a ceramic occupation, is OP 3.11 with 30 sherds in nine units. Most occur along the north wall of the excavation. The distribution of sherds in 2.31 and in both 3.21 and 4.12 are similar and may possibly represent vertical displacements. Five groups of two and two groups of four sherds from this level may be from seven distinct vessels.

## Conclusions

In the final analysis there appears to be at least two distinct long term ceramic occupations at the site. The exact length of occupation cannot readily be ascertained, but a seasonal base camp utilized for a number of months is suggested. Both of these occupations must have occurred during a wetter period when population expansion in the river valleys led to settlement in the uplands, and a spring at or near the site made it a desirable location. Such a conjunction of climate should have been the case during the ninth and tenth centuries A.D., the radiocarbon dates for these levels.

The cultural affiliation of the 16 SA 50 occupants is not clear, but it is suggested they may have been closer to the lower Mississippi Valley Coles Creek tradition than the Caddoan tradition. There is not much evidence either way. In any case, the relatively high percentage of decorated sherds and the predominance of motifs common to both cultural areas at this time indicates there were at least minimal participants in a broader tradition, perhaps as a splinter group from one of the major floodplain ceremonial centers. Alternatively, the lack of any high quality, decorated ceramics may indicate that the inhabitants of 16 SA 50 were not in direct contact with mainstream, river valley occupations.

Whether or not they were an independent band or a group tied politically and/or religiously to a ceremonial center, the presence of a wide variety of paste types in the ceramic sample suggests mobility and possibly trade at some major floodplain center. The flow of trade goods into the site might be expected to peak with high ceramic concentrations.

In contrast to the long term occupations, levels which are the remains of shorter occupations such as OP 1.13 should show a high percentage of nonlocal ceramics and nonlocal materials. Although no date is available for the latest occupation at the site, it is probably relatively recent, perhaps occurring during the late Mississippian period. The lack of ceramics as well as other artifactual evidence suggests a small group of hunters in a temporary camp. Although the climate may possibly have been drier than during the long term occupations, it may have still been wet enough for a spring to have existed at the site. Such a spring (which may have been active only during the rainy season in relatively wet periods, suggesting spring and fall occupations) seems the best explanation for the choice of this location as a campsite throughout the history of its use.

#### IV. BACKGROUND: ANALYSIS OF OCCUPATION PLANES AT ONE-METER RESOLUTION

##### A. THE BACKGROUND-FOREGROUND CONCEPT (Gunn)

Over the last quarter century the capability to generate data from archaeological sites has grown at a phenomenal rate. If Eagle Hill had been excavated in 1950, it would probably have warranted a 10-page report with six projectile points and a dozen or so sherds illustrated. Since that time archaeological interests have expanded in at least two directions. The first set of sources of new data is the multidisciplinary input from geologists, pedologists, biologists, etc. In other words, the context as well as the content of a site is an item of major interest. The second vast new source of information is the various technological facilities developed since World War II that extract both site content and context from the most unexpected sources. Various radioactive isotope laboratories date sites by numerous means. Soils can be analyzed for an infinity of data bits. Even the artifacts can be analyzed for age and chemical content.

In spite of massive efforts to keep pace with the influx of methods and concepts, most archaeologists are restrained from utilizing a full or even sizable range of the techniques available. There are a number of legitimate reasons. It is rightly thought that it is scientifically ill conceived to simply use methods without a specific problem in mind. In this project we would not have tried to date lithics using thermoluminescence if the old reliable radiocarbon analysis had not been denied us as a source of dates. In other words, concepts and needs often come more slowly and painfully than methods inherited from other disciplines. Expense, expertise, availability, personal contacts, etc., are often additional considerations.

On the other hand, archaeologists are generally anxious to develop the concepts and try the new technologies. One might further suggest that the Eagle Hill site is an exemplar of the whys and wherefores for expanding archaeological horizons into the invisible past. Using the methods of the 1950s Eagle Hill is a practically invisible site. Yet in the conceptual framework of late 20th-century archaeology, it is an important site. It is a part of a system of locations between which prehistoric and historic people of western Louisiana and east Texas wove the fabric of their existence. The fact that they did not leave fancy pottery or multitudes of arrowheads is not material to the problem. What is important is understanding the whole system of movements and activities. If people visited Eagle Hill, it is important to that overall concept of human life and process.

Eagle Hill is intriguing because the lines of evidence are faint and the archaeological evidence of prehistoric visits nearly invisible. The water supply on the ridge is unreliable, which dictates temporary habitation. So, who is going to carry fancy pottery to a temporary camp high on a hill?

This is the point where modern analytical technology comes into the picture. In 1950 we might have dusted our hands off and walked away from Eagle Hill. We would have wondered what these faint residues of human occupation meant, and there would have been little we could do about it. In 1980 we are in a position to frame ideas about prehistoric life in the locale and ask if there are methods, which would reveal the lines of ancient movement (even though they are not