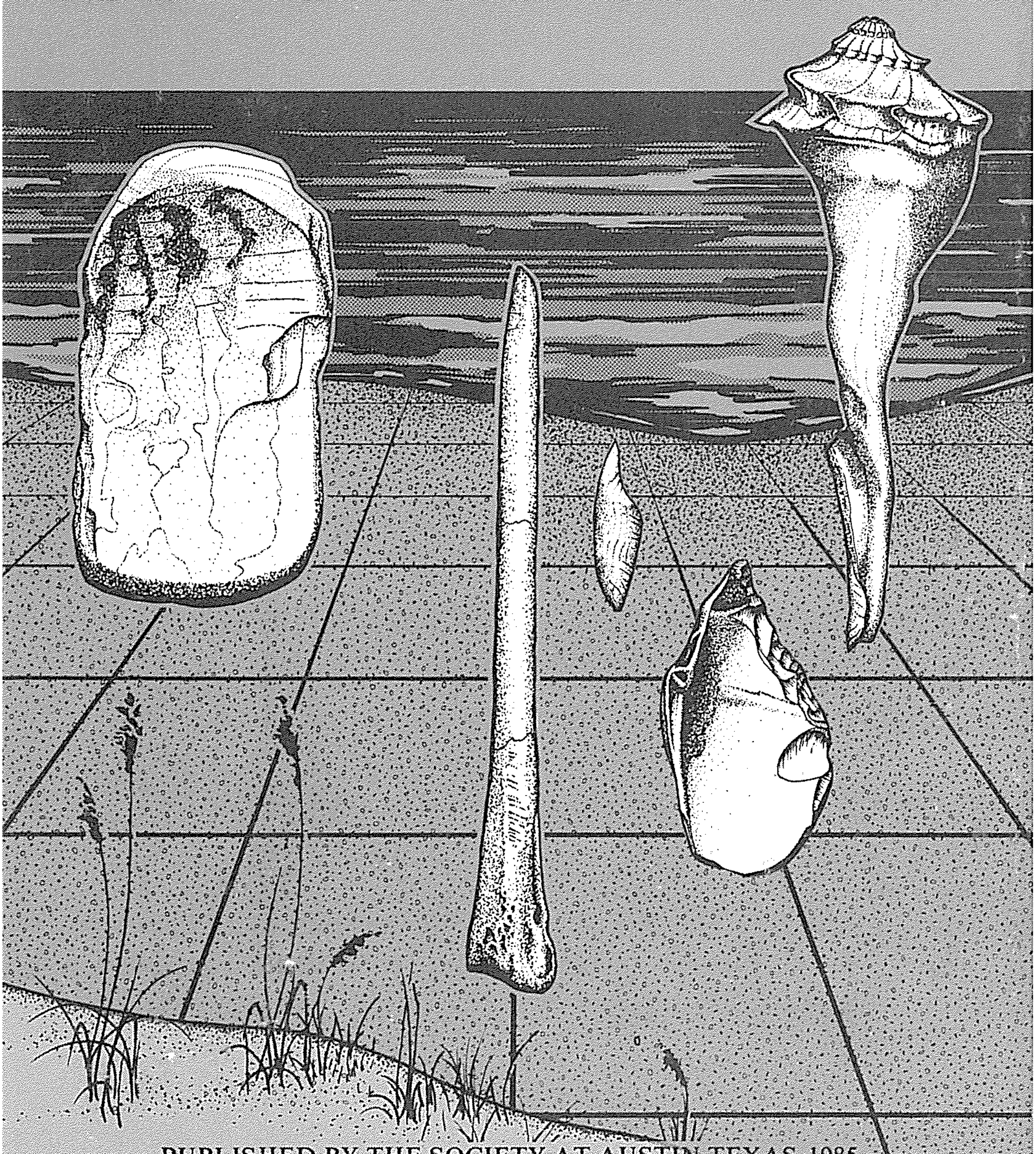
Bulletin of the TEXAS ARCHEOLOGICAL SOCIETY

Volume 54/1983



PUBLISHED BY THE SOCIETY AT AUSTIN, TEXAS, 1985

TEXAS ARCHEOLOGICAL SOCIETY

The Society was organized and chartered in pursuit of a literary and scientific undertaking: the study of man's past in Texas and contiguous areas. The *Bulletin* offers an outlet for the publication of serious research on history, prehistory, and archeological theory. In line with the goals of the Society, it encourages scientific collection, study, and publication of archeological data.

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Bulletin of the TEXAS ARCHEOLOGICAL SOCIETY

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PUBLISHED BY THE SOCIETY AT AUSTIN TEXAS
1985 (for 1983)

This volume of the Bulletin is dedicated to
DR. J. CHARLES KELLEY
a courageous scholar, a gentleman, and a pioneer
in Texas archeology and ethnohistory

Contents

A Technological Analysis of Lithic Assemblages from Guadalupe Mountains National Park, Texas[1]

Richard Boisvert

ABSTRACT

This report concerns the analysis of lithic artifacts collected during the 1970 Texas Archeological Society Field School from 120 prehistoric sites in Guadalupe Mountains National Park, Texas. Research is focused upon three topics: the role of raw material selection in chipped stone tool manufacture, assessment of flaking behavior on the basis of an attribute analysis of the debitage, and identification of potential cultural-temporal-ecological significance of the individual chipped stone tool assemblages. Significant patterns of raw material utilization are noted in the assemblage at large. The debitage study has revealed that certain stages of chipped stone tool manufacture can be identified. Analysis of the tool assemblages revealed no significant cluster of tool forms with the exception of one apparent tool kit that appears to have temporal and ecological significance. An assessment of the quality of the research methodologies is also presented.

INTRODUCTION

This report presents the results of an analysis of the lithic assemblage gathered from more than 100 archeological sites in or adjacent to the Guadalupe Mountains of Trans-Pecos Texas. Three research problems are defined and analyzed in detail. They are:

1) What were the raw materials selected to make chipped stone tools, and were there significant relationships between these materials and the forms into which they were processed?
2) What were the techniques applied in the manufacture of chipped stone tools?
3) What were the variations through time and space of these artifacts and of the assemblages they constituted?

These are interrelated problems and they incorporate the premise that the form of an implement is determined by (1) the kind of material used, (2) the techniques applied to fashion it, and (3) the use(s) for which it was intended and employed.

The data for this study were collected by the Texas Archeological Society (TAS) during its 1970 field school. Harry Shafer and Dessamae Lorrain

[1]Revised version of a thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts at the University of Kentucky.

directed the survey in parts of Hudspeth and Culberson counties, Texas, in anticipation of the area's development into a national park. The data on the ceramics and rock art have been analyzed and published by Phelps (1974) and Clark (1974), respectively, and a study of the historic sites also has been undertaken.

The purpose of this study is to increase our knowledge of the culture history of the area that is now Guadalupe Mountains National Park. The survey conducted there by the TAS accumulated a collection of artifacts dominated by lithics, primarily cores, flakes, unifaces, and numerous chipped stone implement fragments. Although the majority of these artifacts are nondiagnostic, they furnish a significant data base for the study of lithic technology.

Another goal is to explore the potential of debitage analysis as an aid to obtaining insights into prehistoric behavior and to discover what can be learned from, and what are the limitations of, this kind of data.

The systematic analysis of chipped stone artifacts has been of interest to archeologists for many years. William H. Holmes, second director of the Smithsonian Institution, devoted much of his research to the investigation of prehistoric quarry and workshop sites, first in the Potomac Basin area around Washington, D.C., and later in other parts of North America (Holmes 1897). He pioneered the study of lithic technology in North America and laid the groundwork for later studies. He roughly outlined the stages of reduction and shaping required for the manufacture of bifacial artifacts. His best-known contribution was the definition of the intermediate stage of biface manufacture that is usually termed the preform or blank. He accomplished this by systematically analyzing the broken bifaces at quarry and workshop sites. However, in order to arrive at his conclusions, Holmes did not analyze the flakes removed from the cores and preforms; rather, he inferred the flaking process from study of both intact and broken bifaces from the sites.

Another benchmark in the study of American lithic technology is the work of William H. Ellis (1940), who, elaborating on the work of Holmes, systematically carried out a series of replicative experiments in flint knapping aimed at defining the techniques of stone tool manufacture. He identified various techniques of direct and indirect percussion and pressure flaking, and he commented on their effectiveness for performing various tasks in the manufacture of chipped stone tools. He described in some detail the chippage that results from the different fabricating techniques (Ellis 1940:11-39). His work was almost totally based upon replicative experiments, and he made only peripheral reference to ethnographic analogies, except to mention that the techniques he found most suitable were not always chosen by the aboriginal knappers (Ellis 1940:61). Curiously, Ellis never applied his findings to archeologically derived data bases.

Subsequently many other researchers have taken up this neglected task and have begun to study not only the products of chipped stone tool manufacture, but also the by-products. Interpretations of prehistoric lithic technologies that draw from the experimental base have been initiated and are typified by the work of M.B. Collins (1974) and Don E. Crabtree (1972). Both men are experienced knappers, and both have applied their findings to the interpretation of the archeological record. It is with this intent that the debitage analysis component of this report has been undertaken.

This report is a technological analysis of chipped stone artifacts. It is an attempt to bring together several lines of inquiry in the hope of discovering the ways in which certain prehistoric peoples made their stone tools. The study is also an attempt to formulate, utilize, and assess certain methodological approaches toward the analysis of chipped stone technology, especially as it relates to assemblages drawn from surface collection surveys.

ENVIRONMENTAL SETTING

Guadalupe Mountains National Park is in northeastern Trans-Pecos Texas in parts of Hudspeth and Culberson counties (Figure 1). The park includes the southernmost part of the Guadalupe Mountains, which extend southward into Texas from New Mexico, as well as parts of the adjacent Patterson Hills and surrounding desert and salt flats, covering 31,371 ha (77,518 acres) and varying in elevation from 1112 meters (3,650 ft.) at the base of the western escarpment to 2667 meters (8,751 feet) atop Guadalupe Peak (Figure 2). Geologically the mountains are part of the Permian Reef complex of Texas and New Mexico and are composed mainly of limestone, dolomite, and sandstone. The environmental and ecological variations that result from the extremes in elevation make this area unique. The high reef escarpment, rising from the scorched and desiccated desert, is penetrated by steep-sided canyons and supports a perennially green conifer forest.

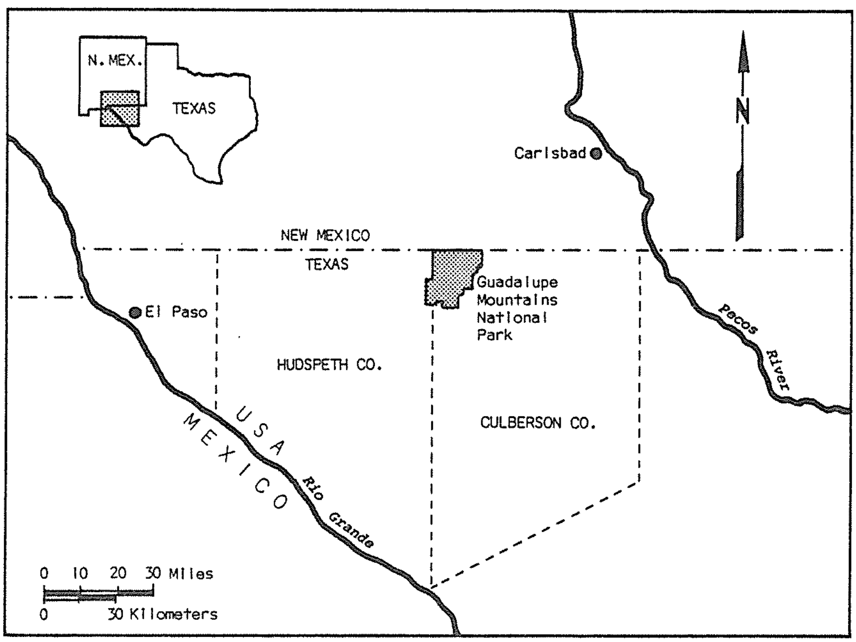


Figure 1. Map of part of Texas and New Mexico showing location of Guadalupe Mountains National Park.

Geology

The present-day nature of the Guadalupe Mountains region is the result of geologic processes. In the early part of the Permian period, the Delaware Basin developed in what is now Trans-Pecos Texas and southeastern New Mexico. On the margin of the basin a series of reefs—the Permian Reef complex—formed. Parts of this reef have survived essentially intact as the Glass, Apache, and, most notably, Guadalupe mountains.

The Guadalupe Mountains are a great wedge that protrudes southeastward into Texas from New Mexico, terminating abruptly at the spectacular promontory El Capitan. The mountains make up the northern half of an eastward-tilting block of the earth's crust that measures about 160 km (100 miles) from north to south by 80 km (50 miles) from east to west.

> The southeastward facing Reef Escarpment . . . extends diagonally across the tilted surface, following an ancient tectonic and stratigraphic axis, along which the limestones of the Guadalupe Mountains come to an end. . . . On the west side of the tilted block, the mountains break off in steep escarpments. . . . The escarpments slope toward the Salt Basin, a depression with no outlet to the sea, whose lower part stands at an altitude above 3,600 feet, or nearly a mile below the summit of Guadalupe Peak not far away. Extending westward from the lowest benches of the basin is a great alluvial apron composed of detritus washed down from the mountains. Rising from the alluvium in places are low rock ridges, such as the Patterson Hills southwest of El Capitan [King 1948:5].

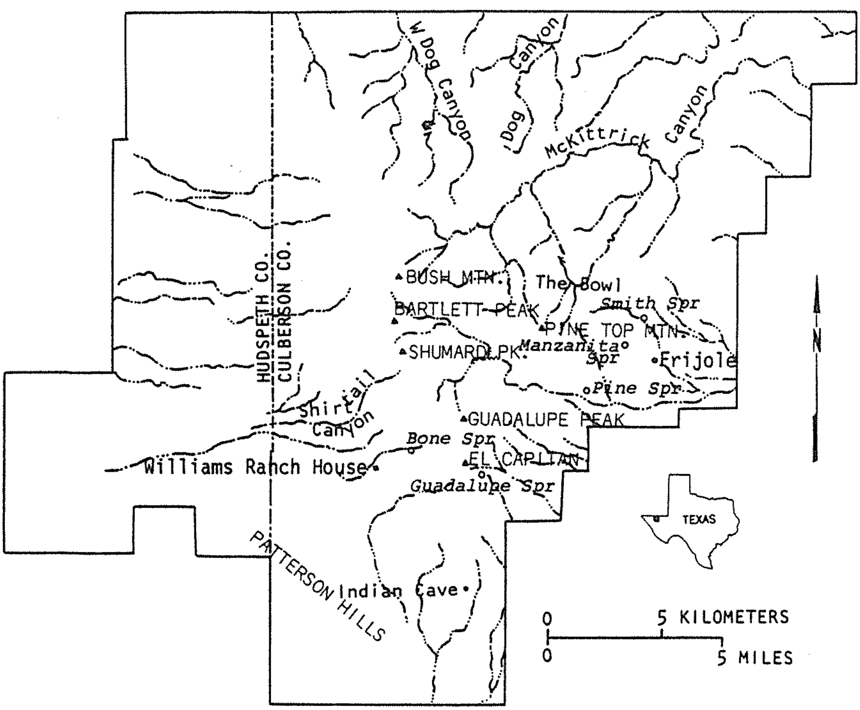


Figure 2. Map of Guadalupe Mountains National Park showing places referred to in this report.

The Guadalupe Mountains consist principally of limestone and sandstone and occasional shale formations. The thick, massive Capitan and Carlsbad limestones make up more than 90 percent of the Guadalupes and the Patterson Hills (Figure 2), which adjoin the mountains on the southwest. Underneath these limestones are other formations of interbedded limestones, sandstones, shales, and quartzites. These are found on the south and east edges of the Guadalupe Mountains and along the east side of the Patterson Hills. The few cherts that are found in the southern Guadalupes are in these rocks, principally on the eastern escarpment in the Manzanita Member of the Brushy Canyon Formation. The floors of Dog Canyon, West Dog Canyon, and the desert surrounding the mountains are of alluvium. These alluvial deposits vary from fine-grained bolson deposits and sand dunes west of the mountains to slope deposits and gravels on the flanks of the mountains and on the desert to the east.

A brief survey turned up poor-grade cherts cropping out in the Manzanita Member of the Brushy Canyon Formation and small nodules (about 10 cm in diameter) of higher quality cherts in the gravels below the southeast escarpment. Less than two days were spent in the attempt to locate sources of chippable stone in the region, so it is likely that further investigations might result in the discovery of deposits of higher quality chippable stone that would have been available to the prehistoric residents of the Guadalupes (see Boisvert 1980: Appendix 1 for a more detailed discussion of the geology of the park area).

Climate

The National Park Service describes the climate in the park as variable and often extreme.

> Summertime temperatures may be disagreeably hot at lower elevations while the highlands and moist canyons are cool by contrast. The western escarpment produces a reflector-oven effect on the west side lowlands which creates pleasant conditions during cool winter months. At the same time, the highlands can be bitterly cold and snowy [National Park Service 1974:34].

The officially recorded extremes of temperature at the 1524-meter (5,000 ft.) elevation are -20° C. (-6° F.) in January and 35° C. (96° F.) in July. Annual precipitation in the park is 56 cm (22.23 in.), but most of it falls in the higher elevations, especially above 2000 meters (7,000 ft.). High winds are common, especially from late fall to early spring, often reaching 95 to 130 kph (60-80 mph). The record high wind is 180 kph (110 mph) on January 25, 1967 (National Park Service 1974:34-35).

Life Zones

Four life zones are recognized in the park: the Lower Sonoran arid division of the Lower Austral zone, the Upper Sonoran arid division of the Upper Austral zone, the Transition zone, and the Canadian zone (Bailey 1928:16-18). The Lower and Upper Sonoran divisions and the Transition zone each cover about a third of the park, but the Canadian zone covers only a very small area at the highest elevations (Figure 3). The division between the Lower and Upper Sonoran zones is usually at the 1400 meter (4,500 ft.)

elevation, with variations resulting from local topography. The Upper Sonoran zone tends to extend down below 1400 meters (4,500 ft.) on eastward-facing canyons and slopes, and tends to retreat above 1400 meters (4,500 ft.) on westward-facing slopes. This difference is the result of the desiccating effect of the prevailing winds, which blow across the salt flats toward the mountains. The Upper Sonoran and Transition zones meet at about 2000 meters (7,000 ft.). The dividing line between the Transition and Canadian zones can be fixed at about 2600 meters (8,500 ft.), restricting the Canadian to the top of the highest mountains in the park (Burns 1967:8). Although there is an overlap in the life forms that inhabit these zones, each zone has its own floral and faunal assemblages.

Lower Sonoran Life Zone

The Lower Sonoran life zone covers the western and southern parts of the park, where it is interrupted only by the Patterson Hills (Figure 3). Most of the area is situated in the sand dune region between the salt flats and the western escarpment. The southern part of the zone is east of the Patterson Hills and has somewhat more relief where low sandstone ridges of the Brushy Canyon and Cherry Canyon formations protrude through the alluvial deposits.

A survey of the flora and fauna of the park was made by the TAS field school in conjunction with the archeological survey. The predominant plants recorded in the Lower Sonoran zone were creosote bush, mesquite (which were bearing many beans at the time), prickly pear and cholla cacti, sotol, agave, lechuguilla, and narrow leaf yuccas. Pincushion, barrel, bear, small spine, and Englemann's cacti also were seen, as were althorn, catclaw, grama grass, and a variety of other grasses and small plants, making up a typical xerophytic plant community.

The fauna recorded during the survey in the Lower Sonoran zone included jackrabbits, cottontails, various species of small rodents and lizards, mockingbird, and quail. In addition, a variety of snakes were recorded: four kinds of rattlesnakes, garter snakes, hognose snakes, and racers or whipsnakes (Gehlbach 1964:1-10). Skunks, roadrunners, orioles, cactus woodpeckers, Texas nighthawks, and white-necked ravens also are found in this area of the Chihuahuan Desert (Bailey 1928:11-12).

Upper Sonoran Life Zone

The Upper Sonoran zone occupies a broad belt along the western and southeastern escarpments of the Guadalupes. With few exceptions the zone is hilly, with steep-sided canyons cutting into the massif. The few level areas that do exist, between 1400 and 2000 meters (4,500 and 7,000 ft.) are dissected by numerous and often deep arroyos, which originate in the canyons above. Due to its higher elevation and proximity to the areas of higher rainfall in the mountain interior, this zone tends to be more moist than the Lower Sonoran zone. In addition, many springs are scattered along the front of the reef.

The flora recorded in the Upper Sonoran zone include all of the yuccas and cacti of the Lower Sonoran zone with the addition of pitaya and

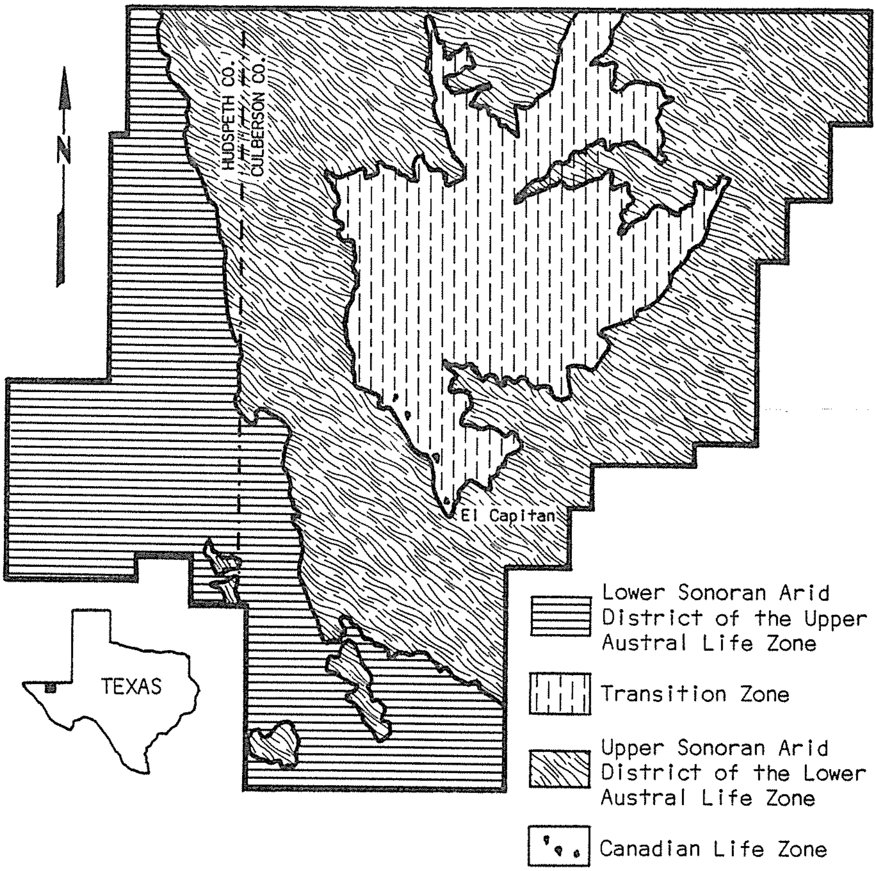


Figure 3. Map showing life zones in Guadalupe Mountains National Park. (Constructed from data of Bailey 1928.)

mammillaria cacti. Trees are more common in the Upper Sonoran, especially on the canyon floors and at the springs. Among the trees are bigtooth maple, five varieties of oak, juniper, spruce, mountain spout mahogany, ponderosa pine, and, occasionally, pinyon pine, Texas walnut, willow, and ironwood. Added to the small xerophytic plants and grasses of the Lower Sonoran that are duplicated here are such plants as *Nolina texana*, or basket grass.

The fauna supported in the Upper Sonoran zone are varied. Bailey (1928:16) reports "Texas mountain sheep, grey mule deer, rock squirrel, Rowles white footed mouse, white throated rat, gray fox, horned lark, raven" and many other birds. Also in the area are porcupines, jackrabbits, desert cottontails, kangaroo rats, wood rats, numerous small rodents, and owls (Lundelius 1979). Burns (1967:10) reports that reptiles occur less frequently here than in the Lower Sonoran.

Transition Life Zone

The Transition zone occupies the central and north central part of the park. The region is cut by canyons and is marked by high, rugged mountains, woods, and parklands, and a wide variety of trees and plants thrive. Surviving in the Bowl (Figure 2) is a mixed mesophytic Pleistocene relic forest, one of the unique ecological aspects of the park.

The TAS spent little survey time in the Transition zone, and no records were made on the flora and fauna, but the area has been described by Bailey.

> This zone is strongly marked by the yellow pine, with huge scaly trunks in wide stretches of beautiful open forest, clear, and grassy underneath. Douglas spruce, southern white pine, large-leaved maple, New Mexico oak and locust occupy secondary places in the forest. Extensive open parks or grassy glades appear....
>
> The characteristic mammals are white-tailed and mule deer, two species of chipmunks, a small form of the thirteen-lined ground squirrel, the Colorado wood rat, Guadalupe meadow mouse, fulvous pocket gopher, mountain cottontail and brown bat [Bailey 1928:18].

The avifauna include Merriam's wild turkey, band-tailed pigeon, spotted owl, screech owl, woodpecker, scaled quail, dove, and a variety of smaller birds. Burns (1967) also reports that the red-tailed hawk and golden eagle are found. The faunal inventory includes the cottontail, squirrel, badger, fox, bobcat, coyote, and porcupine.

Canadian Life Zone

The Canadian zone is restricted to the summits of Brush Mountain, Bartlett Peak, Shumard Peak, and Guadalupe Peak (Figure 3). Bailey (1928:18) reports that the flora consists of spruce, fir, and aspen forests with many other Rocky Mountain plant species. Among the rare and endangered flora of the park is a stand of no more than a hundred quaking aspens on a hillside with a northeast exposure southeast of Brush Mountain. The stand is not reproducing and is steadily diminishing in size (National Park Service 1974:90).

The fauna once included the now extinct Merriam elk; mountain lion and big horn sheep, now very rare, were also present. This small zone is relatively unimportant today, except as an ecological isolate, but it was once much more widespread in the southern Guadalupes.

Summary

Environmentally, the Guadalupe Mountains National Park area is extremely diverse. Confined within its 200 square kilometers (120 square miles) are four major life zones that include isolated relics of a verdant Pleistocene forest, permanent flowing streams, and alkali flats. The elevation ranges between 1100 and 2700 meters (3,650 to 8,750 ft.) within a distance of 11 km (7 miles). Some areas are nearly level and are covered with sand dunes; others have deep arroyos with precipitous clifflike sides, the products of furious flash floods. At first glance the region seems barren and devoid of life, but upon further inspection even the burnt umber landscape of the desert discloses a wide range of plant and animal life.

ARCHEOLOGICAL AND ETHNOHISTORICAL BACKGROUND

Half a century has passed since publication of the first archeological field report from the Guadalupe Mountains. Investigations have been conducted intermittently there since that time, yet the region is by no means well known or understood. The four cultural-historical stages—Paleo-Indian, Archaic, Neo-American (also called Late Prehistoric), and Historic—of Suhm, Krieger, and Jelks (1954) are all recognized in the region. The information available for each of these stages from the southern Guadalupes is summarized below.

Paleo-Indian Stage

The Paleo-Indian stage, a late Pleistocene and early post-Pleistocene hunting and gathering adaptation, has at least two manifestations in North America, distinguished by both geographical and cultural factors. On one hand is the big-game-hunting Paleo-eastern tradition, and on the other, the gathering-oriented Paleo-western tradition (Wormington 1957:21). Paleo-eastern materials, generally found east of the Rocky Mountains, are typified by distinctive, often fluted, lanceolate projectile points. The well-known associations between these points and extinct Pleistocene fauna have been responsible for the identification of big game hunting as part of the culture pattern, but a paucity of excavated Paleo-Indian habitation sites (as opposed to kill sites) has made it difficult to assess the significance of the gathering and small-game-hunting aspects of Paleo-eastern subsistence. Although the evidence is meager, there is a consensus among investigators in the field that plant collecting played a significant role in the Paleo-eastern life-style (Irwin 1971:46).

The Paleo-western tradition is less clearly defined than is the Paleo-eastern. The rarity of associations between recognized western Paleo-Indian projectile points and Pleistocene fauna suggests that big game hunting was not especially important. Irwin (1971:58) has suggested that some big game hunting may have taken place early in the Paleo-western tradition, but it gave way to a more diverse gathering economy.

Archaic Stage

The term *Archaic stage* was first used by William Ritchie (1932) to describe adaptations in New York. The definition has been modified to include a large part of North America, including Texas (Suhm, Krieger, and Jelks 1954:18). The Archaic, which overlaps the Paleo-Indian, is a generalized hunting and gathering subsistence pattern that persisted for several millennia. There is ample evidence in terms of both tool kits and botanical remains that plant food collecting played a major role in Archaic stage subsistence. Pottery and indications of agriculture are absent, except during the final part of the stage, when they appear as either products of internal development or, more commonly, results of diffusion. In a broad sense, the Archaic stage can be equated with the Old World Mesolithic in that it exemplifies a broad-based hunting and gathering post-Pleistocene adaptation.

Neo-American Stage

According to the terminology of Suhm, Krieger, and Jelks (1954), the next prehistoric stage in Texas is the Neo-American. Subsistence in this stage includes agriculture, but the presence of the bow and arrow shows that hunting was still practiced. Ceramic technology is another hallmark of the Neo-American. Permanent settlements were larger; some even approached urban levels. However, Krieger reports that the two new traits—ceramics and agriculture—do not necessarily appear simultaneously; consequently, Neo-American is applied to any group that had two of the traits (Suhm, Krieger, and Jelks 1954:20).

Historic Stage

The Historic stage is defined as beginning when European artifacts are found associated with native American sites. At the time of contact between the Spanish and the native populations, groups having both Archaic and Neo-American lifeways were living in Trans-Pecos Texas. This was a dynamic period in which groups underwent rapid change and, in some cases, extinction. Records left by the early Spanish adventurers and chroniclers not only describe the fate of these people but also provide some information on their life-styles. For this reason the Historic stage is especially important in the interpretation of Trans-Pecos archeology.

Cultural-Historical Stages in the Park Area

The Guadalupe Mountains are on the southeastern periphery of the Rocky Mountains, with the southern Plains, including the Llano Estacado, on the east, and an arid basin and range system of the American Southwest on the west. South of the Guadalupes is the extensive Chihuahuan Desert, which stretches deep into Coahuila and Chihuahua, Mexico. Culturally, the Guadalupes are in the Northeastern district of the Trans-Pecos region as defined by Lehmer (1958:110). The other districts are El Paso at the western extreme of Texas, La Junta along the Rio Grande below El Paso, and Southeastern along the lower Pecos River (Figure 4).

This subdivision unfortunately belies the actual interrelationship of the Trans-Pecos to major culture areas. Lehmer's El Paso and, possibly, La Junta districts (at least during the first millennium A.D.) should be included in the Southwest culture area, and his Southeastern district is in the Northeastern Mexico culture area (Willey 1966:329). Lehmer's Northeastern district should be viewed as transitional between the Southwest, Plains, and Northeastern Mexico culture areas (Figure 4). Indeed the existence of the Trans-Pecos region is a result of modern investigators' attempts to fit that part of a modern geopolitical unit into an existing archeological framework. As work in the area progresses and relations are clearly established with other culture areas, it may become advisable to abandon Trans-Pecos as an archeological subdivision. However, until that happens, the Trans-Pecos is useful for identifying a geographical study area.

Following is a review of the cultural-historical stages within the Northeastern district of the Trans-Pecos of Texas, with emphasis on the southern Guadalupe Mountains and the relationship between this area and adjacent regions.

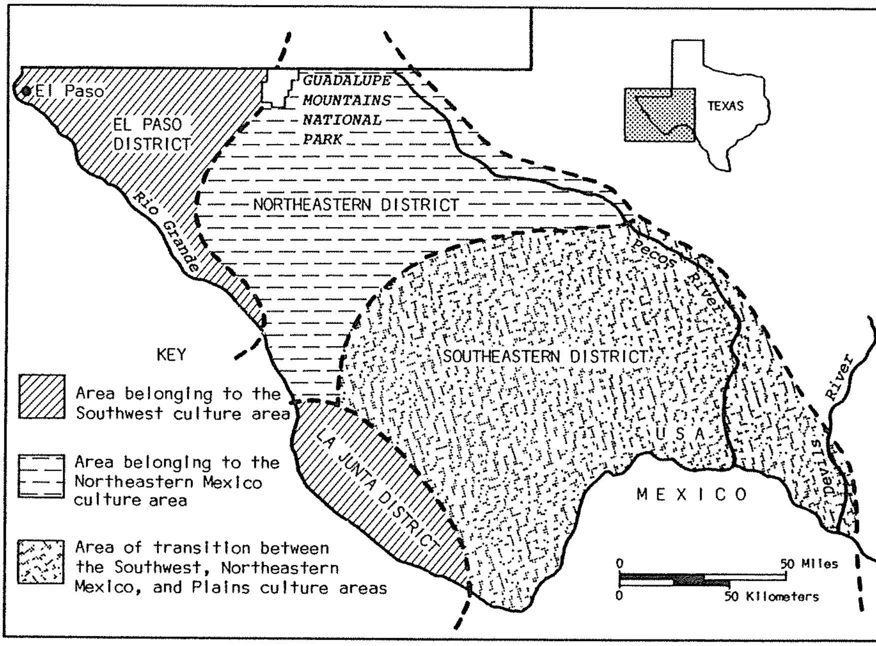


Figure 4. Map showing culture areas in the Trans-Pecos region of Texas. (After Lehmer 1958.)

Paleo-Indian Sites

The best evidence of Paleo-Indian occupation in the Guadalupe Mountains is outside the park in Burnet Cave, a dry cave in New Mexico about 30 km (20 miles) north of the Texas-New Mexico border and 50 km (30 miles) west of Carlsbad. There, in an essentially undisturbed deposit, E.B. Howard (1932) uncovered, at depths from 1 to 2.5 meters (3 to 8 ft.) below the surface, the remains of more than ten extinct animals or animal species that are no longer found in the region. The faunal inventory consisted of "an extinct four horned antelope (Tetrameryx), two extinct horses (Equus fraternus and E. complicatus), extinct bison (Bison alleni), extinct musk-ox (Bootherium sp), a large extinct camel, extinct California condor, and a number of other bird bones, including those of the wild turkey" (Howard 1932:15). Howard also found the remains of marmots (*Marmota falviventris*), which have been significant in the interpretation of the Paleo-environment (Murray 1957; Antevs 1954).

In addition to the faunal material, Howard (1932:13) also found a Clovis point: "The depth at which our spear-point was found was five feet seven inches below the surface and about four feet below the level of the Basket Maker burial. As I mentioned we had to move a large rock which was directly over the hearth, which contained the point." Howard proposed that the location of the hearth below the Basketmaker level and the quantity of broken horse, bison, and camel bones indicated that these animals were hunted by the makers of the Clovis point. He admitted that the fractured condition of the bones could be explained by roof fall, but at this time, with the benefit of hindsight, his suggestion that the animals were hunted by the makers of the Clovis point seems more likely to be the correct interpretation.

In the early 1950s a sample was taken from Burnet Cave materials for radiocarbon dating, and a date of 7432 ± 300 years B.P. was obtained (Wormington 1957:33). However, the composition of the faunal inventory and the much earlier dates for Clovis material in the Southwest have prompted Wormington (1957:33) to suggest that this date is too recent.

Within the park there have been several finds of Paleo-Indian projectile points. Paul and Susanna Katz (1974:54-55) report the base of a probable Plainview point from a site on a bench on the southeast reef front at the north end of the Patterson Hills, and the base of a probable Midland point from a ridge in the northwestern part of the park. They also found a biface fragment, which they attribute to the Paleo-Indian stage, at a site (41CU31) in Pine Spring Canyon (Figure 2). These artifacts are the only signs of Paleo-Indian occupation in the extreme southern part of the Guadalupe Mountains.

Joe Ben Wheat (n.d.) has studied extensive deposits of Paleo-Indian materials from a multicomponent site in the Van Horn area, 96 km (60 miles) south of the park. Occupation of the site extends from early Paleo-Indian through late Paleo-Indian, Archaic, and Neo-American stages; the site covers about 3 ha (9 acres) and was once probably stratified (Wheat n.d.), although most of the material is now on the surface. Wheat reports that the inventory of Folsom materials includes 100 Folsom points, 425 end scrapers, 400 side scrapers, 52 gravers, 11 burins, 16 notches, and 80 channel flakes. In addition, San Jon, Plainview, Agate Basin, and possibly Milnesand points have been recovered. The site is on a chain of late Pleistocene playa lakes and alkali flats in a setting that resembles the physiography to the west of the Guadalupes.

All of the Paleo-Indian materials that have been discovered thus far relate to the Paleo-eastern tradition; no Paleo-western (gathering-oriented) Paleo-Indian materials have been identified in the southern Guadalupes, although some may yet be found. Collins (1976) has proposed that such a gathering-oriented (Paleo-western) terminal Pleistocene adaptation existed on the lower Pecos River some 482 km (300 miles) to the southeast in Lehmer's Southeastern district (Figure 4). He has further proposed that there was no cultural continuity between the terminal Pleistocene big-game-hunting peoples and the earliest Archaic cultures (Collins 1976:22). This raises the question that there may be as yet unidentified non-big-game-hunting Paleo-Indian cultures in the Pecos River region and adjacent areas.

Archaic Sites

The Archaic of northeastern Trans-Pecos Texas is still poorly understood. Radiocarbon dates are rare because few excavations, especially of stratified sites, have been carried out since the introduction of the technique. Consequently, it is difficult to make precise statements about the nature and chronology of Archaic manifestations in the area. The presence of many Archaic stage projectile points and other coeval artifacts does suggest that a wide range of Archaic manifestations may be present.

Suhm, Krieger, and Jelks (1954:31) consider the Cochise culture, defined by Sayles and Antevs (1941), as the ultimate source for the Archaic cultures of the region. Cochise has considerable antiquity; its earliest phase has associations with now extinct Pleistocene fauna. Irwin-Williams (1967:454) reports some radiocarbon dates that range between 9300 and 8300 B.P. for the Sulphur Springs (earliest) phase. The San Pedro (latest) phase, dates between 4000 and 2000 B.P. The Cochise culture thus covers an immense span of time. Sayles and Antevs interpreted the Cochise as having a gathering-oriented subsistence base, with hunting playing only a minor part. Milling stones dominate the artifact assemblage, especially in the first two stages, with chipped stone becoming frequent only during the last stage. Most of the Cochise finds come from Arizona and New Mexico and may not have a direct application to the Trans-Pecos.

To the southeast, in the Lower Pecos region, is another cluster of sites that contain evidence of gathering-oriented Archaic cultures. Collins has synthesized data from 20 components in seven sites that range in time between 14,500 and 5000 B.P. On the basis of his analysis, "the beginnings of a long Archaic tradition of plant food gathering, fishing, and small game hunting occur around 9000 years ago" (Collins 1976:22). In the early part of the Archaic, from 9000 to 5500 B.P., rabbits and rodents were the basic animal foods; deer were hunted regularly only after 5500 B.P. Direct evidence for exploitation of plant food was not preserved in most cases, but the artifact inventory of bifaces, choppers, and grinding stones makes it reasonable to assume that plant foods were probably quite important.

The subsistence strategy for the early Archaic, and quite possibly for most of the Archaic, seems to be oriented more toward gathering than hunting. This is inferred from patterns of the Cochise culture to the west and the Lower Pecos River culture to the southeast. These patterns may not be applicable to the southern Guadalupes, but the environmental similarities and comparable artifact inventories from at least a few sites indicate that the analogy may in fact be appropriate.

There is a nearly total lack of information on the early Archaic in the vicinity of the southern Guadalupes, but there is not quite such a void on the later Archaic. Lehmer (1948) defines the Hueco phase as the precursor of the Jornada branch of the Mogollon, a Neo-American stage culture. The Hueco phase was originally described by Sayles (1935) as the Hueco Cave Dweller phase. The Hueco seems to have had a broader material culture than did the previous Cochise or Cochise-like culture and may represent some degree of specialization in subsistence. The Hueco phase has been summarized as having

> . . . unhafted choppers, leaf blades, drills, flake knives, several kinds of projectile points, core scrapers and grinding tools, including manos and metates, and mortars and pestles. Mortar holes are deep and cylindrical with rounded bottoms and are found in boulders and rock outcrops. Pestles are long and tapered to the top from a point just above the grinding surfaces which are flat or convex along the axis; occasionally wedge-shaped cross sections occur. . . . Metates have flat grinding areas or oval bowls. The trough variety is not known [Lehmer 1948:72].

The atlatl was in use, but apparently not the bow and arrow or ceramics, except in the very latest adaptations.

There are at least two excavated Hueco phase sites in the southern Guadalupes. Williams Cave (or Indian Cave) (41CU16), was excavated by Mary Youngman Ayer in the 1930s under the aegis of E.B. Howard. Although the site was quite deep, Ayer did not indicate whether it was stratified or even dug in arbitrary levels. She recovered an unspecified number of manos—both convex and wedge shaped—flat metates, scrapers, sotol-digging sticks, shafts and foreshafts (presumably of atlatl darts), at least three varieties of sandals, and a wide variety of other basketry and cordage. Under plant remains she reported "primitive flint corn, ears 1½-3 inches long, average 12 rows of kernels, mesquite beans, piñon cones, prickly pears, sotol seeds, bundles of grass (use problematical)" (Ayer 1936:604).

The fauna from the cave consisted of a variety of small rodents, three species of deer (including white-tailed deer), wapati, pronghorn antelope, bobcat, cougar, grizzly bear, and gray fox. A yellow-haired porcupine was noted, and Ayer commented that its natural habitat was in the Transition or Canadian zone. Extinct faunal remains from the cave included direwolf, horse, bighorn sheep, and ground sloth. All of the extinct faunal materials were recovered between 1 and 1.5 meters (4 to 5 feet) below the surface (Ayer 1936:604-617). With the exception of these faunal remains, Ayer does not furnish provenience for any of the faunal or artifactual materials excavated.

Three burials were excavated from the cave, a basket burial of two children and an adult, a cradle burial, and a bag burial of an adult. Ayer reports that the multiple burial was at a depth of 46 cm (18 in.) in the rear of the cave, and the cradle burial was near the innermost wall; no mention was made of the location and depth of the third burial. No evidence of occupation was found more than 1 meter (3 ft.) below the undisturbed surface (Ayer 1936:600-601).

The artifact inventory, nature of the burials, and lack of pottery corresponded to Sayle's Hueco Cave Dweller culture (Ayer 1936:604). Since there were no tabulations of artifact frequencies, faunal materials, or provenience, it is difficult to assess the significance of the site. Clearly, a hunting and gathering subsistence is indicated, probably with emphasis on gathering, since most of the faunal remains represent only one individual per species. Unfortunately, we have no idea how many milling stones or sotol digging sticks were recovered; this data might have given us a better indication of the subsistence emphasis. There is a suggestion of stratigraphic separation of the cultural materials and the Pleistocene fauna, appearing to rule out a late Paleo-Indian or early Archaic occupation. No dates have been suggested for this site, but it is conceivable that some of the organic cultural materials could be used for radiocarbon analysis.

Pratt Cave is on the northeast edge of the park, on the south side of McKittrick Canyon. In 1961 a cache of artifacts was discovered in the cave, and in 1965 excavations were initiated under the direction of Albert Schroeder (Katz and Katz 1974:7). The results of the archeological investigations have recently been published (Schroeder 1983), and the pollen analysis (Bryant 1983) and faunal analysis (Lundelius 1979) are available.

Two radiocarbon dates of perishables in the cache were: TX-1021—wood slab, 1420 ± 60 B.P. (ca. A.D. 530); and TX-1022—basketry, 1840 ± 60 B.P. (ca. A.D. 110) (Valastro et al. 1979:262). These dates indicate that the cache is probably late Hueco.

In addition to the excavations at Pratt Cave described above, H.P. Mera investigated 13 sites in the Guadalupes (Mera 1938). Originally he had planned to work only in caves because they were being destroyed at an alarming rate by relic collectors, but he decided to include some open campsites as well. Although his report contains a wealth of information, it includes neither descriptions of the excavation techniques nor the provenience of the materials recovered, except by site. It is apparent that many of the sites yielded artifacts from the Archaic stage, as well as some evidence of Neo-American occupations. In High Cave, now known as Higher Sloth Cave (Katz and Katz 1974:6), Mera excavated a midden ring, and from this and other excavations in the cave he recovered mescal quids, 46 sandals, a section of net, and a large hardwood projectile point, but no ceramics (Mera 1938:34-35). It is quite possible that this site may date to the Archaic.

Further documentation of Archaic occupations in the southern Guadalupes comes from the recent work of Paul and Suzanna Katz. In their survey of the park subsequent to the TAS survey, they compared many of their projectile points to those in a typology established by LeRoy Johnson (1967). They identified Johnson's C-, D-, and E-group points among ones they recovered from lithic and ceramic-and-lithic scatter sites in the Guadalupes. Johnson's chronology, which the Katzes tentatively adopted, dates these projectile points from 6000 B.C. to A.D. 1. The Transitional period, according to Johnson's scheme, dates from A.D. 1 to A.D. 800 and is represented by H- and I-group points. Transitional period sites are also characterized by brown ware ceramics (presumably Jornada Brown, El Paso Brown, and South-Pecos Brown, all of which are found in the park). The Texas Tech survey conducted by the Katzes, like the TAS survey, dealt only with surface collections; therefore, assignment of Archaic stage dates to their sites is by typological comparison only.

Although Archaic manifestations in the southern Guadalupes have been studied more thoroughly than have any other stages, our understanding of the Archaic is still rudimentary. The existence in the mountains of several caves with Archaic components, as well as many Archaic style points in open sites, indicates a substantial occupation during the Archaic, but there are no clear associations of Archaic materials with extinct fauna, leaving an early Archaic occupation an open question. The single set of radiocarbon dates for the southern Guadalupes confirms a late Archaic presence. The available floral and faunal inventories from the dry caves and shelters indicate that gathering was more important than hunting. It is apparent that there was some variety of generalized Archaic hunter-gatherer culture in the region. Typologically it seems to resemble the Hueco phase most closely.

Neo-American Sites

The Neo-American stage is represented in Trans-Pecos Texas by the Jornada branch of the Mogollon, defined by Donald H. Lehmer (1948). Since ceramics are an integral part of the Jornada inventory, it has been possible to define rather precisely the spatial and temporal limits of the various phases of the Jornada branch. Lehmer was able to date three phases on the basis of a series of Jornada ceramics and the association with them of various previously dated intrusive wares. Below is a brief description of sites in the Guadalupes and adjacent regions that have Jornada branch materials.

Lehmer believes that the Neo-American stage in the Trans-Pecos developed out of a blending of the Hueco culture with influences from the Mogollon pueblos of San Maricial. Since the subsistence pattern already focused on plant gathering, the shift to plant food production was not a drastic change. According to Lehmer (1948:73), "the transition from the earlier gathering economy to a horticultural one was apparently gradual and without marked disturbing effect on the rest of the pattern." The large projectile points of the Hueco continued to be used in the early phases of the Neo-American, especially in the more marginal (i.e., mountainous) areas (Lehmer 1948:38).

Lehmer (1948) defines the Jornada branch of the Mogollon as having northern and southern variants, each subdivided into three phases. The phases of the southern variant (Mesilla, Dona Ana, and El Paso), which are more pertinent to the Guadalupe Mountains, will be discussed here.

Briefly, the Mesilla phase lasted from about A.D. 900 to 1000. Both rectangular and circular pithouses were used during this time, and ceramics were introduced into the region, apparently derived from Alma Plain (Lehmer 1948:74). El Paso Brown is the only ceramic type associated with the Mesilla phase. The subsistence base included some agriculture—probably maize and squash—but hunting and gathering continued to play a significant role (Lehmer 1948:75-78).

The Dona Ana phase (A.D. 1000-1200) is a transitional phase between the Mesilla and El Paso phases. The use of pithouses continued, but Pueblo-style houses also appeared. El Paso Polychrome was added to the El Paso Brown ware already in use. There was probably no significant change in the subsistence pattern (Lehmer 1948:78-80).

The El Paso phase (A.D. 1200-1400) had the most sophisticated development of the Jornada branch. The people lived in pueblos that were often arranged either in simple rows or in squares with interior plazas. Both El Paso Brown and El Paso Polychrome ceramics continued to be used, although the brown wares declined in relative frequency. Also at this time, intrusive potteries, most commonly Chupadero Black on White, became more frequent than at any other time. By this time agriculture had become more important, displacing hunting (Lehmer 1948:30-84).

There are several reported Neo-American sites in the Guadalupe Mountains. Mera (1938) discovered two caves, Goat Cave and Wild Horse Cave, with Neo-American components. In Goat Cave he found a burial, a great deal of vegetable matter, wooden projectile points, dart foreshafts, cane shafts, rabbit sticks (small hardwood sticks presumably used to kill rabbits), a fragment of rabbit-skin robe, and El Paso Polychrome and Chupadero Black on White pottery. His report does not indicate whether all of the materials from the cave came from the same archeological component, or whether they came from stratified deposits. At Wild Horse Cave, Mera found bits of weaving, a scraper, a knife, and 10 potsherds (nine Jornada Brown and a single sherd of Chupadero Black on White), and a midden circle was close by. Mera also commented that in all of the caves where he found vegetable material there were many mescal quids and occasional remains of opuntia fruits (tunas), but he found no mesqite beans or corn.

Another cave in the park with a Neo-American component is Hermit's Cave, excavated by Edwin Ferdon, Jr. (1946). The site had three levels, of which only the uppermost had ceramics. The pottery consisted of Chupadero Black on White, Lincoln Black on Red, and Classic Pueblo, or Pueblo III. Ferdon noted that changes in projectile point types indicated a shift from the use of atlatls in the lower levels to bows and arrows in the upper level. He did not find evidence of agriculture (Ferdon 1946:24-28). The ceramics at the site suggest a date of about A.D. 1350 (Breternitz 1966:72, 82).

About 160 km (100 miles) northeast of the park is the Merchant site, an open site excavated by the Lea County Archeological Society (LCAS) (Leslie 1965). The site was on the edge of a ridge overlooking a dry lake bed. Fourteen permanent structures were found there, including two pitrooms and twelve surface houses. Corely and Leslie report that the walls of the pitrooms were independent of the pit sides (Lehmer 1948:128). However, Collins suggests that they were indeed semisubterranean pithouses. The surface structures were made of caliche stones mortared with clay. An impressive number of projectile points—some 7,000—were recovered from the site (Leslie 1965:28). A few were Archaic dart points, but most were small arrow points. More than 7,000 sherds were recovered, 98 percent of which were made locally; the other 2 percent were intrusive decorated wares. On the basis of the intrusive types, an occupation date of about A.D. 1400 was established (Leslie 1965:29). The subsistence base seems to have been hunting, as "many large and small animal and fowl bones appeared in most all trash and refuse" (Leslie 1965:28). No evidence of agriculture was found, and the investigators suggested that acorns, which were found in small quantities at the site, were substituted for maize in the diet.

The El Paso Archaeological Society has reported on the excavation of a single-room house at the Hot Well site (Shultz 1966) in the Hueco Bolson west of the park. The excavators recovered 388 potsherds from the structure, 95 percent of which were local El Paso Polychrome. The identifiable intrusives from the house were Chupadero Black on White and Lincoln Black on Red. The overlap of the approximate time spans of the wares (Breternitz 1966:72, 74, 82) suggests an occupation date of about A.D. 1350. Stone artifacts were rare at this site; they consisted of a minor amount of chippage, one limestone chopper or hoe, and a hammerstone or anvil. The Hot Well site was an open site with little potential for the preservation of perishables, so no vegetable materials were recovered. No positive evidence for the subsistence base was found, but cultigens were probably a significant factor in the diet.

The nature of the Neo-American occupation of the southern Guadalupes is still poorly known. We know little more than that the region was indeed occupied during that time period. Data on subsistence orientation and possible cultural affinities to nearby regions are totally lacking.

Historic Accounts

The brief Historic stage in the Guadalupes was the final episode of aboriginal occupation. Our knowledge of this era is derived not so much from the study of historic sites as from the study of historic documents, although there are few ethnohistoric accounts concerning residents of the southern Guadalupes (Hammond and Rey 1966). None of the early Spanish expeditions actually entered the mountains; rather, they passed nearby (Figure 5). Nowhere in the historic documents is there any report of agriculture in or near the Guadalupe Mountains. The groups mentioned in the ethnohistories of the area seemed intent upon hunting and gathering, supplementing their needs and wants by trade or raiding. It is the raiding that eventually brought about the final defeat and subjugation of the last Indian residents of the Guadalupes.

At the time of contact with the Spanish, the Trans-Pecos region was an area of great cultural diversity, with representatives of three different cultural adaptations existing in rather close proximity. The Cabris Indians, including the Rayas and Conchos, were representative of the hunter-gatherers who occupied the northeastern region of Texas. They were organized in fairly small bands and apparently subsisted on small game and wild plants. Pueblo influence was manifested in the form of the sedentary villages in the La Junta area, which were described by the Spaniards as pueblos. These people, such as the Patarabueye, cultivated large amounts of maize, beans, and squashes. There were Plains Indians collectively identified as Jumanas or Jumanos. They too were hunter-gatherers, but they focused on large game—bison, deer, and antelope. There was certainly contact between these groups, and some northeastern Mexicans were cultivating a few crops, apparently diffused south from the Pueblo region. The settled Patarabueyes carried on a lively intercourse with the Jumanos and obtained from them bison hides and sturdy Plains bows. In return the Jumanos probably received corn, other foods, and cotton cloth.

Given the environmental and geographical situation of the Guadalupe Mountains, it is likely that all three life-styles—simple hunter-gatherer, Plains hunter-gatherer, and sedentary agriculturalist—played roles in the cultural history of the region.

During the seventeenth century, the Apachean groups became established in this area and put heavy pressure on the southernmost Pueblo towns. During this time groups like the Mansos, Sumas, and Jumanos faded from the records, absorbed or replaced by the Apaches (Schroeder 1974). From this time until their final subjugation late in the 19th century, Apachean groups under a variety of names—Siete Rios, Natage, and Mescalero (Schroeder 1974)—inhabited the mountainous areas between the Pecos River and the Rio Grande, with the Sacramento and Guadalupe Mountains as their heartland. They raided the Spanish and Anglos for livestock and captives during this period. Unfortunately, most accounts of this later period are also meager, limited to short descriptions of military actions taken against the Apachean groups. When these groups were expelled in the nineteenth century, more than 10,000 years of aboriginal occupation in the southern Guadalupe Mountains was abruptly ended.

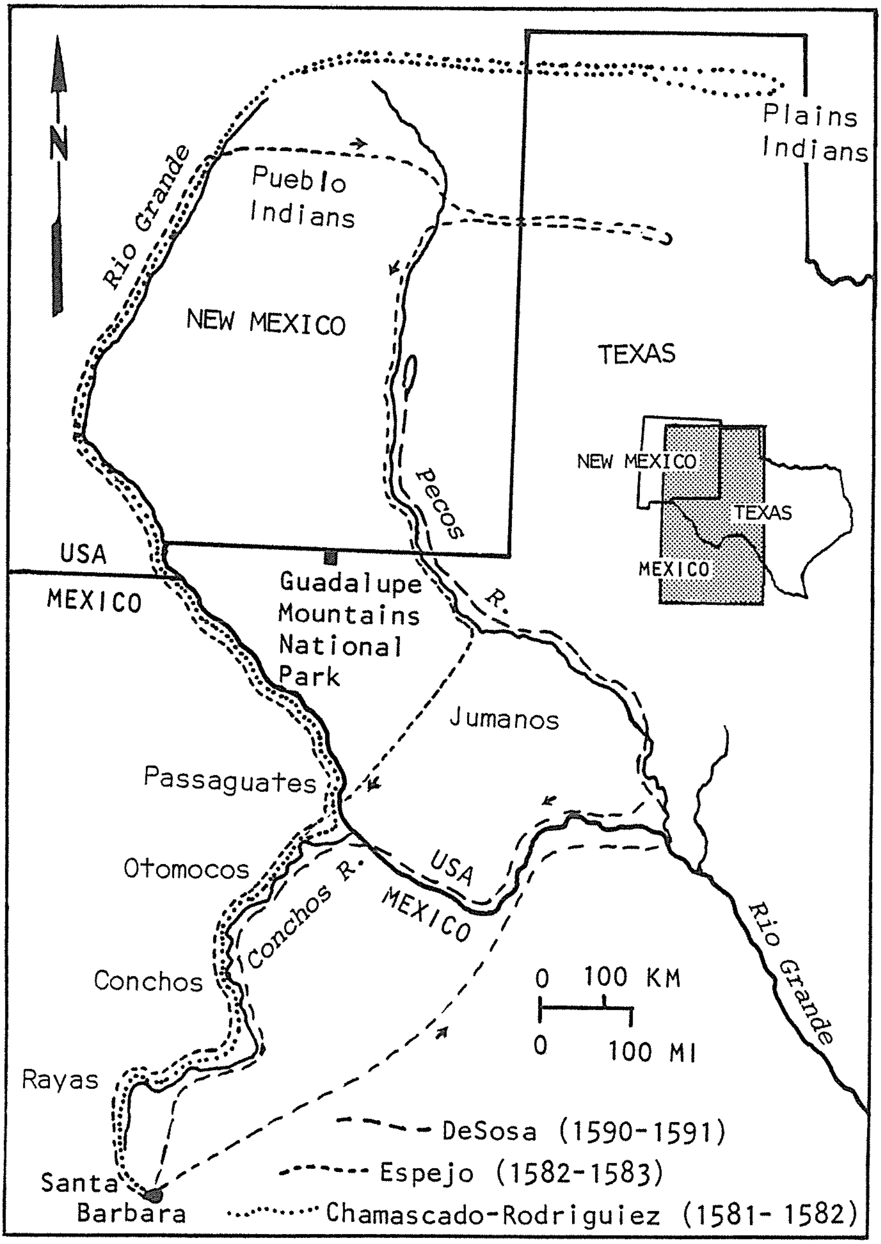


Figure 5. Map showing relation of routes of early Spanish explorers to the Guadalupe Mountains National Park area. The names and general locations of reported Indian groups also are shown. (After Hammond and Rey 1966.)

Although ethnohistorical accounts are limited, the documents that are available do provide information on the life-styles practiced in the area. The diversity of life-styles observed indicates that the southern Guadalupes were an area of cultural transition.

THE DATA BASE

Presented here are descriptions of the survey methodology of the TAS, the kinds of data collected by the survey, and a discussion of the inherent limitations of the data. Following this are descriptions of the artifact categories that were established and used for the analysis, with particular attention to the projectile points, since they constitute the bulk of the culturally and temporally diagnostic artifacts recovered. The flake forms are described, and the process used to define and select them is explained.

The archeological survey conducted by the TAS in 1970 gathered data with the objective of providing solutions to two problems. The first was to establish a relative chronology and to outline the culture history of the park area; the second was to ascertain, if possible, the distribution of various archeological materials with respect to the ecological zones in the park (Shafer 1971:11). The survey focused on the southern and western parts of the park. National Park Service officials requested that the survey be initiated there because they expected these areas to suffer the greatest immediate impact from development and use of the park (Roger Reich, National Park Service, personal communication).

The survey was carried out by about 200 members of the TAS consisting of school children, high school and college students, graduate students in anthropology, and avocational archeologists. Participants in the survey were organized into crews, each under the supervision of a crew chief who had had previous training or experience in archeological field work. The crews alternated a day in the field with a day in camp, cleaning, sorting, and cataloging the materials collected on the previous day.

The surveying was done on foot, and about 10 percent (19 sq km, or 12 square miles) of the park was covered. The survey methodology was designed to ensure recovery of a representative sample of materials from each site visited.

> Collecting techniques allowed for adequate artifact samples from most sites. Crews were discouraged from wandering about the sites looking only for projectile points and pottery. Rather, intensive collection from one or more areas of the site was encouraged with an emphasis on getting a sample of all kinds of artifacts [Shafer 1971:16].

The survey directors attempted to standardize the collecting techniques and to a great extent, but not entirely, they were successful. Some site notes were accompanied by detailed maps of collecting loci, but others gave only the site locations. For example, one site (41CU31) was surveyed by means of a controlled surface collection, a deviation from the standard methodology. Although the crew chiefs occasionally deviated from the prescribed survey approach in order to adapt to the particular conditions at various sites, the actual collection of samples from the sites was generally adequate and comparable from site to site. In most cases there is reasonable assurance that a representative collection of material was taken and the rest left in place for further work. A total of 146 sites were surveyed, including two historic sites. (A description of each is included in Boisvert 1980:Appendix 2.)

Before artifacts were analyzed, they were sorted into typological categories. The organization and construction of a typology must be appropriate to the purposes for which it is intended. One eminent archeologist has stated that "the major goal of classification in most present-day archaeological studies is to use type as a measurement of culture history in time and space" (Ford 1949:44), but an equally eminent one subscribes to other views:

> The artifact type is here viewed as a group of artifacts exhibiting a consistent assemblage of attributes whose combined properties give a characteristic pattern. This implies that, even within a context of quite similar artifacts, classification into types is a process of discovery of combinations of attributes favored by the makers of the artifacts, not an arbitrary procedure of the classifier [Spaulding 1953:305].

This report encompasses both kinds of problems, i.e., descriptions of cultural-historical phenomena and the elucidation of behavioral patterns. To this end the artifact typology is a construct of the author, whose avowed goal was to create the most meaningful and succinct means of describing and defining the artifacts found by the TAS survey. Once categorizing was accomplished, the artifacts were analyzed by various means in order to provide solutions to the stated problems.

The artifacts were classified primarily on a morphological basis, by dividing and subdividing them into increasingly smaller and less heterogeneous groups. The criteria for making these divisions were largely subjective, but in general follow the conventional typological procedures of American archeology. The objective was to arrive at artifact categories defined by morphological attributes, without reference to functional qualities. In several cases, however, functional names were used when morphological attributes coincided with artifact categories such as drills, projectile points, and chopping tools, to which functional significance is attached by most American archeologists. The artifact categories used to describe the survey collection from the park are (1) ground and pecked stone; (2) chipped stone, which is subdivided into the basic categories, cores, flakes, unifaces, and bifaces; and (3) miscellaneous artifacts. Special typological consideration has been given to the projectile points (26 types) and flakes (29 attribute combinations or types). (Boisvert 1980:Appendix 2 contains a site-by-site distribution of materials recovered by the survey.)

Ground and Pecked Stone

Battered Stone

These stones, primarily chert and quartzite, have one or more battered areas that indicate, from placement and quality, that the battering was not naturally derived. The stones have functioned as hammerstones, pounders, or anvils for stoneworking, for plant or pigment processing, or for some other process.

Flat Manos

Flat manos show evidence on one or both planar surfaces of use as grinding stones. All complete specimens in the collection can be held and used with one hand, although a few could have been used with two hands. Their size and shape are identical to artifacts normally termed manos in the Southwest.

Convex Manos

The convex manos are similar to the flat manos, except that the ground surfaces are distinctively convex.

Metates

Metates are slablike stones that have flat or slightly concave ground surfaces. They are thinner than manos and have broad grinding areas that cover most of their surface areas. No complete metates were recovered by the survey, but large metate fragments were collected. As with the manos, the term by which they are most commonly recognized in the Southwest has been adopted for use in this study.

Chipped Stone

Amorphous Cores

Amorphous cores are pieces of chippable stone from which flakes have been removed in seemingly random patterns. They tend to be globular, and apparently they have not been specifically shaped for use as tools or for the production of specialized flakes.

Single Platform Cores

Single platform cores are cores with a number of flakes removed from a single surface or facet. They are prismatic or cone shaped, and at least some are the sources of blades (flakes with prismatic cross section and parallel sides, which are at least twice as long as they are wide).

Flakes

Flakes are the by-product of chipped stone tool manufacture and are collectively termed chippage. Crabtree's succinct definition is followed in this report: "Any piece of stone removed from a larger mass by the application of force—either intentional, accidental or by nature. A portion of isotropic material having a platform and bulb of force at the proximal end (end at which the force was applied)" (Crabtree 1972:64). Included in this category are both fragmentary and complete flakes.

Core Fragments

Core fragments are small, angular pieces of stone similar to flakes, but whose identifying characteristics, platforms and bulbs of force, are missing.

They tend to be larger and, especially, thicker than most flakes, but they are too small to be used as cores. They are artifacts that show evidence of modification by man but that cannot be classed as flakes, cores, or implements. It is probable that they are the remains of shattered cores.

Utilized Flakes

Utilized flakes are flakes modified by use and exhibiting polish, use retouch, or striations on one or more edges. All artifacts identified as utilized flakes in this study were examined under a binocular microscope before being so classified.

Unifaces

Unifaces are flakes or cores that have a planar surface; they have been modified by the removal of a series of flakes at one or more places along the edge of one surface only. A wide variety of shapes can result from such unifacial flaking; some unifaces may have been purposely shaped for specific uses. Listed below are the types of unifaces, defined on the basis of morphology.

Type I unifaces are semicircular, with trimming only along the curbed edges.

Type II unifaces have a semicircular notch on an edge. The notch is produced by unifacial flaking, and parts of the remaining edge may or may not be flaked as well. Artifacts of this type have been called spokeshaves.

Type IIIa unifaces are flaked only along the short axis of the parent flake or core, the worked edge of which is incurvate.

Type IIIb unifaces are flaked only along the short axis of the parent flake or core, the worked edge of which is straight.

Type IIIc unifaces are flaked only along the short axis of the parent flake or core, the worked edge of which is excurvate.

Type IVa unifaces are flaked only along the long axis of the parent flake or core, the worked edge of which is incurvate.

Type IVb unifaces are flaked only along the long axis of the parent flake or core, the worked edge of which is straight.

Type IVc unifaces are flaked only along the long axis of the parent flake or core, the worked edge of which is excurvate.

Type V unifaces are artifacts on which the flaking is not restricted to a particular long or short axis, nor is the shape of the flaked edge readily classifiable as being straight or curved. They are best described as unshaped (amorphous) unifaces.

Type VI unifaces are flakes with minute unifacial retouch along one or more edges. The flake scars are rarely more than 2 mm long. Such flaking could result from use as an implement (intentional retouch) or from unintentional retouch prehistorically (ground wear) or during contemporary times (bag retouch).

Uniface fragments are the broken parts of any of the unifaces described above. Their typically small size, in addition to their fragmentary nature, precludes further classification.

Bifaces

Biface-Uniface Composites

Biface-uniface composite artifacts are any flakes or cores with both unifacially and bifacially flaked edges.

Bifaces

Bifaces are flakes or cores that have been flaked along one or more edges by blows originating from opposing directions, resulting in edges that are formed by the intersection of two planes or surfaces, both bearing negative flake scars.

Unhafted Bifaces

Unhafted bifaces are bifaces with no evidence of modification for the attachment of handles or shafts. This does not necessarily mean that none of these artifacts were ever hafted, but only that they lack hafting modifications. Four specimens that very closely resemble recognized projectile point types are not included in this part of the typology, but are listed with the projectile points.

Marginal bifaces are flakes with retouch similar to Type VI unifaces, except that the retouch is bifacial. Marginal bifaces typically have limited areas of small, irregular bifacial retouch.

Single-edge heavily retouched bifaces are cores or large flakes that have been flaked by percussion along only one edge, thus producing a single crude sinuous edge.

Chopping tools are similar to the single-edge heavily retouched bifaces described above except that they are made exclusively on large pebbles, and the flaked edges are made by removing broader, somewhat flatter flakes. The term *chopping tools* has been adopted because of the similarity between these artifacts and those Old World artifacts called chopping tools (see Bordes 1968:242, 243).

Ovate bifaces are bifacial implements, oval or slightly rectangular, with well-rounded corners, biconvex in cross section. The artifacts are flaked all the way around, generally a result of soft hammer percussion, with some secondary retouch.

Tabular bifaces (Figure 6), made from naturally tabular material, have percussion-flaked edges. They are usually shaped like right triangles with the longest sides usually excurvate and the shorter sides straight and untrimmed. They are relatively large artifacts, measuring from 76 to 221 mm in length, from 54 to 116 mm in width, and from 8 to 20 mm in thickness. All of the specimens collected by the survey were of limestone.

Planoconvex bifaces are defined on the basis of their cross sections, which, as the name indicates, are planoconvex. Most specimens resemble Type IIIc and IVc unifaces and may in fact be rejuvenated versions of the same.

Preforms, or blanks, are unfinished bifacially worked artifacts that have been subjected to primary trimming and shaping but have not yet received the final shaping and such finishing touches as modifications for hafting. They

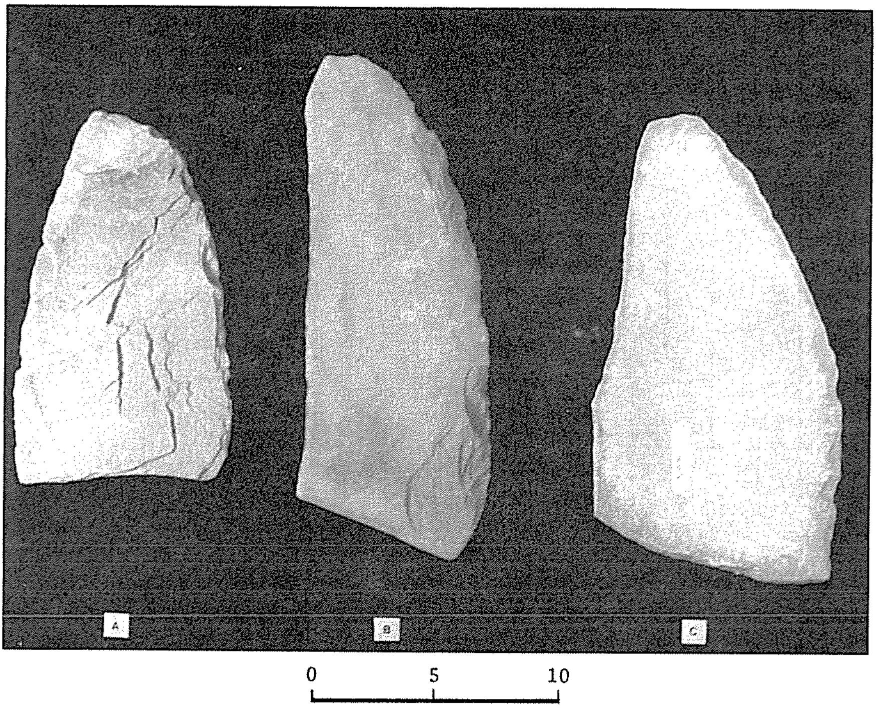


Figure 6. Tabular bifaces.

are usually oval or roughly triangular in outline, with relatively thick cross sections. Percussion flaking is evident on the artifacts, but pressure flaking is not.

Snap fragment bifaces are fragments of bifaces for which the specific cause of breakage could not be determined. All biface fragments except those with hafting modifications fall into this category; it includes tips, large edge sections, midsections, and squared or rounded bases.

Transverse fractured bifaces are similar to the snap fragment bifaces described above, except that the breakage could be related to the manufacturing process. A bulb of percussion, either positive or negative, and radial shatter lines can be seen originating at one of the bifacial edges and continuing across the exposed transverse section of the biface. The particular location of the break is usually associated with other flaking problems such as knots or collapsed edges from unsuccessful shaping.

Hafted Bifaces

All hafted bifaces except drills are considered projectile points. This interpretation is made with the realization that some of the artifacts may have been used as knives, but since many have been found in dry caves or rockshelters hafted to projectile shafts or foreshafts, in most cases their

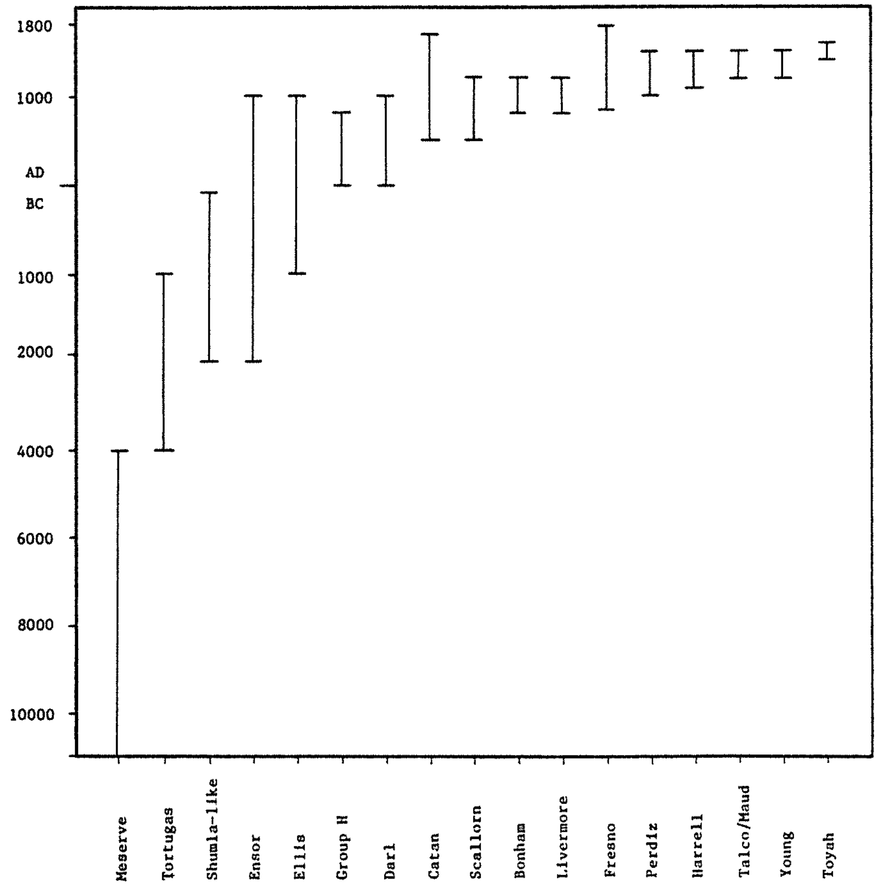


Figure 7. Time spans of identifiable projectile points.

identification as projectile points is probably accurate. The types of projectile points recovered by the survey are described below. Comparisons with previously defined types are made and cultural-temporal affiliations are indicated when possible (Figure 7). Table 1 shows the distribution of the points by site; Table 2 shows the range of metric attributes.

Projectile Points

Type 1—Livermore points (Figure 8, A-D); narrow, spikelike blades with wide shoulders that are more than double the blade width; expanded stems, and rounded bases that may be as wide as the shoulders; made from thin flakes that often retain the original curvature of the flake. They conform well to the type description provided by Suhm and Jelks (1962:279-280), except that in some cases the bases of the points in the survey collection are wider.

Table 1. Distribution of Projectile Points

SITE	TYPE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	TOTALS
CU14		1																									1
CU18	1				1							1													1		4
CU19	3			1	2	1		1	1			1				1					1						12
CU25															1												1
CU27																			1								1
CU29																										1	1
CU31							1	1	3									1									6
CU43										1																	1
CU56													1														1
CU67									1		1						1										3
CU68												1															1
CU75							1																				1
CU80						1		1	1				1														4
CU89								1																			1
CU90													1														1
CU96	1					1		1	1	1				1						1							7
CU98									1																		1
CU108											1																1
CL110																2						1					3
HZ30								1																			1
HZ32									1															1	1		3
HZ36								1																			1
HZ39								1	1																		2
HZ40																	1										1
HZ43										1																	1
HZ47														1													1
HZ50															1												1
HZ51																							1				1
HZ52	2						1																				3
HZ61								1	1																		2
HZ68	3		2													1	1										7
HZ78				1								1															2
Random sf		1							1	1	1				1												5
TOTALS	10	2	2	2	3	3	3	9	12	4	3	4	3	2	3	4	3	1	1	1	1	1	1	1	2	1	82

Table 2. Metric Attributes of the Projectile Points (Measurements in Millimeters)

Name	Type	Length	Width	Thickness	Total
Livermore	1	39*	12-14	3.0 - 4.5	10
Perdiz	2	23*	18-15	3.0 - 4.0	2
Bonham?	3	20	14-15	3.0 - 4.0	2
	4	21-31	13-14	4.0 - 5.0	2
Ellis?	5	23-31	20-21	4.5 - 5.0	3
	6	32*	13-17	5.0 - 6.0	3
Darl?	7	32**	24-25	5.0 - 7.0	3
	8	32-40†	20-27	5.0 - 7.0	9
	9	35*	(29)	4.0 - 8.0	12
Shumla	10	50*	35*	5.5 - 6.0	4
	11	31-45**	17-19	6.0	3
	12	42**†	19-26	5.0 - 9.0	4
	13	28**†	25-27	4.0 - 6.0	3
	14	29-31	15-16	5.0 - 6.0	2
	15	42-50	25-38	7.0 -10.0	3
Ensor	16	42*	20.5-23	6.0 - 7.0	4
	17	27-36	36*	4.0 - 5.0	3
Meserve	18	29	17	5.0	1
Talco/Maud	19		14	4.0	1
Scallorn	20	28	15.5	3.0	1
Fresno	21	21	14	3.0	1
Harrell	22	19	15	4.0	1
Toyah	23	20	12	3.0	1
Young	24	33	24	5.0	1
Catan	25	39-44	29-30	7.0	2
Tortugas	26	56	31	10.0	1
TOTAL					82

*One specimen only.
**Measurement taken on largest of fragmentary specimens.
†Measurement estimated from fragmentary specimen.

Type 2—Perdiz points (Figure 8, E, F); triangular blades with nearly straight sides; shoulders are straight, making the blade shape very nearly an equilateral triangle; stems are slightly contracted, and bases are rounded. Compared to the shoulders, the stems are fairly narrow, about one-third of the total width.

Type 3—Thin, triangular blades, nearly twice as long as they are wide (Figure 8, G, H); thin and finely serrated edges; shoulders are barbed asymmetrically; stems are parallel sided, with slightly rounded bases. These points resemble Bonham points (Suhm and Jelks 1962:267-268), except that stems are not as straight sided and straight based as the type specimens.

Type 4—Small points (Figure 9, A, B), somewhat crudely made compared to other points of similar size in the survey collection; thick relative to their length and width; triangular blades with asymmetrically barbed shoulders; expanded stems; excurvate bases.

Type 5—Triangular blades, as long as they are wide (Figure 9, C-E); blade edges are excurvate or slightly recurvate; stems are broad, almost as wide as the shoulders; expanded stems and slightly barbed shoulders formed by shallow corner notching; basal edges are excurvate; closely resemble Ellis points (Suhm and Jelks 1962:187-188), but are consistently shorter.

Type 6—Triangular blades, slightly longer than they are wide (Figure 9, F,G); blade edges are excurvate; shoulders taper down into the stems, which are relatively broad, over half the width of the point, and have rounded bases.

Type 7—Fairly large (the tips are missing from all specimens) with slightly asymmetrical shoulders (Figure 10, A-C); parallel-sided stems with incurvate bases; resemble Darls (Suhm and Jelks 1962:179-180), but, since all specimens are fragmentary, they are not confidently identified as such.

Type 8—Medium-to-large points with triangular bases nearly as wide as they are long (Figure 10, D-F); blade edges are straight to slightly excurvate and may be slightly serrated; shoulders are usually barbed, but in some cases are rounded yet prominent; stems are expanded and make up about one-fourth of total length. They are also broad, nearly three-fourths of the width at the shoulder; bases are excurvate. Both Type 8 and Type 9, described below, are identical to some of the Group H points in Johnson's typology (1967). Katz and Katz (1974) use Johnson's typology and illustrate points of this type that were recovered in the park during their survey for Texas Tech University.

Type 9—Similar to Type 8 points except that the shoulders are not usually barbed, although they are quite prominent (Figure 10, G-J); blade forms are similar, but serrations are less common; stems are expanded and bases are straight, rather than excurvate.

Type 10—Larger than most other points recovered in the survey (Figure 11, A-D); triangular blades with straight or nearly straight edges; bases have been notched, producing straight or nearly straight stems, and long barbs are either curved or straight. Type 10 corresponds to the Shumla as defined by Suhm and Jelks (1962:247-248). Dibble (1967:35) has subdivided the type on the basis of the shape of the barbs; at Arenosa Shelter the straight-barbed Shumla-like points occur earlier in the stratigraphic sequence than do the curved-barbed Shumlas. Figure 11 C resembles the Shumla-like variety.

Type 11—Elongated blades as much as twice the width (Figure 11, E-G); blade edges are excurvate; shoulders are rounded; stems are rounded and make up about one-fourth of the total length.

Type 12—One of the largest points in the assemblage (Figure 11, H-K); stems are long (13 to 17 mm) and stem sides are incurvate with excurvate bases; shoulders are rounded or slightly barbed; blade edges near the shoulders are often triangular or nearly parallel. There are no complete specimens in the collection.

Type 13—Basal fragments only (Figure 12, A-C); blade edges are serrated and essentially straight where observable; points are broadly side notched, resulting in moderately barbed or rounded shoulders; stems are expanded, with rounded corners that are as wide as the maximum width of the shoulders; bases are slightly incurvate.

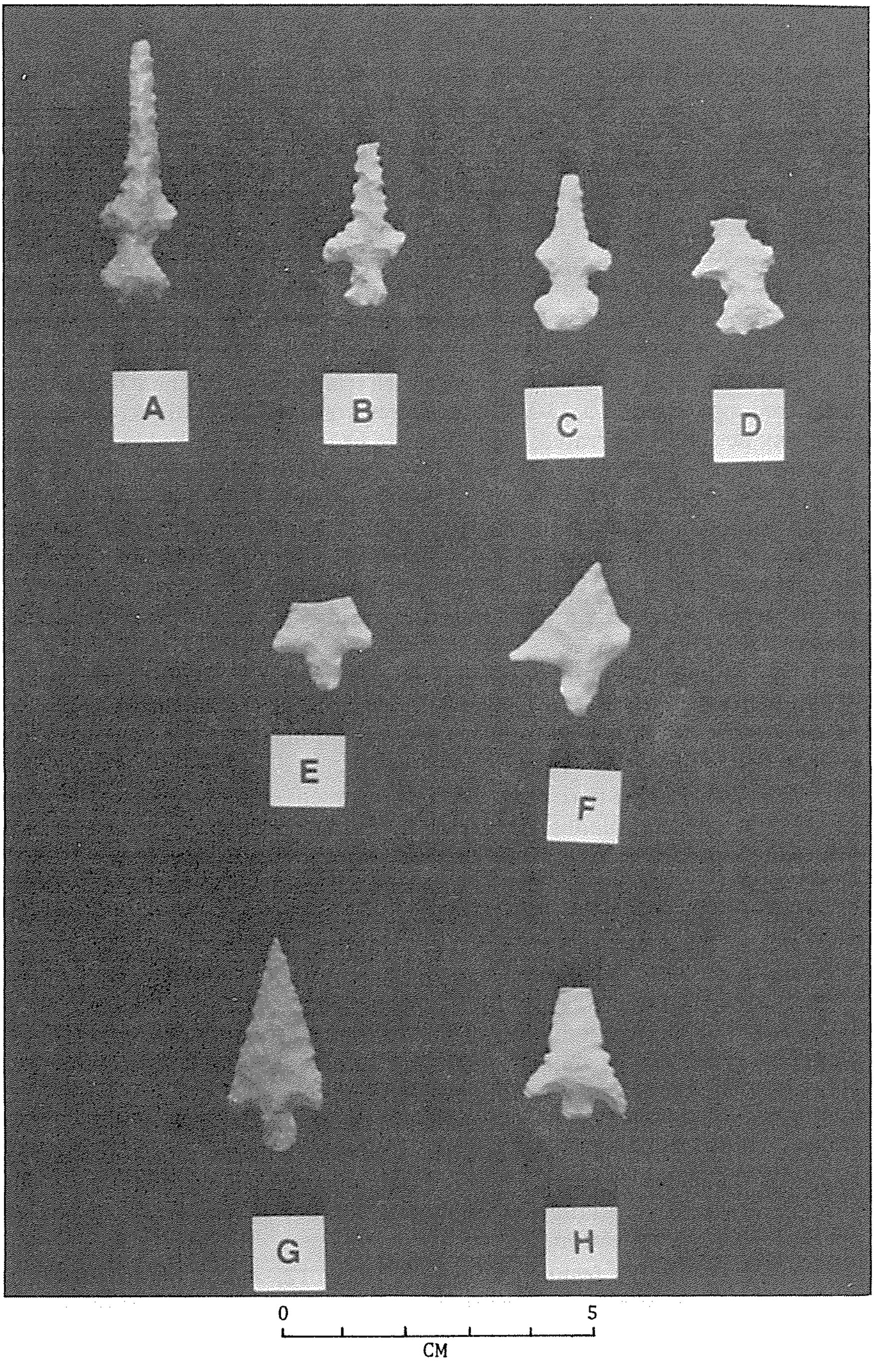


Figure 8. Projectile points: (A-D) Type 1; (E,F) Type 2; (G,H) Type 3.

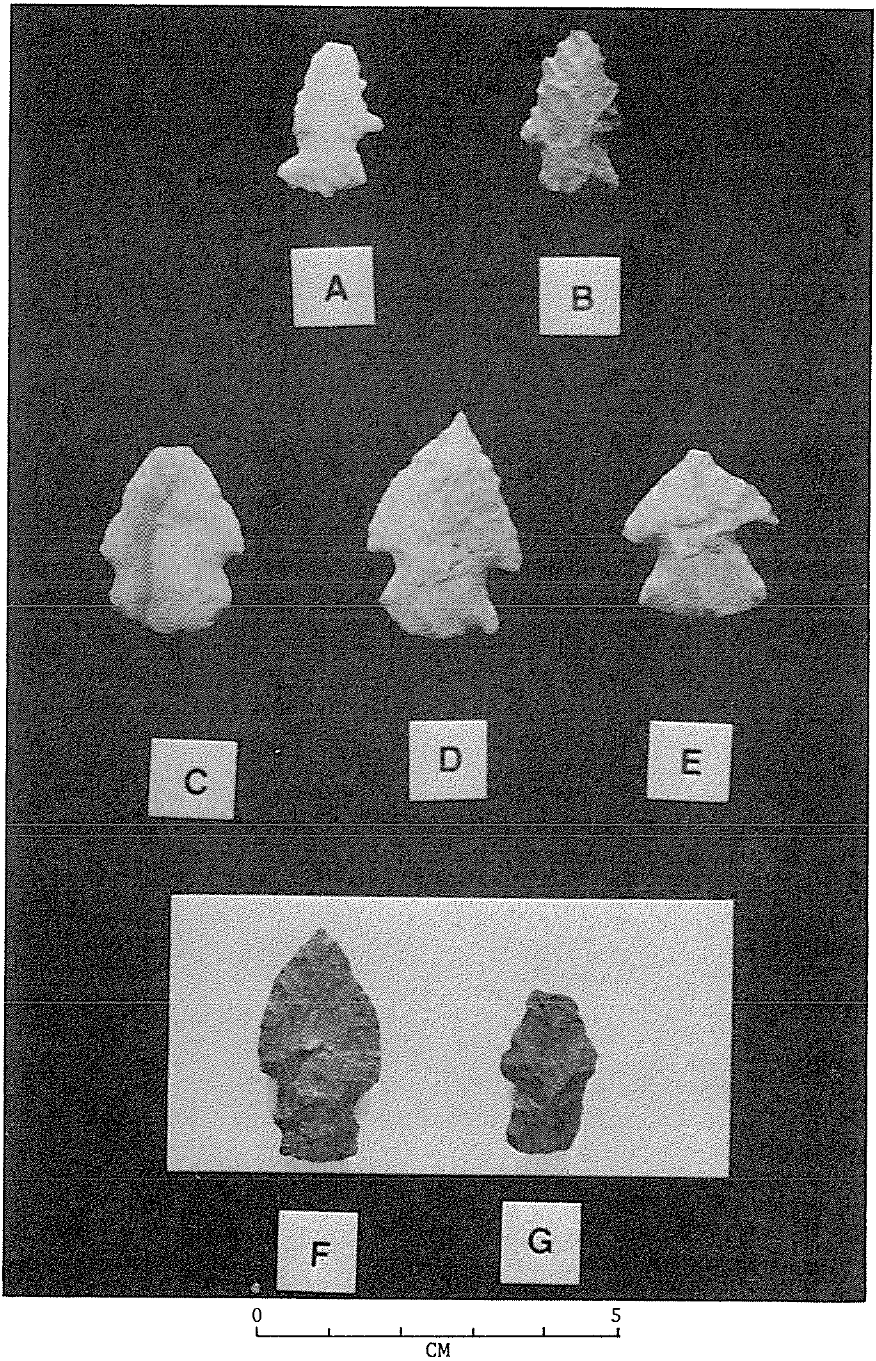


Figure 9. Projectile points: (A-B) Type 4; (C-E) Type 5; (F, G) Type 6.

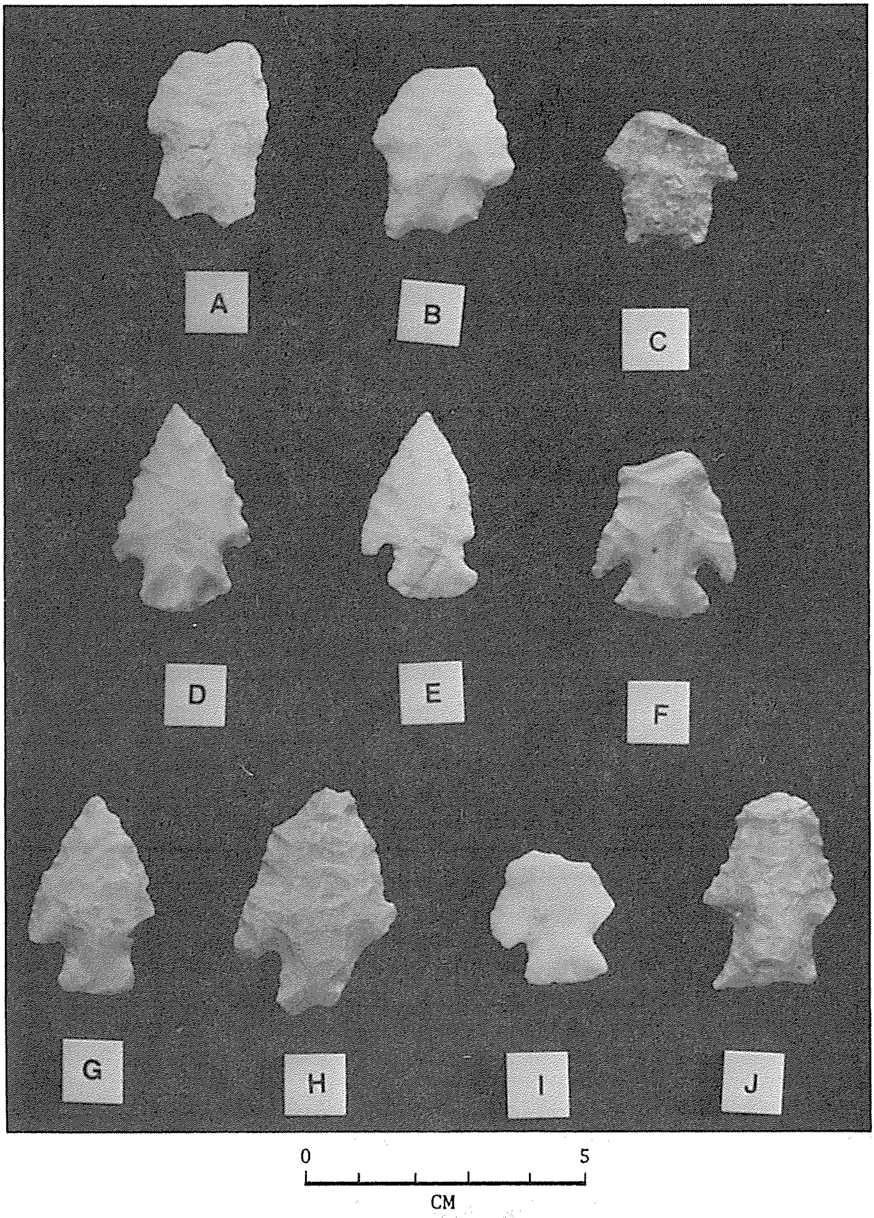


Figure 10. Projectile points: (A-C) Type 7; (D-F) Type 8; (G-J) Type 9.

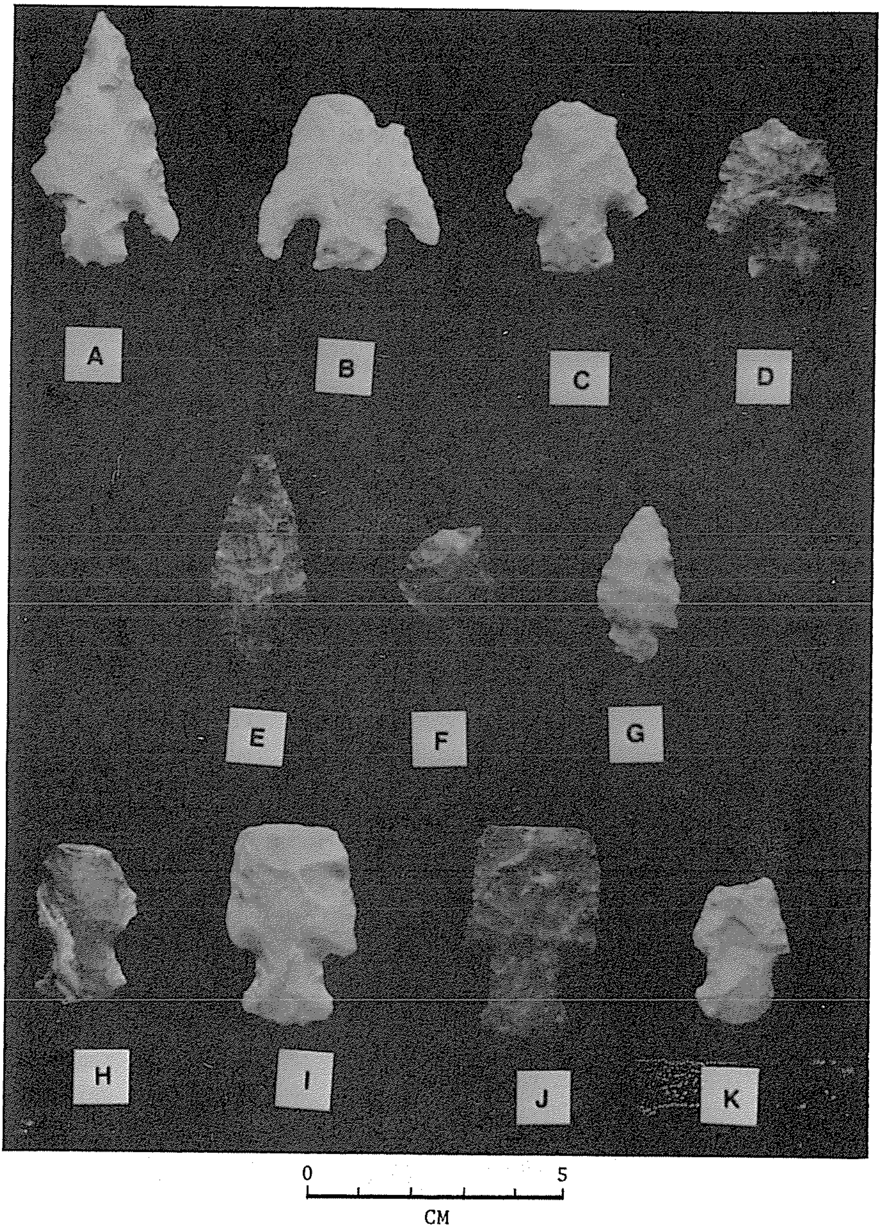


Figure 11. Projectile points: (A-D) Type 10; (E-G) Type 11; (H-K) Type 12.

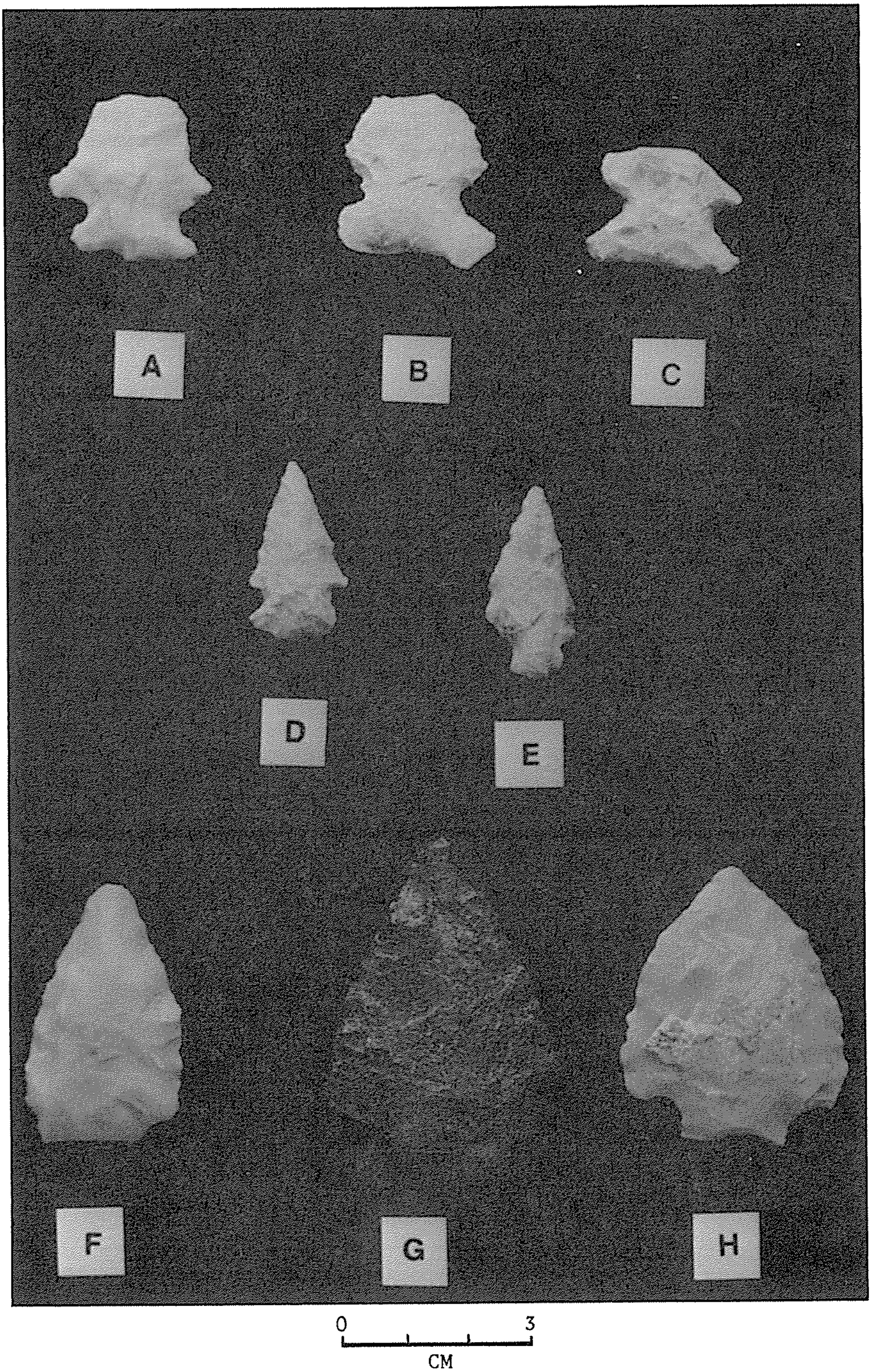


Figure 12. Projectile points: (A-C) Type 13; (D,E) Type 14; (F-H) Type 15.

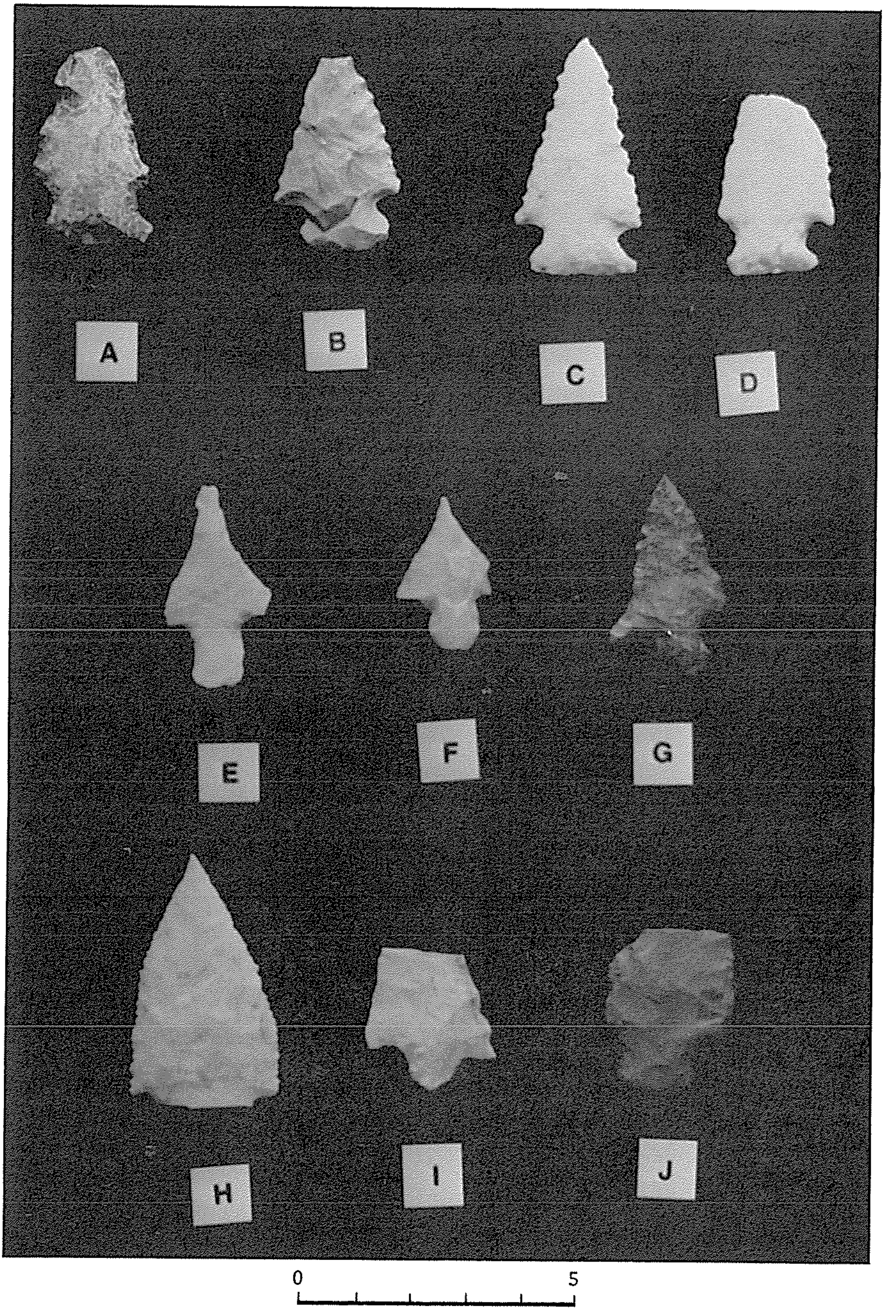


Figure 13. Projectile points: (A-D) Type 16; (E-G) Type 17; (H-J) fragments.

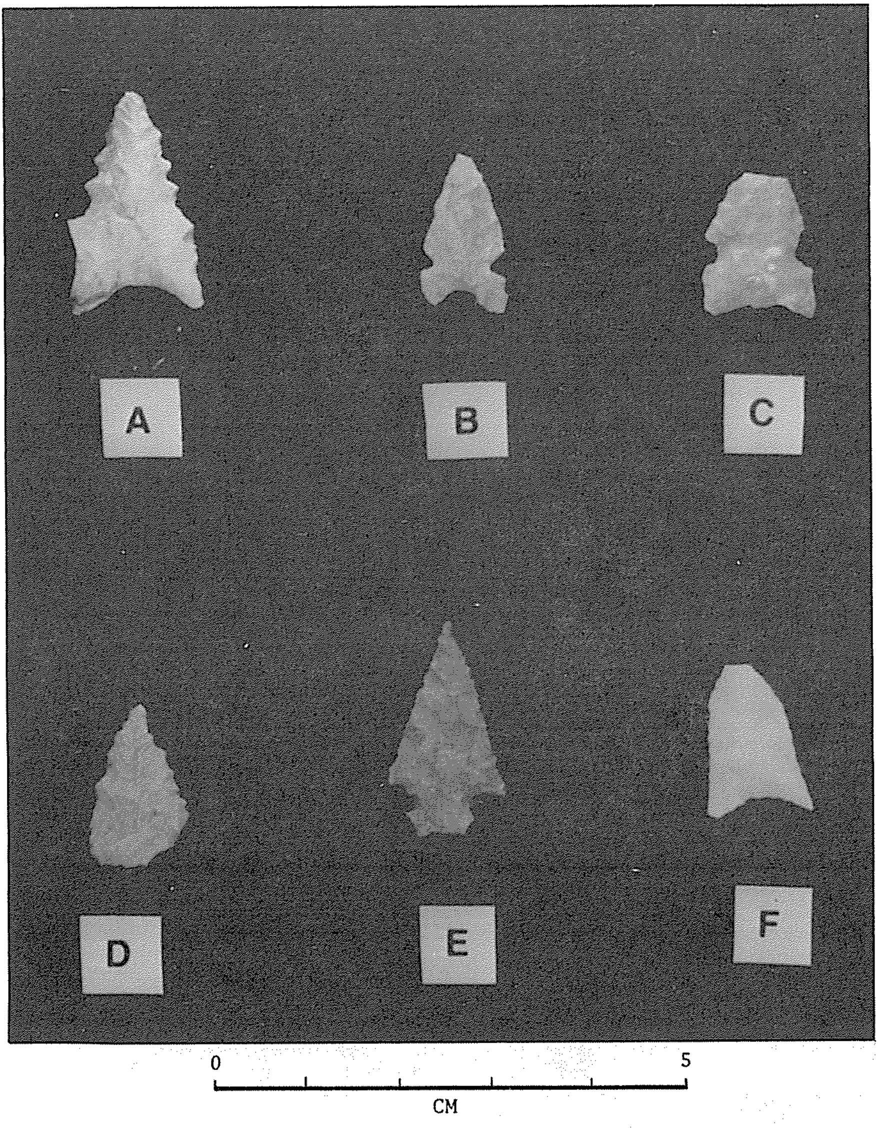


Figure 14. Projectile points: (A) Type 18; (F) Type 19; (E) Type 20; (D) Type 21; (C) Type 22; (B) Type 23.

Type 14—Blade outlines are triangular with rather acute tips (Figure 12, D, E); bases are weakly side notched to straight, with rounded shoulders and expanded stems; somewhat crudely flaked compared to the rest of the collection.

Type 15—Large, broad, triangular points (Figure 12, F-H) with excurvate sides; corners have been removed, forming very short, broad stems with straight or slightly contracting sides and straight bases. All of the points in this type are made of quartzite.

Type 16—Ensor points (Figure 13, A-D); lateral notches, shoulder forms, and blade outlines conform to the type description provided by Suhm and Jelks 1962:189, 190).

Type 17—Relatively thin, small points (Figure 13, E-G); recurvate blade outlines may be the result of some reworking; shoulders are straight or barbed; both stems and bases are straight or slightly excurvate. The points are made on thin flakes, and the original curvature of the flake is still evident on some specimens.

Type 18—A single point (Figure 14, A) closely resembling the Meserve point (Suhm and Jelks 1962; 217, 218); rather small (28.7 mm long, 17.1 mm wide at the base, and as much as 4.7 mm thick at the midsection); serrated triangular blade; base is broader than the blade at its widest part; sides are slightly incurvate; base too is incurvate, having been produced by short flakes—but not fluting flakes—running parallel to the long axis of the point; point has secondary retouch, which enhances the incurvate nature of the base; point is ground at the sides and bottom of the base. It is an exceptionally small example of a Meserve point.

Type 19—A single point (Figure 14, F) that has similarities with both Maud and Talco (Suhm and Jelks 1962:281, 282, 289-293) points; tip of point is broken and blade outline was almost surely recurvate, making it more like Talco; length of the broken point is 2 cm, and the estimated length of the complete point is 3 or 4 mm longer; base is slightly flared and incurvate. Since this point is fragmentary, it is difficult to assess its similarity to the established point types; however, it is likely a variant of either the Talco or the Maud type, both of which have similar temporal and spatial ranges.

Type 20—Small, fairly well-made point (Figure 14, E) closely resembling the Scallorn point (Suhm and Jelks 1962:285-286); made from a flake; blade edges are essentially straight and evenly pressure flaked; blade edges extend to the notches to form slight barbs. The corners of the base have been broken, making an assessment of the hafting morphology difficult; however, it appears to have been diagonally notched, producing an expanded stem.

Type 21—Closely resembles the Fresno point (Figure 14, D) (Suhm and Jelks 1962:273-274); slightly more than 2 cm long and may have measured 1.5 cm in width (exact width cannot be determined because one corner is broken); point was made from a flake and has a smooth interior surface that has been modified by a series of small, relatively crude retouch flakes; opposite surface of point has several small retouch flakes and has evidence that several flakes were removed from the core prior to the removal of the flake from which the point was made; base is essentially straight, with a series of small nibbling flakes along its margin (these flakes could have been produced quite easily by superficial grinding or rasping with an abrader); point is planoconvex in cross section.

Type 22—Triangular blade with straight sides, side-notched with a short, relatively wide, straight stem; base is incurvate and slightly thinned on one face; point is biconvex in cross section, finely pressure flaked on both surfaces, and made from a mottled, honey-colored, jasperlike (probably nonlocal) material (Figure 14, C); assigned to the Harrell type (Suhm and Jelks 1962:275-276); length is estimated at 2.2 cm, well within the Harrell range, and the width at the base is 1.5 cm; maximum thickness is 0.4 cm.

Type 23—Toyah, the only example of a very late prehistoric, possibly protohistoric, point (Suhm and Jelks 1962:289-290); small (Figure 14, B), basically triangular, with excurvate blade edges; point is both side and basal notched, so the hafting area resembles two constricted lobes protruding from the blade area; point is biconvex and finely pressure flaked.

Type 24—Conforms to the description of the Young point (Suhm and Jelks 1962:295-296); essentially triangular with excurvate blade outline and slightly incurvate base (Figure 15, B); made from a flake of banded cherty limestone; multifaceted striking platform is plainly visible on one corner of the point, with a moderate lip overhanging the bulb; nearly half of exterior part of point is covered by flake scars made prior to removal of the flake from the core; rest of chipping is light retouch, apparently for shaping point. This point bears a remarkable resemblance to the specimen pictured in Suhm and Jelks (1962:Plate 148 H).

Type 25—Two bifaces (Figure 15, C, D) resemble the Catan point (Suhm and Jelks 1962:175-176), which lacks specific hafting modifications; triangular (teardrop shaped), with excurvate blade edges and rounded bases.

Type 26—Biface (Figure 15, A) resembling a Tortugas point (Suhm and Jelks 1962:294-295); triangular bordering on pentagonal, as the lower blade edges are nearly parallel; one edge roughly excurvate; the other has a slight angle; one face fairly flat and may retain part of unmodified interior face of a large flake; opposite side beveled, with many flake scars; made from a very grainy purple quartzite, which accounts for its rather crude outline and surface treatment; straight base with no evidence of grinding.

Projectile Point Fragments

As the name implies, these are the pieces of broken projectile points. Usually some part of the hafting area is identifiable, but in most cases there is no possibility of identifying the point type (Figure 13, H-J).

Drills

These artifacts are hafted bifaces with slender spikelike blades. In cross section the blades are either rhomboidal or nearly circular. The bases are generally broad, occasionally shouldered, and typically resemble straight-stemmed or expanding-stemmed projectile points. In some cases they may have been recycled from broken projectile points. The functional term *drill* has been adopted for use in this typology, since these forms are inevitably identified as drills or perforators in the literature of North American archeology.

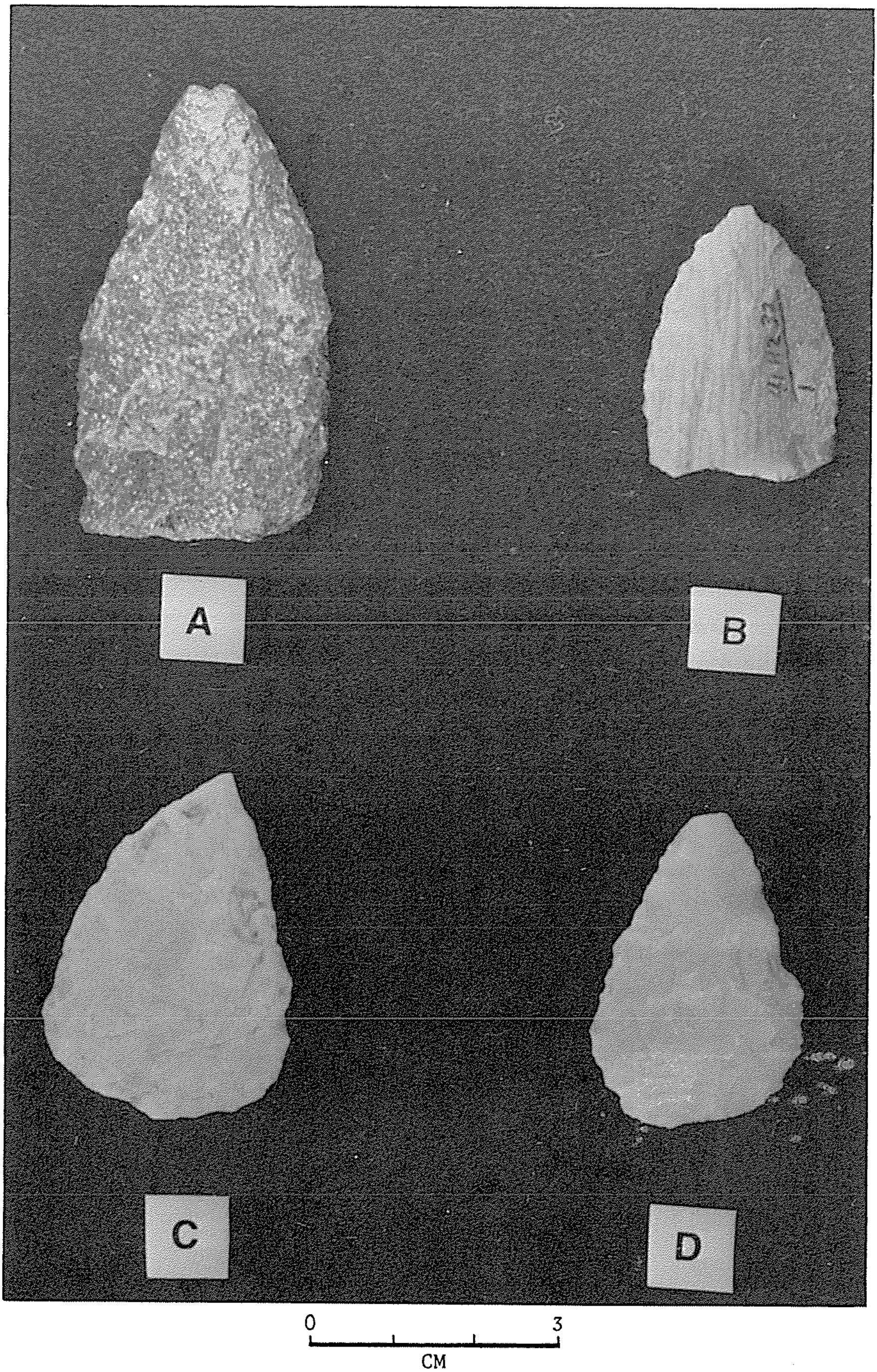


Figure 15. Projectile points: (B) Type 24; (C,D) Type 25; (A) Type 26.

Miscellaneous Artifacts

Some of the artifacts and items collected by the TAS survey do not fit into the lithic artifact typology described above; they are presented here, but they have not been included in the computer-assisted analyses because they are dubious artifacts (i.e., there is some doubt that they were man made) or are so unique in shape, function, or occurrence that no meaningful comparisons could be made. Table 3 shows the distribution of these artifacts, which are described below.

Parallel-sided Bifaces

Parallel-sided bifaces are essentially pentagonal, relatively long and narrow, with essentially parallel sides and biconvex cross sections. This artifact type and the two directly below are similar in some respects to some projectile points; however, no satisfactory comparisons could be made between any of these specimens and point types described in the archeological literature.

Triangular Rounded-base Bifaces

Triangular rounded-base bifaces are biconvex in cross section, with excurvate edges, the bases being defined as the shortest of the three edges.

Triangular Straight-base Bifaces

Triangular straight-base bifaces are similar to the rounded-base bifaces, differing in that the shortest edges are straight rather than rounded or excurvate.

Amorphous Bifaces

Amorphous bifaces constitute a troublesome category. Their crude, irregular shapes defy description or explanation. Some specimens could be abandoned cores, aborted bifacial tools, or even finished implements whose form and function could not be surmised. Rather than adding these artifacts to one of the existing categories, it was decided to leave them out of the analysis altogether.

Hematite

Four specimens of hematite were collected in the survey. Two are ground and gouged and were possibly a source of pigment.

Burins

In the collection are two burins, one from CU19 and one from CU25, both made on broken bifaces. The working edges of the burins were made by removing flakes from the broken surfaces parallel to the bifacial edges.

Hafted Scraper

This scraper was probably made from a broken projectile point. The scraping edge was made by beveling the fracture plane. The hafting area consists of a straight stem with parallel sides and a slightly excurvate base.

Table 3. Distribution of Miscellaneous Artifacts

Artifact	Site																Total
	CU18	CU19	CU25	CU27	CU31	CU33	CU43	CU52	CU53	CU68	CU75	CU85	CU96	HZ32	HZ52	RS2	
Parallei-sided bifaces						1	1			1							3
Triangular rounded-base bifaces	1													2			3
Triangular straight-base bifaces													1				1
Amorphous bifaces				1	1		1	1									4
Hematite					1		1					1	1				4
Burins		1	1														2
Hafted scrapers														1			1
Beveled knives												2					2
Pick											1						1
Large triangular biface					1												1
Tabular limestone biface		1						1	1								3
Limestone bar																1	1
Engraved limestone															1		1
Polished stone					1												1
TOTAL	1	2	1	1	4	1	3	2	1	1	1	3	2	3	1	1	28

Beveled Knives

Two bifaces have been identified as alternately beveled knives. The pointed ends of the bifaces were produced by flaking along one edge of each side to produce a bevel on each edge. One knife is made from a local gray quartzite and measures 78 mm long, 29 mm wide, ad 9 mm thick. The other is made from honey-colored chert and is 64 mm long, 31 mm wide, and 9 mm thick.

Pick

A long, nearly cylindrical limestone rock in the collection may be a pick. The removal of several flakes from one end is interpreted as an attempt to make a working point. However, the flakes were crudely removed and could also have been fortuitous. The specimen measures 23 cm in length and 5 cm in diameter.

Large Triangular Biface

This specimen is 6 cm wide at the base, 10 cm long, and approximately 9 mm thick, and is probably a knife. The long edges are excurvate and slightly asymmetrical; the base is slightly incurvate. The biface is exceptionally well flaked and is made from local limestone. It is the largest and best-flaked limestone biface in the collection.

Tabular Limestone Unifaces

These are thin limestone slabs from which series of flakes have been removed at one or more places on an edge. They may be unifacial versions of the tabular limestone bifaces also collected on the survey. However, the unifacial flaking may be fortuitous. These specimens cannot confidently be identified as artifacts.

Limestone Bar

Another limestone artifact in the collection is from an area designated as Random Surface #2, in Hudspeth County. The exact location is not specified in the field notes, but it is presumed to have come from the sand dune area of the western part of the park, where most of the Hudspeth County sites are located. It is a narrow, bar-shaped, tabular limestone artifact. It is about 48 cm long, 5.5 cm wide, and 3 cm thick. The corners come to right angles, and the broadest surface has been ground smooth. It may have functioned as a kiva bell, for if it were supported by a leather thong and struck with a stick, it would produce a musical tone. Or, it may be a modern whetstone fashioned by a contemporary rancher from local material. Since its precise provenience is not known and there are no known associations of this artifact with prehistoric materials, theories as to its age and function are speculative.

Engraved Stone

The only work of art recovered by the survey is an engraved limestone tablet (Figure 16), 7.4 cm long, 3.9 cm wide, 0.9 cm thick, and rectangular in shape with nearly square corners. A geometric pattern is engraved on one side. The central part of the design is linear and runs nearly the length of the

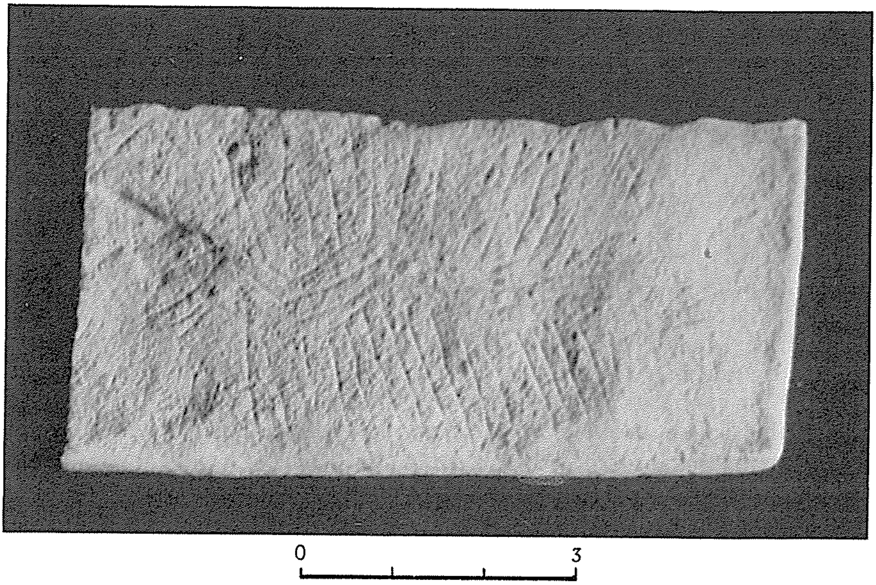


Figure 16. Engraved tablet.

tablet. It is a centipedelike design consisting of four zigzag parallel lines between two series of short lines that are perpendicular to the long axis of the tablet.

Flake Typology

The typology of the artifacts presented above follows the Ford (1949) approach and is useful as a means of defining cultural and temporal limits. However, the analysis of chippage and biface fragments necessitates further subdivision. A description of these two data categories and a discussion of the manner in which they have been manipulated follows.

Analysis of the flakes necessitated construction of a typology. The methods employed here have been taken in large part from the work of M.B. Collins, who has emphasized the isolation of specific attributes of chipping debris obtained from replicative experiments and the observation of their combinations and distribution in archeological assemblages (Collins 1974).

The first step in this flake analysis was to separate the chippage from the rest of the collection while maintaining site-by-site provenience. Pieces of nonartifactual material and occasional tools or tool fragments also were culled. Once the chippage was isolated, observations were made on each flake. All complete flakes and broken flakes that retained at least part of ther platform ends were subjected to further analysis. Once the culled flake fragments (i.e., those parts of flakes without platform ends) were counted and their material types were recorded, they were given no further attention. These fragments were not included in the complete analysis for three reasons: (1) although each flake has only one platform (except in the rarest circumstances), a single flake may consist of many fragments; (2) statistically, assuming that there are no significant sampling errors, any information available from the fragments (such as presence or absence of cortex, flake thickness, and nature of the bulb of percussion) should have been acquired already from the sample; and (3) the breakage might have occurred under circumstances totally unrelated to, and possibly long after, the removal of the flake from the core.

A total of 2,897 flakes from 103 sites (i.e., all sites with flakes) were analyzed. Frequency of flakes per site ranged between 1 and 383. An analysis using research methods similar to those employed in this report (Goodell 1973) has already been conducted on part of the flake assemblage from Guadalupe Mountains National Park. However, the results of this work could not be used in this study for both methodological and practical reasons. Goodell used some different observational criteria, so it would be difficult to adjust his findings to the ones based on this system. In addition, the flakes studied were remixed with the unanalyzed flakes,creating a curatorial problem of immense magnitude. It was more efficient and consistent to analyze all of the flakes by one process. About a third of the analysis was done by an experienced student and the remainder was done by the writer. To minimize bias, the collections were not analyzed in a predetermined order, nor were specific blocks of sites assigned to either analyst. Many collections from the larger sites consisted of several lots, and each of these lots was treated separately. Consequently, the skewing due to differences between observers or changes in judgment of either of the observers over time was minimized.

Table 4 presents five sets of attribute observations made on each flake: platform, bulb, body, size, and material. Each set is independent—i.e., mutually exclusive in its definitional characteristics—from all other sets. The Appendix has a description of each of the attributes in the categories.

Once the flakes were analyzed and the attributes for each of the categories were recorded and coded, the data were keypunched. The keypunched data were then used as the raw data for further analyses, using an IBM 370-165/II computer.

The analyais of the flake morphology is a modified version of the one made by M.B. Collins and uses the IFREQ program written by J. Watts (Collins 1975). IFREQ is a sorting program that allows the investigator to identify and count the number of flake types (attribute state combinations) in a sample. Both expanded and abbreviated versions of the program were used, but these variations did not change the basic operations; rather, they lent more flexibility of analysis by permitting greater or lesser numbers of variables to be sorted and counted.

The number of possible combinations of the 46 attributes observed formed a five-dimensional matrix of 21,600 cells, each one constituting a unique combination of attribute states. Of this number, 760 were actually represented in the collection in frequencies ranging between 1 and 115. The extremely low frequency of most combinations forced a reduction in the number of attributes to be analyzed. Therefore, the size and material categories were deleted from the clustering analysis of the flake morphology, and the resulting abbreviated set of attributes, which emphasizes flake shape,

Table 4. Flake Attributes

Platform	Code No.	Bulb	Code No.	Body	Code No.	Size	Code No.	Material	Code No.
Cortex		Normal	1	Primary cortex		Very small			
straight	1			thin	1	(< 1 cm)	1	Greenstone	1
sequent	2	Exuberant	2	medium	2				
X	3			thick	3	Small		Quartzite	2
		Flated		angular	4	(1–2.5 cm)	2		
Single		(lipped)	3					Cherty lime-	
straight	4			Secondary cortex		Medium		stone	3
sequent	5			thin	5	(2.5–5 cm)	3		
X	6			medium	6			Limestone	5
				thick	7	Large			
Double				angular	8	(5–10 cm)	4	Chert	6
straight	7								
sequent	8			Secondary edge		Very large		Other	7
X	9			cortex		(> 10 cm)	5		
				thin	9				
Multiple				medium	10				
straight	10			thick	11				
sequent	11			angular	12				
X	12								
				Noncortex					
Shattered	13			thin	13				
				medium	14				
Broken	14			thick	15				
				angular	16				
Ground	15								

was used. The platform, bulb, and body attributes totaled 34 and rendered a three-dimensional matrix of 720 possible combinations of attributes. Of these, 147 were present in the collection in frequencies varying from 1 to 254. This number of flake forms was also considered too great for the purposes of cluster analyses, not only because it made it difficult to establish a cognitive framework in which to conceptualize the data, but also because it exceeded the capacity of the clustering program and the computer. Furthermore, a large number of attribute combinations occurred only at very low frequencies, suggesting that they were aberrant flakes and their interpretation would contribute little to a study aimed at eliciting overall patterns of knapping behavior.

Eighty-seven of the recorded combinations occurred only once or twice in the entire collection; that is, 57 percent of the variation in flake types occurred in slightly less than 3 percent of the actual flakes.

For more meaningful analysis of the flake morphology, a smaller number of attribute combinations had to be selected, so a companion program to IFREQ, IFREQ 3 PCT, was written. This program expresses the occurrence of flakes by attribute combinations in terms of their relative percentages in the sample, as well as in terms of their raw frequencies (Table 5). The final number of flake forms was determined by selecting those attribute combinations that accounted for at least 0.76 percent of the flakes in the collection. Using this program, 29 flake types were established, totaling 2,194 flakes; that is, slightly less than 20 percent of the morphological variability accounted for over 75 percent of the flakes.

STONE TYPE ANALYSIS

The production of stone tools begins with the selection and acquisition of suitable materials. Consequently, a comprehensive analysis of lithic technology takes into account the raw materials from which the artifacts have been fashioned. This section investigates the relation between the raw materials used and the forms into which these materials were processed by the prehistoric residents of the southern Guadalupes.

Six raw material categories have been identified in the survey collection. They are greenstone, quartzite, cherty limestone, limestone, chert, and miscellaneous materials; a description of each is presented below. (The geology of the park, with special emphasis on chert, is described in Boisvert 1980:Appendix 1.)

Greenstone is conspicuous but not abundant in the collection. It is bright apple green, although it may weather to a bluish slate gray. It is found in several geologic strata in the Guadalupe Mountains, primarily in the Manzanita Limestone and other members of the Cherry Canyon Formation. It is volcanic ash that has settled into still waters, forming bentonite, a clayey rock that is normally quite friable and has the ability to absorb water, swelling when it is wet. In the Guadalupes this rock has been metamorphosed into greenstone, a chertlike rock with conchoidal fracture. Its structure is platy to blocky, and it occurs in chunks varying from walnut-sized pebbles to blocks of several cubic meters. It erodes out of the southeast escarpment from the Pine Springs area northeastward toward the Texas-New Mexico border (King 1948:37), and in all likelihood it occurs in other areas of the mountains.

Table 5. Flake Forms Selected for Cluster Analysis, with Codes, Frequencies, and Percentages

Code	Platform	Bulb	Body	Freq.	Percent
1 1 14	St cortex	normal	noncortex, medium	29	1.00
1 1 15	St cortex	normal	noncortex, thick	22	0.76
4 1 7	St single	normal	sec cortex, thin	28	0.97
4 1 13	St single	normal	noncortex, thin	45	1.55
4 1 14	St single	normal	noncortex, medium	254	8.76
4 1 15	St single	normal	noncortex, thick	200	6.89
4 2 14	St single	exuber- ant	noncortex, medium	36	1.24
4 2 15	St single	exuber- ant	noncortex, thick	26	0.90
4 3 6	St single	flat	sec cortex, medium	26	0.90
4 3 7	St single	flat	sec cortex, thick	33	1.14
4 3 13	St single	flat	noncortex, thin	59	2.03
4 3 14	St single	flat	noncortex, medium	277	9.55
4 3 15	St single	flat	noncortex, thick	139	4.79
5 1 14	Seq single	normal	noncortex, thick	23	0.79
5 3 14	Seq single	flat	noncortex, thick	26	0.90
7 1 14	St double	normal	noncortex, medium	45	1.55
7 1 15	St double	normal	noncortex, thick	22	0.76
7 3 14	St double	flat	noncortex, medium	37	1.28
10 1 13	St multiple	normal	noncortex, thin	45	1.55
10 1 14	St multiple	normal	noncortex, medium	143	4.93
10 1 15	St multiple	normal	noncortex, thick	53	1.83
10 3 6	St multiple	flat	sec cortex, medium	24	0.83
10 3 13	St multiple	flat	noncortex, thin	111	3.83
10 3 14	St multiple	flat	noncortex, medium	228	7.86
10 3 15	St multiple	flat	noncortex, thick	57	1.96
13 1 13	Shattered	normal	noncortex, thin	51	1.76
13 1 14	Shattered	normal	noncortex, medium	91	3.14
14 1 14	Broken	normal	noncortex, medium	39	1.34
14 1 15	Broken	normal	noncortex, thick	24	0.83

St=Straight Seq=Sequent sec=secondary

Quartzite is extremely common in the Guadalupe Mountains and constitutes major outcrops in the Cherry Canyon and Bell Canyon formations. It varies in color from light tan through buff to reddish brown and sometimes has a greenish tinge. The texture varies from coarse and somewhat friable to sugary and dense to fine grained and quite dense. It is found in the park along the southern periphery of the mountains from below Shumla Peak to the northeast corner of the park (Figure 2). It constitutes the bulk of the Delaware Mountains and the southeast parts of the Patterson Hills (King 1948:Plate 3). Large exposures of quartzite can be seen, and great quantities of boulders, cobbles, and fragments litter the ground in many areas. Quartzite is second only to limestone in abundance in the region.

Cherty limestone was isolated as a separate material after several frustrating attempts to identify it as chert or as limestone. Some specimens made from cherty limestone have very glossy surfaces, are extremely fine grained, and are comparable to what is usually called chert by archeologists and lithic technologists. However, the material grades into a much duller substance that is coarse grained and more closely resembles limestone. It is generally dark, ranging from brownish black to light brown, often with light-and dark-brown banding. Such grading of quality from one end of the spectrum to the other can be found in several samples. Instead of arbitrarily dividing the material into chert and limestone, it was deemed more appropriate to recognize it as having qualities of both and to put it into a separate category. The geologic distribution of the cherty limestone is not precisely known at this time; according to regional experts, it is common in the area from El Paso to Van Horn and into New Mexico (John Hedrick, personal communication), and an outcrop may exist within the park.

Limestone is ubiquitous in the Guadalupe Mountains. Indeed, in most areas it *is* the Guadalupe Mountains. It ranges from white, platy, friable stone in the Capitan Formation to a dark, hard, fine-grained material in the Bone Spring Formation. With the exception of the mainly quartzite south and southeast reef escarpments, as noted above, virtually all of the exposed rock in the Guadalupes is limestone. Boulders, cobbles, pebbles, and fragments of every size litter the canyons, arroyos, and flats. Its quality is highly variable, but significant supplies of material suitable for flaking are available. Limestone is second only to chert in the amount of chippage recovered.

Chert is the material most frequently used by the aboriginal knappers in the southern Guadalupes. It is a very fine-grained cryptocrystalline material, composed for the most part of silica and variable amounts of impurities. Its most notable and desirable quality, from the standpoint of the knapper, is its conchoidal fracture. An attempt was made to identify the varieties of chert used on the basis of macroscopic sorting, but the task proved to be too complex and subject to error, since there were no available comparative collections of cherts from the park or the southern Guadalupes. For the purpose of analysis, all varieties of chert were treated alike, and no attempt was made to distinguish between them.

The miscellaneous category comprises a group of rocks that do not belong in any of the other groups. Some of these materials are specific nonchert stones such as obsidian. Others are cryptocrystalline silicates such as chalcedony and jasper. They are of extremely high quality and in thin sections are translucent to transparent. The high quality, low frequency (26 in the entire collection), and lack of similarity to most of the cherts in the collection suggests that they were obtained outside the park region, as certainly must be true for the obsidian. The chalcedony and jasper artifacts are the smallest of the six groups and account for less than 1 percent of the sample. Included in the miscellaneous category is a white quartzite material that differs significantly in color and texture from the quartzites known to exist in the park region. This quartzite is found only in the metate artifact category.

Artifact Classes and Raw Material Type

Methodology

In order to provide explanations for the selection of particular kinds of stone for the various kinds of artifacts, a methodology was developed that included a statistical test to determine the degree of nonrandom distribution of material types in the artifact classes. First, the frequency of all the artifacts was tabulated by material type and artifact class. Then a Chi Square Goodness of Fit Test was run on each artifact category; this was accomplished by using a WATFIV program written for testing these data.

Data

The data used for the analysis consist of a distribution matrix of the artifact classes and material types. The artifact classes correspond to the typological categories defined above in the section describing the data base, with the exception of two categories, worked hematite and miscellaneous artifacts. Worked hematite was deleted because the artifact was defined in terms of its material type, and miscellaneous artifacts were excluded because the category is not a type of artifact.

Analysis

The tabulated data were keypunched and processed with the Chi Square program. The initial test was based on an analysis of the distribution of all six material types. A preliminary inspection of the output suggested that the very low frequency of greenstone and miscellaneous stone had caused an upward skew in the significance values generated by the test. Consequently, an additional test was run that eliminated the scarce material types from consideration and compared only quartzite, cherty limestone, limestone, and chert.

Results and Interpretation

Table 6 presents the significance values generated by both the Chi Square tests and the distributional data. As expected, there were some changes in the probabilities of nonrandom distribution when greenstone and miscellaneous stone were removed from consideration. In two cases, Type IIIa and Type IVa unifaces, the change in probability that the material type selection was nonrandom changed from less than an .01 to a greater than .05 confidence level. In four other cases—Type I and Type IIIb unifaces, marginal bifaces,

Table 6. Artifact Categories* by Stone Type Chi-Square Goodness of Fit Tests

Artifact Category	Stone Type							Probability of Random Distribution					
								All Types			Four Types		
	Greenstone	Quartzite	Cherty Limestone	Limestone	Chert	Miscellaneous	TOTAL	.05	.05	.01	.05	.05	.01
1 Battered stone	1	4	3	15			23			X			X
2 Amorphous cores	9	49	67	156	94	5	280			X			X
3 Single platform cores	4	7	1	10	7		29			X			X
4 Chippage	83	163	404	719	1501	26	2986			X			X
5 Utilized flakes	1	33	1	4	10		49			X			X
6 Unifaces, Type I		3	6	1	3		13		X		X		
7 Unifaces, Type II		2	3		1		6	X			X		
8 Unifaces, Type IIIa		4	3	11	9		27			X	X		
9 Unifaces, Type IIIb		4	2	2	6		14		X		X		
10 Unifaces, Type IIIc		2			3		5	X			X		
11 Unifaces, Type IVa		14	5	14	13		46			X	X		
12 Unifaces, Type IVb	2	8	3	14	22	3	52			X			X
13 Unifaces, Type IVc	2	3	5	8	20		38			X			X
14 Unifaces, Type V	2	24	26	44	48		144			X			X
15 Unifaces, Type VI	1	24	33	46	64		168			X			X
16 Uniface fragments		3	4		61		68			X			X
17 Biface-uniface composites		2	2	2	5		11	X			X		
18 Marginal bifaces			5	1	6		12			X		X	
19 Single-edge heavily retouched bifaces		2					2	X			X		
20 Chopping tools				5			5			X			X
21 Ovate bifaces		2		7		1	10			X			X
22 Tabular bifaces				27			27			X			X
23 Parallel-sided bifaces					3		3		X			X	
24 Triangular biface, round base					3		3		X			X	
25 Triangular biface, straight base		1			1		2	X			X		
26 Planoconvex biface		1	4	3	5	1	14	X			X		
27 Preforms	3	3	44	52	60	4	155			X			X
28 Drills			2		4		6		X		X		
29 Biface fragments, snap fractures		8	18	25	182	6	239			X			X
30 Biface fragments, transverse		5	16	5	40	1	68			X			X
31 Manos, flat		18		7			25			X			X
32 Manos, convex		13		5			18			X			X
33 Metate fragments		10		1		9	20			X			X
34 Core fragments				1	20		21			X			X
36-52 Projectile points (all types)		2		1	27		60			X			X
53 Projectile point fragments					23		23			X			X
54 Miscellaneous projectile points					15		15			X			X

*Artifact Category 35 was not included, since it consisted of hematite lumps.

and drills—there was a similar change in probability that the material type selection was nonrandom, from an .01 to a less than .05 confidence level.

Interpretations of the test results show that although greenstone of chippable quality occurs within the park area and is conspicuous where it is found, it was never extensively utilized. Isolated cores and flakes constitute the bulk of the greenstone artifacts, with only seven finished tools—all unifaces—and four unfinished tools—three preforms and a biface broken during manufacture. The greatest amount of greenstone occurs at site CH31, adjacent to an outcrop of the material, where 39 flakes, a core, and three unifaces were collected. The use of greenstone may represent opportunistic exploitation of a convenient but inferior resource.

In contrast to greenstone, quartzite was locally available and was frequently used by the prehistoric residents of the southern Guadalupes. Cores are common in the quartzite assemblage, and in numbers rank second only to flakes. However, the ratio of flakes to cores—slightly less than three to one—is the lowest for any material type. This may represent a sampling bias in the data-collecting process. Since quartzite is native to the region and abundant in some areas, many flakes, particularly the smaller ones, could be easily overlooked or dismissed by the field collectors as natural spalls, especially since flake features such as bulbs and ripple marks are almost indiscernible in quartzite.

Four artifact categories have statistically significant numbers of quartzite artifacts, consisting of utilized flakes, both varieties of manos, and metates. The utilized flakes are mainly large to very large, and 20 of the 33 can be described as blades. They are long, relatively thin, often narrow flakes, with relatively straight edges and prismoidal cross sections. Although blades are found at only one site—CU19—there is no indication that prismoidal cores were being systematically fabricated and maintained for the production of blades. Examination of these artifacts indicates that the knappers were exploiting the natural shape of the quartzite, which occurs in blocks, making it a simple matter for the knappers to produce big, long flakes by following the natural ridges on the stone. The flakes were sequentially removed, thus producing blades. Areas of cortex on the flakes are common, and some have cortex covering not only their exterior sides but also their platforms and terminal ends. A blade-core technology is not evident in the Guadalupes, since the only tools made on blades were utilized flakes. There were no projectile points, unifaces, or burins made on blades.

Microscopic examination of the utilized flakes indicated that they were probably used for cutting purposes, since the edges are rounded and the polish extends up both sides. Some flakes have massive amounts of polish, which could have occurred only as a result of long or hard use.

Quartzite was also the favored material for grinding stones. Flat and convex manos and metates are mainly of quartzite. In three cases an apparently nonlocal quartzite was used for the grinding slab, and because the material—a rather coarse white quartzite—bears no resemblance to the known local varieties, it is tabulated under the miscellaneous heading. Limestone was also used, but not as extensively as quartzite.

Quartzite also would have been an ideal choice for hammerstones, but the battered stone artifact category has only four possible examples. In all likelihood, quartzite pebbles were used as hammerstones; their abundance in the area suggests that they may not have been retained and used repeatedly. Furthermore, it would be extremely difficult to discriminate between quartzite hammerstones and natural pebbles in the field, especially if the hammerstone was not used extensively.

Cherty limestone is common in the collection, constituting nearly 13 percent of the chippage and 19 percent of the other artifacts. However, it is the predominant material in only one artifact category—Type I unifaces. It occurs in relatively high proportions in Types V and VI unifaces as well as in preforms and both varieties of biface fragments. With one significant exception—projectile points—cherty limestone generally parallels the distribution of chert artifacts. Only two points, a Type 7 point recovered from a random surface and a Type 24 (Young) point, were made from cherty limestone. The relatively large numbers of artifacts in the preform category is perplexing, in view of the fact that so few finished bifaces of cherty limestone are reported. It is possible that some of the cherty limestone preforms may be finished implements, ones for which no secondary trimming was intended, but no satisfactory explanation for this situation can be found.

Limestone artifacts are common on sites in the Guadalupes, reflecting the abundance of the material in the area. Although second to chert in most artifact categories, it is predominant in several. It accounts for 41 percent of the amorphous cores—16 percent more than chert. This figure may be too low considering that many limestone cores and flakes may not have been collected due to their resemblance to natural pebbles and spalls. Many pebbles and spalls were collected as artifacts during the survey, a fact that attests to the difficulty in discriminating between artifacts and nonartifacts in the field. Indeed, this is often a difficult task even under more favorable laboratory conditions.

Limestone and chert are the dominant material type for Type V and VI unifaces. These are the most generalized forms of unifaces, and little cultural or temporal significance can be attached to them. Examination of the collection shows that virtually any material was used for these artifacts, and that limestone was used nearly as often as chert.

Limestone is significant in the manufacture of three other kinds of artifacts. Two, the chopping tool and the ovate bifaces made from rather large pebbles, are quite similar. Limestone pebbles occur in sizes and shapes convenient for the manufacture of these implements; the only other material that consistently has these characteristics is quartzite. The preference for limestone over quartzite might be explained by the overall suitability of limestone to flaking. Limestone is softer and lighter than quartzite; consequently it would be easier to flake with the quartzite hammerstone. Replicative experiments using materials native to the Guadalupes might confirm this hypothesis or suggest other avenues of explanation. At this point, however, it is not possible to explain further the preference for limestone over quartzite for the production of the large bifaces. The third artifact category in which the use of limestone is significant is tabular bifaces. The use of limestone to produce the tabular bifaces is environmentally determined, since limestone is the only material available that naturally occurs in thin sheets. Manufacture of implements from this material is simple and requires only an appropriate source and virtually any kind of percussor. The stone knappers of the Guadalupes exploited the tabular limestone to produce tools with exceptionally long (some as much as 20.8 cm) bifacial edges.

Chert was the most widely used chippable stone in the Guadalupe Mountains. It was the preferred material for four varieties of unifaces—Types IVb, IVc, V, and VI—and for the production of small bifaces, especially projectile points. The preference for chert in the production of thinned bifaces can be viewed as an interplay between the inherent qualities of the material and the desired attributes of the implement. Very hard, sharp edges can be fashioned in chert, and these are qualities desirable in tools designed for piercing, cutting, and scraping. The cryptocrystalline quality of chert is eminently suited to the removal of the thin, flat flakes that are required in the final stages of reduction and shaping of most bifaces. Such final stages of reduction produce relatively large quantities of flakes, especially in proportion to the mass of material involved; this would explain the high number of chert flakes compared to flakes of other materials.

In general, the use of stone for tool manufacture in the Guadalupes can be described as follows. Very specialized chipped stone tools, such as projectile points, were made almost exclusively from chert. Grinding tools were made mainly from quartzite, but occasionally from limestone. Tools with large mass or cutting or scraping edges were commonly made from limestone. Most unifaces were made from chert or limestone, although all kinds of materials were used. Flake knives were usually made from quartzite or, to a lesser degree, chert. The miscellaneous category is made up of high-quality silicates such as obsidian, jasper, and chalcedony. These materials are presumably exotic in origin, and their usage tends to parallel that of chert.

Flake Size and Material Type

This section deals with the interrelations between the material types and the chippage. It has been implicitly assumed that the use of different kinds of raw material in the manufacture of different kinds of artifacts will result in patterned distributions of different flake sizes. The validity of the assumption was tested by flake-size analysis.

The Data

The data selected for the study of this problem were based on all of the flakes in the survey collection, and derived through observations of flake size and material type, which were encoded together with platform, bulb, and body states. Frequencies for each combination of flake size and material type were obtained.

Methodology

The method of analysis entailed arranging the frequency data in matrix form and comparing the relative frequencies of the sizes and raw material types of the flakes. The objective of this inductive approach was to describe and quantify the patterns of flake size and material type. The interpretations of this information were then compared to findings concerning the raw materials available and the forms into which these materials were processed (Figures 17, 18).

	Small	Very Small	Medium	Large	Very Large	Total
Chert	61* / 4.0 / 91.3	1034 / 68.8 / 76.4	396 / 262 / 33.1	11 / .7 / 4.1	- / - / -	1502
Cherty Limestone	3 / 0.7 / 4.8	143 / 35.4 / 10.5	233 / 57.7 / 19.5	25 / 5.1 / 9.2	- / - / -	404
Limestone	2 / 0.2 / 3.2	102 / 14.2 / 7.5	434 / 60.3 / 36.2	173 / 24.0 / 64.8	8 / 1.1 / 623	719
Quartzite	- / - / -	27 / 16.5 / 2.0	78 / 47.8 / 6.5	53 / 32.5 / 200	5 / 3.1 / 37.7	163
Greenstones	1 / 1.1 / 1.6	40 / 48.2 / 2.9	39 / 47.0 / 3.2	3 / 3.6 / 1.1	- / - / -	83
Misc.	- / - / -	8 / 30,1 / 0.5	16 / 61.5 / 1.3	2 / 7.7 / 0.8	- / - / -	26
Total	67	1353	1196	267	13	2897

*61 Raw Frequency

raw percentage — raw count for each category — column percentage

Figure 17. Distribution of flake sizes and material types

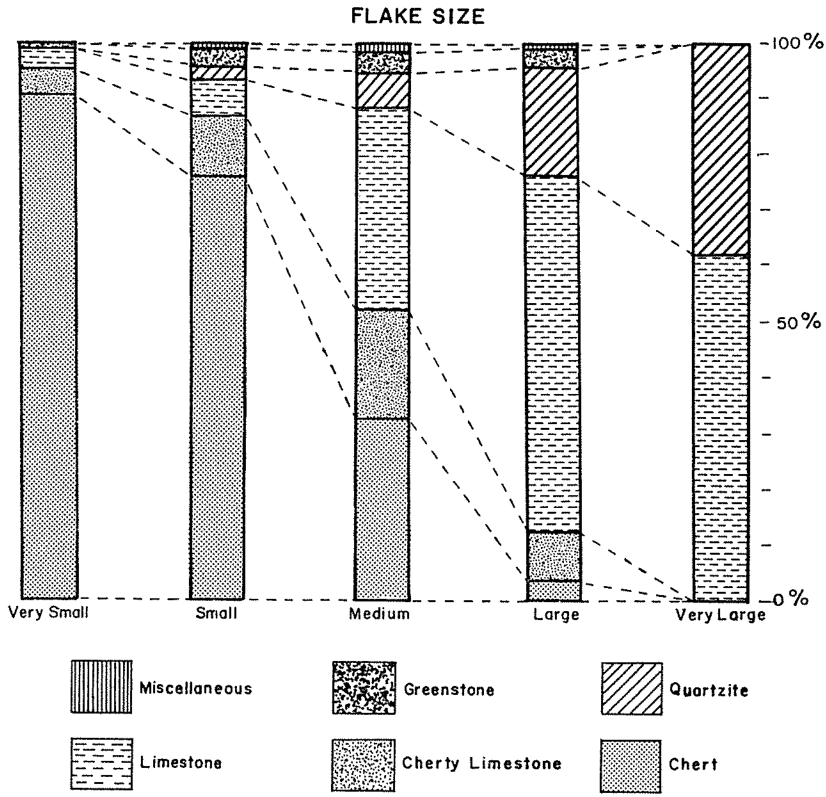


Figure 18. Relative frequency of flakes of size and material type.

The frequency of the flake sizes for each of the material types and the relative percentages are presented in Figure 17. The raw count for each category is in the upper left part of the cell, the raw percentage is in the right side of the cell, and the column percentage is at the bottom of the cell. For example, the raw frequency for small chert flakes is 61, which constitutes 4 percent of all chert flakes and 91.3 percent of all small flakes. Figure 18 presents the same data in a cumulative histogram.

Analysis and Interpretations

It is apparent from the distributions that there is a consistent trend in flake sizes according to material types. The chert flakes are consistently small; greenstone flakes are almost equally divided between small and medium; cherty limestone flakes are consistently medium to small; limestone flakes fall into the medium category, although nearly a quarter of them are large; and quartzite flakes are the largest. Flakes of miscellaneous materials tend to be medium to small, but they are so few in number that size comparisons to flakes of other material types may not be valid.

The interpretation of these distributions incorporates several factors, one of which is sampling error. Limestone and quartzite flakes probably were not recognized in the field as frequently and consistently as were chert and cherty limestone. The escarpment and foothill areas are littered with boulders, cobbles, and spalls of both quartzite and limestone, and their abundance probably masked the presence of the culturally derived quartzite and limestone debitage. Flakes of those materials are probably under-represented in the collection, especially in the smaller-sized specimens. Another factor in the distribution of the samples is the size of the raw materials as they occur in nature. Cherts have not been found, and greenstone has been found only rarely, in the Guadalupes in large blocks. However, large cobbles or boulders of limestone and quartzite are commonly found. Thus, certain parameters are imposed on the flake sizes by the form in which the raw materials naturally occur.

Other factors that would bias the distribution of flake sizes are the method of flaking and the definite preferences for certain materials for the manufacture of specific artifact types. Logically, the manufacture of small bifaces, which were made from chert, would entail the production of small flakes, and the manufacture of large bifaces, which were made from limestone, would probably entail the production of a large number of medium-to-large flakes. Furthermore, an important factor in the choice of material for the manufacture of a given tool is its potential for producing certain kinds of flakes. The cryptocrystalline silicates are much more likely to produce small, thin flakes than are the coarser, less glassy, limestones and quartzites.

The distribution of flake sizes and material types results not from any one variable, but from the interplay of several variables. The size and quality of the raw material, the forms into which it was processed, and the techniques utilized in that process all contribute to the distribution of flakes of different sizes and materials. The tool makers in the Guadalupes clearly recognized the limiting factors of their lithic resources and adapted their tool-making behavior accordingly.

Flake Form and Material Type

A logical next step after the flake-size and material-type analysis is consideration of the relations between flake forms and materials. Because specific interrelations exist among material types, artifact forms, and flake sizes within the assemblages analyzed, patterns of distribution of flake forms in the various material can be expected. Analysis of the flake forms should therefore provide some degree of confirmation of the findings presented above, and it is hoped that it will also provide some unique insights into the flaking of the different material types.

Methodology

The 29 flake morphologies that have been described above were subjected to a hierarchical clustering analysis in order to determine the most frequently co-occurring groups of flake forms. One interpretation of these clusters resulted in the ordering of the flake forms along one axis of a cumulative percentage graph, which was used to compare the frequencies of the flake forms for the various material types.

The percentage of each form was computed for each material type, and from a cumulative total of these percentages a cumulative line graph (Figure 19) was prepared for the flake forms of the five material types. Using these data, the percentages, and the graphic display, correlations of material types with flake forms could be made.

Analysis and Interpretations

From Table 7 and Figure 19 it can be seen that some overall patterns are evident for the flakes as a whole and for particular aspects of certain types of materials.

Certain attribute combinations are more common in some material types than in others. Limestone flakes have more single-faceted platforms with thick to angular decorticated bodies. Chert flakes are much more likely to have complex, or multifaceted, platforms with thin-to-medium noncortex bodies. Cherty limestone falls between limestone and chert, with substantially fewer angular body flakes than limestone and somewhat fewer thin-to-medium noncortex body flakes than chert. Quartzite also falls between limestone and chert but diverges from their distributions, with a greater percentage of flakes with cortex and a decidedly smaller percentage of complex-platformed flakes, especially when compared with chert. The greenstone flake sample is much smaller than the other raw material samples

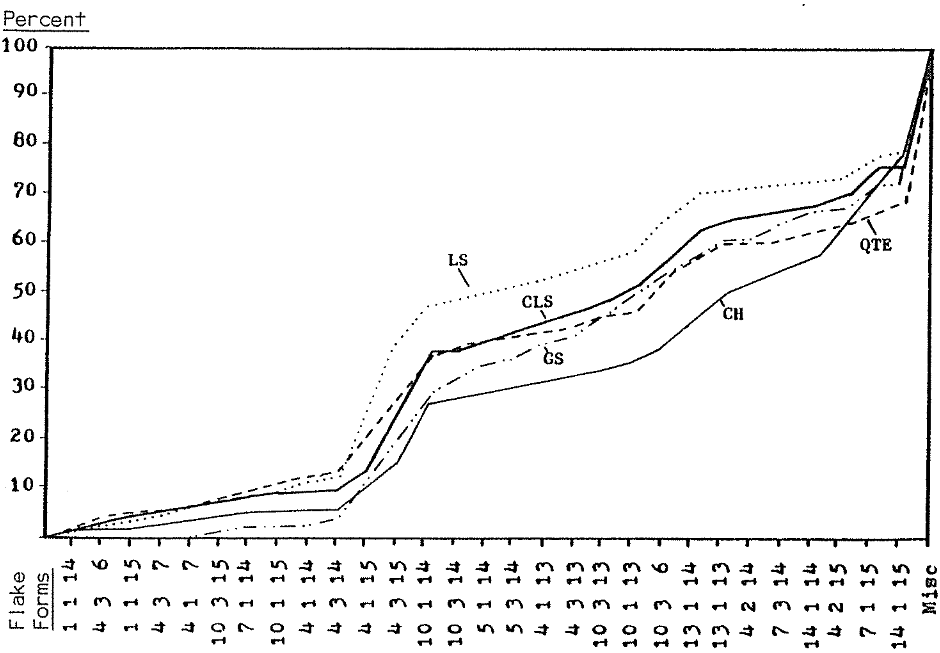


Figure 19. Relative frequency of flake forms by material types. CH, chert; CLS, cherty limestone; LS, limestone; QTE, quartzite; GS, greenstone.

Table 7. Frequency and Relative Percentages of Selected Flake Forms by Material Types

Flake Attribute Combinations	Greenstone			Quartzite			Cherty Limestone			Limestone			Chert		
	#	%	Com %	#	%	Com %	#	%	Com %	#	%	Com %	#	%	Com %
1 1 14			0.0	4	2.45	2.45	5	1.24	1.24	4	.56	0.56	16	1.07	1.07
1 1 15			0.0	3	1.84	4.29	4	.99	2.23	11	1.53	2.09	4	.27	1.34
4 7 7			0.0	1	0.61	4.90	7	1.73	3.96	14	1.95	4.04	5	.33	1.67
4 3 6			0.0	1	0.61	5.51	7	1.73	5.96	1	.14	4.18	17	1.13	2.80
7 1 15			0.0	1	0.61	6.12	3	0.74	6.43	13	1.81	5.99	5	.33	3.13
4 3 7	1	1.20	1.20	3	1.84	7.96	5	1.24	7.67	11	1.53	7.52	12	.80	3.93
10 3 6	1	1.20	2.40	2	1.23	7.19	3	0.74	8.41			7.52	13	1.20	5.13
4 2 15			2.40	3	1.84	11.03	3	0.74	9.15	13	1.81	9.33	7	.47	5.60
5 1 14			2.40	2	1.23	12.26	2	0.50	9.64	13	1.81	11.14	5	.33	5.93
5 3 14	2	2.41	4.81	2	1.23	13.49	1	0.25	9.90	6	0.83	11.97	15	1.00	6.93
4 1 15	5	6.02	10.83	13	7.98	21.47	23	5.69	15.59	116	16.13	28.10	42	2.80	9.73
4 1 14	6	7.23	18.06	11	6.75	28.22	48	11.88	27.47	87	12.10	40.20	99	6.59	16.32
4 3 14	7	8.43	26.49	14	8.59	36.81	41	10.15	37.62	48	6.68	45.88	164	10.93	27.24
14 1 15	5	6.02	32.51	3	1.84	38.65	1	0.25	37.87	9	1.25	48.13	6	0.40	27.64
14 1 14	2	2.41	34.91	1	0.61	39.26	7	1.73	39.60	10	1.39	49.52	19	1.26	28.90
4 2 14	1	1.20	36.12	1	0.61	39.87	9	2.23	41:83	9	1.25	50.77	16	1.07	29.97
7 1 14	3	3.61	39.73	3	1.84	41.71	8	1.98	43.81	16	2.23	53.00	15	1.00	30.97
7 3 14	1	1.20	40.93	1	0.81	42.32	7	1.73	45.54	5	0.70	53.70	23	1.53	32.50
10 1 15	3	3.61	44.54	4	2.45	44.77	7	1.73	47.27	21	2.92	56.62	17	1.13	33.63
10 3 15	3	3.61	48.15	1	0.61	45.38	12	2.97	50.24	11	1.53	58.15	30	2.00	35.63
4 3 15	4	4.52	52.97	12	7.36	52.74	26	6.44	56.68	47	6.54	64.69	50	3.33	38.96
10 1 14	2	2.41	55.38	6	3.68	56.42	23	5.69	62.37	32	4.45	69.14	77	5.13	44.09
13 1 14	4	4.82	60.20	4	2.45	58.87	9	2.23	64.60	8	1.11	70.25	64	4.26	48.35
13 1 13			60.20			58.87	2	0.50	65.10	3	0.42	70.67	45	3.00	51.35
4 1 13	5	3.61	63.81	1	0.61	59.48	2	0.50	65.60	5	0.70	71.37	34	2.26	53.61
4 3 13	2	2.41	66.22	3	1.84	61.32	4	0.99	66.59	7	0.97	72.34	42	2.80	56.41
10 1 13			66.24	2	1.23	62.55	6	1.49	68.08	3	0.42	72.76	34	2.20	58.67
10 3 14	4	4.82	71.04	6	3.68	66.23	25	6.19	74.27	30	4.17	76.98	161	10.72	69.39
10 3 13			71.04	2	1.23	67.46	2	0.50	74.77	2	0.28	77.21	103	6.86	76.25

but is notable for the relatively large proportion of flakes with shattered and broken platforms. Newell et al. (1953:64) report that the siliceous content of greenstone is low—51 to 61 percent—and that the clay content is fairly high—20 to 24 percent. The green color is the result of finely disseminated grains of minerals of the chlorite group, alteration products of volcanic ash (Newell et al. 1953:64), which apparently cause the material to lack the hardness and strength of chert. This weakness may account for the high proportion of greenstone flakes with broken platforms (8.41 percent) compared to flakes of limestone (1.98 percent), and chert (1.66 percent). The generally low silica content, together with the decomposed nature of the original ash structures, may explain the preponderance of broken platforms on the greenstone flakes.

Quartzite is also a local material, but its pattern of flake-form frequencies and distributions differs from greenstone. Not only are cortical areas frequent, but quartzite seems to be an exceptionally strong material. Shattered and broken platforms are relatively rare, a fact which, together with the low frequency of complex platforms, strengthens the premise that the material was selected for the production of cutting blades because of its naturally large size, availability, and overall strength and durability.

The dominant feature of the chert flake forms is their large proportion of multifaceted, flat, medium-to-thin, noncortex flakes. In addition, similar flakes with straight platforms are also quite common. This particular distribution attests to the fact that chert was the material most frequently selected for the manufacture of small, morphologically complex bifaces. Two of the flake forms—thin and medium noncortex flakes that are multifaceted and thin bulbed—are usually interpreted as typical flakes associated with final trimming and maintenance of bifaces. This interpretation is supported by the fact that in cherty limestone, which has a low frequence of bifaces, there is a very low percentage of such flakes.

Summary and Conclusions

The analysis of flake forms based on material type tends to confirm the interpretations developed from the analyses correlating material type with artifact type and flake size with material type. Chippage associated with the production and maintenance of bifaces and other morphologically complex artifacts tends to be chert. Chipped stone artifacts that require long, durable edges are made from quartzite, and the nature of the quartzite chippage affirms the contention that it is indeed a strong and durable material. Limestone is a ubiquitous material in the region, and its distribution in both the artifacts and flake assemblages suggests that it was most suitable for the manufacture of simple tools such as unifaces or large tools that would have required large cores. The distribution of cherty limestone chippage and artifacts parallels that of limestone, with the exception of large bifaces. One might speculate for that reason that large pieces of cherty limestone do not occur in nature. Greenstone was not a popular material of the prehistoric knappers of the Guadalupes, as the flake study suggests, because its platforms have a tendency to break, although it appears to be suitable at first glance. The sample of miscellaneous material is both too diverse and too small to warrant any detailed analysis.

DEBITAGE ANALYSIS

For the purposes of this report, debitage includes not only waste flakes, but also implements broken prehistorically by use, during manufacture, or by accident, and subsequently abandoned or discarded. Also included in debitage are implements abandoned during manufacture because of problems such as failure to thin, excessive hinge fracturing, and edge collapse. Not included in debitage are implements that were broken intentionally or broken by farm equipment or by excavators after they had been committed to the archeological record as completed tools. The study of debitage, rather than complete implements, is the focus of this report for two reasons. First, the finished products usually reflect only the final stages of manufacture, whereas the debitage reflects all stages. Second, the completed implements in the survey collection constitute a very small sample when compared to the debitage. The analysis of the debitage is divided into two parts: first, a hierarchical clustering analysis of the chippage, the purpose of which is to provide an empirical definition of flake types and to explain from a technological standpoint the relative distribution of different flake forms; and second, an analysis of the broken and unfinished implements. The analysis of broken and unfinished implements provides some insights into the modes of chipped stone tool manufacture and tool use in the southern Guadalupes. In other words, two questions are considered: "What can the site collections tell us about flake assemblages?" and "What can flake assemblages tell us about the sites?" It has been important throughout this analysis to maintain the distinction between these two questions in order to avoid a tautology.

Hierarchical Clustering of Flake Attribute Combinations

The first step in the cluster analysis was to determine the natural groupings of flake forms found on the sites, then to use the same data base to determine which sites have the most similar flake assemblages. The eventual goal was to elucidate at least some facets of tool-making behavior.

The Data

The flake clustering analysis used flake morphology data drawn from the output of IFREQ 3 PCT as described in the section on Flake Typology. Each case was defined as one of the 29 attribute combinations (see Table 5). The variables were defined as the distribution of the frequencies of the flake forms at each site (Table 8).

The sites selected for analysis had to satisfy certain criteria. They had to have at least 20 analyzable flakes. The total number of flakes on the site, regardless of whether or not they were included in the 29 flake forms selected for analysis, was used. Another criterion was that the collection of artifacts at the sites, as could be determined from the field notes, was not overly biased. The field notes for some sites indicated that chippage was generally ignored or that no attempt was made to gather representative samples. For that reason, sites were reviewed individually before being included in the analysis.

Table 8. Distribution of Selected Flake Forms by Site

Flake Attribute Combinations	Sites																																		
	CU18	CU19	CU20	CU27	CU31	CU33	CU34	CU38	CU43	CU52	CU67	CU68	CU69	CU83	CU85	CU88	CU91	CU96	CU99	CU108	CU110	HZ29	HZ32	HZ33	HZ39	HZ42	HZ43	HZ44	HZ45	HZ46	HZ52	HZ53	HZ68	HZ71	HZ73
1 1 14	0	1	0	0	1	0	1	0	0	1	0	1	0	2	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	6	1	2	0	0
1 1 15	0	2	0	1	3	2	1	1	2	0	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0
4 1 71	2	1	0	0	3	1	1	0	2	0	0	1	0	2	1	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	2	2	1	0	0
4 1 13	0	3	0	0	6	0	0	0	0	0	0	0	0	1	3	0	1	2	0	1	0	5	0	1	0	0	0	0	1	2	3	9	3	0	0
4 1 14	22	6	2	2	28	7	0	1	6	2	5	3	0	14	2	3	1	11	5	2	2	4	2	4	2	4	0	1	5	0	39	19	14	6	0
4 1 15	20	8	3	10	38	5	1	2	6	1	4	1	1	13	2	4	0	0	5	3	1	3	2	5	2	2	1	3	0	2	14	6	3	3	2
4 2 14	0	0	0	0	2	1	0	0	0	0	2	1	1	3	0	1	1	1	0	0	0	0	2	4	0	0	0	1	3	0	2	1	6	1	0
4 2 15	3	1	0	1	1	0	0	1	0	0	0	0	0	1	0	1	0	0	2	0	0	0	0	1	0	0	0	1	0	0	2	0	2	1	1
4 3 6	0	0	0	1	1	0	0	0	0	2	0	1	0	2	1	0	0	0	0	0	0	1	0	1	1	0	1	0	0	1	4	0	1	0	0
4 2 7	2	3	1	0	2	5	0	2	1	0	0	1	0	0	0	0	0	3	0	0	1	3	0	0	0	0	0	0	0	1	2	1	1	0	0
4 3 13	1	2	1	0	8	2	1	0	2	0	2	0	0	0	1	0	0	3	0	1	0	6	1	0	2	0	0	1	2	2	8	9	0	0	0
4 3 14	9	13	2	2	28	4	1	3	10	1	1	0	1	19	5	2	1	7	3	5	2	8	1	2	2	4	0	2	1	5	48	25	12	2	4
4 3 15	10	8	2	1	12	4	0	3	3	0	1	1	1	6	1	1	0	1	1	6	3	3	2	3	1	2	4	0	2	2	9	10	9	1	1
5 1 14	2	0	0	2	3	2	0	0	1	0	0	0	0	0	0	0	0	2	0	1	0	1	2	1	0	0	0	0	0	0	2	1	0	0	0
5 3 14	2	1	2	2	5	0	0	0	0	0	0	0	0	0	2	0	0	2	1	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	1
7 1 14	2	2	1	0	4	2	0	0	4	0	0	0	1	0	0	0	1	0	3	4	0	0	0	0	1	0	0	1	1	1	7	3	2	0	1
7 1 15	2	3	0	0	3	1	1	0	1	1	0	0	0	0	0	1	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
7 3 14	1	1	0	0	0	3	0	0	0	0	2	0	1	0	1	0	0	0	0	1	0	1	0	2	2	0	1	0	3	0	4	3	2	0	0
10 1 13	1	1	0	1	3	0	0	0	2	0	2	0	0	1	0	0	0	3	1	1	0	5	2	0	0	0	0	0	1	0	5	7	6	0	0
10 1 14	4	2	1	0	10	0	0	1	5	0	1	1	3	5	3	2	1	6	4	6	0	5	3	0	4	2	0	0	5	0	14	15	17	2	2
10 1 15	3	3	0	1	4	0	1	0	6	0	1	0	0	5	2	0	1	2	0	1	2	1	0	0	0	0	0	0	1	0	10	2	0	0	2
10 3 6	1	0	1	0	2	0	0	0	0	0	0	0	0	3	3	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	6	3	0	0	0
10 3 13	2	0	2	1	7	3	0	2	1	0	1	0	0	2	9	1	3	11	0	1	0	13	1	0	3	2	2	3	2	3	10	12	4	0	0
10 3 14	3	6	4	0	9	3	0	6	6	2	2	0	1	1	5	0	3	8	1	4	3	9	4	1	4	3	2	1	8	2	46	20	13	0	1
10 3 15	2	5	3	1	5	0	0	0	2	0	2	0	1	4	1	0	0	0	0	2	3	1	0	1	1	1	0	0	0	0	5	2	5	0	2
13 1 13	2	1	4	0	1	0	0	0	0	0	0	2	0	0	3	0	0	2	2	0	0	8	0	0	0	1	0	0	0	0	15	6	2	0	0
13 1 14	0	4	5	0	5	0	0	2	1	2	0	1	0	4	3	0	0	4	1	1	0	5	0	1	1	0	0	0	0	1	24	4	3	1	1
14 1 14	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	2	0	0	0	4	0	0	0	0	0	0	1	2	2	0	15	1	5	1	0
14 1 15	0	2	0	0	6	0	0	0	0	0	0	0	2	0	0	1	0	0	1	1	0	0	0	0	1	0	0	1	3	0	2	0	0	0	0

Methodology

The cluster analysis used MATRIX, HCLUS, and PLINK computer programs gathered together and articulated by Don W. Graybill (1975). Clustering programs available from the Bimed series (BMDP 2M) (Dixon 1975:323-330) and the H Group clustering program described by Veldman (1967:308-319) were also tested.

The Bimed and Veldman cluster programs were used to verify the results of the HCLUS program. All three programs produced essentially the same results, but with slightly different output displays. The HCLUS version was chosen because it not only displayed the clusters in the form of more clearly understood dendrograms, but it also printed the correlation matrix of all possible comparisons between cases that allowed for specific case-by-case comparisons.

The HCLUS program offers eight options with which to perform clustering operations, and a choice of two kinds of matrices, each of which can be derived from one of four possible combinations of standardizations of the data. The options for performing the clustering are

1) Nearest Neighbor
2) Furthest Neighbor, complete linkage
3) Weighted Pair group arithmetic averages
4) Unweighted Pair group arithmetic averages
5) Median, weighted centroid
6) Centroid, unweighted centroid
7) Lance Williams Flexible Method
8) Ward's Method

The distance similarities matrix is offered as appropriate for methods 1 through 4 and the correlation similarities matrix is recommended for methods 5 through 8. Standardization options are offered for both columns (variables) and rows (cases to be clustered).

Following the work done by Graybill (1975), Ward's method was chosen for analysis. Briefly, the program creates the clusters by calculating a distance that expresses the degree of similarity between any two cases in the sample. It then merges the two cases that are most similar and treats them as one case from then on. It then selects the next two cases that are most similar and merges them. This procedure is continued until all cases are merged into one. The end result is displayed as a dendrogram with N-1 mergings when N equals the number of cases.

In all tests, standardization by column (variables) was applied. This was accomplished by expressing the frequencies in terms of percentage rather than raw count. This operation has the effect of giving each variable equal weight of significance, thus preventing abundantly represented variables from obscuring relatively rare variables. Each cluster analysis was run both with and without the option for standardization by row (cases). This operation would have the same kind of effect as standardization by column. The applicability of these options is discussed and evaluated for each of the cluster analyses in the section to follow. In all, four clusterings were generated, two clusterings of flake forms using site flake assemblages as variables (standardized and nonstandardized) and two clusterings of the site flake assemblages with the flake forms as variables (again, standardized and nonstandardized).

Analysis and Interpretation, Cases Not Standardized

The clustering of the flake forms without the standardization by case is presented in dendrogram form (Figure 20). It indicates that there are two distinct blocks within the flake sample. A comparison with Figure 17 reveals that Cluster II contains the seven most abundant flake forms, accounting for 70.99 percent of all flakes in the sample. The rest of the sample accounts for 29.01 percent of the flakes chosen for analysis. Raw frequency is the determining factor in differentiating between these two groups of flakes. However, within each cluster, the size of each case (i.e., frequency of each flake form) does not seem to be significant.

The clusters can be viewed as two separate, though similar, dendrograms. Cluster I is composed of six subclusters. Cluster Ia reflects activities involved

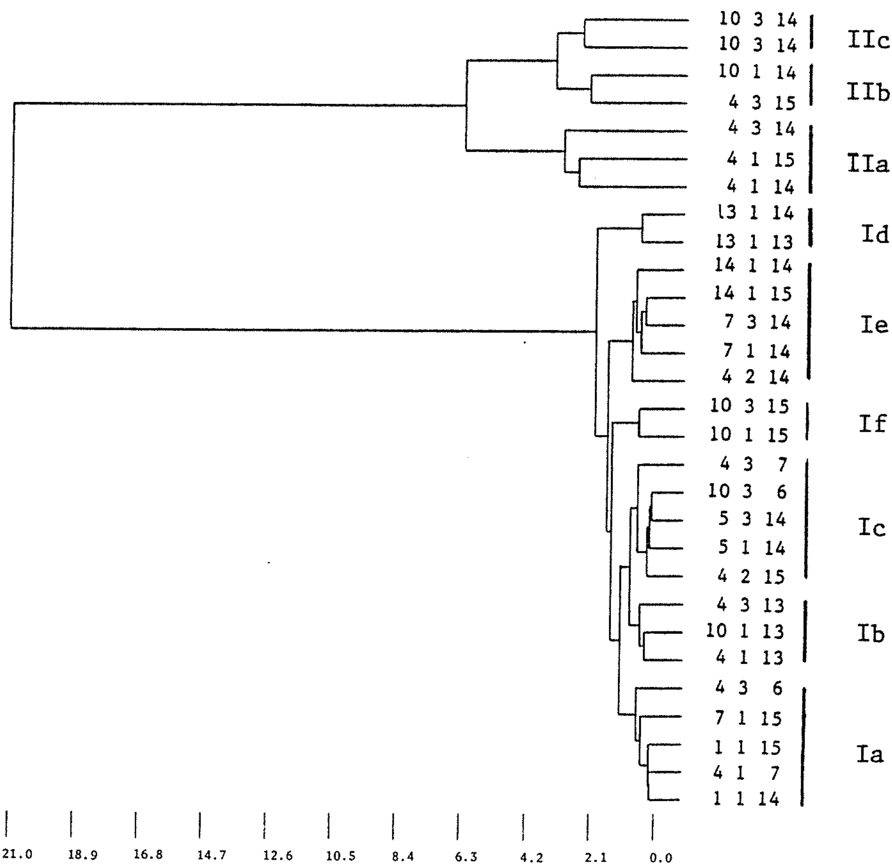


Figure 20. Flake clusters, not standardized by site.

with the initial reduction of cores. It contains four of the six flake forms that have cortical areas either on their platforms or bodies. The fifth case has no cortex, but it does have a double-faceted platform and a thick body, suggesting vigorous percussion flaking with the intention of removing a large flake. Experimental studies suggest that double platforms are especially strong and resist shattering. Otherwise the platforms are simple and the bodies are medium to thick in cross section.

Cluster Ib probably relates to the thinning or rejuvenation of bifaces. The flakes are uniformly thin, with normal and flat bulbs and straight and multifaceted platforms. The exteriors of the flake bodies lack any evidence of cortex.

Cluster Ic contains five flake forms that are commonly produced by the secondary reduction of cores. The remaining two varieties of flakes with cortical areas are included in the group, together with both examples of sequent flakes and a flake with a straight platform, exuberant bulb, and thick cross section. The exuberant bulb suggests hard hammer percussion, or at least vigorous soft hammer percussion. The sequent flakes indicate that at least some flakes have already been removed from the core.

Cluster Id contains only two varieties of flakes, flakes with normal bulbs and flakes with flat bulbs. Both have complex (multifaceted) platforms and thick noncortical bodies. The combination of multifaceted platforms and thick cross sections suggests that these flakes were produced by soft hammer shaping of partially finished bifaces.

Cluster Ie contains flakes that are predominantly of medium thickness. Both varieties of flakes with broken platforms are in this group, as are two of the three kinds of flakes with double-faceted platforms. The third form is one of the two exuberant-bulbed flakes and has a straight platform. This cluster shows evidence of having been produced either by hard hammer or vigorous soft hammer flaking which often produces bulbs and broken platforms.

Cluster If consists exclusively of flakes with shattered platforms. These flakes usually result from poor platform preparation or selection, or from inappropriately delivered blows. Their thin-to-medium thickness and normal bulbs suggest that they are products of soft hammer percussion, possibly in the thinning of bifaces or the manufacture of unifaces.

Cluster II is represented by only seven flake forms, each of which is quite numerous in the collection. Cluster IIa consists of three flake forms, each of which has a straight single-facet platform with normal-to-flat bulb and medium-to-thick body. These flakes would be by-products of core preparation or initial biface reduction done prior to fracture. In either case, they are not the result of bifacial shaping, as the platforms are not multifaceted. The thickness of the flakes and the nature of bulbs suggest fairly strong soft hammer percussion.

Cluster IIb is composed of two flake forms. One has a complex platform, normal bulb, and medium thickness; the other has a simple platform, flat bulb, and thick cross section. Both lack cortex on their bodies. This cluster may represent the result of further soft hammer core reduction with the beginnings of bifacial shaping.

Cluster IIc also is composed of two flake forms, both of which have multifaceted platforms and flat bulbs. They differ in the presence of medium-to-thin noncortical body states. These varieties of flakes are typical results of the final stages of bifacial manufacture and trimming, and of biface rejuvenation.

These nine attribute clusters can be interpreted as representing the by-products of chipped stone tool manufacture. This process may be conceptualized as containing several steps, each with characteristic products and by-products. The scheme illustrated below is an attempt to isolate several activity sets, some of which are optional in the manufacture of chipped stone tools. This is presented in the full realization that such behavior actually constitutes a continuum and that divisions between activities are in large part arbitrary. However, since chipped stone tool manufacture is of necessity a reductive process in which the tool becomes smaller as the process continues, it is legitimate to assume that certain activities must precede others. A biface cannot be rejuvenated until it has been finished, and the secondary trimming of an implement, if it occurs at all, must follow the primary trimming.

Figure 21 presents an outline of the steps or activity sets that have been defined by Collins (1975:25) in the overall process of chipped stone implement

Table 9. Association of Flake-type Clusters and Product Groups

Product Group	Products and By-Products	Clusters (Flake Forms)
i	Unaltered raw material	
ii	Amorphous and prepared cores, primary and secondary cortex flakes, core fragments	Ia
iii	Secondary and edge cortex flakes, large noncortex flakes, preforms, unfinished implements, fragments	Ia, Ic, Ie, IIa
iv	Noncortex flakes, preforms, unfinished implements, fragments	Ib, Id, Ie, If, IIb
v	Finished implements, trimming and retouching flakes, unaltered flake implements*	Ib, If, IIc
vi	Reworked implements, resharpened implements, implement fragments, retouching flakes	Ib, If, IIc
vii	Grave furniture, specialists' caches, ritual offerings	

*Hypothetically any flake could be chosen. Flake clusters presented are mainly those derived from the other artifact categories in product group v.

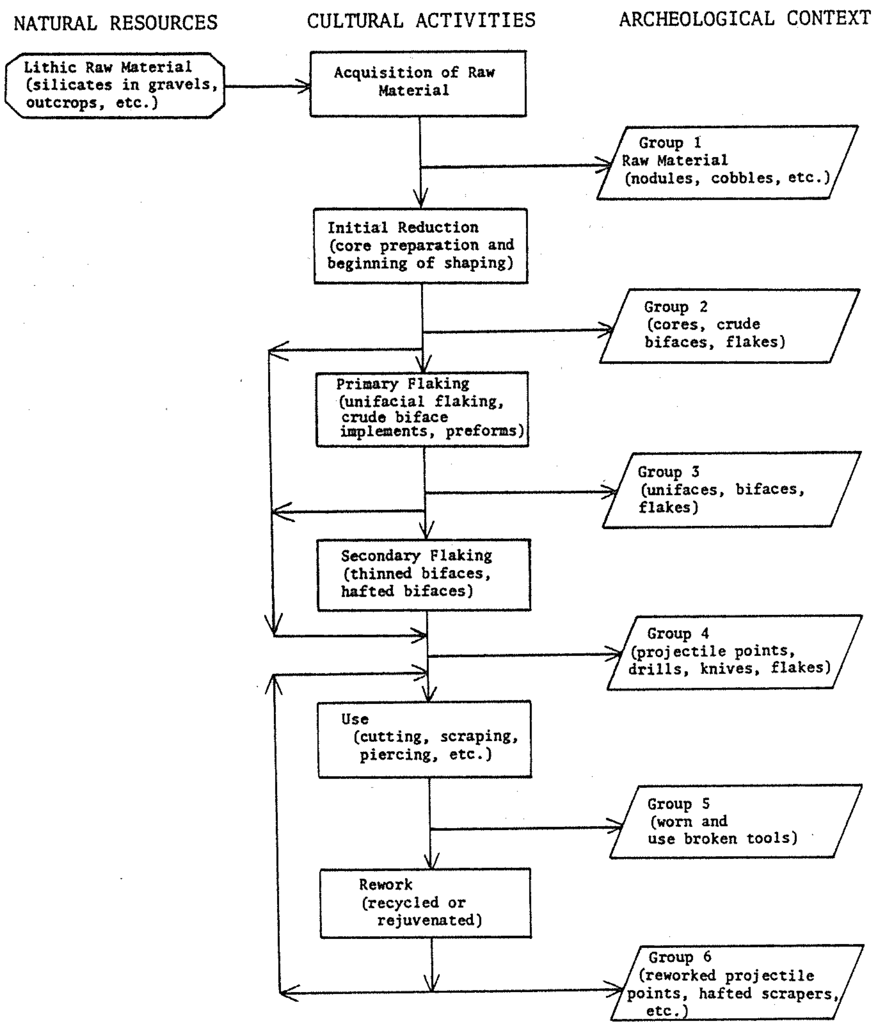


Figure 21. The lithic reduction process. (After Collins 1975.)

manufacture. Table 9 presents the relationship between the flake clusters and the product groups. Some categories, such as preforms, are general categories and are found in more than one product group. In a sense, a piece of raw material that fortuitously resembles a finished or near-finished tool is also a preform. However, for the purposes of this study a preform is a generalized bifacial form that is produced after the initiation of chipping and before the final shaping and thinning of the tool.

Some flake clusters crosscut product groups. This is due in part to the lumping nature of the clustering program; however, activities associated with different stages of chipped stone tool manufacture do produce similar flakes.

Product groups iii through vi are well represented in the collection in terms of both raw frequency and variety of flake clusters. Product group i does not usually have flakes associated with it; consequently, no clusters would be associated with it. Product group ii has only Cluster Ia assigned to it. Although 5 of the 29 attribute combinations make up this cluster, its total frequency is quite low. This may be due to three factors: (1) sampling error, (2) low production of such flakes in the normal sequence of lithic reduction, or (3) the infrequent incidence of behavior that would result in the production of flakes that form this cluster. In addition, the relative frequency of the major component of this cluster, flakes with cortical platforms or bodies, would be influenced by the nature of the raw material. Essentially identical activities by the same knappers with different materials would result in entirely different ratios of cortex- to noncortex-bearing flakes. These data indicate that the acquisition and initial reduction of cores was not a major activity on the sites surveyed.

Product group vii is not represented at all in the survey collection, since such materials would come only from excavated site contexts.

The relationship of the clusters of flake forms to the product groups is incorporated into the arrangements of the cumulative percentage graphs in Figures 25 through 31.

The flake forms are organized according to their clusters (Figure 22) which are arranged in the order of the assigned product groups. The forms associated with the earliest stage (product group ii) are at the lower end of the scale, and those associated with the final stages (product groups v and vi) are at the top. The part of the horizontal axis of the graph specific to each subcluster is shown, indicating the overlap between product groups.

Analysis and Interpretations, Standardized Data

Analyzing the same data but applying standardization by rows (sites) produces a dendrogram that is different, although it is somewhat similar (Figure 23) to the one generated without the row percentages. Three major blocks of clusters are recognizable. Cluster I consists of either very rare flake types or flakes that are best described as fragmentary, such as flakes with missing platforms. Cluster II contains a variety of flakes that tend to be thinner than the rest of the sample. Cluster III is composed of flakes similar to those in Cluster II, but thicker than average.

The organization of the standardized flake clusters could also suggest that there are two modes of flaking within the samples, in addition to a group of rare or essentially unclassifiable flake forms that have little relevance to either of the apparent activities.

Cluster I contains six flake forms, all of which are merged at a relatively high order, indicating dissimilar distributions in the sample (i.e., sites). They include both varieties of flakes with broken platforms, both examples of flakes with exuberant bulbs, and two of the three flake forms with straight double platforms. Both medium and thick forms are represented in the cluster, with indications of an internal differentiation between the two. This cluster reflects hard hammer percussion. Large bulbs of percussion and broken platforms are phenomena usually, although not exclusively, associated with hard hammers. Replicative experiments also suggest that double-faceted

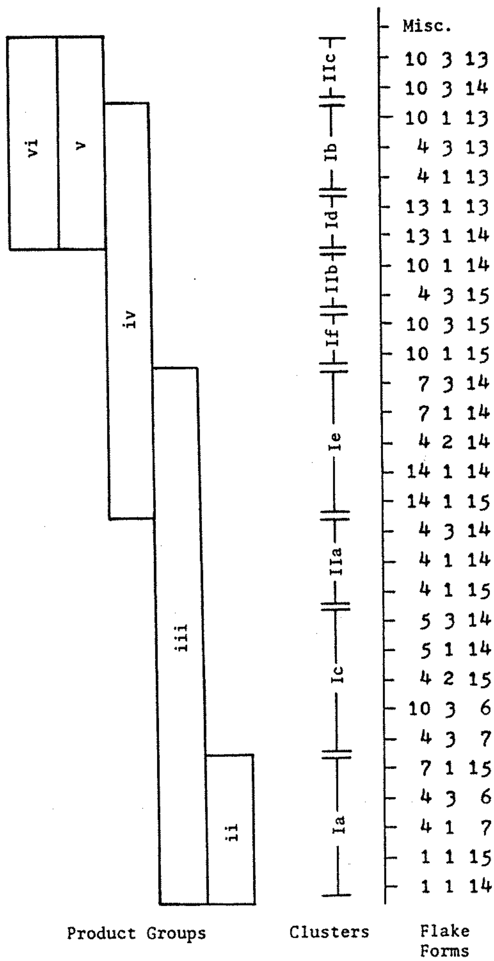


Figure 22. Flake clusters ordered by stages of reduction (product groups).

platforms are significantly stronger than simple platforms and are less likely to break, crush, or shatter when percussion flaking is applied. Significantly, no flake forms with cortical areas are included in this cluster, which suggests that these flaking activities are not related to the acquisition of raw materials or the preparation of the cores (product group i or ii). In addition, there are in this cluster no flakes with thin cross sections and complex platforms. The inference is that these flakes are the result of the primary trimming of cores (product group iii). Cluster I, the final merging accomplished in the clustering process, is distinct from the two other major clusters, suggesting that the flakes were produced at sites different from the ones where the materials were acquired and processed.

Cluster II can be subdivided into at least two subclusters. Cluster IIa comprises thin flakes with either flat or medium bulbs and either single or multifaceted platforms. Cluster IIb contains flakes with shattered platforms and a multifaceted flat flake with secondary cortex body. Six of the seven flake forms of the cluster are thin, all of the bulbs are either flat or medium, and only two of the seven forms have single-faceted platforms. Therefore, these two clusters are believed to represent the secondary trimming and final shaping of thin bifaces, probably by soft hammer percussion and possibly by pressure flaking. The occurrence of a flake form with cortex on part of its body is somewhat anomalous, although certainly not unexpectable. This form is rare in the assemblage, accounting for only 24 specimens (0.83 percent) in the total sample, and 22 specimens in the sample from sites selected for clustering. The nature of the present sample makes it impossible to explain this situation adequately.

Cluster III is subdivided into three or possibly four subclusters. Cluster IIIa consists of the six forms that occur most frequently in the typology. Two multifaceted forms merge at a low order and are then joined by four forms

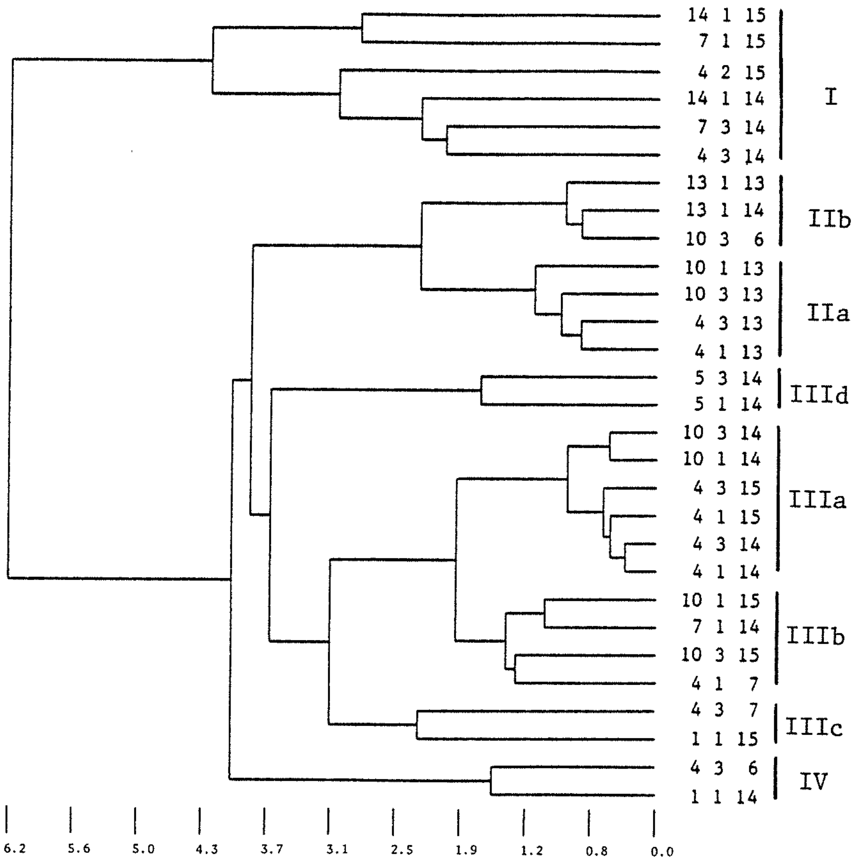


Figure 23. Flake clusters standardized by site.

with simple platforms that are also merged at a low order. Most of the body states are medium, but two are thick noncortical types. Medium and flat bulbs are evenly distributed.

Cluster IIIb is composed of four flake forms. Two are multifaceted, thick noncortical flakes, one is double-faceted medium, and one is single-faceted secondary cortical. The constituents of the subcluster are more diverse than those of IIIa and do not form as tight a cluster.

Cluster IIIc comprises only two forms, both of which are thick and have cortex either on their bodies or on their platforms, which are essentially simple and unmodified. These atributes seem to relate them to the earlier stages of either reduction.

Cluster IIId also is composed of only two forms. This subcluster contains the only flake forms with sequent platforms. They differ only in the bulb attributes, which are either flat or normal. This subcluster combines with the rest of Cluster III at a very high order. Since flakes of this subcluster represent less than 1.7 percent of the total sample, their association with the rest of the flakes in Cluster II may not be significant. The nature of the sample and its size is the source of the uncertainty.

Cluster IV is formed of only two flake forms and by default is defined as a separate cluster. It is quite distinct from the other clusters and is one of the final mergings accomplished in the hierarchical grouping. Both flake forms are rare and number more than two at only one site, HZ52, the site with the largest assemblages of chippage.

Cluster IIc can be interpreted as the result of initial reduction of cores. The thick bodies and cortical areas on the flakes are an argument for assigning this cluster to product group ii. Cluster IIa probably relates mainly to the primary trimming of cores, with some suggestion that the forms with multifaceted platforms may be the products of secondary trimming.

Both Clusters IIa and IIb seem to be derived from activities associated with the secondary trimming processes, with a suggestion of some primary trimming related to Cluster IIb. The chippage is thin, with a preponderance of complex and shattered platforms. The trend toward flatness of the bulbs and the thin flakes suggest soft hammer percussion.

One interpretation of the pattern of clustering derived from this analysis is that there are two distinct flaking activity sets represented in the sample. Clusters I, IV, and IIIc stand essentially isolated from the rest of the clusters. They represent the earliest stages of flaking—basically core preparation and the primary shaping of the core. All of the flake forms from these clusters are relatively scarce in the sample, casting some doubt on their exact relationship to the rest of the flake forms. However, it is apparent that they do stand apart from the main constituents of Clusters II and III.

Cluster III contains subclusters that represent flaking activities from core preparation (IIIb) through primary trimming (IIIa) and possibly some secondary trimming (the multifaceted forms of IIIa). These activities may reflect the production and maintenance of unifacial and, possibly, bifacial scrapers. The dominance of thick flakes and a large proportion of straight platforms tend to confirm this interpretation. Straight platforms reasonably would be associated with uniface manufacture and maintenance. Thick flakes are more likely to occur as a result of primary trimming than secondary.

Cluster II contains flake forms in its subclusters which seem to relate most consistently to the secondary flaking and maintenance of bifacial implements. It is possible that partially finished forms were imported to sites and then finished, or that completed tools were being resharpened or recycled. This is not to suggest that these are the only activities concerning biface production that were carried out on the sites included in the sample. Since the manufacture of bifaces also included those stages necessary for the production of unifaces, it is reasonable to assume that in some cases chippage associated with Cluster III resulted from the production of bifaces as well.

The two methods of treating the flake data—standardizing or not standardizing by cases—have produced two interpretations. The first attempt at clustering without standardization generated a dendrogram that defined two major groups subdivided into nine subclusters. The composition of these subclusters coincides closely to flake forms that might be expected to occur during various stages in the process of lithic reduction.

The second attempt at clustering utilized the option to standardize the data by case. This meant that the clustering of flakes would be less sensitive to the number of flakes in each case. This clustering produced a dendrogram with three major clusters and one minor cluster. The three major clusters were subdivided into eight subclusters, which have been interpreted as representing two different varieties of flaking: one oriented toward the manufacture of unifaces, the other toward the manufacture and maintenance of bifacial implements.

Hierarchical Clustering of Sites

The application of hierarchical clustering techniques in order to delineate the clusters of sites that are most alike on the basis of their flake assemblages uses the same data and methodology but inverts the data matrix so as to render the sites as cases and the flake forms as variables.

Analysis and Interpretations, Cases Not Standardized

The cluster analysis of sites, derived from the flake data, used options for both standardizing and not standardizing the cases (sites). Cluster analysis using the data nonstandardized by case yielded inconclusive results, since the dendrogram that was generated simply merged sites on the basis of their sample size only. For the purpose of interpreting the site clusters, the standardized data is considered to be more appropriate.

Analysis and Interpretations, Cases Standardized

The dendrogram for the site clustering analysis of standardized cases reveals four major divisions, which have been termed Clusters I, II, III, and IV (Figure 24). Several of the subclusters within the major divisions are the result of the pairing of two sites with small sample sizes, usually 40 or fewer flakes. Although these subclusters may represent actual patterns within the overall scheme, their small sample size casts doubt on their validity. More confidence can be placed in clusters with more than two sites, or with sites that have a significantly larger number of flakes.

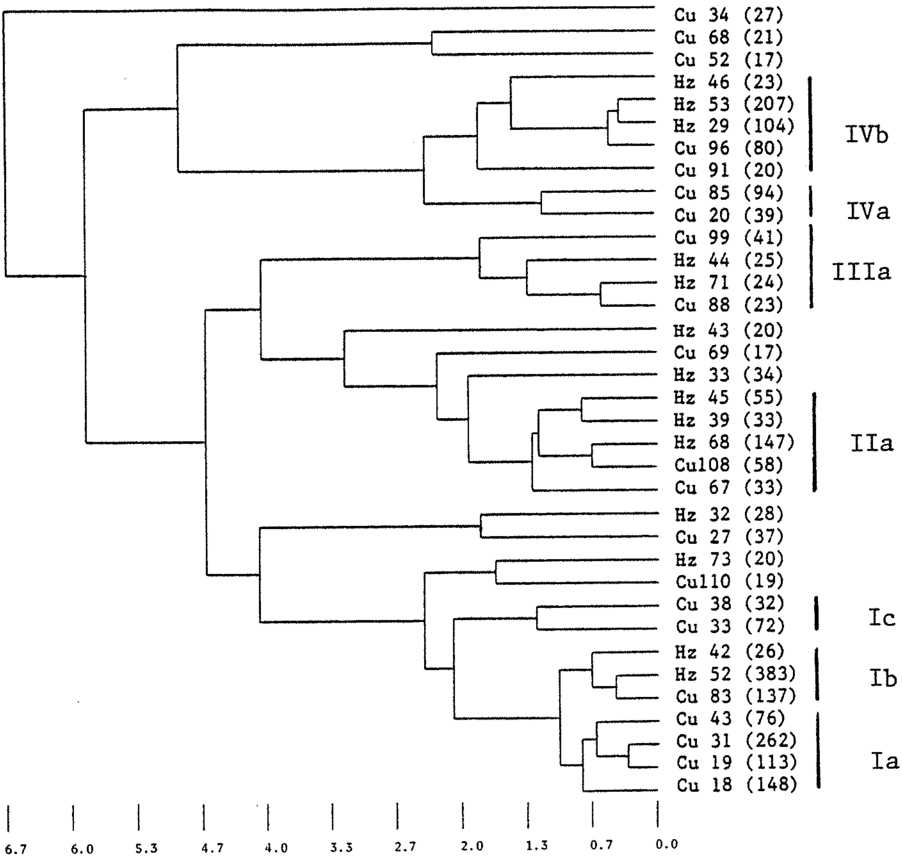


Figure 24. Clusters standardized by flake forms.

Before discussing the result of the clustering analysis, it should be noted that CU34 is unique in that of the 27 flakes that could be analyzed fewer than 30 percent corresponded to one of the 29 flake forms chosen for further analysis. Significantly, all but 8 of the 27 flakes had cortex on their bodies or platforms, and of these 8, 5 were classed as either thick or angular in body thickness. The initial stages of lithic reduction were carried out here, probably by hard hammer percussion.

Seven subclusters were selected for interpretation, three from Cluster I, two from Cluster IV, and one each from Clusters II and III. In the discussion that follows, each cluster is accompanied by a site location map and a cumulative percentage line graph that shows the percentage of each flake form for each site in the cluster.

It should be noted that the cumulative percentage graphs in Figures 25 through 31 differ from the one in Figure 19 in the order in which the flakes are listed. Figure 19 reflects clustering without standardization of the flake frequencies; however, the clustering of sites based upon their flake assemblages incorporates standardization of the flake frequencies. Consequently, the cumulative percentage graphs use the clustering of flake forms standardized by case (flake forms), as shown in Figure 23.

Cluster Ia (Figure 25) is made up of four sites, with sample sizes ranging between 76 and 262. Flakes with straight platforms account for a large part of the variation in this group; only a few flakes have complex, shattered, or broken platforms. Flakes with cortex are relatively abundant when compared to other clusters. This cluster has no temporal significance, as all ceramic periods are represented; however, only one sherd was found at CU43, casting doubt on the assignment of a ceramic date to that site. All of the sites are fairly large; two (CU31 and CU43) are near springs and the other two are in an area where there are many other sites. Product group ii and iii flakes are very well represented, and the absence of product group iv and v flakes suggests that unifaces were being produced in considerable numbers. If this is the case, it is likely—assuming that the unifaces were used as scrapers in domestic situations—that Cluster Ia represents a group of sites where domestic activity was the dominant behavior. Unifaces and hearths are common, especially at CU18 and CU19.

Cluster Ib (Figure 26) is in many respects similar to Cluster Ia. Three sites compose this cluster, and the sizes of the flake samples range between 26 and 383. It is questionable that the smallest site, HZ42, should be included, due to the possibility of chance or sampling error. Like Cluster Ia, the collections from the other sites are fairly large, and these sites were called campsites by the field crews. HZ52 is a well-dated early ceramic site, and the other sites,

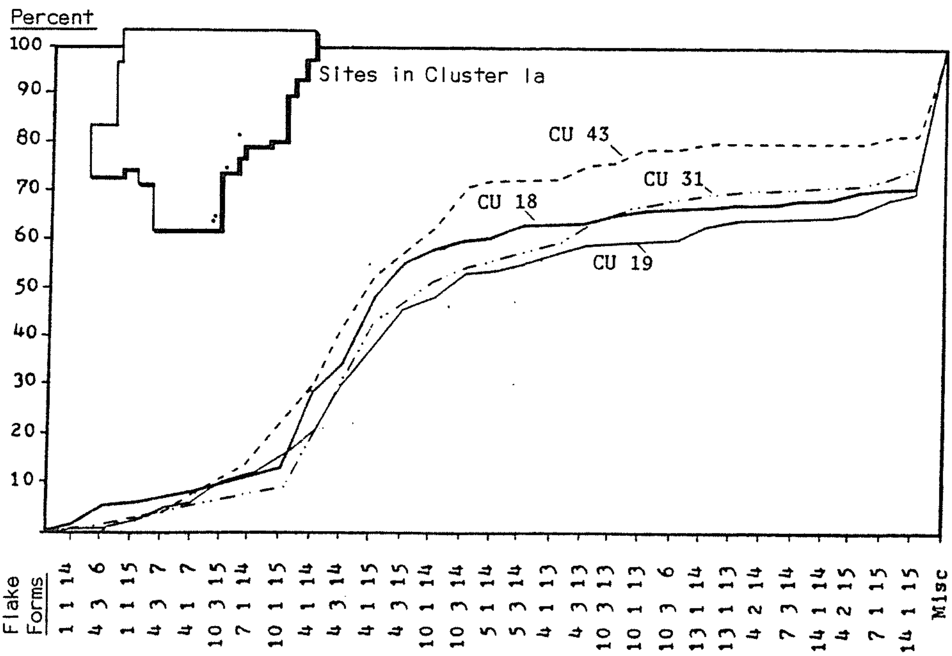


Figure 25. Flake forms in Cluster Ia.

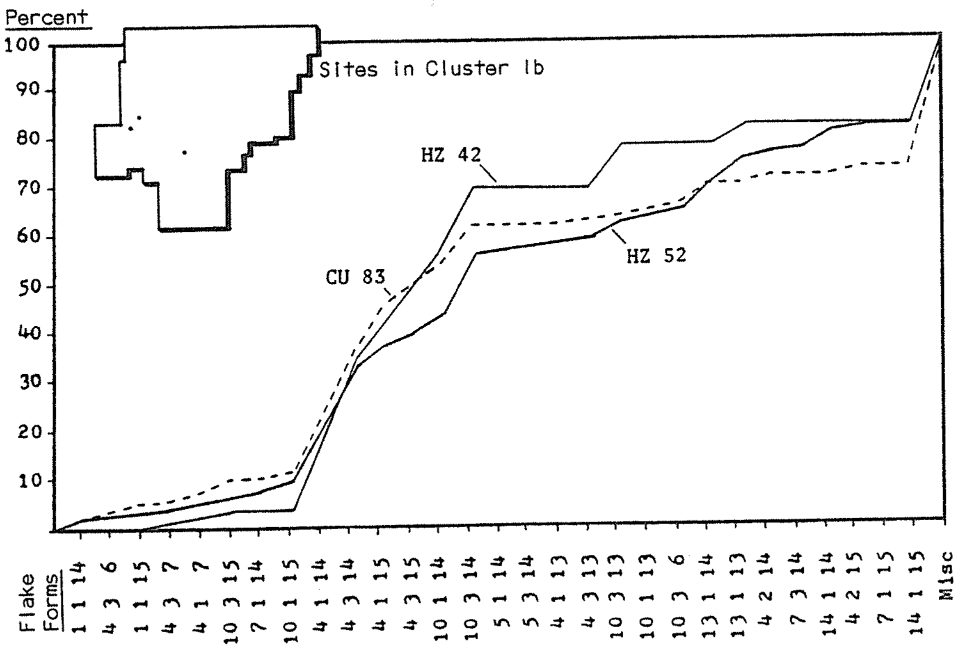


Figure 26. Frequency of flake forms in Cluster Ib.

HZ42 and CU83, are aceramic, suggesting a late preceramic to early ceramic period occupation. The difference between these sites and Cluster Ia is the larger proportion of bifacial retouching flakes (flake Cluster IIc). Although there are indications of a slightly larger component of product group iv flakes (flake Cluster IIb), flakes with straight platforms predominate. The evidence indicates that there was some manufacture of bifacial implements here and, at least at sites HZ52 and CU83, probable manufacture of a considerable number of unifaces.

Cluster Ic (Figure 27) also is similar to the other subclusters, although sites CU33 and CU38 yielded only 72 and 32 flakes, respectively. Much of the materials from these sites, including the chippage, was limestone, which may account in part for the configuration of the curves. The margin of difference between this cluster and Clusters Ia and Ib results from the smaller proportion of straight-platformed flakes. In part, the difference is made by flakes with cortex and, at CU38, a larger number of bifacial trimming flakes. Because there are only two sites in this cluster, they are difficult to assess. Since no ceramics are present at either site, they may have been preceramic occupations or peripheral occupations by later peoples. The flaking technique suggested for these sites relates most strongly to the earlier stages of implement manufacture, for at only one of the sites (and there probably only one item) was there a possibility of some final reduction.

Five of the eight sites in Cluster II form a subcluster that is suitable for interpretation (Figure 28). The sample size in Cluster IIa varies from 33 to 68,

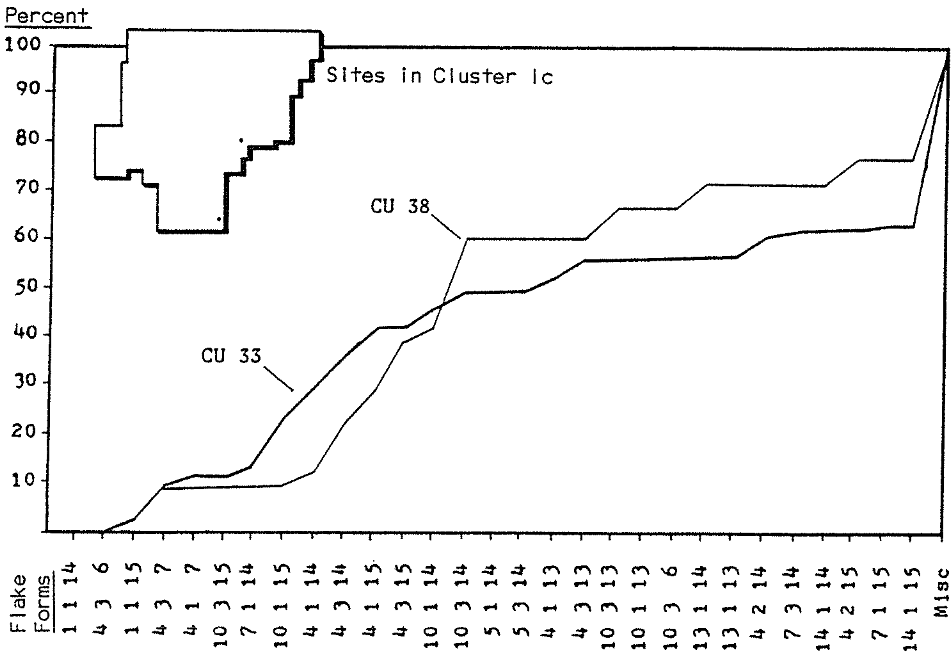


Figure 27. Frequency of flake forms in Cluster Ic.

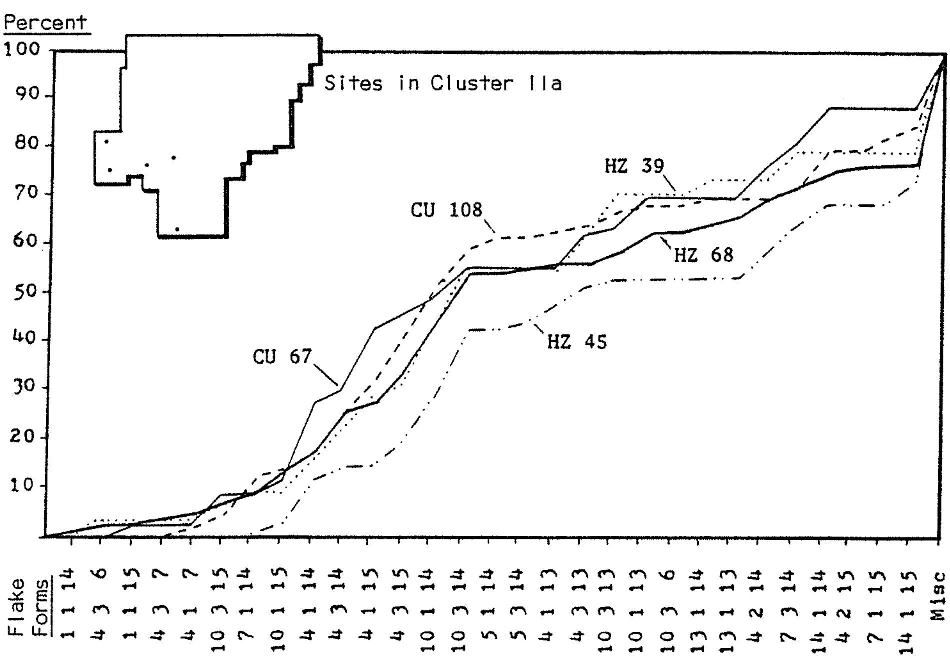


Figure 28. Frequency of flake forms in Cluster IIa.

indicating that the sites have little chippage. The curves in the cluster all reveal the same trend; a very low percentage of flakes associated with product groups ii and iii, but fairly high and consistent percentages of flakes associated with product groups iv, v, and vi. The activity suggested here is the processing of bifaces that have been started at another place. The evidence is clear that the later stages of implement (probably bifaces) manufacture were carried out at these sites. There does not seem to be any temporal loading to this cluster, since two sites are ceramic, two are early ceramic, and one is late ceramic.

If Cluster II represents later stages of lithic reduction, then Cluster III certainly represents earlier stages (Figure 29). Product group iii flakes, especially flake Cluster Ia, account for the bulk of the flakes. The manufacture of unifaces seems to have been the prime activity at the sites in Cluster III, since evidence for further artifact reduction is lacking. Too, there are very few flakes with cortical areas, implying that initial reduction of cores was not being done in any quantity.

Cluster IV contains two subclusters suitable for interpretation. Cluster IVa has two sites, CU20 with 39 flakes and CU85 with 94 flakes (Figure 30), but there is little apparent similarity between the sites. Site CU20 has a much larger percentage of flakes with shattered platforms and with straight platforms than does CU85. Sites CU20 and CU85 are, however, more similar in their proportion of Cluster IIIc flakes. This seems to be a poor cluster and may be an indication of inadequacies in the clustering program and the data base.

Cluster IVb appears to be more cohesive than IVa (Figure 31). Three sites, CU96, HZ29, and HZ53, compose the core of the cluster. Two other sites with much smaller sample sizes (20 flakes each) were tentatively added to the cluster. Their curves resemble those of the core sites, although they run above and below the larger sites. Sample size is again a problem. The interpretations of this subcluster apply primarily to the larger sites, and may or may not apply to the other two. In many respects Cluster IVb resembles Cluster IIb, with a high proportion of final shaping flakes and a fair number of intermediate flakes, but there is a decided scarcity of flakes with broken platforms and a higher proportion of Cluster IIIc flakes. The flaking was apparently more successful at the Cluster IVb sites than at the IIb sites. Two of the sites are aceramic (CU91 and CU96), two (HZ46 and HZ53) have intermediate period ceramics, and one (HZ29) has early period ceramics. Thus there is no obvious temporal loading in this cluster.

Summary of Site Clustering

The cluster analysis of the sites with at least a fair representation of chippage provides some interesting insights into stone tool manufacture in the southern Guadalupes. No particular patterns were related to temporal manifestations; indeed, many of the activities that produce chipped stone implements occur in all time periods, thus masking any sensitive indicators. Knappers had to meet and solve a variety of problems with a limited number of solutions, and it is not surprising that many of the same methods were used over long periods of time.

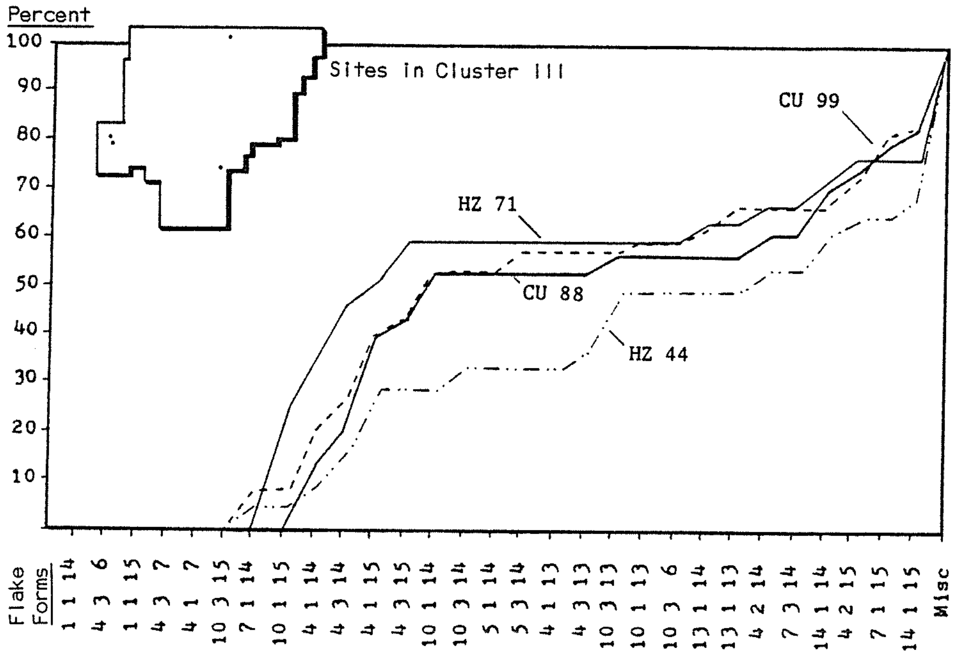


Figure 29. Frequency of flake forms in Cluster III.

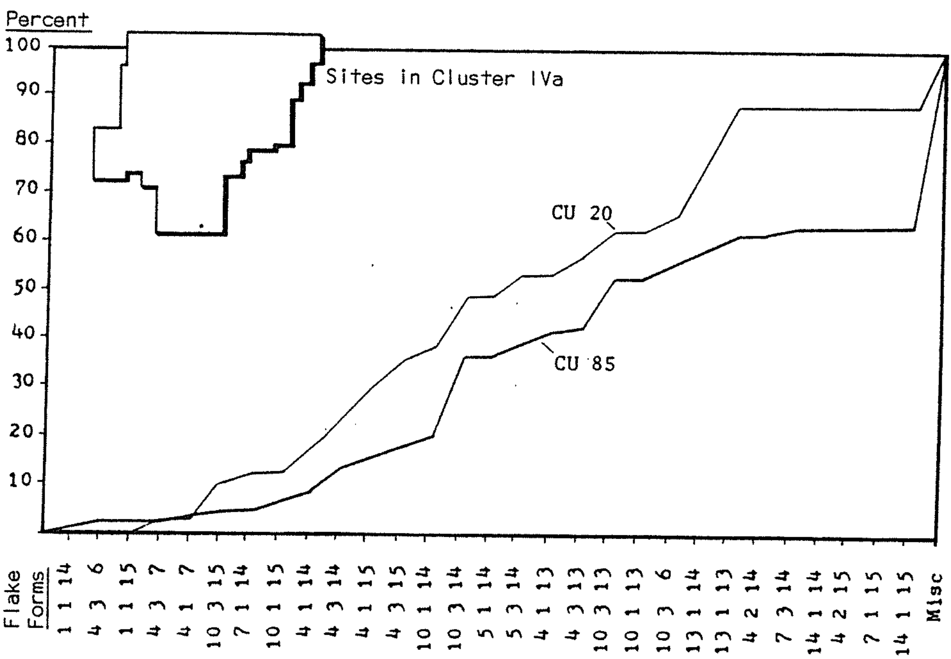


Figure 30. Frequency of flake forms in Cluster IVa.

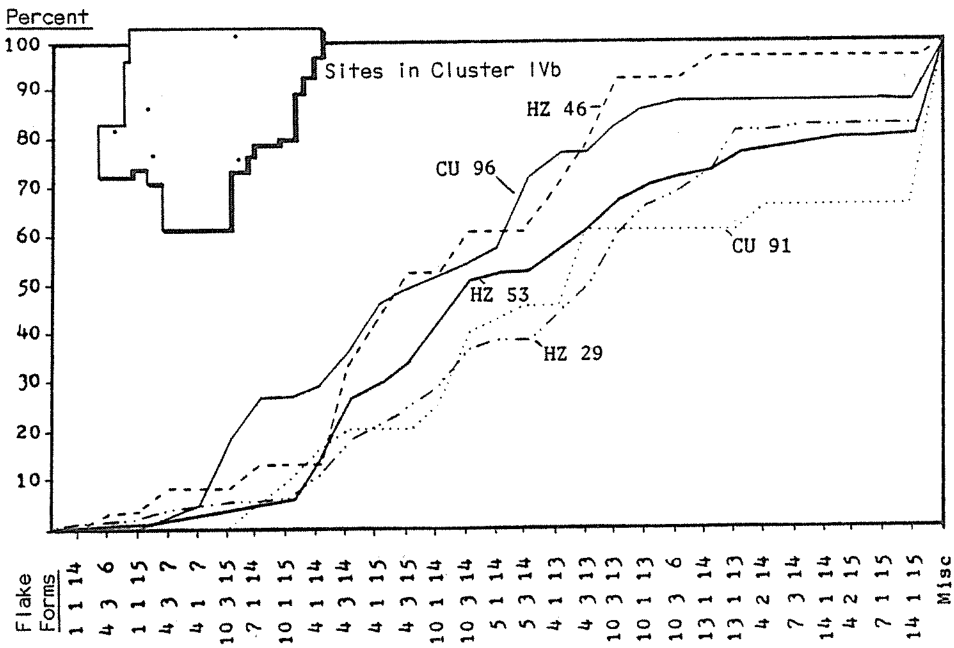


Figure 31. Frequency of flake forms in Cluster IVb.

The clustering analysis does successfully isolate sites at which similar stages of lithic reduction were carried out. Cluster Ib is the closest representation of start-to-finish bifacial implement manufacture. Cluster Ia is similar, but there was probably less final biface trimming. At the sites that constitute Clusters IIa and IVb we find the processing of implements that seem to have been brought to the site in partially finished form. Artifacts with primary trimming or shaping were produced at sites of Cluster III. Whether these artifacts were unifaces or only a stage in the production of bifaces is uncertain.

Biface Fragment Analysis

The second largest category of artifacts in the typology is biface fragments. As the name implies, these are pieces of bifaces that lack diagnostic features assignable to one of the more specific categories.

The Data

The data for this aspect of the study are drawn from the tabulation of nearly 400 bifaces and biface fragments collected by the TAS survey. As part of the initial sorting of the artifacts into the typological categories, the biface fragments and bifaces that were identified as discards during manufacture were set aside for separate analysis. Biface fragments, except for those that were heat damaged, were divided into two basic types: those with transverse fractures, which presumably occurred during manufacture and caused the biface to split transversely along the cross section; and those with snap fractures, which are clean breaks and give no hint of origin.

Eleven criteria for assessing the nature and degree of biface breakage and/or discard were chosen for analysis. Although these criteria do not encompass all possible kinds of chipping errors or problems, they are the ones that occur frequently in replicative experiments and in the archeological record (Collins 1975) and can be identified without elaborate and costly laboratory facilities. All of the features described below could be detected macroscopically or with the aid of a hand lens. Described below are the most frequently encountered causes of broken bifaces.

Heat Damage

Heating can cause a change in the flaking quality of a piece of chert. This is often desirable, but extreme heat causes a considerable amount of damage and breakage. Heat can produce small round spalls, commonly called potlids, on the surface of an artifact and can change the internal structure of the material, causing it to lose its smooth conchoidal fracture and to break irregularly with granular texture. In addition, excessive heating may cause the artifact simply to shatter, presumably along preexisting flaws or stress planes. Often the fracture surfaces on heat-damaged artifacts are indistinguishable from snap fractures, and the heat-damaged pieces are recognizable only from potlids or granular fracture surfaces.

Transverse Fracture

A break that can be identified as the result of an ill-delivered blow to the artifact during manufacture is called a transverse fracture. Either singly or in combinations, a bulb of percussion, ripple marks, or radial shatter lines will occur on some bifaces that have been broken during manufacture. The term manufacturing break is avoided here because experimental knapping indicates that breakage during manufacture does not necessarily produce recognizable attributes on the fracture plane of the broken biface. To use such a term would suggest that all manufacturing breaks can be recognized.

Snap Fracture

A smooth, clean break across the midsection of a biface is termed a snap fracture. The origin of such a break can be manufacturing, usage, or accidental causes (such as dropping or trampling), and in most cases cannot be determined. Occasionally such a fracture will have a lip or hinge on one of the broad surfaces of the biface, usually along the medial axis, indicating that the force causing the breakage was delivered from the opposite face of the artifact directly through the smallest dimension of the piece. It is unlikely that such a blow would be delivered during manufacture.

Overshot Fracture

A biface can be ruined by an overshot fracture: the removal of a flake that extends across the breadth of the biface, over the opposing edge, resulting in a flake with remnants of the bifacial edge on both the striking-platform and terminal ends. In some cases an overshot fracture results in the breakage of the artifacts, and in others, an overreduction of thickness and width so that the artifact is useless. In still other cases the artifact can be salvaged and further processed. Overshot flaking differs from transverse flaking in that the striking platform, location of bulb, ripple marks, and radial shatter lines occur in the plane defined by the intersection of the length and breadth of the artifact (that is, across the face) rather than on the cross section of the artifact (or perpendicular to the face).

Edge Collapse

If an overshot fault in flaking can be considered an overly successful attempt to remove a flake, edge collapse can be considered its reverse. An edge collapse flake is one that is composed essentially of a platform area only, with no appreciable length to its body. The effect of a single edge collapse on a biface is a noticeable notch in the edge.

Hinge Fracture

A hinge fracture is a common error or problem in flaking. A hinge fracture flake differs from a normal flake only in that the end of the flake opposite the striking platform terminates in a smooth edge, which rolls back onto the exterior surface of the flake, rather than in a sharp or feathered edge. The result on the parent piece is a concavity or lip in the medial area of the artifact's surface (Crabtree 1972:68). The effect of this flaking error varies greatly, depending upon its size and placement, and a hinge fracture can be of little concern to the knapper. Hinge fractures can be found on finished artifacts that are apparently perfect in shape and outline.

Knot

A knot is a lump of unremoved material that has been left on the surface of a biface by several hinge fractures originating from different directions, all terminating in one spot. Thus a knot is not one flaking error, but is the end product of several flaking errors—unsuccessful attempts to remove material from the surface of the biface. Knots normally occur in the medial part of a biface, but they can occur near the edges.

Edge Crushing

Edge crushing, as the term implies, occurs when, rather than successfully removing a flake from the surface of a biface, the knapper crushes or shatters the platform area, effectively blunting the edge and reducing the width of the artifact without succeeding in reducing the thickness.

Flaw

Flaws result from circumstances that are often beyond the control of the knapper. Very few cryptocrystalline materials are without impurities, fossil inclusions, or fracture planes either preexistant or the by-products of previously delivered blows to the stone. Otherwise well-struck blows can result in the breakage of the entire piece at the point of the flaw. Occasionally a flaw plane can be detected by a slight patina where it has weathered when a thin fissure existed for some time. In such an instance the knapper might recognize the flaw and abandon the project.

Unsuccessful Shaping

This problem faces all knappers, especially those who are inexperienced and inept. Often the best efforts of the knapper fail to shape or thin the artifact successfully, leaving it an irregular, unshaped mass. Usually such pieces will have other errors. Failure to remove a knot is a relatively rare but recognizable case of unsuccessful shaping. It is difficult at best to determine that a piece is improperly shaped, because the analyst can hardly judge what was in the mind of the prehistoric tool maker.

Methodology

A total of 386 bifacial artifacts, including all the biface fragments and bifaces identified as being unsuccessfully shaped, were examined for the presence or absence of various flaking problems, and these data were recorded for each artifact (Table 10). The flaking errors were subdivided according to the kinds of fractures, and the distribution of the unsuccessfully shaped and discarded or aborted bifaces was tabulated. The number of recorded problems for each category naturally exceeds the number of artifacts in the category, since there is often more than one flaking problem on an artifact. In addition, the number of artifacts exhibiting only fractures and no other flaking problems is also presented. For purposes of comparison, the figures for each cell in the display have been standardized by computing the raw percentage of occurrence of the flaking problem.

Overshot failures were not put into the same category as transverse fractures because they are not morphologically the same as transverse fractures. However, they are a variety of manufacturing break, and, since they are included among the broken bifaces, they are incorporated into this part of the study.

Results and Interpretations

The distribution of the various kinds of flaking problems reveals certain patterns that may be significant in the interpretation of lithic technology in the southern Guadalupes. The category defined as abortion has the highest proportion of knapping errors and problems. Unsuccessful shaping (on 44 percent) and edge collapse (on 43 percent) are two of the most frequent problems occurring on the aborted specimens. Hinge fracturing (on 39 percent) and edge crushing (on 27 percent) are also quite common. Knots are relatively rare, but they occur more than four times as frequently on aborted bifaces as on fractured bifaces of either type. The unsuccessful flaking category is an end result of combinations of other flaking errors, especially edge collapse, hinge fractures, knots, and edge crushing, and as such it is not a truly independent variable. Knots in particular are produced by a variety of flaking errors. Furthermore, continued edge collapsing, hinge fracturing, and edge crushing make bifaces increasingly difficult to flake effectively. Flaws are relatively rare in aborted bifaces.

Aborted bifaces are most likely to have both a variety and a high frequency of flaking errors, which illustrate in large part the major reasons for discard. They were inappropriately shaped for either further flaking or use.

Table 10. Distribution of Flaking Problems

Flaking Problem	Kind of Fracture																Total No. of Speci-mens
	Overshot		Edge Collapse		Hinge Fracture		Knot		Edge Crushing		Flaw		Unsuccessful Shaping		Fracture Only		
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	
Heat damage			2	18	3	33									5	55	9
Transverse fracture			8	13	22	35	1	2	6	10	4	8	14	22	12	20	59
Snap fracture			32	12	65	26	3	1	30	12	24	6	42	16	114	45	251
Aborted biface	16	24	29	43	26	39	6	9	18	27	3*	4	30	44	NA	NA	67
TOTAL	16	4	71	18	116	30	10	2	54	14	31	8	76	20	131	34	386

*Visible in specimen, but not constituting a fracture.

The snap and transverse biface fragments have both similarities and differences. In some categories, the percentages of flaking errors are close, if not virtually equal. Edge collapse and edge crushing differ by 2 percent or less when transverse and snap fractures are compared. The frequency of knots is very low—only four in 310 fragmentary specimens—and the significance of the similarity or difference is questionable. The same is also true of flaws. However, hinge fracturing and unsuccessful shaping do appear to vary significantly. Hinge fractures occur on 35 percent of the transverse biface fragments and on 26 percent of the snap fractures. In addition, 22 percent of the transverse fracture bifaces and 16 percent of the snap fractures were defined as unsuccessfully shaped. Thus artifacts that were broken, presumably during manufacture, seem to have more problems with hinge fracturing and, as a result, a somewhat higher frequency of unsuccessful shaping. The further fracturing of the bifaces may have resulted from unsuccessful attempts to correct the problems arising from the hinge fractures and unsuccessful shaping of the artifact.

The most significant variable found in comparing the transverse and snap fractures is the frequency of specimens with no apparent errors or problems other than the fracture. Only 20 percent of the transverse fractures fall into this category, but the fracture is the only problem in 46 percent of the snap fractures. This indicates that there is significant difference between the two groups in distribution of flaking problems.

The most probable explanation is that the snap fracture category includes not only the completed and perfect, or nearly perfect, bifaces that have been snapped by lateral stress, but also bifaces broken during manufacture, which do not have the characteristic attributes of transverse fractures. This would result in an assemblage of artifacts with similar kinds of fracture planes across their midsections and a distribution of flaking problems suggestive of both well-flaked and finished forms broken after completion of flaking, and forms broken during manufacture. Replicative experiments demonstrate that bifaces broken in manufacture can have the attributes of snap fracture.

Analysis of the biface fragments and aborted bifaces from the southern Guadalupe Mountains and adjacent desert has revealed a patterned distribution of flaking errors and problems. Biface fragments with transverse fractures had a higher frequency of flaking problems, with hinge fractures and unsuccessful shaping particularly common, than did the snap fractured bifaces. Aborted bifaces, as expected, also had a high frequency of flaking problems. This overall pattern suggests that there may be even more patterning of flaking errors that might be recognized in larger collections and in collections with better contextual information. These patterns could be related to the kinds of material used, intended form of the artifacts, or the knapping tradition used by the tool maker.

Summary and Conclusions

Within the limits of accuracy of the interpretations of the flake clusters set forth above, it is possible to isolate some specific activities that went on at sites in the survey area. It is apparent that the process of manufacturing chipped stone tools, particularly bifaces, was not continuous. Segments of the process are evident at different sites. More comprehensive studies of the region may reveal patterns of chippage distribution that suggest movement among the sites.

In addition, it is possible to isolate stages in the reductive process. Replicative experiments can generate data concerning knapping behavior and tangible by-products that are applicable to the archeological data base, with tremendous implications for the study of lithic technology and archeology. We can now isolate with some precision certain activities relating to the manufacture of chipped stone tools. Since it is rare that chippage debris is transported great distance from the point of production, we can pinpoint the locations of these activities. Analysis of chippage debris, in conjunction with other archeological data, greatly increases the potential for describing and, it is hoped, explaining the mechanisms of stone knapping behavior.

Two conclusions can be reached from this study of biface fragments and aborted bifaces. First, the categorization of the three basic groups, snap fractures, transverse fractures, and aborted bifaces, is accurate and meaningful. Aborted bifaces have a very high percentage of flaking problems, which seem to combine to make the bifaces either unworkable or unusable. Second, there is a difference between the transverse and snap fractured bifaces, not so much in the relative percentage of flaking problems observed as in their distribution.

THE IMPLEMENTS

Methodology

The objective of this section is to isolate meaningful groups of artifacts, with the goal of defining both their functional and temporal significance. To do this, the HCLUS clustering program was again used, but the ever-present problem of differential sample size was compounded by the fact that many artifact types were rare, and missing data were quite common, even on sites with large artifact assemblages. Consequently, the cluster analysis of this data has met with only limited success.

The Data

The data input consisted of implement frequencies from the sites surveyed by the TAS. In many cases the site inventories were extremely small or nonexistent, especially when the debitage and preforms were removed. An arbitrary cutoff of seven artifacts was established, and sites with biased samples, as determined by the same criteria used for the sites in the debitage analysis, were withdrawn. The correspondence between the two groups of sites is close, with a few additional sites unique to each analysis. (Artifact frequencies for all sites are tabulated in Boisvert 1980:Appendix 2.)

Analysis and Interpretation, the Artifacts

The artifact clusters were generated (Figures 32 and 33) both with and without standardizing each case (artifact class). In all runs, each variable (site) was standardized. Standardization in both situations was accomplished by

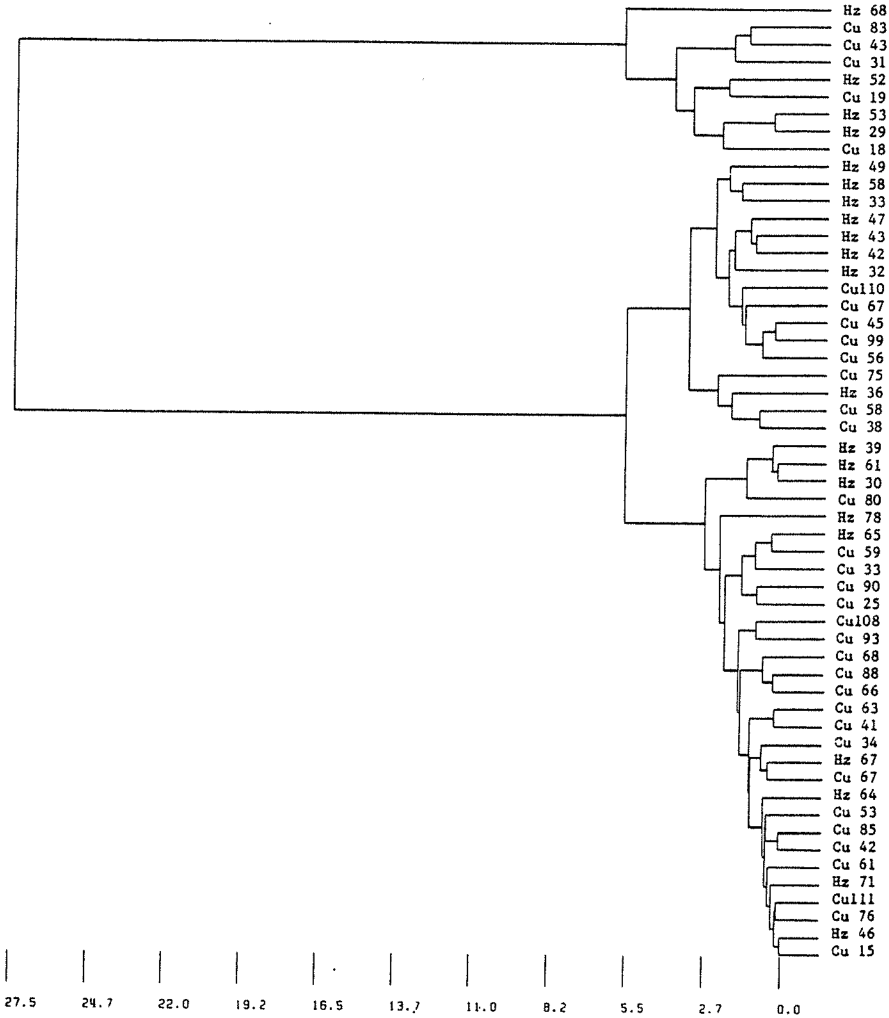


Figure 32. Site clusters standardized by artifact type.

expressing the distribution of artifacts in terms of their (relative) percentages by column or row (variable or case).

The clustering of artifacts was not much altered by the standardization of cases, although some improvement of cluster definition was apparent. The basic problem evident in both versions of HCLUS with this data set was the many instances of missing data. The artifact cluster based upon raw frequency shows an unmistakable skew toward artifact classes with larger frequencies (especially implement fragments and some types of unifaces). Some redefinition was achieved by standardizing the size of the artifact classes, but the same basic patterns prevailed.

Figure 33. Site clusters, not standardized by artifact type.

Some of the lower order mergings remained the same. Type I unifaces merged with ovate bifaces: Types IVb and IVc unifaces retained their close association, as did marginal bifaces and convex manos. Two projectile styles, Types 8 and 9, continued to show a close association. This is most interesting, since both fall into Johnson's Group H points.

One cluster seems to be especially significant, the grouping of battered stone, flat manos, tabular limestone bifaces, and metate fragments. This cluster may represent an activity set or a functionally related group of implements. The mano and metate indicate plant grinding activity, but the function of the tabular limestone bifaces is conjectural. The battered stones

Table 11. Artifact Distribution, Cluster I

Site	Life Zone	Ceramic Age	Battered Stone	Flat Mano	Tabular Limestone Biface	Metate Fragments
CU15	LS	L			1	
CU18	LS	E	3	1	4	4
CU19	LS	I	2	1	2	
CU27	LS	-			2	
CU29	LS	-			2	
CU53	US	-			1	
CU60	LS	-		1		
CU61	LS	-	1	1	2	
CU68	US	-		1		
CU69	LS	-		1		
CU75	LS	I			1	
CU80	T	-		1		
CU84*	US	E		1		
CU85	LS	I				1
CU96	US	-		4		
CU99	US	I		1		
CU108	LS	E	1	1		
HZ29	LS	E	1		1	
HZ33	LS	L	3	3		
HZ41*	LS	I	1	1		
HZ43	LS	E/L	1			1
HZ44*	LS	L	2	1		
HZ46	LS	I			1	1
HZ49	LS	E/L	2	1	1	8
HZ52	LS	E		1		
HZ53	LS	I	2			1
HZ64	LS	I	1			
HZ67*	LS	L		1		
HZ68	LS	L	2	5	9	4
HZ73*	LS	I	1	1		
HZ77	LS	E		1		
HZ78	LS	E	1	2		

*Overall sample size too small for inclusion in clustering analysis.

LS = Lower Sonoran
US = Upper Sonoran
T = Transitional

- = Aceramic
E = Early
I = Intermediate
L = Late

may have been used to pound foodstuffs or to pound leaves for fibers, or they may have been used to produce the tabular limestone bifaces.

There is also a significant distribution of sites with artifacts from this cluster in terms of their spatial distribution. Table 11 lists the sites on which were found one or more artifacts from the cluster. Figure 34 shows their distribution within the park. Of the 32 sites, 26 are in the Lower Sonoran arid division of the lower Austral life zone; 5 are in the Upper Sonoran, and 1 is in the Transition zone. One site, CU68, is at the lower edge of the Upper

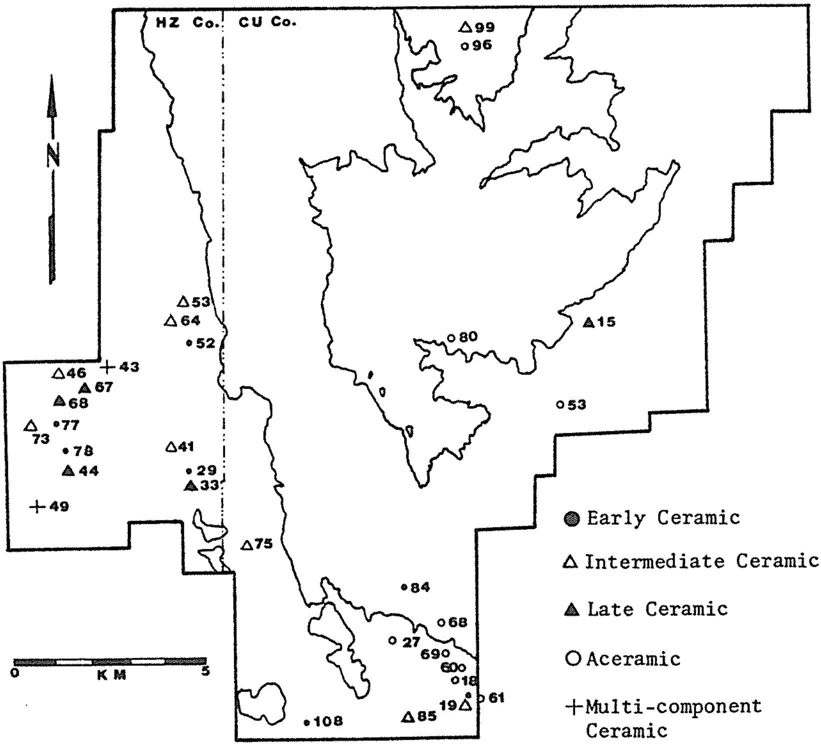


Figure 34. Map of Guadalupe Mountains National Park showing distribution of sites with one or more battered stone, tabular limestone biface, flat mano, and metate fragment.

Sonoran life zone and could conceivably be included in the Lower. The boundary definition of these zones is arbitrarily tied to elevations and fluctuates somewhat. If this association of the artifact cluster is indeed related to the processing of plants, this correlation with the Lower Sonoran zone suggests that this is an area where such plants could be found.

There are also indications of temporal significance for this cluster. Using the presence or absence of ceramics on these sites and the probable age of the ceramic assemblages with reasonable numbers of potsherds, a fairly late date is inferred for the artifacts (Table 11). There is a definite loading for intermediate and late ceramic sites. Other typologically late artifacts are found in loose association with this group. All five sites where Livermore projectile points were found also contain artifacts from the cluster. The frequency of projectile points in the Guadalupes is low (due in part to the activities of relic collectors), making it unlikely that they would cluster with many other artifacts.

The flat manos, metates, tabular limestone bifaces, and battered stones seem to represent tool kits or activity sets used fairly late in the prehistoric occupation of the Guadalupe Mountains. They were found predominantly on the south and west flanks of the mountains in the Lower Sonoran zone. If they were associated with the exploitation of plants from this zone, identification of the plants should shed light on some aspects of subsistence and possibly settlement patterns.

A closer look at the other distinctive clusters in the dendrograms makes it clear that they are made up of the most ubiquitous and least typologically specialized artifacts in the collections. This is most evident in the cluster produced through standardization by case. Here all of the implement fragments—the two kinds of biface fragments and uniface fragments—are clustered together, and the three most frequent uniface types (IVa, V, and VI) are also clustered together. These artifact forms are widespread both in time and space, so no temporal significance can be attached to them.

Analysis and Interpretations, the Site Clustering

The attempt to cluster the sites in terms of their artifact assemblages was disappointing. The dendrograms in Figures 35 and 36 were generated using

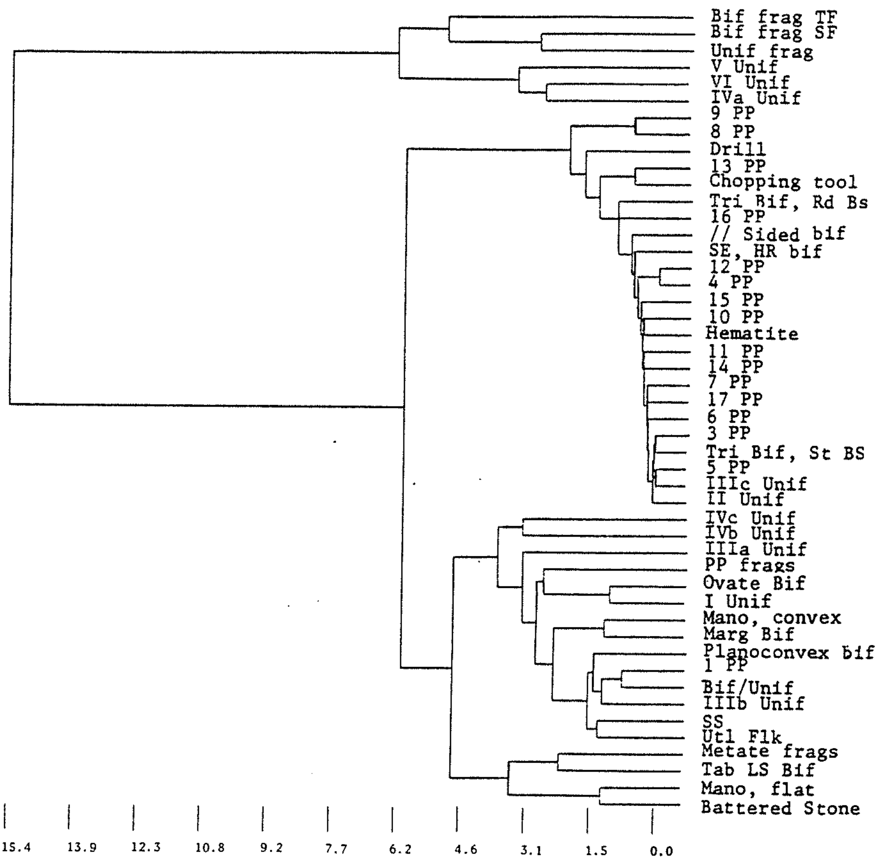


Figure 35. Artifact clusters standardized by sites.

both standardized and nonstandardized data and reveal a significant skewing, which can be attributed to sample sizes. The eight sites with the largest inventories (CU18, CU19, CU31, CU43, CU83, CU96, HZ52, and HZ68) are grouped together in both dendrograms. All of the other sites merge at a very low order, due to the common lack of artifacts in most categories.

There is one subcluster consisting of the essentially aceramic sites CU31, CU43, and CU83 (Figure 37) that might have some significance. The sites have proportionately large numbers of unifaces, especially Type V unifaces. Sites CU31 and CU43 have ring middens, and the debitage analysis indicates that CU83 is a lithic workshop.

These three sites may represent primarily Archaic occupations in the southern Guadalupes. Types 7, 8, and 9 projectile points, which resemble Johnson's Type H Archaic points, and a Meserve point were found at CU31, and Type 10 (Shumla point) was found at CU43. These sites are also near

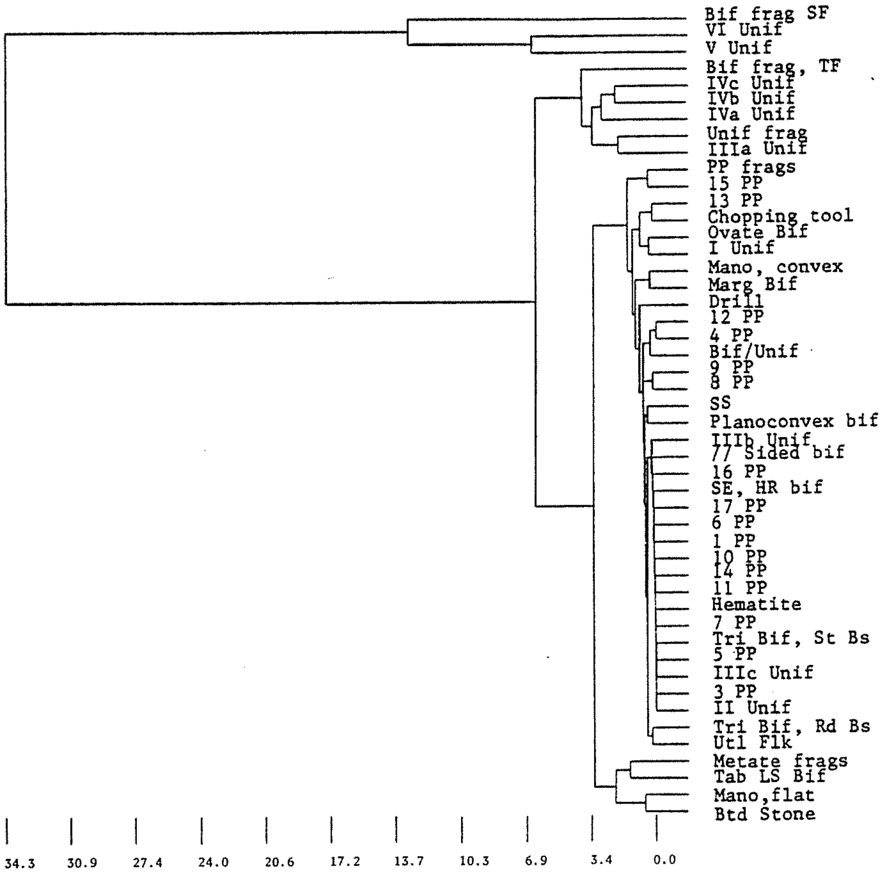


Figure 36. Artifact clusters, not standardized by site.

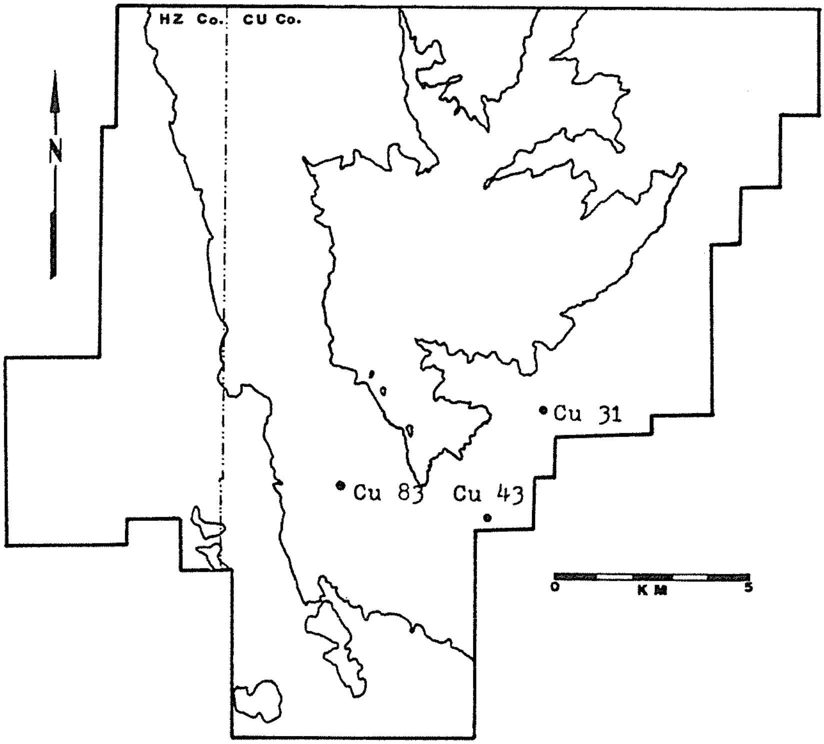


Figure 37. Map of Guadalupe Mountains National Park showing probable Archaic intensively utilized sites.

three of the largest springs in the park: Guadalupe (CU43), Pine (CU31), and Bone springs (CU83). If they were habitation sites that were used repeatedly, that would explain the high proportion of unifaces if the unifaces were assumed to be scrapers associated with domestic activities.

The results of the implement analysis are not as extensive as are the results of the debitage analysis, but one possible activity set that may have temporal and spatial significance has been tentatively isolated. In addition, one small group of sites that may be Archaic base camps has been tentatively defined. However, the goal of isolating well-defined clusters of sites that cover a spectrum of temporal and spatial variation has not been attained, mainly because the methodology applied was not compatible with the data at hand. The sample (case) sizes were too small to produce meaningful clusters, and it is unlikely that additional manipulation of the data by combining artifact categories and increasing minimum sample size would result in any significant improvement. The collection acquired by the TAS survey is not large enough to permit a comprehensive understanding of the cultural and historical sequence in Guadalupe Mountains National Park.

CONCLUSIONS

The analysis of the lithic assemblages recovered by the TAS survey in Guadalupe Mountains National Park was aimed at determining what lithic technologies were practiced there and interpreting their meaning in terms of the culture history of that region. Although it has not been possible to wring this information from the data with the research methods at hand, several conclusions can be drawn.

The best-quality materials, that is, the fine-grained silicates such as chert, were most frequently used to produce morphologically complex bifaces, especially projectile points and drills. These materials were also used for other artifacts, but less frequently.

The local limestones are ubiquitous in the park and may have some degree of conchoidal fracture. They were used primarily for simple tools by the prehistoric inhabitants. The bulk of the limestone artifacts were unifacial forms, presumably scrapers, and indeed some limestone flakes that were used for resharpening unifaces have been identified in the collection. Among the bifaces produced from limestone were the morphologically unique, if not overly complex, tabular limestone bifaces. When they are found unbroken they are relatively large and subtriangular.

Cherty limestone occupies a curious position in the lithic inventory of the southern Guadalupe Mountains. Occurring with frequency at only a few sites, it has qualities of both chert and limestone, as the name implies. Not only was it used in a manner somewhat similar to both, but its reaction to flaking, as demonstrated by the flake analysis, is also intermediate between chert and limestone.

Quartzite was used to make two fundamentally different kinds of tools. On the one hand, it was used for the manufacture of manos and metates, presumably because of its durability, convenient size, shape, and availability. On the other hand, it was chosen for flake knives, often similar in form to Old World blades.

Greenstone was quickly isolated in the collection, but, in spite of its abundance, it does not seem to have been heavily used. Analysis of the greenstone debitage revealed that it had an exceptionally high proportion of broken platforms,, which must reflect failed attempts to shape it into usable implements.

The choice of raw materials by the prehistoric flint knappers of the Guadalupes can be viewed as a balance between convenient and abundant local sources (limestone, quartzite, and possibly cherty limestone) and high-quality chippable stones (exotic silicates and imported cherts), which were apparently less abundant and were probably imported. When morphological complexity was desired, the higher-quality materials were used almost exclusively; when less complexity was desired, a much wider variety of materials was utilized. However, it should not be assumed that chert was an exceptionally scarce resource, for it was frequently used for simple tools that could easily have been made from other materials. For certain implements, local materials were apparently deemed most appropriate, either because of their basic nature (hardness and texture for groundstone tools) or because of natural shapes that facilitated manufacture of particular implements (tabular limestone for specialized bifaces and blocky quartzite for blades). Greenstone, which seems at first glance to have great potential, was generally avoided by knappers.

The difference in sample sizes and a dearth of sites with large artifact assemblages hindered analysis of the artifact clusters, but one group of artifacts—tabular limestone bifaces, flat manos, metates, and battered stones—seem to have both temporal and ecological significance. These artifacts mostly come from the late ceramic period identified by Phelps (1974) as from A.D. 1200 to 1350, and they are found in the Lower Sonoran zone. The functions and interrelations of this group of artifacts should be an avenue for future research in this region. They may represent activity sets or tool kits for particular activities. It is also possible that the people who used these implements were carrying out a variety of essentially unrelated activities, and that this assemblage contains an unrelated set of artifacts from the material culture of a particular group or groups of people. The mano and metate are obviously related, but the interrelationship of the tabular limestone bifaces and the battered stone is not clear.

The place of agriculture in the southern Guadalupes is still an open question. Several sites in the Lower Sonoran arid division, especially along the west flank of the mountains, have many ceramics and food grinding tools, but livestock management practices have significantly altered the availability of water in the region, and it is difficult to determine if sufficient moisture was present to support the cultivation of maize, squash, or beans. Evidence from the Hot Well site about 160 km (100 miles) to the west (Schultz 1966) indicates that the area might have supported agriculture. The association of the tool kit with the sites in the Guadalupes isolated by the clustering analysis remains an intriguing problem.

Analysis of the projectile points suggests a fairly long occupation extending from late Paleo-Indian times into Late Prehistoric times. Continuity with the historic tribes of Jumano and Apache cannot be demonstrated from the TAS collections, but the Trans-Pecos seems to follow the previously defined culture history sequence in West Texas and southern New Mexico. The TAS collection, insofar as the projectile point typologies are accurate and meaningful, contains no particular surprises; indeed the varieties of projectile points are just what would be expected in the Guadalupes.

It had been hoped that analysis of the debitage recovered by the TAS survey would identify the techniques used in manufacturing stone implements in the Guadalupes, but the limited size of the data base and the nature of the collection caused serious problems. Many sites that were reported as having large amounts of lithic material were undercollected; in other instances collections were biased, making the samples from those sites unsuitable for analysis, and many of the sites produced samples that were too small for analysis. Furthermore, the fact that many sites obviously had several components made intersite comparisons difficult to interpret.

Analysis of the chippage reveals that seemingly similar kinds of flakes, when subjected to attribute analysis and hierarchical groupings, fall into constellations of flake forms that may be indicative of the production of bifaces or unifaces. Although biface and uniface production in the early stages can produce quite similar chippage, the results of this study suggest that it may be possible to distinguish between the two activities.

That implements were being produced in quantity in the Guadalupes is evidenced not only by the chippage recovered, but also by recovery of partially finished bifaces in both whole and broken (during manufacture) states. With one possible exception, no sites were identified as loci of activities at or near natural sources of raw material. This is in part a result of the limited area of the TAS survey, an area that does not have substantial chert-bearing deposits, although chert deposits are indeed available in the southern Guadalupes of New Mexico.

As with most scientific endeavors, more questions have been raised than answered in this study, and unsuspected pieces of information surfaced while specifically selected problems remained unsolved. Perhaps the most significant conclusions to be drawn from this study lie in the area of the analytical techniques applied—specifically their utility and limitations. The flake study, based upon an attribute analysis, identified at least some aspects of chipped stone tool manufacture. The fact that specific stages in the reduction of lithic material can be isolated has implications for identification of lithic technologies as practiced by different groups during different cultural-temporal periods, and might even provide some information as to the nature of prehistoric transhumance patterns. In addition, it may be possible to identify the manufacturing debris from different kinds of artifacts. Although such determinations are now only crude and are limited to unifaces and thinned bifaces, the potential exists to further refine the techniques.

In line with the suggestions offered above, it is apparent that hierarchical clustering, such as HCLUS, is useful for eliciting natural groupings of artifacts and sites. However, it is severely limited by the constraints of small sample size and samples with a high proportion of missing data. When used with caution and finesse it can be very helpful.

The IFREQ package, in conjunction with HCLUS, has great potential for investigating variation and patterns in chippage assemblages. The scope of attribute analysis is now limited only by the imagination of the lithic analyst and the capabilities of the computing apparatus. Indeed, other areas of research such as ceramics, folk taxonomies, folklore, and even descriptive linguistics might find useful the techniques presented in this study.

As a result of this study we now know something of the techniques and choices exercised by the prehistoric flint knappers of the Guadalupe Mountains of Texas. Intriguing bits of information have been brought to light and presented, if not as answers to great problems, at least as suggestions that may lead to a greater understanding of the region.

APPENDIX

Flake Morphology

This Appendix describes the various morphological characteristics defined and used for analysis of the flakes. The system employed is an adaptation of the one used by M.B. Collins (1975:161-172) in his analysis of debitage from sites in Texas and southwestern France. Five categories, or attribute states, were defined and incorporated into a coding scheme. These attributes are platform, bulb, body, length, and material type.

The changes from Collins' system are the substitution of a new set of material types and the elimination of any distinction between blades and flakes. Each of the attribute states is given its own code (see Table 4).

Platform

Platforms are defined in terms of two aspects, shape and surface treatment, with a total of 15 states (see Table 4). Collins defines the platform variable as follows:

> Basically, platforms were either straight or recurved when viewed from the top. Each of these shapes, plus any miscellaneous shapes which might be observed, could be placed in one of four categories of degree of treatment: cortex remaining, single-faceted, double-faceted, and multi-faceted. Also noted were those platforms which were either shattered, broken, or ground. A given platform, then, could be described as "straight, single-faceted," or "straight, cortex," etc. Coding standards for these variables were as follows: the recurvate platform shape, designated "sequent," refers to the shallow, U-shaped platform which results from the sequent removal of a flake directly in line with the negative scar left by the removal of a former flake. When the platform is viewed from above, the edge which intersects the exterior of the flake exhibits an inward curve caused by the concavity of the previous negative bulb; the opposite edge curves outward—usually strongly—with the positive bulb of the flake. The category "straight" includes all platform shapes that are rectanguloid or biconvex. A third category, "other," was used to designate platforms whose shape was neither "straight" nor "sequent," such as triangular. Cortex platforms are those which retain the weathered surface of the raw material and indicate that no preparation of that surface was made prior to flake removal. If the platform has been altered by flaking, it may be described as exhibiting one, two, or more facets. These do not necessarily indicate the number of facets produced in preparation of the platform, but they do indicate the nature of the surface area to which force was applied. For example, in experiments the gable-like intersection of two facets is often found to be an advantageous point for the application of force. Shattered platforms are those whose position is observable, but whose form is not (due to crushing or shattering under the force which removed the flake). Broken platforms are similar in that the position of the platform can be determined, but its form is not observable due to breakage (presumably after removal). These two categories are not to be confused with the "broken flake" category which includes flakes with the platform or another edge completely missing. Ground platforms are generally small and "straight" (usually biconvex) with striations across most of the surface. Although these are generally considered to be intentionally ground in platform preparation, the possibility that some represent use wear cannot be overlooked [Collins 1975:161-165].

See Figure 38 for illustration of platform characteristics.

Bulb

Bulbs are classified according to three attribute states: normal, exuberant, and flat. Collins defines the bulb category as follows:

> Under "normal" are recorded flakes which exhibit a bulb of percussion of average properties, i.e., noticeable but not greatly protuberant. "Exuberant" bulbs are those which protrude strongly and are decidedly rounded when viewed either from the side (perpendicular to the axis of flaking) or from either end (parallel to the flaking axis) [Collins 1975:165].

See Figure 39 for bulb characteristics.

Body

The body attribute category encompasses two aspects, the nature and extent of cortex on the flake exterior and the shape of the flake in cross section. Sixteen body states are defined by Collins as follows:

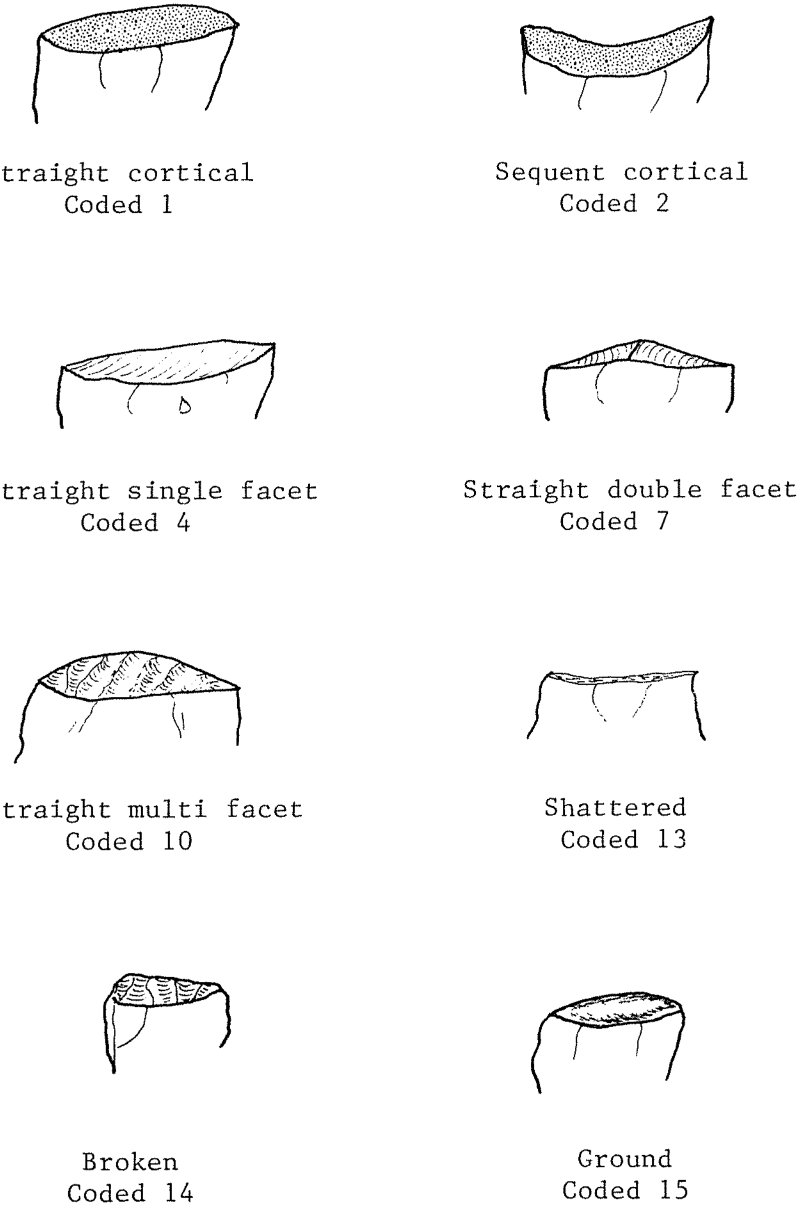
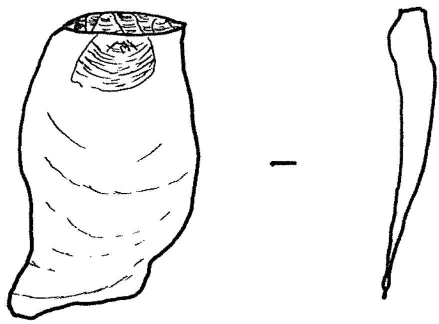
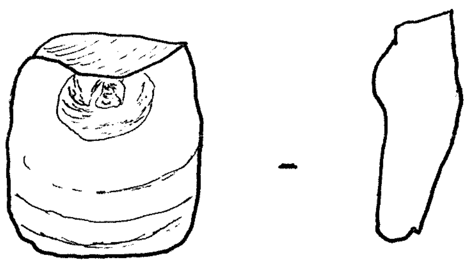


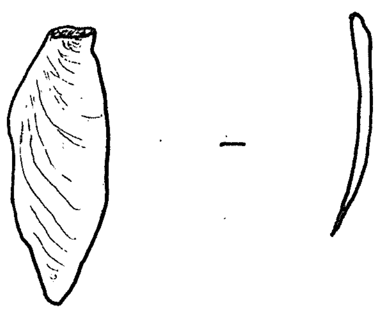
Figure 38. Platform characteristics and their codes.



Normal
Coded 1



Exhuberant
Coded 2



Flat
Coded 3

Figure 39. Bulb characteristics and their codes.

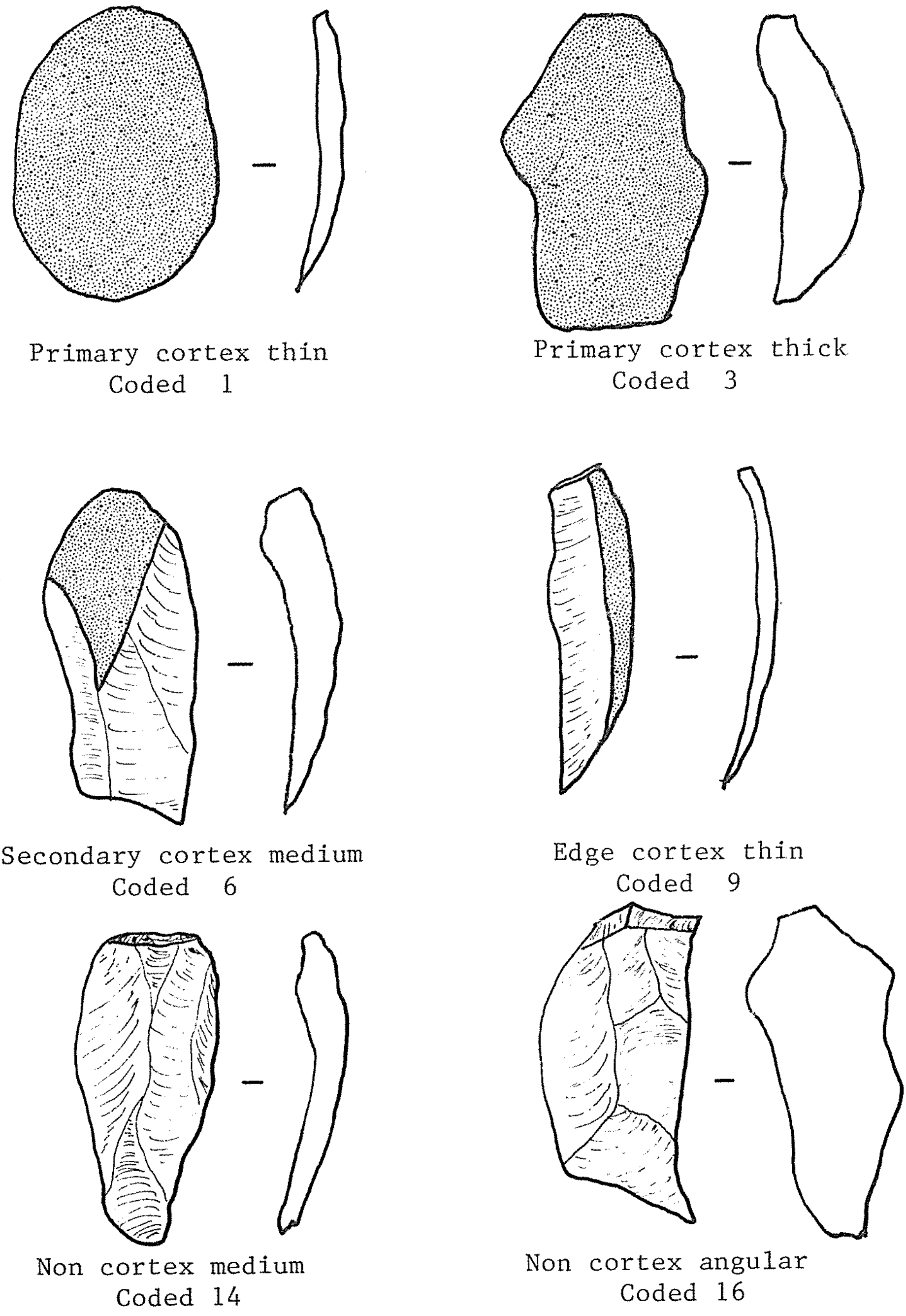


Figure 40. Cortex characteristics and their codes.

> Primary cortex flakes exhibit cortex over the entire exterior and along any edges which are not the sharp intersection between the interior and exterior surfaces. Secondary cortex flakes have cortex on greater than 10 percent of their exterior and may or may not have cortex on any edges. Secondary edge cortex flakes have cortex only along one or more edges, and noncortex flakes lack cortex (or exhibit small patches on less than 10 percent of their exterior). The shape categories are relative. Thin flakes are relatively very thin to length and width, medium ones are intermediate in this regard, and thick ones are relatively thick. Flakes which are thick and have facets on their exterior surface which intersect in an acute angle are recorded as "angular" [Collins 1975:167].

See Figure 40 for illustrations of cortex characteristics.

Length

The length variable was expressed as a discontinuous variable represented by five classes. The length was measured by obtaining the maximum length of the flake perpendicular to the striking platform. The lengths defined are as follows: (1) very small, less than 12 mm; (2) small, 12 to 25 mm; (3) medium, 26 to 50 mm; (4) large, 51 to 100 mm; and (5) very large, more than 100 mm (Collins 1975:169).

Material Type

The material-type variable incorporates the six types defined in the section on stone type analysis. Originally, seven types were defined, including two varieties of limestone. However, after the coding was initiated these two types were combined. Instead of reassigning variable state labels, it was decided simply to combine all limestone under one code number, leaving the other unused.

Each flake in the collection, unless it came from a random surface find, was analyzed according to the five variable states. Site provenience and the attribute state code were recorded on Fortran coding sheets, then keypunched onto cards. These cards provided the basic data, which were processed by the IFREQ and HCLUS programs.

ACKNOWLEDGMENTS

This report would not have been completed if it were not for the support and assistance which I have received from many different quearters, and it is to these people that I wish to extend my most sincere thanks and appreciation. First among those who should be recognized are the members of the Texas Archeological Society who, in the summer of 1970, conducted a survey of Guadalupe Mountains National Park and thus brought together the data that is the focus of this report. Their hard work and diligence is clearly reflected in their copious field notes. Special appreciation is due Harry Shafer, who supervised the survey and who graciously allowed me to use part of the project data. I would like to express my thanks to the University of Kentucky Graduate School, which provided funds to defer travel and subsistence expenses, thus allowing me to travel to the Guadalupe Mountains and conduct my survey of lithic resources. My thanks also go to Roger Reich, park ranger, who offered his advice and assistance to this desert novice during that survey.

The excitement that can be obtained from conducting archeological fieldwork is exceeded only by the tedium that must be endured if anything resembling science is to be obtained from it. Two individuals stand out as ones who shared in that trial and without whose help completion of this report would have been vastly more difficult. Dolores DeCorsey assisted in the coding of flake attributes and relieved me of the task of coding about a third of the assemblage. Carol Straus went far beyond her normal responsibilities as a consultant at the University of Kentucky Computing Center and spent seemingly endless hours, over a period of several months, to bring order out of the chaos of programs. I am deeply indebted to her for for making it possible to utilize the cluster program upon which I have so heavily depended. I also wish to extend my thanks to Don Graybill, who provided me with the clustering program, and to the University of Kentucky Department of Anthropology, which acquired the necessary computer time for me to carry out my research. I am also grateful to Virginia Slattery, who not only typed the manuscript but also caught and corrected many small errors and inconsistencies, thus saving me a tremendous amount of time and worry.

I am sincerely grateful to the members of my thesis committee: to Eugenie Scott for her contributions in the area of statistical application of computers; to Lathel Duffield for his insightful criticisms and appraisal of my methodology and findings; and especially to Michael Collins, chairman, who has guided me through the maze of problems that beset me in my attempt to use lithic technological data in order to understand the behavior behind artifacts. To the extent that this goal has been obtained, Michael Collins shares in the achievement.

Without question this report is as much an accomplishment of my wife Deborah as it is mine. She has patiently endured countless lonely nights as I conducted the analysis and writeup, and she actively encouraged and motivated me to continue when it would have been easier for me to quietly abandon efforts.

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Texas Archeological Society Field Schools 1962 - 1982

Jean A. Richmond, W. L. Richmond, and John W. Greer

ABSTRACT

TAS field schools have grown from a small group of TAS members gathered for a summer dig to a highly organized educational activity for avocational and vocational archeologists. We have attempted to trace this development, presenting the philosophy behind, and the goals for, the annual field schools. The descriptions of 21 field schools at 19 different locations include brief summaries of archeological accomplishments and field school activities.

INTRODUCTION

The 1982 Texas Archeological Society (TAS) annual field school at Rowe Valley marked the twentieth anniversary of the collaboration of Texas archeologists—vocational and avocational—for the improvement of archeological practices and recovery of archeological information.

Our original intent was to focus on 20 years of specific contributions that the TAS field school has made to Texas archeology. As we examined source materials, it became evident that detailed archeological information was available for only a few field schools. As a result, we elected to expand the scope of the article to include details of field school development and training in archeological skills. Briefly stated, we have attempted to: (1) present the specific contributions of TAS field schools to the archeological data pool for Texas; (2) outline the structural development for a hands-on training program in archeology and archeologically related areas; and (3) trace the growth of the TAS field school in education and information dissemination.

The authors have long been interested in, and participants at, the field schools, and it was difficult to exclude many items of personal interest; however, it was felt that anecdotal accounts, for the most part, are best included in the newsletter.

HISTORY AND DEVELOPMENT

"ANNOUNCING: A SUMMER DIG IN WHICH *YOU* CAN PARTICIPATE

When this invitation to Texas Archeological Society members appeared in 1962 in *Texas Archeology* 6(1), neither the organizers of the "dig," the sponsors (the Texas Archeological Society, the Dallas Archeological Society, and the University of Texas in Austin), nor the members of TAS who sent in their applications realized that they were establishing the basis for one of the outstanding programs in Texas archeology—the Texas Archeological Society Annual Field School.

The early field schools were occasions for a group of people who shared an interest in archeology to get together for a dig and to socialize. The dig provided an opportunity to learn a little about archeological methods, but mostly it was an opportunity to help excavate a site that was archeologically exciting, a chance to recover and handle archeological remains, and a chance to share experiences and perhaps exchange archeological information about work being done in various parts of the state. It was a vacation from the workaday world for most of the participants. And, it was a chance to contribute in a small way to the science of archeology.

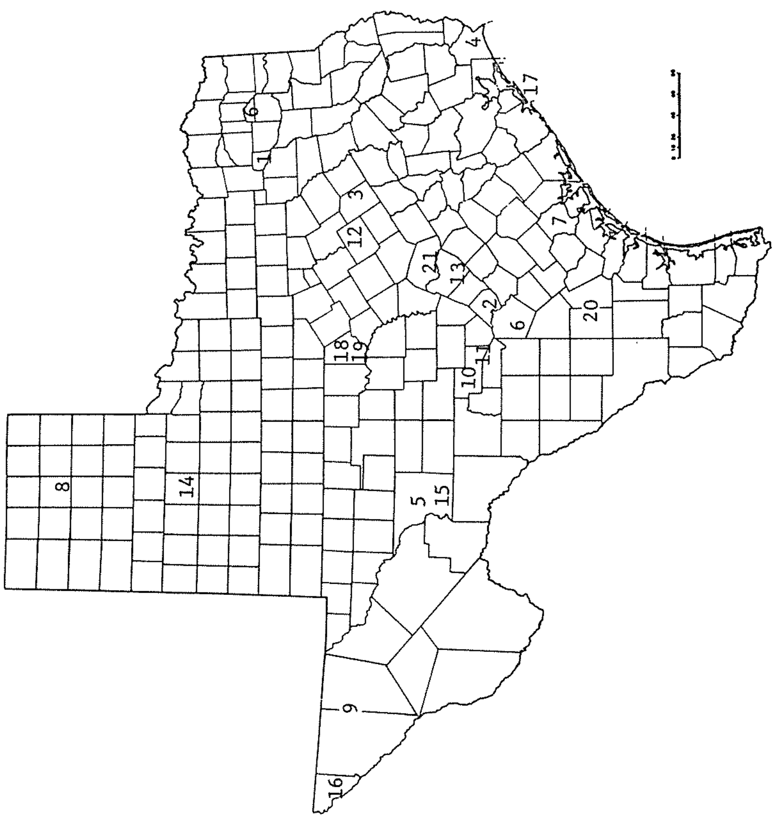
As reported in *Texas Archeology* 6(3), 1962, the "first T.A.S. excavation project" was a "smashing success socially as well as archeologically." Ed Jelks, director of the dig, reported at the TAS Annual Meeting, November 2, 1962, on the "first field school held for TAS members" at the Gilbert site in Rains County (Figure 1). TAS members were enthusiastic, and a motion was made and carried that another field school be sponsored by the society, a host institution, and the university. It was also decided that a director would be appointed from the staff of the university to arrange for the site and the local (cooperating) group, and to make other necessary arrangements.

Administrative Structure

At the time of the inception of the field school in 1962, there were no provisions in the Texas Archeological Society Constitution and By-Laws for sponsored activities. Nevertheless, the program continued and in April 1963 plans for the "Second Annual Texas Archeological Society Summer Field School" were announced in *Texas Archeology* 7(1). In 1964 the board of directors voted to conduct a third field school.

The director for the 1962 and 1963 field schools was the archeologist who had volunteered to be in charge of the dig. By 1964 it was evident that the professional archeologist could not both direct the field school and attend to the many incidental problems associated with running a field camp. At the October 1964 TAS board meeting, Ed Jelks was appointed chairman of the new three-person field school committee, which was given the responsibility of choosing a field school director and making all necessary arrangements for the project.

In December 1964 the board of directors approved a suggestion by Isabel Lobdel that the approach to the summer dig should be that of a school rather than a project. At the same time, it was decided the best time for the school would be two weeks in the middle of June.



1 Gilbert site, Rains County
2 Oblate site, Comal County
3 Vinson site, Limestone County
4 Gaulding site, Jefferson County
5 Dunlap complex, Crockett County
6 Williams (Pittsburg), Camp County
6 Mission San Juan Capistrano,
Bexar County
7 Presidio Loreto, Victoria County
8 Sanford Recreation Area,
Hutchinson County
9 Guadalupe Mountains National Park,
Culberson and Hudspeth counties
10 Kerrville No. 1, Kerr County
11 Kerrville No. 2, Kerr County
12 Asa Warner site, McLennan County
13 McKinney Falls State Park,
Travis County
14 Floydada Country Club site,
Floyd County
15 Musk Hog Canyon, Crockett County
16 Sabine Mountain No. 2,
El Paso County
17 Galveston Island, Galveston County
18 Eubank Ranch No. 1, Brown County
19 Eubank Ranch No. 2, Brown County
20 Choke Canyon, Live Oak and
McMullen counties
21 Rowe Valley, Williamson County

Figure 1. Map of Texas counties with field school locations.

It was recognized that the annual field school had become part of the society's regular activities, and, at the November 1965 annual meeting, the Texas Archeological Society Constitution and By-Laws were amended to include under Article I: Membership and Dues, the privilege of attending and participating in the summer field school. The following provision (Article VI: Field School) was added to the by-laws: "A field school may be conducted when practicable, to train members of the Society in disciplined archeological techniques. The time, place, duration, and administration of the field school shall be at the discretion of the Field School Director, who will be appointed by the President."

Members attending the field schools recognized that logistical problems existed in the operation of the school and the camp. At the October 1966 board meeting, Nancy McClurkan (who had experience in management and public relations and had assisted at the 1966 field school in West Texas) presented a report on analysis and structure of TAS field schools with specific suggestions for future operations. On the basis of her report it was decided that, in addition to the field school director, a camp director should be appointed to take charge of setting up and running the camp. It was also recommended that a general camp mess, using professional cooks instead of volunteers, be established. Other suggested improvements included the following: (1) that a good curriculum for the field school be established well in advance of the session; (2) that performance evaluations of participants be made by crew chiefs; (3) that a strong field school structure be devised to ensure a smooth transition from one TAS administration to another; and (4) that registration forms contain a list of personal equipment that each participant should provide. It was suggested that field school costs be covered by an increase in registration fees. The majority of these suggestions were received favorably, and the budgetary field school allotment was increased from $100 to $200.

Increases in field school registration and meal costs were the result of a formal move in 1968 to make the field school self-supporting. It was decided that any surplus funds would be placed in a special escrow account to be used for field school purposes.

Field School Committee

From 1965 to 1968 the field school committee had consisted of three members appointed annually. In 1969 the committee was increased to include, besides the chairman, five members (two of these to be the archeologist and the camp director) to be appointed annually. Stipends for the archeologist and the camp director were discussed, but no action was taken.

A major change was made in the structure of the field school committee in November 1979. A proposal was presented to the board of directors that a standing field school committee be appointed and that the committee consist of six members with staggered three-year terms. The overlapping terms of committee members would provide a continuity and capability for long-range planning not possible with the annually appointed committees. After a trial period to determine the feasibility of the proposed change, a formal revision of the TAS By-Laws was proposed and passed at the annual meeting in October 1981. Article III was revised to add the following to Section 2, Standing Committees, paragraph (5) *Field School Committee:*

> The Field School Committee shall consist of six members who shall serve three-year terms on a rotating basis, with two members retiring annually. The initial committee shall be appointed by the President and draw lots to determine two each of one-, two-, and three-year terms. Thereafter, the President shall appoint two members annually to replace those who are retiring. The duties of the committee shall be to carry out the directives of Article VI of these bylaws, to solicit and investigate potential field school projects, and to oversee the maintenance and acquisition of Society properties relating to field school operations.

Field Camp and Equipment

Originally an associated institution, such as the University of Texas in Austin, provided most of the field equipment needed for the TAS field schools. Screens, shovels, buckets, line levels, trowels, and wheelbarrows could be borrowed for the short duration of the field school. As archeological work at various universities in Texas increased with governmental requirements for surveys around planned water-impoundment areas, direct alliance of TAS with universities ceased. As a result, TAS members were asked to provide personal field items—clipboards, compasses, trowels, line levels, writing equipment, and, sometimes, buckets and screens. As members added to their personal archeological kits, so, too, did TAS. Gradually the society purchased field equipment, large screens, a portable laboratory, and laboratory supplies.

Purchase of a kitchen trailer, which had been recommended and discussed previously, was approved in January 1970 by the board, and by May a trailer was ready for use at the Guadalupe Mountains National Park field school.

Camp facilities, although still relatively primitive by some standards, have improved (Figure 2). At early field schools it was necessary for teams of volunteers, usually from the local sponsoring society, to work at the camp site during the two weeks before field school. The volunteers dug latrines, gathered or provided field and camp equipment and supplies, erected the large army squad tent that was borrowed from the University of Texas in Austin and that served as a cooking-dining-lab shelter (Figure 3), cleared the proposed camp area, and, in a few cases, constructed access roads—or at least made existing roads passable. Today, equipment other than individual gear is provided by the society. Portable toilets are rented and serviced by the supplier. Electricity and water sources are available and merely have to be connected to the kitchen trailer (Figure 4) and showers. Costs of necessary services and supplies are provided through the registration fees paid by the participants. Local supporting societies and volunteers from among the early arrivals provide the labor required to set up the camp and field laboratory. Members furnish their own camp gear—tents or trailers, ice boxes, chairs, plates and utensils, and tables. The planning, maintenance, and success of the camp is the direct responsibility of the field school chairman and the camp boss.

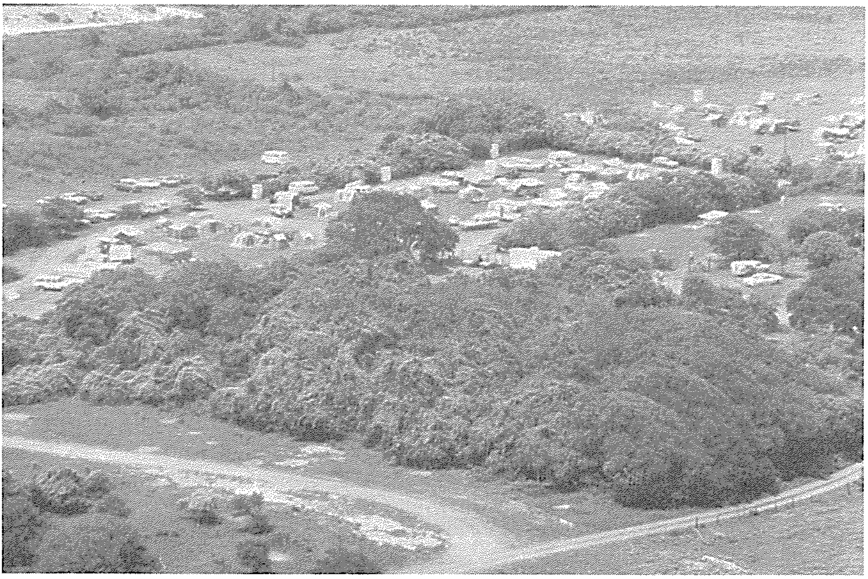


Figure 2. Over the years field camp has grown from a few tents to a small town of 300 people. (Photo: E. Mott Davis)

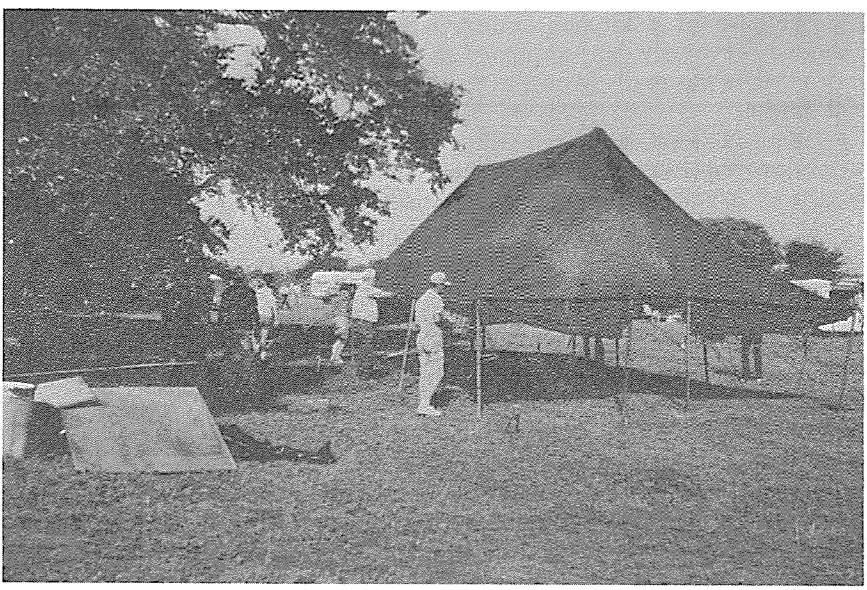


Figure 3. The squad tent served as lab, serving, and conference area. (Photo: E. Mott Davis)

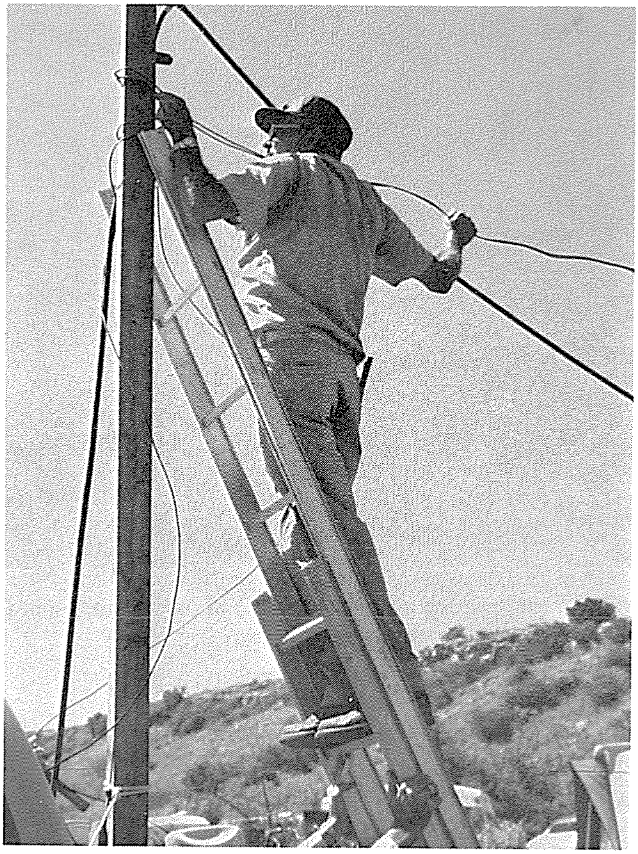


Figure 4. TAS members put up power lines for the cook trailer and for projectors at the evening program. (Photo: Bill Richmond)

Attendance at field schools gradually increased. In 1962 at the Gilbert site, about 77 members participated during the 24-day dig; in 1969 at Sanford, 204 were present; and in 1970, the 245 participants at the Guadalupe Mountains field school far exceeded the anticipated number and taxed the facilities and limited camping area. As a result, at the July 1970 board meeting it was decided that a ceiling should be put on the number of field school participants and that field school planning must begin earlier than the spring before the June field school.

At the August 1970 board meeting it was ruled that the archeologist should be relieved of all duties not directly associated with archeology and archeological planning and theory.

Educational Emphasis

Ed Jelks, director of the first field school at the Gilbert site stated: "It was not a field school, nor was its purpose to train amateurs how to dig; whatever

Figure 5. A talk on tool-making techniques is part of the instruction of field school participants. (Photo: Bill Richmond)

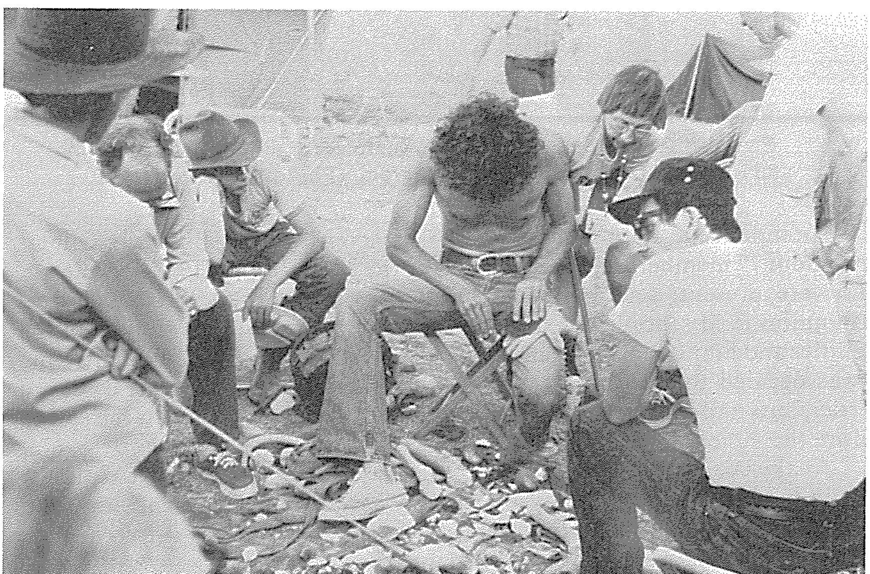


Figure 6. Glen Goode demonstrates a variety of flint knapping techniques. (Photo: E. Mott Davis)

was learned about field techniques by the participants was incidental to the primary objective of getting the site excavated" (Jelks 1967:iii).

Although the first few field schools were conducted primarily as digs, an educational format soon began to take shape (Figure 5). Participants gathered in the afternoons and evenings to discuss not only what they were doing, but also archeological theory, methods, discoveries, and contributions. Vocational archeologists, always present at these gatherings, openly shared their wide variety of archeological experiences.

With the suggestion by Isabel Lobdel at the December 1964 board meeting that the "approach be that of a school rather than a project," the direction in which the summer digs had been moving became formalized. Field school participants received instruction in a variety of field techniques: site survey; excavation of burned rock middens, terrace sites, historic and prehistoric structures, and rockshelters; recording rock art; and laboratory work, including washing and cataloging artifacts. Afternoon instruction, when it occurred, often included activities such as flint knapping (Figure 6), floral and faunal identification, and pottery making. Evening programs became regular events and involved not only the professional archeologists attending the field school, but also invited speakers with expertise in specific aspects of archeology, geology, geography, ethnology, and other fields of related interest.

Conditions and Operations

A committee appointed in 1969 for study of field school conditions and operations reported in January 1971 to the board and recommended that the field school be a continuing program. Specific suggestions were made for the school, including:

1) The field school is for teaching and should be planned in terms of teaching.
2) Curriculum should include theory and technique.
3) The field school should include an awareness of other archeological programs in the state.
4) Teaching methods should include specific topic lectures.
5) The field school committee should consider having the school in the same location for two or three years.
6) There should be an increase in the archeological staff, possibly to include archeological assistants.

The Guadalupe Mountains field school in 1970, which resulted in limiting the number of participants, also brought the realization that the field school needed careful and detailed planning as well as financial assistance for certain staff members. The board of directors allotted $50 to the archeologist for the preparation of a preliminary report. For the first time there was official recognition of the time required of, and expenses incurred by, the archeologist.

In 1971 the board granted a fee of $750 for the archeologist in charge, this fee to compensate for field expenses and to defray costs of preparing a formal archeological report. At the June 1974 board meeting a motion was made and passed to pay the archeologist $1500 on the receipt of a 50- to 100-page print-ready manuscript. However, changes were suggested in the payment schedule at the January 1975 board meeting. Alan Skinner suggested that the archeologist receive $500 at the completion of field school, $200 for a summary report as soon after the field school as possible, and a remaining balance of $700 to be paid on receipt of a final report manuscript for publication. This suggestion was approved by the board in March 1975.

In addition to setting partial compensation to the archeologist for report preparation, board members and the field school committee felt that a contract outlining what the TAS expected of the archeologist was needed. At the January 1977 board meeting, a formal contract was proposed to protect the interests of both the archeologist and TAS.

Field Training and Site Selection

Education of participants in archeological field methods has been a primary goal of the field school. As various individuals became adept in field techniques, they were asked to assume the role of crew chiefs and to train less experienced members (Figure 7). In June 1966 the recommendation was made that the crew chiefs make specific performance evaluations of their crews and that these evaluations be used in selecting future crew chiefs. In actual practice, the use of formal evaluation forms has not been accepted; personal, informal evaluations are preferred.

In the mid-1970s an appointed committee worked for over a year on a field school manual that would outline general goals and specific procedures for crew chiefs. It was expected that the manual would provide consistency in the quality and performance of instructional activities. In March 1975, 30 copies of the first manual for crew chiefs were delivered for distribution and use at field school.

In addition to training field crews, crew chiefs submit to the project archeologist written reports (Figure 8) on daily and overall activities. This information is used in a variety of ways, including the preparation of the preliminary and final archeological reports.

A list of suggested readings is published in the spring issue of *Texas Archeology* preceding the field school. The readings enable prospective field school participants to become familiar with regional archeological research relevant to the site of the forthcoming field school. Although bibliographies of suggested readings had been published for several years, the practice was formalized by a recommendation of the board of directors in April 1969.

The successful, basically unsupervised work of the young people at the Oblate site (1963) laid the groundwork for the early "Beaver Patrol" and current Youth Program. Under this program, young people under the age of 14 who have had no field experience are instructed in many aspects of field work through limited excavation and other activities that are specifically planned for their interests and abilities. Participants in the Youth Program have made positive contributions to the school through surveying, excavation, and ecological studies. Other activities vary with the interests of the group's leaders and have included field trips and experiments in pottery making, rock art, lithic manufacture, cooking, fishing, and construction of habitation

Figure 7. Crew chiefs are briefed on field school plans. (Photo: Bill Richmond)

Figure 8. Crew chief E. Mott Davis keeps daily notes, which are filed for reference. (Photo: Rosanne Henna)

structures. Many archeologists in Texas and elsewhere can trace their early interest in archeology to this program.

TAS field school participants represent a wide variety of occupations and talents: farmers, ranchers, oil field workers, teachers, secretaries, surveyors, artists, photographers, doctors, lawyers, homemakers, and students are a few examples. Except for the very young, there are ways in which each person may contribute to the field school. Members with physical restrictions of mobility, sight, hearing, or age participate in activities such as screening, washing and cataloging artifacts, record keeping, and, depending on the member's experience, assisting and instructing newcomers.

It has been the practice of the board and of the field school committee to select field school sites that offer a variety of experiences to participants, not only in the type of field work to be done but in location within the state and kind of site. As a result, field school participants have experienced site surveys and excavations in the Hill Country; excavations at a historic presidio in southeast Texas; excavation of Caddoan burial sites in deep East Texas; site survey and excavation of prehistoric and historic sites on Galveston Island; excavation of a Panhandle aspect site near Amarillo; area survey and excavations of burned rock middens and rockshelters near the Pecos River; and site survey and rock art recording in Guadalupe Mountains National Park on the Texas-New Mexico border. In all, 19 different areas of Texas (see Figure 1), each with its unique archeological puzzles and natural setting, have been investigated. The profusion of potential archeological data and the variety of field experiences offered, in addition to the hospitality of the landowners, have enabled TAS to conduct field schools for two successive years at each of two locations (Eubank Ranch in Brown County and Paris Ranch in Kerr County) and for three successive years at one location (Rowe Valley in Williamson County).

That TAS is recognized for its professional level of training is evidenced by the collaboration with TAS of both state and federal agencies: the National Park Service at Sanford Reservoir (Figure 9) and Guadalupe Mountains National Park; the Texas Parks and Wildlife Department at McKinney Falls State Park and Galveston Island; and the Texas Highway Department at Musk Hog Canyon and in Kerr County.

Since the beginning of the field school, college students interested in archeology have participated on an informal basis. Occasionally students of the cooperating archeologist have attended for the purpose of gathering data for a report or publication. For example, several students from Texas Tech University attended the Sabina Mountain No. 2 field school near El Paso as part of their field training. Formal academic recognition of the TAS field school came in 1982 at Rowe Valley when Dr. John Fox, director of the anthropology program at Baylor University, accepted student Carol Kehl's plan for an individual study program (Carol Kehl: personal communication). The plan, as outlined, required attendance at the TAS field school, reading and reporting on the suggested readings published with the field school announcement, and a detailed oral report at the end of the summer semester. The course carried three hours of undergraduate credit. Elton Prewitt, archeologist, and Jane Schweitzer, coordinator for the field crews, designed a program that allowed Kehl to experience all phases of field school.

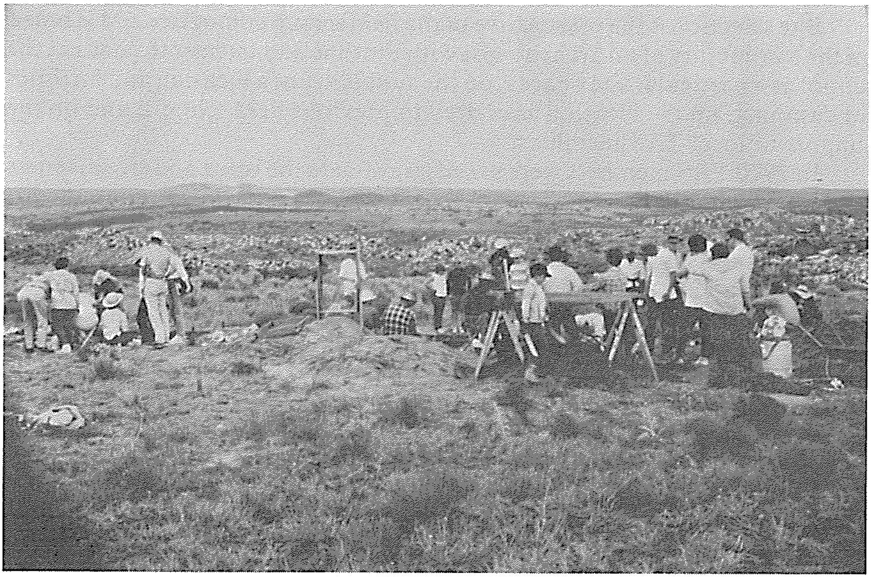


Figure 9. At Sanford Reservoir, TAS had the support of the National Park Service. (Photo: E. Mott Davis)

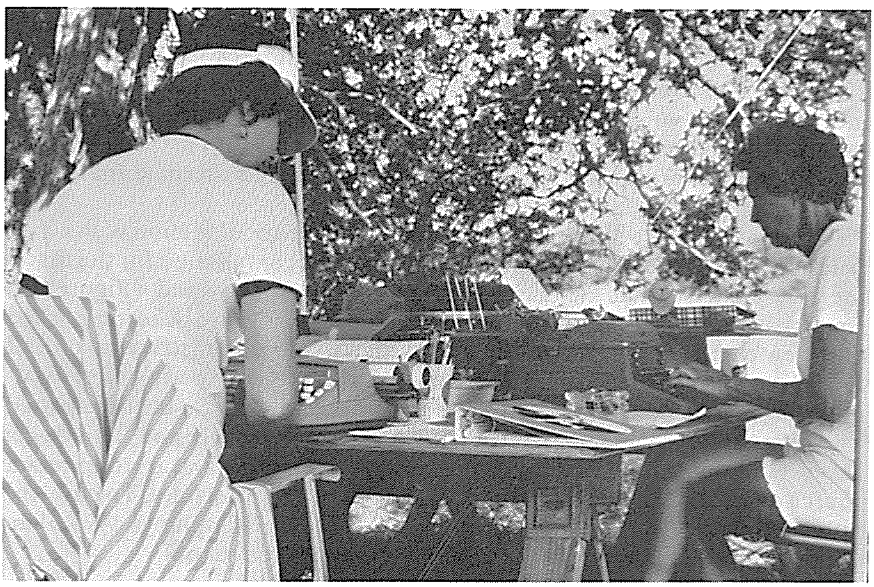


Figure 10. Norma Hoffrichter and Carroll Hedrick work on the writing project at Brownwood. (Photo: Bill Richmond)

Site selection is the prerogative of the field school committee and is based on the availability of an archeologist with the time and interest to conduct the school at a particular site or area, on the suitability of a location and facilities for camping, on the location as related to previous field schools, and on the support of local TAS members.

In 1970 TAS members were asked to evaluate the value and effectiveness of the field school program. The results of the questionnaire were presented at the February 1971 board meeting. Responding members considered the most valuable aspects of field school to be the archeological training they received and the chance to meet and associate with other people interested in archeology. Less than 5 percent of the respondents suggested that the evening lectures needed to be better organized. Responses to a question about the overall effect of the field school were almost unanimous in stating that personal improvement in archeological techniques resulted from participation in field schools.

Information Dissemination

Archeological data, like any other scientific information, is of little use unless it is disseminated. For this reason, TAS members have been encouraged to publish their work (whether resulting from field school or from other areas of study) either as articles in the TAS *Bulletin* or newsletter, as papers at the annual meeting, or as articles in regional archeological society publications, such as *La Tierra* (San Antonio), *The Artifact* (El Paso), and the *Bulletin of the South Plains Archeological Society* (Floydada).

The archeologist's report, one of the most important sources of specifc field school data, may not be published for several years after the date of the field work. Reasons for delays include the lack of funds for special analyses and the lack of available time for the archeologist to work on the report. TAS members often volunteer to analyze data and write sections for the final report. Extenuating circumstances, such as illness, may prevent the completion of a report. In these cases it becomes necessary to find an alternate analyst and author.

One of the more difficult projects undertaken in conjunction with a TAS field school was the writing assignment and report compilation for the first of the two field schools at Eubank Ranch near Brownwood (Figure 10). Emphasis was placed on daily records and summaries of work accomplished, and crew chief Norma Hoffrichter was placed in charge of instruction on daily recording and compilation of the report. The writing experiment proved a much more time-consuming and difficult project than was first contemplated. The final result, compiled and edited by Norma Hoffrichter and Beth Ogden Davis (1981), was issued as a TAS special publication and is an excellent source of data and general information on the 1979 field school. To date, this publication and an article in *Texas Archeology* (G. Humphreys 1979:3) are the only published reports of the 1979 Eubank Ranch school.

The TAS field schools are unique in that vocational and avocational archeologists work together to attain common goals. The success and interest generated by the TAS program has encouraged at least one other state group to initiate a field school program. E. Mott Davis reported to the board at the March 1972 meeting that the Arkansas Archeological Society planned to institute a field school for amateur archeologists. Their interest was generated by the national publicity which the TAS field school had received.

An avocational certification program is incorporated into the field school programs of both Arkansas and New Mexico. In response to membership interest in a similar program for Texas, a TAS committee was appointed to study the Arkansas and New Mexico programs. At the board of directors meeting in October 1973, the committee reported that TAS should not incorporate a certification program since it was not considered necessary or advantageous.

Media coverage of field schools has long been recognized for its value in increasing public awareness of the value of archeological and historic resources. However, media coverage of archeological projects can result in a crowd of visitors who may unintentionally impede or disrupt fieldwork or damage sites. For some field schools, such as the Sanford Reservoir project, the traditional press conference was scheduled on the day before the end of field school, with the agreement that the locations of sites and field camp not be identified. In later years, however, the positive value of widespread media coverage has been recognized, and media personnel have been welcome to visit the sites and the camp activities during the field school. To date, disruption of archeological work and other field school activities has been minimal.

Together with articles in the TAS *Bulletin* and newsletter and formal archeological presentations at the annual meeting, media coverage has assisted the TAS field school program by making the people of Texas aware of the diversity and significance of their historic and prehistoric heritage.

SUMMARY OF TAS FIELD SCHOOLS, 1962-1982

The following summaries are intended as descriptions of field school activities, with emphasis on archeological aspects. Field school summaries are presented in chronological order and include information on the project archeologist, archeological sites investigated, and work accomplished. Administrative information is summarized in Table 1; report information, in Table 2; and archeological work, in Table 3.

Most site numbers are the trinomial numbers (Smithsonian system) assigned by the Texas Archeological Research Laboratory, Austin (e.g., 41TV12, with 41 indicating Texas; the next two letters, the county designation; and the final number, the site). Southern Methodist University numbers are preceded with an X (e.g., X41LR8). Some national recreation areas do not use the trinomial system and their numbers are preceded with area letter designations (e.g., Sanford Recreation Area sites are preceded with SARE).

Table 1. TAS Field School Administrative Data

Date	School	County	Archeologist	Field School Chairman	Camp Boss	Number Attend.	Local Arch. Soc. Sponsor
1962	Gilbert	Rains	Jelks			77	Dallas
1963	Oblate	Comal	Tunnell & Davis			70	Travis Co.
1964	Vinson	Limestone	Story			*	Tarrant Co.
1965	Gaulding	Jefferson	D. Lorrain, McClurkan, & Olds			50+	Beaumont
1966	Dunlap	Crockett	McClurkan			150+	
1967	Williams	Camp	Woodall			80-100+	
1967	Mission San Juan Capistrano	Bexar	Schuetz, Fox, & Wise			42	
1968	Presidio Loreto	Victoria	Davis, Fox, & Tunnell	Bollich	Zoeller	147	
1969	Sanford Rec. Area	Hutchinson	Hughes	Word	Bandy	204	
1970	Guadalupe Mntn. National Park	Culberson, Hudspeth	Shafer & D. Lorrain	F. Stickney	F. Stickney	245+	Midland
1971	Kerrville #1	Kerr	Skinner	Burleson	Locke	300+	Hill Country
1972	Kerrville #2	Kerr	Skinner	Locke	Bandy	250+	Hill Country
1973	Asa Warner	McClennan	Briggs & Mallouf	Locke	P. Lorrain	200+	Central Texas
1974	McKinney Falls State Park	Travis	McEachern & Ralph	Fullen	Richmond & P. Lorrain	230+	Travis Co.
1975	Floydada Country Club	Floyd	Skinner	Word	Carter	210+	South Plains

Table 1. TAS Field School Administrative Data (Continued)

Date	School	County	Archeologist	Field School Chairman	Camp Boss	Number Attend	Local Arch. Soc. Sponsor
1976	Musk Hog Canyon	Crockett	Shafer & Moore	F. Stickney	Eubank & Smelley	*	Iraan
1977	Sabina Mnt. #2	El Paso	Mayer-Oakes	Davis	White	233	El Paso
1978	Galveston Island	Galveston	Atkins	McClure	Magan	326	Houston
1979	Eubank Ranch #1	Brown	Humphreys	Richmond	Everett	275+	
1980	Eubank Ranch #2	Brown	Humphreys	Richmond	Everett & T.L. Stickney	200+	
1981	Choke Canyon	Live Oak, McMullen	Hall	Richmond	Richmond	232	
1982	Rowe Valley	Williamson	Prewitt	F. Stickney	Carpetas	212+	Travis Co.

*Information not available.

Table 2. Status of TAS Field School Reports

Date & School	Archeologist	Final Report	Additional Publications*
1962 Gilbert	Jelks	Jelks 1967	
1963 Oblate	Tunnell & Davis	NA	Davis 1963b
1964 Vinson	Story	NA	Davis 1964b; Harris & Harris 1969a, 1969b, 1969c, 1969d, 1969e
1965 Gaulding	D. Lorrain	NA	Bollich 1965; Davis 1965b
1966 Dunlap	McClurkan	Word 1971	Davis et al. 1966; Word 1967
1967 Williams	Woodall	NA	Woodall 1967
1967 Mission San Juan	Schuetz	Schuetz 1968b, 1969	Schuetz 1967, 1968a
1968 Presidio Loreto	Davis & A. Fox	A. Fox, in prep.	Davis 1968b; Davis & Sharp 1968; P. Lorrain 1970b
1969 Sanford Rec. Area	J. Hughes	B. Couzzourt, in prep.	M. Hughes & Davis 1969
1970 Guadalupe Mntns.	Shafer & D. Lorrain	NA	Shafer 1970a, 1970b; Steed 1970; Clark 1974; Phelps 1974; Boisvert 1980
1971, 1972 Kerrville #1 & # 2	Skinner	Skinner 1974	Skinner 1971b, 1971c, 1972a, 1972b

Table 2. Status of TAS Field School Reports (Continued)

Date & School	Archeologist	Final Report	Additional Publications*
1973 Asa Warner	Briggs	Pending	Briggs 1973
1974 McKinney Falls	McEachern & Ralph	McEachern & Ralph 1980a, 1981	Calvert 1981a, 1981b
1975 Floydada Country Club	Skinner	Pending	Skinner 1975a, 1975c, 1975d
1976 Musk Hog Canyon	Shafer & G. Moore	Excavation: W.E. Moore 1983; Survey: pending	Shafer & G. Moore 1976b, 1976c; Keller & Fullem 1977
1977 Sabina Mntn. #2	Mayer-Oakes	Pending	Mayer-Oakes 1977, 1979; Mayer Oakes et al. 1977; Thoms 1977a; Montgomery 1977a; Bandy & Davis 1977
1978 Galveston	Bruce	Pending	Bruce 1978a, 1978b
1979, 1980 Eubank Ranch #1 & #2	G. Humphreys	Pending	G. Humphreys 1980b; Hoffrichter & Davis 1981
1981 Choke Canyon	Hall	Pending	Hall 1981b
1982 Rowe Valley	Prewitt	Pending additional work	Prewitt 1982b

*Does not include nonarcheological accounts that have appeared in ***Texas Archeology***, the TAS newsletter.

Table 3. Summary of Archeological Work Performed at TAS Field Schools

Date/ Field School	Site Number	Site Classification: Lithic Scatter	Campsite/ Living Area	Mound/ Midden	Burned Rock Midden	Shell Midden	Hearth	Burial	Rockshelter	Pre-, Proto-historic Structure	Historic Structure	Type of Work: Excavation	Site Survey	Survey/ Mapping	Test	Collection	Temporal Context: Paleo-Indian	Late Paleo-Indian	Early Archaic	Middle Archaic	Late Archaic	Late Prehistoric	Historic Indian	Historic 1600-1800	Historic Post 1800	Undetermined
1962 *Gilbert site*	41RA13		X	X	X							X	X										X			
1963 *Oblate site*	41CM1								X			X								X		X				
1964 *Vinson site*	41LT1			X						X		X										X	X			
1965 *Gaulding site*	41JF27					X		X				X		X	X	X						X				
1966 *Dunlap sites*	41CX5			X	X				X			X		X		X				X	X	X				
	41CX6								X						X	X					X					
	41CX7								X						X	X					X					
	41CX8				X										X	X										
1967 *H. Williams (Pittsburg)*	41CP10			X				X		X		X	X			X						X	X			
1967 *Mission San Juan*	41BX5										X	X				X								X	X	
1968 *Presidio Loreto (Victoria)*	41VT8							X			X	X		X	X	X			X	X	X	X	X	X		
1969 *Sanford Reservoir*	SARE145		X							X		X				X						X				
	SARE146		X							X		X				X						X				
	SARE147		X							X		X				X						X				
	SARE242							X				X				X						X				

Table 3. Summary of Archeological Work Performed at TAS Field Schools (Continued)

Date/ Field School	Site Number	Site Classification										Type of Work					Temporal Context									
		Lithic Scatter	Campsite/ Living Area	Mound/ Midden	Burned Rock Midden	Shell Midden	Hearth	Burial	Rockshelter	Pre-, Proto-historic Structure	Historic Structure	Excavation	Site Survey	Survey/ Mapping	Test	Collection	Paleo-Indian	Late Paleo-Indian	Early Archaic	Middle Archaic	Late Archaic	Late Prehistoric	Historic Indian	Historic 1600-1800	Historic Post 1800	Undetermined
1970 *Guadalupe Mntns. Nat'l Park*	150 visited;															X					X	X			X	
	139 recorded	X	X		X		X		X		X	X	X			X					X	X			X	
1971																										
1972 *Kerrville No. 1 & 2*	X41KR1		X		X		X									X					X	X				
	X41KR42		X		X							X				X										X
	X41KR70	X			X									X		X			?	?	?					
	X41KR94	X			X									X		X					?	X				
	X41KR116								X						X	X					X	X				
	X41KR128	X	X											X		X					X					
	X41KR166				X							X				X					X	X				
	165 recorded	X	X		X		X										X	X	X	X	X	X				
1973 *Asa Warner*	41ML46		X						X			X				X				X	X	X				
1974 *McKinney Falls State Park*	41TV289		X								X	X	X	X	X	X				?	?	?			X	
1975 *Floydada Country Club*	X41FL1		X									X		X		X					X	X		X	X	
	X41FL2		X									X		X		X						X				
	X41FL3		X									X		X		X						X				
1976 *Musk Hog Canyon*	435 recorded	X			X		X		X				X			X		X	X	X	X	X				

Table 3. Summary of Archeological Work Performed at TAS Field Schools (Continued)

Date/ Field School	Site Number	Site Classification										Type of Work					Temporal Context									
		Lithic Scatter	Campsite/ Living Area	Mound/ Midden	Burned Rock Midden	Shell Midden	Hearth	Burial	Rockshelter	Pre-, Proto-historic Structure	Historic Structure	Excavation	Site Survey	Survey/ Mapping	Test	Collection	Paleo-Indian	Late Paleo-Indian	Early Archaic	Middle Archaic	Late Archaic	Late Prehistoric	Historic Indian	Historic 1600-1800	Historic Post 1800	Undetermined
Musk Hog Canyon (continued)	41CX133								X			X			X	X				X	X					
	41CX218				X							X			X	X										X
	41CX238				X							X			X	X										X
	41CX241				X							X			X	X										X
1977 *Sabina Mntn. No. 2*	37 re-corded;	X	X		X		X			X			X	X		X					X	X				
	Sabina No. 2						X			X		X		X		X						X				
1978 *Galveston Island*	10 re-corded;		X								X		X		X							X			X	
	41GV66		X					X				X			X	X						X				
	Hall site		X								X				X								X		X	
1979, 1980 *Eubank Ranch No. 1 & 2*	61 re-corded;	X		X	X				X		X		X						X	X	X	X			X	
	41BR9				X							X		X	X							X				
	41BR102										X			X		X									X	
	41BR103	X					X					X		X		X						X	X		X	
	41BR104				X		X					X		X		X					?	?				
	41BR105			X								X		X		X					?					
	41BR106			X	X							X		X		X				?	?					
	41BR107	X	X				X							X		X					?	X				
	41BR108										X	X				X									X	
	41BR109		X		X							X		X						?	?					
	41BR110	X	X	X	X		X					X		X		X					X	X			X	
	41BR111		X									X		X		X					?	?				
	41BR147							X				X				X							X			
	41BR177										X			X		X									X	

Table 3. Summary of Archeological Work Performed at TAS Field Schools (Continued)

Date/ Field School	Site Number	Site Classification: Lithic Scatter	Campsite/ Living Area	Mound/ Midden	Burned Rock Midden	Shell Midden	Hearth	Burial	Rockshelter	Pre-, Proto-historic Structure	Historic Structure	Type of Work: Excavation	Site Survey	Survey/ Mapping	Test	Collection	Temporal Context: Paleo-Indian	Late Paleo-Indian	Early Archaic	Middle Archaic	Late Archaic	Late Prehistoric	Historic Indian	Historic 1600-1800	Historic Post 1800	Undetermined
1981 *Choke Canyon*	41LK51		X									X			X						X	X				
	41LK53										X			X		X									X	
	41LK74		X									X			X	X				X	X				X	
	41LK202										X	X				X									X	
	41MC55		X				X					X			X	X						X				
	41MC67										X	X				X									X	
	41MC222		X									X			X	X						X				
	41MC296		X									X				X					X	X				
	5 sites, House Ranch	X														X				X	X				X	
1982 *Rowe Valley*	18 surveyed;	X	X		X					X	X		X			X			X	X	X	X			X	
	41WM437		X									X		X	X	X						X				

1962: Gilbert Site (41RA13)

Rains County, northeast Texas, June 22-July 15
Director: Edward B. Jelks
Site types: encampment or village area
Work done: excavation—5 middens; site survey
Temporal context: Protohistoric (Historic Indian)
Number of participants: 77

The Gilbert site (41RA13) is located in Rains County in northeast Texas, about 70 miles east of Dallas. The site consists of a series of low mounds located on a hill above Lake Fork Creek. The area contains a wide variety of animal and plant forms—edible (wild blackberries and persimmon) and inedible (poison ivy). Soils in the area of the site consist of red and yellow clays overlain with a fine sand topsoil. Most cultural materials and features were in the sand layer.

Harold Akins of Sulphur Springs originally noted the site in the spring of 1962. Further investigation by R.K. Harris of Dallas verified that the area was probably the location of an Indian encampment or village which, based on the mixture of European and Indian artifacts, predated A.D. 1800.

Tests in two of the site middens produced materials which indicated that the site was of the Norteño focus (eighteenth-century Wichita Indians) dating approximately A.D. 1700-1850 (Jelks 1967:3-4).

The field school camp was located in a loosely designated area near the site. The number of participants per day during the 24-day survey and dig was seldom as many as 30, although the total number over the period of the dig was 77. Meals were prepared by participants (usually two people drew KP for each meal or, in some cases, for the day). A large tarp held up by small trees cut for the purpose and guyed by ropes to larger trees served as a cooking, dining, and lab shelter. Portable stoves and scrounged, donated, and borrowed pots, pans, and cook gear on homemade tables constituted kitchen equipment. Considerable good-natured heckling by hungry onlookers often accompanied preparation of the evening meal.

Work crews of 6 to 10 people during the week and as many as 30 on the weekends recorded 17 middens in the site area. Additionally, two pits which apparently had been used for storage were found. No evidence of permanent structures such as post molds or floors was noted. What appeared to be bits of wattle-and-daub were observed and might indicate locations of possible structures (Jelks 1967:14).

Five small middens were excavated by the field school participants. The number and variety of recovered artifacts contributed to the high morale of the workers. An unexpected stratigraphic problem appeared in the form of a clay mound on top of a midden layer (Davis 1962). It was thought that individual middens represented house structure locations, but no physical evidence of houses was found (Jelks 1967:13-14).

Artifacts recovered at the Gilbert site, although of both Indian and European origin, are believed to represent only an Indian occupation. Certain European materials were adapted by the Indians; for example, arrow points were crafted from flattened gun barrels, bits of brass, and various decorated metal gun fittings (Jelks 1967:30). Metal arrow points, referred to as Benton points, have been found in other sites designated as Norteño focus sites and are estimated to date from the mid-eighteenth to mid-nineteenth centuries (Harris et al. 1967:32). Parts of guns of both English and French origin also support the 1700-1850 estimated dates for the site.

A wide variety of ornaments are of both Indian and European origin. Numerous European trade beads were recovered, as well as objects that apparently were adapted as ornaments, including a coin pendant bearing the date 1749, and two metal buttons. On the basis of bead style alone, dates for the Gilbert site could be estimated to be 1740-1770 (Harper et al. 1967:87-104).

Of the Indian artifacts found, 2,221 pottery sherds, representing a large number of vessels, are certainly the most numerous. The sherds, decorated and undecorated, also represent a variety of vessel types. The ceramics and the geographical location of the site imply a Caddoan association, but diagnostic ceramics to support this conclusion are not present (Story et al. 1967:165).

The final conclusion drawn by Jelks and his associates reflect the success of the investigations: "knowledge of 18th Century French trade goods on the southern plains—guns, beads, knives and the like—is enlarged considerably by the findings at Gilbert" (Jelks 1967:244). To say the least, that was quite an auspicious beginning for the TAS field schools.

1963: Oblate Site (41CM1)

Comal County, Central Texas, June 22-July 7
Directors: Curtis Tunnell and E. Mott Davis
Site type: rockshelter and terrace
Work done: excavation—rockshelter 41CM1; deep test on terrace
Temporal context: Archaic-Late Prehistoric
Number of participants: 70

In June 1963 the second annual TAS summer field school was held on property formerly owned by the Oblate Fathers in Comal County. The property was located below the anticipated reservoir level of Canyon Dam, and TAS work was conducted in the anticipation of probable loss of archeological data as well as loss of any future opportunity to salvage data.

The general purpose of the TAS field school was outlined in *Texas Archeology* 7(1), April 1963: (1) to carry out the excavation and analysis of a significant archeological site (or sites) through the coordinated efforts of the society membership; and (2) to provide society members with instruction in scientific methods and techniques of archeological work.

All materials collected were placed under the custodianship of the University of Texas and the Travis County Archeological Society. It was formally stated that no specimens would revert to individual collections.

The Oblate site (41CM1) was located on the east side of and above Spring Creek, a small, intermittent stream which flowed into the Guadalupe River approximately 300 yards to the north. The area, located 12 miles northwest of New Braunfels, was subsequently inundated when the Canyon Dam reservoir was filled.

Archeologist Curtis Tunnell had participated in Canyon Reservoir archeological work in 1959 and 1960 (see Tunnell 1962) and was considered the logical director of the field school. Additional archeological supervision, suggestions, and shovel-handling were offered by E. Mott Davis, Lathel Duffield, Ed Jelks, Dan Scurlock, and Dee Ann Story (Davis 1963b:6).

The site consisted of a rockshelter at the base of a limestone bluff above a small creek. The northern half of the shelter (75 x 10 feet*) contained about three feet of deposit. The deposit beyond the shelter overhang was considerably deeper. Excavations were carried out within the shelter and in the deeper deposits in front of the shelter. The deep test was dug to a depth of 12 feet during the course of the field school. After the official school closed, some members continued to work during the next two weeks, but bedrock was never reached.

Objectives for the field school included an attempt to establish a more complete temporal/stratigraphic sequence for Central Texas archeology through diagnostic point types and radiocarbon dating. The occupation/use area was considered to be Middle Archaic on the basis of Pedernales and Bulverde points, which were found as deep as 12 feet in the deep-test pit (Davis 1963b:6). Although no conclusive evidence for a stratigraphic sequence was established, work done by TAS at the Oblate site confirmed the results of the initial site investigation (Johnson et al. 1962). Artifacts diagnostic of Archaic and Late Prehistoric periods included dart and arrow points, beads, and a variety of tools.

The TAS youth program was initiated at the Oblate field school. The program originated as activities to keep the youngsters occupied when parents instructed them to "go play" in the southern portion of the shelter. It soon became obvious that the young people were capable of much more than play. They set up a square, excavated it, screened the material, and bagged all artifacts. They literally worked like beavers, thus earning the name Beaver Patrol. The names of some of the beavers have been lost to memory, but it is known that Johnathan and Hugh Davis and Michael and Ann Richmond were included. Future field schools incorporated more formal educational programs for young people, and these programs have been the cornerstone of a career in science for many of the beavers.

The number of daily participants varied from as few as 8 to as many as 30. Participants brought their own camping equipment and camped in an open area about 200 yards west of the site. Two big squad tents were erected, and cooking, eating and laboratory chores were conducted under their shelter. As at the Gilbert site, members took turns with meal preparation and cleanup. An assessed fee for meals was on a per capita basis (Davis 1963a:2).

Participants were not expected to provide their own digging equipment, since most materials were provided by the University of Texas in Austin. Some members, however, did prefer to bring personal items such as trowels, clipboards, and compasses. Members of the Travis County Archeological

*Editor's note: Since this article is a historical narrative, rather than a scientific report, measurements have not been converted to metrics in order to avoid disruption of the narrative.

Society assisted in camp preparation, constructed paths to the site, and mowed and sprayed the camp area.

Informal discussions, lectures, and films or slides were presented in the evenings. Two films shown were from the *Spadework for History* series of archeological films being made by E. Mott Davis and the University of Texas; a third film in the series was made at the Oblate site after the close of field school. Backfilling of the excavation area was postponed until after filming. The need for electricity for the filming activity resulted in a bonus for the field school, since an electrical line was run to the site and was available for use (Davis 1963b:6).

A description of the late-evening activities is best given by E. Mott Davis (1963b:7): "the pickin' and singin' began. The small fry included some of the best ukulele players in the state of Texas. . . . and with the guitars on hand and plenty of loud voices, we killed off many railroad engineers, sank the Titanic innumerable times, and generally made the hills ring with music."

1964: Vinson Site (41LT1)

Near Tehuacana, Limestone County, north-central Texas, June 20-July 4
Director: Dee Ann Story
Site type: habitation area with mounds
Work done: excavation—Vinson site (41LT1)
Temporal context: Late Prehistoric-Historic
Number of participants: Unknown

The Vinson site (41LT1), believed to represent a historic Wichita—possibly Tawakoni—habitation site, was located in a treeless open field in north-central Texas (Davis 1964a:1). This farming area of plowed fields and large pastures was once an extensive rolling grassland prairie cut by small rivers and intermittent streams.

It was recognized that this site would not provide the abudance and variety of artifacts recovered from the two previous TAS field school sites, but unique archeological problems presented participants with invaluable learning experiences (Davis 1964a:1). Evidence of two house structures and storage pits was uncovered with great difficulty in the rock-hard dry soil that could only be worked with picks. The Vinson site was temporally related to the Gilbert site (41RA13) (Jelks 1967:4), although at the Gilbert site positive evidence of habitation structures was lacking. Mounds were suspected to be either filled pit houses or storage pits at Gilbert (Jelks 1967:14). Features at Vinson were demonstrated to be habitation remains, one of which had a floor four feet beneath the ground surface. Three storage pits were excavated, two of which had log floors (Davis 1964b:1).

Under the direction of archeologist Dee Ann Story, the large number of field school daily participants—often more than 40—were divided into groups, which were instructed and directed by crew chiefs. Some of the members had sufficient training and experience to instruct and direct others, thus enabling the professionals to oversee and guide activities and be available for consultation, as needed (Davis 1964b:2).

Although the number of artifacts recovered was less than at Gilbert, morale remained high. One interesting area which was tested was a mound that produced a mixture of Indian and European artifacts (Davis 1964b:1).

The now officially termed Beaver Patrol, under the direction of Cecil Calhoun, excavated one of the house features—a round structure with four center posts and a central fireplace. The positive contributions of the young people under very difficult working conditions speaks well for their enthusiasm and the excellent guidance offered by their directors (Davis 1964b:1).

The field school at 41LT1 lasted for two weeks. Field camp was located on Lake Mexia, about 10 miles from the site. The lake provided a place to swim, and the trees provided much-welcomed shade.

Work usually began at six in the morning and halted at noon so workers could avoid working in the sun as much as possible. After the participants had a chance to cool off, work continued until late afternoon. Cataloging and work with field notes continued after supper. Informal evening archeological talks and discussions were held on an irregular schedule.

Evening programs were followed by the now traditional pickin' 'n singin', with the vocal participants sometimes numbering in excess of 60.

1965: Gaulding Site (41JF27)

French Island, Jefferson County, upper Texas coast southeast of Beaumont, June 12-19
Director: Dessamae Lorrain, assisted by Burney McClurkan and Dorris Olds, archeologists
Site types: shell midden; burial
Work done: excavation—41JF27
Temporal context: Late Prehistoric
Number of participants: 50+

The three previous field schools had lasted for two weeks or more and had been carried out with the cooperation of the University of Texas and local archeological societies. In 1965 the university was unable to offer material and personnel to assist field school operations, so archeologist-in-charge Dessamae Lorrain revised plans for both field school and camp operations. For the first time participants had to furnish most of their own excavation equipment, there was no camp mess, and the field school lasted only one week (Davis 1965a:1).

The Gaulding site (41JF27), located on French's Island on the upper Gulf Coast southeast of Beaumont (Figure 11), offered an opportunity for TAS members to learn something of the intricacies of coastal archeology. The site consisted of a large shell midden, up to four feet deep, in an area that had previously been studied archeologically only through reconnaissance work during the 1940s (Davis 1965b:4). The field school thus had the potential for a positive contribution in Texas archeology and for a learning experience in excavation and evaluation of a shell midden.

The primary aim of the Gaulding field school was to train individuals in archeological techniques. Detailed instruction in field work and leadership was offered both at the dig and in daily archeological lectures (Figure 12). Participants—fluctuating in daily number from a handful to 50—learned the

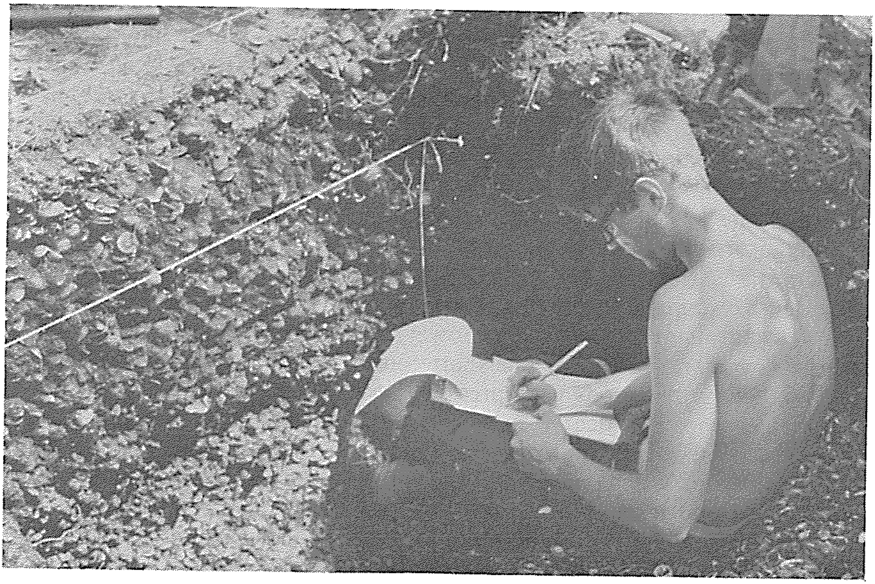


Figure 11. Jonathan Davis takes field notes at 41JF27, a shell midden. (Photo: E. Mott Davis)

Figure 12. At Gaulding (41JF27) daily lectures covered a variety of field techniques. (Photo: E. Mott Davis)

fine points of mapping, gridding, shell midden excavation, feature evaluation, stratification determination, note taking, and cataloging of artifacts. The site area was mapped and gridded, and 13 5x5-foot squares were dug, in addition to trenches and test pits (Davis 1965b:6).

As excavation of the four-foot-deep shell midden proceeded, the layered structure of the midden became apparent. The primary task for the workers was to determine stratigraphy within the midden. Artifacts generally were sparse. Some pottery, a few projectile points, and bones representing turtle and alligator were found (Davis 1965b:4).

On the last official day of field school, the discovery of a flexed burial provided excitement and a final flurry of hard work. The bones were too friable to survive removal intact; however, they were completely recorded, then removed and wrapped. The shattered skull was jacketed in plaster and removed. No grave goods were present (Davis 1965b:6).

Field camp was located in a wooded area shaded by tall trees, and a two-track road led through the rice fields and woods to the camp. In dry weather the road was passable, but five inches of rain fell immediately before field school and turned the access into a morass. The mud was deep and virtually impassable, and with each vehicle that attempted it, the "road" became worse. Once in, members were not inclined to leave. Fortunately, an alternate exit route was available at the conclusion of field school (Anne Fox: personal communication, n.d.).

Despite snakes, mosquitoes, rain, and mud, participants were enthusiastic. Apparently hard work and difficult conditions during the day only make the evening socializing more enjoyable.

1966: Dunlap Site Complex (41CX5)

Crockett County, southwest Texas, June 18-26
Director: Burney McClurkan
Site types: burned rock middens; rockshelters
Work done: excavations—41CX5 (Dunlap site complex consisting of Red Mill rockshelter and 2 burned rock middens), 41CX6, 41CX7 (rockshelters); testing—41CX8 (burned rock midden)
Temporal context: Middle Archaic-Late Prehistoric
Number of participants: 150

Signs directing 150 participants to the fifth annual TAS field school site were posted along the highway between Ozona and Sheffield. The field camp, a relatively short distance from the road, extended at least one-fourth mile along a bench near the base of a hill, where cedar trees helped provide shade (Davis 1966:2-3).

The Dunlap site complex is located in Crockett County at the western edge of the Edwards Plateau and just east of the Pecos River. It is semiarid, rugged country with its share of thorny plants, including yucca, sotol, various cacti, and catclaw. Steep-sided hills with limestone layers harbor rockshelters. In the valleys below the shelters are burned rock middens. Three of these areas—two middens and a rockshelter near the field camp—constituted the primary Dunlap site complex (41CX5). Another midden (41CX8) plus two rockshelters (41CX6 and 41CX7) on the Owens Ranch also were investigated.

The Dunlap site complex (41CX5)—a burned rock midden within the field camp area (Midden 2), a second midden across the gully (Midden 1), and a rockshelter above the field camp (Red Mill Shelter)—apparently was evidence of area use by hunting and gathering peoples during the Middle Archaic to Late Prehistoric periods (Word 1966:10-12). This area, first visited in April 1966 by a TAS reconnaissance group, was selected for the field school because the area offered sufficient work opportunity for participants. Permission to work on the property was given by owner Basil Dunlap, of Ozona. Jeff Owens, of Iraan, also granted permission for work on his ranch, where two shelters were investigated (41CX6 and 41CX7) (McClurkan 1966:5).

The primary purpose of the field school was to provide experience and training in all phases of field archeology. Because of the large registration, various activities were planned, including excavation of shelters and burned rock middens, mapping of sites and instruction in use of mapping instruments such as transit and alidade, cataloging and other laboratory activities, recording procedures, and surveying. Crew chiefs and their crews were assigned specific activities (McClurkan 1966:6). Working crews of 50 to 60 members were present on any single day, and crew assignments and crew size varied with the archeological activities and individual training needs (A. Fox 1966:7).

An analysis of activities at the completion of each field day determined any need for improvement in archeological work, training programs, or camp operation. Archeological record keeping was the responsibility of the crew chiefs, and they, in turn, assigned specific record-keeping chores to crew members. In addition, a recorder was assigned to keep a daily log of progress and to incorporate all individual reports into a permanent file (A Fox 1966:7-8).

Owens No. 1 (41CX6) and Owens No. 2 (41CX7), two rockshelters on the Owens' property, were tested. A test trench showed the deposit in Owens No. 1 rockshelter to be 36 inches at its deepest point. The depth of deposit in Owens No. 2 also was about 36 inches. Deposits were trenched from the back wall of each rockshelter to the overhang. Artifact yields from both tests were similar in number and type of material. On the basis of recovered artifacts—including dart points, knives, scrapers, and a few manos—these shelters were dated to the Late Archaic period (Fullen 1966:15).

Red Mill Shelter, part of 41CX5, is approximately 60 feet wide, 35 feet deep from the front of the overhang to the back wall at its deepest point, and 7 feet high at the highest point. A large talus slope extends about 100 feet downhill from the mouth of the shelter. The presence of three pot holes indicated that the deposit had been disturbed. As excavation progressed, it was noted that culture-bearing deposits were severely disturbed to a depth of 31 inches, and no stratification could be determined. Artifacts included Fresno, Alba, and Livermore arrow points and Ensor and Langtry dart points and indicated a cultural-temporal context of Middle Archaic to Late Prehistoric periods (Word 1966:10-12).

Excavations at Middens 1 and 2 at the Dunlap site complex have been described by Calhoun (1966:12-13) and D. Lorrain (1966:13-15). Midden No.

1, a circular burned rock midden about 30 feet in diameter, contained 12 slab-lined basins believed to have been used in processing sotol. The basins were within a layer of organically stained marl with flecks of charcoal and some burned rock located toward the interior of the 1.5-foot-deep midden. Some of these basins were superimposed on other, similar basins, and therefore represented at least three use episodes. Few artifacts were recovered from the midden. The most numerous were scrapers of various sizes. A small potsherd was found on the surface beside the midden, and mano and metate fragments were found in the midden fill. An area containing flint debitage south of the midden may have represented a habitation area (Calhoun 1966:12-13).

Midden No. 2, a circular mound of burned and cracked limestone rock, was about 50 feet in diameter and about two feet deep at the center. No hearths were evident in this midden, although, excavation in the center of the midden revealed that the bedrock was overlain by a 6-inch-thick layer of loosely cemented calichelike material. This layer contained typical midden soil but no burned rock. The majority of the few artifacts found were located at the edges of the midden; only a few were located near the center, close to the surface. Artifacts recovered consist of dart points, point fragments, scrapers, and some flint flakes (D. Lorrain 1966:13-14).

Again, as in the past, the young people made a positive contribution. A teen-age group with Dan Fox as leader conducted a reconnaissance and excavation of a burned rock midden (41CX8) on Live Oak Creek. The midden, which was about 50 feet in diameter, was gridded and trenched, and

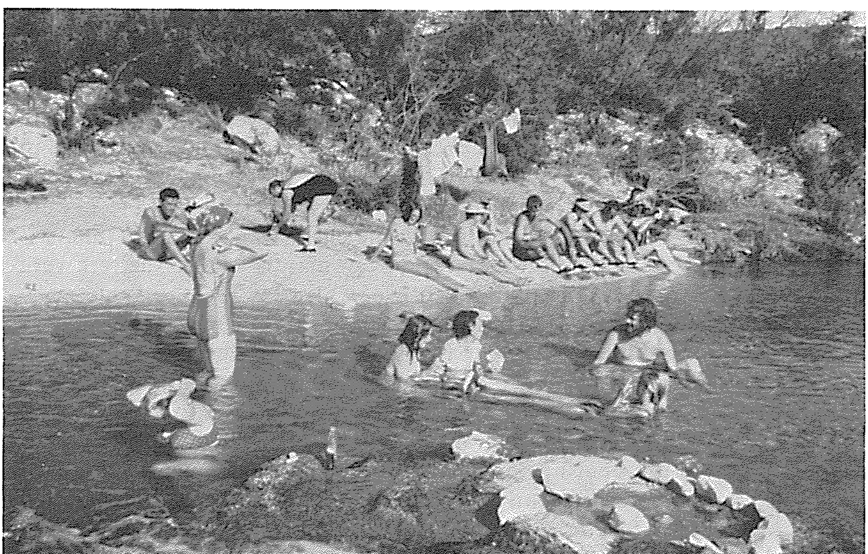


Figure 13. Live Oak Creek, Crockett County, a welcome oasis. (Photo: E. Mott Davis)

the surface of the midden and surrounding area was collected. Most artifacts, scarce and nondiagnostic, were found on the midden (D. Fox 1966:15-16).

At the time the work was done at the Dunlap field school sites, knowledge of the archeology in the immediate area was limited. TAS members experienced an important lesson by observing the destruction pot hunters can cause to a potentially valuable archeological site.

The day's work, reviews of West Texas archeology, pictures of various phases of the work, and crew chief reports were included in discussion periods each afternoon. Opportunity was provided for question-and-answer sessions. After the meetings, most people headed for Live Oak Creek, some six miles away (Figure 13).

1967: Harold Williams Site (41CP10)

Ferrell's Bridge Reservoir near Pittsburg, Camp County, northeast Texas, June 17-24
Director: Ned Woodall
Site types: middens, habitation and burial areas
Work done: excavation—Harold Williams site (41CP10)
Temporal context: Late Prehistoric Caddo (Titus focus)
Number of participants: 80-100 average per day

The Harold Williams site (41CP10) is located on a terrace of Dry Creek, a tributary of Big Cypress Creek in the Ferrell's Bridge Reservoir area near Pittsburg. The slightly undulating low hills and sandy topsoil of the area are typical of the northeast Texas piney woods.

It was known from previous finds that the area represented a Late Prehistoric Caddoan (Titus focus) site from which burial vessels and possibly other materials had been removed (Figure 14). During the field school a midden zone, several burials, and a circle of stains, possibly representing a house outline, were found (Davis 1967b:1).

On the basis of surface evidence, the site was divided into three areas: Area A (Figure 15), in which a ceramic bottle with a unique engraved rattlesnake design was found; Area B, a midden area some 200 feet west of Area A and known to have contained at least 14 burials; and Area C, which was located at the end of a ridge above the flood plain and appeared to be a trash pit. Each of these areas produced a variety of features, artifacts, and problems for field school participants.

The majority of artifacts consisted of various jars, bowls, bottles, and vessels of different pottery types, primarily of the Gibson and Fulton aspects (Woodall 1967:10). The exact temporal relationships of these pottery types was not determined.

Four features in Area B contained burials, two of which apparently had associated pottery grave goods. Other features contained prehistoric pottery and historic artifacts. The single feature located in Area C appeared to be a trash pit. The fill contained sherds, flint flakes, and bone and shell fragments (Woodall 1967:10).

The TAS work presented several archeological problems for future study, including the presence of Gibson aspect pottery types along with an

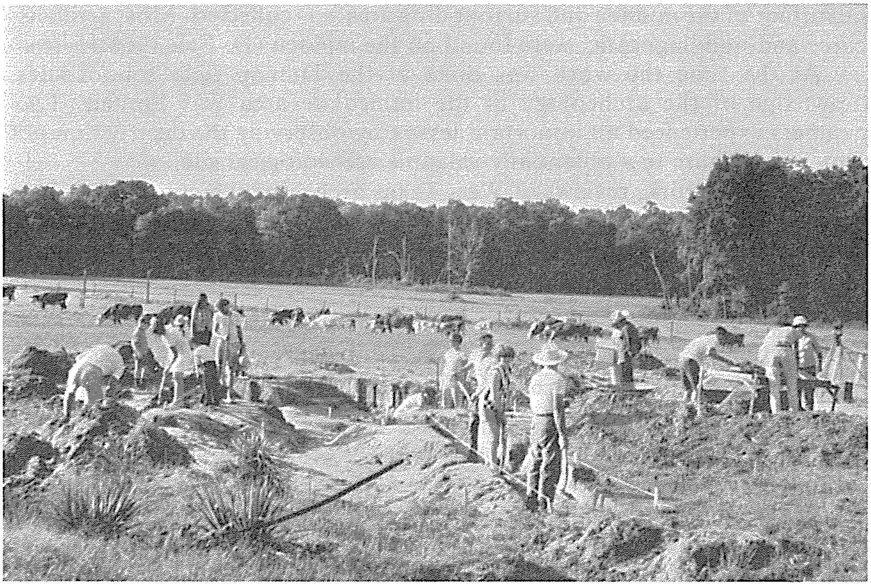


Figure 14. Site 41CP10, a Caddoan site, contained several burials. (Photo: E. Mott Davis)

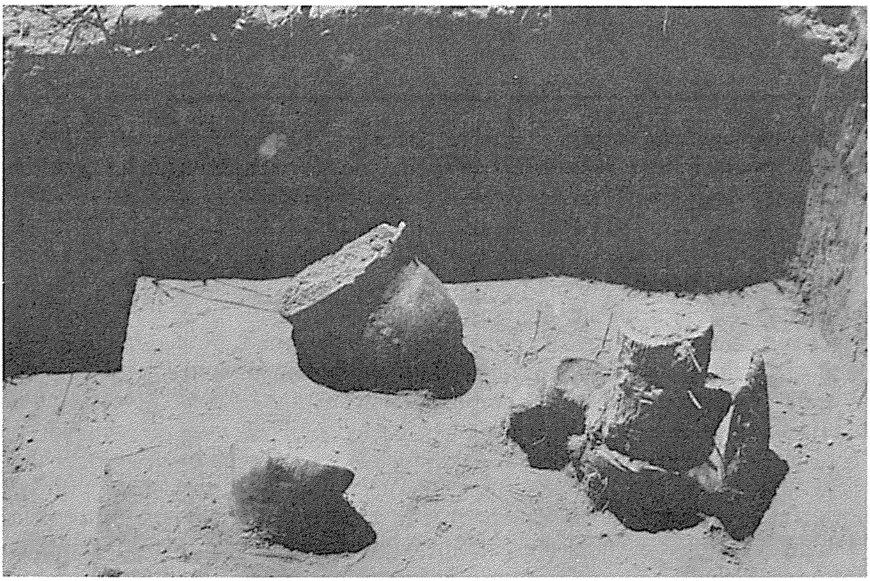


Figure 15. Pottery vessels in situ in Area A, site 41CP10, near Pittsburg. (Photo: E. Mott Davis)

early Fulton aspect pottery; possible differences in periods of occupation at Area A and Area B, as indicated by pottery types; and apparently two burial practices, indicated by burials with and without grave goods (Woodall 1967:10).

Field camp was located in an open area adjacent to the site. Heavy equipment (wheelbarrows, large screens) was provided by TAS and Southern Methodist University, but members were encouraged to bring personal field equipment. A common mess was available, as well as a camp cook, and about 70 people were served at each meal (Davis 1967b:2). In addition to socializing at mealtimes, there were the usual evening song fests, which lasted well into the night.

1967: Mission San Juan de Capistrano (41BX5) (Second 1967 field school)

San Antonio, Bexar County, south-central Texas, July 22-30
Director: Mardith Schuetz, assisted by Anne Fox and Jay Wise
Site type: Spanish mission
Work done: excavation—Mission San Juan de Capistrano (41BX5)
Temporal context: Historic Spanish, A.D. 1700-1800
Number of participants: 42

The primary purpose of the second field school held in 1967 was to provide training in historic archeology (Schuetz 1968a:7). However, the participants also had an opportunity to contribute to the understanding of Spanish mission life in Texas.

Missing walls of the original mission complex, a paved plaza, caliche floors, and cobbled street were located, and Mexican artifacts, including small pots and lava pestles, were recovered (Figure 16). A lab was set up for field processing of artifacts. Afternoon seminars were conducted on such topics as colonial history and buildings, mission life, and identification of eighteenth- and nineteenth-century artifacts (Schuetz 1968a:8).

The 100° Texas weather caused discomfort for participants, but there was no noticeable lack of enthusiasm. According to Mardith Schuetz (1968a:8), "The crew worked like demons and never lost their sense of humor."

1968: Presidio Loreto (41VT8)

Victoria County, southeast Texas, June 15-22
Archeologist: E. Mott Davis, assisted by Anne Fox and Curtis Tunnell
Site type: Spanish colonial and Indian occupation area
Work done: teaching archeological techniques; excavation—Presidio Loreto (41VT8); testing—site area; burial removal
Temporal context: Archaic-Late Prehistoric; Historic Spanish, A.D. 1600-1800
Number of participants: 147

The seventh annual TAS field school was the first administered solely by the society. Emphasis was placed on instruction in the basic principles of archeological field techniques rather than on a summer dig. Testing the site to

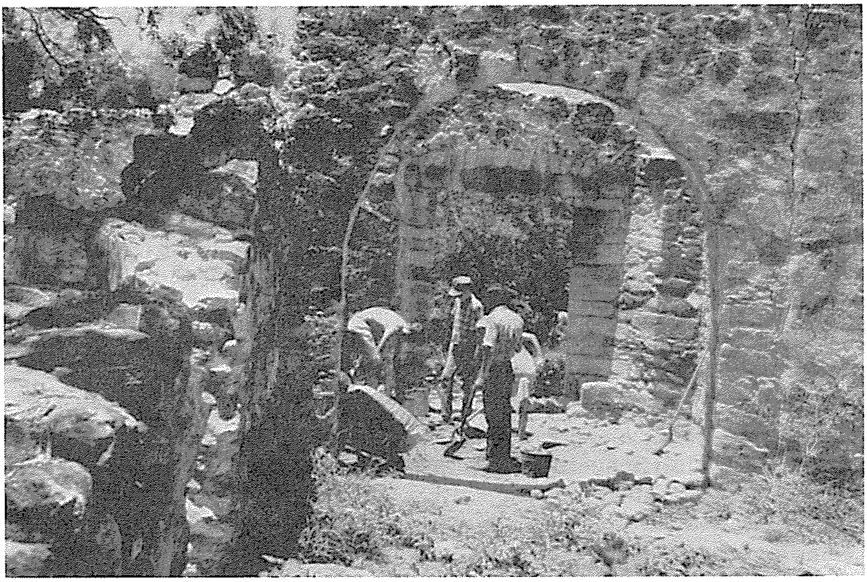


Figure 16. Excavations at San Juan de Capistrano, an early Spanish mission. (Photo: E. Mott Davis)

determine its nature and extent was considered important but secondary to the teaching aspect (Davis 1968a:1).

The Presidio Loreto site (41VT8), in Victoria County about 50 miles from the Gulf Coast, is primarily a Spanish colonial site. Recovered artifacts and features, however, indicated both Spanish and Indian activities (Davis 1968b:2-3).

Of the 130 people in camp at any one time, some 70 to 80 were on the dig each day. Crews of 8 were formed for instruction, testing, and excavation. The school's goal, emphasis on teaching archeological techniques, was immediately instigated with an orientation and mapping survey of the site. The task took all of the first day and provided participants with both skills in mapping and a chance to become familiar with the site prior to excavation (Davis 1968b:3).

Area use and occupational evidence was represented by both Indian and European colonial artifacts, including ceramics and lithics. Crude sandstone circular foundations were located in three areas. Although it was theorized that these might be the remains of four corner structures of a presidio, no evidence of a fourth structure was found. At the location where it was assumed such remains would be, a 10x10 foot test square produced diagnostic materials of a Paleo point base and a Bulverde dart point. No evidence of any structure was found (Davis 1968b:3). In another area, a rock pile appeared to be the remains of fallen stone walls, but there was no apparent relationship to the circular foundations.

The presence of Spanish colonial and Indian artifacts supported the hypothesis that the site might be the location of the second La Bahia Presidio (1726-1749), but no definitive evidence of the presidio or its location was found (Davis 1968b:3).

There seemed to be a transitional area on the northern part of the site where the mixture of artifacts changed from predominantly Spanish to a mixture of predominantly Indian artifacts, including flint artifacts and chips, native pottery, and animal (cattle or bison) bones, with colonial pottery and iron nails. During testing of this northern area of the site a partially frozen flexed burial was uncovered, jacketed, and removed (Davis 1968b:4).

The Beaver Patrol contributed to the overall understanding of the site by extensive testing of areas around one structural complex. The young people were able to demonstrate the size and isolation of one area of ruins (Davis 1968b:3).

Lectures and slide shows on various aspects of archeology were scheduled each evening. Rains, which plagued the field school off and on all week, interfered with some of the lectures but did not dampen the spirits of the participants. Unfortunately, the rains also affected the access road, which became a "mile-long mudbath" to the highway (Davis 1968b:2).

As in past years, the sing-alongs lasted well into the early morning hours. With wake-up call at 5:30 or 6:00 a.m., lack of sleep became something of a problem for some individuals. It should be noted, however, that most of the late-night revelers were on the job early and were diligent workers.

1969: Sanford Recreation Area

Lake Meredith, Canadian River, Hutchinson County, Texas Panhandle, June 14-21
Archeologist: Jack T. Hughes
Site type: puebloan structure and burial area
Work done: excavation—SARE 145, 146, 147, and 242
Temporal context: Panhandle aspect, A.D. 1300-1400
Number of participants: 204

The stated purpose of the 1969 TAS field school was twofold: to provide instruction in the basic principles of archeological field techniques, and to test a series of Panhandle aspect sites to determine time relationships for a period of Plains Indian farming activities and their pueblo-like structures on the Canadian River (Davis 1969a:13). The sites, on the north side of the lake, were located on the upland overlooking a creek and arm of Lake Meredith. Pleistocene soils in the area were generously covered with red gravels and white dolomite (Davis 1969b:7).

Four sites (field numbered SARE 145, 146, 147, and 242) were selected for study and excavation. The numbering system used was that of the National Park Service, and SARE refers to Sanford Recreation Area. Assistants to Jack Hughes were given the responsibility of supervising work at specific locations: E. Mott Davis was in charge at SARE 145, a large, multiroom site; Dessamae Lorrain was in charge at SARE 146, a scattered dwelling site; Bill Harrison supervised at SARE 147, an accumulation of sandstone blocks and a large rock pile; and Cecil Calhoun supervised work at SARE 242, a burial site (Davis 1969b:9).

Each site provided valuable information as well as training experiences for the crews. At SARE 242, four burials were found. These were flexed, in pits, and under concentrations of slabs, with no regular burial orientation (Davis 1969b:13).

SARE 145, a comparatively large area, produced numerous artifacts as well as evidence of habitation structures with remains of walls and floors. Evidence of a succession of buildings—two to five different structures—was found under about 3 feet of deposit. The young people worked in a lower area of the site and located a wall and a trough metate (Southwestern-style but made of local material). A limited amount of trade pottery was found in the pueblo area (Davis 1969b:14).

SARE 146 and 147, both habitation sites, contained different types of structures. At SARE 147 there was a large rectangular structure with the remains of a possible circular tower or storage room against the southeast corner. Excavations at SARE 146 revealed that it was a pithouse village area with five probable structures; the slab-lined pits extended about 18 inches below the ground surface. Very few artifacts were recovered here (Davis 1969b:14).

According to Jack Hughes, three general periods of occupation are represented: pit-houses as the oldest (SARE 146), then earth lodges (SARE 147), and, most recent, the pueblo-type structures (SARE 145). The need for additional archeological information, beyond that recovered from previous work in the area, placed a greater significance on the TAS field school data (Davis 1969b:14-15).

Not only did the field school participants become more aware of the prehistory of the Panhandle, but, thanks to excellent coverage by press, TV, and radio, residents in the Panhandle became aware of the purpose and work of the TAS field school. Media coverage was arranged by the National Park Service as part of their public relations program (Davis 1969b:13).

Camp was located near Lake Meredith and above a mostly dry creek, about two miles from the area of the sites. Field school daily attendance of between 150 and 200 people complicated the logistics of running the camp. The camp director and field school committee, in preparation for the influx of participants, purchased a 10-burner stove, and two refrigerators, a water trailer for a portable water supply, and chemical latrines were rented (Davis 1969a:14, 1969b:7). Experience was proving an excellent teacher.

Again rain proved to be something of a problem. For the first couple of days, heavy rains and the accompanying cooler weather caused some discomfort but did not seem to dampen enthusiasm. Evening and night rains continued into the week during field school, with an especially heavy storm on Tuesday night. Access roads were all but impassable to anything but four-wheel-drive vehicles.

Work continued at the site during the day despite the rains, but the weather definitely slowed the work. Crew chiefs were asked to volunteer to stay on after the field school for a few days to finish some of the work. And then the sun came out with a vengeance!

1970: Guadalupe Mountains National Park

Culberson and Hudspeth counties, far West Texas, June 13-20
Archeologists: Harry Shafer and Dessamae Lorrain
Site types: lithic scatters, burned rock middens, rockshelters with and without rock art, Historic-European habitation areas
Work done: area survey—150 sites visited, 139 new sites recorded; excavation—historic camp and habitation areas, small burned rock midden; rock art recorded
Temporal context: Archaic-Historic
Number of participants: 245+

The 1970 TAS field school goal of an archeological and environmental survey of Guadalupe Mountains National Park presented an opportunity for discovery of both prehistoric and historic sites.

Guadalupe Mountains National Park, in far West Texas along the Texas-New Mexico state line in Culberson and Hudspeth counties, is about 100 miles northeast of El Paso and about 60 miles southwest of Carlsbad, New Mexico. The Guadalupe Mountains rise abruptly above the plains and flats to the east and south. Elevations vary from about 3,500 feet to 8,751 feet at the top of El Capitan, the highest point in Texas. The eastern side of the mountains is cut by deep canyons including McKittrick, Bear, Upper Pine Springs, Smith, Pine Springs, and Guadalupe. To the south and west are salt flats and arid plains, with slopes cut by deep arroyos—topography common to the Chihuahuan Desert. Vegetation on the lower slopes is the typical thorny plants and greasewood of West Texas. Pinyon and scrub oak are found on the upper slopes, where moisture is more abundant.

Archeological work had been done in the area prior to the field school, but only 11 sites were on record at the Texas Archeological Research Laboratory (TARL) in Austin. During the TAS survey, 139 new sites were recorded and 11 previously recorded sites were visited. Some 10 square miles were surveyed during the 10 days of TAS work in the area (Shafer 1970a:10-11). Park personnel had requested more intensive coverage in the southern and western areas of the park; however, Bear, Guadalupe, and Pine Springs canyons on the east side also were investigated (Shafer 1970a:11).

The stated purpose of the school was to provide training in archeological survey techniques and, at the same time, to conduct a systematic site survey of a portion of the park (Davis 1970a:2; Shafer 1970a:10). Although some survey work had been done by TAS members in other areas in the past, this was the first field school to emphasize intensive training in survey techniques. Because environmental conditions, including floral and faunal populations, topography, and geology, are directly related to area utilization, instruction in these topics was included.

Field school participants were divided into two major survey groups with crew chiefs in charge of small crews in each group. Archeologists Harry Shafer and Dessamae Lorrain each were responsible for one group. One of the two major groups went into the field each day, and the group that remained in camp completed lab work from the previous day in the field. Nightly lectures covered a wide variety of topics (including area geology, rock art, and Apache ethnohistory) and were well attended.

Sites in surveyed areas vary in size and shape. The most common sites—large, open campsites—occur along arroyos, at canyon mouths, and around springs. Open campsites were found principally in the south and west flats. Ring midden sites were recorded only at elevations above 4,000 feet, possibly because this elevation represents the lower elevation limit of the kinds of plants cooked (sotol, yucca). In contrast to the ring midden sites, other dome-shaped burned rock midden sites were found only in Pine Springs Canyon (Shafer 1970a:12). Although ring middens are known to occur at lower elevations throughout this part of the Southwest and surrounding areas, in the survey area, specifically, ring middens were found within a rather restricted topographic range.

Rockshelters, common in the park area, vary in size from shallow, 10-foot-long shelters to large shelters as much as 250 feet long and 100 feet deep. Some 20 rockshelters were visited (Shafer 1970a:12). Most shelters on the east side of the massif are solution caves or cavities near the base of a limestone formation that forms a cap over thinly bedded strata (Clark 1974:102). Six rock art sites were visited and recorded, four of which (41CU15, 41CU24, 41CU48, and 41CU70) are within the park area. Rock art was recorded also at two additional shelters (41CU13 and 41CU14) in the Delaware Mountains just outside the park. In addition to recording rock art, TAS members collected any associated artifacts for use in establishing chronological relationships (Clark 1974:99).

Permanent records of the rock art were made by photography, tracing, scale drawing, watercolor, and, in the case of petroglyphs, by rubbings. Shelters 41CU15 and 41CU24 contained pictographs (dots, hands, lines, curvilinear and circular motifs) all done in red; site 41CU48 contained only yellow lines, crosses, and a circle form with rays. Site 41CU70 contained linear petroglyphs as well as polychrome pictographs in red, black, and yellow (Clark 1974:102-105). Rockshelters 41CU13 and 41CU14 contained petroglyphs in projectile point motifs as well as pictographs. With the exception of 41CU15, stylistically attributed to the Desert Abstract Style described by Schaafsma, all rock art motifs examined and recorded conformed to the Jornada Style, eastern phase (Clark 1974:114-116).

Over 3,000 potsherds were found at a variety of sites, and 70 percent of these were of the Jornada-Mogollon pottery group (Phelps 1974:121). Based on ceramic evidence, the surveyed area was occupied from A.D. 850 to 1350 by the Jornada-Mogollon people or, according to Phelps (1974:146), by an unidentified group dependent on the Jornada-Mogollon for pottery or technology. The presence of ceramic sherds of the Middle Pecos Valley indicates interaction with these groups as well. According to Shafer (1970a:16) there was a notable lack of pottery dating after A.D. 1400. This may suggest that, unlike earlier groups, mobile groups known to have occupied this area of the mountains in the 1700s and 1800s did not use pottery made in nearby pueblos.

The location of the majority of the 59 pottery-bearing sites on the lower slopes and flats in the area indicates a possible agrarian population. People may have been drawn to the area by the vast and exploitable salt deposits, and these may have been a determining factor in areal settlement patterns (Phelps 1974:147).

The TAS members participating in site survey in the salt flats of the southwest part of the park can attest that it is not an optimum habitation area during the summer months. Lack of water in addition to the dessicating effects of the salt-sand surfaces indicate a probable seasonal use by earlier occupants of the area.

Three historic sites were investigated and reported by Kathleen Gilmore (1970:14-15). These included a bivouac site probably occupied during the Civil War and again in the 1870s. A house area, north of the bivouac area and seemingly unrelated, apparently dated from the early twentieth century. The third site, the Frijole site, is by Manzaneta Springs and is a building formerly used as a post office for the town of Frijole during the 1930s and 1940s. A skirmish between an army party and Apaches camped in the area reportedly occurred in 1869, but no supportive artifactual evidence could be found (Gilmore 1970:14).

The young people under the supervision of Paul Lorrain tested an eroded burned rock midden (41CU31) in the Pine Springs area. The site was tested in three areas and collected in a 100-square-foot area north of the midden. The group obtained a significant sample of 515 stone fragments, five Darl-like points, and one Meserve point (P. Lorrain 1970a).

The field school camp area was located in Pine Springs Canyon at the base of the mountains. It was a primitive area—no facilities—but with TAS members' ingenuity and the permission of park rangers, a pipeline was run across a mountain foothill from a spring to the camp, a distance of about a mile. With this somewhat unreliable water source (the pipeline was constantly springing leaks), *cold* showers were available. Three portable latrines were brought in, completing the "facilities." Since drinking water was scarce, members were advised to bring at least five gallons of water with them. The Texas National Guard in El Paso provided a 500-gallon water tank, which the Highway Department filled with water. One innovation in 1970 was the addition of a cook trailer, which had been built specifically for TAS. Francis Stickney, camp director, and the Midland Archeological Society managed to have the camp facilities ready for the arrival of about 221 people by Sunday evening (the first weekend). About 25 latecomers drifted in during the following week. As Jerrylee Blaine (1970:19) said, "This was not a simple field school to manage. Contacts had to be made in many places, from the owner of the local Texaco station all the way to the Pentagon."

E. Mott Davis (1970b:9) best summarized the effects of the Guadalupe field school: "As time goes by we should be seeing significant new information being compiled in many parts of the state because of site survey work done by people trained at this field school."

1971, 1972: Kerr County

Southwest of Kerrville, Kerr County, west-central Texas, June 12-19, 1971, and June 10-17, 1972

Archeologist: S. Alan Skinner; assistant, Alton Briggs

Site types: burned rock middens, rockshelter, lithic scatters

Work done: survey—165 sites recorded, Turtle Creek watershed; excavation—burned rock middens X41KR1 (Paris site), X41KR42, X41KR166 (Real site), and rockshelter X41KR116 (Bushwhack Shelter)

Temporal context: Paleo-Indian—Late Prehistoric
Number of participants: 1971, 300; 1972, 250+

The tenth and eleventh annual TAS field schools were held in Kerr County about seven miles southwest of Kerrville in the Edwards Plateau region of Central Texas. The field school camp and part of the study area were on property belonging to Andy Paris, a member of the Hill Country Archeological Society. Archeological work for the 1971 and 1972 field schools was conducted in the Turtle Creek watershed and on many of the same sites; therefore, a combined summary for both years is given here.

Much of western Central Texas is hilly, cut by creek drainages between the hills and broad valleys. The primary survey area covered about 40 percent of the Turtle Creek watershed. Vegetation on the slopes consists of cedar (junipers), various kinds of oak, elm, and black persimmon trees, and bunch and other grasses. In addition, along the creek bottoms sycamore, poplar, wild pecan, hackberry, and willows may be found, as well as abundant smaller bushes and plants. The hills are composed of caliche and limestone rock, while valleys have a sandy, clayey loam topsoil overlying limestone bedrock.

The training and archeological goals included a survey and site study in three 10-square-mile areas (or, about 30 square miles) in order to locate and evaluate prehistoric settlement of the area (Skinner 1971a:5, 1974:5). The Kerr County field schools provided an opportunity for those who had participated in the Guadalupe Mountains area survey to practice and improve their skills in a different environmental setting. During the survey, 165 prehistoric sites were located and recorded. Dates for the sites were estimated from the Paleo-Indian to Late Prehistoric (Neo-American) periods, based on observed diagnostic materials. Late Paleo-Indian occupation of the area was indicated by Plainview and Angostura point types. In addition to period determinations, site activities were inferred from distributions and concentrations of flint flakes, discarded tools, and features, such as hearths and burned rock middens (Skinner 1974:24: 31).

During the area survey, artifact illustrations were drawn in the field notes, but artifacts were not collected. However, six sites were carefully collected for comparative analysis. The following site-use data is compiled from detailed descriptions of TAS work in Skinner (1974):

X41KR191: an apparent chipping station with at least two different occupation periods evidenced by the presence of different point technologies;

X41KR184: possible hunting camp as evidenced by lack of ground stone tools, abundance of lithic debris, and the presence of a burned rock mound;

X41KR70: burned rock mound and surrounding living area—Archaic period, based on surface artifacts;

X41KR201: lithic scatter terrace site represents occupation during two separate time periods;

X41KR128 short-term, single occupation site of the Archaic period represented by Castroville and Marcos-like points;

X41KR94: terrace site with two burned rock mounds and surrounding lithic scatter areas that may represent a multiple occupation, based on the presence of dart and arrow points.

Throughout the survey areas, there was a predominance of lithic workshop sites, while only 63 burned rock mounds were recorded. Sites representing Archaic occupations made up about 80 percent of the recorded sites. Archaic-Late Prehistoric components were evident at 12 sites, and uncontaminated Late Prehistoric components were present at 3 sites. Based on this data, the occupation of the Turtle Creek watershed is considered basically Archaic (Skinner 1974:56-65).

Excavation was conducted at three different types of sites. At the Paris site (X41KR1), a burned rock midden, excavation was directed at testing the hypothesis that living areas were adjacent to, rather than on, middens, and to isolate a "pure" Archaic living area floor. The living floors that were located represented both Archaic and Late Prehistoric use areas which were horizontally separated. Alton Briggs, then survey archeologist for the Office of the State Archeologist, directed this excavation (Skinner 1971a:3-4; 1972:6).

A second site, Bushwhack Shelter (X41KR116), is a large rockshelter on Bushwhack Creek (Figure 17). A 5 x 5-foot test square was excavated in the 54-inch-deep deposit in the center of the shelter. A well-stratified occupational sequence for the shelter was determined on the basis of the test. The shelter apparently was occupied before 1000 B.C. and was abandoned before the Historic period—an inference based, at least in part, on the typology sequence (Skinner 1974:15).

The Real site (X41KR166), a burned rock midden in the western part of the field school area, was selected for excavation for comparison with the Paris midden site. The tools recovered were attributed to a Late Prehistoric time period. An Archaic living surface underlay the midden. Prior to the Real site excavation, midden deposits in the area were generally attributed to Archaic occupations (Skinner 1972b:6).

Two additional studies were conducted by TAS members. The first was a specialized environmental study of area resources. The second involved TAS assistance in a Texas Highway Department archeological survey along a proposed realignment of FM 480 on Verde Creek. Three sites were recorded within the highway right-of-way, and the information was provided to the Highway Department survey personnel (Skinner 1971c:4).

Young people's activities included the excavation of X41KR42, a badly pothunted site for which the depth and type of site, as well as an estimate of the types of activities conducted during occupation, were needed. In addition to the site study, Beaver Patrol supervisors Teddy Lou Stickney and Marge Fullen conducted various activities in plant and fossil studies. The young people helped to prepare an interesting exhibit of various plants in the area.

The field school camp was in a tree-shaded area, level and dry, which had been mowed and sprayed for insects and other pests. In spite of precautions, ticks and chiggers were abundant—especially the tiny seed ticks—so much so that the meeting area was dubbed the Tick Bowl. Other unwelcome native residents included coral snakes. The emphasis at field school is respect for the environment and its residents, so any snakes were caught and released away from camp, unharmed (Figure 18). Ticks, however, were killed mercilessly.

Turtle Creek runs parallel to the campsite area and provided TAS personnel with a swimming hole and recreation area. Late-night revellers gathered on the limestone ledges above the creek for the traditional nightly singin' and guitar pickin'.

Figure 17. A stratified occupational sequence was determined for Bushwhack Shelter (X41KR116). (Photo: Bill Richmond)

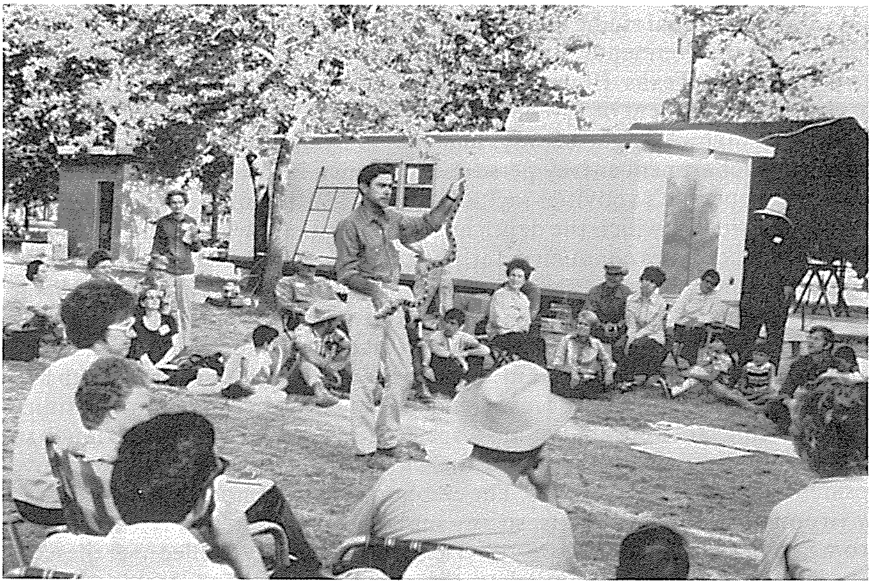


Figure 18. Bill McClure talks about poisonous and nonpoisonous snakes at Kerrville. (Photo: Bill Richmond)

Visitors during the course of the field school included professionals and students from Southern Methodist University, Texas A&M University, West Texas State University, Texas State Historical Survey Committee (now Texas Historical Commission), Texas Archeological Research Laboratories, and Texas Archeological Salvage Project (now Texas Archeological Survey). Participants included TAS members from Colorado, Arkansas, and Louisiana, as well as all areas of Texas.

1973: Asa Warner Site (41ML46)

McClennan County, north-central Texas, June 9-17
Archeologist: Alton Briggs; assistant, Robert Mallouf
Site type: alluvial terrace campsite
Work done: excavation—Asa Warner site (41ML46)
Temporal context: Middle Archaic-Late Prehistoric (Caddo)
Number of participants: 200+

The Asa Warner site (41ML46), located about seven miles southeast of Waco in McClennan County, is situated on an alluvial terrace adjacent to Branch Creek, which drains into the Brazos River. A general soil profile for the site area would show an upper plow zone in reddish, sandy clay overlying a horizon of red clay, which, in turn, overlies a deposit of alluvial sands. Between the clay and lower alluvial sands is a midden layer (Alton Briggs: personal communication, n.d.). The site is on the flood plain and could be destroyed by frequent flooding or construction of flood-control diversions.

Work at the field school included mapping, excavation, and extensive lab work. Several deep tests were made in the sandy, clayey soil. Since most of the site area was in a plowed field, there was no shade. As digging progressed, the heat of the day and the lack of moving air in the bottoms of the pits were the cause of many caustic comments.

The site appears to consist of two components—a Middle to Late Archaic open campsite and a very small village, possibly intermittently occupied, which is either Caddoan or Caddoan influenced. The Caddoan-influenced occupation, although small, was of sufficient duration for the formation of a midden. Since the recovered Caddoan ceramics were not made in the area, the site may have served as a trading outpost (Alton Briggs: personal communication, n.d.).

The temporal designation of Middle to Late Archaic is based on the recovery of 38 dart points, including Gary, Fairland, Edgewood, Godley, and Darl types. During the field school, four burials were located in the Archaic deposits (Figure 19), and three additional burials were located after the close of field school. The amount of skeletal material could indicate a possible cemetery area. Further analysis of the burials and skeletal material may provide data on the morphological and pathological characteristics of an Archaic population in Texas, as well as information on Archaic period burial practices (Alton Briggs: personal communication, n.d.).

The temporal context of the Caddoan-influenced occupation is deduced primarily from the recovered vessel forms and pottery types, which indicate an early to late Gibson aspect occupation. Alto and possibly Sanders foci

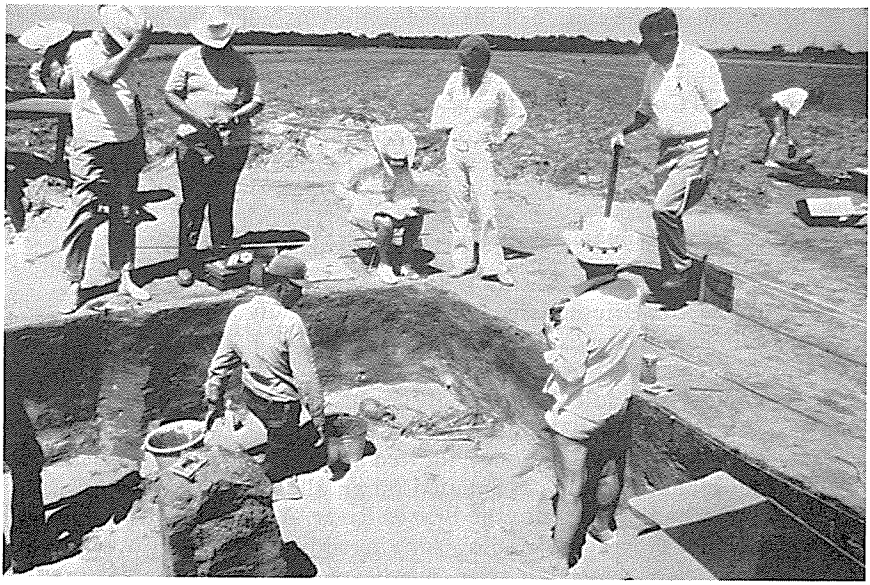


Figure 19. One of four burials found during the dig at 41ML46. (Photo: Bill Richmond)

appear to be represented within the Gibson aspect, along with an early Titus focus of the Fulton aspect. An analysis of the pottery from the Asa Warner site was conducted by Bob Turner. Further examination of these materials may provide comparative information for local ceramics and introduced types from the northeast (Alton Briggs: personal communication, n.d.).

A preliminary lithic analysis by C.K. Chandler indicates that, in addition to the Archaic-type dart points, 121 arrow points were recovered, approximately 50 percent of which are Perdiz. Scallorn, Alba, and Clifton types are also represented. Examination of excavation and lithic analysis data should provide additional correlations to the projectile point chronology from the Archaic to the Late Prehistoric period (Alton Briggs: personal communication, n.d.).

The field school camp area was several miles from the site, where large trees provided shade for the dining and meeting area. Pests seem to follow the field school. At Gaulding and Victoria it was mosquitoes, at Kerrville, ticks, and at Asa Warner, flies. Although it cannot be proved, it is generally believed flies were the distributors of a "bug" that affected the digestive systems of a number of field school participants. The situation was serious enough that some members departed early.

Through it all, the participants retained a sense of humor. After one particularly frustrating day in the pits, Charlie Bandy's crew presented him with a pedestaled, sculpted effigy in their pit. Some avowed the likeness to an unnamed crew chief was remarkable.

Figure 20. The McKinney home, built in 1850-1852, presented a historical challenge to TAS members. (Photo: Bill Richmond)

1974: McKinney Falls State Park (41TV289)

Austin, Travis County, Central Texas, June 8-16
Archeologists: Michael McEachern, Ronald W. Ralph
Site type: Historic house site, mill, and cisterns; prehistoric campsite
Work done: excavation—McKinney homestead, mill, and cistern (41TV289); survey and mapping—homestead area; survey—12 sites recorded
Temporal context: Archaic; Historic, mid-1800s
Number of particticipants: 230+

The thirteenth annual field school, at McKinney Falls State Park in Travis County, was conducted with the cooperation of the Texas Parks and Wildlife Department. The area, located on Onion Creek immediately south of Austin, included the old mill, cisterns, and homesite (Figure 20) of Thomas McKinney, who lived there in the early 1850s. Since McKinney Falls State Park was in the process of construction, it was desirable to survey, excavate, and map historic and prehistoric sites in the park area as soon as possible. TAS had the personnel and expertise to conduct part of the archeological investigation.

The goals of the field school as stated by the archeologists were to illustrate a variety of archeological techniques as well as to appraise the archeological resources of the McKinney homestead complex. A booklet, *TAS Field School 1974* (McEachern and Ralph 1974), outlined the history, proposed research plan, field school activities and responsibilities, supplemental activities (including the evening programs and guest speakers), excavation plan with a detailed explanation of terms and methods, and examples of various site forms with instructions for completion. This booklet was made available to field school participants and provided answers to many of the inevitable questions that arise during any archeological activity. For the novice, the explanation of terms was especially helpful.

Stone ruins of the two-story McKinney homestead stand on the north side of Onion Creek immediately east of a low-water crossing of the creek, where a hundred years of use by wagons and automobiles has left an indelible record on the limestone creek bed. The lower of the two falls for which the park is named is 50 to 100 yards downstream from the crossing.

Four experiments in historical archeology were outlined in the instructional guide (McEachern and Ralph 1974) and reported by McEachern and Ralph (1980a:5-127, 1981:5-55) in their two-part review of the McKinney site work. These experiments included prospecting (examining several methods of detecting archeological features without resorting to excavation); conventional excavation in and near the house, using as a guide a simple predictive model; exploring the value of recent faunal collections from a cistern excavation; and a long-term study of the rate of environmental processes (McEachern and Ralph 1974:3-4, 1980a:6).

The mill, located on the north edge of Onion Creek about 200 yards east and south of the McKinney house, was built in 1852. A low dam was built upstream to divert water to the mill. Drilled holes and cuts in the limestone bedrock, as well as embedded iron rods, mark the location of the dam and millrace (McEachern and Ralph 1981:5-7). TAS excavations at the mill site were done in one-meter squares within a metric grid pattern, and 69 squares were excavated to varying depths in and around the structural remains. Excavated materials were screened and all artifacts and faunal remains were saved. Metal, glass, and ceramic artifacts were mixed with a variety of soil and rock deposits within the remaining walls of the mill structure. The ceramics and some bottle-glass sherds and bases appear to date to the mid-1800s when the mill was in use (McEachern and Ralph 1981:6, 14-15). Metal artifacts include cartridges, nails, spikes, bolts, and a variety of broken tools. Nails, metal construction objects, and some tools seem to date to the time the mill was in use. Other metal artifacts date from the mid-1800s, the World War I era, and later. A number of objects have not been dated (McEachern and Ralph 1981:17-41).

Two cisterns were located to the south and west of the McKinney house, and one of these was excavated. Analysis of the high artifact yield indicated the bulk of materials were discarded prior to the mid-1930s, although a few artifacts dated to post 1940 (McEachern and Ralph 1981:44-45). Before the cistern was backfilled, a "time capsule" and murals were left for any future excavators as evidence of the work done by TAS field school members.

The artifact sample recovered from the McKinney site was particularly important, since it constituted the sample available for analysis. Although additional work was done after the field school, budgetary restrictions limited artifact recovery (McEachern and Ralph 1981:6).

Surveying to locate archeological features utilized both the proton magnetometer (metal detector) and chemical pH and phosphate tests (McEachern and Ralph 1980a:21-35); Burleigh 1980:162-163). The results of these tests are not as important to this discussion as is the fact that TAS field

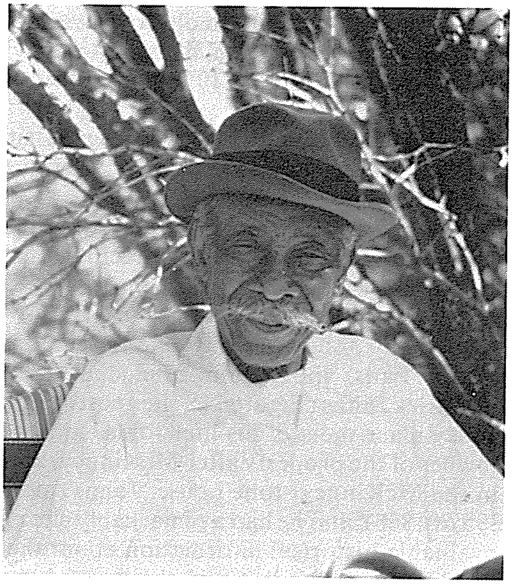


Figure 21. Charles Johns provided much anecdotal history. As a young man he lived in the McKinney house. (Photo: Bill Richmond)

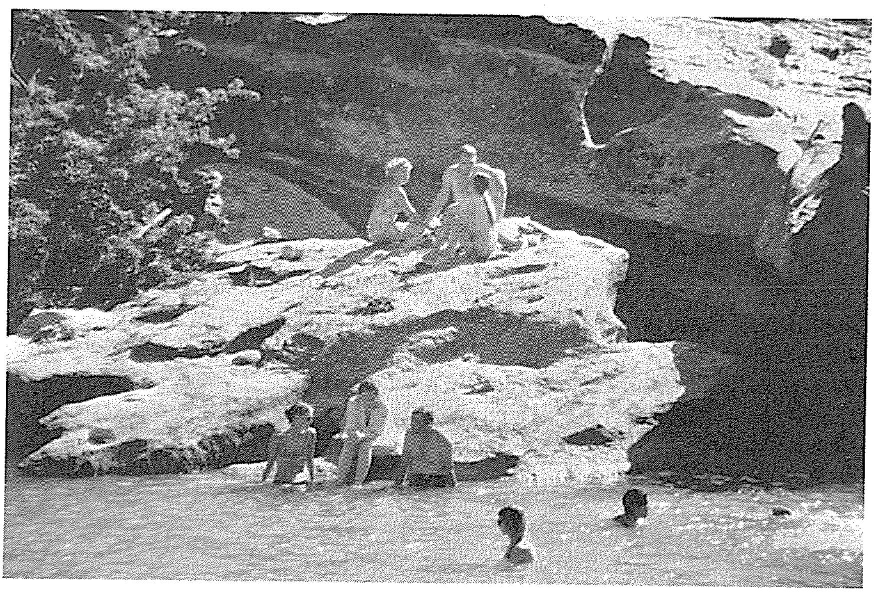


Figure 22. The swimming hole at McKinney Falls. (Photo: Bill Richmond)

school participants had the opportunity to observe a variety of methods for determining occupation and occupation density areas. For detailed information see McEachern and Ralph (1980a:21-35) and Burleigh (1980: 162-163).

Jim Calvert and crew conducted an archeological site survey in the northern one-third of the McKinney Falls State Park. Twelve prehistoric and historic archeological sites were recorded—41TV302 to 41TV313. Examples of prehistoric lithic tools and historic artifacts occurred at four sites. Temporal context for area use inferred from artifactual remains ranges from Archaic to post A.D. 1900 (Calvert 1981a:56-60).

A get-together of field school participants, local landowners, and others interested in the work being done is usually held toward the end of the field school. At McKinney Falls, the evening included exhibits, tours, and informative talks. Charles Johns (Figure 21), the guest of honor, had lived on or near the McKinney place most of his life. Johns' family had worked for James Smith, the owner of the property after McKinney, and as a young man Johns had lived in the McKinney stone house. Johns said he was about 88 years old (born 1885 or 1886), and he had a remarkably clear memory. He was able to provide invaluable historical information about the house, location and kinds of outbuildings, and history of the area. A summation of an interview with Johns is included in the report of McEchern and Ralph (19801:18-20).

Camp was in a field east of and adjacent to the house ruins. For the most part, all areas investigated were within walking distance of the camp. The lower falls pool proved a welcome swimming hole (Figure 22). "Young" people especially enjoyed sliding down the falls. The late evening sing-along was held on the limestone slab above the falls, and songs occasionally seemed to echo from the rocks.

As a direct result of the 1974 field school, Wayne Roberson, an archeologist then with the Parks and Wildlife Department, requested names of TAS volunteers around the state that he could call on for help with various types of archeological projects (A. Fox 1974:3).

1975: Floydada Country Club Site

White River Canyon, Floyd County, Texas Panhandle, June 14-21
Archeologist: S. Alan Skinner
Site type: alluvial terrace occupation area
Work done: excavation—X41FL1, X41FL2, X41FL3; surface collection and shovel tests
Temporal context: Late Archaic-Historic European (estimated A.D. 1000-1850)
Number of participants: 210+

The fourteenth annual TAS field school was held at the Floydada Country Club, about seven miles south of Floydada in White River Canyon. The area is in the central Texas Panhandle where the White River has cut through the caprock to form a broad, meandering canyon (A. Fox 1975:1-2).

Jim Word had been studying the site area for about 20 years, testing the site and making a systematic collection of artifacts. A report of his work in the *South Plains Bulletin* (Word 1963) was among the readings recommended to field school participants.

Two major archeological goals were set for the field school: to develop a well-controlled chronology for this area based on extensive testing for and excavation of in situ deposits with appropriate artifact collection, and to determine any correlations between surface artifact concentrations and subsurface materials through careful excavation of large areas (Skinner 1975a:2-3).

The country club area was divided into three sites: X41FL1, X41FL2, and X41FL3. Each of the sites exhibited different predominant flint sources as well as separate and distinct pottery and artifact distributions.

Site X41FL1 was the most extensive of the three sites. About 1 percent of the site was tested. The 61 one-by-one-meter squares indicated no vertical stratification of the site. Several hearths and bone concentrations were located. The limited amounts and types of artifacts and cultural features led to the inference that the site represents an intermittently occupied camp. Occupation appeared to cover a period from A.D. 1000 to 1800, based on pottery and other prehistoric and historic artifacts. Approximately 70 percent of the flint at this site appears to have originated in Central Texas (Skinner 1975b:6-7).

At site X41FL2, a large part of the site area had been removed for fill on the golf course. About 3 percent of the remaining site was excavated. Accumulations of bison bone and Southwestern pottery types were revealed. Pottery types included El Paso Polychrome, Chupadero Black on White, Ochoa Indented, Pueblo III Corrugated, and Jornada Brown. Known temporal association of the pottery types indicate an estimated occupation for the period A.D. 1300-1400. At site X41FL2, 90 percent of the flint was of Alibates or Tecovas (Quitaque) Panhandle varieties (Skinner 1975b:7).

At site X41FL3, few features were located during excavation of 24 squares. Pottery designation, expected to be East Texas types, is pending analysis. Flint-origin percentages were not as well defined as those calculated for X41FL1 and X41FL2; Central Texas and Alibates-Tecovas varieties each represented 40 percent, and local flints represented 20 percent (Skinner 1975b:7).

The country club remained active during field school—sometimes to the dismay of both golfers and field school participants. In one case a golfer "lost" his ball in one of the excavations; in another instance a crew member received an unexpected blow from a hard-hit golf ball, but damage was done only to dignity (Blaine 1975:4). Surface surveyors on the high bluffs adjoining the golf course on the north and west felt like targets as golf balls landed around them.

The young people were involved in the study of Indian culture and crafts. Under the direction of Claude Brown, they learned to weave baskets, make pottery, build traps for game, and identify natural foods.

The work of the TAS field school resulted in the recovery of much valuable information. Equally important, this investigation indicated that the

Floydada Country Club site "is a good example of the type of site which is worthy of study over a long period of time" (Skinner 1975b:7).

As usual, evening lecture sessions were well attended with speakers emphasizing occupation of, and archeology in, the Panhandle South Plains region. Alan Skinner summarized field school accomplishments in a lecture and guided tour of the area.

The camp was in a treeless area in the northwest part of the country club property. Shade was at a premium (Figure 23). The kitchen trailer again saw duty, and three meals a day were prepared and served to those not wishing to prepare their own. It should be noted that the majority of field school participants took advantage of the meal option.

TAS field schools always seem to be plagued with pesky critters. At Floydada it was mosquitoes and chiggers. The situation was serious, and arrangements were made for aerial spraying of the area (Figure 24). For some, this event may have been the highlight of the field school, and enthusiastic observers cheered the pilot as he maneuvered through the canyon and over the site.

Late evening sing-along festivities were held on a rise several hundred yards above camp. Despite the heat of the day, jackets were welcome in the late evening. Some of the more enthusiastic participants decided a song book would be helpful, since not all singers knew the words to the older songs, so the TAS songbook became available. Flashlights cast eerie glows on faces as singers peered at the dimly lit words.

1976: Musk Hog Canyon

Crockett County, Southwest Texas, June 12-19
Archeologists: Harry Shafer and Gary Moore
Site types: burned rock middens, rockshelters, lithic scatters, rock art, and hearths
Work done: excavation—burned rock midden sites 41CX218, 41CX238, 41CX241, and rockshelter 41CX133; survey—435 sites recorded
Temporal context: Paleo-Indian-Late Prehistoric
Number of participants: not recorded (registration limited to 250)

Musk Hog Canyon is a moderate-sized tributary canyon system of the Pecos River. The area is eroded limestone plateau country with bare rock landscape on the slopes and tops of the mesas and moderate to deep alluvial soils in the canyon floors (Shafer and Moore 1976a:2). In the rugged, rocky terrain and semidesert environment it seemed that all the plants had thorns or spines and all the animals either bit or stung.

As stated in an informal report of Shafer and Moore (1976b:1), "the field school project was conducted in conjunction with plans to construct Interstate Highway 10 through part of the canyon and to provide data on an area which was likely to become a National Register District." Earlier surveys in the area had shown that Musk Hog Canyon contained a large number of archeological sites.

Two major goals for the field school were the excavation of several known sites and the survey of the Musk Hog Canyon system. Field school

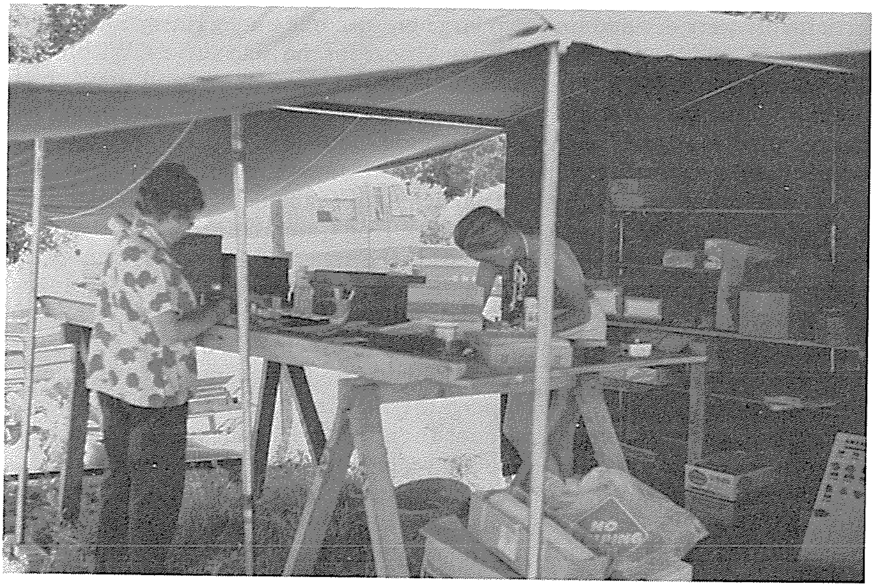


Figure 23. Dot Word and Bobby Speer checking artifacts and records—sometimes the lab shelter is the only shade in the area. (Photo: Bill Richmond)

Figure 24. Crop duster spraying the camp area to reduce numbers of mosquitos. (Photo: Bill Richmond)

participants were divided into two large groups: one under Harry Shafer for excavations, and the other under Gary Moore for the field survey. Within the large groups, smaller groups were assigned to crew chiefs and crew chief supervisors for specific excavations or survey areas. A primary teaching goal was to have each field school participant observe and participate in an on-going research project (Shafer and Moore 1976b:1).

The number of field school participants enabled the archeologists to attempt a 100 percent survey of the Musk Hog Canyon drainage system. Of the 512 documented archeological sites in the area, 435 were documented by TAS members during the field school (Shafer and Moore 1976b:3). Site types include burned rock middens, hearths, lithic and burned rock scatters, and 40 rockshelters, some with associated rock art. Previous work in the Lower Pecos area by the Iraan Archeological Society and other investigators shows the area was utilized by hunting and gathering groups from the Paleo-Indian period through the Archaic and Late Prehistoric periods, with the Archaic sequence spanning some 7000 to 8000 years (Shafer and Moore 1976a:2-3).

Test excavations were conducted at five sites: four burned rock middens (one each at 41CX218 and 41CX238, and two at 41CX241) (Figure 25), and one rockshelter (41CX133). The primary purposes of these excavations were to define and evaluate use areas, to recover charcoal for radiocarbon dating, to recover plant material for botanical analysis, and to recover an artifact sample (Shafer and Moore 1976b:4-6).

The young people were divided into two groups: the 6-to-12-year-olds, who made a number of field trips as well as participating in nature study and flint knapping; and the 12-to-17-year-olds, who were termed the Young Archeologists group. The older group undertook two projects: the excavation of 41CX103 (a burned rock midden), and the experimental baking—and consumption—of lechuguilla, yucca, and sotol in rock ovens (hearths). After 24 hours, the sotol and yucca were not done, but the lechuguilla was thoroughly cooked (Shafer and Moore 1976b:6-7).

An independent study on flotation procedures using soil samples taken from the excavations was conducted by John Keller and Bruce Fullem (1977) during the field school. Goals for the flotation experiments—primarily the collection of a floral sample and an evaluation of flotation methods—were separate from those of the field school. The primary interest of the researchers was methodology, and a floral analysis was not included in their report.

Field camp was located at the Jeff Owens ranch house (Figure 26). The house and yard were off limits for TAS members, but shade from the large trees in the yard was welcome, especially in the late afternoon. Nearby Live Oak Creek served for both bathing and recreation, but no detergents were allowed in the water. At the rancher's request, certain rules were observed: no firearms, no motorcycles or motorbikes, no pets in camp or in the field, a 20-mile-per-hour speed limit on ranch roads, use of established roads only, and avoidance of livestock.

Crews usually left camp before 7:00 a.m. and returned at about noon. Afternoon activities in camp, which included demonstrations of flint knapping by archeologists, proved popular with both young and old. The area was populated by a wide variety of birds because of the abundant water supply at the stock tanks and in the creek. Bird watching was especially good

Figure 25. Jack Hughes and crew trenching a mesa-top burned rock midden (41CK241). (Photo: Beth Davis)

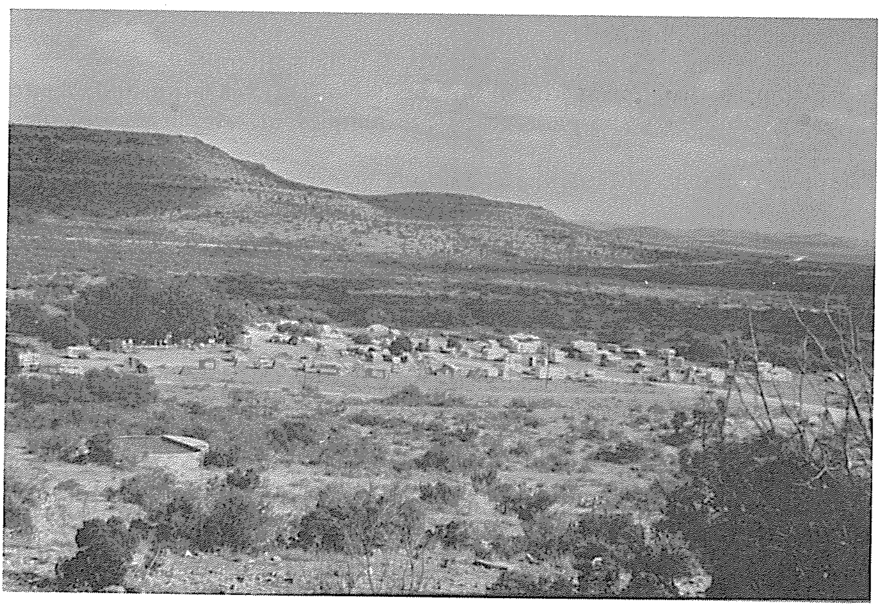


Figure 26. Headquarters for about 200 TAS members on Owens Ranch near Musk Hog Canyon. (Photo: Beth Davis)

late in the afternoon. An activity that drew a large audience was Milton Bell's demonstration of the construction and use of the atlatl and spear.

Emphasis of the evening programs was on the geology, history, ethnology, and archeology of West Texas and Northern Mexico. As usual, speakers were experts in the various fields of study and often included slides with their presentations. The white side of the cook trailer doubled satisfactorily as a projection screen.

Several of the field vehicles contained CB radios, and a base station was set up in camp to monitor the locations of various survey crews and to relay messages. The survey area was fairly extensive, and the use of CB communication provided a degree of safety in case of trouble.

It is the exceptional field school that does not have an accident or a near miss. With over 200 people camping and working in primitive conditions, it is to be expected. Usually mishaps are minor and require only minimal first aid and a band-aid. The 1976 field school mishap, unfortunately, was far from minor. A survey crew ran into a pocket of gas near a buried pipeline, and two members of the crew were rushed to the Iraan hospital. Fortunately neither suffered lasting ill effects, and they returned to camp later that evening.

Rattlesnakes were plentiful in the area, but few were seen during the survey. One exception was the small rock rattler with which crew chief Jimmy Smith shared a resting place while recording a site.

1977: Sabina Mountain No. 2

Tigua Indian Land, El Paso County, far West Texas, June 11-18
Archeologist: William Mayer-Oakes assisted by Alton Thoms, John Montgomery, Phil Bandy
Site types: village, Sabina Mountain No. 2; lithic scatters
Work done: instruction at Sabiña Mountain No. 2 in excavation and on-site survey, laboratory and photographic techniques; off-site survey—37 sites recorded
Temporal context: El Paso phase, Jornada branch, Mogollon culture, A.D. 1300-1400
Number of particcipants: 233

Sabina Mountain No. 2 is a pueblo site located about 22 miles east of El Paso near the edge of the Hueco Bolson. It is a desert area (northern Chihuahuan Desert) with sparse vegetation and sandy soil. The site, an El Paso phase agricultural settlement of the Jornada branch of the Mogollon culture, was probably occupied during A.D. 1300 to 1400 (Mayer-Oakes et al. 1977:1). Such pueblos were built in rows of single-story adobe buildings to which additional rooms could be added. As indicated by stone tools and pottery artifacts recovered during the field school investigation, the prehistoric inhabitants apparently were sedentary agriculturalists who traded with other communities in Texas, New Mexico, and Northern Mexico (Mayer-Oakes et al. 1977:1).

The Tigua Indians, on whose lands the field school excavations were conducted, were congenial and cooperative hosts, and they were interested visitors to the site.

Emphasis for the sixteenth annual field school was on education in archeological technique. Innovative procedures to facilitate the basic goal included pre-field-school workshops, which were held in El Paso in May. Because of distance and time limitations, the pre-field-school work primarily involved those TAS members living in or near El Paso (Fitzgerald 1977:4).

The Sabina Mountain No. 2 field school possibly was, in terms of teaching goals, the most carefully planned and organized school yet offered to TAS members. The school was divided into three broad areas of field activities: on-site excavations (Figure 27), on-site surveys; and off-site survey. Related activities, such as laboratory and photographic work, were also undertaken (Mayer-Oaks 1979:13-16). A great deal of time and effort was expended by Bill Mayer-Oakes, his staff, and students from Texas Tech University. The staff archeologists were research persons, leaders, and teachers for the crew chiefs, who did the actual crew instruction. Four archeologists, assisted by seven Texas Tech University students, constituted the staff (Mayer-Oakes 1979:4-5). The goal was to ensure that each field school participant experienced a representative range of archeological activities, including excavation, on- and off-site surveys, environmental studies, and laboratory work (Figure 28).

Excavations were conducted in limited portions of the Sabina Mountain No. 2 site. With the emphasis on teaching, excavation efforts and data recovery were limited to two rooms that had been excavated previously. Approximately 100 one-meter-square units were excavated by 122 people (Mayer-Oakes 1979:5). Several features noted on the surface were not sampled in excavation (Bandy 1977:2). An area that had been previously disturbed by relic hunters was enlarged in an attempt to determine site stratigraphy.

Various aids and techniques for surface survey, recording, and collecting were demonstrated and taught. On-site survey by 2-meter-wide travel corridors and later by transects was conducted. Collecting corridors provided walkways to undisturbed areas. Some of the survey areas were 100 percent collected; in other cases features were recorded but no collections were made. Ceramics and chert were the major classes of collected materials, with El Paso Brown and El Paso Polychrome the predominant ceramics (Mayer-Oakes 1979:16). For many features, including large lithic and ceramic scatters and a burned rock feature, the density of surface materials precluded exhaustive mapping (Montgomery 1977b:3).

Transect surveys were conducted in areas representing a variety of environmental zones. Roughly 600 acres were covered in the six-day off-site survey. Emphasis was placed on site identification and recording procedures. Participants were able to complete several site survey forms at the 37 sites located, many of which seem to be hunting-gathering campsites. Ceramics of the Mesilla or El Paso phase provided temporal data, as did the variety of lithic tools (Thoms 1977b:3-4).

In addition to the field work, a carefully planned lecture program series and trips to the Tigua Indian reservation and to the Hueco Tanks pictograph site were entertaining as well as informative.

Figure 27. Excavators staking a grid at El Paso, with mapping crew in background. (Photo: E. Mott Davis)

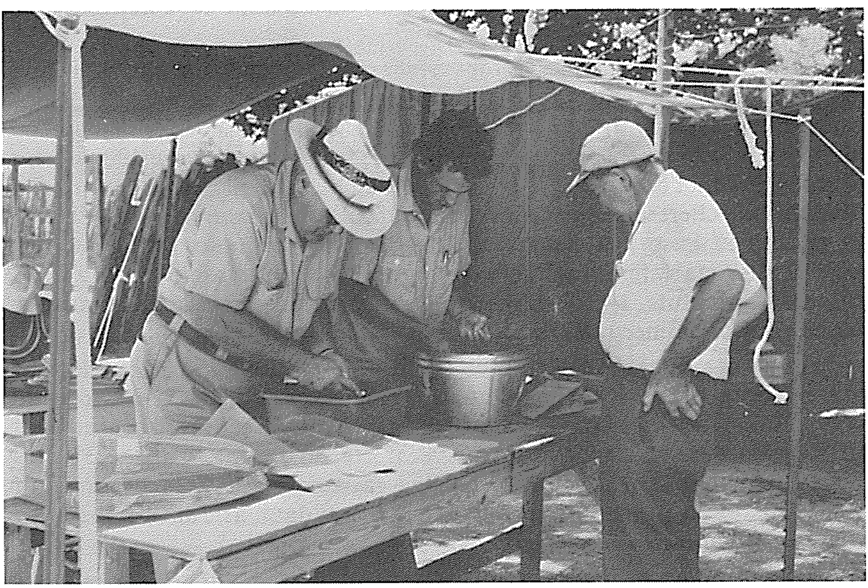


Figure 28. Washing artifacts prior to cataloging. (Photo: Beth Davis)

Field camp was an old Girl Scout camp where there was no shade, plenty of sand, and a limited water supply. Auxilliary water tanks were supplied (including one by the Third Cavalry, Fort Bliss) and kept filled by the El Paso County Water Improvement District (Fitzgerald 1977:5). Coping with high daytime temperatures of over 100 degrees and dessicating winds proved a challenge to TAS members not used to the West Texas summer. Wind blew continually, and tents and gear were distributed across the desert in the wake of the stronger gusts. Other problems were presented by the sand, as vehicles became stuck and were moved with difficulty. Landmarks were few and two-track roads numerous, so off-site surveyors at times had difficulty relocating camp. Although long-sleeved shirts, wide-brimmed hats, and boots were recommended, some daring excavators and surveyors braved the desert bareheaded, barebacked, and sandaled.

1978: Galveston Island

Mitchell Ridge, Galveston Island, Galveston County, upper Texas Gulf Coast, June 10-18
Archeologist: Barbara Bruce Atkins
Site types: prehistoric camp and cemetery sites, early historic occupation area, historic house site
Work done: excavation—Mitchell Ridge site (41GV66); testing—Hall historic house site (41GV70) and Galveston Island State Park; survey—10 sites recorded
Temporal context: Late Prehistoric, Historic European
Number of participants: 326

The history of Galveston Island and the lure of the seashore (especially after El Paso) proved an enticement for some 326 TAS field school participants from Texas, Louisiana, Oklahoma, and Arkansas. Unfortunately, there was little shade and a lot of mosquitoes. A large part of the camp area was located so that it benefitted from a welcome breeze at night, even though the days were hot and sunny. Participants enjoyed the surf after a hot day of digging, mapping, or surveying.

Education in archeological techniques and methods was emphasized in a variety of activities, including location and investigation of prehistoric camp sites and cemeteries, site surveys of areas of the island and adjacent mainland by both on-shore and off-shore (flotilla) surveyors, and investigation of the earliest historic occupation on the west end of Galveston Island. Participants were introduced to specific field techniques through orientation sessions prior to field crew assignment (Bruce 1978a:20). Both afternoon and evening programs were offered; afternoon attendance averaged about 50 and evening attendance about 230.

Testing at the Warren D.C. Hall site (41GV70), a mansion and its surrounding grounds, produced both European ceramics, dating to the 1840s, and Indian materials. One projectile point appears to have been made of glass, indicating historic Indian occupation (Bruce 1978a:20).

In cooperation with the Texas Parks and Wildlife Department, an investigation of the western portion of the Hall site extending into the Galveston Island State Park was carried out by field school personnel to

Figure 29. Shovel testing, the only way to do a survey at Galveston due to ground cover and moving soils. (Photo: Bill Richmond)

determine if the proposed construction of a park maintenance road would disturb important features in the site. Test work included an intensive survey of all the site lying within the park boundaries and test excavations in an area of the site suspected to contain a prehistoric cemetery. The investigation was authorized by Texas Antiquities Permit No. 176.

Surveys by boat and on foot (Figure 29) located 10 previously unrecorded prehistoric sites. All were located on the same high ground as the TAS camp (Bruce 1978a:20).

The Mitchell Ridge site (41GV66) is located toward the west end of Galveston Island, approximately 11 miles west of the city of Galveston. Prehistoric living areas on the crest of the ridge were excavated. Faunal remains, pottery, projectile points, and possible gaming pieces were among

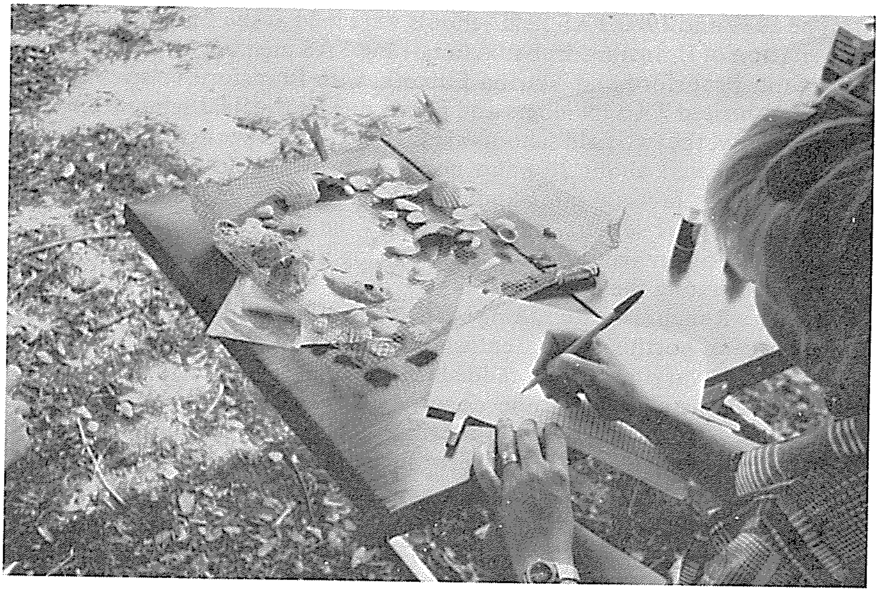


Figure 30. Cataloging artifacts in the lab. (Photo: E. Mott Davis)

the recovered materials cataloged (Figure 30). Two burials, located the last full day of digging, were of an adult woman and a four- or five-year-old child. An arrow point found adjacent to the third lumbar vertebra of the adult was the apparent cause of death. There was no evidence of the cause of death for the child. The burial was removed by the staff and a few helpers who continued to work after the close of the formal field school (Bruce 1978a:20-21).

1979, 1980: Eubank Ranch

Cross Cut, north of Brownwood, Brown County, north-central Texas, June 16-23

Archeologist: Gerald Humphreys

Site types: prehistoric burned rock and mound middens, lithic scatters, quarry (procurement) areas, hearths, open campsites, rockshelter, terrace and historic sites

Work done: testing, excavation—41BR9, 41BR104, 41BR109 (ring midden sites); 41BR105, 41BR110 (mound middens); 41BR165 (rockshelter); 41BR107 (camp area); 41BR103, 41BR106, 41BR108 (house site), 41BR113 (Smith house), 41BR156 (mill site), 41BR159 (house site), 41BR172 (wagon road), 41BR177 (Byrd's store). Survey and collection—61 sites recorded; 41BR112 (lithic scatter), 41BR147 (burial site). Archival search.

Temporal context: Archaic-Historic European

Number of participants: 1979, 275+; 1980, 200+

The 1979 and 1980 TAS field schools were held at the Eubank Ranch at the invitation of Bransford Eubank, long-time TAS member and field school participant. Bransford and Martha Eubank, with Bransford's sisters Mabel and Lydia, hosted TAS members and guests during the field schools (for the sake of brevity, the two field schools are discussed together in this summary). The ranch, located about 20 miles north of Brownwood near Cross Cut, apparently was a favorite camp and living area for both prehistoric nomadic groups and historic settlers, as evidenced by the lithic scatters and burned rock middens of prehistoric groups and by log houses, outbuildings, and a stone bridge among the historic remains.

Eubank Ranch is located along both banks of Pecan Bayou, a permanent water source in northwestern Central Texas. It is a lightly wooded, brushy area with soils varying from a reddish sandy loam overlying a red clay, to yellowish caliche and limestone deposits. Grasses are abundant, and in historic times livestock have been a primary source of income. Even more recently, the general area has been targeted for oil exploration and production.

Field school participants were offered a variety of experiences ranging from walking surveys and boat surveys along Pecan Bayou to midden excavations, mapping and excavating old house sites and ruins, archival searches, compilation of an oral history of the area, and lab work. The 1979 field school concentrated efforts on testing the various known prehistoric sites (primarily burned rock middens), a possible historic Indian site, and the various historic sites, including Byrd's store (Figure 31) and the Dick Stone log house (G. Humphreys 1979:3; Hoffrichter and Davis 1981). Particular attention was concentrated on the site surveys along Turkey Creek, Red River (Brown County), and Pecan Bayou, in addition to the midden excavations. Some 61 sites were located, of which 5 were historic (Figure 32). One rockshelter (41BR165) was located during the Moore Ranch survey. The remainder of the reported sites were prehistoric and included burned rock middens, lithic scatters, quarries (procurement areas), hearths, and buried camp sites. Aboriginal site dates estimated from observed and recovered diagnostic materials ranged from Middle Archaic (Nolan and Pedernales projectile points), to Late Prehistoric (Scallorn, Perdiz, and Washita point types).

Middens were classified either as mound middens (those without an obvious depression or hearth) or ring middens (those with an evident or apparent central depression). Middens were examined primarily to determine structure, use, and age. In addition it was hoped that any similarities or differences between midden sites attributable to physical location could be determined. Generally, middens contained little artifactual information, but the surrounding living areas were more productive.

At the 1979 field school a serious attempt was made to involve participants in writing a major portion of the final report. Norma Hoffrichter chaired the committee that worked with contributors to aid and encourage the production of a detailed account of the 1979 field work. The final informal field school report, edited by Norma with Beth Davis as assistant editor (1981) appeared as a special TAS field school committee publication, *The*

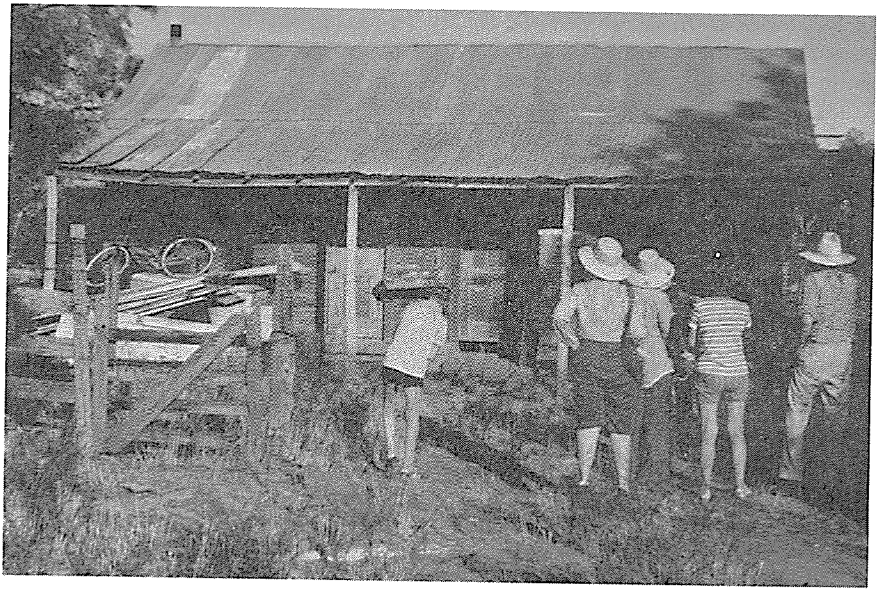


Figure 31. An old post office may also be the site of Byrd's store. (Photo: Bill Richmond)

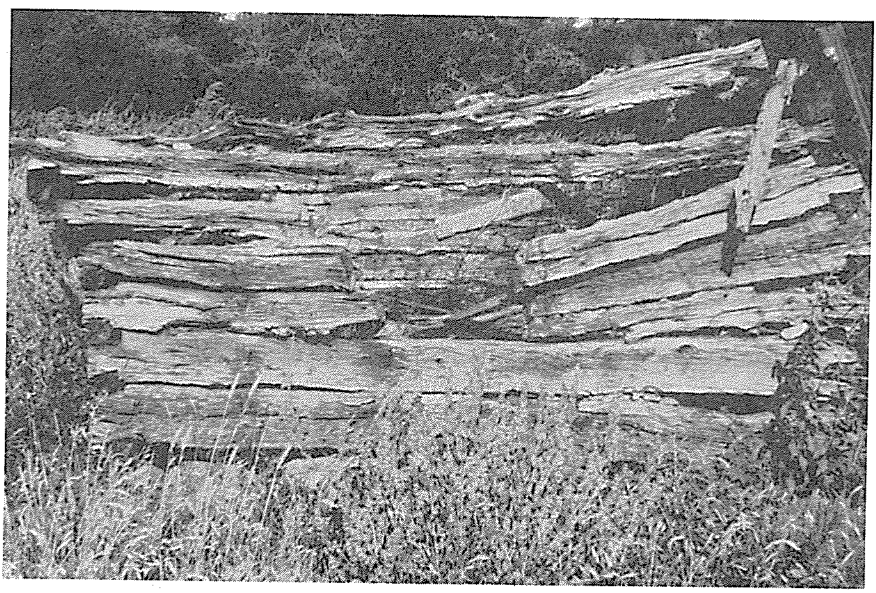


Figure 32. At the Dick Stone log house site (41BR102) only the corn crib walls remain standing. (Photo: Bill Richmond)

TAS Field School, Cross Cut, Texas, 1979. This report provided a source of archeological information on the accomplished work, pending the publication of the archeologist's formal report.

The writing project was intended to educate participants in the importance of recording daily activities and observations at all archeological sites. In the past, field school members were indoctrinated in all phases of field work, but the keeping of daily and detailed field notes received less emphasis than excavation, survey, and laboratory techniques. Although crew chiefs had handled the important field note phase of the work in their daily written reports to the archeologist, it was felt that all participants could develop writing skills and an understanding of the importance of publishing results of archeological work. Recorders were assigned in each crew and daily reports were turned in to Norma for typing. As could be expected, some efforts were excellent, some writers needed more than a little encouragement and guidance, and some gave up in frustration. Admittedly, writing a report of what has been done is time consuming and not as interesting as field work, but without the writing, finding artifacts becomes pothunting and site destruction.

Probably one of the most important aspects of the report writing and detailed record keeping is that reports provide vital physiographic and environmental information to the archeologist. The archeologist working with over 200 field school participants may not have time to make detailed areal observations. Accurate accounts of topography, flora and fauna, soil variations, and site locations in relation to geographical variations can be compiled for the archeologist's report, thus allowing the archeologist to concentrate efforts on analysis and evaluation (Gerald Humphreys: personal communication, n.d.).

Midden testing was completed in 1979. During the 1980 field school, areas surrounding the middens were investigated. Testing at the Fisk Branch ring midden (41BR109) indicated the midden had a depth of 60 to 70 centimeters and contained charcoal, flint flakes, clam shells, and charred seed. A test square north of the midden in what appeared to be an activity area produced 53 potsherds, flint flakes, and cobbles. Tests to the south of the midden located the distal tip of a large biface and a spokeshave (Bugnitz 1981:40-41). Further investigation in 1980 indicated an artifact-rich activity area surrounded the midden. The substantial lithic inventory, including projectile points, scrapers, drills, and bifaces, was recovered from a large hearth containing mussel shells and deer bones (G. Humphreys 1980b:2).

Two unique areas of small burned limestone rubble were tested at site 41BR110, the Gilliam Branch mound midden area. Surface finds in the area included miscellaneous worked flint, a flint knife, and medial blade fragments. No projectile points or pottery was reported. Bob Burleson (1981) describes site 41BR110 as a camping-living-activity area with slab hearths, cores, chips, and debris, indicating a core reduction or chipping station. Finds in the midden include two grinding stones, a mussel shell, flint flakes, a projectile point midsection, and a possible bead. Areas to the south and east of the midden were tested. To the south two shallow, basinlike hearths and a probable third hearth were found. Broken metates and cobbles lined the basins. A test in the area to the east indicated a work area, with about 95 percent of the debris as core reduction flakes; a hammerstone was found in association with the flakes.

The discovery in 1979 of at least three buried hearths and various lithic tools at the Salt Well site (41BR107), a buried site with eroding burned rock, indicated further archeological potential. Investigations of the area in 1980 show this apparent camp site may be older than the midden sites (G. Humphreys 1980b:2).

During the 1980 survey, an additional 49 sites were recorded, the majority of which were along Pecan Bayou, on the Moore Ranch and near the TAS camp. The prehistoric sites included a number of lithic scatters, possible campsite locations. One historic site could be the remains of an old house structure.

An interesting phase of investigation was the interviewing of older area residents for a history of the area. An archival search and the extremely interesting accounts of long-time residents provided an understanding of what life was like in the late 1800s and early 1900s in what is now Brown County. About 26 people were interviewed in 1979. Information on the Dick Stone house (41BR102) included photographs of the area and the family, as well as data on the succession of occupants and specific information on the building construction. Numerous stories and legends about Byrd's store, Indians, schools, outlaws, saloons, and cattle rustlers not only provided data on area life-styles, but were also entertaining. One of the most helpful accounts was that of Mrs. Allie Byrd Hounshell, who was interviewed in 1980. She was born in 1889 and spent her early years in a log house about a mile from the Eubank property (G. Humphreys 1980b:3; S. Humphreys 1981:11).

Bransford Eubank also was a valuable source of historic data. Bransford was born on the ranch, and, except for the years he spent in the ministry and as a foreign missionary, has always lived there. As a result of his and his family's many years and associations in Brown County, Bransford was able to recount much of the area history and to suggest area residents who might supply additional information. Bransford also accompanied a group of area surveyors and pointed out numerous site locations, thereby saving time as well as providing valuable information.

1981: Choke Canyon Reservoir

Near Three Rivers, Live Oak and McMullen counties, South Texas, June 6-13

Archeologist: Grant Hall

Site types: prehistoric campsites, burned rock scatters, two historic homesites, and one historic dugout homesite

Work done: excavation—prehistoric sites 41LK41, 41LK55, 41LK74, 41MC222, 41MC296, and historic sites 41LK53, 41LK202, 41MC67; survey—five sites recorded; archival research—house site 41LK53, dugout site 41MC67

Temporal context: Early Archaic (3400 B.C.) through Late Prehistoric (A.D. 1300-1500), and Historic (A.D. 1850-1880)

Number of participants: 232

Choke Canyon on the Frio River, now the site of a reservoir, is located in Live Oak and McMullen counties in South Texas. The area has been the subject of archeological research by several institutions (including the University of Texas at Austin, Texas Historical Commission, Texas Tech University, and Texas A&M University) and since 1977 has been under intensive investigation by the University of Texas at San Antonio. Approximately 400 sites have been recorded, the majority of which are prehistoric, representing the Archaic and Late Prehistoric periods. The few historic sites date between 1850 and 1880 (Hall 1981a:1).

Grant Hall, associated with the Choke Canyon archeological work, suggested that TAS conduct the 1981 field school in the area. Among the specific sites proposed for the study were several prehistoric open campsites and two historic sites—a dugout homesite (41MC67), the only one known in the area, and a rock-lined well shaft (41LK202) (Hall 1981a:2).

The 1981 field school will be added to the list of field schools that are remembered for the rain and mosquitoes. At Choke Canyon mud was deep in the camp area, and some tenters awoke to find their personal items afloat. And it rained! A number of camps were moved in hopes of finding surroundings that were, if not dry, at least less wet and muddy. Mosquito spray was at a premium.

Despite the conditions, the participants remained cheerful, and work continued after clean-up operations. The laboratory was set up in an old gymnasium building. Field crews surveyed and excavated assigned areas, albeit in the mud. Rain did curtail the amount of work done, but accomplishments were significant by the time field school ended.

Sites were selected for study on the basis of informational need and educational value. Eight sites were selected for excavation, five of which contained prehistoric remains. In addition to the excavations, archival and site survey crews conducted additional investigations.

Crews surveyed 1600 acres of an upland area of the H.D. House ranch on what is now the south side of Choke Canyon Lake. Five sites were recorded, four of which were prehistoric and consisted primarily of burned rock scatters with associated cores, thick bifaces, tools (including a Clear Fork gouge), and debitage. The one historic site located contained wall foundation remains, some scattered whiteware pottery, and glass sherds. The survey has provided important comparative data about the character and distribution of area sites (Hall 1981b:5).

Archival research was conducted primarily at the courthouses in George West and Tilden. Two historical house sites (41LK53 and 41MC67) were the focus of a search for ownership and occupation data. The dugout site (41MC67), one of the more interesting historical sites, dates to the early to middle 1800s and may be the earliest historic structure known in the area. Artifacts recovered include three smoking pipe fragments, ceramics, a musket ball, buttons, and a dangle from a Spanish-style bridle bit (Hall 1981b:5).

TAS crews were unable to complete work on historic site 41LK202, a house structure with an apparently related rock-lined well shaft, which was exposed in the eroding river bank. Work conditions were difficult and somewhat hazardous as crews recorded the superstructure of the well. Rain and a rising Frio River forced the crews to abandon work before the excavation was completed (Hall 1981b:4).

Temporal context for the five excavated prehistoric sites varied. At 41LK51 the upper level deposits yielded Late Prehistoric remains, including arrow points, pottery, and bone. An important find was a piece of obsidian, which originated far from Choke Canyon. Most cultural material was in the upper 30 centimeters and indicated a probable occupation between A.D. 1000 and 1500. A Late Archaic horizon evidenced by materials including Ensor and Fairland dart points was located in the deeper deposits (Hall 1981b:3).

Site 41LK74, a relatively shallow site, revealed Kinney, Tortugas, and Ensor dart points, as well as a great deal of fire-cracked rock. This site is attributed to the Middle to Late Archaic (Hall 1981b:4).

At 41MC55, the activities of one group of people over a short period of time during the Late Prehistoric seem to be evidenced by the shallow deposit and an activity area around a hearth. The Late Prehistoric assignment is based on Perdiz and McGloin arrow points as well as various other artifacts, including ceramics and debitage. The McGloin point, commonly found in the Corpus Christi Bay area, may indicate access to coastal resource areas. Dates for site 41MC55 are estimated at A.D. 1300-1600 (Hall 1981b:3-4).

The most remote site (some 13 miles from camp) was 41MC296, a Late Archaic through Late Prehistoric site as evidenced by diagnostic materials, including Ensor and Tortugas dart points and Perdiz and Scallorn arrow points. One Mission point and a hand-forged knife blade suggest the presence of a historic Indian camp (Hall 1981b:4).

In addition to the traditional evening programs and speakers, afternoon short courses were offered on a variety of topics, including use of a Brunton compass in site mapping, historical artifact analysis, use of a plane table and alidade, making aboriginal-type ceramics, human skeletal material recovery and analysis, and flint knapping (Hall 1981b:5-6). These short courses, although not as well attended as the evening programs, were judged both interesting and helpful by attendees.

1982: Rowe Valley (41WM437)

Williamson County, Central Texas, June 5-12
Archeologist: Elton Prewitt
Site type: Prehistoric campsite
Work done: Excavation—41WM437; survey: 18 new sites recorded; archival research
Temporal context: Late Prehistoric (Toyah phase)
Number of participants: 212+

The Rowe Valley site, located on the San Gabriel River about 14 miles east of Georgetown and approximately 32 miles north of Austin, is a deep terrace site on the south side of the river. The valley is owned by the Rowe brothers, Jack and Lee (now deceased), who hosted the more than 200 TAS members who camped on their property.

The camp, in a grove of pecan, cedar, and elm trees, was immediately adjacent to the site. The level, grassy area had been mowed, cleaned, and sprayed prior to the campers' arrival. The proximity of the camp to the site (about 50 yards) allowed participants to walk to work in a matter of minutes.

Laboratory facilities were located at the site, and laboratory questions or problems usually could be answered promptly by crew chiefs. Probably one of the more valuable aspects of the proximity of site, laboratory facilities, and camp was that all field school participants could observe the daily progress of the investigations. Work areas are often remote and members may never see the various sites and work areas, with the result that only a limited number of participants may observe and learn the various research techniques used.

For the first time since Guadalupe, the cook trailer was not used. Meals were catered for those not choosing to prepare their own.

Preliminary work at the site by Elton Prewitt and the Travis County Archeological Society indicated a Toyah phase component (Perdiz points) apparently discretely separated from earlier materials. The original plan was to expose this occupation area horizontally and reconstruct the camp layout. In addition to the excavation, an area site survey along two stretches of the San Gabriel River and historic-sites archival research were planned (Prewitt 1982a:2).

About two weeks before field school, a sterile alluvial deposit over the central portion of the site area was removed by heavy equipment, including a Gradall and three dump trucks donated for TAS use and manned by volunteers. Removal of the overburden allowed the TAS members to begin work at the top of the first cultural zone. The Gradall operator was able to detect the slightest change in the surface, as well as any rock, flint, or bone, and in only one day removed the overburden to within an inch of the deposit.

The depth of sterile deposit was less than anticipated, and in parts of the site bone and burned rock were revealed. The site adjoins an area that has been used as a gravel borrow pit. Occupational debris (including flakes, tools, charcoal, and bone) could be seen in three distinct levels in the pit wall. Since vertical distribution of cultural materials was evident, field school investigations focused on the horizontal patterning of use areas across the site. Only the upper cultural zone was excavated during the 1982 field school, and even that excavation was not completed in the eight working days available.

A variety of features, including stone-lined hearths, rock hearths (Figure 33), stone-tool production areas, and bison and deer processing stations have been located. Butchering stations are on the northern area of the site toward the San Gabriel River; hearths are generally to the south. A "plaza" area with no discernible features is in the center of the exposed area (Prewitt 1982b:4).

Two features require further investigation. An unusual hearth, which may have post molds adjacent to it (possibly representing remains of a cooking rack), is located at the west side of the site. A concentration of deer antlers was found in the same area. This find was made late in the week, and, since such concentrations have been found in association with burials, their removal was postponed until the 1983 field school (Prewitt 1982b:4; Elton Prewitt: personal communication, n.d.).

The dominant diagnostic lithic tools found are Perdiz and Clifton arrow points, basal- and corner-notched arrow points, four-edge beveled knives, and end scrapers. A number of ceramic sherds, apparently representing at

Figure 33. One of the hearths located in the upper component of the Rowe Valley excavation (41WM437). (Photo: Rosanne Henna)

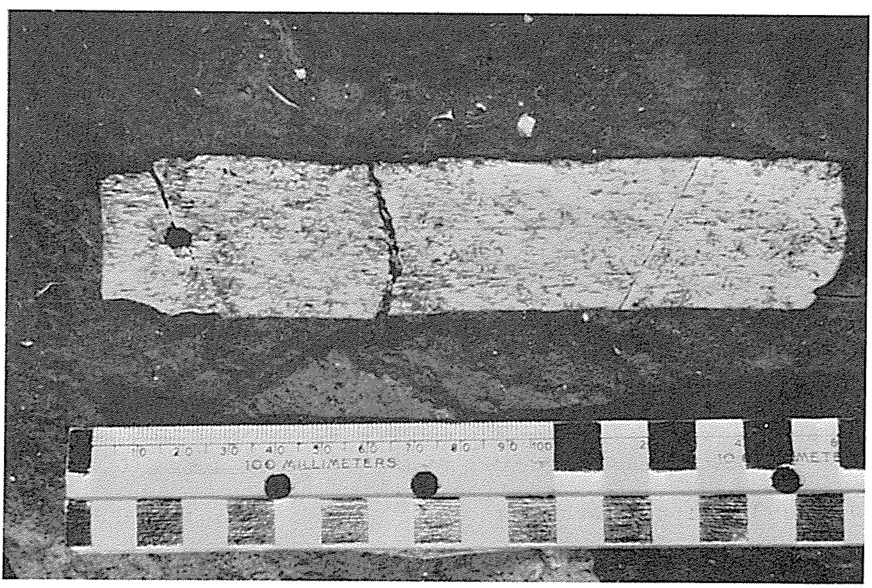


Figure 34. One of two bone pendants recovered at Rowe Valley. Bone beads also were found. (Photo: Prince McKenzie)

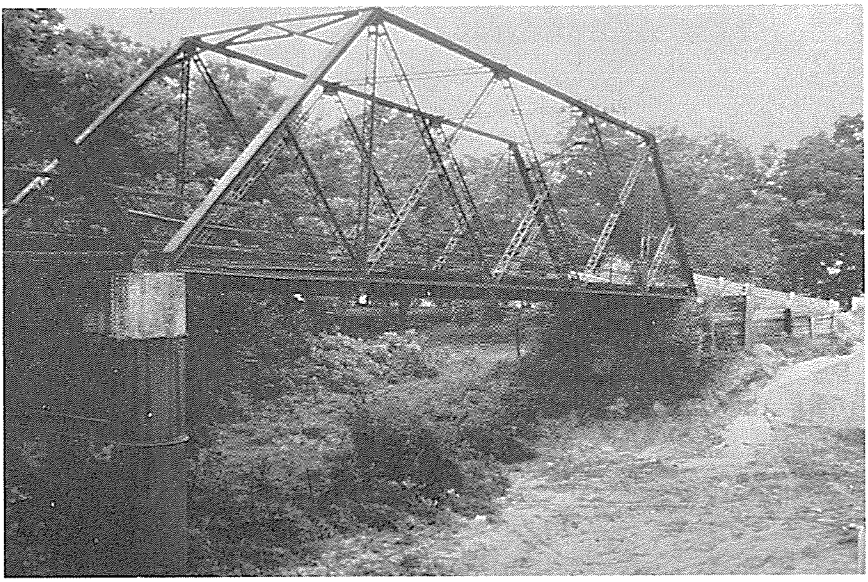


Figure 35. A TAS archival search traced the history of this iron bridge, later designated a State Historical Landmark. (Photo: Rosanne Henna)

Figure 36. Young people learn about Indian lifeways as they construct a brush hut. (Photo: Rosanne Henna)

least four vessels (two of which may be reconstructed), were found. Sherds of one of the vessels have been tentatively identified as Patton Engraved, a Caddoan-type pottery that has a temporal range from Protohistoric to early Historic. Other sherds were described as burnished brownware and redware pottery types typical of Central Texas. Additional artifacts include tubular bone beads, a large, flat bone pendant (Figure 34), and possible bone tools (Prewitt 1982b:4; Elton Prewitt: personal communication, n.d.).

Although the major emphasis was on excavation, site survey and archival research teams made positive contributions to archeological understanding of the area. The survey teams recorded 18 new sites and revisited one prehistoric site. Site dates based on diagnostic materials ranged from Early Archaic to Historic, and all newly reported sites had been disturbed to some degree by farming activities. Sites were limited to the San Gabriel terraces and flood plain. The uplands were almost totally lacking in prehistoric materials (Ralph 1982:8).

Access to Rowe Valley from State Highway 29 was across an old iron bridge (Figure 35) over the San Gabriel River on County Road 369. The bridge, rusty and paved with worn wooden planks, was one of the historic sites researched and recorded by the archival crew. It was learned that the bridge was originally built in 1909, a new part was added in 1914, and the bridge was rebuilt after a flood in 1921 (Victor 1982:7). Members and visitors experienced the thrill of driving over the historic one-way bridge (trailers and heavy trucks were advised of an alternate route). Shortly after field school the old bridge was retired in favor of a modern structure. The iron bridge has been retained as a historic landmark.

An outstanding feature of the 1982 field school was the young people's program conducted by Bob and Mickey Burleson. Under their direction brush shelters (Figure 36) and cooking hearths and racks were constructed, fish were caught, tools made, cooking done, and games played. The Rowes were impressed with the "village" and asked that it be left for visitors to see.

Media coverage was excellent. Newspaper reporters from Taylor, Georgetown, and Austin presented both pictorial and narrative accounts of the site work. Television coverage was given by Temple-Waco and Austin stations. As a result of media exposure, visitors flocked to the site, where they were presented a brief introduction to archeology at Rowe Valley.

The usual evening programs included discussions of areal occupation and history, and other topics related to archeology. On visitors night the local hosts, dignitaries, and friends were invited to share the evening meal and participate in an "awards" night. Traditionally, the *Titanic* was sunk; this year over 200 people participated in the event, led, as usual by the indomitable E. Mott Davis and his guitar (Figure 37), with support from the TAS musical crew.

As usual, work continued to the last day. If a heavy rainstorm had not occurred on Friday, the work probably would have continued past the end of field school. The open pits were given time to dry out, and a week after field school the Travis County Archeological Society helped Elton Prewitt cover all excavated areas with heavy plastic weighted with sand.

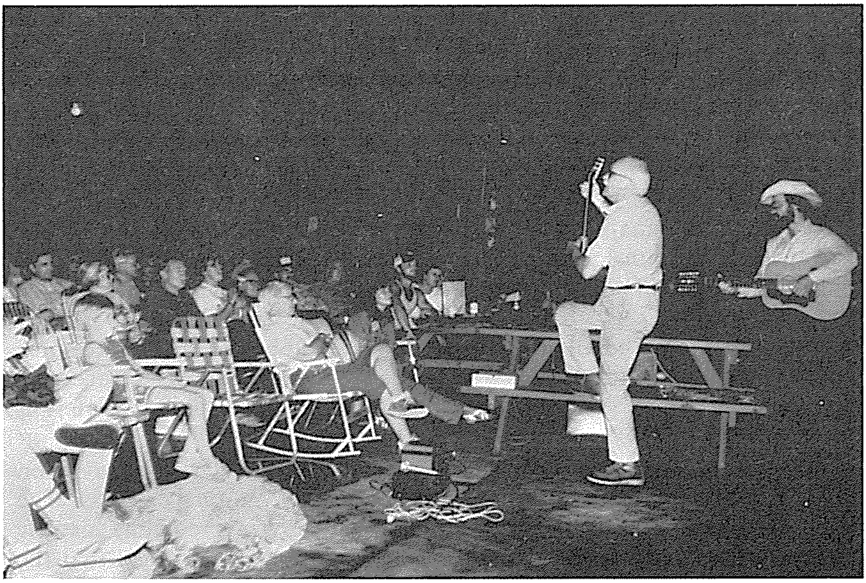


Figure 37. Mott Davis, Hugh Davis, and friends sink the *Titanic* at Rowe Valley 1983. (Photo: Rosanne Henna)

The field school at Rowe Valley in 1983 continues work begun in 1982. Elton Prewitt continues to serve as archeologist at the site, which holds the potential for information not previously reported, as well as presenting TAS members the opportunity to learn and experience a wide variety of excavations and laboratory techniques.

SUMMARY

The annual field school has progressed steadily over the years since 1962 and the summer dig at the Gilbert site. Early field schools, of necessity, depended heavily on vocational archeologists for basic and theoretical instruction, as well as for the more mundane jobs of organization and direction. A cadre of experienced TAS members grew from the roster of participants at the first field schools and were able to assume the responsibilities of basic instruction in field archeology. With relief from the responsibilities of individual instruction, and with the creation of a field school committee to handle planning and camp arrangements, the archeologists were able to concentrate on archeological activities.

Competence of field-school-trained members has resulted in suggestions from state and national agencies (Texas Highway Department, Texas Parks and Wildlife, National Park Service) that TAS participate in planned archeological projects. For example, at Musk Hog Canyon, McKinney Falls State Park, and Guadalupe Mountains National Park, TAS cooperated with governmental agencies in area site surveys and excavations.

Selection of a location for the annual field school is based on archeological data need, suitability of the area for both teaching and educational requirements, and the availability of a professional archeologist able to donate time and energy to a research design, archeological field work supervision, and writing or supervising the writing of a formal report of the work. Preference is given site locations that are in danger of destruction by construction or natural causes.

Accomplishments of the society's summer field school and its contributions to Texas archeology are numerous and widely recognized throughout the state. The first official archeological excavation of a shell midden on the Texas coast was that of the TAS field school at the Gaulding site in 1965. As a result of TAS work in 19 locations around the state, many sites of significant cultural importance have been investigated and reported by avocational and vocational archeologists in TAS and local society publications. Formal reports have included at least one doctoral dissertation (Skinner 1974) and two master's theses (Boisvert 1980; Moore 1982).

The sponsorship by TAS members of young people 17 years old and younger who have an interest in archeology but would be unable to attend field school without an adult has encouraged youthful participation and, for some, the pursuit of archeological careers.

Dissemination of archeological information on various field schools through media coverage of the activities has helped to make the general public more aware of local archeological resources and the need for recording information scientifically.

Field school participation has grown from a handful (often only 6 to 10 people at the site during the week) to 200 to 300 daily participants. Percentages of the TAS membership attending a field school have varied from 1 percent at Oblate to more than 30 percent at Galveston. With this growth have come improvements in educational procedures and activities, field school structure, camp management, and equipment. Texas Archeological Society field schools provide a chance for people of all ages, from all walks of life and numerous professions, to work in and contribute to the field of archeology.

ACKNOWLEDGMENTS

We would like to acknowledge the cooperation of those who knowingly or unknowingly helped us accumulate 21 years of field school information: Shirley VanderVeer, who is TAS secretary and keeper of the files; Anne Fox, Norma Hoffrichter, Jane Schweitzer, Kathleen Gilmore, Charles N. Bollich, Grant Hall, Paul Lorrain, and Francis Stickney, who provided anecdotal information; E. Mott Davis, Elton Prewitt, and Jim Word, who provided photographs and general information; and Carolyn Spock (TARL), who assisted in tracking down field school site numbers.

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Late Caddoan Social Group Identifications and Sociopolitical Organization in the Upper Cypress Basin and Vicinity, Northeastern Texas

J. Peter Thurmond

ABSTRACT

The Late Caddoan culture traditionally referred to as the Titus focus is reconsidered. A new terminology is proposed for the Titus focus, separating its spatial and chronological aspects. The term *Cypress cluster* is recommended as a label for the cultural entity represented by the Titus focus, and the terms *Whelan phase* and *Titus phase* are suggested for its temporal divisions. The boundaries of the Cypress cluster during each phase are delimited. Four spatial divisions within the Cypress cluster are identified during the Titus phase on the basis of differences in material culture; these are termed subclusters. It is suggested that, at least during the Titus phase, one can identify in the archeological record a major Late Caddoan social group and its constituent subgroups, or in more traditional terms, a "confederacy" and its component "tribes."

INTRODUCTION

From January 1980 to May 1981, the author performed an inventory and analysis of recorded archeological sites in the Cypress Creek drainage basin of northeastern Texas and northwestern Louisiana. A total of 476 sites was included in the study, the results of which were submitted to The University of Texas at Austin as a master's thesis (Thurmond 1981). In the course of that study, the author had the opportunity to analyze artifact collections from 172 of the sites in the Texas portion of the basin. Certain spatial patterning became apparent in the distribution of Late Caddoan ceramic attributes and, to a lesser extent, arrow point forms. The scope of the study was therefore expanded to include a consideration of recorded Late Caddoan components in immediately adjacent parts of the Sabine and Sulphur basins (Figure 1). The following article summarizes the spatial patterning suggested by archeological remains of Late Caddoan components in the vicinity of the upper Cypress Basin and explores sociopolitical implications of that patterning.

In making this presentation, the author is climbing out on something of an academic limb, in that the interpretations which follow are based on the results of archeological investigations of extremely variable intensity, purpose, and quality spanning some fifty years. As can be seen in Figure 2, portions of the study area

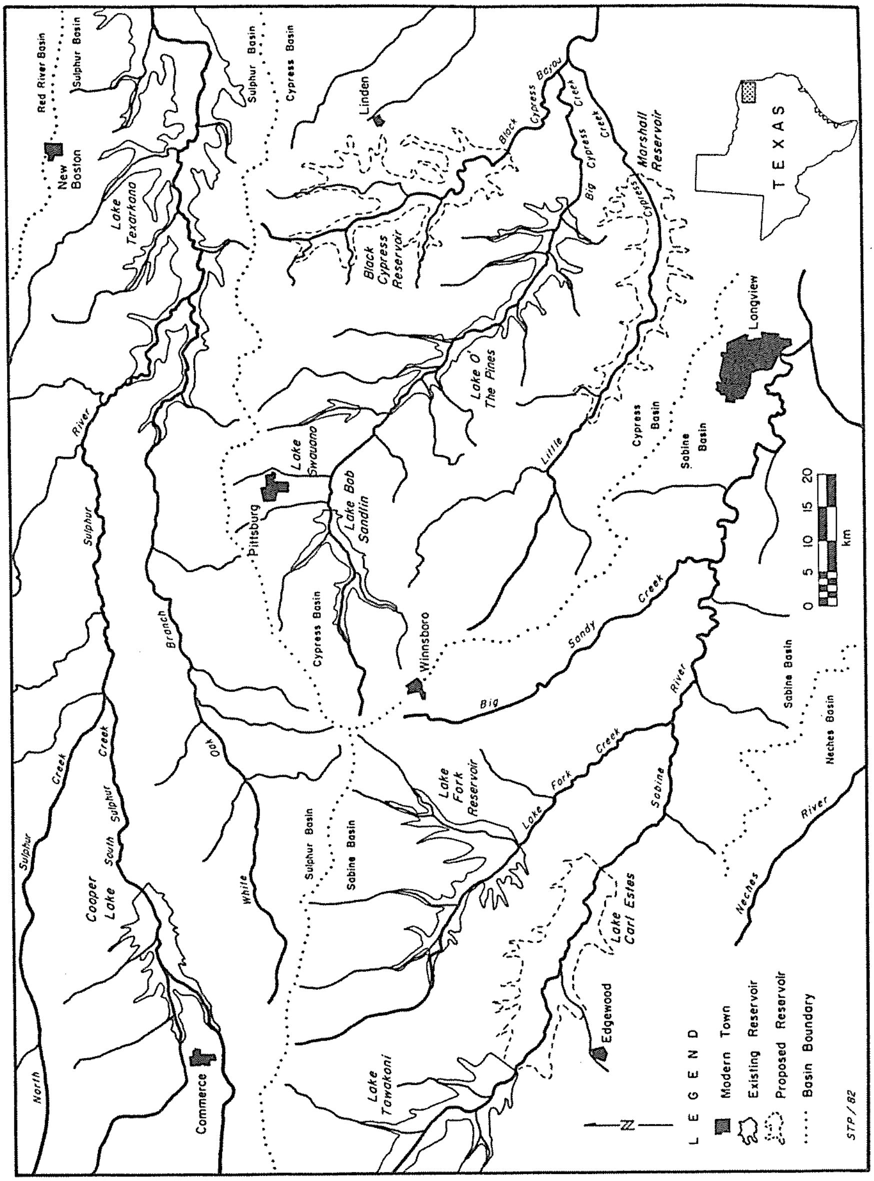

Figure 1. The upper Cypress Basin and its vicinity.

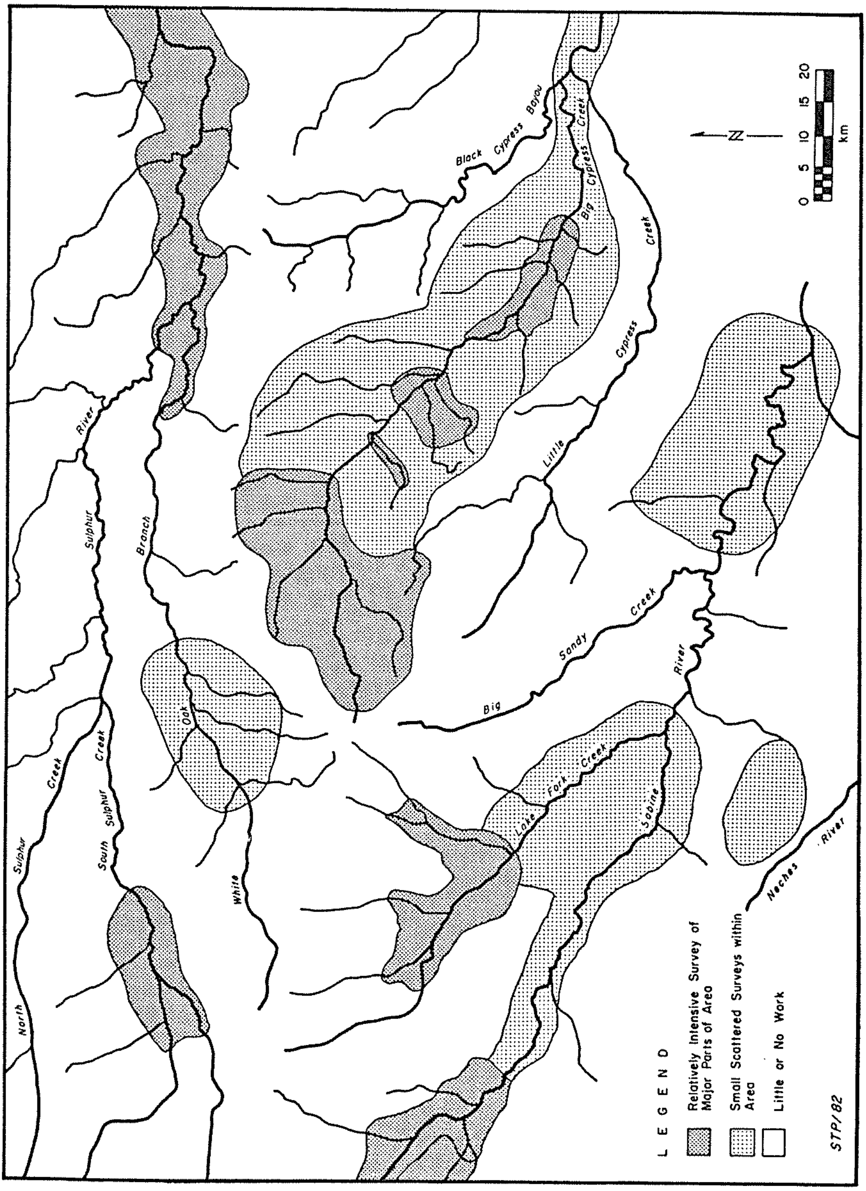

Figure 2. Relative intensity of archeological survey in the upper Cypress Basin and its vicinity.

have been quite carefully surveyed, while other large segments remain virtually unexplored. Such history of investigation is clearly less than ideal to the student of spatial distributions. However, every undertaking must have its beginning, and the following presentation should be construed as nothing more than that.

CHRONOLOGICAL FRAMEWORK

It has become the vogue in recent years to belittle the study of archeological chronology as prehistorians have expanded the scope of their interests to address a broader range of research topics, from settlement and subsistence patterning to paleopathology. As is so often the case, in rejecting the negative characteristics of earlier archeological research, we have tended to overlook its beneficial aspects. It cannot be overstated that a command of the local chronology is a fundamental precursor to all other archeological studies in any region, in that the assumption of contemporaneity underlies so many processual models. This is certainly true of models of sociopolitical organization, and so we must first establish some chronological control over the archeological materials.

Ironically, despite all the derision (seldom in print) in recent years of the concentration upon chronology in the Caddoan area studies of the 1940s and 1950s (c.f. Krieger 1946; Suhm, Krieger, and Jelks 1954), our command of the chronology of this region remains relatively poor for much of the span of human occupation. The rarity of preservation of wood samples suitable for dendrochronological research, a dearth of tightly controlled suites of radiocarbon dates, and the virtual absence of depositional regimes conducive to significant archeological stratification are largely responsible for this state of affairs. However, chronologies have been constructed for the region and its constituent areas over the years on the basis of intersite seriation, rare instances of natural or cultural stratification, and correlation with the chronologies of adjacent regions. Tentative calendric spans have been assigned to the various time periods on the basis of widely scattered radiocarbon dates, a good deal of inference, and, again, comparison to surrounding areas. Although there is still considerable controversy on this topic, the author would summarize the chronological periods of the study area and their diagnostics as follows. Detailed citations tracing the development of the local chronology may be found in Thurmond (1981:90–97, 418–448).

Early Paleo-Indian (10,000 to 8,000 B.C.): fluted projectile points of the types Clovis and Folsom.

Late Paleo-Indian (8,000 to 6,000 B.C.): projectile points of the types Dalton, Meserve, Plainview, San Patrice, and Scottsbluff; early side-notched dart points; and Albany bevelled bifaces.

Archaic (6,000 to 200 B.C.): Perkin bifaces; a high relative incidence of lithic debitage within a site; most nonprojectile bifacial implements; numerous ground stone tools; polished stone gorgets, boatstones, and grooved axes; and Clear Fork gouges.

> *Early Archaic* (6,000 to 4,000 B.C.): dart points of the types Bulverde, Calf Creek, Carrollton, Dawson, Morrill, and Wells; and stemless triangular dart points.

Middle Archaic (4,000 to 2,000 B.C.): dart points of the types Edgewood, Ellis, Evans, Lone Oak, Palmillas, Trinity, Yarbrough, and Wesley; and most other straight- or expanding-stem dart points.

Late Archaic (2,000 to 200 B.C.): dart points of the types Ensor, Gary, and Kent, in the absence of pottery.

Early Ceramic (200 B.C. to A.D.800): Late Archaic dart point styles in association with pottery of the types Williams Plain, Le Flore Plain, Marksville/ Troyville period types of the lower Mississippi Valley, and (rarely) sandy paste ware (e.g. Bear Creek Plain).

Early Caddoan (A.D. 800 to 1400): dominance of body sherd collections by plain, incised, punctated, and fingernail-impressed specimens; paste and thickness of utility wares often grade into types Williams Plain and Le Flore Plain; pottery of the types Hickory Fine Engraved, Carmel Engraved, Crockett Curvilinear Incised, and Pennington Punctated-Incised; Red River ceramic pipes; arrow points of the types Alba, Bonham, Catahoula, Hayes, and Scallorn; and Gahagan bifaces.

Period 1 (A.D. 800 to 1200): pottery of the types Davis Incised, Holly Fine Engraved, Spiro Engraved, and Weches Fingernail Impressed; Coles Creek Incised and other Coles Creek period types of the lower Mississippi Valley; major portion of the utility ware exhibits Williams/Le Flore characteristics.

Period 2 (A.D. 1200 to 1400): pottery of the types Canton Incised, Haley Engraved, Maxey Noded Redware, Sanders Engraved, and Sanders Plain; utility ware exhibiting Williams/Le Flore characteristics much less common than during Period 1.

Transitional Early to Late Caddoan (A.D. 1400 to 1500): ceramic assemblages exhibiting a fusion of Early Caddoan Period 2 and Whelan phase concepts, in association with arrow points of the types Scallorn and Perdiz.

Late Caddoan A.D. (1500 to 1700): pottery of the types Bullard Brushed and Maydelle Incised; relatively high incidence of brushed body fragments in sherd collections from the eastern half of the study area; ceramic elbow and biconical pipes; Galt bifaces.

Whelan phase (A.D. 1500 to 1600): Ripley Engraved bowls exhibiting all motifs other than pendant triangle (Figure 3), with border elements commonly filled by carelessly executed curvilinear hatchures; also pottery of the types Pease Brushed-Incised, proto-Harleton Applique, McKinney Plain, and, rarely, Taylor Engraved, and trade vessels of the type Poynor Engraved; arrow points predominantly of the types Scallorn and Perdiz.

Titus phase (A.D. 1600 to 1700): pottery of the types Bailey Engraved, Harleton Applique, Johns Engraved, Karnack Brushed-Incised, La Rue Neck Banded, McKinney Plain, Ripley Engraved, Taylor Engraved, and Wilder Engraved; Ripley bowls exhibit all but horizontal diamond, bisected diamond, and interlocking diamond motifs (Figure 3), commonly executed in broad, deep excising and engraving; tradeware of the types

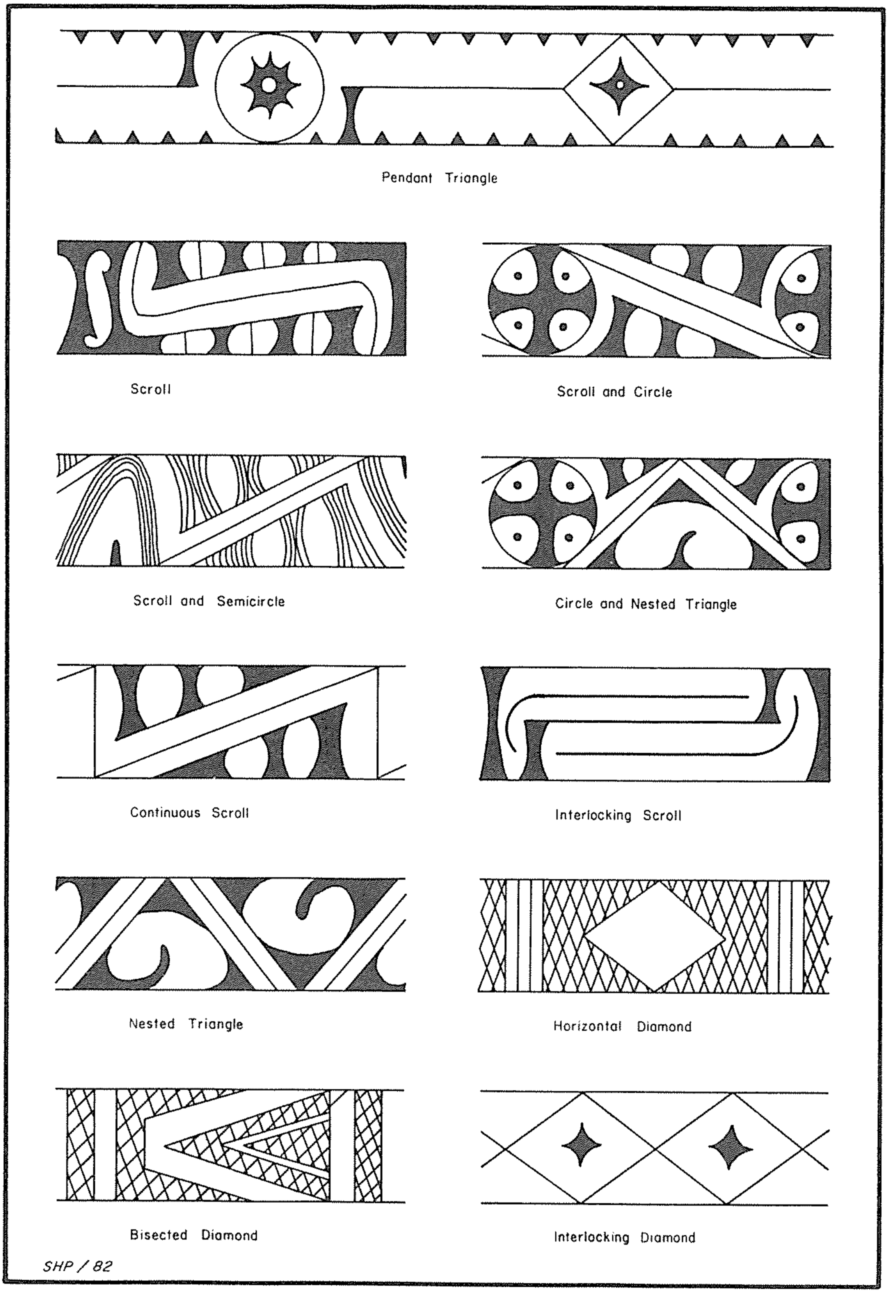

Figure 3. Ripley Engraved bowl-rim motifs.

Avery Engraved, Simms Engraved, Cass Applique, Belcher Engraved, Belcher Ridged, Cowhide Stamped, Foster Trailed-Incised, Glassell Engraved, Hodges Engraved, and Keno Trailed; arrow points predominantly of the types Bassett, Maud, Reed, and Talco; European glass beads and ceramics of the Wichita type Womack Engraved found as burial associations in a few components.

Happily, the present study concentrates upon the briefest of the chronological subdivisions, the Whelan and Titus phases of the Late Caddoan period, previously defined as the Fulton aspect by Krieger (1946). The definition of the Titus phase follows that of Krieger's Titus focus (Krieger 1946), and the separation of the precedent Whelan phase follows Davis's (1958) definition of the Whelan complex. The author employs the term *phase* as a purely chronological division within a tightly circumscribed local culture, distinct from the fusion of the concepts of relative contemporaneity and spatial circumscription in the old McKern (1939) term *focus*.

SOCIAL GROUP IDENTIFICATIONS AND SOCIOPOLITICAL ORGANIZATION

Turner (1978) has recently suggested that a chronological subdivision of the Titus phase can be made on the basis of Ripley Engraved bowl rim motifs and arrow point types. Specifically, he has suggested that the early Titus phase components are characterized by an absence of the Ripley pendant triangle motif (Figure 3) and dominance of the arrow point assemblage by the types Perdiz and Bassett. Late Titus phase components would conversely be indicated by a high incidence of the pendant triangle motif and arrow points of the types Talco and Maud. Turner's interpretations were largely based on his analysis of grave goods from Titus phase cemeteries at the Tuck Carpenter (41CP5), Tommy Johns (41CP2), and Alex Justice (41TT13) sites.

The foregoing struck this author as quite reasonable at the time of its publication in 1978, and Turner's temporal division of the Titus phase was followed during the data collection of my thesis project. However, as the results were analyzed, it became clear that the geographic distribution of the components so classified was quite markedly biased. The "early" components were all in the western part of the Cypress Basin, and the "late" components were near its center.

This observation prompted a harder look at the artifacts associated with the Titus phase components within the Cypress Basin and an expansion of the scope of the study to examine the collections from, and published reports of, Late Caddoan components to the immediate north, west, and south. The collections at the Texas Archeological Research Laboratory in Austin and the published accounts of the Lake Tawakoni (Johnson 1957), Lake Carl Estes (Malone 1972), Lake Fork Reservoir (Bruseth and Perttula 1981; Bruseth et al. 1977), Cooper Lake (Doehner and Larson 1978; Doehner, Peter, and Skinner 1978), and Lake Texarkana (Jelks 1961) archeological projects were consulted. Data more recently published by Skiles, Bruseth, and Perttula (1980) also were utilized.

Even on the basis of the rather gross level of classification employed in my study, it rapidly became clear that many of the geographic limits of the Titus phase ceramics could be defined on the basis of the present site sample, and that at least four groups of components should be defined within those boundaries.

The patterning was clear on a descriptive level, and the concept of a "confederacy" composed of "tribes" á la Swanton (1942) was immediately suggested.

It happened that Dee Ann Story was concurrently working with similar problems in her reanalysis of the Late Caddoan components in the vicinity of the Deshazo site near Nacogdoches, Texas (Story and Creel, 1982). Story has formulated a model of Late Caddoan sociopolitical organization for the local cultures defined by Krieger (1946) as the Frankston and Allen foci which the author believes to be directly applicable to the components at hand. Story interprets the two foci as the archeological manifestations of a single Late Caddoan social group, the Hasinai Confederacy, as defined by Swanton (1942). This "confederacy" is seen as a weakly hierarchical structure with two levels of integration. The terminological equivalent of Swanton's *confederacy*, Story's *affiliated group* is postulated to represent the highest level of Late Caddoan intergroup sociopolitical organization. Comprising this maximal group were a number of *constituent groups*, the equivalents of Swanton's *tribes*, each composed of multiple settlements, cemeteries, and limited use areas (Story and Creel 1982:32–33).

Story predicts that interaction through the mechanisms of intermarriage, economic exchange, joint participation in ceremonies, and visitation would be "more frequent and intense among the constituent groups than between a member group and a nonmember group" of the affiliation (Story and Creel 1982:32–33). One would expect to identify the affiliated group archeologically by means of a pronounced sharing of attributes in the material culture. The predicted archeological manifestation of the model is therefore synonymous with the McKern system *focus*, or what we might alternatively refer to as a local culture. Story terms this spatial expression a *cluster*, and its temporal divisions are designated *phases* in harmony with this author's use of the term (Story and Creel 1982:33–34). She then proceeds to spatially define the Anderson cluster, chronologically divided into the prehistoric Frankston and historic Allen phases. No equivalent archeological term was proposed by Story on the constituent-group level, as she feared that their detection by archeologists would be quite difficult (Story and Creel 1982:33–34).

Again, the author is of the opinion that Story's model of Late Caddoan sociopolitical organization can be quite profitably applied to the Late Caddoan components of the upper Cypress Basin and its vicinity. The term *Cypress cluster* is proposed as a replacement for the spatial element of Krieger's Titus focus and is believed to identify the archeological manifestation of a Late Caddoan affiliated group. Two chronological subdivisions are suggested for the Cypress cluster, the prehistoric *Whelan phase*, dating from approximately A.D. 1500 to 1600, and the protohistorical to early historic *Titus phase*, estimated to span the century from about A.D. 1600 to 1700. At the least, this application of Story's model provides a terminology for the classification of Late Caddoan components in the study area which clearly separates the spatial and chronological elements formerly combined in the term *focus*. The model can also serve as a useful framework for the analysis of Late Caddoan social groups and sociopolitical organization in the study area.

Many of the boundaries of the Cypress cluster during both the Whelan and Titus phases can be identified on the basis of the presently available data. Components exhibiting artifact assemblages characteristic of the Whelan phase of the

Cypress cluster are not known to occur beyond the bounds of the Cypress Basin (Figure 4). The recorded components occur only along Big Cypress Creek, from its confluence with Little Cypress and Black Cypress creeks to its upper reaches in the northwestern part of the Cypress Basin. It is not known whether Whelan phase components occur in the adjacent Little Cypress and Black Cypress valleys, as these areas remain unknown archeologically (Figures 1 and 2).

There is a distinct westward expansion in the occurrence of Cypress cluster components during the Titus phase (Figure 5). Cypress cluster components definitely occur along the eastern reaches of Lake Fork Reservoir, but none were recorded in its western reaches, nor at Lake Tawakoni or Lake Carl Estes (Bruseth and Perttula 1981; Bruseth et al. 1977; Johnson 1957; Malone 1972). To the northwest the University of Texas, in investigations of the 1930s, recorded Cypress cluster components of the Titus phase along the middle reaches of White Oak Bayou, but more recent investigations at Cooper Lake on the South Sulphur failed to identify a single Cypress cluster component (Doehner and Larson 1978; Doehner, Peter, and Skinner 1978). To the north a single Titus phase component, 41TT2, the W. A. Ford site, was recorded by the University of Texas in the 1930s on the Sulphur River, but no Cypress cluster components were recorded at Lake Texarkana (Jelks 1961). It seems likely that Cypress cluster components will be found in the Black Cypress, Little Cypress, and Big Sandy basins, but this clearly remains to be tested. Titus phase components of the Cypress cluster definitely do not occur east of the Big Cypress/Little Cypress confluence (Thurmond 1981: Figure 15) or south of the Sabine River (Kleinschmidt 1982:193–211).

Four distinct spatial groups of components can be identified within the Cypress cluster during the Titus phase on the basis of the artifact assemblages. It is believed that these represent the archeological manifestations of constituent groups, and the term *subcluster* is used as the archeological equivalent of the constituent group. The distribution of the components making up each subcluster is illustrated in Figure 6. The ceramics and arrow points characteristic of each subcluster are as follows.

Three Basins subcluster: Ripley Engraved is by far the dominant engraved ware. Ripley bowls most frequently exhibit the scroll, scroll and circle, and continuous scroll motifs (Figure 3), and the pendant triangle motif is entirely absent. Wilder Engraved is virtually the only other engraved ware, barring apparent trade vessels of the types Avery Engraved, Simms Engraved, and, rarely, Womack Engraved. The utility ware is largely classifiable as McKinney Plain, Maydelle Incised, and Harleton Applique, with very little brushed ware present (less than 5 percent of the utility ware). Arrow points are of the types Talco and Maud, with Perdiz occurring infrequently.

Tankersley Creek subcluster: Ripley Engraved is the most common engraved ware. Ripley bowls most frequently exhibit the scroll, scroll and circle, and continuous scroll motifs, and the pendant triangle motif does occur rarely. Wilder Engraved is the only other common engraved ware, but Taylor Engraved is present at low frequencies. The greatest part of the utility ware is evenly divided between vessels classifiable as Harleton Applique, Maydelle Incised, McKinney Plain, and Bullard Brushed. Brushed ware accounts for 20 to 30 percent of the utility ware. Arrow points are most commonly of the type Maud, but Talco, Bassett, and Perdiz also occur.

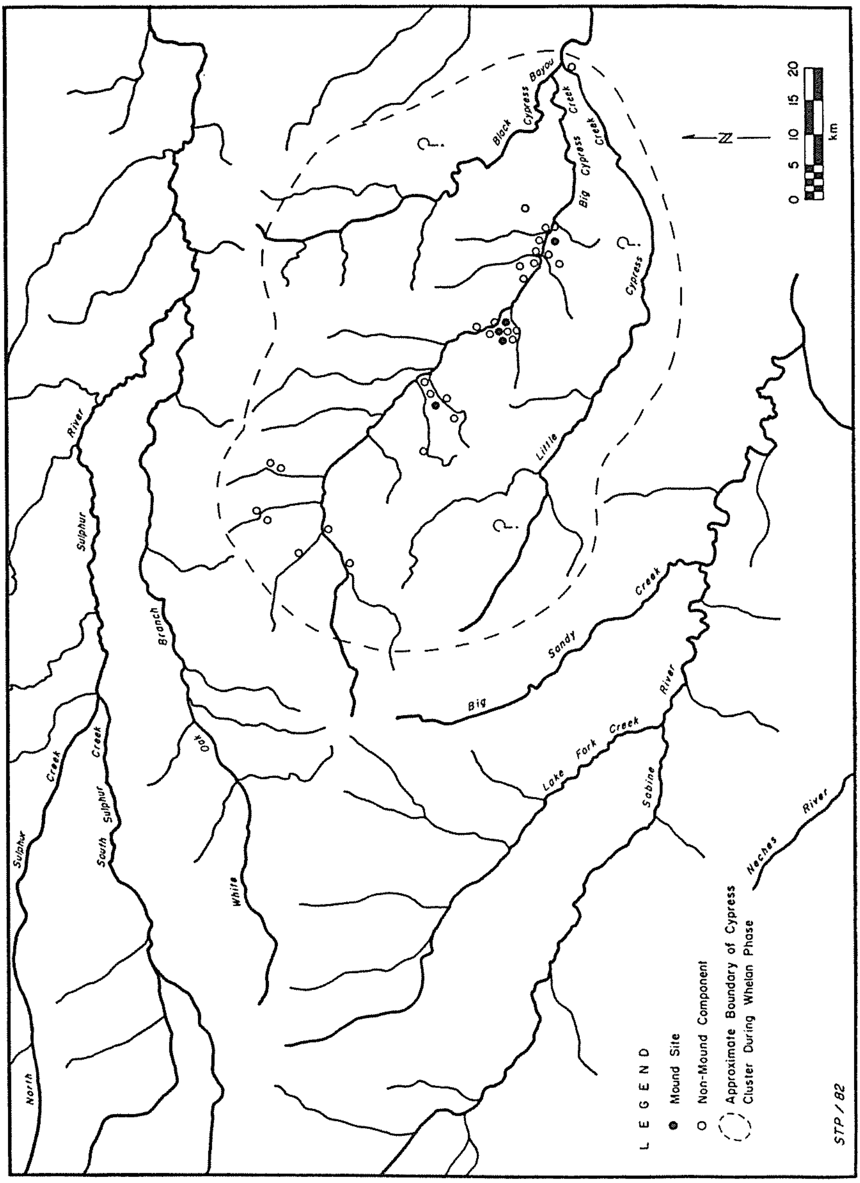

Figure 4. Whelan phase components of the Cypress cluster.

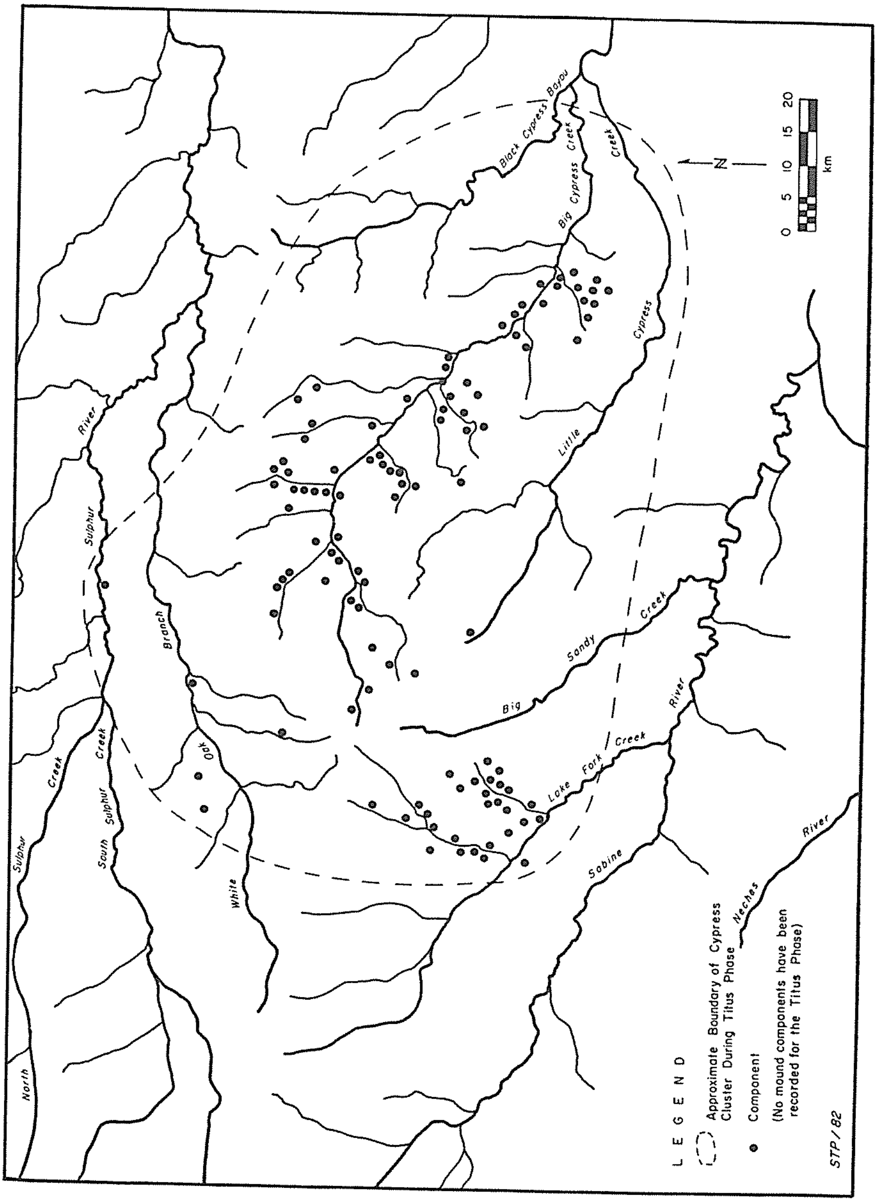

Figure 5. Titus phase components of the Cypress cluster.

Swauano Creek subcluster: Ripley Engraved remains the most common engraved ware, but Bailey Engraved and Wilder Engraved also are quite common, and Johns Engraved and Taylor Engraved occur infrequently. The Ripley bowls most commonly exhibit the pendant triangle, scroll, scroll and circle, and continuous scroll motifs in roughly equal frequencies. Bullard Brushed is the most common utility ware, with Harleton Applique and Maydelle Incised present less frequently than in Tankersley Creek components. McKinney Plain vessels are quite uncommon. Brushed ware accounts for 40 to 50 percent of the utility ware. Arrow points are predominantly of the type Talco, but Maud and Bassett also are common, and Reed occurs infrequently.

Big Cypress Creek subcluster: Ripley Engraved and Taylor Engraved are the dominant engraved wares, occurring at roughly equal frequencies. On the Ripley bowls, the pendant triangle motif is more common than all others combined. Bailey Engraved, Wilder Engraved, and Johns Engraved are all relatively minor types within the engraved ware, but Bailey is the more common of the three. Brushed ware strongly dominates the engraved ware, with Bullard Brushed and Karnack Brushed-Incised the most common types. Harleton Applique, Maydelle Incised, and McKinney Plain are present at lower frequencies than in any other subcluster. Brushed ware accounts for 50 to 60 percent of the utility vessels. Trade vessels of the Belcher phase types Belcher Engraved, Belcher Ridged, Cowhide Stamped, Foster Trailed-Incised, Glassell Engraved, Hodges Engraved, and Keno Trailed also are common. (It should be noted that vessels of the Texarkana phase types Avery Engraved, Simms Engraved, and Cass Applique are ubiquitous at low frequencies within Titus phase components of the Cypress cluster.) Arrow points of the type Talco are by far the most frequent, but Bassett and Maud also are fairly common.

CONCLUSION

To reiterate, it is herein suggested that the Cypress cluster represents the archeological manifestation of a series of social groups banded together in a sociopolitical structure analogous to, and at least partially contemporaneous with, that of the Hasinai to the south and the Kadohadacho to the northeast. Four subclusters, the diagnostics of which have been detailed, are believed to represent the individual constituent groups making up this affiliated group. In Swanton's terms, it appears that we can identify a confederacy and its component tribes in the archeological records.

There is, as noted above, evidence that the Titus phase extends into the early historic period. Glass beads were recovered in burial association at the Tracy site (41CP71) in the Big Cypress Creek subcluster by a private collector (Thurmond 1981:130). Within the Three Basins subcluster, the historic Wichita types Womack Engraved and Womack Plain have been recovered in burial association at 41HP1, the Culpepper site (Scurlock 1962), and at 41TT2, the W. A. Ford site (Thurmond 1981:448). The proximity of the western Titus phase components to the easternmost recorded Wichita components, the Pearson site (41RA5; Duffield and Jelks 1961) and the Gilbert site (41RA13; Jelks 1966), can be seen in Figure 6.

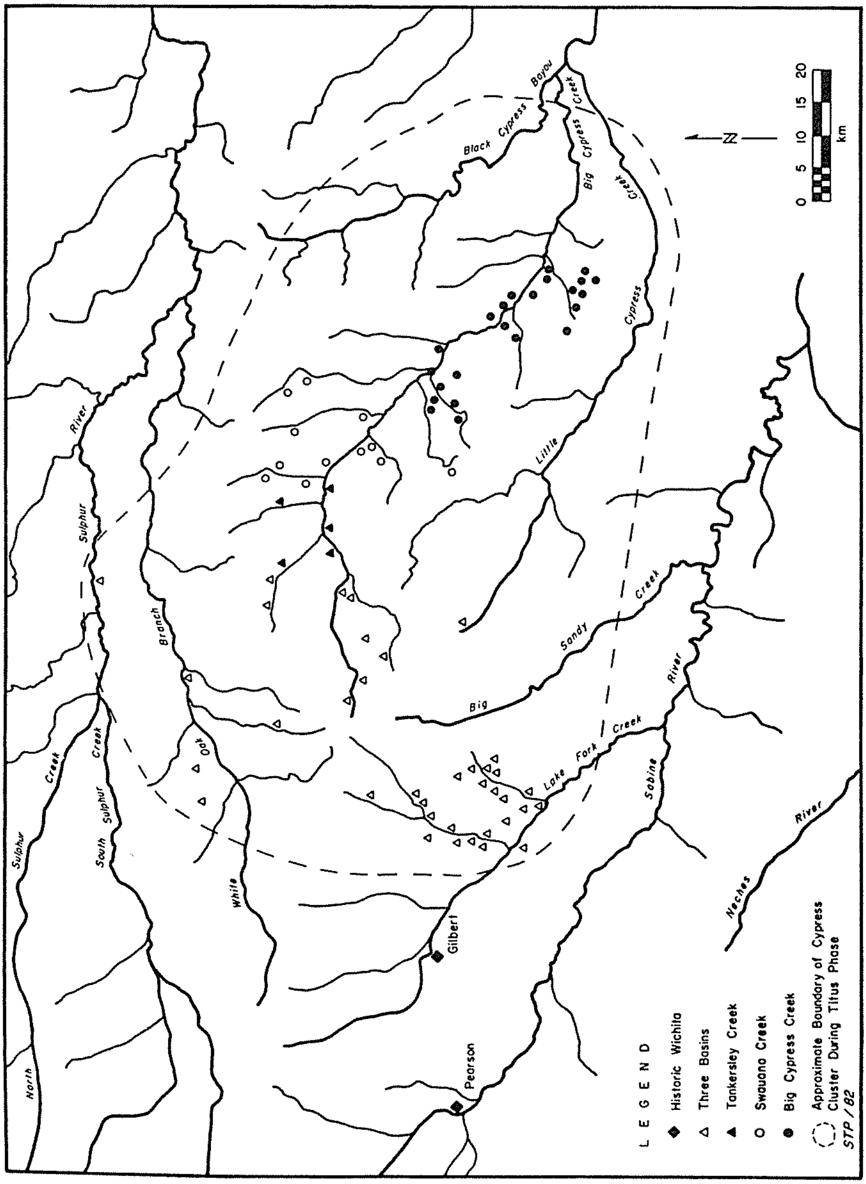

Figure 6. Subcluster associations of the Titus phase components.

One will be naturally led to wonder if the patterning discernible in the Titus phase components might not be attributable to diachronic demographic processes rather than synchronic social group differentiation. In short, it is entirely possible that the discrete sets of Titus phase components identified herein as subclusters are not contemporaneous, but reflect instead a directional shift in the Cypress cluster population over time. However, the author considers this possibility unlikely for two reasons. First, the artifact assemblages of the components within each subcluster are strikingly homogeneous, and the assemblages of neighboring components of different subclusters tend to be quite distinct. This is a subjective impression, but there is simply not the gradation of traits in any direction that one would expect to see in a situation of demographic shift. Perhaps even more convincing is the occurrence of apparently early historic components at opposite ends of the Cypress cluster area during the Titus phase, within the Big Cypress Creek and Three Basins subclusters, as noted above. The evidence would seem to weigh in favor of contemporaneity.

That the Late Caddoan affiliated group postulated herein should have escaped the attention of early European travelers through the Caddoan area, and thus not become a part of the ethnohistoric record, is not entirely surprising. For one thing, the dearth of sites exhibiting historic materials, in comparison to the adjacent Red River (Kadohadacho) and Hasinai areas, is striking. This suggests that the Titus phase occupations extend only into the very earliest period of Spanish and French influence. Further, the most direct route between the Kadohadacho and Hasinai areas crosses the Cypress Basin in the vicinity of Caddo Lake in Harrison and Marion counties. Again, there are no known Titus phase components east of the lower reaches of Lake o' the Pines, and Belcher phase components are not known to occur above the Red River Valley within the Cypress Basin (Thurmond 1981:Figure 15). It therefore seems likely that the area traversed by early explorers of the seventeenth century in passing between the Hasinai and Kadohadacho areas, presumed to be the vicinity of Caddo Lake, held no resident population.

It is intriguing to note in Figure 4 that four groups of Cypress cluster components of the precedent Whelan phase are suggested. The easterly three appear to be centered on mound sites. These are, ranging from east to west, the Whelan site (41MR2), the Dalton-Harroun complex (41UR10, 11, and 18), and the Sam Roberts site (41CP8). There is at least a hint that the four subclusters identified for the Titus phase were already in existence during the Whelan phase. However, this apparent pattern could simply be a function of survey bias (see Figure 2), and the ceramic analysis employed by the author was not sufficiently detailed to permit a detection of any distinctions that may be present within these components. It is highly recommended that any other researcher interested in pursuing this problem employ a detailed attribute analysis of the ceramics from the relevant components (for an inventory of the known Whelan phase components, see Thurmond 1981:Figure 14 and Table 9).

Finally, it should be emphasized that the Big Sandy, Little Cypress, and Black Cypress valleys are virtually unknown archeologically, and these areas are clearly vital to an understanding of the Cypress cluster. Major reservoir construction is planned within the latter two drainages by the U.S. Army Corps of Engineers (Figure 1), and a cultural resources overview of the two areas has already been performed (Northern and Skiles 1981). It is to be hoped that the more intensive site inventory and mitigation phases of the cultural resource management investigations presumably slated for the Little Cypress and Black Cypress valleys will employ techniques of field investigation, analysis, and reporting sufficient to permit the identification and interpretation of any Cypress cluster components that may occur.

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From Circleville to Toyah: Comments on Central Texas Chronology

Elton R. Prewitt

ABSTRACT

Relatively reliable radiocarbon assays for the Central Texas region now total at least 147. These assays, when dendrochronologically corrected, support the sequence of temporal phases proposed by Prewitt (1981). The assays are tabulated and the age ranges are illustrated. Minor adjustments to the beginning and ending dates of some phases are made to reflect additional radiocarbon dates obtained since 1981. The refined chronology provides a departure point for estimating relative population density through time. Frequency of component occurrence is tabulated for 147 sites or surveys reported in Central Texas. These frequencies are then divided by the length of the phases (in years) to obtain a density ratio. Contrary to previous subjective estimates, this method indicates a decrease in population density in the middle Archaic and a peak in the late Archaic. This is followed by a sharp decrease in the Neoarchaic Austin phase and a slight increase in the Toyah phase. Additional discussions are concerned with overlapping ranges of dates between phases. The Neoarchaic Austin and Toyah phases provide an example to show that each of these phases occurs earlier in the northern portions of Central Texas. When compared to the historical incursions of the Apaches, and later the Comanches, a pattern of population translocations is evident. This suggests that a series of southward movements out of the Plains began at least a thousand years before the arrival of the Apaches.

INTRODUCTION

Cultural chronology in Central Texas has received a great deal of attention from archeologists for many years. Refinements of the basic framework continue to be made by various individuals. This trend can be expected to continue as additional data for the region are accumulated. Recently, I published a short synthesis detailing my perception of the Central Texas chronological sequence (Prewitt 1981). A major criticism of that article has been the omission of supporting radiocarbon assays to accompany the age ranges given for the cultural phases. The purpose of this paper is to provide that supporting documentation. The chronological data are then used to construct a method for determining index ratios that may indicate changing relative population densities within the Central Texas archeological region. Finally, an explanation of overlapping date ranges for the Neoarchaic stage is provided.

THE RADIOCARBON DATA

A listing of the radiocarbon assays used in this paper is given in Table 1. This compilation of 147 assays has been screened for general contextual integrity. Dates obtained from snail shells are not included because of their demonstrated unreliability (Valastro and Davis 1970a:273). Other sample results are omitted due to inconsistencies between the known cultural context and the reported age range. The list presented here, then, is not to be regarded as a compilation of all radiocarbon assays that have been obtained for Central Texas. Rather, a degree of judicious screening has been exercised in the compilation. However, it should be noted that all samples which reflect probable overlapping of the age ranges of phases have been retained on the list. No attempt has been made to ignore assays that do not fall neatly within the stated range of a particular phase.

Table 1 presents a variety of data for each sample. The sample number (e.g., Tx 508) is followed by the assay date and range stated in radiocarbon years (e.g., 490 ± 80) B.P. (years before present, corrected to A.D. 1950). The samples are arranged in chronological order of the median date reported by the issuing laboratory. The laboratory date is followed by a corrected date and range derived from Damon et al. (1974). Assays younger than 350 or older than 5700 radiocarbon years are not corrected. The next column indicates the general provenience of each sample by site name and site number. The final column gives the source of each assay.

A plot of all the assay ranges is presented in Figure 1. More detailed plots of the ranges are shown in Figures 2 through 4. It is readily apparent that a large majority (107 of 147, or 73 percent) of the assays fall within the Late Archaic and Neoarchaic phases. However, it is encouraging to note that of the 33 assays obtained since the data were compiled for the 1981 article (Prewitt 1981), 20 assays are Middle Archaic or older. This, as expected, has resulted in the minor adjustment of age ranges for several phases. This procedure can be expected to continue as more dates are obtained. A comparison of the 1981 and the current chronological interpretation is presented in Figure 5.

Table 1. Radiocarbon Assay Compilation, Central Texas Region

No.	Sample No.	Radiocarbon Years (B.P.)	Corrected Date (B.P.)	Site Name and No.	Reference
TOYAH PHASE					
1	Tx 2856	110±50	*	Buckhollow, 41KM16	Personal communication, S. Valastro to Frank Weir, 20 April 1978
2	Tx 2855	190±30	*	Buckhollow, 41KM16	Personal communication, S. Valastro to Frank Weir, 20 April 1978
3	Tx 504	200±70	*	Smith Shelter, 41TV42	Valastro and Davis 1970a:271
4	Tx 510	220±70	*	Smith Shelter, 41TV42	Valastro and Davis 1970a:271
5	Tx 2854	230±50	*	Buckhollow, 41KM16	Personal communication, S. Valastro to Frank Weir, 20 April 1978
6	Tx 509	240±70	*	Smith Shelter, 41TV42	Valastro and Davis 1970a:271
7	Tx 2852	260±60	*	Buckhollow, 41KM16	Personal communication, S. Valastro to Frank Weir, 20 April 1978
8	Tx 71	290±95	*	Pennywinkle, 41BL23	Tamers, Pearson, and Davis 1964:150
9	Tx 2853	330±70	*	Buckhollow, 41KM16	Personal Communication, S. Valastro to Frank Weir, 20 April 1978
10	Tx 2851	350±60	395±70	Buckhollow, 41KM16	Personal communication, S. Valastro to Frank Weir, 20 April 1978
11	Tx 505	370±70	410±80	Smith Shelter, 41TV42	Valastro and Davis 1970a:271
12	S-MC C-5	390±130	440±135	Kyle Shelter, 41HI1	Jelks 1962:97
13	Tx 514	450±70	480±80	Smith Shelter, 41TV42	Valastro and Davis 1970a:272
14	UGa 2477	480±70	510±80	Bigon-Kubala, 41WM258	Hays 1982:7-7
15	Tx 508	490±80	520±90	Smith Shelter, 41TV42	Valastro and Davis 1970a:272
16	Tx 98	560±80	580±90	Kyle Shelter, 41HI1	Tamers, Pearson, and Davis 1964:149
17	Tx 99	560±80	580±90	Kyle Shelter, 41HI1	Tamers, Pearson, and Davis 1964:149
18	Tx 1723	590±60	610±70	Horn Shelter, 41BQ46	Valastro, Davis, and Varela 1979: 263; Watt 1978:119-121
19	Tx 2939	630±50	645±60	Bear Creek Shelter, 41HI17	Valastro, Davis, and Varela 1979: 268; Lynott 1978:30
20	S-MC C-8	670±165	680±170	Kyle Shelter, 41HI1	Jelks 1962:97

Table 1. Radiocarbon Assay Compilation, Central Texas Region (Continued)

No.	Sample No.	Radiocarbon Years (B.P.)	Corrected Date (B.P.)	Site Name and No.	Reference
21	S-MC C-1	660±150	700±170	Kyle Shelter, 41HI1	Jelks 1962:97
22	Tx 2730	700±60	710±70	Hoxie Bridge, 41WM130	Valastro, Davis, and Varela 1979: 266; Bond 1978:79
23	Tx 2963	770±100	775±105	Bear Creek Shelter, 41HI17	Valastro, Davis, and Varela 1979: 269; Lynott 1978:30
AUSTIN PHASE					
24	Tx 25	540±140	565±145	Smith Shelter, 41TV42	Tamers, Pearson, and Davis 1964:146
25	Tx 24	585±85	605±90	Smith Shelter, 41TV42	Tamers, Pearson, and Davis 1964:146
26	Tx 687	660±70	670±75	La Jita, 41UV21	Valastro and Davis 1970b:634
27	Tx 513	680±80	690±85	Smith Shelter, 41TV42	Valastro and Davis 1970a:272
28	Tx 2444	680±50	690±60	Anthon, 41UV60	Valastro, Davis, and Varela 1977:307
29	Tx 26	705±95	715±100	Smith Shelter, 41TV42	Tamers, Pearson, and Davis 1964:146
30	Tx 664	710±70	720±75	La Jita, 41UV21	Valastro and Davis 1970b:634
31	Tx 516	740±80	745±85	Smith Shelter, 41TV42	Valastro and Davis 1970a:272
32	Tx 806	770±70	775±75	Dobias-Vitek, 41WM118	Valastro and Davis 1970b:633; Eddy 1973:35
33	Tx 3168	780±70	780±75	McDonald, X41HI171	Valastro, Davis, Varela, and Ekland-Olson 1980:1100
34	Tx 507	800±50	800±60	Smith Shelter, 41TV42	Valastro and Davis 1970a:272
35	Tx 2729	800±70	800±75	Hoxie Bridge, 41WM130	Valastro, Davis, and Varela 1979: 265; Bond 1978:78
36	Tx 684	810±50	810±60	La Jita, 41UV21	Valastro and Davis 1970b:634
37	Tx 518	830±70	830±75	Smith Shelter, 41TV42	Valastro and Davis 1970a:272
38	Tx 2383	830±70	830±75	Anthon, 41UV60	Valastro, Davis, and Varela 1977:306
39	Tx 1765	850±100	850±105	Loeve-Fox, 41WM230	Valastro, Davis, and Varela 1975:83; Prewitt 1974:23, 1982:29
40	Tx 1925	870±60	870±65	Loeve-Fox, 41WM230	Valastro, Davis, and Varela 1977:302; Prewitt 1974:23, 1982:29
41	Tx 665	910±80	900±85	La Jita, 41UV21	Valastro and Davis 1970b:634
					Tamers, Pearson, and Davis 1964:151

Table 1. Radiocarbon Assay Compilation, Central Texas Region (Continued)

No.	Sample No.	Radiocarbon Years (B.P.)	Corrected Date (B.P.)	Site Name and No.	Reference
42	Tx 75	920±200	915±200	Punkinseed, 41TV48	Tamers, Pearson, and Davis 1964:151
43	Tx 511	930±80	920±85	Smith Shelter, 41TV42	Valastro and Davis 1970a:273
44	Tx 512	930±60	920±65	Smith Shelter, 41TV42	Valastro and Davis 1970a:272
45	Tx 506	940±80	930±85	Smith Shelter, 41TV42	Valastro and Davis 1970a:272
46	Tx 1923	940±60	930±65	Loeve-Fox, 41WM230	Valastro, Davis, and Varela 1977: 302; Prewitt 1974:23, 1982:29
47	Tx 2962	950±50	940±60	Bear Creek Shelter, 41HI17	Valastro, Davis, and Varela 1979: 269; Lynott 1978:30
48	S-MC C-4	980±170	970±175	Kyle Shelter, 41HI1	Jelks 1962:97
49	Tx 681	990±60	980±65	La Jita, 41UV21	Valastro and Davis 1970b:635
50	Tx 3169	1010±70	1000±75	McDonald, X41HI171	Valastro, Davis, Varela, and Ekland-Olson 1980:1100
51	Tx 2961	1030±50	1015±60	Bear Creek Shelter, 41HI17	Valastro, Davis, and Varela 1979: 269; Lynott 1978:30
52	Tx 74	1040±120	1030±125	Barton Springs Rd., 41TV87	Tamers, Pearson, and Davis 1964:143
53	Tx 70	1040±85	1030±90	Pennywinkle, 41BL23	Tamers, Pearson, and Davis 1964:150
54	Tx 340	1050±90	1035±95	Evoe Terrace, 41BL104	Valastro, Pearson, and Davis 1967:447
55	Tx 72	1080±110	1060±120	Pennywinkle, 41BL23	Tamers, Pearson, and Davis 1964:151
56	Tx 1764	1080±60	1060±80	Loeve-Fox, 41WM230	Valastro, Davis, and Varela 1977:302
57	Tx 685	1100±70	1080±85	La Jita, 41UV21	Valastro and Davis 1970b:635
58	Tx 515	1120±80	1100±95	Smith Shelter, 41TV42	Valastro and Davis 1970a:273
59	Tx 2960	1130±50	1110±70	Bear Creek Shelter, 41HI17	Valastro, Davis, and Varela 1979: 269; Lynott 1978:30
60	Tx 8	1140±70	1120±105	Punkinseed, 41TV48	Stipp, Davis, Noakes, and Hoover 1962:49
61	S-MC C-6	1150±150	1130±160	Kyle Shelter, 41HI1	Jelks 1962:97
62	Tx 3403	1240±50	1220±70	Loeve-Fox, 41WM230	Prewitt 1982:29
63	Tx 3402	1250±60	1230±80	Loeve-Fox, 41WM230	Prewitt 1982:29
64	UGa 2470	1290±100	1270±110	41WM328	Hays 1982:7-7
65	S-MC C-2	1390±150	1370±150	Kyle Shelter, 41HI1	Jelks 1962:97

Table 1. Radiocarbon Assay Compilation, Central Texas Region (Continued)

No.	Sample No.	Radiocarbon Years (B.P.)	Corrected Date (B.P.)	Site Name and No.	Reference
66	Tx 10	1410±120	1390±120	Blum Shelter, 41HI8	Stipp, Davis, Noakes, and Hoover 1962:49
DRIFTWOOD PHASE					
67	RI 1088	990±290	980±290	Bigon-Kubala, 41WM258	Hays 1982:7-7
68	Tx 515	1120±80	1100±95	Smith Shelter, 41TV42	Valastro and Davis 1970a:273
69	UGa 2471	1155±95	1135±110	41WM53	Hays 1982:7-7
70	Tx 28	1165±120	1145±130	Smith Shelter, 41TV42	Tamers, Pearson, and Davis 1964:146
71	Tx 27	1180±210	1160±215	Smith Shelter, 41TV42	Tamers, Pearson, and Davis 1964:146
72	UGa 2484	1260±150	1240±160	41WM53	Hays 1982:7-7
73	Tx 1926	1300±60	1280±80	Loeve-Fox, 41WM230	Valastro, Davis, and Varela 1977: 302; Prewitt 1974:23, 1982:29
74	Tx 2941	1340±60	1315±65	Bear Creek Shelter, 41HI17	Valastro, Davis, and Varela 1979: 268; Lynott 1978:30
75	Tx 804	1350±70	1330±75	Dobias-Vitek, 41WM118	Valastro and Davis 1970b:633
76	Tx 2940	1380±100	1360±100	Bear Creek Shelter, 41HI17	Valastro, Davis, and Varela 1979: 268; Lynott 1982:30
TWIN SISTERS PHASE					
77	Tx 686	1460±80	1440±80	La Jita, 41UV21	Valastro and Davis 1970b:635
78	UGa 2481	1460±80	1440±80	41WM328	Hays 1982:7-7
79	Tx 1767	1480±170	1460±170	Loeve-Fox, 41WM230	Valastro, Davis, and Varela 1975: 83; Prewitt 1974:23, 1982:29
80	Tx 1927	1480±80	1460±85	Loeve-Fox, 41WM230	Valastro, Davis, and Varela 1977: 302; Prewitt 1974:23, 1982:29
81	Tx 2952	1550±60	1530±65	Loeve-Fox, 41WM230	Prewitt 1982:29
82	Tx 2942	1570±60	1550±65	Bear Creek Shelter, 41HI17	Valastro, Davis, and Varela 1979: 268; Lynott 1978:30
83	Tx 2378	1580±60	1565±65	Anthon, 41UV60	Valastro, Davis, and Varela 1979:306
84	Tx 122	1600±70	1580±75	Pohl, 41CM27	Pearson, Davis, Tamers, and Johnstone 1965:306

Table 1. Radiocarbon Assay Compilation, Central Texas Region (Continued)

No.	Sample No.	Radiocarbon Years (B.P.)	Corrected Date (B.P.)	Site Name and No.	Reference
85	Tx 1766	1600±110	1580±115	Loeve-Fox, 41WM230	Valastro, Davis, and Varela 1975: 83; Prewitt 1974:23, 1982:29
86	UGa 2483	1610±165	1595±170	41WM328	Hays 1982:7-7
87	Tx 2539	1620±70	1605±75	41WM53	Valastro, Davis, and Varela 1978: 257; Hays 1982:7-7
88	Tx 3409	1620±60	1605±70	Loeve-Fox, 41WM230	Prewitt 1982:29
89	Tx 2384	1640±60	1625±65	Anthon, 41UV60	Valastro, Davis, and Varela 1977:306
90	Tx 3404	1640±140	1625±145	Loeve-Fox, 41WM230	Prewitt 1982:29
91	Tx 1922	1670±100	1660±105	Loeve-Fox, 41WM230	Valastro, Davis, and Varela 1977: 302; Prewitt 1974:23, 1982:29
92	RI 1586	1700±120	1690±125	Cervenka, 41WM267	Hays 1982:7-7
93	Tx 2731	1740±100	1730±105	Hoxie Bridge, 41WM130	Valastro, Davis, and Varela 1979: 266; Bond 1978:91
94	UGa 2476	1745±85	1735±90	Bryan Fox, 41WM124	Hays 1982:7-7
95	Tx 2964	1770±140	1765±140	Bear Creek Shelter, 41HI17	Valastro, Davis, and Varela 1979: 269; Lynott 1978:30
96	Tx 3410	1790±50	1790±60	Loeve-Fox, 41WM230	Prewitt 1982:29
UVALDE PHASE					
97	Tx 692	1850±180	1855±185	La Jita, 41UV21	Valastro and Davis 1970b:635
98	Tx 233	1865±95	1870±100	Britton, 41ML37	Pearson, Davis, and Tamers 1966: 461; Story and Shafer 1965:95
99	Tx 119	1870±160	1875±165	Pohl, 41CM27	Pearson, Davis, Tamers, and Johnstone 1965:306
100	Tx 234	1940±110	1950±115	Britton, 41ML37	Pearson, Davis, and Tamers 1966: 461; Story and Shafer 1965:100
101	Tx 323	1950±130	1960±135	Pecan Springs, 41EL11	Valastro, Pearson, and Davis 1967:447
102	Tx 3407	1960±210	1970±215	Loeve-Fox, 41WM230	Prewitt 1982:29
103	Tx 30	1970±150	1990±155	Oblate Shelter, 41CM1	Tamers, Pearson, and Davis 1964:149

Table 1. Radiocarbon Assay Compilation, Central Texas Region (Continued)

No.	Sample No.	Radiocarbon Years (B.P.)	Corrected Date (B.P.)	Site Name and No.	Reference
104	Tx 121	2040±130	2065±135	Pohl, 41CM27	Pearson, Davis, Tamers, and Johnstone 1965:306
105	Tx 200	2080±80	2110±125	Britton, 41ML37	Pearson, Davis, Tamers, and Johnstone 1965:305; Story and Shafer 1965:86
106	Tx 2959	2110±150	2145±180	Bear Creek Shelter, 41HI17	Valastro, Davis, and Varela 1979:269; Lynott 1978:30
SAN MARCOS PHASE					
107	Tx 2380	2210±60	2265±115	Anthon, 41UV60	Valastro, Davis, and Varela 1977:306
108	Tx 1999	2330±60	2405±120	Horn Shelter, 41BQ46	Valastro, Davis, and Varela 1979:263; Watt 1978:121-122
109	Tx 201	2330±80	2405±130	Britton, 41ML37	Pearson, Davis, Tamers, and Johnstone 1965:305; Story and Shafer 1965:86
110	Tx 2965	2380±220	2470±245	Bear Creek Shelter, 41HI17	Valastro, Davis, and Varela 1979:269; Lynott 1978:30
ROUND ROCK PHASE					
111	Tx 453	2650±80	2800±95	Greenhaw, 41HY29	Valastro, Davis, and Rightmire 1968:396
112	Tx 451	2850±90	3050±95	Greenhaw, 41HY29	Valastro, Davis, and Rightmire 1968:396
113	Tx 465	2900±100	3115±105	Greenhaw, 41HY29	Valastro, Davis, and Rightmire 1968:396
114	Tx 104	2900±180	3115±180	Oblate Shelter, 41CM1	Tamers, Pearson, and Davis 1964:150
115	Tx 2381	3000±60	3245±70	Anthon, 41UV60	Valastro, Davis, and Varela 1977:306
116	Tx 2385	3120±70	3400±90	Anthon, 41UV60	Valastro, Davis, and Varela 1977:306
117	UGa 2480	3225±75	3535±95	Hawes, 41WM56	Hays 1982:7-7
118	Tx 1720	3470±160	3855±165	Horn Shelter, 41BQ46	Valastro, Davis, and Varela 1979:263; Watt 1978:122-123

Table 1. Radiocarbon Assay Compilation, Central Texas Region (Continued)

No.	Sample No.	Radiocarbon Years (B.P.)	Corrected Date (B.P.)	Site Name and No.	Reference
MARSHALL FORD PHASE					
119	Tx 2442	3520±60	3920±145	Anthon, 41UV60	Valastro, Davis, and Varela 1977:306
120	UGa 2485	3615±60	4045±145	Hawes, 41WM56	Hays 1982:7-7
CLEAR FORK PHASE					
121	UGa 2473	3750±90	4225±130	Hawes, 41WM56	Hays 1982:7-7
OAKALLA PHASE					
122	Tx 2958	4150±140	4740±175	Bear Creek Shelter, 41HI17	Valastro, Davis, and Varela 1979:268; Lynott 1978:30
123	RI 1087	4280±240	4910±270	Cervenka, 41WM267	Hays 1982:7-7
124	RI 1086	4330±420	4970±440	Cervenka, 41WM267	Hays 1982:7-7
125	Tx 339	4430±240	5095±270	Evoe Terrace, 41BL104	Valastro, Pearson, and Davis 1967:447
JARRELL PHASE					
126	Tx 3684	4970±90	5740±140	Cervenka, 41WM267	Hays 1982:7-7
127	UGa 2482	5285±725	6090±740	41WM73	Hays 1982:7-7
CIRCLEVILLE PHASE					
128	0-1105	6750±150	*	Levi Shelter, 41TV49	Alexander 1963:513
129	Tx 805	6900±110	*	Loeve, 41WM133	Valastro and Davis 1970b:633; Eddy 1973:35
130	Tx 802	7000±160	*	Loeve, 41WM133	Valastro and Davis 1970b:633; Eddy 1973:35
131	0-1128	7350±150	*	Levi Shelter, 41TV49	Alexander 1963:513
132	-	7470±230	*	Wilson-Leonard, 41WM235	Personal communication, Frank Weir to E. Prewitt, 3 July 1984
133	Tx 1996	8400±110	*	Horn Shelter, 41BQ46	Valastro, Davis, and Varela 1979:263; Watt 1978:125-127

Table 1. Radiocarbon Assay Compilation, Central Texas Region (Continued)

No.	Sample No.	Radiocarbon Years (B.P.)	Corrected Date (B.P.)	Site Name and No.	Reference
134	Tx 2675	8500±130	*	Loeve, 41WM133	Valastro, Davis, and Varela 1978:257; Bond 1978:25
135	Tx 3405	9650±910	*	Loeve, 41WM133	Prewitt 1982:237
PALEO-INDIAN					
136	-	8820±120	*	Wilson-Leonard, 41WM235	Personal communication, Frank Weir to E. Prewitt, 3 July 1984
137	-	8860±150	*	Wilson-Leonard, 41WM235	Personal communication, Frank Weir to E. Prewitt, 3 July 1984
138	-	8940±100	*	Wilson-Leonard, 41WM235	Personal communication, Frank Weir to E. Prewitt, 3 July 1984
139	O-1129	9300±160	*	Levi Rockshelter, 41TV49	Alexander 1963:513
140	-	9470±170	*	Wilson-Leonard, 41WM235	Personal communication, Frank Weir to E. Prewitt, 3 July 1984
141	Tx 1830	9500±200	*	Horn Shelter, 41BQ46	Valastro, Davis, and Varela 1979:263; Watt 1978:129
142	-	9530±90	*	Wilson-Leonard, 41WM235	Personal communication, Frank Weir to E. Prewitt, 3 July 1984
143	-	9650±120	*	Wilson-Leonard, 41WM235	Personal communication, Frank Weir to E. Prewitt, 3 July 1984
144	Tx 1772	9980±370	*	Horn Shelter, 41BQ46	Valastro, Davis, and Varela 1979:263; Watt 1978:129-131
145	O-1106	10,000±175	*	Levi Shelter, 41TV49	Alexander 1963:513
146	Tx 1998	10,030±130	*	Horn Shelter, 41BQ46	Valastro, Davis, and Varela 1979:264; Watt 1978:129
147	Tx 1997	10,310±150	*	Horn Shelter, 41BQ46	Valastro, Davis, and Varela 1979:264; Watt 1978:131

*Dates cannot be corrected to dendrochronological time scale; all others corrected to reflect adjustments described by Damon, Ferguson, Long, and Wallick (1974).

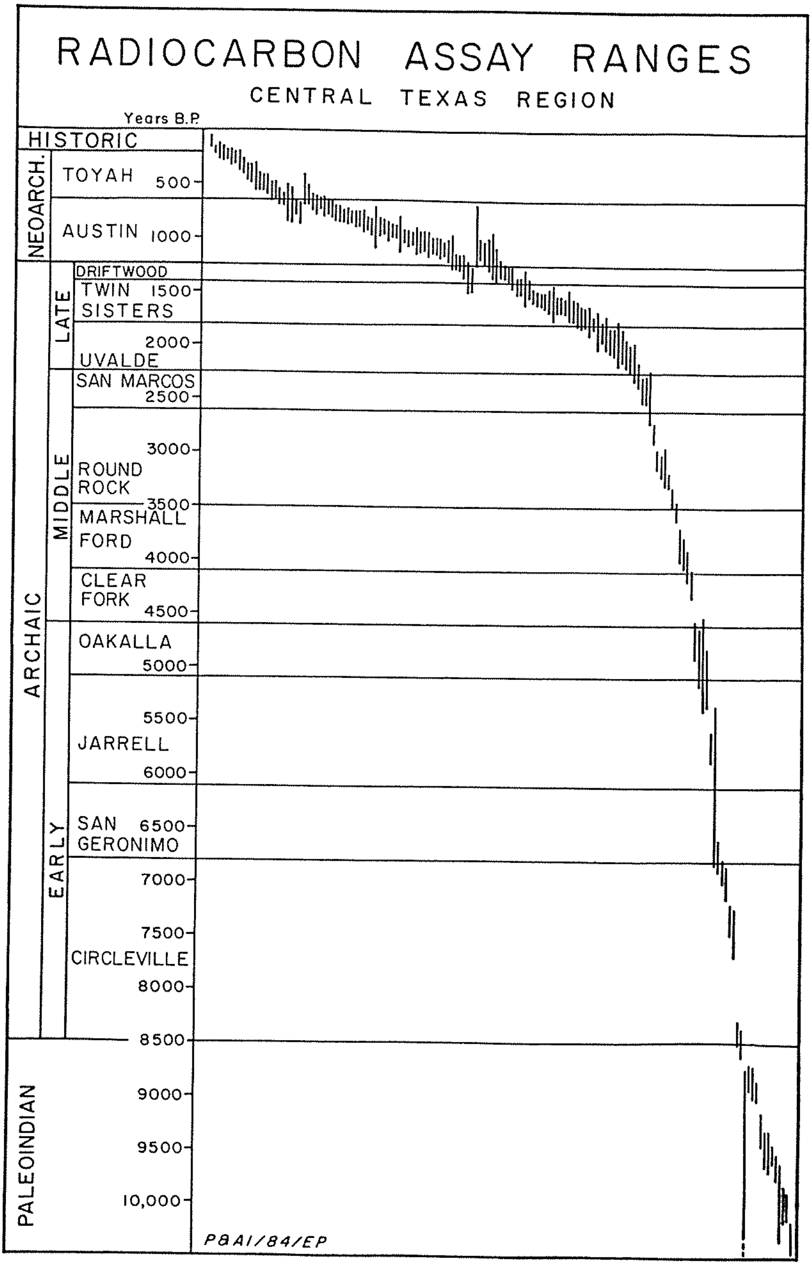

Figure 1. Radiocarbon assay ranges, Central Texas region. Assays (except first 9 in Toyah phase and all of Circleville phase and Paleo-Indian stage) have been dendrochronologically corrected (Damon et al. 1974).

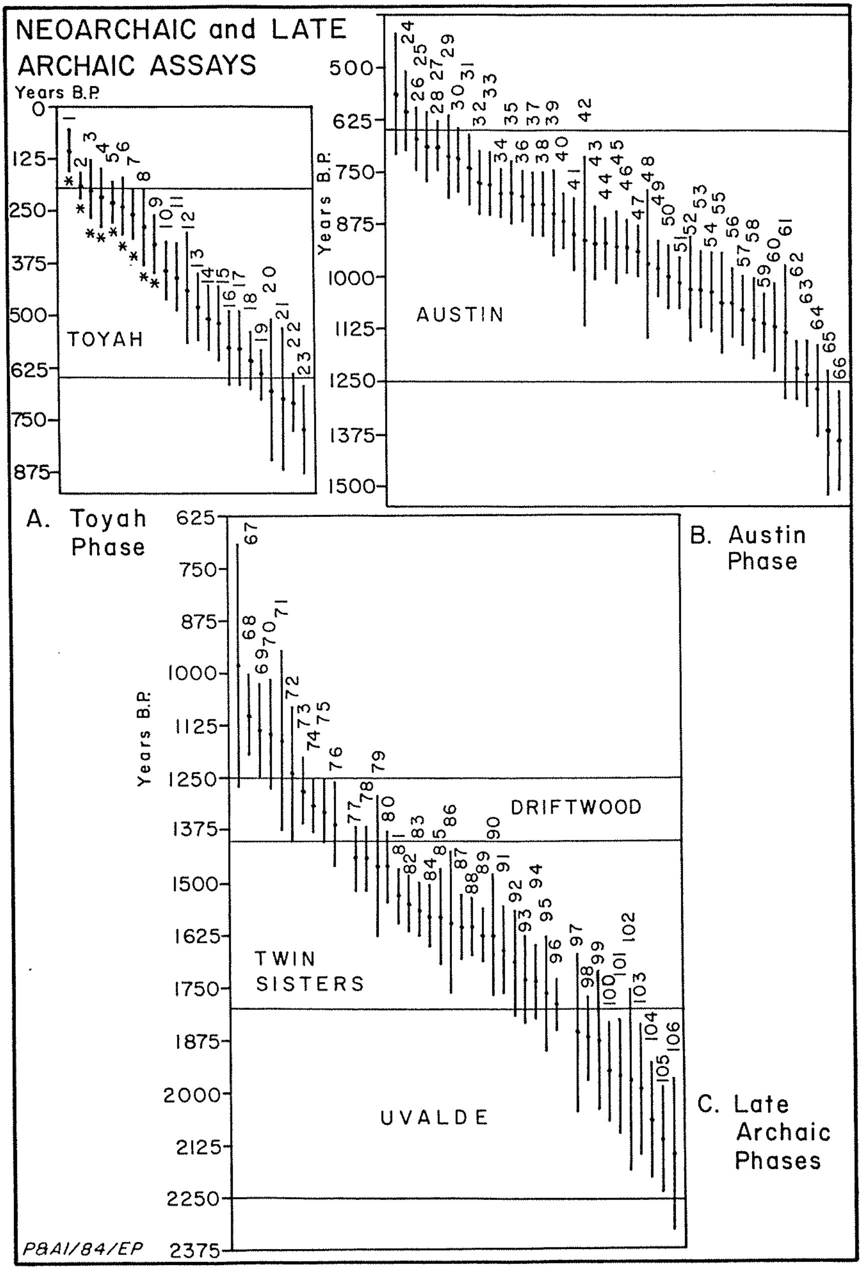

Figure 2. Neoarchaic and Late Archaic assays. Asterisk (*) indicates dendrochronological correction not made. Assays are cross-referenced by number to Table 1.

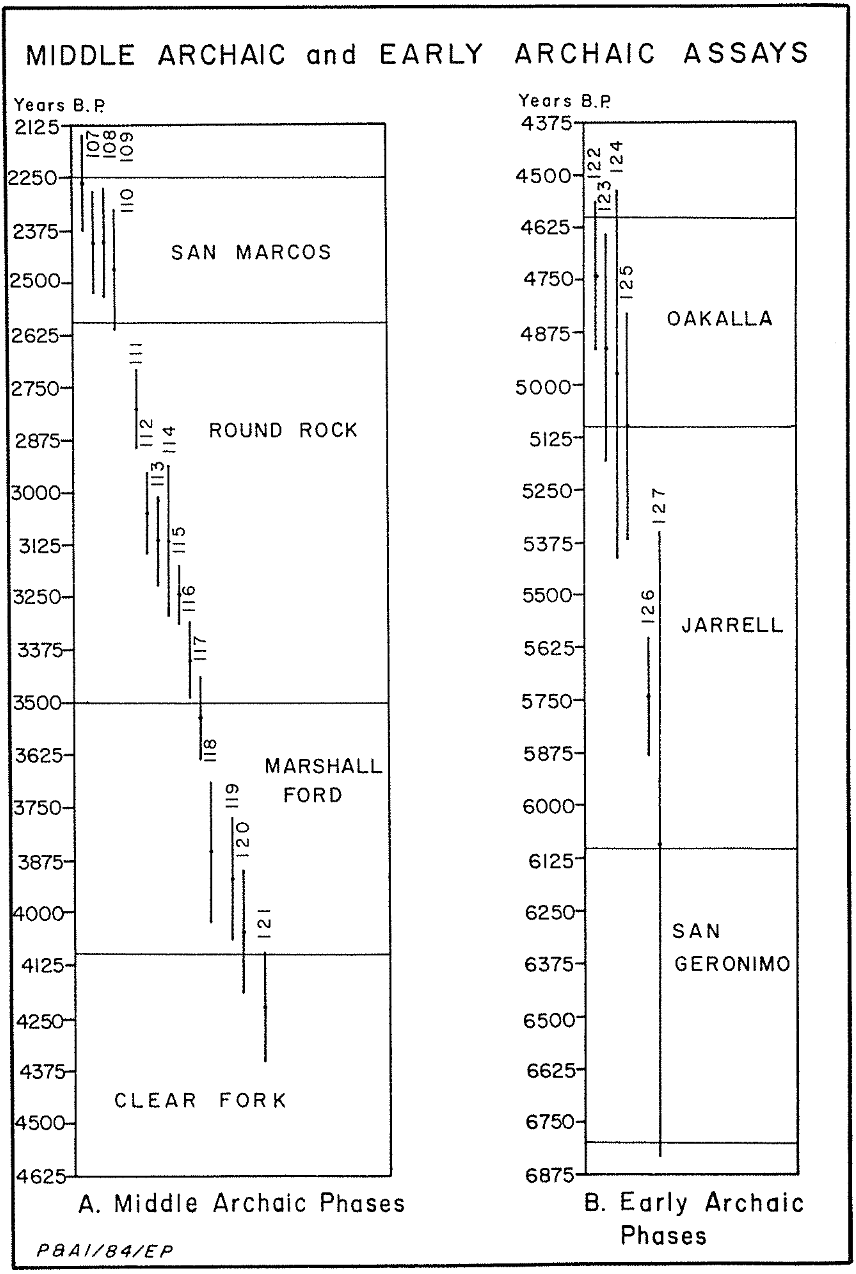

Figure 3. Middle Archaic and Early Archaic assays. Numbers indicate cross-reference to Table 1.

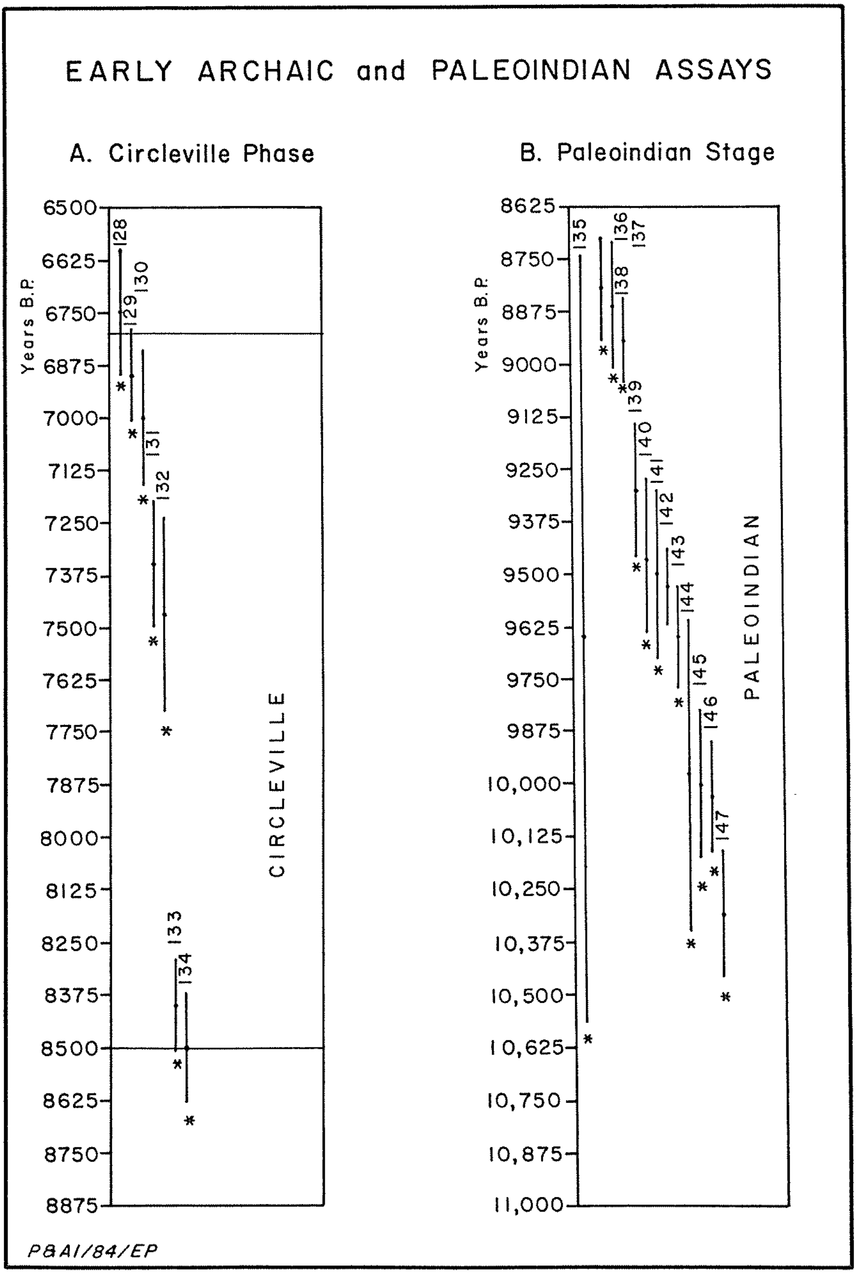

Figure 4. Early Archaic and Paleo-Indian assays. Asterisk (*) indicates dendrochronological correction not made. Assays are cross-referenced by number to Table 1.

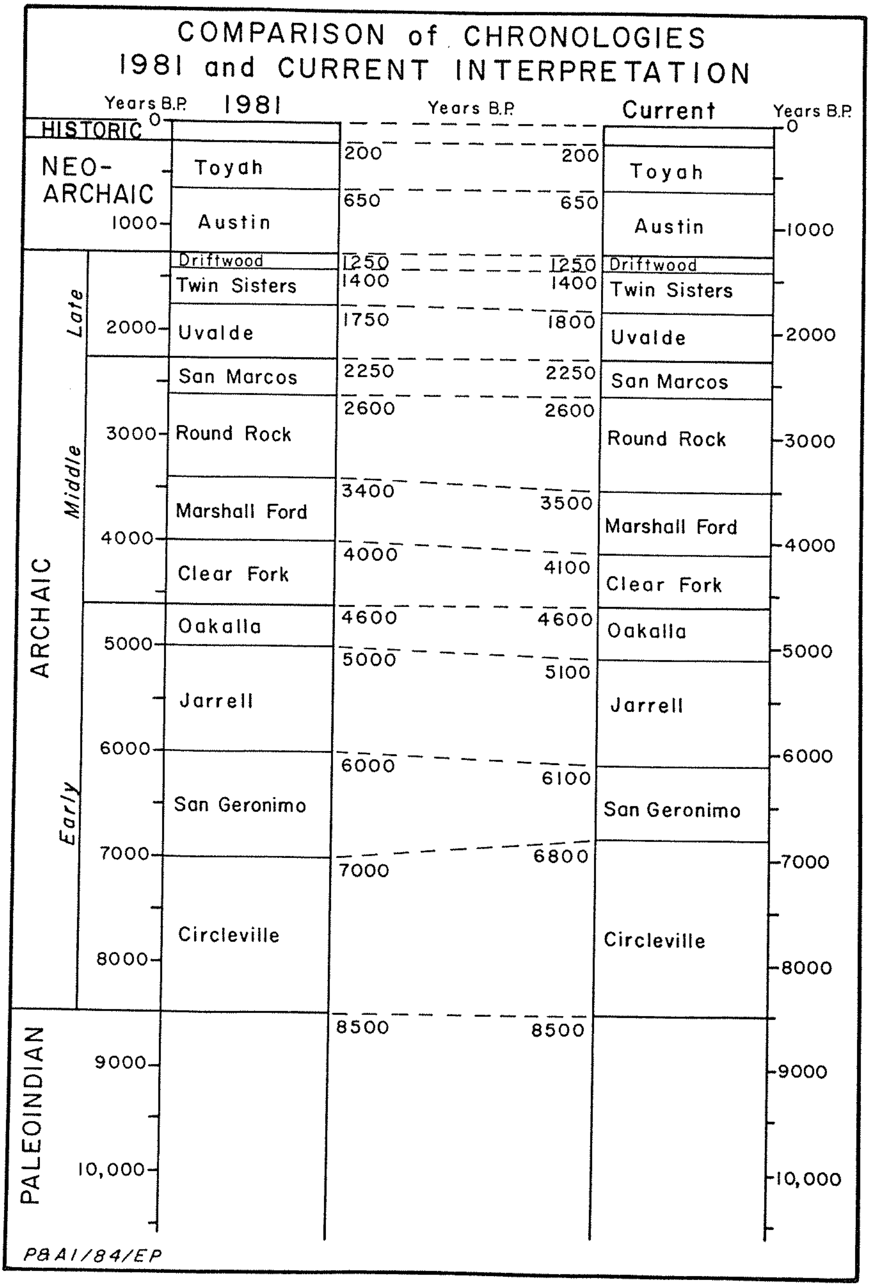

Figure 5. Comparison of chronologies, Prewitt (1981) and current interpretation.

RELATIVE POPULATION DENSITIES

The relative prehistoric population density of any given region is a topic that is difficult to approach. In no case have we totally surveyed a given area, accurately determined approximate band size for each component of each site, and then arrived at a maximum population figure for a given period of prehistory. Recent population estimates have been based on unquantified perceptions rather than on hard data. At best, these are subjective guesses that reflect individual experiences. Two examples, Weir (1976) and Skinner (1981), are reviewed to illustrate this point.

Weir (1976:119–137), in his synthesis of the Central Texas Archaic, includes a general indication of population density to support his assumptions regarding focal or dispersed economic orientations in the subsistence base. This is summarized (Weir 1976:138) as low for the Early Archaic San Geronimo phase, increased in the Clear Fork phase, high in the Middle Archaic Round Rock phase, diminished in the San Marcos phase, and continued diminishing in the terminal Archaic Twin Sisters phase. This reflects Weir's personal orientation toward the Middle Archaic. Since he dealt extensively with that period in his studies (see Weir 1967, 1976, and 1980), his perception of site densities is subjectively (and unconsciously) distorted to emphasize the Middle Archaic.

Skinner (1981) argues a slightly different interpretation, but it is similarly based on subjective dealings with the Late Archaic. He envisions a more-or-less normal distribution curve where there is a steady population increase beginning with a low density in the Paleo-Indian stage and peaking with a high density in the Late Archaic. Population density then decreases steadily through the Neoarchaic until the cultural truncation precipitated by European peoples. Figure 6a illustrates the generalized population density estimates given by both Weir and Skinner.

These two estimates provide an interesting contrast in interpretation based on subjective information. They also provide a point of departure to more realistically discuss generalized population density estimates. While working on the chronological synthesis of Central Texas in 1981, I blundered across a potentially useful method of estimating population density. I did not feel that adequate data had been compiled to effectively support my arguments at the time, so my notes and scribbled ideas were laid aside. Work on a totally separate subject during 1983 resulted in the accumulation of the appropriate data.

While actual numbers will change as new data are published, the basic idea was to obtain a ratio of component occurrences to the duration of a component in years. This should eliminate the subjectivity displayed by Weir and Skinner. The first step in deriving a density ratio index is to determine the approximate duration of each phase or time period. This has been accomplished to a certain degree of accuracy in the first section of this paper. This information is graphically summarized in Figure 6b. As can be seen in this illustration, the duration of most phases varies markedly, although there is a general trend toward shorter periods through the Late Archaic.

The second step is to determine the number of times each component occurs in the region. This is, of course, an impossible task in view of our lack of data about every site that exists, or has existed, in Central Texas. However, if it is accepted that published reports represent a relatively accurate portrayal of the

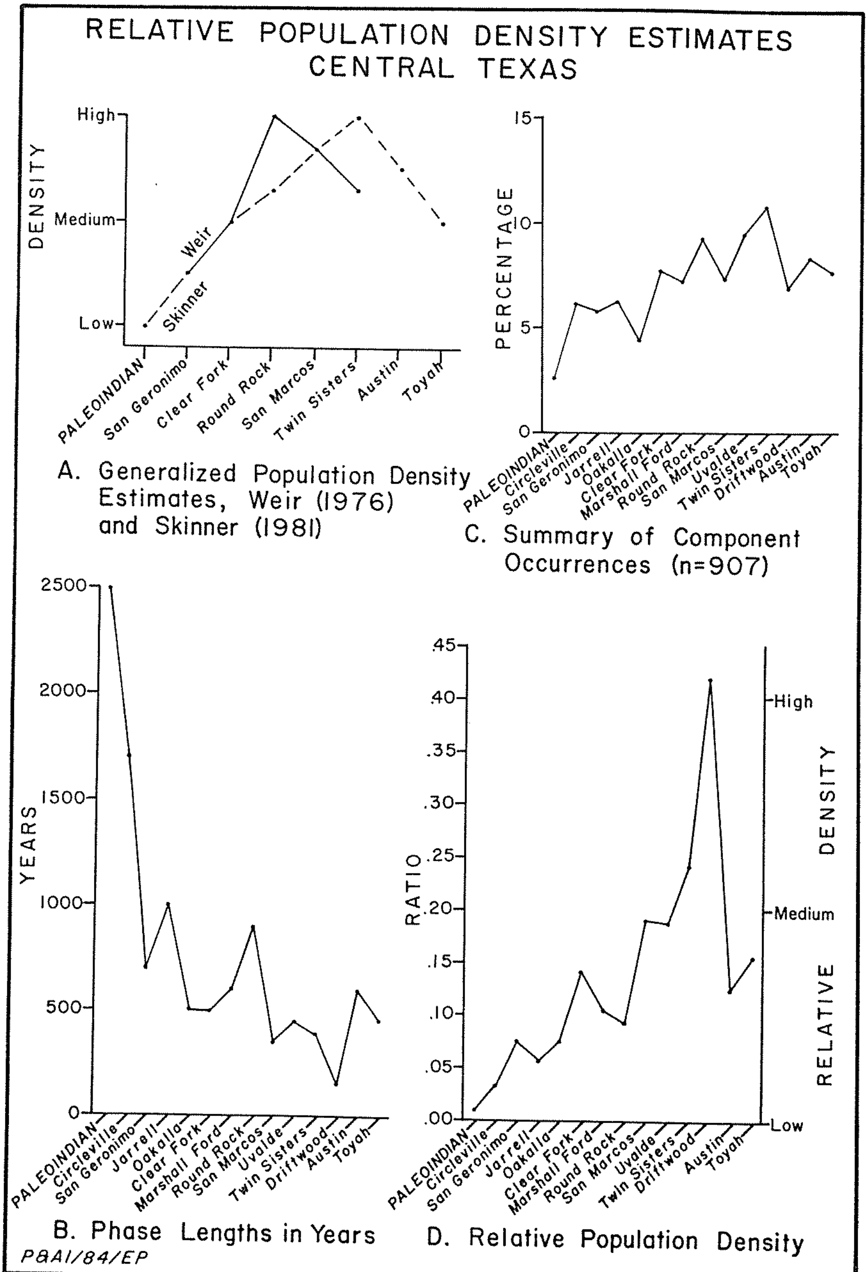

Figure 6. Relative population density estimates, Central Texas. (A) Generalized population density estimates, Weir (1976) and Skinner (1981); phase names follow Weir. (B) Phase lengths in years. (C) Summary of component occurrences (n=907). (D) Relative population density.

relative occurrence of components, then there is a basis from which a ratio can be obtained. The data used here are from a statewide projectile point distribution study I am currently conducting. Over 400 reports have been examined in detail, and the types (and frequency) of projectile points have been tabulated. Within the Central Texas region (as defined in 1981), there are 147 reported sites with 907 component occurrences represented (Table 2). These figures cannot be taken as gospel for several reasons. Variations in the regional boundary through time have not been taken into consideration. Only those sites that fall within the generalized boundary are included. In addition, all sites included do not necessarily represent single sites. Surveys are treated as single site occurrences. However, in some areas, multiple surveys have been reported. Each of these is treated as a separate site occurrence. Some excavation reports lump artifacts from more than one site. Where possible, these have been segregated, but in many instances it has been impossible to effectively sort the materials on the basis of the published information. In those cases, two or more sites may be treated as a single site occurrence.

With these caveats in mind, the frequency of component occurrences is illustrated in Figure 6c. There is a general tendency for the percentage of components to increase through the Late Archaic, then decrease in the terminal Archaic. This is roughly similar to Skinner's postulations (see Figure 6a). As will be seen, though, this is an inaccurate representation.

The third step in deriving general population density is to obtain a ratio of component occurrences to time. This is accomplished by dividing the number of component occurrences by the length of that specific phase in calendar years. Figure 6d, which presents the results of these calculations, suggests that general population densities varied markedly through time. The overall trend is for steady population increase through the Archaic followed by a sharp decrease in the Neoarchaic.

A very low ratio is obtained for the Paleo-Indian stage. This is followed by relatively even increases in the Circleville and San Geronimo phases of the Early Archaic. However, there is a distinct decrease in the Jarrell phase followed by an increase in the Oakalla phase and a sharp increase in the Clear Fork phase. Surprisingly, and in contrast to Weir's perception, there is another distinct decrease in the Marshall Ford phase followed by further decrease in the Round Rock phase. This trend is abruptly reversed with a sharp increase in the San Marcos phase that levels off through the Uvalde phase. The Twin Sisters phase sees another sharp increase followed by a very marked increase that peaks in the Driftwood phase. The ratio then drops abruptly in the Austin phase of the Neoarchaic. In fact, it falls to Middle Archaic levels. The succeeding Toyah phase shows the beginnings of another increase that is truncated by European influences.

These ratios must be used with caution, as they indicate only relative population densities, not actual numbers. It must be kept in mind that we are dealing with component occurrences, not head counts. At this point, our knowledge of the prehistory of Central Texas does not allow us to calculate the frequency of group moves from one site to another. Nor are there substantive data available to indicate the degree of fluctuation in the frequency of movement between phases. Consequently, groups in one phase that may have moved fewer times will be represented by a lower ratio than groups in another phase that may have moved more frequently but had a smaller actual population.

Table 2. Summary of Reported Site and Component Occurrences, Central Texas Region

Site Name and No.	Components Represented*														Reference
	P	C	SG	J	O	CF	MF	RR	SM	U	TS	D	A	T	
Levi Shelter, 41TV49	X	X													Alexander 1963
Dry Comal Creek survey		X		X	X	X		X		X	X				Assad 1978
Olmos Dam, 41BX1		X				X				X					Assad 1979
Enchanted Rock survey		X	X	X		X	X	X	X	X	X		X	X	Assad and Potter 1979
No name, Bandera County						X		X		X	X		X		Beasley 1978
Mason Cave					X	X									Benfer and Benfer 1981
Hoxie Bridge, 41WM130; 41WM284	X	X									X	X	X	X	Bond 1978
Ingram Reservoir survey		X	X					X	X	X	X			X	Briggs 1971
Salado Creek, 41BX427						X	X	X	X	X					Brown et al. 1977
Merrell, 41WM2			X	X	X	X	X	X	X						Campbell 1948
Menger, 41BX272		X				X	X	X	X	X	X				Chadderdon 1975
Devils Hollow, 41TV38						X	X			X					Collins 1973
Seibel	X					X					X				Cox 1977
Granite Beach, 41LL2	X	X	X	X		X									Crawford 1965
I-10 survey		X				X		X		X	X			X	Crawford 1973
South Concho River survey	X	X		X		X	X	X	X	X	X			X	Creel 1978
Randig													X		Daniels 1976
No Name Creek 41GL17						X	X	X	X	X					Denton 1976
Lake Thunderbird, 41BP78		X	X	X	X		X			X			X		Duke 1977
Dobias-Vitek, 41WM118												X	X	X	Eddy 1973
Loeve, 41WM133								X			X		X	X	Eddy 1973
Adamek, 41WM135								X		X	X	X			Eddy 1973
Stacy Reservoir survey	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Espey, Huston and Associates 1981
Stacy Reservoir, 41RN129	X	X													Espey, Huston and Associates 1981
Ashley, 41BX124			X		X		X						X		A. Fox 1977
Classen Shelter, 41BX32								X	X	X	X	X			D. Fox 1980
Hopewell School, X41SV30		X	X	X					X		X	X		X	Gallagher and Bearden 1976
Happy Patch								X		X	X		X	X	Green 1971
Finis Frost, 41SS20														X	Green and Hester 1973
Wheatley, 41BC114			X	X						X	X		X	X	Greer 1976
Pat Parker, 41TV88											X	X	X		Greer and Benfer 1975

Table 2. Summary of Reported Site and Component Occurrences, Central Texas Region (Continued)

Site Name and No.	Components Represented*														Reference
	P	C	SG	J	O	CF	MF	RR	SM	U	TS	D	A	T	
Bear Creek BSA Reservation		X	X		X		X	X	X	X	X				Griffin 1976
Hop Hill, 41GL21			X	X		X	X	X	X	X	X	X	X	X	Gunn and Mahula 1977
Leona River survey											X		X		Hall 1974
41WM53											X	X	X		Hays 1982
Hawes, 41WM56			X	X	X	X	X	X	X	X	X	X	X	X	Hays 1982
41WM57			X			X	X	X	X	X	X				Hays 1982
41WM61, 41WM65, 41WM71			X			X	X	X		X		X			Hays 1982
41WM73						X	X	X	X	X	X				Hays 1982
Bryan Fox, 41WM124						X		X		X	X	X	X		Hays 1982
Cervenka, 41WM267		X	X	X		X	X	X	X	X	X	X	X		Hays 1982
41WM360			X				X	X	X	X	X	X		X	Hays 1982
41WM402											X				Hays 1982
41WM404				X		X	X	X	X	X	X		X	X	Hays 1982
41WM419	X	X	X	X		X									Hays 1982
Granger Lake testing								X		X	X	X	X		Hays 1982
La Jita, 41UV21		X		X	X	X		X	X	X	X		X	X	Hester 1971
Natalia Sewer, 41ME19														X	Hester and Kelly 1976
Wolf Shelter, 41BC73						X					X			X	Highley and Lengefeld 1977
Scorpion Cave, 41ME7			X	X	X	X	X	X	X	X	X		X	X	Highley et al. 1978
No Name, Bexar County	X	X													C. Howard 1974
Booker, 41TV627	X	X	X	X		X	X	X	X	X	X	X	X		M. Howard 1983
Cibola Creek Reservoir survey	X	X	X	X	X		X	X	X		X	X	X	X	Hsu and Ralph 1968
Walker Ranch survey				X			X	X		X	X	X	X	X	Hudson, Lynn, and Scurlock 1974
North Fork survey/testing				X	X	X		X	X		X		X		Jackson 1974
Perro Salvaje, 41SU2			X	X				X		X	X				Jarvis and Crawford 1974
Kyle Shelter, 41HI1			X			X		X		X		X	X	X	Jelks 1962
Proctor Reservoir survey	X		X	X		X	X	X		X	X		X	X	Jelks and Tunnell 1960
Oblate, 41CM1		X			X		X	X	X	X	X		X	X	Johnson, Suhm, and Tunnell 1962
Footbridge, 41CM2		X		X		X	X	X	X	X	X	X	X	X	Johnson, Suhm, and Tunnell 1962
Wunderlich, 41CM3		X	X	X	X	X	X	X	X	X	X	X	X	X	Johnson, Suhm, and Tunnell 1962
John James Park, 41BX305								X		X					Katz 1977

Table 2. Summary of Reported Site and Component Occurrences, Central Texas Region (Continued)

Site Name and No.	Components Represented*														Reference
	P	C	SG	J	O	CF	MF	RR	SM	U	TS	D	A	T	
Crystal Rivers, 41BX195		X		X		X		X	X	X	X	X	X	X	Keller 1976a
Stickleaf, 41ED8								X	X	X					Keller 1976b
Lehmann						X	X	X	X	X	X		X	X	Kelley 1947
Crumley, 41TV86		X	X	X	X	X	X	X	X	X	X				Kelly 1961
Cibolo Creek survey	X	X	X	X	X	X	X	X	X	X	X				Kelly and Hester 1976a
McQueeney MUD survey								X	X				X	X	Kelly and Hester 1976b
Enchanted Rock testing										X			X		Kotter and Nance 1980
Lake Whitney, various		X					X	X	X	X	X	X	X	X	Long 1961
Cook's Slough, 41UV68				X				X		X	X			X	Luke 1979
Shep, 41KR109; Wounded Eye, 41KR107		X		X	X	X			X		X				Luke 1980
Wells, 41TV368			X							X	X	X		X	Lynn and Fuszek 1981
Bear Creek Shelter, 41HI17									X	X		X	X	X	Lynott 1978
Aquilla Lake survey		X	X	X		X	X	X	X		X	X	X	X	Lynott and Peter 1977
Hamilton Creek survey						X	X								McCormick and Filson 1975
Salado Creek survey				X		X									McGraw and Valdez 1978
Encino Park survey			X	X		X		X		X					McGraw, Valdez, and Cox 1977
Live Oak Creek vicinity						X		X	X	X	X	X	X	X	McReynolds 1982
Cross Mountain				X		X	X	X	X	X	X	X	X	X	McReynolds and Grunewald 1981
Tehuacana Creek survey						X				X		X			Mallouf and Baskin 1976
Lake Belton, various			X	X	X	X	X	X		X	X	X	X	X	Miller and Jelks 1952
41CM52										X	X	X			Mitchell 1977
Wells Shelter, 41RE53								X							B. Moore 1982
Centerline, 41WM21				X					X		X				G. Moore 1976
Brawley's Cave, 41BQ20							X		X		X	X			Olds 1965
41BN8		X				X					X		X		L. Patterson 1974
41BN11	X	X	X		X		X				X				L. Patterson 1978
41KE72		X	X		X		X								L. Patterson and Adams 1977
San Marcos watershed survey		X	X	X			X			X					P. Patterson 1974
Tonk Creek Shelter				X			X	X	X		X	X	X	X	Perkins 1956
Boy Scout Shelter, 41TV69				X									X	X	Pollard, Greer, and Sturgis 1963

Table 2. Summary of Reported Site and Component Occurrences, Central Texas Region (Continued)

Site Name and No.	Components Represented*														Reference
	P	C	SG	J	O	CF	MF	RR	SM	U	TS	D	A	T	
McCann	X	X	X	X	X	X	X	X	X	X	X	X			Preston 1969
Terri, 41CJ2; Lightfoot, 41CJ23	X	X		X				X	X				X	X	Prewitt 1964
41WM151		X													Prewitt 1974
Loeve-Fox, 41WM230			X						X	X	X	X	X	X	Prewitt 1974
Rogers Springs, 41TV39			X	X	X	X	X	X	X	X	X	X			Prewitt 1976
Loeve, 41WM130		X													Prewitt 1982
Tombstone Bluff, 41WM165	X	X	X	X	X										Prewitt 1982
Loeve-Fox, 41WM230								X	X	X	X	X	X	X	Prewitt 1982
Possum Branch				X	X						X				Redder 1967
41BX435										X	X				Roemer and Black 1977
Cedar Park Mound, 41WM8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Schuetz 1957
Cobb's Spring	X	X	X	X	X	X	X	X	X	X	X				Schuetz 1957
Hughes	X	X		X	X	X	X	X	X	X	X	X	X	X	Schuetz 1957
Lake Locke		X	X	X	X	X	X	X	X	X	X	X	X	X	Schuetz 1957
San Gabriel Mound	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Schuetz 1957
Mission San Juan Capistrano										X				X	Schuetz 1969
Youngsport			X	X		X	X	X	X	X	X				Shafer 1963
Northwest laterals, 41CN13						X									Shafer and Baxter 1976
Granger Lake survey						X	X	X	X	X	X	X	X	X	Shafer and Corbin 1965
North Fork Reservoir survey					X	X	X	X	X	X	X	X	X	X	Shafer and Corbin 1965
South Fork Reservoir survey					X	X	X	X	X	X	X	X	X	X	Shafer and Corbin 1965
North and South Fork, non-reservoir survey						X	X	X	X	X	X	X	X		Shafer and Corbin 1965
Lake Belton testing	X	X	X	X		X	X	X	X	X	X	X	X	X	Shafer, Suhm, and Scurlock 1964
Camp Swift survey									X	X					Skelton and Freeman 1979
De Cordova Bend												X	X	X	Skinner 1971
Lake Whitney testing	X	X						X	X			X	X	X	Skinner and Gallagher 1974
Squaw Creek Reservoir testing		X									X	X			Skinner and Humphreys 1973
No name, Hood County	X														Skinner and Rash 1969
Friedrich Park survey											X		X		Smith and McDonald 1975
Goat Bluff								X			X		X		Sollberger 1978

Table 2. Summary of Reported Site and Component Occurrences, Central Texas Region (Continued)

Site Name and No.	Components Represented*														Reference
	P	C	SG	J	O	CF	MF	RR	SM	U	TS	D	A	T	
Strohacker, 41KR29	X	X	X	X											Sollberger and Hester 1972
John Ischy, 41WM49				X	X	X	X	X	X	X			X		Sorrow 1969
Barker, 41WM71											X			X	Sorrow 1970
North Fork reservoir testing						X	X	X	X	X	X	X			Sorrow 1973
Landslide, 41BL85		X	X	X	X	X	X	X			X				Sorrow, Shafer, and Ross 1967
Evoe Terrace, 41BL104		X		X		X	X	X	X	X	X	X	X	X	Sorrow, Shafer, and Ross 1967
Buzzard Shelter													X	X	Stephenson 1970
Lake Whitney, various							X	X			X	X		X	Stephenson 1970
Pictograph Shelter												X	X	X	Stephenson 1970
Sheep Shelter							X	X		X	X	X	X	X	Stephenson 1970
Stansbury												X	X	X	Stephenson 1970
Steele		X						X		X	X	X	X	X	Stephenson 1970
Baylor, 41ML35		X	X	X	X		X	X			X	X	X	X	Story and Shafer 1965
Britton, 41ML37							X				X	X			Story and Shafer 1965
Collins		X	X	X	X	X	X	X	X	X	X	X	X	X	Suhm 1955
Smith Shelter, 41TV42		X	X			X	X	X		X	X	X	X	X	Suhm 1957
Williams				X	X	X	X	X	X	X	X	X	X	X	Suhm 1959
LBJ National Park, various									X				X	X	Tunnell and Jensen 1969
Mission San Lorenzo											X		X	X	Tunnell and Newcomb 1969
41KE57								X	X						Valdez and McGraw 1977
Clark														X	Watt 1965
Lookout Point, 41ML33											X				Watt 1967
Greenhaw, 41HY29		X	X	X	X	X	X	X	X	X	X	X	X		Weir 1979
Jetta Court, 41TV151		X	X	X	X	X	X	X		X	X	X	X	X	Wesolowsky, Hester, and Brown 1976
Elm Creek, 41UV67						X				X	X				Young 1979

*Component abbreviations: P = Paleo-Indian; C = Circleville; SG = San Geronimo; J = Jarrell; O = Oakalla; CF = Clear Fork; MF = Marshall Ford; RR = Round Rock; SM = San Marcos; U = Uvalde; TS = Twin Sisters; D = Driftwood; A = Austin; T = Toyah.

For example, the florescence of burned rock midden use in the Middle Archaic phases may have precipitated a relatively high degree of sedentism. Fewer sites would have been occupied by any one group, and group size could have been relatively large. In contrast, the dispersed foraging and hunting economy of the Late Archaic phases may have forced smaller group sizes, but these groups could have moved from one site to another more frequently. These situations would yield the kind of ratios illustrated in Figure 6d but would not yield an accurate estimate of actual population.

However, with these cautions in mind, the data presented in this paper provide quantified indications of relative population density. While it may be argued that at this point I have shown only site density rather than people density, there is still some merit to the method in that it avoids unsupported generalizations such as those made by Weir and Skinner. It provides at least a rudimentary mechanism for comparing ratios of densities between temporal phases even though it is certain that better and more accurate methods will be devised in the future.

That a more accurate system will be devised is not idle speculation in view of the increasing attention that is directed toward estimates of generalized population density. For example, Collins and Driskell (1980) have presented a case for a population peak in the Late Archaic in the Falls of the Ohio River region in Indiana and Kentucky. While they relied on a simple frequency of component occurrence to make their case, the idea of examining the data to make such determinations indicates that thought is increasingly being directed toward this problem. Other researchers within the Central Texas region are similarly concerned. In particular, Carlson and others (1983) present a scenario at Fort Hood that is consistent with the data presented in this paper. At Fort Hood, component frequency was calculated on the basis of number of occurrences per 1,000 years. That they used a grosser chronology (Early, Middle, and Late Archaic) does not detract from the effectiveness of their presentation. Their results are quite compatible with those described here using a more refined chronology. Since Fort Hood is wholly contained within Central Texas, this provides support for the current data.

A dual system relying on both component frequency and projectile point frequency is utilized by Howard (Howard and Freeman 1984). Again, the results are remarkably similar to those described in this paper. Their project involved a survey of about 1,800 acres in northwestern Travis County, so the compatible results are not surprising. I suspect that Howard has identified an additional item to be examined: projectile point frequency in relation to component occurrence.

I must temper my enthusiasm for this angle of investigation by pointing out that projectile point frequency alone is insufficient to solve the problem. As I have discussed previously (Prewitt 1981, 1982), the dependency upon hunting plays an important role in the frequency of projectile points, and this must be determined by the relationships of all tools within a given phase. Still, there is a definite merit to the system Howard has proposed.

However, there is another dimension that needs to be added to the complex formula under development. This concerns the geographic area encompassed by any given phase. As indicated in Prewitt (1981), some phases encompass much smaller areas than others. This must be taken into consideration when dealing with relative population density. I predict that we will have a substantially more accurate idea of population density when we derive an analytical system based upon the relationships of the following elements: (1) length of phase in years; (2)

frequency of component occurrence; (3) frequency of projectile point occurrence; (4) ratio of projectile points to all other tools for a given phase; and (5) area encompassed by each phase. Obviously, this problem will require considerable work to arrive at any reasonable solution. Certainly, the simplified system illustrated in this paper is an improvement, but there are more improvements to come. Once the five elements noted above are combined into one mathematical formula, then we may expect to have a more realistic, although not complete, grasp upon relative population densities in the Central Texas region.

OVERLAPPING PHASES

A recurrent problem with the manner in which ages of phases are presented in this paper is the overlapping of temporal ranges. I prefer to use a median date to indicate the end of one phase and the beginning of the next. This is not a completely accurate portrayal of the realities involved in the passage of time. As is obvious in Figure 1, there are several instances where the date ranges for successive phases overlap to some degree. This is particularly true in the Late Archaic and Neoarchaic phases. I will focus on the Neoarchaic to explain my interpretation of this phenomenon.

Phases are not static units designed for pigeonholing relics of the past. Phases are descriptive tools used to characterize fluid human activities in specific geographic areas. In this instance, phases are used to characterize a very large area termed the Central Texas archeological region. Cultural adaptations or expressions cannot be expected to appear suddenly at the same time over the entire region. Rather, a specific phase must originate, or enter a region, from some limited area, then spread across the remainder.

If the Neoarchaic phases are viewed in this manner, then the overlap between the ending of the Austin phase and the beginning of the Toyah phase is clarified. To do this, the succession of phases must be viewed on a north-south distributional basis along the Balcones fault zone. This is necessary because most of our radiocarbon dates are from sites along this zone; we do not have sufficient data for an east-west comparison, nor can we extend the comparison into the Archaic for the same reason.

Figure 7 presents a graph of the Austin and Toyah phase radiocarbon dates segregated on a north-south basis. It is clear from this illustration that the Austin phase appeared somewhere around 1350 B.P. in the northern area that extends from about Cleburne to Waco. In the middle area that extends from just south of Waco to about Round Rock, the beginning dates are around 1250 B.P. The Austin phase begins in the southern area (extending from about Austin to San Antonio) at about 1100 B.P. Figure 8a illustrates this progression from a geographic perspective. The ending dates show an analogous pattern. The Austin phase ends at about 800 B.P. in the northern area, 700 B.P. in the middle area, and 550 B.P. in the southern area.

Now, compare these with the beginning dates of the Toyah phase (Figure 7). The Toyah phase appears at about 700 B.P. in the northern area, at about 600 B.P. in the middle area, and at about 500 B.P.in the southern area (Figure 8b). The ending dates are again analogous: 350 B.P. in the northern area, 250 B.P. in the middle area, and 200 B.P. in the southern area.

The overlap period of about 700 to 550 B.P. is illustrated in Figure 8c. While

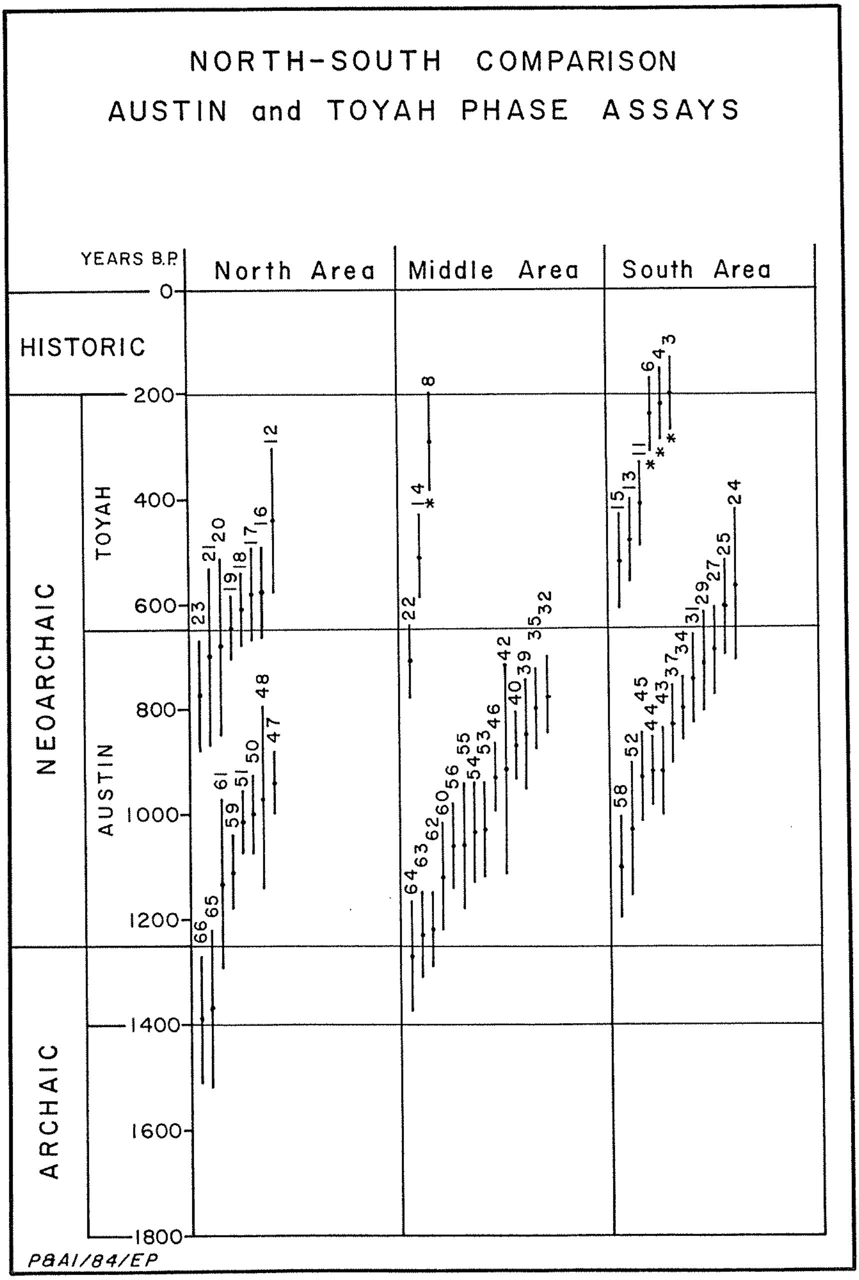

Figure 7. North-south comparison, Austin and Toyah phase assays. Asterisk (*) indicates dendrochronological correction not made. Numbers indicate cross-reference to Table 1.

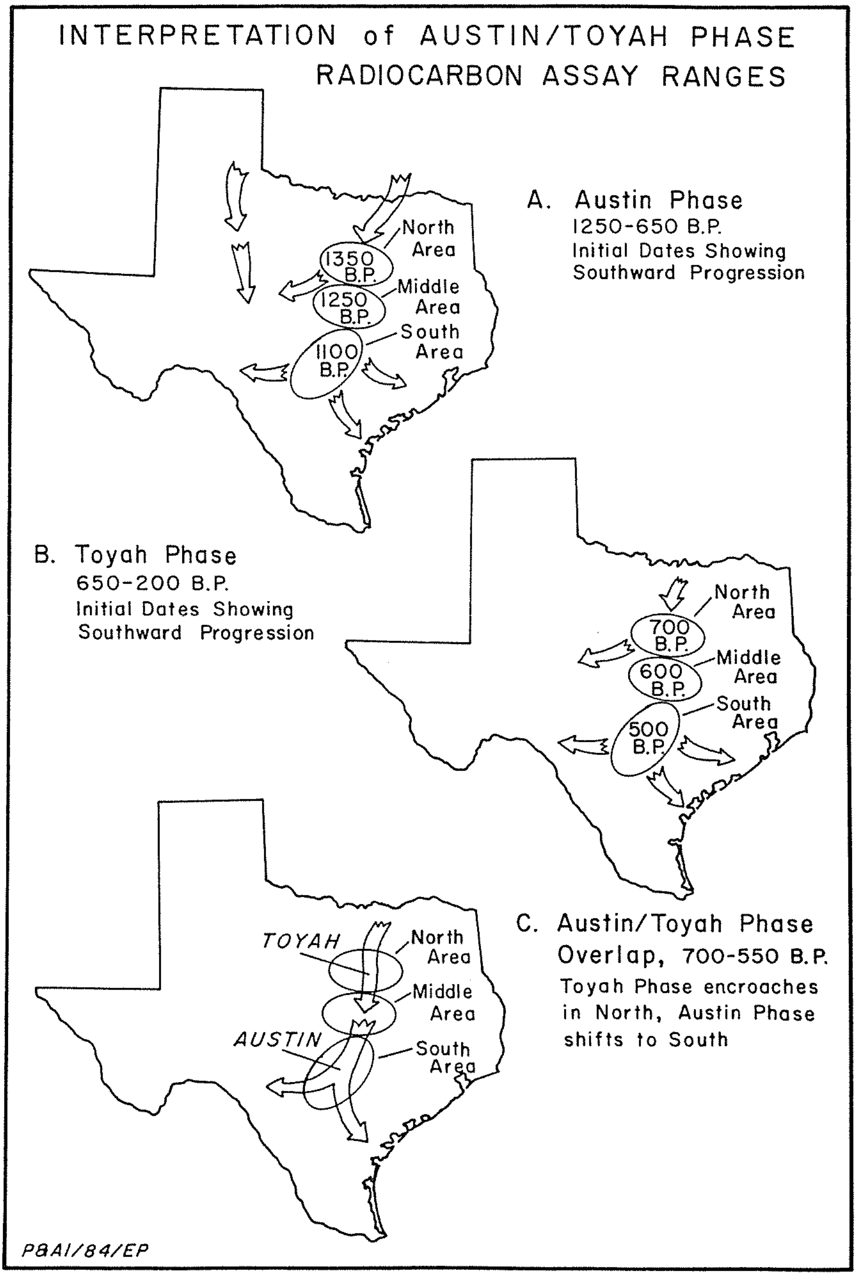

Figure 8. Interpretation of Austin/Toyah phase radiocarbon assay ranges. (A) Austin phase, 1250–650 B.P.; initial dates showing southward progression. (B) Toyah phase, 650–200 B.P.; initial dates showing southward progression. (C) Austin/Toyah phase overlap, 700–550 B.P.; Toyah phase encroaches in north, Austin phase shifts to south.

the Austin phase still exists in the southern area, the Toyah phase has already begun in the northern area. Thus, the overlapping date ranges are not only plausible but are expectable if this model is accepted. Further, there are far-reaching implications to be derived from the model.

It is an accepted fact that major north to south population movements occurred during the early Historic stage. The Apache expansion that swept southward and westward in the seventeenth and eighteenth centuries is well documented. This event was followed by a similar movement by the Comanches in the eighteenth and nineteenth centuries. These historical events are generally attributed to the effects generated by contact with European peoples. Acquisition of guns and horses is credited for giving these groups the military superiority and mobility necessary for rapid expansion and movement.

However, if the model presented here for the Austin and Toyah phases is accurate, then this pattern was established at least a thousand years before the Apaches began their rise to southern Plains domination. What triggered these postulated prehistoric population or cultural expansions? It is possible that the Austin phase could have resulted from the early adoption of the bow and arrow by groups that gained technological superiority over more conservative groups that maintained a dependency on the atlatl and dart weapons systems. Did this result in a movement of people or just ideas? Was the change violent, or was there peaceful interchange through trade? Certainly there are increased suggestions of violence during the Austin phase (Prewitt 1974:46–50, 1982:66, 176–178). Could this reflect an event similar to the later Apachean incursions? The possibilities are there, but I do not think we have sufficient data to answer these questions at the present time.

What about the Toyah phase? What triggered this change? Did another group actually move out of the Plains and into the Central Texas region? The primary changes seem to have been precipitated by the southward expansion of bison. At least, the subsistence base appears to have been related to bison procurement. Did a familiarity with bison-procurement methods provide one group with technological superiority over other resident groups to whom bison were previously unknown? As with the Austin phase, we do not have sufficient data to answer such questions now.

What is important here is that there is a logical explanation for the radiocarbon dates that have been obtained for the Neoarchaic stage in the Central Texas region. Further, this small bit of information can provide the basis with which to examine more detailed questions regarding people and their activities during a specific period of time.

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Dating the Past in Western Trans-Pecos Texas

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ABSTRACT

Direct dating of archeological materials is less than two decades old in western Trans-Pecos Texas and vicinity. Dating has increased significantly since 1975 but has been limited to a few areas, a few time periods, and all too few techniques. This study reports on the status of absolute dating in the western Trans-Pecos by summarizing and reviewing several new dating methods, listing all of the region's dates, commenting on the requirements and limitations of old and new techniques, and identifying promising directions of inquiry in our continued efforts to refine the region's prehistoric chronology. Archeologists are urged to think in terms of a wide range of dating techniques when planning and executing research projects in the western Trans-Pecos.

INTRODUCTION

The purposes of this study are: (1) to report on application of several new dating methods in western Trans-Pecos Texas; (2) to compile the first catalog of dates yielded by all methods of absolute dating attempted in the region; (3) to discuss potentials, limitations, and special requirements of application of these techniques; and (4) to identify areas, time periods, and dating methods meriting more attention in our continuing efforts to refine the prehistoric chronology of the region. More absolute dating techniques than ever before are available to archeologists. We will not reap full benefit from this availability, however, until we structure our thinking and planning to maximize recovery of chronological data in addition to functional, technological, and organizational information. Essential to this end is a clear understanding of available dating techniques, their requirements and limitations, and their current states of development.

The study area comprises the western part of Lehmer's (1958) Trans-Pecos Texas (Figure 1). The region lies in the Southwest's Basin and Range physiographic zone, where roughly parallel mountain ranges alternate with dry, sandy, intermontane basins. The Rio Grande is the region's only major permanent water source. Strong cultural connections with the southwestern United States characterize the western Trans-Pecos, which is in the Mogollon culture area of the Southwest (Lehmer 1948). Part of south-central New Mexico is included in this study because it has cultural affinities with the western Trans-Pecos and because it provides a few more absolute dates to complement the Texas series. Neighboring areas in Chihuahua, Mexico, have yielded no absolute dates (the Casas Grandes series is too distant to be discussed here).

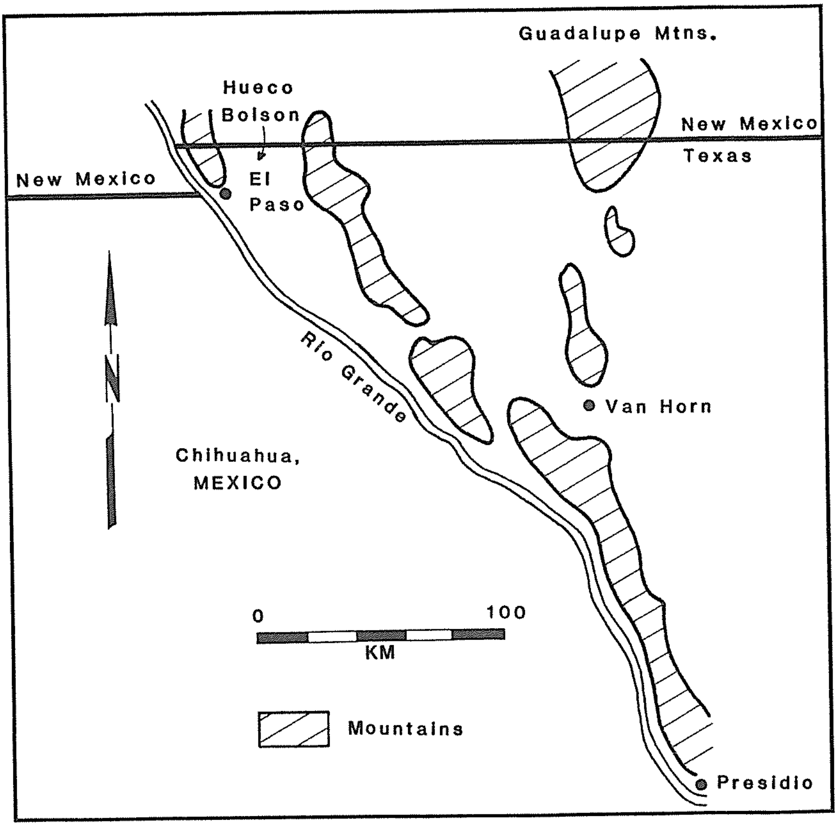

Figure 1. Map of western Trans-Pecos Texas and southern New Mexico, showing localities mentioned in the text. (After Lehmer 1958.)

The chronological sequence for the western Trans-Pecos and adjacent areas was established in broad terms in the 1940s by Kelley, Campbell, and Lehmer (1940) in the Presidio and Big Bend areas, and by Lehmer (1948) in western Texas and south-central New Mexico. Cultural materials were dated by their stratigraphic positions and by association with tree-ring-dated ceramics from better-known parts of the Southwest. This indirect dating provided a basis for seriation of local material cultures. The resulting sequences were generally accurate, and they have served archeologists for decades. As Kelley, Campbell, and Lehmer noted, however, "this is merely a relative chronology, and in many instances and at many points is in need of verification" (1940:39).

The first radiocarbon dates derived from western Trans-Pecos assemblages did not appear until 1968, but their number steadily increased over the next decade. A minor amount of archeomagnetic dating also was carried out. In the late 1970s, the writer began applying untried dating techniques in the western Trans-Pecos. The object of the study was to date a series of cultural features by several methods, thereby cross-checking the relative efficiencies of different techniques.

The chronometric standard for this operation, radiocarbon dating, utilized both old and new dates. For the series of new dates, samples for radiocarbon dating were selected from features that also contained material suitable for ceramic thermoluminescence and obsidian hydration dating. This cross-checking proved to be invaluable in assessing the reliability of the dating techniques and the suitability of several methods of sample collection. The results are summarized and discussed below. Dating techniques considered here are radiocarbon, ceramic thermoluminescence, obsidian hydration, and archeomagnetism. This study will not attempt to explain the physiochemical bases of these dating techniques, except as they affect sample-collection procedures or reliability of results. Readers wishing to learn more about any technique discussed here are advised to consult Michels (1973).

TECHNIQUES AND RESULTS

Radiocarbon Dating

Radiocarbon dating was the first chronometric technique to be applied to western Trans-Pecos sites, and it still provides the largest set of dates for the region. The literature on the region and adjacent parts of south-central New Mexico lists 79 radiocarbon dates (Table 1). These dates have been corrected by correlation with tree-ring sequences whenever possible. Damon et al. (1974) discuss dendrochronologic calibration of the radiocarbon time scale and provide a table for correction of dates. Dates originally published with MASCA corrections are simply copied and identified in Table 1.

In spite of the number of samples processed, radiocarbon dating has not been widely applied in the western Trans-Pecos. Most dates (72, or 91% of the total) are from western El Paso County and adjacent parts of Doña Ana County, New Mexico, where considerable research has been carried out recently under cultural resource programs. The only other part of the region where radiocarbon dates have been obtained is the Guadalupe Mountains in Hudspeth and Culberson counties, Texas, and Eddy County, New Mexico. Seven Guadalupe Mountain dates constitute 9 percent of the regional total. Perusal of the literature shows that datable material is present throughout the region in an interesting variety of preceramic and ceramic era contexts. The fact that no dates have been secured, therefore, can be attributed only to the paucity of work done in the region since radiocarbon dating became available in the late 1950s.

Table 1 shows that radiocarbon dating has not been uniformly applied to sites of all time periods. There are no Paleo-Indian or Early Archaic period dates, but this can be attributed to an extreme scarcity of datable remains for these periods. It is also clear that few radiocarbon dates have been determined for the area's numerous Pueblo period remains. Only the last eight entries in Table 1 (10 percent) are of the Pueblo period. The remaining 90 percent of the dates come from Late Archaic or Pithouse period contexts. This situation probably arises because the chronologies of these periods are still poorly understood relative to the Pueblo period. Moreover, chronologically diagnostic artifacts of the Archaic and Pithouse periods are less common than is the highly visible painted pottery that characterizes even small Pueblo period sites, so the exact periods to which Pueblo sites belong are less often in doubt. As a result, archeologists apparently often choose not to invest in Pueblo period radiocarbon dates.

Table 1. Radiocarbon Dates

Years B.P.	Years B.C./A.D.* (corrected)	Sample No.	Area[†]	Source	Reference
4100±200	2790±310 B.C.	RL-1159	EP	Structure floor	O'Laughlin 1980
3840±130	2370±130 B.C.	RL-881	EP	Hearth	Whalen 1980
3800±140	2350±210 B.C.	RL-1164	EP	Structure floor	O'Laughlin 1980
3640±130	1090±90 B.C.	RL-1158	EP	House floor	O'Laughlin 1980
3480±140	1910±220 B.C.	RL-1163	EP	Hearth	O'Laughlin 1980
3300±140	1590±210 B.C.	RL-1157	EP	Structure floor	O'Laughlin 1980
3190±130	1530±160 B.C.	RL-885	EP	Hearth	Whalen 1980
3080±160	1400±170 B.C.	UTA-3171	EP	Hearth	Thompson & Beckett 1979
2990±120	1290±190 B.C.	RL-892	EP	Hearth	Whalen 1980
2960±120	1240±210 B.C.	RL-891	EP	Hearth	Whalen 1980
2930±60	1200±70 B.C.	WIS-598	ED	Sandal frag.	Applegarth 1976
2770±130	1010±190 B.C.	RL-890	EP	Hearth	Whalen 1980
2630±140	880±140 B.C.	RL-893	EP	Hearth	Whalen 1980
2430±120	610±180 B.C.	RL-920	EP	Firepit	O'Laughlin 1979
2270±130	430±210 B.C.	RL-921	EP	Firepit	O'Laughlin 1979
2170±120	250±180 B.C.	RL-896	EP	Hearth	Whalen 1980
2060±110	170±220 B.C.	RL-894	EP	Hearth	Whalen 1980
2050±110	160±220 B.C.	RL-888	EP	Hearth	Whalen 1980
2050±110	160±220 B.C.	RL-1209	EP	Firepit	O'Laughlin 1980
2030±110	150±220 B.C.	RL-895	EP	Hearth	Whalen 1980
2010±120	130±230 B.C.	RL-1160	EP	Firepit	O'Laughlin 1980
1910±110	A.D. 30±130	RL-883	EP	Hearth	Whalen 1980
1850±120	A.D. 140±120	RL-926	EP	Firepit	O'Laughlin 1979
1830±120	A.D. 150±110	RL-929	EP	Firepit	O'Laughlin 1979
1760±120	A.D. 220±130	RL-925	EP	Firepit	O'Laughlin 1979
1730±120	A.D. 250±140	RL-1162	EP	Pit fill	O'Laughlin 1980
1700±110	A.D. 270±120	RL-889	EP	Hearth	Whalen 1980
1600±120	A.D. 380±150	RL-1161	EP	Pit fill	O'Laughlin 1980
1560±120	A.D. 410±140	RL-927	EP	Firepit	O'Laughlin 1979
1560±120	A.D. 410±140	RL-928	EP	Firepit	O'Laughlin 1979
1560±120	A.D. 410±130	RL-897	EP	Hearth	Whalen 1980
1540±110	A.D. 423±110	RL-657	EP	Hearth	Whalen 1977
	A.D. 440±100[x]	RL-564	EP	Hearth	Lynn 1976
1530±110	A.D. 450±140	RL-887	EP	Hearth	Whalen 1980
1450±120	A.D. 520±120	RL-1208	EP	Loose charcoal	O'Laughlin 1980
1430±120	A.D. 550±120	RL-1211	EP	Hearth	O'Laughlin 1980
1410±110	A.D. 560±110	RL-882	EP	Hearth	Whalen 1980
1390±110	A.D. 582±110	RL-655	EP	Pithouse fill	Whalen 1977
1370±110	A.D. 600±110	RL-658	EP	Pithouse fill	Whalen 1977
1310±110	A.D. 660±110	RL-654	EP	Pithouse fill	Whalen 1977
1310±110	A.D. 660±110	RL-659	EP	Hearth	Whalen 1977
1340±110	A.D. 650±110	RL-924	EP	Firepits	O'Laughlin 1979
	A.D. 660±110[x]	TX-2405	DA	Charcoal layer	Beckes et al. 1977
1285±75	A.D. 690±90	UTA-2356	EP	Hearth	Thompson & Beckett 1979
1270±130	A.D. 720±150	RL-898	EP	Hearth	Whalen 1980
1270±100	A.D. 720±110	RL-886	EP	Hearth	Whalen 1980
1270±100	A.D. 720±110	RL-884	EP	Hearth	Whalen 1980
	A.D. 730±130[x]	TX-1450	EP	Pithouse fill	Aten 1972
	A.D. 750±70[x]	TX-1451	EP	Pithouse fill	Aten 1972
1210±120	A.D. 770±150	RL-899	EP	Hearth	Whalen 1980
	A.D. 770±50[x]	TX-2404	DA	Hearth	Beckes et al. 1977
	A.D. 790±70[x]	TX-695	CU	Ring midden	Sommer 1968
1140±100	A.D. 820±130	RL-1166	EP	Hearth	O'Laughlin 1980
1130±110	A.D. 840±120	RL-779	EP	Pithouse fill	Whalen 1978
	A.D. 840±60[x]	TX-364	EP	Roasting pit	Greer 1968
1110±110	A.D. 857±120	RL-656	EP	Pithouse fill	Whalen 1977
	A.D. 860±100[x]	RL-563	EP	Hearth	Lynn 1976

Table 1. Radiocarbon Dates (Continued)

Years B.P.	Years B.C./A.D.* (corrected)	Sample No.	Area†	Source	Reference
1120±110	A.D. 860±120	*RL-1167	EP	Hearth	O'Laughlin 1980
1075±50	A.D. 890±60	WIS-597	ED	Hearth	Applegarth 1976
1010±120	A.D. 900±120	UTA-2354	EP	Hearth	Thompson & Beckett 1979
1010±110	A.D. 960±110	RL-923	EP	Firepit	O'Laughlin 1979
	A.D. 980±70ˣ	TX-647	CU	Ring midden	Sommer 1968
	A.D. 990±70ˣ	TX-2343	DA	Rockshelter fill	Beckes et al. 1977
	A.D. 990±80ˣ	TX-362	EP	Roasting pit	Greer 1968
970±110	A.D. 1000±110	RL-919	EP	Firepit	O'Laughlin 1979
890±110	A.D. 1060±110	RL-781	EP	Pithouse fill	Whalen 1978
890±110	A.D. 1090±120	RL-922	EP	Firepit	O'Laughlin 1979
870±120	A.D. 1100±120	RL-900	EP	Pithouse fill	Whalen 1980
840±110	A.D. 1130±110	RL-930	EP	Firepit	O'Laughlin 1979
815±50	A.D. 1130±60	WIS-577	ED	Hearth	Applegarth 1976
810±55	A.D. 1140±60	WIS-578	ED	Hearth	Applegarth 1976
800±50	A.D. 1150±50	TX-1735	EP	Pueblo roof post	Kegley 1980
760±110	A.D. 1200±110	RL-932	EP	Firepit	O'Laughlin 1979
750±110	A.D. 1200±110	RL-1210	EP	Hearth	O'Laughlin 1980
730±110	A.D. 1220±110	RL-918	EP	Firepit	O'Laughlin 1979
730±110	A.D. 1220±110	RL-931	EP	Firepit	O'Laughlin 1979
710±50	A.D. 1230±60	TX-2806	CU	Hearth	Katz 1978
	A.D. 1260±70ˣ	TX-2341	DA	Pueblo room fill	Beckes et al. 1977
400±110	A.D. 1500±110	RL-1165	EP	Pit fill	O'Laughlin 1980

*Correction notes: Dates from O'Laughlin (1980) and Whalen (1980) have been MASCA corrected by the analyzing laboratory. Dates marked with an x are uncorrected because the B.P. age was not given in their report. All other dates were corrected by the writer using the method described in Damon et al. (1974). Both this and the MASCA correction are based on radiocarbon-dated tree-ring sequences, and both yield nearly identical results for the time ranges considered here.

†Area abbreviations: DA is southern Doña Ana County, New Mexico; ED is southern Eddy County, New Mexico; EP is western El Paso County, Texas; CU is northwestern Culberson County, Texas.

This is unfortunate, as there is still much refinement to be done on the chronology of the Pueblo period in the western Trans-Pecos.

Thermoluminescence Dating

Ceramic thermoluminescence has considerable potential for dating prehistoric materials for several reasons. First, it is a completely independent technique. It is not tied to a radiocarbon sequence as is, for example, archeomagnetic dating. Second, because the ceramic artifacts themselves are dated, ceramic thermoluminescence avoids many of radiocarbon's problems of association, such as the one between the hearth that yields a charcoal sample and artifacts from a surface near the hearth. Third, ceramics are common enough to provide large samples of datable material and fragile enough to preclude long use or reuse before deposition. Fourth, standard errors occurring on thermoluminescence dates are acceptably small. Aitken, Zimmerman, and Fleming (1968:444) demonstrate this through dating of a series of British ceramics of known age and comparing their resulting thermoluminescence values to their known ages. The results showed an average standard deviation of 10 percent of the mean thermoluminescence age of specimens from the known age, and a standard deviation of 15 percent of individual thermoluminescence dates from known ages. Finally, the cost of thermoluminescence dating is about the same as radiocarbon dating.

Ceramic thermoluminescence has been applied only recently by the writer to dating problems in the El Paso area. It has not yet been attempted elsewhere in the western Trans-Pecos, although it should be applicable all over the region. Most western Trans-Pecos ceramic wares are tempered with sand and crushed quartz-bearing rock. Sherds of this kind are good specimens for dating because quartz contributes a substantial part of a ceramic sample's thermoluminescence (Aitken, Zimmerman, and Fleming 1968:444). These wares are also fired well enough (i.e., at temperatures exceeding 400° C) to have completely drained the naturally acquired radiation from their component materials. Thermoluminescence readings secured from such sherds are therefore accurate measures of radiation accumulated since the time of firing, a situation essential for reliable dating (Drover et al. 1979). In addition, ceramics are widespread throughout the western Trans-Pecos, providing large samples of datable material from a variety of locations.

Development of a ceramic thermoluminescence chronology in this region of Texas began with selection of 10 samples from a series of Pithouse and Pueblo period sites near El Paso (see Whalen 1980, Appendix B, for full details of the dating process). An attempt was made to select ceramic material from the early part of the Pithouse period (ca. A.D. 200–750), the late Pithouse period (ca. A.D.750–1000), the transitional and early Pueblo period (ca. A.D. 1000–1200), and the developed Pueblo period (ca. A.D. 1200–1400). As a monitor on the accuracy of the technique, preference was given to sites that had (or could provide) radiocarbon dates on ceramic-associated contexts. Unfortunately, very few sites in the area had been excavated. In most cases, sherds were simply recovered from dense surface scatters. Body sherds were used in this analysis, and an effort was made to select sherds that were as similar as possible in paste and surface finish to the chronologically diagnostic rim sherds used to date the sites. Rim sherds themselves were not used, as thermoluminescence analysis involves destruction of the sherd sample. Rim sherds of early ceramic times are so few and so small that it is necessary to preserve them intact for other analyses. Temporally later rim sherds are much more common, although body sherds were still used for thermoluminescence dating in the interest of consistency of technique.

Ideally, the sherds dated should be of the same type, since different types of pottery can have different thermoluminescent properties due to variation in constituents (Aitken, Zimmerman, and Fleming 1968:444). For the Pithouse period, sherds of El Paso Brown were used; for the Pueblo period, sherds of El Paso Polychrome were used. Both are locally manufactured wares having similar paste and temper characteristics.

It has been noted that most of the El Paso area sherds selected for dating came from surface scatters, and it was realized at the time that use of surface ceramics was not theoretically ideal, but one of the project's aims was to investigate the level of reliability of thermoluminescence dates derived from surface materials. Potential problems with surface ceramic dates are, first, that one can never be absolutely certain of the provenience and association of surface sherds and, second, that unknown burial histories of sample ceramics lead to uncertainty in determination of the radiation dose received by the sample from its soil matrix. As Zimmerman (1971:818) notes, thermoluminescence readings depend in part on the gamma radiation dose received by the sherd from radioactive decay of constituents of the surrounding soil. To control this variable as closely as possible, Aitken, Zimmerman, and Fleming (1968:443) selected sherds from homogeneous soil layers. These authors note that gamma radiation from the British soil matrix produces 10 to 20 percent of the total radiation dose, and they observe that this fraction could be larger elsewhere (Aitken, Zimmerman, and Fleming 1968:444). Collection of local soil samples for determination of background radiation intensity is thus essential when sampling for thermoluminescence dating. Whatever the local soil situation, however, surface sherds, with their unknown periods of exposure, clearly are not well suited for estimates of gamma radiation dosages. Since the extent of the errors inherent in thermoluminescence dating of surface sherds is still unclear (David W. Zimmerman, personal communication, n.d.), researchers wishing to use thermoluminescence techniques would be safest to date excavated material.

Seven of the thermoluminescence dates obtained in the western Trans-Pecos (sites 3:010, 3:730, 3:1487, 3:1590, 4:010, 4:018, and 4:132) fall within the time ranges suggested by ceramic styles (Table 2). The samples from sites 4:132 and 3:730 were excavated: all other dates discussed here are from surface-collected sherds. The two dates on buried sherds are supported by nearly identical radiocarbon dates. Site 4:132 has a thermoluminescence date of A.D. 868 ± 110 and a radiocarbon date from surrounding matrix of A.D. 890 ± 110. The sample from site 3:739 yielded a thermoluminescence date of A.D. 1057 ± 83 and two radiocarbon dates of A.D. 1060 ± 110 and A.D. 1150 ± 110.

Three other dates are at odds with ceramic styles. Site 3:1070 appeared on ceramic grounds to belong to the early Pithouse period, although its thermoluminescence date places it in very late Pithouse times. It is not clear whether the source of this problem is the ceramic seriation, the classification of the site within this seriation, or the dating technique. Any one, or any combination, of the three is equally likely at this early stage of inquiry. The major occupation of site 3:1374 dates on ceramic grounds to the Pithouse-to-Pueblo transition period. The ceramic assemblage for this period is quite distinctive, and the dating of the transition period at ca. A.D. 1100 to 1200 is also fairly sound. The thermoluminescence date secured for transitional site 3:1374 is A.D. 748 ± 100, falling in the last half of the Pithouse period. This date is substantially at odds with a fairly well-dated ceramic sequence, but the sherd came from the surface, so its origin is therefore open to question and it should not be automatically concluded that the dating technique was at fault.

In another case the thermoluminescence date seems faulty. This is site 3:1642, a late Pueblo period village with a large diagnostic ceramic assemblage dating to A.D. 1561 ± 38. This is more than 150 years after the end of the Pueblo period as determined by all chronological studies done in south-central New Mexico and western Trans-Pecos Texas. This includes ceramic studies, archaeomagnetic dates, tree-ring dates, and other of the ceramic thermoluminescence dates discussed here (site 3:1590, for example). All of these studies consistently

Table 2. Thermoluminescence Dates*

Date	Sample No.	EPCM Site No.†	Period Designation‡
A.D. 798±100	77d6	3:1374	LPt, T
A.D. 818±100	77d8	4:018	LPt
A.D. 838±100	77d4	3:1487	LPt
A.D. 868±100	77d1	4:132	E, MPt
A.D. 998±100	77d5	3:010	LPt
A.D. 1057±83	77d3	3:730	LPt
A.D. 1057±100	77d2	3:1070	EPt
A.D. 1233±67	77d7	4:010	T
A.D. 1338±58	77d9	3:1590	Pu
A.D. 1561±38	77d10	3:1642	Pu

*All reported in Whalen 1980; all located in western El Paso County, Texas.

†El Paso Centennial Museum site numbers.

‡E,M,L = early, middle, late; Pt = Pithouse; T = Transitional Pithouse/Pueblo; Pu = Pueblo. Designations based on surface ceramics except for sites 4:132 and 3739, which are based on radiocarbon dates. Surface sherds were dated in all cases except 4:132 and 3:739.

produced dates clustering tightly in the thirteenth and fourteenth centuries. Spanish accounts also indicate that Pueblo societies did not exist in the El Paso area in the mid-sixteenth century. All of this evidence, then, argues that the thermoluminescence date of A.D. 1561 is unreliable.

Despite some difficulties, this application of ceramic thermoluminescence dating is sufficiently encouraging to recommend its continued use. It should also be observed that thermoluminescence researchers are exploring the feasibility of dating heated stone. Limestone has given uneven results, and attention is now being directed toward granitic stone. Thermoluminescence dating on various materials will probably become increasingly important in archeological research.

Obsidian Hydration

Several recent studies (O'Laughlin 1979; Whalen 1980) have attempted to use obsidian hydration dating in the western Trans-Pecos. The technique involves determination of the rate of hydration of local obsidians. This is the rate at which a newly fractured edge absorbs water molecules from its surroundings. This rate differs for obsidians from different sources, as it is a function of the stone's composition. Local rates of hydration can be determined only by measurement of extent of hydration (or thickness of the *hydration band*) on many obsidian samples from locations dated by other methods. Once a local rate of hydration has been determined, it can be used to calculate the amount of time elapsed since the fracture of a piece of obsidian.

Just over 50 obsidian samples have been measured in the western Trans-Pecos, producing a very small sample of hydration values, which reflects the paucity of obsidian in local prehistoric deposits. In the El Paso area, obsidian occurs as small, water-rolled pebbles that seldom exceed 3 cm in their maximum dimension. These pebbles constitute a minute fraction of the area's Pleistocene gravels. There is no known obsidian source anywhere in the western Trans-Pecos, and the abraded condition of the El Paso area pebbles implies that they were transported by water from distant sources. Obsidian is even less common in the remainder of the western Trans-Pecos, making hydration dating unpractical except in the El Paso area.

Hydration measurements have been made on obsidian samples from a series of Archaic, Pithouse, and Pueblo period sites around El Paso. O'Laughlin (1979: 53, Figure 15) reports 13 hydration measurements from Archaic strata, mixed Archaic-Pithouse period strata, and pure Pithouse deposits at the Keystone Dam site on the Rio Grande at the western edge of El Paso. Both excavated and surface-collected obsidian samples were used. Other hydration measurements come from the Hueco Bolson, a desert basin directly east of El Paso (Whalen 1980:49, Table 15), where all of the obsidian samples—averaging 5 per site—were collected from sites that have been dated by ceramics from early Pithouse to late Pueblo times. Samples were also taken from these sites for thermoluminescence measurements (radiocarbon dates are available for some of the sites). The sites sampled appeared from their surface ceramics to be single-component occupations. Unfortunately, very little excavation has been done in the area, and little obsidian was recovered by excavation, so surface finds constitute the bulk of obsidian for study. Thin sectioning of obsidian samples and measurement of hydration-band thicknesses from both the Keystone Dam and Hueco Bolson studies were done at the Radiocarbon Laboratory at the University of California in Riverside. Hydration-band thickness values for all samples are provided in the original reports of the project (O'Laughlin 1979; Whalen 1980).

These measurements can be used in several ways. Michels (1973:209) shows how a local rate of hydration can be calculated by correlation of hydration-band thickness with some independent method of dating. Absolute dates in the El Paso area are provided by the radiocarbon and ceramic thermoluminescence dates just discussed. Ideally, hydration-band thickness decreases from older to younger specimens; i.e., the older the fracture, the more water molecules have diffused into the body of the obsidian, thickening the hydrated band. The results of this analysis were disappointing. The mean values given in Table 3 show no consistent decrease in hydration-band thickness from early to late. In the absence of such a trend, it is impossible to estimate reliably the rate of hydration of obsidian from the El Paso area, and without this rate no absolute dates can be calculated.

A significant factor in these disappointing results may very well be the surface origin of nearly all of the samples. Michels (1973:207), in his discussion of obsidian hydration techniques, notes that temperature is a crucial variable affecting the rate of hydration. Samples from the desert floor of the study area would have been exposed to substantial fluctuation in day, night, and seasonal temperatures, resulting in considerable variation in the hydration rate. A second factor may be the variability in the composition of the different obsidian flows from which the samples originated. The rates of hydration can vary widely for different obsidian sources (Michels 1973:208). Since Hueco Bolson obsidian consists of waterworn nodules in unconsolidated Pleistocene gravels, the source of the stone is unclear, and several different obsidian flows could have contributed. However, obsidian from the Keystone Dam site produced hydration values consistently increasing with age from a set of proveniences roughly seriated by associated artifacts. Despite this encouraging result, the paucity of absolute dates for the obsidian-yielding sites still prohibits determination of the exact rate of hydration of the sample material, which is essential for calculation of precise sample age.

Nevertheless, obsidian hydration measurements made to date in the El Paso area can still be used for relative chronological ordering (cf. O'Laughlin 1979). According to data from the Keystone Dam site, hydration bands from Archaic components are from ca. 7.0 to 10.5 microns thick, and those from components of the Pithouse period are form 2.8 to 6.0 microns thick. Three of the four Pithouse values lay between 4.3 and 6.0 microns. the writer's values from Pithouse and Pueblo periods in the Hueco Bolson confuse this situation somewhat, coming as they do from uncertain proveniences and from a large number of sites. The data in Table 3 show no clear distinction between hydration values of the Pithouse and Pueblo periods, although none of these values overlaps O'Laughlin's Archaic range. It must be recalled, of course, that the Archaic hydration values are separated from those of the Pithouse period by roughly 3,000 years, while as many as 800 years may separate Pithouse and Pueblo period values. Moreover, late Pithouse deposits constitute the most common segment of the period, and no more than a few centuries separate these from the Pueblo period. It is clear, therefore, that even relative dating of Pithouse and Pueblo remains by obsidian hydration measurement will require many readings from unmixed proveniences. Nevertheless, hydration measurements now seem to be a tool for making at least gross distinction between preceramic and ceramic era contexts. This alone is of considerable utility in the western Trans-Pecos, where the literature often shows considerable confusion over what is preceramic and what is simply aceramic. Archeologists working in the area, especially if they are excavating, are therefore

Table 3. Chronological Ordering of Mean Hydration Band Thickness

Site*	Date†	Mean Band Thickenss (Microns	Standard Deviation	No. of Specimens	Reference
2:033	2790 B.C.	6.86	-	1	O'Laughlin 1979
4:132	A.D. 620	3.68	0.26	7	Whalen 1980
3:1374	A.D. 800	5.37	1.26	5	Whalen 1980
3:1487	A.D. 840	4.66	0.59	8	Whalen 1980
2:033	A.D. 860	4.34	-	1	O'Laughlin 1979
3:739	A.D. 1030	4.84	3.08	3	Whalen 1980
3:1070	A.D. 1130	5.24	1.59	7	Whalen 1980
4:010	A.D. 1240	3.99	0.85	6	Whalen 1980
3:1590	A.D. 1340	3.34	0.53	7	Whalen 1980
3:1642	A.D. 1560	4.92	1.11	10	Whalen 1980

*El Paso Centennial Museum site number.

†Radiocarbon and ceramic thermoluminescence dates, rounded to the nearest decade.

urged to have hydration values determined on all obsidians recovered, even if samples are too small to yield immediately useful results. Only compilation of a large body of obsidian hydration data from well-controlled proveniences will ultimately allow refinement of a promising dating technique. Preparation of obsidian samples and measurement of hydration bands are simple, rapid, inexpensive, and readily available.

Archeomagnetic Dating

The archeomagnetic dating technique has been used in the western Trans-Pecos and vicinity, although its range of application is very limited over both time and space. The technique relies on precise measurement of the orientation of magnetic particles, which align themselves toward the earth's current magnetic pole upon heating. The magnetic particles retain this orientation when their matrices cool. Using data on the movement of the earth's magnetic pole over time, the date of heating can be calculated. Clearly essential for archeomagnetic dating are samples of severely burned earth, adobe, brick, or ceramics *that have not been moved from the original firing positions*. Any severely burned hearth, oven, or other such feature is a potential source of samples. Especially suitable for this purpose in the western Trans-Pecos are the adobe-lined firepits often found inside Pueblo rooms in the El Paso and Presidio areas. A limitation on the use of archeomagnetic dating, however, is that it requires sequences of dates from other sources for initial chronological placement of the earth's magnetic fluctuations at the study locality.

Table 4. Archeomagnetic Dates

Date*	Area†	Provenience‡	Reference
A.D. 1200/1230	DA	Orogrande Pueblo	Brook (n.d.)
A.D. 1260±18	EP	Hot Wells Pueblo	Brook (1970)
A.D. 1270±18	EP	Hot Wells Pueblo	Brook (1970)
A.D. 1275±27	EP	Hot Wells Pueblo	Brook (1970)
A.D. 1295±13	EP	Hot Wells Pueblo	Brook (1970)
A.D. 1300±20	EP	Hot Wells Pueblo	Brook (1975)
A.D. 1300/1320	EP	Hot Wells Pueblo	Brook (1975)
A.D. 1300/1330	EP	Sherman Hog Ranch Pueblo	Brook (1975)
A.D. 1300/1350	DA	Robledo Mountain Pueblo	Brook (1975)
A.D. 1320/1340	EP	Hot Wells Pueblo	Brook (1975)
A.D. 1325/1350	DA	Robledo Mountain Pueblo	Brook (1975)
A.D. 1365±26	EP	Sabina Mountain Pueblo	Brook (1975)
A.D. 1390±41	EP	Sabina Mountain Pueblo	Brook (1975)

*Where determined, first and last firing dates are shown as, for example, 1200/1230.

†Area abbreviations: DA is southern Doña Ana County, New Mexico; EP is western El Paso County, Texas.

‡Samples were taken from intramural hearths.

At present, 13 archeomagnetic dates have been documented in the El Paso area and in adjacent parts of New Mexico, all from Pueblo period sites. Most were taken in the course of El Paso Archeological Society excavations in the early and middle 1970s (Table 4). No archeomagnetic dating has been done in the El Paso area in the past 10 years, and none has ever been done anywhere else in the study area proper (Figure 1). The special equipment and skills required for taking samples prevent the widespread use of archeomagnetic dating (for a full discussion of sampling techniques see Tarling 1975). Excavators who are not prepared to take archeomagnetic samples, however, should still make a practice of recording the exact locations of all heavily burned areas. These areas should also be left undisturbed, insofar as the necessities of the excavation permit, and their locations should be included in published reports. Documentation and preservation of heavily burned areas would permit efficient relocation for sampling by future researchers. These practices are urged in the light of the writer's conversations with specialists in archeomagnetic dating, who indicate that a major impediment to widespread application of the technique is lack of readily available samples with which to build and refine regional paleomagnetic variations. The technique is certainly worth developing, as it should be applicable to all of the cultural remains in the western Trans-Pecos.

CONCLUSIONS

In conclusion, although it is clear that progress has been made in developing the chronology of parts of the western Trans-Pecos, it is equally clear that much remains to be done. Promising new dating techniques are coming into use in the area, although they are still in early stages of development and application, and their spatial distribution is very limited. Radiocarbon, ceramic thermoluminescence, obsidian hydration, and archeomagnetic work are all confined entirely to the El Paso area, and our understanding of the chronology of the rest of the region is therefore underdeveloped. To remedy this situation will clearly require a great deal of time and effort. Archeologists are urged to think in terms of a range of dating techniques when planning research projects, to collect (or locate) datable material of many sorts, to date or process as much of this material as possible, and to include these results, proveniences, and measurements in project reports. This is a laborious task; it is also an essential one, as large-scale dating offers the only means of further refining the chronology of the western Trans-Pecos.

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Prehistoric Settlement and Technological Patterns in Southeast Texas

L. W. Patterson

ABSTRACT

Prehistoric settlement, subsistence, and technological patterns are discussed for the upper Texas coast and a western transitional zone between the Brazos and Colorado rivers. External relationships are considered from the standpoint of technological traits. Stable settlement patterns are indicated for long spans of time in the inland portions of these regions.

INTRODUCTION

Settlement and technological patterns are key subjects in the study of prehistoric lifeways. Data for the study of these subjects in Southeast Texas have increased significantly in the past few years. A general review of the prehistory of the upper Texas coast has been published previously by the author (Patterson 1979a). This current paper provides more details on settlement and technological patterns, including some data not previously available.

This study explores differences in prehistoric settlement and technological patterns in two specific geographical areas of the Southeast Texas coastal plain: the upper Texas coast, defined as the area between the Brazos and Sabine rivers, from the coastal margin to approximately 90 miles inland; and the zone between the Colorado and Brazos rivers, which extends about the same distance inland as the upper Texas coast (Figure 1).

Many similarities as well as differences are evident in cultural patterns of the two regions. Settlement patterns seem to be closely tied to available food resources, while technological patterns may be influenced by several factors, such as subsistence requirements, cultural preferences, availability of raw materials, and external influences.

CHRONOLOGY

The current literature on archeological research tends to deemphasize studies on prehistoric chronology in favor of more narrowly defined problems. It should be realized, however, that precise definition of chronology remains an important research goal in most parts of the state, including Southeast Texas. Explicit problem-oriented studies in prehistoric archeology cannot be done properly without supporting chronological data.

Establishing precise chronological controls for Southeast Texas is difficult. Few of the materials that are normally recovered are suitable for radiocarbon dat-

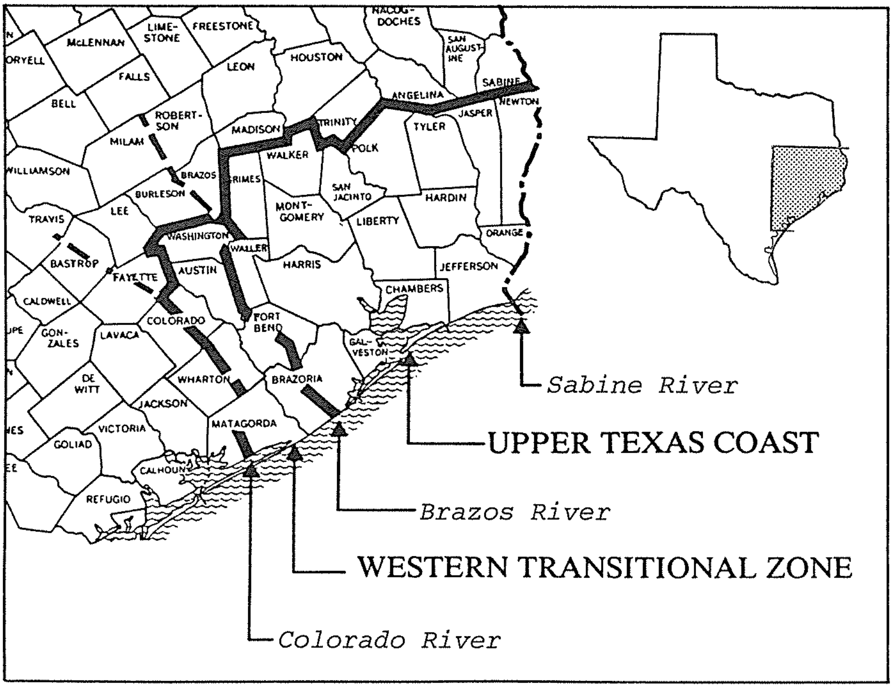

Figure 1. Areas of Southeast Texas under discussion.

ing, and neither ceramic nor projectile point studies have as yet yielded definitive data concerning precise, narrow time periods. In addition, much field work remains to be done before sufficient data to define relative chronologies of artifact types for all prehistoric time periods is available. Enough data exist, however, to construct relative chronologies for broad time periods in Southeast Texas. A few radiocarbon dates are now available, and a fairly good definition of the beginning dates for ceramics has been established on the coastal margin of the upper Texas coast.

A large number of prehistoric sites have now been recorded in Southeast Texas (Patterson 1979a:Table 1); however, most of the data from these sites are from surface collections. For this large body of information to be useful, it is necessary to use projectile point and ceramic typologies as time indicators. Although much research remains to be done, tentative projectile point sequences can be constructed for the two regions under discussion, as shown in Table 1. These proposed point type sequences are based on data from a few excavated sites that have long occupation sequences. The principal sites involved are 41AU1 (Duke 1982) and 41AU36 (Hall 1981) in Austin County, and 41HR5 (Wheat 1953:Table 5) and 41HR315 (Patterson 1980a) in Harris County. Data from several other excavated sites in the upper Texas coast also are available, mainly for the Late Archaic and later periods. These include sites in Austin (Hall 1981), Brazoria (Aten 1971), Chambers (Aten 1979, 1983), Harris (Aten 1979, 1983; O'Brien 1971; Wheat 1953), Liberty (Aten 1967), Montgomery (Shafer 1958),

Table 1. Tentative Projectile Point Sequences

Time Period	Projectile Point Types: Upper Texas Coast	Projectile Point Types: Western Transitional Zone
Early Paleo-Indian 12,000-10,000 B.P.	Clovis, early side-notched(?)	Clovis(?), Folsom, early side-notched
Late Paleo-Indian 10,000-7,000 B.P.	Plainview, Scottsbluff, Angostura, San Patrice, Golondrina, Dalton, Meserve, early stemmed*	Plainview, Scottsbluff, Angostura, San Patrice, Golondrina, early stemmed*
Early/Middle Archaic 7,000-3,500 B.P.	Carrollton, Trinity, Bulverde, Pedernales, Gary/Kent, Ensor, Williams	Bulverde, Pedernales, Gary/Kent, Travis, Marcos, Lange, Ensor, Wells, Bell(?) Williams
Late Archaic/Early Ceramic 3,500-1,400 B.P.	Gary/Kent, Ellis, Ensor, Pedernales, Ponchartrain, Yarbrough, Darl, Palmillas, Wells, Bulverde, Travis, transitional arrow points	Gary/Kent, Pedernales, Ellis, Ensor, Ponchartrain, Fairland, Palmillas, Travis, Darl, Wells, Marcos, Yarbrough, transitional arrow points
Late Prehistoric 1,400-500 B.P.	Alba, Perdiz, Scallorn, Fresno, Catahoula, Edwards, Bonham, Bassett, Gary/Kent	Edwards, Alba, Scallorn, Perdiz, Catahoula, Gary/Kent

*Early stemmed includes a variety of styles.

and Polk (McClurkan 1958) counties. New data from excavated site 41WH19 (L.W. Patterson field notes, n.d.) in Wharton County also will be discussed here.

The early Paleo-Indian period is not well represented in Southeast Texas. There are a few surface finds of Clovis fluted points (Long 1977; Suhm and Jelks 1962; Wheat 1953) and a Clovis point associated with the Galena site in Harris County (Hester 1980). Only one example of a Folsom-type fluted point has been found in this region (site 41WH19). The early Paleo-Indian period is generally recognized as extending from 12,000 to 10,000 B.P. (Jennings 1974:Fig. 3.27).

It is now known that side-notched projectile points occur in very early sites in Central and Southeast Texas. There are three occurrences of side-notched points earlier than Plainview in these regions. In Central Texas these examples include a San Patrice point on the upper Brazos River (Watt 1978) and other side-notched point varieties at the Wilson-Leonard site (41WM235 ; Frank Weir, personal communication, n.d.) north of Austin. In Southeast Texas, at site 41WH19, three varieties of side-notched points have been found in levels below a Plainview point, one at the same level as a Folsom point. The side-notched point at the Folsom level at site 41WH19 is somewhat comparable in time to the earliest dates for Dalton side-notched points during the Folsom time period (Goodyear 1982). The scarcity of Folsom points in Southeast Texas may thus be explained in terms of other point types being used in this region during the period 10,000 to 11,000 years ago.

Since the early Paleo-Indian period is not yet well defined in Southeast Texas, this article will deal primarily with late Paleo-Indian and later time periods for which significant data are now available. The late Paleo-Indian period covers an interval of 10,000 to 7,000 years ago, based on the date summary of Plainview and Golondrina point types given by Johnson and Holliday (1980). Scottsbluff and Angostura point types fall into this time range (Prewitt 1981: Figure 4). Other late Paleo-Indian point types found in Southeast Texas include Dalton, Meserve, and San Patrice. As Story (1981:143) has noted, the San Patrice point type may date from early in the late Paleo-Indian period on the upper Brazos River (Watt 1978) and in the Texas Panhandle (Willey et al. 1978). Distribution of the San Patrice point type in Texas is becoming better known. This point type has a wide distribution in Southeast Texas (Patterson 1980b), and more examples are being found in Central Texas (Watt 1978; Weber 1980). A San Patrice point has been found in situ in late Paleo-Indian context at site 41WH19 (L. W. Patterson field notes, n.d.) in Wharton County.

A surprising variety of stemmed point types has been found for the late Paleo-Indian period at site 41WH19. Straight-stemmed, site-notched, and corner-notched varieties all occur at this site below an Angostura point and above a Plainview point. Most of these points have well-ground basal edges. Based on excavations at site 41HR315 (Patterson 1980a: Table 3), early straight-stemmed points occur in late Paleo-Indian period contexts in Harris County. Early side- and corner-notched points also may occur in Harris County in late Paleo-Indian period components, based on excavations by Wheat (1953:Types 7, 14) and surface collections such as those from site 41HR206 (Patterson 1976c:Figure 1A-C; 1980d:Figures 1E, 2G, 2H).

Using information provided by McCormick (1975) and W. W. Crook, Jr. (personal communication, n.d.) for north-central Texas, I now feel that the

Carrollton and Trinity point types start in the Early Archaic and continue through the Middle Archaic period on the upper Texas coast. These point types have not yet been found in the western transitional zone (Figure 1) but are common in the upper Texas coast. Bell-like points may date from the Early Archaic period in the western transitional zone (Patterson and Hudgins 1981:Figure 1). The Bulverde point type seems to start in the Early or Middle Archaic in the upper Texas coast (Patterson 1980a) and in the western transitional zone (site 41AU1, Duke 1982). This point type continues into the Late Archaic in the upper Texas coast (Patterson 1980a). The Gary/Kent point series starts in the Middle Archaic period in both the upper Texas coast and the western transitional zone and continues throughout all later prehistoric periods (Hall 1981; Patterson 1980a). Other point types associated with the Middle Archaic period in the western transitional zone include Travis, Pedernales, Marcos, Lange, Ensor, and Wells (Hall 1981). Pedernales and Williams point types may also be associated with the Middle Archaic in the upper Texas coast. In contrast to Prewitt's (1981:Figure 4) Central Texas chronology, the Pedernales point type continues into the terminal Archaic in the upper Texas coast (Wheat 1975:Table 5) and in the western transitional zone (site 41AU1, Duke 1982). The Early to Middle Archaic period in this region is estimated at roughly 7,000 to 3,500 B.P. (Patterson 1979a:106). Some unclassified straight-stemmed points with ground basal edges have been found in the Early Archaic level of site 41WH19.

The Late Archaic period in the upper Texas coast is defined here as beginning at approximately 3,500 B.P. and ending with the introduction of ceramics at about 1,900 B.P. (Aten et al. 1975:Figure 16). The introduction of ceramics is not well defined in the western transitional zone. The Early Ceramic (Woodland) period starts at about 1,900 B.P. and ends at about 1,400 B.P., when small bifacial arrow point types become predominant (Aten 1971:Figure 10). Dart point styles are similar throughout the Late Archaic and Early Ceramic periods in the study area. These include Gary/Kent, Ellis, Ensor, Ponchartrain, Palmillas, Darl, Yarbrough, Wells, and Pedernales. Marcos and Fairland point types also occur during these time periods, but only in the western transitional zone. Transitional arrow point types occur during these time periods in both regions (Patterson 1982a).

The Late Prehistoric period is defined here as starting at about 1,400 B.P. and ending with European contact at 500 B.P. Research to date, except for a study of ceramic types on the coastal margin (Aten et al. 1976:Figure 16), has not enabled definition of any subperiods within the Late Prehistoric. Standardized small arrow point types such as Alba, Perdiz, Scallorn, Edwards, and Catahoula are predominant during this time period. It should be noted that the Gary/Kent dart point series continues into the Late Prehistoric throughout the study areas (Wheat 1953:Table 5; Hall 1981; Patterson 1980a:Table 3; Aten 1979), especially at inland sites.

Much research remains to be done to obtain more exact ordering of chronologies in these two regions. Few absolute dates are available, and projectile point sequences are not fully defined. Materials suitable for radiocarbon dating are not found frequently. Some projectile point types are not suitable for defining narrow time periods, and there appear to be geographical differences in pottery type sequences. On the positive side, the amount of data available for the two regions is increasing rapidly (Patterson 1982b). More research is especially needed on projectile point sequences in the Paleo-Indian and Early Archaic periods. Site 41WH19 has the potential to yield radiocarbon dates for a very long time sequence.

SITE OCCUPATION SEQUENCES

The major prehistoric settlement pattern of the inland coastal plain in the upper Texas coast and the western transitional zone is the dense occupation found near all water sources. It has been known for some time that Indian sites are generally found along stream banks or on the first high terraces above the stream banks (Patterson 1979a, 1979c). Recent data indicate a large number of sites on stable landforms that have very long occupation sequences. A number of sites have initial occupations in the Late Paleo-Indian or Early Archaic periods with continued intermittent occupations through the Late Prehistoric. A stable settlement pattern lasting for as long as 10,000 years may be indicated for some of these sites. One of the reasons for the uniformity in settlement patterns is the lack of topographical and geological diversity. There were few opportunities to practice a variety of settlement strategies, such as use of caves or hilltop look-out sites.

A number of sites with long occupation sequences in Wharton County, in the western transitional zone, have now been reported. Sites 41WH2 (Patterson and Hudgins 1980a; Patterson 1980c), 41WH7 (Patterson and Hudgins 1980a), 41WH10 (Patterson and Hudgins 1980b), 41WH19 Location A (Patterson and Hudgins 1981) and 41WH26 (Patterson and Hudgins 1982) have late Paleo-Indian components indicated by point types such as San Patrice, Plainview, Scottsbluff, and Golondrina. With only one exception (41WH7), all of these sites exhibit intermittent use through the Archaic and Late Prehistoric periods. Excavations at site 41WH19 Location B have demonstrated a very long occupation sequence, starting with the early Paleo-Indian period (Folsom) and continuing through the Late Prehistoric (L. W. Patterson field notes, n.d.). Other sites of the western transitional zone having great time depth include sites 41AU1 (Duke 1982), 41AU7 (Patterson 1976a), 41AU19 and 41AU36 (Hall 1981), and 41WH65 (Patterson and Hudgins 1983).

A number of sites in the upper Texas coast with long occupation sequences also are known. Long (1977) has shown that the McFadden Beach area in Jefferson County was utilized from the early Paleo-Indian through at least the Late Archaic periods. Paleo-Indian points here include Clovis, Dalton, San Patrice, and Scottsbluff. This area was possibly grassland before coastal subsidence.

Most of the recorded sites in the upper Texas coast with long occupation sequences are in Harris County, mainly because so much archeological work has been done there. Site 41HR315 (Patterson 1980a) is an excavated site with the longest occupation sequence found to date (Paleo-Indian through Late Prehistoric). Plainview, Angostura, and San Patrice are the earliest point types of this site, and Carrollton points from the Early to Middle Archaic constitute a major component here.

There are a number of repeatedly occupied, but disturbed, sites in Harris County with surface collections that include late Paleo-Indian and later artifacts. Site 41HR182 (Patterson 1975a, and field notes, n.d.) yielded a late Paleo-Indian

Golondrina-like point as well as Archaic and Late Prehistoric materials. The occupation sequence at site 41HR206 (Patterson 1980d) begins with a possible Angostura point and continues through the Late Prehistoric. As noted previously, notched points with ground basal edges from this site (Patterson 1976c:Figure 1A–C) may be from the late Paleo-Indian period, based on similar point types from this period at site 41WH19. Aten et al. (1976), Duke (1971), Hester (1980), McClure (1977, 1978, 1981), McGuff and Cox (1973), and Wheat (1953) have reported sites containing similar long occupation sequences

Excavations by Wheat (1953) at the Doering site (41HR5) in Harris County have yielded projectile point types of all time periods. Late Paleo-Indian point types here include Angostura, Scottsbluff, San Patrice, and Plainview. This site has been difficult to interpret stratigraphically because some point types seem to be out of sequence. However, one problem with this site, the occurrence of notched points at the lowest excavation level, may now be solved. These corner- and side-notched points are similar to types found at the late Paleo-Indian level at Site 41WH19.

If Carrollton and Trinity points were being manufactured in the Early Archaic in Harris County, some sites can now be classified as having occupation sequences starting with the Early Archaic and continuing through the late Prehistoric periods. These sites include 41HR184 (L.W. Patterson field notes, n.d.) and 41HR283 (McClure 1982).

Since it has now been shown that the Gary/Kent point series begins in the Middle Archaic, it is likely that the lengths of occupation periods have been underestimated in published reports for some sites in the upper Texas Coast, perhaps including certain sites in Montgomery (Shafer 1968) and in Polk (McClurkan 1968) counties. It should also be noted that McClurkan refers to site 41PK88 as starting in the Late Archaic, even though San Patrice and lanceolate Paleo-Indian points were found at this site.

SETTLEMENT PATTERNS

No complex settlement patterns have been identified for inland portions of these coastal plain areas. The concept of large base camps with smaller related specialty sites does not seem to apply here. However, the concept of small bands gathering on a seasonal basis is a possibility that deserves continued research.

There is evidence of more intensive use of the coastal margin of the upper Texas coast, in the form of shell middens, starting some time in the later part of the Archaic period. While some of these sites have Late Archaic remains, most shell middens are post-ceramic, dating after A.D. 100 (Patterson 1979a:Table 2). There is a trend toward greater exploitation of marine resources during the Late Prehistoric period in the coastal margin. Since this trend appears to be accompanied by pottery types somewhat related to Louisiana types (Aten and Bollick 1969), this change in settlement and subsistence patterns may be due to influences from the east. Although not regionally uniform, this trend toward greater utilization of marine food sources occurs also in some inland areas, such as along the Brazos River (Hall 1981). The relationships of settlement and subsistence patterns will be discussed in more detail below.

Sites tend to be smaller and more numerous and to contain less pottery in the inland upper Texas coast in the Late Prehistoric. This trend has previously been explained as resulting from a more mobile life style (Patterson 1976c). At the same time, the basic selection of settlement locations along streams did not change. Thus, the nature of inland sites differs from that of Late Prehistoric sites in the coastal margin. Some of the late sites in the coastal margin, such as site 41HR74 (Duke 1981) at Laporte, are quite large and contain large quantities of pottery. Here, a less mobile life style is indicated, although some seasonal movement probably still occurred.

Judging from numbers of sites, there appear to have been continuing population increases in the upper Texas coast from the late Paleo-Indian through the Late Prehistoric periods (Patterson 1979a:Table 1). As Story (1981:144) notes, the highest rate in population increase occurred during the Late Archaic. However, this population increase may not have been as sudden as past data have indicated. An increasing number of sites with Middle Archaic components are now being identified.

Story (1981:148) notes a general lack of settlement pattern data in East Texas. This is no longer true for the two regions being discussed here. Much of the archeological data available for these two regions have now been published (Patterson 1982b) and, including the data from surface collections, are of good contextual quality. Many of the surface collections constitute quantifiable samples of archeological remains and do not simply represent isolated surface finds. While a more detailed picture of settlement patterns in coastal areas may result from future research, it is now possible to delineate settlement patterns to a large degree. Future research should concentrate on more uniform surveys of these regions (Patterson 1979c) and on obtaining a better description of seasonal movements.

In spite of the available data, some difficulties in the study of settlement patterns in these regions do exist. Because of the scarcity of absolute dates and the inaccuracies of radiocarbon dating, quantified data on archeological sites cannot be used to determine settlement density at any given moment in time. Therefore, site density data can be used only as an average over selected time periods. The interpretation of site size is another difficult subject. A horizontally large site may represent either a short-term occupation by a large group or frequent use by small groups. Some of the larger sites on the upper Texas coast, such as 41HR206 (Patterson 1980d), appear to represent frequent occupations over long time periods by small bands. The scarcity of preserved floral and faunal remains makes the study of seasonal habitation patterns another difficult problem. Because of difficulties in obtaining solutions to some types of interpretive problems, future research should concentrate on the types of problems most amenable to solution.

SUBSISTENCE PATTERNS

Settlement patterns alone have little meaning if not related to subsistence patterns. In hunting and gathering lifeways, the availability of natural food resources is a prime consideration in the location of habitation sites. The location of sites near freshwater sources provides access to both potable water and plant and animal food resources. In the upper Texas coast and in the western transitional zone, settlement patterns seem to be tied directly to strategies of maximizing the available food resources. An area resident recalls that early settlers in

Wharton County referred to the nomadic Indians there as "fish eaters," an indication that Indian activities usually concentrated on local creeks and rivers (Joe Hudgins, personal communication, n.d.).

Prehistoric Indians in these regions followed a very broad-based subsistence pattern, exploiting practically any natural resource that was edible. Few floral remains are available for study, and a large number of sites dating from all time periods have yielded primarily deer and turtle. However, in the few cases where large samples of faunal remains have been obtained, it is apparent that a wide variety of animal foods were used (Hall 1981; Dillehay 1975; Wheat 1953: Table 8; McClure 1983; Duke 1981).

Both large and small animals were exploited. Large animals included bear, bison, deer, and antelope. Some of the small animals included rabbit, squirrel, mink, turtle, raccoon, and rat. The foraging Indians appear to have been practically omnivorous, although there were some food types that were either preferred or easier to obtain. Reptile and fish remains are common mainly at coastal margin sites, although this may be a matter of selective preservation, since the alkaline conditions of shell middens are conducive to good bone preservation. Alligator and garfish are examples of marine food remains that have been found in archeological sites in these regions. An example of Late Prehistoric inland use of alligator has been found at site 41WH19.

Even though freshwater shellfish are found near many inland archeological sites, this food resource was not an important factor in the subsistence regimes of prehistoric groups. Parmalee and Klippel (1974) have given reasons why freshwater shellfish would not have been a preferred food resource in terms of available food energy. In some selective inland areas, the use of shellfish was more important, perhaps because of greater availability. Freshwater shellfish remains are important at some sites along the Brazos River (Hall 1981; L. W. Patterson field notes on sites 41WL14 and 41WL15, n.d.). The use of freshwater shellfish is more common after the Middle Archaic, perhaps because increased population pressure forced use of less preferred food types or because this food type became more available at certain locations.

Beginning in the terminal Archaic, shell midden sites become important along the upper Texas coastal margin (Patterson 1979a:Table 2). These sites contain the remains of brackish-water shellfish (*Rangia cuneata*) and saltwater shellfish (oyster). Large-scale use of shellfish on the coastal margin may be indicative of influences that moved progressively west from the Louisiana coast. Data on ceramic types tend to support this hypothesis (Aten and Bollich 1969). It is somewhat of a mystery to modern investigators as to why such large quantities of *Rangia* shellfish were used. A number of my friends in Louisiana have tried to eat *Rangia* without success, using a wide variety of preparation and cooking methods. It is understood that Vietnamese immigrants are currently using *Rangia* as a food source in the Galveston Bay area.

Story (1981:148) notes that two different patterns of adaptation appear to be represented in Southeast Texas: one which relied solely on interior resources, and another which depended on inland and coastal types of resources. Dillehay (1975) and Duke (1981) have shown the large variety of faunal remains that can be found in coastal margin shell middens. Because of the relatively larger amounts of pottery found at coastal margin sites, a more sedentary lifeway is indicated than at inland sites. Pottery is not very portable, and large-scale use of pottery is not suitable for a nomadic lifeway. The account of Cabeza de Vaca (Covey 1961) indicates, however, that some seasonal movement of coastal margin people did occur. Archeological investigations have so far been able to add little detail on this subject.

There seems to have been a mid-Holocene intensification of maritime resource exploitation in the New World, with a higher intensity of energy capture from foods of this type as certain resources (shellfish, for example) became more abundant. "In this regard, population growth appears to have played a significant role in further intensification of maritime adaptation (especially exploitation of more diversified marine resources) in *late* Holocene times in many areas" (Yesner 1981:445). With respect to Texas coastal margin adaptations, marine foods may have been a secondary resource. Perlman (1980) comments that people "locate in terms of critical resources and then adjust those 'optimal' locations to allow for access to secondary resources in order to minimize risk." Clark (1981:444) further notes that "under normal circumstances, most coastally situated hunter-gatherers are not dependent upon marine (or estuarien) resources to any significant extent. Exploitation of these niches is usually confined to 'buffer' resources like shellfish, and those resources can be exploited with varying degrees of intensity."

Future progress in research on subsistence patterns in these regions will depend on the discovery of large samples of faunal remains and on the availability of qualified analysts. The number of people available to do detailed analyses of faunal remains is limited.

TECHNOLOGICAL CHANGES AND REGIONAL DIFFERENCES

As MacNeish (1978) points out, much of archeology is not the investigation of overall culture, but rather the study of prehistoric technologies, since materials related to technology are most often preserved. General technological changes that apply to the regions discussed here have previously been described (Patterson 1976c), and it is now possible to note also some technological differences between and within these two regions.

Regional differences in projectile point types seem to occur as early as the early Paleo-Indian period. For example, the Folsom point from site 41WH19, in the western transitional zone, is the farthest to the southeast that this point type has been found to date. For the late Paleo-Indian period, both the upper Texas coast and the western transitional zone should be regarded as a buffer area between Plains and eastern late Paleo-Indian traditions. Plains styles of late Paleo-Indian points found here include Plainview, Scottsbluff, and Angostura. Eastern styles of late Paleo-Indian points include San Patrice, Dalton, and a variety of side- and corner-notched points with ground basal edges. For the Early and Middle Archaic, some differences in projectile point types are seen between the upper Texas coast and the western transitional zone. Carrollton and Trinity points are common on the upper Texas coast but do not seem to occur west of the Brazos River. Pedernales, Travis, and Lange points are more common in the western transitional zone than in the upper Texas coast. Marcos points occur mainly in the western transitional zone. There also are some similarities in projectile point styles of the Early and Middle Archaic in these two regions. Williams, Bulverde, and the Gary/Kent series occur commonly in both regions.

Projectile point styles in the two regions seem to have been influenced by cultural contacts along the major river systems. The Brazos and Colorado rivers originate from the northwest in Central Texas, and the western transitional zone reflects influences from Central Texas. The Trinity and Sabine rivers originate in Northeast Texas, and the upper Texas coast shows influences from this area. Despite these different influences, the upper Texas coast and the western transitional zone were never culturally isolated areas, as illustrated by a number of shared projectile point styles.

For the Late Archaic and Early Ceramic periods, there are not a large number of differences in projectile point types between the upper Texas coast and the western transitional zone. Pedernales and Marcos points remain principally types of the western transitional zone, perhaps showing continued influences from Central Texas, but some Pedernales points do continue to be found east of the Brazos River. Fairland points from this period found in the western transitional zone (Hall 1981) are another indication of influences from Central Texas. As shown in Table 1, however, the two regions share many projectile point types. Ponchartrain points found in both regions (Hall 1981; McClurkan 1968; Patterson 1980a) show possible contacts with Louisiana to the east. Hall (1981) has shown that the Late Archaic was a period of geographically widespread trading contacts. Fine grades of flint were occasionally imported into these two regions from the Edwards Plateau throughout the Paleo-Indian and Archaic periods. This provided opportunities for cultural contacts between Central Texas and the Texas coast. It has previously been noted (Patterson 1975b) that the upper Texas coast and Louisiana share a large number of Late Archaic projectile point types. Story (1981:139) has commented that in environment and broad patterns of cultural adaptation, the eastern portion of Texas is part of the southeastern United States. In relation to this, the upper Texas coast represents the western end of the eastern Gulf Archaic. It should also be noted that point types such as Catan, Matamoros, and Refugio that occur more commonly in South Texas also are occasionally found in the upper Texas coast.

For the Late Prehistoric period, there are indications of both technological uniformity and diversity between the upper Texas coast and the western transitional zone. Some regional arrow point types, such as Perdiz and Scallorn, have very wide geographical distributions in East and Central Texas. The Edwards point type of Central Texas seems to be found more frequently in the western transitional zone than in the upper Texas coast. The Catahoula arrow point type that is commonly found in the upper Texas coast has a wide geographical distribution to the north and east (Patterson 1976d).

Technological influences from Northeast Texas are apparent on the northern fringe of the upper Texas coast during the Late Prehistoric. Caddo pottery types and Northeast Texas arrow point types, such as Friley, have been found in Montgomery and Polk counties (McClurkan 1968; Shafer 1968). The Early Ceramic period bone-tempered pottery found in inland Harris County (Patterson 1980c) may also indicate an influence from the north (D. A. Story, personal communication, n.d.).

A considerable diversity in pottery types within these two regions (Aten 1979; Patterson 1980a) may indicate increasing cultural diversity in the Late Prehistoric. Rockport pottery styles are commonly found in the western transitional zone (Patterson and Hudgins 1981) but are found only occasionally in the upper

Texas coast. Leon Plain pottery seems to occur only in the western transitional zone, and incised pottery decoration is much more common at coastal margin sites than at inland sites (Aten 1979; Patterson 1980a). Although the introduction of pottery to the upper Texas coast seems to have been from Louisiana (Aten and Bollich 1969), there is a possibility of Mexican influence on the development of Rockport pottery (Corbin 1974:Figure 14).

The distribution of grog-tempered pottery in the Late Prehistoric is not uniform. For example, in Harris County this pottery type is common at late coastal margin sites but is not common at inland sites. Grog-tempered pottery has been found inland in the Brazos River valley (Hall 1981), in Austin County. This might represent seasonal movements of Indians who more frequently inhabited the coastal margin. The nonuniform distribution of grog-tempered pottery could be accounted for by people moving inland on a seasonal basis with selective use of only certain stream systems. In a similar manner, Rockport type pottery at only a few inland sites in eastern Wharton County, such as 41WH19 (Patterson and Hudgins 1981), might indicate seasonal movements of people from the coastal margin, using the San Bernard River system. Aten (1979:205) has noted significant differences in prehistoric ceramic assemblages of the three major river systems of the upper Texas coast: the Sabine-Neches, the Trinity-San Jacinto, and the Brazos.

Even though bone-tempered pottery is found in Early Ceramic period components at inland sites of the upper Texas coast (Patterson 1980a), this pottery type occurs in significant amounts only in components of the later portion of the Late Prehistoric in the Galveston Bay area (Aten et al. 1976:Figure 16).

Use of the dart and spear thrower in these regions was not uniform in the Late Prehistoric. Both dart points and arrow points are found concurrently at inland sites (Aten 1967; Patterson 1980a; Wheat 1953:Table 5). Aten (1979:435) notes that use of the dart and spear thrower may have been abandoned in favor of the bow and arrow at coastal margin sites. This might be interpreted as a cultural preference, as both inland and coastal margin peoples were hunting essentially the same kinds of fauna, such as deer.

The relatively large amounts of pottery used at coastal margin sites, as compared to inland sites, not only indicates a more sedentary seasonal lifeway but may also reflect differences in subsistence activities involving food storage and/or processing. The low amounts of lithic materials found at coastal margin sites is another indication of technological differences between these two areas.

Aten (1983) has proposed archeological evidence for tribal group territories on the upper Texas coastal margin in the Late Prehistoric period, based on the geographic distributions of a few artifact types. However, differences in archeological remains of this time period are much greater between inland and coastal margin areas than are differences in archeological materials that occur parallel to the coastline. This implies that tribal groups may have been organized in a manner corresponding to local subsistence patterns, which may then have developed local cultural patterns. The use of a few technological traits to define prehistoric tribal group boundaries is a rather tenuous concept, especially in view of the nomadic nature of the Indians being discussed here.

CONCLUSIONS

The following are major conclusions that can be made with currently available data regarding settlement, subsistence, and technological patterns in the western transitional zone and the upper Texas coast:

1. A stable settlement pattern, utilizing a broad-based subsistence regime, was characteristic of inland areas from the late Paleo-Indian through the Late Prehistoric periods. Many sites have very long occupation sequences.
2. Coastal margin sites oriented toward greater use of marine food resources become more important after the terminal Archaic.
3. Differences in projectile point styles between the upper Texas coast and the western transitional zone begin as early as the early Paleo-Indian period. These differences may have been caused by external influences.
4. There are several inter- and intra-regional differences in pottery types, most of them apparent in the Late Prehistoric period. These differences possibly indicate cultural differences between and within the regions.
5. Some of the differences in cultural traits between inland and coastal margin sites may reflect local development tied to restricted territorial usages.
6. The upper Texas coast represents the western end of a general Archaic foraging lifeway common to the entire eastern Gulf coastal plain.
7. Technological differences and similarities within the geographic area discussed here show that cultures did not remain static, even though settlement and subsistence patterns remained stable over long periods of time.
8. There seems to have been a continued population increase from the late Paleo-Indian to the Late Prehistoric, judging by the relative number of sites found to date for each time period (Patterson 1979a:Table 1).

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An Archeological Review of the Central Texas Coast

Harry J. Shafer and Clell L. Bond

ABSTRACT

Archeological research into the prehistory of the Coastal Bend region of Texas is reviewed in this paper. Attention is focused on the nature and condition of the archeological resources that occur in the region. Distribution of the natural resources and patterning in the archeological record are used as the basis for suggesting a seasonal foraging pattern for the ancient Coastal Bend populations. Temporal changes in the culture sequence are seen to be due to (1) a shift in the local ecology and (2) a shift in selective preference by the ancient populations.

INTRODUCTION

This paper reviews the history of archeological research and examines the prehistoric period in the Coastal Bend of Texas, which extends from Corpus Christi Bay eastward to the mouth of the Brazos River and about 80 km (50 miles) inland (Figure 1). The region is characterized by a low-lying landscape, many freshwater streams, brackish and saline bays and lagoons, and a generally temperate environment. Prehistoric aboriginal populations lived in the area as early as about 9000 years ago, but the shifting coastline and the coastal ecology limited these populations to an exclusively foraging lifeway. The ancient cultures changed their strategies of exploitation from time to time, leaving recognizable qualitative changes in their artifact assemblages.

ENVIRONMENT

The climate of the area is mild, with hot summers and cool winters, an average annual temperature of about 20° C. (70° F.), and a growing season of about 295 days. Rainfall averages 80 to 90 cm (32 to 36 in.) annually (Arbingast et al. 1976).

Blair (1950) has placed the Texas Coastal Bend in the Tamaulipan Biotic Province, a region that has close biological relations with the thorn scrub, coastal marshes, and sand dunes of northeastern Mexico. According to Gould's (1975) vegetation zones of Texas, the area lies near the geographic center of the Gulf Prairies and Marshes zone, a relatively narrow strip of land extending the length of the Texas coast.

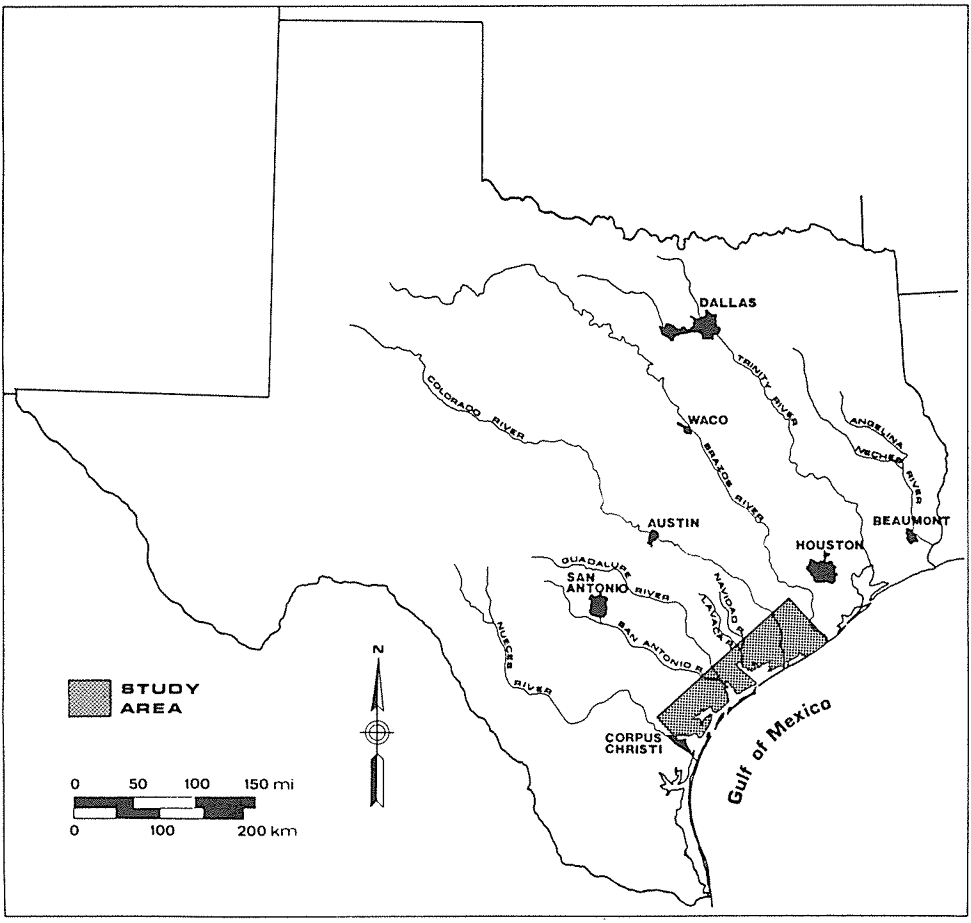

Figure 1. Map of Texas showing location of Coastal Bend region.

The topography of the Coastal Bend, mainly flat and sloping gently to the southeast, is typical of the Pleistocene Beaumont Formation, which comprises most of the coastal plain in Texas (American Association of Petroleum Geologists n.d.). The heavy, clayey prairie soils are not easily permeated and are droughty in nature. The Gulf Prairies and Marshes zone is a typically medium-to-tall-grass prairie composed of such perennial grasses as tanglehead (*Heteropogon contortus*), Indiangrass (*Sorghastrum elliotii*), big bluestem (*Andropogon gerardii*), and *Trichloris pluriflora*, which occupy the well-drained areas; short grasses such as buffalo grass (*Buchloe dactyloides*), 3-awn (*Aristida roemeriana*), and silver bluestem (*Andropogon saccharoides*) occupy the poorly drained clays (Jones 1975; Gould 1975).

In the vicinity of the Aransas National Wildlife Refuge (Figure 2) the topography of the Beaumont Formation has been altered by coastal geological pro-

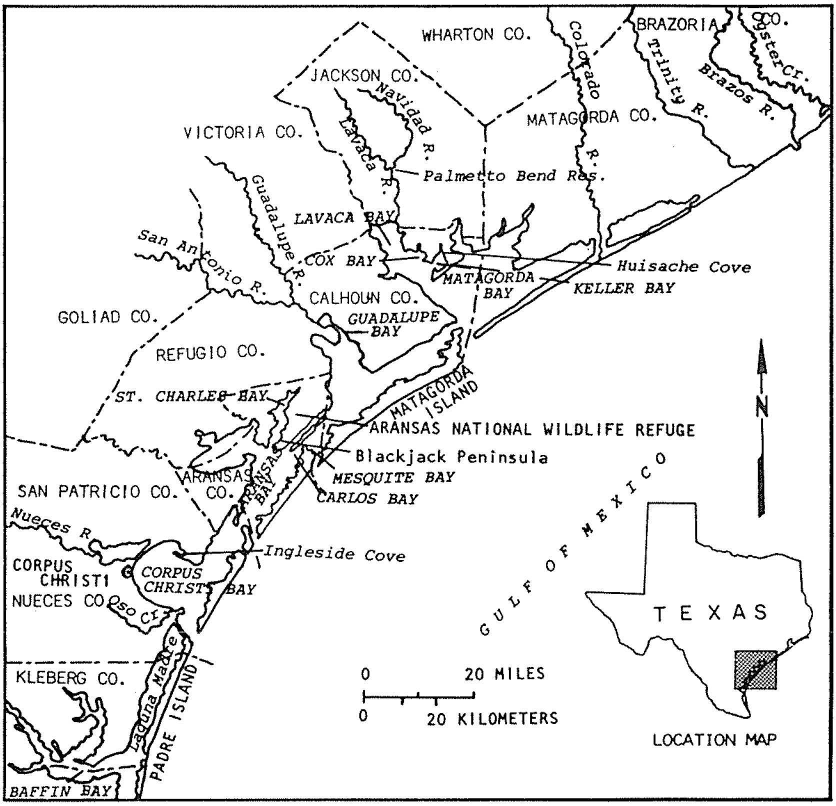

Figure 2. Map of part of the Coastal Bend region of Texas. Base map from U.S. Army Map Service 1:250,000; Bay City, Beeville, Corpus Christi, Houston, Seguin.

cesses. A 5-to-13-km-wide (3-to-8-mile) strip of deep sand runs the length of the Coastal Bend (LeBlanc and Hodgson 1959). This sandy strip, termed the Live Oak Ridge or Barrier in the Aransas National Wildlife Refuge area, is a Pleistocene barrier island that was formed 100 to 120 thousand years ago (Shepard and Moore 1955). In the vicinity of the Wildlife Refuge, the Live Oak Barrier, which includes the Blackjack Peninsula, is paralleled on the landward side by an ancient filled lagoon termed Ingleside Lagoon by Price (1947). On the seaward side, Blackjack Peninsula is flanked by two lagoonal bays, Mesquite and Carlos; a bay of both riverine and lagoonal origin, Aransas; and by a Holocene barrier island, Matagorda (Figure 2). Spectacular shell ridges, which support thick woody growth, have been formed along the edge of the peninsula facing these bays. Unfortunately, some of this interesting area has been mined for shell road-building materials.

The topographic manifestations of these geological features are low, sometimes wooded, sandy ridges alternating with swaley areas on the seaward side, and the ancient filled lagoon (still occupied in part by St. Charles Bay) on the landward side. The deep sands support a woody growth of sweet bay (*Persea* *borbonia*) and oaks such as *Quercus minina, Quercus fusiformis,* laurel oak (*Quercus hemisphaerica*), live oak (*Quercus virginiana*), and blackjack oak (*Quercus marylandica*) from which Blackjack Peninsula gets its name. Due to the sandy, well-drained nature of the soil and the calcareous nature of the shell ridges, other woody plants in the area are quite reminiscent of the South Texas and northern Mexico shrublands. These plants include Mexican buckeye (*Ungnadia speciosa*), granjeno (*Celtis pallida*), guayacan (*Forestieria angustifolia*), prickly ash (*Xanthoxylum clava-herculis*), and the lilly *Yucca treculeana*.

The swaley areas between the wooded ridges are covered with a dense growth of cordgrass (*Spartina spartinae*), gulfdune paspalum (*Paspalum monostachyum*), and seashore paspalum (*Paspalum vaginatum*). Other poorly drained soils near the bays are covered with such salt resistant plants as purslane (*Sesuvium portulacastrum*), salt heliotrope (*Heliotropum curassavicum*), seashore saltgrass (*Distichlis spicata*), smooth cordgrass (*Spartina alterniflora*), and shoregrass (*Monanthocloe littoralis*).

Migratory birds are perhaps the most spectacular aspect of the fauna, as the area is on a major North American flyway and is the winter home of the whooping crane (*Grus americana*). Land mammals occupying the area include pocket gophers (*Cratogeomys castanops*), cotton rat (*Sigmodon hispidus*) and wood rat (*Neotoma floridana*), cottontails (*Sylvilagus floridanus*), swamp rabbits (*Sylvilagus aquaticus*), white-tailed deer (*Odocoileus virginianus*), bobcats (*Lynx rufus*), and even black bear (*Ursus americanus*) as recently as early historic times.

The shallow bays and flats provide shelter for abundant marine life such as blue crab (*Callinectes sapidus*), brown shrimp (*Crago vulgaris*), speckled trout (*Cynoscion nebulosus*), redfish (*Sciaenops ocellata*), drum (*Pogonias cromis*), croaker (*Micropogon undulatus*), and mullet (*Mugil cephalus*), and also have extensive oyster (*Crassostrea virginica*) reefs, all of which could have been exploited by aborigines (Hedgepeth 1953). Except for the lack of a riverine environment, the area should have been an excellent foraging ground for prehistoric inhabitants. However, from the standpoint of the survey archeologist, the physiography and vegetation present many difficulties. The stable sands are covered with vegetation, which in most areas is quite thick, severely limiting visibility at ground level. In those areas of shifting sands—all those not covered with vegetation—wind action greatly alters the ground surface, both covering and destroying sites. In addition, oyster shells have been used extensively for road building, and, as a result of fires, which are common in the area, the ground in many places is covered with flecks of charcoal. The widespread charcoal and oyster shell complicate recognition of sites in this region because charcoal and oyster shell are abundant in the sites and artifacts are scarce.

HISTORY OF ARCHEOLOGICAL WORK

A brief history of the archeological work in the Coastal Bend of Texas points out several regional problems. Some of the information provided in syntheses of the area (Suhm, Krieger, and Jelks 1954; Campbell 1960; Mallouf, Fox, and Briggs 1973) is pertinent to the development of awareness of the cultural diversity in the region.

The first significant attempt to document the archeological remains in the Coastal Bend area was made by two avocational archeologists, George C. Martin and Wendell H. Potter, in the late 1920s and early 1930s (Martin n.d., 1929, 1930a, 1930b, 1931; Potter 1930). These two men recorded sites between Baffin and Matagorda bays and provided the beginning of scientific inquiry into this part of Texas. Although they failed to grasp the evolutionary significance of their own test excavations (they attributed virtually all materials to the Karankawa Indians), the fact that they were first was not the only contribution they made. Information provided by them, particularly from their test excavations at the Johnson (Campbell 1947) and Kent-Crane (Campbell 1952) sites was used to guide the Works Progress Administration (WPA) archeological field work in the Coastal Bend region and laid the groundwork for a sound body of data for the establishment of a cultural sequence. Their findings were also used by Sayles (1935) as a basis for the first synthesis of the archeological assemblages along the Texas coast. Sayles had conducted a reconnaissance of Texas for Gila Pueblo, and, considering the time period, his contribution, "Archaeological Survey of Texas," was remarkable, for he was the first to recognize that the coastal sites covered considerable time spans. Sayles defined two phases, the Oso and Rockport, as part of what he called the Karankawan pattern; his Rockport phase survives, albeit in modified form, to this day, but the Oso phase has not stood the test of time.

Campbell's analysis of materials recovered from excavations at the Johnson and Kent-Crane sites provided the first definition of the Aransas focus (Campbell 1947, 1952). He also analyzed materials from a number of other sites, including sites on five islands in Laguna Madre (Campbell 1956) which provided substantiation of the Rockport focus concept. His synthesis of the archeology along the central and southern Gulf Coast of Texas raised specific questions to aid in guiding future work. Campbell's synthesis, while dated now, is still a major contribution on Texas coastal archeology. Other significant contributions by Campbell (1962, 1964) include his hypotheses on the origin of Rockport wares and a survey of Padre Island(1964), which indicates the degree to which the late prehistoric population utilized this barrier island environment.

Corbin (1963) reported on the results of a prolonged survey in the Coastal Bend. This report is important because several of the sites that Corbin described no longer exist and because it was on the basis of Corbin's recommendations that Story (1968) conducted test excavations at the Ingleside Cove site. Story's work provided a significant body of data on the chronology and human ecology of these prehistoric coastal adaptations. In fact, Story's investigations at the Ingleside Cove and Anaqua sites mark an important shift in the theoretical orientation of coastal archeology. Her investigations had a strong bent toward the ecological approach while at the same time providing excellent and detailed descriptions of the cultural materials recovered from these sites.

Some of the more informative surveys were those of Fritz (1972, 1975) in the Matagorda Bay area. In 1972 Fritz conducted a pilot survey of Cox Bay and Huisache Cove in Calhoun County. This work, conducted under the auspices of the Texas General Land Office, and part of a multi-disciplinary Matagorda Bay-Estuarine Resource Management Study, was followed by a more intensive inspection of six "target areas" extending from the eastern end of Matagorda Island to the eastern end of Matagorda Bay, including sections of the Navidad Delta, Lavaca, Cox, and Keller bays. The 94 archeological sites recorded during these surveys added appreciably to our knowledge of types, distribution, and condition of sites, and of the spatial distribution of ceramic and lithic artifacts. The objectives of the survey were "to provide a general evaluation of Matagorda Bay's archeological resources and to determine as fully as possible, using the limited methods of surficial survey, the potentials of the sites for yielding information concerning the area's paleoenvironment" (Fritz 1975:1,2). (Certain data provided by Fritz will be mentioned later.)

Studies along the coast also provided information on the spatial distribution of some important classes of archeological data. Campbell's (1956) analysis of materials from five islands in the Laguna Madre and Hester's (1969) survey in Kenedy and Kleberg counties south of Corpus Christi provided information on the southern extent of the distribution of Rockport assemblage materials. Hester also published descriptions of the artifacts collected in 1941 by G. C. Arnold, of the University of Texas. Corbin and Hester conducted limited test excavations at the Kirchmeyer site, a clay dune site on Oso Creek. Although this work remains largely unpublished, data on some materials collected from the site by C. A. Calhoun, Corbin, and Hester were incorporated into a study of blade technology in Rockport assemblages on the central and southern coast of Texas (Hester and Shafer 1969).

The Palmetto Bend Reservoir district in Jackson County along the lower Lavaca and Navidad rivers can be considered inland coastal and has received much attention in the past decade. The initial Palmetto Bend Reservoir survey was made by Wakefield (1968) and resulted in the recording of 22 archeological sites. A more intensive survey and limited testing of this reservoir impoundment area was conducted by the Texas Historical Survey Committee (Mallouf, Fox, and Briggs 1973) and an additional 62 sites were added to the inventory. The first mitigation phase of the Palmetto Bend salvage work was carried out in 1974 by the Texas Archeological Survey (McGuff et al. 1978). Five sites were excavated, and data derived from this work have provided a clearer picture of the culture history of the lower Navidad watershed. However, the authors of this latter report departed from the standard terminology used by previous archeologists in the Palmetto Bend area and the Coastal Bend region, so it is difficult to compare their findings with those of Mallouf et al., Fritz, and Story.

Dering and Ayers (1977) report on archeological work at small shell-midden localities along Oyster Creek in Brazoria County. In this study, Dering critically reviewed the various approaches to analysis of shell middens around the world in an effort to establish an appropriate avenue for study of these sites in Texas. Dering observed that research on shell midden economies has produced a composite of theoretical approaches that can be applied to shell middens on the Texas coast.

> Only when the results of a Texas midden analysis are placed in the framework of a clearly stated theory which considers the annual economy of a prehistoric group will the results be placed into the proper perspective. One of the striking accomplishments of Clark's (1954) work at Starr Carr was the visibility of each move that was made in establishing a relationship between the archeological remains and the prehistoric population level. Each step was testable; no intuitive leaps from archeological remains to population size or subsistence patterns were made. As a result, even though modifications of the theory were necessary, the Starr Carr study still

stands as a beautiful example of a scientific approach to prehistoric economy [Dering and Ayers 1977:16].

Dering also noted that data from previous excavations in Texas shell middens were not fitted into a framework of concise testable hypotheses. Shell middens offer a unique opportunity to get reliable quantitative information on prehistoric coastal economy. Several authors have expressed alarm at the rapidity of destruction of these sites from natural and cultural causes. Dering and Ayers have demonstrated the validity of an economic approach to shell midden analysis patterned after Clark's (1954) classic study. They were able to demonstrate the transient nature of the occupants of the Oyster Creek shell midden and to point out that despite the predominance of *Rangia* shells, qualitative analysis of the biomass of the *Rangia* meat showed that shellfish amounted to only a minor part of the diet of the small band who occupied the site. They also cautioned archeologists to consider the economy of individual sites in the context of the total annual economy of the prehistoric inhabitants of coastal zones.

CULTURE HISTORY

When Suhm, Krieger, and Jelks (1954) provided a framework for ordering the archeological materials in Texas, they employed the then-popular stage concept. These stages, Paleo-American, Archaic, Neo-American, and Historic, were based generally on assumed economic patterns. Texas archeologists continue to view culture history in this four-stage sequence, but, although those concepts initially provided a beginning, continued reliance on them has resulted in a series of somewhat rigid assumptions. The validity of these concepts needs to be thoroughly examined.

We assume that all of the prehistoric populations who inhabited the Coastal Bend region were foragers, or hunters and gatherers, if we have interpreted the material remains correctly; however, this should not be taken as proven because there is much we do not know about the inland adaptations.

One locality, the Buckner Ranch site reported by Sellards (1940), has yielded artifacts in context with extinct faunal remains, and, although there is some question about the stratigraphic associations, the early date of the Buckner Ranch materials cannot be denied. The presence of similar early (what some would term Paleo-American) materials along Oso and Petronila creeks in Nueces County (Patterson and Ford 1974) demonstrates that assemblages dating back about 7,000 to 9,000 years do occur in the inland coastal area.

Very little is known of the foraging adaptations from about 7000 to 3000 B.P. Many archeologists have assumed that the so-called Archaic populations were composed of fluid bands of nomadic or seminomadic foragers, but recent findings at the Ernest Witte site (Hall 1981), a reevaluation of the Morhiss site material, and the excavation by the Texas Department of Public Transportation (C. Johnson, personal communication, n.d.) of a large cemetery site, 41LK28, in Live Oak County, northwest of Corpus Christi, illustrate our lack of understanding about the sociocultural systems of the Archaic adaptations in the inlands bordering the coast. The Ernest Witte and Morhiss sites were largely cemetery localities, each containing several hundred interments. Artifact associations with the earlier series of burials at these sites hint at a socioeconomic structure reminiscent of, and possibly linked to, the eastern Archaic. The cultural systems involved in the Morhiss culture complex undoubtedly affected or perhaps even incorporated the early Aransas culture. It is indeed unfortunate that the Morhiss data have never been analyzed and published, because Morhiss is perhaps the single most important site in this part of the coastal inlands.

As noted earlier, Campbell's (1947) analysis of the Johnson site data provide the basis for defining the Aransas focus, an assemblage of hunting and gathering populations who did not use pottery, but had shell, bone, and stone tools. Campbell notes that Aransas focus sites occur on the shores of bays but not along the open Gulf sides of the offshore islands. No definite traces of house remains were found at the Johnson site, but circular pavements of shells about 1.5 meters in diameter may have served as floors for structures surrounding the midden proper. Burials were infrequent but occurred in both flexed and extended positions with no surviving grave goods. Campbell notes that these people made extensive use of materials from the coastal environment. Conch shell was used for hammers, adzes, gouges, scrapers, awls, ornaments, and possibly containers; clam shells were found chipped along an edge, perhaps as a result of their use as knives and scrapers. (Also see Steele and Mokry 1985 for aboriginal uses of shell along the central coast of Texas.) Bone was used extensively for awls, beads, and other tools. Except for sandstone concretions, stone does not occur along the outer coastal zone.

Campbell suggests a minimum date for Aransas focus material of A.D. 1500, since no European goods have been recovered from the Archaic levels. Although he originally limited the extent of the Aransas focus to the area from Guadalupe Bay to Corpus Christi Bay, Corbin (1974) notes that it has been extended to include materials from the Colorado River to Baffin Bay and argues that, with this geographic extension and the inclusion of the Kent-Crane materials, the concept of the Aransas focus has been, in his words, destroyed. Corbin, reevaluating the Kent-Crane and Johnson site materials and incorporating materials from other sites, including the Ingleside Cove site, was able to demonstrate through seriation an evolutionary change in the projectile point forms dating from about 3000 B.C. to A.D. 1200. Palmillas and Bulverde-like forms clustered in the lower levels of both sites; Ensor and Catan forms were late. Also, he notes that conch columella gouges and conch adzes were common in the lower zones of Kent-Crane, but only a few occurred in the lower levels of the Johnson site. Corbin observes differences in the geographic occurrence of certain dart point forms as well; south of a line formed by the Nueces River and Corpus Christi Bay, stemless dart points predominate in the Archaic assemblages, whereas north of that line stemmed forms predominate. These temporal and spatial differences were sufficient to convince Corbin that the Aransas focus, as it was currently used, masked the real keys to cultural change archeologists were looking for. He (Corbin 1974:37) suggests either (1) restricting the term to the most recent archeological manifestations of Archaic cultural adaptations to coastal environments or (2) rejecting the concept of an Aransas focus but applying the term Aransas complex to Archaic cultural adaptations to the coastal environment.

Corbin similarly demonstrated the complexity of the Rockport focus when he critically analyzed and synthesized data associated with the ceramic period (Corbin 1974). Rockport focus materials stratigraphically overlie the Aransas materials. Sayles originally proposed the name Rockport for ceramic assemblages along the entire Texas coast, but Suhm, Krieger, and Jelks (1954) reduced the geographic extent from Baffin Bay to the Colorado River. Like the preceding Aransas focus, the entire ceramic period along the Coastal Bend region was lumped under one heading and therefore was masking whatever temporal or spatial differences that might exist. Before Story (1968) excavated the Anaqua site, all of the coastal pottery was thought to belong to the Rockport series. However, Story found a discrete cultural deposit yielding Scallorn arrow points and sandy-paste pottery similar to the Galveston Bay ceramics. Campbell (1962) has theorized that the origin of Rockport ware was to the east in the Galveston Bay area, and recent explorations in the Trinity River delta have shown that the origin of the Southeast Texas sandy-paste and Galveston Bay wares was the Tchefuncte culture in the lower Mississippi Valley. Corbin, in his examination of the data on temporal changes within the Coastal Bend ceramic period, has convincingly shown that there are changes in projectile point form, with Scallorn appearing before Perdiz. Corbin, together with Story, has suggested that Campbell's thesis regarding the origin of Rockport ware is correct, and it is supported by the temporal data. Corbin also points out parallels between Rockport Incised motifs and motifs found in the Galveston Bay area.

Based on findings at the Anaqua site (Story 1968), Fritz's surveys of Matagorda Bay (Fritz 1975), and Corbin's seriation (1974), the post-Archaic sequence appears to be as follows. From Lavaca Bay eastward perhaps to the Colorado River, the earliest ceramics are a sandy-paste ware associated with Scallorn arrow points. Through time, perhaps no more than two centuries, the ceramics evolved into what we now call the Rockport series, with asphalt painting appearing on some vessels. These ceramics spread southward, eventually reaching the Baffin Bay area. The predominant arrow point types are Perdiz, with a few bulbar-stemmed triangular forms continuing. It is interesting to observe that shell tools are virtually absent in the post-Archaic assemblages. Certain sites yielding Rockport series pottery and mostly Perdiz arrow points also contained glass arrow points and glass beads, artifacts indicative of the Spanish Colonial period. Certainly these associations are convincing enough to tie the materials of the waning Rockport to historic times, or at least to A.D. 1550. A third ware, Goliad, is sometimes associated with these late Rockport sites (Campbell 1962).

ARCHEOLOGICAL RESOURCES IN THE COASTAL BEND REGION

From findings of the archeological surveys of Martin (n.d., 1929), Potter (1930), Corbin (1963), and Fritz (1972, 1975), and of excavations by Campbell at the Johnson (1947), Kent-Crane (1952), and Live Oak Point (1958) sites, the predominant archeological sites to be expected in the central coastal area of Texas are shell middens, lithic scatters, bone and ceramic concentrations, and cemeteries. Fritz (1975:142, 143) lists nine descriptive categories of sites based on appearance and content ranging from large and small shell middens to artifact scatters or artifact concentrations with no shell. The variability in site type may be due to temporal or functional differences or both. Variability may also simply reflect the condition of sites that were modified in prehistoric or modern times.

Shell middens, however, once constituted the dominant resources in the region. At excavated shell midden sites such as Johnson and Kent-Crane, the matrix was shell and dark soil. They contained bone refuse, lithic items, shell tools, ceramics (in the upper levels, which were devoid of shell tools), and occasional flexed or extended burials. The most common shells at Johnson were principally oyster, conch, scallop, and moon shell, with oyster predominating (Campbell 1947:45). Interestingly, conch was the predominant shell mentioned at the Kent-Crane site. Fritz (1975) has provided an important set of data on the spatial distribution of certain economic species of invertebrates. She noted a transition from middens dominated by *Rangia cuneata* in the northeastern part of Matagorda Bay to middens dominated by oysters (*Crossostrea* sp. and *Ostrea* sp.) in the southwestern part. In addition to the north-south transition zone, the composition of middens varied according to their positions in relation to the salinity gradients of the estuaries. Oyster middens were found in primary, secondary, and tertiary bays, and in stream channels near where they joined these bays. *Rangia* middens were found on the shores of brackish freshwater lakes and from a few hundred meters to a few kilometers up freshwater streams.

As suggested by the Ingleside Cove data, the occurrence of conch (*Busycon*) at archeological sites tends to increase southward from Matagorda Bay. Conch is frequent in the early component at Kent-Crane and other sites (Corbin 1974:37). Its presence at the Johnson site and in the lower levels of the Ingleside Cove site (among others) does not necessarily mean that it was a primary food source. As Story (1968) notes, the larger conch shells, those most frequently selected as raw material, are also often inhabited by hermit crabs. Collecting conch shells may have been an expedient way to collect these crustaceans.

Campbell (1947) may have provided the first tangible data on the structure of the Coastal Bend settlements themselves in the finding of small circular deposits of shell around the midden at the Johnson site. These circular features averaged about 1.5 meters in diameter and were found as far as 250 meters from the midden. More recently, similar findings have been documented at the Dow-Cleaver site (Ted Hollingsworth, personal communication, n.d.). Martin (1929) interpreted these phenomena as the shell debris floors of some kind of temporary shelters; Campbell (1947) tends to support this view. These features bring to mind a description of a historic Atakapan settlement in southwestern Louisiana which notes that the shell midden was reserved for the headman's house while the other families camped in the vicinity, and that in the other huts "fireplaces" were of oyster shells (Newcomb 1961:325). Dering and Ayers (1977) report several similar small shell features, but warn against attaching a particular function to them.

Lithic items such as projectile points, awls, other biface tools, flake and uniface tools, and core and flake debitage occur in the sites, but, as several researchers have pointed out, there are no flint deposits along the coast. This absence of local flint was noted by Cabeza de Vaca, who recalled that the Copoques (probably located in the area of what is now Velasco Peninsula in 1528–1533), traded cockles and other seashells to inland tribes for flint, glue, hard cane, and tassels of deer hair (Bandelier 1905).

An examination by the senior author of the lithic artifacts from the Aransas and Rockport collections at the Texas Archeological Research Laboratory of The University of Texas at Austin suggests that different approaches were used to reduce the pebble-sized and small-cobble-sized flint nodules. The predominant method of the Aransas flint knappers was the bifacing or random flaking of nodules, and some bipolar flaking. The Rockport flint knappers, on the other hand, tended to prepare a platform and remove a series of flake blades from the nodules, thus maximizing the amount of cutting edge obtained from the imported resource and producing elongated flakes that were easily transformed into long Perdiz points, triangular arrow points, and other tools (Hester and Shafer 1969). The Rockport knappers also engaged in random core reduction, but their knowledge of blade technology is notable. These differences between the reduction strategies of the Aransas and Rockport knappers undoubtedly were influenced by the end products desired, but they could also be indicative of differences through time in social relations with inland groups. Whatever the reasons are for these differences, thorough analysis of debitage collections may bring to light important temporal and technological differences not indicated by other remains.

The ceramic wares from the Coastal Bend area fall into three basic categories: the thin, sandy-paste Rockport ware, including Rockport Black-on-Gray, Rockport Incised, and Rockport Plain (Campbell 1962), the sand-and-bone-tempered Goliad Ware, including Goliad Plain, Goliad Red-on-Bluff, and Goliad Black-on-Bluff (Campbell 1962), and a thick, sandy-paste and grog-tempered ware related to the Galveston Bay series of ceramic types. As noted earlier, the first example of this ware in the Coastal Bend area was reported by Story (1968). Story's findings have been substantiated by Fritz's survey and indeed Fritz's (1975:106) observations are pertinent to research problems in the study area:

> Sherds collected during the Matagorda Bay survey provide interesting data for interpretations of coastal prehistory. First, the presence of unmistakable Goose Creek and San Jacinto pottery in Matagorda County extends the western limit of these traits associated with the Galveston Bay Focus almost as far west as the Colorado River. Second, the presence of two distinct ceramic traditions—Rockport ware in Calhoun County and Goose Creek-San Jacinto ware in eastern Matagorda County—raises interesting questions concerning territorial ranges of and cultural variation among groups of coastal Indians. Third, the existence of non Rockport pottery as well as Rockport pottery along the Lavaca River in Jackson County suggests a previously undefined ceramic technology which either predates or coexists with the manufacture of Rockport ware in the inland reaches of the western portion of Matagorda Bay study area [Fritz 1975:106].

The vessel forms are predominantly bowls and jars. A question that to our knowledge has never been raised regarding the function of ceramics along the coast is why these seminomadic foragers used pottery at all. Particularly obvious to any viewer of these coastal wares is the coarse, fragile nature of the sandy paste. Transporting the pottery overland would be a tenuous endeavor and would likely yield a cluster of sherds somewhere along the journey. Our contention is that the pottery was made more functional in this nomadic setting as a result of canoe transportation. Pottery would have been a more versatile container when safely stored in the hold of a canoe. Canoes were used extensively by historic groups all along the Texas coast and presumably their use extended into prehistory.

Dering and Ayers (1977) have appropriately cautioned that studies of shell middens alone will not provide sufficient data to predict the annual economy of the foragers who inhabited the Texas coast, but careful examination of the size, volume, and content of shell middens, as Dering has demonstrated, can provide a valuable body of data that will support predictions regardless of the economic patterns on a site level. Aten (1977) has provided the tools for determining the seasonality of harvest of certain species of *Rangia cuneata*. We hope that similar predictive tools can be established for other species as well.

DISCUSSION

Past work has indicated that the sites in the Coastal Bend of Texas are the results of repeated use of specific localities such as low bluffs, bluff remnants, river levees, and ancient beach ridges. The human ecology of the prehistoric populations, perhaps dating back to about 2000 to 3000 B.C., was closely tied to the ecological dynamics of the coastal zone. Changes recognized in the temporal distribution of certain shell species such as conch, which appears early in the coastal sequence but tends to drop out rather abruptly as a resource for tools (and less so as a possible food resource), may represent not so much a shift in cultural preference as a continual alteration in the geomorphology of the coast itself, where Holocene silting constantly alters the depth and therefore the ecology of the bays and estuaries.

The absence of early Archaic (pre-3000 B.C.) materials along the bays and estuaries is largely due to late Holocene changes along the coast, and we suspect that, on drowned landforms of the continental shelf, shell middens occur earlier than those we have mentioned here. Despite the claim that the present sea level was reached about 5,000 years ago, modifications of the shoreline and evolution of the geomorphic features continue. These natural processes, which are still destroying sites occupied by prehistoric populations, are also removing important sources of data that would be useful for documenting the history of the current coastal setting. We believe the aboriginal populations had to adapt to a constantly though perhaps subtly changing environment. Assuming a systemic relation between culture and environment, the changes in the cultural history of the Coastal Bend can be explained in three ways: (1) a shift in the local ecology to the extent that exploitation of some species was no longer economically feasible; (2) a shift in culture preference due to sociocultural stimuli; or (3) a shift in human population.

As Dering and Ayers have noted (1977), it is doubtful that the prehistoric foragers of the Coastal Bend could have lived along the coast the year around. Inland resources were needed, and the groups either practiced a kind of transhumance or established social relations that helped them in acquiring the inland resources. Cabeza de Vaca described just such nomadism in some coastal groups.

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Archeological Investigations of Seven Prehistoric Sites along Oso Creek, Nueces County, Texas

D. Gentry Steele and E. R. Mokry, Jr.

ABSTRACT

The survey and examination of surface collections from seven prehistoric archeological sites has yielded further information concerning the Aransas and Rockport assemblages from the Corpus Christi Bay area. In addition, faunal material has provided a more complete picture of how early inhabitants of the region surrounding Corpus Christi Bay used a wide range of natural resources garnered from marine, riverine, and coastal-prairie habitats.

INTRODUCTION

Prehistoric archeological sites around Corpus Christi Bay and smaller bays emptying into it contain archeological assemblages previously assignable to either the Archaic Aransas focus or the Late Prehistoric Rockport focus (Campbell 1947, 1952, 1956, 1958, 1960). The purpose of this paper is to expand upon our knowledge of man's past exploitation of this part of the Texas coast by reporting the results of a survey of seven prehistoric archeological sites along Oso Creek, which empties through Oso Bay into Corpus Christi Bay (Figure 1). The emphasis of the report is on understanding prehistoric man's adaptation to the region and his exploitation of the available resources.

Martin (1930), the first archeologist to report on sites from the bay area, described two shell midden sites located on a peninsula at the junction of Cayo del Oso and Corpus Christi bays that contained material of both the Aransas and Rockport assemblages. The larger and more exposed of these sites was remarkable in both the large number of human remains that were eroding from the site and the large size of the shell midden. However, the artifacts were minimally described in Martin's report, and the only reports of the skeletal material were those of Woodbury and Woodbury (1935), and Woodbury (1937).

The next report on sites near Corpus Christi Bay was Campbell's (1956) description of five sites from nearby Laguna Madre. One of the five sites, the Indian Island site, was assigned to the Rockport phase; the material from the four other sites appeared to come from both Archaic and Late Prehistoric occupations. Like Martin's, Campbell's report on the Laguna Madre sites provided some documentation of the maritime orientation of the inhabitants of the area, but it was mainly concerned with defining the cultural complexes and their spatial dis-

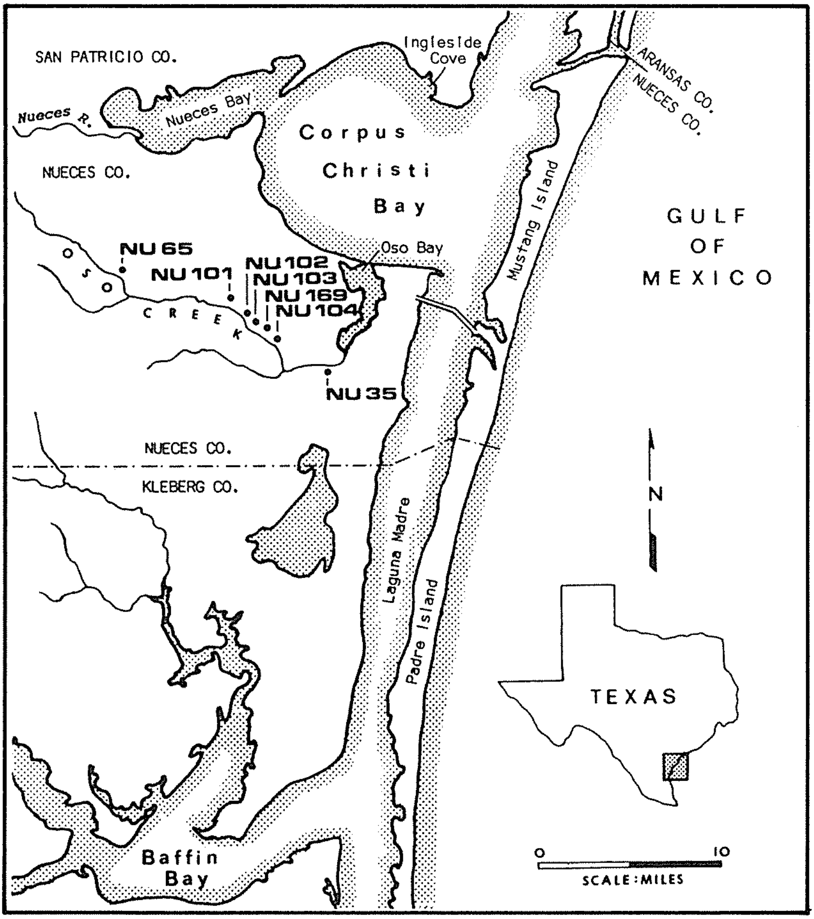

Figure 1. Map of the Coastal Bend of Texas, indicating the location of Corpus Christi and Oso bays and the sites.

tributions. Corbin's report (1963) on archeological materials from the northern shore of Corpus Christi Bay had a similar orientation and, like Campbell's work, helped to clarify the manner of utilization of the bay environment by prehistoric populations.

Story's report (1968) on a site at Ingleside Cove, an eastward extension of Corpus Christi Bay, is the most recent and the most extensive report on a prehistoric site from the Corpus Christi Bay area. It is particularly significant because it is the first to make a determined attempt to analyze the ecological adaptations of the inhabitants to the site. The ecological orientation of Story's report marks the beginning of a trend among archeologists to try to understand man's adaptation to coastal environments. Among Texas archeologists, for instance, Hester and Hill (1975) stated a similar interest in this research problem for the southern part of Texas, and Aten (1979) pursued this interest while examining sites along the upper coast of Texas. Campbell (1960), Corbin (1974), and Hester (1980) have summarized the archeology of other sites in the area, Hester and Corbin (1975) have reported on burials from Ingleside Cove, and Mokry (1980) has described shell artifacts from sites along Oso Bay and Oso Creek.

The major difficulty in furthering our understanding of man's past utilization of the Corpus Christi Bay environment is the incredibly rapid rate at which sites are being destroyed. Both Campbell (1960:150) and Corbin (1963:27) have drawn attention to this, but the history of one of the sites along Oso Bay, as reported by Martin (1930), most aptly dramatizes the tragic loss of archeological information that is occurring in that area. On a peninsula at the junction of Oso and Corpus Christi bays was a site estimated by Martin to be about one kilometer (0.5 mile) in diameter, covering the entire tip of the peninsula. During the 1860s the site was covered by brush, and no artifacts had been noticed there by John B. Dunn, who worked the land at the time. Subsequently, the site was cleared of brush and the soil began to erode, exposing abundant human skeletal remains. The erosion was accelerated around 1900 by a storm that, according to Martin Pearse, who then owned the land, exposed a large number of skeletons. Destruction of the site by erosion, construction, and removal of skeletons and artifacts has continued intermittently to the present time. Martin described the site in 1929 as littered with cultural debris, structural features identified by him as tepee sites, and piles of conch shells. Today, little or nothing remains on the surface. The only reports we have concerning this important site are Martin's preliminary report (1930), two reports on the skeletal remains (Woodbury and Woodbury 1935; Woodbury 1937), and a brief discussion of the site by Hester (1980) in his text on South Texas archeology.

Because of the need to report all of the information that can be salvaged from the area surrounding Corpus Christi Bay, we present the following notes on surface collections of seven sites along Oso Creek (Figure 1). The collections consist of material recovered from intermittent surface surveys by Mokry and from one survey by Steele and Mokry in July 1980. Formal type designations for the projectile points and pottery follow Suhm and Jelks (1962) unless otherwise specified.

SITE 41NU35

Site 41NU35 extends along the southern bank of Oso Creek just upstream from where the creek widens into Oso Bay (Figure 1). Located on a low bluff above the tidal flat, the site is bounded on the north and northeast by the creek and on the west by an extensive flood plain. The northern perimeter of the buried site is being exposed now as intermittent wave action erodes the bluff. Because the surface is protected from erosion by grasses and brush, the southern boundary of the site has not been determined, but, on the basis of the limited area of exposure along the creek bank, it appears that the site is small and may have been used only periodically.

Although no diagnostic stone artifacts were collected from the site by the authors, flint debitage was seen eroding from the bank. A single Matamoros dart point belonging to a local collector is the only stone artifact from the site. Faunal remains include unidentifiable fragments of mammal bones, shells of the land snail *Rabdotus* sp., and marine shells of the taxa *Busycon perversum, Laevicardium robustum, Callista nimbosa*, and *Mercenaria campechiensis* (Table 1).

Table 1. Systematic List of Marine Molluscs Recovered from the Seven Sites (Classification follows Andrews 1977)*

Marine Molluscs	Site 41NU35	41NU65	41NU101	41NU102	41NU103	41NU104	41NU169	TOTAL
Aequipecten irradians amplicostatus (Atlantic bay scallop)		2	2					4
Busycon perversum (lightning whelk)†	1	8	3	70	16	5	9	112
Callista nimbosa (sunray Venus)	1	3	2	7	7	9	3	32
Crassostrea virginica (eastern oyster)		3	1	1	2	2	2	11
Crepidula fornicata (common Atlantic slipper shell)					1			1
Fasciolaria lilium (banded tulip)		1		2	2		1	6
Laevicardium robustum (giant Atlantic cockle)	1	1	1	1	1	1	1	7
Mercenaria campechiensis (southern quahog)	1	2	8	7	5	1	4	28
Murex pomum (apple murex)			1	1				2
Noetia ponderosa (ponderous ark)		1				1		2
Pleuroploca gigantea (Florida horse conch)			1				1	2
Polinices duplicatus (shark's eye)				3	1			4
Rangia cuneata (common rangia)		4						4
Rangia flexuosa (brown rangia)		1			1			2
Thais haemastoma floridana (Florida rock shell)							1	1

*Since the sites were not sampled in a systematic fashion, the frequencies of the species are only approximate.

†All fragments assignable to the genus *Busycon*, whether or not they could be assigned specifically to *B. perversum*, are listed under this species.

SITE 41NU65

Of the seven sites reported here, 41NU65 is the farthest upstream. Today the site, near a tributary of Oso Creek, slopes gently and is cut by several shallow gullies.

While the survey was being conducted, two areas of concentrated debris, apparently representing different occupational events, were exposed by deep plowing. One area, on the western margin of the site, measured some 20 by 30 meters, with many specimens of *Rabdotus* sp. snail shells, marine shells, lithic debitage, and dart points identified as Tortugas, Matamoros, Catan, and Ensor eroding from the surface. The second area was to the east and had a smaller scatter of *Rabdotus* sp. snail shells, marine shells, baked clay nodules, and Perdiz, Starr, and Fresno arrow points. Also found in the second area were two potsherds and a conch shell pendant.

The stone artifacts recovered from 41NU65 also include an unidentified barbed, expanding-stemmed projectile point, thick oval bifaces, laterally and distally retouched unifaces, a marginally worked blade fragment, cores with multiple flake scars and hinge fractures, and sandstone fragments with smoothed surfaces.

The two small sherds recovered from the site are of hard, compact, sandy paste with no visible temper. Both exterior and interior surfaces of the sherds are smooth and are of a uniformly light tan color. Asphaltum adheres to one face of each sherd. Sherd thickness is 4 to 5 mm.

Shell artifacts found at the site include adzes made from the body whorls of *Busycon* sp., fragments of awls made from the columellae of *Busycon* sp., a bead made from *Noetia* sp., and a fragment of concho or pendant made from the body whorl of an unidentified species of conch. The pendant apparently was circular and smoothed along the edge, with four shallow pits forming a diamond-shaped motif on its inner face. The pendant was found in the area containing the sherds.

Vertebrate remains recovered from the site include fragments of long bones of small and medium-sized mammals (such as rodents, rabbits, dogs, and deer), and fragments of a turtle carapace. Invertebrates include remains of *Rhabdotus sp., Busycon perversum, Crassostrea virginica, Laevicardium robustum, Callista nimbosa, Aequipecten irradians, Crepidula fornicata, Fasciolaria lilium, Mercenaria campechiensis, Noetia ponderosa, Rangia cuneata*, and *Rangia flexuosa* (Table 1).

SITE 41NU101

Site 41NU101 is about 150 meters inland from the north bank of Oso Creek and about 1.6 km upstream from 41NU35. Lying on an abandoned terrace, the site is bounded on the south by the flood plain, and on the east and west by deeply eroded gullies. The original site appears to have covered an area about 70 meters east to west by 30 meters north to south. Up until 1972 the site was subjected to extensive erosion, and in 1972 and 1973 to deep plowing and extensive landscaping. Because of these activities little of the site is undisturbed.

Stone artifacts recovered from the site include single specimens of Refugio, Morhiss, and Ensor dart points (Figure 2, K-M) and two undefined dart points. One is approximately 38 mm long, 18 mm wide, and 9 mm thick, lozenge shaped, with straight to slightly convex lateral edges and a base that contracts to a convex point. The second undefined point is triangular with convex lateral blade edges and a straight base. The point is 28 mm long, 15 mm wide, and 7 mm thick. Smaller arrow points recovered from the site are Perdiz (Figure 2, A-E) and Fresno (Figure 2, F-I) points. Thirteen specimens or fragments of Perdiz points were recovered; all were made from thin flakes characterized by fine workmanship with unifacial chipping along the lateral edges. Both faces were modified at distal tips, barbs, and stems. The length of the specimens ranges between 18 and 28 mm; the width, between 14 and 22 mm; the thickness, between 3 and 4 mm; and the stem length, between 5 and 11 mm. Eight specimens or fragments of Fresno points were recovered; these range between 7 and 20 mm in length, 13 and 17 mm in width, and 3 and 6 mm in thickness. In addition to these projectile points, the lithic assemblage includes one large bifacially worked flake (Figure 2, Q), three smaller unifacially worked scrapers (Figure 2, P) and one small core from which several flakes have been removed.

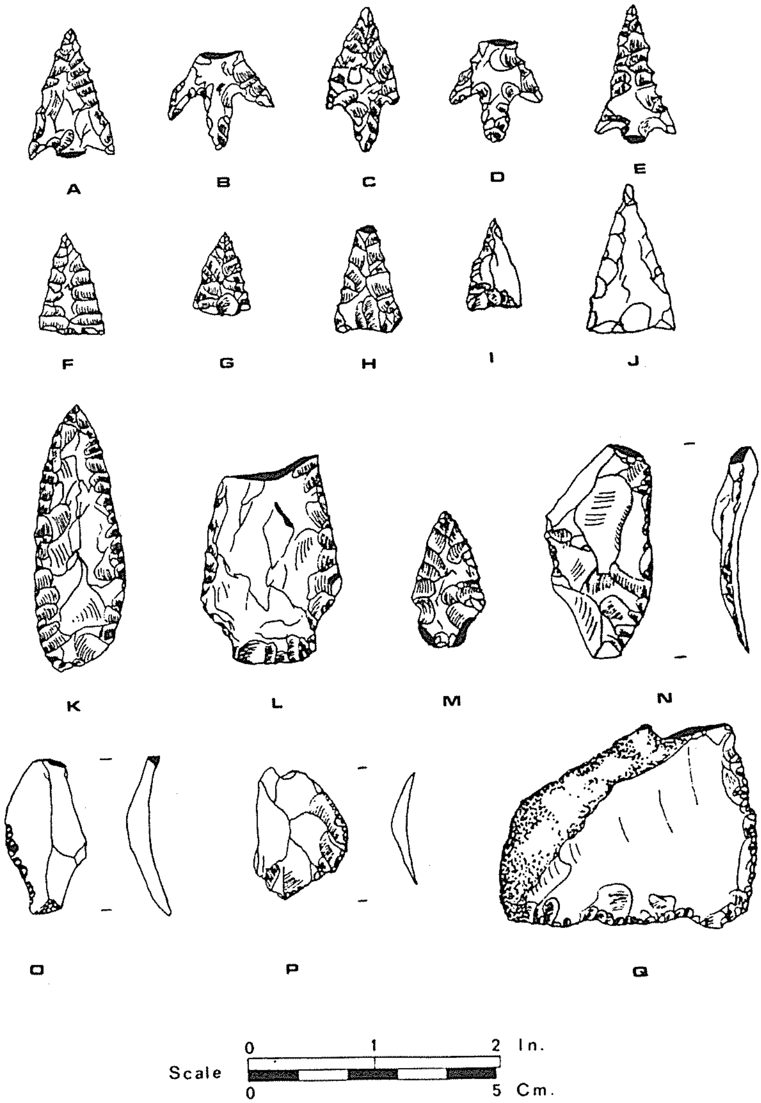

Figure 2. Drawings of selected stone artifacts from 41NU101. Classification of the projectile points follows Suhm and Jelks (1962): (A) Perdiz arrow point; (F–I) Fresno arrow points; (J) shell Fresno-like arrow point; (K) Refugio dart point; (L) Morhiss dart point; (M) Ensor dart point; (N–O) unifacial flakes; (P) unifacial side scraper; (Q) large flake with one edge worked bifacially and the other worked unifacially.

Pottery fragments recovered from the site include 13 sherds characterized by hard, compact, sandy paste with burned and unburned bone temper that is moderate to very coarse in size, with some exposed fragments measuring as much as 5 mm in length. The sherds vary in color from grayish brown to dark gray, and the surface finish is generally smooth. Sherd thickness varies from 5 to 8 mm. In addition to these fragments, a single small sherd with hard, compact, sandy paste and no visible temper was recovered. The sherd is 7 mm thick; the color varies from tan to pink, and the surfaces are smooth.

Shell artifacts are relatively common in the material recovered from the site. Two specimens that could be projectile points or blades were recovered. Both are triangular with straight lateral edges and slightly convex bases; they are 23 and 29 mm long, 10 and 18 mm wide, and 3 mm thick. The blades were probably made from *Callista nimbosa* shells, which are of a dense calcareous material with no observable microstructure. Also recovered were five adzes made from body whorls of *Busycon* sp. Triangular to irregular in outline, three of the specimens have steep, bevelled, slightly convex edges. The fourth specimen is similar in shape, but one edge is bifacially ground to a sharp edge. These adzes range between 32 and 62 mm in length, between 35 and 57 mm in width, and between 4 and 9 mm in thickness. One artifact is a gouge made from the columella of a *Pleuroploca gigantea* (Figure 3, G). Unlike other columella gouges found in the area, this specimen has an obliquely ground edge on the canal side, which forms a U-shaped bit. The specimen is 109 mm long, and the diameter of the columella is 26 mm. Five modified *Busycon* sp. shells have been recovered from the site; all are modified by having been broken, cut, or ground along the edge of the body whorl.

Two bone artifacts recovered from the site are a bone awl (Figure 5, A) made from the metapodial of a cervid (not *Odocoileus*), and the perforated canine tooth of a mammal. The tooth, possibly from *Canis* sp., has a hole in the root end that was drilled from both the lingual and labial sides of the tooth.

Faunal remains recovered from the site include bones of both small and medium-sized mammals, fragments of turtle carapace, and otoliths of *Sciaenops ocellata* and *Pogonia cromis*. Marine shells recovered from the site include *Aequipectin irradians, Busycon perversum, Callista nimbosa, Crassostrea virginica, Laevicardium robustum, Mercenaria campechiensis, Murex pomum*, and *Pleuroploca gigantea* (Table 1).

SITE 41NU102

This site is a little less than 1 km (0.5 miles) downstream, on the same (northeast) side of the creek as 41NU101, on a sloping terrace, about 40 meters from the present stream bed. Material has been recovered from the site over an area about 110 meters east to west by 85 meters north to south. Although no clearly defined features could be discerned at the site, concentrations of land snails (predominantly *Rabdotus*) and separate concentrations of baked clay nodules were found.

Stone artifacts recovered from the site include both large and small projectile points, bifaces, side scrapers, exhausted cores, and flint debitage. The majority of the 54 large dart points recovered have been identified as Matamoros. Other forms recognized include Tortugas, Catan, Ensor, and Kent, and 16 small,

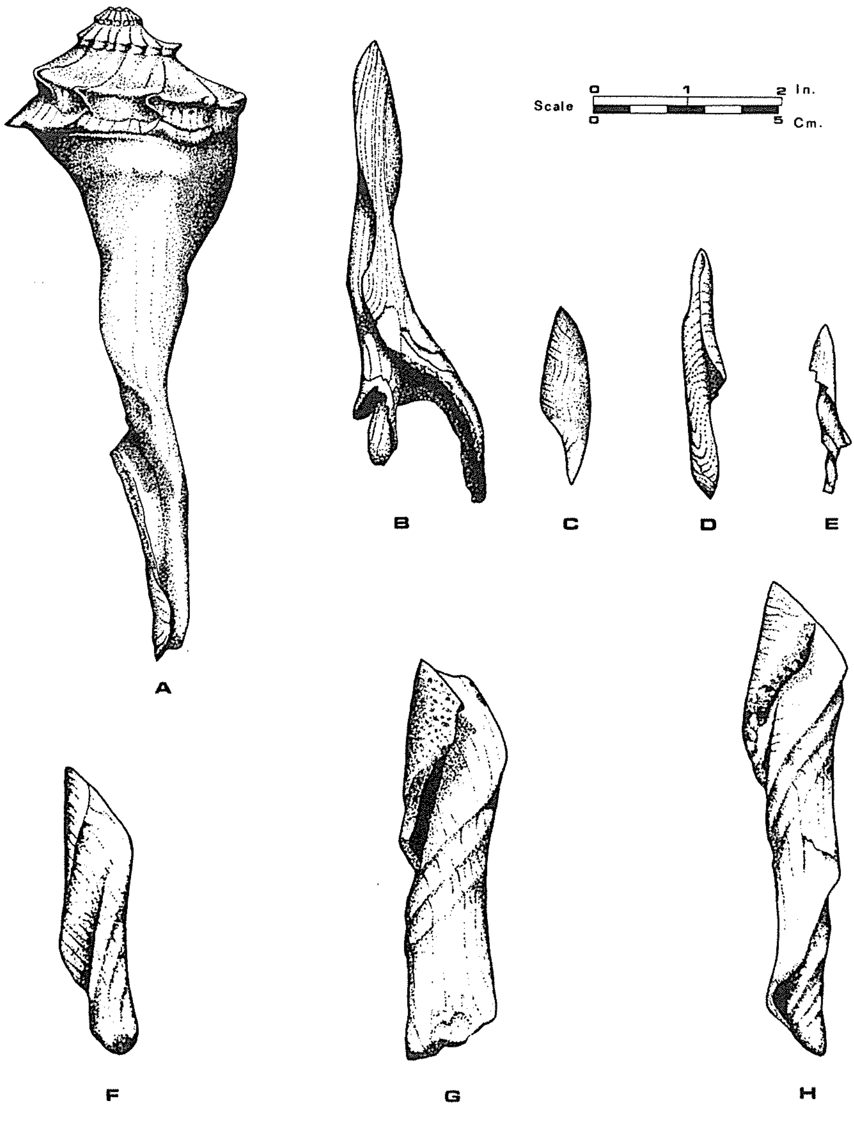

Figure 3. Drawings of selected shell artifacts made from columellae of *Busycon* and *Pleuroploca*: (A) *Busycon* hammer, from 41NU102; (B–E) awls made from the columellae of *Busycon*, (B–D) from 41NU102, (E) from 41NU169; (F–H) *Pleuroploca* gouges, (F) from 41NU103, (G) from 41NU101, (H) from 41NU159. Specimen H comes from a site not reported here.

thick dart points were found that do not conform to any defined types. The smaller arrow points include Perdiz, Fresno, and Cameron (Cameron arrow points have been described and illustrated in MacNeish 1958:74; Mallouf, Baskin, and Killen 1977:261–262; Hester 1980:104; and Highley 1980:64).

Shell artifacts recovered from the site include an adz formed from the body whorl of *Busycon*, awls and hammers made from the columellae of *Busycon* (Figure 3, A-D), and scrapers and blades made from valves of *Callista nimbosa* (Figure 4, B).

Bone artifacts recovered from the site include two deer-ulna bone awls, one cervid bone awl made from a metatarsal, and a fragmentary bone bead.

A large sample of faunal remains was recovered from this site and from site 41NU103, providing a more complete picture of the inhabitants' utilization of their resources (Table 2). Remains of the following mammal species have been recovered: *Didelphis virginiana, Odocoileus virginianus, Dicotyles tajacu, Lepus* c.f. *L. Californicus, Sylvilagus* sp. indet., *Neotoma* c.f. *N. micropus*, and *Sigmodon hispidus*. Remains of two species of snakes and of the following marine fishes have been recovered: *Arius felis, Cynoscion arenarius, Cynoscion nebulosus, Micropogan undulatus, Pogonias cromis*, and *Sciaenops ocellata*. Marine invertebrates recovered include *Busycon* sp., *Crassostrea virginica, Laevicardium robustum, Fasciolaria lilium, Callista nimbosa, Mercinaria campechiensis, Murex pomum*, and *Polinices duplicatus* (Table 1).

Two burials have been exposed at the site. The first burial, which was resting on its left side with the skull facing northwest, was exposed in a pasture road. The legs were drawn up slightly toward the chest, and the arms were drawn toward the face. The individual was an adult, but the sex was undetermined. The second burial was only partially exposed by deep plowing so the skeleton was left in situ. From an examination of the partially exposed skeleton it appeared that that individual also was buried in a flexed position. Sex and age of the individual were not determined.

SITE 41NU103

Site 41NU103 is about half a kilometer (0.25 mile) downstream from site 41NU102 and is also on the northeast side of the creek. The site is about 100 meters from the present stream bed on an old terrace of the creek overlooking the meander of a small stream that joins Oso Creek at this point. The stream is obscured by contour plowing and a stock tank. The site appeared to have covered an area about 165 meters east to west by about 75 meters north to south.

Stone artifacts recovered from the site include specimens of large Matamoros, Catan, Ensor, and Morhiss dart points. One of the Matamoros points has asphaltum adhering to the base. The smaller arrow points are fewer in number and include a single Fresno point and a short oval unclassified projectile point. In addition, the assemblage includes bifaces, side and end scrapers, and exhausted cores.

Two potsherds have been recovered at 41NU103 and are characterized by hard, compact paste with bone and shell temper. Both exteriors and interiors of the sherds are tan to gray and smooth. Sherd thicknesses are approximately 6 mm.

Bone and shell artifacts also have been recovered from the site. The bone artifacts include fragments of awls made from the ulnae of cervids (Figure 5, B),

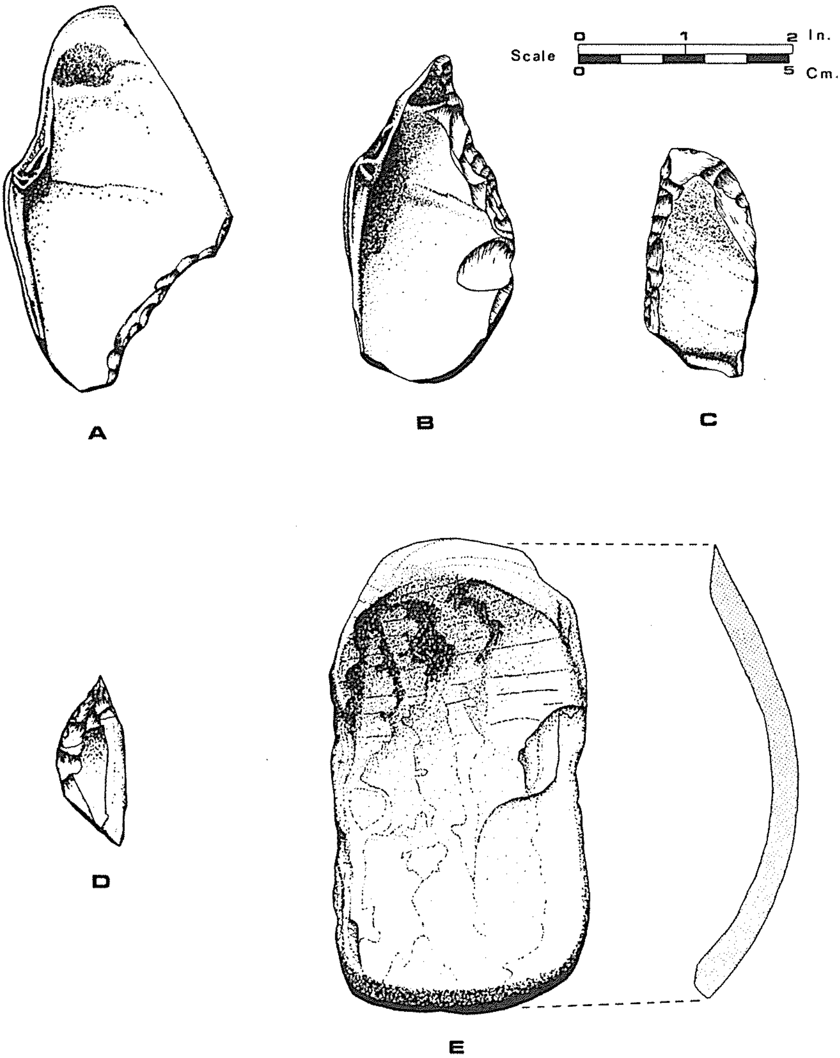

Figure 4. Drawings of selected shell artifacts made from bivalves and body-whorl fragments of *Busycon*: (A–D) shell scrapers and flakes from valves of *Callista nimbosa*, (A,C,D) from 41NU103, (B) from 41NU102; (E) adz made from body whorl of *Busycon*, from 41NU104.

Table 2. Systematic List of Vertebrates Recovered from 41NU102 and 41NU103

Vertebrates	Site 41NU102	Site 41NU103
CLASS MAMMALIA*		
Order Marsupialia		
Didelphis virginiana (opposum)	X	X
Order Artiodactyla		
Bison bison (bison)	-	X
Odocoileus virginianus (white-tailed deer)	X	X
Dicotyles tajacu (collared peccary)	X	X
Order Carnivora		
Canis sp. indet. (canid)	-	X
Order Lagomorpha		
Lepus c.f. *L. californicus* (jackrabbit)	X	X
Sylvilagus sp. indet. (cottontail rabbit)	X	X
Order Rodentia		
Geomys sp. indet. (pocket gopher)	-	X
Neotoma c.f. *N. micropus* (gray woodrat)	X	X
Perognathus c.f. *P. hispidus* (hispid pocket mouse)	-	X
Sigmodon hispidus (hispid cotton rat)	X	X
CLASS AVES†		
Order Galiformes		
c.f. *Colinus* sp. indet. (quail)	-	X
Order Gruiformes		
c.f. *Rallidae* genus indet. (marsh bird)	-	X
CLASS AMPHIBIA‡		
Order Anura		
Rana sp. indet. (true frog)	-	X
CLASS REPTILIA		
Order Chelonia		
Gopherus berlandieri (Texas tortoise)	X	X
Order Squamata		
Phrynosoma cornutum (Texas horned lizard)	-	X
Colubridae genus indet. (Colubrid snake)	X	X
Crotalus c.f. *C. atrox* (west. diamondback rattlesnake	X	X
CLASS OSTEICTHYES**		
Order Cypriniformes		
Arius felis (sea catfish)	X	X
Order Perciformes		
Cynoscion arenarius (sand seatrout)	X	X
Cynoscion nebulosus (spotted seatrout)	X	X
Micropogonias undulatus (Atlantic croaker)	X	X
Pogonias cromis (black drum)	X	X
Sciaenops ocellata (red drum)	X	X

Note: Because the skeletal material was not collected in a systematic manner and the skeletal remains were in fragmentary and incomplete condition, only the presence (X) or absence (-) of the species was recorded.

* Classification of the mammals follows Davis (1974)

† Classification of the birds follows Robbins et al. (1966).

‡ Classification of the amphibians and reptiles follows Conant (1975).

** Classification of the fish follows Robbins et al. (1980).

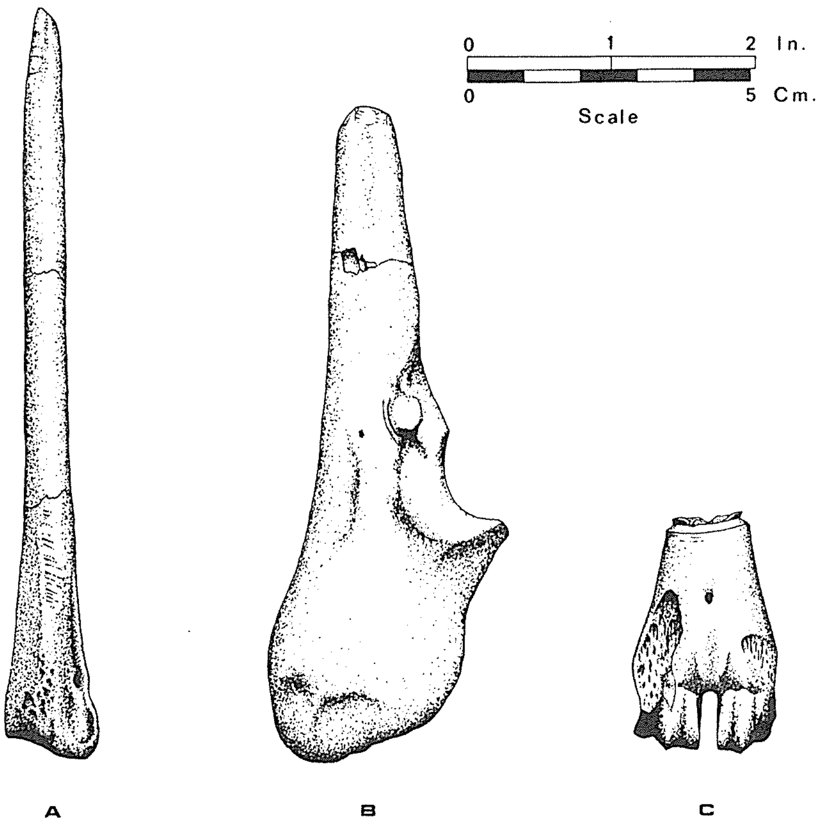

Figure 5. Drawings of selected bone artifacts from sites 41NU101 and 41NU103: (A) awl made from the metapodial of a cervid, from 41NU101; (B) awl made from the ulna of a cervid, from 41NU103; (C) distal end, cut away from the shaft, of a metapodial of a cervid.

and a singular rectangular fragment of cortical bone with incised lines on one face. Several artifacts of shell have been recovered and include adzes made from the body whorls of conchs, awls made from the columellae of *Busycon* whelks, valves of *Callista nimbosa* with flakes removed from the margins of the valves (Figure 4, A, C, D), and a single small conch columella bead.

In addition to these artifacts, many baked clay nodules and a few burned caliche nodules have been recovered. Two small bits of asphaltum have also been recovered from 41NU103.

In the course of salvaging an exposed burial site in August 1978, a 1-meter-square unit and a 2-by-5-ft. unit were excavated to sterile soil. Occupational debris was recovered to a depth of 44 cm, and all excavated material was passed through quarter-inch screen. The faunal material recovered from this limited salvage excavation, when combined with material recovered from surface surveys of the site, provided the largest faunal sample yet recovered from the seven sites. Mammalian remains recovered from the site include elements of *Didelphis virginiana, Bison bison, Odocoileus virginianus, Dicotyles tajacu, Canis* sp. indet., *Lepus* c.f. *L. californicus, Sylvilagus, Geomys, Neotoma* c.f. *N. micropus, Perognathus* c.f. *P. hispidus,* and *Sigmodon hispidus.* The remains of other terrestrial vertebrates include birds (possibly a quail and a marsh bird), *Rana* sp., *Gopherus berlandieri, Phrynosoma cornutum,* and two species of snakes. Marine fishes include *Arius felis, Cynoscion arenarius, Cynoscion nebulosus, Micropogan undulatus, Pogonias cromis,* and *Sciaenops ocellata.* Marine molluscs recovered include *Busycon perversum, Callista nimbosa, Crassostrea virginica, Crepidula fornicata, Fasciolaria lilium, Laevicardium robustum, Mercenaria campechiensis, Polinices duplicatus,* and *Rangia flexuosa* (Table 1).

During investigations of the site in August 1978 by Mokry, human skeletal elements were encountered in the west-central part of the site. Excavation and salvage of the burial was begun after it was learned that further cultivation of the site was to occur the following day. Two areas, a 1-meter square and a 2-by-5-ft. unit, were excavated in the vicinity of the surface remains of the skeleton. After removal of the underlying disturbed soil, the units were excavated in 10-cm levels until sterile deposit was reached.

The 1-meter unit revealed no human skeletal remains other than those deposited on the surface. The north wall of this unit, however, was profiled and yielded evidence of three strata. The upper stratum (0 to 32 cm) consisted of a light gray to gray sandy loam. Contents of this level included land snail shells, fragments of marine shells, baked clay nodules, and occasional fragments of nonhuman bones. The second stratum (32 to 44 cm) was a gray to dark gray compact sandy loam, again containing cultural debris consisting of land snail shells, fragments of marine shells, fragments of nonhuman bone, and charcoal specks. The third stratum (below 44 cm) consisted of a culturally sterile, compact, gray-brown to gray-white mottled clay.

The human skeleton was recovered in the adjacent 2-by-5-ft. unit at the level of 32 cm (top of the second stratum). No evidence of a burial pit was recognized during the process of excavation. In situ skeletal elements consisted of a fragmentary left femur, fragments of a fibula and radius, and two incisors. From the excavation it could be determined that, during deep plowing of the field, the turnover plow had cut just above the long bones, removing the skull and mandible and depositing these elements on the surface. The completely disarticulated nature of the elements, together with the lack of pelvic, vertebrae, or rib elements, suggests a bundle burial, but the disturbed condition of the feature makes it difficult to confirm this suspicion. The individual was apparently an adult, but the sex could not be determined.

SITE 41NU104

This site is about half a kilometer (0.25 mile) downstream from 41NU103 and is on the northeast side of the creek. The site lies on an inactive clay dune, 240 meters from the present bed of Oso Creek. An extensive flood plain separates the site from the creek.

Only a few artifacts and little occupational debris have been exposed on the surface of the site. Artifacts recovered consist of a single triangular shell projectile point or blade, a Perdiz arrow point, an adz made from the body whorl of a *Busycon* shell (Figure 4, E), a small end scraper, distal fragments of projectile points, and a biface. Other recovered material consists of baked clay nodules and flake debitage.

Occupational debris is scattered sparsely over the site and consists of the remains of *Rabdotus, Callista nimbosa, Crassostrea virginica, Mercenaria campechiensis, Busycon perversum, Laevicardium robustum, Noetia ponderosa,* and skeletal elements of small and medium-sized vertebrates.

SITE 41NU169

This site also is on the northeast side of Oso Creek, lying midway between sites 41NU103 and 41NU104. The site is on the east bank of the same meander stream that 41NU103 overlooks, and it occupies the same terrace of Oso Creek. The site area appears to extend for about 200 meters north-south and about 150 meters east-west.

Stone artifacts from the site include large Tortugas, Matamoros, Ensor, Morhiss, and Kent dart points, and smaller Fresno and Perdiz arrow points (Figure 6). In addition, bifaces, end and side scrapers, and exhausted cores have been found. Included in the assemblage is one large bifacially worked knife with an extensively ground distal edge (Figure 6, K).

Two small sherds from the site have hard, compact, sandy paste with no visible temper. Paste color varies from gray to tan, and the exterior surfaces are smooth. The interior surfaces of both sherds are grooved or scored by what may have been a marine shell, and both sherds have orange to red slip on both exterior and interior surfaces.

Shell artifacts include adzes made from the body whorls of *Busycon*, an extensively smoothed columella from *Busycon* (Figure 3, E), and a single shell bead from a bivalve (possibly *Noetia*).

Faunal remains have not been collected extensively at this site, but specimens of the following molluscs have been recovered: *Busycon perversum, Callista nimbosa, Crassostrea virginica, Fasciolaria lilium, Laevicardium robustum, Mercenaria campechiensis, Pleuroploca gigantea,* and *Thais haemastoma.*

Human bone occurs in two areas of the site. Three small skull fragments were collected along the terrace bank after a heavy rain, but no other skeletal elements were recovered from the area. A fragment of a human radius was recovered near the stream meander. The recovered skeletal material was extremely fragmentary.

DISCUSSION

All of the lithic material recovered from the seven sites (Table 3) fits the descriptions of material assigned to the Aransas and Rockport assemblages by previous researchers (Campbell 1960; Corbin 1974; Story 1968); therefore, detailed descriptions of the material will not be presented here. A major point the authors wish to make, however, concerns the diversity of the recovered lithic material. A wide variety of dart points and arrow points are contained in each site assemblage. Unfortunately, since stratigraphic and spatial provenience of the material is not available, we can make no inferences as to the meaning of this diversity. Story (1968) notes a similar diversity of forms from the nearby Ingleside Cove site.

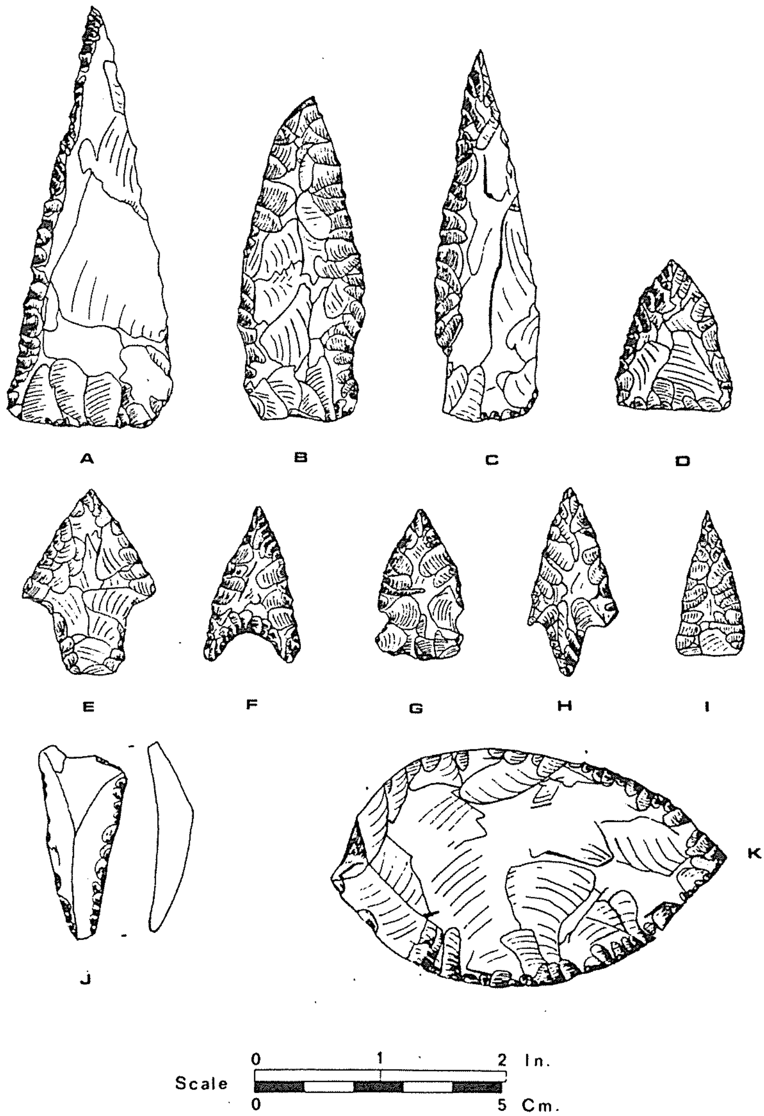

Figure 6. Drawings of selected stone artifacts from 41NU169. Classification of the projectile points follows Suhm and Jelks (1962): (A) Tortugas dart point; (B) untyped dart point; (C) Tortugas dart point; (D) Matamoros dart point; (E) untyped stemmed dart point; (F) untyped dart point; (G) Ensor dart point; (H) Perdiz arrow point; (I) Fresno arrow point; (J) unifacial flake; (K) beveled knife with an extensively ground distal edge.

Table 3. Systematic List of Stone Points Recovered from the Seven Sites

Projectile Points	Site						
	41NU35	41NU65	41NU101	41NU102	41NU103	41NU104	41NU169
DART POINTS							
Tortugas	-	X	-	X	-	-	X
Matamoros	X	X	-	X	X	-	X
Catan	-	X	-	X	X	-	-
Ensor	-	X	X	X	X	-	X
Kent	-	-	-	X	-	-	X
Morhiss	-	-	X	-	X	-	X
Refugio	-	-	X	-	-	-	-
ARROW POINTS							
Starr	-	X	-	-	-	-	-
Fresno	-	X	X	X	X	-	X
Perdiz	-	X	X	X	-	X	X
Cameron	-	-	-	X	-	-	-

Note: Type designations follow Suhm and Jelks (1962), Hester (1980), and Highley (1980).

Prehistoric inhabitants made extensive use of the area from the confluence of Oso and Corpus Christi bays upstream for several kilometers. Hester (1980) notes that the greatest concentration of burials known for South Texas, including several sites with large cemeteries, occurs along the lower reaches of Oso Creek. Most of these sites appear to represent small, temporary occupations, but at least one site at the confluence of Oso and Corpus Christi bays was quite extensive and appeared to be a favored site, which was reoccupied through the centuries. Two factors can probably account for the high concentration of sites along Oso Creek and Oso Bay. Along this part of the Texas coastline, fresh water is a limited resource, and the creek and its tributaries are a major source of fresh water. Although under the cooler, moister conditions of the past, fresh water may have been more abundant, even then the creek would have been one of the most constant sources of fresh water. This reason alone may account for the concentration of sites along the waterway. Additionally, the area provided riverine and marine resources that were extensively exploited by the inhabitants.

From the limited material recovered from surface scatters alone, it can be seen that marine invertebrates, particularly molluscs, were collected both for food and as a source of materials for tools and ornaments. The soft tissue of all the molluscs found in the sites could have been eaten. The presence of relatively large numbers of the southern quahog *Mercenaria campechiensis* and the eastern oyster *Crassostrea virginica* clearly indicate that these two species were taken primarily for food, since few if any of these shells were modified as tools. The lightning whelk *Busycon perversum* and the sunray Venus *Callista nimbosa* were probably taken as food resources as well, but since most of these shells evidenced human modification, their value as food resources is not as unequivocally documented.

In addition to gathering invertebrates from the bays and creek, the inhabitants also harvested a variety of fish. The sea catfish, sand seatrout, spotted seatrout, Atlantic croaker, black drum, and red drum were all recovered from sites 41NU102 and 41NU103. since systematic collecting has not been done on the sites, the frequencies of the species recovered can only be taken as a rough approximation of the importance of the species to the inhabitants, but it appears that black drum and spotted seatrout were the two most commonly utilized of the species recovered. Smaller species of fish may also have been commonly eaten, but, because of the small size of their skeletal remains, they may have been missed during collecting.

Analysis of the faunal remains from these seven sites also indicates a broad spectrum of terrestrial food resources. If the remains from sites 41NU102 and 41NU103 are typical of sites along the creek and Oso Bay, food resources included all classes and sizes of vertebrates, and there is no evidence that any one food resource was favored to the exclusion of others.

Two taxa whose remains were recovered warrant comment. One is *Rabdotus*, the land snail. *Rabdotus* shells were plentiful in all sites examined, and, in fact, the areal extent of the sites could be fairly accurately determined on the presence of *Rabdotus* shells alone. In the past there has been a question as to whether the shells were food refuse of the inhabitants, or whether the snails were attracted to the rich organic remains of the soils that resulted from human habitation of the area (Clark 1973, 1976; Hester and Hill 1975). The authors' impression is that the shells represent food refuse.

Another taxon whose presence is particularly noteworthy is the collared peccary, or javelina. Lundelius (1974), in discussing faunal changes in North America, notes that collared peccary, armadillo, rock squirrel, and ringtail have not been recovered from sites dating from the late Pleistocene and early Holocene. Since all of these species are adapted to warm or xeric conditions, their absence from faunal collections is evidence that the warm, dry conditions of the Southwest are a relatively recent climatic trend. This climatic interpretation is also supported by the occurrence of remains of many cold- and cool-summer-adapted species in southwestern sites that are no longer suitable habitats for such species. The presence of the remains of collared peccary in the faunal collections from 41NU102 and 41NU103 then may be of significance. An early presence of the species in the region has been suggested by remains recovered from 41MC222 (Hall et al. 1982) and from remains identified by Steele from Site 41LK201. Consequently, the peccary could have been present as early as 2,000 years ago and may have been one of the first xeric-adapted immigrants to the area.

Another observation that became apparent during examination of the assemblages from the seven sites was the extensive use the inhabitants made of marine shell for making tools and ornaments. Adzes, awls, gouges, scrapers, blades, beads, hammers, and possibly net weights all were made from marine shell (Table 4). Additionally, it is probable that bivalves such as the giant Atlantic cockle (*Laevicardium robustum*) were used as containers, although there was no direct evidence of this in the form of wear patterns on recovered specimens. It is also apparent that the inhabitants were selecting specific kinds of shells for specific tools. Sunray Venus shells were commonly found to have had flakes removed, much as flakes are removed from chert blanks in the manufacture of

Table 4. Shell Artifacts Recovered from the Seven Sites

Shell Artifact	Site						
	41NU135	41NU65	41NU101	41NU102	41NU103	41NU104	41NU169
Busycon hammers	-	X	X	X	X	X	X
Busycon whorl adzes	-	X	X	X	X	X	X
Busycon awls	-	X	-	-	X	-	X
Pleuroploca gouges	-	-	X	-	-	-	X
Callista flakes	-	-	X	X	X	X	-
Noetia beads	-	X	-	-	-	-	X
Conch whorl pendants	-	X	-	-	-	-	-
Conch columella beads	-	-	-	-	X	-	-

projectile points. In some instances the umbo of the Venus shell was left intact so the back part of the tool was smooth. In other examples the valve had been reduced to fragments, and these fragments in turn were flaked on all sides to produce blades or points. A Florida horse conch (*Pleuroploca gigantea*) columella was made into what appeared to be a small adz. Shell beads made from valves of the ark (*Noetia* sp. indet.) were recovered from two sites. The lightning whelk (*Busycon*) provided material for the manufacture of a variety of tools and ornaments. Fragments removed from body whorls of this species were commonly fashioned into adzes (Mokry 1980). The columellae were frequently made into drills, and the columellae with the spires attached were commonly used as hammers.

The use of shell as material for tools is typical of prehistoric inhabitants along the entire Gulf of Mexico, where there are few ready sources of rock, so in this respect the shell artifacts from Oso Creek sites are what one would expect to find in most Gulf Coast sites. What does seem noteworthy is that there are more tools than ornaments among these artifacts. For example, only one bead and a fragment of a concho or pendant were recovered from 41NU65, and only one bead (possibly from a specimen of *Noetia* sp.) was recovered from 41NU169. Compared to sites of the Brownsville complex to the south, which are noted for their shell industry (Collins, Hester, and Weir 1969; Hester 1969, 1980), and sites such as Morhiss (41VT1) of Victoria County to the east, the material assemblages from the Oso Bay region are remarkably limited in the variety and frequency of shell ornaments. In this way the shell industry strongly corroborates historic descriptions of the meager material possessions of the Coahuiltecans and Karankawans, who were local inhabitants at the time of Spanish contact.

The presence of skeletal remains in three of the seven sites raises questions about burial customs in the region. In discussing the distribution of burials along Oso Creek, Hester (1980) has already mentioned that the clay dunes overlooking the bay and the creek were preferred areas for both habitation and cemeteries, with the cemeteries at the edge of, or separate from, habitation sites. Along Oso Creek, however, occupation sites are common and very close together. When a burial is encountered, it is difficult to confirm the individual's association with a particular habitation site or outlying cemetery. For this reason, the presence of burials in these habitation sites cannot easily be used to infer patterns of burial location.

Another problem that needs addressing pertains to the size of the prehistoric populations in the Oso Bay and Oso Creek area, but this is one of the more difficult questions to address archeologically, for estimates of population size or density must invariably draw upon a wide range of evidence. The Oso Creek sites all appeared to be relatively small in area, and without large masses of accumulated shell or cultural debris. In fact, along Oso Creek and Oso Bay only one really large accumulation of shell and cultural debris has been reported: the previously discussed site at the junction of the Oso and Corpus Christi bays (Martin 1930). The majority of the sites along the creek and surrounding bay shore appear to have been encampments occupied by small numbers of people for short periods of time. If this is true, these sites reflect the same lifeways and settlement patterns that were described in the early historical accounts for both the Coahuiltecans and the Karankawans—groups consisting of nomadic family units or small bands moving from place to place with the seasons as different food resources became available (Newcomb 1961).

Such a life-style has now been well documented for the majority of hunters and gatherers studied during historic times, but what has been less well established are the environmental and cultural factors that have allowed such populations to vary in size and density. To attempt to review and relate all of the literature on the population density of hunters and gatherers to the Texas coastal populations would not be appropriate here, but a few ideas should be noted. There is probably more ethnographic information available about the hunters and gatherers that have existed in Australia during historic times than there is about any others, and Birdsell (1953), in examining their population structures, found a significant correlation between size of tribal area and amount of annual rainfall in their territories, the large tribal areas occurring in areas of lesser rainfall. Birdsell felt that the number of individuals within tribes was relatively constant, so population density was also inversely correlated with rainfall. He noted exceptions to this generalization that are pertinent to our discussion of populations of Indians along the Texas coast. One exception was that Australian tribes along a permanent water source had the smallest tribal areas and highest population densities, densities Birdsell felt could be maintained because of the riverine food resouces available to these tribes. The other exception concerned coastal tribes, for whom Birdsell proposed (1953:189) that the availability of marine resources made smaller tribal areas and higher population densities possible.

Three environmental factors could affect human population densities if Birdsell's Australian model is applicable to Texas hunters and gatherers. The first is the Gulf of Mexico; the second is a rainfall gradient that decreases from southeast to northwest; and the third is the gradual decrease in the number of creeks and rivers from east to west. Following Birdsell's model, all three of these suggest that the highest population densities for hunters and gatherers in Texas would be in the southeastern part of the state (that number would decrease to the north and west), and the highest population densities would be expected along the coast. These trends certainly are apparent when we examine today's population distribution in Texas (Arbingast et al. 1976:60–61), but the difficulty is in finding archeological evidence to support such hypotheses about past population densities and distributions. We have no evidence from the seven sites along Oso Creek to help us answer this question, but we can emphasize that only through the study of rapidly disappearing sites will we find an answer.

The authors could end with the observation that far more questions have been raised than answered. Questions of particular concern are those of adaptations to, and manners of exploitation of, the Coastal Bend of Texas by these early inhabitants. Were the band sizes always as small as the ethnographic sources indicate? Were most sites occupied only for short periods of time, and, if so, were they occupied only on a seasonal basis? Were there seasonal periods when available food or other resources permitted greater concentrations of people, and can we find archeological evidence of this? Were there differences in exploitation of resources between the peoples of the Aransas complex and the Rockport focus, and will we be able to find evidence of this difference in the archeological record? It is more than likely that these issues will be clarified only through problem-oriented excavations of selected sites, but what must be kept in mind is that undisturbed sites of the kind that are needed are not plentiful, and they should be excavated only when conditions allow excavators enough time to work with extremely great care.

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Archeology of the Sheldon Site, Hidalgo County, Texas

Joel L. Shiner

ABSTRACT

Two summers of excavation at the Sheldon site are described. Prehistoric activities are portrayed as oriented around fire hearths. The site, dated at A.D. 1086 ± 56 by the radiocarbon method, is related to similar late occupations in northeastern Mexico.

INTRODUCTION

The Sheldon site in Hidalgo County, Texas, was the scene of two summer archeological field schools conducted by the Department of Social Sciences, Pan American University, Edinburg, Texas. The primary purpose of the field schools was to introduce to students of sociology and anthropology the most recent techniques of data gathering in a field situation, as well as problems of data classification and statistical treatment. During the first season (1976), general hypotheses were developed and tested to gain basic information about an area that had never before been investigated through scientific excavation. During the second season (1977) we tested more specific hypotheses that had been generated from a study of the first year of work.

Sacrificing an archeological site in the name of education alone is not acceptable. Archeologists are obligated to see that the description and interpretation of recovered data are carried to fruition even when beyond the scope of a field school. The author performed those statistical analyses that were too complex for the class and prepared the manuscript for publication. All recovered artifacts are permanently housed at the International Museum in McAllen, Texas.

A review of the literature on the Lower Rio Grande shows that most knowledge of prehistory in the area is based on limited surveys on both sides of the river. Attempts to describe the regional prehistory in terms of excavation data from adjoinging or nearby regions are not necessarily successful. In the present report almost nothing is added to our general knowledge of the Lower Rio Grande because the Sheldon site, as will be demonstrated, is not representative of the general area. Instead, the site appears to be related more directly to sites of northeastern Tamaulipas and Nuevo Leon, primarily due to a striking similarity of tool assemblages and raw materials used.

LANDFORMS AND SETTLEMENTS IN THE LOWER RIO GRANDE

A common and distinctive landform along the flood plain of the Lower Rio Grande consists of low, rolling, gravel hills covered with stunted brush. Major and minor creeks are frequent, and some of these drain large areas away from the river.

Near the location of the present town of La Jolla, the hills end and both banks of the river grade imperceptibly from flood plain to flat, featureless plain. East of this escarpment (Bordas Escarpment) there is almost no local drainage in evidence in spite of ample rainfall.

Upstream from La Jolla there are numerous Indian campsites, mostly above the flood plain and away from the river. The hills, having extensive gravel exposures, are essentially sterile of cultural material, except for occasional large cortex flakes, some of Indian origin and some from the testing of pebbles by modern agate collectors. Prehistoric sites are located along the edges of the gravel exposures or where there is substantial silt deposited on top of the gravel. Large creeks passing between the hills have both trapped Rio Grande silt and deposited silt of their own. Sites associated with these landforms usually feature an unusually varied growth of trees. Nunley and Hester (1975) have referred to these sites as *gallery locales*, and to the more upland hill sites as *bower locales*. Both landforms offer rich microenvironments for the hunter-gatherer, especially with respect to seeds, roots, and small game.

The Sheldon site is in a bower location on a silt-covered hilltop (Figure 1). Trees, especially mesquite, offer both shade and abundant food in the form of bean pods. In addition, the wood is superior for some forms of cooking because of hard, long-lasting coals. Ebony, a hardwood of large size, is more common in the flood plain, and prickly pear (*Opuntia* sp.) is more at home in the lower hills. Both plants produce seasonal opportunities for food (ebony beans and prickly pear seed pods called *tunas*). A more compelling reason for the site location may be the presence of a small spring flowing from between two layers of caliche conglomerate some 50 meters downhill from the area of concentrated occupation.

SOME EARLY WORK ON LOWER RIO GRANDE ARCHEOLOGY

Sayles (1935) noted the abundance of sites along the Rio Grande, and the surveyors of the proposed Falcón Reservoir collected many artifacts and information about area landforms in the 1950s. Unfortunately, very little of the archeological data from work in the reservoir area was formally published, and some of the conclusions regarding terrace systems and artifact ages remain untested hypotheses.

A major archeological synthesis for South Texas was published by Suhm, Krieger, and Jelks (1954), but the Lower Rio Grande suffered from lack of excavation data. Their temporal phases Falcón and Mier still need clarification through excavations and problem-oriented surveys.

Nunley (1971) studied an area along the Texas side of the Rio Grande from north of Laredo to the Falcón dam vicinity, both in the field and through collections in Balcones Research Center. He essentially rejected the Falcón and Mier phases as well as some of the dart point typology. A later study (Nunley and Hester 1975) more specifically defined settlement patterns characteristic of the area upstream from Hidalgo County.

Hidalgo County apparently can be divided by a geographical and a cultural boundary that separates the coastal Indians from those in the interior (Hester and Ruecking 1969; Nunley and Hester 1975). The county is also sharply divided into the eastern low coastal plain and the western rolling hills. Today, much of the eastern portion of the county is blanketed by citrus groves and contiguous small cities. Archeological materials within the coastal plain are rarely encountered except as a result of deep disturbance by construction.

SURVEY FOR A FIELD SCHOOL SITE

During the spring of 1976, I began a search for a prehistoric site to use as a field laboratory for excavations to be sponsored by Pan American University. It was imperative that such a site be close enough to the campus for commuting, intact enough to justify excavation, and complex enough to permit testing of hypotheses.

After examining the published records and talking to several friendly artifact collectors, it became apparent that I would have to find a site the hard way—by driving around and walking across country. Two days of intensive search convinced me that the low hills of western Hidalgo County were the only hope. Dr. Robert Trotter of Pan American had been going into the brushy hills with local *curanderos* in search of medicinal plants, and he steered me to a promising area near La Jolla. During the search, I passed over several surface scatters of Late Prehistoric sites. A presence of Starr arrow points (Campbell 1958) and an absence of marine shell and pottery suggested that these small sites might be affiliated with interior, rather than with coastal, groups.

THE SHELDON SITE

Several preliminary trips were made to the Sheldon site before the students were introduced to the physical problems of excavation and of sampling for various kinds of data. Approximately half of the site area was intact, and the tops of the larger rocks in a number of fire hearths were visible. About one-fourth of the site had been displaced by sheet erosion, and another fourth was destroyed by gullies up to 1.5 meters deep.

Examination of the eroded areas produced more than a dozen dart points of the general Archaic to very late Archaic range. These rather small points with triangular to teardrop silhouettes might be variously called Abasolo, Catan, Tortugas, or Matamoros, but in my opinion form a continuum from square to round bases with only a mild beveling of edges (Figure 2). As noted by Hester (1976), these point forms are difficult to place in time or with any specific culture type. Two dart points from the deep gully are obviously much older and must represent an association with the spring. One is a Scottsbluff point, which would seem to be far south of its usual distribution, and the other is a large stemmed point of unknown affiliation.

Pre-Excavation Questions

The presence of hearths, a projected lack of meaningful stratigraphy, and overall site conditon limited the number of questions that could be addressed by a field school excavation. It was decided to seek reasons for the site location, the principal activities carried out there, the distribution of economic activities in regard to space, and possibly hints as to the division of labor. Answers to these questions would have to be sought in terms of stone technology and functional

Figure 1. General view of the Sheldon site area.

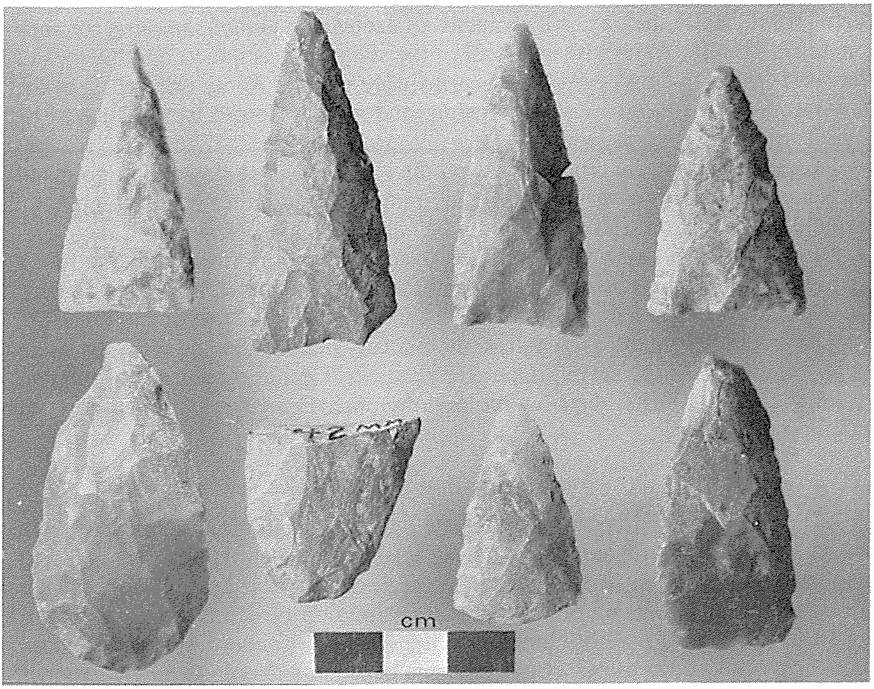

Figure 2. Examples of dart points from the Sheldon site.

typology. Practice sessions provided experience in the recognition of fire-fractured rock, cortex flakes, biface thinning flakes, chips, and cores. Laboratory sessions with simulated tasks and microscopic examination of artifacts gave adequate skill in gross categorization of scraping, slicing, boring, and chopping wear patterns.

The preliminary plan was to divide the intact portion of the site into 1-meter squares and to use a stratified sampling technique. It soon became apparent that the site consisted of fire hearths of 1.5 to 2 meters in diameter, each ringed with a limited number of tools and flaking debris. Spaces between the hearths were significantly free of artifacts. For this reason we turned to the excavation of each hearth as a distinct feature and concentrated on mapping artifacts and hearth stones.

Excavation

Once it was recognized that the Sheldon site consisted of fire hearths with associated activity areas, an excavation technique consisting primarily of evenly spaced test squares was used. Removal of earth was done with trowel and whisk broom. All loose material was sifted through ¼ in. hardware cloth. Hearth stones, areas of burned soil, and tools were left in place until they could be mapped. Within midden areas, usually distinguished by large numbers of snail shells (*Rabdotus* sp.) and a few flakes, vertical controls consisted of arbitrary 20 cm levels.

The fire hearths consisted of clusters of tightly packed river cobbles, mostly of quartzite (Figure 3). Activity around each hearth had left hard-packed earth, which could be easily detected by trowelling. Plan maps of each hearth revealed patterns of debitage (flakes) clustered 1 to 2 meters beyond the outermost hearth

Figure 3. An excavated hearth at the Sheldon site.

stones. Thus features with their associated debitage ranged from 4.5 to perhaps 7 meters in diameter. Smaller artifacts, such as chips, ranged more widely but still formed part of each cluster.

Total recovery for the site might be presented as a multiple of all hearth clusters. Table 1 is a technological breakdown representing the order of tool production. All artifacts listed are from excavations. The figures suggest that whole cobbles of chert were brought to the site and reduced. Cortex flakes and chips are frequent, while finished tools are relatively infrequent.

The morphologically distinctive tools are listed under the universal system of Bordes (1961). The primary concern is overall shape and process of manufacture (Table 2). In order of frequency, finished and unfinished dart points are the dominant form of tool and are followed by retouched flakes. In this methodology only a small reliance is placed on correlating name with function. Some points could have been used as knives or saws, and some scrapers could have been used as push planes. In view of the quantity of chippage present in the assemblage, four hammerstones seem inadequate (Table 2). Three choppers (Table 2) do not seem to be sufficient to produce the amount of firewood that was consumed.

Activity, in terms of tool production and tool use, is best determined by experimentation with the local stone and microscopic analysis. Functional tools (Table 3) include those of named morphological types plus flakes and core fragments that clearly show wear patterns of direction, angle, and movement. The utility of this typology is evident in that, excluding dart points, which are presumed to be used in the field, the number of activity-related artifacts is more than doubled. None of the bifaces exhibited evidence of wear, and they were therefore not used for cutting.

Individual Hearths

Three features appear to represent the terminal occupation at the site. Each hearth contained large numbers of fire-fractured cobbles and abundant charcoal in well-preserved cubical fragments. Unfortunately, one of the features suffered major disturbance from exploration drilling conducted during the 1930s or 1940s. The hearths were all buried, and from the condition of the charcoal, I would suggest that each had been deliberately banked with earth. It is probable that all three were contemporary, and charcoal from one yielded a date of A.D. 1086 ± 56 (SMU 583).

At least six other, apparently older, hearths were present. Each contained rocks that were burned and shattered into small granular fragments. No charcoal was recovered, but small quantities of white ash were present. The peripheries of the hearth activity areas did not produce frequent or patterned tool clusters. These hearths appear to have been exposed to the elements at some time in the past and were possibly exposed to the comings and goings of later occupants.

Hearth feature No. 1, when mapped, showed 4 preforms, 2 choppers, and 1 scraper on the west side of the hearth (6 large tools and 1 small tool). On the east side of the hearth were 1 dart point, 1 hammer, 7 small scraping tools, and 3 slicing tools. I do not want to push the interpretation of these data too far, but there is a high probability that these reflect differing activity patterns divided by the hearth.

Hearth feature No. 3, some 15 meters to the south, yielded 1 preform and 8 small scraping or slicing tools on the west side of the hearth, while the east side

Table 1. Technology

Specimens	Number	Percent
Cores	40	0.6
Cortex	700	9.9
Flakes	363	5.1
Chips	5,421	76.7
Bifacial thinning flakes	474	6.7
Tools	74	1.0
Total	7,072	100.0

Table 2. Morphologically Distinctive Tools

Tools	Number	Percent
End scrapers	5	6.8
Side scrapers	4	5.4
Raclettes	3	4.1
Denticulates	2	2.6
Notches	4	5.4
Points	15	20.3
Preforms	14	18.9
Burins	1	1.3
Gravers	5	6.8
Gouges	3	4.1
Retouched flakes	11	14.9
Hammers	4	5.4
Choppers	3	4.0
Total	74	100.0

Table 3. Functional Tools

Function	Number	Percent
Scraping	46	49
Slicing-sawing	20	21
Graving	10	11
Boring	1	1
Chopping	3	3
Hammering	7	7
Planing	4	4
Rasping	3	3
Total	94	99

produced 6 preforms and 1 small functional scraper. Although there are only 35 artifacts from both of these hearth features, the distributions are highly suggestive. Unfortunately, a statistical test is ruled out by the small sample size.

There is the distinct possibility that the artifact distribution reflects a division of labor, with biface production and heavy chopping related to male activity. The small scraping, slicing, and graving tools would seem to be more appropriate for women's work with hides, clothing, and possibly the butchering of animals. This speculation is supported by dozens of ethnographies (e.g., Murdock 1946; Service 1971). A universal rule in hunting and gathering societies is that males make and use weapons, while women prepare hides, make and repair clothing, and butcher game.

Sexual division of labor has been suggested by Varner (1968), Whallon (1962), and others, based on data recovered from hearths in northeastern Mexico. The Sheldon site is the first example that I can find where functional typology was combined with mapping around small hearths. The technique has been used previously in different kinds of sites (Shiner 1970; Shiner and Shiner 1977).

Whereas the hearths provided clues to the structure of activities at the site, artifacts of stone proved to be remarkably unrevealing. Excavated dart points, 15 in number, matched those ubiquitous triangular through teardrop shapes found in the eroded gully. All were carelessly made and comparatively thick, with little evidence of craftsmanship or style. Three points were made of a black marine chert that is common to northeastern Tamaulipas and Nuevo Leon (Department of Geology, Pan American University, personal communication, 1977). The same lack of interpretive significance was evident for the other stone tools, although the range of morphological types was rather wide for such a small sample. We had not expected to find Clear Fork gouges in a site this late in time, but neither did we anticipate an absence of arrow points.

Animal bones are not well preserved due to calcium carbonates in the soil. The few samples of cottontail rabbit and wood rat may represent debris from food or material from rodent burrows. As such, they are of little significance. Several fragments of turtle carapace were recovered.

CONCLUSIONS

The Sheldon site appears to be a temporary camp visited periodically, or perhaps seasonally, as part of a patterned movement out of Tamaulipas and Nuevo Leon. An intensive survey by the author along the Conchos River east of Montemorelos, along the Arroyo Mohinas, north to China and west of the Rio Salado has revealed almost identical hearths and tool assemblages. These sites also represent repeated visits by small groups, but indicate special exploitation of local resources. Among these resources are particular cactii and shellfish from the arroyos. More importantly, the same projectile point shapes were present at every site and included significant numbers of points made of a black marine chert that outcrops in the vicinity of Linares, Nuevo Leon.

I will speculate as to why the Sheldon site was part of a seasonal round. The hill has a spring of clear water and is close to resources of the flood plain, but is apparently free of insect pests at night. Mesquite beans, tunas, ebony beans, and small game are available. If interior Mexico were also a part of the patterned movement, the Arroyo Mohinas and most of the Rio Conchos offer completely different but complimentary resources. I cannot push the data beyond these assumptions, but I have covered the western part of Hidalgo County and the aforementioned areas of Mexico intensively (Shiner 1976a, 1976b).

The nonutility of the Catan, Abasolo, and Matamoros morphological construct is again demonstrated. If the interpretive value of these so-called projectile point types is to be discerned, then an intensive restudy is needed. Perhaps flaking technology may be the key.

As to the suggested evidence for the division of labor, I offer it only as a hypothesis generated by scant data. The interpretation of activities around hearths, however, is strengthened by this excavation. It now appears that the basic pattern or structure of Late Archaic band activity in southern Texas and northeastern Mexico is based upon self-sufficient nuclear families or small groups, and that hearths, burned-rock middens, earth ovens, or other fireplaces were a focal point of group activities (Shiner and Shiner 1977). Except at quarries, I find no evidence for site areas reserved for highly specific activities. It is probable that other cultural patterns existed in nearby mountainous regions and the coastal plain, but no comparative descriptive reports have yet been published.

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Diet and Medicinal Plant Usage of a Late Archaic Population from Culberson County, Texas

Richard G. Holloway

ABSTRACT

Eight coprolites, recovered from a test excavation at Caldwell Cave (41CU1), Culberson County, Texas, were analyzed for their fossil pollen and macrobiological remains. Based on the results of the analyses, a warm season of occupation of the site is suggested. Evidence obtained from the coprolites indicates that some of the material was probably parched prior to consumption. A preliminary analysis of area water quality indicates that this prehistoric population may have suffered from a condition of chronic diarrhea. Evidence is presented for medicinal plant use in an apparent attempt to alleviate this condition.

INTRODUCTION

Caldwell Cave (41CU1) is a sinkhole shelter located in east-central Culberson County, Texas. The site was initially excavated by Jackson (1937) and reported on by Tanner (1949) in his study of several sites in the area. Caldwell Cave yielded a large number of perishable artifacts, including baskets, ropes, sandals, and wooden artifacts. During the summer of 1979, 20 human coprolites were recovered from an exposed wall profile by D. L. Hamilton (personal communication, 1982).

Coprolite analyses are important sources of data that are not normally recovered from archeological sites. Coprolites can reveal direct evidence of diet, nutrition, and methods of food preparation. In early archeological studies and until the mid-1960s, most coprolite studies examined only the macrofossil remains such as seeds, bone, and fibers. Martin and Sharrock (1964), in their study of the Glen Canyon area of Arizona, introduced the concept of examining coprolites for their fossil pollen content.

With the new analytical techniques advanced by Martin and Sharrock (1964) and by Callen (1963, 1965, 1967), other investigators soon realized the importance of coprolite evidence. Heizer (1967, 1969), Heizer and Napton (1969), and Napton and Kelso (1969) reported on the analysis of coprolites recovered from several sites in the Great Basin of Utah and Nevada. Williams-Dean and Bryant (1975) reported on coprolites recovered from Antelope House, Arizona. Coprolite materials recovered from sites in Southwest Texas, all in Val Verde County, also have been reported: Riskind (1970) analyzed coprolites from Parida Cave;

Bryant (1974a) analyzed coprolites from the Conejo Shelter site; and Williams-Dean (1978) analyzed coprolites from Hinds Cave. The present analysis of coprolites from Caldwell Cave represents the first analysis of such materials from Culberson County, Texas, and emphasizes the need for additional sources of data.

METHODS AND MATERIALS

The 20 coprolites were initially divided into four groups based on specimen morphology (Table 1). Morphological categorization of coprolites usually has not been reported but may be significant as an indication of general health. Eight specimens were selected for further analysis (these are denoted in Table 1 by an asterisk) and were chosen to represent all four morphological groups as well as degrees of specimen completeness.

Each specimen was initially cleaned by brushing the surface and was then weighed. Smaller subsamples consisting of approximately one-half of the original specimen were removed by cutting the specimen lengthwise (where possible). These subsamples were then reweighed. Table 2 presents these data and the computed fraction used in analysis. Cutting the coprolites lengthwise ensured that the entire contents of the specimen would be sampled and reduced the potential for bias due to differential migration of materials through the digestive system (Bryant 1974a). The subsamples were placed in an airtight container and covered with a 0.5 percent solution of trisodium phosphate (Na_3PO_4) for several weeks prior to analysis. Trisodium phosphate acts as a reconstituting agent and often produces an offensive fecal odor (Callen 1967). Compounds such as hydrogen sulfide, which form from bacterial decomposition (Oser 1965:530), also contribute to this fecal odor.

Within a period of 72 hours, the supernatant liquid in all eight samples turned a dark, opaque black. At the same time, an unusually strong, pungent fecal odor was noted. The combination of coloration, strong fecal odor, and overall morphology indicated that these coprolites are most likely human in origin (Bryant 1974a; Williams-Dean 1978).

The samples were retained in the solution for a period of several weeks, and the softened material was then passed through a series of screens, the smallest being 200 um mesh. All material remaining on the screens was saved for later macrofossil analysis, while the materials passing through were subjected to the following procedure for the removal of fossil pollen.

The residue was treated with 10 percent HCl in order to remove the carbonate material, and silicates and other inorganic materials were removed through use of a heavy density separation. The samples were treated with zinc chloride ($ZnCl_2$, specific gravity 1.99–2.00) and were centrifuged at 1950 rpm for 30 minutes. The light polleniferous fraction was removed by pipet and then concentrated into 12 ml centrifuge tubes. The extraneous organic material was removed by acetolysis (Erdtman 1960), and the residue was dehydrated by an ethanol series and transferred to 1000 cs silicon oil with butanol (TBA). A minimum of 200 grains per sample were counted where possible (Barkley 1934), and the entire slide was scanned at 1 mm intervals to avoid nonrandom distribution of the pollen grains on the slide (Brooks and Thomas 1967).

The macrobotanical remains were dried, and a stereomicroscope was used in sorting these remains. Identifications were based on comparisons with ma-

Table 1. Morphological Descriptions of Coprolites

Coprolite No.*	Type†	Condition	Coprolite No.*	Type†	Condition
1*	I	partial	11*	III	complete
2*	II	complete	12*	IV	complete
3*	III	partial	13	III/IV	complete
4*	IV	complete	14	IV	complete
5*	IV	complete	15	IV	complete
6*	I	partial	16	IV	complete
7	II	partial	17	IV	partial
8	II	partial	18	IV	partial
9	II	complete	19	IV	complete
10	III	complete	20	II	partial

* = subjected to intensive analysis.

†Type I: solid, firm, well formed; Type II: soft, well formed; Type III: soft, not well formed; Type IV: soft, paddy-like, apparently runny.

Table 2. Weight and Percent of Sample Used

Coprolite No. and Type	Sample Weight	Subsample Weight	% Weight Sampled
No. 1, Type I	30.4 g	17.0 g	55.9
No. 2, Type II	68.2 g	38.7 g	56.7
No. 3, Type III	44.5 g	24.1 g	54.1
No. 4, Type IV	83.3 g	30.8 g	36.9
No. 5, Type IV	182.8 g	86.9 g	47.5
No. 6, Type I	36.7 g	18.9 g	51.4
No. 11, Type III	133.0 g	64.9 g	48.7
No. 12, Type IV	153.8 g	54.7 g	35.6

terial in the Texas A&M University Anthropology Department reference collections. When necessary, specimens were sent to other specialists for positive identification.

ANALYTICAL RESULTS

Results of the palynological analyses are presented in Table 3. Both raw pollen counts and calculated pollen percentages are included for each taxon. Macrofossil data are presented in Table 4.

Coprolite No. 1: Type I. The pollen spectra recovered from this coprolite were dominated by Gramineae pollen, with only trace occurrences of other pollen taxa. Gramineae seeds also dominated the macrobotanical remains. No identifiable fragments of bone were recovered from this specimen.

Coprolite No. 2: Type II. The pollen spectra were again dominated by Gramineae pollen, with only traces of other pollen taxa. The taxa represented by the trace occurrences were very similar to those recovered from Coprolite No. 1. The macroremains again were dominated by Gramineae seeds. In addition, 2 seeds identified as *Prosopsis* sp., a single rodent hair, 2 bones of *Sylvilagus* cf. *auduboni* (rabbit), and 11 fragmentary pieces of unidentifiable bone were recovered.

Coprolite No. 3: Type III. A total of only 126 pollen grains from two slides were recovered from this specimen. Again, Gramineae pollen dominated. Other taxa represented included Cactaceae, Cheno-Ams, *Quercus* (oak), *Artemisia (sage brush), Larrea* (Creosote bush), and Lamiaceae. The macrobotanical remains consisted almost entirely of *Opuntia* (prickly pear) seeds, which were identified by Donald J. Pinkava (Arizona State University Herbarium) as *O. lindheimeri*. No identifiable bone material was recovered from this specimen.

Coprolite No. 4: Type IV. Gramineae pollen dominated, but there were somewhat larger percentages of *Pinus, Quercus*, and Compositae pollen than previously encountered. In addition, a more diverse pollen flora was recovered, and Gramineae seeds were numerous. Evidence of *Sylvilagus* cf. *auduboni* was present, as were 34 unidentified bone fragments.

Coprolite No. 5: Type IV. Gramineae pollen clearly dominated the pollen spectra. Also recovered were significant percentages of Cheno-Ams, low-spine and high-spine Compositae, and *Artemisia*. Several seeds of *O. lindheimeri*, stems of Gramineae, and epidermal tissues of Liliaceae were recovered. The Liliaceae specimen was most likely *Allium* sp. (onion), but positive identification was not possible. Fragments of an insect exoskeleton, 105 unidentifiable bone fragments, and a large amount of mammalian hair (as yet unidentified) also were recovered.

Coprolite No. 6: Type I. The pollen spectra were completely dominated by Gramineae pollen, with *Ephedra* pollen being the next most common type. This coprolite contained a large quantity of Gramineae seeds and two bone fragments of *Neotoma* cf. *albigula* (packrat).

Coprolite No. 11: Type III. The pollen assemblage was again dominated by Gramineae pollen. Relatively large quantities of low-spine Compositae and *Artemisia* pollen also were present. The macroplant remains from this coprolite, which were somewhat meager in quantity, included some Liliaceae epidermal fragments (possibly *Allium* sp. but not positively identified) and a portion of the lower bracts of *Allium*. This coprolite also contained a number of bone fragments identified as *Sylvilagus* cf. *auduboni*.

Coprolite No. 12: Type IV. The pollen spectra from this specimen were clearly dominated by pollen of the Hydrophyllaceae (water leaf) family. In addition, there was a good representation of fossil pollen taxa, with *Larrea* and Gramineae the next most common taxa. Numerous fibrous bracts of *Allium* sp. were present, as were numerous grass stems, several of which were singed. A small number of fragments of both *Sylvilagus* cf. *auduboni* and *Neotoma albigula* also were recovered.

DISCUSSION

Seasonality

Only one coprolite (No. 3) failed to produce a statistically valid pollen count of 200 grains (Barkely 1934). A total of only 126 grains was counted in

Table 3. Pollen Results from Coprolites

Taxon	Specimen Number															
	1		2		3*		4		5		6		11		12	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Pinus	1	0.4	1	0.4	4	3.1	28	12.6	7	2.3	3	1.0	4	1.8	4	1.6
Quercus					7	5.5	25	11.3	3	1.0			2	0.9	3	1.2
Populus							1	0.4								
Alnus															1	0.4
Carya					1	0.7										
Juniperus					1	0.7					2	0.6				
Salix							8	3.6	5	1.6			3	1.4	5	2.0
Gramineae	217	94.7	203	93.9	69	54.4	85	38.4	182	61.4	227	78.8	102	47.6	26	10.8
Cheno-am			1	0.4	4	3.1	6	2.2	13	4.3	6	2.0	7	3.2	4	1.6
Compositae, low spine	2	0.8	1	0.4	6	4.7	20	9.0	18	6.0	12	4.1	23	10.7	11	4.5
Compositae, high spine	3	1.3	2	0.9	2	1.5	10	4.5	12	4.0	2	0.6	10	4.6	2	0.8
Liguliflorae									1	0.3						
Artemisia			2	0.9	9	7.1	12	5.4	36	10.1			19	8.8	7	2.9
Opuntia							1	0.4								
Cactaceae, other					2	1.5							2	0.9		
Cornaceae															8	3.3
Lamiaceae					1	0.7	3	1.3	2	0.6			2	0.9	3	1.2
Liliaceae	3	1.3					6	2.7	1	0.3	5	1.7			3	1.2
Brassicaceae							2	0.9	3	1.0					1	0.4
Solanaceae			1	0.4			3	1.3								
Anacardiaceae							1	0.4								
Rosaceae							1	0.4								
Larrea					5	3.9							4	1.8	45	18.7
Hydrophyllaceae															109	45.4
Ephedra											31	10.7				
Cyperaceae	1	0.4														
Cleome									2	0.6						
Fabaceae	1	0.4	1	0.4			3	1.4	10	3.3					2	0.8
Indeterminate			4	1.2	14	11.1	3	1.3					4	1.8	1	0.4
Total	228		216		125		218		295		288		182		235	

*Not statistically valid.
Note: No. = number of grains; % = percent of total number of grains per specimen.

Table 4. Macrofossil Remains from Coprolites

Coprolite Number	Gramineae Seeds	Gramineae Rachis	Plant Fiber	*Opuntia lindheimeri* Seeds	*Prosopis* sp. Seeds	*Allium* sp. Bracts	Epidermis cf. *Allium* sp.	Epidermis cf. *Opuntia*	Epidermis (undifferentiated plant species)	Charcoal	Inorganic	Insect Parts	Rodent Hair	Unidentified Mammalian Hair	*Silvilagus* cf. *auduboni***	*Neotoma* cf. *albigula***	Unidentified Bone Fragments
1	X		X							X							6
2	X	X	X		X					X			X	X	1 L. humerus distal, 1 distal phalanx		11
3			X	X*†				X									12
4	X	X							X	X	X				1 atlas vertebra, 1 proximal phalanx		34
5		X	X	X			X			X	X	X		X‡			105
6	X								X							1 R. femur distal, 1 cervical vertebra	
11						X			X						1 R. humerus proximal, 1 L. P_3, 1 tooth frag., 3 proximal phalanges, 2 distal phalanges		80
12	X	X*	X			X									1 molar mandibular	1 radius proximal	6

*Some specimens singed. †Includes some fragments. ‡Constituted large portion of fiber matrix.
**Bone identification by C. Assad.

two slides, or an average of only 60+ grains per slide. This could be interpreted as being indicative of a winter or cold-season occupation, or alternatively, as the result of ingestion of primarily nonpolleniferous food items (Williams-Dean 1978). I believe that the latter is a more defensible interpretation. As seen in Table 4, very few macrobiological remains were recovered from this coprolite. These remains were dominated by whole and broken pieces of *Opuntia linheimeri* L. seeds, and some plant fibrous material and a small number of mammalian bone fragments were recovered. This may indicate a meal consisting almost entirely of *Opuntia* or, alternatively, the remains of several meals. The paucity of bone fragments recovered may indicate a small amount of meat ingested or possibly the remains of an earlier meal.

Many of the coprolites (Nos. 1, 2, 4, 5, and 12) contained evidence of direct ingestion of Gramineae seeds. Coprolite No. 5 contained no Gramineae seeds but did contain a grass rachis. Three coprolites (Nos. 1, 2, and 6; see Table 3) contained grass pollen in excess of 75 percent, and two others contained grass pollen in excess of 50 percent. These high percentages of Gramineae pollen indicate direct ingestion of the pollen along with the seeds.

High percentages of *Artemisia* (12.1 and 8.8 percent) occurred in two coprolites, and low-spine Compositae pollen (9.0 and 10.7 percent) also occurred in two specimens. These percentages may suggest a late summer occupation when these plants were flowering. Coprolite No. 11 contained 10.7 percent low-spine Compositae pollen and also contained the fibrous bracts of *Allium* sp. *Allium* will flower at any time during the summer if the correct moisture conditions are present, but the accompanying Compositae pollen indicate a late summer time period. Coprolite No. 12, however, may indicate a late spring/early summer period occupation, based on the large percentage of Hydrophyllaceae pollen (45 percent); these plants normally flower from March through May or perhaps into June.

As Williams-Dean (1978) has observed, seasonality is extremely difficult to determine on the basis of coprolite data. Taken together, these eight coprolites suggest occupation during a warm season, possibly extending from February or March until August or perhaps into the early fall. None of the coprolite contents indicate occupation during a cold season.

The consistent presence of some botanical materials described above do not support the inferred occupation of Caldwell Cave during periods when plants were not flowering. The best interpretation of the existing data is that the occupants of the site left at the end of the warm season. This same pattern of seasonal occupation is noted from Hinds Cave (Williams-Dean 1978) and from Parida Cave (Riskind 1970) in Val Verde County.

Food Preparation

Coprolite No. 3 contained a very large amount of *Opuntia lindheimeri* L. seeds, both broken and whole. The whole seeds suggest that entire tunas were being consumed. A small amount of charred seeds were present, suggesting that some tunas were parched prior to consumption. It is unlikely that the tunas were being stored for long periods of time, and the evidence suggests that the tunas were consumed soon after the fruit ripened. The seed fragments may indicate an alternative method of food preparation. *Opuntia* seed coats are very hard, and it is unlikely that they were broken by chewing. Also, the frequency of charring is much greater among the broken seeds, substantiating the interpretation that these remains reflect more than one meal.

None of the grass seeds examined revealed direct evidence of parching, but some of the grass stems or rachis were charred. This indicates that the entire grass inflorescences were picked, and these were then charred, possibly to remove the chaff. D. L. Hamilton (personal communication, n.d.) reports the recovery of baskets charred on the inside, which suggests their use in food preparation. Parching probably was done by adding fire-heated rocks or coals into the baskets containing the food items.

Dietary Habits and General Health

Of the 20 coprolites recovered during the excavation of Caldwell Cave, 13 (65 percent) were placed in categories III or IV. Coprolites in these categories were not well formed and may have been loosely formed as the result of digestive and/or alimentary disorders.

According to water-chemical analysis of local water sources (Table 5), magnesium content is very high (105 mg/1). While the site's water source might have varied with time in the exact reading of this element, a typically high proportion of magnesium in local water sources could be expected due to the presence of local gypsum deposits. Magnesium is known to have laxative properties and is a major component of commercially available laxatives. Therefore, the high concentration of magnesium in the water may account in part for the high percentage of loosely formed, amorphously shaped coprolites recovered in the sample.

Examination of the botanical remains revealed several interesting correlations. Coprolite No. 6 contained 10.7 percent *Ephedra* pollen, which has been used to consolidate stools as a treatment for diarrhea by the Tewa Indians of New Mexico (Robbins, Harrington, and Freire-Marreco 1916). In several coprolites from Granado Cave, frequencies of greater than 85 percent *Ephedra* pollen were noted. Since pollen often remains in the digestive system for several days after ingestion (Bryant 1974b; Williams-Dean 1978), the frequency of 10.7 percent in coprolite No. 6 may reflect residual pollen remaining after a treatment designed to cure diarrhea. Conversely, the percentage of *Ephedra* pollen in these coprolites may reflect nothing more than background pollen inhaled during the ingestion of a meal.

Larrea pollen was present in specimens No. 3, 11, and 12. All three coprolites were either Type III or Type IV, which may indicate diarrhea. *Larrea*, boiled in a tea and ingested, has been used to aid in problems in urinating as well as to remove calcium deposits in the kidneys (Martinez 1959; Ford 1975). Lewis and Elvin-Lewis (1977) also report the use of a hot decoction of *Larrea* as a treatment for diarrhea.

The coprolite evidence from Caldwell Cave is sufficiently different from other reported analyses to warrant a few comments. Bryant (1974b), in his study of coprolites from Conejo Shelter in Val Verde County, interpreted the presence of entomophilous (insect-pollinated) pollen in frequencies greater than 2 percent as evidence of direct ingestion of a variety of flowers. Evidence from Caldwell Cave, on the other hand, does not indicate a similar use of local flowering plants.

Williams-Dean (1978:222) identified 25 percent of the coprolites from

Table 5. Water Chemical Analysis of Local Spring*

Element	Dissolved Solids (mg/l)	Element	Dissolved Solids (mg/l)
Na^{+}	91.2	F^{-}	2.6
K^{+}	43.1	SiO_2	27.6
Mg^{++}	105	Br^{-}	0.7
Ca^{++}	981	NO_3	31.0
SO_4	1,400	NH_3	0.10
Fe	0.280	Ba	0.040
Cl^{-}	114	HCO_3	80.5
Total Dissolved Solids			2,877.12

pH = 7.8
*Analysis by Clara L. Ho, Chemist-in-Charge, and Cynthia Mahan, Chemist, Mineral Studies Laboratory, The University of Texas at Austin.

Hinds Cave as being "amorphous or diarrheic specimens" and attributed this to diarrhea-toxin-producing algae. However, no algal taxa were recovered in these coprolites. Although the sample is small, it is interesting to note the higher frequency of amorphous coprolites from Caldwell Cave than from other sites.

Riskind (1970) reported on the analysis of coprolites from Parida Cave, Val Verde County. Many of those specimens contained high percentages of Gramineae pollen, which Riskind attributed to economic importance. Of greater interest to the Caldwell Cave sample, however, is the high percentage of *Ephedra* and Hydrophyllaceae pollen in certain coprolites. At Parida Cave, Riskind (1970) observed that members of the Hydrophyllaceae family were eaten as greens. Similar high percentages of Hydrophyllaceae pollen at Caldwell Cave suggest that members of this plant family had economic importance for the local prehistoric population.

SUMMARY

Of the eight coprolites chosen for intensive analysis from Caldwell Cave, only one specimen did not produce a statistically valid count, and this was probably the result of ingestion of nonpolleniferous materials. Evidence from all eight coprolites indicates that occupation of the cave occurred during the warm season of the year. In addition, many of the food items may have been parched prior to ingestion.

Analysis of springs in the area suggests that the occupants may have suffered from a condition of diarrhea induced by high magnesium content in the local water supply. The presence of *Larrea* and *Ephedra* pollen in some of the Caldwell Cave coprolites may indicate that these plants were used medicinally. The evidence for medicinal use, however, is not conclusive. Further analysis of local spring deposits and analyses of additional coprolites from all four morphological types will be necessary before substantive conclusions can be made.

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Laboratory Procedures for the Care of Prehistoric Ceramic Collections

Elaine R. Hughes

ABSTRACT

With increasing awareness of the long-term research and educational potential of archeological collections has come increasing concern about their proper care. The need for preservation applies to all artifacts and materials collected, but ceramic collections need special attention because they appear to be immune to decay and misuse. Ceramic artifacts are often processed by outdated laboratory methods that eventually damage their integrity. This paper introduces alternatives for cleaning, labeling, repairing, and housing ceramic materials. With the application of proper techniques, ceramic collections can be maintained for future educators and researchers.

INTRODUCTION

Most of the time professional and avocational archeologists practice extreme diligence when recording and excavating sites, taking great care to protect and preserve valuable research data. One would expect similar care to be taken in the processing of artifacts, but this is not always the case. Artifacts are often hastily cleaned and restored, and, after the termination of research, it is not uncommon for these materials to be placed in dead storage. The term *dead storage* usually means any out-of-the-way enclosure, such as a basement or attic, where collections receive little or no maintenance.

Any collection will deteriorate if stored carelessly; ceramic materials in particular will suffer abraded surfaces, postexcavation cracks, enlargement of missing areas, and complete breakdown or peeling of adhesives. This kind of damage greatly limits the educational and research potential of collections, since eventually it renders the artifacts too fragile to handle, thus rendering the collection inaccessible (Ford 1977: 2–3).

Careless storage of ceramic collections is unacceptable, for these collections are irreplaceable. The objects may be all that has ever been collected from, or all that remains of, a site—a significant fact since prehistoric sites are limited in number, and the overall quality of sites is deteriorating due to increased pothunting activity and lack of government support of antiquities laws (Collins and Green 1978:1055–1059). These factors, together with recent government regulations limiting collection rights, have resulted in a gradual trend toward reutilization of collections by researchers (Norick 1982:2–6; Ford 1977:1).

Because the research potential of archeological collections extends beyond initial study, it is the duty of the archeologist to ensure the future integrity of the artifacts, and this can be accomplished only if sound laboratory procedures are used. However, determination of what constitutes adequate procedure is not always easy, since artifacts must be protected from damage for an indefinite length of time. Early archeological collections in museums are an invaluable source for study of methods.

This article is based on field laboratory experience and is intended to alert both avocational and professional archeologists to the danger of employing certain laboratory procedures when dealing with prehistoric ceramic collections. Harmful methods are often used because they appear to solve particular problems, but there are usually other more suitable methods that will not result in damage to the artifacts. The alternatives recommended here are suggestions and will not necessarily meet the needs of every situation. In fact, they are based on the meeting of several conditions.

The first condition is that the ceramic materials are stable, i.e., the sherd bodies are not deteriorating. (The methods for dealing with unstable ceramics will not be dealt with here; this report is concerned with general laboratory methods rather than specific conservation techniques.) If unstable ceramic materials are encountered, consult a conservator or research the literature (for example, Dowman 1970; Lins 1976; Grist, Lormans, and Lynn 1982).

The second condition is that the pigments are not water soluble and the ceramic materials are not sensitive to chemicals. Paint solubility can be determined by rubbing the surface of the sherd with a wet cotton-tipped applicator while observing the reactions under a 10-power microscope. Tests for chemical sensitivity can be conducted in the same manner (Wilson 1968; Shepard 1976). If solubility or sensitivity is noticed, consult a conservator.

The last condition is that cleaning is in fact desirable. Sherds or wares that are destined for use-wear studies, trace-element analysis, and dating should not be cleaned. If the ceramic material meets these conditions, the procedures outlined below are appropriate for dealing with typical Texas pottery types and most southwestern wares.

Throughout laboratory processing it is important that workers record all treatment dates, treatments, preservatives, and adhesives used on artifacts. No one should assume that any treatment or conservation effort will be the final one. Documenting what has been done to an artifact will aid future technicians in their efforts to determine what methods will best reverse the effects of inappropriate treatments.

CLEANING CERAMIC ARTIFACTS

If a ceramic artifact is covered with soil it is difficult to analyze characteristics such as design, use wear, and surface treatment, but harsh and abrasive cleaning, as, for instance, with a toothbrush, can obliterate those attributes (Figure 1). Although some toothbrushes are soft, many of them rival wire brushes in their abrasive ability, and, because of this, toothbrushes should never be used for cleaning prehistoric ceramic artifacts. The recommended procedure is to use clean water and fingers or a natural sponge, and, for soil lodged in corrugated or incised areas, a soft 1-inch paintbrush or a natural sponge. Clay deposits that re-

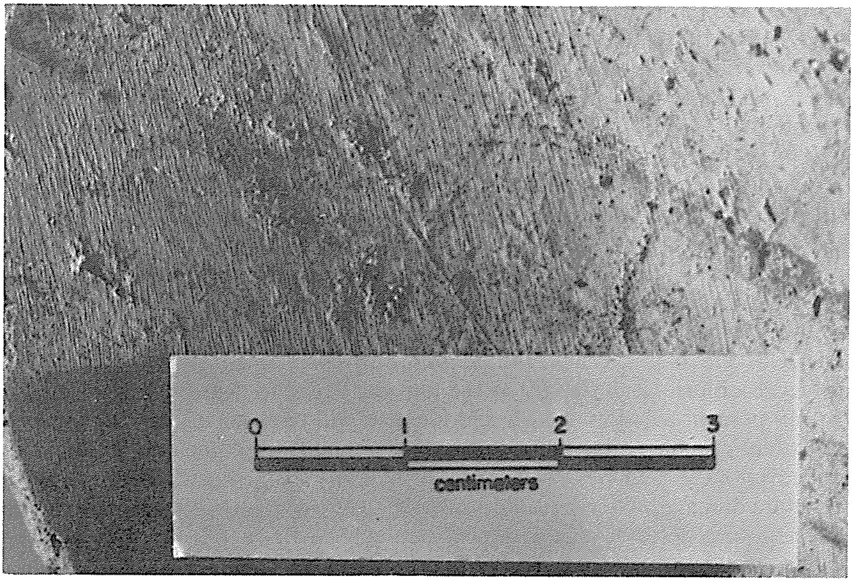

Figure 1. Southwestern sherd showing damage from cleaning with a toothbrush. Part of the design has been obliterated, and the remaining painted surfaces are covered with fine striations.

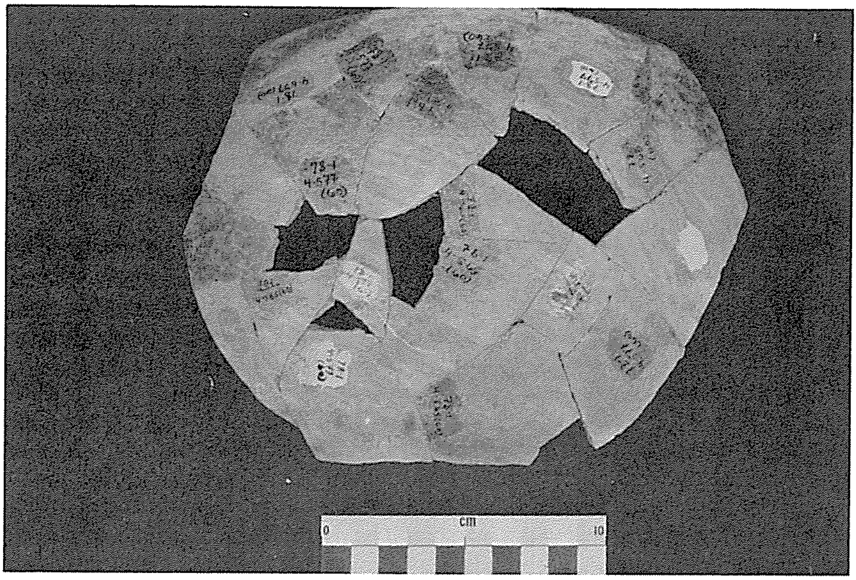

Figure 2. Reverse side of part of a Mimbres bowl, showing labels that were applied before the sherds were found to fit together.

main after hand washing can be removed best with a 5 percent sequestering agent such as sodium hexametaphosphate. According to Dr. Don Hamilton, of Texas A&M University (personal communication, 1983), all traces of this chemical should be removed by flushing with water after treatment, since it can soften pottery paste.

Removal of calcium carbonate (lime) is another problem. This deposit is usually evidenced by a rough white-to-gray film that obscures the surface of the sherd. A common mistake when cleaning is removing these deposits by mechanical means such as a toothbrush, and we have seen what damage that can cause in Figure 1. Chemical methods are preferable, since they remove the calcium carbonate with minimal damage to ceramic surfaces.

Several acids will remove lime from ceramics (Dowman 1970), but hydrochloric acid, due to its easy availability, is the one most frequently used. (Muriatic acid is hydrochloric acid; the difference in name is due to grade and price.)

A 10 percent solution of hydrochloric acid will remove calcium carbonate, but the solution should be applied only when sherds are completely wet. The water prevents the acid from soaking into the body of the sherd, where it will cause future damage. After the acid treatment, sherds should be flushed with running water, since leftover acid will turn them yellow. Because hydrochloric acid dissolves calcareous materials, it should not be used on sherds that have bone or shell temper. If sherds with shell or bone temper are encountered, a conservator should be consulted.

A preferable alternative to acids for the removal of calcium carbonate is a chelating agent. A 5 to 10 percent solution of EDTA tetrasodium will remove calcium carbonate, but not with the speed of acid.

Procedures for marking artifacts vary widely, but ceramics are most commonly labelled with india ink. This type of label is difficult to remove because the ink soaks into the sherd. Normally, removal of labels is not a matter of concern; however, several things should be considered. First, labeling is often done by persons who are not experienced enough to avoid labeling over diagnostic features, with the result that labels have to be removed and relocated. Second, areas that are nondiagnostic at the time of initial cataloging may be found to be diagnostic later on. Third, after labeling, pieces are sometimes found to fit together (Figure 2).

Fortunately, india ink labels can be removed if they have been applied in accordance with a two-coat system using polyvinyl acetate (PVA), a thermoplastic synthetic resin that resists crosslinking when exposed to light and high temperatures. These factors make the labeling process reversible (Dowman 1970: 61–64). The first coat of PVA prevents the ink from soaking into the sherd; the second coat, applied over the india ink, protects the number.

Correction fluid for typewritten copy (such as the Liquid Paper brand) is often used on dark artifacts so black ink will show up; the correction fluid should not be substituted for the first coat of PVA. Correction fluid has a tendency to peel with age and, when removed, usually leaves a white residue that is difficult to clean off. On dark artifacts white ink should be used instead of india ink, but it is important to note that not all brands of white ink are suitable, and all require constant stirring. (Pelikan is the brand successfully used at The Museum, Texas Tech University.)

The question of thickness of the two-coat PVA solution now arises. Clear fingernail polish (a type of PVA), a favorite among archeologists, varies in quality and viscosity, is expensive, and is usually too thick for labeling. Thick solutions of PVA are not desirable, since the differences in expansion and contraction rates of ceramic material and thick PVA at different temperatures sometimes cause the nail polish to peel off.

In an experiment conducted at The Museum, Texas Tech University, 10, 15, and 20 percent solutions of Vinac B15 (a type of PVA; see Appendix) in acetone were tested to determine which solution was thick enough to prevent ink from soaking into the sherds, yet thick enough to expand and contract with the sherds. The weakest solution that met these requirements was 20 percent Vinac B15. Krylon Clear Acrylic 1301 (Acryloid B72 in toluene) also was tested, but it was equivalent to 15 percent Vinac B15 and allowed ink to soak into the sherds.

The second most popular method for marking ceramic materials is by attaching tags to them. Tags attached by string are acceptable, but their use is limited to vessels with handles or narrow necks. Adhesive-backed tags should never be used; those that adhere well will, when peeled off after a few years, leave adhesive residue on ceramic surfaces, which is not easily removed and can result in permanent dark stains. Tags with less adhesive usually fall off after a few years.

REPAIRING CERAMICS

The first concern in the repairing process is to remove all traces of soil and calcium carbonate from surfaces and edges. Vessels may fall apart after restoring if edges are not clean, and surfaces that remain obscured by these deposits will require more cleaning in the future. Removal of surface deposits should proceed as described above, but edges usually require diligent cleaning with a paintbrush.

The second and most important concern is piecing the vessel together. The method used most often is to glue sherds together as they are found, but, unless it is done by one who has had extensive prior experience, randomly gluing sherds together seldom produces satisfactory results. Another method sometimes employed in the field is gluing vessels together in situ; this practice is discouraged because the vessel is usually deformed as a result of having been buried so long in the ground.

A correct beginning step for piecing a vessel together is to arrange the sherds so they radiate outward from the base (Figure 3). Reconstruction should begin at the base, with the gluing together of two or three sherds. If the base is not correctly glued together, each successive sherd will magnify the error, so it is important to check alignment of the sherds at every stage of the reconstruction process. After the base sherds have set up, successive sherds are added until the vessel is complete (Figure 4) (Wolff 1960; Wilson 1968; Larney 1971; Rye 1982).

The type of adhesive used depends upon the size and condition of the vessel. For example, the main concern with Mimbres vessels (a Southwestern ware), since they are nonporous, is the size of the vessel and the strength of the adhesive, but the main concern with Caddoan material (an East Texas ware), which is porous, is the viscosity of the adhesive.

The adhesives most commonly used by archeologists are Duco and Elmer's Glue-All. Duco is a cellulose nitrate adhesive that sets up quickly and remains reversible, but it also breaks down quickly, due to a plasticizer deficiency (Mibach

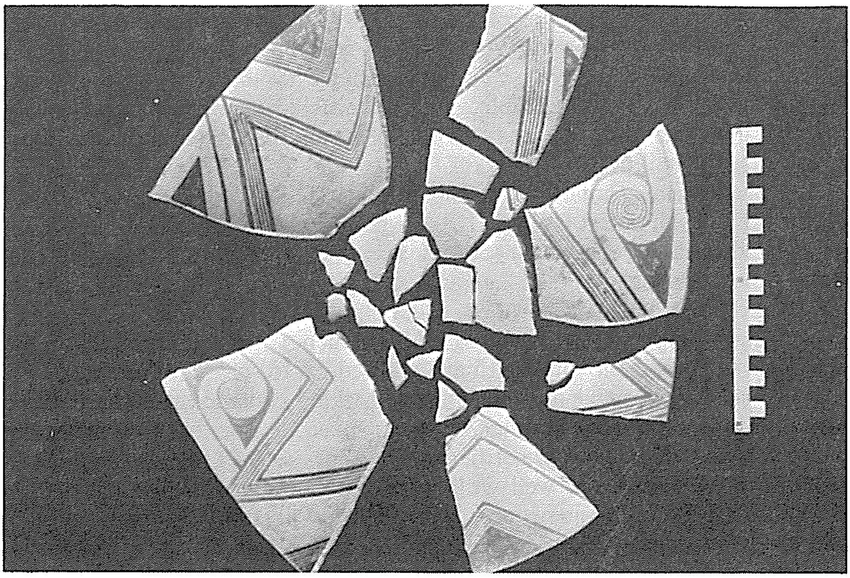

Figure 3. Correct beginning for piecing a vessel together.

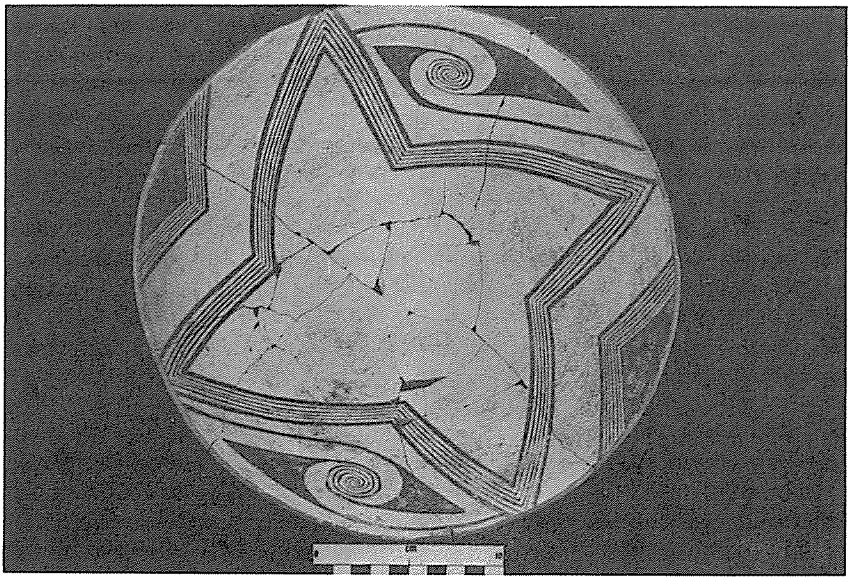

Figure 4. The vessel shown in Figure 3, after it was pieced together.

1975:58). This means that after a few years, artifacts may become too fragile to handle because of the brittle state of the Duco. Duco is not the worst adhesive to use, but it is certainly not the best for repairing vessels.

Elmer's Glue-All has fortunately become less popular over the past few years. It was once made from casein (a phosphoprotein of milk), but 10 to 15 years ago the Borden Co. changed the formula to a polyvinyl acetate (PVA) emulsion. Normally, after, drying, PVA emulsions are soluble in PVA solvents such as acetone, toluene, and lower alcohols (alcohols of low molecular weight), but this is not true for Elmer's Glue-All. The Borden Co. recommends water as a solvent and claims that other solvents will "set the glue more" (Borden Co., personal communication 1982). However, Elmer's Glue-All is only slightly soluble in water, so it should be considered irreversible and therefore inappropriate for repairing purposes.

Other brands of PVA emulsions and solids in a range of grade and viscosities have been used by conservators for several years (UNESCO 1968). Vinac B25 (see Appendix) is the PVA used by the Anthropology Department, Texas A&M University, and by The Museum, Texas Tech University. A 20 to 25 percent solution of Vinac B25 in acetone is adequate for most repairs, but, prior to gluing, sherd edges should be coated with a 5 to 10 percent solution of Vinac B25. The PVC coating will consolidate and thus protect the edges of the sherds that are ground down whenever two sherds are casually fitted together and taken apart, and will prevent the adhesive from soaking into the body of the sherd, creating a plane along which future breaks are more likely to occur than they are along the join (Figure 5).

Glued pieces can be set to dry in a sand box or a foam-padded box. Clothespins and rubber bands can be used to maintain correct alignment of the sherds, but adhesive tape should never be used to hold pieces together. If the tape is strong enough to support the sherds, it will also pull off some of the ceramic surfaces (Figure 6).

After repair, all traces of adhesive should be removed from ceramic surfaces. A common misconception is that adhesive smeared over surfaces will help to hold a vessel together. This is not true, and the adhesive can cause serious problems after a few years (Figure 7), for removal of the adhesive at this time will leave damaged areas that will require the expensive services of a conservator. It is best to avoid this situation by cleaning extra adhesive from ceramic surfaces.

REPAIRING REBROKEN SURFACES

When a vessel starts to disintegrate due to rebreakage or breakdown of the adhesive, it should be taken completely apart by loosening the joins between the sherds with the solvent recommended by the adhesive manufacturer. (It is at this time that one appreciates whatever conservation records have been kept.) As the adhesive softens, the sherds should be pulled apart, starting at the rim. Before the pieces are reglued, all of the adhesive residue must be removed or the resulting joins will not be as tight as before. Once the residue has been removed, repairing can proceed.

Vessels should not be "temporarily" mended with adhesive tape in the belief that time will be found later for a permanent job. This is a mistake, for quite

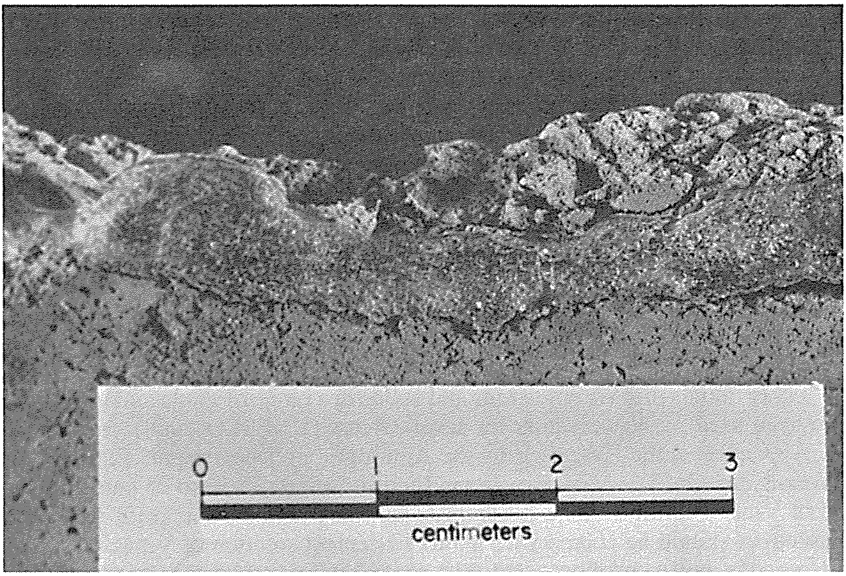

Figure 5. A sherd that was repaired with Duco. When the piece accidentally rebroke, it broke not along the join (A), but at the plane marking the extent of the absorption of the Duco (B).

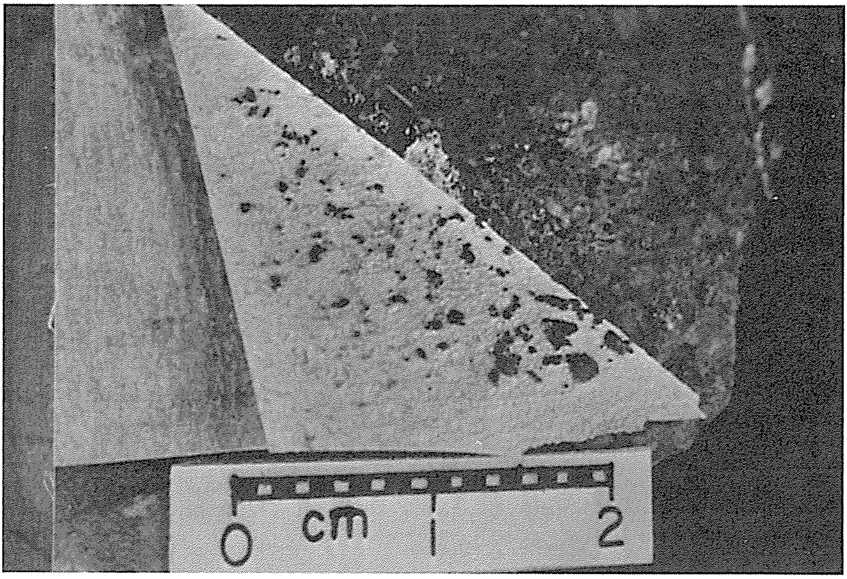

Figure 6. Masking tape removed from a sherd, showing particles of the ceramic surface (black spots) adhering to the tape.

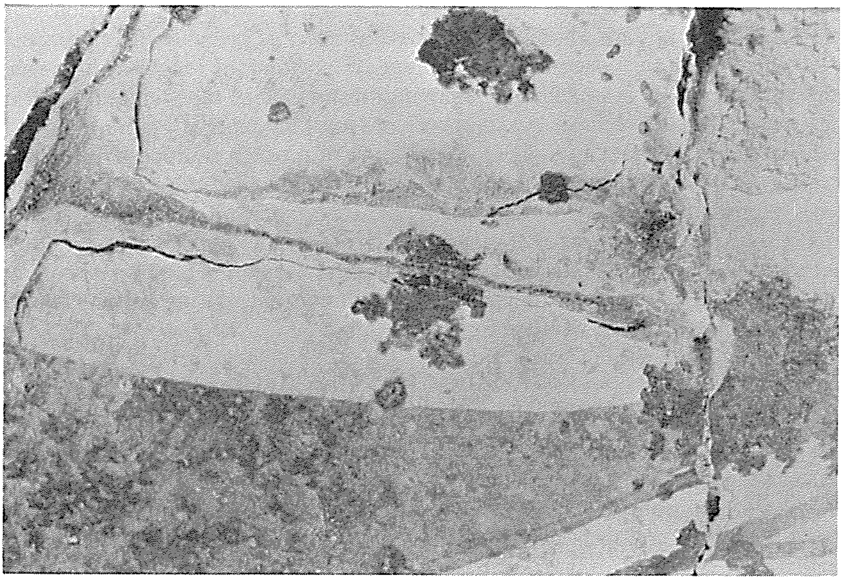

Figure 7. Damage caused by adhesive that was smeared over slipped ceramic surface when the vessel was repaired. The adhesive has peeled up, taking the surface with it.

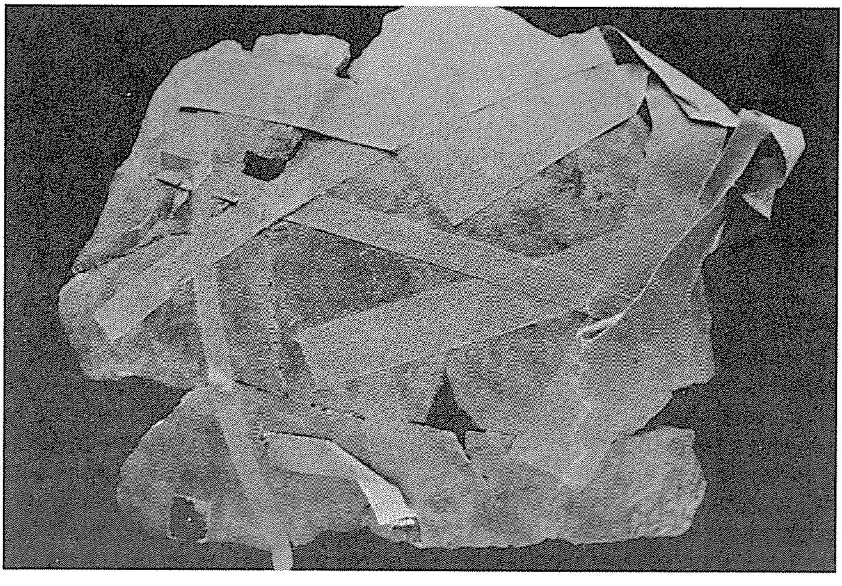

Figure 8. Part of an olla, showing the effects of leaving bookbinders' tape on the surface for 12 years. Note the adhesive stain on the lower left sherd.

often the vessel is forgotten (Figure 8). If a vessel is found that has been taped and forgotten, the tape should be removed as soon as possible. The procedure used for removal will depend upon the type of tape and the length of time it has been on the vessel. For example, removing fresh masking tape will only pull off parts of the sherd's surface, but removing old masking tape will pull off surfaces or leave an adhesive stain or both. Applicaton of a water poultice will facilitate removal of the fresh masking tape, but a water poultice and toluene or other solvents are required for removal of old masking tape and the stain it leaves. Acetone would not remove the adhesive stains from the olla shown in Figure 8, but some success was achieved by using toluene (Joan Gardner, personal communication, 1982). If these problems are to be prevented, the use of any type of adhesive tape should be avoided in ceramic repair.

CONCERNING RESTORATION

After or during the process of repair, it is sometimes necessary to fill in missing areas. Whether plaster of paris or Poly-filla—a durable substitute for plaster of paris (see Appendix)—is used, edges should first be coated with a 5 to 10 percent solution of PVA. If the vessel ever breaks or if missing pieces are found after restoration is complete, the supporting materials can be removed easily.

HOUSING CERAMIC COLLECTIONS

The process of excavation removes archeological materials from relatively stable environments. To prevent deterioration, excavated artifacts, especially repaired vessels, should be placed in environments that allow them to reestablish chemical stability, or equilibrium. It is a state not easily achieved, but its importance cannot be overemphasized; for this a collection room must have controlled temperature, light, and humidity. Under uncontrolled conditions adhesives will peel, become irreversible, or break down completely. These problems occur more frequently and are more pronounced when poor adhesives such as Duco have been used, but even good adhesives will deteriorate in adverse environments. No amount of conservation or preservation effort will make an artifact immune to its environment. A poorly conserved collection in an environmentally controlled setting will almost always fare better than a well-conserved collection in dead storage. For the best results, ceramic materials should be housed, not stored.

Equal in importance to the environment is the arrangement of ceramic material in collection rooms. Boxes or cabinets are adequate for sherds, but whole vessels, regardless of form, are best housed on open shelves with dust-blocking muslin curtains. This is especially important in humid environments where pockets of high relative humidity can form in enclosed areas (Werner 1963: 594–595). Shelves should be padded, and, when possible, vessels should be placed on covered rings of rope or in padded boxes. The padding prevents vessels from rocking, which grinds down ceramic surfaces. Vessels should never be stacked or stored on rims; both practices could put stress on glued joints, and storing on rims increases the amount of handling vessels receive, since they must be flipped over for viewing. Finally, vessels should be stored with spaces between them so they do not touch one another.

It is not possible to cover every detail of adequate housing in this short article; for further information readers are referred to Guldbeck 1976; Lewis 1976; Guthe 1977; Reese 1977; Burcaw 1979; and Dudley and Wilkinson 1979.

CONCLUSION

A recent trend, due in part to current government regulations and accelerated pothunting activity, is toward the reutilization of collections by researchers, so the time has passed when archeologists can avoid responsibility for the post-excavation condition of the artifacts they recover. It is the archeologist's responsibility to ensure the integrity of collections by utilizing appropriate laboratory methods and by providing adequate housing. The suggestions put forth here should aid archeologists in determining what methods will best serve their needs.

ACKNOWLEDGMENTS

I would like to thank Sylvia Bento, Karen Gardner, George Michaels, Erwin Roemer, and Roger Colemen for reviewing the manuscript. Gentry Steele, of Texas A&M University, edited parts of the manuscript and helped with the photography. Nicky Olsen photographed several of the artifacts, and Dory Funk aided in the research. Eileen Johnson, of The Museum, Texas Tech University (TTU), and conservators Joan Gardner and Donny Hamilton, both of Texas A&M University (TAMU), supplied information and guidance. In addition, without the use of collections at The Museum, TTU, and the Anthropology Department, TAMU, the research would not have been possible. I would especially like to thank Suzanne Wilson for suggesting the topic and reviewing the manuscript.

APPENDIX

Sources for Materials

Polyvinyl Acetate (PVA)

Vinac B15 and Vinac B25: Air Products and Chemicals, Inc., Chemicals Group, P.O. Box 97, Calvert City, KY 42029; (502) 395-4181.

AYAF and AYAT: Union Carbide Corporation, 120 S. Riverside Plaza, Chicago, IL 60606; (312) 454-2000.

Support Material

Poly-filla: Conservation Warehouse, Materials Limited, Box 2884, Sparks, NV 89431; (702) 331-9582.

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Book Review

Historic Indian groups of the Choke Canyon Reservoir and surrounding area, southern Texas. By T. N. Campbell and T. J. Campbell. *Center for Archaeological Research, The University of Texas at San Antonio, Choke Canyon Series*, Vol. 1. 1981. vi + 80 pp., 1 fig.

The modestly bound, typewritten publication of 1981 by Thomas Nolan Campbell, *père*, and Tommy Jo Campbell, *fille*, seems to promise the reader merely a tidy résumé of the historic Indian groups who sometimes lived near the intersection of the Frio and Nueces rivers. Let the reader beware. The 80 pages of this volume are crowded with findings from the Campbells' research, among which is an explicit reconstruction of part of Cabeza de Vaca's route of travel, along with a compilation of ethnographic material and locational data from primary documents and publications. Also given is an exacting scrutiny of the most relevant literature touching upon all of this.

The Campbells' work is the first volume in a notable research series about Choke Canyon, a section of the Frio River not far west of the town of Three Rivers. The series is coordinated by Thomas R. Hester of the Center for Archaeological Research, San Antonio. But since the Campbells' publication is not apt to be seen by many outside Texas, or by very many historians or ethnologists anywhere, I shall summarize rather more of the volume than is ritually fit in a book review.

At the outset the authors establish an area of interest, or "target area," which is a circle whose radius extends 50 miles from the town of Three Rivers on the Frio River in Live Oak County. They then assemble information about Indian groups reported in that circle before their ethnic identities were lost. The materials found are from (1) the travel accounts of Alvar Núñez Cabeza de Vaca and his companions, (2) eighteenth-century documents dealing with the mission Indians settled around San Antonio, and (3) records about later immigrant Apaches.

Cabeza de Vaca's Route and His Indians

The Campbells use both of the published accounts of Cabeza de Vaca's trek. The first is the *Relación* of 1542 (nearly identical to the edition of 1555), which was composed shortly after the journey, at least by 1537. The second is the so-called *Joint Report* as retold by the obstreperous historian Gonzalo Fernández de Oviedo y Valdés in 1543 or 1544, but published in 1853. The Campbells use this latter source to advantage, although it gives no names of Indian groups and has frequently been ignored by scholars tracing the Spaniards' route. The Campbells search both publications for details on the terrain and on plant or animal life, using them to fix places where the Spaniards were at the time observations about the Indians were given.

A signal contribution to the study of history is made, for if ever historians were guilty of naïve analysis and chauvinism it is in many of the studies printed about Cabeza de Vaca's journey. Exceptions are the analyses of Davenport and

Wells (1918–1919), and Krieger (1955, 1961). Even among quite reputable historians, a "trans-Texas" route has been argued which moves westward across Central Texas to north-central Mexico. This reconstruction lives on innocently in a host of school texts and modern publications.[1] Although Alex Krieger prefers this route, he also presents evidence for an alternative way, a "trans-Mexico" route through southernmost Texas. The big contribution of the Campbells' study is its convincing demolition of the trans-Texas route.

Both routes are often made to commence on the lower Guadalupe River. The trans-Texas route goes thence to a nopal-collecting area in and around Atascosa County, and on westward to the Rio Grande. The southern route runs from the Guadalupe to beyond the lower Nueces River, and on from there southwest or south to the lower Rio Grande and adjacent Mexico.

The authors stress that the surviving three Spaniards and one Moorish slave, the only members to return alive from the 1528 expedition to Florida of the cruel and inept conquistador Pánfilo de Narváez, pursued a generally southern or southwestern route from the Nueces River, since they were expressly trying to reach the European settlement at Pánuco, New Spain. The Spaniards had seen, or at least were aware of, the map of the gulf coast made in 1519 by Alonso Alvarez Pineda, which gave Pánuco's location. It is argued that if the collecting area for nopal tunas had not been well along on such a direct route toward Pánuco (as is their preferred one near Alice, Jim Wells County), then the Spaniards would have made their escape from where they were previously established on the lower Guadalupe River. It makes no sense to have Cabeza de Vaca depart from nopal fields far to the northwest of the lower Nueces, as in Alex Krieger's favorite explanation.

In a convincing argument that uses abundant material from the two primary Spanish sources, the Campbells effectively establish, as others have done, that the "Río de las Nueces" where some of the Spaniards lived for a while with the Mariam[2] and with the Iguaz, and where abundant pecans were harvested, is the lower Guadalupe. It and the adjacent section of the San Antonio River are the westernmost large streams on the coast with extensive pecan bottoms. The nearest large river to the west is the Nueces, which has a much narrower valley than the Guadalupe and more xerophytic plant life. The name "Nueces" is misleading, for it bespeaks the presence of nuts on the river's upper reaches near La Pryor and Uvalde, far from the area of contention. From the Guadalupe, it was to the lower Nueces and beyond that the Mariam, with Cabeza de Vaca in tow, went to gather nopal fruit in summer. The distances specified in the two main sources match this interpretation well. From the nopal fields the Spaniards, after considerable delay, began their flight towards Pánuco.[3]

Although it is difficult to place Cabeza de Vaca's Indians on a map, the Campbells are often successful in doing so. They convincingly locate the Guaicón on Matagorda and St. Joseph islands and the adjacent mainland, the Quitol between Copano and Corpus Christi bays, the Camol along the shore of Corpus Christi Bay, and the Fig People south of that body of water. Closer to the Three Rivers target area, at least in summer, were the inland folk who seasonally congregated at nopal collecting grounds. Considerable information exists about the Mariam, whom the Campbells identify with the Muruam of Mission San Antonio de Valero in the years between 1722 and 1762, as does A. C. Fletcher (*in* Hodge

1907, I:805). The identification of the Mariam with the Aranama at Goliad by Castañeda (1936, I:64), Krieger (1955:74), and Newcomb (1961:49) is shown to be wrong. Also, an identity is suggested between the Iguaz and Oaz listed by Isidro Félix de Espinosa in 1708 at present-day Guerrero, Coahuila (Maas 1915:37), still living near the "Moroamo" at that time.

The Maliacón or Malicón may be the Manico reported by Damián Massanet in 1690 about 100 miles northwest of Alice, Jim Wells County; the Malicón were located east of Alice or near that town in Cabeza de Vaca's time. In 1708 Fray Isidro de Espinosa reported Manicu still living in what is now southern Texas (Mass 1915:36, 37). The Campbells convincingly repudiate any equation of the Malicón with the Malaguitas of the lower Rio Grande (Newcomb 1961:60).

Excellent arguments are given for placing the inland groups geographically. Citing only a few examples, the Acubadao or Decubadao are placed in southern Bee County, and the Avavar or Chavavar in San Patricio County ranging as far west as Benavides in Duval county. It is shown that the Anegado or Ganegado may have spent the winters in southern Nueces County. The Susola, who traveled eastward to the Guadalupe River to collect pecans, had their principal range on the lower Nueces, whence they journeyed west to eat nopal in summer.

The Campbells draw many conclusions about Cabeza de Vaca's Indians, far too many to review here. The following seem the most noteworthy: (1) At least four different dialects or languages are indicated for the Indians closest to Three Rivers and Choke Canyon (Mariam, Avavar, Cutalchuch, and Malicón), although the languages themselves are unknown. (2) Human transhumance was practiced in this area, with nopal fruit sought in summer, nuts in the fall. (3) The geographic range covered by this transhumance was as great as 110 miles, at least for the Mariam. (4) Some groups, especially the Mariam, may have consisted of as many as 200 people. Details of social life and material culture also are described and summarized by the authors.

Finally, the Campbells treat the two Indian groups encountered by the fleeing Spaniards just before they reached the Rio Grande: the Arbadao and the Cuchendado. Their economic pursuits and settlements are described, and we learn that one ranchería of Cuchendado had 40 to 50 huts. The Arbadao are placed near Hebbronville, Jim Hogg County; the Cuchendado, in the southwestern part of that same county. For the first time, the locations chosen by the Campbells are probably wrong; this questions is discussed below under *criticism*.

The Mission Indians

The five main missions near San Antonio were established between 1718 and 1731, and became the homes of several Indian groups native to the Three Rivers target area, and of many others brought in from elsewhere. The Campbells summarize what they have learned from published accounts and from surviving religious records, mainly from the three missions moved to San Antonio from eastern Texas in 1731: Nuestra Señora de la Purísima Concepción de Acuña, San Francisco de la Espada, and San Juan Capistrano. In instances it was possible to learn the previous locations of the Indians, and recognize which were from the Three Rivers area and from south of it. But there the useful material almost stops, for Cabeza de Vaca was the first and last European to live with Indians of the area and recount their life and habits. There was never a story like his in mission times, or anyone else to write from an inside view of the local societies. He, alone, captured a shadow of what it meant to be a native in nonagricultural southern Texas, and to experience a world of cold, hunger, infanticide, and surprise attacks. Of course, although Cabeza de Vaca did not emphasize them, he also spoke obliquely of life's pleasures—dancing, ceremonies, summertime gluttony, and vengeful strikes against enemies.

Seventeen mission groups are treated by the Campbells and several larger groupings of them recognized. In certain localities from the upper San Antonio and Medina rivers southwestward to the confluence of the Frio and Nueces ranged the Siupam (Chayopin), Sulujam, Pampopa, and Pastia, while on the lower San Antonio were the Pajalat and Pacao. All six peoples spoke dialects or languages of the Coahuilteco family. Between the lower San Antonio and lower Nueces rivers lived the so-called "Orejones," whose tongue before mission life is uncertain. On the coast between the lower Nueces and San Antonio rivers, and on the offshore islands, were several groups collectively labeled "Piquique," who did not speak Coahuilteco. And just west of the lower Nueces were groups called "Pamaque" that probably spoke some non-Coahuilteco language before mission living. None of these groups, or any of the other eight treated by the Campbells, can be identified with Indians encountered 200 years earlier by Cabeza de Vaca's party, although group locations from the two periods sometimes overlap.

The Campbells wring out a few important data from the unproductive documents of the eighteenth century, and rigorously correct several misidentifications which have been made in the literature. For instance, we learn that Orozco y Berra (1864:304) misinterpreted a Spanish document and wrongly located the Pampopa 22 leagues south of the mission of San Juan Bautista. The Tacanana at San José y San Miguel de Aguayo were Tacame, not Pasnacan as H. E. Bolton suggested (*in* Hodge 1910, II:206). Hodge (1907, I:239) erroneously claimed that the Chayopin (Sulujam) spoke Tonkawa; no Spanish documents have been found that agree with his statement. And there is also no evidence for what Ruecking claimed (1955:369), that the Sulujam were closely connected with the Pachal on the Frio and Nueces rivers. Further, the earlier statement by T. N. Campbell (*in* Branda 1976:709, 736) that the Pitalac lived in northeastern Coahuila, and were in fact the Pitaloque or Pita, was a mistake and is withdrawn.

As for cultural information, an indication is gotten about maximum geographic ranges for the Pampopa and Pastia, who traveled over a distance of some 85 miles. Interestingly, this approximates the figure estimated for Cabeza de Vaca's Mariam Indians. Also, although political spokesmen for mission groups are referred to, they are not mentioned earlier by Cabeza de Vaca.

Immigrant Apaches

The Campbells learn several things from documents referring to the intruding Apaches. The first records mention "Apaches," but give no group names. The name "Lipanes" is not used till late in the eighteenth century, when this group is identified as stealing horses and cattle from Spanish ranches on both sides of the San Antonio River. The La Paz Map (ca. 1783) shows "Apaches Lipanes" in all of southern Texas east of Laredo and south of San Antonio, and this distribution is not contradicted by the documents. Favored camping areas were northern Atascosa County and the Nueces River in La Salle, McMullen, Live Oak, and Nueces counties, much of which territory falls within the Three Rivers target area.

Criticism

In my opinion, the main error made by the Campbells does not affect most of their conclusions or useful findings, and is this: The route which they choose for Cabeza de Vaca's party after leaving the lower part of the target area (Figure 1, p. 2) probably veers too much toward the west and strikes the Rio Grande as much as 70 miles too far upstream, at Falcón Lake. The result is to place the Arbadao and Cuchendado Indians farther inland than they likely were, and to throw off by a similar distance the Spaniards' trail through northeastern Mexico.

This mistake seems ironic, since throughout their volume the Campbells carefully point out, in attacking a trans-Texas route, that Cabeza de Vaca is very explicit about trying to reach the Spanish settlement at Pánuco. It is my firm opinion that this would have entailed traveling due south from the nopal fields east of Alice and not far from the coast, to cross the Rio Grande in its delta–the Valley. Yet the Campbells bring the Spanish around considerably to the west, for they assume that the Mesteño Sand Plains which this route would cross were too uninviting to travel over given other choices, and would have been skirted. They also imply (p. 8) that the mountains first observed by the Spaniards after crossing the Rio Grande could only have been seen in the neighborhood of Falcón Lake or northwest from there, meaning that the Spaniards must have traveled in a southwestern direction from the nopal fields. Both conclusions are unlikely.

That the Spaniards stayed away from, but near, the coast throughout their trek is indicated several times in the sources. For instance, one way of reading the *Relación* shows that the place where the Mariam went to eat nopal tunas was near the sea. In the original, the 1542, edition of the *Relación*, nopal fruit and sea beaches were mentioned in practically the same breath. Later editions and translations sometimes split the topics into two separate paragraphs, and made it appear as if different events and places were being described. This is from the original:

> And when it was time we went to eat nopal tunas. On land we found a great quantity of mosquitos of three different kinds that are very bad and vexing; and *most of the summer* they caused us great fatigue. And to protect ourselves from them, all around the people we would build many fires of rotten and wet wood that smoked but did not burn. And this protection caused another great bother, for all night long we could only weep from the smoke that got into our eyes, besides the great heat the many fires caused. And [thus] we used to go to the *coast* to sleep [Núñez Cabeza de Vaca 1542:66, 67, my emphases and translation].[4]

The Spaniards went to the *costa* to escape the smoke and heat, a word which is not used in Spanish for lake, pond, or river shores. That at least some part of the harvesting area for nopal was not far from the coast is implied, and the Spaniards could very well have begun their flight from quite near the Gulf of Mexico.

Next, not long after crossing the Rio Grande while headed south, the trekkers began to see mountains. "And, yonder, we believe that [the mountains] are fifteen leagues from the sea, according to the account the Indians gave us about the matter" (Núñez Cabeza de Vaca 1542:94). The Spaniards soon accompanied the Indians toward these mountains. Then, according to the *Relación*, the Indians tried to escort the Spaniards to the *point* of the mountains (Núñez Cabeza de Vaca 1542:95). It has sometimes been thought that a "peak" or "spur" was indicated, but this is wrong.[5] In context, the word *punta* means "beginning point" or "end point"; this is made clear in the account of Gonzalo Oviedo y Valdés who, giving a rather different version of the same event, says that "From there [the Indians] brought the Christians another five leagues onward, to a river which was at the foot of the *point* where the aforementioned mountain began" (Oviedo y Valdés 1853, ed. of 1945:229, my emphasis and translation). Oviedo y Valdés also says that

> straightaway they sent Indians to call people from down towards the sea, and the following day many men and women came to see these Christians and their miracles . . . . and these people tried hard to carry the Spaniards towards the sea. . . . But the Christians only wanted to go upwards and inland, because they had been well tutored by their experience with coastal people, and also because they had always said that they did not go out to the sea at sundown; and up till now they had been fearful of striking the sea when they would be thinking least about it; and for these reasons they were wanting to push on to the land above [Oviedo y Valdés 1853, ed. of 1945:229].

There is no reasonable doubt, reading the foregoing, that the Europeans knew that they were near the sea and wanted nothing more to do with coastal Indians, who had always tormented and killed the Spaniards. At this juncture, I believe that Cabeza de Vaca's party was north of the Sierra de San Carlos, in Tamaulipas.

As an aside, I should add that my recognition of a route of travel near the coast was made strictly from reading the two original Spanish documents. It was only later that I examined the study by Davenport and Wells (1918–1919) and was almost startled to see that their very scholarly reconstruction of the route coincides closely with mine, and with that sketched out in 1896 (pp. ix–xiii) by Rains. Independent replication is encouraging.

Circumstantial evidence also supports this route. When the Europeans decided to give up their goal of reaching Pánuco, and determined to turn inland instead, they must have known, as a fact, that the mountains beyond came down very near the gulf coast, so near that contact with coastal people would be inevitable. To get this sort of precise information, it is reasonable to infer that Cabeza de Vaca must have been near to both the coast and the end of the mountains. The Spaniards' determination to change their route was made, then, when they were faced with very uncomfortable facts.

Perhaps the decision saved their lives, for agents of Nuño de Guzmán may already have been hunting slaves in Tamaulipas and antagonizing natives, although Guzmán, himself, was busy founding settlements in west Mexico. In 1528 he had sent his relative Sancho de Caniego (or "Caniedo") to explore the area somewhat beyond the Río de las Palmas (Del Hoyo 1972:12–14); the present Río Soto la Marina, which is meant, is only 60 miles south of the area reached by Cabeza de Vaca. We need to remember, too, that it was near this river in 1554 that coastal Indians massacred several score Spaniards from the ships wrecked on

Padre Island (Dávila Padilla 1596, *in* McDonald and Arnold 1979:227–238). Those Europeans were also attempting to reach Pánuco.

The first thing which led the Campbells to reject a route southward from the nopal fields and not far from the coast was the sandy Mesteño Plains of southern Texas. The Campbells believe that the sandy plains would have been a hindrance to our trekkers, and that they were avoided by traveling to their west. But far from being an undesirable area for travelers afoot, the plains are at least as attractive as other routes. It is true that U.S. military commanders, and some earlier Spanish parties, had considerable trouble getting wheeled vehicles, howitzers, and herds of livestock through the sand; and that their attitude about the place has infected the literature. Yet the sand sheets are covered with grass and low plant cover comfortable to walk upon, and in autumn have many well-distributed ponds of drinkable water that reach westward from the gulf to the boundary of Brooks and Kenedy counties (Brown et al. 1977). The sandy dunes are few and easy to avoid, and the old blowouts often have water just below the surface. In 1747, the military force led by Joaquín Orobio y Basterra dug shallow holes in the sandy plains north of Raymondville to get water for their horses (Castañeda 1938:145).

There is considerable native food in the plains, including acorns from the large live-oak mottes or *matas*, pond lotus in some places, mesquite and ebony beans in the southern parts of the plains, nopal in the far north and far south; and many game animals, particularly in the live-oak mottes. The fact that much brush–mesquite, nopal, etc.–has spread to over-grazed grasslands since Cabeza de Vaca's day is taken into account in assessing the original plant resources (e.g., Neck and Riskind n.d.).

I have examined the plains on U.S. Highway 77 and on U.S. 281, and judge them at least as attractive and well supplied as the route suggested by the Campbells, which goes roughly from San Diego through Benavides, Hebbronville, and Escobas to Zapata. In addition, the sections of the plains that have been surveyed by archeologists, such as the northern parts of Hidalgo and Willacy counties, turned up numerous late-prehistoric sites around old blowouts and salt lakes (Mallouf et al., 1977). The Mesteño Plains were clearly no hindrance to aboriginal people, or to Europeans living and traveling as the Indians would have done.

That section of the Rio Grande delta due south of the plains may have been more of a barrier than the plains themselves, for it is flat and drier with fewer ponds. Yet several springs are known in the delta, and were probably used by travelers (Brune 1981, map of springs). Also, oxbows or resacas with water can soon be reached when proceeding south. The negative evidence cited by the Campbells that Cabeza de Vaca does not make specific mention of the Mesteño Plains means little, for a great many geographic peculiarities were not recorded about areas covered during the journey. The Mesteño area is not a bleak, Sahara-like place, and would likely have seemed no more noteworthy to our Spanish travelers than many of the other areas they penetrated and did not describe.

Not far south or southwest of the Rio Grande, Cabeza de Vaca's party reported that they began seeing mountains in the distance for the first time. The Campbells and other historians have assumed that the point of first sighting must have been somewhere near present Laredo or Falcón Lake, and that the Spanish party must thus have traversed southern Texas some considerable distance inland from the coast in order to reach this point. Such an interpretation of the route is possible, but not very likely given that the group was headed for Pánuco.

In point of fact, the mountains of Mexico can be seen, according to two academic informants of mine who have lived long in the Valley, at points in Tamaulipas a few miles beyond the U.S. towns of Roma-Los Sáenz, La Joya, and Mission. The Sierra Picachos of Nuevo León, elev. 5,036 ft., is visible in clear weather at a distance of some 85 miles to the west, while the Sierra de San Carlos, of Tamaulipas, elev. 5,869 ft., lies some 90 miles to the south-southwest; either could have been the first mountains seen by Cabeza de Vaca and his party. I conclude, with some certainty, that the Spaniards could have made their river crossing anywhere upstream from Reynosa, Tamaulipas, but probably not far north of that city. Were a crossing made near Falcón Lake, assuming clear weather, mountains would first have been observed from the left (U.S.) bank of the Rio Grande, and this was not what happened. The travelers were several leagues beyond the Rio Grande before the sighting took place. I further suspect that the Spaniards headed for the Sierra de San Carlos, rather than the Picachos, in spite of Oviedo y Valdés' statement (ed. of 1945:229) that the party was only seven and a half leagues beyond the Rio Grande when they finally arrived at a village close to the mountains. There is no high ground anywhere near that distance from the Rio Grande in the area south of Del Río-Ciudad Acuña, and the distances recounted in the *Joint Account* are notoriously unreliable.

Another bit of evidence that the southernmost point to which the Spaniards penetrated beyond the Rio Grande was near the Sierra de San Carlos is Cabeza de Vaca's mention (1542:96) of having come across two women carrying loads of cornmeal. Agriculture appears to have been practiced on the coast of Mexico as far north as the Conchos (San Fernando) River, which runs just along the northern flank of the Sierra de San Carlos.

In themselves the foregoing arguments do not prove that the Spaniards necessarily traveled the Mesteño Plains, for other routes could also have been traversed. After all, we know that Cabeza de Vaca had some practice carrying water and firewood while among the Indians. The point to be made is that a way through the plains is more in keeping with what we know of the Spaniards' destination to have been, and with information which they provided on their whereabouts after crossing the Rio Grande.

In summary, the work of T. N. and T. J. Campbell in locating and documenting Indian groups in and near the Three Rivers target area around Choke Canyon Reservoir is a benefaction to Southwestern history and ethnohistory. I suspect that almost all the available and pertinent Spanish records were examined. The study contradicts the notion of a northern trans-Texas route for Cabeza de Vaca, posits the original locations for many of his Indian groups and others known much later at the San Antonio missions, and produces material about group range and size, social customs, and material culture which I have not had the space to summarize here. Also, the Campbells have recognized many errors in the published literature and corrected them. Their probably mistaken ideas about Cabeza de Vaca's route after leaving the nopal fields do not detract from the main study. The only other fault of the monograph is its place of publication. As fine as the Choke Canyon report series is, the Campbells' results deserve to be made available to a larger audience.

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NOTES

1. The Campbells cite many (p. 65). In a brief survey of fairly recent publications, I found the trans-Texas route, or worse, embraced by a study on springs and their distribution (Brune 1981), in a history of New Mexico (Beck 1962:42), and in a flawed translation of Cabeza de Vaca's *Naufragios* (Covey 1961). The *Atlas of Texas* (Arbingast et al. 1976:44), however, traces a southern route.

2. Cabeza de Vaca says "Mariames." Castilian plural endings are omitted here for names of Indian groups, however, as they obscure the main nouns and hinder comparison with eighteenth-century spellings which often lack the plurals.

3. There is confusion among scholars who espouse a southern route about where the last, or final, nopal fields were located from which the Spaniards departed for Pánuco, although most agree that fields visited earlier on were near Alice, or east of Alice and near the coast. Davenport and Wells (1918–1919), for example, argue that the last-visited cactus fields were in the northern Rio Grande delta, but the matter has not been resolved.

4. The pages of the original *Relación* of 1542 whose photocopy I used (Barker Texas History Center, University of Texas, Austin) are not numbered. I have therefore assigned numbers, beginning the count with the first page of text, whose dedication begins *"Sacra, Cesárea, Católica Magestad."*

5. An example: "The next day, as we were going to leave, they all wanted to take us to others of their friends, who dwelt on a spur of the mountains (Bandelier 1905, ed. of Bandelier et al. 1972:110)."

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