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BOOK REVIEWS

Prehistoric Human Food Resource Patches on the Texas Coastal Plain

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ABSTRACT

The Texas coastal plain is remarkable for its ecotonal diversity and natural food productivity. This study takes a look at broad patterns in the occurrence of such food resources, with emphasis on the aquatic products of rivers and bays, nuts and acorns, animals, and prickly pear fruit. These resources converged in parts of the coastal plain to form areas that were especially productive to prehistoric hunter-gatherers. These food resource patches clearly had a profound affect on the behavior and character of people present on the Texas coastal plain over the past 4,000 years.

INTRODUCTION

In an earlier study focusing on the interpretation of prehistoric aboriginal cemetery distribution and character, I noted that the Texas central coastal plain "was blessed with a variety of plants and animals which, in their aggregate, would have provided a superabundance of native foods to prehistoric hunter-gatherers" (Hall 1995a:637). I attempted to show that native pecans were the most critical of these food resources in terms of the definition of Archaic territories across the region, but this idea was not supported by the pattern of known cemeteries relative to native pecan distribution. I concluded my study by observing that: "It was the variety and density of the aggregate of native food resources of southeast Texas that contributed to the area's attractiveness of prehistoric human groups" (Hall 1995a:644). Here, pecans will again be briefly considered, but more attention will be paid, in terms of broad patterns of resource availability, to the coastal plain's rich mosaic of food resources considered only marginally in the earlier study. These include the natural products of Holocene flood plains, bays and estuaries, the Post Oak Belt, the Cross Timbers, and prickly pear fields.

The Texas coastal plain is defined for present purposes as extending from the Sabine River catchment in the northeast to the Río Grande catchment in the southwest (Figure 1). The region is bounded on the southeast by the Gulf of Mexico and on the northwest by the Balcones Escarpment and Edwards Plateau. The climate, landforms, and floral and faunal communities to be discussed have been in place for the past 2000 to 4000 years, and this will be the period of Texas prehistory relevant to this study.

LATE PLEISTOCENE AND HOLOCENE DEVELOPMENT OF THE COASTAL PLAIN

During the Pleistocene, when sea level was 100 m below that of today, Texas rivers were coursing down steeper regional gradients to a coastline that was 65 to 160 km seaward from where it is at present (Frazier 1974:22). Because of the steeper gradients, water was flowing down the river channels faster, cutting deep, V-shaped, relatively straight channels. Due to a wetter Pleistocene climate throughout the catchment basins, the rivers were also carrying more water than in later times. As glaciers began to retreat, sea level gradually rose, river gradients decreased, water flow rates slowed, and the deep valleys began to fill with alluvium.

Following stabilization of modern sea level, the channels of Texas rivers became more sinuous, creating active aggradational environments where spring floods, periodic channel abandonment, and formation of oxbow lakes were more common events in the broad, flat alluvial plains that were developing. Coastward, the flooding of the river

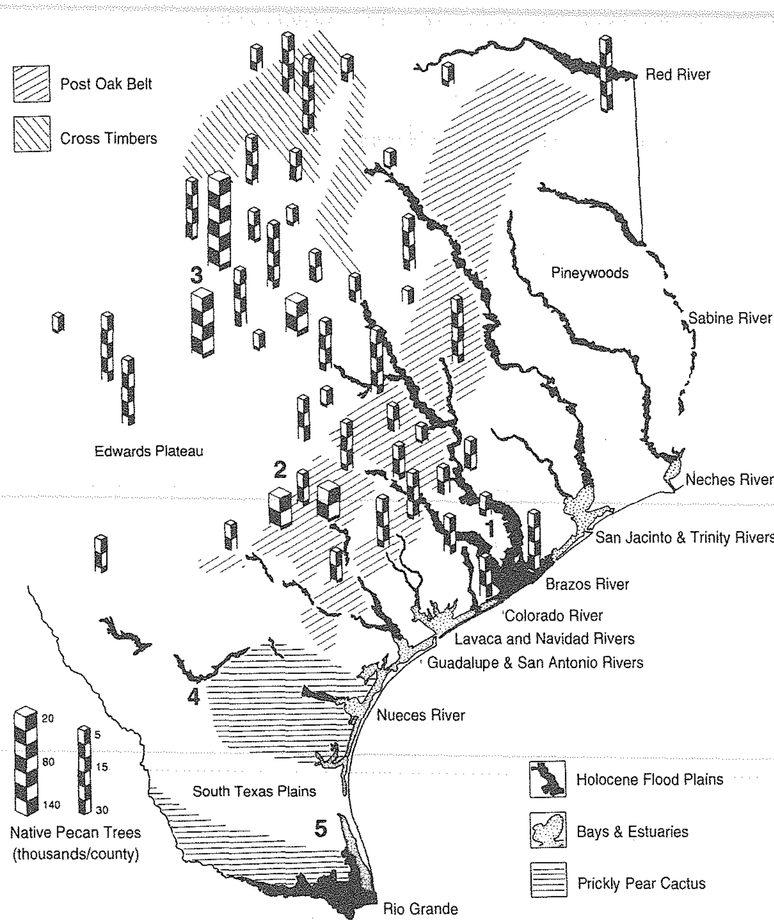

Figure 1. Extent of Food Resource Patches in Eastern Texas. Sources: Post Oak Belt and Cross Timbers (McMahan et al. 1984); native pecans (U. S. Department of Commerce 1981:282-283 and Table 32); prickly pear cactus (Davenport and Wells 1919); and Holocene floodplains, bays, and estuaries (Barnes 1975, 1982).

valleys by the sea level rise created estuaries and, later, bays and barrier islands (Ricklis 1995:289). During the same period, the floral and faunal communities witnessed by native peoples living on the coastal plain during the final 4000 years of Texas prehistory emerged (Story 1985:25, 40). Over these final four millennia, however, average rainfall rates and temperature have fluctuated (Nordt et al. 1994:117).

HOLOCENE FLOODPLAINS

Of the Mariame, an aboriginal group inhabiting the lower Guadalupe River valley, the Spaniard Oviedo said: "Sometimes they eat fish which they kill in that river, but few, except when it overflows which is in the month of April, and sometimes it overflows twice. The second time is through May, and then they kill great quantities of fish, and very good ones" (Oviedo y Valdés 1853:601). The rivers along the Texas coastal plain were important sources of aquatic foods for prehistoric people, and the abundance and availability of riverine food resources varied in proportion to the size of the Holocene floodplain of each river. The larger the floodplain, the more area of active channel, abandoned channels or sloughs, swamps, and oxbows can potentially occur: all features where aquatic food species would flourish and/or be trapped.

It is evident from examination of maps showing the extent of Holocene valley fills (e.g., Frazier 1974:2; Barnes 1975, 1982) that the floodplains of Texas rivers vary considerably in extent. These size differences can be seen in Figure 1, with the coalescent valleys of the lower Brazos and Colorado rivers and the valley of the Río Grande standing out prominently on the Texas coastal plain. Nevertheless, these "biggest" Texas floodplains are dwarfed by the coastal Holocene floodplain of the Mississippi River to the east (Frazier 1974:2). The size of the floodplain of Texas rivers is dictated by geologic and physiographic factors, the drainage area of the river, and annual rainfall rates in the river catchment (Table 1).

Floodplain features such as oxbow lakes, sloughs, and backwater swamps were places where aquatic species were introduced during spring floods and then naturally trapped or contained as flood waters receded. They were the prehistoric equivalents of "catfish farms" where aquatic species were, in essence, preserved and stored through spring and into the summer to be harvested by people as needed. Such features were fixed in space and would have been a predictable source of food from year to year to the extent that broader climatic patterns cooperated in bringing integral spring floods. The same processes that were creating such features also brought about their eventual demise.

Table 1. Drainage Areas, Rainfall Rates, and Annual Runoff Statistics for Texas Rivers*

River	Total Basin Drainage Area (Sq. Miles)	Mean Annual Rainfall (inches)	Average Annual Runoff (Acre Feet)
Red	48,030	17-47	7,492,680
Sabine	9,756	44-53	6,243,840
Neches	10,011	45-47	5,225,742
Trinity	17,969	32-50	5,570,390
San Jacinto	3,834	48	1,686,960
Brazos	45,573	17-46	5,423,187
Colorado	41,763	14-44	3,341,040
Lavaca-Navidad	2,309	34-41	544,924-773,515
Guadalupe	6,070	25-49	1,080,460
San Antonio	4,180	26-36	627,000-773,300
Nueces	16,950	23	1,254,300-2,000,100
Río Grande	182,215	8-18	5,284,235

*Data Source: Texas Water Development Board (1977).

Sloughs and oxbows gradually fill with sediments or are cut off from influx of floodwaters, thus becoming less effective as fish traps and storage ponds. The geomorphic evolution of such features through time is reflected in local settlement patterns of contemporary prehistoric people. Good examples of this situation are provided by the Flat Bank Creek site (Kelley et al. 1994:7-1 to 7-3) and sites near Shy Pond (Hamilton 1987) in the lower Brazos River valley, and in the lower Guadalupe River valley (Weinstein 1992:367-377). Examining faunal lists from such sites (e.g., Weinstein 1992:306-308; Kelley et al. 1994:6-2 to 6-4), gar, drum, catfish, bass, perch, sunfish, minnows, mussels, turtles, snakes, and alligators are all seen to have been important food resources procured from floodplain features.

BAYS AND ESTUARIES

For the Nueces River estuary and the bays in the vicinity of Corpus Christi, Ricklis (1995:280-281) has shown that the formation of estuaries and shallow bays protected by barrier islands occurred during at least three sea level stillstand intervals over the past 7500 years. As with the two earlier intervals, the latest versions of these features, in place along the Texas coast by Late Archaic times (2500 to 2000 B.P.), "led to a considerable increase in estuarine fish carrying capacity, and human populations shifted to greater economic focus on fish procurement." The bays and estuaries also supported a variety of shellfish, which were also harvested by the fishermen. In Late Prehistoric times (700 to 250 B.P.), fishing appears to have become even more important (Ricklis 1995:286). For both the Late Archaic and Late Prehistoric periods, Ricklis (1995:281, 287) believes that fishing was most intense from fall and winter through early spring, corresponding to the spawning season of redfish and black drum. He further notes (1995:287) that the movement of fish into the bay shallows to spawn provided "the kind of predictable and concentrated food resources required to support relatively large human groups."

Scott (1992:423-424) provides a consideration of aquatic food resource exploitation in the lower

Guadalupe River valley, where both marine and freshwater species were available. There, Scott equated increased use of aquatic foods with stress brought on by an "insidious increase in population" beginning in the Late Archaic. Though often considered by hunter-gatherers to be a second-line, less desirable resource, aquatic foods became more attractive in times of stress because of their abundance, ease of procurement, and nutritional value. Gradually increasing reliance on aquatic foods, as observed by Ricklis (1995) and Scott (1992), may be interpreted, along with the appearance of cemeteries, as a sign of increased population and greater demands on the food base.

PECANS, ACORNS, AND OTHER NUTS

The floodplains of creeks and rivers over portions of the eastern half of Texas support the world's densest stands of native pecans. Data on the distribution and other characteristics of native pecans have been presented in Hall (1995a:638-644). Figure 1 shows the distribution of native pecans on a county-by-county basis over the study area (though only counties having 5,000 or more native pecan trees are included). In the fall season of years of maximum productivity, these groves yield millions of kilograms of pecans. Then, for a couple of years, sometimes longer, nut yields are lower, reflecting naturally-dictated cycles of productivity. In addition to being "rooted" in the landscape, and thus predictable as to location, other attractive qualities of native pecans as a human food resource include their abundance; relative ease of collection, processing, and preparation prior to eating; good preservation and storage properties; and nutritional value. Most important with respect to nutrition is that over 70 percent of the nut meat consists of fat, a critical component of the diet that was often in short supply for hunter-gatherers. Campbell and Campbell (1981:17-18) provide an informative summary of pecan utilization by the Mariame on the lower Guadalupe River, and Campbell (1975:18-19) tells of pecan usage by the Payaya people along the Medina River south of San Antonio.

Acorn-producing oaks grow extensively over the Texas coastal plain and on the Edwards Plateau, but are most heavily concentrated in two major features of the Texas floral landscape known as the Post Oak Belt and the Cross Timbers (see Figure 1). Also embedded in these forests are hickory and walnut trees. The acorns and nuts produced by these trees would have been utilized as food resources by prehistoric people during the fall and winter. Less is known about the density and productivity of oaks, hickories, and walnuts because, unlike pecans, they do not have enough direct economic value to have justified extensive study. But localized studies (e.g., Marietta and Nixon 1983; Ward and Nixon 1992) do show that oaks and hickories are major components of these forests. Though the labor investment to collect and process acorns, hickory nuts, and walnuts is higher than for pecans, the acorns and other nuts do provide important sources of carbohydrates, fats, and proteins. Like pecans, the productivity of acorns and nuts from these other trees is variable from year to year. Of additional importance, the pecans, acorns, and other nuts attracted and fed a variety of wildlife species.

PRICKLY PEAR CACTUS

From the Nueces River southward to the Río Grande, vast stands of prickly pear cactus yielded abundant fruits (known as *tunas*) that were an important food resource to early historic aboriginal populations, mainly in the summer when the greatest numbers of the *tunas* ripen. In their study of the route of Cabeza de Vaca across Texas, Davenport and Wells (1919:208-210) gathered good distributional data on prickly pear in southern Texas. The prickly pear areas shown in Figure 1 come from this study. Other good 19th century descriptions of the size, extent, and density of the prickly pear concentrations are mentioned by Campbell and Campbell (1981:7, 18), who also provide a good summary of Cabeza de Vaca's 1533 observations concerning the utilization of prickly pear by the Mariame, who annually moved south to the prickly pear fields from their home in the pecan groves of the lower Guadalupe River valley. From May until August, *tunas* were a staple of the diet. The harvest apparently attracted different ethnic groups from a wide region around the main concentrations, and was an occasion for larger-than-usual aggregations of people. Though similar behavior related to prickly pear exploitation undoubtedly occurred in prehistoric times, it has not yet been verified archeologically, and the time-depth of the activity is unknown.

ECOTONAL DIVERSITY EQUALS RICH FLORA AND FAUNA

The interfingering of the roughly north-south trending nut- and acorn-rich forested areas of the Cross Timbers and Post Oak Belt with prairie and savannah zones, and the bounding of the entire region by the Pineywoods, Edwards Plateau, South Texas Plains, and Gulf of Mexico (see Figure 1), creates a landscape mosaic of rich floral and faunal communities. The entire region is slashed northwest to southeast by the floodplains of the major rivers. For Texas, this landscape is one of relatively great ecotonal diversity, supporting dense and diverse plant and animal communities. Foster (1995:233-260) summarizes reports of plants and animals seen by 17th and 18th century Spanish explorers as they traveled along the Camino Real from the Rio Grande to the Sabine River. Alston V. Thoms does an excellent job of characterizing the ecological diversity and productivity of small areas of the Post Oak Belt (Thoms 1993:12-17) and the Cross Timbers (Thoms 1994:17-20). These studies vividly demonstrate how productive the Texas coastal plain was (and, for many species, still is), especially in terms of white-tailed deer, but also including bison, antelope, bears, turkeys, raccoons, beavers, rabbits, snakes, migratory waterfowl and other aquatic fauna, prairie chickens, and quail. Thoms (1993, 1994) and Foster (1995) also mention, in addition to the nuts and acorns already discussed, a variety of other plant food resources such as mesquite beans, hackberries, dewberries, hawthorns, plums, mustang grapes, greenbriars, persimmons, and generic "roots," "seeds," "berries," and "herbs" that are available throughout the region.

DISCUSSION

Having briefly mentioned the various food resource patches present on the Texas coastal plain, attention is now turned to specific areas within the region to consider how the availability of aggregate food resources may have affected the behavior of prehistoric human groups inhabiting each area. The areas to be discussed are numbered 1 to 5 on Figure 1.

Area 1 encompasses the lower valleys of the Brazos and Colorado rivers. It was in this area that I attempted to show that, during the Late Archaic, relatively dense human populations, formation of territories, and subsequent development of large cemeteries were keyed to native pecan availability (Hall 1995a, 1995b). However, pecans alone failed to account for this Late Archaic cultural phenomenon. Looking beyond the pecans, it is seen that Area 1 is also blessed with the expansive, coalescent floodplains of two big rivers, the Brazos and Colorado, their floodplains rivaled in extent here in Texas only by the Río Grande delta. The channels, oxbows, sloughs, and swamps of these big plains were a bountiful source of aquatic foods.

I now believe that it was a combination of the pecans and the aquatic resources that provided the main impetus for Late Archaic settlement in this area of the coastal plain. These two foods complemented each other in terms of seasonal availability, pecans being harvested in the fall and winter, and aquatic resources primarily in the spring and summer. Both the nut groves and the floodplain "catfish farms" were fixed on the landscape, and thus were predictable as to where the food resources would be. This geographic resource fixity would be consistent with the prehistoric settlement patterns hypothesized by Vernon (1989:53-55) wherein Late Archaic populations were not sedentary, but were operating over reduced territories. As time went by, enough deaths and burials occurred in the vicinity to result in development of the large cemeteries characteristic of the area. There was good storage potential in the sense that pecans can be cached for a year or more without spoiling, and fish would continue to live, but be trapped, in sloughs to be used on into the summer. The pecans and aquatic foods in Area 1 were augmented by bay foods on the coast, products of the Pineywoods region to the northeast, acorns and hickory nuts from adjacent segments of the Post Oak Belt, and the various other plant and animal resources supported by prairie, savannah, floodplain, and forest ecotones. These subsidiary resources were abundant enough to support the people at times when primary resources were in short supply.

Late Archaic cemeteries in Area 1 are distinguished by remarkable grave inclusions, including specimens made of raw materials originating in the Ouachita Mountains of Arkansas and the Llano Uplift of Central Texas (Hall 1981, 1995a, 1995b). If these artifacts are tangible signs of reciprocal resource-sharing alliances (Hall 1995a), then the higher incidence of such objects in the cemeteries of Area 1 suggests that the area had, year-in and year-out, the most abundant food resource base available on the Texas coastal plain. In this scenario, the "exotic" objects and materials found in the cemeteries would have been brought in by visiting bands when they came to partake of surplus food resources, the exotics being given to members of the hosting band. Binford outlines this process and refers to such resource-rich areas as "centers of secure production" (Binford 1983:219-220). The bands of Area 1 likely experienced occasional food shortages themselves and had to pay visits to neighboring territories to get by. These movements might explain the occurrence of distinctive bone artifacts typical of Area 1 (Hall 1989) at more remote sites such as Morhiss and Texas West Indies to the southwest in the Guadalupe River valley (Birmingham and Huebner 1991; J. Dockall and H. D. Dockall 1996). Parallels may also be seen in marine shell ornaments (Birmingham and Huebner 1991; H. D. Dockall and J. Dockall 1996).

Area 2 in the middle reaches of the Guadalupe and San Antonio rivers has concentrated native pecan resources second only to Area 3 along the San Saba, Colorado, and Leon rivers. Late Archaic burials and related grave inclusions, such as found at Rudy Haiduk (Mitchell et al. 1984), at the Olmos Dam cemetery (Lukowski 1988), and at the Silo cemetery (Lovata 1996), suggest settlement systems and a food resource base similar to those in the Late Archaic of Area 1. In Area 2, the pecan groves are solidly embedded in the forests of the Post Oak Belt, which is bifurcated by prairies at its southwestern end (see Figure 1). Pecans, acorns, and perhaps hickory nuts are abundant. The floodplains of the area's two major rivers are not large, so aquatic resources would not have been a significant factor affecting local settlement. There are big bays and estuaries at the mouths of the rivers that trend through this area, so aquatic food resource potential was high coastward.

In addition to the immediate plant and animal food resources available in Area 2, its location with respect to the Edwards Plateau, Area 1, and Area 4 may have been an advantage to its Late Archaic people in two respects. First, ecotonal diversity was high, with attendant rich floral and faunal communities. Secondly, if the Area 2 people had reciprocal resource-sharing alliances with their neighbors (Hall 1995a), they were strategically positioned to draw on the resources of several well-endowed adjacent regions. In years when their substantial pecan groves were producing bumper crops, the Area 2 people would have been in a position to invite neighbors in to partake of surplus pecans. The Mariame, early historic inhabitants of the Guadalupe River valley, provide a model for this type of inter-regional movement. Cabeza de Vaca reported that the Mariame exploited pecans in their valley during the fall and winter, then moved southward to the prickly pear fields of Area 4 in the summer (Campbell and Campbell 1981).

Area 3, comprising the upper reaches of the San Saba and Leon rivers, and the middle stretches of the Colorado River (see Figure 1), supports the densest concentration of native pecans in the world. The apparent absence of large Late Archaic cemeteries in the area (Hall 1995b; Taylor 1995:668) indicates that abundant native pecans alone did not constitute a resource around which Late Archaic settlement patterns of the type that emerged in Areas 1 and 2 could develop. However, if more Archaic burials and related artifacts such as were found at the Bering Sinkhole site (Bement 1994) show up, this picture may change. There are thousands of such sinkholes in Central Texas, including the vicinity of Area 3 (Wermand et al. 1978:13). The one big drawback to pecans is that the groves do not naturally produce bumper crops every year, and, though described as being "biennial" in their productivity, it can actually be anywhere from two to four years between bumper crops. Hunter-gatherers thus could not have relied totally on pecans, but would have needed complementary resources to take up the slack at times when the pecans were in short supply.

Area 3 lacks the critical ecotonal diversity and food product variability of coastal plain regions to the southeast needed for the sustenance of large populations of people. On the Edwards Plateau, the floodplains of rivers and streams are very narrow, and not nearly as productive in terms of aquatic resources as are their coastal plain counterparts. Durable Late Archaic products from Central Texas, such as corner-tang chert knives, graphite, and biotite schist, show up in Area 1 cemeteries (Hall 1981, 1995b), suggesting that Area 3 people may have arranged resource-sharing agreements that took them down to the lower reaches of the Brazos and Colorado valleys. When they were producing bumper crops, the vast groves of native pecan in Area 3 must have been irresistibly attractive to people living in a wide radius around the area, a pattern that was certainly in place in early historic times. J. Charles Kelley (1955) describes the cross-state trading expeditions of Juan Sabeata, a Jumano Indian, as having been timed partly to coordinate with Area 3 fall pecan harvests.

Area 4 incorporates the lower reaches of the Nueces River valley on the South Texas Plains (see Figure 1). It is defined in this article by the huge northernmost prickly pear cactus "patch" delimited by Davenport and Wells (1919:209-211). For its drainage area, the Nueces River has a comparatively large Holocene floodplain, with good slough and oxbow development even far inland. Area 4 is blessed with extensive bays and estuaries on the coast. Large prehistoric and early historic aboriginal cemeteries are known for the area, including the late Middle Archaic Loma Sandia cemetery (Taylor and Highley 1995) and the Oso site, a huge, but poorly-known cemetery on Oso Bay (Hall 1995b:47-49). The presence of these cemeteries suggests that the prehistoric food resource base was adequate to support concentrated populations at certain times in prehistory, with its bay and estuarine resources, deer, and the prickly pear patches being especially important (Campbell and Campbell 1981; Ricklis 1995). Grave inclusions in the Loma Sandia cemetery are varied and remarkable, but are substantially different in terms of forms and raw materials when compared to those found in the Late Archaic cemeteries of Areas 1 and 2. Though the Loma Sandia grave inclusions are apparently not "exotic" in terms of being from distant sources, they are suggestive of participation in exchange systems, perhaps driven by reciprocal resource-sharing arrangements (Hall 1995a). From Area 4 southward to Area 5, there is actually more ecotonal diversity than is indicated in Figure 1. For example, the area supports dense concentrations of acorn-producing live oaks, and mesquites in the region yield prolific quantities of nutritious "beans" (McMahan et al. 1984).

Along the Río Grande is Area 5. This area is defined by Davenport and Wells' southern prickly pear patch, the extensive Holocene floodplain of the Río Grande delta, and some big bays. The sloughs and oxbows of the Río Grande delta, known locally as *resacas*, are numerous. Salinas (1990:116-119) suggests that fishing was probably the most important subsistence pursuit of native people in Area 5 in early historic times, augmented by hunting of deer, javelinas, turkeys, and rabbits, and harvesting of wild plant foods such as prickly pear leaves and fruits, mesquite beans, and various other roots, beans, seeds, and fruits. The Ayala site is the one large cemetery known in the area, and it is dated to the Late Prehistoric period (Hester and Ruecking 1969). Though the available cemetery data does not strongly support the idea that a large prehistoric population was present in Area 5, there is substantial documentary evidence for a surprisingly large aboriginal population there in the early historic period (Salinas 1990:138-139; Ricklis 1995:293).

CONCLUSIONS

Native pecans and the floodplain aquatic resources of the Texas coastal plain were key natural foods with respect to Late Archaic settlement patterns, especially in Area 1. More broadly across this plain, it was the diversity and richness of the natural food matrix created by unusual ecotonal diversity that made the region very attractive to prehistoric hunter-gatherers. The emerging "patchy" distribution of Archaic and Late Prehistoric cemeteries on the coastal plain and its margins indicates that key natural food resources were themselves patchy, and definitely not equitably distributed across the area. This circumstance led to the formation of exclusive territories. "Exotic" or otherwise unusual grave inclusions found with Archaic burials on the coastal plain seem best to be interpreted as signs of reciprocal alliances that facilitated access of populations to food surpluses in a territorial context. Their concentration in Areas 1 and 2 is a tangible indication that these areas were "centers of secure production" in prehistoric times.

There remains great potential for further study of Texas coastal plain food resources to determine more specifically how they influenced the behavior of prehistoric people. For example, it would be useful to know the aquatic species yield of typical sloughs, oxbows, and swamps in the lower reaches of rivers such as the Brazos, Colorado, and Guadalupe. What is the density and distribution of hickory and walnut trees in the Cross Timbers and Post Oak Belt? How reliable are production rates for the various species from year to year? If pecans are not plentiful in groves along the Brazos and Colorado valleys one year, is the same true of the Guadalupe or San Saba valleys? If spring floods do not come down the Guadalupe one year to replenish the oxbows with fish, what is the likelihood that the same thing happened along the Brazos? In terms of seasons of production, how do all of the resources relate to one another? What is the potential for preservation and storage of a particular resource? From the perspective of human dietary requirements, what are the nutritional benefits or drawbacks of particular natural foods?

Alston Thoms (1997 personal communication) is well on his way to recognizing additional important natural plant foods of the region. He identifies arrowhead (*Sagittaria* sp.), crow poison (*Nothoscordum bivalve*), lotus (*Nelumbo* sp.), blue camass (*Camassia scilloides*), and spring beauty (*Claytonia virginiana*) as producers of nutritious tubers, bulbs, or roots. Like native pecans and acorns, Thoms feels that these species would have been particularly important to hunter-gatherers because they are non-mobile, widely distributed, as well as abundant, and could be collected and processed with relative ease. There are undoubtedly other floral species having similar beneficial characteristics that are waiting to be factored into the region's prehistoric human food resource equation.

Thoms (1993, 1994) has also provided good models of how deer populations can be evaluated on an area-by-area basis on the coastal plain. More fine-grained delineation of wildlife densities, especially with respect to deer, bison, and bear, would be very useful. Intensive study of the heartland of prickly pear country down in Area 4, generally from Palo Blanco Creek and Baffin Bay northward to the Nueces River, holds great potential. This area has received much less attention than the central coastal plain. The same is true of the Río Grande delta. From the Nueces River south, species such as prickly pear, ebony, and mesquite become important, and need to be studied in terms of their distribution, nutritional value, and productivity.

The area of paleoenvironmental research has seen substantial progress. The emerging picture for Central Texas as painted, for example, by Nordt et al. (1994:117) depicts warm, dry weather from 6000 to 4000 B.P.; cooler, wetter weather beginning about 4000 B.P.; and a "brief shift" to a dry, warm spell "around 2000 years B.P." I have previously speculated that the timing of this dry-wet-dry sequence had an impact on the character and behavior of Middle and Late Archaic populations in Area 1 (Hall 1981:267-268, 308), and Story (1985:50-51) has developed this scenario even more completely. This complex interplay of climate, geomorphology, human behavior, and food resources in the period from 4000 to 2000 B.P. holds exciting potential for further research.

As we get control of some of the above variables, as new sites come to light, and as we continue to apply more sophisticated theories concerning hunter-gatherer behavior to the available data (cf. Kelly 1995), we can expect more refined interpretations of the prehistoric archeological record on the Texas coastal plain to be put forth.

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Archeological Investigations at the Tortuga Flat Site (41ZV155), Zavala County, Southern Texas

Betty J. Inman, T.C. Hill, Jr., and Thomas R. Hester

ABSTRACT

During 1972-1973, T. C. Hill Jr., an avocational archeologist from Crystal City, conducted test excavations in Zavala County at the Late Prehistoric/Protohistoric period Tortuga Flat site (41ZV155). Seven test units and a refuse area (containing dense faunal materials) were excavated and artifacts were surface collected from three features. Cultural deposits at Tortuga Flat were concentrated in a compact, discrete zone between 5-15 cm below surface. Cultural materials recovered from the site include arrow points, unifaces (scrapers), bifaces, ground stone artifacts, debitage, bone-tempered ceramics, burned rocks, and a wide variety of faunal remains. Perdiz and Scallorn arrow points, and a single Cuney arrow point, appear to be contemporaneous. Microwear analysis of a sample of lithic tools from the site revealed polish indicative of meat and hide processing. Faunal remains attest to a diverse subsistence economy, including various large and small animals, and aquatic resources. Bone-tempered ceramics from Tortuga Flat are similar to others recovered from the area. One reliable radiocarbon date from the site indicates probable occupations during the 15th and 16th centuries. Ethnohistoric data indicates Tortuga Flat was in the territorial range of a cultural group named the Pacuache, and it is likely that they and other small bands occupied the site on a seasonal basis.

INTRODUCTION

Preliminary notes on the Tortuga Flat Site (41ZV155) were published by Hill and Hester (1973). In 1981, Margaret Greco and Ralph Snavely, then students at The University of Texas at San Antonio, analyzed the site materials and prepared a report (Greco and Snavely 1981) as a class project with Professor Hester. This third inquiry into the archeology of the Tortuga Flat site incorporates information from previous research and provides additional analysis of the lithic and ceramic artifacts. Cultural materials from the site are then examined to determine how the diagnostic artifacts, toolkit composition, ceramics, and faunal remains from Tortuga Flat contribute to our knowledge of Late Prehistoric and Protohistoric sites in southern Texas. Ethnohistoric information will be used in an attempt to link the site's archeological record to cultural groups living in the South Texas region during the Late Prehistoric and Protohistoric eras.

ENVIRONMENTAL BACKGROUND

Zavala County (Figure 1) lies in the Rio Grande Plain in the southern part of Texas, bordered on the west by the Rio Grande, on the east and south by the Gulf of Mexico, and on the north by the Edwards Plateau. Zavala county is near the northern edge of the Tamaulipan biotic province and has a semi-arid, warm climate with brushy vegetation (Hill and Hester 1971). Although brush and mesquite presently dominate the landscape, it is possible that, under native range, the area was a more open grassland (see Stevens and Arriaga 1985).

Tortugas Creek, which drains into the Nueces River, is in the eastern part of the county. The area contains well-developed stream valleys with networks of old channels caused by fluctuations in the stream courses (Hill and Hester 1971). During historic times, Tortugas Creek has been an intermittent stream, but there are some Spanish accounts of the Tortugas Creek area that indicate there were

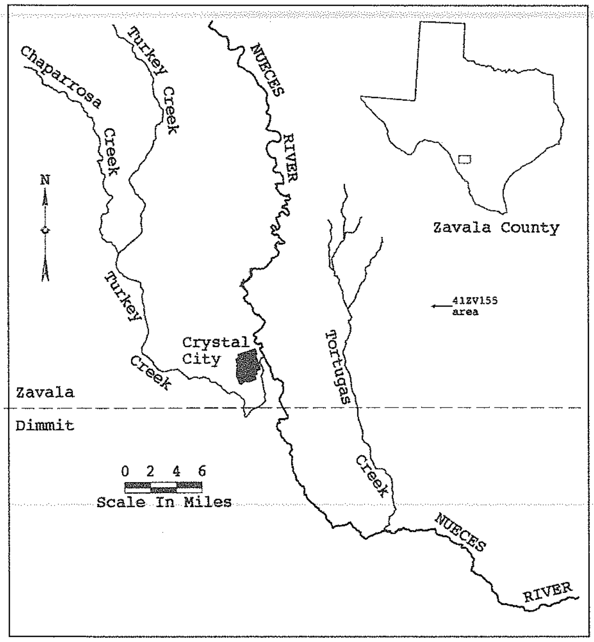


Figure 1. General location of site 41ZV155 in Zavala County, Texas. Insert shows location of county within the state.

springs along it that maintained permanent water sources (Inglis 1964). Large oak trees in the creek's riparian zone support this recorded observation (Hester and Hill 1973).

The soil in the site area along Tortugas Creek is Brundage fine sandy clay loam. This is a brown to dark brown to yellowish-brown loamy Aridisol formed on alluvium. This soil occurs on level or nearly level areas, mainly in close proximity to drainages that transect the county. The upper soil horizons are generally grayish brown fine sandy loam with few calcium carbonate masses. At a depth of about 98 cm is a pale yellow sandy clay loam that is mottled and contains about 10 percent calcium carbonate nodules. Brundage soils are well drained and permeability is very slow. Surface crusting and tight subsoil limit water movement into these soils (Stevens and Arriaga 1985).

Historical documents provide some environmental information about the Zavala county area. In 1691, the Teran expedition traveled near Chaparrosa Creek. Entries in the diaries of these early explorers indicated the country was level with mesquite in some of the sections. "Great quantities of buffaloes" were reported near the Nueces River (Inglis 1964). Archeological data also attests to the presence of bison and pronghorn in prehistoric times (Hester 1975a). Deer, rabbits, rats, and mice were available to the native populations and other sources of food were fish, freshwater mussels, land snails, snakes, and lizards (Hester 1980).

John Holdsworth (in Hester and Hill 1973) describes the modern environment of the Tortugas Creek area, indicating it contains various species of waterfowl, frogs, turtles, raptors, gray fox, and native wild cats. Holdsworth mentions roots and tubers (for example, cattail roots) that may have been food sources. It is likely that most of these resources (with the exception of the intrusive armadillo) were also available to the Late Prehistoric inhabitants of the region (Hester 1975a). Peccary may have been present, given the faunal data from 41MC222 (Hall 1986) and 41JW8 (Black 1986). However, it is absent in extensive faunal analyses at Late Prehistoric and Protohistoric sites in the Zavala County area (Hester and Hill 1975). Indeed, it is found only in the 18th century mission Indian fauna at San Juan Bautista and San Bernardo (Davidson and Valdez 1976).

Other food resources include prickly pear cactus (the new leaves in spring; *tunas* in summer), and mesquite beans, the latter also ripening in early summer. It has been noted that, in the event of a drought, an additional fall crop of mesquite beans may be produced (Windberg 1997). The leaves and bulbs of yucca were likely harvested and eaten (Hill et al. 1976). Fall resources included acorns and presumably pecans. Although pecan trees are not present along Tortugas Creek, they are found nearby along the Nueces River (at a distance of about 10 km) and well within the range of migrating peoples.

CULTURAL BACKGROUND

The native groups of South Texas were hunters and gatherers, part of an 11,000-year tradition (Hester 1981). These inhabitants have long been labeled as "Coahuiltecan" in reference to a language supposedly spoken by numerous hunting and gathering groups in southern Texas and northeastern Mexico at the time of Spanish contact. Research by Campbell (1991) and Goddard (1979) has determined that other languages besides "Coahuilteco" were spoken in the region, including seven major linguistic groups: Coahuilteco, Karankawa, Comecrudo, Cotoname, Solano, Tonkawa, and Aranama. A study by Johnson and Campbell (1992) named "Sanan" as one of the aboriginal languages in Eastern Coahuila and Southern Texas.

Early historical records indicate that the native peoples of South Texas were mobile and that group size was relatively small, usually 300 persons or less. It is probable that these groups had exclusive territories during the winter but in summer and fall shared a distant area with other groups because of abundant seasonal food resources (i.e., prickly pear fruit in summer, and pecans and acorns in fall). An example of overlapping territories can be found in the Mariames, a coastal Texas group that ranged over two areas separated by a distance of at least 130 km (Campbell 1988).

Some general characteristics of native lifeways can be extracted from records of the Spanish colonial missions at Guerrero, Coahuila, Mexico. Mission San Juan Bautista and Mission San Bernardo, established in 1700, were located approximately 64 km southwest of Tortuga Flat. For example, there are accounts of the gathering of wild plant foods (roots, acorns), the use of bison meat, and descriptions of houses—round structures made of poles and covered with bison skins (Campbell 1988).

Cabeza de Vaca's arrival on the Texas coast in 1528 and the accounts of his travels across southern Texas (including the Rio Grande vicinity), confirm that bison were present there during this time. Small animals such as rats, mice, frogs, snakes, and certain insects were mentioned as food sources for the Mariames (Campbell 1988), and research by Black (1986) indicates they were also used by the more inland South Texas inhabitants.

Ethnohistoric research on a specific cultural group from southern Texas, the Pacuache, has been conducted by T. N. Campbell (n.d.) from civil, military, and ecclesiastical records. Early maps, traveler's accounts, presidio records (garrison inspection reports), and mission records (progress reports, administrative inspection records, census reports, baptismal, marriage and burial registers) also provided relevant ethnohistoric data, as well as the few books compiled by early church historians. The Pacuache can be associated with the Zavala County area, and with some aspects of the archaeological record from sites in the vicinity.

Campbell's (n.d.) research indicates that the Pacuache name first appears in documents in 1684 and disappears from the records after 1775. Most ethnohistoric data was taken from Spanish colonial mission documents (mainly at Guerrero, Coahuila) written between 1690 and 1730. Several of these documents are pertinent to the placement of the Pacuache in the Tortuga Flat area: a 1709 diary kept by Espinosa stated his party encountered three "Pacuasian" Indians as they approached the Nueces River (in either present-day northern Dimmit or southern Zavala county) who were out hunting mice (*ratones*); a document dated 1726 mentions Pacuaches on the Nueces River; and an account dated 1729 mentions Spaniards encountering an unspecified number of Pacuaches hunting buffalo near present day Del Rio (less than 160 km from Zavala county). Further, the Pacuache have been closely linked with Mission San Bernardo, Guerrero, Coahuila. Census records from the mission list 85 Pacuache individuals present in 1772 (Almaraz 1980). An earlier report, dated 1727, indicates that many Pacuache had been living at Mission San Bernardo but, because of food shortages there, had returned to their lands some 15 leagues (about 65 km) from the mission. This seems to indicate their homeland was the Zavala/Dimmit county area. A document dated 1728 also places the land of the Pacuache in the area now covered by eastern Maverick county and the western parts of Zavala and Dimmit counties. In addition, a report from 1709 mentions an encounter that appears to have taken place near the present Leona River (near the boundary between Frio and Zavala county) with a group numbering about 20 and identifying themselves as Xarame and Pacuache (Campbell n.d.).

Research by Campbell (1979) on the ethnohistory of the Spanish missions at Guerrero indicates that the Pacuache, when first known to Europeans, had a population of about 400. Campbell (1979) compiled the following details on Pacuache culture: hunting of bison, deer, rats, and mice; use of the bow and arrow; temporary settlements, usually shared with other groups, in wooded areas near streams; one house form (poorly described), apparently a lean-to, made of branches, covered with grasses, open on one side; hides processed by women and decorated with designs in red and yellow paint; smoke signaling; horses stolen at night from a Spanish travel party; and decorated hides and other unspecified items traded to Spaniards and Indians at the Guerrero missions.

ARCHEOLOGICAL BACKGROUND

The first published report of Late Prehistoric and Protohistoric sites in the Zavala (and Dimmit) county area described artifacts recovered from surveys (Nunley and Hester 1966). Of the 26 mentioned sites, two were Late Prehistoric and 14 contained both Archaic and Late Prehistoric diagnostics. The Late Prehistoric sites were represented by arrow points (Perdiz, Scallorn, Fresno) and a smattering of pottery sherds.

Hester and Hill (1975) reviewed Late Prehistoric and Protohistoric sites in Zavala county (and adjacent Dimmit county), and outlined general characteristics of this era through descriptions of the lithic artifacts and ceramics, analysis of sites and settlement patterns, and radiocarbon dates. Hester and Hill (1975) described the Late Prehistoric toolkit as including small arrow points (Scallorn, Perdiz, Edwards, and Zavala), being used with the bow as the principal hunting device and weapon. Other artifacts were bifaces, unifaces (scrapers), perforators, bone pressure-flaking tools and awls, quartzite hammerstones, manos, and bone-tempered ceramics; ornaments (primarily small bone beads) and stone pipes were rare. Regarding settlement patterns, Hester and Hill (1975) noted that while sites were generally located in riparian zones along major stream courses, there were other resource-rich micro-environments that were easily accessible. Uncorrected radiocarbon dates from five sites indicated the occupations ranged from A.D. 1440 to 1760 (Hester and Hill 1975).

Other Late Prehistoric sites in the Zavala county area include 41ZV10, 41ZV83, Holdsworth, and the Errol Jonsson #1 site (Hester 1978; Montgomery 1978; Hester and Hill 1973; Inman et al. 1995). In Dimmit county, Late Prehistoric sites include 41DM70 (the Spillway site), 41DM3l, and 41DM33 (Hester and Hill 1975). From a review of the artifacts from these sites, it appears that there is no distinct separation of diagnostic artifacts associated with the early part of the Late Prehistoric (as has been documented for Central Texas), and that during the latter part of the period, Perdiz, Scallorn, and Edwards arrow points were all used. It is noted that at some Late Prehistoric sites, small dart points (Ensor, Zavala, Matamoros, and Catan) may have been used with the bow and arrow. In general, the sites share similar toolkits (arrow points, end scrapers, beveled knives); late radiocarbon dates; an overlap of arrow points and small dart points; the presence of pottery sherds; large amounts of diverse faunal material; and site locations in riparian environments (see Hester and Hill 1975; Black 1986; Hester et al. 1989; Hester 1995 for more comprehensive discussions of the Late Prehistoric/ Protohistoric era in Southern Texas).

Important Late Prehistoric sites located east of the Tortuga Flat area include 41LK201, 41LK67, and 41MC222, all at Choke Canyon (Hall et al. 1986; Brown et al. 1982); 41LK28, Loma Sandia (Taylor and Highley 1995); the Hinojosa site (41JW8 [Black 1986]); and 41GD4, the Berclair site (Hester and Parker 1970). Expanding-stem arrow points were found to date earlier than contracting stem arrow points (Perdiz) in the Choke Canyon area. Bone-tempered pottery was dated earlier than A.D. 1000 at several Choke Canyon sites and was found in association with expanding-stem arrow point forms (Hall et al. 1986). The Late Prehistoric component at 41LK67 (Brown et al. 1982), yielded Perdiz arrow points and preforms, Scallorn arrow points, beveled knives (quadrilateral bifaces), bone-tempered pottery, mussel and snail shells, chipping debris, and fire-cracked rocks. Brown et al. (1982) suggest the site dates to about A.D. 1300. Research at the Berclair site revealed an assemblage characteristic of Central Texas sites dating to the latter part of the Late Prehistoric. These included arrow points (predominantly Perdiz), bone-tempered pottery, beveled biface fragments and small unifaces or end scrapers (Hester and Parker 1970). The occupation of the Hinojosa site, a major Late Prehistoric campsite, dates to A.D. 1350-1400. The assemblage includes Perdiz arrow points, bone-tempered pottery, beveled bifaces (with two sides beveled), unifaces, flake drills, and bison bone (Black (1986).

To the northeast of Tortuga Flat, archeological investigations at the Pampopa-Talon Crossings site in Bexar county (Thoms and Ahr 1995), yielded Guerrero, Perdiz, Cuney, and Scallorn arrow points, large bifaces, bone-tempered pottery, medium and large endscrapers, and slickstones (suggestive of hide processing) and one small fragment of lead-glazed (non-native) pottery. The site, located on a terrace rising 12 m above the Medina River floodplain, had abundant surface materials and artifacts in the upper 30 cm of the terrace.

EXCAVATION PROCEDURES

Data upon which this paper is based consists of cultural materials recovered from surface collections and test excavations conducted by T. C. Hill, Jr., in 1972-1973. Information was also extracted from Hill's field notes (including maps and photographs), correspondence between Hester and Hill and the senior author and Hill, the preliminary re-

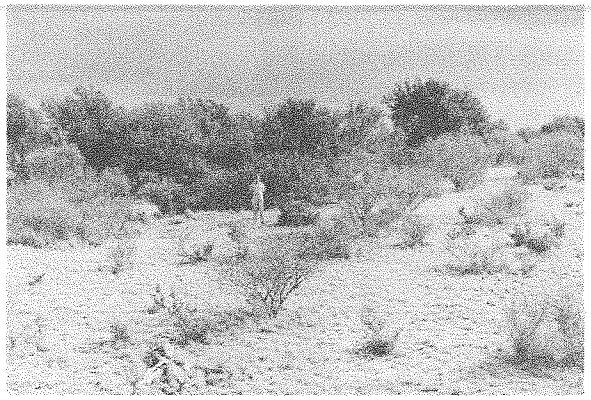


Figure 2. Occupation area of the Tortuga Flat site with Tortugas Creek in the background (looking west).

Figure 3. View of the site to the southeast.

port published by Hill and Hester (1973), and the unpublished paper by Greco and Snavely (1981).

The Tortuga Flat site (Figures 2-4), located on the east bank of Tortugas Creek, is oval in plan and measures 60 by 66 m (Hester and Hill 1975). Cultural remains were concentrated in a discrete, compact zone ranging from a depth of 5 cm near the eastern edge of the site to 15 cm near the creek. A thin layer of alluvium covered the site, except on the eastern edge where debris was exposed on the surface. Three surface features in this area contained pottery sherds as well as Scallorn and Perdiz arrow points. It is possible these features were exposed due to erosion near a road cut located to the east of the site. Hill indicated that the soil away from the creek bank is composed of fine sandy loam. The creek bank consists of dark, organic deposits from flood sediments deposited since the occupation of the site.

Hill's investigations included surface collection of three features and the excavation of seven test units of varying dimensions (a total of 21.4 square meters) and a refuse area (0.25 square meters). Cultural deposits were screened through 1/4-inch wire mesh and approximately 5 percent of these deposits were screened through 1/8-inch wire mesh. Hill's field notes indicate that Test Unit I and II were expanded to determine the extent of cultural deposits.

Hill probed below the cultural materials on several occasions to ascertain there were no deeper levels. He found no stratigraphic evidence of mixing of cultural materials and the records emphasize his view that the site contained a discrete, single component.

The contents of the test units, surface collections, and refuse area are outlined in Table 1. Larger concentrations of cultural materials occur in Test Units I, II, and IV, as well as Feature 1 and 2 and the refuse area. Charcoal and wood species samples were taken from Test Unit I. The large amount of lithic debitage, including three exhausted

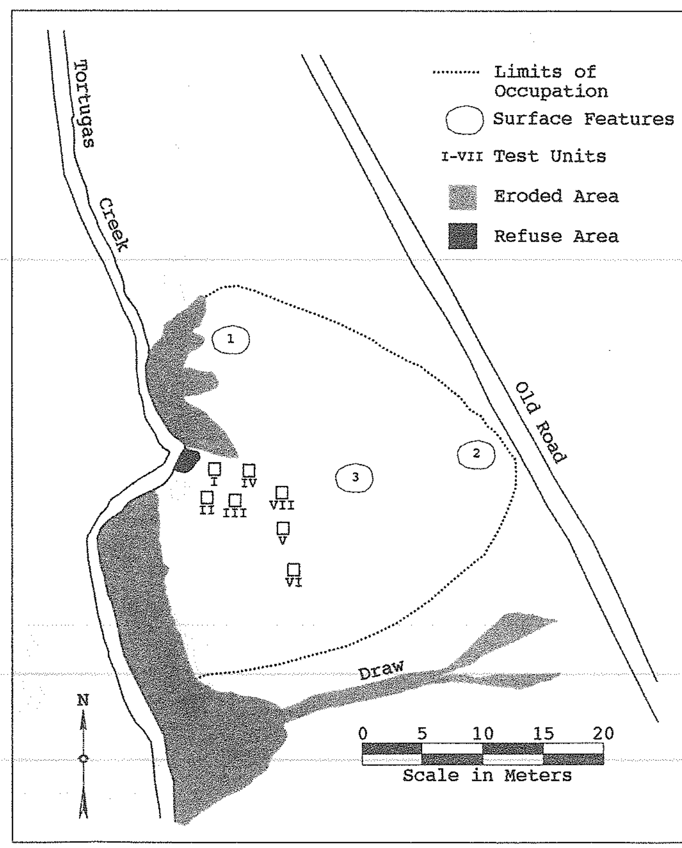


Figure 4. Tortuga Flat site map.

cores, indicate lithic manufacturing was taking place in this area. Test Unit II and the refuse area have the largest concentration of biface thinning flakes, indicating that biface reduction or tool resharpening activities were taking place in these areas.

Test Unit IV was the largest in size and, accordingly, produced the most lithics: six arrow points and/or point fragments and other tools (see Table 1). Heat-treated flakes, charcoal, wood, bone, and pieces of burned clay indicate this may have been an activity area associated with a hearth.

Surface Feature 1, located approximately 10 m east of the creek in a sandy depression, contained a Scallorn arrow point fragment, a preform, a utilized biface fragment, and two unifacial tools. Numerous pottery sherds, as well as two hammerstone fragments and a metate fragment, suggest food processing at this locale. Another surface feature, Feature 2, was located approximately 20 m east of Feature 1 in a similar low, sandy area. It contained two Scallorn; one Perdiz; a beveled biface; three hammerstones; one unifacial tool; one modified flake; a small amount of lithic debris; and 30 sherds. Surface Feature 3, located near the center of the site, yielded only small amounts of cultural materials, mainly pottery sherds.

The refuse area, located near the creek's eastern edge, was an eroded area or gully containing dense faunal materials, two Scallorn arrow points, five unifacial tools, six bifaces, four cores, and other cultural debris. The unit was excavated to a depth of approximately 15 cm, however, the eastern section of the midden area was slightly deeper and was explored to a depth of approximately 20-25 cm. A moderate amount of debitage was also recovered from the refuse area.

ARTIFACT ANALYSIS

The lithic artifacts from Tortuga Flat are described here; provenience data are given in Table 1. Projectile point typology follows that of Turner and Hester (1993). All measurements given are in mm and weights in grams. The following abbreviations are employed: L, maximum length; W, maximum width; T, maximum thickness; SL, stem length; SW, stem width; and WT, weight. A dash (–) indicates a fragmentary specimen.

Some general comments can be made about the majority of artifacts from the assemblage. It appears that local chert was obtained from the uplands in the form of Uvalde gravels (an exception is discussed later in this report) and that the raw materials were heat-treated. This is evident from the vitreous sheen and pink or purple coloring of some of the lithics. Previous research in South Texas has shown that heat-treated materials may have facilitated chipping and even appears to have been preferred for the manufacture of Shumla dart points (Hester and Collins 1974). Evidence of heat-treating can be seen in an examination of the debitage

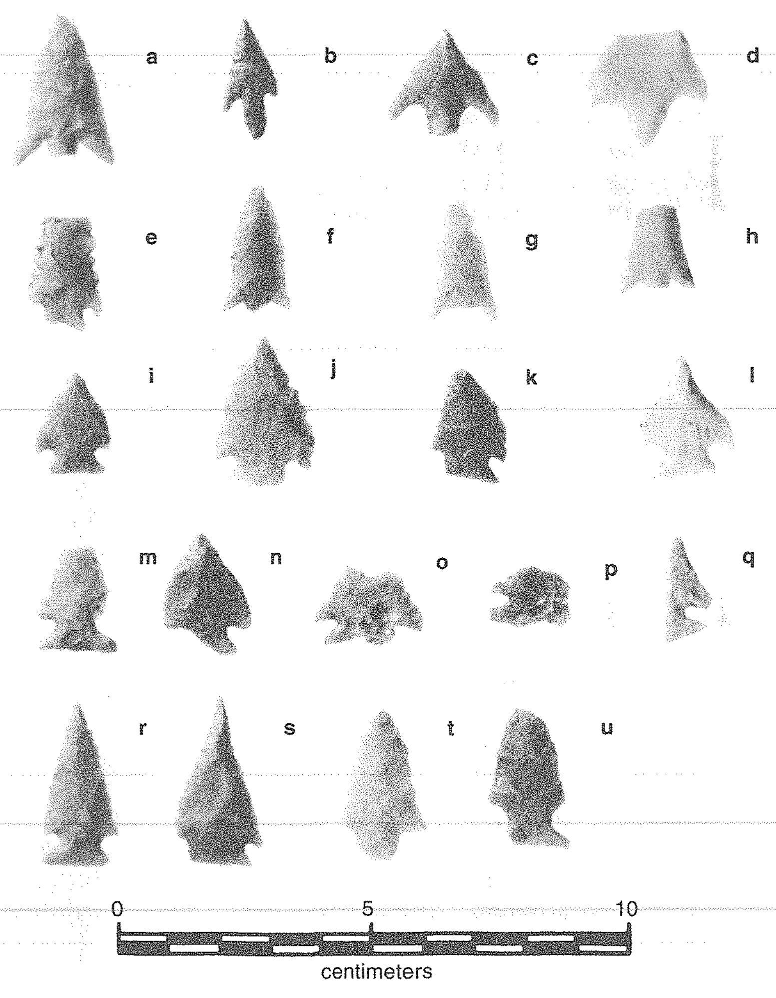


Figure 5. Arrow points: a-d, f-h, Perdiz; e, Cuney; i-u, Scallorn.

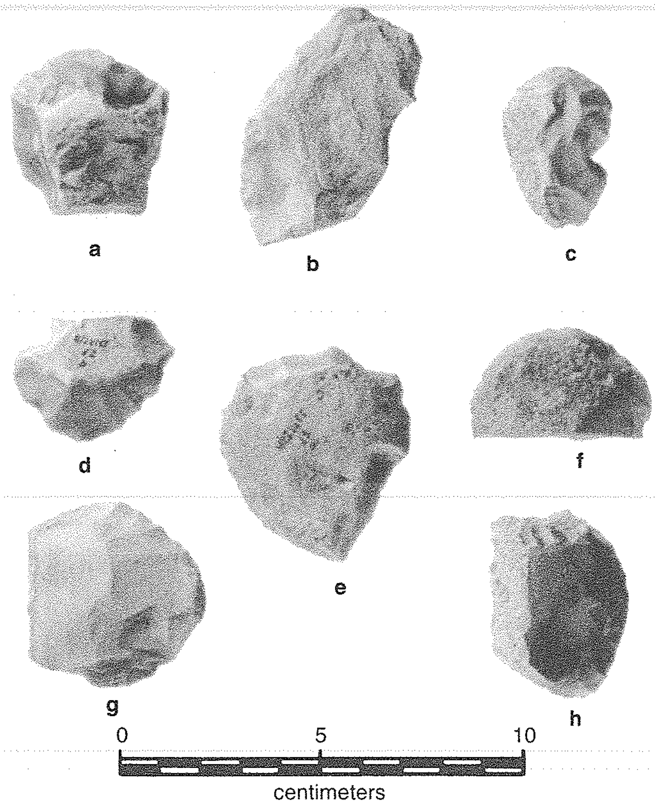


Figure 6. Unifaces.

in size from small thumbnail scrapers (Figure 6c) to a large heavy uniface (Figure 7h). One is a recycled tool, having been patinated and subsequently pressure-flaked along one edge on the ventral surface resulting in differential patination (Figure 7a). Another (Figure 7d) is a possible perforator made on a flake. The unifaces range in color from light to medium tan/gray chert. Several have a pink hue due to heat-treating.

Bifaces

Eleven bifaces were found at the Tortuga Flat site (Figures 8 and 9a-b). Table 4 provides data on each specimen. One biface is made from medium gray chert and is oval in shape, and is possibly a preform (Figure 8a). Another is a pointed biface of medium gray chert, convex in cross-section, that has been broken (by end-shock or as a result of an overshot flake) (Figure 8b). A third biface, perhaps a preform, is

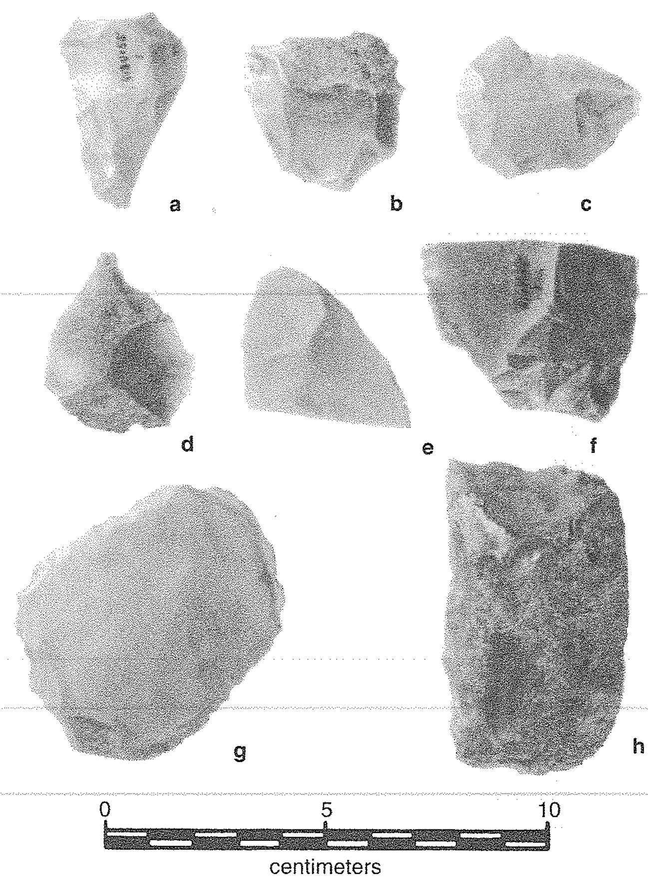


Figure 7. Unifaces.

from Tortuga Flat and on some finished tools; therefore, it is likely that materials were heated at an early stage of reduction.

Arrow Points

Twenty-one arrow points and fragments thereof were recovered from the site (Table 2). Seven are examples of the Perdiz type (Figure 5a-d, f-h), and they are made from light gray, tan, and cream cherts; one is made on a flake (Figure 5h). The Cuney point has finely serrated lateral edges (Figure 5e). Several of the arrow points have a pink cast resulting from thermal alteration (Figure 5b, h, j, l-m). There are 13 corner-notched Scallorn points (Figure 5i-u). Several have heat induced-pot lid fractures (Figure 5m-q).

Unifaces

Twenty-three unifacial tools were recovered from the site (Table 3 and Figures 6 and 7; see also Figure 9c). The unifaces range

Table 1. Lithic artifact distributions

	Test Pit							Feature			Refuse
Artifact Type	I	II	III	IV	V	VI	VII	1	2	3	Area
Perdiz	2	1		2					1	1	
Scallorn	1	3	1	3				1	2		2
Cuney				1							
Unifaces	3	2	1	7	2			2	1		5
Bifaces	5	1	1	5				1	3		3
Preforms	1	3		7				1			2
Blades		1		7	2			1			
Bifaces (lg. choppers)			1	1							1
Groundstone				1				1	1		
Hammerstones			1	3			1	2	3		
Cores (& core fragments)	3	2	2	6		1	3	1			4
Pottery sherds								45	30	7	
Primary cortex flakes	23	17	17	28	7	5	5	4	7		24
Secondary cortex flakes	63	110	73	110	3	31	11		9		59
Interior flakes	300	480	180	603	7	13	16	23	25		233
Biface thinning flakes	55	101	53	29		4	6	2			47
Cores (& core fragments)	2	3	2	6		1	3	1			4
Total	458	724	332	819	21	55	45	85	82	8	384

Table 2. Measurements of arrow points

Type	L	W	T	SL	SW	Wt.	Figure
Perdiz	–	20.0	2.9	–	0.5	1.5	5a
Perdiz	23.9	–	1.9	0.9	0.3	0.4	5b
Perdiz	–	21.6	3.0	–	0.7	1.1	5c
Perdiz	–	21.9	3.0	0.9	1.0	1.5	5d
Perdiz	–	13.3	3.0	–	–	0.7	5f
Perdiz	–	13.2	3.6	–	–	0.6	5g
Perdiz	–	16.0	2.0	–	–	0.3	5h
Cuney	–	–	3.5	0.5	0.7	1.2	5e
Scallorn	20.0	15.0	3.0	0.6	–	1.0	5i
Scallorn	29.6	19.4	3.0	0.5	–	1.6	5j
Scallorn	–	15.0	3.4	–	–	1.0	5k
Scallorn	24.1	19.0	4.7	0.6	–	1.6	5l
Scallorn	–	–	3.6	0.7	15.4	1.0	5m
Scallorn	30.0	17.0	3.1	–	–	1.2	5n
Scallorn	–	–	2.5	–	–	0.7	5o
Scallorn	–	–	2.7	–	–	0.5	5p
Scallorn	–	–	2.8	–	–	0.4	5q
Scallorn	32.2	14.5	3.6	0.6	13.0	1.4	5r
Scallorn	32.8	–	4.3	0.5	–	1.8	5s
Scallorn	29.2	–	4.4	–	–	1.9	5t
Scallorn	26.8	–	3.6	0.6	–	1.5	5u

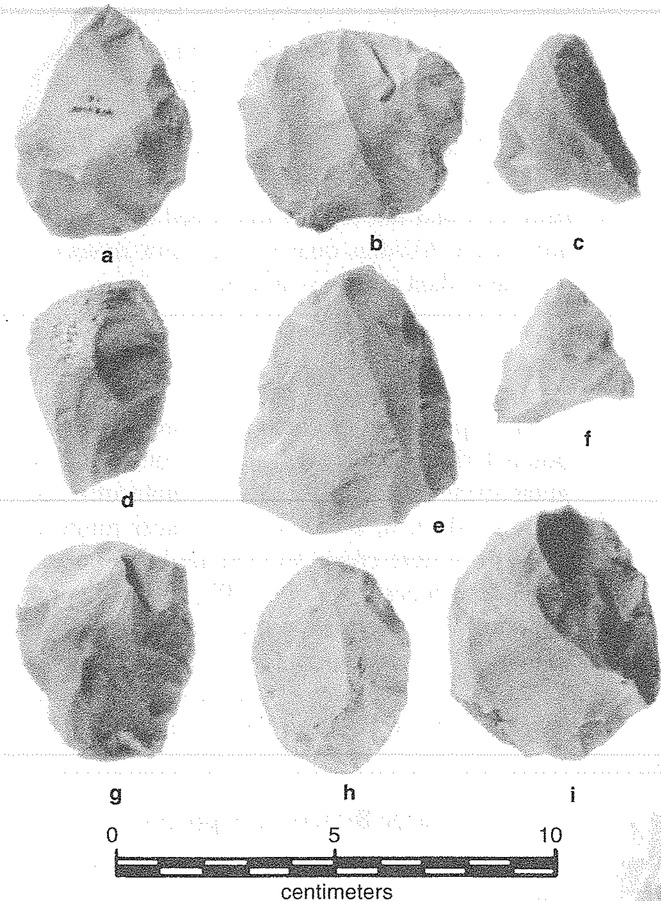


Figure 8. Bifaces.

(Michael B. Collins, 1997 personal communication). It is therefore likely that this tool was a trade item from Central Texas.

Functionally, beveled knives have been linked to bison processing, and spatially they are a diagnostic of the Late Prehistoric of South and Central Texas, part of the Toyah horizon toolkit (Black 1989). These beveled bifaces were efficient tools for processing large game because their design permits any and all edges to be used in skinning regardless of how the tool is held (Sollberger 1971). Experiments by Sollberger (1971) with beveling of the edges of bifaces compared to bifacial resharpening revealed a dramatic increase in the use life of these tools. Other works have provided interesting details about these beveled bifaces. For example, research at 41LK67 (Brown et al. 1982) found that bifaces with two beveled edges, rather than four, are more commonly found at South Texas sites. Brown's analysis

oval in shape, and is heavily patinated on the dorsal surface (Figure 8h).

There is a bipointed biface (beveled biface form) in the collection with a broken area on one edge of the proximal end (Figure 9b). It is made from dark gray chert and is beveled on two opposite lateral edges. This tool and one other, a uniface fragment (see Figure 7f), are the only lithics from the site that are not tan or light gray in color. The dark gray fine-grained chert is similar to the distinctive Georgetown chert from Central Texas. Examination of the material through the use of ultraviolet fluorescence (both long wave and short-wave) was conducted by Dr. Michael B. Collins of the Texas Archeological Research Laboratory. The methodology uses comparative Edwards chert samples (see Hofman et al. 1991). Collins' findings indicate that although the material appears atypical of Edwards chert, it does fluoresce, and the color it exhibits is within the range (orange-yellow-gold) of other samples tested from the Edwards formation

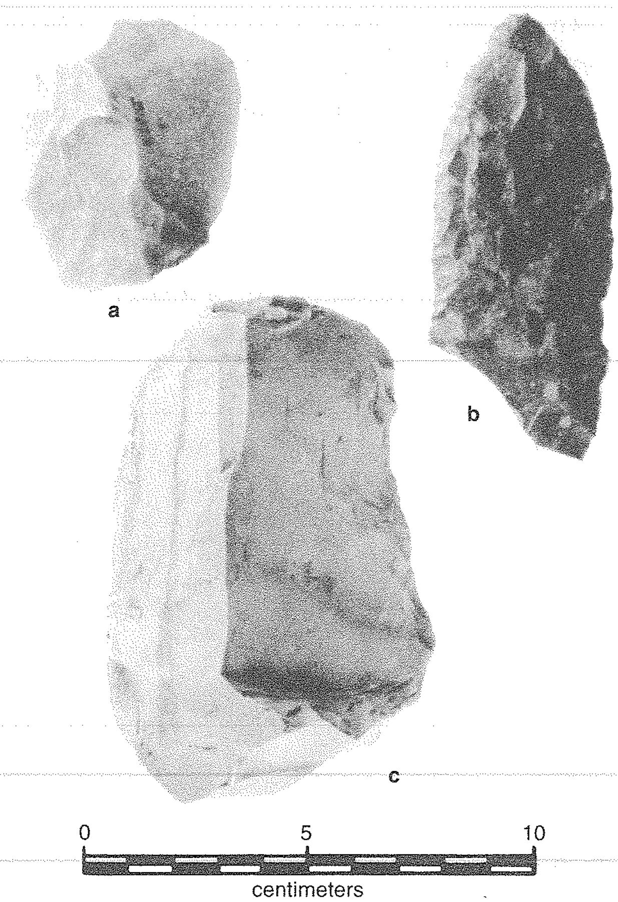


Figure 9. Bifaces and uniface; a, biface; b, beveled biface; c, heavy uniface.

Table 3. Measurements of unifaces

L	W	T	Bit Edge	Wt.	Figure
39.9	38.4	16.9	50°	28.4	6a
64.5	36.9	13.6	50°	27.9	6b
40.2	27.4	8.2	45°	9.4	6c
29.0	39.7	11.0	40°	12.7	6d
52.1	46.2	11.1	48°	33.7	6e
44.7	28.3	8.8	48°	13.0	6f
43.3	46.0	12.1	48°	27.0	6g
44.1	32.9	12.6	45°	28.2	6h
43.3	27.4	7.6	–	10.7	7a
34.9	35.0	9.1	–	13.0	7b
41.5	33.4	7.4	–	9.7	7c
41.0	33.8	8.7	–	9.0	7d
46.9	31.6	6.8	–	8.1	7e
39.8	48.4	12.2	–	30.1	7f
64.0	49.1	15.2	–	60.6	7g
69.7	41.0	19.9	55°	76.7	7h
107.5	71.6	30.0	70°	266.3	9c

Table 4. Measurements of Bifaces

L	W	T	Wt.	Figure
51.9	38.5	1.59	29.8	8a
49.6	45.5	11.3	28.8	8b
36.5	32.1	9.1	10.7	8c
41.5	31.4	13.9	22.5	8d
58.0	48.6	14.8	43.3	8e
28.7	31.5	6.8	7.3	8f
49.8	39.4	12.7	29.0	8g
49.1	35.4	11.5	21.5	8h
54.8	53.6	17.2	49.3	8i
61.4	46.5	15.7	45.8	9a
96.7	38.3	7.6	38.1	9b

also suggests that beveling may increase edge angles to allow for heavy-duty cutting, and minimizes width reduction due to resharpening. Another study of beveled knives (quadrilateral) from Sanford Reservoir in the Texas Panhandle (Shoberg n.d.) indicates that these tools were reworked and not readily discarded even in the area of the Alibates quarry where raw materials were abundant and close at hand.

Preforms

Two preforms specimens (Figure 10a-b) are pointed triangular forms (Table 5); four are triangular forms (Figure 10f-g, i-j), and eight are ovate (Figure 10c-e, h, k-n). The 14 bifaces range in color from light cream to medium brown chert. Three specimens (see Figure 10b, i-j) have a pink hue resulting from heat treating and three others exhibit a vitreous sheen. One of the preforms is made on a blade but is bifacially chipped and may be an arrow point preform (see Figure 10n).

Large Bifaces (Choppers)

The term "chopper" is often applied to cobbles or large pieces of stone with a few flakes removed from one end (Turner and Hester 1993). Two specimens from Tortuga Flat are included in this category (Figure 11 and Table 6). One is a chert cobble that has been bifaced (Figure 11a). Two large flakes have been removed at one end on the ventral surface. The other is made from chalcedony. The dorsal surface has the majority of cortex remaining (Figure 11b).

It should be noted that these specimens could also be classified as cores. Cobbles were sometimes "tested" by removing one or two flakes (Hester 1975b:Figure 2e). This can result in a bifaced cobble that may subsequently have been used for cutting tasks. An examination for use-wear revealed none on one specimen, while the other (see Figure 11b) has slight dulling on the flaked end. Whether this is the result of abrading to establish a better striking platform or actual use-wear is unclear.

Cores

Three prepared cores and 19 core fragments were present at the site (Figure 12). Several of

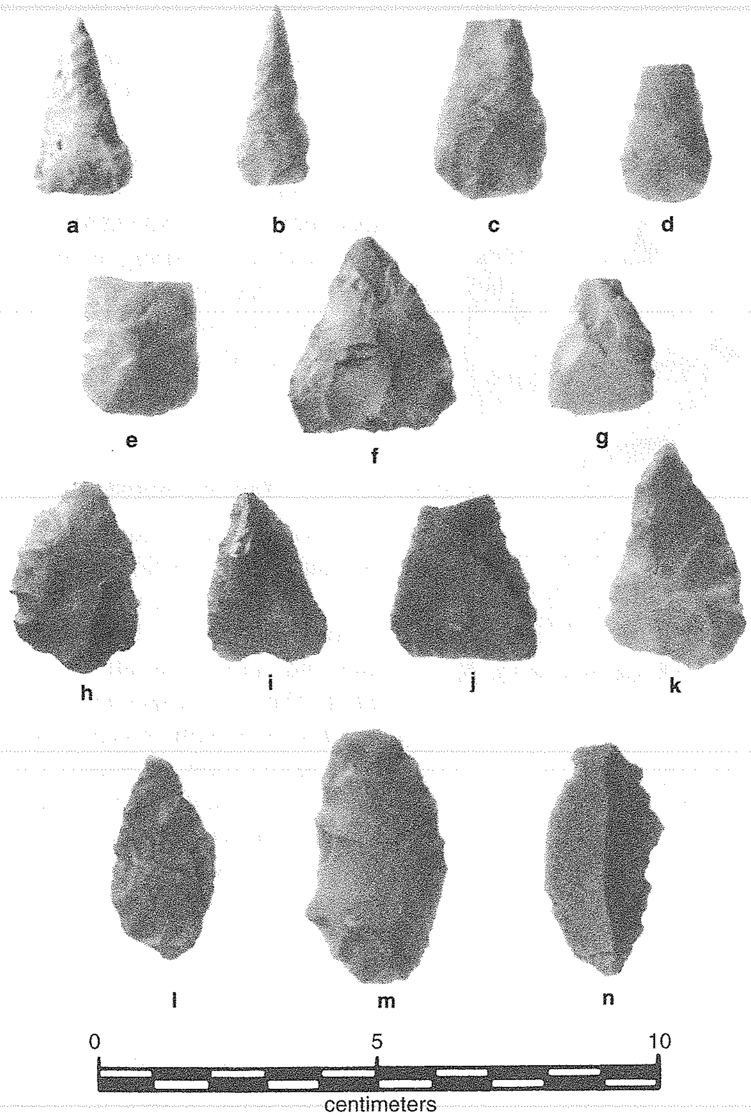


Figure 10. Preforms.

the fragments are expended cores. All cortex and numerous flakes have been removed from one of the cores (Figure 12a). It is light tan in color and has several, small, quartz inclusions on the ventral surface and one on the dorsal surface. Reduction of this core may have ceased as the inclusions made the material undesirable for tool manufacture. Flakes have been removed from five areas of another core (Figure 12b). The core illustrated in Figure 12c has a glassy sheen, areas of pink coloration from heat treating, and is made from a light gray, fine-grained chert. This specimen resembles an expended Toyah Horizon blade core (Turner and Hester 1993:Figure 2-20; Johnson 1994:Figure 94). Blade-core technology (Hester and Shafer 1975; Turner and Hester 1993) may have been an efficient use of small cobbles in the manufacture of Perdiz points and end scrapers that are characteristic of the Toyah Horizon in Central and South Texas (as well as the contemporary Rockport Horizon).

Debitage

All flakes from each test pit and the refuse area (see Table 1) were collected, analyzed, and sorted into categories which reflect the technological processes carried out in tool manufacture. Primary cortex flakes have the dorsal surface covered with cortex; they represent the initial decortification of a core. Further shaping of both cores and preforms is represented by flakes with dorsal surfaces retaining some cortex, but showing one or more previous flake removals (secondary cortex flakes). In general, secondary cortex flakes retain some cortex on the dorsal surface, representing further reduction of a core. Interior flakes have no cortex on the dorsal surface, indicating further reduction from the interior of a core or a larger biface. Biface thinning flakes are distinctive small flakes resulting from the soft hammer technique of biface reduction (Hester 1975b).

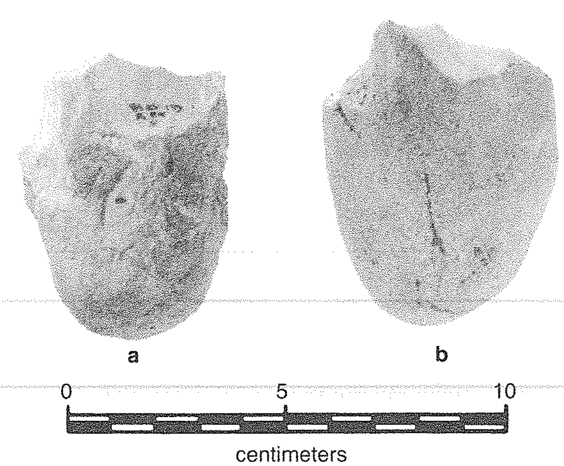


Figure 11. Large Bifaces (Choppers).

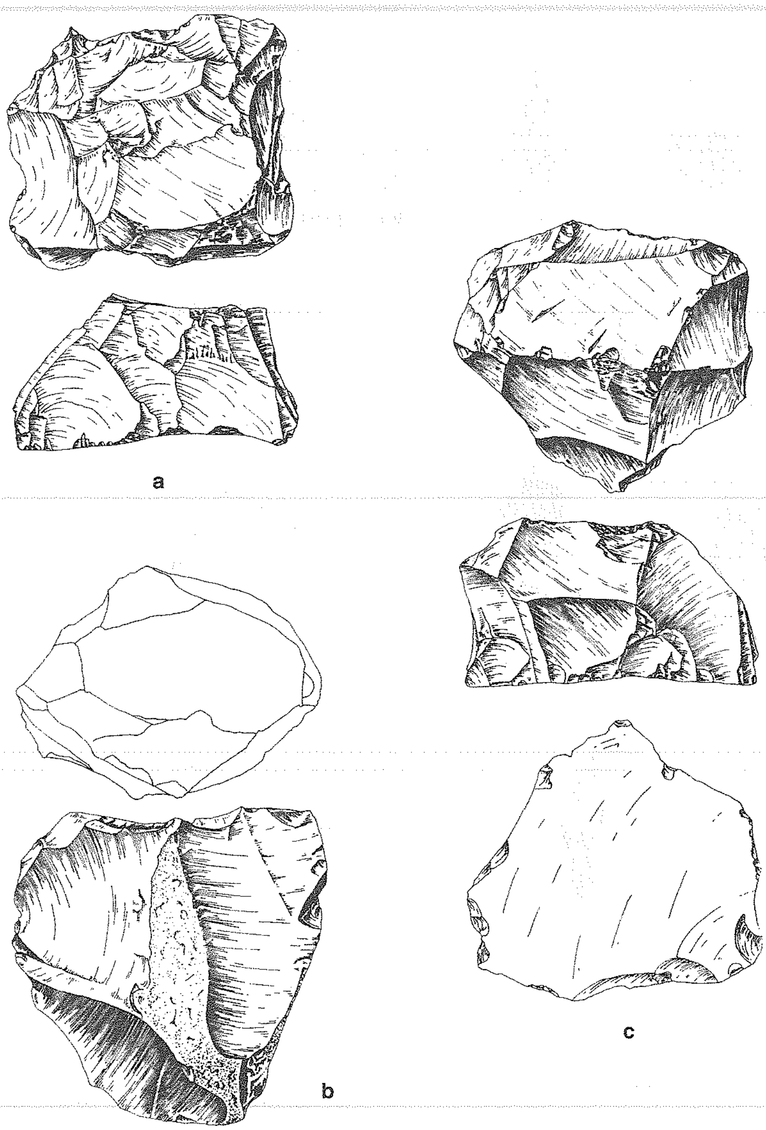


Figure 12. Cores. Drawings by Pam Headrick.

Raw materials were obtained in cobble form from terrace exposures near the site. A variety of multicolored fine and coarse-grained cherts (Uvalde gravels) are present in the debitage. There is evidence of heat treating on some flakes and a number of flakes are fire-cracked.

Ground Stone

Ground stone artifacts from the site include a dense sandstone mano (Figure 13a) with extensive battering on both ends and large damaged areas on one side and both ends. A metate fragment (Figure 13b) of dense sandstone was a surface find from Feature 1. The stone is flat with a smoothed area in the center exhibiting very fine scratches on the dorsal surface. Both lateral edges show use-wear in the form of smoothing. A third groundstone specimen is a quartzite mano with brownish/red coloring near the center of the dorsal side (probably burned) and moderate battering or grinding damage on both ends.

Hammerstones

Two hammerstones were present in the collections from the site. One specimen is purple quartzite with heavy battering on one end and moderate on the other. The second specimen is of tan quartzite with moderate use wear in the form of battering or grinding on one end. In addition, three hammerstone fragments were recovered from test unit IV and two were surface finds from Feature 1.

Microwear Analysis of Lithic Artifacts

Microwear analysis was conducted on a selected number of chipped stone artifacts. Equipment used for photomicroscopy was the Leica Wild M100 microscope, Optronics DEI-470 video camera, and HP Laser Jet 4 printer. In some instances, Nomarski DIC (Differential Interference Contrast prisms) were used to enhance the view of tool topography. In these cases, notations have been made.

All chipped stone tools (n=69) from the site (excluding arrow points and debitage) were subjected to macroscopic examination for obvious use-wear indicators: polish, striations, or edge damage (micro-flaking, rounding, or crushing). Of this total, 28 specimens, exhibiting some of the above characteristics, were selected for microscopic study (range of 10X-40X power). This examination resulted in the selection of 18 tools (eight unifaces

Table 5. Measurements of Preforms

L	W	T	Wt.	Figure
32.5	17.9	5.0	2.5	10a
32.5	12.9	3.2	1.1	10b
–	19.5	4.2	3.0	10c
–	16.0	4.8	2.0	10d
–	20.9	6.9	4.5	10e
34.4	28.2	6.8	7.1	10f
–	18.6	6.4	3.1	10g
34.5	21.3	5.6	4.4	10h
31.1	20.7	7.5	4.4	10i
–	25.6	4.4	3.9	10j
39.4	24.2	7.9	7.4	10k
36.8	18.1	4.8	3.3	10l
45.5	23.8	7.2	9.0	10m
41.4	20.9	5.0	4.1	10n

Table 6. Measurements of Large Bifaces (Choppers)

L	W	T	Wt.	Figure
63.6	47.8	33.3	159.6	11a
65.6	57.6	36.8	103.8	11b

and 10 bifaces) for high magnification microscopy. Of this total, three tools exhibited some form of identifiable use-wear. In general, use-wear polish was identified. Use-wear polish is produced by the gradual loss of superficial materials and the wearing down and smoothing of those surfaces (Vaughan 1985).

One specimen (see Figure 6a) is a small uniface which may have functioned as an end scraper. The proximal end is broken (snap fracture) and the ventral surface has a large flake scar that may have resulted from use. The polish on this tool is located on the dorsal surface near the center of the bit end (Figure 14a). The distal end of the tool was examined under high magnification and was photographed at 200X. Based on replicative experiments by Vaughan (1985:28), the polish appears to be what he terms a "weakly developed polish." This type of polish is characterized by an uneven patchy distribution usually very close to the work edge and can be associated with the processing of meat or fresh hide.

The second worn tool specimen 9b is the beveled biface (see Figure 9b). Striations in a triangular pattern were detected on the ventral side of the tool near the bit end (see Figure 14b). The striations are likely indicators of use of the tool as a knife. A replicative study by Kay (1996) on tools used for butchering yielded a similar triangular pattern that he describes as "striated micropolishes." Another image from this same tool (see Figure 14c), taken on the ventral lateral edge near the proximal end of the tool, revealed polish. The polish appears similar to one defined by Vaughan (1985:123) as bone residue resulting from butchering. Both images were taken at 200X using Nomarski Optics.

A uniface (end scraper) (see Figure 6f), examined at 200X power, exhibited generic polish

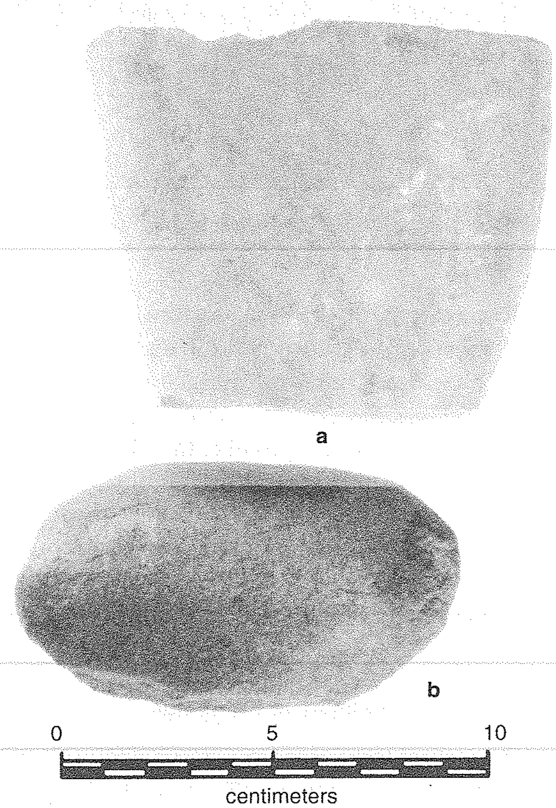


Figure 13. Ground Stone: a, metate fragment; b, mano.

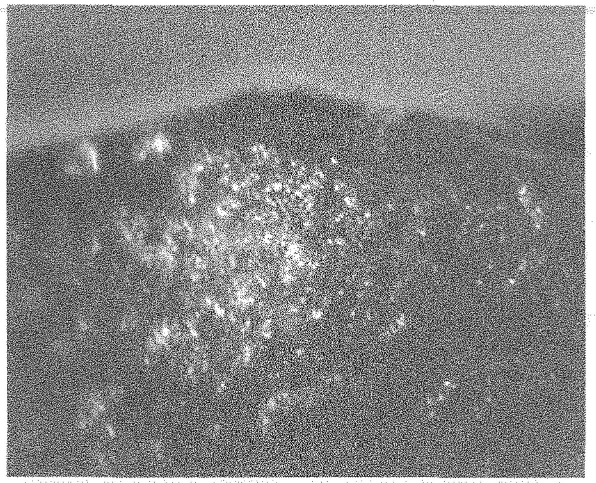


Figure 14a. Uniface (Specimen 6a).

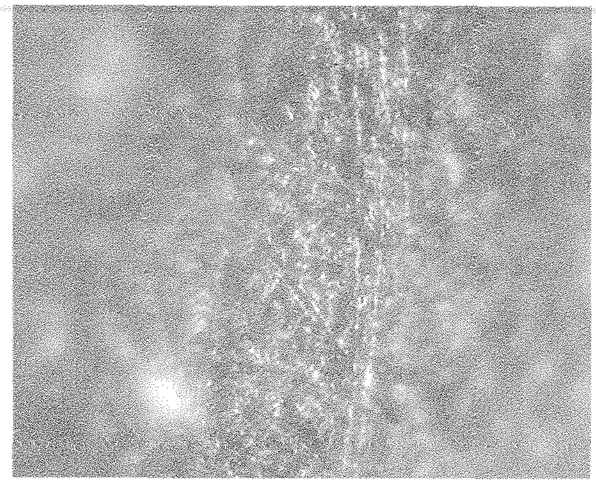


Figure 14b. Beveled Biface (Specimen 9b).

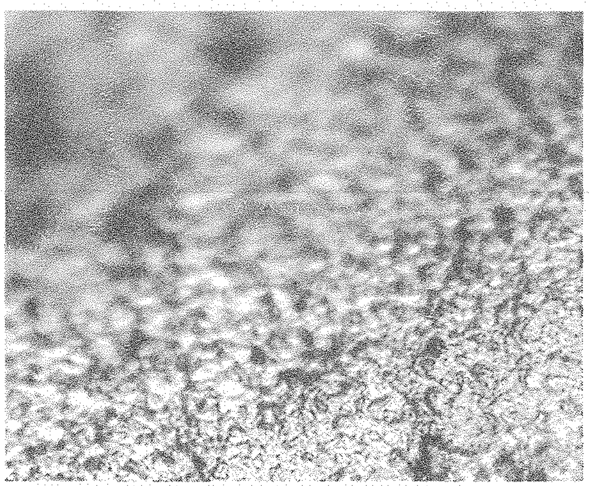


Figure 14c. Beveled Biface (Specimen 9b).

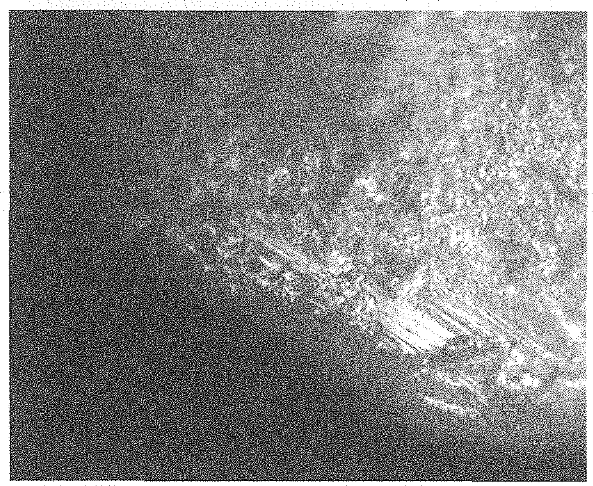


Figure 14d. Uniface (Specimen 6f).

near the bit end of the tool (ventral surface) and striations at the edge of the tool (see Figure 14d). These characteristics are similar to Vaughan's (1985:127) description of a smooth type grit polish with some grooves. It is possible that the polish can be attributed to the processing of hides and the striations caused by grit on the surface being worked (removing hair from a hide with embedded soil or sand). Nomarski optics were used for increased resolution of the digital image.

Prehistoric Ceramics

In general, ceramics from South Texas closely resemble the bone-tempered Leon Plain type of Central Texas. However, sandy-paste sherds are known from 41DM70 in the southern Texas interior and a grog-tempered jar was recovered from the Berclair site in Goliad County (Hester and Parker 1970).

Work by Hester and Hill (1975) indicated that bone-tempered plainware pottery occurred at many Late Prehistoric sites in South Texas, especially along the middle Nueces River drainage area (Calhoun 1966; Hester 1975a). Ceramic vessels were formed by coiling and the method of firing was oxidization. Decoration of exterior surfaces with incised lines or painted red bands has been noted but is very rare. Exterior surfaces are generally well-smoothed and burnished. Interiors are poorly finished and sometimes striated; coil junctures are often visible (Hester and Hill 1975). This has been interpreted to be from the use of a bundle of grass or a stick used in smoothing. Experiments by Hill (1975) indicate that smoothing with the fingers can also cause striations as sand grains or other particles are picked up and dragged across the surface during smoothing. Some sherds appear to have a red slip on the exterior. The paste is generally compact and contains finely crushed bone fragments. Vessel shapes are poorly known; however, two ollas have been recorded from the Scarborough Farm site (41KA1) in Karnes County (Calhoun 1966; Hester 1980). In other parts of Texas, vessels were sometimes small, round-bottomed bowls or jars. One flat-bottomed vessel, however, has been observed in a private Dimmit County collection. Attachments on the vessels consist of lugs and loop handles (Hester and Hill 1975).

More recently, Black (1986) analyzed sherds from the Hinojosa site. The site contained a total of 711 sherds, although the majority of the sherds were small and in poor condition. From Black's study of a sample of 100 of the better-preserved sherds, he determined that the ceramics could be strongly identified with the bone-tempered ceramics from other southern Texas sites. Sherds had a silty paste or a sandy paste. The silty paste sherds were slightly less numerous than the sandy paste sherds and had moderate to profuse quantities of bone inclusions. Sandy paste sherds had only sparse to moderate bone quantities. Some sherds had asphaltum and fugitive red decorations indicating contact with coastal groups. Black concluded that the inland ceramic tradition and the coastal tradition shared many attributes, suggesting a common origin. He theorized that the differences were technological, not cultural, and related to the variation in available raw materials. Black indicates this would also account for differences in vessel forms due to the unique characteristics of different pastes.

In other areas of South Texas, nearer to the coast, bone-tempered pottery has been dated earlier than A.D. 1000 at several Choke Canyon sites in Live Oak county (Hall et al. 1982). Ceramics from 41LK201 at Choke Canyon (Highley 1986) were analyzed by Black. No whole vessels were found, but rim sherds that probably represent bowl or jar fragments (possible ollas) and pipe bowl fragments were recovered. In general, the sherds were highly burnished, with fugitive red film and bone-temper. Most sherds have a similar sandy paste, suggesting a common clay source, and some have traces of asphaltum.

The Loma Sandia site (41LK28) yielded a total of 22 pottery sherds. Analysis indicates that the ceramics had a uniform sandy matrix with moderate quantities of crushed bone. All the sherds appear to be fragments from a single vessel of undetermined form (Black 1995).

Methodology

Pottery sherds from Tortuga Flat were examined macroscopically and microscopically to determine constituents, aplastics, method of firing, and to look for evidence of degradation through the natural processes of erosion, deposition, and chemical weathering. The firing of experimental tiles was conducted for comparative purposes. Sherds were sorted according to size. Those smaller than 2 mm were excluded from the sample under the premise that little information could be extracted from small specimens. From the total of 82 sherds from the site, 27 sherds were selected for microscopic examination.

The sherds were examined using a binocular microscope at 10X power. The exterior, interior, and cross-section of each sherd was examined microscopically. Sherds were broken to expose the cross section of the core for detection of carbon streaks, to determine the firing method, or to detect evidence of a slip. Cross-section examination also included the clay matrix to determine the constituents and percentage of aplastic temper present.

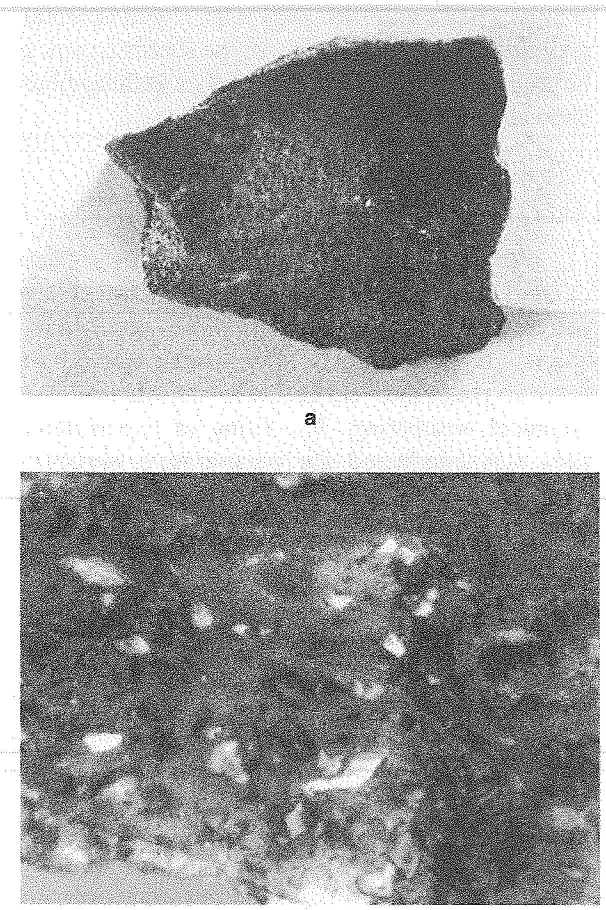
Photo-micrographs were taken on a select sample of sherds to show bone temper and carbon streak (Figures 15 and 16). The scale for photo-micrographs is in cm and cross-section views are at 12.8X power.

Ceramic Data

The conditions of the sherds range from relatively well-preserved to highly eroded. Attempts to determine vessel form have not been made due to the small size of the sherds. The sherds range in thickness from 5.3-6.4 mm.

Exterior surface: 41 percent (n=11) are light tan/beige in color (Munsell 7.5YR8/2); 59 percent (N=16) are medium tan (Munsell 5YR6/3).

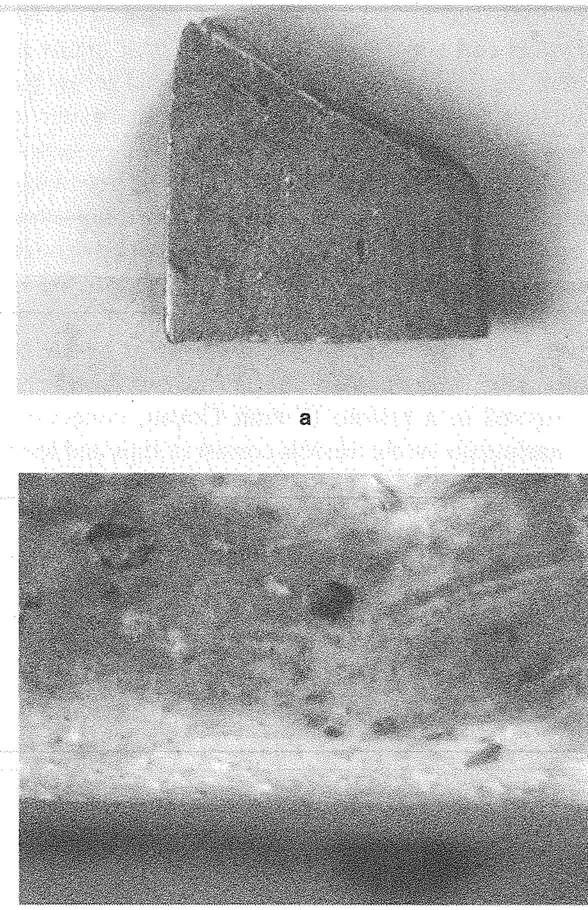
Interior Surface: Of the sherds, 36 percent are light tan in color (Munsell 7.5YR8/2); 10 have bone tempering visible at the



a

b

Figure 15. a, Digital image of sherd with slight burnishing; b, Sherd cross-section at 12.8X power.



a

b

Figure 16. a, Digital image of sherd with use-wear; b. Sherd cross-section at 12.8X power.

macroscopic level. One sherd has a dark gray interior, possibly due to smudging, but more probably due to burning.

The paste consists of a fine-grained silty matrix with moderate amounts of crushed bone (range from 3-5 percent). Bone fragments range from 0.1 to 1.0 mm in size. Other than the bone temper, no paste inclusions were observed.

Examination of sherd cores reveals a definite carbon streak present in 33 percent (n=9); a faint carbon streak visible in 15 percent (n=4); no carbon streak detected in 44 percent (n=12); and two sherds exhibited possible post-firing heat damage as evidenced by the uniformly dark gray color throughout the specimens.

All sherds from the site are body sherds with two exceptions: a possible node for a lug attachment and a vessel base or foot fragment.

Traces of a red slip appear on the interiors of two sherds and on the exteriors of three others. Remnants of a substance resembling asphaltum or pine pitch appear on the interiors of two sherds. Approximately 25 percent of the sherds are moderately to highly eroded. One sherd has a moderately burnished exterior, and one has a wet brushed interior. Five sherds from this site have use-wear in the form of smoothed, beveled edges. One of these exhibits striations on each edge of the exterior.

Experimental Data

Test tiles were fired and analyzed to obtain technological and firing data on the Tortuga Flat sherds. Temper in the form of sand, crushed bone fragments, mussel shell fragments, and marine shell fragments was added to test tiles for comparison with sherds from the site. The tiles were fired at 1280° F, then broken, and examined microscopically.

The experimental work with test tiles allowed for the comparison of paste with sand inclusions to the silty paste of sherds from the Tortuga Flat site. Upon microscopic examination, the distinction between the sand grains in the test tiles and the smoother, silty paste of the sherds from the site was evident. Examination of the bone temper from the test tiles showed that the bone fragments were more chalky and less translucent than those seen in the sherds from the site. A possible explanation is that the bone used in the sherds from Tortuga Flat had been burned prior to being ground for use as temper. Burned bone sometimes appears shiny and has a blue cast. Experiments by Hill (1975) indicate that burned bone is easier to pulverize for use as temper. The bone selected for the test tiles had been leached from exposure to the elements and had a chalky appearance. Other possibilities to be considered include repeated firings, whether intentional or accidental. Hill's experiments (1975) found that cooking oils caused the core of pottery to darken from absorption of oil. It is possible that oils from cooking were also absorbed by the bone fragments, resulting in their shiny appearance under microscopic examination. This experiment also made clear the difference between bone temper and shell (fresh water mussel and marine) temper under microscopic examination. The cancellous (spongy) structure of the bone was readily distinguished from the shiny appearance of the mussel shell inclusions and the chalky appearance of the marine shell fragments.

Conclusions of the Ceramic Analysis

The method of ceramic vessel manufacture appears to have been by coil and scrape as evidenced by the grooves or striations on the interior of several sherds. These markings are probably the result of poorly bonded coils and are remnants of joints after smoothing of the coils had been attempted (possibly through the use of a wooden tool, a smooth stone, or sherd edge). Hill (1975) believes these interior striations may have resulted from the use of a bundle of grass or a stick used in smoothing the coils.

The visible carbon streaks (the result of incomplete oxidation of the carbon in the clay) on the cores of some sherds indicate a non-kiln, open firing. Additionally, the presence of fire clouds on two sherds and the light color of the sherds in general supports the premise of an open firing with characteristic uneven temperatures. Possible smudging of vessel interiors could be inferred from only two sherds. These sherds, however, were uniformly dark gray in color throughout so it is more likely that they incurred post-manufacture fire damage.

The bone-tempered ceramics from the Tortuga Flat site are very similar to those from other South Texas sites as described by Hester and Hill (1975). The traces of red slip, possibly red ocher, need further analysis to determine if this is the agent responsible for the red coloring of some sherds.

Perhaps further study (use-wear experiments) of the five sherds that have obvious modifications could give new insight into their function. It is possible they were used for smoothing vessels during manufacture; however, other uses unrelated to pottery making should be considered.

RADIOCARBON DATES

Charcoal for radiocarbon dating was collected by Hill, packed in aluminum foil pouches, and sealed in polyethylene bags. The samples were submitted to the Radiocarbon Laboratory at the University of Texas at Austin where they were processed under the direction of Salvatore Valastro.

The results of two radiocarbon assays are provided below. The calibrations are based on Methods A and B in Stuiver and Reimer (1993) and Stuiver and Pearson (1993):

Sample Tx-1514 170 ± 60 B.P.
(uncorrected)

Method A calibrated age ranges at 1 sigma for Tx-1514 are AD 1663-1822, 1833-1882, and 1912-1954; at two sigma the calibrated age range is AD 1644-1955* (* indicates post-atomic bomb contamination). Method B calibrated ages at 1 sigma are AD 1666-1703 (0.20 under the probability distribution), 1717-1819 (0.57), 1856-1861 (0.02), and 1917-1955* (0.21). At two sigma, the calibrated age ranges are AD 1658-1893 (0.82) and 1905-1955 (0.18).

Sample Tx-1515 410 ± 40 B.P.
(uncorrected)

Method A calibrated age ranges at one sigma for Tx-1515 are AD 1443-1488 and 1609-1611; at two sigma the calibrated age ranges are AD 1432-

1525 and 1558-1631. Method B calibrated ages at one sigma are AD 1441-1510 (0.86 under the probability distribution) and 1601-1615 (0.14). At two sigma, the calibrated age ranges are AD 1432-1526 (0.70) and 1556-1632 (0.30).

Radiocarbon sample Tx-1514 was a composite sample from test unit I (depth of 0-15 cm). It is likely that the sample was contaminated with charcoal of more recent age that was not related to the aboriginal occupation of the site. The late date of this sample, and the absence of artifacts of Spanish origin at the site, support this premise. Sample Tx-1515 was collected from the refuse area and was probably less subject to contamination than the previous sample.

FAUNAL REMAINS

The faunal remains (Table 7) were analyzed by Billy Davidson of Austin, Texas. The majority of bone fragments were recovered from the refuse area; however, small amounts of bone were present in all test units.

A variety of animals served as food sources for the native peoples. The major large game animals were pronghorn and deer; bison played a minor role in the diet. This pattern is found at several other sites in the study area. The large number of smaller mammals (rabbits and rodents) present at Tortuga Flat attests to their importance in the natives' diet. Most of the fauna could have been obtained by hunters and foragers in the immediate site area (Hester and Hill 1975).

Other materials recovered from the site include land and aquatic gastropods (*Rabdotus, Polygyra*, and *Helisoma*) and highly fragmented mussel shell fragments (*Unio proptera purpurata*). Fire-cracked stones, baked lumps of clay, and charcoal were also present (Hill and Hester 1973).

DISCUSSION

During the 15th and 16th centuries (based on the radiocarbon dates and the arrow points), the peoples who at times inhabited Tortuga Flat made their living by hunting a variety of animals and by gathering and processing plant foods. Seeds, nuts, aquatic resources (freshwater mussel, fish), reptiles, rodents, and land snails were part of their diverse diet. It is likely that small, mobile groups were living at Tortuga Flat for certain times during the year, returning periodically to harvest seasonal plant foods and to hunt. Summer attraction to the area may have been the abundant tunas of the prickly pear cactus and mesquite beans. In the fall of the year, many small groups may have convened for the harvesting of pecans and acorns.

Bison bone was present at the site; a minimum of three individuals were represented in the faunal materials. Other large animals (deer and pronghorn) were also food sources. The faunal assemblage included large numbers of rabbits and rodents attesting to their importance in the native diet. Information from Espinosa's diary (Campbell n.d.) about mice hunting by native residents (Pacuaches) can be used as an additional line of evidence in this regard. Perhaps specialized wooden tools (clubs, throwing sticks, or rabbit sticks) were used for this aspect of food procurement. If these tools were used at Tortuga Flat, they were not preserved in the archeological record, although examples have been recovered from the Lower Pecos.

The native peoples living at Tortuga Flat manufactured and maintained stone tools of various types and used pottery (probably made from local clays, based on experiments by the senior author). Local chert from the uplands was heat-treated and used for lithic manufacturing. The hunters at Tortuga Flat used the bow and arrow with predominately Scallorn and Perdiz points (one Cuney arrow point was also recovered from the site). Other lithic forms present include bifacial and unifacial tools, preforms, hammerstones, and ground stone implements. These reflect the various food procurement, processing, and domestic activities taking place at the site. Use-wear study indicates that unifacial and bifacial tools were used for meat and hide processing. Manos and metate fragments from the site substantiate the importance of plant foods in the native diet that are mentioned in historic accounts.

From the Late Prehistoric/Protohistoric perspective, the apparent contemporaneity of Scallorn and Perdiz points from Tortuga Flat is in contrast to Central Texas where Scallorn points appear earlier in the Late Prehistoric than do Perdiz points. In addition, the lithic artifacts from Tortuga Flat cannot be considered wholly compatible with those of the Toyah horizon as it appears there is more variability in the assemblage at Tortuga Flat. Perhaps this reflects a later southward diffusion of selected artifacts of Plains technology (the Toyah horizon), and specifically adapted for bison hunting

Table 7. Number of Identified Faunal Specimens.

	Test Pit								Refuse
Common Name	I	IA	II	III	IV	V	VI	VII	Area
bison						1		1	1
antelope		1		1		1			3
cf. antelope									2
whitetail deer	3	1	2	1	2	2	2	1	9
coyote	1								2
jackrabbit	1		1			1			3
cottontail rabbit	1		1	1	3	2		1	5
pocket gopher									2
gopher									1
packrat			1		1			1	6
cotton rat									13
white-footed mouse							1		1
raccoon									1
gray fox					1		1		1
box turtle				1					2
bull snake									1
rat snake									1
fish (species?)									5
mockingbird									1
duck									1
rabbits (species?)									2
deer, antelope (sp.?)									several
horned toad					1				
hog-nosed skunk				1					
ground squirrel					1				
turtle (species?)									1

the same natural deposit. Also, the mix of arrow point types is found in several test units within the site (see Table 1).

Although a mix of arrow point types is not typically found at single component sites in Central Texas, several South Texas sites have yielded such a variety. The Pampopa-Talon Crossings site (Thoms and Ahr 1995) yielded Guerrero, Cuney, Perdiz, and Scallorn points in the upper 30 cm. The Skillet Mountain No. 4 site (41MC222) at Choke Canyon (Hall et al. 1986), contained only Late Prehistoric remains (with well preserved faunal materials) that appeared to be uncontaminated by debris from earlier periods of activity. Uncorrected radiocarbon dates ranged from A.D. 1247-1500 and diagnostic arrow points included Perdiz, Scallorn, and Edwards.

From Victoria County, test excavations in 1995 (Walter 1997) at 41VT11 (the third location of Mission Espiritu Santo) at a depth of 30 cm below the surface (bs) yielded Cuney, Guerrero, and Perdiz points from the aboriginal habitation area. Recent block excavations at the same site (Texas Archeological Society Field School, June 1997) recovered Guerrero points, a small dart point (Ensor-like), and a Perdiz point from 0-15 cm bs. Another block excavation, approximately 10 m to the south, excavated to a depth of 25 cm bs, had a Guerrero point, a beveled knife (possible Toyah horizon), and two drills.

In addition, work carried out in late summer 1997 at a Wilson County site (41WN88) yielded Perdiz, Scallorn, Cuney, and Guerrero arrow points. These appear to be contemporaneous in a discrete occupation zone just below the present ground surface (Brett Houk, 1997 personal communication).

The one Cuney arrow point from Tortuga Flat is a diagnostic of the Protohistoric and Historic eras. These points appear to have originated in East Texas and were reported by Hudgins (1986) at the Shanklin site (41WH8). Recently, a single Cuney

and processing. This may coincide with a change to a more mesic climate and the return of bison to the southernmost parts of Texas. If the Toyah horizon does not represent a change of technology but instead indicates a cultural migration, then perhaps these migrating peoples joined other groups (local residents or others migrating through the region) and this merger has been expressed in the archeological record as a combination toolkit.

Data on site stratigraphy, taken from field notes, argues against bioturbation (rodent burrowing) or pedogenic disturbance (root intrusions) as the cause of artifact mixing. The tendency of Tortugas Creek to over-bank flooding (witnessed in modern times), which would naturally separate components if they represent different ages, suggests that slow deposition was not the cause of arrow points of different ages being incorporated in point was reported by Walter (1997) at 41VT11, and a single arrow point resembling a Cuney was recovered from the excavation of La Salle's ship, *Belle,* in Matagorda Bay (Martin 1997). In addition, Cuney points occur with Perdiz points at a nearby Dimmit County site (41DM33) documented by Nunley and Hester (1966).

Contact or trade with Central Texas can be inferred by the presence of one large biface (a beveled form, probably used as a knife), made from Edwards chert, and one uniface fragment. The Cuney arrow point, an East Texas form, also provides evidence of contact through migrations, trade networks, or bison-hunting parties coming onto the coastal plain. Creel (1991) suggests that the occurrence of beveled knives and end scrapers in assemblages dating after about A.D. 1300 reflects the importance of bison hides in a widespread exchange network in the early historic period in the Southern Plains and adjacent areas. This trade network, reported by early Spanish explorers, continued into the historic period. The knives were believed to have been used to cut the hides during skinning, and the end scrapers were probably used to remove hair and to reduce hide thickness. Campbell's research (n.d.) on the Pacuache provides information on hide trading in the region of Tortuga Flat at the time of the Guerrero missions (beginning in 1700). An account from 1709 by Espinosa links the Pacuache to this trade at Mission San Juan Bautista, Coahuila. The following passage by Espinosa is excerpted from Campbell (n.d.): "They are much inclined to the chase, the men engaging in no other occupation. The women are trained to cure and tan the hides of buffalo and deer. These they curiously paint to trade to the Spaniards..."

The abundance of large end scrapers from the Pampopa-Talons Crossing site in Bexar county could be related to this important bison hide trade. While the faunal evidence from this site emphasizes deer processing, perhaps this indicates that bison hide processing was taking place at the site, but not bison butchering.

Approaching the site from the cultural-historical aspect, it appears that the diagnostic artifacts from Mission San Bernardo and San Juan Bautista at Guerrero, Coahuila (Hester 1977), have little in common with those from Tortuga Flat. In general, the dart points (which are Archaic in age, collected from local eroded sites and clearly "recycled" by the Mission Indians) and arrow points are crude and fragmentary. The exceptions are the Guerrero arrow points, a number of which are more finely-made. No beveled bifaces were found at the Guerrero missions. It is likely that Spanish metal knives were possibly being used, although in what numbers is not known. The large array of modified flakes from the mission lithic assemblages indicate that these informal, utilitarian tools were an important part of the toolkit. Two arrow points (one a fragmentary specimen) from excavations at the aboriginal habitation area north of San Bernardo somewhat resemble Perdiz arrow points.

It is also important to keep in mind Campbell's (1988) caution that, when considering the native groups of South Texas during the latter part of the 17th century, it should not be assumed that they fully represent the groups who lived there during the Late Prehistoric. It is likely that upheaval of aboriginal lifeways had probably already begun in South Texas at that time, and that movement of groups out of Mexico, and even the spread of Spanish diseases, may have already altered native populations.

Regarding the identification of specific cultural groups at Tortuga Flat, the Pacuache can be placed in the vicinity of the site in the late 17th and early 18th centuries and they are considered to be one of several native groups occupying the site or migrating through the area periodically. The cultural materials from Tortuga Flat can likely be attributed, in part, to this group. How this can be read in the archeological record is unclear because, at present, it is not possible to attribute an entire assemblage, nor to isolate specific artifact forms or styles, from the cultural remains at Tortuga Flat and link them to a particular native population. The lithic assemblages from the missions at Guerrero offer little insight into the problem. Study of these assemblages does, however, reveal that certain Late Prehistoric/Protohistoric tools were not part of the 18th century mission Indian lithic toolkit.

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Treachery and Tragedy in the Texas Wilderness: The Adventures of Jean L'Archeveque in Texas (A Member of La Salle's Colony)

Kathleen Gilmore

Jean l'Archeveque stood on the deck of the supply ship *L'Aimable*, regarding with apprehension the strange and dismal shore where he was going to land. Never had he seen anything like it. In the distance behind the flat sand beach he could see a few small rises. Patches of scrubby grass dotted the landscape; not a tree was in sight. Glancing up at the dull gray sky, he shivered when he felt the cold damp wind that whipped the waves high against the shore. He remembered that Minet, an engineer from the ship, on land the day before saw ice on some freshwater ponds (Weddle 1987). Despite this bleak and uninviting scene, Jean was glad to be landing after the long and wearying days of searching for the mouth of the Mississippi River with the great explorer Robert Cavelier de La Salle.

The day was February 20, 1685. Jean l'Archeveque was 13 years old (Records of Bibliotheque Municipal, Bayonne).[1] Perhaps he thought of his parents, Claude l'Archeveque and Maria d'Armana back in Bayonne, France. Day by day the ships of the La Salle enterprise, loaded with supplies and about 250 persons, had slowly made their way along the coast looking for the settlement La Salle had left at the mouth of the Mississippi River in 1682.

La Salle's dream was to include the entire Mississippi River valley in the French empire. This area he claimed for France based on his 1682 trip from Canada down the river to its mouth. But his dream could not become a reality without a permanent settlement. With the King's blessing and financial support, La Salle left La Rochelle, France, in July 1684, with four well-loaded ships and headed to the mouth of the Mississippi River to validate his claim. This is the story of Jean l'Archeveque, a member of that expedition, and his adventures in Texas before he was exiled to New Mexico.[2]

Bad luck stalked the venture from the beginning. After crossing the Atlantic Ocean, the fleet was headed for Petit Goave, a French colony on the southern coast of Santo Domingo, when the *Francois*, carrying most of the supplies for the colony, was captured by Spaniards off the northern coast of the island. The other supply ship *L'Aimable*, in which Jean was traveling, was the slowest of the three remaining ships. Another of the three was a small frigate, *La Belle*, a gift from the King of France to La Salle. The third ship was a man-of-war with orders to return to France as soon as the colony was established. After a two month stay, the three ships left Petit Goave on November 25, 1684 (Joutel 1962:30). The men were already on low rations; many were sick, some with diseases picked up during the stay at Petit Goave.

Jean joined the expedition with Pierre Duhaut, a volunteer merchant who, with his younger brother, Dominique, were from Jean's home town of Bayonne, France. The Duhaut brothers may have been his cousins.[3] These three were Basques, who characteristically are of medium height, have rather long faces, and prominent noses. Many Basques have darkish skins, but not as dark as their surrounding French and Spanish neighbors (Krogman 1952:632).

Jean watched as the sailors unloaded cargo, such as cannon, trunks, and heavy items, from *L'Aimable* to lighten her load so she could enter the shallow waters of the bay La Salle had mistaken for the mouth of the Mississippi River. The route to enter the bay was marked where the water was deepest between an island and a tongue of land stretching eastward.[4] La Salle was ashore with some of the men, and the little frigate *La Belle*, already inside the bay, was waiting for the bigger ship to enter. The warship *La Jolie* was anchored a few miles offshore.

Jean got into the loaded longboat headed toward shore where a camp had been made, but the boat sprung a leak and the passengers barely escaped with their lives. Shivering as he climbed on shore, Jean looked back and saw the supply ship with sails unfurled beginning its entrance into the bay. As he watched, the lumbering ship suddenly swayed off the marked course and almost immediately ran aground. Strenuous efforts to free the ship failed. How had this disaster happened? The route was plainly marked. The ship's captain, Aigron, and La Salle had quarreled because La Salle wanted the pilot of the *Belle* to help bring the ship into the bay, but Aigron insisted he needed no help. Later Jean learned that Aigron was accused of deliberately stranding the ship (see O'Donnell 1936:16, 24).

A cannon boomed, signaling that *L'Aimable* was fast aground. Emergency measures were immediately put into effect. First, the men were taken from the stranded ship, then the unloading began using the longboats from the *Jolie* and a canoe. The ship carried almost all the ammunition, utensils, tools, a mill, and other essentials for a settlement (Joutel 1962:51). All during the cold night, trip after trip was made from the listing ship to the shore (Weddle 1987:108). Chilled to the bone and exhausted from the hard work of extricating goods from the sinking ship, the men became less and less effective, although they were able to save flour, corn, some meat, and a good part of the wine and brandy.

Further bad luck befell them on February 23rd, when bad weather with rain and fog delayed their recovery efforts. In the night, the ship began to break apart, letting supplies float out into the water. When morning came, La Salle sent the men out to rescue what they could (Joutel 1962:53). On the 26th, good weather returned, and part of the powder, more cannon, food, and some of the merchandise could be saved. All recovered materials were piled together at the shore camp. The Frenchmen, fearing the local Indians, who, being good swimmers, were helping themselves to the floating and beached cargo, used recovered ship's timbers to make an emergency stockade. By March 7th, the *L'Aimable* could no longer be seen (Weddle 1987:112).

A pitiful, cold, hungry, and disillusioned group camped on the sandy shore. Sickness was rampant and soldiers were dying every day from weakness and long exposure in the water. Some were deserting (see O'Donnell 1936; Joutel 1962:57). Adding to the sad condition of the colonists, Captain Beaujeu of the *Jolie*, who was engaged in almost constant disagreement with La Salle about provisions for his ship and the direction of the Mississippi River, decided to set sail for France on March 14th.

The local natives, not appreciating the invasion of their territory, harassed the survivors and continued to take what they could from the ship's wreckage. Gun shots, sounds never before heard, were frightening and would usually scare them away. But when La Salle appropriated some of their canoes to explore the bay, the Indians retaliated. Two men of an exploring party were killed and others were wounded. The colonists were shocked and terrified, and the feeling of constant danger never left them.

More timbers, washed ashore from the shipwreck, were used to protect the camp and make it a little more livable. But food was scarce. The "biskets" were gone, and the remaining food was water-soaked. Meal doled out in rations was mixed with water to make a sort of hasty pudding. Large beans and Indian corn were also rationed. Fortunately, plentiful deer and bison roamed the local prairies. Abundant fish swam in the nearby lakes and the bay. The hunting and fishing became constant activities to keep the more than 100 persons at the shore camp from starving (Joutel 1962:53).

With the camp fairly secure, La Salle began exploring the area, hoping to find the Mississippi River and the settlement he had left in 1682. The location of the river remained elusive, but farther inland he found a prairie where crops could be planted and where buffalo and birds were plentiful (Joutel 1962:58)—a good spot for a permanent village. There he left a few men to start building a settlement and to plant crops.

Not until the first of June did material from the shore camp begin to be moved to the other settlement (Figure 1) located about two leagues (a league is a little less than three miles) up the bay.[5] About 70 men, women, and children left for the new settlement, with about 30 staying at the shore camp with Henri Joutel, who was in charge. By

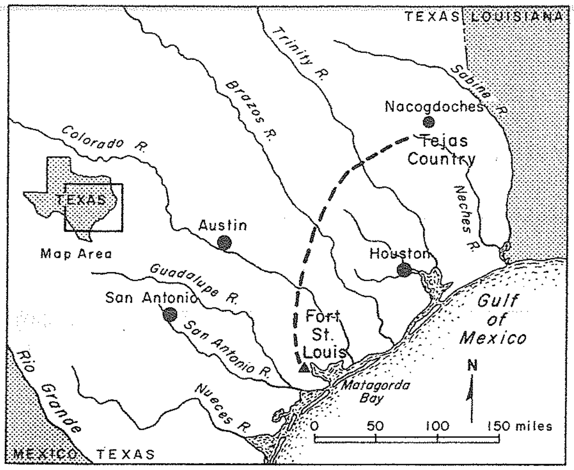

Figure 1. Map showing location of the French settlement and the Cenis (or Tejas) country, with the general route the Frenchmen took between them.

July, all the material, including salvaged ship's timbers, had been transferred to the settlement, now named Saint Louis. St. Louis was a miserable place. Drought, birds, and animals had ruined the planted seeds. Several people had died; others were sick. The single sheltered area protected only the powder and brandy.

The nearest wood suitable for building grew a league away. Lacking draft animals and carts, the men, after cutting and squaring the logs, had to drag them back over uneven terrain—no simple chore. The labor was eased a bit when someone thought to use a gun carriage as a wagon to haul the timbers. The already sparse rations were reduced if work was shirked, and La Salle was not an easy taskmaster. Jean l'Archeveque was well aware of this, and may have taken part in these activities (Canedo 1968:107; O'Donnell 1936:23). More than 30 died from this labor (Joutel 1962:64).

A lodge was finished by sometime in September, and La Salle again explored the local area. Later that winter he set out with 20 men and did not return until March 1686. Adding to the beleaguered colony's troubles, this same spring, the *Belle* was blown across the bay and stranded on the shore with a tragic loss of materials.[6] Now the little colony was really isolated, and La Salle knew it was necessary to find help.

He set out again toward the east at the end of April with 20 men haphazardly equipped with anything that could be found among the colonists. Only eight of these men returned to St. Louis in August 1686, with five horses loaded with maize. The men were in rags and tatters. Besides those who had died or had been killed by Indians, three deserted (two sailors, Groslet and Ruter, and a man from Provence). Dominique, younger brother of Pierre Duhaut, did not return, causing Pierre to harbor bitter resentment toward La Salle. Neither the Mississippi River nor the aimed-for post of the Illinois was reached. The disappointment among the villagers was overwhelming, but La Salle revived their spirits, according to Henri Joutel, one of his leading aides and supporters. He "made all Men easy, and he found, by his great Vivacity of Spirit, Expedients, which reviv'd the lowest ebb of hope" (Joutel 1962:82).

With the colony dwindling and supplies almost non-existent, La Salle had no choice but to try again to get help. Near the second anniversary of the landing on the Gulf shore, 17 set out on January 12, 1687, to go to France by way of the Mississippi River and the Illinois Post to Canada: La Salle; his brother, Abbe Cavelier; his nephews, Moranget and the young Cavelier who was 11 or 12; Father Anastasius Douay; Pierre Duhaut, l'Archeveque's employer and possibly his cousin; l'Archeveque, now 15; Hiens (James), the English gunner; Liotot, the surgeon; young (Pierre) Talon, age 11; an Indian named Nika; La Salle's footman Saget; Henri Joutel; Tessier, pilot of the wrecked ship *La Belle*; de Marle, a volunteer; a young man from Paris, Bartholomew; and Pierre Meunier, a nobleman's (Sieur de Preville) son from Paris, about 15 years old.

Equipment for this long journey was the best to be had in the colony, but the best was improvised. Belts became leather for shoes, and salvaged sails became material for shirts. The only five horses were loaded with some of the most valuable belongings of each man including what might be needed. The horses also carried gifts for the Indians: axes, knives, glass beads, and ribbons, essentials for peaceful passage.

Thirteen men and seven women bid the group an emotional and touching good-bye, hoping desperately that eventually help would come. On hand were about 70 swine, 18 or 20 hens, some meal, powder, ball, and eight useless cannon, according to Joutel (1962:84).[7]

When they could finally leave, it was a time of rain, flooding, and cold. Using their compasses to head northeast, the group set out from Fort St. Louis for the Cenis[8] in present-day East Texas where La Salle had made friends the year before (see Figure

1). Soon they encountered marshy lands made worse by heavy rains. Freshly-killed buffalo hides provided some protection from the rain, but the trekkers remained wet from frequently wading in water up to their knees. Adding to their misery and fatigue, they had to hack through thick woods to give the horses passage until they discovered buffalo trails leading through the woods.

It was not long before the group's shabby shoes were useless, and since buffalo hides, although untanned, were plentiful, the men fitted them around their feet. This worked until the skins dried, then they became so hard and rough they had to be soaked periodically to restore the softness.

Crossing rivers was an ordeal. Some of the smaller ones could be spanned by cutting a tree to fall from bank to bank. To cross the larger rivers, a small boat made of buffalo skins sewed together and stretched over a sapling framework answered their problem.

Progress was slow. Such exhausting labor required frequent rests, some for several days or a week. Indians along the way for the most part were friendly and helpful, some trading buffalo hides for a knife, others advising on the way to travel. Some Indians traded the Frenchmen tanned "goat" (probably pronghorn) skins, a boon to the travelers since shoes made of these skins remained soft and supple.

By March 15th, after two months of travel, food was getting scarce. Camp was made two or three leagues from where La Salle had stashed a quantity of corn and beans the year before. The seven or eight sent to retrieve the food included Pierre Duhaut, the Basque; Liotot, the surgeon; Hiens, the gunner; Tessier, the pilot; Nika, the Indian hunter; Saget, La Salle's servant (Margry 1886:319); and l'Archeveque. When they found the food spoiled, hunger set the stage for tragedy.

On the way back to camp the next day, Nika fortunately killed two buffalo, and Saget was sent to tell La Salle to send horses for the meat. When morning came, La Salle dispatched the horses with Moranget, his nephew, de Marle, and Meunier[9] with Saget to guide them.

When Moranget[10] and the others found the men, they were smoking the meat and eating the marrow from the marrow bones, a customary tradition, but Moranget was enraged. He told them the meat was not dry enough, and that he would take all of it, including the marrow bones. The men, angry at such treatment, and this combined with other times they felt Moranget had been cruel and unjust, decided Moranget had to be killed. But this meant Nika and Saget, both loyal to La Salle, also had to be killed. That night when all was quiet, Liotot took an axe and smashed the heads of the three men while Duhaut, Hiens, Tessier, and l'Archeveque stood guard. Nika and Saget died instantly, but Moranget, although mortally wounded, sat up and de Marle, an innocent bystander, was forced to end Moranget's life with a shot.

The conspirators then realized their gruesome scenario had to be completed with the death of La Salle. To accomplish this, they would have to go to La Salle's camp. Those who defied them would be killed first, then it would be easier to kill the rest. But the river near the conspirator's camp was in flood, too high to cross, causing delay of their plans.

When the men had not returned to La Salle's camp by the 18th, La Salle became worried, fearing something had happened—an accident, an Indian attack? Taking an Indian guide, he and Father Anastasius set out for the hunting camp. Joutel waited on a rise watching the horses and gathering twigs for a signal fire to guide them back.

Crossing the river, La Salle fired a shot at several eagles circling overhead, inadvertently warning the conspirators of his approach, and giving them time to plan their strategy. As La Salle neared the hunting camp, he saw Jean some distance ahead, and called out, inquiring for his nephew, Moranget. To this l'Archeveque replied that he was "along the river" (Joutel 1962:102). Simultaneously, Duhaut, hidden nearby, fired a shot that hit La Salle in the head, killing him instantly. The conspirators gathered around the body, and Father Anastasius, terrified, was sure he would be the next to die. La Salle's body was partially stripped and rolled into the woods with no eulogy but blasphemy.[11] After reassuring Father Anastasius, the group headed back across the river for the main camp.[12]

After crossing the river, Jean l'Archeveque left the group to find Joutel. Jean, 15 years old but probably looking older, had always liked Joutel and now, possibly shocked at his own part in the murders and at the plan of the murderers to kill any who resisted them, he came to Joutel excited and afraid. He said he had news, that there was bad luck. Then he told the story of the murders and warned Joutel of the plot to kill any who resisted. Jean assured Joutel that he would be all right if he kept silent (Margry 1886:321).

The only choice of those not in the plot, including La Salle's brother, the Abbe, his nephew, young Cavelier, and Father Anastasius, was to keep silent and try not to irritate those now in charge. Duhaut, l'Archeveque's employer and the one who had shot La Salle, had taken control.

The time came to continue the journey, and on March 21st camp was broken. With their Indian companions, the Frenchmen began following the path to the Cenis. Finally, on the 28th, after crossing flooded rivers and being low on food (no buffalo had been seen), they camped on the Cenis River, 10 leagues (about 26 miles) from the Cenis village. Joutel, Liotot, Tessier, and Hiens proceeded toward the village to barter for corn and horses with axes and knives.

After a fair amount of supplies had been gathered, they were taken back to the camp by the men, but Joutel stayed at the village to barter for more. This left Joutel free to quiz the French sailors, Groslet and Ruter, who had deserted La Salle the year before, concerning the whereabouts of the Mississippi River in case the Indians might have talked about it.

When the men came to see Joutel, they were dressed like Indians in breech clouts and turkey feathers. Ruter was tattooed with lines running across his forehead and down his nose to the tip of his chin. Groslet, who did not know of La Salle's murder, was not tattooed, nor was his hair cut in the Indian fashion (which left a small lock on the crown of the head). Some of the Indians also had hair hanging from their temples (Joutel 1962:118). Ruter and Groslet enjoyed the free and easy life of the Indians and the high status their guns gave them. Furthermore, there were few restrictions on sexual activity, and the Cenis women desired the glass beads and colored ribbons the French men had.

Since the Cenis did know of a great river toward the northeast where there were men like the Frenchmen, Joutel decided they would go in that direction to find the Mississippi River, but they would go without the Duhaut faction. Groslet and Ruter could go, but they must keep the plans a secret from the group in the murder plot.

Duhaut and the others had come to the conclusion that the best way out of their dilemma was to return to Fort St. Louis, their settlement on the coast, build a boat and head for the islands. But all the carpenters were dead, no one knew how to build a boat, and wood was scarce. Joutel, knowing the project had little chance of success, pleaded exhaustion for himself, Abbe Cavelier and young Cavelier, and Father Anastasius, as an excuse to stay behind in the Cenis village. They could later set out for the Mississippi River by themselves. Duhaut's group, talking it over among themselves, agreed to give those staying half the trade goods and to send word if they were successful in building a boat. If they were not successful, they would return and continue to search for the Mississippi.

Meanwhile, word got to Duhaut that the Indians had knowledge of European settlements on a large river toward the northeast, and all his gang now agreed they should try to get there along with Cavelier, Father Anastasius, and Joutel. L'Archeveque, Hiens, and a few others had been staying at the Cenis village collecting supplies and enjoying the natives' lifestyle, when word came that Duhaut had decided to go find the Mississippi River. Hiens was decidedly against this, thinking he would lose his head if he went back. L'Archeveque left the Cenis village immediately to inform Duhaut, and possibly to warn him of Hiens' attitude. Even though Duhaut had killed La Salle, Duhaut had been Jean's protector and employer, as well as perhaps his kinsmen; no doubt Jean felt some loyalty to him.

A few days later while Jean was out hunting, Hiens appeared at Duhaut's camp with the two French deserters and about 20 Indians. Hiens, confronting Duhaut, was adamant in his decision not to go to the Mississippi River, and demanded his share of the goods. Duhaut refused. Hiens quickly drew his pistol and shot Duhaut. Almost immediately, Ruter shot Liotot, the surgeon who had performed the axe murders. The men were buried nearby in a common grave (Joutel 1962:123).

Hiens waited for l'Archeveque, planning to kill him when he returned. But Father Anastasius and Cavelier, with considerable effort, persuaded him not to do it. Joutel went out to meet Jean when he returned to tell him about the disastrous happenings and what he should do. Thus, Joutel reciprocated for Jean's similar action for Joutel after La Salle was killed. They went to Hiens and each pledged no harm to the other.

Hiens, having promised the Indians to go to war with them, persuaded Joutel, Cavelier, and Father Anastasius to delay their journey toward the Mississippi River and wait in the Cenis village until they returned. Those who went to war were probably Hiens, Groslet, Ruter, de Marle, the Provencal, Meunier, and l'Archeveque.

Victory was easy. The enemy, the Cannohatinno, met the Cenis with aggressiveness, but they scattered wildly when they heard the loud noise of the Frenchmen's guns. Many women trying to escape scampered up the nearest trees and were killed. About 48 men and women died, and scalps were taken from each. The women were brought back to the Cenis village; one who had been scalped was sent back to her people with a warning that this kind of war could happen again. The other Cannohatinno woman was slowly tortured to death by the Cenis women in revenge for the men they had lost in war (Joutel 1962:126; Margry 1886:374).

The victory celebration lasted three days, and the Frenchmen, whose guns were responsible for the victory, participated in the ceremonies. Each warrior, carrying a bow and two arrows, with his wife in front of him holding the scalp he had taken, proceeded to the house where the ceremony took place. The warrior took the scalp from his wife and presented it to the master of ceremonies, who, holding the scalp with two hands, pointed to each of the cardinal directions while he uttered incantations. After all the warriors had presented scalps, the master of ceremonies delivered a speech. Food was then served, but before it was eaten, a bowl of food was presented to each of the scalps, and then tobacco was blown over each. After eating and then smoking, the Indians began the dancing and singing.

With the war and the victory ceremonies over, preparations to move on were again in the forefront of the minds of the Frenchmen. Tessier and l'Archeveque decided to go along with Joutel and his group to France via Canada if Abbe Cavelier would give them a pardon for their part in the murder of La Salle. The Abbe agreed. Meunier then decided to join the group. Hiens, though, still felt that if he returned to France he would have his head chopped off.

Time came for departure. Seven travelers—Joutel, Cavelier, young Cavelier, Father Anastasius, de Marle, Tessier, and Bartholomew—waited for l'Archeveque and Meunier to join them, but they waited in vain. Joutel (1962:129) thought they wanted to stay with the Indians because of, as Joutel viewed it, the lack of restraint in the Indians' lifestyle, but later both insisted (perhaps truthfully, perhaps not) they were sick and could not leave (O'Donnell 1936; Meunier 1690).

The group left the Cenis near the end of May 1687. Word came to the village that one of the party had drowned and the others had been killed (l'Archeveque in O'Donnell 1936:24; see also Gilmore 1991). It was true that de Marle drowned near the Cadohadacho village on the Red River, but the others survived. Joutel, Cavelier, and Father Anastasius arrived at Rochelle, France in October 1688 (Joutel 1962:170). L'Archeveque remained in the village with Meunier, Hiens, Pierre Talon, Groslet, Ruter, and the Provencal. Hiens was later killed, according to l'Archeveque, possibly by Ruter. Or both may have been killed by the Indians (l'Archeveque in O'Donnell 1936:24; Weddle 1973:28). The Provencal disappears from the record.

But life went on in the Indian village for those who stayed behind. The natives were kind and gentle and took care of the Frenchmen. No doubt the Frenchmen had their favorite ladies, who along with others were able to persuade the reluctant Groslet, l'Archeveque, Meunier, and Pierre Talon to endure the painful process of being tattooed on the face, hands, and chest with lines and flowers, thus showing their appreciation to their hosts (Weddle 1973:172). Perhaps they were not aware that these designs were permanent and could not be removed.

Through the yearly visits of the Cibolo and Jumano nations to the Cenis, the Frenchmen learned there were Spaniards some distance away. Usually these nations, hunters and traders, made their spring trip before the heavy spring rains came, just before the buds on the trees opened (Kelley 1952:277). This was probably about the middle of February on the Rio Grande near present-day Presidio, Texas, where the Jumano usually wintered (Kelley 1952:278). But this year, 1689, the traders brought tragic news to the Frenchmen: the settlement of Fort St. Louis on the Gulf had been attacked.[13] L'Archeveque, Groslet, and Meunier persuaded the Cenis to take them to the settlement, but Meunier became sick and stayed with Pierre Talon (Meunier, Declaration 1690).

When they came to the road leading to the settlement, Jean and Groslet wanted to go into it alone, but their Indian friends insisted that they go with them. As they approached nearer, a stench must have arisen from the direction of the settlement, and Jean and Groslet were, no doubt, dreading what they might see. Even in their imagination they were not prepared for the grisly scene they beheld. Their former home was in total destruction. The supply room was wrecked. Guns, boxes, cases, wine barrels, pistols, and arquebuses (guns) were broken and strewn everywhere. Books had been torn apart. Doors had been yanked from the six houses, and the meager furniture demolished. But worst of all, everyone was dead—killed, murdered, their bodies lying where they had died. The attackers in their fury had laid waste to everything, even killing the livestock. It was a scene of death; the only life was in a few pigs, scrounging for food,

Angry, sad, and fearful for their own lives, they buried the 14 bodies of their friends, including two priests, and set fire to about 150 barrels of powder so the Indians could not use it (Groslet in O'Donnell 1936:20). L'Archeveque, now 16, in outrage and hatred mixed with fear, determined to leave life among the "savages" even if it meant working in the Mexican mines or being in prison.

There was no choice now but to return with the Cenis. Back at their village, Jean told Meunier about the horrible destruction and ghastly scene. Miguel, a Cibolo Indian visiting at the village, offered to take the Frenchmen to the Spaniards. They agreed, but after three days of rough travel through lands of hostile Indians, the Frenchmen became increasingly apprehensive and turned back to the Cenis village. Talon and Meunier may not have been on this trip, but at some time their fear of the Spaniards must have become greater than their fear of the Indians. The next year when the Spaniard, General Alonso de Leon, returned to the Tejas looking for them, Meunier and Talon left the Tejas village to escape the Spaniards, but inadvertently went towards them and were captured (Weddle 1987:240).

Now what could they do to get out of this country? Were they doomed to a life thinking each minute they would be stalked by the destroyers of Fort St. Louis who had vowed to kill all intruders? Since it was dangerous to go to the Spaniards, they would send a note to the Spaniards to come for them. In the papers they had saved was the drawing of a ship on a piece of parchment that would have a good chance of surviving rough treatment. Jean wrote his plea with a piece of red ochre on the right side of the drawing. Groslet, not being able to write, dictated his message for Jean to write on the left side of the drawing (Figure 2; Hackett 1923-1926, Vol. II:471).

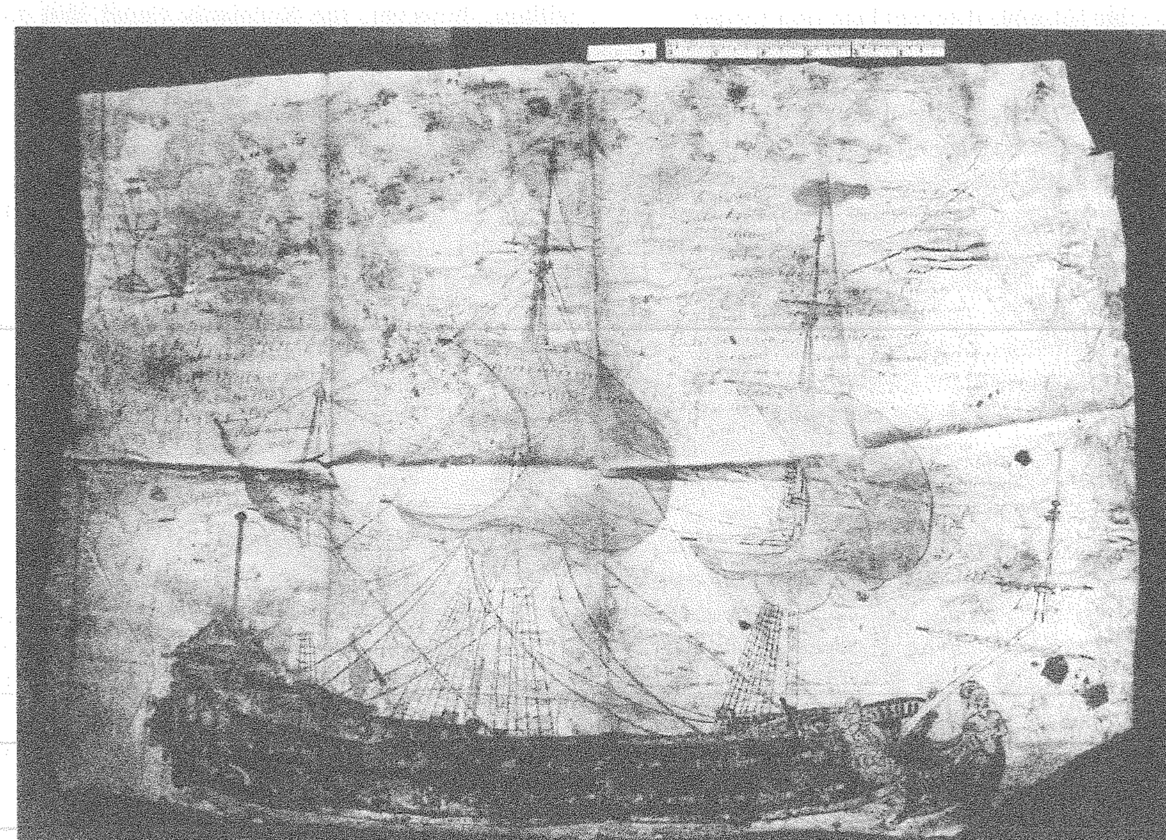

Figure 2. Drawing of a ship with full sails and damaged masts, possibly the *Belle*, and messages on parchment sent to De Leon by l'Archeveque. Reproduced with the permission of the Barker Texas History Center, The University of Texas at Austin.

The translation of what Jean wrote:

> Sir:
> I do not know what sort of people you are. We are French. We are among the savages. We would like very much to be among Christians such as we are. We know well that you are Spaniards. We do not know whether you will attack us...we are sorely grieved to be among the beasts like these who believe neither in God nor in anything. Gentlemen, if you are willing to take us away, you have only to send a message, as we have but little or nothing to do. As soon as we see the note we will deliver ourselves up to you.
> Sir, I am your very humble and obedient servant.
>
> Jean Larcheveque
> of Bayonne
>
> We have given this to [illegible] to take to you we are young men who are not [illegible] we [illegible] you [illegible] are [illegible illegible] I am your servant
>
> Groslet

They tore a few pages from the log book of the *Belle* that someone had brought on this last expedition of La Salle. These they wrapped with the parchment containing their messages and other papers in a necklace. Some of their native friends set out to overtake the Indians (probably the Cibolo and Jumanos) on their way to the Spanish settlements to give them the messages. By March 3, 1689, these papers were in the hands of the Spanish General Juan Fernandez de Retana, who was told at the same time of the destruction of the French village. Unfortunately, none of the Spaniards with Retana could read French, so answers to the letters were not made. The messages were sent with a letter to Governor Juan Isidro de Pardinas at Parral, then on to Mexico City, thence to Spain, where they lay unread and forgotten for 200 years (see Hackett [1923-1926] and Dunn [1917] for the story of Dunn's rediscovery of these papers in the Seville Archives).

While the young Frenchmen were anxiously awaiting an answer to their letters, an expedition sent to find the French colony was nearing success. From the first news of the French plans to establish a colony on the Gulf coast, the Spaniards had been hunting for such a place without success. Five sea expeditions and four land expeditions had to report "no luck" (Weddle 1973:160). When the Indians told General Retana of the destruction of the village, the Governor canceled plans to continue to look for it. But Alonso de Leon, not aware of the destruction, was already on the way with a force of about 100 soldiers, using as guide Yan Jarri (Jean Gery), whom de Leon had captured the year before.

Gery, who had set himself up as the leader of an Indian group, said he was French, but he insisted that he was not one of La Salle's colonists. Gery was ambiguous in his statements—one time saying he knew where the French colony was, and again saying that he did not. Father Massanet, chaplain of the expedition, called him demented.

When the expedition came to the Guadalupe River (probably near present-day Victoria) on April 14, 1689, Gery said they were near the French settlement. Not knowing what he would find there, de Leon left the main force at the river and took 60 well-equipped soldiers on the search. They had not gone far when they encountered an Indian who said there were four Frenchmen in his village. At his village, however, the Spaniards found that the Frenchmen had left four days before. De Leon chased the Frenchmen, who were on horseback, for some distance, always several days behind.[14]

At one village, using the French guide as interpreter, the Spaniards found that the Frenchmen, as usual, had gone to the Tejas four days before. In this village, they were shocked to learn that "the rest who had settled on the sea" had died at the hands of the coastal Indians three months before (Bolton 1963:395).

De Leon, anxious to find the French settlement, sent a letter to the Frenchmen, and proceeded on to St. Louis, where finally on April 22nd, the Spaniards viewed the destruction of the long sought-after colony (Bolton 1963:398). The letter to the Frenchmen, written in French by Francisco Martinez, said, according to de Leon (Bolton 1963:396), that they had been informed of their escape when some Christians on the coast had been killed by the Indians, and that they could come with the Spaniards, who would wait three or four days for them in the village from where they set out. Father Massanet added a few lines in Latin in case one of the Frenchmen might be a "religious." Paper for a reply was sent with the message.

Already at the Tejas village, l'Archeveque received the message, probably with much excitement.[15] At last he could return to his own kind. But since the other Frenchmen were not there, they would not know they could be rescued. He sent them a message, and told them he would ask the Spaniards to wait a little longer for them. He found a piece of red ochre, and wrote on the paper sent by the Spaniards:

> ...I have received your letter informing us that you are near to where we are. We pray that you may have the kindness to wait for us two days more, since we are separated from each other... As soon as [the others] have come, we shall not spurn your aid. Your coming does honor to the Christian European. We shall not be kept from reuniting ourselves with Christians. It is such a long time that we have been among barbarians, who are not even social people. I am satisfied, lord, with everything expressed in your letter. I will not permit separating [ourselves] to go and look for the others, lord. Gentlemen, I am your most humble and obedient servant.
>
> l'Archeveque of Bayonne
> (translation by Weddle 1973:193)

L'Archeveque and Groslet, with the Tejas chief and eight of his people as guides, proceeded to the meeting place with the Spaniards, but stopped along the way at a village of the Toaa Indians (Bolton 1963:363), probably near the Colorado River, where they were waiting for the other Frenchmen to join them. De Leon received the letter after he had been to St. Louis, and anxious to know what had happened with the French colony, he went to the Toaa village instead of waiting for them at the appointed village. Without the other Frenchmen, they set out for de Leon's main camp on the Guadalupe River, arriving there May 1, 1689 (Bolton 1963:402). Jean was perhaps disappointed to leave without his companions, yet he was determined to leave the country with or without them.

Two years had passed since La Salle's murder, two years of the Frenchmen living as a small minority among people who did not speak their language, probably in a constant state of culture shock. Their only clothes were like the Indians—antelope and buffalo skins—their French clothes long since worn out. Tattoos were on their faces, breasts, and arms.

L'Archeveque and Groslet knew they would be subject to questions about themselves, La Salle, and his enterprise. They knew they would have to tell of La Salle's murder. Together, they decided to tell the Spaniards that Hiens had fatally shot La Salle, and that Hiens had been killed by the Indians.[16] Jean probably feared Hiens, especially since Hiens had wanted to kill him, and, moreover Hiens was not French but probably English. Furthermore, Jean might be in deep trouble if it became known that Duhaut, his friend and possibly his kinsmen, was the murderer.

They were interrogated separately by de Leon with Francisco Martinez as interpreter, and each gave a similar account, though varying in detail, of their actions (O'Donnell 1936; Canedo 1968). Somehow they had learned how the coastal Indians had been able to destroy the French settlement.[17] They related how a few Indians, pretending friendship, went to the remotest house in the settlement. When the settlers, unarmed, came to see the Indians, they were attacked and killed, while other Indians approached from the creek, attacking the rest of the village (Bolton 1963:402).

The expedition, with l'Archeveque and Groslet, arrived in Coahuila on May 13th. The Frenchmen were sent on to Mexico City with Francisco Martinez, where they were cross-examined again on June 10th by two Captains, Andres de Pez and Juan Enriquez Barroto. This time Jean gave the primary deposition, and Groslet was asked only if he agreed. Jean intimates in this deposition that they did not know previously of the destruction of the village when they saw it (l'Archeveque in O'Donnell 1936:25). At another time, he says they went to St. Louis to help the settlers. This action, true or not, certainly would make a good impression, since it seems that they had made no attempt to go back to the settlement in two years.

That summer the two captive Frenchmen were sent to Spain with Captain Pez, no doubt creating a sensation there with their story of French aggression and failure. The Spaniards feared that the two Frenchmen, especially l'Archeveque, being the better educated and perhaps more intelligent and perceptive, could benefit France with their knowledge of New Spain. Thus, they were finally sent back across the Atlantic, in exile, beyond the reach of the French government. L'Archeveque, Groslet, and Meunier, who had been taken by the Spaniards in 1690, reached Santa Fe, New Mexico, on June 22, 1694 with settlers mainly from Mexico City (Espinosa 1977:189, fn. 31). On a muster roll of the colonists made November 16, 1693, near

Zacatecas, the three Frenchmen were listed as Pedro Munier, Santiago Grola, and Juan Arechibeca. They were described as "*forzados...rayados en la cara*" (enemy prisoners... streaked or tattooed on the face) (Twitchell 1914).

So ends the story of Jean l'Archeveque (later known as Juan Archibeque) in Texas. It is a story of a well-educated, intelligent young man, always mindful of his own welfare, experiencing deprivation, treachery, and tragedy, and perhaps romance, but who could not tolerate a culture radically different from his own.

EPILOGUE

L'Archeveque, who became Juan Archibeque (variously spelled) and Pierre Meunier, who became Pedro Muesnier (variously spelled) were attached to the presidio of the Villa of Santa Fe as soldiers. Jaques Groslet became Santiago Groslet (variously spelled). Groslet married Elaine Gallegos in 1697 and settled in Bernalillo (State Records Center and Archives, Vol. 5, Document 8, 1699).

In 1699, Pedro Muesnier married Lucia Madrid, age 14, of San Antonio de Senecu in El Paso (State Records Center and Archives, Vol. 5, Document 12, 1699). Further information on his life is lacking, but descendants of Archebeque and Groslet are living in the Santa Fe-Albuquerque area today.

Archibeque married Antonia Gutierrez, widow of Tomas Uta, in 1697 (State Records Center and Archives, Vol. 5, Document 9, 1699). Antonia and Uta had joined the caravan, probably in Mexico City, of settlers headed for New Mexico. This expedition of settlers was in the charge of Father Farfan, and included the three Frenchmen. On the way, not far from Zacatecas, Tomas was killed in a fight with a mulatto. Antonia, a "tall, broad faced, brown-haired, brown-eyed" young woman of 16 (Twitchell 1914), despite being a widow, continued on to Santa Fe. Perhaps l'Archeveque befriended the lonesome widow, and they formed an attachment during the difficult journey to Santa Fe.

Archibeque and Antonia had two children, Miguel and Maria. During the time he was married to Antonia, he had a "natural" (illegitimate) son, Augustin, whom he raised in his household "as a son." Antonia died between 1700 and 1701 (Bandelier 1962). About 1719, Archibeque had a son, Juan, by an "orphan maid," Maria de Mascarena. Both were members of the household.

Archibeque became a successful trader and merchant aided by his sons. He did not marry again until 1719. His bride, Dona Maria Roybal, was the daughter of a prominent Santa Fe family.

At 47 years of age, Jean l'Archeveque had led an eventful and colorful life, and his death followed the pattern of his life. The year after his second marriage, Archibeque was asked by the Governor to accompany an expedition eastward onto the plains where it was believed the Pawnee Indians, abetted by French merchants, were gathering to attack the Spanish colony. Juan was to act as an interpreter. This was not to be.

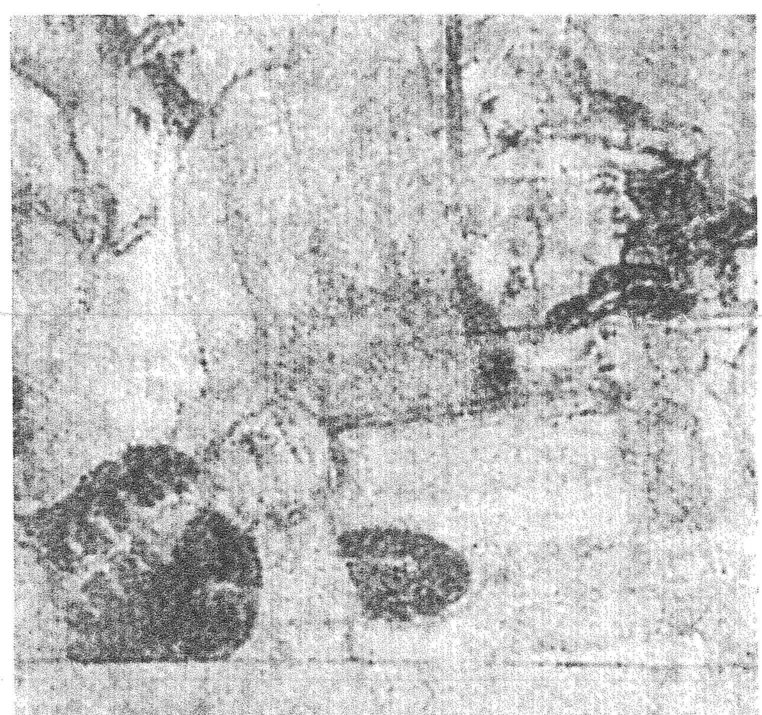

Figure 3. A part of the painting (Segesser II) depicting the attack on the Villasur Expedition in 1720. Villasur, with his head raised by a pillow, is lying dead near his tent. To the right, a portrait of a man facing toward the right may be that of l'Archeveque. Reproduced with the permission of the Museum of New Mexico, Santa Fe.

In a surprise attack, the Indians routed the expeditionary force, killing all but a few. Jean l'Archeveque, for all his wily ways, did not escape, nor did the commander of the force, Villasur. The colorful Frenchman was colorful still, even in death.

This rout of the Spanish forces is depicted on a painting on hide (see Holtz 1991), now owned by the Museum of New Mexico, Santa Fe, and known as Segesser II. It is believed that it was painted by a witness of the battle, but some years after it took place. The painting is a series of portraits of those present. There is a difference of opinion concerning which portrait might be l'Archeveque. I favor a person shown near and to the right of the wounded commander (Figure 3). This person is wearing a large hat, and seems to have rather heavy features with a somewhat large nose. There is no hair visible, and no tattoos.

NOTES

1. Jean was informally baptized (ondoye) on October 5, 1672 when he was six days old. He was formally baptized, obviously in absentia, May 4, 1687. His mother died in 1716.

2. Jean left only two documents of his adventures in Texas as far as is known, namely his declarations to the Spanish authorities found in O'Donnell (1936) and Canedo (1968). His story is patched with experiences of his companions, with the assumption he had shared them, with a heavy reliance on Henri Joutel's journal (1962). His journal is also found in a less abridged addition in Pierre Margry (1886). Joutel is the most reliable of the chroniclers of La Salle's last expedition.

3. In his declaration to De Leon in 1689, l'Archeveque said he came with "primo hijo" [cousin?] in four ships in the charge of La Salle (O'Donnell 1936:16). Joutel (Margry 1886:323) notes that Duhaut had taken Jean at Petit Goave, where he was enlisted. In a pre-nuptial affidavit for Pedro (Pierre) Meunier (1699), l'Archeveque implies that he and Meunier left France together in 1684. Nowhere does Jean say he left La Rochelle with La Salle, but nowhere does he say he joined the expedition at Petit Goave. Conceivably, the Duhaut brothers and Jean took earlier passage to Petit Goave, and Jean was reluctant to acknowledge his relationship with Duhaut.

4. This was Cabello Pass, the entrance to Matagorda Bay.

5. The settlement was five miles up Garcitas Creek; the creek flows into Lavaca Bay, an extension of Matagorda Bay (see Gilmore 1973, 1986).

6. In the summer of 1995, the Texas Historical Commission found the wreckage of the *Belle* on the north shore of Matagorda Peninsula (see Arnold 1996 for a preliminary report of the findings).

7. These cannons were discovered in 1996 by a ranch hand, and were recovered by a team from the Texas Historical Commission in September 1996 (Tunnell 1997).

8. These Indians, also known as the Tejas and the Hasinai by the Spaniards, lived in East Texas west of and near Nacogdoches, and were Caddo peoples (Swanton 1942).

9. Margry (1886:320) includes Monnier (a different spelling of Meunier) as being sent with Moranget and de Marle, indicating that Meunier probably witnessed the action that follows.

10. Joutel's (1962:100) account of what happened next may have been told to him by l'Archeveque.

11. There is controversy about where the murder took place. It was probably on a southern branch of the Trinity River.

12. This account of La Salle's death was told to Joutel (1962:108) by Father Anastasius.

13. This sequence of events is conjectural, but, I believe, reasonable. I could not determine with certainty whether the Jumanos told of the attack, or if the Frenchmen discovered it.

14. It is not clear who these four Frenchmen were, or whether they were fleeing before the Spaniards. Probably neither l'Archeveque nor Groslet were among the four since they would have been at St. Louis and returned to the Cenis or Tejas before March 3 when Retana received the message Jean had written on the parchment.

15. Weddle (1973:192) and Picardo (in Hackett 1931-1934, Vol. II:184) have a different version of this episode.

16. It is unclear whether Hiens was still alive at this date, but he probably was not. It was probably Jean's idea to credit Hiens with La Salle's murder, especially since Groslet was not a witness to the event.

17. The settlement was destroyed on Christmas Eve, 1688, according to Jean Baptiste Talon, an eyewitness (Weddle 1987:216).

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The Washington Square Mound Site: A Middle Caddo Mound Complex in South Central East Texas

James E. Corbin and John P. Hart [1]

ABSTRACT

The Washington Square Mound site (41NA49) is a Middle Caddoan period mound complex located in the city of Nacogdoches in Nacogdoches County, Texas. The site is located on an interfluve between two streams, La Nana and Banita creeks, in one of the oldest residential districts of the city. There were originally at least three mounds present at Washington Square, although, based on historic descriptions, there may have been four or even five mounds present at the time Europeans first entered the area. Today, only the remnant of one is still visible, as the other two known mounds were destroyed or partially destroyed by 1904 and 1939 construction activities. Excavations conducted under Texas Antiquities Permit No. 213 by the Stephen F. Austin State University Archaeological Field School (1979 to 1982) and the Texas Archeological Society Annual Field School (1985) revealed a previously unknown Caddoan complex in the southern Caddo region that dates to ca. A.D. 1250-1350. The numerous ceramic artifacts recovered from the excavations (including complete vessels from two mortuaries in the remaining mound) indicate strong ties with the Haley phase, but with a local flair. These ceramics also suggest that the culture represented at the site contributed significantly to the development of later Caddoan manifestations in the region.

INTRODUCTION

The Washington Square Mound site is a Caddoan mound complex dated ca. A.D. 1250-1350 that is located in the city of Nacogdoches in Nacogdoches County, Texas (Figure 1). The site is located on an interfluve between two streams, La Nana and Banita creeks (Figure 2), in one of the oldest residential districts of the city. The main portion of the remaining parts of the site is restricted to the east and south portions of the campus of the Thomas J. Rusk Middle School, originally built as the Nacogdoches High School in 1939 by the Works Project Administration (WPA). Archeological testing has shown that some aboriginal artifacts are also present in the yards of the houses directly adjacent to the school.

The site has suffered tremendous impact from buildings, roads, and sidewalks, and yet exhibits an amazing preservation of archeological data in intervening areas. This level of preservation is due in part to the establishment and maintenance of a public commons prior to the agricultural impact that has devastated many other Caddoan sites. The mounds associated with this site have suffered the most impact, however. The extant mortuary mound (and its environs) is owned by two individuals and the City of Nacogdoches, and intact portions of the non-public portions of the site may be owned by as many as five or six parties. The mound could only be significantly damaged by extensive and premeditated vandalism. This seems highly unlikely at the present time, particularly given the public interest and concern with the site. The largest and probably most significant portion of the site is on public land owned by the Nacogdoches Independent School District. Because it is on public land, the site is a State Archeological Landmark (designated in 1984). Thus, it would appear that this portion of the site is offered the greatest protection. Nevertheless, it is this particular public ownership that continues to impact (through school facilities and landscaping) this portion of the site on a yearly basis.

SITE LOCATION AND DESCRIPTION

The Washington Square site is on an interfluve between Banita Creek and La Nana Creek, a northern tributary of the Angelina River (Figure 3).

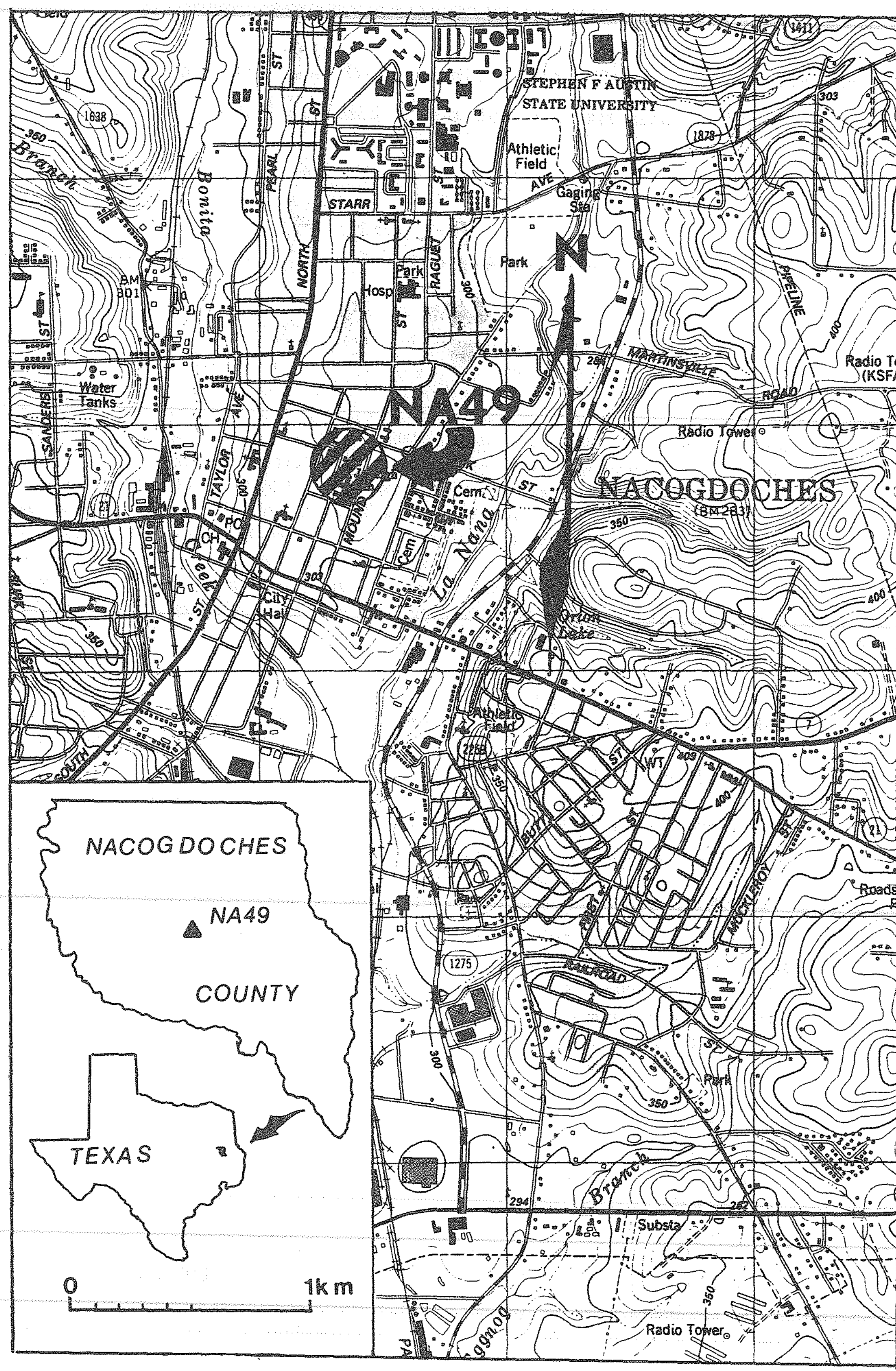


Figure 1. Location of the Washington Square Mound site (41NA49).

The site is surrounded by residential and commercial buildings. The majority of the extant portions of the site (Figure 4) are in the east and north yards of the T. J. Rusk Middle School, between the Middle School and the Old University Building (1859) and the 1916 High School (razed in 1984) to the north, and between the Middle School and North Mound Street on the east. Aboriginal artifacts are also present in the yards of the houses and businesses bordering Washington Square. In addition, a classic Washington Square style incised vessel (Figure 5) was recovered from a burial in the Oak Grove Cemetery (several blocks to the southeast of the school) during the excavation for a contemporary burial (Fain 1957). Therefore, it is apparent that the site was once originally much larger in size.

It is believed that originally there were at least three mounds present at the Washington Square site. However, today, only the remnant of one mound is visible. One mound, south of Washington Square (see below), was destroyed in 1937 while the other was partially leveled and buried in 1904. The visible mound, the Reavely-House Mound, is a mortuary mound located just east of the school property. Excavations in and around the mound indicate, based on the location of several burial pit outlines and mound stratigraphy, that the mound was originally much larger than it is today.

In addition to the construction of various buildings, recent disturbance of the site includes historic pits, water and gas pipe trenches, sidewalks, and rodent burrows. Nevertheless, the site has, unlike many Caddoan sites, never been plowed, and in the undisturbed portions of the site, preservation is re-

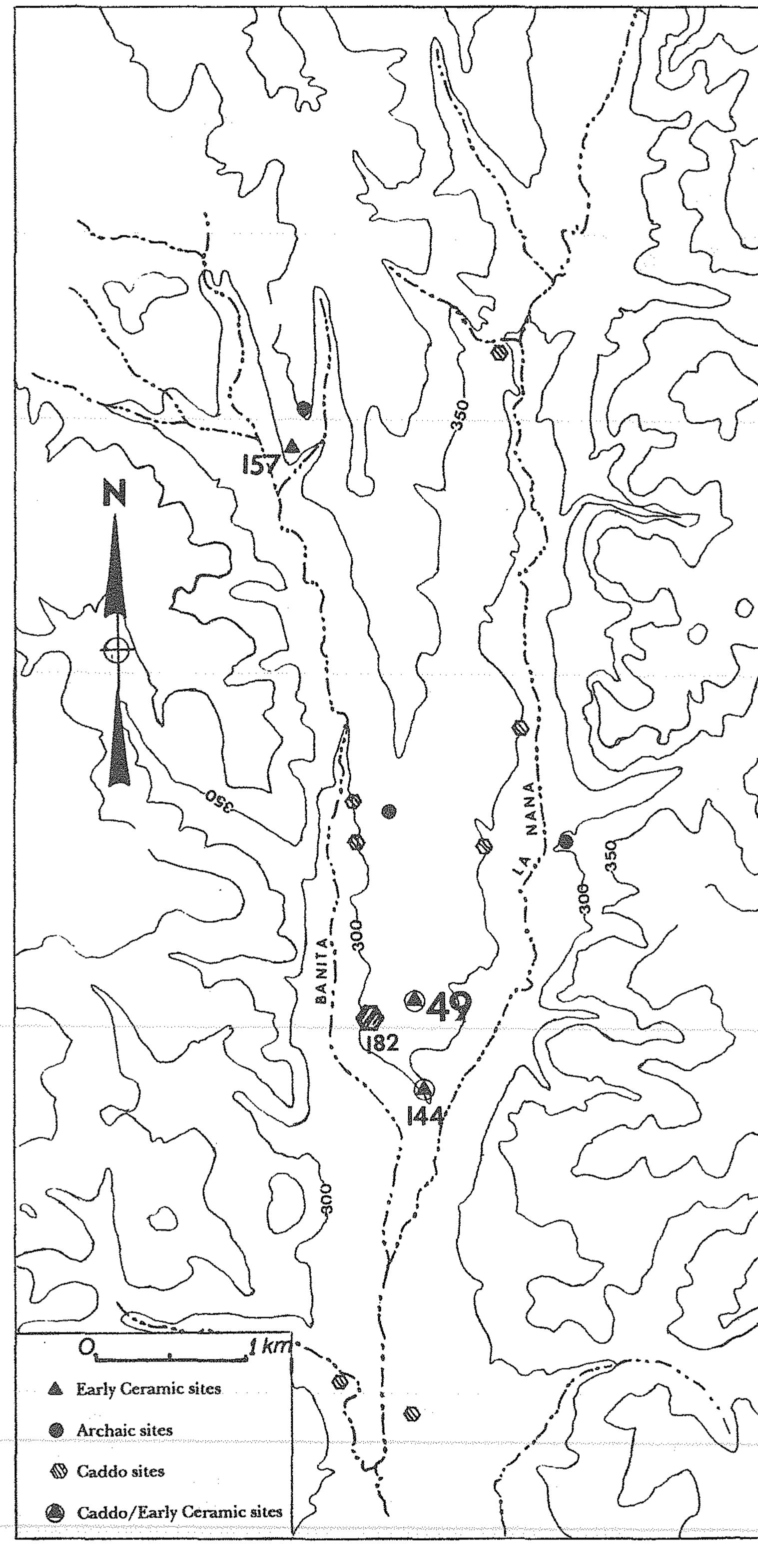


Figure 2. Area Map showing the Topographic Location of the Washington Square Mound site and other Sites in the Vicinity.

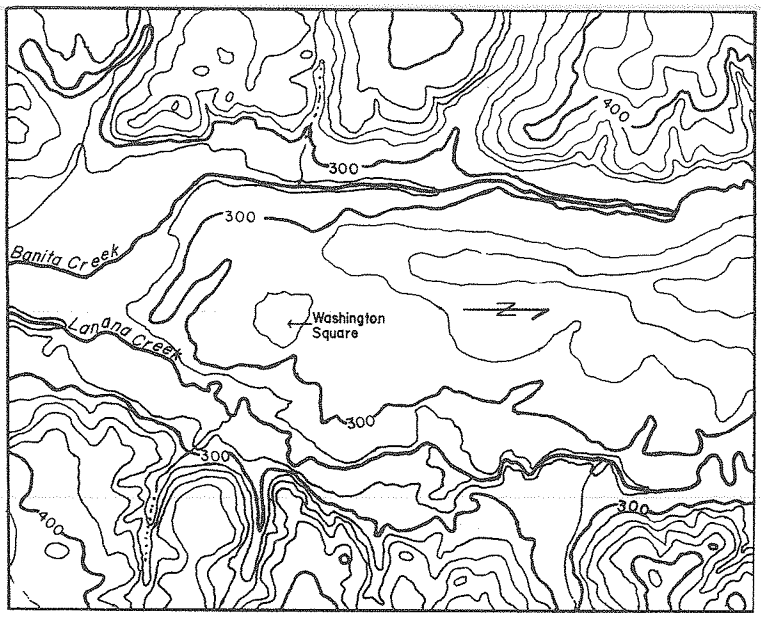


Figure 3. Contour Map of the Area around the Washington Square Mound site (from Nacogdoches 7.5' USGS quadrangle).

markably good. This unusual preservation has been greatly facilitated by the placement of fill on top of the original ground surface as a means of leveling the school yard during and after construction of the school building in 1939. In the southeastern part of the site there is as much as 60 cm of fill on top of the original soil. There is generally 5-15 cm of gravelly fill present in the northeastern portion of the site. Farther west in the northern portions of the site, the fill reaches a depth of 80 cm. The majority of the archeological material recovered has come from 5-20 cm below the original ground surface. Although there has been no midden layer observable in many excavation units, such a midden zone is present in some units in Area A at this depth.

THE ENVIRONMENTAL SETTING

The geology of Nacogdoches County is dominated by the Eocene Sparta, Weches, and Queen City formations (Bureau of Economic Geology 1993), with recent alluvium covering the bottoms of the stream valleys. The glauconitic Weches formation generally weathers reddish-brown or yellowish-brown and creates the familiar red deposits characteristic of this portion of East Texas. The topography of the region is rolling uplands with relatively shallow, well-developed, stream drainages. Outcrops of indurated sandstones generally mark the upper and lower boundary of the Weches, forming small local cuestas. Numerous small springs occur along the margins of the uplands, particularly at the contact of the Weches and the overlying Sparta Sand. These springs feed a variety of small tributary branches to the major perennial creeks.

The interfluve on which the site is located is a weathered upland remnant primarily composed of the Weches formation. The interfluve runs generally north-south, sloping to the south and the intersection of the two streams. The site is located on a rise near the southern end of the interfluve. The topography is relatively level; the terrain slopes slightly to the south to the end of the interfluve, but slopes fairly steeply to the north, east and west.

The surface of the interfluve is characterized by shallow colluvial deposits derived from the Sparta Sand upslope and eolian deposits derived from the floodplains of the nearby streams. Remnants of a few small to medium pimple mounds occur on the interfluve. Historical descriptions of the locale suggest that, in the past, these features were more numerous on the southern end of the interfluve. Our archeological investigations indicates that two of the mounds at the site may have been constructed on these geologic features.

Springs and marshy areas occur along the margins of the interfluve and on the interfluve. Oral history accounts indicate that there was a marshy, spring-fed pond (now filled in) just to the north of the site, and a marshy area to the southwest.

Washington Square is located on the Nacogdoches Urban land soil complex, part of the Nacogdoches soil series (Dolezel 1980:34-35). Based on undisturbed buried soil profiles at the site (i.e., under the extant mound), the soil was a Nacogdoches gravelly fine sandy loam with an A-horizon approximately 12.5 cm thick. The B-horizon is approximately 1.8 m thick, the initial 45 cm consisting of a red clay and the remaining 1.35 m of red clay with some hematite and limestone nodules. The C-horizon is a weathered, glauconitic sandstone of the Weches formation (Dolezel 1980:3, 70).

The Nacogdoches area is located in the Austroriparian biotic province (Blair 1950), and is dominated by the post oak and pine forest typical of the northern and western portions of this province in Texas. The dominant trees include loblolly pine, yellow pine, red oak, post oak, and blackjack oak. There are over 47 mammal species present as well as 41 species of reptiles, 17 anurans, and 18 urodeles. Common local mammals include deer, rabbits, squirrels, opossums, rats, mice, and bats (Blair 1957:98-99).

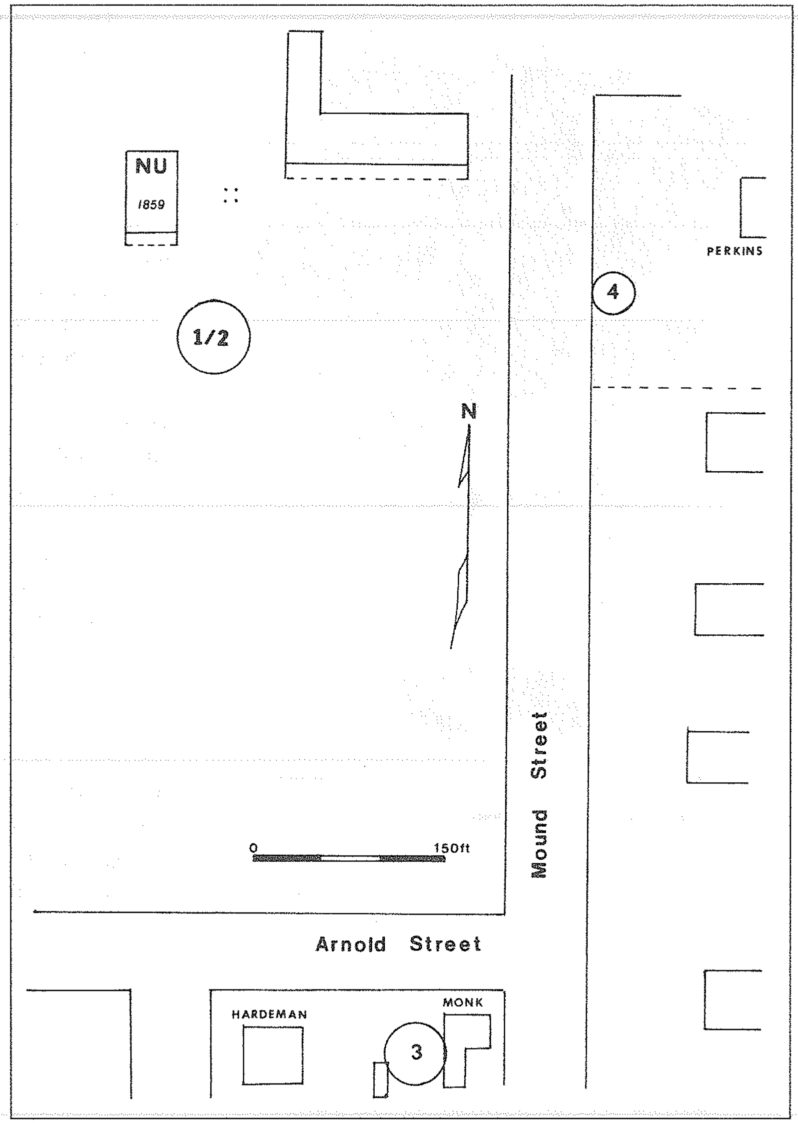


Figure 4. Portion of the 1900 Sanborn Insurance Map of Nacogdoches showing the location of historic and extant buildings on the site, and mound locations based on historic descriptions. NU=Nacogdoches University.

HISTORICAL BACKGROUND

Although the City of Nacogdoches was established in 1779, there are no known descriptions of the Washington Square Mound site prior to the 1830s. The earliest recorded mention of the site is found in the diary of Colonel William F. Gray in 1835-1836. Gray (1909:91) noted "There are several mounds on the north side of town." Later, O. M. Roberts wrote (Roberts 1898:146) that:

> During the years from 1842 to 1845, when I attended the district courts at Nacogdoches, in Eastern Texas, there was discovered an earth mound of oblong form fifty feet long and ten feet high, with a large sugar maple (then dead) that had grown near the middle of it, and in connection with the mound were four other lesser mounds, fifty feet apart, located in the line of a large circle, so that each of the small ones could be plainly seen while standing at the large one.

In 1851, Adolphus Sterne (McDonald 1969:218) wrote in his diary "...had a beutifull [sic] ceremony performed on the mound North of the Town, on the commons."

An interesting description of the site was published in 1880 in a small pamphlet entitled "History and Description of Nacogdoches County, Texas" by Richard W. Haltom, the local newspaper editor. He said (Haltom 1880:58) that:

> In front of it [the Nacogdoches University building, which he notes is five hundred yards northeast of the public square] a hundred yards or more are two mounds, a few yards apart, the larger one being near ten feet high, and more than one

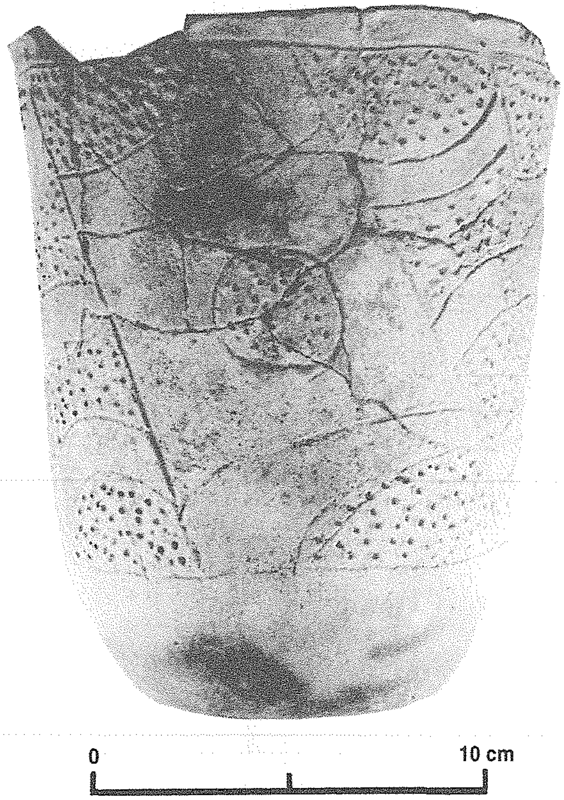


Figure 5. Vessel recovered from a burial at the Oak Grove Cemetery, Nacogdoches, Texas, in 1957. Excavations at the Washington Square Mound site have recovered many sherds from vessels having this shape and general design motif.

> hundred feet in diameter at the base. These mounds were evidently built by human hands. There is an excavation from which the dirt was probably obtained, situated about one hundred and fifty yards east of them. Large trees are growing in this pit. It is not of much depth or extent, seeming to have filled up in the long period of time. There once was a large sugar maple tree, scrubby in character, growing on the top of the larger mound.

When Thomas E. Baker (Karle Wilson Baker Papers 1887) first came to Nacogdoches in 1887, he noted that there were several mounds, including the one (Stephenson's Mound #4) on the Perkins (later Reavely) property and some on the school campus. The largest was on the corner lot just southeast of the corner of the campus.

The local historian, Mayfield (n.d.), writing in ca. 1906-1907, noted that in an area 200 yards across were four mounds, arranged in no apparent pattern. The largest mound, at about the date 1850, was circular, ca. 120 feet in diameter, and was located at the southeast corner of the school campus crossing of two streets (Mound and Arnold). This mound he said was 12 feet high, 50 feet in diameter at the top, and had a large sugar maple on top. Mayfield also noted the small mound across Mound Street (Stephenson's Mound #4) and that several borrow pits were still visible. Later, in 1936, he wrote that only the smallest mound was still visible.

R. G. Upton (Upton 1940:10), a professor of Biology at Stephen F. Austin State College, delivered a paper at the 1939 Texas Academy of Science meeting in Houston. In that address he described the mound site, noting that the highest mound was on the corner of Mound and Arnold streets, and that it had been mostly leveled by Mayor Mims in about 1890 (but see Hardeman interview below). He reported that, in 1937, 4-5 feet of the base of what remained of the mound had been removed, to prepare for the construction of a filling station, so that the edges were 2-3 feet above the street level. Upton noticed only a few bones and pieces of pottery during the removal of this portion of the mound. Upton also describes another mound, longer than the one leveled for the filling station, that had been on the school campus. This mound, informants had told him, was estimated to be 50 feet wide, 75-100 feet in length, and about six feet high. The mound had been completely leveled by 1914 and, he was told, this was where the 1939 school was constructed. During the WPA construction of the 1939 High School, Upton recovered most of a large brushed-punctated vessel from the excavations at the northeast corner of the building foundation (Sanders 1939).

In 1979, an interview with Mrs. Gladys Hardeman, Nacogdoches resident since 1893, cleared up some of the confusion that had begun to dominate the *remembered* history of the mounds. The Hardeman's owned the westernmost of the two lots immediately south of the school campus and south of Arnold Street. The northeast corner of those lots was the corner of Mound and Arnold streets. As a young child, Mrs. Hardeman remembered playing on the mound, located partially on the easternmost lot and on the lot that her family owned, and finding artifacts around it. The mound

(Stephenson's Mound #3) was very large and had enough slope that the west side of the barn constructed in their backyard had to be raised considerably to have a level floor. Mrs. Hardeman also remembered the mound(s) on the school campus. They were on either side of a drive that extended north from Church Street to the University building; the largest was on the east side of the drive (Mrs. Hardeman said she believed that there was actually only one mound, the drive cutting it into two). This mound was just below (south of) the Old University Building and had been destroyed in 1904 by the construction of the Central Public School (at that time the main high school).

R. L. Stephenson's 1948 archeological survey notes (Stephenson 1948a:20) describe:

> one small mound [Figure 6; the existing mortuary mound; Stephenson's photo identifies this as Mound #4] remaining across Mound street from the High School [1939 WPA High School]... another mound was leveled near the high school to build a filling station [Mound #3, the Hardeman mound]...two large mounds, each over 15 feet high, were leveled sometime between 1903 and 1910 for the building of the Nacogdoches High School [actually the 1904 Central Public School, but later known as the High School]. Burials, pottery and many other relics were found at the time [Perusal of the 1904 Nacogdoches newspapers did not find any reports of artifacts found during construction].

HISTORICAL RECONSTRUCTION

From the earliest descriptions in 1837 and 1842, it was noted that there were at least three mounds (Figure 7) visible on the site.[2] All descriptions agree that the largest mound (numbered by Stephenson as Mound #3, the same as the Hardeman mound), with a large sugar maple tree on top of it, was the southernmost mound. Statements vary on the size (ca. 50 feet in diameter; ca. 100 feet in diameter; ca. 120 feet in diameter; 50 feet in diameter at the top and 12 feet high) and shape (circular to oval) of the mound. Upton's 1939 description indicates that at that time it was at least 50 feet in diameter and between six and eight feet high. Roberts described four smaller mounds, placed in a circle, that could be seen from this mound. It is not clear how far these were from the mound, nor can these four be reconciled with the other mounds described below.

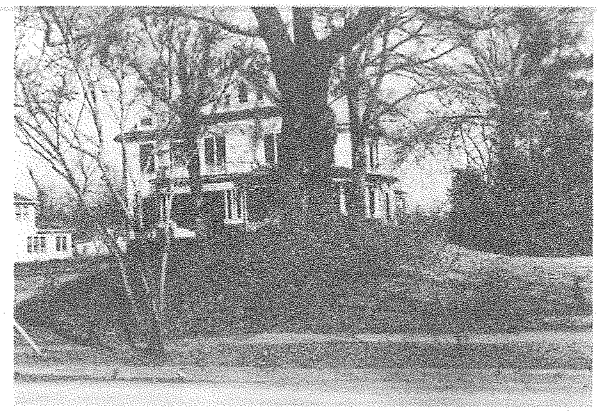


Figure 6. Stephenson's Mound #4, ca. 1948, North Mound Street, view to the northeast.

Another large mound, or mounds, was located in the central part of the original commons. Although apparently not described by Roberts, this mound is described by many others and is clearly not the mound described by Roberts. This mound (labeled by Stephenson as Mounds #1 and #2) may have actually been one mound, and lay in front of the Old Nacogdoches University, which was constructed in 1859. Upton's informants (who apparently were describing the site from ca. 1880) describe a single mound 50 feet wide, 75-100 feet in length, and six feet high. Stephenson's informants said it was over 15 feet high, although this is unlikely. Surely Roberts would have noticed two mounds this high less than 100 m from the mound he described. In 1857, Sterne describes a ceremony on the mound on the commons. Historic photographs from the 1890s show a mound (or mound remnant?) that fits Upton's description sitting just in front of the Old University Building (Figure 8).

A third mound (labeled by Stephenson as Mound #4, also known as the Reavely-House mound), the only remaining visible mound, was always noted as the smallest of the Washington Square mounds. The earliest mention of this mound is by Baker in 1887, who commented that it was "...the one now standing on the old Charles Perkins place..." Stephenson photographed this mound in 1948.

One obvious borrow pit was visible on the site at one time. Haltom (1880:58) describes a large, tree-filled borrow pit about 150 yards east of the

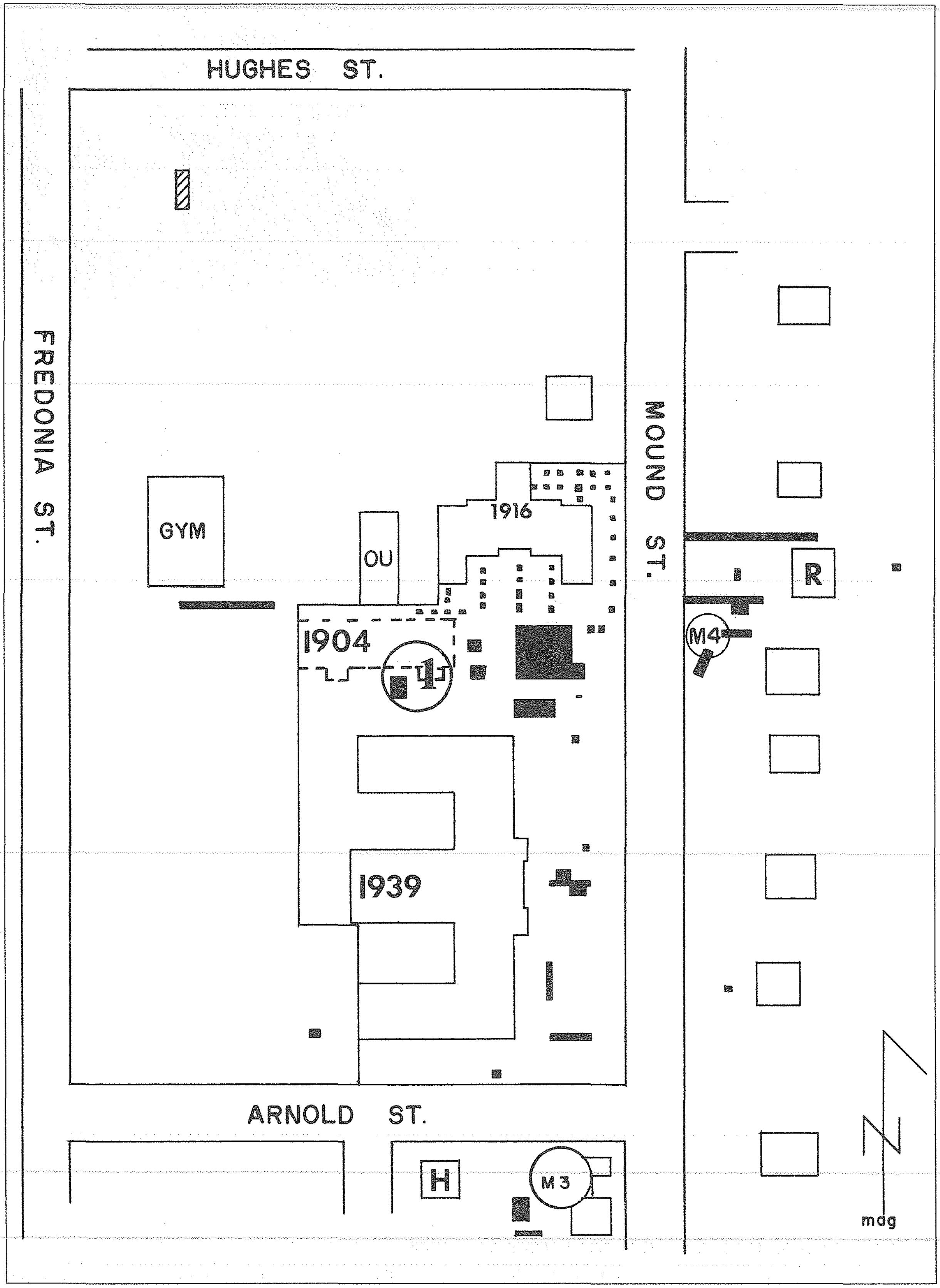
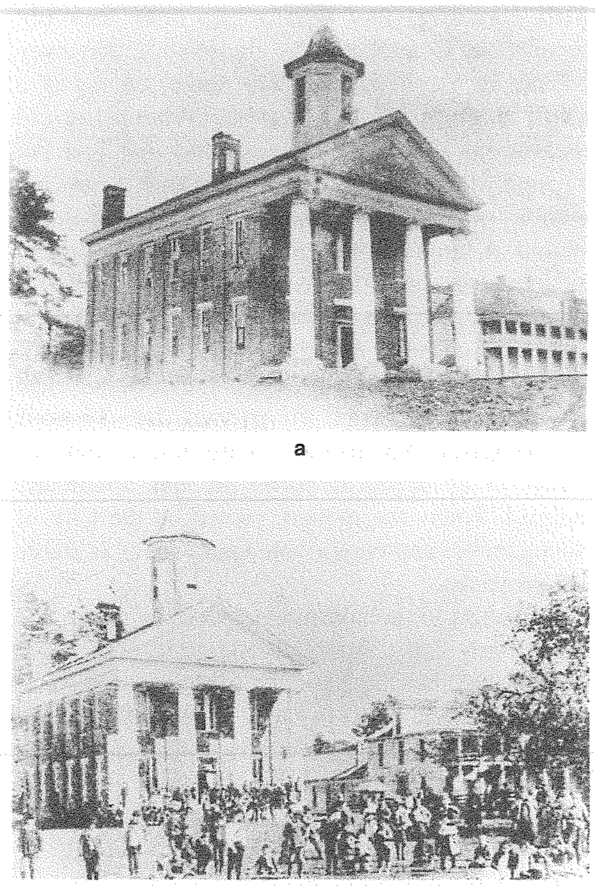


Figure 7. Composite Sanborn Insurance Map showing historic buildings, mound locations, and archeological excavations. OU=Nacogdoches University; H=Hardeman residence; R=Reavely residence.



a

b

Figure 8. Nacogdoches University: a, ca. 1887, looking northeast. Note edge of mound at right edge of photo; b, before 1904; people and tree are on the mound.

southern mound. This would place the pit near or at the edge of the interfluve, a situation similar to the borrow pit(s) at the George C. Davis site on the Neches River (Story 1997; Story and Valastro 1977:64-65).

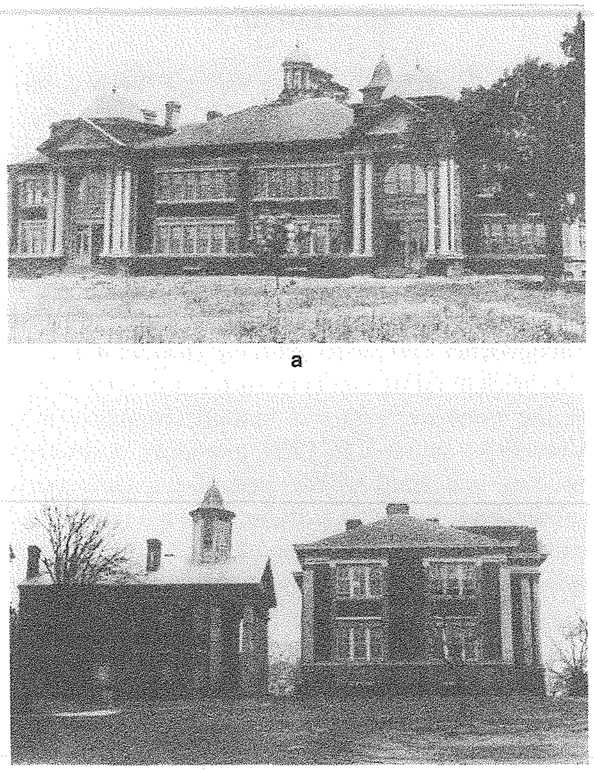
In summary, historic documents and oral histories describe three mounds at Washington Square. The southernmost and largest mound was probably a structural mound. This mound was destroyed in 1937. Another large mound, also probably a structural mound, was located near the center of the commons (Washington Square) and was mostly destroyed in 1904. Archeological research indicates (see below) that some of the lowest portions of this mound are intact, but buried beneath construction fill. A third mound, the northeasternmost, was always described as the smallest mound. Archeological excavations indicate that this mound is a mortuary mound that may have been much larger than it is now.

SITE IMPACT

The Washington Square Mound site was initially protected, if only fortuitously, in 1855, when most of the known site was deeded as a public tract for a school (Blount n.d.:22). This tract later became a public commons known as Washington Square. As the commons developed, impact to the site began. The earliest construction impact came about 1859 with the construction of the Nacogdoches University building (Blount n.d.:23). This brick building was constructed just to the north of the northwesternmost mound (Stephenson's Mounds #1 and #2). In 1860, a wooden dormitory building was built to the east of the University building; a cistern was built between the two buildings. In 1904, this mound was leveled off (as noted below, archeological excavations showed that the mound was not completely leveled to the original ground surface), a thick clay pad was laid down, and the 1904 Central Public School (Figure 9) was built over it.[3] Although Stephenson's informants (?) indicated that "burials, pottery, and other relics were found," the local newspaper did not describe leveling the mound or note that archeological remains had been found. The 1904 building was razed in the 1950s with little further damage occurring to the mound. Contrary to public history, it appears that the construction of the 1939 WPA High School had little if any impact on this mound. Today, the location suffers from some erosion, but is essentially stabilized.

Sometime after about 1887, the southernmost mound began to be impacted. This began as leveling by the owner of the easternmost lot, Carl Monk, Sr. (Hardeman 1979), and removed an unknown volume of the original mound. Of that, Baker notes that only a few pieces of pottery were found. Interestingly, an early accession (Cooper 1930) by the Stone Fort Museum is a complete cranium and femur that was donated in May 1930 by a Captain Cooper. The accession cards note that the skeletal material[4] came from the "...Indian mound south of the High School Campus. Mound said to be about fifteen feet high. Was leveled off to improve campus."

In 1937, this mound,[5] according to Upton, was still six to eight feet high. In that year approximately four to five feet of fill was removed, leaving a low platform ca. two to three feet above street level. Upton's report states that only a few bones and pottery sherds were recovered in 1937. A filling



a

b

Figure 9. Central Public School: a, picture postcard, looking north; archeological excavations and F101 were near the east entrance; b, photograph, date unknown, showing the 1904 Central Public School in front of the Nacogdoches University building.

station was constructed on the mound remnants. At the time of our first excavations at Washington Square, the filling station was still standing, although the surrounding terrain was at street level (Figure 10). In 1996, the filling station was razed and its large underground storage tank was removed. No artifacts were noted by the senior author during the destruction. Today, the area has been re-landscaped and is occupied by a florist shop.

The small mound (Stephenson's Mound #4) to the east of the school campus across Mound Street has also been impacted, apparently through reduction of its original size by landscaping. There are no recorded instances of landscaping or other impacts, but the archeological excavations indicate a reduction in height and possibly a considerable reduction in diameter of the mound. This may be a result of the construction of the original Perkins house (still standing) and during the later Reavely occupation. Construction of the historic driveway (visible in Stephenson's 1948 photo) cut away a small portion of the mound. Archeological excavations documented a gas line that had cut through the mound, disturbing and removing portions of a ceramic vessel from a mortuary in the mound. A large oak tree grew on top of the mound for at least 40 years (the tree appears in Stephenson's 1948 photo; the tree is quite large at that time) and was removed (after dying) in 1977. Recent (1995) lowering of the driveway across the northern edge of the mound was monitored by SFASU archeologists. No artifacts were found, but the corner of an apparent burial pit was noted and mapped. Today the mound, owned by the City of Nacogdoches and two private landowners, is stable and protected.

Impacts to the non-mound portions of the site began fairly early. Adolphus Sterne (Sterne 1923) told his son that the Mexican soldiers (only those that were Masons) killed in the Battle of Nacogdoches in 1828 were buried near the mound on the commons (some oral traditions note that when the basement of the 1916 High School was constructed, a large number of bodies were uncovered and the remains dumped in the creek). Most of the impact has been primarily through recent construction activities and erosion, principally with the construction of the 1916 High School (Figure 11). Footings for the building and a large central basement obviously had considerable subsurface impact. The fill removed by this construction was

Figure 10. East yard of the T. J. Rusk Middle School, looking south, showing excavations in Area B. The 1937 filling station (location of Mound #3 or Hardeman Mound) is marked by the arrow.

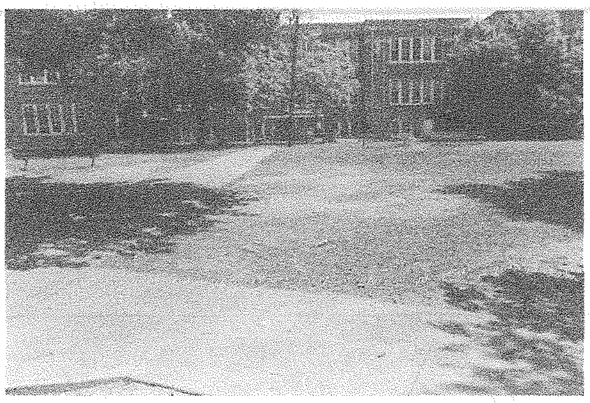


Figure 11. 1916 High School Building, looking north. Area A is in the right middle ground, while 1985 Texas Archeological Society excavations and F134 and F138 are in the area north and east of the sidewalks

placed to the north of the building to create more level space. Portions of this fill were excavated in 1982 and 1984 (Corbin et al. 1984); numerous artifacts, including very large pottery sherds, were recovered. During demolition of the building in 1984, heavy rains softened the ground considerably and heavy trucks churned and destroyed some unexcavated areas south of the building.

The construction of the 1939 WPA High School may have protected more of the site than it destroyed (Figure 12). Construction of the footings was apparently accomplished by manual excavation, and only the footings were excavated. Thus, there are intact portions of the site between the footings. Upton collected most of a large brushed-punctated vessel (Figure 13) that was uncovered while excavating the footing at the northeast corner of the building (Sanders 1939). In addition, archeological excavations indicate that leveling of the terrain was accomplished by bringing in fill from off site rather than by cutting and filling on the site. Therefore, large areas of the southeast portion of the school property is still protected by up to 60 cm of fill.

Since 1939, extensive building construction has occurred across the entire northern half of the original commons as the school property was developed. The extent of impacts to the archeological remains is not known at this time. Portions of the area north of the 1916 High School were known locally as a prime area to collect artifacts; most of this area is now believed to be disturbed to below the level of the known archeological deposits. Construction of buildings in the northwest quadrant has also left few if any intact archeological deposits. The construction of a sports playing field in the southwest quadrant completely obliterated any archeological remains in that vicinity. And yet there

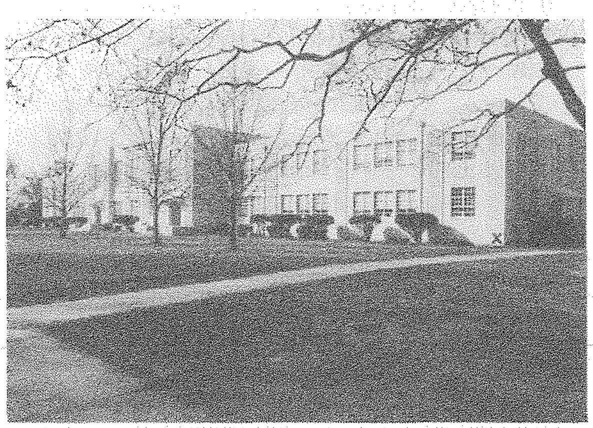


Figure 12. View of the Thomas J. Rusk Middle School (1939 WPA Nacogdoches High School), looking southwest. The place where the Caddo vessel found by Upton in 1939 is marked by the "X" on the photograph.

Figure 13. Brushed-punctated vessel (possibly parts of two or three vessels) recovered by Upton in 1939. Sherds recovered in our excavations indicate that this vessel form and decoration was very common.

are, in the southeast quadrant of the school property (i.e., Washington Square), archeological remains that are virtually intact and much like they were prior to European settlement.

ARCHEOLOGICAL BACKGROUND

Archeological investigations at the Washington Square Mound site comprise part of ongoing investigations in Nacogdoches County and adjacent areas. These investigations help to provide a context for our Washington Square investigations. The earliest archeological work done in the area were surveys conducted in 1939-1940 by Gus Arnold as part of a larger survey of East Texas (Arnold 1939, 1940). This was followed by survey work in 1948 by Robert L. Stephenson (Stephenson 1948a, 1948b) as a preliminary step to the archeological excavation of sites within the proposed McGee Bend (Lake Sam Rayburn) reservoir. Archeological research, survey, and excavations in the Lake Rayburn area were conducted in the 1950s and early 1960s by Edward B. Jelks and others. Numerous sites were recorded, and 13 were excavated and reported (Jelks 1965).

More recent work has been carried out in the vicinity of present Lake Nacogdoches. Prior to the construction of the lake, the Nacogdoches Archaeological Society had conducted an archeological survey of Bayou Loco, Bayou Moral, and Bayou Alazan, recording numerous Caddoan and Archaic period sites. Subsequently, the Texas Archeological Survey (Prewitt et al. 1972) recorded more sites. Large-scale excavations at the DeShazo site (41NA27), now under Lake Nacogdoches, were carried out by the University of Texas Archeological Field School during the summers of 1975 and 1976 (Story 1982, 1995). Research at this significant early historic Caddo site and the nearby Mayhew site (41NA21) has significantly enhanced our archeological knowledge (Kenmotsu 1992) of the Late Caddoan occupation of the region.

In 1976, the Stephen F. Austin (SFA) Archaeological Field School excavated a small Late Archaic to Late Caddoan site, 41NA44 (Corbin et al. 1978), on Legg Creek, west of Bayou Loco and Lake Nacogdoches. An archeological survey of the proposed Angelina-Nacogdoches Regional Airport recorded eight Late Archaic sites along Bayou Moral (Corbin 1978).

From 1979 through 1982, the SFA Field School conducted large-scale excavations at the Washington Square Mound site (41NA49). In 1984, the Laboratory of Anthropology conducted excavations there prior to removal of the 1916 High School building. The Texas Archeological Society Annual Field School, under the direction of the senior author, excavated portions of the site in June 1985. The excavations from 1979 to 1985 are the subject of the current paper.

In addition, the SFA Field School has conducted archeological investigations at several other sites on the same interfluve occupied by the Washington Square site. Site 41NA144 (Corbin and Kisling 1983), to the south of Washington Square, is primarily an 18th and 19th century Spanish Colonial and Euro-American site, but also has significant Early Ceramic and Late Caddoan occupations. The excavations at the Acosta-Taylor House site (41NA182), another significant 18th and 19th century site just to the southwest of Washington Square, produced evidence to indicate that the Middle Caddoan Washington Square occupation continued at least 300 m to the southwest of the mound complex.

SITE INVESTIGATIONS

Stephen F. Austin State University Archaeological Field School investigations of the site began in the spring of 1979. Earlier that year, the senior author had discovered, along the southern edge of the 1939 school building, numerous pottery sherds eroding from what appeared to be an undisturbed soil horizon beneath the fill associated with the building. In addition, some pottery sherds were also collected just north of the northwest corner of the building. At this time, little was known historically about the site other than from local tradition and occasional newspaper articles. To determine if anything remained of what was believed to be a severely impacted site, three backhoe trenches were excavated in the southern half of the front (east) yard of what is today the Thomas J. Rusk Middle School. These excavations revealed that a large part of the site was intact, capped by as much as 60 cm of overburden that had literally sealed off the site. Surprisingly, there was no plow zone evident in the trench profiles, and many large sherds and several cultural features were noted very close to the original ground surface.

Five 1 x 1 m test pits excavated by the field school students in the first week of June 1979 in the area north (Area A) of the trenches also indicated relatively undisturbed and concentrated archeological deposits. Although there was virtually no overburden on this portion of the site, there again was no plow zone, and many large sherds were recovered quite near the surface.

At this time a permanent datum (assigned an arbitrary vertical elevation of 100 m) was established on the bottom step of the northernmost front (east) steps of the 1939 school building; a secondary datum was established on the bottom step of the north steps of the building. Two permanent grid markers (N100/W100 and N240/W100), iron rebar set in concrete, were established using a laser theodolite. The excavation plan was designed to focus on the excavation of 3 x 3 m units excavated in 1 x 1 m sub-units. Excavation units were designated by their southeast corner coordinates. Since there was little visible stratigraphy other than that of a normal soil profile, the soil was removed in arbitrary 10 cm levels measured from the southeast corner of the 3 x 3 m unit. Using flat-point shovels, the soil was usually removed in shallow increments so that features could be recognized early in the process. Detailed maps were drawn of the floor of each 10 cm level. In units with complex archeological deposits, composite maps of each level of the unit were drawn as the excavation proceeded, recording as many large sherds and other objects as possible in situ. Features were recorded in plan as soon as they were detected; if deemed necessary, excavations would proceed in 2-5 cm increments to facilitate exposure and mapping of the feature. Most pit/posthole features were also cross-sectioned.

The initial research philosophy was to determine the nature of the site, its level of preservation, and how the site was related to known Caddoan components and phases in this portion of eastern Texas. We hoped to accomplish this in the context of an archeological field school (ranging from 10 to 25 students), where the primary task was to instruct students in proper excavation and field recording techniques. Thus, there was no plan that called for a certain volume of earth to be moved or number of units to be excavated. To some degree then, much of the initial excavations were exploratory in nature, using trenches, 1 x 1 m, and 3 x 3 m, excavation units. The exposure of features or the presence of artifacts usually led to the larger scale excavations. In this manner, from 1979 to the present, over 480 m^2 of the site have been excavated, recovering several thousands artifacts and many cultural features.

Excavation History

In 1979, the initial field school excavations consisted of 92 m^2, including 25 m^2 of machine-excavated trenches (Figure 14). Four 3 x 3 m units were excavated by hand in the eastern portion of the school yard. Two were excavated in Area A near test units 3-5, and two others were established in Area B, adjacent to the northernmost backhoe trench. Near the end of the season, a 1 x 5 m trench was excavated into the remaining mound, revealing that it was an artificial construction that contained burials. A burial, Feature 31 (F31), was excavated in this part of the mound.

In 1980, excavations west of Area A, designated Area C (23 m^2), documented portions of a large structure (F101) under the remnants of a mound. A 1 x 3 m trench (Trench 7A) excavated into the east side of the Reavley-House Mound revealed more of the nature of the mound construction and the outlines of at least two deep shaft burials.

Excavations in Area A continued in 1981 and Trench 10 (18 m^2), north of the Reavley-House Mound, was excavated prior to the construction of a new sewer line. In addition, we excavated one of

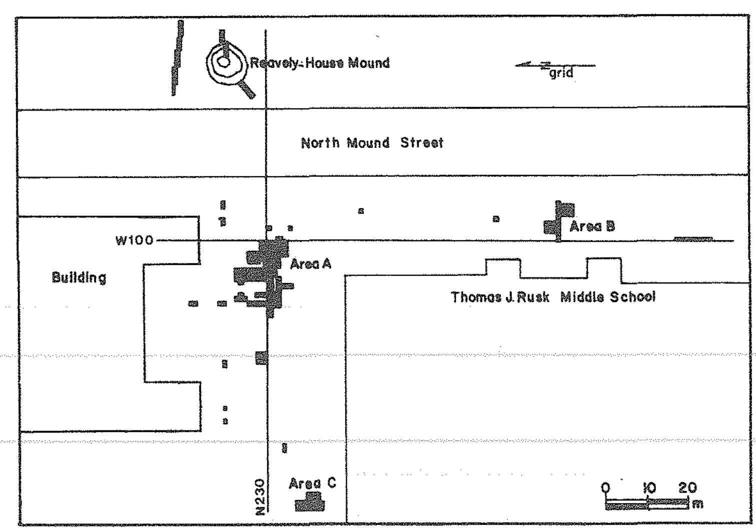


Figure 14. Excavation plan, 1979-1985.

the burial pits, F95, found in Trench 7A the previous year.

In 1982, Trench 7B (a 1 x 3 m unit) extended the profile along the N239 line into the center of the mound. An attempt was made to excavate a burial pit (F112) located the previous season in Trench 10, but this was abandoned when it was determined that the pit was larger than our 3 x 3 m unit and at least 2 m in depth.

In 1984, the Nacogdoches Independent School District (NISD) decided to raze the 1916 Nacogdoches High School building. Under a contract with the district, the SFASU Laboratory of Anthropology excavated 48 m^2 and two backhoe trenches (23.25 m^2) to partially mitigate any impact to the site caused by the destruction and removal of the building (Corbin et al. 1984).

The last major excavations at the site were conducted by the Texas Archeological Society Annual Field School in 1985. This enterprise focused entirely on expanding excavations in Area A. A total of 101 m^2 were excavated, revealing several features, including the enigmatic ceramic-filled pits.

From 1979 to the present, a number of small excavations have been conducted in conjunction with various small construction projects initiated by the NISD. In some cases, controlled excavations (ca. 4 m^2) were completed prior to the project, but most often the archeologists performed clean-up functions and spot screening as the project was nearing completion or after it had been completed. Occasionally, some school construction projects that impacted the site were initiated and completed without any archeological work.

Other small (three or four 1 x 1 m units) short-term excavations were conducted as a part of laboratory exercises for university introductory archeology classes, and for training and educational programs for groups such as the *Junior Historians* at the Middle School. Some were also conducted as a part of an annual University program, *Fabulous Friday*, a day-long enterprise to introduce talented 5th graders from the region to the University. The archeology program, entitled *Search for the Lost Texans*, was supervised by the senior author and assisted by members of the SFASU Anthropology/ Archaeology Club.

Non-mound Features

A number of features were exposed during the area excavations. Most of these were postholes, small charcoal-filled pits, ceramic-filled pits, and various other pits. Although there is no plow zone at Washington Square, the features were usually detected at ca. 10-20 cm *below the original ground surface* (bs). When detected in profile, a definite demarcation of the original point/surface of origin of features was not discernible, although they generally could be traced higher in the profile than they could be detected in horizontal excavations. Thus, the actual depth of the original feature can only be estimated, but it is believed that most features, including the charcoal-filled pits, originated 10-15 cm above the level of detection.

Postholes

With the exception of the postholes associated with the structure under Mound1/2, none of the postholes (Figures 15-17 and Table 1) appear to be associated with a typical circular Caddoan structure. While it is possible that the excavations were not extensive enough to detect circular alignments, it is interesting that the excavations in Area A did not reveal even a small portion of a circular alignment. In most cases the few postholes appeared to be isolated, or associated with only a few other features. They differ from the charcoal-filled pits in that they are usually deeper and lack masses of charred organic material. Most have a tan, sandy fill, occasionally with tiny flecks of charcoal.

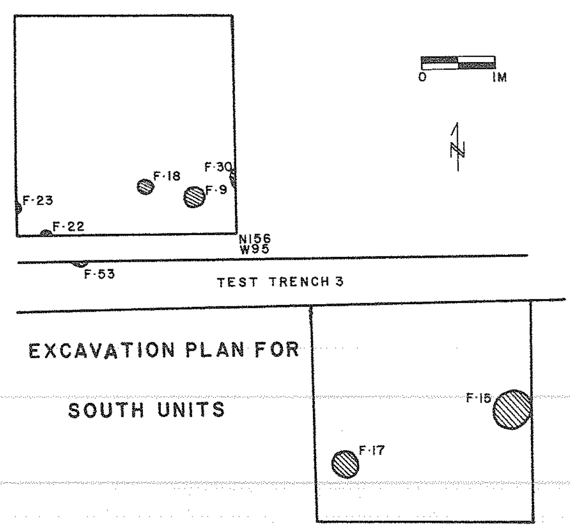


Figure 15. Plan of 1979 Area B excavations showing feature locations.

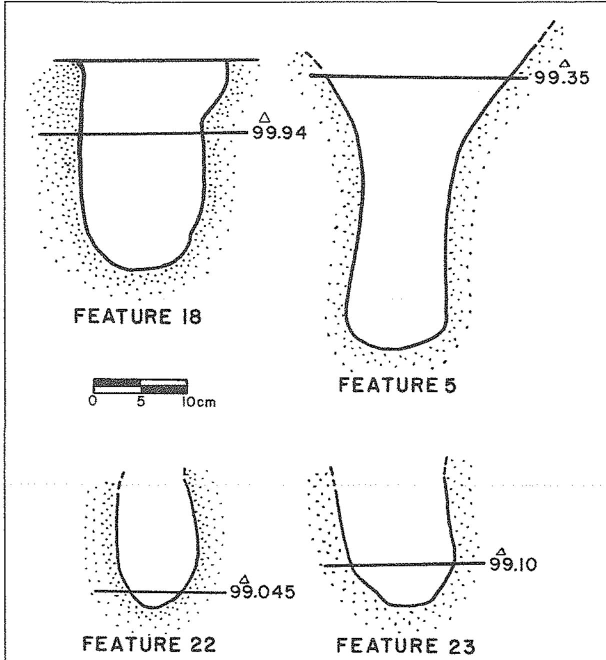


Figure 16. Profiles of typical postholes.

Charcoal-filled pits

These aboriginal features occur in many Caddo archeological sites in south-central East Texas, from the earliest periods (e.g., George C. Davis site) through the historic period (e.g., Mission Dolores de los Ais), and are a common source for carbonized material for radiocarbon dating. At Washington Square (Figures 18-19 and Table 2), the amount of carbonized material in the pits varied as did the type of charred organic remains. The charred material was primarily wood, but several features also included charred corn cobs, hardwood nut shells, and pine cones. In addition, other materials (small pottery sherds, small bone fragments, and small bits of fired clay) were occasionally recovered from the fill of the pits. Large pottery sherds occurred in the upper few cm of two (F9 and F199) of these pits.

Most of these features at Washington Square appear to have been used repeatedly or at least had multiple fill and excavation

Table 1. Postholes

Feature #	Provenience	BS (cm)	Dimensions	Fill Material
5	Test Pit 1	?	top=21 cm; bottom= 11 cm; depth=30+ cm	Tan sand, sherds, Charcoal flecks
18	N156/W96	?	top=20 cm; bottom= 15 cm; depth=27 cm+	Tan sand, Charcoal flecks
22	N156/W97	30	top=11 cm; bottom= 11 cm; depth=17 cm+	Tan sand
23	N156/W97	30	top=15 cm; bottom= 15 cm; depth=17 cm+	Tan sand
53	Test Trench 3	?	top=60 cm; bottom= 20 cm; depth=30 cm+	Tan sand
64	N219/W162	55	top=20 cm; bottom= 13 cm; depth=7 cm+	Tan sand
68	N230/W106	10	depth=42 cm	Reddish sand, Clay lumps, Charcoal flecks
78	N214/W161	?	top=18 cm; bottom= 18 cm; depth=16 cm+	Dark grayish sand
96	N228/W105, under F45	39	top=17 cm; bottom=?	Tan sand, Charcoal flecks

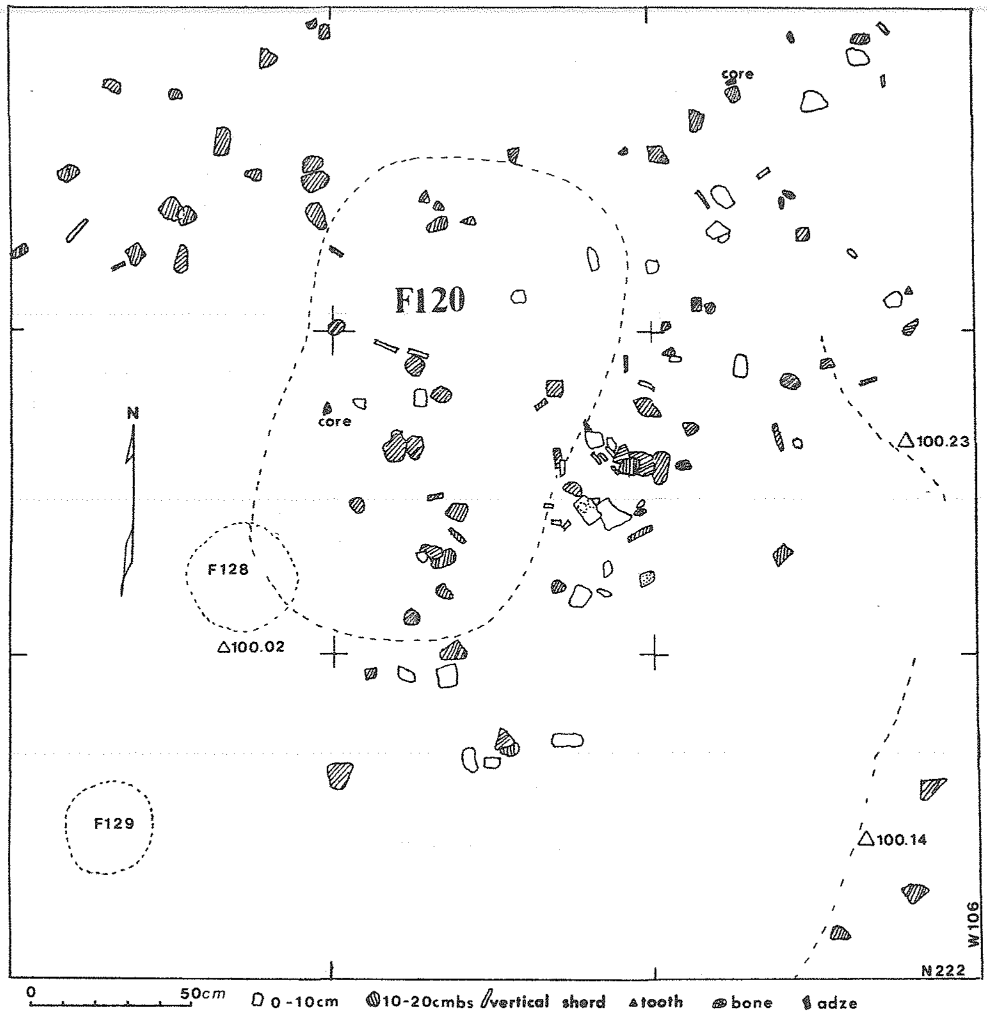


Figure 17. Plan view of Feature 120.

episodes. The charcoal-filled pits averaged ca. 25-30 cm in diameter and ranged from ca. 20-30 cm in depth. Based on radiocarbon dates from six of these features (F8, F9, F30, F75, F80, and F199), four (F8, F9, F75, and F199) are clearly associated with the primary occupation of the site at ca. AD 1300. The other two (F30, with a calibrated two sigma date range of AD 1430-1666; and F80, with a calibrated two sigma data range of AD 604-984) may be associated with the very ephemeral earlier and later occupations that occur at the site.

Pits

Five pits of varying size have been identified at the site (Table 3). The characteristics of the pits are such that we suggest that each had a very different function or use.

Feature 15, located in N153/W91 (see Figure 15), was first recorded as a ca. 40 cm circular area with a darker, more friable matrix than the surrounding soil. A even more friable circular area occurred in the center of the feature. The soil was removed from the feature before profiling, and the matrix was screened. The matrix was comprised primarily of a soft brown sand with fine charcoal flecks, charred hickory nut fragments, a small charred bean seed, and a fragmentary charred corn cob. The pit was slightly bell-shaped and ca. 50 cm deep.

Feature 17 first appeared as a soft circular area of sandy soil ca. 20 cm in diameter in N152/W93 (see Figure 15). An east-west profile of the feature indicated it was a pit with three distinct areas of fill (Figure 20). The western area, possibly a large post mold, was ca. 20 cm in diameter and 57 cm deep, and had a very dark mottled sandy fill.

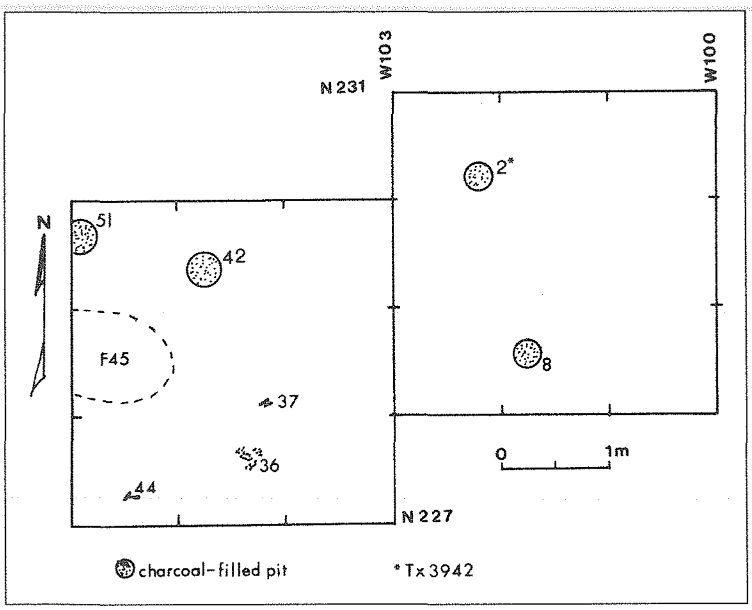


Figure 18. Plan of 1979 Area A excavations showing feature locations.

Feature 115 occurred in the northwest quadrant of the 3 x 3 m unit N224/W103, ca. 3 m due south of Feature 45. First detected at ca. 10 cm bs, the feature appeared as an oval area of soft brown sandy loam bordered by several small post holes (Figure 21). Most of the pit was ca. 30 cm below detection level. A circular area 40 cm in diameter in the southeast end of F115 was 40 cm below detection level. Within this depression was a smaller round-bottomed pit ca. 10 cm in diameter and 8-10 cm deeper than the rest of the feature.

A number of small and shallow post holes were clustered along the southeastern margins of the pit. Some had clearly been intersected by the pit, while others clearly intruded into the pit margins. Two post holes were in the pit fill (see Figure 21). In the northwest end of the pit was a concentration of red clay lumps. The lumps were similar to that of the B2t soil horizon that occurs lower in the solum at the site.

The second fill was sandier and lighter, and may represent fill around the post. The third area, a tree root mold, was a light tan sand. Water screening of the primary matrix produced small deteriorated bone fragments, charcoal, and three small pottery sherds.

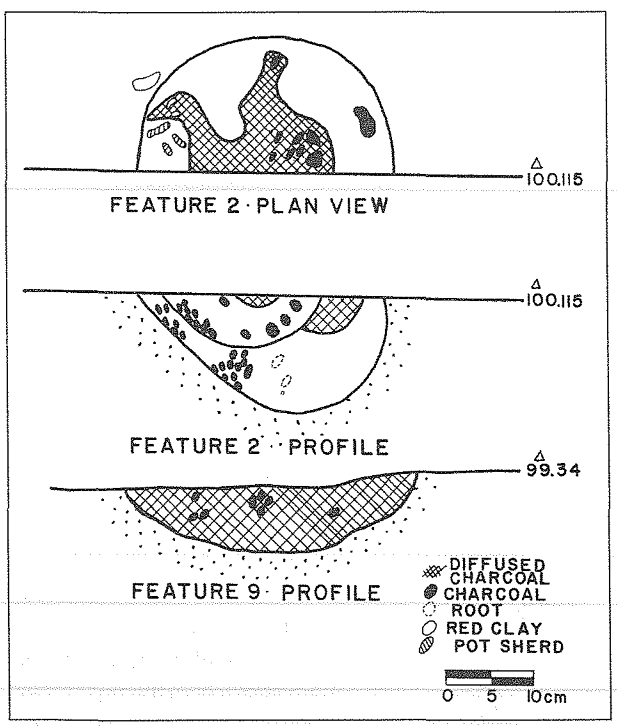


Figure 19. Plan and profile of charcoal-filled pits: a, F2; b, F9; c, F8; d, F42.

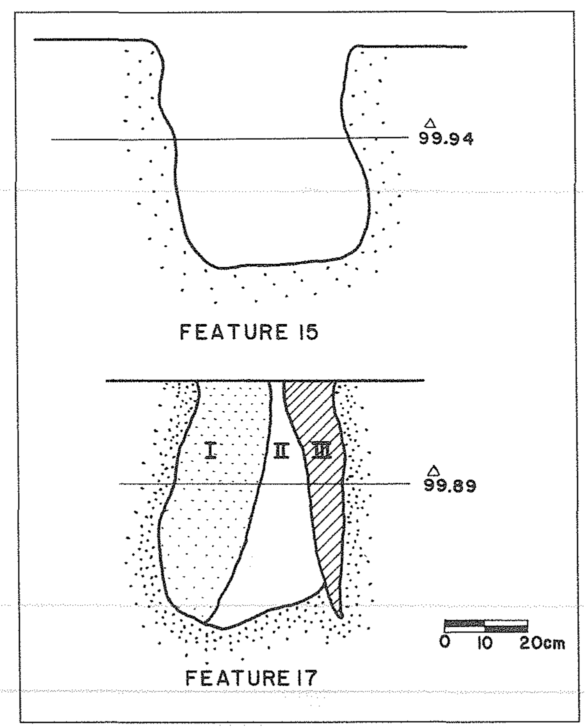


Figure 20. Profiles of Features 15 and 17.

Table 2. Charcoal-filled Pits

Feature #	Provenience	BS (cm)	Dimensions (cm)	Fill Material
2	Test Pit 3	28	27 x 12+	Charcoal flecks
8*	N230 / W102	30	30 x 10+	Wood Charcoal
9*	N156 / W95	30	30 x 13+	Corncobs, Wood
30*	N156 / W95	25	20 x 10+	Corncobs, Wood
42	N299 / W104	20	30 x 18+	Wood Charcoal
51	N229 / W105	30	27 x 8+	Wood Charcoal
75*	N214 / W160	30	40 x 27+	Wood Charcoal
79	N214 / W161	30	25 x 10+	Nutshells, Wood
80*	N214 / W160	?	30 x 15+	Wood Charcoal
86	N124 / W162	?	27 x 8+	Wood Charcoal
199*	N195 / W95	?	?	Corncobs, Wood

* Features associated with radiocarbon dates (see Table 4)

An excavated area of ca. 6 x 5 m incorporated the original 3 x 3 m excavation unit. Over 7,000 pottery sherds were recovered here, many in clusters that may mark small, shallow pits. In addition, most of the ground stone tools from the site, including fragments of a large battered ground stone celt, were also recovered from the units adjacent to F115.

Feature 52 is a shallow pit exposed in the profile of Test Trench 2. The pit was ca. 150 cm wide and 20 cm deep at ca. 10 cm bs. No artifacts were recovered from F52 while preparing the profile.

Feature 108 was recorded in the south profile of Trench 9. The top of the pit originated just below the A-horizon (ca. 17 cm bs). The sides of the pit, 87 cm wide and 21 cm deep, tapered smoothly to form a sharp angle at the bottom. The matrix in the pit is a fine, compact, grey sand containing flecks of charcoal. One sherd was recovered from the pit during troweling of the profile.

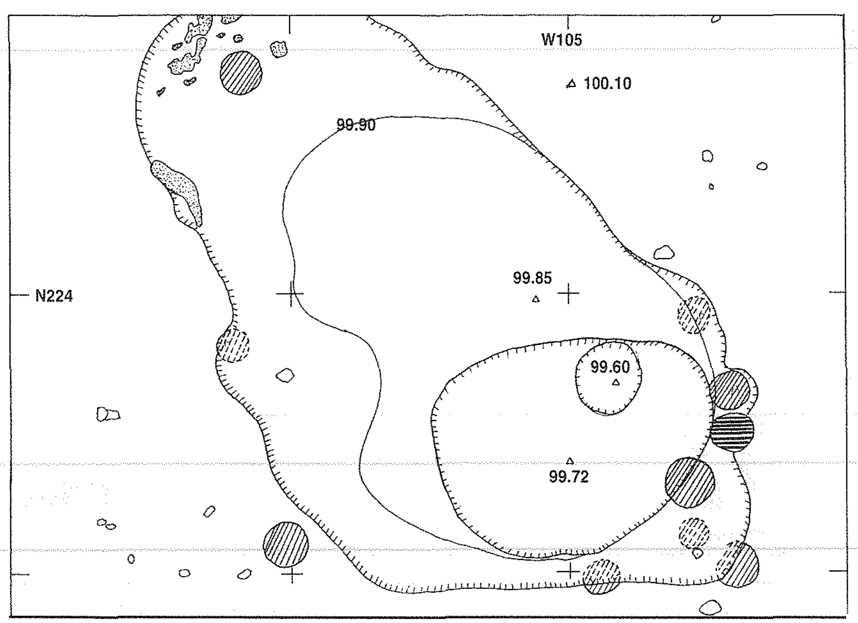


Figure 21. Plan view of Feature 115.

Sherd-filled Pits

Four shallow pits contained numerous small to very large sherds from ceramic vessels. While several sherds from the same vessel did occur, usually many vessels were represented in the pits. In almost each case, the cluster of sherds in the pit was detected before the outlines of the pit were visible. Usually the pit was noted only if it had been excavated into the B2t soil horizon. Although sherds were the main artifacts in the pits, some lithic and bone debris were also associated.

Table 3. Other Features

Feature #	Provenience/Unit	Description
15	N153/W91	Pit
17	N152/W93	Pit
31	Reavely-House Md.	Burial
35	Reavely-House Md.	Burial Pit
36	N227/W104	Charred Corn Cobs
37	N228/W104	2 Deer Bones
43	Reavely House Md.	Burial Pit
44	N227/W105	2 Deer Bones
45	N227/W103	Sherd-filled Pit
52	Test Trench 2	Pit
64	Feature 101	Post Hole
90	Reavely-House Md.	Burial Pit
95	Reavely-House Md.	Burial
98	N219/W163	Post Mold/Fea. 101
99	N217/W162	Post Mold/Fea. 101
101	N217/W163, N219/W162	Buried Structure Remains
102	N217/W162	Shallow Post Mold/ Fea. 101
104	N217/W162	Compacted Floor of Fea. 101
107	N237/W107	Sandstone, Pottery Sherds, and Charcoal
108	Trench 9, N239/W104	Pit
112	Trench 10, N249/W51	Burial Pit
113	Reavely-House Md.	Burial Pit
115	N224/W103	Pit
116/122	N224/W103	Burned Clay associated with Fea. 115
117	N224/W104	Small Ash Lens
118/119	N224/W103	Area of Dark Sandy Loam
121	N223/W103	Post Mold associated with Fea. 115
123	N225/W105	Pit associated with Fea. 115
126	Reavley-House Md.	Burial Pit
128	N223/W108	Possible Shallow Post Mold
129	N222/W108	Possible Post Mold
134	N214/W106	Sherd-Filled Pit
138	N211/W112	Sherd-Filled Pit

Feature 45, a large, oval shallow pit, occurred in the northwest quadrant of the 3 x 3 m unit N227/W103 (Figure 22). It first appeared as an indistinct area of mottled brown soil containing small red clay lumps and charcoal flecks at ca. 20 cm bs. The feature bottomed out at ca. 50 cm bs, and was at least 2 m in diameter. Excavations of F45 produced over 100 sherds; 63 large sherds were mapped in place. These sherds represent major portions of at least seven different vessels. Features 51 and F42, charcoal-filled pits, F36, a concentration of charred corncob fragments, and F37 and F44 (bone clusters) circumscribed F45. Feature 96, a possible posthole, was discovered beneath F45 in N228/W105.

Feature 120 was the second of these interesting features to be discovered at the site. The cluster of large sherds was first detected at ca. 9 cm bs. It was not readily apparent that the cluster of sherds was in a pit, but the vertical position of many large sherds and overlapping sherds suggested a pit (see Figure 17). Once the sherds had been plotted and removed, a very faint pit outline could be seen at ca 30 cm bs where the very bottom of the original excavation had cut into the B2 soil horizon. At the detection level, F120 may have exceeded 2 m in diameter, with a deeper area ca. 1 m in diameter.

Feature 134 is similar to F120 in that no distinct pit outlines were visible (Figure 23), but the very large size of the sherds, the number of vertically-oriented sherds, and the presence of overlapping sherds, indicated that the sherds were not on a horizontal surface. The matrix associated with the sherds was less homogeneous and more mottled than the surrounding

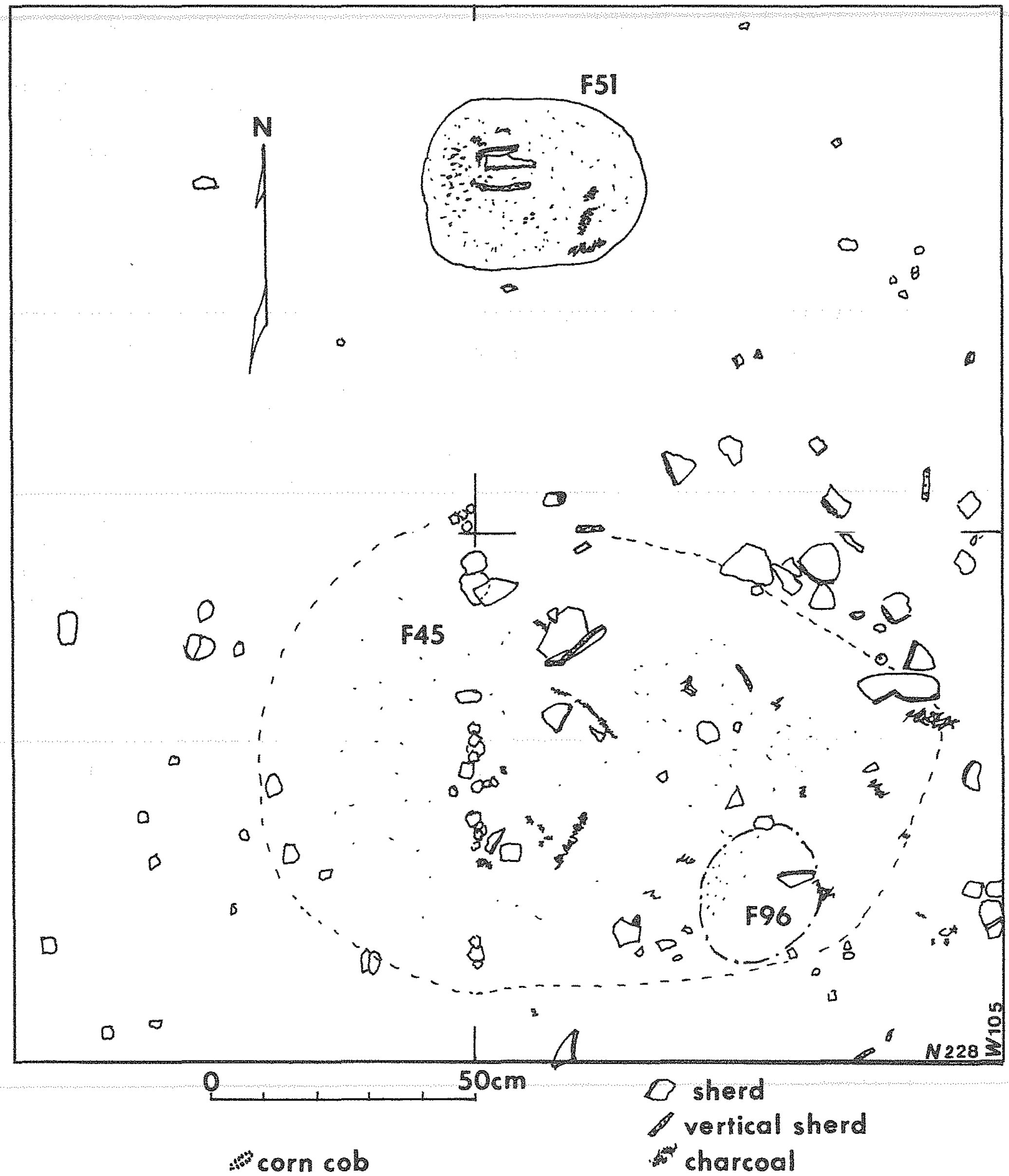


Figure 22. Plan view of Features 45, 51, and 96.

soil. The sherds first appeared ca. 8 cm below the original ground surface and continued to ca. 25 cm bs. The pit apparently encompassed an area at least 1 m in diameter.

Feature 138, like the other ceramic-filled pits, was originally noted as a large concentration of pottery sherds containing many overlapping and vertically-oriented sherds. While no pit outline could be discerned in plan view, adjacent profiles revealed that the sherds and other artifacts were in a large (> 4 m^2) shallow depression (Figures 24 and 25). The distribution of the sherds by 10 cm level suggest either that the bottom of the depression was irregular in depth or that the pit/depression may have been filled with loads of debris that included soil and sherds.

MOUND FEATURES

The Reavely-House Mound (Mound 4)

As previously mentioned, portions of two of the three mounds known to have existed at the site are still extant. Of these, the Reavely-House Mound (Mound 4) is the best preserved. The initial trench (Trench 5) into the mound was excavated to deter-

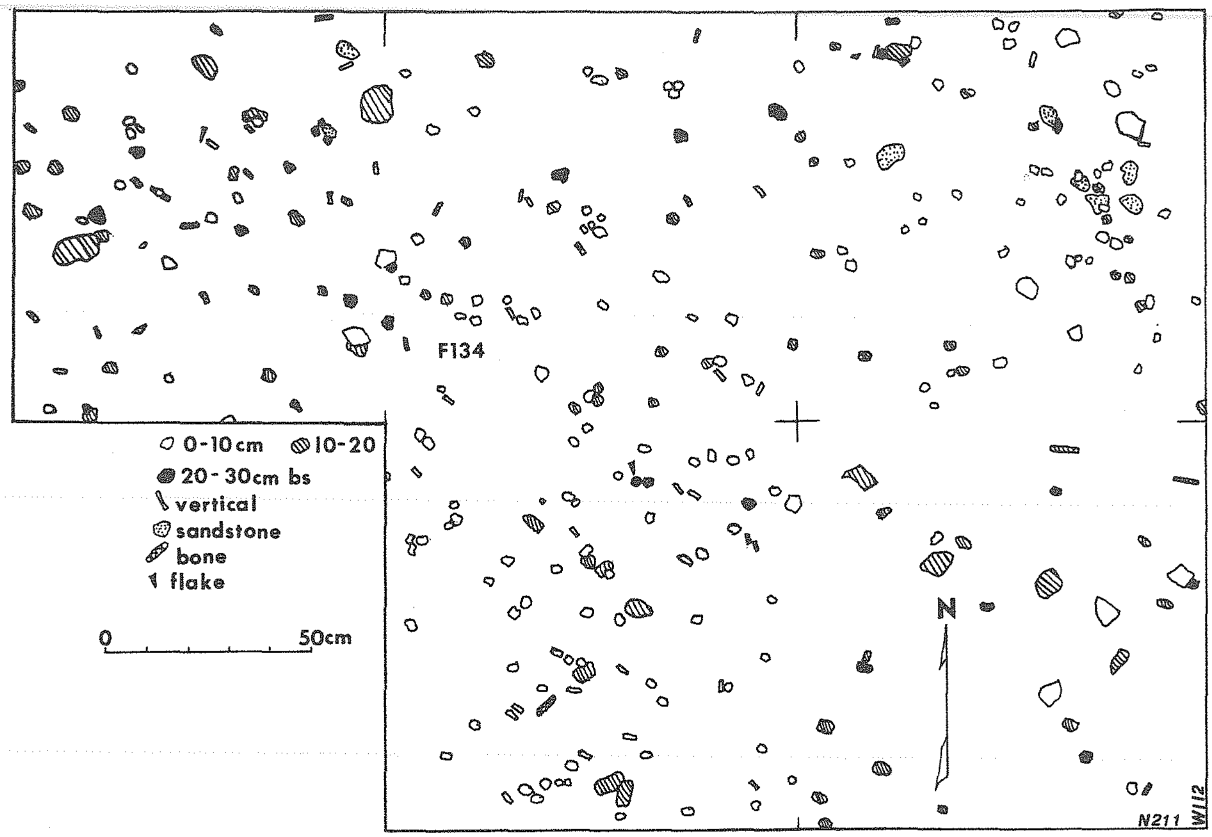


Figure 23. Plan view of Feature 134.

mine the nature of the mound and record the stratigraphic sequence (Figure 26). By 20 cm bs, the complex layering of brightly colored red and yellow fills indicated that the mound was a man-made construction. Slightly deeper, a ceramic vessel was uncovered within an area of fill that suggested a shaft burial.

Since the primary function of the trench was to obtain a stratigraphic profile of the mound, it was decided to continue excavating the trench even if it cut through the presumed burial, designated F31. As the excavations continued, detailed photographs and drawings recorded other ceramic vessels and conch columella beads. The walls and floor of the trench had a complex series of deep shaft burials, mound construction episodes, and occasional segments of the pre-mound surface (Figure 27). The F31 burial was apparently one of

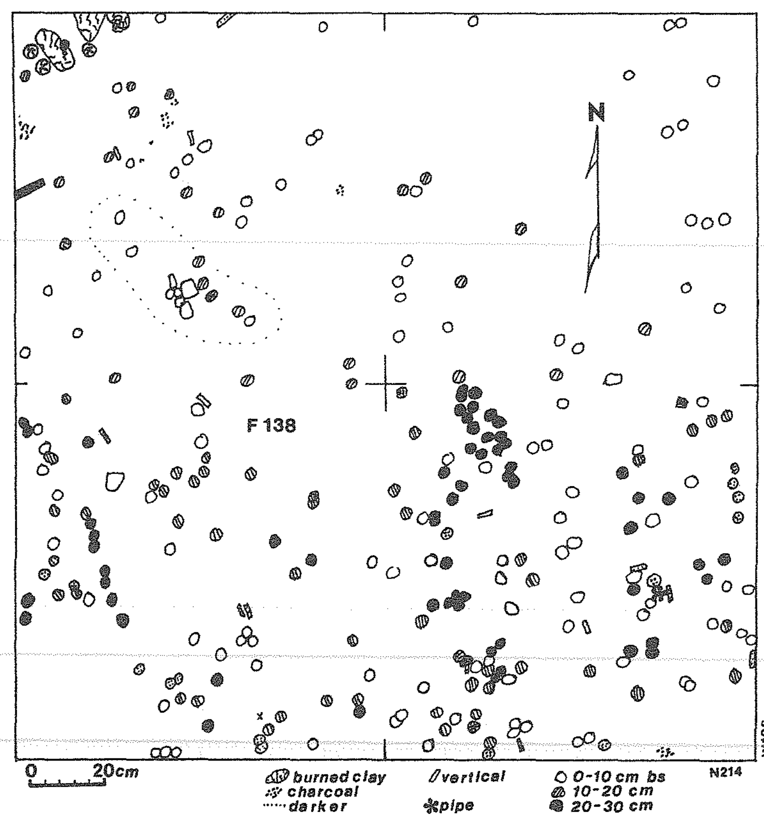


Figure 24. Plan view of Feature 138.

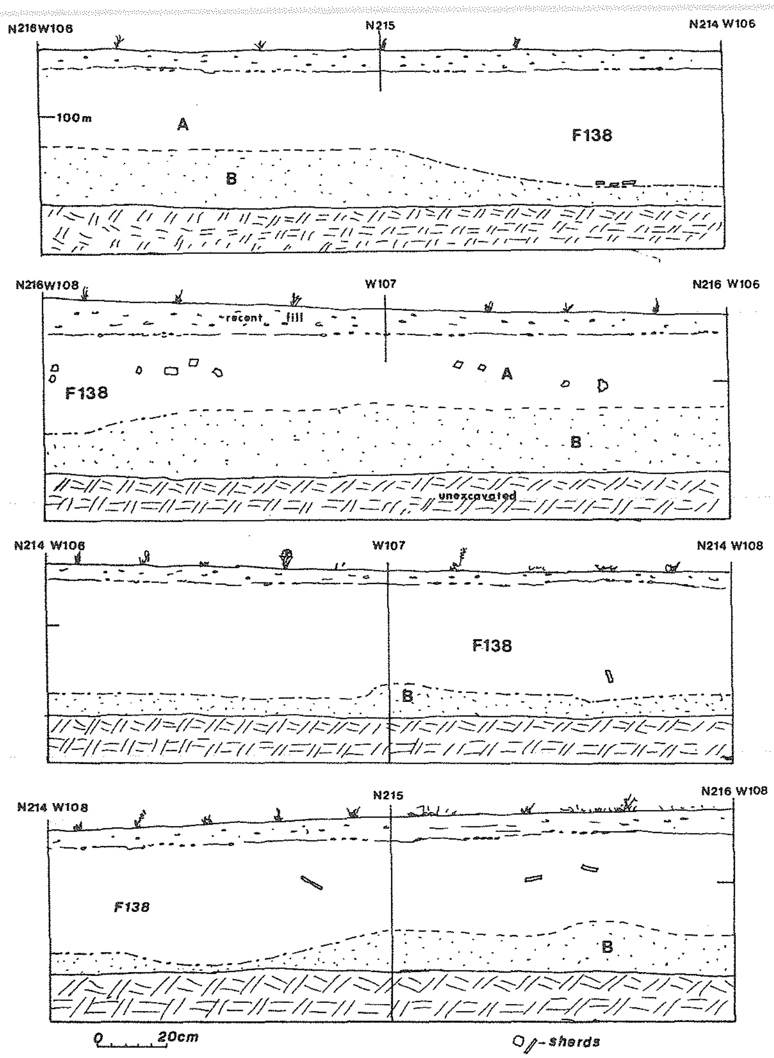


Figure 25. Profile of Feature 138.

the latest interments in the mound. After recording the profiles and floor plan, the rest of F31 was excavated.

The following season, a 1 x 3 m Trench 7A was excavated to determine if the extant basal edge of the mound was indeed the original edge. The walls and floor of the trench, however, uncovered two burial pits (Figure 28), suggesting that the mound had been larger in the past. The walls and floors of Trench 7B had a complex sequence of mound construction and shaft burials similar to Trench 5. Feature 95, one of the burial pits recorded in Trench 7A, was also excavated at this time. This excavation exposed another burial pit (F113) immediately to the north of F95. Trench 10 encountered another burial pit, F112, about 3 m to the northeast of the current mound, but this feature has not been investigated.

Feature 31

Feature 31 was a burial of a single individual in a northwest-southeast oriented pit that was ca. 160 cm x 105 cm in size (Figure 29). A trench and pipe for the original gas line to the historic Reavely house had cut through the burial pit and disturbed a ceramic vessel. The skeletal remains, possibly those of a young male, were very poorly preserved; the cranium was at the southeast end of the pit. Fifteen ceramic vessels (including two bottles), 13 conch columella beads, and a cache of 11 chert flakes were associated with the human remains. Several areas of darkly stained soil in the vicinity of the skeletal remains suggested the presence of organic materials in the grave, while one cluster of beads around the wrist was from a bead bracelet. For the most part, the ceramic vessels were clustered, some nested, in the corners of the pit. A large, undecorated olla near the skull was sitting on a small area of charred wood. Associated fire-reddened earth suggests that a small fire (or at least glowing embers) had been placed in the pit before the vessel.

Feature 95

This burial contained the poorly preserved skeletal remains of two individuals placed one on top of the other (Figure 30). The shaft for the burial had been excavated deep into the C-horizon; digging stick marks were readily visible on the walls of the shaft. The floor of the grave was excavated to a bright yellow clay strata. The floor was not level; small humps of clay, apparently left intentionally, often served as pedestals for clusters of ceramic vessels. A distinct organic layer overlay the yellow clay in all areas of the floor.

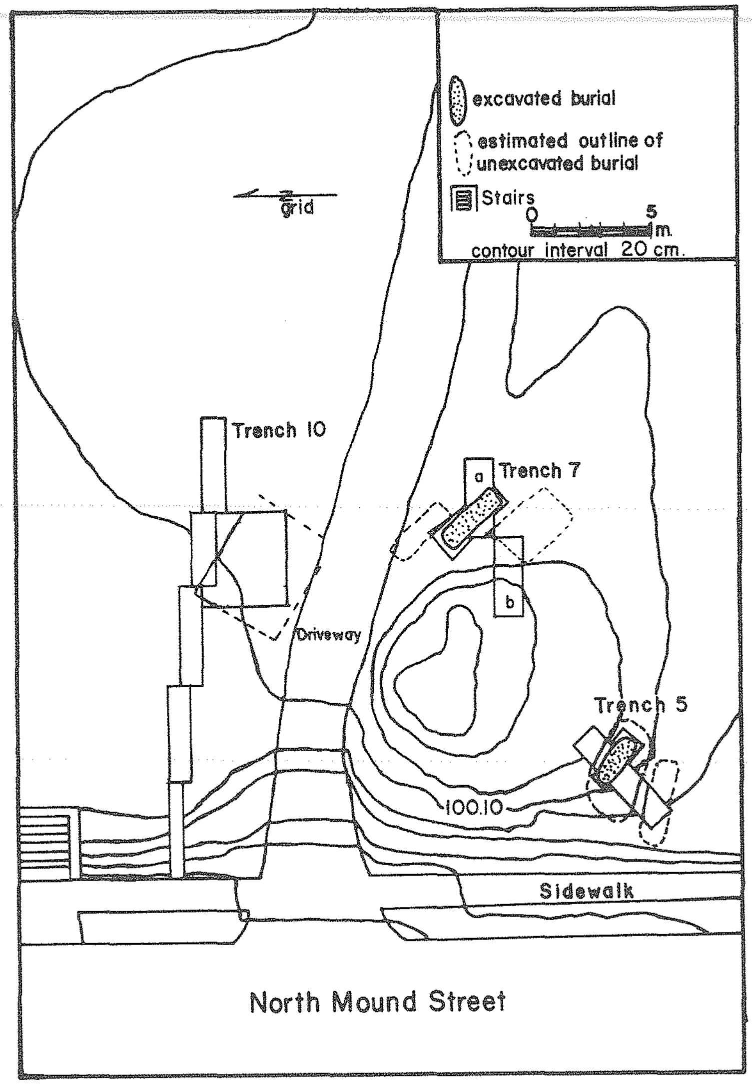


Figure 26. Excavation plan of Area D and Reavely-House Mound.

The clay into which the shaft had been excavated is highly impermeable; at the time of the archeological excavations, the matrix in the burial was very damp. Many of the ceramic vessels, particularly the lowest ones, were very soft and deteriorated, and their removal was extremely difficult. Horizontal surfaces of the vessels were highly leached and some interior and exterior surfaces were completely removed.

Analysis of the skeletal remains suggest the lower individual (B-II) was an adult female, while the other (B-I) may have been a sub-adult male. Both had cranially modeled skulls. Interred with the individuals were 34 ceramic vessels, including two bottles. In contrast to F31, most of the vessels, many nested within each other, were placed in a row along each side of the individuals. The two bottles, obviously intentionally smashed, occurred at each wrist area. One of these bottles is engraved with the canebrake rattlesnake motif (Figure 31), a motif that may be a Middle Caddoan period cultural marker (Middlebrook and Perttula 1997:7).

Many of the vessels contained small lumps of yellow clay as if some of the material from the bottom of the pit had been intentionally placed in the vessels. Almost all of the complete, unbroken, vessels contained some organic debris. In addition, Vessel 1 contained small lumps of red, yellow, and black pigment; Vessel 13 contained a small mass of soft reddish material; Vessel 24 contained a lump of reddish-purple and yellow pigment; and Vessels 30 and 32 contained lumps of white clay.

Badly deteriorated conch columella beads were recovered at each wrist of the adult female (B-II), along with a small shell pendant from the chest area. Furthermore, a small shell disc and two possible bone artifacts were also recovered in association with this adult female. Organic staining and debris in and around the vessels and skeletal remains suggest that the individuals were both covered with some material distinct from clothing at the time of interment.

The University Mound (Mounds 1/2)

The excavations at the Washington Square Mound site that uncovered this mound were directed at explaining the occurrence of a large rectangular area of dead grass immediately south of the Old University Building. South of this anomaly was a gently sloping eroded surface that usually exhibited a number of pottery sherds after a rain. Our excavations showed that the rectangular anomaly was a thick clay pad that had been the foundation for the 1904 Central Public School. Excavations

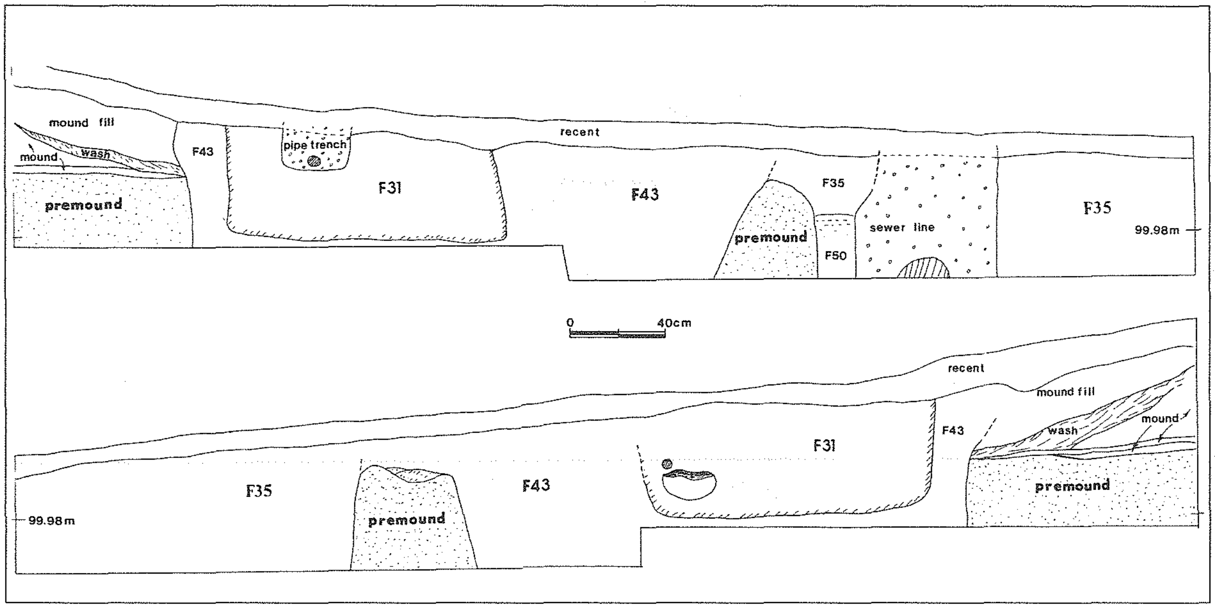


Figure 27. Profile and Plan, Trench 5, Reavely-House Mound.

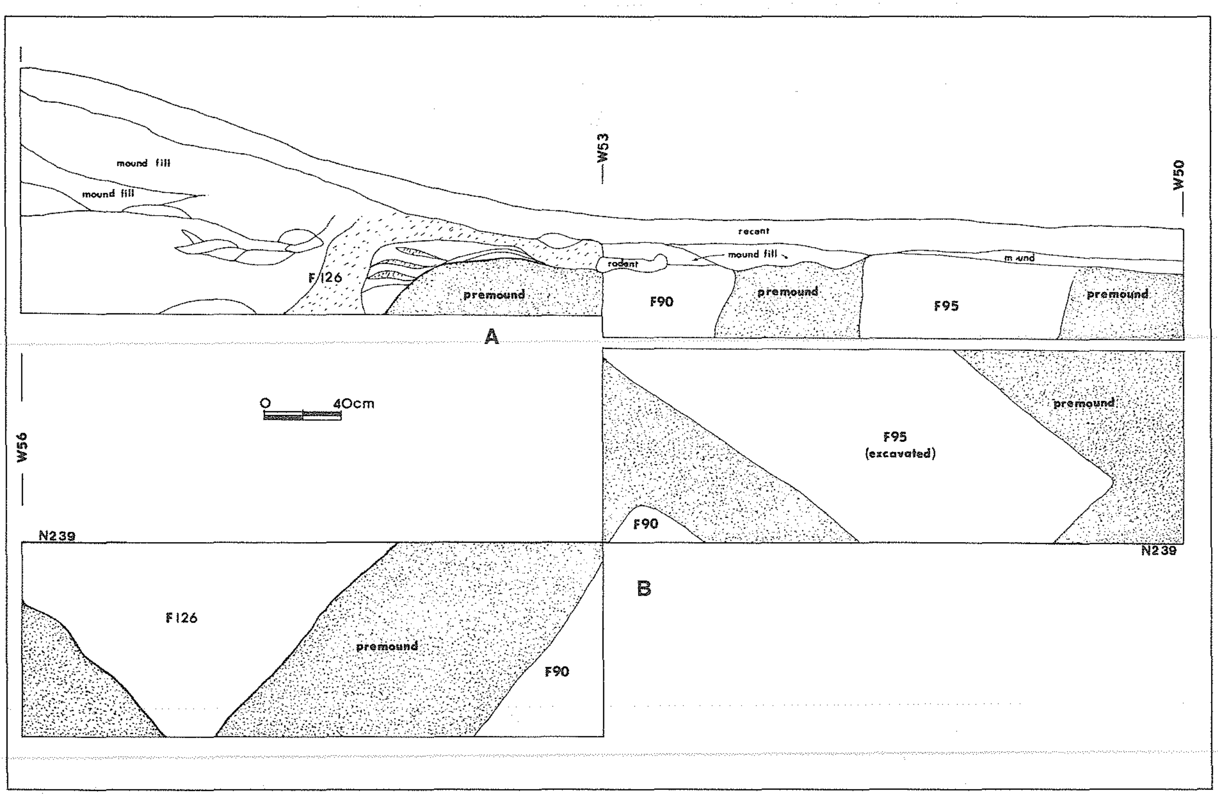


Figure 28. Profile and Plan, Trench 7A and 7B: a, north profile of Trench 7B along W239 line; b, south profile of Trench 7A along N239 line.

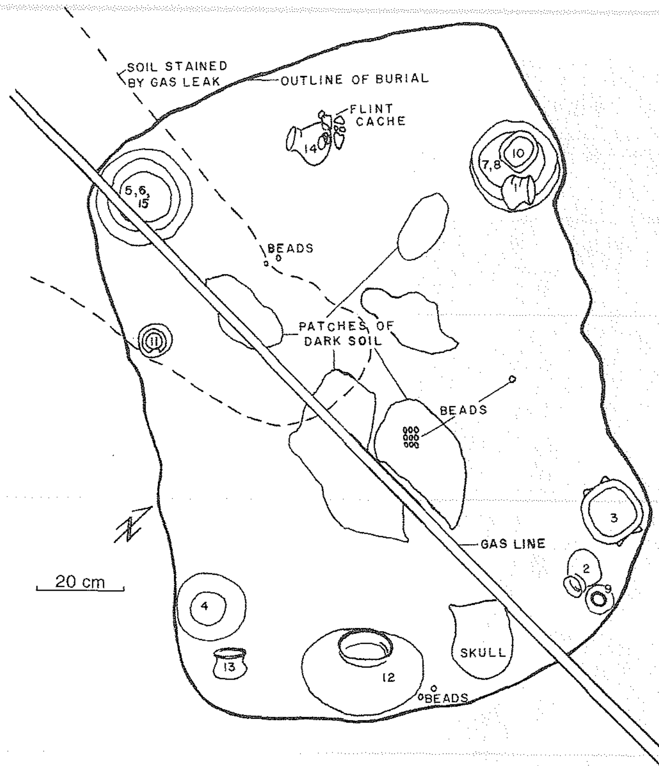


Figure 29. Plan of Feature 31.

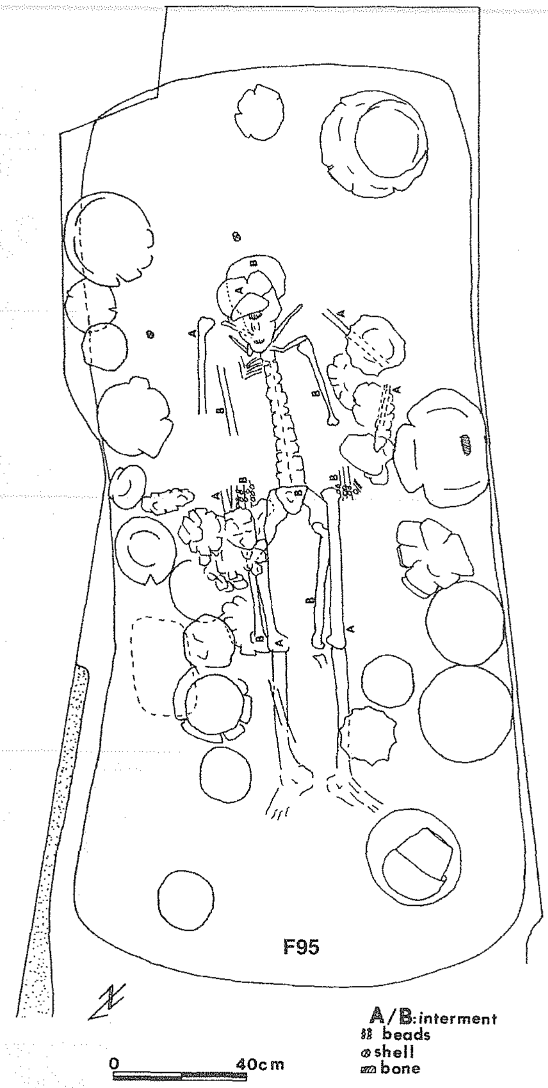


Figure 30. Plan of Feature 95.

beneath the clay pad found relatively intact Caddoan archeological remains that were probably associated with the mound that stood immediately south of the Old University Building.

The Caddoan remains (F101) were originally identified as a series of long, narrow, and parallel organic stains (Figure 32). Once the first 1 x 1 m unit was expanded, it was obvious that the long tapering stains, generally oval in cross-section, were the archeological remains of long wood structural members from a building. There appeared to be two sets of stains; one set of stains is wider and thicker and generally appeared to overlie or lie atop the second set. The second set of stains was not as wide or thick, but may only represent the upper portion of long tapering structural members.

Among the structural stains was a series of shallow post depressions and two postholes that formed a slight arc. The two postholes and attendant post molds (F64 and F99) were much deeper than the rest of the shallow depressions. Seven very compact circular depressions may be from sturdy posts set on the surface that supported considerable weight. These shallow depressions contained a light tan sandy fill. These features generally appeared to overlie the remains of the horizontal structural members. Four other similar features were shallow, dark, organically-stained compacted depressions, but occurred below the horizontal structural remains.

Within the arc the matrix was hard and compact, while outside to the east the matrix was similar to that found throughout the site. Incorporated into the compacted surface were tiny sherd and bone fragments, along with bits of charcoal. Outside the arc, sherds were much larger and artifacts were much more numerous.

The excavations suggest that the structure had been constructed on the leveled surface of a low, natural sandy rise. There is a normal soil profile below the surface on which the structure was built, and there was no indication of occupation below F101. Only a portion of a thin layer of the sandy fill that had been placed over the razed structure had not

Figure 31. Bottle (Vessel #23) with Canebrake Rattlesnake Motif, Feature 95.

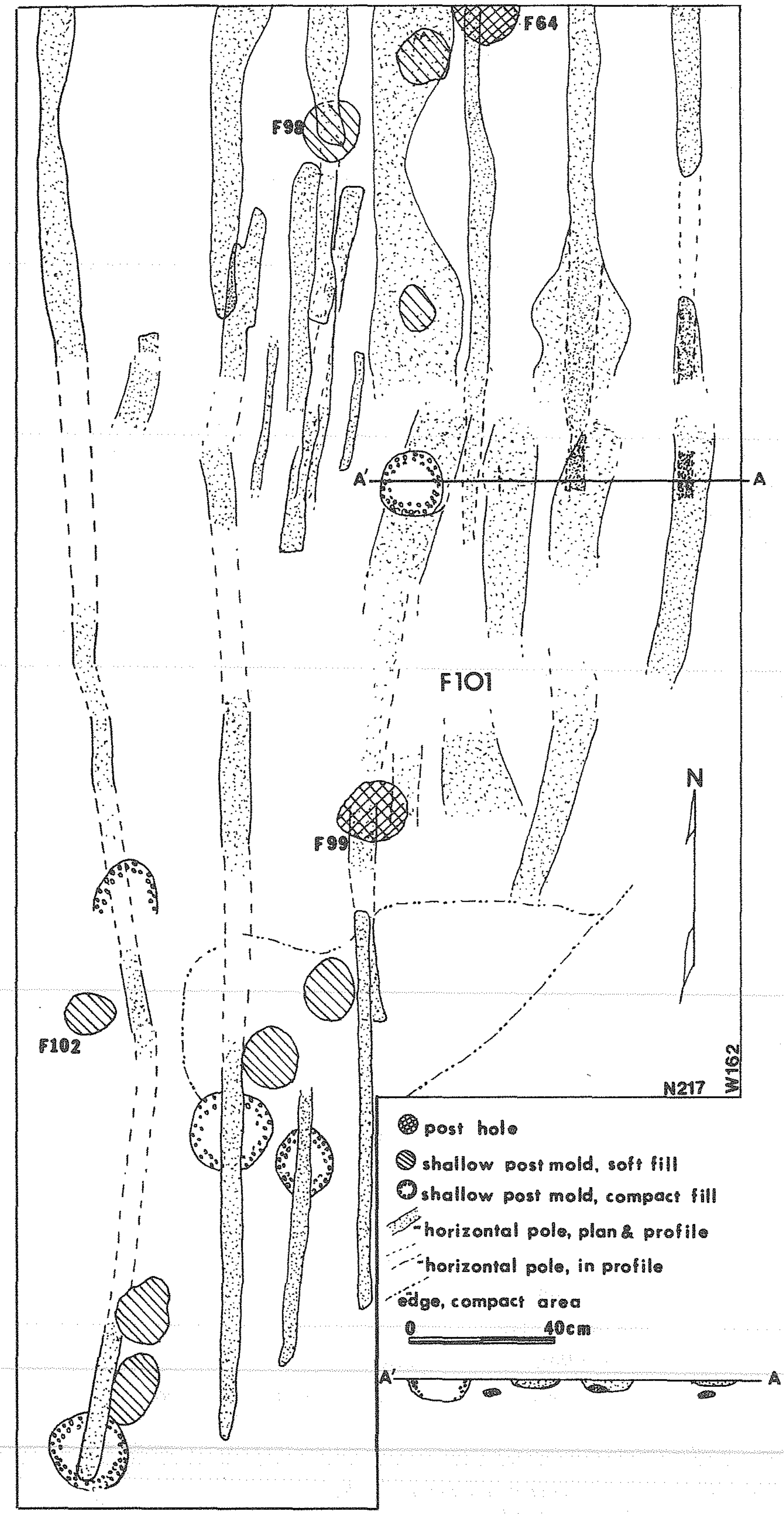


Figure 32. Plan View and Profile of Feature 101, a collapsed structure in the University Mound.

been removed by the construction of the 1904 building. This fill contained many artifacts, suggesting an origin in a nearby occupation area. Most of the sherds recovered from the surface immediately south of the F101 structure came from disturbed fill from the upper portion of the original mound.

RADIOCARBON DATES

Twelve radiocarbon samples, primarily from charcoal-filled pits, were collected, processed, and analyzed from the Washington Square Mound site (Table 4).[6] Seven of the dates (calibrated and 2 sigma age range) derived from the radiocarbon analysis cluster between A.D. 1268-1302. Ward and Wilson's (1978) chi-square test, as implemented in the CALIB rev. 3.0.3 program (Stuiver and Reimer 1993:27), was used to determine that these dates are statistically the same at the 95 percent confidence level. The dates were subsequently pooled with CALIB 3.0.3, producing a radiocarbon age of 720 ± 28 B.P. The calibrated age range at two sigma is AD 1268-1302. These dates are consistent with calibrated radiocarbon dates from Caddoan sites to the north and northeast with similar ceramic styles—such as Oak Hill Village (41RK214), where the 30+ calibrated dates range between A.D. 1150-1400, and Tyson (41SY92), whose four calibrated dates range from AD 1336-1490 (Perttula 1997:Table 1)—and with the estimated age of the Haley phase (ca. A.D. 1200-1400). Thus, the AD 1268-1302 age range is believed to reflect the primary occupation of the site.

Samples Tx-3944 and Tx-4873 suggest that the occupation of the site may have begun 100+ years prior to the primary occupation. Sample Tx-4528 is consistent with a small series of Late Caddoan artifacts (specifically sherds of Patton Engraved and Emory Punctated-Incised) that occur at the site. Similarly, sample Tx-4876 may pertain to the small Early Ceramic occupation (sandy paste pottery sherds, small dart points, etc.). While there are no classic Early Caddoan period sherds from the site, there are some Pennington Punctated-Incised or Pennington-like sherds that may be evidence for a small Early Caddoan occupation at Washington Square; sample Tx-4876 could also be associated with this material.

Table 4. Radiocarbon Dates for the Washington Square Mound Site

Sample #	Lab #	Provenience	Material	Radiocarbon Age (B.P.)	Calibrated 2-sigma (A.D.)*
1	Tx-3941	F8, N230/W102	Charcoal (wood)	650 ± 80	1238-1434
2	Tx-3942	F31, N214/W161	Charcoal (wood)	1000 ± 260	552-1436
3	Tx-3943	F18, N156/W96	Charcoal (wood)	710 ± 70	1217-1403
4	Tx-3944	F30, N156/W95	Charcoal (wood)	1150 ± 140	640-1199
5	Tx-3945	F9, N156/W95	Charcoal (wood)	790 ± 200	881-1478
6	Tx-4257	F75, N214/W160	Charcoal (pine cone fragments, hardwood nut shell)	620 ± 70	1278-1436
7	Tx-4258	F30, N156/W95	Charred corn	360 ± 70	1430-1666
8	Tx-4872	F75, N214/W160	Charcoal (wood, corn, hardwood nuts)	830 ± 110	1004-1322
9	Tx-4873	F199, N195/W112	Charred corn	840 ± 50	1153-1285
10	Tx-4874	F199, N195/W112	Charcoal (wood)	980 ± 60	974-1215
11	Tx-4875	F9, N156/W95	Charred corn	630 ± 60	1280-1427
12	Tx-4876	F80, N214/W161	Hardwood nutshell	1280 ± 100	604-984
POOLED DATE,** SAMPLES 1, 3, 5, 6, 8, 9, 11				720 ± 28	1268-1302

*Calibrations done with CALIB 3.03 (Stuiver and Reimer 1993)
**Pooled dates are statistically the same at 95% level of confidence (Stuiver and Reimer 1993)

SUMMARY

Excavations at the Washington Mound site have uncovered the archeological remains of a large Middle Caddoan period (ca. A.D. 1250-1350) mound complex in south-central East Texas. The investigations of this heretofore unknown complex indicate that there was a significant post-Alto phase culture in the region that may have had a significant impact on subsequent regional Caddoan manifestations.

The excavations were conducted primarily in the area between three historically known artificial mounds. Although fairly extensive, the excavations did not identify any structural evidence (i.e., circular alignments of postholes) of on-site habitation in the non-mound area. While a number of archeological features, primarily pits, were recovered, they do not appear to be the kinds of features generally associated with permanent Caddoan habitation. In Area A, ca. 250 m^2 of excavations found only large shallow pits that contained sherds of numerous ceramic vessels, and a few charcoal-filled pits. If there had been a house or houses in the vicinity, logic suggests that the excavations should have intersected at least a portion of a circle of postholes. Similarly, in Area B, 18 m^2 of excavation and ca. 30 m of backhoe trenches did not intersect any readily definable posthole alignments. There were some large pits, different from the sherd-filled pits in Area A and not obviously refuse pits or storage pits, that could have been large postholes, but again, no pattern was discernible. While pottery sherds were common in this area, their numbers did not approach the concentrations in Area A.

The only obvious structural remains were recovered in Area C in a part of the site known historically to have been the location of at least one mound. The excavations suggest that this feature, F101, is the remains of a circular structure constructed on a low natural sandy rise. If it was associated with the mound, which we believe it was, then F101 may be the remnants of one of the first, if not the first, structure associated with the mound. The available archeological evidence suggests that the University Mound (Mounds 1/2) was a typical Caddoan structural mound.

Excavations into the one visible extant mound on the site, the Reavely-House Mound, indicate that it was a typical Caddoan mortuary mound. The original mortuary (or mortuaries) was excavated into a low natural sandy rise. As the mortuary expanded, various layers of red and yellow clays and other brightly colored soil were added to the original mound, raising its height and increasing its diameter. Planning in the use of the mound was obvious since subsequent burials generally did not impinge on existing burials. Mortuary offerings, primarily ceramic vessels, and the skeletal remains of the interred individuals, are consistent with those generally associated with the prehistoric Caddoan tradition and culture area.

The excavations also recovered a large assemblage of Caddoan pottery and a relatively small assemblage of chipped and ground stone tools and debitage (we will discuss this material in a subsequent paper). Of particular note is the definition of three new pottery types (Hart 1982) that, although showing strong ties with the Haley phase of the Great Bend area of the Red River, constitute a regionally distinct Middle Caddoan horizon in south-central East Texas. This horizon exhibits continuities with Early Caddoan (e.g., Pennington Punctated-Incised and Crockett Curvilinear Incised manifestations) and Late Caddoan ceramic styles (e.g., grog tempering and brushed-incised modes) in this region.

ACKNOWLEDGMENTS

Many people have been instrumental in facilitating the archeological and archival research on the Washington Square Mound Site. Much of the preliminary feature and excavation description was done as class projects or papers presented at professional meetings from 1979-1984 by the authors and archeology students at Stephen F. Austin State University (SFASU). The student papers include those by Heather Brown, Charles Curb, John P. Hart, Deborah C. Kisling, Jeanine McDonald, and Sharon Toups. Heather Brown also served as the crew chief for the 1984 mitigation work prior to the demolition of the 1916 school building, and as field assistant for the 1985 TAS Field School excavations. Much of the original drafting of the mound profiles and features was done by an Anthropology Lab Assistant, Carolyn Spears.

The excavations would not have been possible without the hard work of some 100 SFASU archaeology field school students and the members of the Texas Archeological Society that participated in the 1985 Annual Field School. In addition, over the years historical information has been forwarded to the authors by various researchers, specifically Darrell Creel (Mayfield-Fewkes), Bob D. Skiles (Roberts 1898), Carolyn Spock (Stephenson 1948b and Krieger's Mounds notes), and Dee Ann Story (Upton 1930).

Special thanks are due to Mr. H. L. House, now deceased, and Leland House for their concern about the Reavely-House Mound and for allowing the excavations in the southern portion of the mound. Thanks are also due to Robert and Ruth Carroll for allowing excavations in the northern portion of the mound and for allowing archeological excavations in their yard prior to any subsurface impact to the site. The Nacogdoches Independent School District enthusiastically allowed the excavations on their portion of the site year after year and made their various facilities available to us during the four archeological field schools. The district also supplied the funds to conduct archeological excavations prior to the 1984 removal of the 1916 High School building.

NOTES

1. John P. Hart conducted a detailed analysis of the ceramics from Washington Square as the subject of a Master's Thesis (Hart 1982) at Northeast Louisiana University, Monroe. This material and the other artifacts will be the subject of a future article in the BTAS.

2. There has never been any formal designation of the mounds associated with Washington Square. Stephenson's 1948 photograph (McGee Bend Miscellaneous) of the extant mound on the east side of Mound Street was labeled Mound #4. Given the sequence of his discussion, Mound #3 would have been the mound opposite the southeast corner of the campus, the same mound described by Upton that was destroyed in 1937 by the construction of a service station. Mounds #1 and #2 would be the mound(s) destroyed by the building of the 1904 Nacogdoches High School (see end note 3). Prior to discovering Stephenson's notes, we had named the small extant mound (that we now know is a mortuary mound) east of Mound Street the Reavely-House Mound after past and present owners. Since the mound destroyed by the service station had been in the ownership of the Hardeman family many years, we named it the Hardeman Mound. This is the mound that most early descriptions refer to as the largest mound, or the mound with the maple tree growing on it.

Stephenson's Mound #1 and Mound #2, supposedly mostly razed prior to 1939, and supposedly totally destroyed by the construction of the 1939 WPA Nacogdoches High School (see end note 3), may have only been one mound. Various historic references note one or two mounds. Mrs. Hardeman believed it was "two" only because a road had cut through a single large mound. Rather than refer to the mound(s) that existed at that locality as Mound(s) 1 (and 2), we have referred to the archeological expression of that mound (F101 and associated features) as the University Mound.

3. There is considerable folklore in Nacogdoches (newspapers, various articles, Centennial booklets, etc.) concerning the location and history of the mounds at the Washington Square Mound site. During the course of time, there have been three structures on Washington Square that have been called, informally or formally, the Nacogdoches High School. The first school building constructed by the Nacogdoches School District (who acquired Washington Square in 1904) was the Nacogdoches Central Public School in 1904. It later became the Nacogdoches High School; a number of historic photographs and picture postcards identify the building. This building, according to Gladys Hardeman, who was intimately familiar with the building and the mound under it, was the high school building that destroyed the mound (Stephenson's Mounds #1 and #2), *not* the 1939 Nacogdoches High School as local folklore and various newspaper articles would have us believe. To further confuse matters, another Nacogdoches High School had been built on the campus in 1916; this was the building razed in 1984. A detailed perusal of the various Sanborn Fire Insurance maps from 1900-1939 indicate the sequence of construction and names of various buildings on the campus. It was these maps, historic photographs, and the various historical descriptions that allowed us to accurately locate (see end note 5 below) the Hardeman Mound and the University Mound.

4. This skeletal material is currently curated in the Laboratory of Anthropology, Stephen F. Austin State University. The material was studied briefly in the laboratory by Dr. Clyde Snow about 1982. His assessment was that the cranium was definitely aboriginal, and its features were consistent with his knowledge of Caddoan skeletal remains.

5. In Alex D. Krieger's files, "Mound Records N. E. Texas," at the Texas Archeological Research Laboratory, is a sketch map of the Washington Square Mound site. A note on the map attributes it to R. L. Stephenson, 1948 or 1949. The map is inaccurate, either because it was drawn by Stephenson from memory or possibly because it was drawn by Krieger or someone else based on the description by Stephenson. The map has a north arrow pointing east, while the service station and mound (shown with a dotted line) is on the northwest corner rather than the northeast corner of the Hardeman lot. The map also shows a huge mound (shown with a dotted line) under the 1939 Nacogdoches High School (labeled Hi School).

6. The radiocarbon dates for the Washington Square Mound site were previously published in Story et al. (1990).

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Terrace Deposits and Late Quaternary Climate, South-Central Edwards Plateau, Texas

Charles E. Mear

ABSTRACT

Late Quaternary fluvial terrace deposits are complex stratigraphic units that contain archeological sites and various clues to paleoclimatic conditions that prevailed during and after deposition. In the upper Sabinal River valley of the south-central Edwards Plateau, three Holocene and two Pleistocene terrace deposits have been mapped and correlated with dated deposits located in the eastern Edwards Plateau and the east-central Lampasas Cut Plain, where differing and sometimes conflicting, Late Quaternary paleoclimatic models have been reconstructed by various investigators from studies of stable carbon isotope ratios, and of plant and animal remains in the Quaternary sediments. The climatic data appear to indicate that periods of predominant downcutting by the Sabinal River and its tributaries occurred after a change from cooler and moister conditions to a drier and warmer climate; and, at least once, downcutting occurred during an indicated change to a cooler and moister period. Late Quaternary fluvial deposition occurred during drier and warmer, as well as cooler and moister, climatic regimes.

INTRODUCTION

River terraces and terrace deposits are important indicators of climatic and hydrological changes that force streams to change behavior while regaining equilibrium (Oberlander and Muller 1987:424). The following discussion compares and contrasts evidence for Late Quaternary climatic control of stream downcutting and deposition along Cowhouse Creek, upper Brushy Creek, and the Pedernales River drainage systems (Figure 1). The terrace deposits in these valleys are correlated with terrace deposits in the upper Sabinal River valley, and tentative paleoclimatic conditions are postulated throughout the Late Quaternary for the south-central Edward Plateau.

PREVIOUS INVESTIGATIONS

Of the several deep stream valleys present in the south-central Edwards Plateau, only the upper Sabinal River Quaternary geology has been studied (Mear 1953, 1995). Cursory investigations by the author indicate that the Quaternary geology of the upper Frio River valley (see Figure 1) corresponds closely to the upper Sabinal.

The Quaternary deposits of the upper Sabinal valley were correlated by Mear (1995) with those that occur along the Pedernales River of the eastern Edwards Plateau, and with those along upper Brushy Creek and upper Cowhouse Creek in the east-central Lampasas Cut Plain. The deposits along the Pedernales were dated by Blum and Valastro (1989), and those along Cowhouse Creek by Nordt et al. (1994). Mear (1995) utilized information from Collins et al. (1993) to date the "Wilson-Leonard" terrace deposit along upper Brushy Creek. Quaternary paleoclimate in the Cowhouse Creek valley was established by Nordt et al. (1994), and Toomey et al. (1993) and Toomey and Stafford (1994) reconstructed the Late Quaternary paleoclimate of the eastern Edwards Plateau from deposits in Hall's Cave (see Figure 1).

The geological field study of the upper Sabinal River valley was conducted by the author in 1951 and 1952 (Mear 1953). In 1995 the study was updated and published (Mear 1995). Recently the author mapped the geology of the upper Brushy Creek valley in Williamson County (report on file, Texas Archeological Research Laboratory, The University of Texas at Austin).

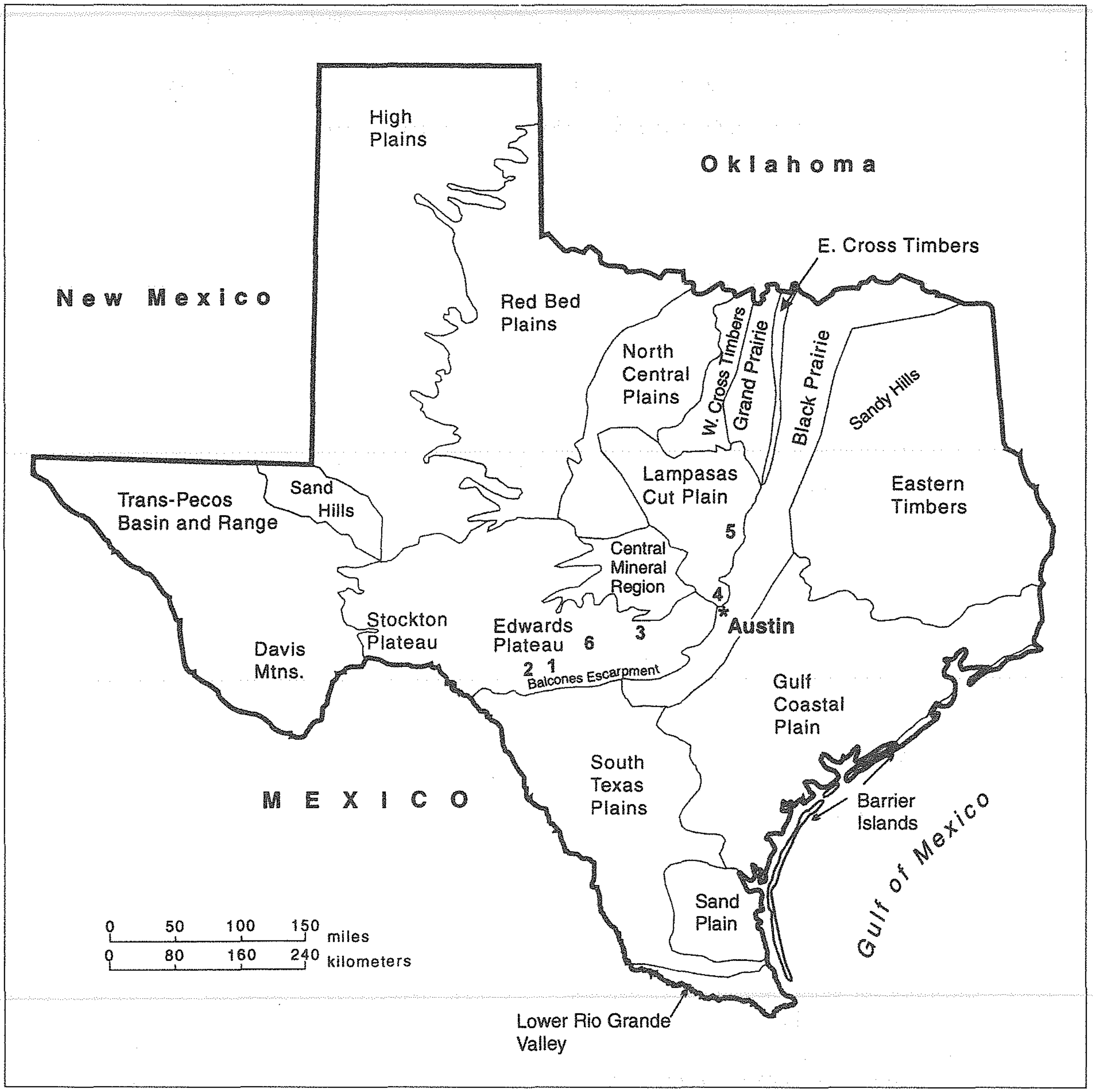

Figure 1. Physiographic features of Texas (after Kier et al. 1977) and location of areas discussed in the text: (1) upper Sabinal River valley, (2) upper Frio River valley, (3) Pedernales River valley, (4) upper Brushy Creek, (5) Cowhouse Creek, and (6) Hall's Cave.

TERRACE DEPOSITS

Terraces are bench-like surfaces located on stream-deposited alluvium (terrace deposits) and on bedrock (strath terraces). Terrace deposits are composed largely of alluvial sediment deposited by streams during and immediately following flood-stage, but they also contain soils, paleosols, and minor amounts of colluvium, anthropogenic materials, and wind-blown sediment. Terrace deposits are alloformations as defined by the North American Commission on Stratigraphic Nomenclature (1983:865). They transgress time, and are bounded above and below by discontinuities, but also contain lesser discontinuities, often indicated by paleosols that mark periods of relative non-deposition. Other discontinuities are recognizable only by reliable radiocarbon dating that indicates periods of non-deposition. Colluvium, anthropogenic materials, younger overbank deposits, and eolian sediment that lie on a terrace deposit are not part of the formation (Figure 2).

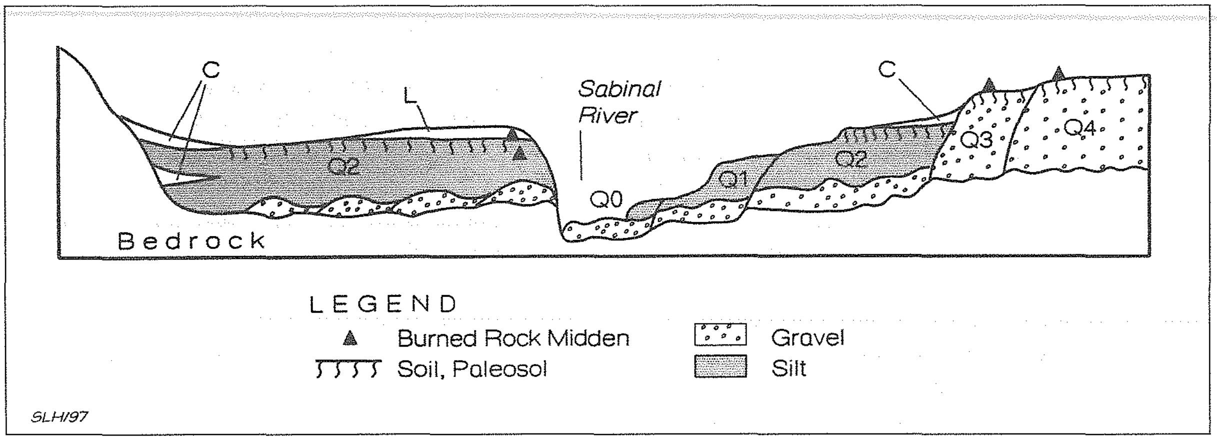

Figure 2. Summary geological section of the upper Sabinal River valley terrace deposits Q0 through Q4, showing the generalized relationship of Late Quaternary terrace deposits (no scale). L is recent levee on the Q2 deposit; C is colluvium within and above the Q2. Colluvium, burned rock middens, and other sites lying on terrace deposits are not part of the underlying deposit. The Q2 deposit on the left (west) side of the section is a point bar whose basal gravel decreases in age westward.

The basal unconformity of a terrace deposit usually is obvious where exposed. Establishing the upper boundary of a deposit can be difficult where there is no discernible exposed erosional unconformity between it and younger overlying sediment; in some cases, the upper terrace boundary is arbitrary.

Virtually all terrace deposits are composed of lower coarser material and finer-grained material in the upper deposit. In geological terms this is "fineing-upward." In general, the lower part of a terrace deposit is formed by the stream channel; and the upper, finer-grained sediment is deposited from muddy overbank flood water.

The lower, coarser-grained part of a point bar formed by stream meandering is deposited in a series of contiguous arcuate bars while the stream bed meanders; thus the age of the bars decreases laterally (see Figure 2). The overlying finer material decreases in age upward, but erosional cut-outs and irregular overbank deposits may be present, causing laterally-contiguous parts to be of somewhat different ages.

Other terrace deposits not in the form of a point bar are linear, and also fine-upward. These deposits are formed sub-parallel to the stream course, and consist of ridge and swale topography usually buried under the upper part of the deposit.

The upper Sabinal River and its tributaries contains only a few meanders (indicating low sinuosity), some of which seem to be the result of deflection of the channels along the strike of joints in the limestone bedrock. The principal joint systems in the area strike about N20° E and N60° W and appear to control the present direction of stream flow throughout much of the valley. In the upper part of the upper Sabinal valley, the Sabinal river is downcutting and flowing largely on bedrock. It is largely bed-load dominated (channel on gravel) in the lower part of the valley; but even here the stream is downcutting locally. This contrasts with conditions along the Pedernales River where Blum and Valastro (1989) report that it has been an aggrading, gravel-dominated meandering stream for the last 1000 years. Upper Brushy Creek is gravel bed-load dominated and it has low sinuosity, based on a detailed study of the creek and its tributaries by the author. Cowhouse Creek was not investigated by the author, but appears to have moderate sinuosity (Nordt et al. 1994).

ORIGIN OF TERRACE DEPOSITS

As stated by Shelton (1966:134), if over the years the supply of sediment available is greater than the carrying capacity of a given part of a stream, then the stream aggrades its bed in that part by depositing alluvium. Where the average available load is less than the average capacity, erosion will take place and the stream degrades, or cuts into its channel.

Both alluviation and degradation can occur simultaneously along the course of streams, although erosion may predominate along the upper part of the stream, degradation and aggradation alternate in the middle course of a stream, and deposition prevails in the lower course of a stream (Shelton 1966:134). In the stream valleys of the southern Edwards Plateau, the rivers have an upper, middle, and lower course upstream from the Balcones Fault Zone where downfaulted Edwards and Comanche Peak limestones form a slowly-lowering base level. Thus, it would be expected that degradation and deposition could occur simultaneously within a very few miles along the streams.

Downcutting by streams follows lowering of base level, rejuvenation by uplift, or by increase in carrying capacity, and/or decrease in sediment load. Deposition occurs when sediment overload occurs at any part of a stream. As explained by Oberlander and Muller (1987:424), where a stream cuts downward into the floodplain of a valley floor, some floodplain sediments may be left standing above the new channel as a fluvial terrace. Fluvial terraces also can be formed by aggradation when increased stream energy or increased sediment input raises the stream bed, forming an alluvial fill. These stream behaviors often result in paired terraces along both sides of stream valleys. Unpaired terrace deposits can result where downcutting occurs during stream meandering.

FACTORS CONTROLLING STREAM DOWNCUTTING AND ALLUVIATION

Streams respond to sea level changes, structural movements, climatic conditions, differences in bedrock, changes in climate, and to stream piracy. During the Late Quaternary, the streams of the south-central Edwards Plateau were not noticeably influenced by any of these conditions except by climate, and by changes in bedrock encountered as the streams downcut into the Glen Rose (Cretaceous) bedrock.

Early geoarcheologists Albritton and Bryan (1939:1472) concluded that field evidence in the Davis Mountains corroborated the working hypothesis that along ephemeral and intermittent streams, "...aggradation of valley floors occurs in periods of relative humidity, and erosion by channeling occurs in periods of relative aridity." Shortly thereafter, Evans and Meade (1945:502) deduced from their investigation of the High Plains that terrace deposition along the streams had occurred during a period of increased aridity. Blum and Valastro (1989) determined that the Pedernales River in the eastern Edwards Plateau had been an aggrading, gravel-dominated meandering stream, operating in a climate more moist than at present, at least between 4500 to 1000 B.P. They also determined that the Pedernales River and its tributaries incised their channels following a transition to drier conditions that occurred about 1000 B.P.

Ellis et al. (1995:412) point out that various investigators working in North America and Great Britain have deduced that stream downcutting occurred during periods of increased aridity, as well as in periods of increased humidity, and that deposition resulted during wet and dry periods. I conclude that all of these relationships have occurred in the south-central Edwards Plateau, and that downcutting and deposition have taken place simultaneously, based on ancient and modern stream behavior of the Sabinal and its tributaries.

TERRACE DEPOSITS IN SOUTH-CENTRAL EDWARDS PLATEAU

Along the upper Sabinal River valley of Uvalde and Bandera counties, Mear (1953, 1995) described and mapped five terrace deposits. In order of increasing height above stream level and age, these were informally called the Q0 (present major floodplain), Ql, Q2, Q3, and the Q4 (Figure 3). Based on elevation above stream level, soil development, and archeological data, Q0, Ql and Q2 were identified as Holocene, and Q3 and Q4 as Pleistocene. Two remnants of older terrace deposits were noted and described near the head of the Sabinal (see discussion in Mear 1953, 1995).

The Q4 and Q3 Pleistocene alluvial deposits comprise the bulk of the terrace deposits in the upper Sabinal valley. Composed predominantly of limestone gravel with minor amounts of limestone sand, and silt, the Q4 and Q3 are characterized by a hard pedogenic calcium carbonate-cemented conglomerate (calcrete) in the upper 3 meters or so, in what is the Bk-horizon of a calcic soil. The Bk-horizon is capped with a hard calcareous crust, in which is contained solution-faceted limestone pebbles and cobbles as described by Bryan (1929). A reddish-brown clayey A-horizon containing weathered chert fragments overlies the Bk-horizon.

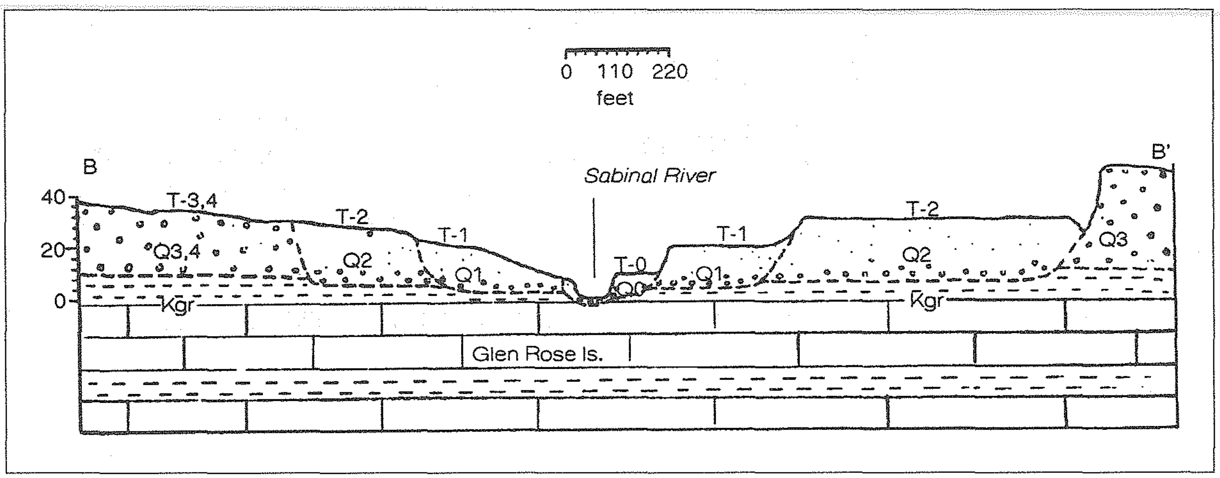

Figure 3. South to north transverse section B-B' of upper Sabinal River valley looking westward, about 11 km south of Utopia. All surface measurements by plane table and alidade. Vertical exaggeration 5.5:1. Note truncation of Q1 deposit, left side of river. Terraces are numbered in order of increasing age. Thickness of deposits estimated from isolated exposures not necessarily in line of section.

These horizons constitute Stage III and IV calcic soils (Machette (1985) that form mainly during arid to semiarid climates. Deposits similar to the Q4 and Q3 have been observed in the upper Frio, upper Pedernales, and upper Medina river valleys. Archaic burned rock middens and other archeological sites are present on the Q4 and Q3 deposits in the upper Sabinal valley.

The younger Q2 and Ql deposits are dominantly limestone gravel in the lower one-third, and buff featureless silt in the upper part. These recently have been eroded by the Sabinal in some areas, but have received overbank deposition in others. The Q2 deposit has a moderate calcic soil development, ranging to Machette Stage II near Utopia where post-terrace deposition has not occurred. South of Utopia, the Q2 has only a Stage I calcic soil, and the Bk-horizon contains only wisps and a few soft nodules of calcium carbonate. The Ql deposit has an incipient soil at its surface, in areas protected from flooding, where 5-15 cm of A-horizon is present. No definable B-horizon was observed. The Q0 is the present major floodplain deposit, and is still being formed.

Middle Archaic and younger cultural material lie on the Q2, often partially buried by a veneer of younger clastics (see Figure 2). In the valley, older Archaic material was observed to a maximum depth of 3.4 m below the surface of the Q2. Midden material and artifacts were found in all levels of the Q1 alluvium, although diagnostic artifacts were scarce (Mear 1953:56).

Based on relative elevation above stream level, soil development, and archeological sites located on and in the terrace deposits of the upper Sabinal, Mear (1995) correlated the Q2 with the Georgetown and Fort Hood formations along Cowhouse Creek in the east-central Lampasas Cut Plain, which range in age from 11,000 B.P. to 5000 B.P. (Nordt et al. 1994). The Q2 also was correlated with the Q2 equivalent ("Wilson-Leonard") terrace deposit along upper Brushy Creek in the southern Lampasas Cut Plain, whose basal gravel is about 11,200 years in age (Collins et al. 1993) and its upper boundary appears to be about 4500 B.P. (Mear 1995:474).

A corrected radiocarbon date of 6284-6413 B.P. (Hester 1990) was obtained from a firepit at a depth of about 1 m in the Q2 deposit at the Smith site (41UV132) in the upper Sabinal valley. A Middle Archaic burned rock midden lay above it on the Q2. This relationship indicates that deposition of the Q2 was completed prior to about 4500 B.P.

The Ql in the upper Sabinal valley was correlated with the West Range alluvium along Cowhouse Creek. This has been dated by Nordt et al. (1994) as ranging in age from 4200 to 600 B.P. Furthermore, the Q0 correlated with the Ford deposit, dated by them at 400 B.P. to the present (Figure 4).

The Q3 of the Sabinal valley was correlated by Mear (1995) with Unit D of the Pedernales River dated by Blum and Valastro (1989) to 17,670

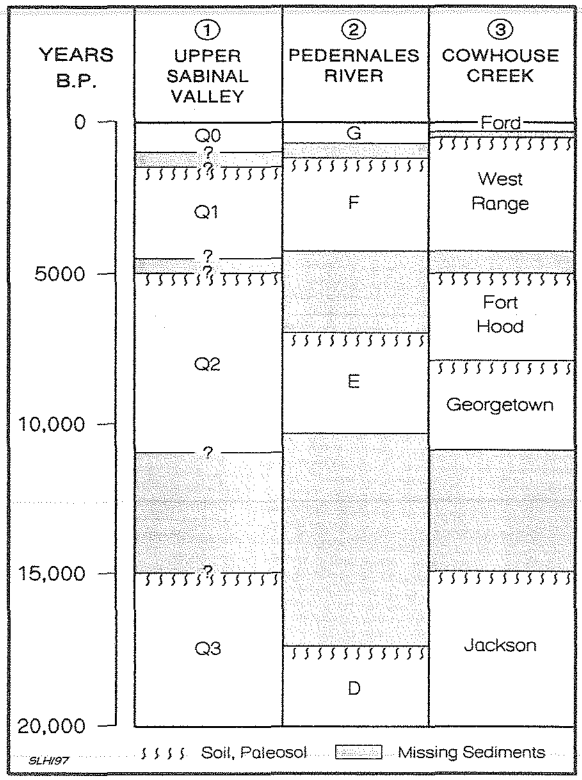

Figure 4. Correlation of some stratigraphic units discussed in the text. Column 1 is from Mear (1995), Column 2 from Blum and Valastro (1989), and Column 3 from Nordt et al. (1994).

± 230 B.P. in its upper part. The Q4 was correlated with Unit C along the Pedernales River, believed to be about 33,000 B.P. in part by Blum and Valastro (1989). The Q2 is believed to be equivalent to Unit E (ranging from 10,550 ± 130 to 7150 ± 90 B.P.), and the Q1 to Unit F, ranging from 4140 ± 90 to 1050 ± 50 B.P. Finally, the Q0 alluvium was correlated with Blum and Valastro's Unit G, which they dated to range from about 830 ± 70 B.P. to 150 ± 50 B.P. (see Figure 4).

LATE QUATERNARY PALEOCLIMATE

In an effort to determine Late Quaternary climatic conditions along Cowhouse, Table Rock, and Owl creeks in the east-central Lampasas Cut Plain, Nordt et al. (1994) analyzed stable carbon isotope ratios that revealed the past proportions of C3-C4 plant production. Nordt et al. (1994:110) reported that C4 plants are most abundant in warm, semiarid environments, and C3 plants are predominantly trees, shrubs, forbs, and cool season temperate grasses that grow in forest communities and temperate-zone plant communities. The data indicated to them that the Late Pleistocene was cooler and wetter than at any time during the last 15,000 years. During the transition to the Holocene, 11,000 to 8000 B.P., the climate was transitional to warmer and drier Holocene conditions. Between 6000 and 5000 B.P., the climate reached its maximum warm and dry conditions. By 4000 B.P., climate was similar to that of the Early Holocene. These conditions have persisted to the present, except for a brief drying episode about 2000 B.P. (Nordt et al. 1994:119) (Figure 5).

Toomey and Stafford (1994:96) reported that at Hall's Cave in the east-central Edwards Plateau, the proportions of vertebrate remains, pollen, and gastropod shells in the cave deposits suggest that in Central Texas significant warming ensued between 12,500 and 11,000 B.P. and between 7000 to 2500 B.P. Moister periods occurred before 12,500 B.P. and 11,000 B.P. and briefly after 2500 B.P. (see Figure 5).

In the southern United States Great Plains, including the Lampasas Cut Plain, Hall (1990) used increases in hickory in the Cross Timbers and the greater abundance of moist-habitat land snails in rock-shelter deposits to conclude that Central Texas was wetter than today from 2000 to 1000 years ago. This wet period was "unprecedented in the late Holocene" (Hall 1990:343), and resulted in low rates of sediment deposition and the formation of a soil having a cumulic, organic-rich, over-thickened A-horizon (Copan soil). Hall (1990:342) also reported that at 1000 B.P. the regional climate changed from moist to dry, and channel trenching lasting 200 years abruptly terminated a 4000 year period of generally uninterrupted floodplain deposition on the southern Great Plains (see Figure 5).

Collins (1995:377), using Bousman's interpretation of the reported pollen data from Weakly and Boriack bogs located in East Central Texas, shows a dry period about 12,000 B.P., followed by a wet period that lasted until about 7500 B.P. At 7500 B.P., the climate became drier and stayed drier than previously, until 2500 B.P. This dry period of about 5000 years duration is shown to be slightly wetter during the period about 6000 to 5000 years ago. At 2500 B.P., the climate became wetter than at any time after 7500 B.P., and has stayed more humid to the present, interrupted by a drier period about 1000 B.P. (see Figure 5).

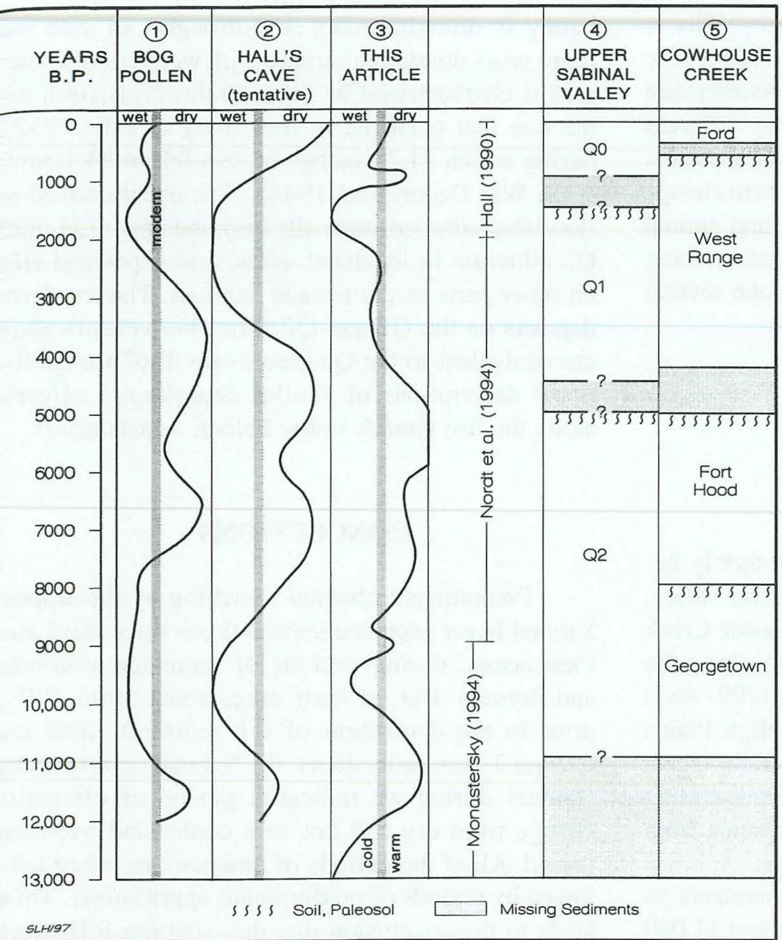

Figure 5. Comparison of Late Quaternary paleoclimatic conditions in Central Texas as interpreted by Collins (1995), Column 1 and Column 2; Column 3 by Mear from data in Hall (1990), Nordt et al. (1994), and Monastersky (1994). Terrace deposits in Column 4 are those of the upper Sabinal River valley; in Column 5, those of Cowhouse Creek (Nordt et al. 1994).

Analyses of air trapped in ice cores from the Greenland ice cap are indicative of a warm period that lasted from about 10,000 to 12,000 years ago (Monastersky 1994:74). This corresponds roughly to a period of drought about 11,000 B.P. evident in several Clovis sites in the southwestern U.S.A. (Haynes 1991).

At the present time, I mainly have utilized the climatic data of Nordt et al. (1994), Hall (1990), and Monastersky (1994) to establish a tentative interpretation of the Late Quaternary paleoclimate of the southern Edwards Plateau. These conclusions are fairly consistent with those of Collins, Bousman, and Toomey et al., although differing somewhat in the timing of climatic changes. The investigation by Nordt et al. utilized extensive testing of carbon isotope ratios in alluvial deposits and soils, mainly from dated terrace deposits of Cowhouse Creek. Nordt et al. (1994:109) report that differences in the stable carbon isotopic composition of C3 and C4 plant species allows an assessment of the long-term stability of plant communities and climate of a region, and relative C3/C4 biomass in grassland correlates well with mean annual temperature. There is little change in the carbon isotopic composition during deposition and burial and it is possible to infer vegetation composition in alluvium, modern soils, and in paleosols from the stable carbon isotopic composition of soil organic material (Nordt et al. 1994:110). Because of possible changes in the amount of carbon isotopes that may have occurred during the late Quaternary, only major shifts in C3/C4 production during the period can be determined.

Collins (1995:378) reported that the bog-pollen sequence at Boriack and Weakly bogs is not well-controlled chronologically. Most of the radiocarbon dates at Hall's Cave are on bone (three on charcoal) as reported by Collins (1995:379), and he concludes that the cave stratigraphy is one of the best-dated and most environmentally sensitive records in North America (Collins 1995:379). The climatic history depicted for Hall's Cave by Collins (1995) is based on the relative proportions of the least shrew (*Cryptotis*) (moist habitat) to the desert shrew (*Notiosorex*) (arid habitat), but is supplemented by pollen records. These data do not show the same climatic changes during the past 2000 years that were detected by Hall (1990).

At the present time, a precise Late Quaternary paleoclimatic model is lacking for the Central Texas area, which includes the south-central Edwards Plateau. The differences in timing of mesic and xeric periods in the area (see Figure 5) are considerable, although the climatic changes have a roughly similar pattern through the past 12,000 years. Perhaps these different interpretations result partly from the different proxies used for the climatic interpretations. As postulated by Ellis et al. (1995:413), climatic models may differ because the proxies from which the interpretations are made may record the same climatic events at different levels of temporal precision, some reacting almost immediately and others taking many years to change sufficiently to be recorded in the plant and animal remains. Ellis et al. (1995:412) report striking changes in the pollen record appear to take several millennia to be discernible.

RELATIONSHIP OF PALEOCLIMATE AND STREAM ACTION

A period of downcutting occurred shortly before 11,000 B.P. along the Pedernales River valley, along the upper Brushy Creek and Cowhouse Creek in the Lampasas Cut Plain, and probably along the upper Sabinal River. Gustavson et al. (1991:483) report a period of downcutting in the High Plains between 11,500 and 11,100 B.P., followed by aggradation prior to 11,000 B.P. This regional downcutting took place during a period of climatic change from cool and wet to warm and dry conditions.

Deposition of the Q2 and its equivalents in Central Texas apparently ensued from about 11,000 to 5000 B.P. This was a period of generally increasing warmth and dryness in the area.

About 5000 years ago, a period of predominant downcutting took place prior to the deposition of Unit F (Blum and Valastro 1989) along the Pedernales River, the Ql in the upper Sabinal valley, and its equivalent along upper Brushy Creek (Mear 1995). The downcutting occurred during a change in climate from warmer and drier to cooler and wetter conditions. This downcutting may have resulted from an increase in carrying capacity of the streams, and a reduction of sediment supplied from the drainage area. After equilibrium was regained by the Sabinal and its tributaries, the Ql was deposited during a cooler and wetter climate.

The effects on stream behavior in the south-central Edwards Plateau by the brief drying episode about 2000 B.P. are unknown. Minor downcutting by the Sabinal probably resulted from the change in climate from moist to dry that occurred 1000 years ago and was accompanied by channel trenching of streams throughout the southern High Plains (Hall 1990:342). The present climate in the upper Sabinal valley is drought-prone, and droughts of one or more years duration alternate with wet periods. The area is characterized by severe rainstorms such as the one that occurred in the valley in July 1932, during which 31.28 inches of rain fell in 24 hours (U.S. War Department 1944). This event caused a flood that stripped some silt from the upper Q1 and Q2 alluvium in localized areas, and deposited silt on other parts of the terrace deposits. The modern deposits on the Q1 and Q2 form thin veneers that are equivalent to the Q0 (see Evans 1962 for additional descriptions of similar depositional effects along the Rio Grande in the Falcon-Zapata area).

CONCLUSIONS

Predominant channel trenching by the upper Sabinal River occurred several times since the Late Pleistocene, during periods of increased warmth and dryness. But, at least once, about 5000 B.P., prior to the deposition of Q1 sediments and its Central Texas equivalents, the Sabinal downcut its channel during an indicated period of climatic change from dry and hot to a cooler and moister period. All of the periods of downcutting were followed by periods of predominant aggradation. This leads to the conclusion that downcutting followed climatic events that caused disequilibrium in the stream system, such as an increase of carrying capacity or decreased sediment supply; following the periods of predominant downcutting, the supply of alluvium fed into the Sabinal largely exceeded its carrying capacity and the Holocene Q2 and Q1 sediments were deposited.

Downcutting and deposition can occur simultaneously along a stream, during both dry and humid climatic regimes. A break in sedimentation can occur in one part of a stream valley at the same time that deposition is occurring in other parts of the valley. Most stream terrace deposits contain minor unconformities that resulted from various activities, such as localized scouring by side tributaries, migration of streams, and interruptions in regional and localized sedimentation that can result from changes in a stream's course, or from climatic changes. The upper and lower limits of a terrace deposit range in age throughout a river basin, and the formations are time-transgressive. They may be overlain by a veneer of younger colluvial, alluvial, or anthropogenic sediment.

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Infierno Phase Pottery of the Lower Pecos River Region

Solveig A. Turpin and David G. Robinson

ABSTRACT

Although the Lower Pecos region is usually considered almost aceramic, small numbers of sherds have been collected from 12 sites, most of them on terraces paralleling the major rivers or on promontories overlooking spring-fed water holes. The vast majority of the sherds are undecorated brownwares made of clays that naturally include some sand particles. Surface treatment is generally limited to smoothing and polishing although red-slipped pieces may appear late in the pottery tradition. The most distinctive characteristic is the combination of bone and calcium carbonate tempering material, evident as large white inclusions protruding from a pinkish-tan paste that is incompletely fired, leaving a darkened core. This ceramic ware is an index artifact of the Late Prehistoric/Protohistoric Infierno phase in the Lower Pecos region. Similarities with some historic indigenous pottery at the Apache mission San Lorenzo de la Santa Cruz suggest the basic constituents were adapted by native potters to the new technology of wheel-made ceramics.

INTRODUCTION

Although ceramics are so rare in the Lower Pecos cultural area that the region was omitted from a recent resume of pottery traditions in Texas (Perttula et al. 1995), bone and calcium carbonate-tempered, plain brownware sherds are a defining attribute of the Infierno phase in the local chronology. Dibble (1978) established the Late Prehistoric or Protohistoric Infierno phase on the basis of the type site, Infierno Camp, where tipi rings, or circular stone alignments made of paired limestone blocks, are surrounded by small stemmed arrow points, steeply beveled end scrapers, four-beveled knives, and fragments of plain pottery. Survey later demonstrated a relationship between tipi rings and cairn burials that may indicate the two are contemporaneous. The Infierno phase became an accepted division of the Lower Pecos chronology, occupying the period between A.D. 1500 and 1780 (Turpin 1991), although the steeply beveled end scrapers are the only typical artifact class that has been analyzed and reported in detail (Bement and Turpin 1987).

Infierno phase ceramics, albeit fragmentary and in small quantities, have been recovered from at least 12 sites in the Lower Pecos proper, specifically southeastern Val Verde County, although the sources that report them are scattered and not widely circulated. Similarities between the majority of the sherds that have been recovered and one class of historic indigenous pottery from the late 18th century Mission San Lorenzo de la Santa Cruz on the Nueces River, 100 km east of the Lower Pecos region (Tunnell and Newcomb 1969), suggest an affiliation with Protohistoric and Historic migrants who entered the region after A.D. 1500.

THE SAMPLE INVENTORY

In the Lower Pecos region, ceramic fragments have been recovered from Infierno Camp (41VV446: Dibble 1978; Turpin 1982); Javelina Bluff (41VV11: McClurkan 1968); Coontail Spin (41VV82: Nunley et al. 1965); Devil's Mouth (41VV188: Johnson 1961, 1964; Sorrow 1968); Black Cave Camp (41VV365: Turpin 1982); Baker's Crossing (41VV424: Word 1978); Brite Terrace (41VV662); Live Oak Hole (41VV828: Turpin and Bement 1989); Dolan Creek Terrace (41VV869); two unreported Rio Grande terrace sites, 41VV1723 and 41VV1724 (Billingsley, 1996 personal communication); and an unidentified rock

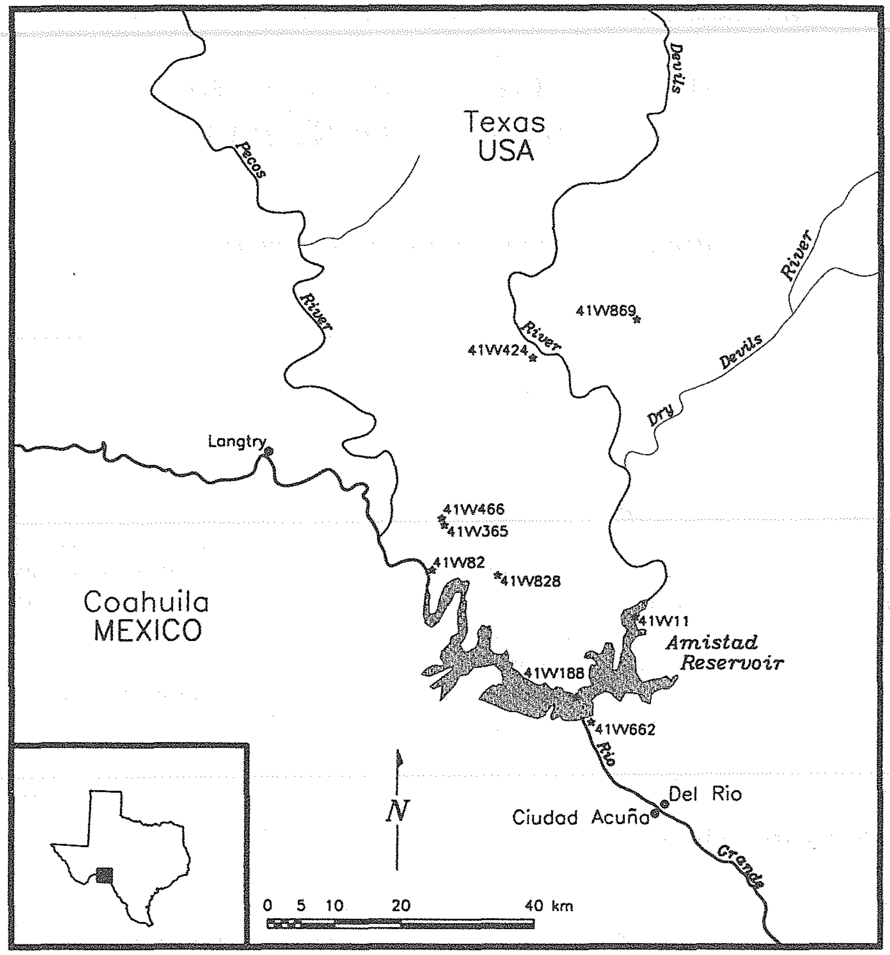

Figure 1. The Lower Pecos Region. The majority of the ceramic-bearing sites are on or near the Rio Grande

shelter on the Pecos River (Figure 1). Individual specimens from all the sites total more than 50 and less than 100.

Of the 58 sherds reported or known to the authors, all but three are similar in color, firing temperature, paste, temper, and finish. The exceptions are decorated sherds: one from the unidentified rock shelter on the Pecos River and two from Coontail Spin on the Rio Grande. The more common plain brownware may have developed into one strain of historic indigenous pottery found at Mission San Lorenzo. To further explore this relationship, 13 sherds—two each from the mission, 41VV11, 41VV188, 41VV365, and 41VV446, and one each from 41VV424, 41RG26, and 41FY1—were thin-sectioned and subjected to macroscopic analysis.

THE CERAMIC-PRODUCING SITES OF THE LOWER PECOS

Rio Grande Tributaries and Terraces

Infierno Camp has more ceramics than all the other Lower Pecos sites added together, but only a few were collected before the site was closed to further study. High on an upland divide between two tributaries to the Rio Grande and overlooking a permanent spring, over 100 tipi rings provided the context for an artifact assemblage that is clearly different from the Archaic tool kit. Dibble (1978) described this large open camp site and its artifacts, using it as the type site for his definition of the Infierno phase, the latest prehistoric division of his Lower Pecos chronology. Dozens of plain brownware sherds were clearly associated with small triangular arrow points, steeply beveled end scrapers, four-beveled knives, and circular stone alignments that presumably served as pole supports for brush or hide-covered structures. Based on the highly specific features and tool types, Dibble (1978) estimated that the site was Protohistoric in age and served as a base camp for bison hunters who exploited the expansion of the Plains biota into the Lower Pecos sometime after A.D. 1500, a supposition that is not inconsistent with the ethnographic record (Turpin 1987). The Infierno phase is roughly contemporaneous with, but not an extension of, the Toyah phase of Central and South Texas (Turpin 1991). Dibble thought that the Infierno pottery differed from the more generic Leon Plain wares of Texas and explored its possible relationship with ceramics from the Panhandle.

Only a few hundred meters from Infierno Camp, 13 sherds, possibly from the same vessel, were collected from Black Cave Camp, an Infierno phase artifact scatter that consisted of steeply beveled end scrapers, a four-beveled knife, and ceramics found atop a high promontory near a series of burial cairns. The sherds were described as 2 to 4 mm thick, light tan with a darkened core, and tempered by aplastic inclusions of calcite, rounded quartz, and black and grey rounded and angular volcanic material (Turpin 1982:124-125). Most surfaces were roughened from weathering but one fragment had a slightly redder polished finish.

Excavations at Coontail Spin, a large rock shelter on the Rio Grande, produced two sherds that apparently differed from each other and from the bulk of the Lower Pecos ceramic inventory. The larger of the two, a punctated rim fragment, was unlike the rest of Lower Pecos sherds in paste, color, surface treatment, and texture. The other, a body sherd, was described as having a fine-textured reddish paste with interior and exterior smoothing. Reportedly, its ornamentation consisted of "two concentric arcs of small, closely spaced punctations made with a sharp, needle-like object—perhaps a cactus thorn" (Nunley et al. 1965:96). Unfortunately, this sherd could not be located in the Texas Archeological Research laboratory (TARL) collections so any resemblance to the undecorated specimens attributed to the Infierno phase cannot be verified.

One sherd was found on the limestone bedrock adjacent to a circular stone feature at the Live Oak Hole site, a tipi ring site overlooking the historic pictograph at Live Oak Hole on Cow Creek, a tributary of the Rio Grande east of the Pecos River (Turpin and Bement 1989). Slightly downstream, on the banks of the Rio Grande below Amistad Dam, Turpin and Bement collected four sherds from the surface of the Brite Terrace site, a site exposed in the walls of a borrow pit. The National Park Service's survey of river terraces exposed during the drought and subsequent lowering of Amistad Reservoir encountered sherds on two topographically similar locations along the Rio Grande (Billingsley, 1996 personal communication; TARL site files). Seven pieces of pottery, two of which fit together, were collected from 41VV1723 and five were found on neighboring 41VV1724. One of the latter was a rim sherd. According to Sandra Billingsley, who recorded these sites, the ceramics outwardly fit the description of Infierno phase pottery.

Devils River Drainage

The first report on the Devil's Mouth site, a deeply stratified, multi-component terrace site (Johnson 1961:279), mentions three sherds. By 1964, excavations had produced six sherds that Johnson (1964:73) described as 5 to 8 mm thick, smooth but not polished, and tan or cream-colored with a surface hardness that equaled 2.5-3 on Moh's scale. The paste was said to be soft and porous, tempered with abundant bone fragments, clay lumps or ground pottery sherds (grog), and a small amount of sand. One was associated with arrow points between 60-80 cm deep in Area B, and five came from the upper four strata of Area A. The third season at Devil's Mouth produced two more sherds, similar to those recovered earlier but thinner. Sorrow (1968:42) described them as reddish-tan with a darker core. The aplastic inclusions were thought to be crushed bone with some sand. The basal sherd, a fragment from a flat-bottomed bowl, was well-smoothed but not polished, and the smaller body sherd was polished on the exterior surface. Sorrow (1968:42) states that three field seasons produced a total of 11 sherds, but a review of the collections and his calculations suggests that there were only eight: three from the first season, three from the second, and two from the third.

Test excavations at the Javelina Bluff site, an upland open camp that overlooked the Devils River prior to the impoundment of Amistad Reservoir, produced 12 sherds in the upper three levels of one excavation unit. The ceramic fragments were described as ranging in color from orange-tan to buff and gray (McClurkan 1968:8). The specimens were smoothed and one had a polished exterior. Temper, thickness, or paste were not discussed but the sherds were likened to those from Devil's Mouth in appearance and composition.

James H. Word recorded 41VV424, a terrace site on the banks of the Devils River near Baker's Crossing (TARL files), where he collected a fragment of a ceramic pipe and two sherds which he described as reddish pink, quite firm, 3 to 4 mm thick, and tempered with a white material, either bone or crushed caliche. To him, the pottery seemed similar to sherds that he had seen from the San Angelo area, and material he had collected from the Floydada Country Club site (41FL1; Word 1963:57, 1968).

Turpin and Bement collected yet another sherd, 13 steeply beveled end scrapers, and four arrow points from the Dolan Creek Terrace site, paralleling Dolan Creek, across from an historic pictograph, a Spanish mission scene at 41VV343. Reportedly, the landowner also found a metal arrow point on this site.

Pecos River Drainage

An incised rim sherd in a private collection reportedly came from a unspecified rock shelter on the Pecos River. This fragment of brownware differs from Infierno phase pottery in its fine-textured paste, sand tempering, higher firing temperature, and decoration. The exterior of a simple rim was apparently encircled by a zigzag line about 1 cm in height.

Other Locations

North of the Lower Pecos region, one specimen used in this preliminary analysis is from Reagan County. A sherd that outwardly looked very much like Infierno phase pottery was eroding from a dissected sand drift on the north shore of Big Lake (41RG26), the largest playa lake in Texas. This ceramic fragment was generally associated with Perdiz and Toyah arrow points (Turpin 1994).

Long ago, collectors and amateur archeologists working even farther north recognized similarities in sherds from sites near Abilene, San Angelo, and Rotan that in turn are very like the Lower Pecos complement discussed here. The pottery was informally called Abilene Brown (Word 1978) and presumably was similar to ceramics reported in the 1930s by Ray (1935; Griffin 1935). Word (1978) corresponded with Dibble about the possible Infierno-Abilene link based on the perceived similarities, and loaned him a comparative sample from the Floydada Country Club site (41FL1). One of those sherds was thin-sectioned for this analysis.

In addition, one of two sherds collected during excavation of Sotol Shelter (41CX9), a rock shelter in Crockett County (Lorrain 1968), may be relevant to this discussion in that it was associated with arrow points and radiocarbon dates, although its physical description is not conclusive. Hearths associated with arrow points and ceramic fragments, one of which has crushed rock temper only vaguely reminiscent of the Infierno sherds, produced uncorrected, uncalibrated ages of 400 $\pm$ 60 (Tx-649) and 370 $\pm$ 60 B.P. (Tx-650). The 1-sigma calibrated date range of the hearths is A.D. 1440-1640 (Stuiver and Reimer 1993, Method A). In fact, a number of sherds from Crockett and Pecos counties were reported by Rogers (1972), who attributed many of them to Caddoan or Jornada Mogollon influences, leaving only a few that might potentially match the Infierno sample. However, none of these specimens were available for our analyses.

Mission San Lorenzo de la Santa Cruz

The history and archeology of Mission San Lorenzo are discussed in detail by Tunnell and Newcomb (1969). Established for the Apaches, the mission was only in existence from 1762 to 1771 when it was abandoned and left to disintegrate. Archeological excavations unearthed massive amounts of pottery, including several sherds whose description was given as "soft paste, wheel-made earthenware" (Tunnell and Newcomb 1969:80-81). Six sherds assigned to this group were borrowed from TARL for this analysis. Only one of these evidences wheel turning, and none bear the red slip attributed to this category (Tunnell and Newcomb 1969:80-81).

Coil undulations are visible on some sherds, indicating that these specimens were hand-made. The paste has a granular sandy texture and the aplastic inclusions are small angular fragments of calcium carbonate. Some, but not all, of the sherds also contained crushed bone. On most of them, the paste has oxidized to a light orange on the surface; and the core is dark gray and constitutes up to one-half of the sherd. Gross characteristics, such as the tempering materials, paste, color, and firing temperatures, align this particular sample of sherds with the Lower Pecos assemblage so two sherds were thin-sectioned for the next stage of the analysis.

ANALYSIS OF SELECTED SHERDS

Point counts of the 13 thin-sectioned sherds demonstrate the similarities and differences within a sample that outwardly appeared to be uniformly one type (Table 1). Perhaps typical of poorly fired, hand-molded ceramics, the variability within any one sherd often exceeded that between sherds from different locations. Two 100-point counts per sherd were averaged to arrive at the percentages provided in the table.

The two sherds from Javelina Bluff (41VV11), share smooth texture, straight fracture, and pore space in fine and very fine voids. Both have sub-rounded to sub-angular and angular black to white particles, a mixture of limestone and bone. One sherd (1119) has smoothed interior and exterior surfaces but the other (1131) has a smoothed interior and polished exterior. The latter sherd is pinkish-tan throughout; the other has a dull grey core streak interrupting its pinkish-tan body. The variety in color and surface attributes mitigate against attributing both sherds to the same vessel but this variability may also be the result of casual finishing and poorly controlled firing.

Both the thin-sectioned sherds from the Devils Mouth site (41VV188), have pinkish to dark tan clay bodies with carbon core streaks. Their unifying characteristic is the inclusion of fine to coarse and sub-rounded to sub-angular limestone and bone particles. One sherd has granular texture and wavy fracture, and the other has a smooth texture and straight fracture. The former has smoothed exterior and interior surfaces while the other has a polished interior and a smoothed exterior. Body particles protrude from the smoothed surfaces of both sherds.

Both sherds from Black Camp Cave (41VV365) share irregularly-shaped pore space, fine to very coarse black to white particles of limestone and bone, a distinct carbon streak, pinkish-tan clay bodies, and smoothed exterior and interior surfaces with protruding particles. One has smooth texture and straight fracture, while the other has a rough texture and wavy fracture.

The sherd from Baker's Crossing, 41VV424, has granular texture and wavy fracture; pore space in irregularly shaped voids; and fine-to-coarse, sub-angular to sub-rounded black to white particles of limestone and bone. The interior clay body is pinkish-tan, and its surface is smoothed; the exterior is blackened by a carbon flare and polished.

The two sherds from Infierno Camp (41VV446) have irregular fracture and texture that is coarser than either Leon Plain pottery of coastal and South Texas or Mogollon brownware of the Trans-Pecos. The clay bodies have very small amounts of fine sand with rounded edges, suggesting it probably is a natural inclusion. The most obvious tempering agent consists of large white particles of limestone, partially slaked by the firing process. Voids in the ceramic fabric are rod-like, their interior surfaces scored longitudinally, indicating additional tempering with clipped grass or herbivore dung. Both sherds have thick black core streaks. One sherd has a red exterior and interior, the other is yellowish-tan. Both were manufactured by coiling; the surfaces are haphazardly polished with a hard instrument that left polishing marks and smeared the outer layer of clay. The polishing action created both piles of clay and gaps in the surface.

The small fragment of plain pottery from the Floydada Country Club site (41FL1) has even fracture and smooth texture. Both exterior and interior surfaces are smoothed and paste particles are visible on the surface. Paste colors range from yellowish tan to grayish-tan; the core has a wide gray carbon streak. The paste has medium to coarse voids and numerous medium to coarse sub-angular and angular particles that range in color from gray to white. The sherd failed to effervesce in hydrochloric acid, the first indication that the particles are bone or bone phosphate without the calcium carbonate that is the key diagnostic element in Infierno ceramics (see Matson 1935 for a discussion of these tempering materials). This preliminary finding was confirmed by the point count (see Table 1), which clearly segregates the Floydada sherd from the Lower Pecos sample based on the

Table 1. Thin-Section Analyses of Selected Lower Pecos Sherds

Site No.	41VV11	41VV11	41VV188	41VV188	41VV365	41VV365	41VV424	41VV446	41VV446	MSL	MSL	41FL1	41RG26
Thin Section	1119	1131	751	761	3651	3652	424	GQU-1	GQU-2	22	67	FL-12	GQU-1
Texture	smooth	smooth	smooth	granular	smooth	rough	granular	coarse	coarse	blocky	even	smooth	coarse
Surface Color	pink-tan	pink-tan	dark tan	pink-tan	pink-tan	pink-tan	pink-tan	red	yellow-tan	red-brown	red	yellow-tan	red-tan
Finishing	smooth	sm/pol*	sm/pol	smooth	smooth	smooth	sm/pol	polish	polish	smooth	sm/pol	smooth	smooth
Matrix	64.5†	53.5	58.5	61.0	59.5	58.0	66.0	52.5	55.0	52.0	58.5	45.5	41.5
Pore Space	4.5	5.0	3.5	11.5	11.0	7.0	3.0	19.5	17.5	4.0	1.5	25.0	10.5
Quartz	2.5	2.5	13.0	5.0	1.5	1.0	1.5	11.5	17.0	7.5	12.0	15.0	16.5
Bone	12.0	30.0	17.0	18.0	24.0	30.0	21.0	13.0	8.0	36.0	20.0	10.0	–
Limestone	10.5	5.5	3.5	1.5	1.5	2.0	4.5	2.5	2.5	–	3.5	–	–
Calcite	–	–	–	–	–	–	–	1.0	–	–	–	–	–
Chert	–	–	–	–	–	–	–	–	–	–	–	0.5	
Fe-stain	3.0	2.0	4.0	2.5	1.0	2.0	4.0	1.0	1.5	–	–	–	7.5**
Clayballs	3.0	1.0	0.5	0.5	1.5	–	–	–	–	–	3.5	4.0	–
Other	–	–	–	–	–	–	–	–	–	–	–	–	24.0***

* sm/pol = smooth/polished
** Appears as black particles, not red patches
*** Quartz rock 5.5%, Orthoclase 7.5%, Microline 1.5%, Pyroxene 3.5%, and Unknown 6.0%
† = percentage

absence of limestone tempering material and the minor presence of chert.

The ceramic fragment from 41RG26 was very small, about 6 mm thick, and almost destroyed by thin-sectioning. This sherd has reddish-brown interior and exterior surfaces and a grey-brown core. Its texture is coarse. The ceramic fabric has numerous coarse white particles and a few fine black particles. The thin section analysis clearly isolates this sherd based on the absence of bone and limestone tempering and the inclusion of irregular crushed quartz rock as opposed to quartz sand, feldspars (orthoclase, microcline), igneous silicates (pyrozene), and unknown particles (see Table 1).

The two thin-sectioned sherds from Mission San Lorenzo vary in a number of attributes. One has a crazed, blocky texture while the other has even texture. The latter has a polished exterior and smoothed interior; the former has smoothed interior and exterior surfaces. Although both have reddish exteriors, neither is slipped. They have thick black carbon streaks and fine to coarse white particles of bone and/or limestone as well; very fine, well-rounded sand particles may be naturally occurring in the ceramic paste. The point count demonstrated that one of the sherds (67) was tempered with both bone and limestone, like the Lower Pecos sample, but the only aplastic additive identified in the other specimen was bone.

Summary Descriptions

The sum of the sherds examined macroscopically and in thin-section indicates that Lower Pecos pottery is predominantly low-to-moderately fired earthenware, perhaps a variation on the widespread tradition found in Central, South, and West Texas and often subsumed under the generic name Leon Plain. The Lower Pecos pottery is coil-made and fired in an open oxidizing atmosphere with few controls. Surface colors range from orange-red through yellowish-brown to pinkish and light tan. Black and gray carbon streaks are common in the core of the clay bodies and carbon flares occasionally darken the exterior surfaces. Smoothing and polishing are the most common finishing modes, although initial brushing is occasionally indicated by marks. The red slip attributed to Mission San Lorenzo pottery may be a late introduction or it may imply yet another variety of simple earthenware.

Ceramic pastes are alluvial clays with inclusions of very fine quartz sand particles. Medium and coarse rounded chunks of hematite are often accidentally incorporated into the clay body. The most dramatic tempering agent is crushed calcium carbonate (limestone) which gives the sherds their distinctive appearance, especially when coarse particles protrude from the smoothed and polished surfaces. All of the thin-sectioned sherds from the Lower Pecos proper contain both bone and limestone aplastic material, a combination found in only one sherd from Mission San Lorenzo in the outside sample. Variability is expectable in a short-lived site such as the mission where people from different ethnic groups entered and exited at will. However, the use of calcium carbonate tempering agents in the Lower Pecos ceramics and its absence in the sherds from the Big Lake and Floydada sites are consistent with local geology and may indicate local manufacture.

Little is known about vessel forms. Sorrow (1968:42) collected one basal sherd from a flat-bottomed bowl at the Devil's Mouth site; a few simple rims were noted at Infierno Camp. Generally, vessel walls ranged in thickness from 2 to 9 mm. The Mission San Lorenzo sherds were considered to be fragments from large jars, unlike the prehistoric vessels. Wheel turning of some of the plain pottery from Mission San Lorenzo probably reflects the indigenous application of imported technology to an old art to create new forms and may signal the end of the production of typical ceramics.

DISCUSSION

The typological classification of Infierno ceramics is currently limited by the small sample size, all of which was collected from the Lower Pecos region: more specifically from open camp sites on the terraces of the major rivers or on promontories overlooking spring-fed tributaries. Only three sherds, two of which are definitely different from the bulk of the ceramic inventory, came from rock shelters—Coontail Spin and an unidentified Pecos River site—in the Lower Pecos proper. Four of the ceramic-bearing sites (41VV365, 41VV446, 41VV828, and 41VV869) clearly belong to the Infierno phase artifact and feature complex with stone circles, small arrow points, and/or steeply beveled end scrapers. Two of these are on high promontories; all four overlook permanent springs or water holes.

The estimated age of the Infierno phase is post-A.D. 1500 (Turpin 1991:36-37), a time not inconsistent with the sherds found at the eastern limits of the current sample at Mission San Lorenzo (Tunnell and Newcomb 1969). The commonality in gross characteristics and the combined limestone/bone temper in one of the thin-sections from the Mission assemblage suggests that the basic constituents of Infierno pottery were carried into the post-contact period by local artisans. Thus, temporal parameters of A.D. 1500-1780 are a logical first estimate.

Speculation on the origin of the ceramic technology employed by the people who accidentally left these few sherds on the banks of the Rio Grande and its tributaries is surely premature given the small size of the sample. Whether they constitute a distinct ceramic type or are more comfortably envisioned as a variety of Leon Plain produced on the western periphery of the Toyah phase, it is clear that specific similarities in paste, temper, and finishing unite these few sherds into a useful tool for identifying the Infierno phase sites and people late in the prehistory of the Lower Pecos region.

ACKNOWLEDGMENTS

Sandra Billingsley and Bryant Saner were instrumental in directing us to the unreported sherds found during the Amistad Reservoir low-water survey. Lee Bement was the first to spot the sherds at 41VV365, 41VV662, 41VV828, and 41VV869. Several of the thin-sectioned sherds were obtained from the Texas Archeological Research Laboratory, some in the 1980s with the consent of Dr. Dee Ann Story, and others more recently with permission granted by Dr. Thomas R. Hester. Other specimens were contributed by James H. Word and David S. Dibble, who initiated their correspondence about Infierno pottery in the 1970s. This paper is a logical continuation of Dibble's work.

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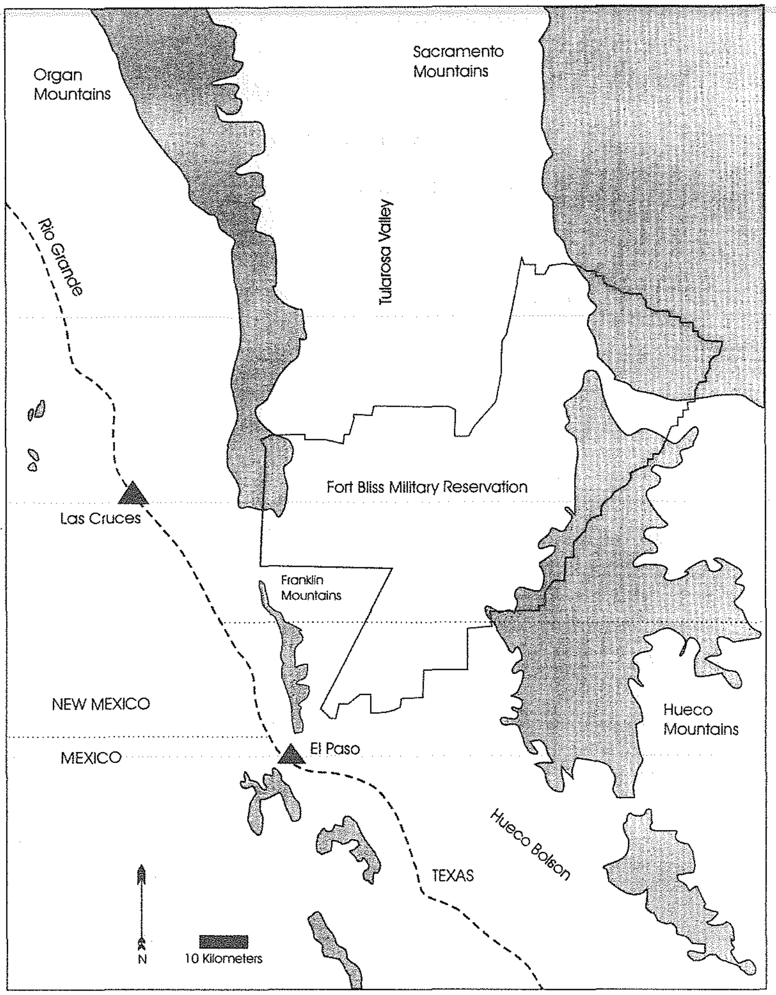

Figure 1. Map of the study area.

of stable grassland with a mesquite-dominated landscape. This vegetational change, possibly enhanced by climate change (Mauldin 1995; Neilson 1986), has resulted in significant erosion. As Figure 2 shows, the basin portion of Fort Bliss is currently characterized by mesquite-stabilized sand dunes, sheet sands, sand ridges, and eroded inter-dune blowouts (see Abbott 1996).

Archeological research in the study area reveals human use for more than 11,000 years (Carmichael 1986; Mauldin and Leach 1996; Whalen 1986, 1994a), although recent studies of occupation patterns (Carmichael 1986; Mauldin 1994) suggest that most of the record has been generated within the last 5,000 years. While the surrounding area has some of the earliest evidence for agriculture in the Southwest (Tagg 1996; Upham et al. 1987), summaries of subsistence patterns suggest that the region was primarily occupied by highly mobile groups relying on hunting and gathering for most of the prehistoric sequence (Hard et al. 1996; Mauldin 1996; Whalen 1994a).

Over three decades of survey and excavation work in the region suggests that the archeological record generally consists of small (ca. 1000 m^2) sites dominated by a few thermal features, an occasional pit structure, and low density scatters of fire-cracked rock, ceramics, and chipped and ground stone (e.g., Abbott et al. 1996; Leach 1994; Mauldin 1994; Seaman et al. 1988). The first evidence of ceramic production appeared in the area as undecorated brownwares about 1700 B.P. (Perttula et al. 1995; Whalen 1981), although many sites that date to this time period lack ceramics (Mauldin et al. 1994; Whalen 1994a). Pueblo architecture, associated with adaptations that may rely on agriculture, develops in the region at about 750 B.P. (Whalen 1994b). This increased reliance on agriculture, which may begin prior to the appearance of pueblo architecture at about 750 to 850 B.P. (Hard et al. 1996:297-299), also marks the appearance of water control features (Bentley 1993; Leach et al. 1993, 1996; Scarborough 1988). By 500 B.P., these agriculturally-based systems seem to have collapsed.

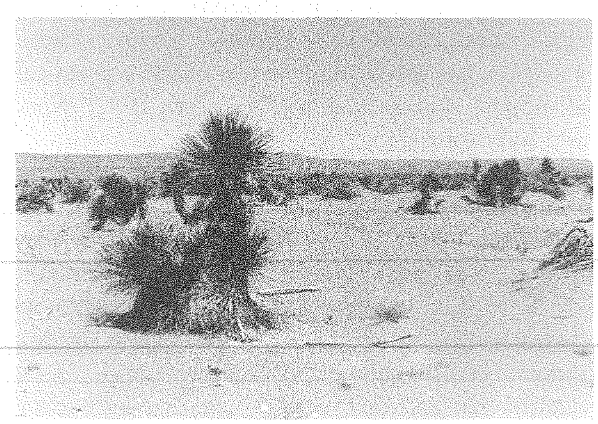

Figure 2. Photograph of the Hueco Bolson.

THE ARCHEOLOGICAL DATA SET

The archeological sites used in this study were recorded during three large surveys conducted in the late 1970s and early 1980s (Carmichael 1986; Whalen 1977, 1978). These surveys recorded over 10,000 archeological sites that reflect occupation in the region from the terminal Pleistocene throughout the Holocene. While a few large sites (> 1 km^2) are present, most are small (< 1000 m^2), and consist of low-density scatters of chipped and ground stone, ceramics, fire-cracked rock, and occasional hearth and structural features. Radiocarbon dates from recent excavations demonstrate that regardless of site size, most appear to represent multiple occupations (Doleman et al. 1992; Mauldin et al. 1994; Miller 1997; O'Laughlin 1980; Whalen 1994b). For example, data from Mauldin et al. (1994) suggest that of 12 sites with multiple radiocarbon dates from different features, only three sites (25 percent) had date ranges that overlapped at two sigmas (see also Whalen 1980; O'Laughlin and Martin 1989). In several cases, radiocarbon dates from a given site span several thousand years (Leach et al. in press; Mauldin 1994, 1995, 1996; Mauldin and Leach 1996), suggesting that most sites may reflect multiple occupations. Therefore, much of the current archeological data points to a pattern of short-term reuse of the basin areas. Combined with the erosion brought about by overgrazing and climate change over the last 100 years (Buffington and Herbel 1965; Mauldin 1995; Monger 1993; Neilson 1986), the current surface record is often a palimpsest of archeological material.

GEOMORPHIC AND ARCHEOLOGICAL PATTERNING

Maps of eolian surface features in military maneuver areas on Fort Bliss (see Figure 1) were made to identify areas where erosion—resulting primarily from modern eolian activity—had altered the stratigraphic integrity of soils, causing the deflation and exposure of archeological deposits, and also identify areas where eolian deposition may have buried archeological material (Monger 1993:35-40, 1995). These maps contain four eolian erosion and deposition units based on the presence or absence of dunes, inter-dune sheet sand deposits, or caliche nodules, fragments, and gravels (Table 1). Using combinations of these variables, Monger further subdivides the four mapping units into sub-units. For example, Mapping Unit 2, characterized by dunes, inter-dune sheet deposits, and lacking caliche and gravel, is subdivided into subunits 2a and 2b on the basis of dune size (Table 1 provides definitions of the four eolian mapping units and their respective sub-units). Figure 3 presents an example of the distribution of these units in a portion of the study area. Note that combinations of sub-units (e.g., 2a/1a) are present. These are cases in which two mapping sub-units are in-

Table 1. Eolian Mapping Units defined by Monger (1993:35-38, 1995:41-43)

Mapping Units	Sub-units
1 - Modern deflational surfaces	1a- Large dunes (generally >1m) with collapsed interdune strata; 1b- Small dunes (generally <1m) with collapsed interdune strata; 1c- deflated nondune areas.
2 - Dunes with interdune sheet deposits	2a- Large dunes (generally >1m) with interdune sheet deposits; 2b- Small dunes (generally <1m) with interdune sheet deposits.
3 - Depositional areas composed of sand sheet deposits.	No subunits defined
4 - Areas where soil strata are modified little by wind.	No subunits defined

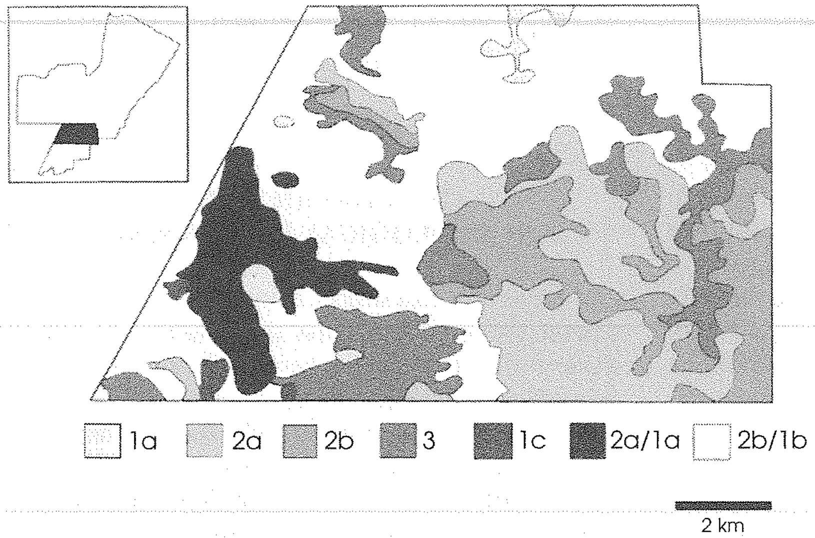

Figure 3. Eolian mapping units from a portion of the study area (adapted from Monger 1993).

termingled at small scales, with the initial designation indicating the dominant unit (Monger 1993:40).

As the purpose of the present analysis is to consider the impact of eolian erosion (exposure) and deposition (burial) on archeological site size and site characteristics, we reclassified the mapping units to highlight erosion and deposition. For example, Mapping Unit 1 is characterized by dunes and inter-dune areas with lagged deposits, that reflect high rates of eolian erosion and subsequent deposition in the form of dunes and sheet sands. Consequently, we classify all areas in which Mapping Unit 1, or a sub-unit of Mapping Unit 1, is present as high erosion. The high dunes and inter-dune sheet sands of Mapping Unit 2 are classified as reflecting moderate levels of erosion and deposition. Mapping Units 3 and 4 reflect stable or aggrading surfaces, and are classified as a low erosion/deposition category. While it can be argued that these two units should be separated to reflect the potential for buried occupations in Unit 4, our goal in combining the units is to highlight erosional and depositional differences. These regrouped units (i.e., high, moderate, and low erosion/deposition) form the basis for our consideration of site characteristics. The high to moderate erosion designations are used to highlight areas that are likely to have exposed archeological material. In contrast, areas that are characterized by low erosion are likely to mask underlying archeological deposits (Blair et al. 1990).

We consider only the basin area (ca. 1200 km^2) between the Franklin-Organ and the Hueco-Otero Mesa-Sacramento fan systems (see Figure 1). The alluvial fans are not used due to the lack of survey data for those areas. Over 8,000 previously recorded survey sites fall within the basin area. We assigned each of these sites to a corresponding erosional unit by overlaying the survey and geomorphic data sets in a CAD program. However, archeological sites that extended from one mapping unit onto another, and could not be confidently assigned to a unit, were omitted from further analysis, along with any sites that lacked complete data on site level assemblage content. This sampling process resulted in 7,923 sites with complete locational and content data for our analysis. High erosion/deposition settings (Mapping Unit 1) cover less than five percent of the basin and contain 218 archeological sites. The moderate erosion/deposition areas cover about 91 percent of the basin and contain 7,247 sites. The low erosion/deposition areas cover roughly five percent of the basin and contain 458 sites.

SITE SIZE AND EROSION

The first pattern involves relationships between the size of archeological sites and the erosion/deposition units. While variation in site size is commonly tied to different numbers of people and different activities, it could be hypothesized that as erosion increases, site size will increase as previously buried archeological material would be collapsed onto an exposed surface. However, the erosion of sediments will simultaneously be redeposited in the form of dunes and sheet sands nearby, creating small windows in which archeological material may be present. In this environmental setting, we suggest that erosion and deposition combine to create different site boundaries. Figure 4 presents a hypothetical scenario of how erosion and deposition affect artifact distribution. In situations of minimal erosion and sedimentation, artifact visibility would be high

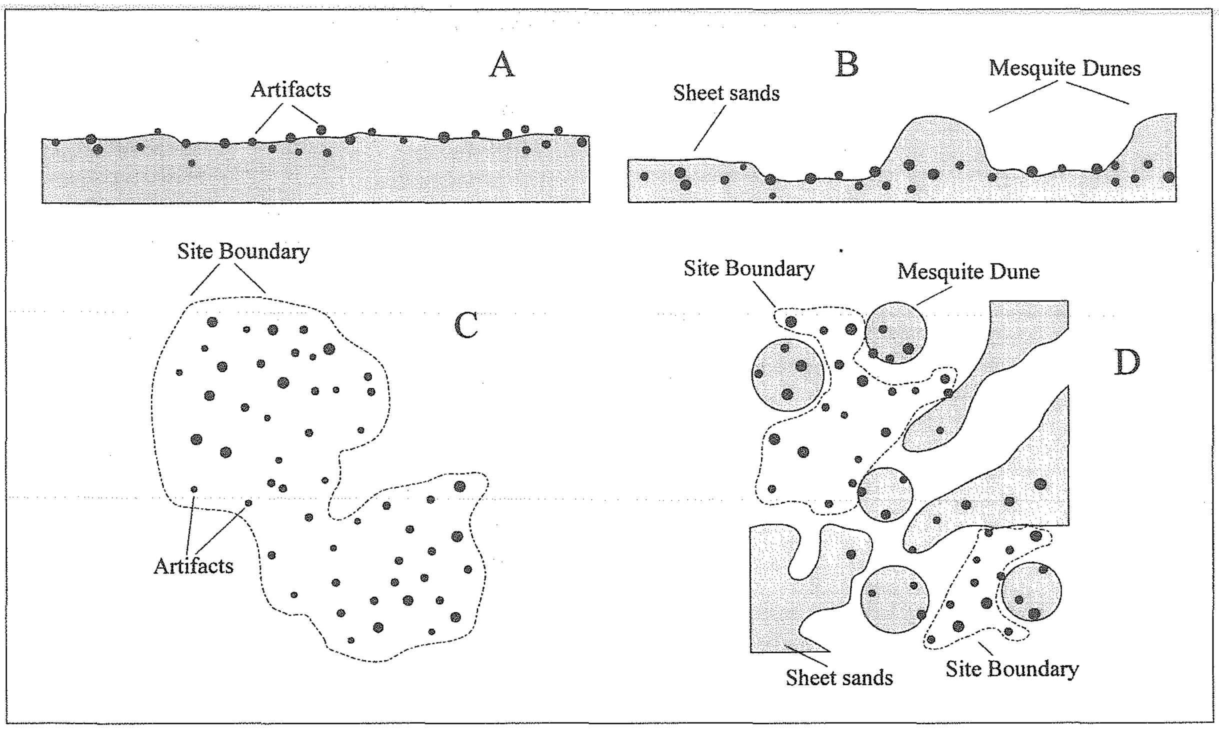

Figure 4. An idealized scenario of the impact of varying erosion and deposition on an archeological assemblage (A, B) and site size (C, D).

(Figure 4a, c). In areas of high erosion (exposure), and subsequent localized deposition of sheet sands and dunes, artifact visibility could increase as a result of sediment loss (Figure 4b, d). However, as the area undergoes localized erosion and subsequent sedimentation, the artifact distribution is broken up into spatially smaller units. In this scenario, if the distance between these smaller units exceeds the minimal distance in the definition of a site, two smaller sites will be assigned (see Figure 4d).

Site size and erosional data from the 7,923 sites in the survey data base support the Figure 4 scenario. The mean site size for the 218 sites in the high erosion/deposition unit is 906 m^2. In the moderate erosion unit, the mean site size is 1536 m^2. Finally, in the low erosion unit, the average site size is 3167 m^2. As erosion increases, the mean site size decreases. Sites in the low erosion group are, on average, 3.5 times larger than sites in the high erosion group. While the patterns in site size may still reflect past decisions regarding where to locate activities, or overall population size, the patterns can also be the result of recent eolian processes.

IMPLICATIONS OF SITE SIZE AND EROSIONAL PATTERNS FOR SITE TYPES

If surface site size is linked to erosion/ deposition, then variables that are commonly used to assign sites to different functional and temporal groups, or site types, would be affected. Site types, such as residential, base camp, macro-band, and limited activity sites, form the basis of settlement and subsistence reconstructions in the study area (e.g., Carmichael 1986; MacNeish 1993; Whalen 1977). Variables used to create site types commonly include the number and variety of artifact types, usually as a measure of behavioral complexity at that location (e.g., Whalen 1977), as well as the presence of temporally diagnostic artifact forms that are used to assign sites or components within sites to phases (e.g., MacNeish 1993). In the study area, these variables correlate with site size. As such, these variables may not directly reflect past settlement types.

Table 2 presents various measures of site size (mean, medium, and quartiles) and number of artifact types (e.g., mano, flake, Mimbres Black-on-

Table 2. Number of Artifact Types by Site Size

No. of Artifact Types	Number of Sites	Mean Site Size*	Lower Quartile*	Median*	Upper Quartile*
0+	2818	124	50	50	50
1	1745	441	50	200	400
2	1185	855	50	400	800
3	855	1466	100	500	1200
4	502	2501	200	800	2200
5	336	4052	400	1400	4350
6	200	6538	900	2600	7150
7	134	11954	1900	4600	11200
8	87	14983	2700	7100	14000
9	30	17153	2600	5100	18600
10	24	66512	10850	33800	70350
11	7	62471	20200	25800	131900

* Site size in m^2.
+ Site is defined by the presence of a feature(s).

white pottery) using survey records from Fort Bliss (Mauldin 1995). Sites with no artifacts, consisting of features only, have the lowest recorded mean site size (124 m^2). Sites with the highest number of artifact types (n=11) have an average site area of more than 62,000 m^2.

Clearly, the number of artifact types is closely related to site size. In the "site type approach," sites with greater artifact variety are frequently assumed to represent a greater range of activities, while sites with lower artifact variety are interpreted as reflecting a more limited activity range. As artifact variety is dependent on site size, and site size is related to eolian settings, using artifact variety as a measure of activity diversity at a site level in the study area may be problematic. While it is possible to consider artifact variability on sites taking into account site size (e.g., Mauldin 1996), the size of surface sites in this eolian setting is, in part, a function of the history of erosion and deposition, and not directly reflective of past behavior.

The number of temporal components on a site, identified by the presence of time-sensitive artifacts (e.g., Mimbres Black-on-white ceramics, Bajada projectile points), also correlates with modern erosional units. Considering relationships between erosional settings and the presence of temporally diagnostic artifacts, over 90 percent of the sites in high erosion/deposition settings lack temporal diagnostics. This percentage declines to just below 88 percent in moderate erosion areas, and to 70.5 percent in low erosion settings. The percentage of sites that lack diagnostic artifacts appears to be related to modern eolian processes, primarily as a result of the impacts of these processes on site size. This relationship can be seen by considering the number of temporal components and site size. The 6,866 archaeological sites with no diagnostic artifacts (no identified temporal components) have the smallest site size (mean=555 m^2). Sites with only one temporal component (n=962) average 6577 m^2, and sites with two temporal components (n=85) average 24,434 m^2. Finally, those sites with more than two temporal components average 54,990 m^2 in size. As the number of components increase, the average site size increases. This pattern is probably a function of the overall increase in artifacts on larger sites. That is, as the size of the site increases, which we have seen is related in part to erosional factors, more artifacts are likely to be present, increasing the probability that diagnostic artifacts will be discovered in the assemblage. The larger the assemblage, the more likely it is that artifacts representing different temporal periods will be uncovered.

In the site survey data base, the number of artifacts on a site was not recorded by the original

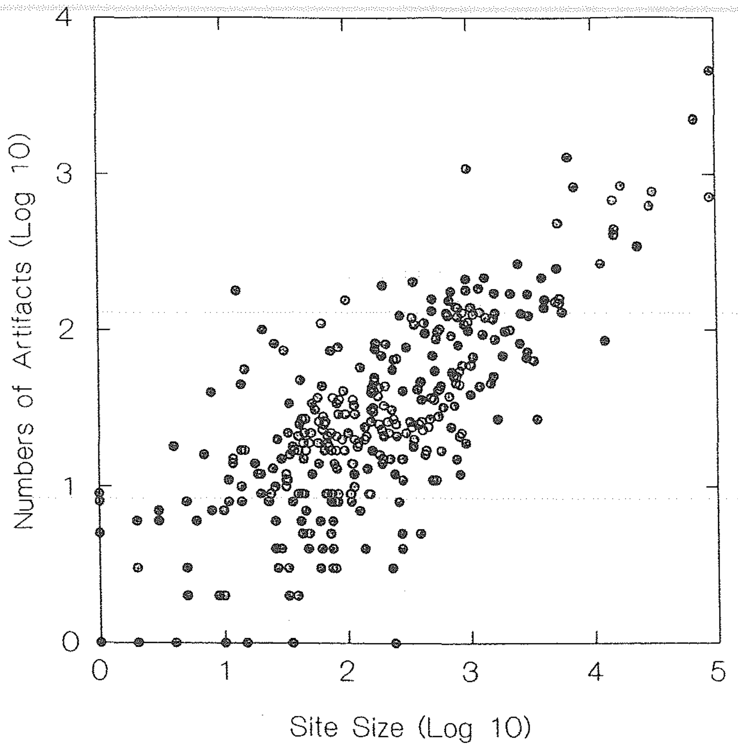

Figure 5. Bivariate (log x log) plot of the number of artifacts by site size for 336 basin sites.

researchers. However, we can consider this relationship using recently collected surface data from another project in the study area (Leach 1994). Figure 5 plots (log x log) the number of artifacts (including fire-cracked rock) and site size using data from 336 basin sites (Leach et al. in press). As site size increases, so does the number of artifacts. Assemblage size and site area are significantly correlated with a Pearson's R of .76 (p=.0001). The number of artifacts influences artifact variety, and the probability that time-sensitive artifacts will be recovered. These overall patterns, then, may simply be a function of sample size (see Leonard and Jones 1989; McCartney and Glass 1990; Rhode 1988).

DISCUSSION AND CONCLUSION

By definition, cultural materials enter the archeological record as the result of human behavior. After deposition, these cultural materials may be transformed by a number of cultural and natural processes that potentially alter their original systemic context (Ebert 1992; Schiffer 1987). Archeological survey, using some definition of what is and is not a site, then records some portion of this material as sites. In the current study area, these sites are frequently assigned to temporal groups on the basis of diagnostic artifacts, and to functional groups on the basis of artifact variety. These temporal-functional groups then are used in settlement analysis, as well as for making basic decisions regarding research potential, significance, and treatment procedures.

The focus of this paper has been to demonstrate that eolian processes can have a substantial effect on how we see, and ultimately interpret, the surface archeological record of the basin areas of West Texas and southern New Mexico. Many other factors, including survey intensity (e.g., Leach 1994; Mauldin 1995), site definition (Mauldin 1995), topographic location (e.g., Doleman et al. 1992), and artifact obtrusiveness (Schiffer 1987), also affect the surface archeological record. However, in the current study area, patterns of artifact variety, artifact number, and the number of temporal components on a site correlate with site size. In this area and, we suspect, in other eolian environments, site size is related to the history of natural deposition and erosion. The way we draw site boundaries around artifact and feature distributions in eolian settings is tied, in part, to artifact and feature visibility. These sites, defined for management purposes, are commonly used to reconstruct settlement and subsistence patterns during a given temporal period, and differences between periods are identified and "explained" (e.g., Carmichael 1986; MacNeish 1993; Whalen 1977, 1978). However, the patterns identified in this paper suggest that in the northern Chihuahuan Desert, any attempt to reconstruct prehistoric settlement from site level data such as artifact variety, the number of artifacts, or even the presence or number of temporal components, without detailed attention to the geomorphic setting, is problematic. Patterns identified at a site level correlate with patterns of eolian erosion and deposition. Such patterns are not directly representative of prehistoric behavior.

The realization that past and present landscapes are dynamic and continually changing (Waters and Kuehn 1996), thus resulting in different opportunities for site discovery (Bettis 1995; Collins 1995), is a necessary first step in developing reasonable behavioral inferences from the surface archeological record. A second step involves the realization that in eolian settings such as the current study area, these changing landscapes significantly impact the character of the sites that are discovered. Interpretations that fail to consider the impact of eolian processes on the character of sites will not advance our understanding of past settlement systems.

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Hand Prints at Pace Bend Park That Are Probably Not Prehistoric

E. J. Mawk and M. W. Rowe

ABSTRACT

We studied tiny samples scraped from a white hand print painted in Pace Bend Park by scanning electron microscopy equipped with energy dispersive X-ray spectroscopy. Titanium was the most prominent element seen in the X-ray spectra, indicating the use of a 20th century paint. The hand print is probably not prehistoric.

INTRODUCTION

Several painted hand prints are located in Pace Bend Park at Lake Travis in Travis County, Texas; one of them is shown in Figure 1. To ascertain the authenticity of the hand print rock paintings—whether they were painted in prehistoric times by Native Americans or more recently—we were sent small scrapings of the paint for chemical analysis.

Figure 1. Hand print rock painting located at Pace Bend Park, Lake Travis, Texas. Photograph by Solveig Turpin.

Scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX) was chosen for qualitative elemental characterization of major and minor qualitative elemental analysis of the sample. SEM-EDX is rapid, and requires small sample sizes of approximately 0.1 mm or less. Thus, the technique is virtually non-destructive and no visible damage is suffered by the rock paintings. SEM uses electron bombardment and secondary electrons to image the sample, much the same way that optical microscopes image using light. A byproduct of SEM is the generation of X-rays; fortunately, X-rays emitted are of distinctive energies that are characteristic of the elements being bombarded with electrons. An energy dispersion spectrum (EDX) thus allows determination of major and minor elements present in a sample. Major constituents ($\geq$ 10 percent by weight) can be determined in only 10 seconds; minor constituents, on the order of a few percent, can be determined in 100 seconds (Goldstein et al. 1992).

EXPERIMENTAL METHOD

We mounted pigment fragments on a standard aluminum SEM sample mount by attaching them with double-sided sticky tape. They were coated with 100 μm of gold/palladium to render the surfaces electrically conducting, as this is necessary for good images and chemical analyses. The sample mount was placed in a JEOL JSM-6400 analytical grade scanning electron microscope equipped with an EDX. One-hundred second EDX spectra were taken on numerous ~0.1 mm-sized samples of the hand print pigment.

RESULTS AND DISCUSSION

Figure 2 shows the EDX spectrum for a representative sample. The element titanium (Ti) was prominent in all of the pigment scrapings. We took multiple spectra from various pieces of the scrapings, always with the same result: the dominant presence of titanium.

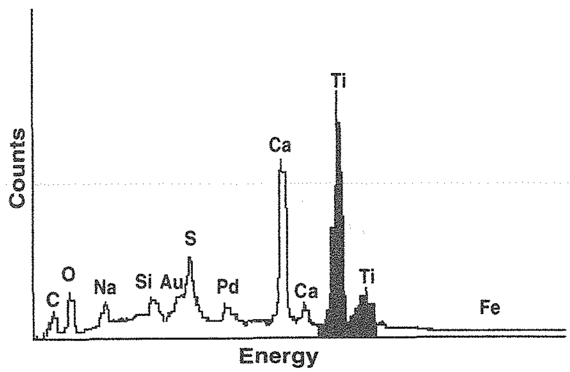

Figure 2. SEM-EDX spectrum of a sample of white pigment from a Pace Bend Park hand print rock painting. The spectrum, typical for all samples examined, shows abundant titanium.

Ancient people have used white pigments throughout the world. The pigments are generally clay minerals or other naturally occurring minerals. For example, Mawk et al. (1996) analyzed white pigments from four rock paintings in South Australia and found they contained micaceous clay with the addition of gypsum (calcite sulfate) in some cases. The presence of the other elements in the Pace Bend Park spectra is consistent with those expected from rock surfaces and mineral accretions that accumulate on rock and rock painting surfaces. Calcium (Ca) and sulfur (S) are indicative of the presence of gypsum, while calcium, carbon (C), and oxygen (O) are indicative of whewellite. These are found in mineral accretions seen both on top and underneath pigment layers in rock paintings in the lower Pecos River region of Texas by Hyman et al. (1996) and Russ et al. (1995); in Utah by Chaffee et al. (1994); in Australia by Mawk et al. (1996); and other researchers listed in the references in those papers. The sodium (Na) and silicon (Si) in the Pace Bend sample are probably from the underlying rock itself.

Titanium was not used by ancient painters as a white pigment; its use as a pigment is a modern occurrence (Paul 1985; Remington 1945; Wilson et al. 1987). The commonly available modern white pigments now used are titanium dioxide, zinc oxide, and zinc sulfide. Until titanium dioxide was introduced as a pigment, white lead (basic lead carbonates) and zinc oxide were most commonly used as pigments. Titanium dioxide is now the most commonly used white pigment in the coatings industry. The main raw material for titanium pigments is the iron-black-colored mineral, ilmenite (iron-titanium oxide). In order to obtain a white pigment from ilmenite, it is first ground and dissolved in concentrated sulfuric acid to form titanyl sulfate. Iron is added to reduce the iron(III) to iron(II), and some titanium is reduced to prevent re-oxidation of iron. The titanyl sulfate is purified by sedimentation and crystallization, after which the titanium is then precipitated by hydrosis to yield titanium dioxide that functions as the pigment (Paul 1985). Clearly, the presence of titanium in the Pace Bend hand print pigment indicates that this rock painting is of 20th century vintage rather than prehistoric. By inference, we assume that none of the others are either. Alternatively, an earlier prehistoric image could have been repainted in modern times. The samples taken for our analyses were too small to make a section to investigate the possibility of more than one layer of paint.

ACKNOWLEDGMENTS

Partial support for this work was supplied by the Lower Colorado River Authority (LCRA) and the National Center for Preservation Technology and Training. We also thank Bruce A. Nightengale (LCRA) and the Travis County Park Rangers, for finding and supplying us with the samples. We gratefully acknowledge discussion with, and suggestions and support from, Marian Hyman. We appreciate the cooperation of the staff of the Texas A&M University Electron Microscopy Center.

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Life and Death in the Templo Mayor, by Eduardo Matos Moctezuma, translated by Bernard R. Ortiz de Montellano and Thelma Ortiz de Montellano. University Press of Colorado, Niwot, CO. 1995, 138 pages, index, bibliography and appendices.

Reviewed by John A. Giacobbe

Life and Death in the Templo Mayor, by Eduardo Matos Moctezuma, is a well-written (and presumably translated) text that is readable and edifying for both the educated laymen and the professional anthropologist. The main theme of the book centers around an examination of the spiritual and ritualistic importance of the Templo Mayor, a large great temple of the Aztec or Mexica people located in Tenochtitlan, present day Mexico City.

Moctezuma developed his interpretation of the significance of the site aided by both the recent archeological excavations of the site, and extensive ethnographic and ethnohistoric research. In fact, although this is not clear from the introduction or book backing, this text is more properly thought of as an interpretative ethnohistoric account, backed by archeological data.

The Templo Mayor was discovered in 1978 by workmen in downtown Mexico City during the construction of a hotel complex. The site discovered to date includes a multi-tiered temple complex and an impressive assortment of well preserved artifacts, including burial urns, effigies, ceramics and lithics, and an extensive collection of additional artifactual material, although not much information regarding these finds is detailed in the book. Moctezuma utilizes stelae, statues, and various inscriptions located during excavations to suggest the ritualistic importance of the Templo Mayor and its symbolic place in the Mexica universe.

While one's first impressions of this text may be that it appears to stray towards post-processualistic impressionism, one cannot but be impressed by the scholarly treatment of the material presented, and the thoughtful examination of the ancient Mexica codices and the writings of the early Spanish religious and military chroniclers. Moctezuma, while perhaps overextending himself down the interpretative path, does so with a creative flair, and an appreciation of the historic context of the Templo Mayor in the Mexica spiritual universe.

Chapter One outlines the basis for Moctezumas' theoretical and methodological perspective. This includes a review of the major ethnographic and ethnohistoric sources he utilized to gain his contemporary understanding of the Mexica ritualistic world. The references form a well-rounded starting point for one interested in further exploring this topic area. Next he mentions the import of archeological data for his interpretations, and refers readers to additional texts that describe this source information in detail. He concludes the chapter by reiterating his goals and perspectives in combining archeology and ethnohistoric interpretation.

Chapter Two briefly reviews the manner in which a society develops ritualistic behaviors, and the place such behaviors have in molding that society. Moctezuma begins by touching on the work of Gordon Childe and other researchers attempting to understand the importance of ritual, and eventually works his way around to describing his Marxist approach to such interpretations. He concludes with a brief explanation of the Mexica culture from a Marxist perspective. This part of the text is rather weak, both theoretically and contextually, but thankfully the Marxist diatribe ends quickly and does not appear again in the text.

Chapter Three reviews the origins of myth in a society, and delves into the origins of several Mexica myths. Moctezuma attempts to correlate such myths with the little known archeological evidence about the establishment of the Mexica in the Valley of Mexico. This melding of myth, legend, and fact is brief but well done, and sets the stage for the remainder of the text.

Chapter Four specifically reviews the creation myth of the Mexica. Moctezuma goes point by point through the recorded versions of the creation myth of the Mexica, and correlates these verses with either archeologically-derived contextual associations or additional ethnohistoric data. This chapter attempts the difficult task of making the origin and development of a myth understandable by placing it in a historical and social perspective among a living people. This is handled very well by an individual clearly familiar with both the historic and ritualistic background of his study population.

Chapter Five concludes the body of the text by placing the Templo Mayor in regional perspective within both the Mexica spiritual world and the historic culture of the Aztecs of the Valley of Mexico. Moctezuma summarizes his initial hypothesis about the place of the Templo Mayor in Mexica ritual and Mexica society, and how this symbolic role functioned in a living culture.

Appendix One includes a series of black and white photographs of the site of Templo Mayor and several of the artifacts unearthed during excavations there. Appendix Two presents several Nahua poems translated into English. This is a pleasant addition, and follows the spiritual tone of the text rather well. One might want the original Nahua versions alongside, however.

Overall, *Life and Death in the Templo Mayor* by Eduardo Matos Moctezuma is a well written and organized book. If one has either a professional or casual interest in the time period in question, one would be encouraged to read this book. In addition, the effort Moctezuma makes in correlating archeological knowledge with ethnohistoric ritualistic interpretation provides a fine example of the practice.

The Lion Creek Site (41BT105): Aboriginal Houses and Other Remains at a Prehistoric Ranchería in the Texas Hill Country (Burnet County), by LeRoy Johnson. Environmental Affairs Division, Archeology Studies Program, Report 1, Texas Department of Transportation and Office of the State Archeologist, Report 41, Texas Historical Commission, Austin, 1997. xviii + 191 pp.

Reviewed by Dawn Youngblood

In helping the Texas Department of Transportation (TxDOT) catch up on their backlog of site reports, LeRoy Johnson has taken on a series of challenges. He must derive his information from journals, logs, maps, photographs, sketches, and data bases produced many years ago. He was not present at the excavations, and had no control over the research design or the quality of the work. In bringing together the Lion Creek report, therefore, Johnson has met the challenge, and in the process has done Texas archeology a tremendous service by offering a quality published record of the excavations. This volume is beautifully presented, with high quality tables, photographs, and illustrations.

The Lion Creek site was excavated in 1975 under the direction of TxDOT archeologists Frank A. Weir, Raymond D. Crawford, and Joe T. Denton in anticipation of roadway improvements along RM690 just south of Lake Buchanan. It is a shallow, chronologically-mixed site dominated by rock features on a relict terrace of the Colorado River, some 100 m south and 3 m above present-day Lake Buchanan. Several rock features were uncovered that are of particular interest in light of current discussions regarding the nature of large Archaic rock features, including burned rock middens and possible house structures. In part, Johnson takes advantage of the time gap between excavation and publication by adding some current references, and by offering a limited consideration of the implications of this more recent body of archeological research (primarily in the Afterword and in a section discussing other house-like rock structures in Central Texas).

Two, and possibly three, rock features at Lion Creek are interpreted by Johnson as houses that are part of a prehistoric ranchería. He distinguishes between hearths and fireplaces, with hearths being very large, paved fire areas and fireplaces being small, outdoor clusters of rocks that supported fire sticks. Some 150 m north of Lion Creek is a large and heavily looted burned rock midden; Lion Creek may have been one encampment that utilized the midden.

Due to the shallow nature of the archeological deposit, Lion Creek is not well-dated. One calibrated one-sigma radiocarbon date of AD 982-1045 pertains to the structure termed House 3. A wide range of projectile point styles, including Scallorn, Pedernales, Nolan, and Travis, were recovered in association with the identified house features. Clearly, unequivocal association of the structures with a specific time period is not possible. Only by comparison with similar structures at other sites can Johnson, and others (Lintz et al. 1995), attempt to temporally correlate them; regional perspectives are necessary for Johnson to comprehensively assess prehistoric house structures in Central Texas. To place the temporal associations used in the report to current terms, readers should refer to Johnson and Goode (1994). For example, Johnson (p. 37) suggests House 1 is Middle Archaic based on the presence of Pedernales points, but in the 1994 article, he correlates Pedernales points with a revised definition of the Late Archaic. This inconsistency is clearly the product of the present volume having been so long in production. Whatever the categorical definition. Pedernales points have been associated with a dry climatic interval on the Edwards Plateau that peaked shortly after 2000 B.C. (Johnson and Goode 1994).

Throughout the volume, the interpretation of the rock structures labeled House 1 and House 3 as dwellings is taken somewhat for granted. Consideration of multiple alternative hypotheses would have strengthened Johnson's argument that the site locality is a ranchería. As alternatives are not seriously considered, the reader is left wondering whether these structures with only 1 m of space between the hearth pavement and the outside "wall" could be interpreted as something other than a house. Could they be some form of meat smoking or roasting area, with post-supported racks? Could they be sweat lodges, or some other kind of structure?

Artifacts from the site are carefully documented. Johnson thoroughly describes the 35 milling stones, and suggests that the majority came from the stratigraphically lower layers. While most authors would avoid a discussion of knapping debitage from a clearly mixed context such as Lion Creek, Johnson does not shy away from the challenge. The heavier debitage is reported from the lower layers of the site, perhaps indicating that the larger artifacts have simply worked their way down to lower levels. Lithic raw materials from all time periods at the site are believed to have been transported from nearby Colorado River gravel bars. The section on bifacial tools is well-done and nicely illustrated, most notably the bifacial "stars," carefully retouched three-pointed objects tentatively interpreted as gorges.

Johnson concludes the report with a word of hope that if future multiple "house" sites are found in the Lion Creek region, they will be carefully investigated using all available modern methods. An important lesson learned and reinforced from the Lion Creek site is to carefully consider all rock features that may represent house structures.

Anyone wishing to stay current on the Archaic and Late Prehistoric periods in Central Texas should obtain a copy of the *Lion Creek Site* report. Unlike many site reports, this one has the advantage of being written in a clear and engaging style that should encourage a more general readership. For this reason, avocational archeologists who work in the Central Texas area are particularly encouraged to obtain a copy of Johnson's report, and consider the interpretations for themselves.

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Trade and Discovery: The Scientific Study of Artefacts from Post-Medieval Europe and Beyond, edited by Duncan R. Hook and David R. M. Gaimster, 1995. Occasional Paper 109, Department of Scientific Research, British Museum, London, v + 326 pp.

Reviewed by Timothy K. Perttula

This volume is the product of a conference held in November 1992 by the British Museum and the Society for Post-Medieval Archaeology to commemorate the 500th anniversary of the Voyages of Discovery. The conference's purpose was to discuss current projects and approaches to the archeological study of post-medieval trade in Europe and across the World, specifically the examination of the artifacts that so vividly demonstrate "the development in intercontinental trade and the simultaneous growth in consumption at all levels of society" (p. 1). In *Trade and Discovery*, the papers focus on ceramics, glass, precious metals, copper-based alloys, and other metals found in archeological sites from Native American contexts in the Dominican Republic, Canada, and northeastern North America, as well as sites (and museum collections) from a variety of archeological contexts in South America, Europe, England, and Trans-Saharan Africa. Of particular interest from the perspective of contact and trade between Native Americans and Europeans are papers by Kathleen Deagan and Jose M. Cruxent, Reginald Auger et al., and William R. Fitzgerald that discuss, respectively, the character of 15th and 16th century European trade goods from La Isabela (1493-1498), the 1576-1578 Martin Frobisher expeditions among the Inuit, and various aboriginal sites around the Gulf of St. Lawrence with goods from Basque/Breton/Norman fisherman and trappers.

The ceramic studies of Spanish, Italian, and English tin-glazed wares, English earthenware (redware) ceramics, salt-glazed stoneware from the Rhineland, French stonewares, English ceramic stove-tiles, and Moroccan trade ceramics concentrate on determinations of provenance and source (i.e., the place of production). Instrumental neutron activation (INAA) and inductively coupled plasma emission spectrography analyses of the mineralogical/chemical constituents of these ceramic wares independently document their extensive trade around Europe and the New World. In the case of the French stonewares, widely distributed in the 17th and 18th centuries, the preferred forms made for trade were commercial containers of "foodstuff, beverage, potion or ointment" (p. 94).

Of particular concern in the study of glass is the technology of glass production, both in Europe (particularly Venice and the Netherlands) and as it was introduced into the New World and elsewhere. Mark Redknap and Ian C. Freestone employ energy-dispersive X-ray analysis of glass cakes or ingots from a 1765 shipwreck to show through compositional analysis that the raw glass cakes were items of commerce destined for China, where they "were being exported for use in Chinese glassworks" (p. 145).

The studies of metals in *Trade and Discovery* examine the extraction of New World mineral resources with European and Native American technologies, as well as the wide-ranging impact of the movement of precious metals (gold and silver) from the Americas into post-medieval Europe. W. Iain Mackay's paper on gold extraction equipment at Maukallqta (in Bolivia) indicates that the techniques, equipment, and production methods employed in one part of the Americas represents a hybrid of European and aboriginal metallurgic technologies (particularly the use of *quimbaletes* or rocker-grinding stones and *arrastra* or *cabeza de ingenio*, a Spanish-introduced powered grinding mechanism) over several centuries.

Artifacts made of copper-based alloys were widely traded after 1492 within Europe, the Americas, Africa, and the Far East, and through the archeological perspective, provide direct evidence of the scale of trade. Other papers concern ferrous metals, armor, and 16th and 17th century English lead cloth seals. Hancock et al.'s INAA study of native copper and copper-based metals (including European copper and brass) from pre-contact and post-contact archeological sites indicates that these materials can be readily distinguished on chemical compositional grounds, such that "pre-European contact sites can be separated from contact sites" (p. 286).

Trade and Discovery is an important archeological monograph on European trade, and the archeometric methods and techniques currently being employed on a broad range of material goods found in the New World as well as the Old World. Several of the papers have direct relevance to archeological studies of the post-1492 era in Texas, especially those dealing with the chemical composition, identification, and origins of stonewares and tin-glazed ceramic wares found on Texas sites, as well as the provenance of copper-based metal goods recovered in aboriginal contexts across the state. I recommend the monograph to those archeologists particularly concerned with the archaeometric study of artifactual remains, and to those interested in the material evidence of trade and context in the post-medieval period.

Hunter-Gatherer Mortuary Practices During the Central Texas Archaic, by Leland C. Bement. University of Texas Press, Austin, 1994. x + 165 pp.

Reviewed by Helen Danzeiser Dockall

This book, composed of nine chapters and an appendix, focuses on the results of excavation from one site, the Bering Sinkhole, in Kerr County, Texas. The first chapter discusses the site, specifically the site description, location, history, and duration of use for burial purposes (approximately 5500 years). Further, Bement states (p. 5) that the analysis of the Bering Sinkhole "concentrates on reconstructing the biological, cultural, and environmental aspects of prehistoric mortuary practices of the hunter and gatherer groups of the Edwards Plateau." Bement also expresses an interest in social complexity during the Archaic period, an important issue that has been long overlooked (or understated) in Texas prehistoric archeology.

Chapter 2 focuses on the site setting, specifying various flora and fauna from the region, in addition to discussing the regional geology. Chapter 3 provides background information on mortuary studies and the regional chronology. Bement provides a thorough discussion of Weir's Central Texas Archaic chronology, comparing it with more recent developments. He also provides a clear discussion of theories of mortuary behaviors and their reflections on social structure and inter-group relationships. Bement focuses on the importance of mortuary sites as territorial markers and addresses the important issue of how "sedentary" a hunter-gatherer group needs to be before this behavior occurs. The impact shifts in mobility patterns will have on mortuary affairs and health is another significant issue raised in this chapter. At this point in the book, Bement also introduces Central Texas sites used for comparisons with the Bering Sinkhole. His primary comparative sites are the large cemeteries of Ernest Witte (all burial groups) and Loma Sandia, as well as the smaller Olmos Dam site. Interestingly, these are not sinkhole sites, but Bement does find many similarities between grave goods at these "traditional" cemetery sites with information obtained from the Bering Sinkhole, the primary focus of this book. In addition, Bering Sinkhole is compared with Seminole Sink in the Lower Pecos region, which Bement points out is the only sinkhole in Texas that has a detailed excavation and analysis comparable to larger mortuary sites. Perhaps the strongest point about this book is that it chronicles results and techniques of excavation at a large Central Texas sinkhole, a type of site that appears to have been neglected in past research.

Chapters 4 and 5 detail the site excavations and its depositional history. The sinkhole consists of four discrete levels representing several thousands years of use as a burial site. Both of these chapters, although specific to excavations at the Bering Sinkhole, will be useful to anyone attempting the excavation of other sinkhole mortuary locales.

Chapters 6, 7, and 8 present the results of excavation at the site. Chapter 6 focuses on faunal remains (specifically, mammals and molluscs) recovered from the site, with an emphasis placed on utilizing faunal remains to reconstruct the paleoenvironment. Another section of this chapter is dedicated to the discussion of culturally significant fauna, such as the presence of antlers with burials, and the existence of dog burials. Most of this discussion emphasizes the geographical distribution of these remains, rather than their significance in a mortuary setting. Chapter 7 provides descriptions of lithic, shell, and bone artifacts recovered from the Bering Sinkhole, along with a consideration of their cultural significance in a mortuary setting. There is also some discussion of the implications of these artifacts to the existence of a trade network in Archaic times.

Chapter 8 discusses the bioarcheological analysis of the (minimally) 62 individuals recovered from the Bering Sinkhole. The discussion of taphonomic impacts on the human skeletal remains is timely, as this is an area of bioarcheological research that is too often neglected. In his analysis of human skeletal material, Bement addresses basic demographic data and information pertaining to skeletal stress that he hopes can indicate shifts in mobility, subsistence, or technology. Demographic data are limited because of the commingled nature of the sample, while the discussion of osseous lesions is limited by being presented in a "percent per individual" fashion rather than "percent per element," which may have been more appropriate given that at least part of this sample was commingled and could not be associated to specific individuals. In his discussions of traumatic injuries and infectious disease, no accounting is given of differences between males and females or adult vs. subadult rates, nor was there any discussion of the specific elements on which these disorders were observed. This type of information would have been particularly useful to other researchers interested in understanding more about the intricacies of skeletal health in prehistoric hunter-gatherers. It is also not clear why trauma and infection were discussed, while degenerative joint disease and porotic hyperostosis/cribra orbitalia—disorders that can provide a great deal of information about a skeletal sample—were not discussed. Bement's discussion of linear enamel hypoplasias also utilizes a "per individual" style of analysis, rather than the more methodologically solid technique based on the total number of observable teeth. However, the discussion of caries and wear patterns is especially cogent. In particular, Bement feels that the evidence from caries frequency suggests a shift to a higher carbohydrate diet during the Middle Archaic. His discussion of dental wear utilizes results from scanning electron microscopy, a forum that has not been used to its fullest potential by other researchers. Based on this evidence, Bement is able to argue for different seasonal uses over the periods in which the sinkhole was used for mortuary purposes. This chapter concludes with a section on stable carbon and nitrogen isotope analysis.

Chapter 9 summarizes what was found at Bering Sinkhole and describes the utilization of sinkhole sites. The last half of the chapter discusses mortuary patterns at the site, mentioning evidence for changes in social systems, settlement patterns, and subsistence during the Round Rock phase. Some comparisons are drawn between mortuary practices at the Bering Sinkhole and some other Texas (non-sinkhole) mortuary sites.

Most readers of *Hunter-Gatherer Mortuary Practices During the Central Texas Archaic* will find Chapters 3, 7, and 9 to bear most of the topics that will interest them, as Chapters 3 and 9 focus on mortuary patterns, while Chapter 7 describes the archeological material recovered from the Bering Sinkhole, being especially relevant to researchers specializing in Central or Southeastern Texas archeology. However, Chapter 4 will be distinctly pertinent to anyone excavating a sinkhole site. The most appropriate audience for this book is researchers interested primarily in hunter-gatherer groups from the Central Texas area, or researchers interested in studying the differences between sinkhole sites and "traditional" mortuary sites.

Individual reviewers have their own feelings about what subject matter they would like to see emphasized, or how they would like material covered, in books they review. In this particular case, I found the title of this book to be misleading in terms of what I had anticipated based solely on the title, as it implies a synthesis of information from Central Texas Archaic sites pertaining to mortuary practices. The book title suggests that it will concentrate on Central Texas Archaic mortuary sites, implying that more than one site will be presented, and that not all discussed sites will be sinkhole sites. This book might better have been titled "Hunter-Gatherer Mortuary Practices During the Central Texas Archaic: An Example from the Bering Sinkhole." Taken in this tone, the book does a better job of meeting its stated and implied objectives. This book does provide a thorough accounting of how sinkholes are systematically excavated and what was recovered from this particular site, but does not focus as well on Archaic period mortuary affairs in Central Texas during the Archaic as I had anticipated.

The Story of Big Bend National Park, by John R. Jameson. University of Texas Press, Austin, 1996. 208 pp.

Reviewed by Jean L. Epperson

John Jameson was introduced to the Texas Big Bend as a child by his parents on camping trips. It is apparent that he became entranced with the breathtakingly beautiful mountain peaks, arid deserts, and spectacular river canyons of the future national park. Jameson has crafted an informative and vigorous story of the region. Eight chapters, 52 photographs, comprehensive chapter notes, and an excellent index leave the reader as replete as having digested a good meal.

Of special interest to the archeological community, Jameson states that the Big Bend National Park has an estimated 10,000 sites ranging from Late Paleoindian, Archaic, Late Prehistoric, and Historic eras. These sites belong to Indian and Anglo-Mexican cultures. Among others, the Indians are identified as Jornada Mogollon, Chisos, Jumano, Mescalero Apache, and Comanche. Within the park are nine National Register of Historic Places archeological and historic sites or districts, including Castelon district (trading post), Hot Springs district (recreational and therapeutic springs), Mariscal Mining district, the Homer Wilson Ranch, Rancho Estelle, Luna's jacal (a Mexican goat herder abode), and several archeological sites.

The first half of the book describes in minute detail the individuals involved in the conceptualization of, and the trials and tribulations of, the beginnings of a national park in Texas. Jameson also explores the local and national political climate about the creation of the park. The Big Bend was finally established on June 20, 1935, as the 27th national park, containing 800,000 acres of land (about the size of Rhode Island). The first 50 years of the park's existence is detailed in the book through land acquisition, development, and options of the guiding authorities.

The remainder of the book focuses on local and national plans, issues, and controversies surrounding Big Bend National Park. Jameson thoroughly treats other complex issues, such as international park development, the use of the park as a preserve for endangered species or as an incubator for predators, and preservation versus development. The book is a must resource for those readers interested in the Big Bend region.

Stone Tools: Theoretical Insights into Human Prehistory, edited by George H. Odell. Plenum Press, New York, 1996. 401 pp.

Reviewed by John E. Dockall

One of the most important aspirations of symposia and conferences should be the publication and dissemination of results. George Odell has admirably done this in *Stone Tools: Theoretical Insights into Human Prehistory*. This book represents the second installment of symposium papers from the Tulsa Conference on Lithic Analysis held at the University of Tulsa. The current Tulsa Conference volume presents a very useful blend of papers presenting theoretical, methodological, and practical applications for the study of lithic material culture, and represent a broad temporal and geographic perspective necessary for today's well-rounded archeologist. Additionally, many aspects of these papers can be applied to other categories of material culture.

This book comprises 13 chapters, each with numerous tables and illustrations. It is not overly data-laden, but has enough presented in tabular form to be clearly interpreted from the text portion. A most welcome aspect of the book is its presentation in five independent sections or broad topical areas in an organized manner so that the reader can proceed through each section without becoming lost in a morass of competing theories. Even so, the sections elegantly tie into one another, benefiting the reader whether one section or the entire book is read.

Part I, on Research Design, is represented by a chapter written by Hayden, Franco, and Spafford that focuses on tool design and manufacturing techniques. Hayden and colleagues employ the concepts of design theory as an analytical tool for examining lithic assemblage variability and implement morphology. Their paper examines the relationship between material and technological limitations, tool manufacture, and use with data from the Keatley Creek site in British Columbia. They take to task such vaguely defined concepts as maintainability, versatility, and curation.

The concept and utility of curation is the focus of Part II, with papers that examine "curation" in terms of lithic technology and conservation. George Odell (Chapter 2) provides an in-depth review of curation and its multiple and often confusing meanings in the archeological literature. The term has come to be associated with the advance manufacture of implements, multi-functionality, artifact transport, recycling, and resharpening. Odell uses data from five sites in the lower Illinois River valley to examine these views of curation and the importance of raw material variability. Stephen Nash (Chapter 3) employs curation as a means to discover patterns of conservation within the Middle Paleolithic assemblages from Tabun Cave and Central Negev sites. Variables used include abundance of cortex, artifact transport, platform preparation, flake type, and retouch intensity. Nash demonstrates that curational behaviors existed in the Middle Paleolithic following the definitions of curation entrenched in the archeological literature. An important aspect of curation behavior established by Nash is that it has not been properly defined by archeologists that employ it in their research. Paul Thacker's paper (Chapter 4) is innovative in that he employed curation behavior to factor out differences between Gravettian and Magdalenian material procurement patterns. Patterns of tool/core conservation were related to distinct curation patterns; Gravettian procurement was specialized via extraction and workshop sites while Magdalenian peoples employed direct procurement of chert cobbles.

Recently, there has been renewed interest in technology and complex societies. Part III explores the relationship between lithic technology and social complexity. Three papers by Steven Rosen, Jay Johnson, and Michael Nassaney address such issues as raw material procurement, craft specialization, access to raw material, and control of production.

Rosen (Chapter 5) tackles the seldom considered topic of replacement of stone with metal tools. The decline of stone tools in the Near East from the Chalcolithic to Bronze Age is shown not to be directly or solely related to the increasing importance of metal tools. Expansion of trade and exchange networks, economic shifts from household to specialist economies, and the increasing availability of iron were contributing factors. Rosen illustrates the unique dynamics of the process of technological innovation and replacement, and his paper serves to dispel assumptions of linear developments in technology. Chapter 6, by Jay Johnson, provides a detailed review of Maya lithic technology since its early days as a typological exercise to the forefront of Mayan lithic studies at Colha. Although the importance of ad hoc tools is addressed, most of the emphasis is placed on craft specialization and raw material access and control. I would have liked to have seen more attention given to stone tool exchange networks and producer-consumer relationships. Nassaney's paper (Chapter 7) employs a political-economic framework to examine the role of lithic technology in the Plum Bayou culture in central Arkansas. This chapter is complex and may require more than the customary first read to absorb and synthesize. Much effort is given to provide the reader with a working understanding of the political and material aspects of social ranking as it relates to stone tools. Nassaney then examines lithic resource procurement of chert, novaculite, and quartz crystal, and notes that only quartz crystal was associated with any type of social control to access and use. The implications are that quartz crystal was a part of the dynamics of social ranking in prehistoric central Arkansas. Variations in the abundance of quartz crystal through time, and from the primary source, suggested to Nassaney the existence of some type of down-the-line exchange network.

Part IV of the book addresses style and innovation in projectile points, and should be reviewed by Texas archeologists interested in projectile points. The arguments and broad theoretical issues raised by the Part IV papers are equally applicable to other categories of material culture. Therefore, I highly recommend this section to lithicists and non-lithicists alike.

In Chapter 8, Michael Rondeau employs breakage patterns and evidence of reworking to evaluate morphological variability among Elko Corner-notched points. He demonstrates that although tool refurbishing can be proffered as an agent of variability, repair can follow original point morphology. John Rick (Chapter 9) provides an extensive and ambitious program for investigating changes in projectile point sequences. The major sources of morphological variability are stylistic. Rick's type classifications are based entirely on morphological characteristics (such as outline) with little consideration of post-manufacture sources of variability, breakage, resharpening, and repair. While this may prompt some (this reviewer included) to distrust the developed point sequences, Rick's study is a fine example of a multi-level approach to temporal and spatial variability in artifact form, and promises future potential. Chapter 10, authored by Michael Shott, examines technological innovation and projectile point change in the American Bottom. Shott employs metric attributes, particularly neck width and basal width, to examine temporal changes associated with the transition from dart points to arrow points. These changes are then interpreted within a framework of the diet breadth model to predict weapon design changes necessary to increase hunting efficiency.

In Part V, Odell provides two articles presenting technique and methodology. Marvin Kay (Chapter 11) describes and presents new equipment available to microwear analysts. Relying upon Nomarski optics, this equipment promises greater interpretive power for the analyst and more comprehensive use-wear histories for lithic tools and assemblages. The drawbacks of cost and increased analysis time should be ameliorated by the increased level of accuracy and detail that can be provided for reconstruction of behaviors associated with tool use and repair. Chapter 12 by Toby Morrow addresses the utility of intensive lithic refitting projects. Morrow emphasizes systematic efforts to refit flakes, flakes to cores, and flakes to bifaces, and provides the reader with a series of refitting shortcuts. Refitting of artifacts from the Twin Ditch site revealed horizontal and vertical patterning that indicated two distinct episodes of occupation. Morrow's work on the Two Ditch assemblage also detailed complex technological histories associated with biface manufacture, use, and repair.

Part VI is the conclusion and is co-authored by all volume contributors. This chapter (Chapter 13) serves the reader by concisely summarizing the most salient aspects of each chapter and book section. Because some of the chapters are of considerable length and detail, the summary chapter enables the reader to refocus and begin to synthesize a very meaty and significant contribution to lithic technology. This book promises to be a well-worn member of any library, and should be considered by all interested in lithic technology as well as those doing research in prehistoric material culture.

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