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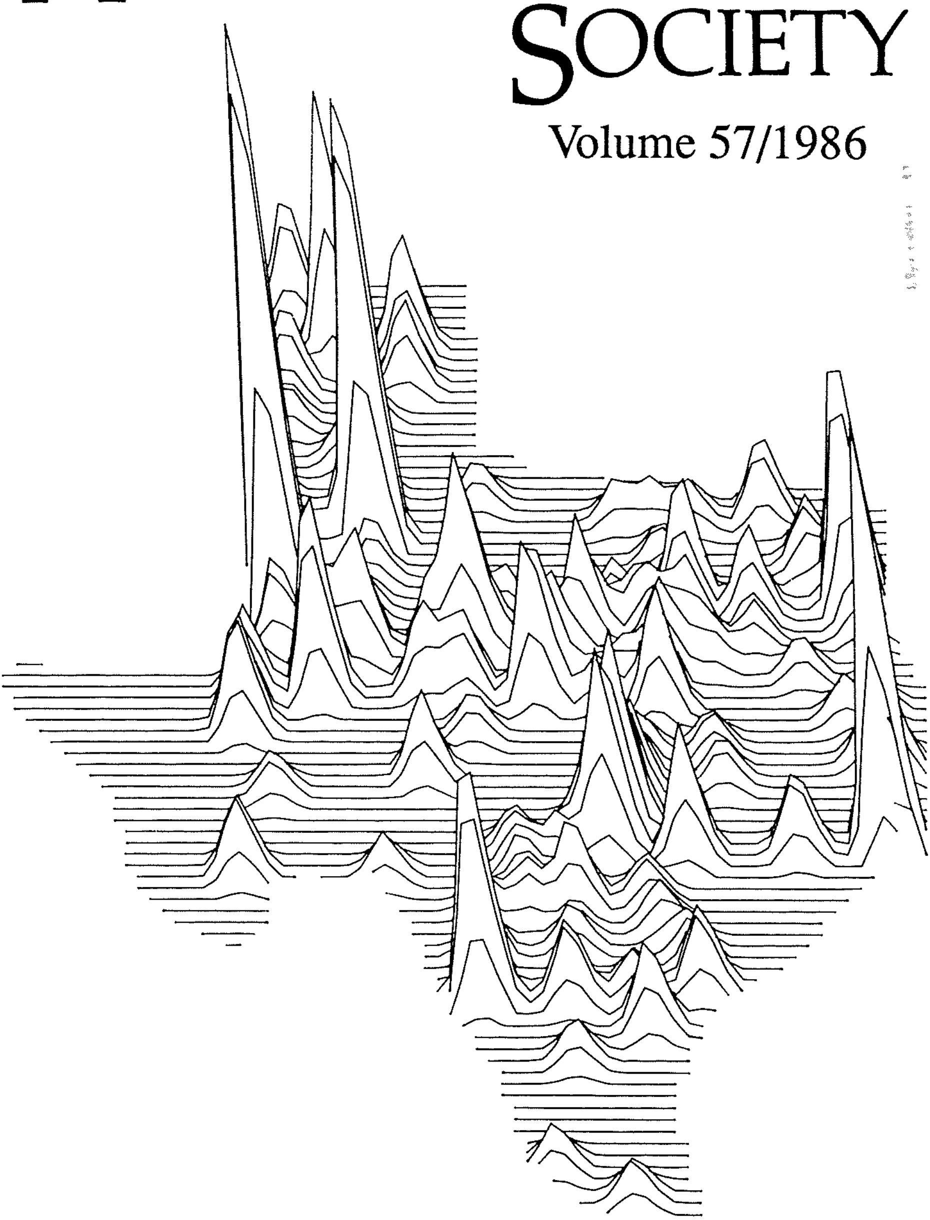

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Bulletin of the TEXAS ARCHEOLOGICAL SOCIETY Volume 57/1986

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Editor's Note

This *Bulletin* would not have been possible without the exceptional effort of Associate Editor Beth O. Davis. I also wish to thank all of my reviewers and authors. They were much more punctual than the Editor in returning manuscripts.

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A Plague of Phases

LeRoy Johnson, Jr.

ABSTRACT

The phases named in the last decade by Weir (1976), Prewitt (1981, 1983), Dibble (Turpin 1985), Bruseth and Perttula (1981), and Thurmond (1983) are reviewed in terms of the writer's views on proper phase definition. The demonstration of strong contextual associations among items in a phase's site components is considered a *sine qua non* for establishing sociocultural units that can correspond to single societies. Examples of both satisfactory and unwarranted phase definitions are discussed, and the recommendation is made that many flawed phases can best be treated as named regional periods or, when appropriate, general cultural patterns. The kind of phase endorsed for much of Texas—for areas of semimobile aborigines or dispersed farmers—is a broadly construed unit allowing for some functional and temporal variation among its components; it should ideally represent an ethnic group or society as it existed throughout a region. Local units should be called subphases.

THE PROBLEM

This paper is a short critique of several published descriptions of phases that have appeared in Texas during the last 10 years. Without argument, defining sociocultural units in the archeological record can be a step forward for the prehistorian. When established with understanding and care, the units are *representations* in either of two senses—they can stand for the fairly consistent material remains and behaviors of separate groups of bygone people, or can represent quite different periods in the history of a single society. In either case the consequence is to set apart for scrutiny separate human groups that correspond to multitribal, tribal, or other kinds of entities. Depending on whose system of nomenclature and classification is followed, the smallest units are called foci, complexes, phases, or whatever. Sadly, not many of the named phases proposed in Texas during recent years are acceptable sociocultural units. In many cases the absolutely minimal methods necessary for establishing units have not been followed, with the result that phases are named and described that are either speculative constructs or merely named regional periods. Although good integration and interpretation of the archeological data have resulted from the use of proper phase definitions, considerable confusion has been the result of publishing flawed units.

As a matter of fact, having false or misbegotten phases in the archeological literature is sometimes worse than having none at all, for they easily become dangerous and useless recipes for careless archeologists. This is the malady that I see affecting the archeological community in Texas, infecting even the attitudes of supervisory personnel who review salvage efforts. Because of the obsession to tie new research into culture sequences, partly flawed schemes are accepted uncritically by people who should know better. So in various parts of the state, some phases have been named in the past decade that ought to be rejected or treated as entities of another sort. And there are rumors of even more phase names in the works for other regions. It is my hope to inject a certain amount of antibiotic into the literature and help slow the infection's spread, though I am reminded of an old Spanish *dicho* to the effect that "it is easier to raise a devil than to put him away." At the same time I want to encourage a scholarly search for phases and recommend their use.

Before describing, again, the proper method for defining phases (for the first description, see Johnson 1967:1-10), it needs to be underlined that such units are hardly God's gift to archeology; nor are they the Cosmic Glue that binds together the archeological universe and keeps it from scattering to the four winds. Problems have surrounded the use of even fairly well defined phases that have hindered our understanding of past societies in terms of their total economies, internal complexity, relationships to other peoples, and their rate of change through the years. For example, as T. K. Perttula and others (1986:41-43) have recently said, sociocultural units (in their case, in the Caddoan area) are usually named with little appreciation for the diversity among sites of a given unit. Sometimes sites resulting from different social and economic activities practiced by a single society are not always placed in the same unit, and the proper variation is not allowed. E. B. Jelks (1961:74) wrestled with this problem long ago in his work on the lower Sulphur River.

Serious problems also exist in setting unit boundaries in time, especially in the case where a single society changed considerably but slowly through the years, and warrants division into phases or subphases. In these instances, deciding upon phase markers, choosing the most appropriate number of phases for the sequence, and setting phase limits in time can cause a brain snarl that will not easily unravel. Regrettably, there are no firm guidelines to follow—only common sense coupled with an understanding of local history. But if the age limits of a phase are set too broadly, the result is an impression of stability and uniformity that may belie reality. In the same vein, if the age span of a phase is set too short, and very minor social and stylistic changes are overemphasized, then a false picture of rapid change emerges. The recommended usage allows for some temporal flexibility in phase definitions so that quite brief periods of uniformity--in the neighborhood of a century or two—can be recognized as subphases. But when a local society is replaced by interlopers, resulting in a major cultural change, then it is relatively simple to establish main phase boundaries that mirror this replacement.

However important functional studies may be, the importance of style in archeological phases should never be belittled. Recent ethnoarcheological studies (e.g., Wiessner 1983, 1984; Lemonnier 1986) have illustrated convincingly that single societies—whether of the multitribal, tribal, or subtribal sort—often have unique stylistic expressions in their tools, dress, etc., that furnish a means for contemporary people, including ethnoarcheologists, to recognize ethnic identity. As a consequence, it is perfectly legitimate for the archeologist to use cooccurring styles in defining phases, as long as he also concerns himself with reconstructing economic and other behaviors.

In spite of the foregoing problems, phases or other archeological units can be helpful constructs for packaging masses of data, providing, albeit imperfectly, units that should reflect past social reality. But phases will be most useful only if certain instructions are followed: (1) use only major social and stylistic changes for marking phase boundaries in time, (2) allow for spatial, age, and functional variation that may be expressed, when appropriate, as subphases, (3) recognize the dynamic nature of human life and social activity in the society whose remains are being classified, and (4) fight the ever-present temptation to reify a phase and consider it the prime actor in past human drama. Types, phases, and the like do nothing. Only people act, and we should strive never to lose sight of them in our analytic and classificatory machinations.

THE PROPER METHOD OF RECOGNIZING PHASES

With the preliminary comments about the nature and usefulness of phases out of the way, we turn to the question of unit recognition: the mechanics of the step-by-step definition. I beg the reader's indulgence to repeat part of what I wrote in 1967 (pp. 1-10), but those few lines directed at Texas archeologists appear only rarely to have been read or pondered.

Not surprisingly, figuring out the formal content of units is the main act in their definition. To assign a collection of artifacts to an archeological unit we have to know, and demonstrate convincingly, that those things are truly the *residue* (Gould 1980:42) of a discrete and linked series of local communities (each a maximal group of persons in face-to-face association). Recognizing site components is the first step, and a *primary association* is demanded for this kind of assignment—a close contextual relationship among artifacts. In the best cases of primary association, the context of the artifacts and other things that are found together is such that there remains little doubt they were used or produced by the same social group. For instance, if tools, ornaments, and garments were included with a corpse at the time of burial, this provides an excellent case of primary association; we know these items characterize a single community during one period of time.

Even here there are lurking problems, since grave fill can fortuitously contain artifacts made in a different time period or by other societies who used the site. So the archeologist is obliged to study the context of the grave he excavates. A group of arrowpoints lying near the corpse and all oriented alike indicates the deliberate placement of a bundle or quiver of arrows with the deceased. For another example, stone tools found in a storage pit or as a cache can also be viewed as an instance of primary association if, from their uniformity and position, it can be inferred that they were deliberately stored there together and were not included accidentally with fill later on.

I could continue with further examples of possible primary associations among tools and site features: artifacts found on house floors, around and in stone hearths, in baking ovens, and so on. The point, however, has been made. In each case the context needs analyzing, and the archeologist should act out the role of Sherlock Holmes or his clever brother Mycroft—carefully collecting and weighing each piece of evidence to reach, when possible, a reasonable explanation. It is also extremely useful to recognize instances of likely *secondary association* so they will not be taken for primary ones. Examples of things in secondary association are tools made by different societies, or the same society during quite distinct periods, that have come to lie together through human agency such as pit digging, by deposition on a living surface stable for many years, or from joint redeposition by some natural agency such as slope wash.

Returning to the main theme, when associations have been recognized in graves, house floors, perhaps even in strata with homogeneous artifact styles, then these associational lots are compared to see which artifact forms or types, as well as inferred behaviors, are sufficiently similar to warrant their being lumped together as a single phase component of the site. Physical evidence such as the association of the features with a living surface, their similar depth below the site's surface, etc., may be used to verify this kind of component recognition. The job can be difficult, but any definition of archeological units should adhere to this approach. W. W. Taylor, in *A Study of Archaeology* (1948), affirms that sociocultural units should represent given groups of people, for "since the local human groups represented by . . . localized finds are the only empirical ones with which the archaeologist . . . deals, they are . . . the starting point of all archaeological taxonomy" (pp. 146, 147). In his *Prehistoric Migrations in Europe* (1950), V. Gordon Childe states that, to define cultures (his archeological units), an archeologist must show that traits, artifacts, etc., relate contextually to one anther in such a way that we know they are the concrete expressions of the common social traditions of a single people.

W. C. McKern (1939:30) has stated, in presenting the procedure to be followed in defining foci, that materials and associated data that have cultural significance are first collected for a site; if a consistent complex of traits so determined also is found at other sites, then we have a true focus which, he says, "may in instances correspond closely to the local tribe in ethnology" (p. 308). Avoiding the question of whether foci represent tribes or some other social entities, at least we see that McKern meant his focus to stand for the residue of a definite group of people, recognizable at several archeological sites as individual components. I can only add that there is almost no difference between a Midwestern focus and a phase as defined by Willey and Phillips (1958:22), except that foci are explicitly required to have almost identical site components, thus making it hard to allow for functional or other variation among the sites of a single society. Perhaps through oversight, Willey and Phillips were not quite so strict, but nonetheless failed to discuss intraphase variation and its significance.

For my purposes, the reason for discussing foci is to underline a necessary step in defining sociocultural units: once associations are worked out at single sites, moderately similar components need to be recognized at a number of sites. Of course, the constituent components must be permitted to vary somewhat, to allow for the economic, magico-religious, and other activities carried out by a society at some sites and not others; when deemed helpful, minor variation in age or geographic spread can be formalized in subphases, though their definition is not required; such variation within a phase may merely be described.

In discussing their idea of phase, Willey and Phillips (1958:22) indicate that it is an archeological unit having characteristic traits that set it apart from all other such units, that it occurs within a locality or region, and that it is limited in time to a relatively brief interval. And in treating the representational nature of a phase, they say that its equivalent ought to be, and often is, society (p. 49). Although it is obvious from their statement that phase components can be defined only by isolating archeological materials into associational units, it is nevertheless difficult to understand why this methodology was not given more attention by Willey and Phillips. The implications of their discussion in this direction are perfectly clear, but Willey and Phillips's failure to illustrate in more detail the mechanics of phase recognition has brought more than one archeologist to grief.

THE ARCHEOLOGIST'S BANE

The siren who lures the hapless prehistorian onto the Rock of Misinterpretation uses no enticing melody; she merely presents him with site strata rich in artifacts but obscure in origin. Clutching at the bait, the archeologist will too often interpret the contents of the individual strata as if they were artifacts of a single community in primary association, when very often they are not. This temptation to misinterpret can become a curse, a true bane. So how should we appraise artifacts discovered together in a single natural stratum lacking features that connect them into associational lots—a situation common enough in open middens and rockshelters? Are these tools and debris the remains of a single ethnic community or of several?

Although site strata may very well contain artifacts all made by one community and represent cases of true primary association, such zones can also result from the formation of soil horizons, clay lenses, etc., long after the original deposition of the human tools. Artifacts and features from different peoples and periods can come to lie in a single stratum. Then, too, artifacts migrate considerably in some soils through turbation caused by roots, animal burrowing, and human pit digging. So even strata whose formation and origin are fairly well understood can contain artifacts that have been moved from their original places—particularly in the case of middens used continually (even off and on) over thousands of years. Generally, however, if a thin stratum preserves within it tools that are stylistically all of a piece, it is more likely than not that they are the residue of one society. If there is much stylistic diversity, then the likelihood is reduced that the stratum's artifacts come from a single social group. Nevertheless, only tight associations of tools and features discovered elsewhere usually can help the archeologist decide (by interpolation) which artifacts in a homogeneous midden zone belong to which specific societies and periods. Lacking hearths and graves, internal evidence is scarce and hard to read, and the soil itself is often churned up. To define phases only on the bases of the association of artifacts with such a zone is to court trouble brazenly.

There is also an ethnographic explanation for the mixing together of artifacts from different social/ethnic groups in many sites. In parts of Texas away from Formative farming communities, restricted or central-based wanderers ranged over large areas, in some cases practicing seasonal transhumance. For example, the Tonkawa and allied groups, the Karankawas, the so-called Coahuiltecans, and others were mainly nonhorticultural collectors and hunters without much stability of settlement. Three patterns appear from their ethnographic accounts dating to the sixteenth, seventeenth and eighteenth centuries: such people moved their campsites readily, often traveled hundreds of miles to take advantage of special food sources, and probably reoccupied old habitation sites. Furthermore, there are indications that the bands were not strictly territorial and that several different groups of people moved over some areas in certain seasons.

If the semiwandering habits of local Indians in Spanish colonial days were at all characteristic of the prehistoric inhabitants of the state, especially during Archaic times, then there is no support for the assumption that approximately contemporary artifacts from a site stratum will necessarily be the relics of one group. "Camp sites and cave sites and other stopping places of more or less transient peoples can conceivably preserve within a very limited space the products of not a few separate cultural and political entities" (Taylor 1948:141).

But let us return to the penchant for misinterpreting site strata and their contents, although it is nothing new to the archeology of the state. Unfortunately, the siren has been enticing her victims for many decades, and her handiwork can be seen in numerous invalid sociocultural units from yesteryear, as well as in mistaken beliefs about the contemporaneity of units and artifact types. For instance, J. Charles Kelley (1947, 1959) was led to believe that the Pedernales and Nolan dart point types were of the same age because of their frequent stratigraphic cooccurrence, although he placed them in separate foci—Round Rock and Clear Fork, respectively. In 1959 (p. 282) he affirmed that "the contemporaneous Round Rock . . . and Clear Fork . . . foci extend from very early to very late times but are replaced locally on the west by the late Uvalde focus." The evidence of a similar age for Pedernales and Nolan dart point was found throughout the excavations of the 40-foot and part of the 20-foot terrace of the Colorado River. As an aside, however, none of Kelley's foci were defined by careful study of primary associations in sites; they were merely areal and temporal patterns in the distribution of artifact forms.

When Thomas C. Kelly (1960) found proof at the Crumley site that Nolan was an earlier type than Pedernales, as this writer did soon afterwards at the Wunderlich site (Johnson et al. 1962:15-48), resistance to this new evidence was considerable. Some archeologists were strongly convinced of the contemporaneity of the two types because of their previous occurrence in the same discrete terrace deposits and at the Williams site (Suhm [Story] 1959). Indeed, so powerful was the prevailing misconception that one of the writers contributing to the "Conclusions" of the Canyon Reservoir archeological publication spilt considerable ink waffling about the possible meaning of the separation of the two dart point types at Crumley and Wunderlich (Johnson et al. 1962:117-124). Finally, however, she was willing to consider, among other possibilities, the likelihood "that the materials from the sites analyzed by Kelley were considerably mixed, in spite of the presence of apparently clear-cut geologic strata at most of the sites" (p. 119).

It was not until the 1970s that *sondage* (test) excavations were partly abandoned in the state in favor of clearing large living areas where chances were improved for finding artifacts in primary contextual association around hearths and other activity areas, as recommended by Lewis Binford (1964). In 1971, the Ram's Head site of Crockett County (Young 1982) was dug in this fashion, and in 1973 the Buckhollow site of Kimball County. Both pieces of work were accomplished by the State Department of Highways and Public Transportation, following techniques for stripping village and mound sites in North Carolina. It is now fairly common to see living areas uncovered layer by layer, with the result that more activity spots and instances of primary association among features and artifacts are being recognized; with them the likelihood increases that sociocultural units will eventually be defined in much of the state.

The manner in which the Loeve-Fox site (Prewitt 1982) was cleared and a fairly large area excavated stratum by stratum is an example of the proper manner of digging sites, finding their features and activity areas, and studying in a Holmesian fashion their cases of primary association. In the central part of Texas there is enough evidence, right now, to recognize phases at several different periods of time. But this has been done in an acceptable, yet minimal, way only for the Austin and Toyah foci (Jelks 1962; Prewitt 1982), and for the Driftwood, Twin Sisters, and Round Rock phases (Prewitt 1982). In other attempts to define phases, sketchy or faulty procedures have been used, or else regional periods or other units have been defined and mistakenly called phases. Five proposed phase syntheses will be reviewed.

Weir's Cultural Patterns

In his doctoral dissertation of 1976, Frank A. Weir presented a new framework within which the Archaic cultures of central Texas could be described in a dynamic way. His search for intervals of stability and equilibrium, as well as abrupt change, led Weir to name five uniform intervals that he inaccurately called phases, borrowing some of their names from J. C. Kelley and earlier researchers: San Geronimo (6000-2500 B.C.), Clear Fork (3000-2000 B.D.), Round Rock (2200-600 B.C.), San Marcos (800 B.C.-A.D. 200), and Twin Sisters (A.D. 1-1300). Seventeen subject archeological sites, whose collections were divided (using both function and style) into 34 artifact classes and 17 flake categories, made up the raw material of the study, though the tallies and frequencies were only occasionally put in the dissertation.

Weir depicts a sequence that begins with numbers of small, scattered human groups during San Geronimo times, proceeds on to the Round Rock era of coalescense and uniformity, and finally ends in a proliferation of cultures and social groups in the San Marcos and Twin Sisters phases. Yet Weir's archeological units were not proper phases, as he freely admits (1986). First, both the earliest and latest units separately encompass the residue of several communities of people who, though they shared some behaviors, may not have been terribly close ethnic relatives. That can be seen, for example, in the diverse dart point forms (Uvalde, Gower, Martindale, Early Barbed, etc.) allowed in the San Geronimo unit. Second, the units were not defined by phase-recognizing methods—by comparing many cases of primary association to build up phase components that would strongly resemble each other. Rather, since Weir's interests were largely behavioral, patterns or trends in the site data were discerned by general inspection. Then a numerical summary of each unit was acquired by pooling the artifact counts (by class) for all appropriate sites or parts of sites. This unusual summing of collections was quite clever, since it combined the tool classes from different kinds of specialized sites to produce a single picture of the artifact content and range of the whole unit. Third, the final units are patterns of uniformity on a level of conceptualization far above that represented by sociocultural phases.

Additionally, units such as San Geronimo lasted much too long ever to represent phases. Hence, for all the foregoing reasons, they can best be labeled cultural patterns, or simply just patterns—San Geronimo pattern, Clear Fork pattern, and so forth. Each represents a generally uniform trend in behavior illustrated in detail in Weir's dissertation. (No connection is implied between this usage of the word pattern and that found in the Midwestern system of taxonomy.) So, simply by replacing the phase label with one more appropriate to the creator's actual interests, the scheme could easily be corrected and kept in use. The reader should also note that some of the cultural patterns overlap each other in age, which seems a reasonable phenomenon, and that they are partly dated by interpolation using radiocarbon assays from the Lake Amistad area of the Rio Grande (Weir 1976:Table 1), which may or may not be reasonable. Ten years, now, after its appearance, Weir's *The Central Texas Archaic* could benefit from a general refurbishing that would incorporate recent discoveries and provide additional proofs of major social trends.

PREWITT'S CHRONOLOGIES: GOOD PHASES AND BAD

In the early 1980s, Elton R. Prewitt published a two-part synthesis for the prehistory of central Texas, in which 13 phase names appeared. Although he states that his purpose was to refine the culture history presented earlier by Jelks (1962) and Weir (1976), Prewitt's interests also touched upon population density and prehistoric migrations. Some of his ideas regarding chronology and unit definition had appeared earlier in a manuscript (1976) on the Rogers Spring site, while a later report (1982) actually identified several phases, component by component, at sites on Granger Lake. The major presentation was in the form of two papers: *Cultural Chronology in Central Texas* (1981), which described each of his phases briefly and gave its age span, and *From Circleville to Toyah: Comments on Central Texas Chronology* (1983). This second work listed each of the 147 radiocarbon assays consulted, revised the basic chronology in small ways, and discussed ideas about changing demography.

As fascinating as all the studies are, it is felt here that Prewitt's proposed sociocultural units fall into two quality classes: a group of minimally defined, "good" phases (Toyah, Austin, Driftwood, Twin Sisters, and Round Rock)[1] (endnote) and, on the opposite shore, all the rest of the named phases (Uvalde, San Marcos, Marshall Ford, Clear Fork, Oakalla, Jarrell, San Geronimo, and Circleville), each seriously flawed.

When I say that some of the proposed phases are good, only one thing is meant: that these units meet the minimal requirements for a phase—a preliminary phase. At least some associations of the primary sort have been described for them and a number of components recognized. There is no implication that the phase definitions are in any sense complete, that geographic boundaries have been set, or that the full archeological content of each phase is known. The definitions of Prewitt's good phases are quite preliminary, but will surely be added to as additional associational information is uncovered.

The peculiar dichotomy in the quality of Prewitt's work on phases is not easy to understand, though it can be described as follows. When using borrowed or published information, the treatment he gives phase data can be a bit cavalier. But when good site data are produced by his own research, Prewitt takes all the appropriate steps to find primary associations and recognize evidence for separate human societies in the archeological record. His study at the Loeve-Fox site, 41WM230 (Prewitt 1982:3-229), of the distribution of features and associated artifacts in the strata characterized by the Toyah, Austin, Driftwood, Twin Sisters, and Round Rock phases, is a textbook example of how to go about recognizing and presenting proof for site components, then interpreting them. Let me cite a few examples from that insightful study.

In strata *1d* through *1g*, Austin-phase arrowpoints and marine-shell ornaments were found as grave goods or (in the case of the arrowheads) as weapons that killed the people buried there. With two basin hearths and a burned-clay pit were also found three Scallorn and two Granbury arrowpoints. Additionally, the various features and concentrations of mussel shell were plotted to reveal a site plan for the Austin phase component that was amenable to interpretation. Among the sociological inferences and historical interpretations were these. Internecine warfare with other Austin phase people is bespoken by the Austin arrowpoints in several bodies, and various possible causes of intragroup fighting are explored. Further, the ornaments of conch shell found in graves show that local people acquired goods by trade or more direct methods from the Gulf of Mexico. In earlier Driftwood times, however, the absence of marine shell from Loeve-Fox and the lack of diagnostic Mahomet dart points near the coast can be used to argue that the Driftwood people of eastern central Texas were an intrusive population excluded, for some reason, from the coastal zone of the Gulf of Mexico.

To recapitulate, Prewitt has redefined the previously published Austin and Toyah phases in a (barely) usable way, and has also presented minimal, yet acceptable, evidence at Loeve-Fox and elsewhere (Prewitt 1981) that the Driftwood, Twin Sisters, and Round Rock units are true sociocultural phases of several components, though their definitions depend heavily on associational evidence from one well-studied site—Loeve-Fox. The other named Archaic phases have to be considered false entities or else named regional periods that include the residue of more than one human society, for published associational studies of their artifacts and features are inadequate or lacking.

Since chronological schemes tend to be quoted often and religiously by archeologists who never take time to review the underlying data, I think it behooves me to criticize parts of Prewitt's study, as I have in fact done, and suggest a few changes before the whole scheme becomes deeply embedded in archeological folklore. Prewitt is always pleased, I believe, when his ideas stimulate interest and discussion. What I do not believe he would approve, however, is a mindless apeing of his entire, unfinished system of Holocene phases for central Texas. Regrettably, the parts of the system that I consider flawed are being accepted as readily as are the five probably valid phases listed above.

I would like it better if Prewitt had researched his phases one at a time and published them singly, rather than tossing in the ring an entire but incomplete post-Ice Age chronology all at once. But, rather than reject the eight phase names for which good primary associations and proved components are missing, let us retain them as labels for provisional regional periods whenever possible. Some, however, may be complete figments incapable of being viewed as time units. But when feasible, the retained phases will enjoy a respectable existence as periods through shedding their misleading "phase" labels. It is hoped that innocent bystanders will be forewarned not to judge each "phase" as a body of information necessarily characterizing a separate society or ethnic group.

To underline the difference between regional periods and phases may seem like academic nit-picking, but it is not. A regional period may set off the material culture and inferred behaviors of several communities or societies who, though different, were contemporaneous or nearly so. A phase, on the other hand, should always represent one society, or a society as it was at a certain period in time. The definition of each kind of entity involves different processes and requires somewhat different proofs. For regional periods one only needs evidence of rough contemporaneity or close similarity in age for the included materials, as well as a common geographic range. For phases something else is wanted—fair evidence for the use of tools, sharing of behaviors, etc., by one society. The reader who was not woolgathering earlier will remember the discussion of this subject in "The Proper Method of Recognizing Phases," above.

At this juncture I want to plead strongly against considering the eight flawed phases as preliminary phases whose definitions can be improved later on with new discoveries. This may indeed be an accurate prediction of what will transpire, but while waiting for the Christopher Columbus of Texas archeology to emerge, let us not call these things phases or even preliminary phases. Why my stubborn attitude? After all, Prewitt said that "the full configuration of a phase need not be defined before that phase is recognized, and the key index markers are essential for such recognition" (1981:69). Now, a preliminary definition of a phase may certainly be published but, as said previously, in doing so some data to prove associations are nonetheless required, though additional associated materials may eventually be added to the phase's definition. No associations, no phases—not even preliminary ones. The reader must be told that such-and-such phase component is represented, say, by dart types 4 and 7 found in burial lots A and G, as well as by stone axes or whatever occurring on living surfaces 3 and 2. Only when this proving is done publicly can the reader review the archeologist's actions and conclusions, and judge whether a true phase is involved or not. The point to be made is that there are no published discussions of associational data for Prewitt's bad phases.

A preliminary phase definition may not be given if associations between items are merely thought or expected to exist. That practice smacks of divination and requires the reader to accept the archeologist's intuitions on faith. If Prewitt's regional periods are accepted as preliminary, partially constituted phases, we should all don the diviner's robe, as has F. F. Schambach (1982) in Arkansas, who sometimes names phases for regions yet to be properly researched. Phases are a lot like pregnancies; either you have some acceptable associational information as proof (even if just a little bit) or you do not. It is a yea or nay matter.

Let me move to the argument that most of Prewitt's bad phases are indeed regional periods. Consulting the trait list for the Circleville phase (Prewitt 1981:77), we find Angostura, Golondrina, Meserve, and Scottsbluff dart points listed as diagnostics (see also Prewitt 1982:300-312). Given what is known about the occurrence elsewhere of some of those dart points in pure complexes such as Cody, it would be incredible to ask us to believe that all of those items were the residue of one society and worthy of being encompassed within a single phase. Where are the specific proofs of primary association among the several dart point types? And after examining the trait list for the San Geronimo (Prewitt 1981:77-78), Jarrell (p. 78), and San Marcos (pp. 80-81) phases, can the reader truly sleep well at night secure in the belief that all the dart point types of each are, together, the residue of single societies? Let us take a lesson from a similar foul-up, and remember how convinced J. Charles Kelley (1959) once was that Nolan and Pedernales dart points were of the same age because of their occurrence together in terraces.

I pose these rhetorical questions only to show that, in the case of Circleville, Jarrell, and some other phases, Prewitt is dealing not with sociocultural units, but rather with historical time periods. There is no other plausible way to explain the content of several of his phases. This being so, the main problem with Prewitt's scheme can be remedied easily, by calling the bad phases something else—regional periods or intervals. Then one can speak of the Jarrell period in central Texas, the Clear Fork period, and so on should the archeologist deem time units of relatively short duration helpful in organizing the Archaic. Regrettably, these periods are often too short to mirror the kinds of large-scale and long-term social patterns Weir describes with his entities, the ones I suggested calling cultured patterns. Division has occurred to such a degree among Prewitt's Archaic cultures that the forest can no longer be seen for the many named coppices. Anticipating one kind of objection to my suggestion, above, let me say that it would bother me not at all to use a culture-historical sequence made up of mixed phases and periods, particularly if great accuracy were thereby gained. True phases can also play the role of periods when one's heuristic needs call for it.

The evidence Prewitt is very likely using to recognize the bad phases is stratigraphic. Tools that occur in the same zones and strata, or are believed to be of the same age for other reasons, have been pigeonholed in his named units. And whereas purely stratigraphic evidence is usually not sufficient for recognizing phases, it is quite suitable for defining regional periods. But the success of the units as named periods, after the matter of content is dealt with, will depend on how well the temporal framework of each is handled. Here, most unfortunately, we encounter the biggest snarl in Prewitt's scheme of classification: his age data often do not apply to the units for which they are claimed to be appropriate. In many cases, radiocarbon assays said to date one period were in fact run on charcoal associated with the diagnostic dart points of another, or of several together. I do not know how the problem in organizing his radiocarbon assays for each phase arose, but it seems that the assays were put in chronological order (see Prewitt 1983:Figure 1) with almost no regard for the artifacts associated with each. Exceptions are the assays for the Toyah and Austin phases. Whatever the cause of the poor correspondence of the phase assays and the phase diagnostics, it clearly exists and places in doubt the temporal details of Prewitt's entire central Texas chronology.

A helpful listing of the artifact associations for all of Prewitt's radiocarbon assays has recently been prepared by another researcher (MS by Wayne C. Young, n.d.), and is scheduled for publication. However, so that the reader of the present critique will have some age data to get his teeth into, I include in Table 1 my own tabulation of dart-point associations for radiocarbon dates of six periods/phases: Round Rock through San Geronimo (though no dates were given by Prewitt for the last), covering in all some 4,000 years. The sample is adequate to illustrate the serious problems in Prewitt's assignment of many inappropriate dates to his various units.

Of the 17 assays said to belong to the Round Rock through San Geronimo phases (Prewitt 1983:Table 1, assays 111 through 127), four (24 percent) are from strata that have the diagnostic dart points of single units (but not always the one specified), seven come from mixed contexts representing two or more of the named periods, and one comes from a zone whose diagnostic dart points are incompletely known. Another three are soil assays thought to produce age estimates somewhat too recent for their associated artifacts (which represent several different periods in any case, though one tends to dominate), one has no associated dart points, and the final assay was made on charcoal believed by the excavator of the site to have been introduced accidentally into the zone where it was discovered. Inspection of Table 2 will show that, for all the early Archaic phases and periods for which radiocarbon assays have been listed by Prewitt, only the age limits of the Round Rock phase can even be estimated from the available radiocarbon assays. The actual correspondence between the 17 assays and their supposed phase markers, in contrast to what has been claimed, is miserable.

Table 1. Radiocarbon Assays and Associated Archaic Dart Points (Pedernales Interval and Earlier)

ROUND ROCK PHASE
(Pedernales dart points)

SITE	ASSAY No.	SAMPLE No.	DATE B.P.	CORRECTED DATE, B.C.*
Greenhaw site				
(Valastro, Davis, &	**111**	**TX-453**	**2650±80**	**850±95**
Rightmire 1968:896)	**112**	**TX-451**	**2850±90**	**1100±95**
	113	**TX-465**	**2900±100**	**1165±105**

41HY29 (Weir 1979:Table 6); three assays of soil containing charcoal of several periods, possibly including recent charcoal (all pretreated to remove humic acids); radiocarbon assays probably too recent for associated artifacts; soil samples from midden F, zones C & D (zone D has much humic activity); C & D plus zone of contact C/D contained 13 Pedernales, 7 Bulverde, 2 Marshall, 1 type VII (narrow rectanguloid stem, barbs), 1 Lange; association between samples and Pedernales points only fair.

Oblate shelter	**114**	**Tx-104**	**2900±180**	**1165±180**
(Tamers, Pearson, & Davis 1964:150)				

41CM1 (Tunnell 1962:Table 3); lower zone 2 contained 1 Angostura, 1 Bulverde, 26 Ensor, 2 Fairland, 10 Frio, 1 Marshall, 5 Montell, 1 Pedernales; dart points are diagnostic mainly of periods later than Round Rock.

Anthon site	**115****	**Tx-2381**	**3000±60**	**1295±70**
(Valastro, Davis, & Varela 1977)	**116****	**Tx-2385**	**3120±70**	**1450±90**

41UV60 (Glenn T. Goode 1986); site analysis and dating incomplete; assays are from lower early midden with ca. 20 Pedernales points, ca. 25 Kinney points, and 3 points with small rectangular stems plus long barbs (basal notches); association of dated charcoal and Pedernales points is apparently excellent; Pedernales and some Kinney points made by the same social group.

Hawes site	**117**	**UGa-2480**	**3225±75**	**1585±95**

41WM56 (Hays 1982, vol.1:Table 7.1-1, Table 8.2-1; vol.2:14-27); area C, level 5 contained 1 Darl, 1 Marcos, 1 Castroville, 2 Marshall, 4 Pedernales, 5 Bulverde, 2 Nolan, 1 Travis, and 1 group 4 (rect. stem); assayed charcoal associated with dart points typical of several periods.

Table 1, continued

SITE	ASSAY No.	SAMPLE No.	DATE B.P.	CORRECTED DATE, B.C.*
Horn shelter No. 2 (Valastro, Davis, & Varela 1979:263)	**118**	**Tx-1720**	**3470±160**	**1905±165**

41BQ46 (Watt 1978:122-123). Site analysis continuing; assayed charcoal from S. half of shelter, square 52, depth 102-114 inches "in red alluvial sands that also contained fishhooks and Pedernales points" (Watt 1978:122); other associated dart-point types not identified, and dart point referents of assay incompletely known.

MARSHALL FORD PERIOD
(Bulverde dart points)

SITE	ASSAY No.	SAMPLE No.	DATE B.P.	CORRECTED DATE, B.C.*
Anthon site (Valastro, Davis, and Varela 1977:306)	**119****	**Tx-2442** (Acceptable for Round Rock phase)	**3520±60**	**1970±145**

41UV60 (Glenn T.Goode 1986); site analysis and dating incomplete; this assay is on charcoal from lower early midden with ca. 20 Pedernales points and 25 Kinney points from the zone, and three points with rectangular stems and basal notches a bit like the Marshall type; no Bulverde points from the site; association of dated charcoal and Pedernales points is apparently excellent; Pedernales and some Kinney specimens made by one social group.

SITE	ASSAY No.	SAMPLE No.	DATE B.P.	CORRECTED DATE, B.C.*
Hawes site	**120**	**UGa-2485**	**3615±60**	**2095±145**

41WM56 (Hays 1982 vol. 1: Table 7.1-1, Table 8.2-1, 8-36; vol. 2: 14-21, 14-27, 14-33); area C, level 7 contained 1 Pedernales, 2 Bulverde, 1 Buda, 1 group 2 (Travis-like), 1 group 4 (rect. stem), 1 group 5 (Buda-like), 1 group 7 (long, rect. stem), 3 group 14 (rect. stem); assessment: points have rectanguloid stems, related to Nolan-Travis or Bulverde time period.

CLEAR FORK PERIOD
(Nolan, Travis dart points)

SITE	ASSAY No.	SAMPLE No.	DATE B.P.	CORRECTED DATE, B.C.*
Hawes site	**121****	**UGa-2473**	**3750±90**	**2275±130**

41WM56 (Hays 1982, vol.1: Table 7.1-1, Table 8.2-1, 8-36, 8-41; vol. 2:14-27, 14-33); feature 14b (hearth); area C, level 8 contained 2 Bulverde, 4 Nolan, 2 group 7 (long, rect. stem), 2 group 14 (rect. stem); assayed charcoal appears to come from Nolan and Travis zone (level 8). However, zones 9 and 10 (below) together produced 2 Pedernales, 2 Nolan, 2 Travis, 1 Martindale, 1 group 2 (Travis-like), and 1 group 3 points.

SITE	ASSAY No.	SAMPLE No.	DATE B.P.	CORRECTED DATE, B.C.*
Bear Creek shelter (Valastro, Davis, & Varela 1979:268)	**122**	**Tx-2958**	**4150±140**	**2790±175**

41HI17 (Lynott 1978, 1985); assay made from intrusive piece of charcoal; Lynott agrees with present evaluation that charcoal does not date stratum in which it was found.

Table 1, continued

SITE	ASSAY No.	SAMPLE No.	DATE B.P.	CORRECTED DATE, B.C.*

Cervenka site **123** **RI-1087** **4280±240** **2960±270**

41WM267 (Hays 1982, vol. 1:Table 7.1-1, Table 8.10-1; vol. 2:14-13, 14-21, 2:14-13, 14-21, 14-27); feature 9 (hearth); area D, level 63/64; various references in Hays do not agree as to number and type of points from level, which at least contained 1 Bulverde, 1 Travis, 1 Dawson, 1 group 2 (Travis-like), 1 group 4 (rect. stem), and 1 group 7 (long, rect. stem); main association is with Bulverde and Nolan-Travis periods (mixed). Hoxie and Uvalde points were found below this level.

Cervenka site **124** **RI-1086** **4330±420** **3020±440**

41WM267 (Hays 1982, vol. 1:Table 7.1-1, Table 8.10-1; vol. 2:14-13, 14-21, 14-33); area D, level 69/70 contained 1 Uvalde dart point, 1 Hoxie, 1 group 1 (Nolan-like), 1 group 9 (lanceolate), 1 group 10 (Nolan-like?); main association is with rectangular-stem and early Archaic points, mixed. Below foregoing points associated with assayed charcoal were 1 Travis, 1 Uvalde, 2 Wells, 2 Tortugas, 1 early expanding-stem point at several different elevations.

Evoe Terrace site **125** **Tx-339** **4430±240** **3145±270**
(Valastro, Pearson, &
Davis 1967:447)

41BL104 (Sorrow, Shafer, and Ross 1967:45-148); area B, zone 7 produced 8 Bulverde and similar points with narrow and rectangular stems, 2 Travis, 5 points (groups 6, 7, 10, 12; Kent- or Yarbrough-like) with small rectangular stems, 1 group 13 point (short expanding stem), 1 misc. point (contracting stem), and 1 group 3 point (unidentifiable fragment); assayed charcoal associated with artifacts of several periods mixed together.

JARRELL PERIOD
Calf Creek [Bell-Andice], Martindale, Uvalde

Cervenka site **126** **Tx-3684** **4970±90** **3790±140**

41WM267 (Hays 1982, vol. 1:Table 7.1-1, Table 8.10-1); feature 19 (hearth), area D, level 117/118, large hearth with borer and graver in fill. Above feature 19, at level 103/104, was 1 Tortugas; at level 85/86, 2 Wells, 1 Tortugas; below feature 19, at level 131, was 1 expanding-stem point.

41WM73 **127** **UGa-2482** **5285±726** **4140±736**

(Hays 1982, vol. 1:Table 7.1-1, Table 8.4-1; vol. 2:14-21); charcoal from level 19 of area B contained 1 Bulverde-like, 1 Nolan, 1 group 2 (Travis-like) [level 18, above the assayed charcoal, contained 1 Bulverde and 1 Nolan; level 17 (above 18) yielded 4 Pedernales, 2 Bulverde, 1 group 7 (long, rect. stem), 1 unidentified]; assayed charcoal was in mixed Bulverde-Nolan zone.

Table 1, continued

SAN GERONIMO PERIOD (Gower, Hoxie, Wells) No assays listed

* Corrected years B.C., Arizona calibration of 1974 (Damon et al. 1974).
** Assay acceptable for periodization
Notes: Attributed phases/periods according to Prewitt 1983, Table 1

Table 2. Listing by Age of Seven Radiocarbon Assays Known to Associate with Diagnostic Dart Points of One or Two Periods (Mixed): San Geronimo to Round Rock Intervals.

Assay No. (Prewitt 1983)	Age in Corrected Radiocarbon Years B.C.*	Associated Diagnostic Dart Points	Interval
115, Tx-2381	1295±70	Pedernales	Round Rock
116, Tx-2385	1450±90	Pedernales	Round Rock
119, Tx-2442	1970±145	Pedernales	Round Rock
120, UGa-2485	2095±145	Nolan-Travis/ Bulverde mixed	Clear Fork/ Marshall Ford
121, UGa-2473	2275±130	Nolan-Travis	Clear Fork
123, RI-1087	2960±270	Nolan-Travis/ Bulverde mixed	Clear Fork/ Marshall Ford
127, UGa-2482	4140±736	Nolan/Bulverde mixed	Clear Fork/ Marshall Ford

*Corrected years B.C., Arizona calibration of 1974 (Damon et al. 1974).

From inspecting Young's manuscript on assays and associated dart points, I am convinced that both major and minor adjustments will need to be made to all the time spans set for the phases by Prewitt, and in some instances beginning and ending dates will not be known. Consequently it is premature to estimate relative population densities for each phase by calculating a ratio of phase component occurrences to the duration of a phase in years (Prewitt 1983:216). Once age ranges can be recalculated for some of the phases and periods, particularly the more recent units, it may be possible to compare certain pairs by their estimated population densities, but it will be decades, I predict, before firm age estimates are available for the entire sequence of Archaic phases. Meanwhile, it is also too early to try correlating phase length and the length of major climatic intervals caused by precession and volcanism as in Gunn and Prewitt (n.d.).

As an aside, I need to add that if my recommendations are followed about calling Wier's phases *cultural patterns* and some of Prewitt's *periods*, an overlap of proper nouns will result, as in Clear Fork pattern vs. Clear Fork period. If this transpires, one of the entities will need to be given a substitute name. That bridge can be crossed when the water rises, although Weir's names will take precedence because of their earlier use.

PHASES IN THE DESERT

Two first-rate publications have appeared of late that add to an understanding of burial practices and Ice Age bone deposits in the Lower Pecos River region. I refer to *Seminole Sink: Excavation of a Vertical Shaft Tomb, Val Verde County, Texas* (1985), written and compiled by Solveig A. Turpin; and *Excavation of the Late Pleistocene Deposits of Bonfire Shelter, 41VV218, Val Verde County, Texas, 1983-1984* (1986), by Leland C. Bement. To provide some historical perspective for their readers, both workers describe and reference an unpublished series of phases for the desert attributed to David S. Dibble, well known for his studies of the nearby Arenosa and Bonfire shelters. Dibble (1978, n.d.) offered a long series of phase names as follows: Aurora, Bonfire, Oriente, Viejo, Eagle Nest, San Felipe, Cibola, Flanders, Blue Hills, Flecha, and Infierno—extending from the end of the Ice Age to about A.D. 1725 (Turpin 1985:6-11). As things now stand, associational and distributional information has been presented only in part for the possibly Apachean Infierno phase (Dibble 1978), which should perhaps be considered a valid sociocultural unit.

Some of the remaining phases also may be shown eventually to represent proper units that stand for the residue and reconstructed behaviors of single societies, but for most, this hope is dim. They have far too many diagnostic artifact styles. The Bonfire phase, for instance, includes both Folsom and Plainview dart points which are known to belong to separate complexes elsewhere. I also find it hard to believe that the Gower, Martindale, Uvalde, and Early Barbed dart points of the Viejo unit will turn out all to be the remains of one society. Then, again, the Perdiz and Livermore arrowpoints of the Flecha unit may be shown to belong to separate sociocultural units.

The remedy for the taxonomic problem can be the same suggested for Prewitt's taxonomy: for the time being, consider each of the so-called phases regional periods or subperiods, but continue the same proper nouns. Hence Bonfire period, Eagle Nest period, Cibola period, etc. To harangue further on the Lower Pecos taxonomy would be beating a dead horse, since Turpin has already made the recommended shift in unit labels in a new synthesis she is composing on the Lower Pecos region.

STRANGE PHASES ON THE SABINE RIVER

In 1981, J. E. Bruseth and T. K. Perttula published their *Prehistoric Settlement Patterns at Lake Fork Reservoir*, which reports a wealth of ceramic sites and artifact styles on the Sabine River. But in organizing the new information, the term phase was used in several different ways. First, there are some lithic phases and ceramic phases that I take to be slightly different local styles and patterns, each with a given span of years (Bruseth and Perttula 1981:87-96, 102-104). Finally, four cultural phases are named in the concluding section (pp. 139-143): Archaic (6000B.C.-A.D.1), Lone Oak (A.D. 1-850), Pecan Grove (A.D. 850-1350), and Forest Hill (A.D. 1350-1650)—although an Archaic phase of six millennia is a patent absurdity. Although the contents of the post-Archaic cultural phases are described in some detail, associational evidence is not recapitulated for the reader's benefit. However, settlement patterning, economic data, age information, and stylistic modes are discussed. The trouble is, there is a hierarchy of phases here that is hard to keep straight. The lithic and ceramic phases are each labeled I through III, but the ceramic units, especially, become part of the local cultural phases that themselves somehow interdigitate with existing large-scale phases (foci) such as Sanders and Titus. Perttula, however, is firmly convinced that at least the localized Forest Hill phase (I would call it a subphase) will be an important construct for understanding regional ethnic clustering along streams and valleys (Perttula 1986), and one should lend an ear when such hopes are expressed.

As useful as some of these cultural and temporal distinctions may eventually be, a great deal of associational information (as well as age data and distributional information) will have to be collected before the Lake Fork cultural phases can be considered valid. Furthermore, it is very confusing to have such different kinds of phenomena—lithic, ceramic, cultural, etc.—all parading under the same banner labeled phase. To remedy the problem, I hope Bruseth and Perttula will assign easily separable labels such as facies, subphases, or subpatterns to their small-scale phases, and free the phase label for sociocultural entities that represent the remains of major prehistoric ethnic groups. I suspect Bruseth and Perttula have already reached a similar point of view with no prompting from me.

FOCI, CLUSTERS, PHASES, AND SUBCLUSTERS ON CYPRESS BAYOU

The most fascinating use of sociocultural units in recent years is J. Peter Thurmond's study (1981, 1983) of Caddoan pottery and arrowheads and their geographical clustering along Cypress Bayou and its tributaries. Using associated batches of earthenware vessels from grave lots and potsherds from village middens, Thurmond was able to divide the old Titus focus into two phases of different ages, an earlier Whelan phase and later Titus phase, while lumping both in the Cypress cluster. What is even more important, to me, is the recognition of four subclusters during Titus phase times that are spatial groups of components probably representing tribes or subtribes united at a higher level into a confederacy like those known historically on the Red River and among the Hasinai. There are even suggestions in the preceding Whelan phase of the four geographic groups, though those patterns may merely reflect a survey bias (Thurmond 1983:198).

In most respects, the study on Cypress Bayou imitates another useful reanalysis in the Piney Woods, this by Dee Ann Story and Darrell G. Creel (1982:30-

34). In the Hasinai area an Anderson cluster was recommended that contained the earlier Frankston phase and later Allen phase, though there it was doubted that "archeologists can ever command enough well-controlled data to make identification at [the subcluster] level practical" (Story and Creel 1982:33-34).

Turning to the smallest Cypress Bayou groupings, the Three Basins, Tankersley Creek, Swauano Creek, and Big Cypress Creek subclusters have slightly different design motifs, or motif combinations, in shared pottery types, as well as different proportions of various arrowpoint styles (Thurmond 1983:193-194). These findings are important for people who have been following the debates among ethnoarcheologists concerning the existence of ethnic and social-group stylistic markers among aboriginal people (e.g., Wiessner 1985, Sackett 1985, Lemonnier 1986). Behold, here is a case where both small- and large-scale group marking can be discerned and used by the archeologist for ethnic-group identification—though with the aid, certainly, of a model of social relations dependent on known historic social patterns among speakers of Southern Caddoan. A fascinating and useful contribution of Thurmond's is that small-group ethnic marking among his people is more a matter of differences in local combinations or proportions of styles, rather than in the simple presence of styles among one cluster and their absence from others. Ethnoarcheologists will want to cast an eye on these significant findings, which will probably fit Sackett's (1982) model for ethnic styles (isochrestic variations) better than others.

Finally, I suggest a simple improvement in the system of labels Thurmond used, stating at the outset that this is a minor point that in no way affects his conclusions. I recommend organizing the Cypress Bayou Caddoan components as follows:

Titus phase (Johnson)		**Cypress cluster (Thurmond)**
subphase I (Titus I)		Whelan phase
subphase II (Titus II)	vs.	Titus phase
(4 named clusters)		(4 named subclusters)

The advantages are two. First, the altered system is more economical in terms of the number of proper nouns used—two usages of the term Titus take the places of the names Cypress, Whelan, and Titus. Though a minor matter, the fewer the number of names employed, the easier the learning and memorization of the labels. Second, the term phase continues to be used the way it has generally been applied (as phase or focus) elsewhere in the state, where the term tends to correspond to fairly major ethnic or social entities. Further, by speaking of a large-scale Titus phase divided into subphases, the terminology automatically expresses the continuity from earlier to later times. However, "That which we call a phase, by any other name would smell as sweet"—at least almost as sweet.

LOOKING FORWARD

The thread I have tried to trace in the foregoing lines is quite simple. Of interest to me are phases of the kind that can reflect entire hunting-gathering or simple agricultural societies like those known from colonial days in Texas and adjacent areas. I realize that phase can mean something different from this when used by Mesoamerican scholars or Harvard archeologists, but those people have their own interests that need not mesh with mine. However, the sort of phase useful for effectively recognizing and organizing the residue and inferred behaviors of simple societies has to be treated in a special way. Phase limits in terms of geographic range, time span, and content need to be fairly broad and variable. If the archeologist finds it helpful also to define very small scale units in this part of the world, then let him call them subphases (sociocultural patterns limited, say, to one river valley or range of hills, or to a brief period) instead of phases.

What is most crucial is to define phases carefully and describe the evidence for them to the reading audience. In doing this, the archeologist should imagine he is truly a detective examining and interpreting all site clues that point to primary associations among tools and features. When, in his study of the evidence, he can prove to his readers the existence of similar components from several sites that could be the product of a single people, at that point he has defined a new phase.

Within the last decade a plague of phases has been broadcast by the state's archeologists, showing—at least—that there is no little enthusiasm for doing sociocultural integration in local archeology. But I recall the old adage, "act in haste, repent at leisure," since many of the phase definitions will not hold as much water as one would like. At the same time, the future of phases seems safe and assured, since it is possible to remedy past faults and look for clues that will reveal social units in the surviving debris and garbage of archeological sites. And in looking for this evidence for primitive communities, it will help to recall that we are mainly building taxonomies—social taxonomies, at that. For too long, a series of phases has been looked upon as a chronological scheme. But the taxa should be our main interest, even if they are floating around freely in time with no anchors, since they are all that remains of the societies we claim to be interested in. Dating them is secondary to finding them in the first place. So I hope the trend of the future will be toward more detailed, but flexible, taxonomies. It is at the point where we have (re)created phases that truly interesting, large-scale comparative studies of prehistoric societies begin. As for small-scale studies of economics, religious behavior, and so forth, they can be done with no phases at all.

In leavetaking, let me say that the question of new phases and their worth is merely one part of a larger matter—the criticism of archeological units in general, of all kinds. The creation of named complexes, the application of preexisting Mexican phase names in southernmost Texas, and related actions all want critiquing, though my purpose here has been to concentrate only upon recently defined phases.

Endnote

[1] To review all the evidence for each of Prewitt's five good phases, the ones I have judged minimally adequate, is a chore too large for the present paper, given its restricted theme. Each serious archeologist working in the central part of the state will, in any case, want to conduct his own review, perhaps producing judgments somewhat different from mine. In recommending that the Driftwood, Twin Sisters, and Round Rock phases should be accepted, I rely very much on associational data from the Loeve-Fox site (Prewitt 1982). But the case of the Austin and Toyah phases is somewhat different, since they were originally defined long before the era of phase definition (which began in 1976) now being considered. However, since Prewitt added to their definitions, especially by describing associations at Loeve-Fox, these two phases warrant a short discussion.

As defined, the Toyah phase or focus (Jelks 1962; Prewitt 1981) is too broad a unit, since traits are included in it for which primary associations have not been discussed in print. Nevertheless, the material from stratum 5 of the Kyle site (41HL1) is extremely consistent and may represent the residue of a social group recognizable at other sites. At the Loeve-Fox site there is also some new evidence for a separate Toyah component (Prewitt 1982). The described components occur in a tight area near the eastern margin of the Edwards Plateau, as well as in immediately adjacent areas. The Austin phase or focus suffers from all the weaknesses of the Toyah, but has one well-defined component with examples of primary associations at the Loeve-Fox site (Prewitt 1982). The major published sites are found in the eastern half of the Edwards Plateau and some distance into the prairies to the east (Jelks 1962; Prewitt 1981). Rather than citing the published trait lists, anyone wishing to make use of the Austin and Toyah phases, or refer to them in print, needs to review very carefully the instances of good association among the artifact forms of each. This advice applies, as well, when using any of Prewitt's Archaic phases.

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The Clovis Paleoindian Occupation of Texas: Results of the Texas Clovis Fluted Point Survey

David J. Meltzer

ABSTRACT

A survey of private and public archeological collections in Texas produced data on 205 Clovis points. Areas with high densities of Clovis points are the High Plains, or Llano Estacado, the Balcones fault zone, and the eastern and coastal region of the state. Areas low in Clovis points are the lower Plains and the Trans-Pecos region. These patterns result from differences in site exposure and from the differences in the amount of careful archeological work in the areas, but may also reveal differential land use by Clovis groups. Analysis of functional and technological attributes in this sample of points convirms that Clovis adaptive strategies varied across the state and indicates the strong possibility that Texas Clovis points had multiple uses: many functioned as knives, and some may not have been projectiles at all.

INTRODUCTION

One of the most striking facets of the North American Clovis Paleoindian archeological record is that it comprises largely isolated fluted points not in site contexts. What is true of North America is true of Texas as well; here the Clovis archeological record is dominated by scattered, isolated surface finds (Hester 1977; Mallouf 1981). In general, Clovis Paleoindian sites are uncommon, though admittedly less so on the western Plains than in the forests of eastern North America (Meltzer 1984).

This pattern may be the result of 10,000 years of erosion and other natural and cultural destructive processes that have irretrievably drowned, buried, dispersed, or destroyed the visibility, integrity, or cohesion of later Pleistocene Clovis sites. Certainly one cannot account for the Clovis archeological record without recognition of these processes.

Yet there is a second, more intriguing possibility to consider: it is conceivable that the archeological record of isolated fluted points accurately reflects the structure of Clovis subsistence and settlement strategies. Clovis groups may have participated only rarely in the highly structured spatial behavior that produces sites. This possibility raises some significant questions: what kinds of adaptive strategies produce an archeological record that comprises primarily largely scattered isolated points?, why no other tools?, and what implications does this have for Clovis subsistence strategies? are just a few.

Clovis studies have not yet reached the point where answers to these questions are at hand, but although as yet unanswered, they guide researchers to potentially valuable lines of inquiry. For one thing, they highlight the importance of careful study and analysis of all the Clovis fluted points that litter the landscape. This consideration prompted the Texas Clovis Fluted Point Survey.

Studies of fluted points are not uncommon, particularly in the eastern United States (for the most recent ones see Brennan 1982; Seeman and Prufer 1982). However, with the notable exception of an unpublished paper prepared some 20 years ago (Hester 1967) and a survey of the published record for Clovis points (Prewitt 1985), recent systematic studies do not exist for Texas or, for that matter, for any area west of the Mississippi. Indeed, as Dee Ann Story has noted (1981:142), our views of the Clovis occupation of Texas are based more on speculation than on substantive information; there has not been in the last two decades a systematic study or even inventory of Texas Clovis materials. So the first aim of this study was to compile information on the *amount* and *distribution* of Clovis remains from Texas, beginning with Clovis points, their most readily identified element.

Just as there is no current inventory of Texas Clovis points, so too there is no study of their *typology*. It has long been known that Clovis points show marked morphological variability across the continent and even in single sites (e.g. Haury 1953, Haury et al. 1959). But what causes the variability, whether in use or in style, is unclear and probably will not become clear until, as Alex Krieger noted (1954), the problem is addressed on a large scale through statewide and state-by-state detailed typological studies of Clovis points. So the second aim of this study is to document the morphological diversity in Texas Clovis points. In order to insure that this effort was not constrained by the writer's or others' biases as to what constitues a Clovis fluted point, the analysis included all *non-Folsom* fluted points. Basally thinned Plainview points were not included in the study.

Such a study has implications that go beyond simply detailing point diversity. Take, for example, the matter of Clovis subsistence strategies. Although Clovis groups probably scavenged or occasionally killed mammoths, there is no evidence that Clovis groups were solely specialized big game hunters. But this is not surprising. As a host of authors have argued (Bryant and Shafer 1977; Collins 1976; Johnson 1977; Johnson and Holliday 1984; Meltzer 1984; Meltzer and Smith 1986; Shafer 1977; Story 1981), there are good theoretical reasons to hypothesize that Clovis groups probably practiced a mixed foraging or generalized hunting and gathering, adaptation rather than a specialized big-game-hunting adaptation.

This suggestion, in turn, has significant archeological implications. It has been assumed that the Clovis archeological record of scattered, isolated surface finds represents the remains of highly mobile hunters. Yet the points themselves are rarely found in unequivocal association with faunal remains (Hester 1977:173). More important, the points may not be hunting implements. So the third aim of this study was to detect whether these points were used as anything but projectiles and whether their distribution, when combined with paleoenvironmental data, would provide a glimpse into the foraging and gathering strategies in which they once functioned.

It was for these reasons that the Texas Clovis Fluted Point Survey was undertaken.

THE TEXAS CLOVIS FLUTED POINT SURVEY: METHODS AND BIASES

Any research project that aims to gather data on the abundance, distribution, and diversity of Texas Clovis fluted points faces certain obstacles. The distribution of Clovis points in public and private collections is similar to their distribution in archeological settings, and the points often occur in isolation without meaningful contexts, so few archeologists are able to see many of them. For these reasons collection of data for this study moved along two fronts.

All available published information on Texas Clovis points was recorded, and as many points in private and public collections as was feasible were examined. These collections include the Haynes Collection at the Institute for the Study of the Earth and Man at Southern Methodist University in Dallas, the collections at the Texas Archeological Research Laboratory at The University of Texas at Austin, the Bissell Collection at the Museum of the Southwest in Midland, and the collections at the Plains/Panhandle Historical Society Museum in Canyon. These collections included Clovis points from several sites, though it should be noted that many of the Clovis points found in archeological sites in Texas are intrusive. See, for example, the Clovis points at the Crockett Gardens (Hays 1982), Doering (Wheat 1953), 41SP69 (Chandler 1982), Fred Yarbrough (Johnson 1961), La Perdida (Weir 1956), Meier (Meier and Hester 1972, 1976), and Obshner sites (Crook and Harris 1955), to name just a few that have been published.

In addition, in order to obtain information from unpublished collections throughout the state a questionnaire was sent to the membership of the Texas Archeological Society in the April and July 1985 (Vol. 29, Nos. 2 and 3) issues of the Society's newsletter *Texas Archeology.* This source provided the bulk of the data used here.

Any conclusions drawn in this kind of analysis are constrained by the degree to which the sample is reliable and representative. It is therefore important to identify and assess potential biases in the data that might skew interpretations.

Use of published data on Clovis points is complicated by two potential biases. First, because not all researchers are aware of what kind of information is useful, data needed for my purposes were not always available. This bias should not unduly influence the analysis, since most published reports provide data on point location, size, and shape, as well as a photograph or drawing.

Second, the published record of Clovis material tends to emphasize areas where more extensive archeological survey and fieldwark have been conducted. Indeed, a map of Clovis finds based *solely* on the published record is likely to conform closely to the distribution of major reservoir and highway projects undertaken in the last few decades. This bias is largely offset by the inclusion of unpublished data from private collections.

Data gathered by questionnaire through the TAS Newsletter comes from an extensive network linking avocational and professional archeologists throughout the state, but it has its own biases. There are the usual problems that plague any effort to gather data by questionnaire. Will everyone with Clovis points respond to the survey? Will they fill out the forms correctly? Collecting data by questionnaire limits the quantity of information received for each artifact.

There are also limits on the *kind* of data available. It would be wholly unreasonable to burden survey participants with an extensive list of functional, morphological, and technological attributes to identify, measure, and calculate and to demand precise drawings and technical quality photographs. The information requested in the questionnaire was therefore kept to a minimum, focusing largely on the measurement and description of attributes that carry important functional, technological, and stylistic information (Meltzer 1984). A copy of the survey form is included here as Appendix A, and the data compiled in this study are available from the author. (Any readers who have data on so-far-unreported Texas Clovis points are urged to fill out this form or a facsimile and send it to me.)

There are additional more subtle biases that attend the use of this data set. For one, the questionnaire directly reached only TAS members. Yet, as Elton Prewitt has observed (1985), nonmembers—casual collectors and "hard-core" pothunters—probably control the bulk of the private archeological collections in Texas. Although many TAS members worked to record Clovis points in undocumented collections of nonmembers, most of that material remains unrecorded. (Let me urge again the continued effort to document the collections that exist in the archeological twilight zone.)

Collections of TAS members also may not comprise a representative sample of the Clovis archeological resources of Texas. Visibility of archeological remains varies by region, according to several factors, including vegetation, degree and kind of cultivation, the age of the surface, rate of erosion, and so on. Similarly, the intensity of collecting and survey also varies by region. Because of these biases, blank spots on an archeological distribution map may not reflect the absence of Clovis occupation, but rather the absence of archeological collections or fieldwork. Similarly, areas of high density may well reflect particularly vigorous collectors rather than abundant archeological resources. Interpreting the distribution of Clovis material is complicated by the fact that not all parts of the state have been under the same degree of archeological scrutiny.

Although one can never wholly correct for these biases, they are offset to a certain extent here; part of the bias is eliminated by the splendid and enthusiastic participation of TAS members in completing the survey forms. Equally important, certain biases will fade out as "background noise," owing to the spatial unit (the county) used in the analysis of the distribution of Clovis points. Using the county of discovery as the basic unit for spatial patterning compensates for often incomplete data on the precise location of many Clovis points, insuring that uneven data do not unduly influence the analysis.

More specific matters of bias are addressed in the discussion of spatial patterning below.

THE TEXAS CLOVIS FLUTED POINT SURVEY: RESULTS

The Texas Clovis Fluted Point Survey produced data on 205 points, distributed rather evenly among 95 (37 percent) of the 254 counties in Texas (Table 1, Figures 1, 2). This number is probably on the low side, but what

Table 1. Texas Clovis Fluted Points by County

County	(Site)	Number of Clovis Fluted Points	Reference
Andrews		2	TCFPS
Angelina		1	TCFPS
Armstrong		1	TCFPS
Atascosa		1	Hester 1974 (Fig.1:j)
Bailey		1	TCFPS
Bandera		1	TCFPS
Bee		1	Sellards 1940
Bell		1	TCFPS
Bexar	(41BX 52)	2	TCFPS
Blanco		1	TCFPS, Orchard & Campbell 1954
Borden		1	TCFPS
Bosque		1	TCFPS
Brazos		1	TCFPS
Brewster		2	Enlow and Campbell 1955; Hester 1967
Brown		4	TCFPS
Calhoun		2	Suhm and Jelks 1962
Callahan		1	TCFPS
Cameron		1	Hester 1967
Camp		1	TCFPS
Cherokee		1	Hester 1967, TCFPS
Coke		2	TCFPS
Comanche		2	TCFPS
Concho		1	Stacey Reservoir Report, THC
Cooke		1	Jensen 1968
Crosby	(41CB 64)	12	TCFPS
Dallam		3	TCFPS
Dallas	(Obshner)	3	TCFPS; Crook and Harris 1955 Suhm and Jelks 1962

County	(Site)	Number of Clovis Fluted Points	Reference
Deaf Smith		1	Suhm and Jelks 1962
Denton	(Lewisville)	1	Crook and Harris 1957
De Witt		1	Prewitt, unpublished
Dimmit		6	Hester 1967, 1974 (Fig.1:a,c,f,g)
Duval		1	Hester 1967, 1974 (Fig.1:b)
Ellis		2	TCFPS
Erath		3	TCFPS
Fayette	(Little Pin Oak)	3	Wilson
	(Meier)		Meier and Hester 1972, 1976
Floyd	(41FL6)	1	TCFPS
Foard		1	Etchieson et al. 1979
Gaines		16	TCFPS
Garza		1	TCFPS
Gonzales		1	Hester 1967
Gray		2	TCFPS
Grayson		1	TCFPS
Hamilton		1	TCFPS
Harris	(Galena)	2	Hester 1967; Suhm and Jelks 1962
	(Doering)		Wheat 1953
Harrison		5	Hayner 1955, Hester 1967
Hays	(Spring Lake)	4	TCFPS, Hester 1967
Henderson		1	TCFPS
Hill		2	TCFPS
Hockley		1	Parker, n.d.
Hood		1	Skinner and Rash 1969
Howard		3	TCFPS
Jasper		2	TCFPS
Jefferson	(McFaddin)	10	TCFPS; Long 1977
Johnson		2	TCFPS
Jones		1	TCFPS
Kendall		1	Chandler 1983
Kerr		1	TCFPS
Lamar		2	TCFPS
Lubbock	(Lubbock Lake)	1	Johnson 1983
McLennan		3	TCFPS
McMullen		2	Cooper 1974; Kelly 1983
Marion		4	Hayner 1955; TCFPS
Martin		2	TCFPS
Medina		1	TCFPS
Midland	(Scharbauer)	5	TCFPS
Montague		1	TCFPS
Moore		6	TCFPS

County	(Site)	Number of Clovis Fluted Points	Reference
Navarro		1	TCFPS
Nolan		2	TCFPS
Oldham		2	TCFPS
Panola	(41PN6)	1	Surlock and Davis 1962
Parker		1	TCFPS
Pecos		1	Hester 1967
Roberts	(Miami)	3	Sellards 1952
Robertson		1	TCFPS
Runnels		2	Hester 1967, TCFPS
San Augustine		1	TCFPS
San Patricio	(41SP69)	2	Chandler 1982, Hester 1980
Schackleford		1	TCFPS
Schleicher		2	TCFPS
Starr	(La Perdida)	1	Weir 1956
Swisher		1	TCFPS
Taylor	(McLean)	5	Ray 1930; Sellards 1952; TCFPS
Titus		1	TCFPS
Travis	(Levi; 41TV139)	4	Alexander 1963; Hester 1967
Tyler		1	Suhm and Jelks 1962
Uvalde	(41UV20)	1	Hester 1967
Val Verde		1	Greer 1968
Van Zandt	(Fred Yarbrough)	2	Johnson 1961
Victoria		1	Hester 1974 (Fig.1:i)
Ward		3	TCFPS
Williamson	(Crockett Gar.) Wilson Leonard)	2	Hays 1982 TCFPS
Winkler		2	TCFPS
Yoakum		1	TCFPS
Zavala		2	Hester 1974 (Fig.1:d,e)
Unknown		1	
	TOTAL	205	

NOTES: TCFPS indicates that the source of the data was the Texas Clovis Fluted Point Survey.
The listing of a site on this table does not indicate that all points in the county came from that site.

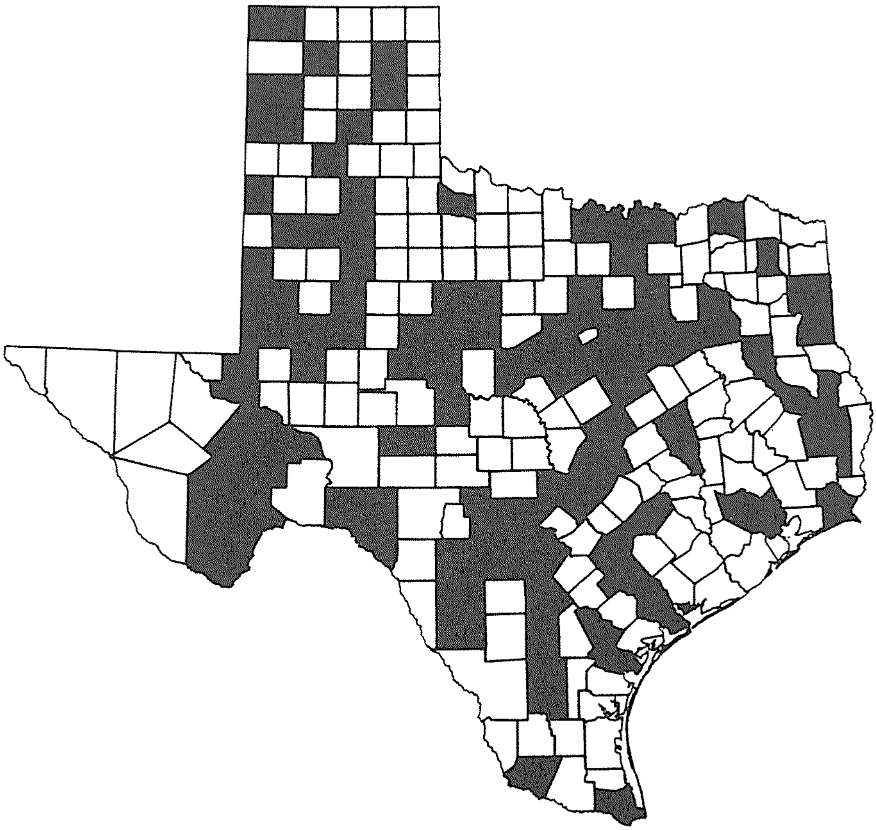

Figure 1. Map of Texas showing the occurrences of Texas Clovis fluted points by county. Data from the Texas Clovis Fluted Point survey.

proportion of Texas Clovis materials it represents cannot be determined in any statistical sense since so little is known of the relevant population parameters.

However, although 205 points may be only a fraction of the points recovered or recoverable in Texas, it nonetheless becomes a substantial sample when compared with tallies from two other surveys of Texas Clovis fluted points. Systematic examination by Prewitt (1985) of 428 published and unpublished site, survey, and salvage reports for the state of Texas resulted in a list of 14 sites and 16 Clovis points. Thomas R. Hester has made a distributional study of Paleoindian points in Texas (Hester 1967), based on an inventory of the published record and public and private collections. He recorded 50 Clovis fluted points scattered among 31 counties in Texas. Although the Texas Clovis Fluted Point Survey may not have produced data on all Texas Clovis points, the sample is at least a fourfold increase over previous tallies.

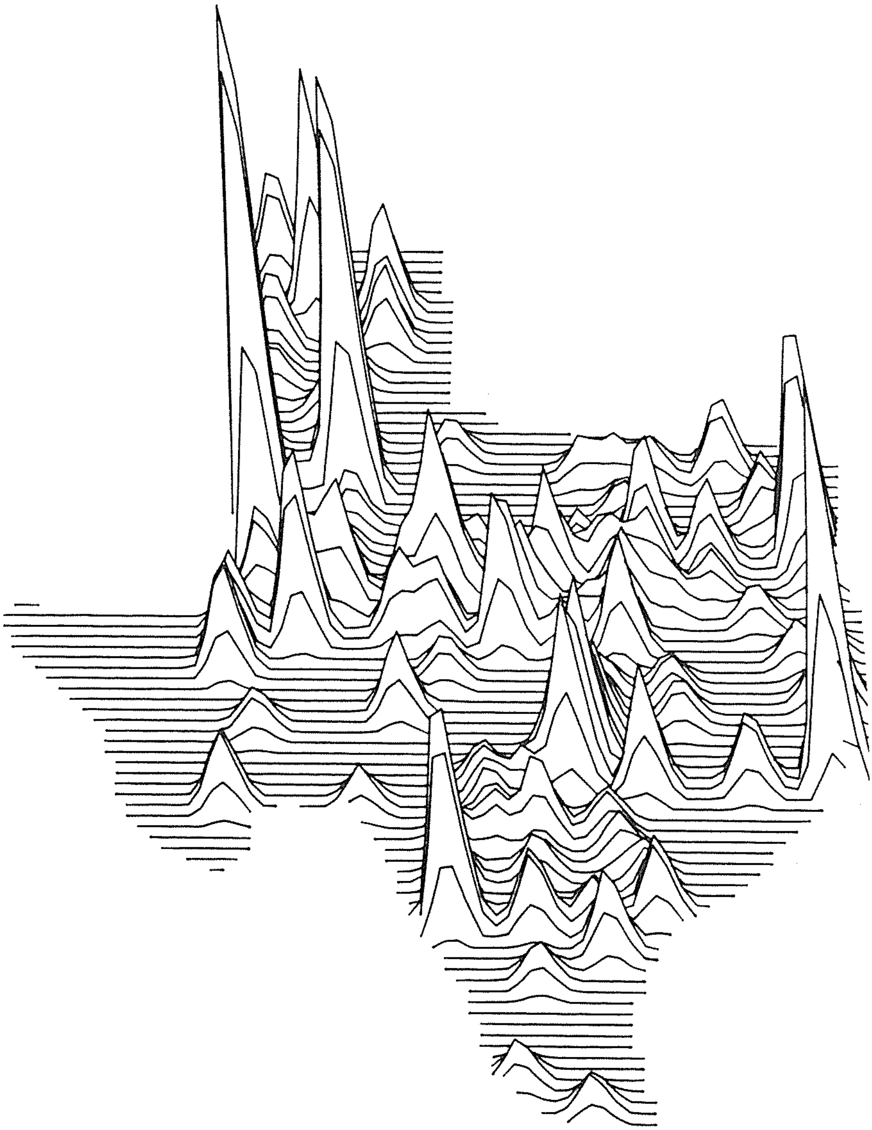

Figure 2. Computer-generated map of Texas showing frequency of Texas Clovis fluted points by County. The highest of the spikes, in Gaines County, represents 16 clovis fluted point occurrences. Data from the Texas Clovis Fluted Point Survey.

The Spatial Distribution of Texas Clovis Points

Of the 95 Texas counties with Clovis points, only three have produced more than six points: two of these, Gaines and Crosby, are High Plains counties, and the third, Jefferson, is a coastal county. In Crosby and Jefferson counties the points come from relatively small sites, 41CB64 and McFaddin Beach respectively. In Gaines County the points were not in site contexts but were dispersed throughout the county. The large number of points from Gaines county is apparently due to the fact that this county has been under more intense scrutiny than have other areas of comparable size.

The three counties just mentioned notwithstanding, Clovis points are fairly evenly distributed. Indeed, the average comes to roughly two points per county, though the statistical mean in this case is somewhat misleading, inflated as it is by the high numbers of points in the three counties mentioned. The modal tendency in this case is more informative (Table 2); 51 of the 95 counties (54 percent) have only one Clovis point, and 87 percent (82/95) of all counties with points have three or less.

Table 2. Modal Distribution of Clovis Fluted Points by County

Number of Clovis Points	1	2	3	4	5	6	<10
Number of Counties	51	23	8	4	3	2	3

Oddly enough, not only do isolated Clovis points fail to cluster significantly in any one county, they do not even appear to reflect the distribution of Paleoindian sites—sites dated between 12,000 and 7000 B.P. (Biessart et al. 1985:40) across the state. A comparison of the distribution by county of isolated Clovis points with the distribution of Paleoindian sites (data from Biessart et al. 1985:107-200, 203-214) reveals that there is no concordance or correlation between the two (Kendall's W=.0001 [n=95]; Kendall's W was used in this instance because of the large number of tied observations). For comparative purposes, there was nearly complete agreement in the frequency distribution by county of Paleoindian sites and the total number of sites of any age (Kendall's W=.957 [n=95]). The distributions of isolated Clovis points and Paleoindian sites by county across the state are unrelated.

One must exercise caution in drawing any conclusions of great moment from this result, given the nature of the data being analyzed and possible distributional biases in the record of Paleoindian sites. But it is worth speculating that this analysis lends credence to the suggestion raised earlier that there might be something distinctive about the distribution of isolated Clovis points in comparison with the distribution of later Paleoindian material. Perhaps this in turn indicates differences in settlement systems through the Paleoindian period. Obviously this possibility warrants further inquiry, though such inquiry is beyond the scope of this paper.

The number of points by county is also unrelated to collector activity, as seen in a comparison of the distribution of Clovis points and collector activity (where TAS members reside is used as a proxy measure of where collecting activity takes place, on the assumption that collecting tends to be done near where one lives). If the distribution of points were a function of the intensity of collector efforts (Hester 1977:173; Lepper 1983), then a map of the distribution of Clovis points by county (Figures 1, 2) would correspond to a map of TAS nember residence by county (Figures 3, 4, Table 3). Comparison of Figures

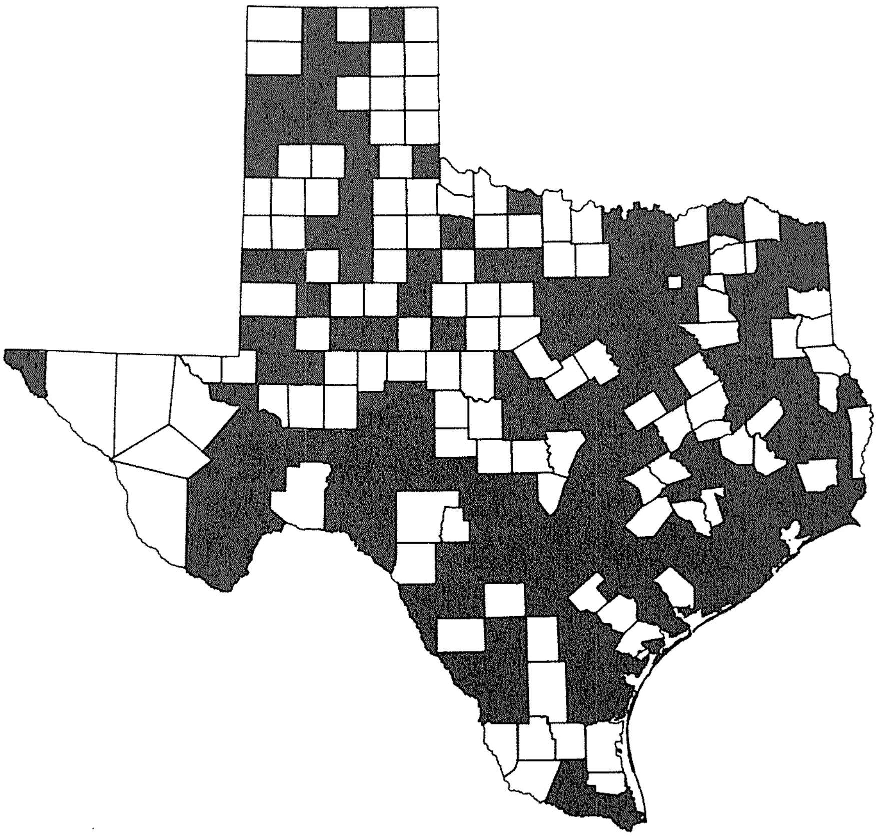

Figure 3. Map of Texas showing the occurrence of TAS members by county. Membership data from TAS membership list, December 22, 1984.

1 and 2 with Figures 3 and 4 shows little overlap between Clovis finds and membership. The two distributions are statistically unrelated(Kendall's W=.221 for counties with both points and TAS members [n=61]; Kendall's W=.179 for all counties with either TAS members or points [n=171]); one would expect the reverse if the number of Clovis points were a function of the amount of

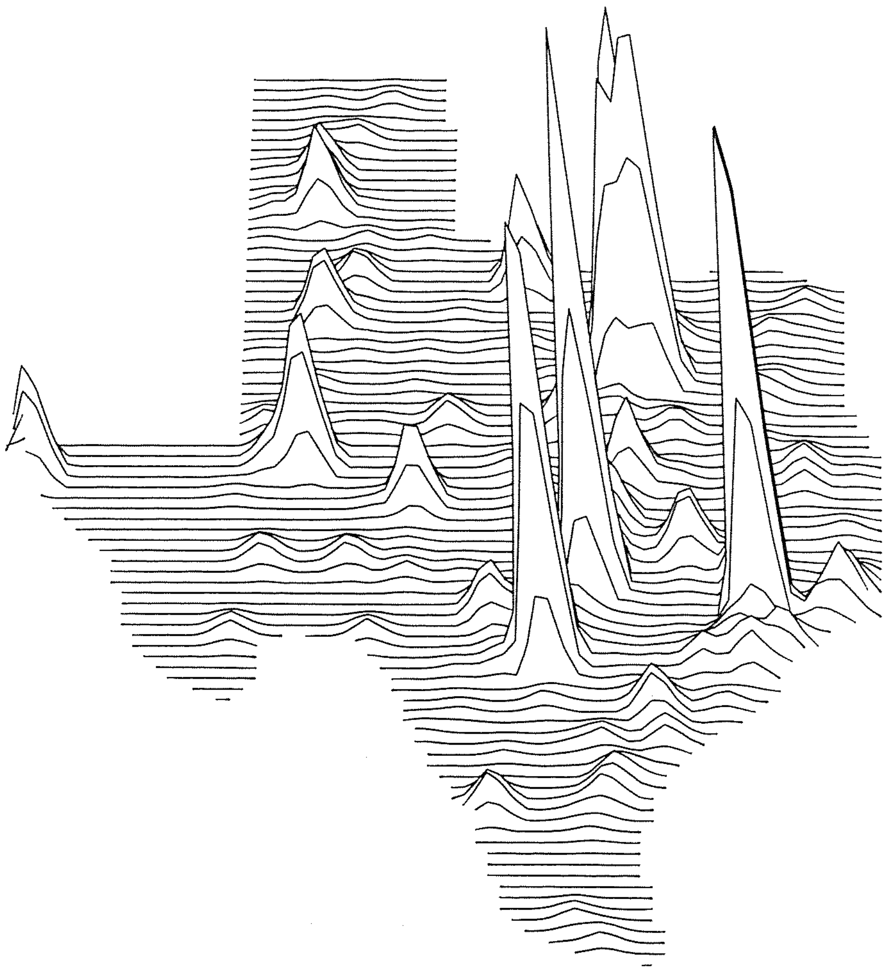

Figure 4. Computer-generated map of Texas showing frequency of TAS members by county. The highest of the spikes, in Harris County, represents 105 TAS members. Membership data from TAS membership list, December 22, 1984.

collecting activity. There may be a relationship between the distribution of archeological finds and collector activity, but the relationship is not evident in this analysis. Low numbers of fluted points in counties of high membership density (e.g. Bexar, Dallas, Denton, Harris, and Travis) are probably not a result of recovery bias. But although the presence or abundance of Clovis points per county is not a direct function of the presence or abundance of TAS members per county, there still remains the possibility that the absence of TAS members in a given county may account for an absence of Clovis points in that county.

Table 3. Frequency of TAS Membership and Texas Clovis Fluted Points by County.

County	TAS Members	Clovis Points	County	TAS Members	Clovis Points
Anderson	1	0	De Witt	1	1
Andrews	3	2	Dimmit	0	6
Angelina	3	1	Duval	0	1
Aransas	1	0	Ector	6	0
Armstrong	1	1	Ellis	1	2
Atascosa	2	1	El Paso	20	0
Bailey	0	1	Erath	7	3
Bandera	2	1	Fayette	0	3
Bastrop	1	0	Fisher	1	0
Bee	3	1	Floyd	6	1
Bell	12	1	Foard	0	1
Bexar	85	2	Fort Bend	6	0
Blanco	0	1	Gaines	0	16
Borden	0	1	Galveston	8	0
Bosque	0	1	Garza	1	1
Bowie	3	0	Gillespie	1	0
Brazoria	8	0	Gonzales	1	1
Brazos	12	1	Gray	0	2
Brewster	3	2	Grayson	1	1
Briscoe	2	0	Gregg	2	0
Brown	2	4	Grimes	1	0
Caldwell	1	0	Guadalupe	2	0
Calhoun	4	2	Hamilton	0	1
Callahan	0	1	Harris	105	2
Cameron	2	1	Harrison	0	5
Camp	1	1	Hays	7	4
Cass	1	0	Henderson	0	1
Chambers	5	0	Hidalgo	2	0
Cherokee	2	1	Hill	1	2
Childress	1	0	Hockley	0	1
Coke	0	2	Hood	2	1
Collin	7	0	Houston	2	0
Colorado	1	0	Howard	1	3
Comal	4	0	Hunt	1	0
Comanche	0	2	Hutchinson	3	0
Concho	0	1	Irion	1	0
Cooke	3	1	Jasper	2	2
Coryell	2	0	Jefferson	11	10
Crockett	4	0	Jim Wells	1	0
Crosby	1	12	Johnson	4	2
Dallam	0	3	Jones	0	1
Dallas	65	3	Kaufman	1	0
Dawson	2	0	Kendall	5	1
Deaf Smith	2	1	Kerr	9	
Denton	67	1	Kimble	1	0

County	TAS Members	Clovis Points	County	TAS Members	Clovis Points
Kleberg	1	0	Robertson	0	1
Knox	1	0	Runnels	0	2
Lamar	1	2	Sabine	1	0
Lampasas	1	0	San Augustine	0	1
La Salle	1	0	San Ptricio	4	2
Lavaca	1	0	San Saba	1	0
Liberty	1	0	Schackleford	0	1
Limestone	2	0	Schleicher	1	2
Live Oak	1	0	Sherman	1	0
Lubbock	14	1	Smith	4	0
McLennan	15	3	Somervell	1	0
McMullen	0	2	Starr	0	1
Marion	1	4	Stonewall	1	0
Martin	0	2	Sutton	2	0
Matagorda	2	0	Swisher	0	1
Maverick	1	0	Tarrant	49	0
Medina	3	1	Taylor	5	5
Midland	29	5	Terry	1	0
Milam	1	0	Throckmorton	1	0
Mills	2	0	Titus	2	1
Mitchell	1	0	Tom Green	15	0
Montague	0	1	Travis	98	4
Montgomery	15	0	Tyler	1	1
Moore	2	6	Upshur	1	0
Morris	1	0	Uvalde	1	1
Nacagdoches	4	0	Val Verde	3	1
Navarro	4	1	Van Zandt	0	2
Nolan	0	2	Victoria	8	1
Nueces	4	0	Ward	1	3
Ochiltree	2	0	Washington	1	0
Oldham	1	2	Webb	7	0
Orange	3	0	Wharton	5	0
Palo Pinto	2	0	Wichita	19	0
Panola	0	1	Williamson	10	2
Parker	2	1	Wilson	1	0
Parmer	1	0	Winkler	0	2
Pecos	4	1	Wood	1	0
Polk	1	0	Yoakum	1	1
Potter	9	0	Young	2	0
Randall	16	0	Zavala	1	2
Roberts	0	3	Unkown	0	1

NOTE: Membership data from TAS Membership List, December 22, 1984.
Number of Texas counties = 254

a. Texas counties with TAS members and 0 Clovis points = 76
b. Texas counties with TAS members and Clovis points = 61
c. Texas counties with Clovis points and 0 TAS members = 34
d. Texas counties with 0 Clovis points and 0 TAS members = 83

In a plot of Clovis points by county certain broad patterns emerge. Points are found from southernmost Cameron County to far northwestern Dallam County , so in a general sense they cover the entire state of Texas. But they do not cover the state evenly; there are clusters of contiguous counties with and without Clovis points. Briefly, the patterns are summarized below (see Figures 1 and 2). Regional designations (Figure 5) follow the geographic and cultural boundaries in *The Handbook of Texas Archeology* (Suhm, Krieger, and Jelks 1954).

1) There is an apparent concentration of Clovis points in the Plains/Panhandle region, specifically in the Llano Estacado or High Plains of West Texas (Brown et al. 1982).

2) There is a scarcity of Clovis points on the lower Plains (Brown et al. 1982); Clovis points are uncommon in a north-south swath 100-km (60-mile) wide and more than 600 km (400 miles) long just to the east of and below the Llano Estacado.

3) The Trans-Pecos region is lowest in the state in both abundance and density of Clovis points.

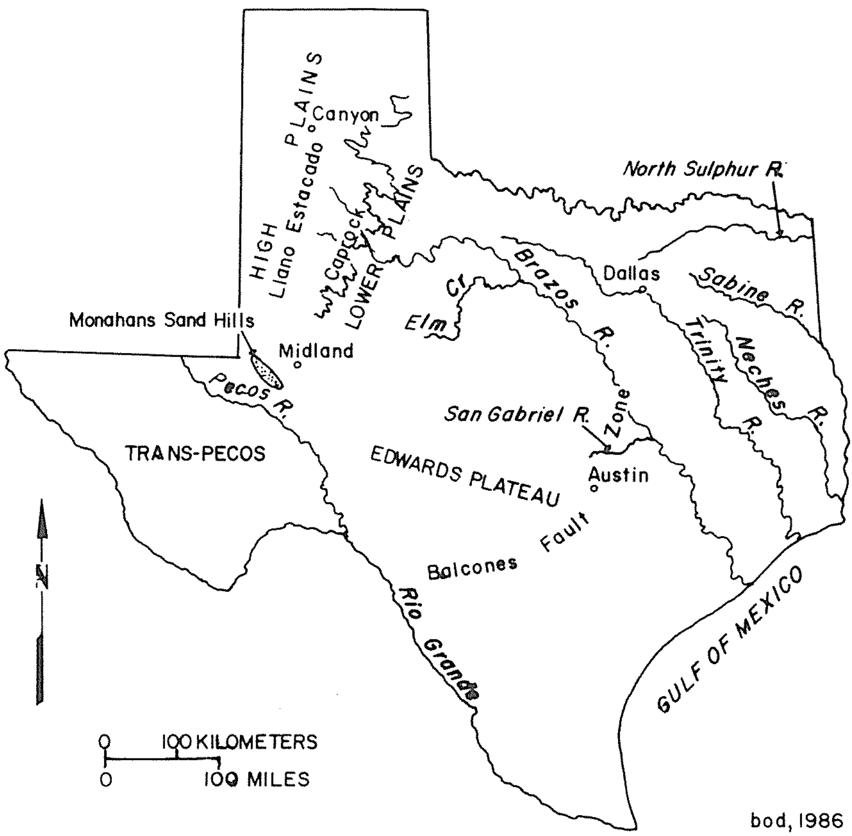

Figure 5. Map of Texas showing the geographical features mentioned in this report. From Erwin Raisz, *Landforms of the United States*, 1939, Revised 1941.

4) Clovis points occur frequently and are rather evenly distributed in a slightly elliptical pattern of contiguous counties extending through Central Texas, from Uvalde County in the southwest to Bell County in Central Texas.

5) Clovis points appear at first glance to be relatively scarce in the coastal region, but some concentrations are found there together with some areas of apparent high versus low densities of point materials.

6) An apparent abundance of Clovis points has been recorded from East Texas.

Table 4. Frequency and Density of Clovis Fluted Points by Region

Region[a]	No. of Points	Area (m^2)	Clovis Points (10,000 m^2)
Plains/Panhandle	73	65,388	11.2
High Plains[b]	66	41,965	15.7
Lower Plains	7	23,423	3.0
Central	59	67,235	8.8
East	22	26,765	8.2
Coast	19	21,527	8.8
Southwest	13	21,683	6.0
North Central	12	24,719	4.9
Trans-Pecos	4	34,797	1.1
Unknown	1	0	0

NOTE: Data on area compiled from Arbingast et al. 1976:78, 79

a All regional divisions except High Plains and lower Plains from Suhm et al. 1954

b High Plains and lower Plains divisions by Brown et al. 1982

The density of Clovis material (Table 4) in the Plains/Panhandle area of West Texas is the highest, by an order of magnitude, in the state. Archeological visibility in the area is high, owing to low vegetation cover and extensive tracts of wheat, grain sorghum, and cotton (Arbingast et al. 1976). Surveys and collecting for Paleoindian remains in the area have also been more common here than in other parts of the state. It was on the Llano Estacado that the Clovis occupation was first discovered and systematically described (e.g. Howard 1935, Sellards 1952). Since that time the area has been scrutinized by archeologists on almost an annual basis.

As a result, there is an extensive record of Clovis material from the High Plains, indeed over one-third (73/205) of all Clovis points in Texas come from this region. In late Pleistocene times the area was undergoing substantial vegetational change. As parklands gave way to extensive grasslands (Bryant and Holloway 1985), a wide variety of Plains floral and faunal resources would have been available, particularly in well-watered settings. Based on both site data and admittedly sketchy information from this survey, Clovis points in this area are found near fossil lakes and marshes and, of course, in association with the draws that today are dry but in the Pleistocene carried substantial amounts of water, perhaps in the form of beaded lakes, across the Plains.

Lithic resources on the Llano Estacado, an area blanketed by extensive Quaternary deposits, are limited to highly localized outcrops or exposures of the Caprock along its west, north, and east margins (Collins 1971:92; Hester 1975:254; Johnson and Holliday 1984:67; Holliday and Welty 1981:202). Clovis projectile points from the Llano Estacado recorded by the Texas Clovis Fluted Point Survey were made from a variety of rocks including Alibates agatized dolomite, Tecovas (or Quitaque) jasper, Edwards chert, and, in the northern counties, Dakota quartzite (see also Hester 1975:254, 255). Unidentified cherts cover a veritable rainbow of colors and a wide range of quality, but no points made from obsidian were recorded (see also Holliday and Welty 1981).

But more important than the diversity of the raw material is the condition of the Clovis points. Johnson and Holliday (1984:67) have suggested that the limited availability of lithic resources on the Llano Estacado led Paleoindian groups to conserve their raw materials through reworking and reuse of artifacts. The data gathered here support this suggestion.

The relative scarcity (Table 4) of Clovis points in a broad, north-south swath on the lower Plains (east of and below the Caprock of the Llano Estacado is intriguing, but the lack of Clovis debris may be more apparent than real. Examination of the data (Table 4, Figures 3, 4) reveals that there are few TAS members living in this 100-to-660-km (60-to-400- mile) corridor, which stretches from Hall and Childress counties in the north to Sterling and Coke counties in the south. The rolling plains and mesquite savanna here probably have not been as intensely surveyed as have other parts of the state.

Perhaps equally important is the fact that even Archaic sites in this corridor are covered by thick overburden. The most striking example of this is a series of hearths associated with chipping debris buried some 8 to 9 meters (24 to 27 ft.) below the surface in the Elm Creek Drainage (see Ray 1930:50, 51; Ray 1940; Figure 6). If this extraordinary report is correct, it demonstrates the potential depth of deposits in the alluvial valleys of the region. In these areas of deeply buried Pleistocene deposits Clovis materials will be less visible than in other parts of the state. Obviously, further work is needed on the surface age and amount of deposition in this corridor.

Fewer Clovis points have been found in the Trans-Pecos region than in any other part of Texas and, given its size, these few points translate into an extremely low Clovis point density (Table 4). The significance of the low frequency and density figures is unclear. It is conceivable that Clovis materials are there in abundance but simply have not yet been found, since surface visibility is low from the Trans-Pecos eastward onto the Edwards Plateau, a region where livestock ranches occupy large tracts of desert scrub and (further east) juniper-oak-mesquite savanna. In addition, many large tracts in this area simply have not been surveyed for archeological remains (Hedrick 1985) and research in the area has been concentrated on sites of later periods (Hester 1967). So the blank spot on the map may result from incomplete sampling.

Nonetheless, it is possible that Clovis groups did not occupy the area in great numbers. Clovis Paleoindian remains are scarce even in the more intensely surveyed parts of the Trans-Pecos (Collins 1976; Mallouf 1981, 1985), suggesting that further survey work may not produce a substantial addition to the Clovis record. Perhaps this should be expected, for, owing to severe environmental constraints on human adaptation, later Paleoindian and prehistoric occupations are only "scattered thinly" throughout the region (Mallouf 1985:100). During the terminal Pleistocene the Trans-Pecos had more water and was more habitable than it is today (Mallouf 1985:16), but the process of postglacial warming and drying was already underway, and by latest Pleistocene times the area probably could support only the kinds of dispersed and fairly mobile populations that occupied the Trans-Pecos in later periods (Mallouf 1981:134).

The distribution of Clovis points through Central Texas forms an ellipse along the east edge of the Edwards Plateau, the Balcones Fault zone. During the glacial period the area supported a mosaic of deciduous and boreal plant and animal taxa, but toward the end of the Pleistocene there was steady warming with a corresponding reduction in forest cover and expansion of grasslands (Bryant and Shafer 1977:14). The Texas Clovis Fluted Point Survey produced little data on the precise settings of Clovis point finds, but the evidence suggests that most were found along streams or on terraces. Prewitt (1984:8) found a similar pattern in the San Gabriel drainage where most sites were on terraces near springs.

In fact, Shiner (1983) has observed that many Clovis and later Paleoindian sites and high concentrations of Paleoindian lithic materials occur along the Balcones Fault zone, particularly at spring heads that emerge at intervals where aquifers breach the fault. He infers that the high density of archeological material at these sites is the result of continuous occupation by Clovis groups who exploited the water, plant, and animal resources that were available yearround at the springs (Shiner 1983:5, 6). Shiner's suggestion is a provocative departure from the common belief that Clovis groups were highly mobile, and appears to rest on sound theoretical principles: sedentary occupations, although uncommon among hunting and gathering groups, are possible when resources in a small area are abundant, reliable, and readily available.

However, an additional, equally important resource occurs along the Balcones Fault zone that influences the character of the archeological record, raising a question as to the validity of the evidence for a sedentary occupation. The same geological process that created the springs also exposed extensive deposits of chert-bearing Cretaceous limestone of the Fredericksburg Group, producing an abundance of high-quality chert in the area. Data collected by the Texas Clovis Fluted Point Survey on rock types used in point manufacture in this area confirm the dominance of the local Edwards cherts. It would be unreasonable to suggest that Clovis settlement patterns were determined by the presence of chert deposits, but certainly the chert deposits would have been a focal point in the settlement system and, more important, would have survived as a highly visible, spatially concentrated component of the archeological record.

When stone is abundant, a substantial archeological record can be produced by a series of brief periods of occupation. Repeated visits to quarry or spring sites will produce interleaved components that, in terms of the sheer amount of archeological debris, mimic a single more sedentary, longterm occupation. Confirmation of the provocative suggestion that Clovis and later Paleoindian groups were almost sedentary (Shiner 1983:6) can be achieved only by an empirical demonstration that goes beyond the observation that lithic materials are there in abundance. Johnson and Holliday (1984:67) reach a similar conclusion.

The figures (Table 4) for the abundance and density of Clovis materials on the Coastal Plain are relatively high. Roughly half of the points came from McFaddin Beach in Jefferson County, an extensively collected locality that has yielded a startling diversity of projectile points and a late Pleistocene fauna (Long 1977). Although it is now on the shoreline, it was far inland during Clovis times, on a vast plain crossed by the Sabine-Neches, Trinity, and smaller rivers (Long 1977:6). Artifacts are not in situ, but are found on the modern beach, where they have been deposited after being eroded out offshore and carried in by currents.

Like the McFaddin Beach material, most of the Clovis points recorded from the coastal region were found in counties bordering the Gulf (Calhoun, Cameron, Jefferson, San Patricio), often just inland, on the beaches, or by drainages that run into the Gulf (e.g. Chandler 1982). The modern Gulf beaches are a Holocene phenomenon, representing the high water mark of postglacial sea levels; the Pleistocene coastline is under water. So any association between Clovis points and modern beaches is significant only for what that association reveals about Clovis materials now lying beneath coastal waters on drowned river terraces and other landforms. Unfortunately, the paleoenvironmental habitat of the Coastal Plain during the Pleistocene is virtually unknown (Bryant and Holloway 1985).

So the relatively high density of Clovis remains in the coastal region (Table 4) is both an underestimate and an overestimate: an underestimate insofar as there is probably a substantial coastal Clovis record under the Gulf waters; an overestimate insofar as the count from McFaddin Beach significantly inflates the density figure for Clovis remains from the inland counties (Bee, Harris, Victoria) of the present-day coastal region, which, in Pleistocene times, were even farther inland. For if the density of Clovis remains is calculated for only the inland counties, the figure—3.9 points in 2,600,0000 hectares (10,000 square miles)—is less than half the figure for the entire coastal region.

It is relevant to add here that although the bulk of the Clovis points from the coastal region are made of Edwards chert from Central Texas (Long 1977), Clovis groups may not have traveled to the Central Texas outcrops for their stone supplies. Several rivers that empty into the Gulf traverse the Edwards Plateau and the Balcones Escarpment, transporting cobbles and gravels of Edwards chert downriver. Although these gravels rarely reach the Gulf Coast (Story 1986), Edwards chert used on the coast may have been transported substantial distances from the outcrops by nonhuman means. It would be valuable to determine whether Clovis lithic debris in Coastal Plain sites shows evidence of rounded, water-smoothed, or pebblelike cortical flakes (Meltzer 1985).

A Clovis point made of Alibates "flint" that has been reported from McFaddin Beach (Long 1977:7) shows little of the wear and attrition that is routinely seen on points that are far from their sources, so it seems oddly out of place on the Gulf Coast of Texas.

The pine and oak forests of East Texas, particularly those in Marion, Harrison, and Panola counties along the Louisiana border, have yielded a number of Clovis points. But 64 percent (14) of the 22 Clovis points from the area recorded in this survey have only minimal documentation, and eight of those have no documentation at all (Hayner 1955). In 1955, using Suhm, Krieger, and Jelks's just-published *Introductory Handbook of Texas Archeology* (1954), Hayner (1955) identified eight Clovis points from Marion and Harrison counties, together with 23 Meserve points that he thought, based on the presence of flutes (Hayner 1955:241), were reworked from original Clovis forms. Unfortunately, none of the purported Clovis points are illustrated. There is no reason for immediate rejection of Hayner's point identifications, but there is room for question. The three Marion County points were purchased from farm hands and could not be documented. Moreover, since the frequency of points for these two counties is rather high (Table 1), a substantial number of Clovis points should have turned up in the 30 years between his report (Hayner 1955) and this survey. Recent work in this area has yielded but one Clovis point, certainly not what is expected from Hayner's report, so these data should be used with caution.

At the time of the Clovis occupation the paleoenvironmental setting of East Texas was probably a complex woodland with a wide variety of deciduous trees and perhaps an occasional boreal species such as spruce. In all likelihood this forest did not support large herds of megafauna (Shafer 1977), save on the north and east edges, where the forest gave way to prairie (Story 1981). Clovis points, together with later Paleoindian material, have been reported from along the North Sulphur River in Lamar County, in an area that has yielded and continues to yield fossils of late Pleistocene megafauna, including mammoth, mastodon, horse, and bison, but there are no associations of Clovis points with the megafauna. If we accept Shafer's (1977) argument (independently developed in Meltzer and Smith 1986), it is likely that any such associations will be rare in this area. Clovis groups in complex forests were probably generalized foragers.

Function, Technology, and Style in Texas Clovis Points

The patterning evident in the distribution of Texas Clovis points raises an interesting question. Are there corresponding differences in point style, function, or technology? Based solely on paleoenvironmental data, one would anticipate significant differences between the Clovis occupations of, for instance, the Llano Estacado and those of the forested east (Bryant and Shafer 1977). Those differences could be manifested in any of a number of ways, including point function or use, technology, and style.

Function

Ideally, a study of the function of Texas Clovis fluted points would include analysis of macro- and microwear patterning. Unfortunately, such analysis was impossible, since most of the data were compiled from questionnaires. This constraint does not preclude the possibility of making statements about tool use, but instead forces the consideration of alternative, less direct clues for information on wear, such as grinding, breakage, and reworking patterns.

In keeping with patterns in other regions—grinding is present on virtually all Clovis points, east and west (Meltzer 1984)—basal and lateral grinding was reported on 96 percent (147/153) of the points recorded for the survey. Grinding is an important element of point function, for it prolongs the life of hafts by preventing the edges of hafted tools from cutting the bindings that attach the tools to the shafts. Judge (1973:263, 264) has suggested that the purpose of grinding—especially lateral grinding—is to allow the final fitting of the point to the haft, and in their studies of the manufacturing process of Folsom points, Tunnell (1977) and others (e.g. Frison and Bradley 1980) support this suggestion, showing that grinding is one of the last stages in point production.

It has also been argued (Frison 1978; Goodyear 1974) that heavy basal and especially *lateral* grinding is necessary where a biface is used for cutting. When a hafted tool is used as a knife, the haft area is under extreme lateral stress while the blade is being worked back and forth in the process of cutting, so butchering tools require strong hafts with heavy binding (Frison 1978:336).

By contrast, a projectile does not make the same demands on the haft, for the projectile haft has only a split second of critical use-life. The stress in a projectile is directed predominantly against its base, making basal—but not lateral—grinding a critical need for effective use.

Heavy lateral and basal grinding on Texas Clovis points suggests their use as knives as well as projectiles. This is not to suggest that all laterally ground points are knives. The fact that heavy lateral grinding *would* enhance the value of these points as knives does not mean that it *did* serve that purpose. Rather, instances of heavy lateral grinding on projectiles are important because they indicate that the points may have been used as knives as well as, or instead of, projectiles. But it should be noted here that the sharp-bladed points from the Casper site, a Hell Gap bison kill in Wyoming, although heavily ground along their lateral edges, were used as projectiles and have impact fractures, and they have no wear patterns indicating their use as knives (Frison 1974:71, 82).

Analysis of the breakage patterns in Texas Clovis fluted points revealed that only 37 percent (66/180) were complete; the remaining 63 percent (114/180) were broken (Table 5). This frequency of breakage is comparable to fluted point samples from other areas (Meltzer n.d.). If anything, the Texas Clovis Fluted Point Survey recorded fewer broken points than would be expected in a sample of this size, but it is not suprising when the difficulty of identifying Clovis fragments is considered.

Although 10 breakage categories used here are largely morphological (a limitation imposed by the available data), they do have implications for technology and use. Broken tips, bases, and corners, for example, result from actions that occur when points are unprotected by hafts, during both manufacture and use; tips and corners are structurally the weakest parts of a point. In contrast, lateral snaps, reworking, and impact fractures most often occur when the points are buried in the hafts and commonly result from actions that occur while the points are in use. The pattern of use-related breaks supports the suggestion that these points may also have been knives, and reveals variation across Texas in point use.

Table 5. Breakage Patterns of 25 Texas Clovis Fluted Points

Type of Break	Frequency
1. No break (point complete)	66
2. Base only (lateral snap)	34
3. Reworked (distal end)	23
4. Distal tip broken	20
5. Base only (lateral snap) with broken corners	7
6. Broken corners	9
7. Distal tip broken with broken corners	8
8. Broken base	4
9. Distal tip broken with broken base	4
10. Reworked (distal end) and impact fracture	4
11. Edge damage	1
Total	180

Lateral snaps (Figure 6) were the most common breaks recorded in this sample (Table 5) and also in a larger sample of points from the eastern United States (Meltzer n.d.). A lateral snap commonly results when an artifact is bowed beyond the limits of its tensile strength (Frison and Bradley 1980:43), which can happen during either manufacture or use (Bradley 1974:197). In the Texas Clovis Fluted Point Survey sample nearly all of the snaps occur at the furthest extent of fluting

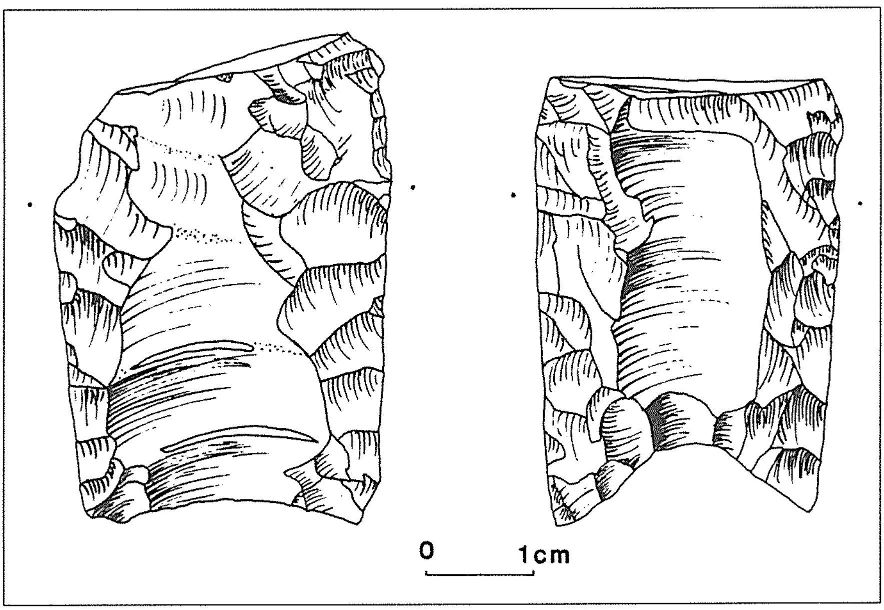

Figure 6. Drawings of Clovis fluted points with lateral snaps: left, from Borden County; right, from Brazos County. Drawn by David Meltzer and Suzanne Siegel.

and lateral grinding, indicating that the breaks occurred during use, while the basal parts of the points were anchored in hafts.

Determining the kind of use that caused these breaks is not a simple task, since lateral snaps can result from use of hafted points as either projectiles or knives (Frison 1974:90, 91; Frison and Stanford 1982:105-107; Purdy 1975:134, 135). However, breakage patterns in Hell Gap projectile points from the Casper site (Frison 1974:72-80) shed some light on this matter. Frison (1974:90, 91) convincingly argues, based on independent evidence including site context and impact fractures, that the Hell Gap points are projectiles that snapped as a result of impact and shock. Examination of the Hell Gap points revealed that less than 15 percent broke at the widest part of the blade, which would coincide with the furthest extent of the haft; most snapped across the lower part of the tang, which would have been buried deep inside the haft; and a smaller percentage snapped above the haft (Frison 1974:90).

Without claiming that this pattern is universal, for much more data and, perhaps, experimentation are needed for such a claim, it is reasonable to assume that all lateral snaps caused by impact and end shock do not occur at the same place on the point, and only rarely do they occur at the distal end of the haft. Based on that assumption, breakage patterns in the Texas Clovis points take on some significance, since in that sample lateral snaps *almost uniformly* occur at or just beyond the distal end of the haft. In other words, although impact-caused snaps occur at virtually any place along the point—but most often within the haft—Texas Clovis points routinely broke at or just beyond the edges of the hafts. This is the break pattern that would be expected in points that were levered in hafts. If the levering that produced these breaks occurred when the hafted points were used as knives, it can be inferred from their breakage patterns that the Texas Clovis points were multifunctional.

Judge (1974:126) has suggested that resharpening and reworking is indicative of multifunctional points. These attributes also occur in areas where stone supplies are scarce. Several reworked points were recorded in the Texas Clovis Fluted Point Survey (Figure 7), but 12.8 percent (23/180) is probably low, since in many cases it was dificult to determine from the sketches and photographs whether a point had been reworked or resharpened. The obvious clues: abrupt changes in thickness, interruptions in the flaking patterns, distal ends that taper asymmetrically in outline and cross section, and remnants of breaks (Bradley 1982:196), were not always evident. When there was any doubt, points were not included in the reworked category.

Reworking generally took place while the points were still set in the hafts. Statistical analysis, using the T test, indicates that width and basal width are identical in points with and without reworking (Table 6, a, b), but that points with and without reworking differ significantly in their overall length (Table 6, c), clearly demonstrating that reworking affects the point length. The constancy in width of points with and without reworking is explained by the fact that reworking took place while the points were still socketed in the hafts, so the sides were protected.

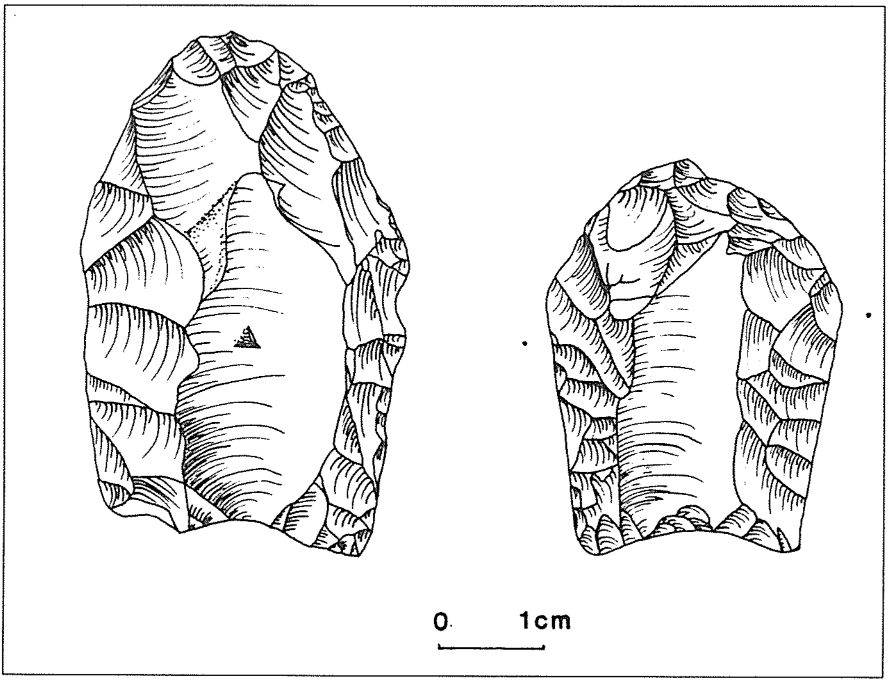

Figure 7. Drawings of reworked Clovis fluted points: left, from Hays County; right, from Monahans Sand Hills. Drawn by David Meltzer and Suzanne Siegel.

This finding is corroborated by Bradley (1982:196, 197), who states that the width:length ratios might be useful for distinguishing points with reworking from those without. Statistical analyses of Texas Clovis data indicate a significant difference in the width:length and base-width:length ratios of points with and without reworking (Table 6, d, e). Overall, width:length ratios are higher in points that have been reworked (Figure 8). These data indicate that it may be possible to use measures of point width:length ratios to determine reworking when direct examination of the points is not possible.

Impact fractures, "small to medium-sized flakes originating at the tip of the point and extending along the face of the blade toward the base" (Wheat 1979:90; Bradley 1974:194), are rare in the Texas Clovis point survey (seen on only two percent of the points). Impact fractures (Figure 9) result from the kind of compressive stress that would be applied to the distal end of a point that made forceful impact with a highly dense material such as bone. Frison (1978:153, 173) indicates that such fractures can result from the use of both hand-thrust spears and thrown spears, suggesting that the angle of attack and impact is as important as the degree of force in producing this breakage pattern. However, experimental work by Dennis Stanford (1985) indicates that hand-thrust spears may not produce sufficient force to cause impact fractures, so more work is needed on this problem.

Table 6. Comparison of Metric Dimensions in Points With and Without Reworking

	Number	Mean cm	Standard Deviation cm
a) Width (T=0.36, df =767, p=0.717)			
Reworking absent	54	2.718	.465
Reworking present	25	2.672	.593
b) Base width (T=0.21, df=76, p=0.833)			
Reworking absent	53	2.289	.437
Reworking present	25	2.264	.565
c) Length (T=5.19, df=77, p <0.001)			
Reworking absent	54	7.463	2.129
Reworking present	25	4.963	1.654
d) Width:length ratio (T=-8.15, df=77, p <0.001)			
Reworking absent	54	.381	.081
Reworking present	25	.564	.113
e) Base width:length ratio (T=-6.93, df=76, p <0.001)			
Reworking absent	53	.327	.005
Reworking present	25	.478	.102

NOTE: T - T value
df - Degrees of freedom
p - Probability

Impact fractures are common in Plains Paleoindian and Archaic bison-kill sites (e.g. Bradley 1982:197; Frison 1974:83; Frison 1978:125, 153, 167, 173, 200; Frison et al. 1976:44-46; Stanford 1978:92; Wheat 1979:90), even in those that predate the earliest record—ca. 9000 B.P. (Wheat 1979:135, 136)—for use of the atlatl. Yet impact fractures are rare, often absent, in most of the classic Clovis mammoth-kill sites, including Blackwater Draw locality No. 1 (Hester 1972:97-99), Dent (Wormington 1957:45), Domebo (Leonhardy 1966:21), Lehner (Haury et al. 1959:16, 17, but see specimen A-12684), McLean (Sellards 1952:39), Miami (Sellards 1952:25, 26), and Naco (Haury 1953:8, 9).

The scarcity of impact fractures among Texas Clovis points again implies that few of these points were in fact used as projectile points. All points with impact fractures have been subsequently reworked and repointed, as is common on bison-kill sites (Frison 1978:200; Wheat 1979:90).

Points from the Llano Estacado have been reworked more often (20 percent) than have points from any other region, and impact fractures on Clovis points occur *only* in those from the Llano Estacado. This hints at possible functional differences in Clovis points from different parts of the state, differences that could be easily explored by analyzing breakage patterns by regions (Table 7),

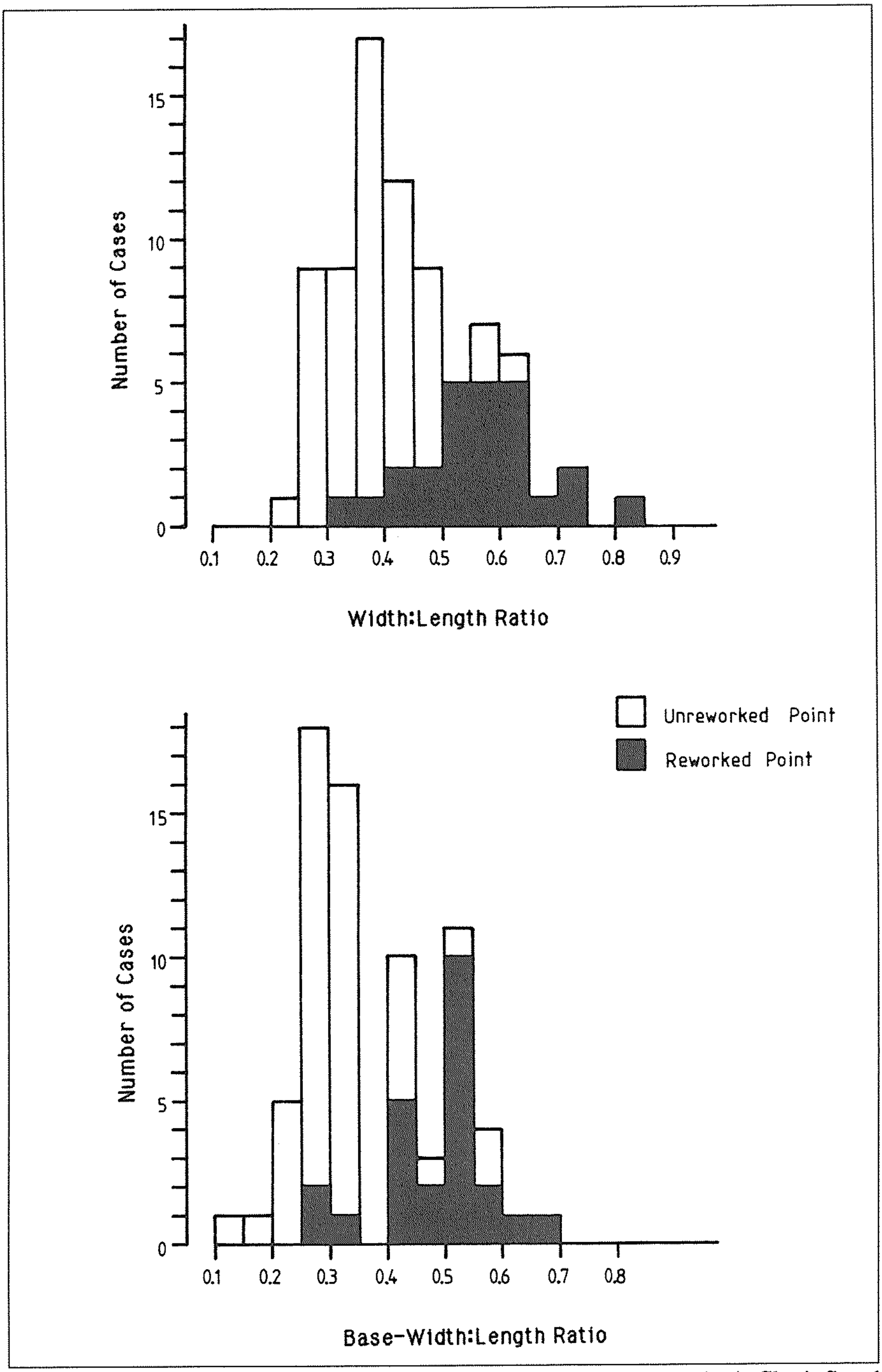

Figure 8. Histograms of values for width: length and base-width:length ratios in Clovis fluted points with and without reworking.

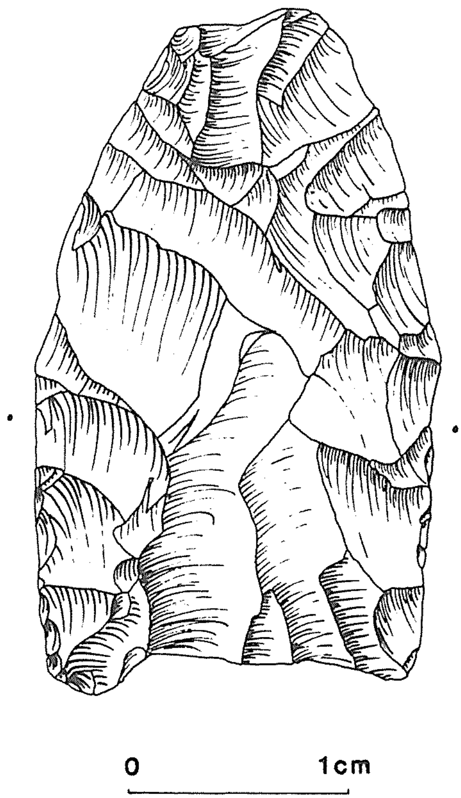

Figure 9. Drawing of reworked Clovis fluted point from Gaines County with impact fracture. Drawn by David Meltzer and Suzanne Siegel.

distinguishing between use and nonuse breaks (see Bradley 1982:197, 198 for a similar discussion).

Chi-square analysis of the data in Table 7 indicates that breakage patterns do not differ significantly by region, but there is some variation in certain regions. Adjusted residual values (Everitt 1977), read as standard normal deviates, reveal that two regions vary significantly from the expected pattern: in the Panhandle-Plains region, use breaks occur more often than would be expected by chance (adjusted residual value=2.12, p=0.0170). By contrast, in the coastal region, whole points and points with nonuse breaks occur more often than would be expected by chance (adjusted residual value=2.73, p=0.0032).

Those data indicate that reworking is relatively high among points from the High Plains and further corroborates the suggestion by Johnson and Holliday (1984) that a shortage of abundant raw material in the region led to use and reuse of the existing supplies. The disproportionately high number of whole points and nonuse breaks from the coastal region may be a function of more abundant raw material, a tendency to collect and record data only on complete or nearly complete points, or different uses for these points.

One feature not identified in Table 5, but worthy of mention, is that none of the points examined had the needle-sharp tips and blade edges characteristic of points in kill sites (Frison 1978:337, 338).

Table 7. Frequency of Whole Points and Nonuse Breaks Versus Use Breaks by Region

Region	Whole Points and Nonuse Breaks[a]	Use Breaks[b]
Plains-Panhandle	38 (-2.08)	34 (2.08)
North-Central	7 (0.11)	4 (-0.11)
East	9 (0.18)	5 (-0.18)
Central	34 (0.38)	19 (-0.38)
Coastal	15 (2.74)	1 (-2.74)
Southwest	7 (0.11)	4 (-0.11)
Trans-Pecos	1 (-0.35)	1 (0.35)

NOTE: Adjusted residual values
Chi-square=9.72, df=6, $0.10 < p < 0.25$
a Comprises categories 1, 4, 6-9, and 11 from Table 5
b Comprises categories 2, 3, 5, and 10 from Table 5

Based on the heavy grinding of the edges and bases of these points, the high frequency of lateral snaps and bend breaks, the scarcity of impact fractures, the incidence of reworking, and the absence of sharp tips or blades, there is a strong possibility that many of the Texas Clovis fluted points had multiple uses as projectiles and as long-handled hafted knives. Following a different line of argument, Judge (1973:128, 1974:126) reaches a similar conclusion, but it is here suggested that at least some of the High Plains Clovis points were used primarily as projectiles, as evidenced by substantial impact fractures. This conclusion must be considered tentative, based as it is on only indirect evidence of tool function. Further intensive work is needed on wear patterns on Texas Clovis points.

Technology

Only half a dozen points recorded in the Texas Clovis Fluted Point Survey were manufacturing rejects, so few direct clues were provided concerning Clovis point technology and manufacturing processes. It is curious that so few unfinished points or preforms were recorded by the survey; the scarcity of unfinished Clovis points from Central Texas is especially puzzling since point production often took place at stone sources, resulting in deposits of manufacturing debris and failed efforts. In areas without abundant stone sources, manufacturing failures probably were carried along and used as other tools in order to stretch the supply of the scarce resource. So it is likely that careful examination of stone source localities will yield evidence of point manufacture as well as a record of used-up points abandoned at the quarry after replenishment of the stone supply (e.g. Gramly 1980).

There are three different techniques for fluting projectile points: (1) Enterline or multiple fluting using guide flakes, (2) straight-based fluting from a beveled edge, and (3) fluting from a prepared nipple or striking platform (see Meltzer 1984:277-282 for a detailed discussion). Multiple fluting of the sort that produces three flute scars—two of which guide the third and main flute—appears to be characteristic of reworking and refluting or perhaps of less proficiency on the part of the knapper. In any case, multiple fluting—three or more flutes—is rare in Texas Clovis points (Table 8).

Table 8. Number of Flute Scars on Texas Clovis Fluted Points

	Number of Flute Scars					Total
	0	1	2	3	4	
Obverse	5	114	29	10	0	158
Reverse	17	91	37	9	3	157

Most Texas Clovis fluted points are singly fluted. Single flutes can be produced from a straight base or from an isolated raised platform. Fluting from a straight base begins with the preparation of a striking platform by beveling one of the faces of the base. On this prepared platform a blow is struck, detaching the flute from the face of the point. This procedure is repeated on the opposite face. In the other process, fluting is accomplished after the careful preparation of a convex or nipple-shaped striking platform on the base. This platform serves as the seat for indirect percussion, which removes the channel flake and creates the flute scar (Roberts 1935; Tunnell 1977).

The primary distinguishing attributes of these techniques are the striking platforms, which are commonly lost in the process of point production. However, the process used for fluting can be recognized from the morphology of the flute scar (Judge 1973:250). In general, short, flakelike—length less than twice the width—flute scars result from striking a straight base; long, bladelike—length twice the width—flute scars result from fluting off a prepared nipple.

Among the points reported in this study, each of these techniques is represented in roughly equal numbers. Of the 205 points, 59 have bladelike flute scars and 57 have flakelike flute scars. In 10/205 cases both blade and flake fluting are present; no data are available for the remaining 79 points in the sample.

Summary statistical data are presented for length, maximum width, maximum width to base, basal width, and thickness (Table 9). Two of these—base and width thickness—clearly are dictated by the technology of hafting and demonstrate that the manufacture of Texas Clovis points was a remarkably precise activity. There were evidently very specific limits within which the finished products could vary.

Table 9. Statistical Data for Selected Variables of Texas Clovis Points

Variable	n	Mean	Minimum	Maximum	Standard Deviation	Kurtosis
Length	153	5.75	1.10	13.04	2.71	-.311
Width	153	2.73	1.71	4.80	.49	1.369
Width to Base	130	2.79	.00	6.50	1.27	.025
Base Width	143	2.34	1.38	4.50	.47	2.343
Thickness	135	.73	.07	2.80	.24	40.014

NOTE: Table includes all points for which measurements are available.
All values except number of observations (n) and kurtosis are in centimeters.
Broken points are included in these calculations. Reanalysis excluding broken points significantly changes the values only forLength, since most breaks affect the length of the point. Mean value of Length in unbroken points is 7.42 cm, standard deviation, 2.13 cm.

This is most readily seen in the positive kurtosis values. Kurtosis measures the relative peakedness or flatness of cases distributed about a mean. Normal distributions have a kurtosis value of zero; in distributions where the curve is flat (cases spread widely about the mean), kurtosis values are negative. In cases where the distribution is more akin to a spike (cases clustered narrowly about the mean), kurtosis values are positive. As is evident in Table 9, kurtosis values for width, base width, and especially, thickness are significantly positive. As mentioned above, because of the reworking of the points, length values vary much more.

These statistics indicate that substantial precision was required in the manufacture of Clovis points; certain dimensions of the points are remarkably standardized. But why the precision? Judge (1973:264) and others, among them Keeley (1982:800), have argued that more time was required to produce a haft than to make a tool, at least when that tool was flaked rather than ground. The obvious implication of this argument is that points were made for hafts, and not vice versa, and that hafts were maintained and curated through the lifetimes of several points. Making a new tool was more efficient than making a new haft.

The disparity in cost between tool making and haft making would have selected for production of many points to fit a few hafts. The resulting standardization in the manufacturing process is reflected in the high kurtosis values for the hafting dimensions: width, basal width, and thickness.

Style

Analysis of stylistic diversity in Texas Clovis fluted points and of the relationship of Texas Clovis points to fluted points in other regions is incomplete, but some preliminary comments can be made.

The great diversity in the morphology of Texas Clovis fluted points (Figure 10) covers forms that mimic both the classic Clovis style and other fluted points. Some of the Texas forms resemble points from the east and particularly the southeast

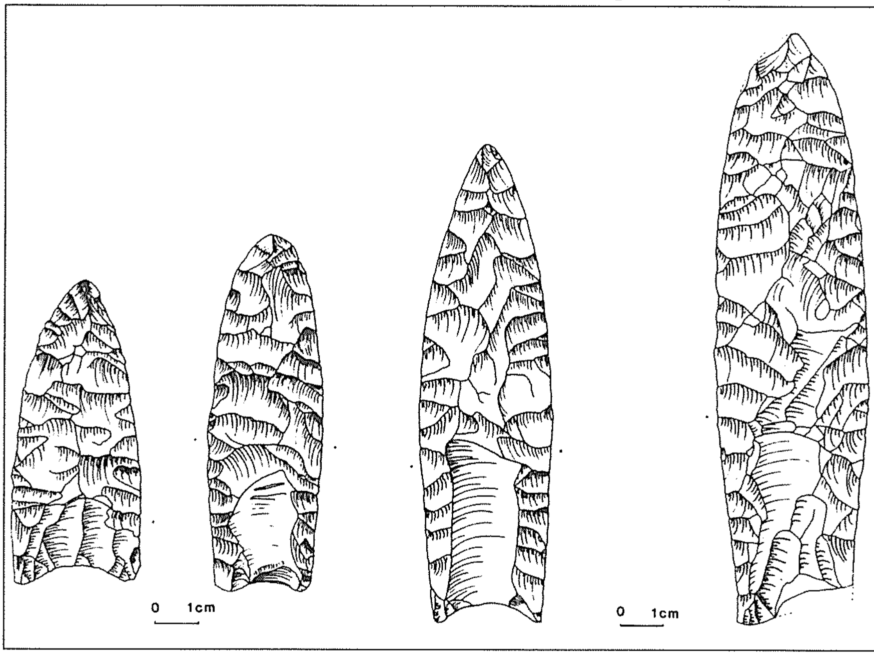

Figure 10. Drawings of Texas Clovis fluted points showing examples of morphological variation. Left to right, from McLennan, McLennan, Winkler, and unknown counties. Drawn by David Meltzer and Suzanne Siegel.

(though there are no Cumberland forms in Texas), but it is noteworthy that the most common point form in the eastern United States—parallel-sided, flake-fluted, elliptical-based points with no "ears"—is not well represented in Texas, comprising less than 5 percent of the points in the Texas Clovis Fluted Point Survey. The Texas sample is dominated by points with tapered sides, and bases that are significantly narrower than the widest parts of the blades.

Presumably this morphological diversity reflects changes in point styles over space and time, but analysis of attributes such as base size and shape failed to produce any significant spatial patterning that might in turn reveal variation in time. The presence or absence of "ears" on the points may have a nonrandom distribution in space. Apparently there are no "ears" on the points from Central Texas, but the significance of this is unclear. Fluting technology is the attribute of fluted points that has the greatest promise for significant variation over space and time. Certainly, fluting from a prepared nipple—producing bladelike flute scars—appears to come late in the Clovis sequence, and by Folsom times it was the dominant fluting technology. However, as noted earlier, fluting from a straight base and from a prepared nipple occur in roughly equal frequency in the sample of Texas Clovis points, and there is no apparent difference in the distribution of blade and flake fluting. Blade and flake fluting appear to be as common on the High Plains as in other parts of the state.

The fact that blade and flake fluting overlap in space does not mean that they necessarily overlap in time. It would be interesting to pursue—through further analysis of the points and through excavation—the hypothesis that flake fluting occurs earlier than blade fluting in Clovis points. If this could be demonstrated, it would provide a valuable indicator of age in the absence of other dating.

It has been suggested that certain exotic fluted point styles, specifically Cumberland points, are found in Texas. In 1935, E. B. Howard (1935: Plates 30(1) and 37(1) illustrated two Clovis points from Texas. One was a classic Cumberland: a large, blade-fluted, fish-tailed point, but no information was given on its provenience, though Howard credited Cyrus Ray and W. E. Baker as having provided him with Texas specimens. Hester (1967:13) later reported that the Galena site in Harris County yielded a point "quite similar to the so-called Cumberland Fluted point" of the eastern United States. There is no way to determine whether the points mentioned by Howard and Hester are one and the same. Whether they are the same or not, this identification poses a problem, for there is no evidence that any other Cumberland forms have been found in Texas. Since Cumberland points are restricted largely to Ohio, Tennessee, and Kentucky, they would be well out of their range in Texas, so in both cases an effort should be made to determine whether the points were actually found in Texas.

SUMMARY AND CONCLUSIONS

Aided by the membership of the Texas Archeological Society and through studies of museum and private collections, the Texas Clovis Fluted Point Survey recorded data on 205 Clovis points from 95 Texas counties. It is not known how representative that sample is of Clovis material recovered in Texas, since an unknown number of points lie out of sight in undocumented collections. And it is not known how representative that sample is of the Clovis archeological record in Texas, since not all parts of the state have been under the same degree of archeological scrutiny, nor do all areas have equivalent exposures of Pleistocene deposits. These limitations notwithstanding, the Texas Clovis Fluted Point Survey data provide a measure of the density and distribution of Clovis points across the state.

Texas Clovis points are distributed evenly by county (mode of one per county). Only a few counties have disproportionately large samples; these are probably counties in which there are particularly active collectors. Texas Clovis points are concentrated generally on the High Plains (Llano Estacado), along the Balcones Fault zone, and in north-central and East Texas. The concentrations in north-central and East Texas may reflect the high intensity of collecting activities there. However, the dense concentration of points on the High Plains and along the Balcones Escarpment probably has archeological significance.

In contrast, Clovis points are relatively scarce off the caprock in the lower Plains (Brown et al. 1982), in the Trans-Pecos region, and perhaps in the coastal area. These patterns may simply reflect sampling patterns or, in the case of the coastal regions, geological processes that have obscured the archeological record.

There is a great deal of morphological diversity in Texas Clovis points, but no clear-cut patterns can be found in the distribution of particular attributes across the state. This does not preclude the possibility that such attributes may ultimately reveal temporal patterning, but the possibility remains that differences such as differences such as those in fluting technology will help sort out some of the temporal variation in the Texas Clovis occupation.

It appears from this study that many or most of the Texas Clovis fluted points were multifunctional, serving as both handled or hafted knives and projectiles. These uses are in keeping with the patterns of breakage, reworking, fracture, and grinding evident in this sample. Obviously, more detailed macro- and microwear studies are needed.

Although the Texas Clovis Fluted Point Survey has uncovered a substantial sample of data on the Texas Clovis occupations, much is still unknown. Attention should be paid to several parts of the archeological and paleoenvironmental record, including documenting the now undocumented collections of Clovis Paleoindian materials, gathering detailed paleoenvironmental data on Texas in the late Pleistocene (Hester 1977), gathering more precise information on locations of Texas Clovis material and relating that information to paleotopography and paleoenvironments, identifying primary and secondary sources of lithic raw material and documenting the use of those sources by Clovis groups, examining macro- and microwear traces on Clovis points in order to understand tool use better, and continuing to explore the spatial and temporal variation of the Texas Clovis Paleoindian occupation through stylistic variations in the points.

The call then is not simply for new data, but also for better refinement of existing data. Obviously many of the most pressing issues regarding the Clovis Paleoindian occupation can be answered only by the discovery and careful excavation of Clovis sites. In the interim, much can be learned from the distribution of Clovis points across Texas.

APPENDIX: TEXAS CLOVIS FLUTED POINT SURVEY FORM

TEXAS CLOVIS FLUTED POINT SURVEY

1. Please trace the outline of the fluted point on the back of this page. Be sure to show the outline of the flute(s). A photocopy of the point would be fine. Please be sure to show both faces.

2. Maximum length ____________ (cm or inches)

3. Maximum width _____________ (cm or inches)

4. Length from base to site of maximum width ______________ (cm or inches) (If widest part of point is at the base, this value is 0).

5. Maximum thickness _____________ (cm or inches)

6. Width of base ______________ (cm or inches)

   (On items (2) through (6), above, be sure to circle whether measurements were taken in centimeters [cm] or inches).

7. Is the base of the point ground smooth? Yes No

8. Are the sides of the point ground smooth? Yes No

9. If the answer to (8) is Yes, please show the extent of the grinding on your sketch or photocopy of the point (see figure).

10. How many flute scars are on each face of the point?
    a. Flute scars on obverse: 1 2 3 4 (circle one)
    b. Flute scars on reverse: 1 2 3 4 (circle one)

11. Is the largest flute scar on the obverse face twice as long as it is wide?
    Yes No

12. Is the largest flute scar ont he reverse face twice as long as it is wide?
    Yes No

13. Location where point was discovered: ______________________________

____

____

(Please be as specific as possible: include County name)

14. Associated artifacts or features found with point: ______________________
____
____

15. Describe the color and type of stone material: ______________________
____

Please print your name and address: Please mail the completed form to

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Dallas, Texas 75275

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San Patrice and Dalton Affinities on the Central and Western Gulf Coastal Plain

H. Blaine Ensor

ABSTRACT

This paper recommends integrating the San Patrice phenomenon of Texas and Louisiana as defined by Webb (1946), Webb, Shiner, and Roberts (1971), and Duffield (1963) into a broader regional perspective. Recent research on the Gulf Coastal Plain of Alabama and Mississippi has produced evidence for widespread similarities between San Patrice and Dalton in morphology, technology, and environment. Supporting data are presented for the inclusion of San Patrice as a local Gulf Coastal expression of the eastern Woodlands Dalton horizon, and evidence for a Dalton subhorizon marker is discussed. Finally, a plea is made for the increased use of interregional taxonomic classifications and standard artifact descriptions.

INTRODUCTION

This paper attempts to place the San Patrice phenomenon of Louisiana and East Texas as defined by Webb (1946) and Webb, Shiner, and Roberts (1971) into a broader regional perspective. Recent syntheses and reviews of the archeology of East Texas and Louisiana offer somewhat conflicting interpretations of San Patrice and its cultural and chronological position (cf. Patterson 1980). The San Patrice finds of East Texas and Louisiana have been variously associated with the Paleoindian period by Story (1981) and Webb, Shiner, and Roberts (1971), and with other late Pleistocene-early Holocene manifestations by Shafer (1973, 1977) and Duffield (1963). Wallace (1982:221) discusses the overall cultural and chronological placement of San Patrice occupations in Louisiana and also notes that in general, San Patrice occupations have been designated terminal Paleoindian. Story (1981), in her overview of East Texas archeology, considers San Patrice a part of the Paleoindian period, although she points out that this is by no means certain. In basic agreement with Shafer (1977), she indicates that the traditional Plains model of big game hunting is probably not applicable in East Texas.

Duffield (1963:138) suggests that San Patrice points at the Wolfshead site in East Texas are associated with a pre-Archaic manifestation that occurs before corner- and side-notched expanding-stem forms such as Edgewood and Neches River. He further assigns San Patrice points to the same general time period with lanceolate projectile points of the Paleoindian tradition. Webb, Shiner, and Roberts (1971:46) state that the San Patrice assemblage at the John Pearce site is technologically closer to Plains Paleoindian. Morse (1973:30) considers San Patrice a southern variant of Dalton but notes that San Patrice is usually referred to as Paleoindian in the lower

Mississippi Valley. The general consensus, however, has been that data for adequately distinguishing San Patrice from earlier, later, or contemporaneous manifestations are not available (Patterson 1980). Radiocarbon dates and stratigraphic sequences are badly needed to aid in clarifying much of the conflicting data (Story 1981).

Recently, Goodyear (1982) has argued for temporal placement of the Dalton horizon in the eastern Woodlands between 10,500 and 9,900 years ago. Other estimates place the age of Dalton between 10,000 and 9,500 years ago (Walthall 1980; Ensor 1981). The Dalton horizon is believed by many to bridge the gap between Paleoindian manifestations and later Early Archaic assemblages characterized by corner- and side-notched bifaces. Projectile points resembling the Dalton type are generally believed to date between 11,000 and 9,000 years ago over a wide area of the Gulf Coastal Plain from the Mississippi River to East Texas and northward into Oklahoma, Arkansas, and Missouri (Webb et al. 1971).

DISTRIBUTION OF SAN PATRICE AND DALTON SITES ON THE GULF COASTAL PLAIN

Recent research on the Gulf Coastal Plain of Alabama and Mississippi has produced evidence of widespread similarity in patterns of cultural expression from about 11,000-9,000 years B.P., or the terminal Pleistocene-early Holocene interface, over much of the southeastern United States (Ensor 1981, 1982; Brookes 1979). The distribution of Dalton, San Patrice, and related lanceolate forms across the Gulf Coastal Plain (Figure 1)suggests that the Dalton horizon extends over much

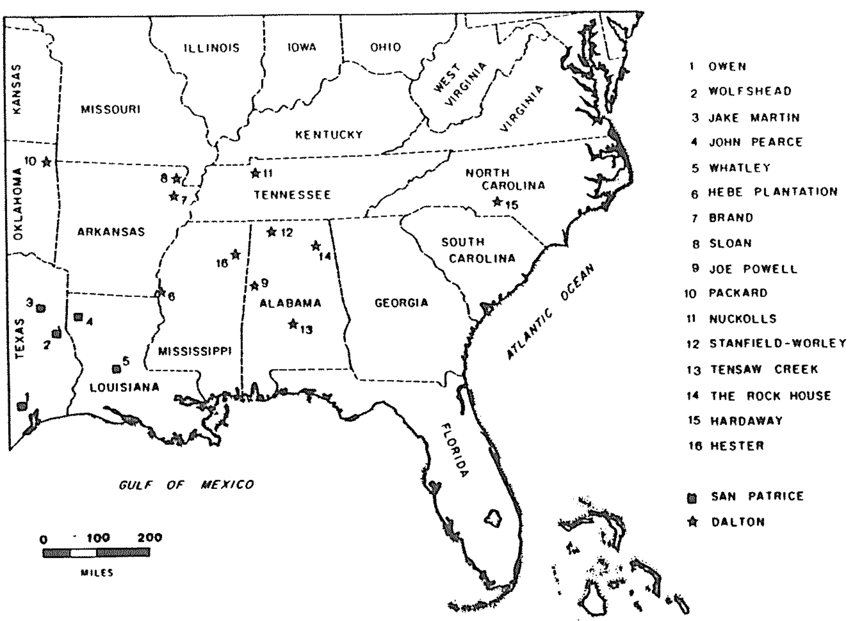

Figure 1. Map showing selected San Patrice and Dalton sites in the central and western Gulf Coastal Plain. Drawn by Kathy Reese.

of East Texas and Louisiana.

Attempts at integrating the vast and largely unknown terminal Pleistocene-early Holocene cultures of the Gulf Coastal Plain have been impeded by the lack of comparative data and precise descriptive/taxonomic practices. Fenwick and Collins (1975) point out that traditional archeological lithic analysis in the southeastern United States and Texas has often fallen short of producing the well-rounded studies needed to complement other data and permit in-depth interpretation of cultural systems. The number of terminal Pleistocene-early Holocene sites on the Gulf Coastal Plain that have been adequately described is still limited.

Recent work on the coastal plains of Alabama and Mississippi has provided some initial insights into this largely unknown area. A stratigraphic sequence at the Hester site (Brookes 1979) and data from the Joe Powell site in the Gainesville Lake area of west-central Alabama (Ensor 1985), have provided much needed data on terminal Pleistocene-early Holocene cultures on this part of the Gulf Coastal Plain. Close technological and morphological affinities between San Patrice and Dalton forms are apparent from these investigations.

The work of Clarence Webb and others at the Pearce site in northwestern Louisiana has clearly isolated an early lithic horizon consistent with Dalton morphologies on the coastal plains of Alabama and Mississippi (Webb et al. 1971). Westward extensions of San Patrice are found in East Texas at the Wolfshead (Duffield 1963) and Jake Martin sites (Davis and Davis 1960), among others.

The western limits of San Patrice forms, according to Webb, Shiner, and Roberts (1971), occur in the Brazos River valley of east-central Texas, but they are more common in East Texas. Morphologically similar forms such as Brazos Fishtail (Watt 1978) and Rodgers Side-Hollowed (Willey et al. 1978) from north-central Texas reflect more of a Plains adaptation and should not be confused with the San Patrice type. Local chronological constructs in Central Texas do not recognize San Patrice as a major component (cf. Weir 1976; Prewitt 1981). Webb, Shiner, and Roberts (1971), Gagliano and Gregory (1965), Thomas and Campbell (1978), and Yarborough (1981) have demonstrated that San Patrice and related forms are common throughout most of Louisiana, western Mississippi, and southern Arkansas (cf. Morse 1973). Patterson (1980) has noted San Patrice points in Harris and Wharton counties of southeastern Texas, and Greenwell (1984:129) has described an apparent San Patrice variant from coastal Mississippi.

MORPHOLOGICAL AND TECHNOLOGICAL RELATIONS

Dalton varieties from the Hester site in northeastern Mississippi (Brookes 1979) and the Joe Powell site in west-central Alabama (Ensor 1985) closely parallel morphological and technological diversity found in the San Patrice Hope and St. Johns varieties (Duffield 1963; Webb et al. 1971) from Louisiana and East Texas (Figures 2, 3). Dalton varieties from Alabama and Mississippi include a lanceolate version (Cochrane) and another (River Bend) with incipient side notching (Ensor 1985; Brookes 1979). Smith (1986:10-14) has noted that early Holocene projectile points, including Dalton and related forms, characteristically have been resharpened. In the case of Dalton points, Goodyear (1974:19) demonstrates several different stages of bifacial blade modification. However, none of these appears to affect the haft element to a large degree. The designation of neither Dalton nor San Patrice varieties is based herein on blade modification; both varieties of each type have been resharpened, some with beveling. Rather, the variety designations are determined by differences noted in haft element morphology. The cultural and chronological significance of these differences is unclear, given the lack of stratigraphic data. At this time one can only make these distinctions and hypothesize concerning their meaning. The two Dalton varieties defined for the Tombigbee drainage may represent chronologically and spatially restricted forms. These may prove eventually to be indicative of local or regional cultural groups and provide markers for local phase definition. The varieties discussed by Webb, Shiner, and Roberts (1971) appear to parallel the morphological variation found in Dalton forms over much of the southeastern United States (Ensor 1985:39) and may represent differences in local phase content. Morse (1973) has noted a similar breakdown of Dalton morphology in the lower Mississippi alluvial valley that includes both lanceolate and side-notched variants. Coe (1964) has demonstrated similar morphological distinctions from North Carolina, where the Hardaway-Dalton and Hardaway Side-Notched types are found in an early context below corner-notched forms. As noted by Ensor (1985:39), these data indicate that there may be a broad subhorizon marker within the Dalton horizon as it is currently defined.

The San Patrice Hope and Dalton Cochrane varieties (Figures 2, 3) have overall morphological and technological similarities. They are basically triangular forms with incurvate ground bases and no definite lateral haft-element modification. Blade edges are straight, and most have been resharpened. There is strong evidence that flutelike flakes have been removed from the basal edge of the San Patrice Hope variety, but this is not characteristic of the Dalton Cochrane variety.

The San Patrice St. Johns and Dalton River Bend varieties (Figures 2, 3) also have strong morphological and technological similarities. Both have incurvate to recurvate ground basal edges, expanding lateral haft elements, and straight, tapered shoulders. Blade edges are straight and intensively resharpened. Perhaps the most striking similarity is in the removal of broad, flutelike flakes from the base. The Dalton and San Patrice varieties are also similar in size.

Evidence for other close technological relations between Dalton and San Patrice is also apparent. Technological similarities include the use of local chert resources in tool manufacture and the use of flakes to make many tools such as projectile points, hafted end scrapers, and other scrapers. By themselves, these proposed similarities offer no direct basis for comparison, since they could be applied to many prehistoric lithic assemblages in North America. However, when viewed from a regional perspective, they do reveal some interesting trends. As noted by Smith (1986:14, 15), early Holocene lithic assemblages in the Southeast are dominated by resharpened projectile points and demonstrate the use of bipolar flaking to produce usable flake blanks and to recycle tools. Woodworking tools such as the Dalton adze (Morse and Goodyear 1973) and unifacial scraper-planes (Ensor 1981, 1985) are common at Dalton sites in the Southeast. Uniface end and

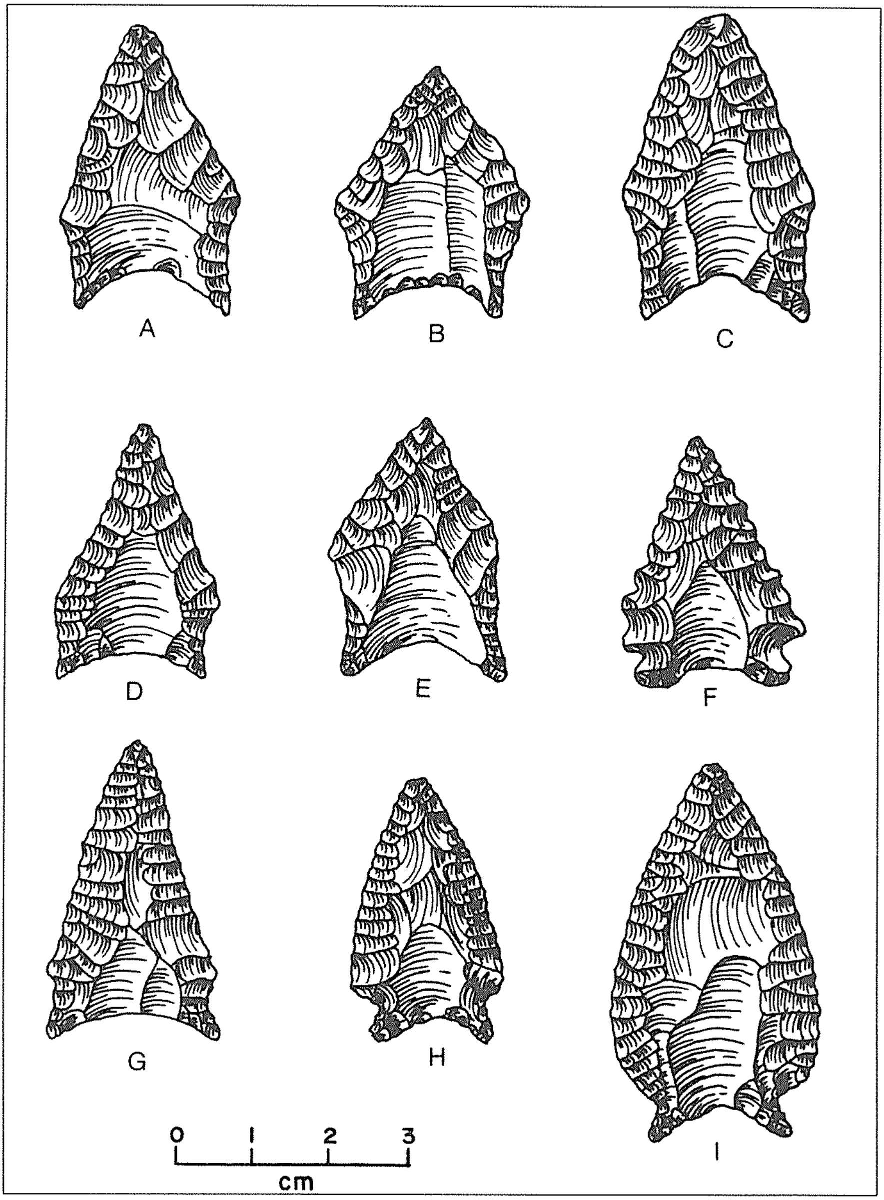

Figure 2. Drawings of San Patrice points. A-E, Hope variety; F-I, St. Johns variety. Redrawn by Kathy Roemer from Webb 1946, Plate 1.

lateral scrapers, burins, gravers, and other notched tool forms are also common at Dalton sites (Goodyear 1974; Brookes 1979). San Patrice assemblages have similar content and, except for the Dalton adze, include all of the above forms, albeit under different names in some cases (Webb, Shiner, and Roberts 1971; Duffield 1963).

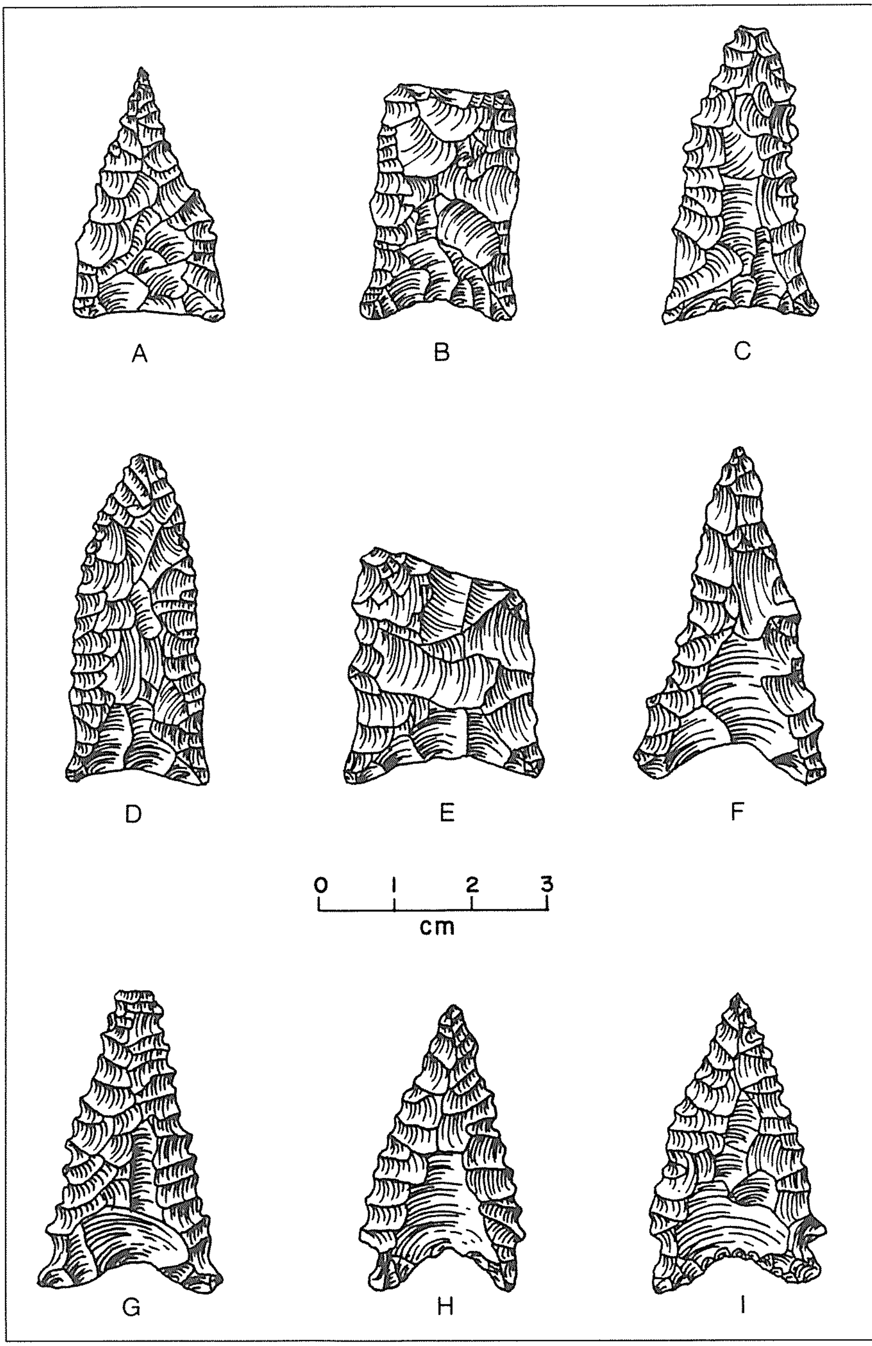

Figure 3. Drawings of Dalton points. A-E, Cochrane variety; F-I, River Bend variety. Redrawn by Kathy Roemer from Ensor 1985, Figure 5.

In summation, the use of local chert to manufacture the greater number of tool forms is seen in this case as evidence for close technological affinity in the Dalton and San Patrice assemblages. Both are directly preceded by Paleoindian tool kits that are dominated by nonlocal materials (Goodyear 1979). San Patrice and Dalton points on the Gulf Coastal Plain are most often made from local materials, but earlier lanceolate froms such as Clovis, Folsom, and Plainview are more often made from exotic materials. The use of bipolar flaking to produce adzelike scraper-planes, wedges, burins, and flakes for tool manufacture is common in western Alabama and northeastern Mississippi. Although bifacial Dalton adzes do not seem to be present in San Patricie assemblages, functional equivalents may be present (cf. Duffield 1963:107-114). Comparing this aspect of coastal plain Dalton and San Patrice assemblages is difficult due to differences in the availability of raw materials and in techniques of artifact description. Certain tools referred to as *scaled pieces* at the Pearce site resemble bipolar cores that have been rotated and turned over for additional flaking (Webb et al. 1971:23). Duffield (1963) illustrates several quadrilateral forms manufactured from petrified wood, which he terms *knives*. Some of these may or may not have been produced by a bipolar technique. The diversity of technology and use of San Patrice and Dalton assemblages on the Gulf Coastal Plain is apparently similar if differences in local raw materials are held constant. In general, both the San Patrice and Dalton assemblages on the coastal plains of Alabama and Mississippi are made up of small artifacts, their size limited by the raw materials available. This appears to reflect both the small size of natural raw materials and the nature of the local settlement system. The need for procuring large pieces of knappable stone evidently had diminished, compared to earlier Paleoindian resource exploitation.

CULTURE AND ENVIRONMENT

As already noted, Goodyear (1982a) has proposed a chronological position for the Dalton horizon in the southeastern United States, which places it between 8500 and 7900 B.C. (10,500 -9,900 B.P.). His estimate is based on radiocarbon dates of major hafted-biface styles from sites in the Eastern Woodlands. He postulates a post-Pleistocene adaptation to a mesic deciduous forest for the Dalton culture. Along the Gulf Coastal Plain it has been difficult to pinpoint a particular time period for late glacial and early postglacial forest transition. Current evidence suggests that a general warming and drying took place over much of the area from South Carolina to Central Texas during late glacial and early postglacial times, from about 11,000 to 8,000 B.P., which apparently resulted in the establishment of a xeric oak-hickory- southern-pine forest along the Gulf Coastal and southern Atlantic plains (Delcourt and Delcourt 1979). The mixed deciduous forest environments covering much of the southeastern United States by 10,000 B.P. provided the environmental conditions to which Dalton culture was adapted. The westward extensions of San Patrice into East Texas corresponds closely to modern-day extensions of the eastern Woodlands or the Austroriparian Biotic Province as defined by Blair (1950).

If San Patrice belongs culturally and environmentally to the eastern Woodlands

Dalton horizon, it can be inferred that a hunter and gatherer adaptation to essentially modern floral and faunal species was made. Dalton groups over much of the eastern Woodlands were at least partially adapted to modern floral and faunal regimes (Goodyear 1982a).

Shafer's (1977) interpretation of early lithic assemblages and environmental adaptations in East Texas points to a mixed hunter and gatherer economy between the eastern High Plains and the eastern Woodlands. Wyckoff (1985:23) has argued for complex late Pleistocene-early Holocene hunter-gatherer adaptations along the prairie-eastern Woodlands interface in eastern Oklahoma. Some San Patrice groups may have adapted to this transitional zone in East Texas and focused on the exploitation of a mixed deciduous forest; other late Pleistocene-early Holocene groups further west and north may have adapted to more of a big game-plains environment (Shafer 1977; Story 1981). Both Shafer and Story suggest that cultural and environmental forces may differentiate Paleoindian or big game hunting cultures from San Patrice groups in the East Texas area. They cite shifts in lithic procurement systems and an increase in frequency of San Patrice points as evidence for more restrictive adaptive patterns and perhaps for increased population. As Goodyear (1979) has noted, this may reflect changes in economic orientation and attendant settlement systems or a settling-in of ethnic populations. Gunn (1982:224) has pointed out that Gagliano and Gregory's survey of Paleoindian points in Louisiana upholds Goodyear's thesis; data from Clovis and Dalton sites in west-central Alabama (Ensor 1982) also support this trend.

SUMMARY AND CONCLUSIONS

In summary, current research points to the existence of widespread uniformity in Dalton-San Patrice technology and morphology, with regional environmental differences apparent from roughly 11,000-8,000 B.P. on the Gulf Coastal Plain across Louisiana, southern Arkansas, Mississippi, and western Alabama (Figure 1). Data from Alabama and Mississippi suggest that terminal Pleistocene-early Holocene occupations reflect increased territorialism and regional diversity over earlier fluted point cultures. It is suggested here that the San Patrice phenomenon, based on stylistic, technological, and environmental considerations, represents a central and western Gulf Coastal Plain extension of the eastern Woodlands Dalton horizon.

Taxonomic schemes conducive to integrating widespread areas from both cultural and environmental viewpoints are relatively scarce. Stoltman's (1978) recent attempt to provide such an areal framework for eastern North America is a noteworthy example. Although there has been improvement in descriptive and taxonomic practices, it is felt that until such concepts are systematically applied across diverse regions, differences and similarities in local phases will continue to be masked. The San Patrice-Dalton example provided here is clear indication of a need for the application of interregional taxonomic schemes that stress cultural and environmental relations. Admittedly, much of the data, both cultural and environmental, is still sketchy with regard to the prehistoric record. However, it is imperative that an attempt be made to integrate regional constructs into larger interregional schemes.

Wyckoff (1985) has offered some timely criticisms on the use of projectile points or a few other tools for horizon markers. Use of such markers uncritically, without regard to strict definitions and purpose, undoubtedly leads to pitfalls.

There are systems of projectile point or hafted biface typology, such as the cluster/type approach advocated by Faulkner and McCollough (1973), Ensor (1981), and Futato (1983) for parts of Tennessee and Alabama, for integrating widespread cultural phenomena. The cluster/type concept has close parallels with the horizon style; both serve to integrate phenomena that are widely distributed in space and of relatively short duration (Willey 1945; Willey and Phillips 1958). Under such a scheme the Dalton horizon as defined by Tuck (1974), Morse (1973), and Goodyear (1982) for the eastern Woodlands area would extend into Louisiana and East Texas to integrate local manifestations such as San Patrice. San Patrice would reflect local adaptations to microenvironments but, on a broader scale, through common elements such as style, technology, and environment, would be tied to Dalton manifestations over eastern North America.

Smith (1986:9, 10), in discussing the nature of early Holocene environments in the southeastern United States, indicates that a picture of environmental homogeneity is not accurate. Regional diversity abounds in terms of resource potential and species diversity. Smith restates an opinion (Clausen et al. 1979) and deduces that "as a result, one might reasonably expect the documented, if often over-emphasized, geographic variation that does exist within early Holocene projectile point type categories to be paralleled by regional diversity in tool kits and subsistence patterns (Smith 1986:9)."

The approach taken to projectile point typology, including variety designation, is that formal variation should be explicitly documented within a regional setting. The creation of varieties is useful only if they are articulated within an overall regional taxonomic scheme that allows meaningful assessment of local phase content.

Under such a scheme, it is doubtful that the term Dalton should be applied at the type level to all morphologically similar forms equivalent in age to the Dalton horizon as defined by Goodyear (1982). Type designations should reflect regional diversity and adaptations. The terms San Patrice and Hardaway-Dalton (Coe 1964) conform to this concept, since they appear to reflect regional traditions. The term Dalton, as construed, is best used as a horizon marker. Continued referral to morphologically similar forms that date to the Dalton time period as typologically Dalton, regardless of their geographic distribution or cultural context, will only confuse cultural-historical reality. In retrospect, referral to the Gainesville Lake area Dalton horizon forms as Dalton contributes to this confusion and tends to obfuscate important regional differences that undoubtedly obtain among various early Holocene cultures of the Gulf Coastal Plain.

Type designations generally should reflect local culture and environmental adaptations. At a different level of classification, phase content could be signified through variety designations, where plausible, and could reflect local variations in phase content. Therefore, the different varieties of San Patrice and Dalton noted herein may lead eventually to definition of local phase content.

Crucial to the successful adoption of such a system, however, are both precise techniques for describing artifacts and terminological clarity. Metrical analysis is obviously an important part of description, but there are formal qualitative and quantitative descriptive techniques that make it possible to describe hafted biface morphology and eliminate many descriptive ambiguities (cf. Futato 1983; Ensor 1981). Only when overall taxonomic purpose is articulated with precise description will communication among researchers grow and the utility of various regional models be evaluated. Evaluation and refinement are necessary, but perhaps even more is required for growth and maturity in the discipline of archeology.

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The Lott Site (41GR56): A Late Prehistoric Site in Garza County, Texas

Frank A. Runkles and E. D. Dorchester

ABSTRACT

A prehistoric site in southern Garza County, Texas has yielded several specimens of a distinct, previously undescribed arrowpoint type that is named here the Lott point. Because of the large number of distinctive pottery sherds, this site is also important in providing a link in the transfer of traits among the cultures of the southern Plains and the Caddoan culture of northeastern Texas, southeastern Oklahoma, and southwestern Arkansas.

INTRODUCTION

The Lott site (41GR56), about 3 km (2 miles) east of the Llano Estacado in Garza County (Figure 1), was discovered in 1961 by Emmett Shedd and Frank Runkles, who were surveying an area about 26 km (16 miles) south of Post for prehistoric sites that had not been recorded. As Shedd walked from the streambed of Sand Creek, he came upon a gently sloping, relatively flat area between two ravines (Figure 2), on which lay a great profusion of chips, hearths, potsherds, and other artifacts where the thin covering of soil had weathered away. This was after the severe drought of the 1950s, when little or no vegetation was left on much of the land, and the few remaining cattle had pulverized the soil. Then, as the rains came, the loosened soil was gradually eroded away where there was no vegetation to hold it. This gentle sheet erosion left cultural material exposed essentially as it would have been had controlled excavation exposed it. Shedd realized that this was a site of major importance, so he, Runkles, and members of the South Plains Archeological Society staked it out in 10-foot squares so records could be kept of the locations of features and artifacts. This report is based on a surface collection rather than one resulting from controlled excavation. A review of the literature (Varner 1968 and others) indicates that the locations of surface materials can be useful evidence if the materials were exposed in such a way that they are not badly displaced laterally or vertically. The investigators of this site believe there was little or no lateral displacement of artifacts, in fact many were still partially covered and were definitely in situ. The limited excavations described later have verified that the cultural material had only a thin covering of the sort that would leave the artifacts exposed in situ when it was gently eroded away.

This site is unique in several ways. For many years arrowpoints of a previously unknown form had been found by collectors in very small numbers around Post. On

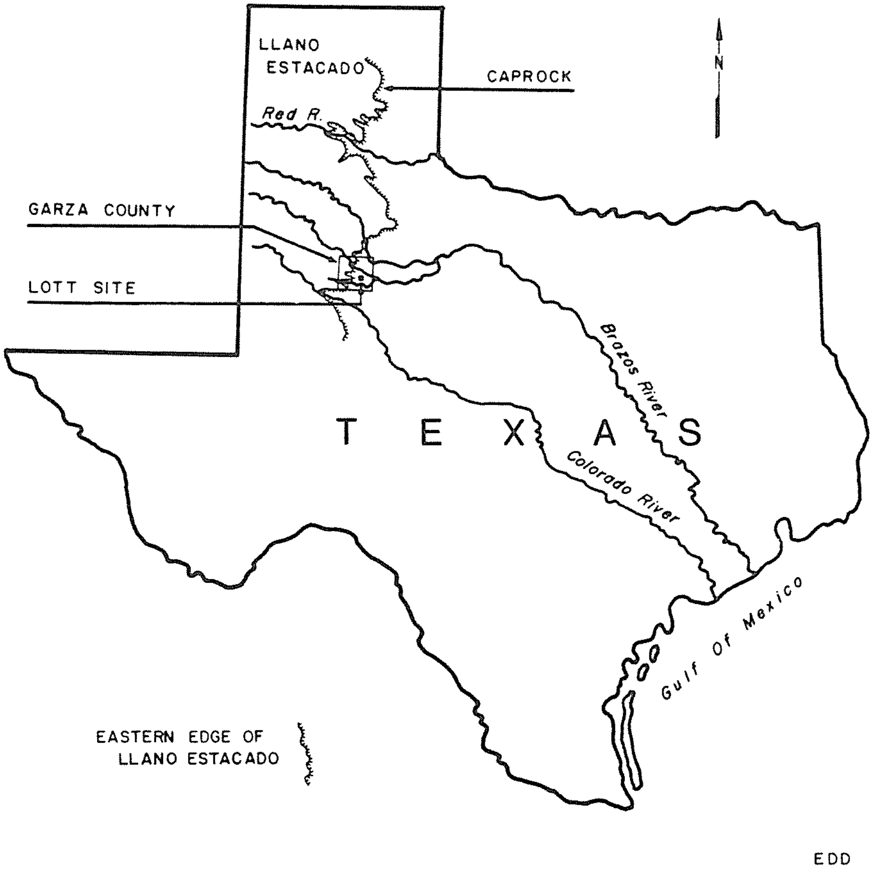

Figure 1. Map of Texas showing Garza County and the Lott site. Drawn by E. D. Dorchester.

this site, however, this type was found in considerable numbers in a relatively small area. The site was on the property of John Lott, of Lubbock, so in proposing a new point type we are calling it the Lott Point.

The other unique feature of the site was the large number of sherds of well-made and distinctive pottery. Except for three sherds, all of the pottery appears to have been made or manufactured at or near this site. Although some sites in the High Plains have large numbers of potsherds, a large percentage of the sherds are from vessels imported from the Rio Grande drainage area of New Mexico. Pottery was made on the Texas High Plains, but it is generally thick, coarse, and not plentiful except in the upper Panhandle where Borger Cordmarked is common. The pottery from the Lott site is made from Triassic clays found in the area and is tempered with burned or calcined bone.

More than 750 sherds were found at the Lott site, and a great number of them show traits of Caddoan pottery from East Texas. In fact many of the sherds could

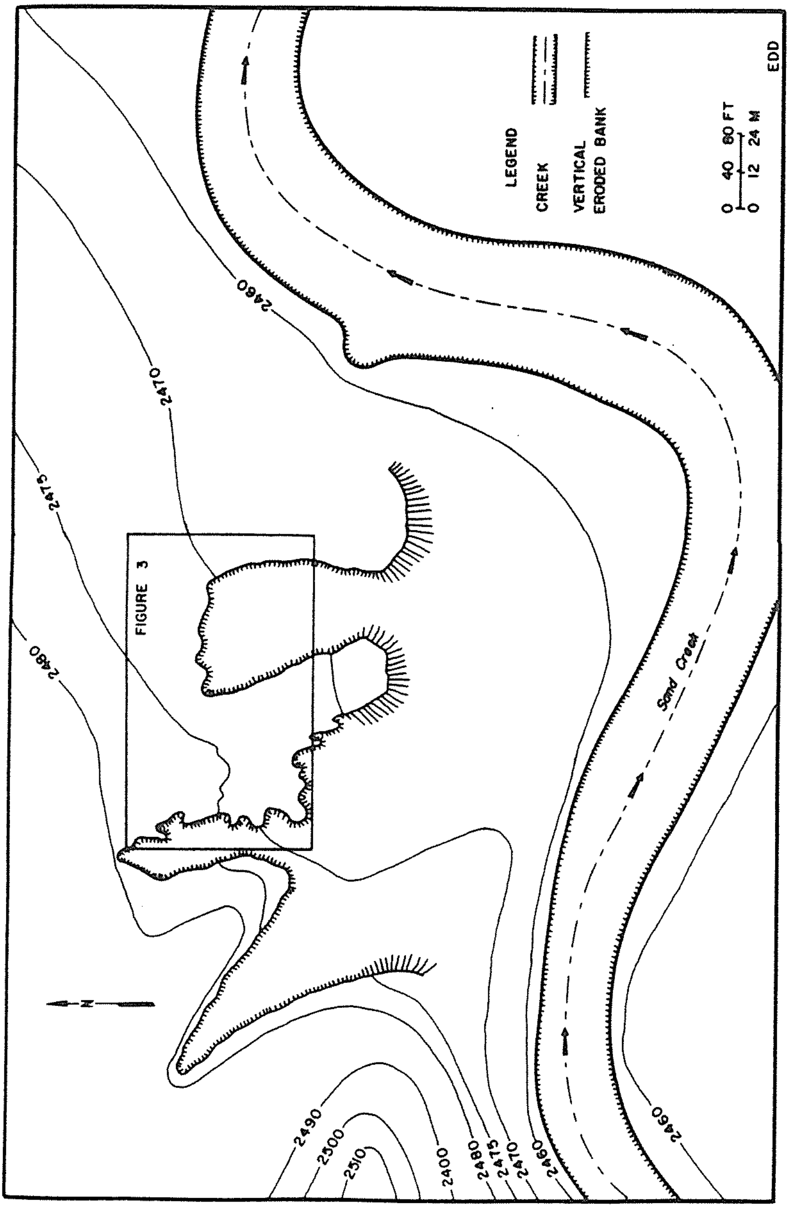

Figure 2. Topographic map of part of Garza County, Texas showing how the Lott site (41GR56) relates to Sand Creek. Drawn by E. D. Dorchester.

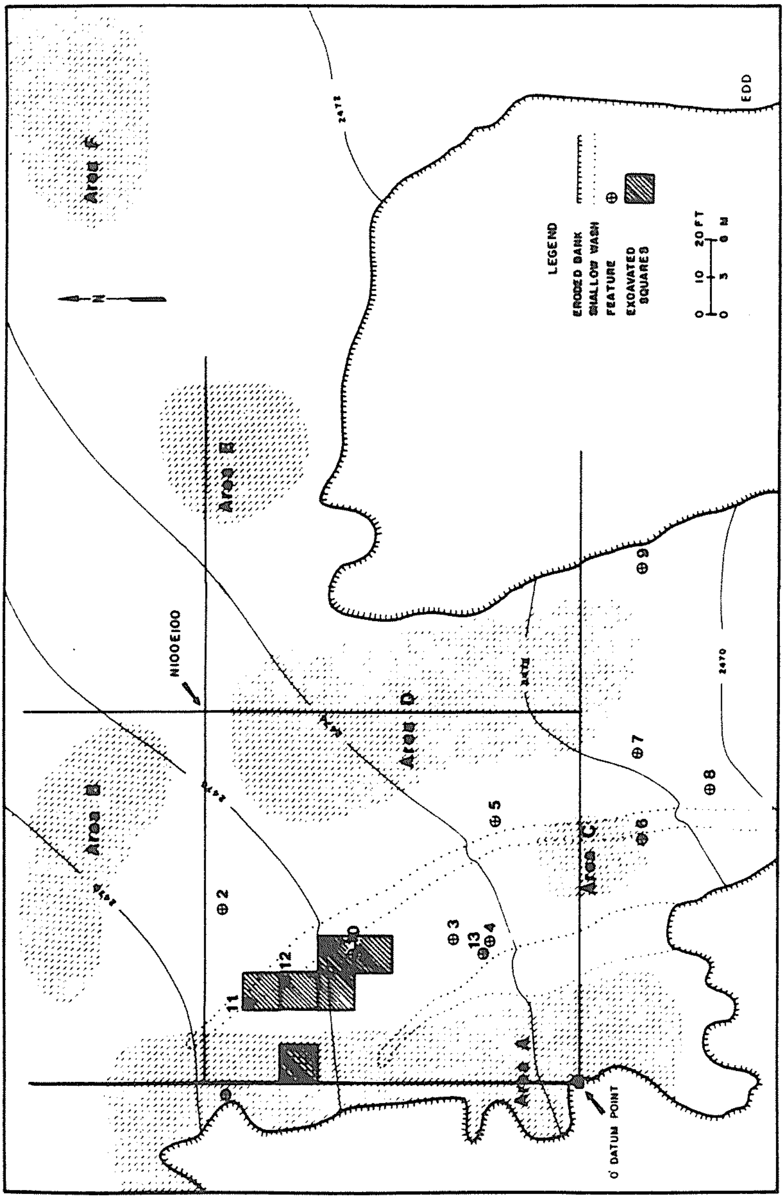

Figure 3. Topographic map of the Lott site (41GR56) showing locations of features: 1-10, hearths; 11, 12, workshops; 13, bison skeleton.

be easily identified as Caddoan except for the fact that they are made from the Triassic clays that are exposed below the Caprock.

The site is unusual in another way. Three types of arrowpoints were found: Lott, Garza, and Perdiz, each in sufficient numbers to indicate that the people using them occupied the site several times. With few exceptions each of the three types, to the best of the writers' knowledge, was found in a separate part of the site (Figure 3). Lott points were found in areas designated A and F, Garza points in areas C and D, and Perdiz points in areas B and E. Very few Harrell points were found on the site, and triangular preforms were found in Lott- and Garza-point areas. Perdiz points are relatively scarce on the Texas High Plains, and they are not found in large numbers on any site.

Some limited excavation was done about 3-6 meters (10-20 feet) east of the east edge of area A to verify that the exposed cultural material probably had been covered by only a thin layer and that its surface occurrence represented a true distribution of the artifacts (Figure 4). In this limited area, a triangular preform, three Lott points,

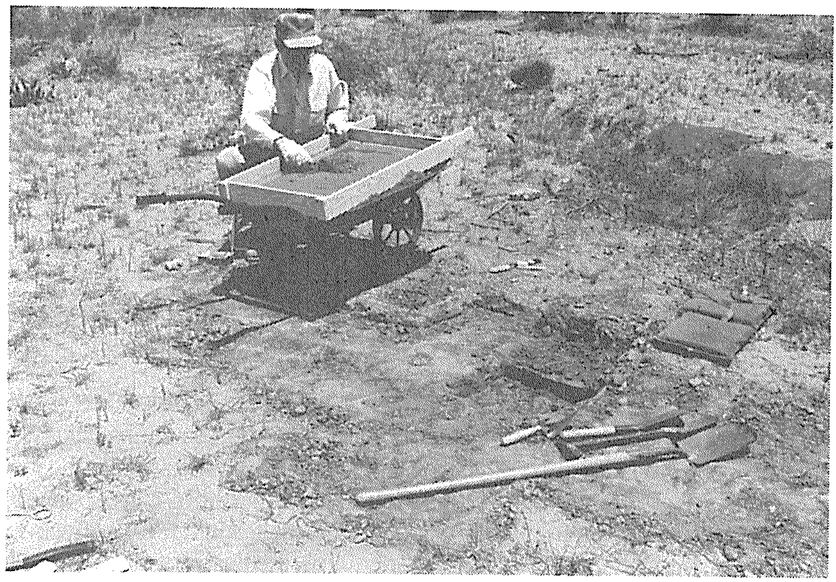

Figure 4. Photograph showing Frank Runkles working at the excavation to test still-buried parts of the site.

and two drills were recovered from the top 8 cm (3 inches). Below this level there was no evidence of cultural material. This excavation seems to verify that there was a thin cultural layer and that Lott points were concentrated in area A. Additional excavation should be carried out to define better the occupation areas on which the different point types were found.

GEOGRAPHY AND ENVIRONMENT

The Lott site is about 3 km (2 miles) east of the eastern edge of the Llano Estacado, or Staked Plains. The Llano Estacado is a vast, flat, largely treeless grassland that is the southern extension of the Great Plains, which extend through the central United States. This flat plain terminates along its eastern edge in an escarpment (the Caprock), marking an abrupt drop from 15 to more than 60 meters (50-200 feet). Below the Caprock are canyons, hills, creeks, washes, and gently sloping terraces that were formed as the Caprock eroded (Figure 1).

The Plains were an ideal habitat for large mammals such as bison and pronghorns, and there were large populations of rabbits, badgers, skunks, coyotes, wolves, bobcats, deer, prairie chickens, quail, and others. On the Plains are many playa lakes that were originally small depressions that filled with water during spring thunderstorms, killing the vegetation. As the water receded, bison or antelope pulverized the bare dirt as they went out to the water, and when the lakes dried up, winds carried away the loose soil, making the depressions larger and deeper. Some of these depressions. popularly known in West Texas as buffalo wallows, reached several acres in size. This area, with its vast grassland and playa lakes, could support large numbers of animals when there was sufficient moisture, but changing climatic conditions on the Plains resulted in mass migrations of the bison herds. In his detailed study of many sites on the Plains, Dillehay has determined that there were periods when bison were absent from the Texas plains and other periods when the large bison herds returned (Dillehay 1974:181). Since bison are short-grass animals, they were not found on the Southern Plains for several hundred years before A.D. 1200 when moisture levels were high and the tall grass varieties predominated. During the next 250 years, as the shorter varieties of grass predominated, the bison population literally exploded, and when this happened, more prehistoric people migrated into the area and moved with the game. Campsites were occupied for only short periods of time, or seasonally, as these people followed the herds, but they came back to good sites again and again for many years. The Lott site shows evidence of occupation by several groups; people making Lott, Garza, and Perdiz points apparently occupied different parts of the site, leading the writers to believe that these groups occupied the site over and over, but not at the same time.

Most of the High Plains is underlain by the Ogallala aquifer, a vast fresh-water reservoir. Above the Caprock in prehistoric times, the distance to the water table was only 9-15 meters (30-50 feet), and below the caprock the water table was exposed in many places, resulting in springs and seeps that provided water to ideal campsites for the roving groups of hunting and gathering people. The escarpment also provided some shelter from winter winds and, at some times of the year, the springs and water seeps provided the only water available in this part of Texas.

THE SITE

The Lott site is on the higher of two terraces on the west bank of Sand Creek, a tributary of the South Fork of the Double Mountain Fork of the Brazos River (Figure 1). The occupation area is about 45 meters (150 feet) from north to south and about 100 meters (350 feet) from east to west. The area is generally flat with a few north-to-south-trending washes; it slopes gently southward toward the creek with a drop of about 3.5 meters in 100 meters (10 feet in 350 feet). The site is bounded on the west by a ravine with a sharply defined bank that has a drop of about 1.5 meters (5 feet) (Figure 5). It is likely, from the appearance of this ravine, that

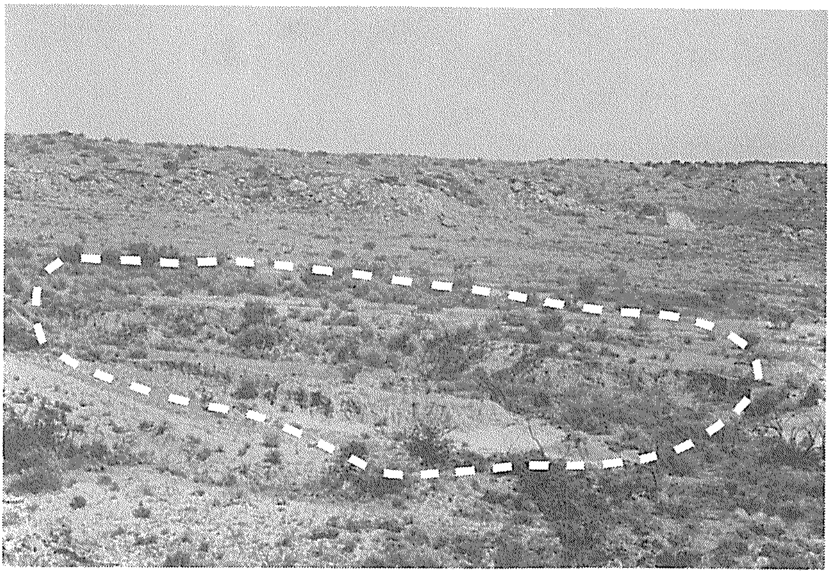

Figure 5. Photograph showing the Lott site (outlined by dashed white line) from a nearby hill.

there was a spring in the area. A circular ravine with a 1-meter (4-foot) cut extends into the site about 45 meters (150 feet) to the east. Sand Creek is about 100 meters (110 yards) south and 150 meters (165 yards) east of the site (Figure 2). About 140 meters (150 yards) to the north are small rises, about 3-4.5 meters (10-15 feet) above the terrace.

FEATURES

The features in this site consist of 10 hearths (Figure 6), a young, nearly complete bison skeleton, and two separate chipping stations with concentrations of chips and flakes (Figure 3). Features 1-10 are hearths consisting of flat limestone rocks that have been arranged to contain the fire; in many, bits of charcoal have been exposed by erosion. Three of these (features 1, 4, and 6) were the source of charcoal samples from which radiocarbon dates were obtained (Figure 20). Hearth feature 10 was uncovered during test excavations in square 60N/30E. Feature 11, the site of workshop debris consisting of about 750 chips and flakes, was exposed by erosion; limited excavation in the area exposed many more flakes. A 10-foot square whose southwest corner was 70N/20 E was excavated; artifacts were found in the

Figure 6. Photograph of a typical hearth at the Lott site.

northeast quarter in the upper 8 cm (3 inches), and below this was sterile soil. Feature 12, the site of another concentration of workshop debris, consisting of about 375 flakes and chips, was excavated during work in square 70N/20E. The debris from both features indicates a complete range of flaking operations: cortex removed by percussion from nodules, thinning flakes removed by percussion, and trimming flakes removed by direct pressure. Since tools were manufactured at these two workshops, the site apparently was occupied for extended periods of time. Undoubtedly other chipping or work stations will be revealed by further excavation, for the nearby creek and hills provide a ready source of lithic material. The absence of larger cores from which material has been removed could indicate that most of the tools made here were made from small nodules.

A nearly complete young bison skeleton (feature 13) had been partially eroded out when the site was discovered. No photographs were taken, and the bones, which were in extremely poor condition, have since weathered away.

ARTIFACTS

The artifacts from the Lott site include flaked arrowpoints, knives, scrapers, drills, gravers, a few bone tools, shell beads, arrow-shaft abraders, many hammerstones and choppers, and a great many potsherds. As workers picked up the exposed artifacts on the surface, reasonably good records were kept of the numbers, types, and locations of most of the artifacts, but many of them were kept by those who worked on the site, and the writers have been able to examine and photograph only a small percentage of them. However, the artifact descriptions and photographs are of a completely representative assemblage retained by the senior author, which included almost all of the potsherds.

Most of the artifacts apparently were made from local materials. The site is near outcrops of the Dockum Group (Triassic) (Holliday and Welty 1981:205, 207), which contains coarse- to medium-grained, light colored quartzite, red jasper. flint, and light, glossy, fine-grained, tan and light to medium gray cherts that are suitable for the manufacture of tools. The only nonlocal material found was a very small amount of obsidian.

Two obsidian Garza points were recovered, together with an unknown number of obsidian flakes. The Garza points and three flakes were submitted to the Lawrence Berkeley Laboratory at the University of California for x-ray fluorescence analysis, which determined that two of the Lott specimens came from the Valles Caldera area of northern New Mexico (Table 1); the source of the three

Table 1. Neutron Activation Analysis of Trace Elements in Obsidian from the Lott Site (41GR56)

		Ba	Ce	Nb	Zr	Sr/Zr	Rb/Zr
Artifacts from Texas Panhandle, unknown provenience							
8137-E	Lott-1	15±5	93±9	52	211	.059±.017	.869±.040
-F	-2	16±4	96±8	47	206	.048±.012	.871±.034
-G	-3	13±4	90±7	46	187	.027±.013	.850±.034
Average		15	93	48	201	.045	.863
RMSD		±2	±3			±.016	±.012
Artifacts assigned provenience of a Valles Caldera source							
-H	Lott-4	<8	81±7	85	219	<.037	1.138±.038
-I	-5	≤8	81±8	84	221	≤.027	1.117±.043
Average		<8	81	85	220	<.032	1.078
RMSD							±.056
Ref. group							
Valles Caldera Source (Valles Caldera Composition Group)		<4	78±1	85	192	<.026	1.07±.05

SOURCE: Lawrence Berkeley Laboratory, University of California

NOTE: The ratios are precise, but the absolute values of Nb and Zr will not be accurate because of uncertainties inherent in our nondestructive analyses due to the varying shapes and sizes of the samples. These errors would tend to make the Zr and Nb values larger than the reference Valles Caldera source.

other Lott samples is unknown, but they came from the same source as an obsidian biface from Blackwater Draw Locality No. 1 that was submitted for sourcing by Texas Tech University (Table 2) (Johnson:1984).

Table 2. Neutron Activation Analysis of Trace Elements in Obsidian From Lubbock Lake and Blackwater Draw

	Ba	Ce	Nb	Zr	Sr/Zr	Rb/Zr
Artifacts assigned to Valles Caldera						
8138-ELUBK-1 TTU-A 39314 FAS-17	<8	83±7	91	225	<.023	1.013±.014
8138-C BLWD-2937—862 Bed C	<6	81±6	79	200	<.017	1.044±.013
Ref. group						
Valles Caldera Source	<4	77.7±.9	85	192	<.026	1.07±.05
Unassigned Source						
8138-F BLWD-1 937-33 Bed A	13±3	107±7	45	192	.018±.006	.865±.012
Texas Panhandle Artifacts						
Lott Specimens 1, 2, 3	15±2	93±3	48	201	.045±.016	.863±.012

SOURCE: Lawrence Berkeley Laboratory, University of California

NOTE: The ratios are precise, but the absolute values of Nb and Zr will not be accurate because of uncertainties inherent in our nondestructive analyses due to the varying shapes and sizes of the samples. These errors would tend to make the Zr and Nb values larger than the reference Valles Caldera source.

Lithic Artifacts

Lott Points (N=56)

The Lott point (Figure 7) is named for John Lott, owner of the ranch in Garza County on which the site is located[1]. It is basically triangular; most have indented bases and all have central basal notches. The sides are trimmed parallel to the edges from the base about a third of the way to the tip to form shoulders (Figure 7, C-F), most of which are slight and nearly perpendicular to the edges; a few specimens have small barbs (Figure 7, A, B). The sides are straight or slightly convex, and some specimens are slightly serrated. Most of the points from this site are thin and finely made from local cherts and flints. Many are widest at the shoulders, but in the typical or classic Lott point (Figure 7, C) the "ears" flare at the base, making them wider there. The "ears" formed by the basal notches vary from pointed (Figure 7, C, D) to square (Figure 7, E).

On the basis of about 75 specimens, the length ranges between 18.8 and 45 mm, with an average of 27 mm. Width at the shoulders varies from 7.4 to 20 mm, with

[1] A preliminary description of the type has been published by Turner and Hester (1985:182). A more complete description is given here.

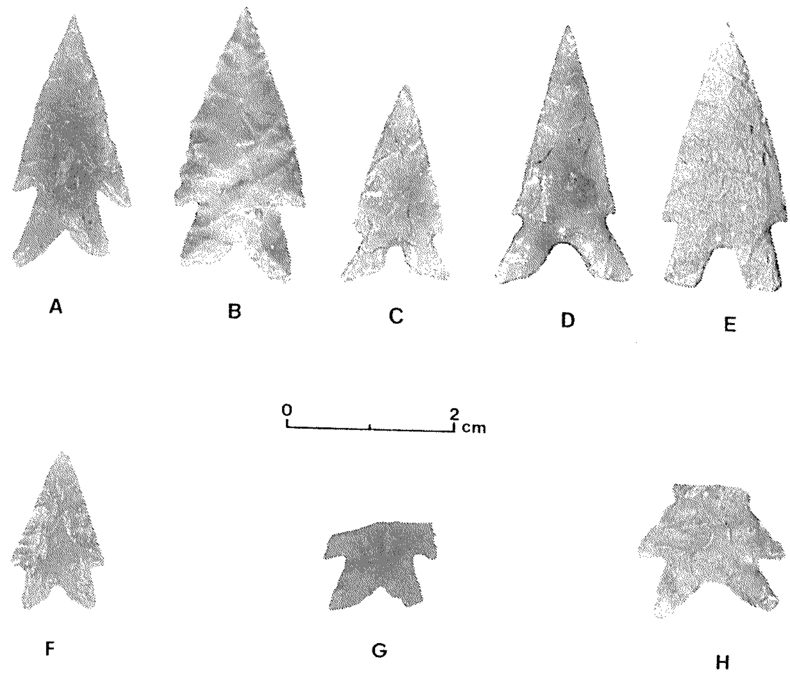

Figure 7. Lott points from the Lott site. A-E came from the surface of the site; F-H came from the test excavation at 70N/20E.

an average of 12.37 mm. The width at the base varies from 9.1 to 19.4 mm, averaging 12.44 mm.

The Lott points at this site cover the range of Lott varieties (Figure 7). Specimen A has a deeply indented base with a very slight U-shaped notch at the bottom and side trimming deep enough to form barbs. Specimen B has a deeper U notch in the base and only very slight barbs. Specimen C is a typical Lott point; its slightly concave base has a very distinct U notch and the sides are trimmed to form square shoulders. Specimen D has a slightly concave base with a much wider U notch and slight shoulders. Specimen E has a straight base with a wide, deep U notch and typical shoulders. About 82 percent of the points are like specimens B, C, D, and E; only 18 percent have barbs like specimen A. One Lott base (Figure 7, H) and a complete Lott point (Figure 7, F) were recovered from the top 8 cm (3 inches) of the test excavation in the northeast quarter of square 70N/20E about 6 meters (20 feet) east and 20-25 meters (70-80 feet) north of the reference datum point (Figure 3). Another Lott base (Figure 7, G) came from the southeast corner of the same test square. All of the Lott points came from areas A and F.

Garza Points (N=49; Figure 8)

Specimens A-E are typical of the Garza points as defined by Turner and Hester (1985:176) found at the Lott site as well as at other sites in the area. The Garza points were found in areas C and D (Figure 3). Specimen D is made from obsidian. Specimen C is of special interest: the sides are straight from the base for about a third of the way to the tip, where there is the hint of a shoulder. It is possible that this is a Lott Point in a not-quite-finished stage of manufacture, or perhaps the maker had started to trim these edges to make the Lott shoulders but did not finish the work. On the other hand, since the Lott point appears from existing data to be the older of these two, specimen C may be a transition point between the Lott and Garza points, when the makers were beginning to leave the side trimming off to form shoulders.

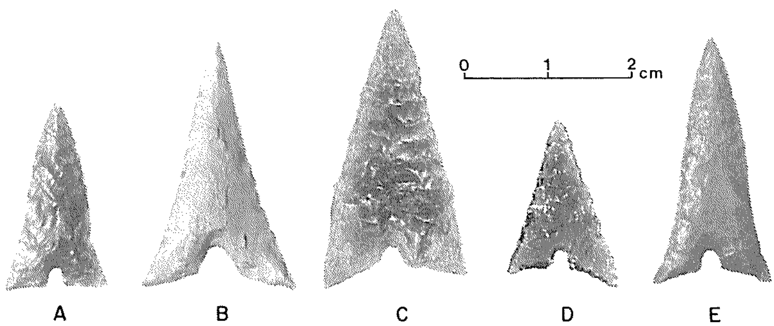

Figure 8. Garza points found at the Lott site.

Triangular Preforms (N=52; Figure 9)

The triangular points recovered at the site are preforms for manufacturing both Lott and Garza types. Most of the triangular points examined have defects, are broken in two, or are apparently unfinished. Both pieces of many broken points were found, which indicates that the makers broke the points before completing either Lott or Garza points. The triangular preforms were found only in areas A, C, D, and F, which are the areas containing the Lott and Garza specimens. One (Figure 9, F) was recovered from the test excavation at 70N/20E.

Perdiz Points (N=58; Figure 10)

Perdiz points (Turner and Hester 1985:187) are not common on the Llano Estacado or on the sites along the Caprock. The 58 specimens found at the Lott site put it among the most prolific Perdiz sites in the area. The Perdiz points were in the relatively small areas B and E on the northern edge of the site. No hearths have been found in areas B and E, so no radiocarbon dating has been possible.

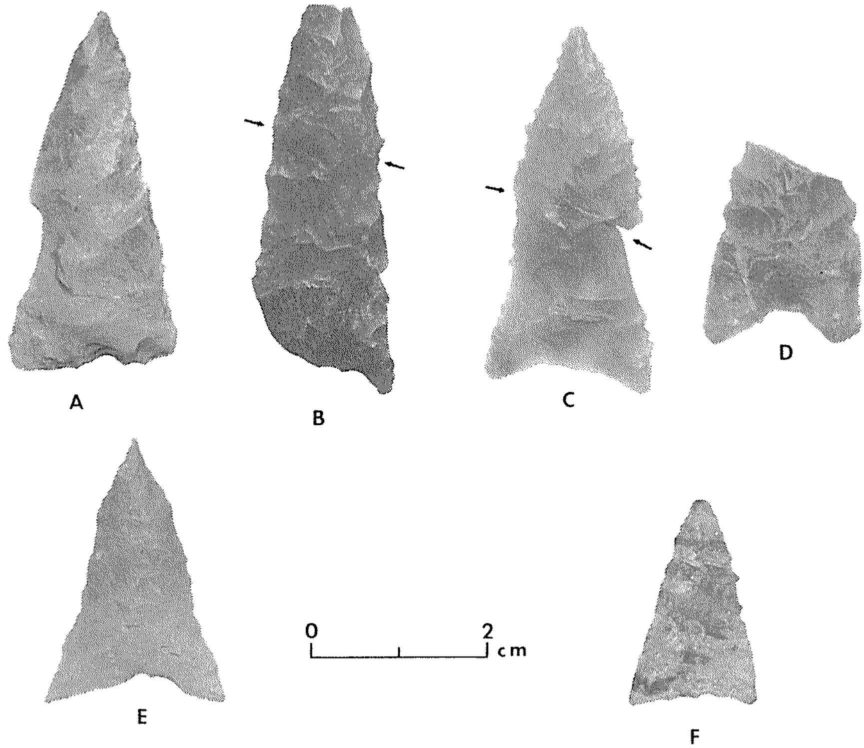

Figure 9. Triangular preforms found at the Lott site. Point F was recovered during the excavation of square 70N/20E.

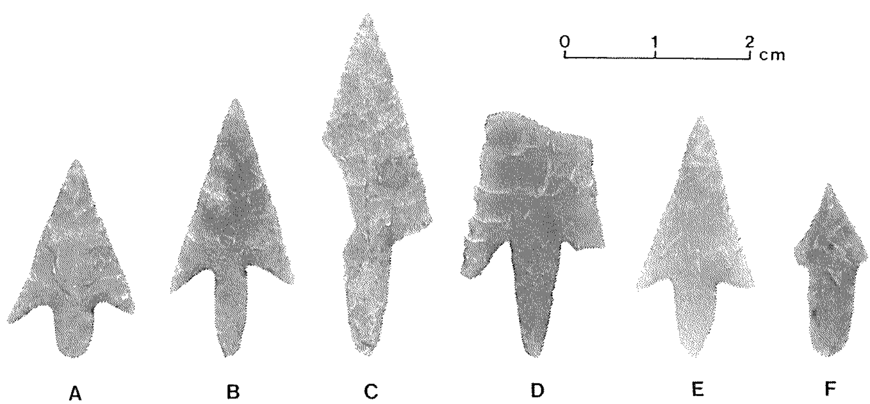

Figure 10. Perdiz points from the Lott site. Specimen F has been sharpened so much that very little is left of the blade.

Harrell Points (N=6)

Only six Harrell type points (Turner and Hester 1985:178) were found; none were available for photographing. Harrell points are common on the High Plains and were found at the Garza site as well as at many other sites.

Drills (N=35; Figure 11)

Most of the drills or awls from the site have slender shafts and are made on flakes. They are well made, but none have bifacially worked bases. About half of the artifacts originally classified as drills consist of the shafts only; reexamination indicated that these are probably Perdiz stems that were removed from arrow shafts and discarded after the points were broken.

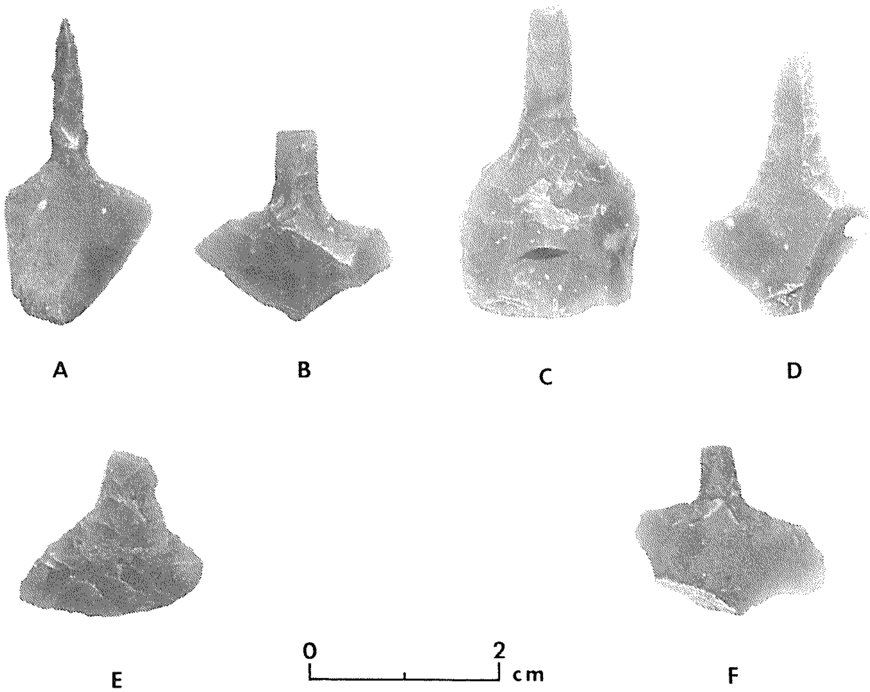

Figure 11. Drills from the Lott site. A-D were surface finds; E was recovered from the southeast corner of the test excavation 70N/20E.

Gravers (N-12; Figure 12, A-C)

All of the gravers were manufactured from flakes that had one or more points worked onto them. The graver points are well worked and steeply chipped on both sides of the points, but they are generally unworked on the undersides; resulting in points that are sharp and hooklike in appearance. They would have been ideal for cutting shell, bone, or wood, or for incising pottery.

Serrated Flakes (N=2; Figure 12, D)

Two heavily serrated flakes were found.

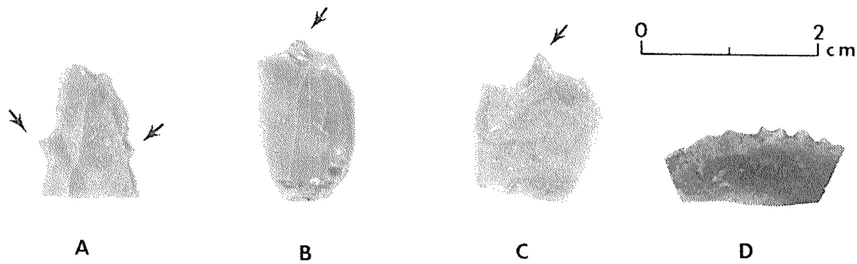

Figure 12. Gravers, A-C, and a serrated flake, D, from the Lott site.

Knives (N=34; Figure 13)

A total of 34 exceptionally well worked bifacial alternately beveled knives (Figure 13, C-F) made from high quality materials were recovered. These alternately beveled knives were created by resharpening knives that were otiginally long and leaf shaped, generally with rounded ends. Resharpening of both sides beveled the edges on opposite sides along about two-thirds of the length. Specimen F (Figure 13) is a knife that has been sharpened several times; it would eventually have become sharp pointed and shorter if sharpening had continued.

Another variety of knife (Figure 13, A, B, and G) is relatively small, round or oblong, and bifacially worked. The knives in this category show no signs of sharpening. What cutting chore these knives were used for is not apparent; they would have been less effective for butchering and meat cutting than the larger, beveled knives (Figure 13, C-F). In any event the larger, beveled knives seemed to be preferred at this site. Knives were found only in Areas A, B, and D (Figure 3).

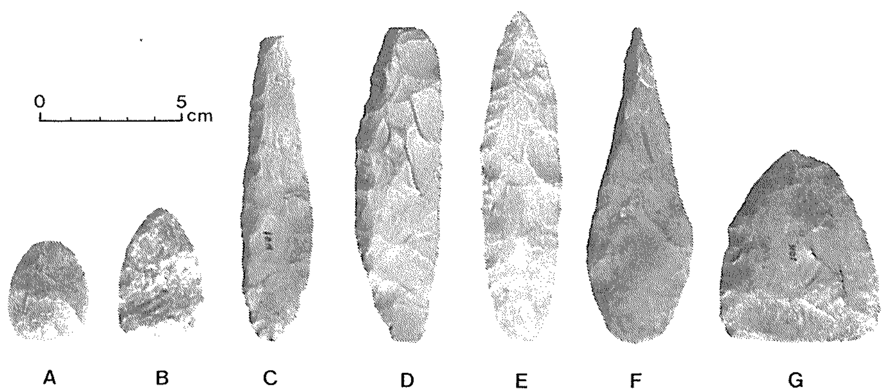

Figure 13. Two kinds of knives found at the Lott site: alternately beveled, C-F; and small round bifacially worked, A, B, and G.

Scrapers (N=81; Figure 14)

The most prevalent scraper was the snub-nosed end scraper (Figure 14, B, E) represented by 41 specimens. These scrapers were generally made from thick flakes

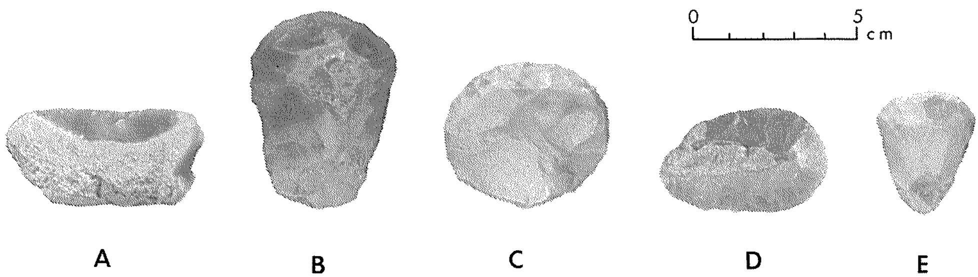

Figure 14. Scrapers from the Lott site.

that were worked and shaped on one face so one end was steeply beveled. The resulting tool was very effective for scraping meat or fat from hides or bones. The junior author has experimented with scraping hides with both snub-nosed scrapers and scrapers with thin edges; the steeply beveled edge is more effective. Three of the scrapers were round, with longer steeply beveled scraping edges. A third form (Figure 14, D), represented by 26 specimens, many with some of the cortex, came from flakes that were worked on only one edge. The scraping edges have been steeply beveled, but they are not as well made as the totally worked tools. Another form represented by 11 specimens, has one worked concave edge (Figure 14, A). These scrapers could have been used as spokeshaves to shape arrow shafts or bows, or to remove fat and tissue from bones or from hides that were laid across logs.

Modified Flakes

An examination of the workshop debris from features 11 and 12 revealed several flakes measuring about 1.5 by 2 cm, with exceedingly fine chipping along one edge. This chipping is fairly steep, and the flaked edges are less than 1 mm wide. If these flakes originally had sharp edges and were used for scraping, this fine chipping could be the result of wear from dragging, but if the edges were flaked intentionally, the flakes were used as tiny knife blades.

Choppers and Hammerstones (Figure 15, A, B)

Several stream-bed cobbles have been used as hammerstones (Figure 15, B), and several have been modified on one edge for use as choppers (Figure 15, A). The hammerstone could have been used to break bison or other mammal bones for marrow or to prepare local chert for flaking.

Arrowshaft Smoother (Figure 15, C)

Two tools, one of sandstone and the other of black lava rock (Figure 15, C), were recovered at the Lott site that are believed to be arrowshaft smoothers. Both tools have grooves that are approximately 11-12 mm wide, 4 mm deep, extend across the tool, and are very smooth, apparently from use.

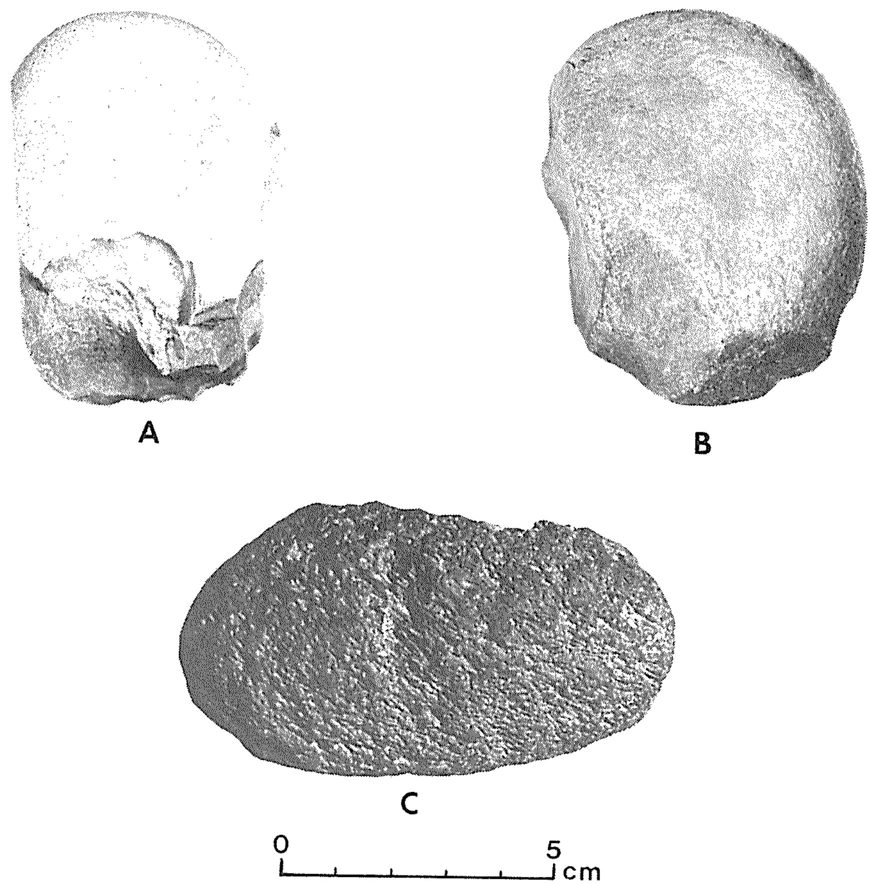

Figure 15. Chopper, A, and hammerstone, B, made by modifying river cobbles. Arrowshaft smoother, C, is made of black volcanic rock.

Shell Artifacts

About 13 shell beads and part of a shell pendant were recovered in area D (Figure 16). The beads are about 5 to 6 mm long and 9 mm in diameter. The walls, which are between 1 and 2 mm thick, have rings similar to tree rings. The beads are thought to have been made from a Pacific coast marine shell, Dentalium semipolitum, since similar beads positively identified as being made from this shell were found at Casas Grandes. The Casas Grande area became a commercial manufacturing and trade center for shell beads (DiPeso et al. 1974). One of the apparent trade routes was to the Jemez Mountains in New Mexico, in the same general area determined to be the source of some of the Lott site obsidian samples.

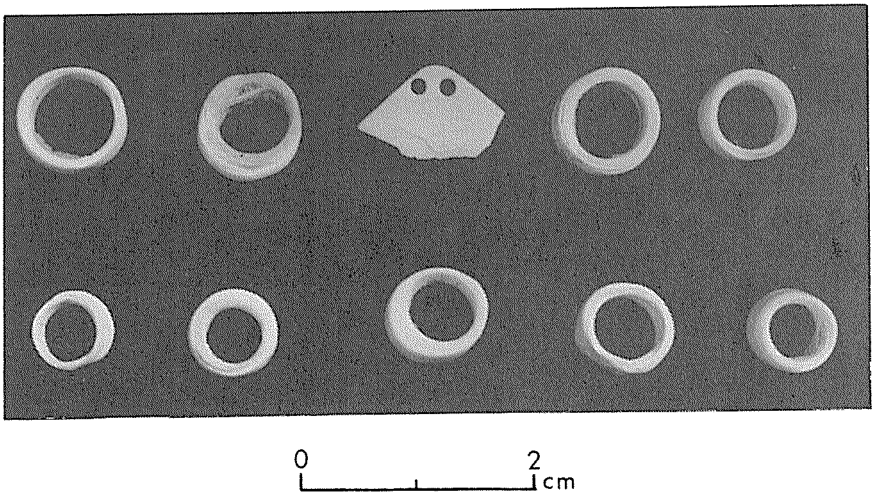

Figure 16. Shell artifacts from the Lott site. Beads and—top row center—part of a pendant, about a millimeter thick, made probably from a local mussel shell.

Bone Artifacts

Two nearly identical bone beads were found, but only one was available for examination (Figure 17, A). This bead, 25 mm long and 9 mm in diameter, was made by scribing a ring around the bone and snapping it off. The other end has

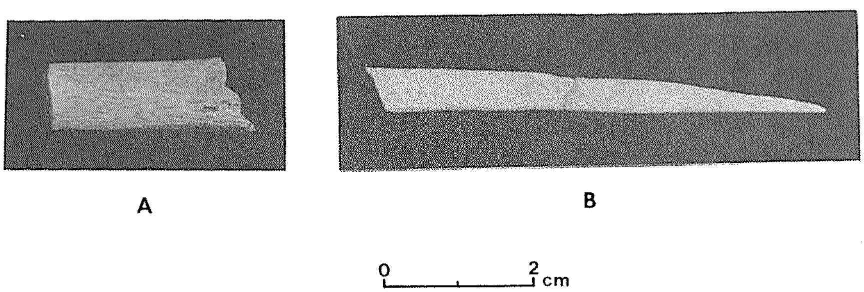

Figure 17. Bone artifacts from the Lott site. A bead, A, is made from a foot bone of a coyote or wolf; an awl, B, is made from an unidentified bone.

indications of the ringing procedure, but the bone evidently broke before it was finished. Specialists at the bone analysis laboratory at North Texas State University, who examined the bead, believe it could be a coyote or wolf foot bone (Yates 1985). These two bone beads are almost identical to four bone beads that were found at the Garza site (41GA40).

A finely made and highly polished bone splinter awl, broken on the end, is 6.3 cm long and 2 mm thick (Figure 17, B), but the bone has not been identified.

Pottery

Four kinds of pottery were found at the Lott site. In Figure 18, Group 1 is represented by specimen A, Group II by specimen B, Group III by specimens C and D, and Group IV by specimens E-I. Specimen J (Figure 18) is one of several pieces of fired clay that were found near two hearths. Color codes in the descriptions that follow are from the Munsell Color Charts (Munsell 1975).

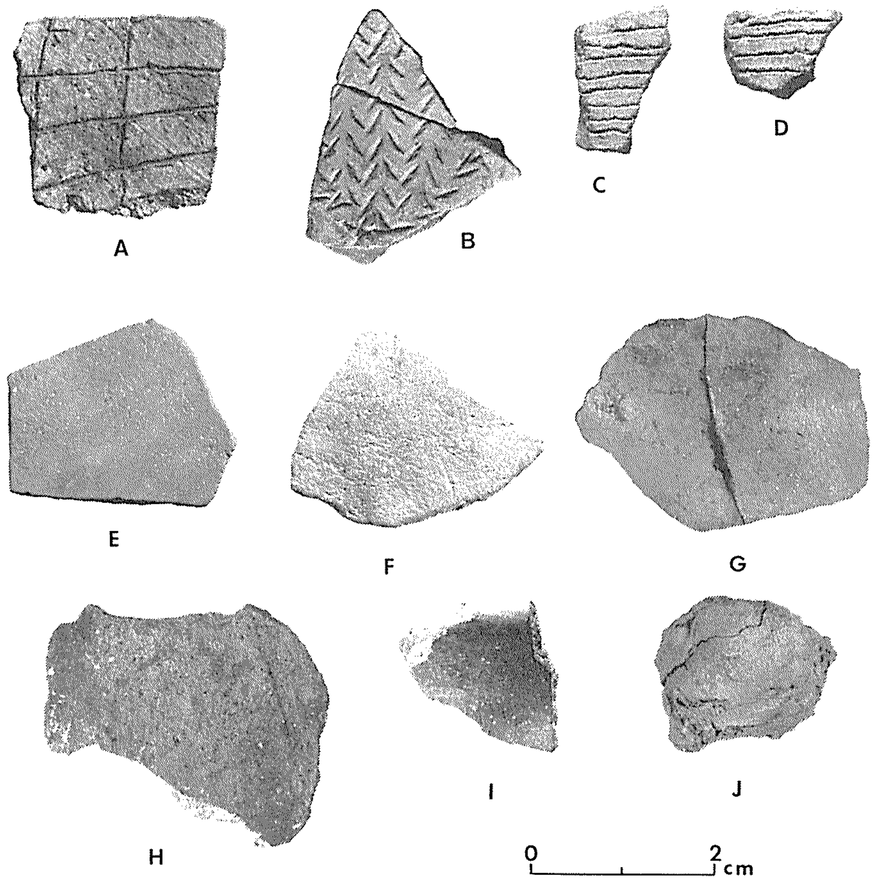

Figure 18. Pottery from the Lott site. Specimen A illustrates Group I; B illustrates Group II; C and D illustrate Group III; E-I illustrate Group IV. Specimen J is a fragment of fired clay.

Group 1

Group I is represented by only one sherd (Figure 18, A), which differs from all other sherds at the site.

Method of Manufacture: Breaks along welds indicate that coiling was the form of construction. The exterior is fairly well smoothed; the interior is well finished.

Paste: Compact and even paste, with crushed clay particles and occasional particles of quartz sand. The exterior is gray (5Y5/1), shading into light gray (5Y7/1); the interior is very dark gray (10YR3/1), shading into light gray (5Y7/1); the cores are black (10YR2/1).

Form: Since this sherd has no apparent curvature, the vessel shape cannot be determined.

Decoration: The exterior has light diagonal brushing by corn cob or other means. Over the brushing are incised rectangles at a slight diagonal to the coil welds and slanted opposite to the angle of the brushing (Figure 18, A).

Dimensions: Maximum thickness, 7.5 mm.

Comments: Sherds of this type are commonly associated with sites affiliated with the Edwards complex in southwestern Oklahoma (Swenson 1985); this specimen probably represents a trade vessel from one of these sites.

Group II

Group II (Figure 18, B) is represented by at least 75 sherds. Fourteen sherds (9 body sherds and 5 rim sherds), representing at least five vessels, have been studied in detail.

Method of Manufacture: Coiling is indicated by several breaks along welds. Both interiors and exteriors are well smoothed.

Paste: A finely crushed bone temper is visible throughout the fabric of these sherds together with small pieces of chert, gypsum, igneous quartz, and small pebbles typical of weathered sedimentary materials in the Triassic clays. Most of the tempering materials measure less than 1 mm. Mica is visible; a natural inclusion in the clay. Exterior colors are brown (10YR5/3), pale brown (10YR6/3), very pale brown (10YR7/3), light brown (7.5YR6/4), reddish yellow (5YR6/6 and 5YR7/6), light reddish brown (5YR6/4), yellowish red (5YR5/6), and pink (7.5YR8/4). One specimen has a very dark gray (7YR3/0) firing cloud. Interiors are light yellowish brown (10YR6/4), pale brown (10YR6/3), very pale brown (10YR7/3 and 10YR7/4), light brown (7.5YR6/4), pink (7.5YR7/4), and reddish yellow (7.5YR7/6). Cores are dark gray (10YR4/1), very dark gray (10YR3/1), gray (10YR5/1 and 10YR6/1), light brownish gray (10YR6/2), light yellowish brown (10YR6/4), and dark gray (7.5YR4/0).

Form: Three rim sherds have simple direct lips (Figure 19, A-C), one has a simple flattened lip, and one has a simple rolled lip (Figure 19, D). Four have flaring walls and one has relatively straight walls; these are probably jar rims. One body sherd suggests a carinated bowl. The other sherds are too small to provide any information about vessel shape.

Decoration: All of the Group II sherds are fingernail punctated. On only the two largest can the overall pattern—parallel rows of chevrons—be seen.

Dimensions: The mean maximum thickness of the rim sherds is 6.52 mm, with a standard deviation of .94 and a range of 5.5 to 7.9 mm. The mean maximum thickness of the body sherds is 7.14 mm, with a standard deviation of .52 mm and a range of 6.6 to 8.1 mm.

Comments: Group 11 and III sherds are the ones that first got the attention of the writers. The decorations are similar or even identical to Caddoan pottery from East Texas, Arkansas, and Louisiana. The pottery is also similar to Caddoan pottery in method of manufacture, color, and in its bone tempering. The writers have not seen similar pottery sherds from this area of West Texas. Reid Ferring has prepared thin sections of sherds from Groups II, III, and IV, and has done a petrographic analysis. It is his opinion that the pottery could not have been made from East Texas materials. He further states that the materials are consistant with those found in the Triassic clay beds exposed along the Caprock, and there is no evidence that would preclude the pottery's manufacture in West Texas (Ferring 1986).

Group III

Group III (Figure 18, C, D) is represented by at least 60 sherds. Eight body sherds were studied in detail.

Method of manufacture: Several of the sherds have visible coil welds. Interior surfaces are well smoothed to burnished; exteriors are smoothed.

Paste: Group III sherds have compact, even paste with fine bone temper (generally less then 1 mm in size) that can be seen on the exterior surfaces, and with very small pebbles, feldspar, gypsum, and other weathered sedimentary materials. Exterior colors range between pale brown (10YR6/3) and light brown (7.5YR6/4). Interiors very from pale brown (10YR6/30) and light yellowish brown (10YR6/4) and between very pale brown (10YR7/3 and 90YR7/4) and light yellowish brown (10YR6/4) to very pale brown (10YR7/3 and 10YR7/4). Most cores are gray (10YR5/1 and 5YR5/1), yellowish brown (10YR5/4), pale brown (10YR6/3), and dark gray (10YR4/1).

Form: One body sherd may be a bowl fragment. The others are too small to afford any inferences concerning vessel shape.

Decoration: All of the Group III sherds have parallel incised lines. Six have either vertical or slightly diagonal incised lines originating at the coil welds.

Dimensions: The mean maximum thickness of Group III sherds is 6.57 mm, with a standard deviation of .74 mm and a range of 5.8 to 7.8 mm

Comments: See Group II comments.

Group IV

Group IV (Figure 18, E-J) is represented by at least 500 sherds. Twenty-seven sherds from at least six vessels were studied in detail.

Method of manufacture: Coiling is indicated by breaks along welds. Exteriors are well smoothed to burnished; interiors are well finished.

Paste: Compact and even, with fine bone temper measuring less than 1 mm in addition to very small pebbles, feldspar, gypsum, and other weathered sedimentary materials. Exterior colors are light red (2.5YR6/8), yellowish red (5YR5/6 and 5YR5/8), reddish yellow (5YR6/6, 5YR6/8, and 5YR7/6), pinkish gray (5YR6/2), dark gray (10YR4/1), dark grayish brown (10YR4/2), brown (10YR5/3), light yellowish brown (10YR6/4), light gray (10YR7/2), very pale brown (10YR7/4), light brown (7.5YR6/4), and brown (7.5YR5/2). Interiors vary in color from gray (5YR6/1), pinkish gray (5YR7/2), pink (5YR7/4), and reddish yellow (5YR7/6) through light brown (7.5YR6/4) and reddish yellow (7.5YR6/6 and 7.5YR6/8) to very pale brown (10YR7/4), light yellowish brown (10YR6/4), dark gray (10YR4/1), and dark brown (10YR4/4). Cores are very pale brown (10YR7/3 and 10YR7/4), reddish yellow (7.5YR6/6), dark gray (10YR4/1 and 7.5YR4/0), very dark gray (10YR3/1 and 5YR3/1), pinkish gray (7.5YR6/2), brown (7.5YR5/2), gray (10YR5/1 and 5 YR5/1), light yellowish brown (10YR6/4), and black (7.5YR2/0).

Form: Three rimsherds (Figure 19, A-C) have simple direct lips. Seven (Figure 19, G-M) are direct rounded, one (Figure 19, L) with an overlap of clay on its exterior surface, and one (Figure 19, M) probably from a miniature bowl. Three rimsherds (Figure 19, D-F) are simple rolled. Three bowls and one jar are apparently represented by these rims.

Decoration: None.

Dimensions: The mean maximum thickness of the rim sherds is 6.42 mm, with a standard deviation of 1.82 mm and a range of 4.7 to 9.9mm. The mean maximum thickness of the body sherds is 6.8 mm, with a standard deviation of 1.12 mm and a range from 5.4 to 9.9 mm.

Comments: Group IV sherds are all from plainware vessels. These vessels are well made, hard and smooth, and are similar in appearance to Caddoan plainware. They do not resemble other locally made plainware sherds from the southern High Plains examined by the writers.

Rim Sherds (Figure 19)

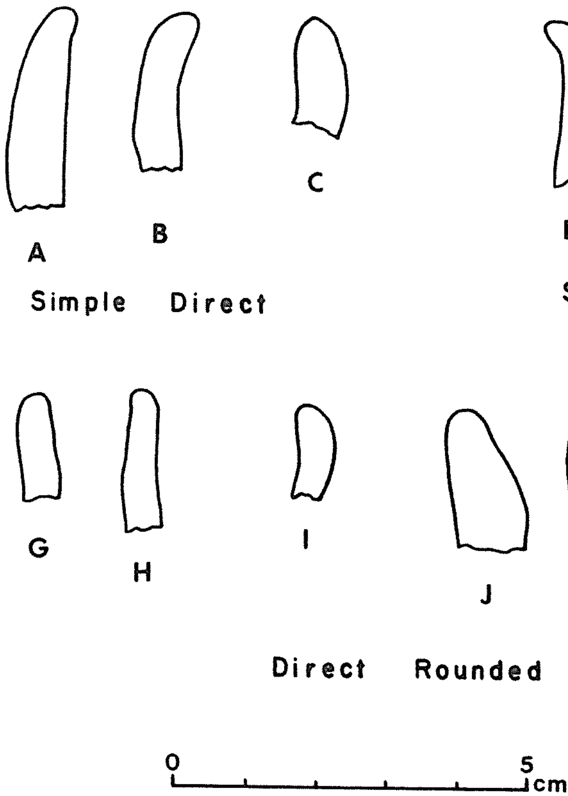

Figure 19. Rim outlines: A-C, simple direct; D-F, simple rolled; G-M, direct rounded.

Sixteen of the rim sherds recovered were sufficiently large that vessel shapes and diameters of the openings could be determined from them (Table 3).Additional rim sherds were found at the site, none large enough for inferring size or shape, but representing at least 16 to 18 vessels, including at least one carinated bowl. A high percentage of the sherds are of a ware of extremely high quality; most are hard and smooth, and many are highly burnished. The paste is, without exception, fine and compact.

Rio Grande Area Sherds

Three of the sherds from the Lott site have been identified by Helene Warren, of Albuquerque (Warren 1984), as Agua Fria or Glaze 1 from the Rio Grande drainage area. They came from one vessel, but its size and shape could not be determined.

Table 3. Vessel Shapes and Orifice Diameters Inferred From Rim Sherds at the Lott Site

Sherd No.	Sherd, from Figure 19	Oriface Diameter cm	Oriface Diameter inches	Shape
PT-1	A	15.24	6	Jar
PT-2	B	-	-	Bowl
PT-3	D	-	-	Jar
PT-4	G	10.16	4	Jar
PT-5	H	17.78	7	Bowl
PT-6	E	-	-	Jar
PT-7	C	7.62	3	Jar
PT-8	I	12.70	5	Jar
PT-9	F	10.16	4	Jar
PT-10	J	10.16	4	Jar
PT-11	K	7.62	3	Jar
PT-12	L	10.16	4	Jar
PT-13	M	7.62	3	Jar
PT-14	-	-	-	Bowl
PT-15	-	10.16	4	-
PT-16	-	15.24	6	Bowl

DATING

The Lott site is believed to have been occupied periodically by people who made and used Lott points, from the middle 1300s of the Christian Era into the early 1400s. That the site was not occupied continuously during this time is evidenced by the very thin cultural layer, the small number of hearths, and the apparent lack of permanent living structures. However, a considerable number of fire-hardened clay lumps that have impressions of grass and sticks and finger prints were found in and near two hearths. The lumps could have come from wattle-and-daub structures that caught fire, but there has been no excavation where the clay lumps were found that might have yielded evidence of post holes or other structural features.

The number of arrowpoint preforms, arrowpoints, other tools, bison bones, and chipping stations indicates that the site was probably a base camp for hunting expeditions, where tools were made and limited butchering and meat drying was done. The number of potsherds, representing at least 16 to 18 vessels, further supports this base-camp theory. The Lott site was probably used intermittently and seasonally, but only in the years when there were concentrations of bison or other game in the area.

Only the part of the site where Lott points were concentrated has been dated by the radiocarbon method. Most of the features, including most of the hearths where charcoal samples could be found, were in this part of the site. The parts of the site where Garza and Perdiz points have been found will be investigated further in an attempt to establish reliable dates.

The time from A.D. 1350 to1400 is suggested for the Lott site by several lines of evidence. Three radiocarbon dates, listed below, were obtained on charcoal samples from three different hearths in the area of the site on which Lott points were found almost exclusively. One of the hearths, Feature 4, from which radiocarbon sample Tx-4600 was obtained, was excavated by entering from the side rather than from the top in order to obtain a suitable amount of wood charcoal with a minimum of disturbance to the hearth. During this excavating a Lott point was found in situ (Figure 20), further indicating that the hearth was in use during the Lott period of occupation.

Figure 20. Photograph of Feature 4, from which a charcoal sample was taken for radiocarbon dating. The arrow points to the base of a Lott point found during the excavation for the charcoal sample.

The radiocarbon dates of the three samples, which were run at the Radiocarbon Laboratory at The University of Texas at Austin (Valastro n.d.), with their dendrochronological corrections according to the calibration table of Klein, Lerman, Damon, and Ralph (1982), are as follows:

Sample No.	Radiocarbon Age	Corrected Date
Tx-4442	450±70 B.P.	A.D.1390-1505
Tx-4600	510±60 B.P.	A.D.1335-1435
Tx-4788	540±50 B.P.	A.D.1325-1435

This dating is further supported by the quantity of bison bones at the site. One virtually intact skeleton was found, and all of the hearths examined contained burned and fragmented bison bones. Bison bone and tooth fragments are scattered over the entire site. There were almost no bison in this area before A.D. 1200; however, they became much more plentiful on the Llano Estacado beginning about A.D. 1200 (Dillehay 1974:181). In addition, three sherds of Agua Fria or Rio Grande Glaze I pottery were found on the site. This pottery, which originated in the Albuquerque area, was widely traded during the 1300s, the peak trade period being A.D. 1315-1400 (Warren 1970:6). These dates indicate that the Lott point was in use as much as 50 years earlier than the Garza point. The suggested date for occupation of the Garza site, which is only about 3 km (2 miles) from the Lott site, is before A.D. 1500 (Runkles 1964:123). Excavations at the Lubbock Lake site revealed Garza occupation zones that were dated by two radiocarbon samples, one of which came from the hearth in which a Garza point was found in situ. The dates were A.D. 1635 and 1665, but these dates may be 50 years too young (Johnson et al. 1977:105). However, most of the few Lott points found at other locations in the Garza County area have been found on Garza types of sites. So there probably was a transition from the Lott point to the Garza point. The writers believe that Lott and Garza points represent not two different cultures, but rather a change in the making of the arrowpoint over a period of time. Such a transition fits in with the general trend of simplification of artifact manufacture that, in this case, amounted to simply discontinuing trimming the lateral edges of the points. In many areas through which there was a diffusion of Plains traits and traits from the East, the simple triangular point became predominant in later periods.

DISCUSSION

The Lott site differs from other prehistoric sites on the southern High Plains in ways that make it an important link in the study and interpretation of the archeology of the southern High Plains.

The writers are not aware of any other site in the southern High Plains with such a concentration of arrowpoints. The site has yielded more than 60 Lott points, more than 50 Garza points, more than 60 Perdiz points, and more than 60 triangular preforms. The count of Perdiz points is probably falsely low because, as noted above, about half of the artifacts originally classified as broken drills are believed to be Perdiz stems that were removed from arrow shafts after the points were broken off. In addition, 50 to 75 other points were broken so badly that type could not be determined. The site is small, covering only about a half a hectare (1.25 acres), the zones from which artifacts were recovered covering less than a fifth of a hectare (less than half an acre). The number of Perdiz points is especially noteworthy, since they are scarce in this part of Texas. On sites at the edges of the Llano Estacado there are rarely more than 3 or 4 Perdiz points.

In addition to the large number of arrowpoints, this site has produced more than 750 sherds of a distinctive pottery representing at least 16 to 18 vessels. The sherds were found in areas A, C, D, and F, as shown on Figure 3. No sherds were found in areas B and E. Only three of the sherds are from the Rio Grande drainage area of New Mexico; all the rest appear to have been made locally. Most of the sherds resemble Caddoan pottery and are tempered with burned or calcined bone, which is found in 20 to 30 percent of Caddoan sites (Davis 1961:6). Bone tempering is found in other pottery as far west as west-central Texas (Suhm and Jelks 1962:95), but only rarely on the Llano Estacado. The writers have examined sherds from at least 90 sites in West Texas and found none that resemble the most common group of the Lott site sherds. Our observation is that the typical pottery from Llano Estacado sites is thick, coarse, tempered with grit or sand, and not well finished. Apache pottery on these sites is coarse and usually black, with mica inclusions. In addition, pottery from the Rio Grande drainage is common on West Texas sites. On most sites there is a mixture of pottery, with a high percentage from the Rio Grande drainage together with locally made vessels.

By contrast, the Lott site had only three Rio Grande sherds, and the locally made Lott pottery is extremely well made. It has a fine paste, is highly smoothed and hard, and some is burnished. The intentional temper is not sand or clay, but burned bone. There are some inclusions of small weathered rocks, gravel, and minerals that, as we have found, occur typically in the Triassic clays of the area. The decoration on three varieties closely resembles the decoration on some Caddoan vessels.

Ceramics have long been used by archeologists to help establish dates, cultural associations, diffusion of cultural traits, and social changes. Ceramics are especially useful for these purposes because temper, firing techniques, finish, and decoration can be used to support some assumptions. Pottery of a distinctive type manufactured in a known area is often found in another locale. The assumption is then often made that the pottery was brought by the makers or traded to the other place. But assumptions based on pottery for establishing cultural backgrounds cannot be made blindly without in-depth investigation. For example, some of the sherds found at Edwards complex sites in southwestern Oklahoma have long been thought to have been traded from Caddoan areas in East Texas. Recent thin-section and petrographic analyses, however, have indicated that this pottery was made at the Edwards complex sites (Ferring 1986). People in different areas and of different cultures used their own techniques in making ceramics, and when they moved, their techniques usually went with them, so their techniques could be easily recognized in their new locations. Researchers must make sufficient tests and investigations to determine if the pottery was traded into the area, if its presence represents a movement of people, or if it represents diffusion of traits or techniques. Since the pottery found at the Lott site appears from our examination to be made from local materials and yet has Caddoan decorative elements, its presence there is clearly an important manifestation of the movement of traits from the Caddoan area to the Plains.

The large quantities of arrowpoints, chipping debris, and pottery strongly suggest that this site is more than a temporary or short-term campsite. Rather it is most likely a base camp for hunting expeditions in the area, used seasonally for making and repairing hunting equipment. Further investigation should be made of the pieces of fired-clay with imprints of grass and sticks, described earlier, to try to determine if they came from wattle-and-daub shelters.The writers believe there is a definite relationship between Caddoan and Plains cultures and that the Lott site is an important link in this relationship. In the rest of this discussion we will consider many of the factors bearing on related changes in Caddoan and Plains prehistory.

In the last 10 years, a great deal of work has been done that is beginning to provide explanations for the conditions and factors that brought about changes in the southern Plains and Caddoan cultures. Much archeological information has been obtained from research in Central Texas, East Texas, and Oklahoma,dealing with population declines or increases, population shifts, and changes in culture. Several researchers are beginning to discern patterns of climate and weather changes that parallel changes in archeological patterns; these parallels may lead to the most logical solutions to many archeological puzzles.

In the eastern half of Texas the density of archeological sites suggests that for 1600 years, from 1000 B.C to A.D. 500, there was an increase in population, after which the population remained about static. In Central Texas an apparent decline in population began in the late Prehistoric period, or about A.D. 500 (Skinner 1981:114). Then, after A.D. 1200, the population in north-central and East Texas apparently began to decline (Peters 1986). The decline in prehistoric populations seems to have begun in Central Texas around A.D. 500 and to have moved after that to the north and east.

Bruseth has made extensive studies as part of the Richland Creek Archeological Project (RCAP)(Bruseth et al. 1986), dealing with the paleoecological conditions for the late Holocene period. A variety of disciplines were exploited, the principle ones being pollen analysis, radiocarbon dating, and studies of alluvial stratigraphy. When these studies are combined with archeological data, a clear picture of cause and effect emerges. From archeological data and study of utilization of bison and other mammals through faunal analysis, it is possible to trace fluctuations in prehistoric populations and, especially, movements of people and cultures.

The Richland Creek Project has been ideally suited to make these studies of climatic change. Its geographic setting is along the Prairie Margin, a major ecotone separating the eastern Deciduous Forest Biome from the Grassland Biome in Texas and Oklahoma (Shelford 1963), where the forests of eastern Texas and Oklahoma give way to the Great Plains, sharply and distinctly in some parts of the zone, and through a complex mixture of forest, prairie, and savannah in other parts. The zone has not been static during the Holocene but has advanced and retreated as temperature and moisture conditions have changed (Borchert 1953). These changes have had a major impact on the adaptations of prehistoric peoples because grasslands and forests have markedly different subsistence potentials. The overall change that occurs during drought conditions is a retreat and replacement of forests by tall grasses. The existing tall grasses are in turn replaced by medium grasses and by short grasses, which are very tolerant of drought conditions.

The studies by Bruseth have established some patterns of climatic changes. Although each site is different, his studies of pollen remains and fluvial or floodplain deposition at many sites indicate a wet period from 1000 B.C. to about A.D. 800 (Bruseth 1986). From A.D. 800 to 1170 the climate began a drying trend, and from A.D. 1170 to the present the climate in the study area has been dry. Studies by Hall in eastern, central, and southwestern Oklahoma have indicated a similar pattern (Hall 1982:391). In southwesten Oklahoma, 650 B.C. to A.D. 950 was a moist period; A.D. 950 to 1290 began a dryer period; and A.D. 1290 to the present was a dry period. Studies by Ferring in Delaware Canyon in southwestern Oklahoma also indicate that A.D. 1 to 1000 was moist. Other research (Hall 1982) suggests that the area has been dry from A.D. 1000 to the present.

These better-defined climatic changes relate exceptionally well to changes noted among the southern Plains cultures and the Caddoans of eastern Oklahoma and Texas. Wyckoff has made extensive studies of the Caddoan cultures in the Arkansas River basin (Wyckoff 1980:514), dividing the sequence into four periods. We are interested in his Period III (A.D. 1200-1400) and Period IV (1400-1550). The changes noted during these periods are definitely related to events on the southern High Plains. The Caddoans were farmers, who supplemented their diet with hunting and gathering. They lived in scattered villages and houses on the rich soil of stream and river terraces. Their pottery, arrowpoints, houses, mounds, and religious items resembled the Mississippian cultures to the east. Around A.D. 1200, a decrease in the number of houses demonstrates that the villages began to disperse to other areas. At about the same time, Plains traits began to appear in Caddoan sites, and by A.D. 1400 Caddoan villagers were using southern Plains flints, turquoise, and tool types, and the farmers were using bison scapulas for digging tools.

All of these changes coincide with the drying trend that began in A.D. 1200 and has continued to the present. This drying trend adversely affected farming activities; the short-grass prairies moved to the east where bison herds became much more plentiful. In fact, the ratio of deer to bison usage changed from 10.6:1 (A.D. 950-1200) to 1.04:1 (A.D. 1400-1550). These ratios are based on bone counts in dated sites (Wyckoff 1980:500). The Plains people apparently were moving into eastern areas following and hunting bison, and the Caddoan farmers began to move westward onto the plains on hunting expeditions. These events could explain the mixing of Plains and Caddoan traits seen at the Lott site and other sites from north-central Texas to western Oklahoma. It is possible that groups of Caddoan hunters actually reached the Llano Estacado by traveling up the Brazos River basin from known Caddoan sites such as Stansbury and Chupek in the Waco area. It is also possible that groups traveled up the Red River and then southward down the east edge of the Llano Estacado along the Caprock, where water and campsites were readily available. The radiocarbon dates from the Lott site fit very well into the time frame proposed here for the movement and intermixing of the Plains and Caddoan people.

CONCLUSIONS

The writers believe the Lott site is a distinct manifestation of the movement of Caddoan traits to the southern High Plains and that the people used the site seasonally as a base camp for hunting, manufacturing stone tools, and perhaps for making pottery. The site was used for 50 to 100 years beginning in the mid A.D. 1300s and continuing into the early 1400s. During this time their arrowpoint making went through a transition, and with elimination of the side trimming, the Lott points became Garza points. Sherds of one Rio Grande glaze vessel and two obsidian Garza points, obsidian flakes, and shell beads made from Pacific Ocean shells found at the site indicate that in the late 1300s some limited trade with areas to the west took place.

Since the tools and arrowpoints, generally thought to have been made by the men, are Plains varieties, we believe they were from Plains rather than Caddoan groups. On the other hand, ceramics are generally thought to have been made by women, so it is possible that men in Plains hunting parties that encountered Caddoan groups to the east may have married Caddoan women who went with them to the plains. This could account for the Caddoan-style pottery that was made on or in the vicinity of the Lott site. However, we cannot see any way to test or validate this explanation, although it has plausibility on its side.

We are unable to explain the large number of Perdiz points on this site. They are common in many parts of Texas, including parts of the Caddo area, in very late prehistoric times. Their distribution on this site does not correspond to the distribution of Caddoan-style pottery. This problem will be investigated further and we hope to deal with it in a later report.

ACKNOWLEDGEMENTS

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Finally, it is not possible to thank properly Michael B. Collins, who offered much guidance, especially editorial comments and organizational suggestions. John Lott, owner of the ranch on which the Lott site is located, is to be especially thanked for allowing the writers and others to work at the site. Lott has supported the project in other ways, and this support is especially appreciated, for it allowed us to obtain some data that otherwise would have been difficult to get. The report has been improved by all of these people. The junior author was able to write the paper only because of the help of very detailed notes, representative artifacts, and the senior author's long-term knowledge of this site.

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Prehistoric Population Dynamics of Southeastern Texas

L. W. Patterson

ABSTRACT

A study is presented on development of tentative models of population dynamics for prehistoric periods of southeastern Texas. The inland and coastal margin areas of this region, which appear to have significant differences in population dynamics, are considered separately.

INTRODUCTION

Demography is of general interest in the study of prehistoric lifeways and cultural change, but population studies are often limited by problems in obtaining and interpreting data from archeological sites. There now appear to be enough data available to begin development of models for prehistoric population dynamics in southeastern Texas, especially for the later postceramic periods.

The only demographic model published for this region is one proposed by Aten (1983:Figure 17.1), which covers mainly postceramic and historic Indian time periods for the upper Texas coastal margin. This article considers prehistoric population dynamics of both the coastal margin and inland parts of the Coastal Plain of southeastern Texas (Figure 1); there appear to be significant demographic differences between the two.

STUDY PROBLEMS

Several factors that make demographic studies for prehistoric periods difficult are listed below.

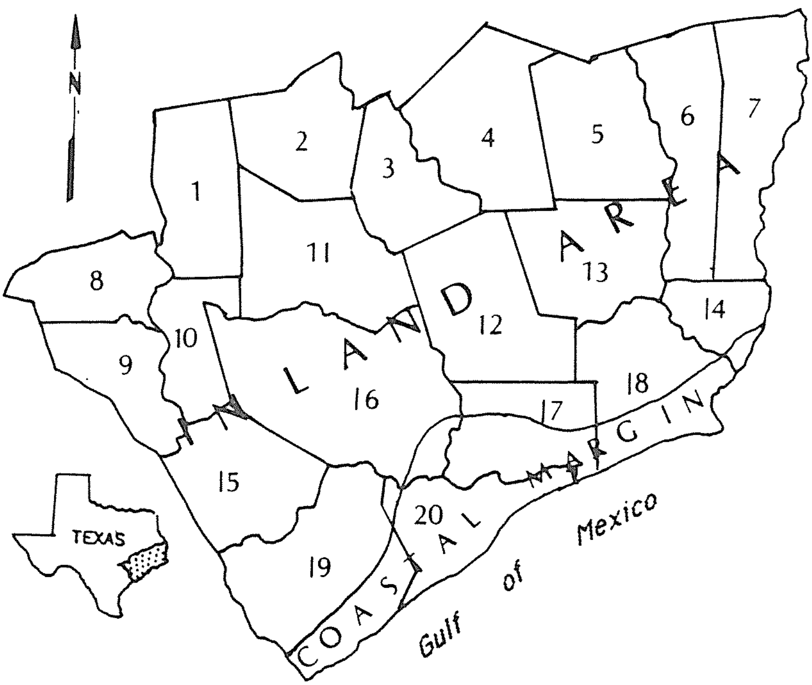
1. The limitations of radiocarbon dating diminish its value for determining the populations of areas for short time periods.
2. Most cause-effect studies are of limited value because they do not have usable data. For example, there are problems in relating cultural dynamics to climatic changes (Butzer 1983:301).
3. Sampling patterns can cause problems, especially if there are intraregional differences in population densities.
4. The time ranges established for many artifact types that are commonly used as time indicators for archeological sites are not sufficiently accurate for demographic use.

5. The kind of data needed for dating sites are available for only a limited number of sites.

6. Chronological data from one region may be of limited value for dating an adjacent region because of interregional differences in chronologies for specific artifact types.

7. The data base for early preceramic periods is generally limited.

8. Possible differences in interpretation of identical data can make conclusions meaningless. For example, was a large site occupied by a large group for a long period or by small groups for several short periods.



KEY TO COUNTIES

1. Grimes	6. Jasper	11. Montgomery	16. Harris
2. Walker	7. Newton	12. Liberty	17. Chambers
3. San Jacinto	8. Washington	13. Hardin	18. Jefferson
4. Polk	9. Austin	14. Orange	19. Brazoria
5. Tyler	10. Waller	15. Fort Bend	20. Galveston

Figure 1. Map of the eastern part of the Gulf Coastal Plain of Texas, showing the coastal margin and inland areas.

SOUTHEASTERN TEXAS

Data published by Patterson (1979:Tables 1, 2) on recorded prehistoric sites of various time periods for a 20-county area in southeastern Texas can be used for developing tentative models of population dynamics in this region. At this stage of study, available data are useful for judging population changes, but not for establishing absolute population densities. The time period for occupation for a large number of sites in this region is unknown (Patterson 1979:Table 1). For this study, the following time periods have been used:

Late Prehistoric, 900 years, from A.D. 600 to 1500
Early Ceramic, 500 years, from A.D. 100 to 600
Middle/Late Archaic, 3100 years, from 3000 B.C. to A.D. 100.

The time ranges shown above are the same ones used previously in a discussion (Patterson 1985:Table 1) of southeastern Texas prehistoric settlement patterns. The Paleoindian and Early Archaic periods have not been used because the data base for those periods is insufficient. The term *Early Ceramic period* (Story 1981:145) is used here rather than the term *Woodland* (Patterson 1979:108).

Population density factors (PF) for each prehistoric time period are calculated here by taking the number of sites in a region for the time period in question (Table 1) and dividing this by the number of years in the time

Table 1. Summary of Population Factors

Time Period	Inland		Coastal Margin	
	No. of Sites	PF	No. of Sites	PF
Late Prehistoric	232	25.8	74	8.2
Early Ceramic	214	42.8	27	5.4
Middle/Late Archaic	104	3.4	8	0.3

PF: Population Factor
SOURCE: Patterson 1979

period. The result is here termed the Population Factor (PF). For the convenience of dealing with large numbers, all results have been multiplied by 100. This is essentially the same method used by Prewitt (1983:216) to examine population densities for various time periods in Central Texas. Population Factors have been calculated here separately for inland sites and coastal margin shell middens (Table 1; Figure 2). The curve for the coastal margin shows population increasing from the Archaic through the Late Prehistoric periods. This is in agreement with Aten's population model for this area (1983:Figure 17.1). In comparison, it can be seen (Figure 2) that for the inland area there is a population peak in the Early Ceramic period and a population decline in the Late Prehistoric.

The population decline in the Late Prehistoric for the inland area of southeastern Texas may be underestimated here. It has been noted (Patterson 1976) that

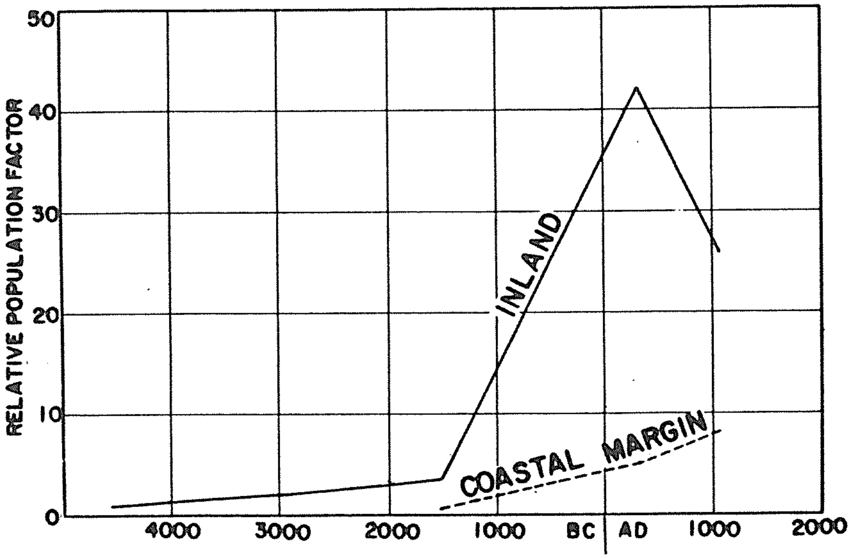


Figure 2. Graph showing population density estimates for the inland and coastal margin areas.

Indians on the inland part of the Coastal Plain of southeastern Texas may have been more mobile in the Late Prehistoric, using smaller sites perhaps for shorter periods. A given number of mobile people would occupy more sites in a time period than would the same number of sedentary people.

DISCUSSION

This study establishes for the inland part of the Coastal Plain of southeastern Texas during the Early Ceramic period a population density peak that is similar to the peak shown by Prewitt (1983:Figure 6) for Central Texas during roughly the same period. Still unexplained is why a population decline occurred in the Late Prehistoric after continuous population increases in all preceding prehistoric time periods. Some common reasons for population decreases are climatic change, disease, and warfare, but this question remains a subject for future research in Central and southeastern Texas. As noted by Story (1981:144), reasons for population change can be difficult to determine.

In contrast to the inland Coastal Plain, the population density of the upper Texas coastal margin seems to have continued to increase from the Late Archaic through the Late Prehistoric, as shown by both this study and Aten's (1983:Figure 17.1) model. Apparently the marine food resources of the coastal margin could be exploited more intensely, supporting a larger population. There are several indications too that the Indians of the coastal margin continued to follow a sedentary lifeway while Indians of the adjacent inland areas were becoming more mobile (Patterson 1983:260) in the Late Prehistoric. Large amounts of pottery are generally found at coastal margin shell middens during the Early Ceramic and Late Prehistoric periods, one indication of a fairly sedentary lifeway. Inland sites, however, do not have large amounts of pottery in the Early Ceramic period and have even less in the Late Prehistoric.

Artifact assemblages at inland sites in postceramic periods differ significantly from artifact assemblages at coastal margin sites in southeastern Texas, indicating not only differences in lifeways, but also suggesting relatively little communication between the two areas. For example, inland sites usually have large lithic assemblages and coastal margin sites have small lithic assemblages. Too, incised pottery comprises a small percentage of the ceramics at inland sites but is common at coastal margin sites. It is concluded that potential population shifts from inland to the coastal margin did not contribute much to population increases on the coastal margin.

SUMMARY

This study has provided two patterns of population dynamics for southeastern Texas. In the inland area there seem to have been continuing population increases from the Archaic through the Early Ceramic periods, followed by a leveling off, or more likely a decline, in population density in the Late Prehistoric. In contrast, on the coastal margin, population density seems to increase from the Late Archaic continuously through the Late Prehistoric. These conclusions are, of course, subject to change as more data become available. More research is needed to determine why population changes have occurred and to refine the data on the magnitude of population changes.

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A Preliminary Assessment of Environmental and Cultural Determinants of Settlement in Central Texas During the Nineteenth Century

Shawn Bonath Carlson

ABSTRACT

An archeological survey was conducted for the Department of the Army at Fort Hood in Central Texas during the winter of 1982-1983 by the Texas Archeological Survey at The University of Texas at Austin. The results of the survey were later analyzed by the Archeological Research Laboratory at Texas A&M University. Of the nearly 200 sites recorded, 88 were historic. This paper strives to identify possible trends in historic settlement through the use of basic environmental data observed and recorded in the field. Combined with historical documentation pertaining to the project area and chronological data obtained from the recovered artifacts, suggestions are made concerning preferred site locations and periods of settlement.

INTRODUCTION

Eighty-eight historic sites were recorded during a 35 km² survey at the Fort Hood Military Installation in Central Texas and are summarized here for the purpose of identifying possible trends in historic settlement (Figure 1). Environmental and cultural determinants are examined and regular patterns of settlement found in regard to zone of settlement, landform, vegetation, distance to water, beginning date of settlement, length of settlement, ethnicity, and occupations. Environmental data and historical documentation are particularly stressed at Fort Hood because of impacts to the cultural remains by military activities that have destroyed their contextual integrity. Initial impacts occurred at the time of acquisition in the 1940s when all domestic structures were razed or moved to nearby Killeen. Since then, tracked and wheeled vehicles, bulldozing, artillery fire, ordnance, and bivouac operations have caused daily impacts to the sites. In spite of these weaknesses, the United States military installation at Fort Hood offers a unique opportunity to examine historic site settlement in a contiguous area covering approximately 546 km² (339 square miles).

The survey was conducted for the army during the winter of 1982-1983 by the Texas Archeological Survey (TAS) at the University of Texas at Austin under contract to Science Applications, Inc., of LaJolla, California. The results of the survey were analyzed for the army during the summer of 1983 by the Archeological Research Laboratory (ARL) at Texas A&M University under contract to S-Cubed, also of LaJolla, California.

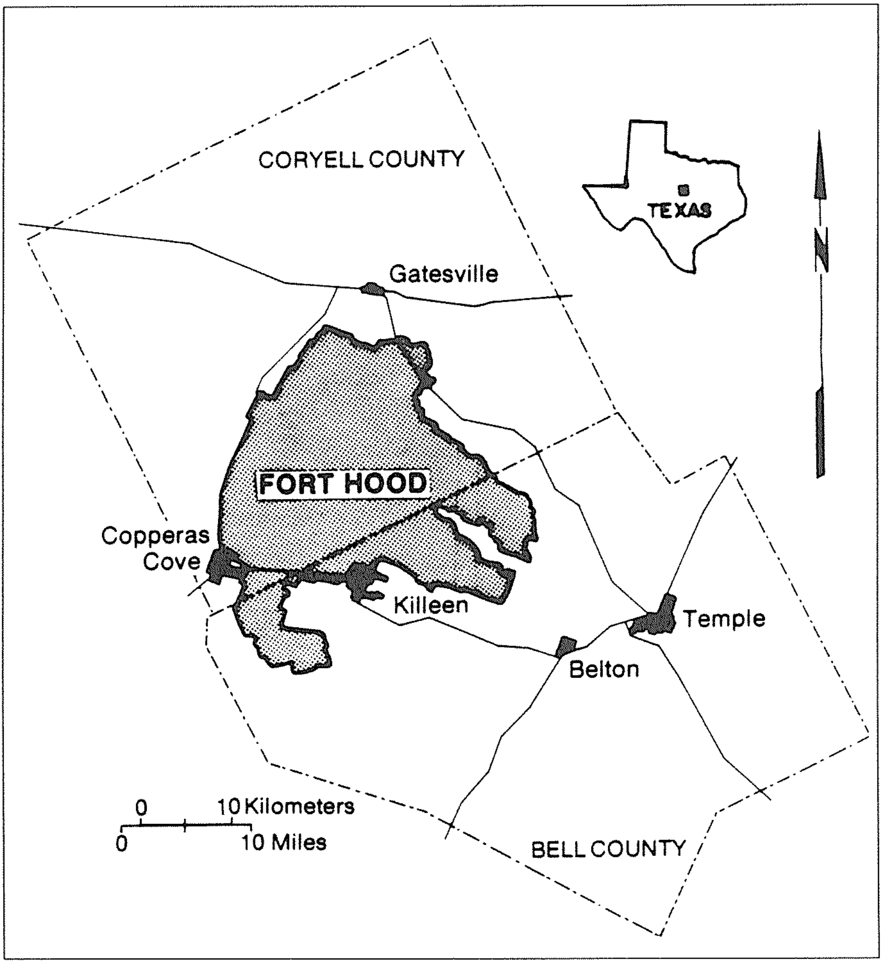

Figure 1. Map of parts of Bell and Coryell Counties, Texas, showing the location of Fort Hood Military Installation.

BACKGROUND

Fort Hood, one of the largest military installations in the world, is located in Bell and Coryell counties in Central Texas. The sites discussed here are in Coryell County in the northern part of the fort (Figure 1). Characterized by varying relief within the Lampasas Cut Plains, Fort Hood lies adjacent to Texas's major physiographic feature, the Balcones Escarpment (Arbingast et al. 1976:8,12,13). It also lies near the juncture of three physiographic regions: the Edwards Plateau, the Cross Timbers, and the Blackland Prairies (Figure 2).

The cultural history of Coryell County does not begin until after the establishment of Fort Gates in 1849 (Scott 1965). As one of a series of forts established by the War Department to protect the frontiersmen from marauding Indians, it was located beyond the fringes of westernmost settlement in Texas. Within two years,

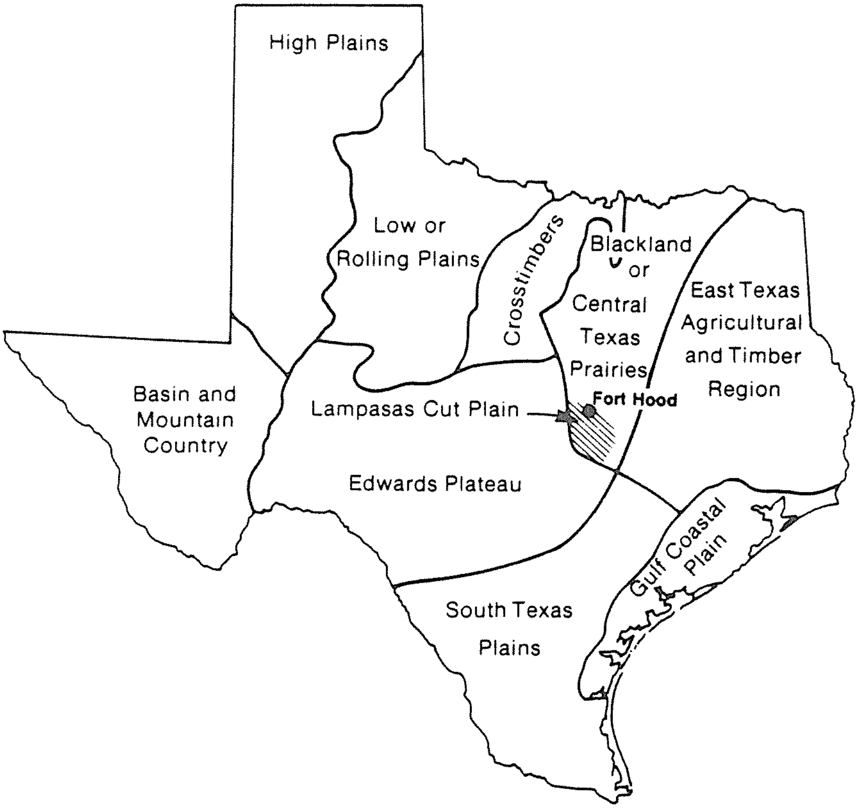

Figure 2. Map showing the relation of Fort Hood to the natural regions of Texas, according to Richardson, Wallace, and Anderson 1981.

settlement had advanced to this permanent line of defense, and Fort Gates was abandoned. During the early years of settlement, the problem of straying livestock was complicated by the threat of Indian theft. The Assistant Marshall stated in the population schedules of Coryell County in 1860 that "the dwellings in the southwest portion of this county are unoccupied, the inhabitants were forced to abandon for the purpose of self preservation from Indian depredations" (United States Bureau of the Census 1860a).

Indian dissension continued for many years, and it was not until the 1880s that settlement intensified and the development of Coryell County really began. Industrial manufacturing was never significant, and farming and stock raising were the critical industries. The interpretation of historic sites at Fort Hood presupposes knowledge of these industries, which dominate the archeological record.

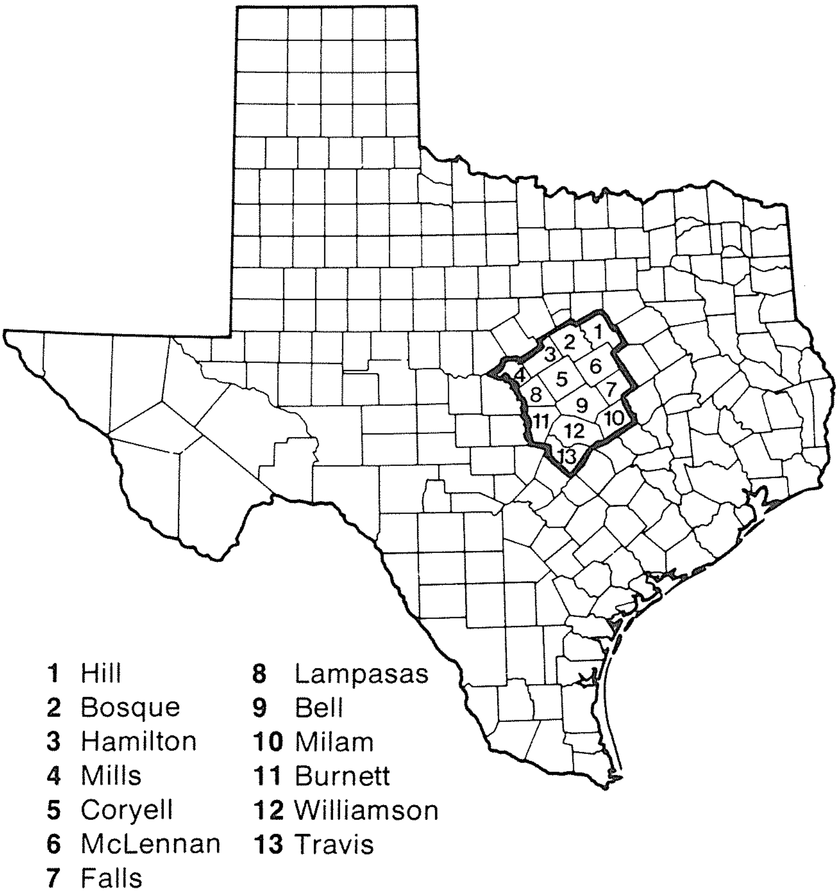

Figure 3. Map of Texas showing the 13-county area for which a search of the literature was conducted.

A literature search for previously known historic sites in the Fort Hood vicinity was conducted for a 13-county area extending from the Colorado River to the Brazos River and slightly north and south of the project area (Figure 3). The counties chosen encompass the Fort Hood area and lie within the Central Texas Prairies (Richardson et al. 1981). The search was admittedly limited to current indices of Texas archeology (Simons 1981, 1983), but it does acknowledge most of the major historic sites that have been previously recorded for the area. With the exception of recent studies at Fort Hood (D. Carlson et al. 1980; S. Carlson 1984; Dibble et al. 1984a, 1984b; Guderjan et al. 1980; Jackson 1982; Jackson et al. 1982a, 1982b; Prewitt et al. 1983; Roemer et al. 1985; Skinner et al. 1981, 1984), no reports of investigations could be found for eight of the thirteen counties (Bell, Bosque, Burnet, Coryell, Falls, Hamilton, Lampasas, and Mills), including the counties that encompass Fort Hood. For the remaining counties (Hill, McLennan, Milam, Travis, and Williamson), most of the studies were outdated descriptive survey reports.

The high number of historic sites recorded at the Fort Hood Military Installation, which to date number more than 800, suggests the need for pattern recognition. Though the project area discussed in this paper does not cover a contiguous area, subsequent surveys have been completed recently for more than 200 contiguous square kilometers and should provide more reliable data (D. Carlson et al. 1986; S. Carlson, Ensor, et al. 1987; S. Carlson, D. Carlson, et al. 1987). These Central Texas sites represent a unique "time capsule." Most were settled during the latter part of the nineteenth century (ca. 1880) and were purchased by the army beginning in 1942. It is likely that many of these sites represent continuous occupations. As a group, they are similar to many other settlements throughout Texas during the nineteenth century and may reflect adaptations peculiar to later settlers of the western frontier.

RESEARCH DESIGN

The investigations at Fort Hood required only inventory and assessment of the cultural resources, since the sites were not being threatened immediately. Research objectives were developed using only the basic information necessary for inventory and assessment and primarily included locational, documentary, and chronological data. Those objectives focused upon the following six expectations:

(1) It was expected that fewer sites would be found per square kilometer in either the uplands or flood plain areas than in the intermediate zone.

(2) The early settlers were expected to favor easily accessible drinking water from streams, cisterns, or wells.

(3) It was expected that a relationship would be found between site complexity and site function.

(4) The distributions of sites by landform were expected to be an indicator of site function.

(5) It was expected that the increased manufacturing and production of goods during the late nineteenth century would be reflected by a higher deposition of artifacts during that period.

(6) It was expected that the increased manufacturing and production of the late nineteenth century would be reflected by increased size of activity areas.

The locational data were recorded in the field and ranged from grid coordinates and site size to a variety of environmental data such as elevation, slope, landform, vegetation, and distance to water. These data were coded for computer analysis and provided a variety of answers regarding preferences of the early pioneers for settlement of the project area.

The research questions also assumed the availability and use of a limited number of primary documents, which included (1) title abstracts, (2) population, agricultural, and industrial manuscript census schedules, and (3) General Land Office records. These documents generally provided information on land ownership, length of land use, use of the land through time, population density, ethnicity, etc. Although many other documents could have been consulted, these records provided a wide variety of information that could be examined quickly and used in the assessment of site significance.

Research questions addressing the chronological data were difficult to construct, due to the limited number of diagnostic cultural remains. Because of the minimal collection policies established by the Fort Hood archeologist, many historic artifacts have been recorded simply as being present or absent. Only a representative sample of those believed to be diagnostic was collected. Usually this included decorated ceramics, bottle lips and bases, the characteristic lavender glass, and any items with trademarks or patent numbers. However, the frequently occurring undecorated whitewares may be useful eventually as diagnostic markers for the late nineteenth century and early twentieth century (Lebo and Marcaurelle 1983). Because the chronological data were so limited at Fort Hood, the date ranges presented here represent the range of manufacture for the artifacts observed or collected at each site and not the occupational range of the site. However, the range of manufacture is currently our best estimate for when sites may have been occupied and should overlap the range of occupation.

ENVIRONMENTAL DETERMINANTS OF SETTLEMENT

Three broad environmental zones have been identified by the Fort Hood archeologist: (1) the lowlands, which include bottomland associated with perennial and intermittent streams, (2) the intermediate uplands, which encompass land higher than the lowland zone but do not include the massive limestone found in parts of Fort Hood, and (3) the uplands, which encompass only the areas where limestone is exposed (Briuer 1983; Roemer et al. 1985:III-1, 2). The 88 historic sites were primarily in the lowland and intermediate uplands (Figure 4). More than half of these occurred in the intermediate uplands and were defined as domestic dwellings, farm/ranch complexes, and trash dumps. Slightly fewer sites of similar functions occurred in the lowlands. The fewest sites occurred in the uplands, and most were trash dumps.

More than half of the sites were distributed between 244 and 251 meters (800 and 825 feet) above mean sea level (AMSL), with the range of elevations extending from 213 to 305 meters (700 to 1000 feet) AMSL. However, previous studies using statistical methods have suggested that there are no preferred site locations for historic sites at Fort Hood based on either elevation or environmental zone (Carlson et al. 1983). The chronological distribution of the 88 historic sites by elevation, however, appears to suggest some regularities (Figure 5). Using the range of beginning dates of manufacture for artifacts recovered, a preliminary range of occupation was established. Sites located between 244 and 274 meters (800 and 900 feet) AMSL tended to be both the earliest settled and the longest occupied. A distribution based on the average range of beginning and ending dates of manufacture suggested other regularities as well. The lowland sites seemed to be somewhat earlier and were also abandoned earlier. The remaining sites were probably occupied until the time of purchase by the army beginning in 1942.

Similar analyses of the site distribution of landforms have suggested that slopes, secondary terraces, and knolls were preferred site locations, with

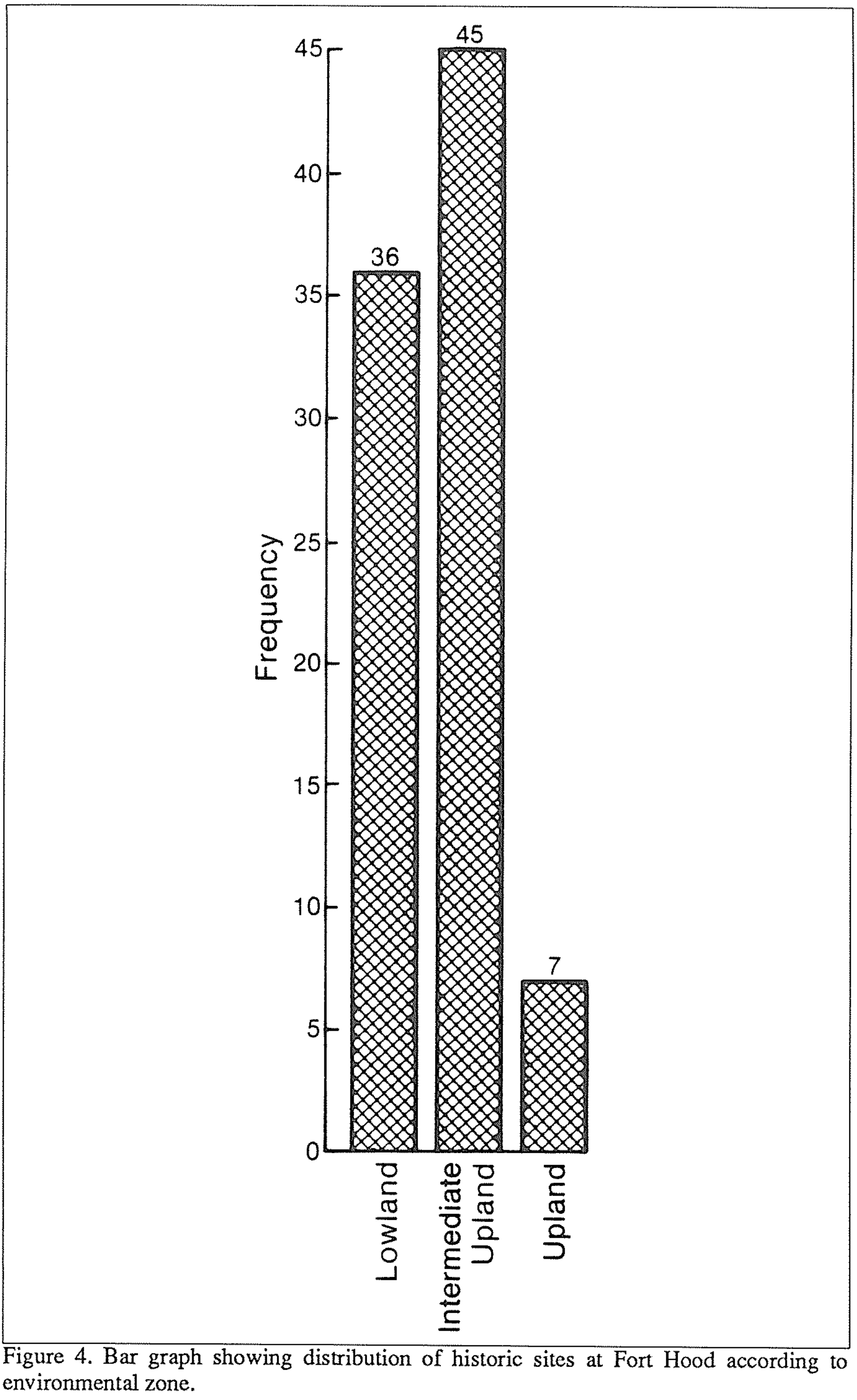

Figure 4. Bar graph showing distribution of historic sites at Fort Hood according to environmental zone.

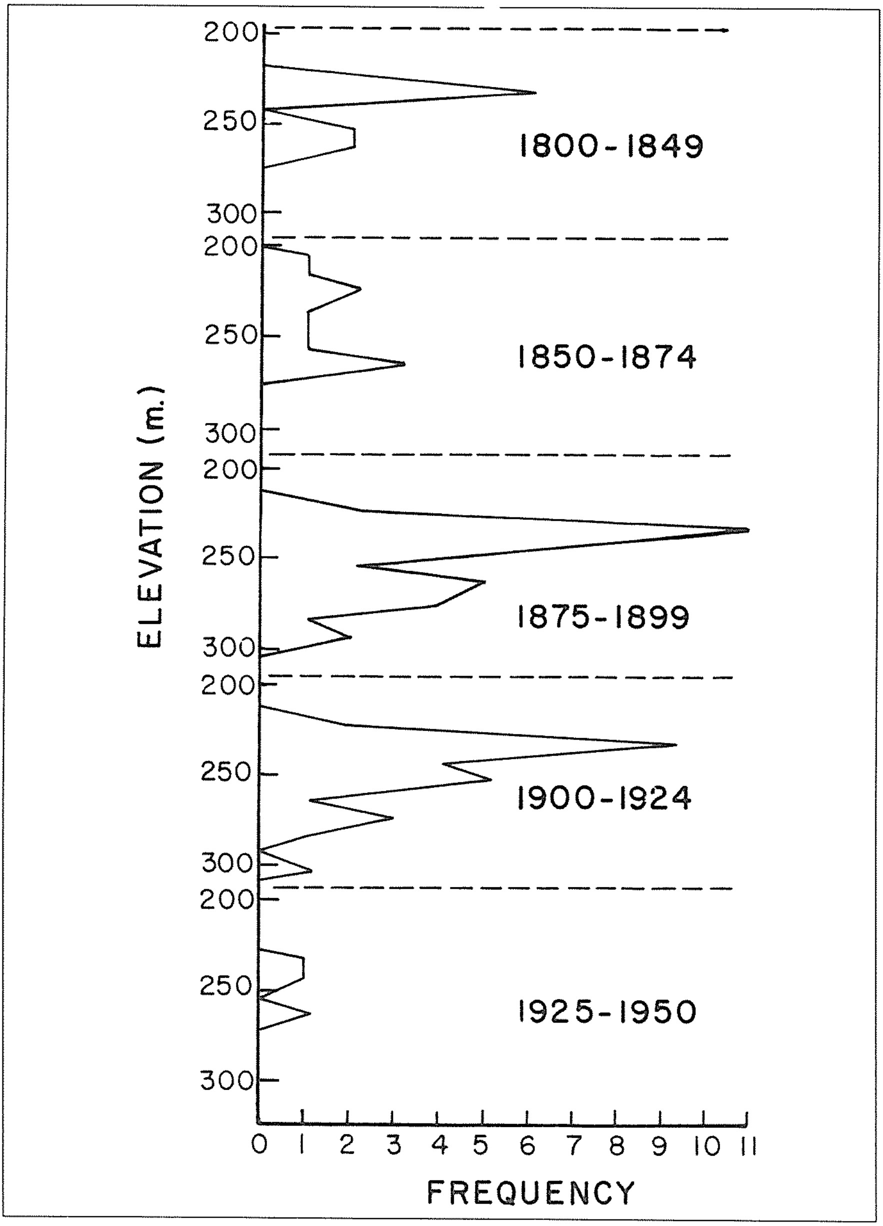

Figure 5. Frequency polygon showing distribution of historic sites at Fort Hood according to elevation and date.

interfluvials and banks also somewhat favored (Figure 6). Slopes and knolls seemed to be the preferred locations for farm/ranch complexes characterized by multiple structures, while secondary terraces, knolls, and interfluvials were the most frequent choices for domestic dwellings (Figure 7). Trash dumps corresponded with

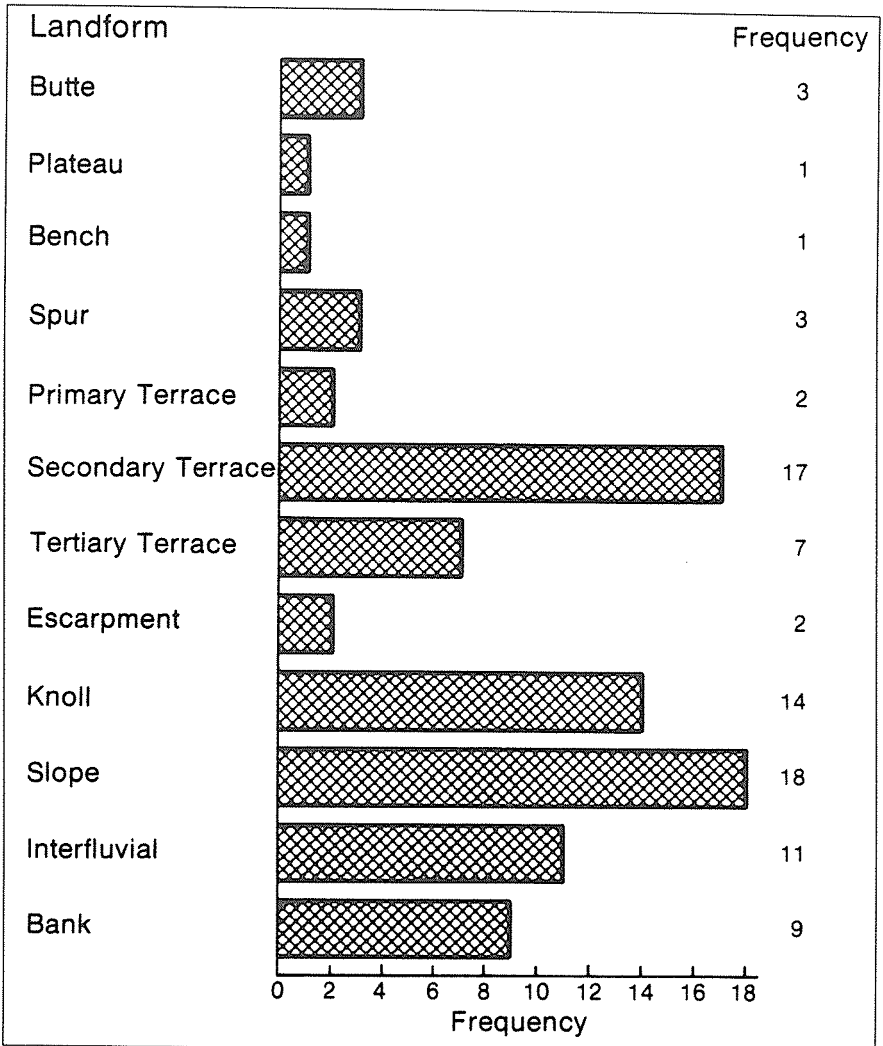

Figure 6. Bar graph showing distribution of historic sites at Fort Hood according to landform.

secondary terraces, slopes, and interfluvials but did not seem to be associated with individual dwellings or farm/ranch complexes. On the whole, all historic sites in the study area favored prominent locations.

The vegetation recorded at these sites had little diversity (Figure 8). Most sites were in open grassland, and the remainder were in mixed forests. The nearest water was generally available from on-site concrete-ringed wells and cisterns or nearby streams. More than half were within 150 meters, though none was more than 330 meters distant (Figure 9). The distance to these water sources from the main site areas generally increased after 1880. The availability of permanent water also appeared to have no bearing on the choice of site location (Figure 10). All sites in

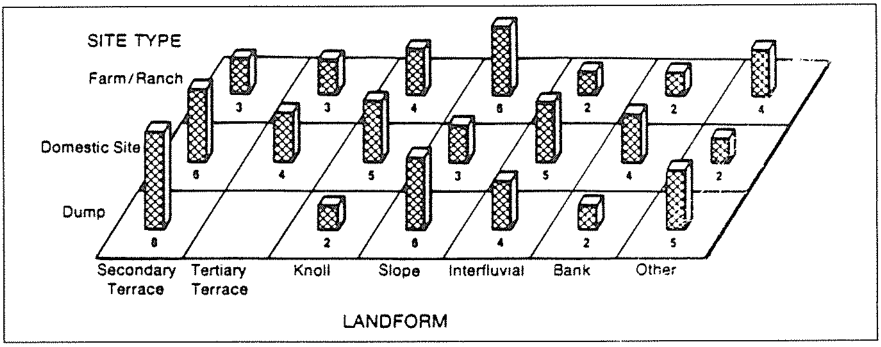

Figure 7. Frequency block chart showing historic sites at Fort Hood according to landform and type.

the study area were between 15 and 75 km from a major drainage, suggesting that nearness to water was not a critical factor. The poor navigability of many Texas rivers may also have detracted from settlement near permanent water (Puryear and Winfield 1976:xvi). Overland routes to the Brazos River, about 80 to 113 km (50 to 75 miles) to the east, may have been used more frequently than the locally unreliable waterways (Puryear and Winfield 1976:4). Lastly, a chronological plot of the site locations along each of the major drainages revealed that initial settlement occurred in waves at periodic intervals (Figure 11), each successive wave filling in the gaps remaining from the previous influxes. The resulting pattern is chronologically mixed, probably reflecting the partitioning of the original land grants through time.

CULTURAL DETERMINANTS OF INITIAL SETTLEMENT

The cultural determinants for initial site settlement in the study area were identified from documentary data concerning the original land grants, ethnicity of the original settlers, and the local industries.

Nine types of land grants were issued in the study area (Table 1). Of the original 46 grantees, only 13 had been issued title to their land by 1860 (Texas General Land

Table 1. Types of Original Land Grants in Project Area

1st class	6
2nd class	1
3rd class	5
Bounty	5
Donation	2
Preemption	17
School	5
Scrip	4
Unknown	1
TOTAL	46

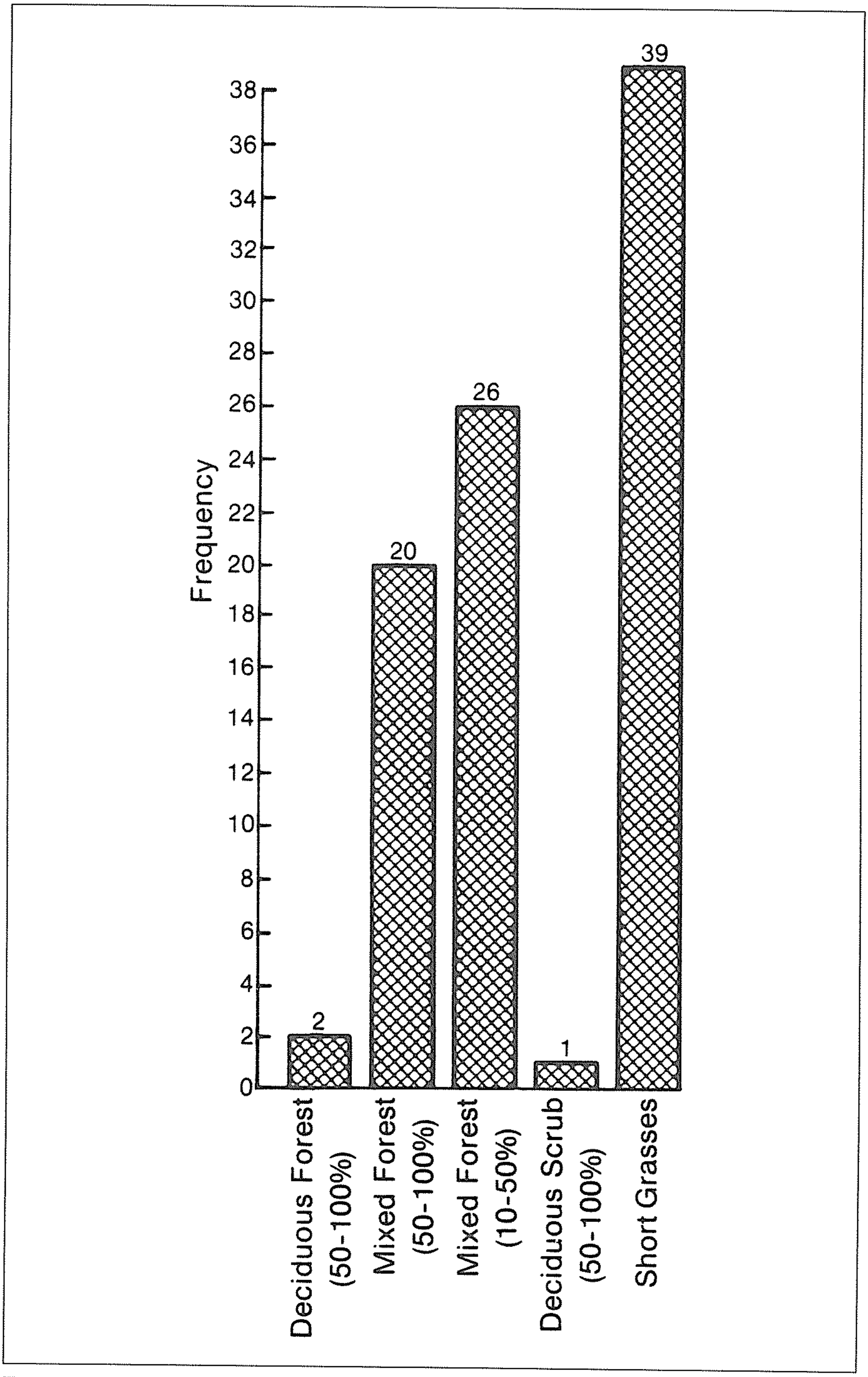

Figure 8. Bar graph showing historic sites at Fort Hood according to vegetation zone.

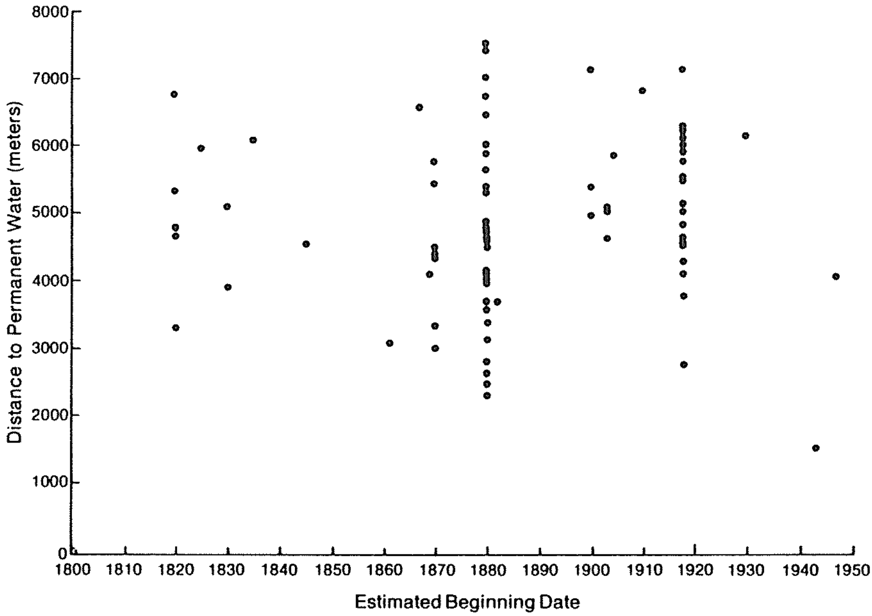

Figure 9. Scattergram showing distance of Fort Hood sites from nearest water according to date of first settlement.

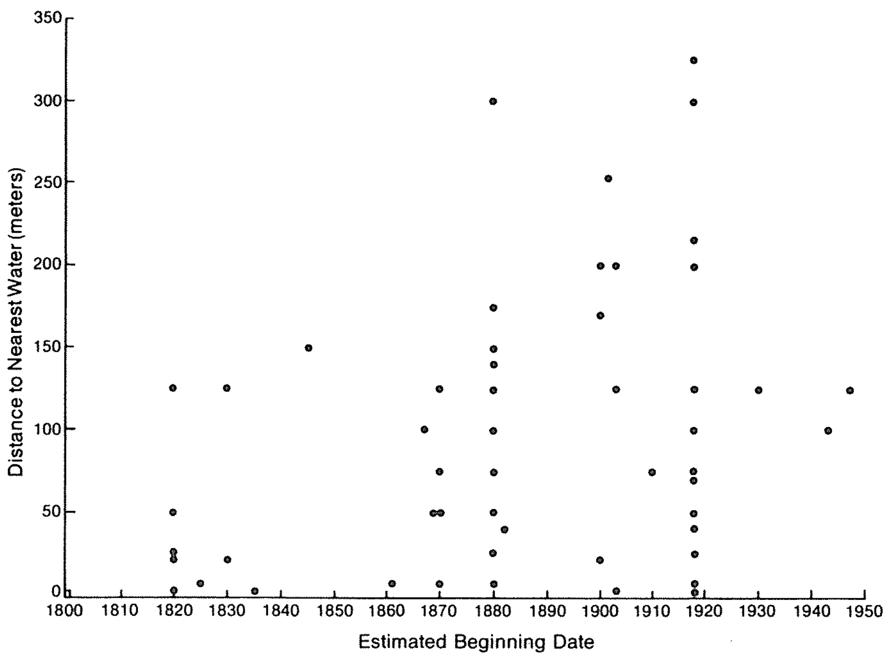

Figure 10. Scattergram showing distance of Fort Hood sites from permanent water course according to date of first settlement.

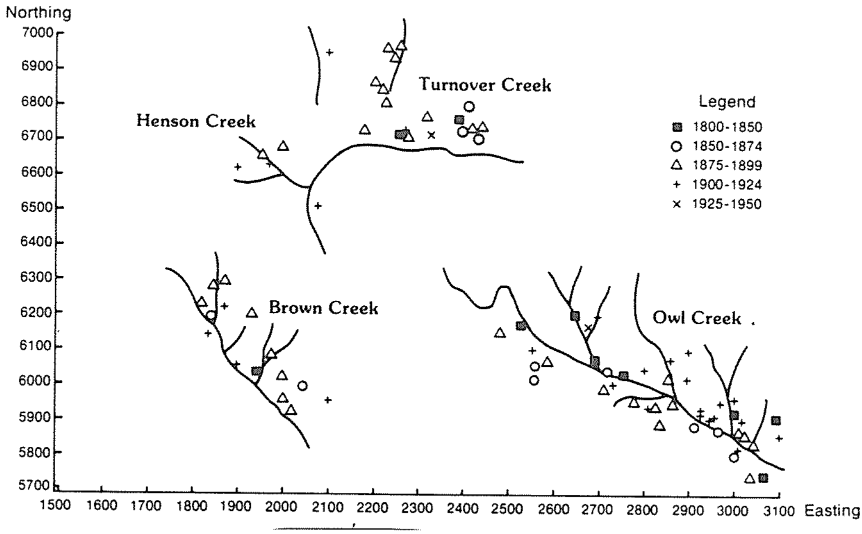

Figure 11. Maps of major creeks in Fort Hood showing Universal Transverse Mercator (UTM) locations and dates of initial settlement of historic sites.

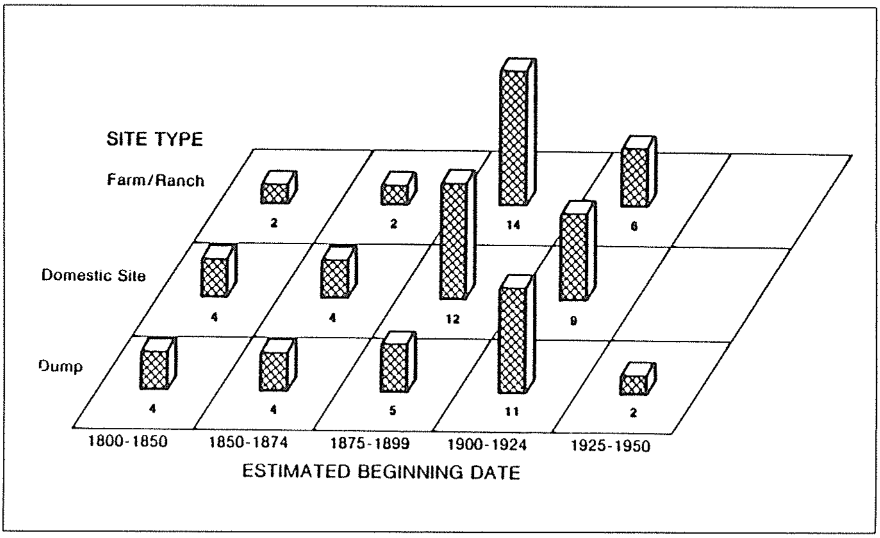

Figure 12. Frequency block chart showing historic sites at Fort Hood according to estimated beginning date and type.

Office 1941). These grants included first-, second-, and third-class headrights, military bounties, and battle donations. Many of these were given for military service, either during the 1836 fight for independence or on the frontier afterwards.

The first-, second-, and third-class grants issued in the study area before 1860 largely indicate settlement in Texas before 1840. The first-class grants were intended to reward those who assisted during the war for independence. The second-and third-class grants were issued to encourage settlement in Texas (Miller 1967:151,739).

Titles issued after 1860 in the project area were for preemption, school, and Confederate scrip certificates. The greatest number of settlers in the project area acquired their land by preemption; that is, they settled vacant lands in the public domain and were given first choice at purchase of those lands (Miller 1972:35).

School certificates were issued for lands set aside by the Texas congress in 1840, the proceeds of which were invested in Texas or United States bonds (Miller 1972:110). Confederate scrip certificates were issued to permanently disabled veterans or to widows (Miller 1972:52-53).

The variety of land grants available and the criteria for eligibility were designed to encourage settlement on the Texas frontier. Many of the earliest settlers, before statehood, were required to swear allegiance to Mexico and adherence to the Catholic faith (Miller 1972:16, 22). Some came to escape the law and others to continue the southern practice of slavery (Miller 1972:21). The influence of these grants upon settlement was significant. In particular, they caused settlement to occur earlier and faster, and they influenced large waves of Europeans to settle in Texas. Finally, they attracted a certain breed of settler who was willing to accept the conditions of settlement in order to obtain free or inexpensive land.

The original settlers in Coryell County, which encompasses part of Fort Hood, were largely Texas born (33 percent), while the greatest migrations came from Tennessee (16 percent), Arkansas (7 percent), Alabama (7 percent), Missouri (6 percent), Georgia (4.5 percent), and Mississippi (4.5 percent) (United States Bureau of the Census 1860b). Similarly, the leading states of birth for the surrounding counties in 1860 were Arkansas, Missouri, and Tennessee (Jordan 1970:413). Recent studies by Jordan (1970:426) have successfully demonstrated the similarities of the hilly area, in which all of Fort Hood is included, to the Ozarks and Appalachians. These similarities are attributed to transplantation of economy and culture. In particular, they are similar in cultural landscape, educational levels, place names, feuding, and the use of log structures. Economically, their underdevelopment, lack of urbanization and industrialization, and dependence on stock raising are comparable. Jordan (1970:427) suggests that "the migration of these people to the hills of central Texas was in part guided by their perception of the environment, by their desire to find another milieu similar to that they had left behind."

Though Coryell County was largely a stock-producing county in 1860 (Scott 1965:47), not a single person gave his occupation as stock raiser in the 1860 United States Census. Ironically, this was in contradiction to some of the earliest land-grant policies that conveyed one labor (71.6 ha, 177.1 acres) of land to farmers and one league (1720 ha,4251 acres) of farm land to ranchers (Miller 1972:17). That is, the land policies favored those claiming to be stock raisers by granting them more acreage than they did the farmers. Of the 596 people (male and female) over the age of 15 who listed their occupations with the census taker in 1860, 235 were farmers and 118 farm laborers (United States Bureau of the Census 1860b). These men accounted for more than 59 percent of the working population. Though the third most frequently listed occupation was herdsman (87), these were mostly young teenage boys and the sons of men who claimed to be farmers.

The county tax rolls also support stock raising as the primary industry in Coryell County, particularly between 1860 and 1870, when the number of cattle being raised was at its per-capita peak (Coryell County Tax Rolls 1855-1985). During this early period, limited quantities of feed corn and wheat were the major crops. By 1870, sheep were becoming an important commodity, replacing cattle in importance and reaching their peak production in 1890. Hogs were also raised in quantity, but never to the same extent as sheep and cattle. The Assistant Marshall for Coryell County concluded the 1860 census schedule for industrial productions by stating that the land was well adapted to stock raising due to the "mountainous" and rocky terrain. The massive limestone was the only industrial product listed and was used extensively in building throughout the country (United States Bureau of the Census 1860c).

SUMMARY

The preceding discussion has summarized the historic sites data from the 1982-1983 survey of 35 km^2 at the Fort Hood Military Installation in Central Texas. Based primarily on the environmental data, the documentary evidence, and the archeological remains, a series of six research objectives were identified and tested for the 88 historic sites recorded. The expectations of this research are summarized here.

(1) It was expected that fewer sites would be found per square kilometer in either the uplands or flood plain areas than in the intermediate zone, which was believed to have the most favorable environment. Also, the most densely settled zones were expected to be the earliest settled. However, the lowlands were found to be the most densely settled environmental zone, probably due to the varying relief at Fort Hood which ranges from 213 to 305 meters (700 to 1000 feet) AMSL in the project area. In addition, the lowlands were also found to be the earliest settled zone, confirming the expectation that the earliest settled zone would also be the most densely settled zone.

(2) The early settlers were expected to favor easily accessible drinking water from streams, cisterns, and wells. Nearness to rivers for transport of marketable goods would have been desirable and low flood-prone areas avoided. Also, sites located adjacent to permanent streams and rivers were expected to be the earliest settled. However, no sites were closer than 1500 meters to permanent water. The nearest available water, which included cisterns and wells, was within 150 meters. The negative results of this test suggest that the distance to permanent water had little influence on the early settlers, who were more likely to depend on overland travel and artificial sources of water. However, since the lowlands were the most densely settled zone, it is likely that these sites were located above flood stage at the interface of the lowlands with the intermediate uplands.

It was also expected that sites adjacent to water would reflect the choronology of population movements upstream. Though the data were insufficient to support this expectation, it appeared that higher ranked streams were settled first and that settlement along each stream occurred at periodic intervals, with later settlement resulting from the partitioning of the original land grants.

(3) It was anticipated that a relationship would be found between site complexity and site function. In particular, it was expected that farm/ranch complexes would be larger in size, contain more structural remains, and have a wider variety of artifacts. Not one of these assumptions held true when tested, a finding that may be attributed to inaccurate site definitions or multiple site use. Similarly, it was expected that domestic dwellings would contain more household items. Household items were defined as personal, kitchen, and craft or activity items (as opposed to hardware such as hand tools, wagon/carriage remains, and agricultural implements). This implication was supported by the archeological data when tested.

(4) The distributions of sites by landform were expected to be an indicator of site function (Figure 11). Habitation sites were most frequently found on knolls, secondary terraces, slopes, and tertiary terraces, all above flood stage. Trash disposal tended to correspond with the same natural features as the habitation areas, but isolated incidents of trash disposal occurred on ridges, benches, and primary terraces.

(5) It was expected that the increased manufacturing and production of goods during the late nineteenth century would be reflected by a higher deposition of artifacts during that period. This difference in depositional history could be used as a distinguishing marker between early and late sites. Unfortunately, sites containing both early and late components were not analyzed separately. However, they were found to contain a wider variety of artifacts by virtue of their longer occupations.

(6) It was expected that the increased manufacturing and production of the late nineteenth century would also be reflected by increased size of activity areas. The production of new and unique materials might result in additional buildings per site (garages, machine sheds, tool sheds, etc.). Large sites were found, instead, to result from continuous occupation of early sites.

CONCLUSIONS

In conclusion, it appears that most of the historic settlement in the northern part of Fort Hood occurred in the lowland areas, probably at the interface with the intermediate uplands. Because of the poor navigability of many Texas rivers and the distance to navigable waterways, nearness to permanent water did not appear to be a significant factor in settlement. However, the remnants of wells and cisterns indicated that all sites had access to drinking water within 150 to 300 meters. Prominent landforms, such as knolls and secondary terraces, were most frequently settled as habitation sites, although isolated trash dumps occurred on benches and ridges (Figure 7). Sites were located primarily in open grasslands and secondarily in mixed forests. The vast quantities of land available in the public domain of Texas and the variety of land grants issued for that land were probably the single most important cultural factor in determining settlement in Texas.

Most of the original settlers of the project area had migrated from the Upper South, bringing with them a variety of traits peculiar to the Ozarks and Appalachians where they originated. In particular, stock raising was identified as the primary industry in many of the public records examined. The predominance of historic site locations in open grasslands further suggests that stock raising was the major industry. It is well documented that grasslands were commonly burned by the early settlers for pasture land, a practice that was originated by the Indians for grazing bison (Jordan 1973:252).

The limited archeological remains did not distinguish activities peculiar to stock raising from those peculiar to farming or other activities, but stone fences and large tanks, apparently for stock use, were quite common. Many above-ground features had been dismantled by the army, but were still recognizable as the remnants of farmsteads and ranches. Ongoing investigations at Fort Hood will be concerned primarily with determining rural land usage and the characteristics of rural activities that can be identified from the archeological record.

ACKNOWLEDGMENTS

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Post West Bernard (41WH16) - Republic of Texas Armory, 1837-1839, Wharton County, Texas

Joe D. Hudgins

ABSTRACT

Post West Bernard was one of the major ordnance depots for the Republic of Texas Army from 1837 to 1839. Initial surface collections and later excavations yielded more than 2,000 artifacts, most of which apparently represent the residue of firearms refurbishing.

INTRODUCTION

The Post West Bernard site is in Wharton County about 6 km (4 miles) west of Hungerford, near a spring about 69 m (75 yards) west of the present channel of the West Bernard River. This site, recorded as 41WH16 with the Texas Archeological Research Laboratory at the Balcones Research Laboratory of The University of Texas in Austin, is in a cultivated field, so the artifacts were exposed on the surface. Initial surface collecting was done by the writer, who took note of the heaviest concentrations of various types of artifacts.

Cultivation of the site area was to be continued, so the writer, with the consent of the landowner and the farmer, asked the Houston Archaeological Society to survey the site further and salvage the remaining artifacts. The site was mapped, and a grid of 5-meter squares was set up covering the roughly rectangular area in which artifacts were found (Figure 1). A systematic search for metal artifacts was made using a metal detector; they and nonmetal artifacts such as fragments of glass, ceramics, and gun flints, were plotted on the grid, and each was recorded, bagged, and labeled. Artifact distribution plans (Figures 7-11) were made, but vertical placement of the artifacts was not recorded, since all were found in the disturbed plow zone.

The metal artifacts were taken to the Department of Nautical Archeology at Texas A&M University in College Station, where they were treated by electrolysis to prevent further oxidation. They were photographed before and after cleaning, then they were cataloged and identified (Hudgins 1984).

HISTORY

Post West Bernard was established soon after the mass furlough of the troops at Camp Bowie in May and June of 1837. Much of the army's ordnance and military stores were apparently taken to this small outpost. Lt. H. L. Gush commanded about two dozen men of the Permanent Volunteers in 1838 and 1839. As late as January 1839, sheds were built to protect the artillery. Lt. Gush was ordered to discharge the Permanent Volunteers as soon as they could be replaced by the new First Infantry, commanded by Capt. Martin K. Snell (Pierce 1969:179).

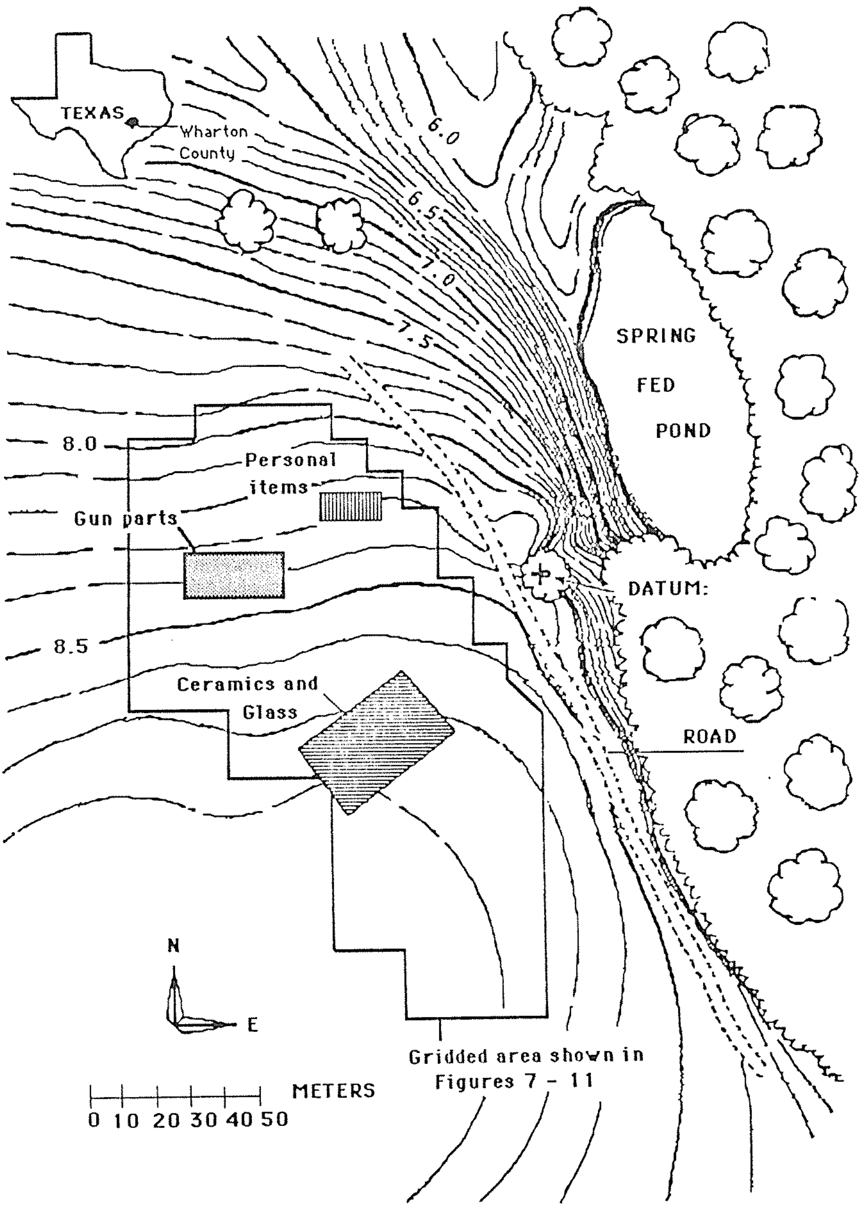

Figure 1. Topographic map of the Post West Bernard site (41WH16) showing gridded area and areas of greatest concentration of artifacts. Contours are in meters above datum. Map by David E. Atherton and Sheldon Kindall.

Information concerning military camps and outposts of the Texas Army is scarce. Many of the small outposts existed for only a short time, and very little has been recorded concerning the duties of the men who garrisoned them (Pierce 1984). However, insight into the living conditions and some information about the location of Post West Bernard were revealed in the following letter from Thomas Anderson, a medical officer stationed at the post, to Ashbel Smith, Surgeon General of the Texas Army (Briggs 1983).

West Bernard Station
June 12, 1838

To Ashbel Smith, M.D.
Surgeon Genl. T. A.

My Dear Sir,

You will no doubt be somewhat surprised to received my letter of resignation so soon after my arrival at this Post. I assure you sir it is no small degree of reluctance that I solicit its acceptance. It has never been my wish to leave the service nor would I do so, could I remain with the slightest comfort to myself or without doing very great violence to my feelings. Our Station is in a perfect wilderness, some five or six miles from any human habitation, we have but five men and they are all on duty, consequently I am forced to bring my own wood and water, make my own fire and cook my own meals in the hot sun without a shelter to protect me from the weather and no place to sleep but in the open air, we are eight miles from a post office and thus I am cutt off from all communications with my friends here or in the U.S. All this I could bear had I books to read but there is not one I presume within twenty miles of us.

I dislike very much sir, to admit the foregoing reasons as the cause of my desire to leave the service, a soldier should never compain of such things and did I conceive that there was the slightest necessity for it, I would remain without a murmur.

Could I be removed to any other station, I would still be plaeased to retain my commission, or should this station be removed to any other point, I will have no objection to remain, but under existing circumstances, I hope sir, that you will relieve me.

Most Respectfully your friend,

[signed] Ths. P. Anderson

Anderson's complaint that the post is "eight miles from a post office" is an important clue to the location of the post. The nearest post office in the summer of 1838 was at Egypt, Texas (Williams 1972:31). The small community of Egypt exists today 7.5 miles west of the site of Post West Bernard. There is no description available of the duties of the five men stationed at the post with Anderson.

Orders dated as late as 1839 indicated that wagoneers were making trips between Houston and Post West Bernard carrying ordnance to the new armory at Houston. On April 22, 1839 a shipment of muskets was delivered by W. T. C. Pierce from Post West Bernard to Houston. On April 26 Pierce delivered about 5,461 lbs.

of ordnance from Post West Bernard to Houston, and on May 4, two howitzers, two iron cannon, and one brass cannon (Williams 1984). No other orders from the post have been found and, considering the amount of ordnance shipped to the Houston armory, it is probable, although no official record of the closing has been found, that the armory at Post West Bernard was no longer in existence after 1839.

The arms at the Post West Bernard armory came from several sources. The U.S. Government shipped 440 flintlock muskets into Texas from New Orleans in 1836, and the Texians captured 200 muskets from the Mexicans a year earlier during the Goliad and San Antonio campaigns of 1835 (Gilbert 1971). Personal arms such as flintlock muskets, rifles, pistols, and shotguns arrived with volunteer units coming to Texas, but most of the weapons by far were captured from the Mexican Army at the Battle of San Jacinto (Koury 1973:8).

In October 1838, the Republic of Texas's military stores consisted of the following items located at Houston, Galveston, and Post West Bernard: 25 cannons (both fit and unfit for service), two howitzers, one mortar, 992 cannon balls, 110 shells, 988 complete muskets, 440 muskets needing repair, 129 muskets unfit for service, seven rifles, musket balls, powder, bayonts, and other military equipment. At Post West Bernard there were 653 muskets described as out of order (Nance 1963:44).

Records of arms purchased by the Mexican Government have not been found, but one Mexican weapon of that period was the .75 caliber Indian Pattern Brown Bess musket marked with the eagle and snake of Mexico. This weapon was made for the British East India Co. until 1815. In 1833, British Ordnance had 440,000 India Pattern arms, of which 176,000 were still serviceable. It was, however, no longer the standard weapon, and it is likely that unless the British considered these muskets outmoded, they would not have sold so many of them (Koury 1973:8). However, Wilson (1985) points out that no contracts for arms sales between the British and Mexican governments have been found, and it is therefore more likely that the British muskets were supplied to the Mexican government by Birmingham gunmakers and contractors, who had also supplied the British government with muskets. Although the India Pattern muskets were undoubtedly the most readily available at the time, several other flintlock British Brown Bess models that were made from 1715 to 1815 would have been considered surplus. These were the Pre-Land Pattern and New Land Pattern (Bailey 1971:13).

Information is vague concerning the models of U.S. flintlock muskets shipped into Texas between 1836 and 1840, and also about the various models of private muskets, pistols, and shotguns brought in by volunteers. Before this time the U.S. Government was manufacturing several models of flintlock muskets that would have been available to the Texas Army. These include models 1795, 1798, 1808, 1812, and 1816, type I & II, all .69 caliber (Gluckman 1965:37).

The first U.S. Government contract with a private gunsmith to produce flintlock pistols was in 1799. The .69 caliber pistols were based on the French Army's model 1777. In 1805 a .54 caliber horseman's pistol was produced by the National Armory at Harpers Ferry, and in 1819 the U.S. Ordnance Department contracted for 20,000 pistols to be patterned after an English type (Hicks 1968:19-22). Kentucky flintlock pistols were also available in .44 and .48 caliber sizes (Chapel 1961:24). Rifles produced in the United States after 1700 were .54 caliber; some of the models were the Kentucky rifle, U.S. model 1817, and the U.S. model 1819. The 1819 model rifle, known as Hall's rifle, was .52 caliber. The armory at Harpers Ferry was also directed to produce a model 1803 rifle (Hicks 1968:19-22).

MILITARY ARTIFACTS

Most of the artifacts found at the Post West Bernard site were iron or brass gun parts from British and U.S. flintlock arms (Crowley and Brezik 1985).

The most difficult gun parts to identify as to type or model were the lock plates. Models of both the U.S. and foreigh muskets were identified from the shields, letters, or numbers stamped in the centers of the lock plates under the flash pans and on the tails of the lock plates behind the hammers (Darling 1931:Figure 37; Gluckman 1965:Plate 1). Due to their exposure to the elements on or near the surface for about 150 years, no markings could be seen on any of the lock plates found at Post West Bernard; identifications had to be made by comparing lock plates from the site with present-day lock plates, and from photographs and drawings of flintlock arms. Only one of the 31 lock plates found at the site was complete. The degree of competeness of these lock plates shows how much repair work and cannibalization would have been necessary to refurbish these arms (Hudgins 1985a) (Table 1).

Table 1. Degree of Assemblage of 29 Lock Plates, Showing Cannibalism that has Occurred and Repair Work that Would be Required for Refurbishing

CATALOG NO.	MODEL	MECHANISM ASSEMBLY	COMMENTS
1401	British Brown Bess India Pattern	Side screw and pan screw are only mechanisms removed	Lock completelyassembled, except for screws. Frizzen in open position, hammer in resting position
1402	British Brown Bess India Pattern	Hammer screw, cap side screw, and upper part of frizzen spring removed	Hammer in resting position, frizzen closed
1403	British Brown Bess India Pattern	All mechanisms removed except iron pan	Lock plate broken behind iron. pan at side screw hole
1404	British Brown Bess India Pattern	All mechanisms removed except iron pan	Lock plate straight
1405	British Brown Bess India Pattern	All mechanisms removed except iron pan, frizzen screws, and frizzen	Lock plate broken in front of iron pan and behind pan at tumbler screws hole. Frizzen in closed position

CATALOG NO.	MODEL	MECHANISM ASSEMBLY	COMMENTS
1406	British Brown Bess India Pattern	All mechanisms removed except iron pan, bridle, tumbler, and tumbler screw	Lock plate broken in front of pan and slightly bent between pan and tumbler screw hole
1407	British Brown Bess India Pattern	All mechanisms removed except iron pan, frizzen, and frizzen screw	Lock plate broken behind pan at tumbler screw hole. Frizzen in open position
1408	British Brown Bess India Pattern	All mechanisms removed except iron pan	Lock plate is straight
1409	British Brown Bess India Pattern	All mechanisms removed except iron pan, frizzen, and frizzen screw	Lock plate broken behind pan at tumbler screw hole Frizzen in closed position
1410	British Brown Bess India Pattern	All mechanisms removed except iron pan	Lock plate slightly bent behind pan at tumbler screw hole
1411	British Brown Bess India Pattern	All mechanisms removed except iron pan	Lock plate slightly bent at frizzen screw hole
1412	British Brown Bess Land Pattern	All mechanisms removed except iron pan	Lock plate slightly bent behind pan at tumbler screw hole
1413	British Brown Bess Land Pattern	All mechanisms removed except iron pan	Lock plate bent behind pan at tumbler screw hole
1414	British Brown Bess Land Pattern	All mechanisms removed except iron pan	Lock plate straight
1415	British Brown Bess Early Land Pattern	All mechanisms removed except iron pan, bridle screw, tumbler, tumbler screw, and sear spring screw	Lock plate broken at side screw hole
1416	British Brown Bess Long Land Pattern	All mechanisms removed except iron pan, frizzen, frizzen screw, frizzen spring, and frizzen spring screw	Lock plate broken behind pan at tumbler screw hole; frizzen in closed position
1417	U.S. Model 1816	All mechanisms removed except brass pan frizzen, frizzen screw, frizzen bridle, bridle screw, tumbler, tumbler screw, sear spring, and sear spring screw	Lock plate straight; frizzen in closed position

CATALOG NO.	MODEL	MECHANISMASSEMBLY	COMMENTS
1418	U.S. Model 1816 Contract	All mechanisms removed except brass pan bridle, bridle screw, tumbler, and tumbler screw	Lock plate straight
1419	U.S. Model 1816	All mechanisms removed except brass pan	Lock plate broken in front and behind pan
1420	U.S. Model 1808	All mechanisms removed except iron pan, frizzen spring, frizzen spring screw, tumbler, tumbler screw, sear, sear spring screw, andpart of sear spring	Lock plate straight
1421	U.S. Model 1808	All mechanisms removed except iron pan, frizzen, and frizzen screw	Lock plate straight; frizzen in closed position
1422	U.S. Model 1808	All mechanisms removed except iron pan, tumbler, tumbler screw, and main spring	Lock plate straight; hammer in cocked position
1423	U.S. Model 1808	All mechanisms removed except frizzen spring screw, iron pan, frizzen, frizzen screw, tumbler, bridle, sear, tumbler screw, sear spring, sear spring screw, and hammer	Hammer in resting position
1424	U.S. Model 1812	Only mechanisms removed are hammer, frizzen spring, and part of sear spring	Lock plate almost completely assembled; frizzen in open position
1425	U.S. Model 1795 Springfield or U.S. Contract Model 1798	All mechanisms removed except iron pan, frizzen, frizzen screw, tumbler, tumbler screw, bridle, sear, and sear spring screw	Lock plate broken at side screw hole; frizzen in closed position
1426	Shotgun	All mechanisms removed except iron pan	Lock plate straight
1427	Shotgun	All mechanisms removed except iron pan	Lock plate straight; iron pan broken
1428	Possible pistol	All mechanisms removed except iron pan	Lock plate broken at side screw hole
1429	Possible pistol	All mechanisms removed except iron pan, tumbler, tumbler screw, bridle, and bridle screw	Lock plate bent between pan and tumbler

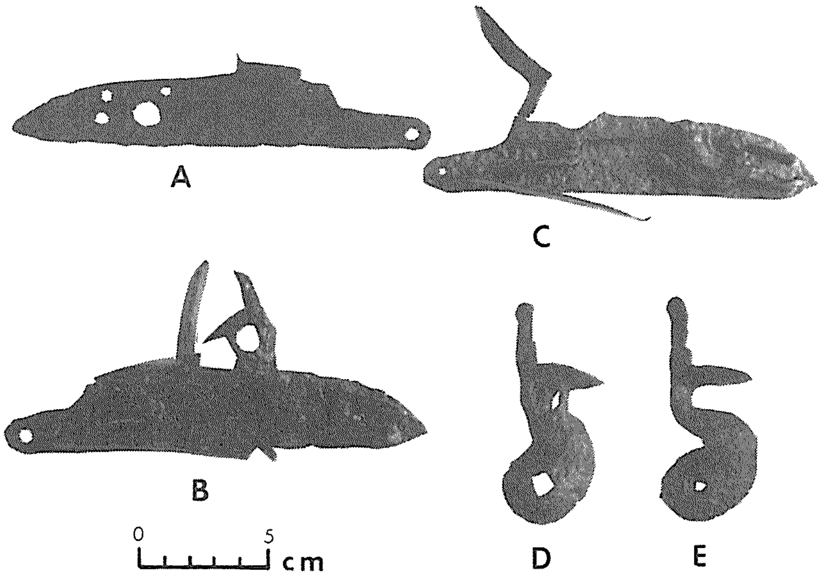

Figure 2. Lock plates and hammers: A-C, lock plates from British Pattern muskets missing one or more mechanisms; D, unreinforced hammer from an early India Pattern or Long Land Pattern British musket missing cap and cap screw; E, reinforced hammer from India Pattern British musket missing cap and cap screw.

Most of the lock plates (65 percent) were from British muskets (primarily the India Pattern) (Figure 2, A-C); lock plates from U.S. muskets accounted for 25 percent of the total. These include models 1795, 1798, 1808, 1812, and 1816. Two lock plates from pistols and two from shotguns were also found at the site. British and United States flintlock arms manufactured in the late eighteenth and early nineteenth centuries had basically the same working mechanisms (Figures 3, 4).

Detached lock plate mechanisms and parts from various arms were found in abundance (Hudgins 1985a, 1985b), together with detached hammers from both U.S. and British arms. Fifteen hammers from British Brown Bess muskets were of the reinforced design ("ring-necked cock," Figure 2, E) typical of the India Pattern made after 1809. Seven hammers were the older, unreinforced variety (swan-neck cock, Figure 2, D), but since the cap screws were missing on all seven, it was difficult to tell whether they were from the early India Pattern made before 1809 or from the even older Long Land Pattern musket. Hammers from a U.S. model 1812 musket and a U.S. model 1816 musket were also found together with two hammers from shotguns and two from nonmilitary rifles. Frizzens were also found from a variety of arms: five from the British Brown Bess musket, one from a U.S. model 1808 musket, three from the U.S. model 1816 musket, five from the U.S. model 1812 musket, and three smaller frizzens from nonmilitary arms. Preservation of lock plate mechanisms such as sears, sear springs, tumblers, bridles, main springs, and frizzen springs was poor, and no identification as to model could be made.

Other gun parts found at the site include 25 sling swivels, eight butt plates, 12

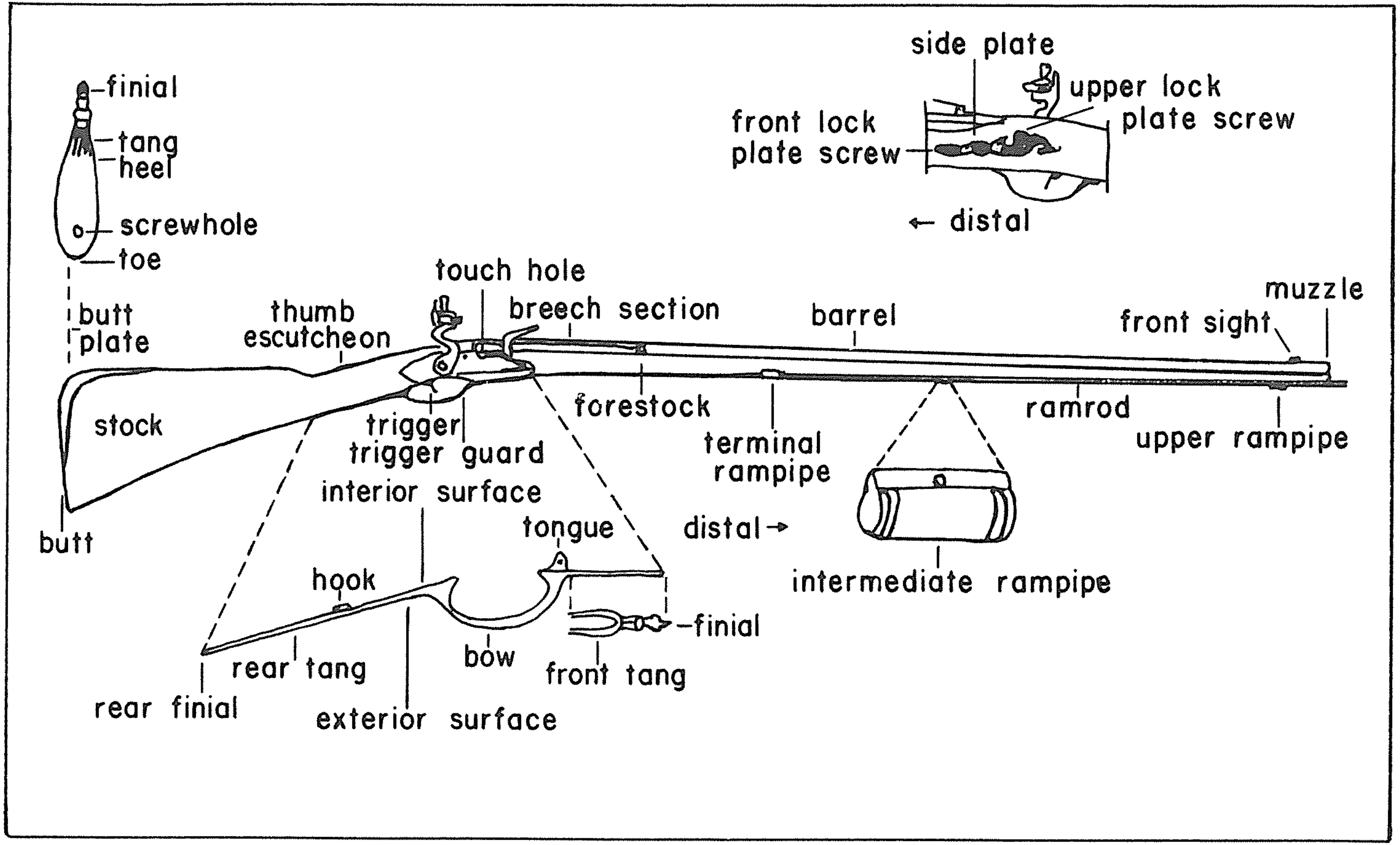

Figure 3. Drawing; parts of a flintlock musket, by Jay C. Blaine (Harris et al., 1965).

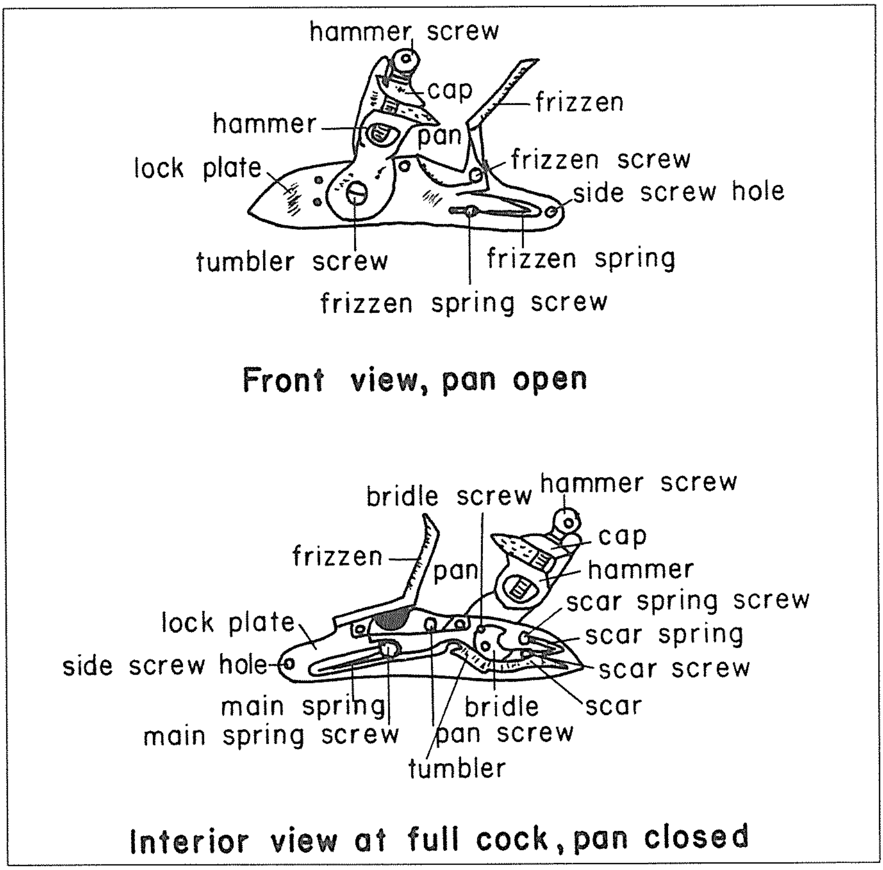

Figure 4. Sketches showing working mechanisms of a flintlock musket. From Gluckman 1965.

side plates, 32 rampipes, nine nose caps, 65 trigger guards and trigger guard fragments, three breech plugs, and five bayonet fragments. The brass trigger guards, brass rampipes, and nose caps from the British muskets were the most altered or damaged of all the gun parts (Figure 5). Most of the trigger guards had both front and rear tangs removed. Some had been cut and hammered, and several tangs were partially melted (Figure 4). Most were from the India Pattern Brown Bess musket, but two were from U.S. arms: one from a U.S. model 1803 Harpers Ferry rifle, the other from a U.S. model 1805 pistol (Figure 6). The rampipes and nose caps were all from the India Pattern British musket. Most of the butt plates and side plates were also from the India Pattern British Brown Bess musket, with the only exceptions a butt plate from a U.S. model 1803 Harpers Ferry rifle and a side plate from a New Land Pattern British musket.

More than half of the brass rampipes and the trigger guard tangs from British India Pattern muskets were incised with Roman numerals. These numerals are identification marks put on in storage when the gun parts were collected to be

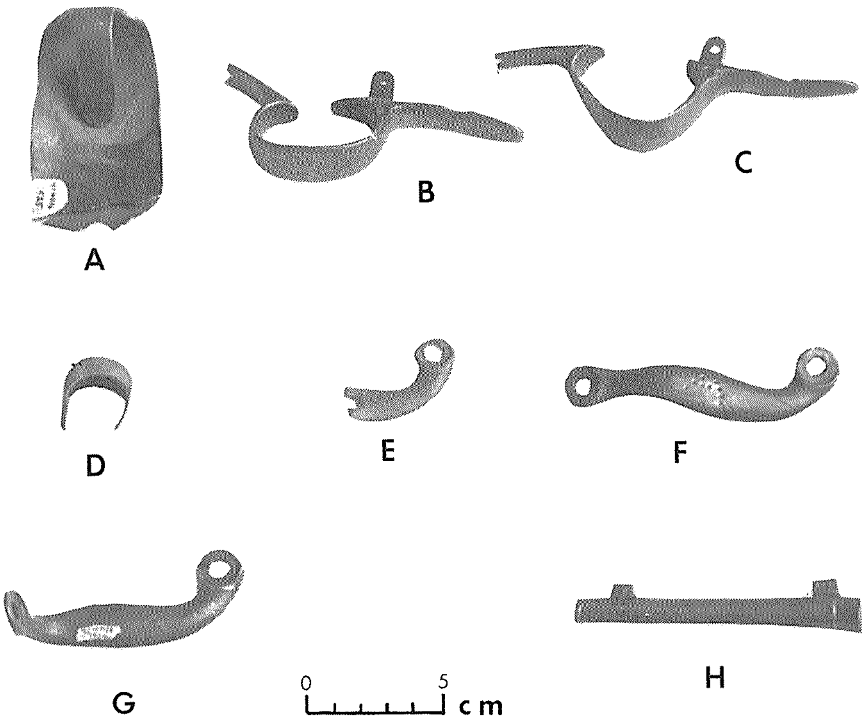

Figure 5. Selected group of British gun parts: A, brass butt plate fragment, unidentified as to model; B, C, brass trigger guards from British India Pattern muskets with rear tangs missing at the screw holes; D, brass nose cap from British India Pattern musket; E, brass side plate from British New Land Pattern musket; F, G, brass side plates from British India Pattern muskets; H, brass upper rampipe from British India Pattern musket.

mounted together as firearms (Wilson 1985). Several gun parts were stamped or engraved with contractors' marks representing individual companies or private contractors who made musket parts for the British ordnance (Wilson 1985). For example, a side plate was stamped with the letter *B*; a terminal rampipe was stamped *C* on the tang; the tang of a butt plate was engraved with a rack number, 1456. Darling (1931) notes that rack numbers occasionally were engraved on the butt-plate tangs of India Pattern muskets made by private contractors. One side plate found at the site was stamped with a short, flaring arrow, one of several used by the British to signify government ownership (Darling 1931). Another side plate had punctation marks that formed the letter *A* (Figure 3, A). This is not typical of identification marks on British military firearms; they were probably added in Mexico or in Texas (Wilson 1985).

Two of the three barrel fragments were from .75 caliber British muskets. One barrel (breech plug in place) was cut in half and bent at a 10° angle. The other British

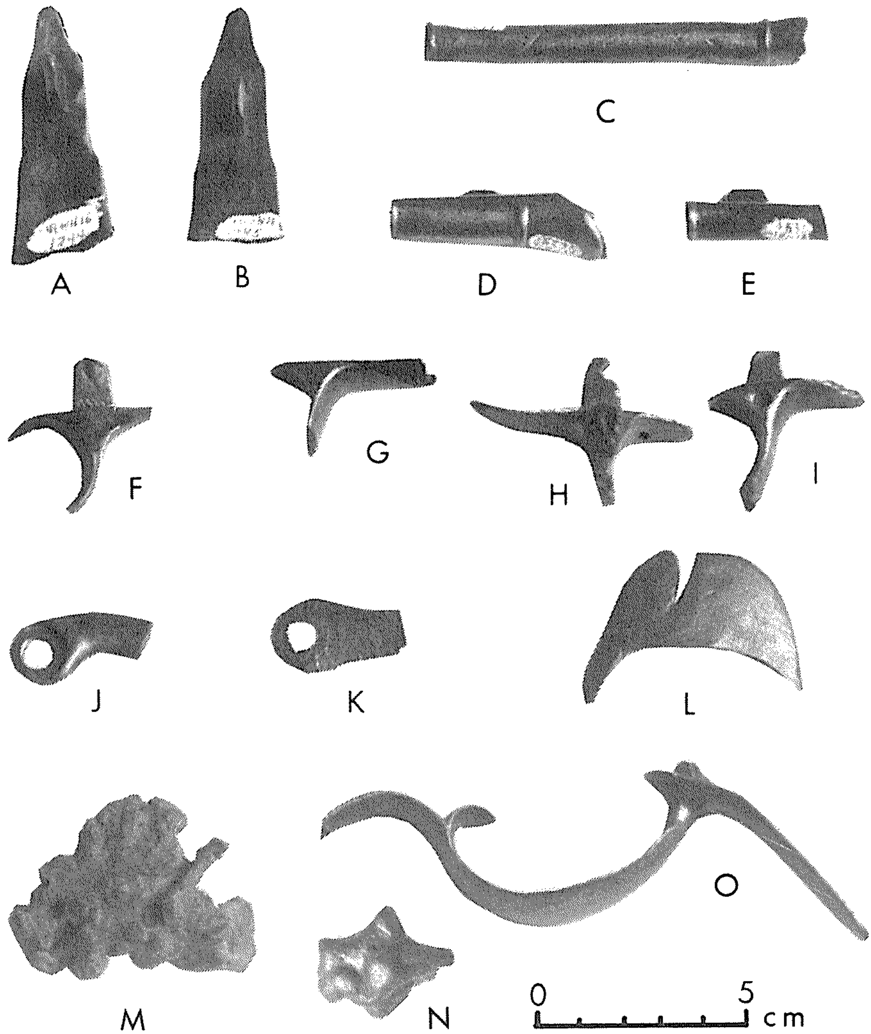

Figure 6. Altered and damaged gun parts: A. B. brass butt plate tangs from British India Pattern muskets; C, brass upper rampipe from India Pattern musket; D, brass terminal rampipe from India Pattern musket with tang removed; E, brass intermediate rampipe from India Pattern musket with one end partially melted; F-I, brass trigger fragments from British muskets; J, K, fragments of brass side plates from British muskets; L, fragment of brass butt plate from a British musket; M, N, melted brass; O, brass trigger guard from a United States model 1805 pistol.803 Harpers Ferry rifle and a side plate from a New Land Pattern British musket.

musket barrel was cut at both ends. One end had been heated and hammered into a rectangle with a small hole through the center. The remaining barrel fragment was the muzzel from a .44- or .45-caliber octagonal rifle that had been removed by sawing (Briggs n.d.).

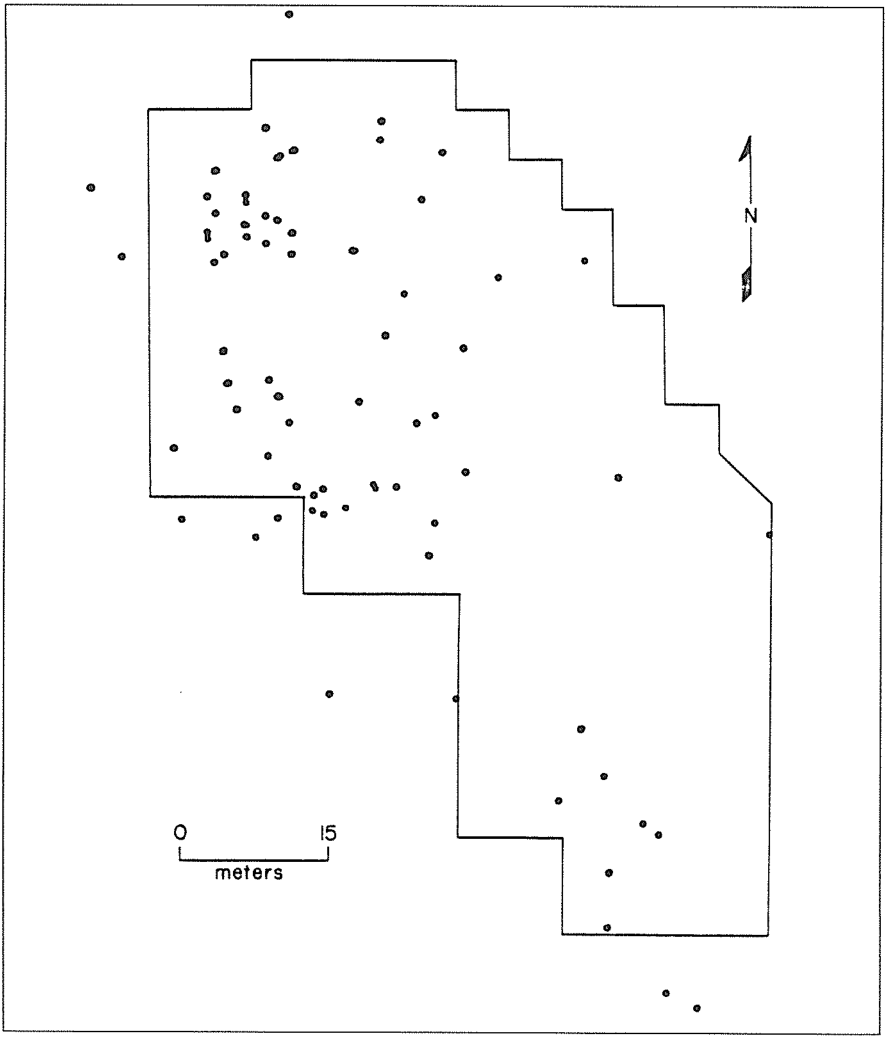

Figure 7. Plan of gridded part of the Post West Bernard site (41WH16), showing locations of gun parts. By Richard L. Gregg.

Most of the sling swivels were from British muskets. Many of were broken and without swivel pins. Front and rear sling swivels from U.S. muskets were also found, some of the front swivels with parts of the barrel bands attached.

All of the lock plates and most of the brass furnishings were found in one small area of the site (Figure 1). Smaller gun parts—lock-plate mechanisms and sling swivels—were found over a larger area (Figure 7), but there were none in the northwestern part of the site where the heaviest concentration of gun parts was found (Figure 1).

Evidence of bullet manufacturing at the post came with the discovery of an iron lead-dipper, tongs, dipper handles, melted lead, melted brass, rolled lead, rectangu-

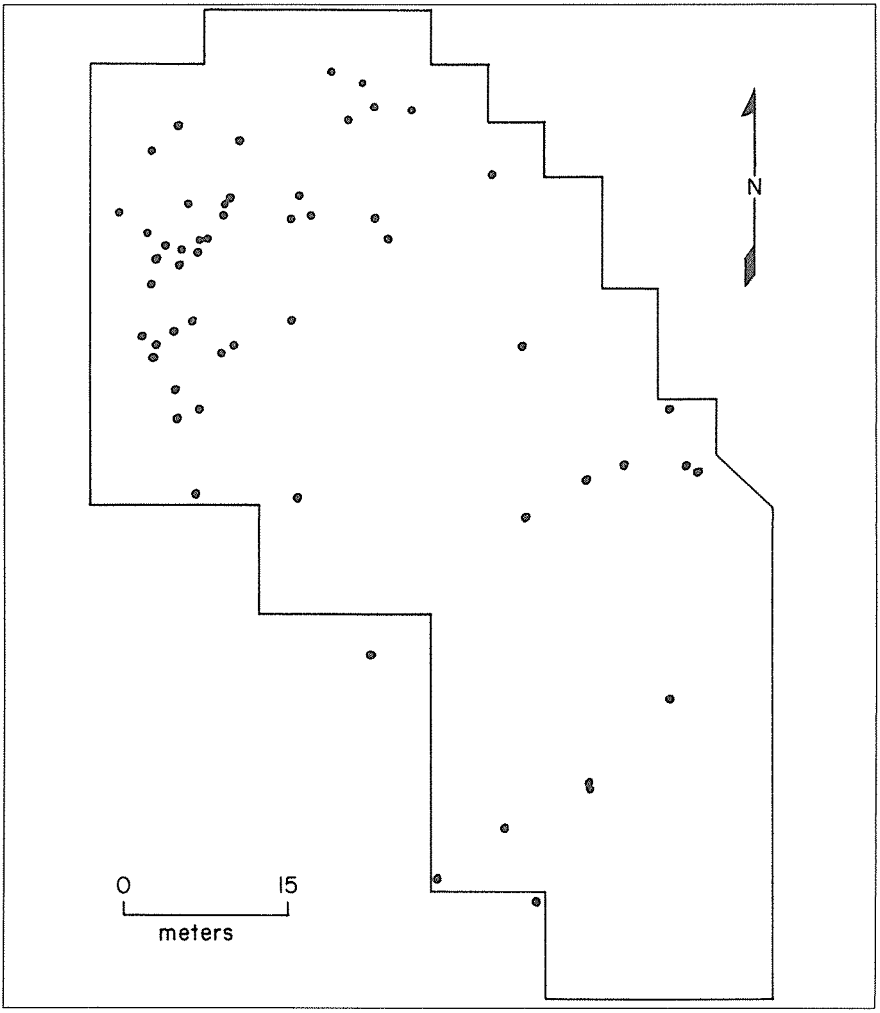

Figure 8. Plan of gridded part of the Post West Bernard site (41WH16), showing locations of lead artifacts. By Richard L. Gregg.

lar lead bars, and 24 lead musket shot (Figure 8). Thirteen lead musket shot were .69 caliber, three were .75 caliber, and six, smaller than .69 caliber, were distorted to some extent and, although difficult to measure, appear to be .52 or .54 caliber. Several lead shot of different calibers had been flattened from impact. Iron and brass shot were also found: three iron shot were 1 inch and three were 1.5 inches in diameter; four brass shot were 1 inch and two were 1.25 inches in diameter.

NONMILITARY ARTIFACTS

Seventy ceramic sherds and 44 fragments of glass were collected from the surface. These artifacts, found throughout the site, were concentrated in the southern area (Figures 1, 9, 10). The entire collection of ceramics appears to be of

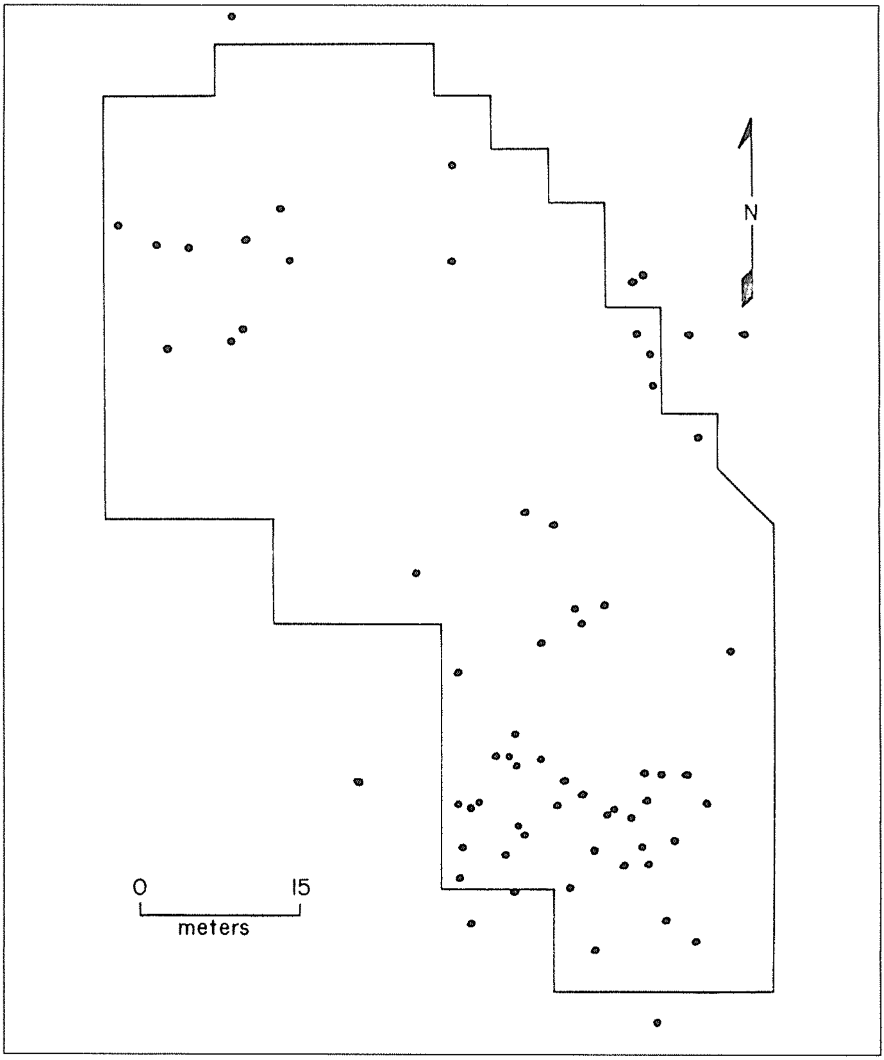

Figure 9. Plan of gridded part of the Post West Bernard site (41WH16), showing locations of ceramic artifacts. By Richard L. Gregg.

the Regency period (1810-1830) and none appear to be of the post-1837 Victorian era. During the early years of the Texas Republic the army did not issue mess kits, therefore these sherds may represent dinnerware that was used by the men at the post (Briggs n.d.).

Preliminary analysis of the glass fragments was based on the necks and bases of wine, ale, or spirit bottles (Wetzel 1985). Further analysis of the glass fragments is in progress to determine if they are from the same time period as the ceramics.

Several brass buttons (Figure 10) from men's clothing and fragments of a brass spur were recovered (Hudgins 1985c). Other personal items such as pocket-knife

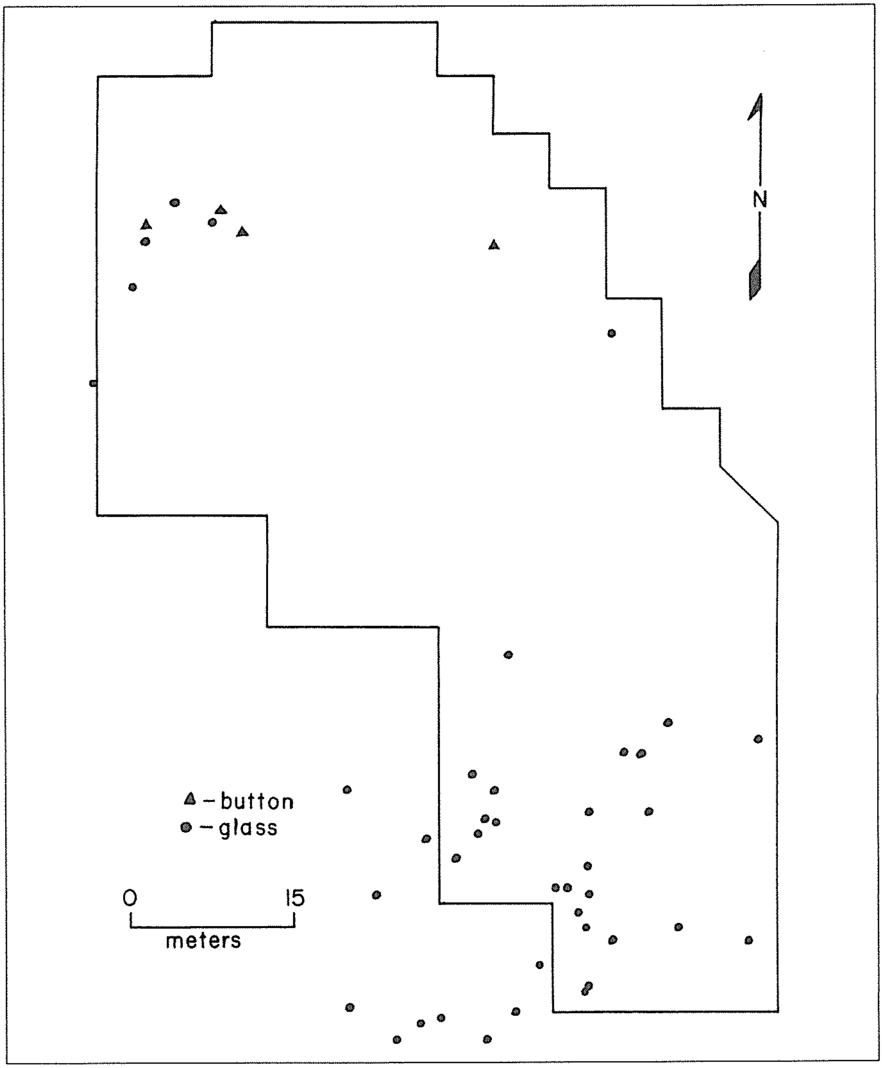

Figure 10. Plan of gridded part of the Post West Bernard site (41WH16), showing locations of glass artifacts (•); buttons (Δ). By Richard L. Gregg.

fragments and a brass thimble were found at the north end of the site.

More than 600 square nails and spikes were scattered over most of the site, but due to extensive oxidation, only fragments remain, making it difficult to determine accurately their exact sizes or types. The nails may have come from the structure that was erected in 1839 to protect the artillery. Two areas of the site have the heaviest concentrations of nails: one is the area that yielded most of the gun parts; the other is at the south end of the site and may represent an additional structure (Figure 11).

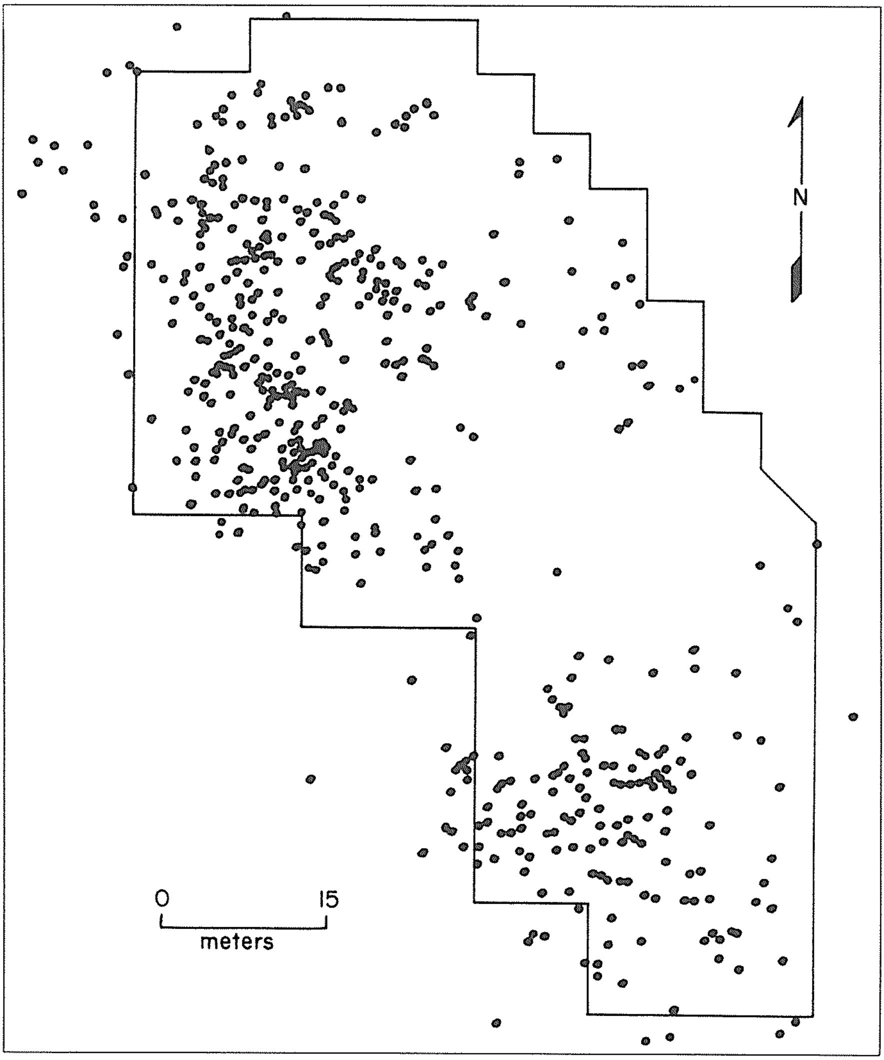

Figure 11. Plan of gridded part of the Post West Bernard site (41WH 16), showing locations of nails. By Richard L. Gregg.

An iron object (Figure 12) that appears to be an ox goad (Taylor 1986) was found in the part of the site that had the heaviest concentration of gun parts (Figure 1). It is 20 cm (8 inches) long and has a conical base that tapers to a square-sectioned point or handle.

There were several iron and brass artifacts that could not be identified positively. Most were simply pieces of irregularly shaped metal, but some are interesting enough to warrant further investigation.

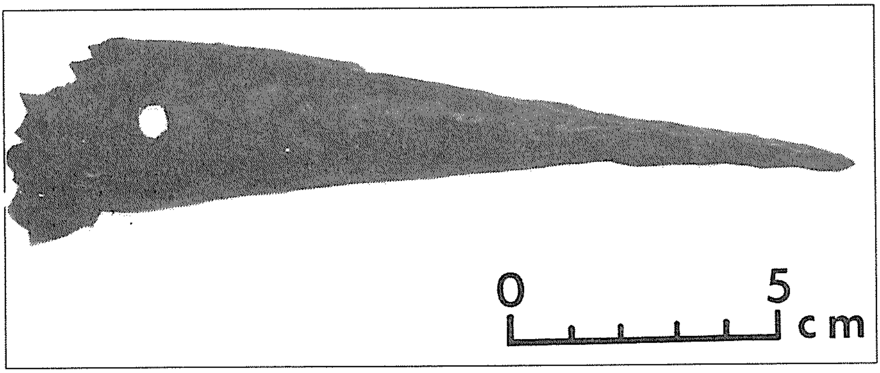

Figure 12. Iron object: ox goad.

CONCLUSIONS

Historical records indicate that Post West Bernard served as the armory for the Republic of Texas Army from 1837 to 1839. Documents concerning the armory indicate that it consisted of personal weapons brought to Texas by volunteers from surrounding states and included flintlock muskets supplied by the U.S. Government, but most of the weapons were captured Mexican arms from the Goliad and San Antonio campaigns of 1835 and the Battle of San Jacinto in 1836. The Mexican army was thought to have been armed primarily with surplus British flintlock muskets, and the predominance (65 percent) of parts from British muskets found on the site supports this view.

Gun parts such as lock plates in various stages of assembly and lock plate mechanisms that are apparently results of cannibalizing (Blaine 1980), together with a sawed rifle muzzle, two cut and reworked musket barrels, and tools indicate that gunsmith work, of the kind required to refurbish the arms, was being done.

The predominance of broken, cut, and melted brass from the furniture of the British muskets may indicate that many of these muskets were damaged beyond repair and that the brass parts were being removed and used for scrap metal. In fact the brass shot found at the site may have been made from these parts.

No records of daily activities and duties of the soldiers stationed at Post West Bernard have been found, but Anderson's letter stating that all five men stationed at the post in 1838 were on duty and not available for routine orderly duties raises the possibility that they could have been involved in reconditioning arms. Documents in the Texas Archives show that a wagonload of muskets and large amounts of ordnance were being shipped from Post West Bernard to the armory at Houston in 1839 (Williams 1984), adding further to the evidence that the men at Post West Bernard were reconditioning arms.

The existence of such a large number of flintlock gun parts, together with evidence from correspondence in the Texas Archives (Brigg 1983; Williams 1984), strongly suggests that 41WH16 is indeed the site of the Post West Bernard armory.

Work continues at the site in the seasons when the area is not under cultivation. The Wharton County Historical Museum in Wharton, Texas will be the curator of all artifacts from the site.

ACKNOWLEDGEMENTS

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The gun parts found on site 41WH16 were identified by Houston Archeological Society members Frank Brezik, Jr. and David Crowley. David Atherton, Sheldon Kindall, and Richard Gregg, also of the Houston Archeological Society, prepared the maps. Jay C. Blaine, of the Dallas Archeological Society, made comments and gave advice during the early stage of the investigation; G. M. Wilson, Deputy Master of Armouries, H.M. Tower of London, made valuable comments on the gun parts from the British muskets.

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Human Skeletal Remains From the Clark and Holdeman Sites, Red River County, Texas

Carol J. Loveland

ABSTRACT

About 6.5 km (4 miles) apart, the Clark and Holdeman sites are situated on terraces adjacent to the Red River in Red River County, Texas. The 26 individuals from the Holdeman site (41RR11) are dated from A.D. 1000 to 1650. The Clark site (41RR77), from which 39 skeletons were recovered, is dated from A.D. 1300 to 1600+. Skeletal material from both sites is in fragmentary condition; age and sex determinations were not possible in many cases. Sixty-nine percent of the skeletal remains recovered were adults. The ratio of adult to subadult skeletons is similar to that found in other Caddoan populations. Stature estimates suggest that the Clark and Holdeman people were comparable in size to other Caddoans. Among the skeletal anomalies noted were caries, degenerative conditions, infections, traumatic lesions, and hematologic disorders. Information obtained from this study demonstrates that small studies are worth the attention of skeletal biologists.

INTRODUCTION

The Clark and Holdeman sites are on the south bank of the Red River in Red River County, Texas. The Holdeman site (41RR11), which is situated on a river terrace on the east side of Texas Route 37, was excavated by Gregory Perino, of the Museum of the Red River, Idabel, Oklahoma, in 1983. Earlier, in 1981, Perino directed excavation of the Clark site (41RR77), located about 6.5 km (4 miles) downriver from the Holdeman site.

Burials at both sites span occupation periods of several hundred years. The 26 skeletons recovered from the Holdeman site are dated, by pottery types found with the human remains, from A.D. 1000 to A.D. 1650. The remains of an additional 15 individuals were not retrieved due to their poor preservation (Perino 1985).

The 39 skeletons from the Clark site are dated to the period between A. D. 1300 and 1600+. The acidity of the soil at both sites contributed to considerable disintegration of the bones, so almost all of the skeletons are in fragmentary condition. Although both sites were occupied over an extended period of time, the poor state of preservation coupled with small sample size necessitated treating human remains from each site as a single sample.

All of the burials from the Clark and Holdeman sites were extended inhumations, which is the typical pattern followed by the prehistoric Caddo. There was some difference in burial orientation, however. Nineteen of the 26 individuals from the Holdeman site were buried with their heads toward the east, ranging between southeast and northeast. The remaining seven were interred with their heads to the west or southwest. At the Clark site, 32 individuals were buried headed west through northwest. One subadult's bones were so scattered that no orientation could be determined; the remaining individuals were headed east to southeast.

At the Holdeman site, the burials, which averaged 127 cm in depth, were recovered from 66 to 163 cm below the present ground surface. The Clark site interments were excavated from depths ranging between 15 cm (subadult) and 158 cm, with an average depth of 109 cm. An average depth of 99 cm was recorded for the burials from Kaufman-Williams (Loveland 1980).

Many objects had been placed in the graves with the dead, including ceramics, bone tools, arrowpoints, plant and animal food items, clay pipes, rattles, and jewelry.

This paper summarizes the available bioarcheological information about the biological adaptation of the prehistoric inhabitants of the Holdeman and Clark sites to their environment. Unfortunately, due to the fragmentary nature of the remains, only provisional interpretations are possible.

METHODOLOGY

The skeletal material from both sites was cleaned, labeled, and arranged in anatomical position for study. Standard anthropological techniques were followed in all observations and measurements. Because the innominate, the most reliable indicator of both age and sex, was missing from most of the skeletons, it was necessary to use less reliable characteristics.

Cranial features, such as robusticity of the brow, occipital, and mastoid regions and morphology of the eye orbits, chin, and posterior part of the zygomatic process (Bass 1971; Krogman 1978), proved most useful for adult sex determination. Diameter of the femoral head (Dwight 1905) and circumference of the femoral shaft (Black 1978) were used as sexing criteria when possible. No attempt was made to sex subadults.

Adult age determination was based on evaluation of dental attrition (Miles 1963; Brothwell 1965) and closure of endocranial and ectocranial skull sutures (Krogman 1978; McKern and Stewart 1957). These skeletal changes were compared within each sample, resulting in the establishment of two adult age categories: (a) individuals 20 to 30 years old, and (b) individuals over 30. A few individuals could only be classified as adults, due to the fragmentary nature of the remains.

The age of immature skeletons was determined by three methods: (a) evaluation of epiphyseal closure (Johnston 1961; McKern and Stewart 1957; McKern 1970), (b) analysis of dental development (Ubelaker 1978; Schour and Massler 1941), and (c) length of long bones without epipheses (Merchant and Ubelaker 1977).

The formulas established by Trotter and Gleser (1952, 1958) for white females and Mongoloid males, and by Neumann and Waldman (1968) for American Indians, were used in stature determination. Long-bone measurements were taken following the procedures outlined in Bass (1964, 1971).

Skeletal anomalies were observed and recorded as skeletons were inventoried for completeness. In each case the bone involved, as well as the extent and type of lesion, was documented. Standard paleopathology references (Ortner and Putschar 1981; Steinbock 1976; Morse 1978; Zimmerman and Kelley 1982; Manchester 1983) were frequently consulted.

DISCUSSION

The poor preservation of the skeletal material from the Clark and Holdeman sites complicated the paleodemographic analysis. Age and sex determinations of skeletons from both sites was difficult, and failure to recover 15 skeletons from the Holdeman site certainly skewed the sample.

The subadult mortality profile was probably affected by bone preservation and recovery techniques. Gordon and Buikstra (1981) stress that bone maturity is an important factor in preservation; fragile immature bones are more susceptible to deterioration than adult bone. Underrepresentation of subadults in a skeletal population may also occur if children are interred away from cemetery areas. Furthermore, subadult bone, which is difficult to recognize, may be included in the faunal sample if archeologists are not careful (Buikstra and Mielke 1985).

The skeletal remains from both sites represent individuals who lived over a span of several hundred years. Ideally, human remains associated with each time period at a single site should be evaluated as separate samples; however, due to the fragmentary nature of the skeletons and the small number of individuals available for study, only two samples were delineated—one from each site. The Holdeman sample consists of 26 skeletons and the Clark, of 39.

Paleodemography

Eighteen (69 percent) of the 26 skeletons at the Holdeman site are adults; eight (31 percent) are subadults (Table 1). One-third of the subadults at the Clark site (Table 2) were under five at the time of death, whereas half of thesubadults at the Holdeman site were under five. The subadult mortality rate at both sites falls within the range of juvenile mortality in preindustrial populations recorded by Weiss (1973) and is similar to that reported at other Caddoan sites such as Kaufman-Williams (28 percent) (Loveland 1980) and Roden (22 percent) (Rose et al. 1981).

At the Clark site, 45 percent of the adults were classified as female, 48 percent were males, and for 7 percent, sex determination was not possible. There was considerable disparity in age at death between males and females. Only 20 percent of the Clark females were over 30 at the time of death, whereas 75 percent of the males were over 30. Fifty-six percent of those of unknown sex were over 30. Several suggestions have been made to account for such differences in adult mortality. These include the high female mortality during the reproductive period of life associated with pregnancy, childbirth, or post-partum complications (Powell and Rogers 1980). Coupled with this is the possibility that women may have been overworked and underfed, which may have made them more susceptible to life-threatening illnesses (Manchester 1983). Bass, Evans, and Jantz (1971) suggest that

Table 1. Human Remains from the Holdeman Site Represented in Each Age and Sex Category by Time Period

		Age Groups					
Sex	Number	0-6	7-12	13-18	20-30	30+	Adult
		Skeletons Dated A.D. 1000					
Male							
Female							
Undetermined							
Adult	2					1	1
Subadult	1		1				
		Skeletons Dated A.D. 1200					
Male	10				8	2	
Female	4				2	2	
Undetermined							
Adult	2				1	1	
Subadult	6	3	1	2			
		Skeletons Dated A.D. 1650					
Undetermined							
Subadult	1	1					
Totals	26	4	2	2	11	6	1

young males may be underrepresented in skeletal populations due to their having been buried elsewhere after raiding or hunting accidents.

Ten of the 18 Holdeman adults (56 percent) were males, four (22 percent) were females, and sex determination was not possible for four (22 percent). Since almost one-fourth of the Holdeman skeletons could not be sexed, no particular significance is attached to the sex ratio disparity.

Fifty percent of the Holdeman females and 80 percent of the males were under 30 when they died. This is in stark contrast to the situation at the Clark site, where female mortality was higher in the 20 to 30 group than among the males, who tended to survive longer. No explanation of this disparity seems satisfactory except perhaps that the recovery and analysis of the 15 skeletons that had disintegrated would have created a more typical mortality profile.

Stature

It was possible to provide stature estimates for five individuals from the Holdeman site and three from the Clark site (Table 3). The fragmentary condition of the bones necessitated using whichever long bones were available, but whenever possible the lower limb bones, especially the femora, were used since they provide the most accurate estimates of stature.

Table 2. Skeletons from the Clark Site Represented in Each Age and Sex Category by Time Period

		Age Groups						
Sex	Number	Subadult	0-6	7-12	13-18	20-30	30+	Adult
		Skeletons Dated A.D. 1300-1450						
Male	4					1	3	
Female	5					4	1	
Undetermined								
Adult	7					2	4	1
Subadult	5	2	1		2			
		Skeletons Dated A.D. 1450-1600						
Male	2						2	
Female	5					4	1	
Undetermined								
Adult	2						1	1
Subadult	6	2	2	1	1			
		Skeletons Dated A.D. 1600+						
Male	2					1	1	
Undetermined	1		1					
Totals	39	4	4	1	3	12	13	2

Trotter and Gleser did not provide stature formulas for Mongoloid females, so the formulas for white females (Trotter and Gleser 1952) and for Mongoloid females (Neumann and Waldman 1968) were used. Use of the femur in estimating stature provided close agreement between the two methods as reflected in the estimated stature of the female from the Clark site. A greater difference occurred in the estimated stature based on the two methods when the tibia of the Holdeman female was used. Stature formulas are developed according to measurements based on distinct landmarks, so use of the tibia, which can be measured several ways, provided less satisfactory results.

Stature estimates for two Clark males were derived from the formulas developed by Trotter and Gleser (1958) for Mongoloid males. The Neumann and Waldman (1968) formulas are based only on the femur and tibia and hence could not be used. The four Holdeman males whose femora contributed to the stature estimate were evaluated using both formulas. Scarcely a centimeter separated the stature estimates for each individual when both methods were used. The estimated statute of a Clark female was 161.79 cm, following Trotter and Gleser (1952), or 161.54 cm, using the Neumann and Waldman (1968) formula. Clark male stature estimates ranged between 166.81 cm and 174.16 cm. Use of the Neumann and Waldman (1968) formula produced a stature estimate for a Holdeman female of 163.15 cm. The estimate for the same individual, based on the Trotter and Gleser

Table 3. Stature Estimates of Clark and Holdeman Individuals

Burial No.	Sex	Bone	Measurement	Trotter and Gleser (1952,1958)	Newmann and Waldman (1968)
			Clark Site		
1	F	Femur (R)	436	161.79±3.72 cm	161.54 cm
3	M	Fibula (R)	390	174.16±3.24 cm	—
38	M	Humerus (R)	312*	166.81±4.16 cm	—
			Holdeman Site		
7	F	Tibia (R)	374	169.99±3.66 cm	163.15 cm
2A	M	Femur (L)	446	168.46±3.80 cm	168.31 cm
3	M	Femur (R)	433	165.67±3.80 cm	166.83 cm
10	M	Femur (L)	430	165.02±3.80 cm	166.50 cm
13	M	Femur (L)	434	165.88±3.80 cm	166.94 cm

*Estimated measurement

(1952) formula, was 169.99 cm. The estimated stature of four males from the Holdeman site ranged between 165.02 cm and 168.46 cm, using the Trotter and Gleser (1958) formula, and between 166.50 cm and 168.31 cm, using the Neuman-nand Waldman (1968) formula.

Since the sample sizes are so small, little can be said about the stature of the Clark and Holdeman people except that it was probably comparable to other Caddoan populations (Table 4).

Skeletal Anomalies

Because the Clark and Holdeman remains are fragmentary, the skeletal anomalies tend to appear as isolated occurrences, often not reflecting the health of either the individual or the group. This is especially true for abnormalities such as degenerative conditions and infections. A single bone may show evidence of an abnormality, but it is difficult to gauge the severity of the condition when much of the skeleton is missing. For this reason, analysis of the anomalies observed in each age and sex category at the two sites (Tables 5, 6) suggests areas of possible health concern for the people, but it does not permit accurate assessment of the health status of the two populations.

The abnormalities noted in the Clark and Holdeman skeletons have been divided into the following categories: degenerative conditions, developmental abnormalities, neoplasms, traumatic lesions, infections, and hematologic conditions. However, it must be stressed that the cause and development of specific conditions is not always certain, and the etiology of many anomalies often overlaps these arbitrary classifications.

Table 4. Estimated Stature of Selected Caddoan Populations

Formula	Kaufman-Williams (Loveland1980)	Kaufman Portion Kaufman-Willams (Butler 1969)	Cooper Lake (Westbury 1978)	East Fork Trinity River (Navey 1975)
Males				
Trotter and Gleser (1958)	168.91±3.80 cm	167.49±3.80 cm	178.08±3.29 cm	171.53±3.80 cm
Newman and Waldman (1968)	168.91±3.80 cm	167.80 cm	172.01 cm	169.93cm
Females				
Trotter and Gleser (1952)	156.33±3.72 cm	157.82±3.72 cm	167.36±3.70 cm	164.26±3.72 cm
Newmann and Waldman (1968)	158.89 cm	159.61 cm	162.91 cm	162.74 cm

Table 5. Anomalies Observed on Skeletons From the Clark Site

Abnormality	Number of Males			Number of Females			Number of Undetermined Sex		
	20-30	30±	Adult	20-30	30+	Adult	20-30	30+	Adult
Degenerative									
Osteophytosis	-	4	-	-	-	-	-	-	-
Osteoarthritis	1	-	-	-	-	-	-	1	-
Developmental									
None	-	-	-	-	-	-	-	-	-
Neoplasms									
Button osteomas	-	1	-	-	-	-	-	-	-
Trauma									
Skull Fracture	-	-	-	-	-	-	-	-	1
Schmorl's Node	-	-	-	-	-	-	1	-	-
Infection									
Periostitis	-	1	-	1	-	-	-	1	-
Dental Abscess	-	1	-	-	-	-	-	1	-
Hematologic									
Cribra Orbitalia	-	-	-	1	-	-	-	-	-

Degenerative Conditions

Degenerative conditions were noted on skeletal remains at both sites, but evidence of osteophytosis, which is common among the older segments of most populations, was not observed on any of the skeletons from the Holdeman site. This is probably attributable to sampling error, since few vertebrae were recovered. The four males from the Clark site who displayed evidence of osteophytosis were over 30. One individual from the Holdeman site was afflicted with tempomandibular joint disease, and two skeletons from the Clark site exhibited evidence of osteoarthritis. The distal humeri of one young Clark male indicated very heavy elbow wear.

Developmental Abnormalities

Developmental anomalies were noted on four Holdeman skeletons. Enamel hypoplasia was observed on the maxillary incisors of two individuals: a young male and a subadult. This condition develops in response to general disease processes and/or nutritional deficiencies occurring during the period of enamel formation, but El-Najjar, De Santi, and Ozebek (1978) suggest that the specific etiology is still idiopathic. Ortner and Putschar (1981) include infectious diseases (especially tuberculosis and congenital syphilis), metabolic and endocrine disorders, and nutritional deficiencies as factors reponsible for the development of hypoplastic defects.

A lesion on the lateral surface of the right distal femur of a 12-to-18-year-old subadult from the Holdeman site (Figure 1) was evaluated by Gregg (1985) as

Table 6. Abnormalities on Holdeman Remains

Abnormality	Number of Subadults		Number of Males		Number of Females		Number of Undetermined Sex
Degenerative							
Tempomandibular Joint Disease	-	-	1	-	-	-	-
Developmental							
Benign Fibrous Cortical Defect	-	1	-	-	-	-	
Fibrous Dysplasia	-	-	-	-	-	-	1
Enamel Hypoplasia	-	1	1	-	-	-	-
Neoplasms							
Button Osteomas	-	-	1	-	-	1	-
Trauma							
Skull Fracture	-	-	-	1	-	-	-
Vertebral Compression L5	-	-	1	-	-	-	-
Infection							
Periostitis	-	-	-	1	1	-	-
Dental Abscess	-	-	1	-	-	-	-
Hematologic							
Cribra Ortoitalia	2	-	-	-	-	-	-
Porotic Hyperostosis	1	-	-	-	-	-	-

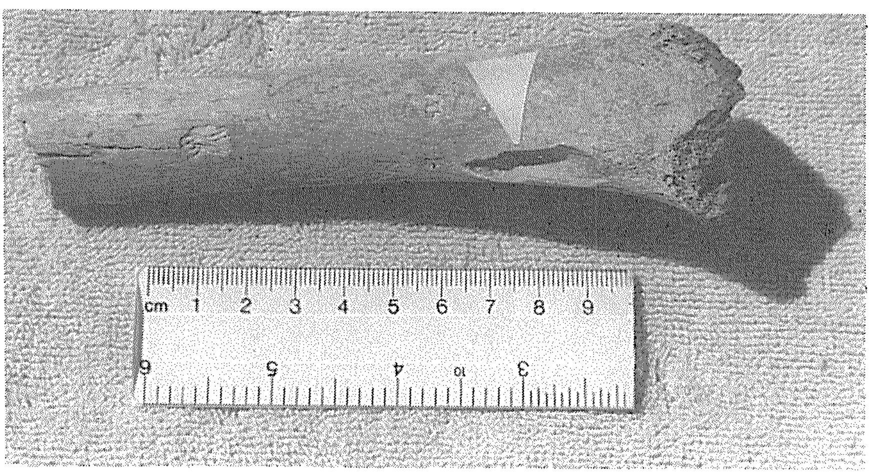

Figure 1. Located on the lateral surface of the right distal femur, 25 mm proximal to the epiphyseal plate, a benign fibrous cortical defect has a smooth base and edges. The medullary space is not involved.

a benign fibrous cortical defect. The base and edges of the 27-by-11-mm lesion are smooth, although the edges are slightly raised peripherally. These localized defects are found in 30 to 40 percent of all children during the period of ossification, but they usually disappear as growth proceeds (Paul and Juhl 1973).

An abnormality on a long bone of an unsexed adult from the Holdeman site was evaluated as fibrous dysplasia in the late inactive stage (Gregg 1985) (Figures 2, 3). An intramedullary lesion expanded and thinned the cortex for a distance of about 12.5 cm along the shaft of the bone. In one place the cortex is less than 1 mm thick; in another the bone has expanded to 36 x 32 mm. The medullary space is filled with trabeculated bone. The bone surface remains intact except in one area where the cortex is broken, exposing the medullary space.

According to Ortner and Putschar (1981) fibrous dysplasia is a disease of unknown etiology that affects females more frequently than males. It usually begins in childhood and often ceases development in early adulthood. It never involves the entire skeleton, although more than one bone may be affected.

Similar lesions may be produced by hyperparathyroidism and Paget's disease, but they can usually be distinguished on the basis of age and lesion pattern and appearance (Zimmerman and Kelley 1982:132).

Neoplasms

The only neoplasms observed on the skeletal material from either site were button osteomas, small benign tumors composed of osseous tissue.

Traumatic Lesions

Traumatic lesions of the skull and vertebral column were seen on skeletal remains from both the Clark and Holdeman sites. At the Clark site a healed depressed fracture was seen on the occipital bone of an unsexed adult and a

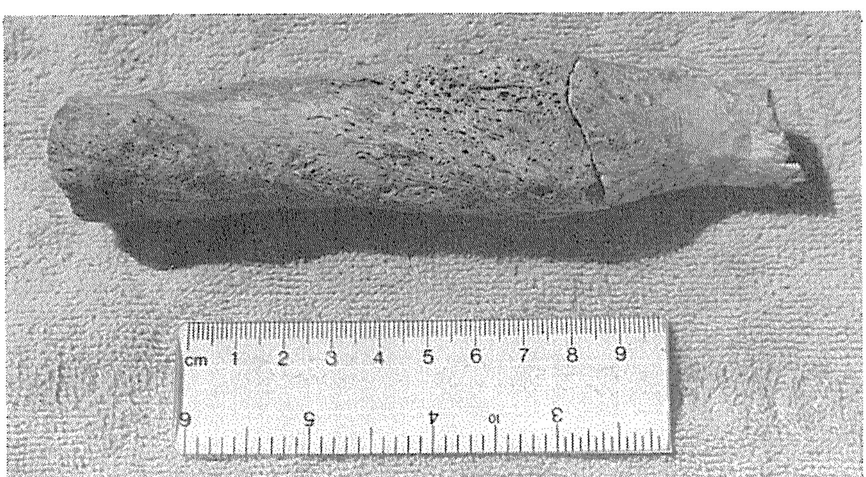

Figure 2. A lesion attributed to fibrous dysplasia has affected the shaft of a long bone for about 12.5 cm. The cortical bone is roughened, and vascular markings are accentuated.

Figure 3. The medullary space is filled with trabeculated bone as a result of fibrous dysplasia. The interstices within the bone's medullary space were probably filled with fibrous tissue during life.

Schmorl's Node was observed on a thoracic vertebra of a young adult of unknown sex. According to Knowles (1983), Schmorl's Nodes are caused by severe strain, especially from carrying heavy weights during childhood or adolescence. Such activity may cause gelatinous material in the intervertebral disks to rupture and create pressure against adjacent vertebrae. As the vertebra yields to pressure, a small pit or cavity is formed in its body. The presence of Schmorl's Nodes suggests that the "workload was fairly severe for teenagers and was probably already imposed on young persons in their late childhood" (Knowles 1983:69).

At the Holdeman site, a male over 30 years of age had a healed depressed fracture on the left frontal. Another male, 20-30 years old, had anterior compression of the fifth lumbar vertebra, probably of traumatic origin.

Infections

Three individuals—two from the Clark site and one from the Holdeman site—had dental abscesses. All of the abscesses were associated with caries in the molars. The Holdeman male had lost the first right maxillary molar antemortem and had a carious second molar.

Periostitis was observed on tibiae from two skeletons from the Holdeman site and on lower limb bones of three Clark site individuals. The incidence of periostitis (7.7 percent) in both the Clark and Holdeman skeletal remains must be regarded with suspicion, since the skeletons are fragmentary. The combined adult/subadult infection rate at the Kaufman-Williams site is 25.3 percent (Loveland et al. 1985). At the Roden site, Rose, Clancy, and Moore-Jansen (1981) found an adult infection rate of 19.2 percent and a subadult infection rate of 77.8 percent.

Hematologic Conditions

Cribra orbitalia was observed on skeletons from both sites, and porotic hyperostosis was found on the skeleton of a subadult from the Holdeman site. These conditions are usually attributed to iron-deficiency anemia resulting from illness and nutritional stress (El-Najjar et al. 1975; Mensforth et al. 1978). Blood loss caused by intestinal parasites has been suggested by Walker (1985) as a cause of the anemia.

Although evidence of these conditions appears on only 11.5 percent of the Holdeman skeletons (all under five) and 2.6 percent of the Clark skeletons, it does suggest that the people were under some stress. In fact, hematologic disorders may have played a significant role in childhood morality at the Holdeman site, where 37.5 percent of the subadult skeletons show evidence of either cribra orbitalia or porotic hyperostosis.

Summary

In summary, the anomalies associated with the Clark and Holdeman skeletons are similar to those in other Caddoan populations. Infections, hematologic disorders, and degenerative diseases are indicated as health problems of possible severity faced by the people, but the fragmentary nature of the skeletal remains makes it impossible to assess the impact each of these conditions actually had.

Dental Caries

At both sites males had a higher incidence of caries than did the females (Table 7). In all categories, the Holdeman population had higher caries rates than theClark population. The biggest contributors to this disparity, however, were two individuals whose remains were too fragmentary to either age or sex.

The caries rate at the Clark and Holdeman sites is lower than that reported for other Caddoan populations such as Bentsen-Clark (14.1 percent) (Buikstra and Fowler 1975), Roden (23.3 percent) (Rose et al. 1981), and Kaufman-Williams (15.3 percent) (Loveland 1980). Rose (1982) proposed that caries rates at Caddoan sites are tied to differential reliance upon maize; populations that depended most heavily upon maize would have the highest caries rates.

Table 7. Incidence of Caries Among Adults At the Clark and Holdeman Sites

Sex	Age		Adults	Total	% of Teeth
	20-30	30+	No Age		with Caries
		Clark Site			
Male	0/55*	10/61		10/116	8.6
Female	8/166	-		8/166	4.8
Undetermined	-	1/55		1/55	1.8
Total	8/221	11/116		19/337	5.6
		Holdeman Site			
Male	13/157	0/12	-	13/169	7.7
Female	1/50	4/43	-	5/93	5.4
Undetermined	0/26	5/24	10/14	15/64	23.4
Total	14/233	9/79	10/14	33/326	10.1

*Number of Caries/Number of Teeth Observed

CONCLUSIONS

The people who lived at the Clark and Holdeman sites encountered many of the same adaptive problems faced by other Caddoan populations. The subadult mortality rate, which is similar to that documented at other Caddoan sites, is somewhat lower than the rate for many Native American populations (Bass et al. 1971). It remains to be determined whether the lower childhood mortality observed reflects a true incidence of childhood death or some aspect of disposal or recovery of the dead. Caddoan children were frequently buried under house floors rather than in cemetery areas, so it is possible that not all subadult remains were recovered. Furthermore, the poor skeletal preservation at many Caddoan sites may result in the loss of some subadult skeletons.

The demographic profile at the Clark site suggests a high mortality among young females, whereas 75 percent of the males were over 30 when they died. This may be a reflection of obstetrical complications, although it is possible too that young males who died away from home were buried elsewhere. At the Holdeman site, on the other hand, 80 percent of the males were under 30 when they died. Adult males are overrepresented there by a ratio of 10 to 4. Four individuals could not be sexed, and an additional 15 skeletons were not recovered during excavation. The unequal sex distribution is probably the result of the loss of this skeletal data rather than an indication of differential burial practices. The Holdeman mortality profile may be skewed because of sample size and poor preservation.

The anomalies observed on the skeletons from the two sites are among those most commonly noted on individuals from other Caddoan sites. These include caries, degenerative conditions, infections, developmental defects, and hematologic disorders. The presence of cribra orbitalia and porotic hyperostosis in both populations provides evidence of disease or nutritional stress. Whether these conditions were the result of heavy dependence upon maize agriculture, use of maize gruel as a weaning food, culinary practices, or diarrheal or helmith infections remains to be determined. Their occurrence in both populations, coupled with the presence of dental caries and enamel hypoplasia, suggests a health burden whose magnitude cannot be fully assessed because of the fragmentary nature of the remains.

Although the seletons were fragmentary, evaluation of the human remains from the Clark and Holdeman sites contributes to our understanding of the Caddoan people. As Westbury (1978:185) stated, "if enough small studies are undertaken, eventually sufficient data will be available to draw valid conclusions about the peoples who prehistorically populated the area."

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Possible Cases of Endemic Treponematosis in a Prehistoric Hunter-Gatherer Population on the Texas Coast

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ABSTRACT

A case study of possible endemic treponematosis in a prehistoric hunter-gatherer population from the Gulf Coast of Texas is presented. A chief interest of the study is the high incidence of skeletal lesions indicative of infectious disease in a nonsedentary hunter-gatherer population, which may be indicative of seasonal aggregation.

INTRODUCTION

This paper describes a case study of possible endemic treponematosis in the skeletal population from Callo del Oso (41NU2) on the Central Gulf Coast of Texas. Cultural and temporal context of the population is discussed, and a differential diagnosis arguing for treponematosis is presented, together with an analysis of the location and incidence of skeletal lesions. One of the chief interests of this case study is the apparent high incidence of skeletal lesions compared to the incidence reported for any of the recognized treponemal syndromes. Similar cases on the Texas coast and in the eastern United States are discussed, and it is suggested that the high incidence of infectious disease may be due to seasonal aggregations among this population of hunter-gatherers.

The prevalence and distribution of treponemal infections has been the topic of scholarly debate for more than a century (see Steinbock 1976:87-97 and Ortner and Putschar 1981:200-207 for review of this debate). Formerly, much of this debate centered around the question of whether one particular manifestation of this disease, venereal syphilis, originated in the Old or the New World. Theoretical advances and closer examination of evidence in the past two decades have changed considerably the emphasis and character of this debate. Hudson's Unitary hypothesis (1965) argues that the four existing clinical manifestations: pinta, yaws, endemic syphilis (bejel, treponarid), and venereal syphilis form a pathological continuum and are caused by different strains of the same infectious agent, *Treponema pallidum*. Differences in clinical manifestations of the infection are attributable to differences in the mode of transmission of the infectious agent, which are in turn affected by environmental factors such as climate and by level of sociocultural development. Hackett's theory (1963) emphasizes that there has been a continual coevolution of host and infectious agent. Both points of view carry the implication that the prevalence, distribution, and specific clinical manifestations of treponemal infection in the past may have been very different from what they are now, and that the question of geographic origin of a specific manifestation of the disease, such as venereal syphilis, may be misplaced.

Paleopathological studies of treponematoses remain an important area of study because they are among the [relatively] few widespread infectious diseases that leave recognizable skeletal lesions in a consistent fashion and because varying clinical manifestations of the disease appear to be linked in part to levels of social and demographic development. Studies of the prevalence and distribution of treponematoses in the past have the potential to tell us much about the coevolution of disease and human populations. Such studies are complicated, however, by the fact that different clinical manifestations of the disease can leave identical lesions (Steinbock 1972:111,139; Ortner and Putschar 1982:180, 182). Steinbock argues that a differential diagnosis of a specific known clinical manifestation of the disease from skeletal remains necessarily involves specification of type and location of lesions, incidence of skeletal involvement, and a consideration of the sociocultural and climactic context of the population in question. So, adequate descriptions of treponemal infections in the past, which may differ from those of the present, should take the same approach. Because of the prevailing emphasis on identification of specific cases of venereal syphilis, this population approach has not always been followed.

GEOGRAPHIC AND ARCHEOLOGICAL CONTEXT

The Callo del Oso Burial site (41NU2) is located within the present-day city limit of Corpus Christi, [Texas] on a clay dune overlooking the Corpus Christi and Oso Bays on the central Gulf coast of Texas. Callo del Oso has been noted as a burial site for more than a century (Martin 1930). The skeletal sample dealt with here was excavated in the summer of 1933 by a team from the University of Texas under the direction of A.T. Jackson (n.d.). Jackson recorded a total of 101 burials, including a number of partial skeletons that had been disturbed by later burials and by erosion.

Sixty-eight individuals were sufficiently intact for determination of burial position and orientation. Many of the skeletons were recovered as groups of interments, each of which was given a feature number. Thirty-nine such burial features were excavated, each containing between one and fourteen individuals. Most of the group burials were single interments that had intruded upon one another, although there are a few multiple interments, particularly of infants together with adult females. Due to the accessioning procedure that prevailed at the museum where the bones were curated, individual skeletal integrity was lost, and bones were ultimately labeled only by feature number. This greatly complicated the rematching of skeletal parts, a problem that was compounded by the eroded and fragmentary nature of many of the bones. As a result, our analyses of skeletal-lesion location and incidence are by bone element rather than by individual. The minimum number of individuals in the existing collection is 68, based on the number of left femorae. It was possible to rematch relatively complete skeletons for 21 of these individuals. Attrition of the collection appears to have been the result of poor preservation and of recovery by relatively crude excavation methods.

Temporally diagnostic grave goods at Callo del Oso were scarce, but several lines of evidence indicate that the burial site dates to late in the Archaic sequence of the Central Gulf Coast. Chronological precedence to the Rockport period beginning some time after 1250 A.D. (Story 1968; Corbin 1974) is indicated by the conspicuous absence of Rockport sherds in the burial fill or the dune deposit, despite the face that more than 400 m^2 of the dune was excavated (Jackson n.d.). Known Rockport burials occur in campsites or middens where Rockport or other sherds are among the most common artifact class recovered in the burial fill (cf. Hester and Corbin 1975; Hole and Wilkinson 1973; Wingate and Hester 1972).

Consistency in burial positioning and orientation (Jackson n.d.) argues for a high degree of cultural-temporal continuity within the cemetery. All 68 of the relatively undisturbed burials were flexed, and 59 of the 68 (86.7 percent) were placed on the left side with the head oriented in an easterly to southerly direction (facing Oso Bay). Twenty-seven of the 68 were placed specifically in a southeasterly direction, on the left side, with the hands placed over or near the face.

It should be emphasized that Archaic settlement and subsistence patterns persist until very late on the central and southern Texas coast, as well as in the adjacent interior. The introduction of local pottery manufacture in the Rockport period may indicate a degree of decreased mobility, but there is no evidence for the development of sedentary agricultural communities such as those that existed in the equidistant Huastecan and Caddoan regions during the same period. When Cabeza de Vaca and his companions explored the Gulf Coast of Texas between 1527 and 1536, they met with small groups of semisedentary hunter-gatherers (Campbell and Campbell 1981), and there is no evidence to indicate that subsistence and settlement there had been radically different in previous centuries.

DESCRIPTION OF SKELETAL LESIONS

Analyses of stature, cranial morphology, and pathologies, which include parts of the Callo del Oso skeletal series, have appeared in earlier publications (Goldstein 1957; Neuman 1952; Woodbury 1935). Goldstein (1957:302) suggested that lesions on the long bones of the collection "may be due to syphilis." Recent analysis by the authors confirms that the Callo del Oso skeletal series has a high incidence of inflammatory bone disease characterized by subperiosteal remodeling, cortical thickening, expansion of trabecular bone growth, and occurrence of destructive lesions. Periostitis is evident in all of the affected bones and is concentrated on the metaphyses of the long bones. In the least severe cases, subperiosteal bone apposition on the midshaft forms a thickened area defined on the surface by a pattern of longitudinal striations (see Figure 2, A-C). In some tibiae, subperiosteal bone apposition on the anterior surface of the midshaft produces the *saber-shin* appearance characteristic of treponematosis (Figure 1, A: Steinbock 1972:102-104). Further bone changes involve the increased growth of the endosteum to the extent that cancellous bone sometimes entirely closes the medullary cavity (Figure 2, D). In the most severe cases, the formation of destructive gummata occurs (Figure 2, C).

The most frequently affected bone is the tibia (23.4 percent of 94 left and right

A B

Figure 1. Right (A) and left (B) tibiae showing saber-shin effect bone changes typical of treponemal infection.

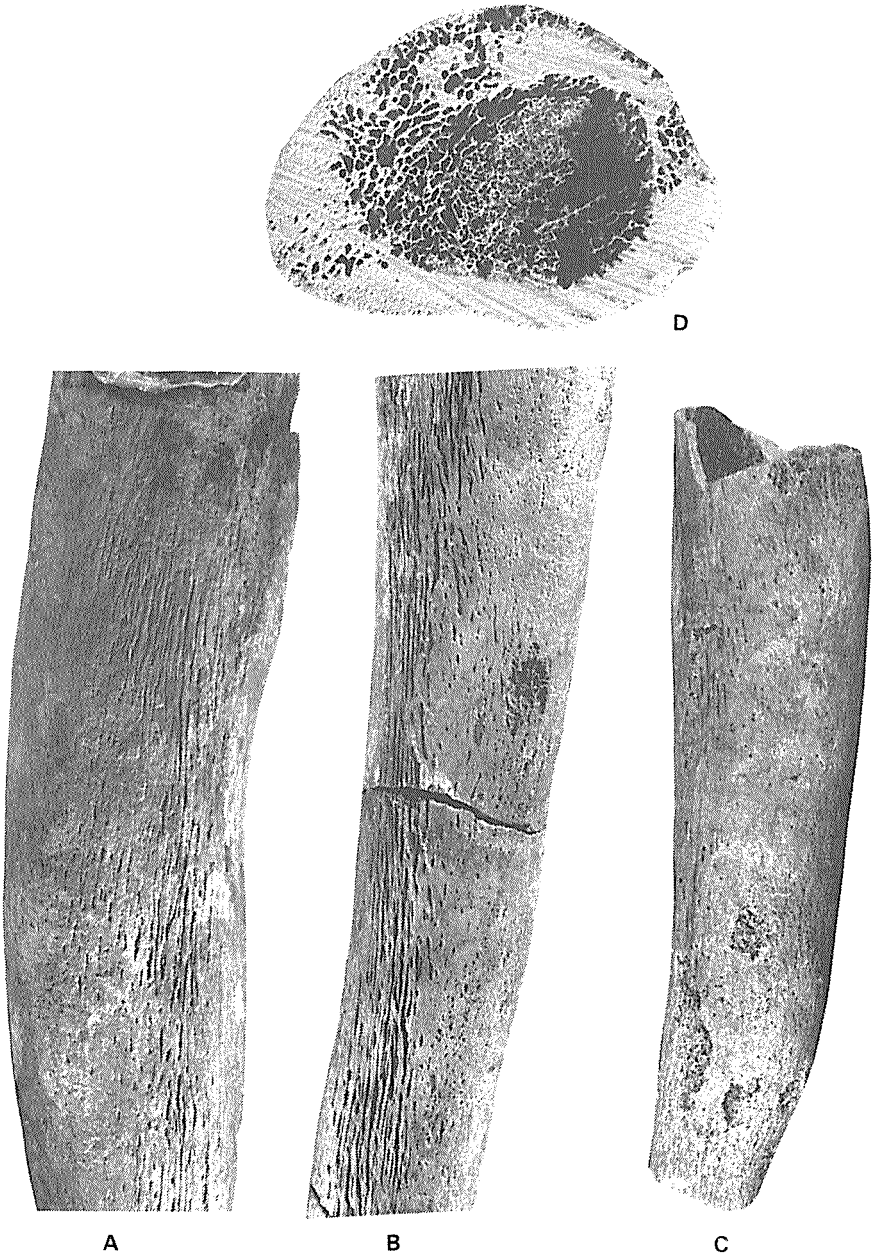

Figure 2. A, Stage one: midsection of right tibia showing beginning subperiosteal remodeling characterized by striations and cortical thickening. B, Stage two: midsection of left tibia showing extensive striations, appearance of bone lesions, and continued cortical thickening resulting in narrowing of medullary canal. C, Stage three: left tibia with marked deformation of bone shaft with cortical apposition and exostoses accompanied by continued bone lesioning and cloaca formation. D, Cross section of left tibia shown in Figure 2, C, with third-stage internal changes characterized by nearly complete closure of the medullary canal.

tibiae, see Table 1), followed by the clavicle (11.5 percent of 26 left and right, note low sample size), fibulae (8.9 percent), ulnae and humerii (both 4.7 percent), radii (3.8 percent), and femorae (2.3 percent). Of 21 rematched skeletons in the series, five were affected on three or more bones. Of 29 relatively complete crania and frontal and parietal fragments of about 40 other individuals, not a single individual showed cranial lesions. The frontal, parietal, and nasal bones are the first or second most frequently affected bones in venereal syphilis (Steinbock 1972: 112, 113; Ortner and Putschar 1981:188), but are much less commonly affected in endemic syphilis or yaws (Steinbock 1972:139). Steinbock further notes that cranial lesions are present in nonvenereal syphilis in about 4 percent of individuals involving bone lesions, so the population analyzed here is probably too small to determine definitively whether a low frequency appearance of cranial lesions was a characteristic of the syndrome in this population. Projecting from Steinbock's figures, it is clear that a sample of at least 25 affected individuals would be required before a single case involving specifically cranial lesions could be expected due to nonvenereal treponemal infection.

No dental stigmata typical of congenital syphilis were observed among the 33 individuals with teeth. Dactylitis, frequently associated with yaws (Ortner and Putschar 1982:180), was not observed. The nasal and palatal bones were generally too poorly preserved to determine whether lesioning occurred there, as is noted in venereal syphilis and less commonly, in yaws (Ortner and Putschar 1982:180-181) Nasal lesions have been reported in a skeletal series from the nearby Palm Harbor site (Commuzzie et al. 1984). Two infant tibiae (out of a total of eight infants in the series) exhibited periostitis characterized by thin successive layering of bone with pitting and formation of destructive lesions.

A scale was developed to characterize the degree of bone affectation (Figure 2, Table 1). The first stage of affectation is characterized by appearance of longitudinal striations and cortical thickening at the midshaft. In the second stage, cortical thickening increases and involves more of the midshaft; endosteal growth results in the narrowing of the medullary cavity (Figure 1, B). In stage three, the entire diaphysis is heavily involved, and there are frequently destructive gummata (Figure 1, C). Table 1 shows that few cases reached stage three of affectation and all of these were adults. These data suggest the disease was a chronic, progressive, but subacute disease in this population. The markedly high stature, robusticity and sexual dimorphism of the Callo del Oso series suggest that the population was healthy and well nourished, except for the subacute condition described here.

DISCUSSION

The form, incidence, and location of bone lesions in the Callo del Oso skeletal series argue for a diagnosis of a chronic, progressive, subacute form of treponematosis that was endemic to the population. The incidence of skeletal involvement appears to be much higher than in any of the described syndromes. Steinbock (1972:139) estimates that skeletal lesions should be present in 1 to 5 percent of a skeletal series where nonvenereal syphilis is endemic. He arrives at a similar figure for yaws (page 143), while the prevalence of skeletal lesions in a population where

Table 1. Table Showing the Frequency of Bones Affected by Various Stages of Periostitis in the Callo del Oso Sample

	SUBADULTS					ADULTS					TOTAL	
		Number Affected					Number affected					
	No. of Bones	Stage 1	Stage 2	Stage 3	Percent Affected	No. of Bones	Stage 1	Stage 2	Stage 3	Percent Affected	No. of Human Bones	Percent Affected
Ulnae	13	-	-	-	-	82	2	1	1	4.7	95	4.7
Radii	7	-	-	-	-	78	2	-	1	3.9	85	3.5
Humeri	18	2	-	-	11.1	88	2	1	-	3.4	106	4.7
Femorae	28	1	-	-	3.6	100	1	1	-	2.0	128	2.3
Tibulae	15	2	1	-	20.0	79	7	9	3	24.1	94	23.4
Fibulae	7	1	-	-	14.3	72	1	4	1	8.3	79	8.9
Clavicles	6	-	-	-	-	20	1	-	2	15.0	26	11.5

venereal syphilis is present is estimated to be lower: .5 to 1 percent (page 110). Using tibiae as an index (i.e. assuming that the tibia is always affected in any case with skeletal involvement), the incidence of skeletal involvement in the Callo del Oso population was at least 23.4 percent. So even if 100 percent of the population had active cases of the disease, the degree of skeletal involvement would be much higher than any of the known syndromes of treponematosis.

The level of incidence of the disease at Callo del Oso is close, however, to the figure obtained by Cassidy (1972:89) for the Hardin Village skeletal series. This series was associated with a sedentary agricultural population of the Fort Ancient Tradition in Kentucky, dating to just prior to historic contact. Cassidy found evidence of varying degrees of periosteal inflammation in about 30 percent of the population. Cassidy concluded that the periostitis was due to a form of endemic treponematosis, and found similar cases of the disease in nearby cemetery sites, including Indian Knoll. At Indian Knoll, however, which was associated with an earlier gatherer-hunter population, the incidence was much lower: only about 2 percent.

At Callo del Oso the high incidence of an infectious disease in what appears to be a small, dispersed hunter-gather population is worth further discussion. Endemic treponematosis is typically associated with small populations living under primitive, unhygienic conditions (Steinbock 1972:138). It is spread by skin contact or by common use of drinking and eating vessels and is commonly spread among children, whereupon the disease becomes chronic, with long periods of latency, in the adult population. With the introduction of urbanization and modern systems of hygiene, the disease generally disappears and may be replaced by venereal syphilis (Steinbock 1972:139). Most recognized forms of nonvenereal endemic treponematosis are associated with primitive farming communities or pastoral nomads. However, Hudson (1963:22) reports that endemic treponematosis was "able to maintain itself in nomadic aboriginal family groups [in Australia] which conjugated into larger groups for only a few weeks a year." Such seasonal aggregations are likely to have occurred among some of the Texas Coastal Indians (see Ricklis 1986), so it is possible that the disease of the Callo del Oso population was maintained through seasonal groupings.

St. Hoyme and Bass (1962:376-378; Cassidy 1972:99) cite a historical observation of what may be the syndrome in question among the Carolina Indians of the early eighteenth century. The disease was described as a "burning of the limbs," which caused considerable discomfort to some of the older members of the village. St. Hoyme and Bass suggest this affliction may have been the disease responsible for bone lesions they observed in a skeletal population from the Clarksville site in Virginia. The lesions they observe resemble very closely those observed by Cassidy (1972:92-100) and in the Callo del Oso population. This syndrome, which may well corrspond to the endemic nonvenereal syphilis of the Old World, may have been widespread in North America before European contact. It may well account for many of the isolated reports of Precolumbian "syphilis" in North America.

Skeletal lesions similar to those described here have been noted in other skeletal samples from the Texas coast. In their report of the Palm Harbor burials (41AS80), Marek, and Steele (1984) report lesions characteristic of treponemal infection on the tibiae and other long bones in the sample, as well as on the nasal bones of one of the crania. Three of eight individuals recovered at the Shell Point site (41B046; Hole and Wilkinson 1973) were afflicted with a "progressive periostitis" characteristic of treponematosis. Interestingly, these three skeletal series have morphological similarities in the form of marked robusticity and sexual dimorphism (Comuzzie et al. 1984). At the same time it is worth noting that the Shell Point burials were definitely associated with pottery, possibly making them somewhat later than the Callo del Oso burials. The authors have noted lesions characteristic of treponematosis on many other skeletons from the coastal and inland regions of Texas during their reinventory and reorganization of the skeletal collection at the Texas Archeological Research Laboratory at The University of Texas at Austin, although it is beyond the scope of this paper to describe all of these. In order to trace the development and distribution of this syndrome through time, more reports are needed that describe the specific lesion location and incidence of osteoperiostitis. Such studies may well provide answers to questions of more general interest involving population dynamics and settlement patterns.

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Book Reviews

Adobe Walls: The History and Archeology of the 1874 Trading Post. By T. Lindsay Baker and Billy R. Harrison; Foreword by B. Byron Price. Texas A&M University Press, 1986. xx + 413 pp., 284 figs., 2 maps, 22 tables. Hardcover $39.50.

The Texas A&M Press has published a definitive history and comprehensive archeological analysis of the Adobe Walls site (41HC1), situated just north of the Canadian River in Hutchinson County. Steely describes this National Register site, a historic occupation from March to September 1874, as a site of short occupation by buffalo hunters; contains ruins of sod and picket structures, well, grave markers, subsurface artifacts and foundation remains, and stone monuments to Second Battle of Adobe Walls. Named for adobe ruins of 1843 William Bent trading post a mile distant. On 27 June 1874 a group of hunters here repelled 5-day attack and seige by Indian force under command of Quanah Parker and Lone Wolf [Steely 1984:107].

This site and the battle have been the subject of myths for more than a century, and the authors have rendered an exceptional service in seeking out the facts. The volume has two major sections. In the first, T. Lindsay Baker, Curator of Agriculture and Technology at the Panhandle-Plains Historical Museum, interprets the history of Adobe Walls within the broader context of the sweeping trends of nineteenth century developments on the Southern Plains. He concludes that the battle was more than a local incident; it was an Indian reaction to Anglo hunters' destruction of the Southern Plains buffalo herds in areas believed by the Indians to be their exclusive hunting range. But in the Texas Panhandle, unlike the Indian Territory of Oklahoma, there were no federally protected public lands, since all common lands in Texas had been reserved to the State when Texas entered the Union. So the Indians had no legal claim to buffalo herds in the Texas Panhandle, in spite of the fact that the Panhandle had been part of their hunting range for centuries.

The confrontation at Adobe Walls was also a critical test of the spiritual leadership of the young Comanche medicine man Isatal among his people. He had toured several camps of the Comanche and their Cheyenne, Arapahoe, and Kiowa allies, boasting of the powers of his protective medicine to make warriors invulnerable to the buffalo hunters' bullets. So when they rode out to fight, the Comanche bands were accompanied by Cheyenne and other allies who wanted to observe Isatal's medicine at work.

Baker outlines both the Indian and Anglo events that led up to the battle, details the specific actions during the five days of the battle, and traces the history of the site and the participants through the years that followed. He is remarkably successful—through his evaluation of the often exaggerated historical accounts and his blending of logical analysis with archeological evidence. He validates several phenomenal occurrences, including Billy Dixon's famous *long shot* with the new .50-caliber Sharps rifle that killed several attackers at ranges between 800 and 1500 yards. Concerning the killing of Isatal's horse, Baker notes that "the death of Isatal's horse demoralized the warriors, who now realized that no supernatural power would help them in their fight" (pages 65, 66). Quanah Parker was also hit, a fact that "definitely affected the course of the battle" (pages 64, 65.) Outgunned, the Comanche withdrew after five days of harassing raids.

The battle immediately made national headlines from San Antonio and Denver to New York and Washington, and the resulting furor helped create an atmosphere of crisis that provided justification for the final Plains Indian Wars of the late 1870s. Tales of the battle and the Indian "threat" continued to grow, and by the end of September 1874, the Adobe Walls site was abandoned by the traders and buffalo hunters, who removed as much of their goods as possible back to Dodge City, Kansas, where they had been outfitted originally. The structures at the site were later looted and burned by the Indians.

In the second half of this volume, Billy Harrison, Curator or Archeology at the Panhandle-Plains Historical Museum, reports on systematic excavations that began at the site in 1975. His well-written and extremely well illustrated section provides a wealth of information, not only about this important battle site, but also about the life-style of Southern Plains buffalo hunters, their food preferences, and other characteristics. The construction and destruction of the buildings at the site—stores, stable, mess hall, saloon, blacksmith shop, and privy—are examined in considerable detail. Artifacts recovered are remarkably varied, ranging from whiskey and medicine bottles to Ironstone dinnerware and tobacco pipes.

Several metal Indian arrowpoints document the survival of the bow and arrow as a weapon of the Comanche as late as 1874, and the elegant English dinnerware shows that the buffalo hunters dined in style. From some tin cans recovered and from the historical record, we learn that they also enjoyed fresh peaches, dried and canned fruit, and canned tomatoes. Medicine bottles suggest their ailments, and buckles, buttons, and purchase receipts help illustrate their taste in clothes. Much of the archeological evidence shows that this trading post, a well-equipped outpost of American popular culture, carried imported goods and was not simply a rude place to swap buffalo hides for beans and bacon. The archeological evidence proves that the site was a mercantile colony rather than just a hunters' temporary campsite, and that the Comanches' fears of territorial intrusion and possible colonialism were well founded.

This study of the history and archeology of the Adobe Walls site is extremely well done, but it has a few minor defects. Although both the historical and archeological sections have detailed descriptions of the structures, maps of the site and drawings of the buildings are confined to the archeology section in the second half of the book; consolidation of these descriptions, together with the maps and drawings, into an expanded introduction probably would have helped readers develop a perspective of the site. The photographs of both Anglo and Indian participants are reproduced very early on eight unnumbered pages between pages 10 and 11 and on eight more between pages 42 and 43. They would have been more helpful as single pages of photographs placed near where the individuals or events were discussed, as was done in the archeology section.

In the history section there are a few trite expressions: "through 1872 and 1873, the numbers of *shaggies* were so depleted that the hide men were forced to look farther afield" (page 8), and on page 9 there is a minor error; where "the Indians were permitted to hunt on federally owned plains south of the Arkansas River and east of the reservations" probably should read *west* of the reservations.

In the archeology section the site number is missing from both maps and text. Most measurements are in English units (inches, feet, miles), although metric measurements are standard in American archeology. Moreover, 135 pages into the archeological section, on page 261, when buttons are discussed, measurements suddenly shift to metric, and on page 270, where the topic shifts to buckles, measurements are again in English units without explanation. References to commercial sources, comparative collections, and other archeological investigations are sometimes inserted into the narrative and are sometimes just cited in the "Chapter Notes" at the end of the text. This is a distinct difference from the in-text citation format that is standard in archeological literature. This practice is understandable, considering the dual historical-archeological thrust of the volume, but it is awkward for archeologists and requires much thumbing back and forth. There is very little comparison of the artifacts from Adobe Walls to those from other Texas sites, although some types of nineteenth century artifacts such as beads (Harris and Harris 1967; Davison and Harris 1974), conchas and hair pipes (Word and Fox 1975), and metal arrowpoints (Baker and Campbell 1959; Thompson 1980) are well documented in the Texas and Oklahoma archeological literature.

Overall, this volume makes a considerable contribution to our knowledge of the nineteenth century Panhandle, one of the last frontiers in the history of Texas and the United States. The authors are to be commended for an outstanding analysis of the history and archeology of this important battle site. Their work is extremely significant for anyone interested in understanding the final days of freedom for the Southern Plains Indians in general and the Comanche in particular. By examining both Anglo and Indian perspectives on the Battle of Adobe Walls, Baker and Harrison have destroyed many stereotypes and challenged many myths. Their work should stand for a long time as the definitive analysis of both the battle and the site.

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Seminole Sink: Excavation of a Vertical Shaft Tomb, Val Verde County, Texas. By S. A. Turpin, L. C. Bement, T. M. Byrd, M. K. Marks, J. C. Rose, E. L. Buie, R. Rosenberg, W. R. Elliott, and J. R. Reddell. Texas Archeological Survey, University of Texas at Austin, Research Report No. 93. 1985. xii + 216 pp., 58 figs., 28 tables.

It was a happy event when the nine scholars and graduate students from the universities of Texas and Arkansas combined their specialized abilities to analyze Seminole Sink in the desert of Val Verde County, Texas. Spelunking, entomology, paleontology, soils analysis, and prehistoric archeology were among the specializations possessed by the group, whose work was financed by the Texas Parks and Wildlife Department and encouraged by Ron Ralph, of that organization. Additionally, the various technical sections of the resulting report were wedded to the archeological interpretations and to each other in a way almost never seen in the site reports produced in Texas during the past two decades. Surely editor Deborah L. Smith is due credit for the clear, straightforward writing style and lack of jargon that characterize the report.

The study's leading claim to glory, however, is its attempt to explain the archeology of the sinkhole in terms of human behavior. The possible actions and beliefs of prehistoric people are not usually treated, even speculatively, in local archeological publications—certainly not in the way they are dealt with in *Seminole Sink*. The report suffers from only one flaw, and that one can be easily compensated for by the alert reader, as will be shown at the end of this review.

A quick summary is appropriate. The skeletal remains of 22 people were exhumed below the vertical shaft opening of an underground solution cavity in Seminole Canyon State Park, not far from the mouth of the Pecos River. Twenty-one of them rested in a conical talus directly beneath the sinkhole's opening, while the remains of a single cremated male lay atop the cone. Both the discovery of one Early Corner Notched dart point in the cone and the results of the technical studies support an assigned age of several millennia, putting the main part of the find firmly in the early part of the Archaic period. I shall sketch here a few of the principal findings.

The detailed review of similar sites shows that sinkhole burial was practiced throughout prehistory, and the sinkholes so used occur mainly along the westernmost margins of the Edwards Plateau and in Terrell and Val Verde counties. Radiocarbon assays from Seminole Sink, presented as uncorrected years before the present, produced age estimates of (1) 19,000 years for the site's travertine zone, which underlies the burials, (2) about 4,000 years for the 21 Archaic burials, and (3) 400 years for the overlying cremation. However, the dates for the Archaic burials came from soil that probably contained some amount of carbon from the much younger cremation, and so are too recent. According to the authors, a comparison of age calculations for Early Corner Notehed dart points found elsewhere, one of which was definitely associated with the Early Archaic burials at Seminole Sink, suggests a true age of 5,000 plus years for those human remains. My own belief is that an age of 8,000 or 7,000 years is probably a more accurate figure, interpolating from the older assays of carbon from the base of Eagle, Baker, and Hinds caves (Ross 1965; Word and Douglas 1970; Lord 1984). Turpin and associates also allow for this possibility.

The technical study of the cave's sediments included ph determinations, x-ray diffraction of clays, and a textural analysis. From these, the cave's entire history was divined, showing that the underground environment acted as a repository of ancient surface soil free from subsequent environmental change. It was learned that the Ice Age climate was more humid than in later episodes and a trend toward xeric conditions during the Holocene was also documented. These conclusions were carefully compared with other climatological reconstructions.

The fascinating analysis of the fragments of human skeletons showed several important things. The first is that some evidence of bacterial infection exists, though it is not high; that iron-deficiency anemia can be inferred from porotic hyperostosis, indicating a plant diet with only minimal amounts of iron; and that one adult was wounded with a wide-bladed, sharp instrument, though he later healed. There is also evidence for considerable physical stress, but not at the high levels predicted by Neumann (1967). Additionally, the angled wear on the teeth, which have many caries, is thought to bespeak the mastication of plants with high fiber content that mainly produced carbohydrates. The evidence for such an early emphasis on plants in the local diet and for violence (note, also, that the single associated dart point may have been imbedded in flesh) is worthy of note.

It is the social interpretation, however, that raises the report above the level of those that treat sites as collections of artifacts suitable only for classifications designed for trilobites. In chapter 5, Turpin calculates the span of years during which the site was used as a cemetery by relating reasonable population figures to the duration of local residence (Table 26); she further suggests that the living group responsible for the burials spent the greater part of any year within a limited distance of the sinkhole. Corroboration of that view can be found in the physical evidence that death came to the sinkhole population during different seasons of the year. From this conclusion it is reasonable to infer a limited territoriality for the prehistoric community. Turpin also suggests that some cave art in the area, and the art sites themselves, may have served as ethnic or territorial markers.

It is also inferred that primary interment is represented by the Archaic burials, but that the bodies were not flexed and bound—else they would have been too bulky to be cast down the sinkhole's chimney. Additionally, bodies would have been transported from living sites where death occurred in marches probably of only a few hours. Within a radius of 1.6 km (1 mile), using the sinkhole as the circle's center, numerous rockshelters, open camping sites, and one burned rock midden were located. Fate Bell shelter is suggested as a very likely home for the sinkhole band.

Since there were apparently no distinctions among the burials at this and other sites in age, sex, or social status, and for other reasons, several ideological interpretations are offered, as follows. Death is an emotionally disturbing event, and funeral rites must serve the needs of the individuals who survive, whatever else they may show about role and status in the society. Interestingly, infant burials in the Lower Pecos area received all the attention due adults, though this fact flies in the face of the idea that young children were nonpersons of no real status in hunting-gathering societies (see p. 161). I like the speculations from reasonable ethnographic analogies that Turpin introduced at this point, one of which is that if the ghost is perceived as malevolent and seeks to torment the living, sinkholes may have served as sealed sepulchres to lock in the spirits. Another possibility is that a sink may have been analogous to a womb, and "the chimney is both the means by which the earth is fertilized and the birth canal, passage from the underworld. In terms of the lexicon of rites of passage, the shaft symbolizes a life portal" (p. 162). If even partly true, the main importance of such inferences is to dispel the notion that throwing the corpse into a sinkhole was a hasty act devoid of emotion and meaning. Other enticing ideas are also offered, though I lack space for their review.

To recapitulate, an excellent attempt is made to use ethnographic knowledge about treatment of the dead to suggest how the burials at Seminole Sink may have been dealt with by the prehistoric people of the Lower Pecos. The suggestion of a concept of limited territories is also stimulating, though Turpin is careful not to take extreme positions in either argument.

The single error I see in *Seminole Sink* is a borrowed one—the use of a series of phases for the Lower Pecos region that promises to cause trouble. Citing a manuscript by D. S. Dibble, the Bonfire, Oriente, and Viejo phases are discussed for the Paleoindian and Early Archaic "stages" in terms of their age-diagnostic tool types and radiocarbon assays (pp. 6-11). Note that both Plainview and Folsom dart points are listed for the bonfire phase, and Gower, Martindale, Uvalde, and Early Barbed points for the Viejo. Such a construction of phases, as presented, is entirely in error. I should add, however, that the earliest Lower Pecos phases were only meant to be named local periods (Dibble 1986), although the much later Infierno phase is intended by Dibble (1978) to be a true cultural-social unit in the system of Willey and Phillips. But since the phase label has been used for the early periods, the following comments are called for to prevent confusion.

In discussing the idea of phase, Willey and Phillips (1958:22) indicate (1) that it is an archeological unit having characteristic traits that set it apart from all other such units, (2) that it occurs within a locality or region, and (3) that it is limited in time to a relatively brief interval (see discussion by Johnson 1967: 1-10). All components of any phase must be consistent, allowing, of course, for functional differences in the sites themselves. In dealing with the problem of recognizing components of phases, Willey and Phillips (1958:49) say that "the social equivalent of the component is 'community' as defined by Murdock and others....The equivalent of phase, then, ought to be 'society' and in a good many cases it probably is."

Now, the only way that phase components can be defined is by isolating archeological materials into associational units. Even W. C. McKern's (1939:30) prcedure for defining foci state that the investigator must collect materials that have cultural (i.e., social) significance. If the complex of traits so determined recurs in purity, the recurring complex establishes the focus. So associational complexes are the stuff of foci and phases. I believe that anyone can see that Folsom and Plainview dart point belong to different tool complexes, and it is highly likely that the many dart points of the Viejo phase will also be shown to associate with distinct complexes. At any rate, it is the archeologist's duty, always, to demonstrate the existence of site components, then consistent intersite complexes, before naming phases. Showing the approximate contemporaneity of a number of dart point types will not do for phase definition, for the types may represent the remains of distinct communities of people with different tools, even in one natural region.

This same mistake has been made in Central Texas with the provisional early phases suggested by Prewitt (1981, 1983). In that case the error is magnified by the fact that the radiocarbon assays said to date the earliest phases are not often associated with the diagnostic tool types. In fact, the first test of Prewitt's phases (Peter et al. 1982:21-1 to 21-8) tends to show a sequence different form the one that has been proposed.

In the case of the Lower Pecos phases, a simple change in thinking will make the proposed names quite usable. We can view them as names for fairly broad periods, each of which may encompass the material remains of several different complexes comparable in the way they are made up to the Folsom, Dalton, and Cody complexes of late Paleoindian days. If the reader of *Seminole Sink* makes this simple mental adjustment when using the Lower Pecos chronology, the report can be used for what it is: a clever and avant-garde reconstruction of prehistoric economic and social practices.

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Prehistoric Rock Art of the Cross Timbers Management Unit, East Central Oklahoma: An Introductory Study. By Charles D. Neel, with original artwork by Kenneth Sampson. Archeological Resource Survey Report Number 27. Oklahoma Archeological Survey, Norman Oklahoma, 1966. 48 figs., 4 tables, 21 sketches, appendices, 130 pp., $8.50 postpaid.

This study describes seven petroglyph and two pictograph sites in east-central Oklahoma. But its goals are broader, "to make Oklahomans, its diverse bunch of everyday citizens as well as the professional archaeological community, aware of a genuine art form—that left in stone by Oklahoma's native Americans" (p. 1). That it succeeds in this respect is doubtful, considering the crude, unspectacular, limited nature of the art at these sites.

By way of figures and tables, individual rock-art elements from sites in Kansas, Colorado, New Mexico, and Texas (but not Oklahoma) have been arranged in a section titled "Regional Perspectives." Its usefulness is severely limited, since the elements are divorced from their contexts, their colors and relative sizes are ignored, and the criteria for their classification vary from table to table and even within tables. A hunchbacked flute player from New Mexico is appropriately classified with Kokopelli Figures (Table 3, p. 13), but a similar figure from Mesa Verde, Colorado is classified with Naturalistic Animate Figures in Table 2 (p. 7). Similarly, a distinctive Pecos River Style, Period 3 shaman from Texas is lumped with Butterflies and Other Insects in Table 4 (p. 19), but later in the same table (p. 21) it is listed with Feathered Headdresses. Even if objective categories could be established, how significant would many of them be? A rakelike figure to one investigator may be a rain-cloud symbol to another and may have been either or neither to the artists. That the artists who created such simple figures at various widely scattered sites shared a common purpose and artistic tradition is to be seriously doubted. In short, the attempt to find connections between the rock art of various regions is of course laudable but unattainable by these techniques.

Following brief discussions of the biotically ecotonal "Cross Timbers Management Region" and the "Geology of the Cross Timbers," the description of the area's rock art is divided into "The Sites and Their Petroglyphs" and "The Sites and Their Pictographs." Helpful and generally clear photographs accompany the text, including six (Figures 37-42) outstanding color photographs. The sketches by Sampson, particularly of the appearance of the sites, are an effective and attractive means of communicating their nature. A brief "Concluding Statements" section completes the study. Its final sentence is curious, suggesting that further studies of Oklahoma's rock art will serve "our enjoyment and wonder," apparently implying that they will do little or nothing to enhance our understanding of how these prehistoric peoples perceived themselves and their world. Bibliographic appendices for Kansas, Missouri, Arkansas, Texas, and Oklahoma round out the study. Unfortunately, the text is marred by frequent misspellings and typographical and grammatical errors.

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Commentary

The article written by Elaine R. Hughes on the care of prehistoric ceramics (Bulletin of the Texas Archeological Society 54:331-343) fills what has been an unfortunate gap in archeological literature by discussing modern conservation practice as applied to practical techniques for archeologists. However, there are several technical points in her article that I believe need some clarification.

It is made clear that the article is not intended as a substitute for the advice or work of a trained conservator. In that light, I believe that the paragraph on removing calcium carbonate deposits with hydrochloric acid should have been omitted. It is a risky treatment even when performed by a conservator, and then is used only as a last resort. It is not necessay to mention such treatments when addressing general audiences in articles such as this. What should have been mentioned but was not, was that the current practice of soaking sherds and bones in a solution of the proprietary product Limeaway should be discontinued immediately. Limeaway contains hydroxyacetic and phosphoric acids and is intended for use in water heaters and other appliances for the removal of hard-water scale. It will harm archeological objects. Its use was originally advocated in a thesis that dealt with artifacts from West Texas, where caliche encrustations are much more obscuring and indurate than they are in Central Texas where this technique was being applied. The use of tetrasodium EDTA is a much more appropriate treatment and should have been described further. The pH of the solution can be adjusted with ammonium acetate in order to increase the chelation power and rate. Sodium hexametaphosphate, and sodium triphosphate for that matter, will sequester calcium carbonate, calcium sulphate, and the other slightly soluble and soluble salts that are found in caliche crusts, when applied in a poultice at a higher concentration than when used as a surface-cleaning agent.

A second point concerns the terminology used to describe polyvinyl acetate resins. In the currect conservation literature, polyvinyl alcohol resins are referred to as PVAs, whereas polyvinyl acetate resins are called PVAc's to avoid confusion. Also, some nail polishes that are formulated with acrylic resins may be appropriate for labeling purposes if they are thinned properly and when nothing else is available in the field. On page 337, PVC is accidentally written for PVAc in the discussion of sherd-margin consolidation.

The author does not state why Vinac B-25 was chosen over other PVAc resins (such as the four grades manufactured by Union Carbide) or the difference between Vinac B-15 and B-25.

The proprietary aerosol resin product Krylon 1301 Clear Acrylic Spray, is not Acryloid B-72 in toluene, as stated on page 335. Krylon 1301 is manufactured by Borden, Inc., whereas B-72 is manufactured by Rohm and Haas Corp. B-72 is an internally plasticized ethylmethacrylate-methylmethacrylate copolymer. Krylon can be described as a methyl butyl methacrylate copolymer, which, while still being an acrylic ester resin, is a completely different product from B-72 and has different properties. We have found that Krylon spray lacks long-term durability and is not, therefore, a conservation-quality product. The spray formulation contains a mixture of ketone, aliphatic and aromatic solvents, which also distinguishes it from B-72.

I am curious as to why incorrect practices of infilling were not completely addressed in the section entitled "Concerning Restoration." In the recent past and, most likely, currently, such materials as wood putty, masonry putty, and hydrocal (resin-impregnated quick-setting dental plaster) were being used to fill and restore gaps in ceramics. Wood, metal, and cloth have been used to support the mended sherds and the fills, creating bizarre composite sculptural parodies of the original vessels.

Finally, in the Appendix listing sources for materials, the firm Conservation Materials, Ltd. was referred to erroneously as Conservation Warehouse Materials Limited. It should be noted that the proprietors of this firm orient the sales of conservation chemicals and resins toward trained conservators rather than to the general public, since many of these products are classified as hazardous materials and must be used with proper safety facilities and precautions.

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