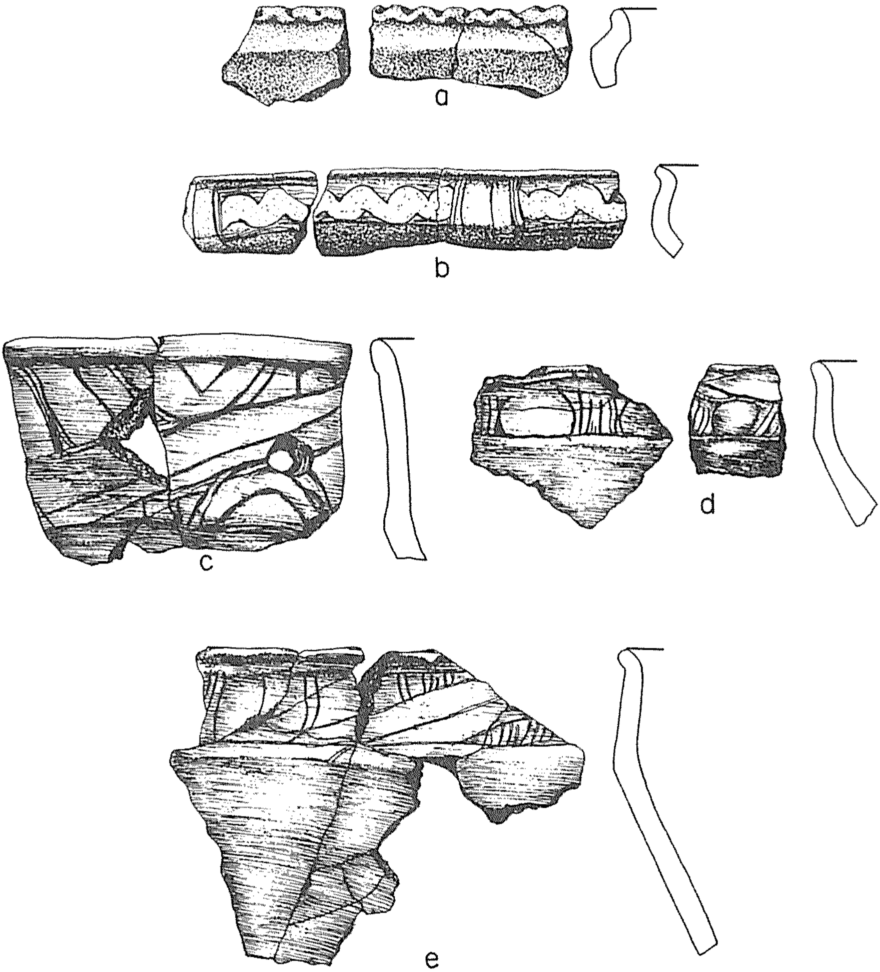
Bulletin of the TEXAS ARCHEOLOGICAL SOCIETY

Volume 65/1994



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TEXAS ARCHEOLOGICAL SOCIETY

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

The *Bulletin* is published annually for distribution to the members of the Society. Opinions expressed herein are those of the writers and do not necessarily represent the views of the Society or editorial staff.

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Bulletin of the TEXAS ARCHEOLOGICAL SOCIETY

Volume 65/1994

Timothy K. Perttula, Editor
Nancy Reese, Associate Editor

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FOREWORD

Editing and producing the *Bulletin of the Texas Archeological Society* (BTAS) for the membership and subscribers requires considerable commitment from a number of people besides the Publication Editor to insure that the BTAS is of high quality and scholarship, and is on schedule. With the publication of Volume 65 of the BTAS, I would like to take this opportunity to recognize the many others who have contributed to this publication.

I would like to first thank all the authors: for their willingness to publish in the Bulletin, the caliber of their writing, and for their patience with the Publications Editor and Associate Editor. Second, the Editor's job has been much eased by the excellent, timely, and thorough manuscript reviews by volunteer peer reviewers. I have called on the assistance of archeologists across the state (and in other states) for these substantive reviews; their comments have considerably improved the quality of the volume. For their help, I owe thanks to: Neal W. Ackerly, Lawrence E. Aten, Stephen P. Austin, Kenneth M. Brown, James E. Bruseth, David Carlson, David Carmichael, Amy C. Earls, H. Blaine Ensor, Ross C. Fields, Anne A. Fox, Jeffrey S. Girard, Margaret Hines, Jack Jackson, Chris Lintz, Carol J. Loveland, Leland W. Patterson, Charles E. Pearson, Daniel J. Prikryl, Jerome C. Rose, Harry J. Shafer, S. Alan Skinner, Dee Ann Story, and Richard A. Weinstein.

All the people at Morgan Printing of Austin contributed their considerable expertise to the production and publication of the BTAS. Not only do they complete the formatting and typesetting, as well as the halftones and the manuscript pasteup, quickly and efficiently, along with the mail-out, they also cover all the small, but essential details that ensure a great product. I particularly want to thank Terry Sherrill of Morgan Printing for all her help.

Nancy Reese, Associate Editor of the BTAS, brings her editing skills to Bulletin production, along with her considerable computer software expertise. Laura Beavers of the Texas Archeological Society Business Office provides needed administrative assistance. And finally, Sergio Iruegas has stepped in, when requested, to redraw and/or revise figures in the Bulletin.

Timothy K. Perttula, Editor
October 1994

A New Try at Dating and Characterizing Holocene Climates, as Well as Archeological Periods, on the Eastern Edwards Plateau[1]

LeRoy Johnson

with the collaboration of
Glenn T. Goode

ABSTRACT

This paper helps redefine the Holocene climate of the eastern Edwards Plateau and dates its changes with radiocarbon assays only of charcoal. Age determinations are largely from the Jonas Terrace site (41ME29) of Medina County and stream deposits from the Fort Hood Military Reservation. No Hypsithermal climate obviously affected the Edwards Plateau, although a dry, Late Holocene Edwards Interval peaked forcefully around 1900 B.C. (all dates calibrated). Three principal Archaic archeological periods are redefined as to cultural content, and also in terms of major climatic events. The Early and Middle Archaic periods are set backward in time, the former beginning about 6500 B.C. and the latter around 3600 B.C. The Late Archaic period, which commences with the onset of the Edwards climatic interval, began at 2300 B.C. and was arid in its earliest days. It may have seen a spread of xerophytic plants in the Plateau's uplands and did witness the creation of many burned-rock middens largely from baking those and other plants in stone-lined pits and basins. The creation of rock middens is surely unconnected with the cooking or leaching of acorns, in spite of claims. Foreign influences are mentioned, in different periods, that come ultimately from the Plains and Eastern Woodlands.

[1] Much of this study was sponsored by the Texas Department of Transportation (Environmental Affairs Division, Dianna Noble, Director) as part of the analysis of archeological site 41ME29 by LeRoy Johnson of the Texas Historical Commission. The TxDOT has kindly permitted publication of the present document, as part of their general program of inquiry into Texas history and prehistory.

CLIMATES AND ARCHEOLOGICAL REMAINS

In most syntheses of regions, it is customary to see natural and archeological materials treated as quite separate topics. Those expositions are seldom meshed and melded to present a single picture based on local flora, paleoclimates, and so forth. Here, at least I try to do just that, and sketch out a unitary history of the eastern Edwards Plateau to which assorted disciplines offer information in one way or another. Findings made at the Jonas Terrace site (41ME29) contribute to that general history, and even make timely its rewriting and restructuring.

This paper does two tolerably specific things: it refines the definition of Holocene climates for the Edwards Plateau east of 99° 30' West longitude and sanitizes their dating, and also refines and re-periodizes the regional Archaic and Post-Archaic cultures. The idea behind choosing the indicated meridian is to separate (somewhat arbitrarily) the western and drier part of the Plateau from the moister eastern section (Figure 1), so that the latter can be considered separately. On the Edwards Plateau, Holocene climates of different periods furnished occasionally dissimilar environmental stages upon which aboriginal populations performed their social and economic dramas. Because aboriginal culture is molded to climate at least in part, the two are worth summarizing together. Although all the information which follows applies to the Plateau in one way or another, some of it is from the adjacent Blackland Prairie or Coastal Plain south of the Plateau's escarpment, while other useful data come from more distant places. The possible seasonal movement of some aboriginal groups between the Plateau and its attached lowlands makes the latter important.

Central Texas, particularly the eastern Edwards Plateau, is a transitional region of subtropical, subhumid climate that can easily swing to dry extremes. Average annual precipitation on the eastern half of the Plateau, for 1951-1980, ranged from 32 inches in the east to 26 inches in the west; and average annual temperatures varied from 67° F in the south of the eastern Plateau to 65° F in the north (Larkin and Bomar 1983:2, 18, 50). Also, the region is a biological transition zone, not a biotic province, and is made up of juniper and live oak savannas lying west of the Eastern Woodlands (though sundered from them by the narrow Blackland Prairie) and east of grasslands or desert scrublands.

Furthermore, the Plateau lies just south and southeast of the American Great Plains. It is striking and significant that two-thirds of the terrestrial vertebrates of central Texas are at the edge of their range (Gehlbach 1991). Given the transitional nature of the eastern Edwards Plateau, one would predict certain vegetational and faunal changes in the region throughout the Holocene, as climate varied somewhat from one subperiod to another. Nonetheless, the Post-Glacial climatic norm, once established, has been (and is) mesic and subhumid, with only occasional major lapses into drier conditions. Past shifts in the Plateau's climate and natural environment, whether gradual or sudden, must not be overstated.

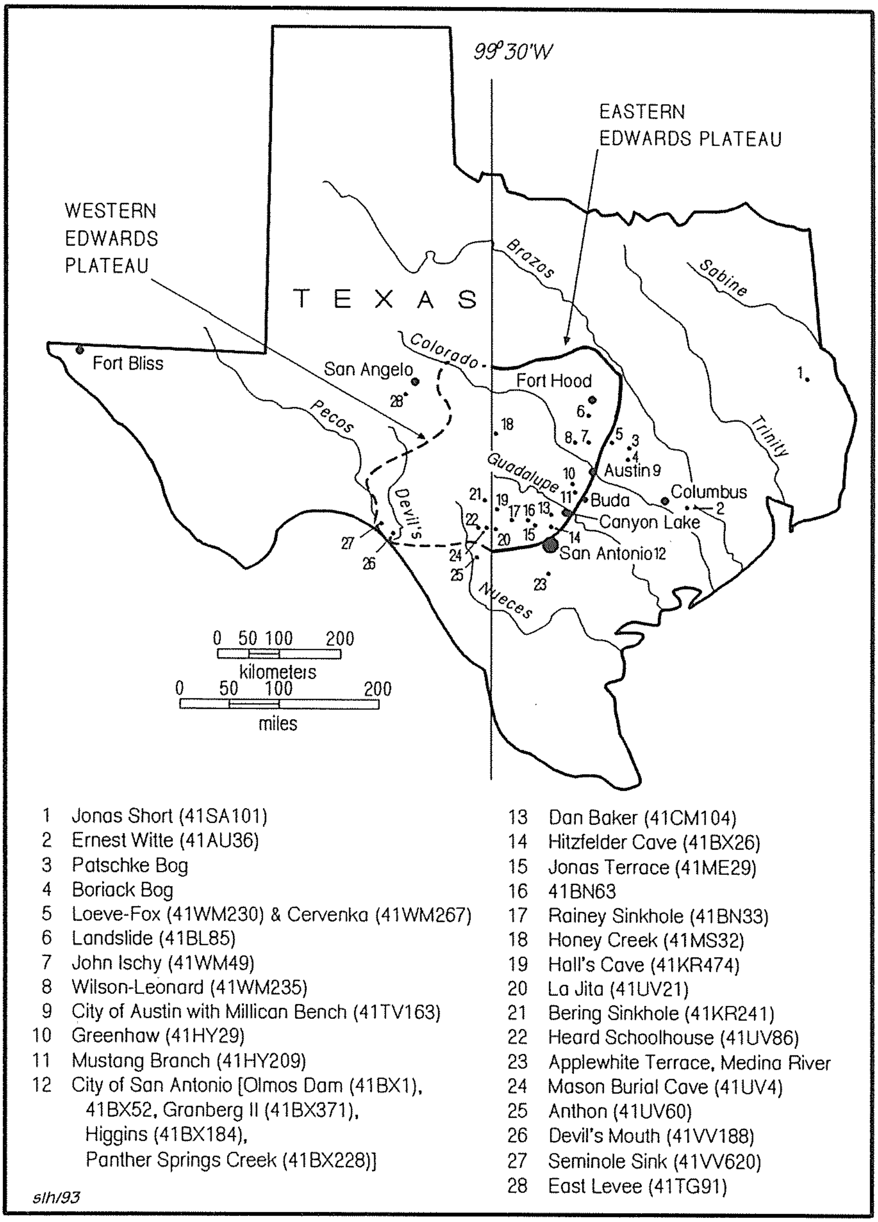

Figure 1. Map of Texas showing the eastern Edwards Plateau (bounded by heavy lines) as well as major archeological sites and other localities mentioned in the text.

On the left-hand side of Figure 2 is a graph that represents the Holocene climate for the central part of Texas, which has the Plateau at its center, from 7000 B.C.[2] onwards. The chart mainly shows a very slow and slight increase in temperature and associated dryness, although the Holocene is punctuated by a few major long-term weather changes.[3] On the chart, the nature of temperature and moisture changes is fixed more securely than previously, because of what has been learned in the last decade or so from so-termed geomorphological studies (e.g., Cowhouse Creek at Fort Hood [Nordt 1992, 1993]), as well as from a consideration of vertebrate fossils (e.g., from Hall's Cave [Toomey 1993]) and fossil pollen (e.g., from Patschke Bog [Camper 1991]).

Compared to what was accomplished before, it is now possible to make considerable improvements in dating climatic events. This has largely been done by selecting for use nearly 50 wood-charcoal radiocarbon assays mostly from joint archeological and "geomorphic" contexts, and by calibrating those dates using tree-ring corrections (Tables 1 and 2). The principal assays are for material collected from the terrace of San Geronimo Creek (at site 41ME29),[4] northwest of San Antonio, and from the streams of Fort Hood;[5] depositional and erosional events in the two areas can be correlated.

Regrettably, no other suitably precise and long series of geomorphic charcoal dates exists for the area of study. A quite long sequence has been reported by Blum (1992) for the Colorado River, but its radiocarbon ages fail to date contacts between sedimentary members at all well. I have mainly, but not exclusively, consulted age results from charcoal found in place in aboriginal hearths or middens, on or within terraces; solitary fragments of wood charcoal occurring loose in sediments are less reliable for dating stratigraphic members, since their origin can be ambiguous. This is not to say that humate dates should be employed in their stead when one has a choice between radiocarbon assays for the two materials.

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[2] All dates used here are true calendric ages, so far as they can be estimated from radiocarbon assays or calculated by counting ice varves—including dates that originally appeared in other publications. Ages produced by the radiocarbon dating technique have been calibrated via Stuiver and Reimer (1993).

[3] This progressive change toward aridity is not reflected in the new temperature chart for the Summit ice core of Greenland (Dansgaard et al. 1993:Figure 1) or in the Vostok ice column from eastern Antarctica (Dansgaard et al. 1993:note 5); both indicate an opposite but minor cooling trend over the last ten millennia that should generalize to large parts of the planet.

[4] Twelve charcoal assays, with tree-ring calibrations, come from the present Jonas Terrace site, and helped date the present climatic and archeological chart (Table 1).

[5] Nordt (1992:Appendix J) describes, among others, 34 radiocarbon ages corrected for $\delta^{13}C$ that are used to date the present chart; he provides their provenience and sedimentary context. The results of Nordt's assays have here been calibrated with tree-ring data in Table 2.

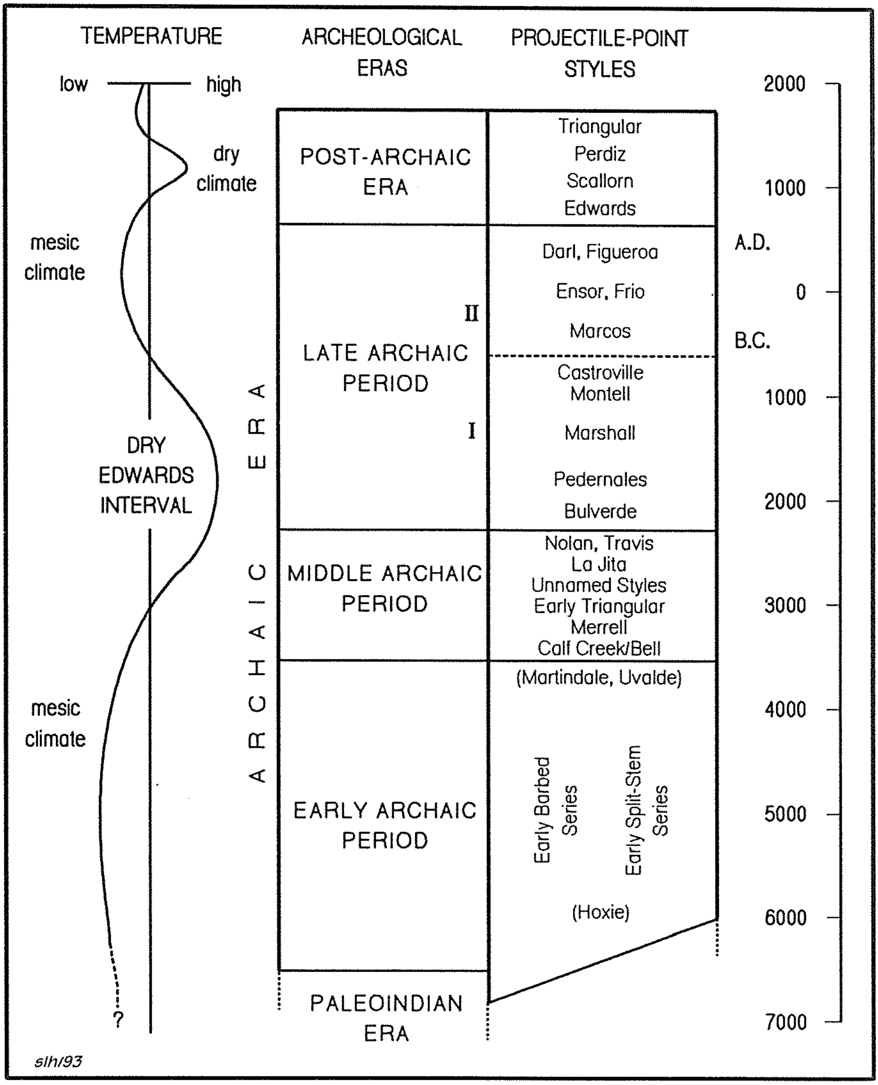

Figure 2. Chart of Holocene temperature fluctuations, archeological eras and periods, and marker projectile point styles. Calendric dates from calibrated radiocarbon assays of charcoal.

As things have turned out, attempts by geographers studying landforms to use bulk humate assays of soil carbon in order to date periods of soil formation (and, by inference, resident but earlier depositional members and associated climates) are often wrong or ambiguous; the dates are too old. Generally speaking, soil dates should be more recent than the depositional age of the sediments in which they form, except in the case of slowly building deposits where soils

Table 1

Radiocarbon Assays of Charcoal from The Jonas Terrace Site, 41ME29

Date No.	Assay No. & Context	Corrected Age before 1950	Calibrated Age (20-yr. scale)	Area of 68% Range ≥.20
1	Beta-62340 (standard assay) Stratum 6	4480±80 (4490±80 uncorrected) $\delta^{13}C$ = -25.8°/oo	3330-3150 BC 3140-3040 BC	.65 .35
2	Beta-62343/ CAMS-6503 (AMS assay) Stratum 6	4370±90	3100-2890 BC	.94
3	Beta-62341/ CAMS-6501 (AMS assay) Stratum 6	4180±60	2820-2660 BC	.89
4	Beta-62347/ CAMS-6506 (AMS assay) Stratum 5	3870±60	2450-2280 BC	.95
5	Beta-62348/ CAMS-6507 (AMS assay) Stratum 4	3140±80	1510-1310 BC	1.00
6	Beta-62349/ CAMS-6508 (AMS assay) Stratum 4	2600±70	830-760 BC 640-550 BC	.51 .38
7	Beta-62338 (standard assay) Stratum 4	2570±60 (2580±60 uncorrected) $\delta^{13}C$ = -25.8°/oo	810-760 BC 680-550 BC	.37 .63

Table 1 (Continued)

Date No.	Assay No. & Context	Corrected Age before 1950	Calibrated Age (20-yr. scale)	Area of 68% Range ≥.20
8	Beta-62342/ CAMS-6502 (AMS assay) Stratum 4	2400±70	760-690 BC 540-390 BC	.26 .74
9	Beta-62346/ CAMS-6505 (AMS assay) Stratum 4	2420±60	750-690 BC 540-400 BC	.26 .74
10	Beta-62339/ ETH-10478 (AMS assay) Stratum 4	1295±55 [This assay comes from a late occupation atop the exposed surface of the burned rock mound (Stratum 4)]	AD 670-780	1.00
11	Beta-11250 (standard assay) Stratum 2	1830±110 (1860±110 uncorrected) avg. $\delta^{13}C$ =-26.7 °/oo*	AD 80-340	1.00
12	Beta-26345/ CAMS-6504 (AMS assay) Stratum 2	1430±60	AD 590-670	.92

*Average of $\delta^{13}C$ values for 11 pieces of wood charcoal from the site (various proveniences).

develop during aggradation. Further, it is understood that humate dates for bulk soil samples in fact produce mean-residence ages, since both recent and more ancient *in situ* humates are mixed in soils. Archeologists sometimes try to correct mean-residence dates by correlating a number of them with the results of wood-charcoal assays, although the results are usually imprecise and hard to justify using.

Table 2

Radiocarbon Assays of Charcoal from Various Streams, Fort Hood (Nordt 1992:Appendix J)[a]

Date No.	Assay No. & Context[b]	Corrected Age before 1950	Calibrated Age (20-yr. scale)	Area of 68% Range ≥.20
1	GX-15762 (AMS assay) Str. Unit B Table Rock Creek hearth charcoal	8260±100	7420-7240 BC	.65
2	GX-15760 (AMS assay) Str. Unit C Leon River hearth charcoal	8616±92 [rejected as too old]	7700-7530 BC	.86
3	Beta-37618 (standard assay) Str. Unit C Cowhouse Creek dispersed charcoal	6850±90	5760-5600 BC	1.00
4	GX-15892 (AMS assay) Str. Unit C Cowhouse Creek midden charcoal	5740±300	4940-4320 BC	.97
5	Beta-37452 (standard assay) Str. Unit C Cowhouse Creek hearth charcoal	5210±230	4250-3790 BC	.95

Table 2 (Continued)

Date No.	Assay No. & Context[b]	Corrected Age before 1950	Calibrated Age (20-yr. scale)	Area of 68% Range ≥.20
6	Beta-38179 (standard assay) Str. Unit C Table Rock Creek hearth charcoal	4840±70	3700-3620 BC 3590-3530 BC	.60 .40
7	Tx-6696 (standard assay) Str. Unit C Table Rock Creek hearth charcoal (duplicate assay for No. 6)	4680±90	3530-3350 BC	.84
8	Tx-6705 (standard assay) Str. Unit D1 Cowhouse Creek dispersed charcoal	4170±100	2830-2620 BC	.84
9	Tx-6704 (standard assay) Str. Unit D1 Cowhouse Creek dispersed charcoal	3950±290	2780-2120 BC	.86

Table 2 (Continued)

Date No.	Assay No. & Context[b]	Corrected Age before 1950	Calibrated Age (20-yr. scale)	Area of 68% Range ≥.20
10	Tx-6703 (standard assay) Str. Unit D1 Cowhouse Creek hearth charcoal	3010±110	1390-1110 BC	.97
11	Beta-38173 (standard assay) Str. Unit D2 Cowhouse Creek dispersed charcoal	2860±50	1064-927 BC	.94
12	Beta-37451 (standard assay) Str. Unit D1 Cowhouse Creek hearth charcoal	2720±110	1010-790 BC	1.00
13	Tx-6702 (standard assay) Str. Unit D2 Cowhouse Creek dispersed charcoal	2380±150	760-620 BC 610-360 BC	.33 .63
14	GX-15794 (AMS assay) Str. Unit D2 Leon River hearth charcoal	1936±51	AD 20-130	1.00
15	Beta-37156 (standard assay) Str. Unit D2 Cowhouse Creek hearth charcoal	1820±80	AD 120-260	.77

Table 2 (Continued)

Date No.	Assay No. & Context[b]	Corrected Age before 1950	Calibrated Age (20-yr. scale)	Area of 68% Range ≥.20
16	Beta-37450 (standard assay) Str. Unit D2 Cowhouse Creek hearth charcoal	1690±90	AD 240-450	1.00
17	Beta-38174 (standard assay) Str. Unit D2 Cowhouse Creek dispersed charcoal	1500±60	AD 530-640	1.00
18	Beta-37011 (standard assay) Str. Unit D2 Henson Creek hearth charcoal	1300±80	AD 660-810	1.00
19	Tx-6698 (standard assay) Str. Unit D2 Table Rock Creek midden charcoal	1250±110	AD 680-890	1.00
20	GX-15761 (AMS assay) Str. Unit D2 Owl Creek hearth charcoal	890±51	AD 1050-1090 AD 1150-1220	.29 .56
21	Beta-37016 (standard assay) Str. Unit D2 Owl Creek dispersed charcoal	750±80	AD 1210-1310	.89

Table 2 (Continued)

Date No.	Assay No. & Context[b]	Corrected Age before 1950	Calibrated Age (20-yr. scale)	Area of 68% Range ≥.20
22	Beta-37021 (standard assay) Str. Unit D2 Reese Creek hearth charcoal	650±90	AD 1290-1400	1.00
23	Tx-6701 (standard assay) Str. Unit D2 Cowhouse Creek hearth charcoal	650±160	AD 1210-1450	1.00
24	Tx-6700 (standard assay) Str. Unit D2 Cowhouse Creek hearth charcoal	600±140	AD 1270-1460	1.00
25	Beta-37448 (standard assay) Str. Unit E Table Rock Creek dispersed charcoal	710±260	AD 1020-1460	1.00
26	Beta-38695 (standard assay) Str. Unit E Leon River midden charcoal	610±50	AD 1307-1360 AD 1379-1400	.72 .28

Table 2 (Continued)

Date No.	Assay No. & Context[b]	Corrected Age before 1950	Calibrated Age (20-yr. scale)	Area of 68% Range ≥.20
27	Beta-37023 (standard assay) Str. Unit E Table Rock Creek dispersed charcoal	480±80	AD 1390-1501	.91
28	Beta-37009 (standard assay) Str. Unit E Henson Creek dispersed charcoal	420±70	AD 1430-1520 AD 1580-1620	.73 .27
29	Beta-38177 (standard assay) Str. Unit E Cowhouse Creek wood	390±60	AD 1450-1520 AD 1570-1630	.56 .44
30	Tx-6699 (standard assay) Str. Unit E Cowhouse Creek dispersed charcoal	370±180	AD 1400-1680	.88
31	Beta-37449 (standard assay) Str. Unit E Owl Creek dispersed charcoal	330±80	AD 1490-1650	1.00

Table 2 (Continued)

Date No.	Assay No. & Context[b]	Corrected Age before 1950	Calibrated Age (20-yr. scale)	Area of 68% Range ≥.20
32	Tx-6697 (standard assay) Str. Unit E Cowhouse Creek dispersed charcoal	300±100	AD 1470-1670	.91
33	Beta-37008 (standard assay) Str. Unit E Cowhouse Creek hearth charcoal	190±90	AD 1650-1710 AD 1720-1820	.26 .47
34	Beta-37020 (standard assay) Str. Unit E Reese Creek dispersed charcoal	130±60	AD 1680-1750 AD 1810-1890	.41 .47

[a] GX=Geochron Laboratories; Beta=Beta Analytic, Inc; and Tx=University of Texas Radiocarbon Laboratory

[b] B=Georgetown Alluvium; C=Fort Hood Alluvium; D1=Lower West Range Alluvium; D2=Upper West Range Alluvium; and E=Ford Alluvium

The point to be made here, however, is that intrusive dead carbon can become incorporated in developing soils, and this carbon does not derive from locally decomposing organic matter which contributes to the true average residence age of humates. When ancient, dead carbon from upland areas or elsewhere is added to humates that developed in place, it causes the results of soil radiocarbon assays to be too old (Nordt 1992:9). Recent studies for Fort Hood (Nordt 1992) and Buda (Abbott 1993) compare humate and charcoal assays from similar contexts, proving that humate assays, especially on or near the Edwards

Plateau, produce ages that can be centuries or millennia too ancient for the soils they are supposed to date. It is also true that sediment dates from colloidal carbon attached mainly to clays can run older than the true age of deposition. Charcoal of known origin is the key to the successful dating of sediments, at least when one can reasonably infer that it is contemporaneous with the enclosing deposits.

A few words are in order concerning the correlation of strata or unconformities at the Jonas Terrace site, 41ME29, with similar stratigraphic members defined for the Fort Hood Military Reservation (Figure 3). This correlation is the underpinning of events depicted and dated in Figure 2. Alluvial Stratum 6 of 41ME29 correlates with Fort Hood's alluvial Member C quite nicely, and the beginnings of each may date to around 6000 or 5900 B.C. Both of these deep strata were truncated by erosion, according to the radiocarbon assays, between about 2700 and 2500 B.C., marking a very dry period when floodplain aggradation stopped everywhere for a shorter or longer period.

During this period of surface stability, man-made detritus and colluvium accumulated slowly to create Strata 5 and 4 at the Jonas Terrace site, during an interval of almost 1,700 years. At Ford Hood, certain streams likewise failed to build fluvial overbank deposits during the same period, whereas other streams recommenced floodplain aggradation quickly, maybe around 2600 or 2500 B.C. This created alluvial (or outwash-fan) Member D1 at Fort Hood, which correlates in time with Strata 5 and 4 of the Jonas Terrace site on San Geronimo Creek. The growth of Stratum 4 and Member D1 ceased about 600 or 500 B.C., according to the charcoal dates, and shortly thereafter floodplain/terrace aggradation commenced once more, creating alluvial Stratum 3 at Jonas Terrace and alluvial Member D2 at Fort Hood.

A correlation between Jonas Terrace Strata 2-3 (probably including Stratum 1 [not shown]) and alluvial Member D2 at Fort Hood is indicated, while the widespread aggradation responsible for D2 continued presumably until about A.D. 1200 or 1250. I deem the latest radiocarbon assay for D2 (Table 2, no. 24), which is a bit more modern than A.D. 1300, to be too recent since deposition of overlying alluvial Member E had apparently commenced by that date. Before that time, in any case, a long period of alluviation had created Member D2 at Fort Hood, as well as Stratum 3 (mainly lacking human debris) and then Stratum 2 (with hearths and aboriginal artifacts) at Jonas Terrace. The sedimentary record above Stratum 2 is unclear at Jonas Terrace, because overlying deposits were damaged by agriculture and road construction. Dating to A.D. 1200 or 1250, an unconformity at Fort Hood suggests a short period of considerable aridity.

DEFINING ARCHEOLOGICAL PERIODS

On the right-hand side of Figure 2 there appears a tentative revision of the Archaic Era into periods named Early, Middle, and Late; the Paleoindian and Post-Archaic eras are also shown. My desire is to redefine the three Archaic

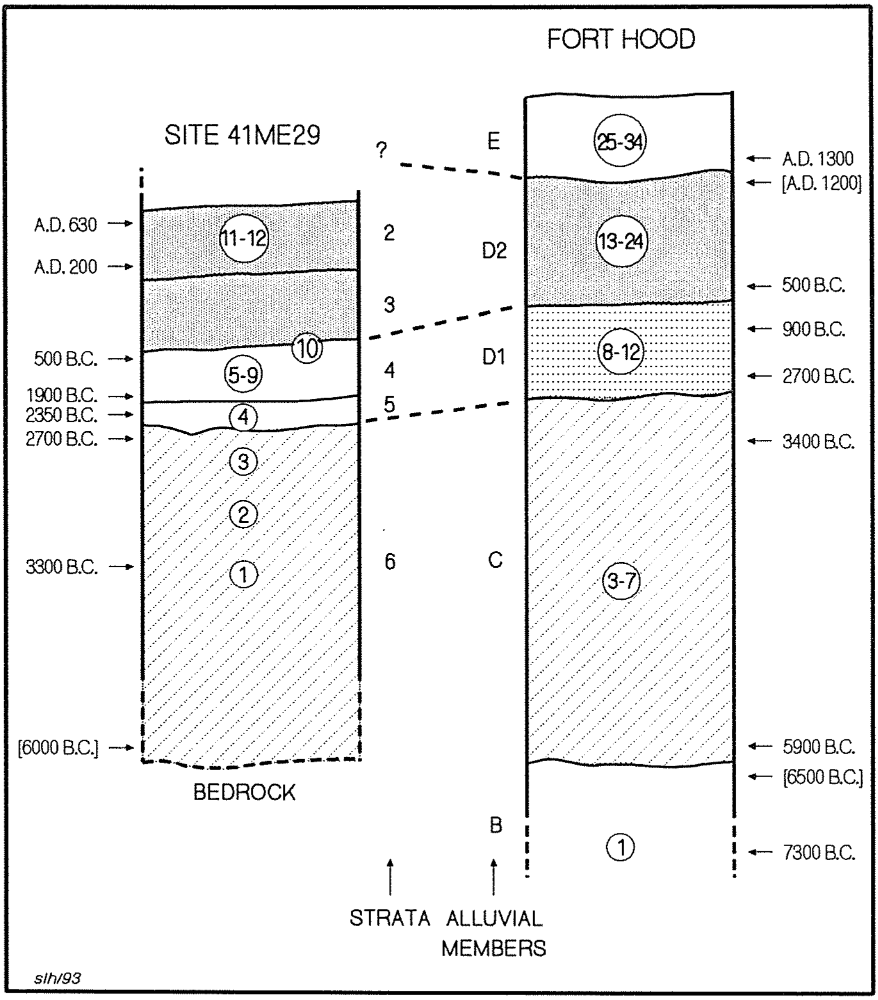

Figure 3. Idealized stratigraphic columns for site 41ME29 (left) and Fort Hood stream deposits (right). Circled numbers are radiocarbon dates identified in Table 1 (41ME29) and Table 2 (Fort Hood). Inferred dates for specific parts of stratigraphic units appear in square brackets. Columns not to scale.

periods in terms of what they reflect about gross patterns of human behavior and their changes. Everyone will surely agree that periods should correspond to the major perceived events of the past, and that periods will serve little purpose if they carve up history in an arbitrary way.

To be useful, periods should segregate time spans whose archeological content is fairly uniform. Furthermore, they ought ideally to commence with some combination of the following: the appearance in a region of new artifact complexes, new dart-point styles, or new people; a change in economic and other behavior; a shift in the size of a region's human population; or a major climatic and vegetational change capable of affecting human life. And for major periods of the type defined below, the perceived events need to represent trends of some duration, although a period's content can vary a bit through the years.

In 1962, Dee Ann Suhm counseled a division of the Archaic Era of Canyon Lake into periods (Johnson et al. 1962), with the idea in mind of imitating temporal units defined for the Eastern Woodlands. At that time, it seemed that a few developmental parallels could be seen with the Archaic cultures of the eastern United States, where a three-part division was first proposed and used. In the Canyon Lake study, however, a fourth or Transitional period was added to the three primary Archaic divisions, since some scholars seemingly think four to be a magical number, although the extra period was never used by all scholars working in central Texas.

Then, in 1964, Lee Johnson published a three-part division of the Archaic Era for the Lower Pecos/Devil's River region, and the composition and dating of the previous periods for Canyon Lake had to be modified to bring them in line with new information about the age of Archaic materials. It was also necessary to allow for inclusion in the Archaic Era of stone tools from the Devil's Mouth site (41VV188) that preceded the misidentified and hence mislabeled "Early Archaic" (here, upper Middle Archaic) of the eastern Edwards Plateau. The curious reader may wonder why the 1962 attempt to define Archaic periods at Canyon Lake was inadequate for certain stretches of time. I can only say that it is a wonder that the results were as useful as they turned out to be, since before excavations were done at Canyon Lake not much was known about the relative ages of major dart-point styles on the Plateau, much less about their true ages. Furthermore, the writers of the Canyon Lake study were burdened by false notions about the evolution of dart point styles, and mistakenly thought that Nolan and Travis dart points, which they placed in an Early Archaic period, derived directly from Paleoindian ancestors such as Angostura points.

Before long, the 1964 revision was applied by various archeologists to eastern parts of the Edwards Plateau, since it is relatively easy to correlate the archeology of that region with the prehistory of the Lower Pecos. The first general and quite successful application was made by Sorrow et al. (1967) for Stillhouse Hollow Lake on the Lampasas River. Although several period changes and additions have been suggested (though not accepted universally) for the Archaic Era since 1964, the three major Archaic periods and their artifact content have been left largely unaltered until now. Of course, a number of tool styles have been assigned to the various Archaic periods since 1964. As said, Johnson et al. (1962:Figure 45) originally proposed a Transitional Archaic period at the end of the Archaic Era. This time unit, corresponding to the latest part of the present Late Archaic II subperiod (with small "dart" points), proved of little interest, although a number of later writers have used that period label.

Additionally, Sollberger and Hester (1972:326-327) proposed adding a transitional Pre-Archaic period following the Paleoindian Era, although the concept did not take hold. Not long afterwards, E. Mott Davis (Prewitt and Nance 1980:3-4; Prewitt 1981:68) suggested *Neoarchaic* as a period label for the Archaic-like cultures of central Texas that existed after the bow was adopted, yet lacked horticulture. However, Prewitt's (n.d.) *Post-Archaic* appellation encompasses the same cultural phenomena that characterize the variously termed Neo-American, Neoindian, Neoarchaic, or Late Prehistoric period. As a simple designation free of perhaps unwanted interpretive baggage, Post-Archaic is here preferred over the other labels.

The reader interested in general archeological syntheses of the eastern Edwards Plateau and adjacent areas is referred to papers by Dee Ann Story (1985) and Stephen L. Black (1989). Among a number of other things, their reviews treat the melancholy history of archeological research in the region and summarize a number of profusely speculative published statements by regional archeologists about aboriginal settlement patterning, prehistoric social organization, group mobility, and the establishment of group territories. The present work tries to avoid that kind of speculation, which nevertheless involves fascinating mental calisthenics.

At this point, it is appropriate to mention the publication of a number of named, supposedly sociocultural, phases for central Texas archeology by Frank Weir (1976) and Elton Prewitt (1981). Although the "phase" label was used for them, the San Geronimo, Clear Fork, Round Rock, and other phases were actually defined to function as periods within the Archaic or Post-Archaic eras (Prewitt 1981:71-74). Of course, when a named regional period is given a specific artifact content, it cannot help but function as a quasi-cultural entity.

As true phases the published units have not proven useful (Johnson 1987), since the items that are said to make them up have rarely been shown to be properly associated. And as minor periods often of uncertain content and age the named "phases" are not of outstanding utility. Johnson (1987:Tables 1 and 2) demonstrated explicitly that, all too routinely, the dated charcoal used to set the span of a particular phase (Prewitt 1985:Table 1) was not in proper association with diagnostic phase artifacts. In fact, the advice that Weir's and Prewitt's phase names be employed as appellations for regional periods (e.g., Collins et al. 1990:92) has been one source of the recent confusion in dating and characterizing the archeology of the Edwards Plateau.

Such confusion can be seen in Bement's (1991) study of Bering Sinkhole (41KR241), where phases were sometimes identified strictly on the basis of the known or suspected age of deposits, with none of the diagnostic artifacts of the phases being present. It may well be that a series of valid Archaic and Post-Archaic phases of the sociocultural sort will someday be defined for the Edwards Plateau, but that day lies beyond the horizon.

The present revision of a threefold division of the Archaic Era can provide all that is needed in the way of broadly conceived periods useful for culture-historical descriptions and reconstructions. In any case, it is unquestionably time to reconstitute the periods of the Archaic Era for the Plateau, and overhaul their age boundaries and content. In 1964, Lee Johnson explained that his proposed Archaic periods were tentative constructs, and anticipated changes. And, for some time now, the periodization of the Archaic Era has needed reworking because events and cultural trends have been perceived that were not suspected in the 1960s.

The historical sketch outlined below partakes of general Holocene climatic and human-behavioral shifts in large parts of North America, such as population growth and the development of proficient economies, which became noticeable after mid-Holocene times. In some instances, however, the sketch recounts particular Archaic or Woodland period events in the East which have affected the Plateau, albeit weakly. In other cases, influences from the Great Plains can be detected on the Plateau, whereas in yet others the major events of the eastern Edwards Plateau are purely regional developments, as far as is known. Certainly some of the climatic episodes on the Plateau that affected aboriginal people may be regional phenomena linked to water temperature and air currents of the Gulf of Mexico, or even of the Pacific Ocean.

Sometimes it is possible to see that projectile point styles, which help characterize the Archaic periods, appeared fairly suddenly on the Edwards Plateau—particularly when new styles lack eastern Plateau antecedents either in shape or manufacturing methods. It is more difficult, however, to decide whether new styles were carried in by immigrants or merely borrowed (usually with modification) by Plateau folk from people living outside the region. Of course, it is also conceivable that certain styles may have been developed locally on the Plateau, itself, and occasionally one can choose among the three explanations. However, if innovations in dart-head style or manufacturing were made very quickly, whether by borrowing or by local invention, the chance is poor of capturing the actual developmental steps in our always gross archeological record.

The existing Early Archaic and Middle Archaic periods (as well as the versions offered here) fall much later in time than similarly named units of the Midwest and the eastern United States. For example, the Early Archaic of North Carolina (Phelps 1983:Figure 1.2), with Kirk dart points, began around 8000 or 7500 B.C., whereas the Early Archaic on the Edwards Plateau commences some 1500 years later. Thus a large part of the difference for the Plateau mirrors reality, because Archaic-type cultures developed much earlier near the eastern seaboard than in areas adjacent to the Great Plains such as the Edwards Plateau. On the Plains and some quite nearby areas, Paleoindian cultures lasted longer than in the East, and Archaic-type societies appeared mainly at the time Paleoindian culture died out. Archaic tools—numerous small bifacial knives, chipped axes and adzes, multi-purpose scrapers, abundant plant-milling implements, and barbed dart points—reflect an emphasis on a more sedentary, collecting way of life (usually with deer hunting) than do Paleoindian unifacial tools and lance-shaped dart heads (Johnson 1989b:52).

Carving up the Archaic Era

The Early Archaic Period

The Early Archaic period of the Plateau, in some places beginning around 6500 B.C. or earlier, as at the Wilson-Leonard site (41WM235), represents almost three millennia when bison were supposedly absent from the region (cf. Dillehay 1974). Unfortunately, the Early Holocene climate of the period is not yet well understood and work remains to be done in characterizing it. However, although the climate near the beginning of Holocene times was obviously warmer and drier than previously, the pollen cores from peat bogs of east-central Texas (especially Boriack [Bryant 1977; Bryant and Holloway 1985] and Patschke [Camper 1991] bogs] do not reveal vegetation noticeably more xeric than the flora of Middle Archaic days. So whatever the climate was like in the Early Archaic period, it is apparent that no long-lasting, dry Hypsithermal climate affected the eastern Edwards Plateau and the lowlands to its east (cf. Bryant and Holloway 1985:61-62), although a warm-moist Hypsithermal climate is at least possible. Evidence for a "standard" Hypsithermal Interval would require a climatic regimen drier than what went both before and *after* it. Perhaps the absence of a dry Hypsithermal is due, partly, to effects of the nearby Gulf of Mexico and its idiosyncratic temperature patterns and wind currents, or of Pacific Ocean air currents that cross Mexico to reach the Edwards Plateau.

However, the Hypsithermal-Atlantic climatic maximum correlates in time with the Early Archaic period and the first part of the Middle Archaic period of the Edwards Plateau, and in many parts of North America this warm interval was dry. In the lower U.S. Midwest and elsewhere east of the Great Plains, the Hypsithermal peak has been dated at around 5600-5000 B.C. (calibrated), and the total span of the interval stretched from about 6700 B.C. to 3300 B.C., although it is dated variously (e.g., Brown and Vierra 1983:167). However, the Summit ice core from Greenland shows little patterned temperature change within the Holocene, except for a widespread, persistent cool period around 6200 B.C.—before the peak of the North American Hypsithermal. Arctic and Antarctic air and water temperatures, as well as precipitation patterns, are important because they are often capable of mirroring planet-wide climatic trends.

Some evidence from central Texas suggests a fairly brief interval of droughts with episodes of violent flooding at the very beginning of the Early Archaic or just before that period. The question of interest is whether these should be thought of as Hypsithermal events, since they appear to be a bit too early for such a characterization.

A period of erosion and cessation of alluviation is indicated by the unconformity separating the Pleistocene Georgetown Alluvium (Member B) from the Early Holocene Fort Hood Member (C), in Bell and Coryell counties, Texas (Nordt 1992). The Georgetown Member may have stopped its growth at around 6500 B.C. or earlier (my estimate), but in any case the date is not well fixed (see Figure 3). At the Jonas Terrace site, medium-sized gravel dating by inference to around 6000 or 5900 B.C. rests upon limestone scored by flooding perhaps some centuries earlier.[6] These data betoken large-scale but brief climate shifts during the earliest Holocene, which appear in the geologic record in a number of other areas in and near the central part of Texas.

Lee Nordt (1992:Figure 31) assumes that terrace aggradation at Fort Hood corresponding to the long Early Archaic period, as well as the first part of the Middle Archaic, may represent the "Altithermal" climatic maximum. *Altithermal* is a rather loosely used appellation in the American West for what is termed the Hypsithermal Interval elsewhere in North America; the term has been applied, however, to a number of Holocene dry periods that may be unconnected. At any rate, Nordt suspects depletion of upland vegetation at Fort Hood, but may be guilty of error or overstatement. A long period with some amount of overbank flooding and floodplain growth, often producing fine-grained sediments, indicates a fairly moist climatic regimen more often than not. A dry period, typically with periodic torrential rains but dry summers, would surely cause downcutting and erosion. Nevertheless, it is clear that some drying occurred at least in latest Early Archaic times.

Importantly, the bone study of Hall's Cave (41KR474) of Kerr County appears to support the idea of gradual drying from Late Glacial times forward (Toomey 1993:474-475; Toomey et al. 1993), and to my eyes indicates no recognizable Hypsithermal Interval capable of being separated out from the remainder of the Holocene's climatic record. However, the age of Hall's Cave is poorly known, since many of the site's eleven radiocarbon assays listed by Toomey (1993) are from unsuitable materials such as travertine and bone apatite. For that reason I decided upon a (tentative) re-dating, using only the cave's few charcoal assays and the stratigraphic position of certain Early Archaic dart heads of known age.

Whatever the case, my interpretation of Hall's Cave is as follows (Figure 4). The indicated maximum for the woodland least shrew of a mesic disposition, at a depth of 1.45 m, falls already in the earliest Holocene, since Pleistocene buffalo bones are found in the column below a depth of 1.55 m. The Holocene shift largely winnowed out a number of moisture-loving creatures: mainly the pipistrelle bat, eastern mole, woodland vole, and northern prairie vole. Then there was a period of yet-increasing dryness until 3500 B.C. that falls at the end

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[6] The Chappice Lake sediments from southeastern Alberta are interesting because they indicate wild fluctuations in water levels between 6100 B.C. and 5300 B.C. (Vance and Clague 1992). At Chappice Lake, a Holocene climatic disruption, perhaps equal to that seen at Fort Hood and Jonas Terrace before 6000 B.C., was clearly followed by a long period of weather that was much warmer and drier than anything that came later. Nothing like this long Hypsithermal period at Chappice Lake is indicated on the eastern Edwards Plateau, lending support to the idea that a dry Hypsithermal climate did not affect central (and coastal) Texas.

of the Early Archaic period. The indicated calendar date is reasonably appropriate for the three terminal Early Archaic dart points, discovered between the 1.00- and 1.10-m depths (see Figure 4), of the Martindale and Uvalde styles.

It is hard to know what the desert shrew maximum at a depth of 0.80 m means, since an earlier *Notiosorex* spike correlates with the mesic least shrew maximum at 1.45 m. That ambiguity is unfortunate, since the 0.80 m depth probably falls in the climatically poorly differentiated Middle Archaic period. Because the smooth-toothed pocket gopher was still around in those days, but fell out of the stratigraphic column soon afterwards, I surmise that a drying trend merely continued during the Middle Archaic; I see no evidence for a massive Hypsithermal/Altithermal climate shift. However, at the 0.50 m depth (1500 B.C.) the indicated conditions were indeed considerably drier, for this was in the middle of the Edwards Interval recognizable at Fort Hood, the Jonas Terrace site, and elsewhere. (In no way is the Edwards Interval to be thought of as an Altithermal/Hypsithermal dry period, for it is much too recent.) The smooth-toothed pocked gopher, as well as both the woodland least shrew and the dry-environment desert shrew, were gone for the most part. It would be dimwitted to use these data to argue for a mesic Late Archaic I subperiod.

These are the trends and dates important for archeologists. But let the prehistorian beware, for in late 1993 Thomas Stafford of the University of Colorado secured scores of new (but as yet unpublished) radiocarbon assays for the Hall's Cave stratigraphic column. Series of assays were run separately for bone collagen, various kinds of soil humic matter, etc., and mainly produced much earlier dates for the site's strata (Stafford, 1993 personal communication and public lecture) than Toomey proposed or I reckoned (in my case, using three available charcoal assays and the known ages of Archaic projectile point styles). I fear that dead carbon has become incorporated in some of Stafford's dated soils, to produce ages for Hall's Cave *Archaic* strata that may be too old.

Whatever the Plateau's climate and vegetation were like in Early Archaic times, the people did their stone knapping in an Archaic as opposed to a Paleoindian mode. Their dart points largely represent two broad styles, the Early Barbed and the Early Split-Stem traditions (Prikryl 1990:51; Johnson 1991:105ff), which did not obviously develop from the region's Paleoindian points.[7] Early Barbed dart points (many of which have been called Early Corner-Notched [Hester 1971:71-73]) tend to have wide blades, as well as short and narrow stems (produced by deep basal or corner notching) and longish down-

[7] At the bottom of the Early Archaic section of Figure 2, the Hoxie point type appears in parentheses. Elton Prewitt (1994 personal communication) believes Hoxie to be an intrusive style related to Pryor Stemmed of the High Plains, which dates to the seventh millennium B.C. (Frison 1978:24, 26). Hoxie is not related to either of the two main projectile-point traditions of the Early Archaic: Early Barbed (Corner-Notched) and Early Split Stem.

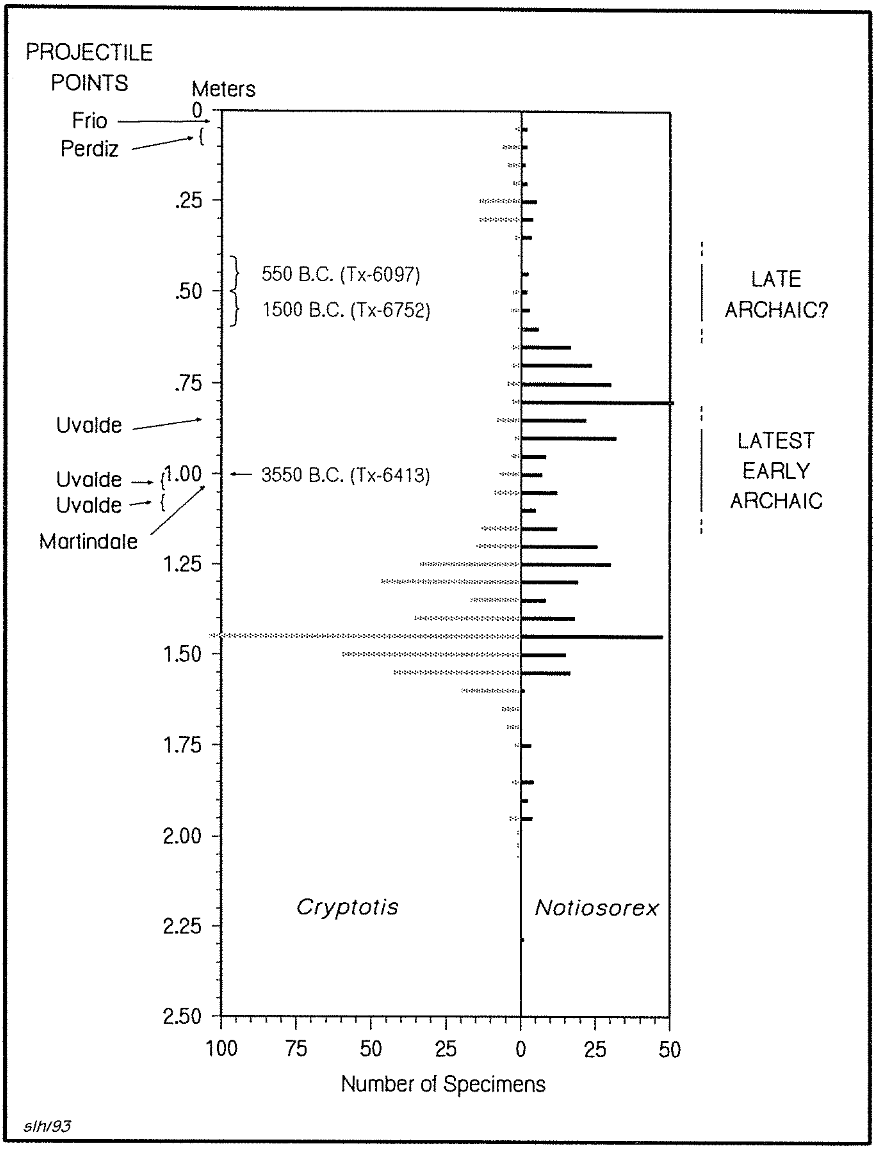

Figure 4. Graph of Composite Pit 1 of Hall's Cave, with number of specimens for the woodland least shrew (*Cryptotis*) and desert shrew (*Notiosorex*) by depth (m) (adapted from Toomey 1993:Figure 38). To the chart have been added the locations of radiocarbon dates on charcoal, as well as the locations of four early dart points and two later projectile heads. A tentative correlation of the cave's sediments with periods of the Archaic Era appears at the far right.

hanging barbs (e.g., Sorrow 1968:Figure 3m-r). Early Split-Stem dart points have a clear-cut stem with bifurcated base with a central notch or concavity, and usually exhibit very short barbs or else barbless shoulders (e.g., Johnson 1991:Figures 42-44). This almost continental style was spread far beyond the bounds of the Edwards Plateau, as in Alabama, West Virginia, and New York (Fiedel 1992:91-92) during the seventh and sixth millennia B.C. Related dart points, such as the Pinto type, were also well established in the American West (Fiedel 1992:126-129) at least by 5000 B.C.

The last Early Archaic dart points of the Edwards Plateau were arguably the Uvalde and Martindale[8] styles, as well as unnamed wide-stemmed dart heads otherwise shaped very much like Martindale points, and found at the Dan Baker site (41CM104) on the Guadalupe River of the Plateau, lying just above Early Split-Stem dart points of various sorts (Shirley Van der Veer, 1993 personal communication).

Early Archaic burials from the eastern Edwards Plateau are uncommon, and most come from Bering Sinkhole (Bement 1991) of Kerr County, on the westernmost margin of the eastern half of the Plateau. At that site, three Early Barbed dart points, as well as radiocarbon assays, help date some of the scattered human skeletal material to Early Archaic times. Significantly, a low or moderate rate of tooth-enamel hypoplasia is indicated and the caaries rate is low relative to that of later burials. Those data indicate little weaning stress and a general diet fairly low in carbohydrates, lower than for the Early Archaic desert people found at Seminole Sink in the Lower Pecos area (Turpin 1985). Moreover, ratios for stable-carbon isotopes argue for a low reliance on C_3 plants and animals consuming such vegetation; both sotol (in Texas) and acorns are classed as C_3.

The Middle Archaic Period

The short Middle Archaic period of some 1300 years commences around 3600 B.C. and can best be taken as a transitional epoch. Prikryl (1990:Figure 4) likewise begins his newly defined Middle Archaic period for north-central Texas at about that date, just before the heyday of Calf Creek dart points. Turning again to the Plateau, the first dart-point style of the Middle Archaic was probably the

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[8] At the Landslide site (41BL85), Martindale points tend to occur mainly in Stratum V, deeper in the site terrace than Calf Creek/Bell specimens (Sorrow et al. 1967:Figure 72; Johnson 1991:154). At the Panther Springs Creek site (41BX228), whose stratigraphic separation of point styles is admittedly imperfect, Martindale points (which are rare) occur in Area M with Early Barbed points and below a single Calf Creek/Bell specimen (Black and McGraw 1985:Table 48), but perhaps in mixed deposits. At the Camp Pearl Wheat site (41KR243) Martindale and Uvalde dart points were found in the same isolated stratum as a Calf Creek/Bell point (Collins et al. 1990:32-34), but the stratum in question represents many years.

intrusive Calf Creek/Bell dart head. It was during the early part of the Middle Archaic period that buffalo came briefly into the region, attracting hunters probably from the Eastern Woodland's margins who introduced Calf Creek dart heads of the Bell and Andice varieties.[9]

My interpretation is that most of the Middle Archaic period was moderately moist but drying, as can be seen from the steady deposition of overbank sediments on San Geronimo Creek (at the Jonas Terrace site) and from the aggradation of stream terraces (creating alluvial Member C) at Cowhouse Creek at Fort Hood, Texas. Furthermore, at the Jonas Terrace site of upland Medina County, Middle Archaic sediments typically contained large quantities of a snail (*Oligyra orbiculata*) preferring a wooded riparian or savanna environment, which may speak for mesic weather conditions. The moist-environment snail was largely replaced in the sedimentary column at 41ME29, around 2400 or 2300 B.C. or so, by a species of snail (*Rabdotus mooreanus*) much more tolerant of open spaces and drier conditions (Johnson 1994). The Middle Archaic record of vertebrate life, if present at Hall's Cave, cannot now be isolated stratigraphically by acceptable radiocarbon assays.

My idea of a relatively mesic Middle Archaic period is somewhat at variance with Lee Nordt's interpretations about Fort Hood vegetational changes, or at least his ideas as to their magnitude (Nordt 1993:57-71). He finds a shift in $\delta^{13}C$ values for soil organics roughly between 4900 and 3800 B.C. (calibrated years), producing readings for $\delta^{13}C$ of -14.6, -14.5, -14.0, and -15.4 per mil (Trench 19, Fort Hood Member C, approximately 0.32-1.53 m in depth). He thinks that a substantial increase in the contribution of C_4 plants to the biomass is indicated, which Nordt believes is due to a decrease in trees and forbs (C_3 plants) locally, because of reduced rainfall and higher temperatures equatable with the so-called Altithermal drought.

That interpretation is partially correct, since no mesic period is indicated by the above $\delta^{13}C$ values. An *increase* in rainfall would cause an expansion of trees (with associated C_3 grasses) on the creeks' floodplains and low terraces (Gehlbach, 1994 personal communication), changing stable-carbon isotope ratios to those indicating a dominance of C_3 plants. Of course, increased moisture would also foster lush upland grasses. The point I make, however, is that Nordt may overstate the severity of the change seen in Trench 19. According to my view of depositional and isotopic data from Fort Hood, the temporary shift in the direction of C_4 plants (surely grasses) sometime between 4900 and 3800 B.C.

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[9] In addition to the fact that the Calf Creek point type occurs with buffalo bones in Oklahoma (Newsletter, Oklahoma Archeological Survey 1993), such an association exists in central Texas. Feature 2 of the Landslide site (41BL85) was a stone baking heap with several bison bones and a Calf Creek/Bell dart head directly atop its rocks (Sorrow et al. 1967:41). Additionally, Feature 26 of the Cervenka site (41WM267) was an early earthen fireplace with bison bones lying on it (Peter et al. 1982:8-260 to 8-261). It may be of the same age as Feature 2 from the Landslide site.

was not the result of a major change in climate or vegetation. No clear-cut Altithermal period is represented, either in Trench 19 or elsewhere in the eastern part of central Texas (Gehlbach, 1994 personal communication). Consequently, I conclude that the Plateau's Middle Archaic climate was still somewhat mesic but gradually drying, though around 4500 B.C. or so a fairly modest shift (in a geological sense) toward temporary aridity occurred.

A gradual drift away from mesic conditions, in the Middle Archaic period, is borne out by the development, mostly at the end of that time span, of a number of burned rock middens,[10] whose presence elsewhere indicates the baking largely (but not exclusively) of upland xerophytic plants that had increased their range. According to sedimentary and snail information from the Jonas Terrace site, mentioned above, the climate in late Middle Archaic times was not nearly so dry as during the first part of the succeeding Late Archaic I subperiod. However, a steady and modest shift toward aridity could have put semi-succulents on the road to becoming a significant food source in the latter half of the Middle Archaic period, though not to the degree seen in Late Archaic days. Nevertheless, the weather shift was moderate enough not to affect the growth by flooding of headwater terraces in upland areas, at least until aggradation stopped just before the Bulverde dart point style made its appearance on the eastern Edwards Plateau.

In the eastern Plateau, scattered stands of sotol and other xerophytic plants such as yucca and nopal persist even today under reasonably mesic conditions, particularly in loose soil on southwestern slopes, and these stands could easily expand if encouraged by drought to do so. The modern distribution of sotol plants, which in the north includes parts of Bell County, is summarized usefully by Goode (1991:87). The distribution of yucca is even greater, including as it does fairly tight soils. One factor that has restricted the range of sotol plants a bit, in recent times, is their past use as cattle feed by the region's ranchers, as Ernest Wilson (1930) documented for western parts of the Edwards Plateau. In some areas of the Plateau the sotol population has been eliminated by the hand of man and the tooth of ox.

As for regional prehistory, the Middle Archaic archeology of the eastern Edwards Plateau was varied, and in one sense witnessed a transition from "antique" Early Archaic material cultures to "advanced" plant-collecting and hunting cultures of the Late Archaic period. The evidence for fairly rapid change

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[10] Calling these features "burned rock middens" may be something of a misnomer (cf. Kroesen and Schneider 1991:44, note 1), although that designation is retained here. In the sense that burned rock middens are made up of rock debris from baking pits and basins, they do not constitute "kitchen middens" of quotidian domestic detritus. However, the contents of hearths and other kinds of domestic debris have been added to burned rock middens at a number of sites, contributing sometimes extraordinary amounts of typical kitchen midden garbage to the piles of burned rocks.

consists of the appearance in the region of Early Triangular dart heads[11] and the brief emergence of Merrell points (conceivably, however, of Early rather than Middle Archaic age).[12] There is also a profusion of probably Middle Archaic dart-head styles, some of which have long and narrow rectangular stems, at the Wounded Eye (41KR107) and Shep (41KR109) sites (Luke 1980), as well as Cervenka (41WM267).[13] And later within the period, the La Jita[14] dart head appears, which Glenn T. Goode believes to be of the same age as Travis and Nolan dart heads, since it shares manufacturing features with them.

In the late part of the Middle Archaic, large and narrow Nolan-Travis dart points were dominant in much of the Plateau, though local styles such as La Jita seem partly to have taken their place at the southern edge of the Plateau and just south of there. It is consequential that thick Nolan-Travis dart points, and their long and narrow predecessors with rectangular tangs (as found at the Cervenka site), portray a major stylistic and technological change in point making. Calf Creek and Early Triangular specimens, made during the first part of the Middle Archaic period, are wide-bladed and thin, and their blade surfaces were flaked partly by pressure. The large, narrow, and thick dart heads which followed them in the region could be well made (as in the case of Nolan specimens), but were often knapped crudely (as in the case of many Travis dart points). In any case, they are distinct from Early Archaic and early Middle Archaic dart-point styles.

Elton Prewitt (1993 personal communication) believes that the general style of the first Nolan and Travis points appearing in central Texas may have been borrowed from the Lower Pecos region, since beveled-stemmed and roughly similar dart heads (mostly of Pandale type) may be more ancient there. For the Lower Pecos region, calibrated dates for charcoal possibly associated (at least stratigraphically) with Pandale points or their Nolan congeners cluster between 3800 B.C. and 3100 B.C. (Turpin 1991:Table 1.1). The best radiocarbon assays

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[11] At the Landslide site (41BL85), Early Triangular points/knives appear from their stratigraphic position to be of approximately the same age as Calf Creek/Bell dart heads (Sorrow et al. 1967:Figure 72). Additionally, most Early Triangular artifacts from the John Ischy site (41WM49) were found below Nolan (upper Middle Archaic) points (Sorrow 1969:Table 4-6), although the artifact count is low and perhaps unreliable. It is reasonable to conclude, provisionally, that Early Triangular artifacts are of about the same age as Calf Creek points or else slightly more modern. In so doing, the data from the Landslide site are given great importance.

[12] Dart points of the so-termed Merrell type, and specimens rather like it, occur in a mixed Early and Middle Archaic context at the site of that name (41WM2; Campbell 1948:Plate 3A, No. 9). From what we presently know about this style, it could be either Early Archaic or early Middle Archaic in age, although my preference is for the latter.

[13] For illustrations of such miscellaneous styles that are particularly clear and useful, see Peter (1982:Figure 14.1-3e, 14.1-4b, j and 14.1-5b).

[14] The La Jita type was named by T.R. Hester (1971) for a Girl Scout camp and an archeological site (41UV21) of that name. The word *lajita* is Spanish for "flagstone."

for Pandale points, however, may be Tx-2747, Tx-773, and Tx-2742 (Turpin 1991:Table 1.7), which produced calendar dates falling between 3500 and 3200 B.C. Lacking conclusive evidence, I nonetheless believe that Nolan and Travis dart heads are no earlier than 3000 B.C. on the eastern Edwards Plateau, if that ancient.

It is possible to see a redefined Middle Archaic period, generally, as one in which considerable borrowing of alien artifact styles took place. Additionally, some outlanders with new tool styles may have intruded physically onto the Plateau. In contrast, there is evidence for general stylistic continuity from one century to another throughout large parts of the preceding Early Archaic period, as said, although archeologists who think only in terms of types (rather than broader stylistic traditions) can be blind to such trends.

It is apparent to all that mixed economies characterized the Middle Archaic period. Nevertheless, toward the end of Middle Archaic days one can see evidence for the gathering of sizeable quantities of single plant resources. For instance, a number of charred acorns were found in small man-made depressions at site 41BN63 (Hester 1985), although most came from a single hollow. The man-made holes were in the surface of a clay stratum, below a Late Archaic Pedernales-Montell burned rock midden, and radiocarbon dating discloses their terminal Middle Archaic age. Furthermore, the appearance of burned rock middens points to an economic emphasis on collecting plants at appropriate seasons, in quantities, and baking them in pit ovens. The people who made and used large Nolan and Travis dart points occasionally baked (xerophytic?) plants in stone-lined ovens, causing a certain quantity of burned rock middens to accumulate.[15]

Burial practices for the Middle Archaic period are most uncertain, at least for the Edwards Plateau, itself. However, near the margin of the Plateau in Uvalde County, on the western edge of the area of interest, is Mason Burial Cave (41UV4). That deep sinkhole contained the earthly remains of 25 to 50 people and a few Travis, Nolan, and triangular dart heads (Benfer and Benfer 1962). The projectile points date at least some of the Mason Cave burials to the upper Middle Archaic period.

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[15] Burned rock middens with Nolan and/or Travis dart heads are known from several locales, although at most eastern Plateau sites with rock middens, Nolan and Travis dart points are found below rock accumulations of Pedernales or Montell age. According to G.T. Goode, Nolan or Travis specimens occurred in the Archaic burned rock midden found at the Wilson-Leonard site (41WM235); in an "upper" rock pile at the Millican Bench site (41TV163) on a tributary of the Colorado River's Bull Creek, at the very edge of the Plateau (Frank A. Weir, 1993 personal communication); and within middens B, C, and G at the Greenhaw site (41HY29) on a tributary of Onion Creek, near the eastern verge of the Edwards Plateau (Weir 1979).

The Late Archaic Period

The lengthy and important Late Archaic period is divided into subperiods I and II. The entire period, however, lasted nearly three millennia and can be said to have commenced around 2300 B.C. with people who used Bulverde dart points. That style appeared immediately after the regional climate had been distressed by a sharp decrease either in yearly rainfall or in seasonal precipitation, and by an inferred rise in temperature portending the longish Late Archaic I drought to follow. The classic Bulverde type, with its abrupt pressure flaking and thin, wedge-shaped rectangular stem, may be intrusive onto the eastern Edwards Plateau, perhaps coming from the prairies of northern or northeastern Texas—the general area where Calf Creek points throve a thousand years earlier. Bulverde points were soon followed by specimens of the almost omnipresent Pedernales type.

Of the changes proposed herein, I foresee resistance most of all to the reclassification of the Bulverde and Pedernales intervals as Late Archaic. Habits have a tenacious life of their own and those intervals have been thought of as Middle Archaic for nearly 30 years, in spite of the fact that the original period assignment in the 1960s was arbitrary. In any case, I petition the reader to ponder the reasons for extending the beginning date of the Late Archaic period back in time. First, in the eastern United States a large human population and an efficient economy have long distinguished a Late Archaic period dating earlier than the Texan period of that name, and similar developments will be inferred for the eastern Edwards Plateau perhaps during Bulverde times but certainly in the Pedernales period. Second, strong continuity exists between Pedernales material culture (and economics) and later Montell implements (and subsistence practices). The Montell interval has long been classed as Late Archaic.

The reader is referred to Johnson (1994), which documents the carry over of specific facets of Pedernales dart-point manufacture and styling (most noticeably, blade shape) to later Montell specimens. (One says "dart heads" by habit, although Pedernales and Montell specimens could have been used on thrusting spears, rather than atlatl-thrown darts!) Moreover, the same large and thin billet-made knives were created both in Pedernales and Montell times. So one should not let the new stem style of Montell dart points (a combination of Plains corner notching and Plateau bifurcating) overshadow technological and stylistic continuities that link Montell with earlier point types. And equally as important as the foregoing evidence is the continuance of Pedernales-period plant baking by subsequent Montell folk, in a big way, in burned rock piles. Montell plant bakers often worked in the selfsame middens that Pedernales folk had earlier accumulated with their oven- or pit-roasting activities. Reasonably, throughout the first part of the Late Archaic period (from Pedernales through Montell days), economic and culture-historical clues point to the existence, on the eastern Plateau, of *ein Volk*.

Daniel J. Prikryl (1990:Figure 24) initiates his Late Archaic period for northern Texas at 1500 B.C.—earlier than is traditionally done in the central part of the state, but not so early as proposed here. Interestingly, Pedernales projectile heads typical of much of the early part of the Late Archaic period on the Edwards Plateau do not occur in north-central Texas. It is possible that this type, which is based on a particular kind of thinned or fluted tang with concave base, was developed locally on the Edwards Plateau from the preceding Bulverde style. For instance, specimens of an intermediate shape are illustrated by Gearhart (1987:Figure 46d-e) for Williamson County. In any eventuality, Bulverde and especially Pedernales folk (surely the same society at two different periods) lived through the peak of the dry Edwards Interval. At this stage of understanding I do not claim that the climate of the Edwards Interval can be traced northward from the Plateau. However, the warm and dry climatic period in question corresponds to a rapid rise in the Gulf's sea level, which had taken place by 2200 B.C. or so, and with a recognizable Gulf highstand (Ricklis 1993:66ff).

This adjustment in sea level may mirror hemispherical or global temperature changes, although the question has not been settled. According to sedimentary and other information from the Jonas Terrace site, the dry and hot climatic shift, though seemingly presaged by incipient weather changes in that direction during the latter part of the Middle Archaic, nonetheless struck the uplands of the Edwards Plateau a considerable blow. Evidence for some such abruptness or suddenness is seen at the Jonas Terrace site, where floodplain aggradation indicative of a relatively moist climate suddenly ceased (Johnson 1994). In Bulverde times (not long before Pedernales points appeared), aggradation of upland floodplains stopped and xerophytic plants seem to have completed their extension over parts of the Plateau, where they must have thriven, as foretold by E. Prewitt (n.d.) some years ago.

At the Jonas Terrace site, the main snail living on the terrace (*Rabdotus mooreanus*) was of a type avoiding shady areas with trees, preferring open space. However, the claim that a mesic snail (*Glyphyalinia umbilicata*) at Bering Sinkhole in Kerr County was extirpated in Late Archaic I times, indicating a dry climatic regimen, is unconvincing.[16] The absence of this snail from the pertinent cave zones is apt to be a function of small sample size, since snails of all species become rare at the indicated depths and *Glyphyalinia umbilicata* is never abundant at any level.

The Late Archaic period at Hall's Cave is not particularly easy to identify, although a segment of deposits at least 0.25 m thick are of that age, at least according to the two relevant radiocarbon assays of charcoal (see Figure 4). Neither desert shrews nor mesic least shrews were present in any numbers in

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[16] See Bement (1991:80, especially Table 6) for data on the occurrence of Bering Sinkhole snails; the reader is also referred to the radiocarbon dates for that site (Bement 1991:Table 1).

Late Archaic zones, nor were vertebrates who required a mesic environment. The climate during much of Late Archaic I times must have been very dry, since the least shrew returned to Hall's Cave only later, perhaps near the end of the Late Archaic period when conditions became wetter. The deposits of Patschke Bog of Lee County are better dated for the period in question; that peat bog is situated in Post Oak savanna (with some blackjack) east of the Blackland Prairie (Camper 1991). During Early and Middle Archaic times, a rise in percentages for oak and grass pollen surely indicates progressive regional drying. However, in the Late Archaic period that followed, grass pollen was both abundant and reasonably stable in its percentages, apparently bespeaking a long period of submesic (perhaps arid) climate, with elevated temperatures and less precipitation.[17]

The end of overbank flooding and floodplain/terrace aggradation mentioned for San Geronimo Creek (at 41ME29) and Fort Hood can be seen in other localities, which deserve mention. Not too far beyond the Plateau, and about 15 miles south of San Antonio, the Medina River's Applewhite Terrace preserves a buried alluvial member which ceased aggrading during the period of concern, probably at or near the beginning of the Edwards Interval. For the Medina, I would date this cessation of flooding, which is surely a dryness indicator, to sometime between 2700 B.C. and 2300 B.C., judging from the available radiocarbon assays (Thoms and Mandel 1992).

Closer to the Gulf coast, the Columbus Bend formation of the lower Colorado River is composed of several alluvial members of interest. According to sometimes ambiguous radiocarbon assays for West Point and Columbus, Member 1 appears to have stopped its growth and become stable sometime between 3200 B.C. and 2500 B.C. (Blum 1992:156, 175-178, 189). In actuality, the indicated dry period almost certainly corresponds to the Edwards Interval.

It may be that most (but not nearly all) of the manos and metates of the Plateau, such as those found along the middle Colorado River above Austin, are of Pedernales or Montell-point age and were used in milling unknown plant parts, although manos also occur in some Nolan-Travis burned rock middens and in numbers at the Early Archaic Sleeper site (Johnson 1991). This conclusion is suggested, for example, by the apparent stratigraphic association of many milling stones with Pedernales and/or Montell projectile heads at the shallow Toungate (41TV33) burned rock site on the Colorado (Clark n.d.). Of course, locales are known that have Pedernales points but no manos whatever, indicating that special economic chores were done at different kinds of sites.

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[17] For Patschke Bog, a date of approximately 2550 B.C. (SI-5232) applies to the 1.10-1.20 m depth of Core 2, while an age of about 825 B.C. (SI-5231) comes from the 0.40-0.50 m depth of the same core (Camper 1991:Table 2). Those are calibrated ages, figured with an estimated $\delta^{13}C$ value of -25.0‰; the two age calculations are from depths corresponding to high grass and oak pollen percentages, and bracket most of the Late Archaic I subperiod.

Late Archaic burned rock middens grew in many places, and are made up of heat-broken limestone rocks left over from baking yucca, sotol, various bulbs, nopal tunas, etc., in rock-lined and sometimes rock-filled pits, sizeable hearths, and basins.[18] Sotol was certainly only one of a number of plants chosen for baking and consumption. However, some piles of heat-broken baking rocks came also to serve as garbage dumps and had spent hearth rocks and kitchen midden trash added to them from time to time. Glenn T. Goode (1991:78) believes he had good evidence for the dumping of discarded hearth stones and human debris on the edge of an oven midden at the Heard Schoolhouse site (41UV86). Dumped human residue is also found in other burned rock middens (see provenience data for tools and other detritus in Peter et al. 1982:8-107 to 8-129). For that reason, a number of burned rock middens of the eastern (and western) Edwards Plateau contain quantities of animal bones, broken stone tools, and flintknapping debris.

Recently, fragments of burned sotol leaves were identified for the burned rock middens of the Jonas Terrace site and the Heard Schoolhouse site (41UV86) on the Dry Frio River (P. Dering, 1993 personal communication), and it is important to point out that the Jonas Terrace burned rock midden is not principally a dumping place. Few flint flakes or artifact parts were found among its fire-broken stones, and for that reason one can be fairly certain that the burned sotol was produced by pit (oven) baking and not dumped there with hearth debris.

Mescalero Apaches and other aborigines did similar pit baking of xerophytic plants with heated rocks thousands of years later, and their behavior in that regard is documented very well. Also recorded is their practice of drying oven-cooked plants and then making bread from them. For fairly detailed and fascinating ethnographic descriptions of rock-oven baking, the reader is directed to Castetter and Opler (1936), as well as Basehart (1960) and Wilson (1930:62-63). Additionally, Tunnell and Madrid (1990) supply interesting portrayals of the present-day baking of sotol heads within rock-lined pits in Chihuahua, as a first step in manufacturing soothingly delicious sotol liquor.

As a significant aside, the reader should consult Black et al. (1993:24-31) for a reconstruction of the way burned rock middens grew through the repetitive baking of plants in single places. The compelling argument of those writers, is that the "domed middens" of central Texas (which lack visible surface pits) are mainly rock-oven sites, nonetheless. Additionally, Black et al. (1993:29) doubt that acorns were processed in burned-rock middens:

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[18] Howard (1991:59 and Table 1) lists a number of burned rock middens with baking pits or basins, most of which she calls "hearths." In addition, such baking features appear in middens, some of which are of Late Archaic age: according to G.T. Goode, at the Mustang Branch site (41HY209); at site 41BX52; at the Higgins site (41BX184; Black et al. 1993:25); and at a number of newly excavated burned rock middens at Fort Hood (J.M. Quigg, 1993 personal communication).

> Acorns, to generalize from North American ethnographic analogy, are commonly parched, leached, simmered, and baked, but none of these steps would seem to require a massive oven that holds heat for days. Therefore, to us it seems unlikely that acorns represent the major resource associated with BRMs [burned rock middens].

It is entirely sensible to believe that the development of burned rock piles had nothing to do with a California-style addiction to cooking acorn mush with hot stones, or to leaching tannic acid from acorns with heated limestone.[19] Those notions are mostly based on a partial agreement in the occurrence of oak trees and some (but not all) burned rock middens in west-central Texas. The idea that burned rock middens had to do with acorn processing is best summarized by Creel (1991). Clearly, however, the explanation of large rock piles primarily as acorn-processing features needs to be set aside pending more reasonable evidence, for the arguments that have been made are unconvincing. The mere presence of a few charred acorns in occasional burned rock accumulations is not a conclusive clue that limestone was heated principally to process those nuts. (Howard [1991:Table 8] reports charred acorns in a few sites with burned-rock middens: the Indian Creek site [no trinomial], 41UV48, 41WM53, and 41WM56.) Acorns are properly leached by being ground and having water poured through the meal, by being soaked whole in water, or by being boiled with calcium in the water.

That does not mean, however, that acorns were never dried at times on existing burned rock middens or never burned with the fuel used to heat the mound's oven; acorns make a very hot fire. At any rate, the existence of a few acorns in a burned rock midden can have a number of explanations that have nothing to do with acorn cooking or leaching, such as their use as fuel or their accidental inclusion in fire basins because of nearby, even overhanging, live oak trees. The discovery, however, of charred leaf fragments of sotol (as well as nopal seeds, plant bulbs, etc.) in a burned rock midden is a different matter. Charred parts of such fragile plant are apt to represent debris left over from baking, since other explanations of their presence would be farfetched.

Echoing the comments of Black and his fellow writers (above), I also state that the idea that the Plateau's aborigines would accumulate rock middens by somehow processing acorns with heated limestone is a fatuous notion. Acorns do not need to be baked in rock ovens or leached in them (assuming such to be

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[19] Stone-boiling experiments conducted by S. Black, at the Texas Archeological Research Laboratory in 1993, produced fractured stones with saw-toothed sides (composed of jagged interlocking fractures) that are very distinctive. On the other hand, burned rock middens in central Texas contain fractured rock with squared-off faces, of a type consistently produced by the direct and repeated application of heat. Apparently, the limestone rock found in the middens of central Texas was not fractured by being dropped, hot, in water.

possible), although the parching of acorns on hot rocks might help preserve them for storage (by killing worms). A person familiar with acorn consumption in the Northwest or California knows that the drying, leaching, and cooking of acorns is a simple matter hardly warranting the kinds of efforts that would accumulate burned rock middens. Furthermore, the occurrence of burned rock middens largely in live oak groves along streams, in west-central Texas, may simply mean that both pit baking of xerophytic plants and the health of live oaks demand a good source of water. In the region in question, live oaks may prefer areas with a limestone bedrock capable of furnishing oven stones for baking desert plants.

However dry the climate of the Edwards Interval, Part I of the Late Archaic period (2300 B.C. to 600 B.C.) witnessed no hardships for the aborigines, who apparently came to thrive on upland semi-succulents. Nevertheless, some data (Bement 1991) indicate a less healthy diet for the period under consideration, with too much in the way of carbohydrates (or sugars; sotol leaves produce sugar when baked quite slowly). In any event, at certain seasons of the year people continued to enjoy the nuts and game of the wooded river valleys, which were not much affected by the inferred temperature rise. In fact, streams such as the San Gabriel and Nueces rivers are known to have continued aggrading during Late Archaic I times, at places not too far below the Plateau's escarpment.[20] Certain Fort Hood streams also built up alluvial deposits (Member D1) of Late Archaic I age (Nordt 1992:passim).

In conclusion, burned rock middens were *much more abundant* on the eastern Edwards Plateau in Late Archaic I times than in any other period.[21] Nevertheless, in western Texas as well as Mason, Kerr, and Uvalde counties (areas that continued to experience fairly xeric conditions long after this dry period), burned rock middens commonly accumulated also in Post-Archaic days. Thus some arrowhead-period burned rock middens are known from the western border of what is here called the eastern Edwards Plateau. But on the eastern Plateau proper, fewer burned rock middens built up in later times than during the Late Archaic I period, and became less common than in the west. A burned rock

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[20] The Loeve-Fox site (41WM230), located within alluvial sediments of the San Gabriel River, shows floodplain aggradation both before and during Pedernales times (Prewitt 1982a:Figure 5). And at the Anthon site (41UV60) on the Nueces River, G.T. Goode reports that the river's floodplain continued to build upwards during the Pedernales period, after a pre-Pedernales pause. Both sites contain fine-grained sediments and are situated not too far below the escarpment of the Edwards Plateau. Nearer the Gulf coast, however, aggrading ceased on the Colorado River, presumably during the early part of the Late Archaic period; that stream's exposed floodplain consequently remained stable for centuries. Evidence for this event appears, for example, at the top of truncated Alluvial Member 1 at Columbus Bend, about 120 miles inland from the Gulf (Blum 1992:70, 156).

[21] See Weir's population estimates as graphed in Prewitt (1985:Figure 6A).

midden with central baking oven is known from the Mustang Branch site (41HY209) near the eastern edge of the Edwards Plateau (though the basin may be later than the body of the midden), and apparently dates to terminal Late Archaic or early Post-Archaic times. According to Goode, who took part in that site's excavations, Darl and Fairland dart heads, as well as a few arrow points, were found within the rock midden. Additionally, a few burned rock middens possibly of Late Archaic II and/or Post-Archaic age have been reported from Williamson County (Gearhart 1987:58, 78, 117-118).

Glenn T. Goode (1991) reviewed a few such Post-Archaic midden sites on the southwestern or western edge of the eastern Edwards Plateau, discussing their possible function in baking sotol heads. He conscientiously described the Honey Creek site (41MS32) in Mason County and the Heard Schoolhouse site (41UV86) in Uvalde County. It can be added that Scallorn arrowheads may have occurred in a burned rock midden outside Hall's Cave (see Figure 1). One can argue that most Post-Archaic middens are largely tied to the remnant sotol fields near, or west of, the far western edge of the present study region.

There is no evidence that the eastern Edwards Plateau, with its many springs and streams, served as a refuge area (as has been suggested) for parched and hungry outsiders during the dry Edwards Interval. Local Pedernales projectile points and associated knife forms prevailed uniformly during the supposed peak of the dry Edwards temperature maximum, and Plateau folk maintained a quite uniform material culture. Had outlanders arrived in any numbers, a variety of projectile point styles representing alien forms would surely occur on the Plateau at this time, and they do not.

Further into the Late Archaic I subperiod, after Pedernales projectile heads had given way to the related Marshall and (later) Montell styles,[22] buffalo seem to have appeared again in the eastern Edwards Plateau.[23] And although the effects of the dry climate of the Edwards Interval may have been lessening by that time, the people using Marshall and Montell projectile points continued the Pedernales-period baking of semi-succulent xerophytic plants, and accumulated or added to burned rock middens during the same period that they sometimes barbecued buffalo. Obviously, the climate and vegetation were still fairly xeric.

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[22] The fact has gone largely unrecognized that broad-bladed Pedernales points, Marshall dart heads, and Montell points are all made in the same way, by expert billet thinning (Johnson 1994). Very thin and flat blades are produced which show large flake scars from such billet work. According to G. T. Goode, the differently shaped stem of Montell points can obscure the indicated continuity, which also appears among large and flat, oval knives that run through Pedernales, Marshall, and Montell times.

[23] On the Edwards Plateau, buffalo bones may be part of the Montell-period debris of the John Ischy site (41WM49; Sorrow 1969:62) and the Jonas Terrace site (Johnson 1994). In the Lower Pecos region, Montell dart points are definitely associated with bison bones at Bonfire Shelter (41VV218; Dibble and Lorrain 1968:42-55).

In bidding subperiod I *adieu* (though the Castroville style is formally transitional,[24] it can perhaps be put at the end of that subperiod), three additional observations can be made. The first is that the Late Archaic I period lasted for about 1700 years. The second is that the billet thinning of sizeable bifacial knives and projectile heads saw its artistic and technological flowering during that subperiod, making flint-knapping debris of the epoch easy to identify when it occurs abundantly. The third is that the human population appears to have increased during Late Archaic I times (see Weir's data in Prewitt 1985:Figure 6A; also, for the Lower pecos area, consult Turpin 1990).

In the Late Archaic II subperiod (largely corresponding to the Middle Woodland in eastern North America), which lasted from 600 B.C. to A.D. 600, fairly mesic conditions had returned to all but the western and southwestern parts of the Edwards Plateau, although some increase in moisture had already taken place during Montell days. Local aborigines lost most or part of their former supply of upland xerophytic plants. As said, plausibly towards the end of subperiod II the moisture-loving least shrew returned to Hall's Cave in Kerr County. Burned rock middens no longer accumulated in very large numbers as a consequence of pit baking, except in the far west and on the southwestern edge of the eastern Plateau, and evidence of buffalo hunting has not yet been found in the eastern Edwards Plateau for subperiod II. However, Marcos points of this epoch (at least one of them!) occur with bison bones near San Angelo (Creel 1990:220)—which is quite a distance from the eastern Plateau.

It behooves me to say, once again, that Lee Nordt's climatic notions do not always run parallel to mine. His study (Nordt 1993:68 and Figure 4) of changes in the biomass at Fort Hood during this period (specifically, around 200 B.C. [calibrated]) argues for a brief warming/drying trend, producing increases in the relative abundance of C_4 grasses. Those increases, relative to the abundance of trees and forbs, could well mirror mild drought conditions, although other interpretations are at least possible. For instance, short-term increases in rainfall could easily increase local C_4 grass cover and make it denser, at the expense of C_3 weedy plants. Strangely, perhaps, the earlier dry Edwards Interval does not readily reveal itself in the plant-biomass data from Fort Hood, which is perhaps sufficiently far north to experience Plains-like or "northern" long-term weather changes not felt in southern Central Texas—but I doubt it. Quite possibly, the interval in question merely saw little sedimentary deposition in the Fort Hood area.

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[24] Statistical comparisons (Johnson 1994) demonstrate that the blades of Castroville dart points are thicker, on the average, than Montell specimens and resemble yet later styles in several respects. Castroville points also tend to have biconvex rather than flat lateral cross sections, and frequently lack the large billet-flake scars of Montell dart points. Additionally, evidence of pressure flaking appears on many Castroville blade surfaces, but not those of Montell points.

My rendition of Late Archaic II climate calls for somewhat moister conditions than previously, to explain the active aggradation of floodplains in many localities. And during the indicated time period, one of two things happened. Either foreigners from the Southern Plains showed up with new styles of projectile points and made themselves to home, or else Plateau residents borrowed certain tricks and techniques of projectile making from outsiders. Marcos dart heads came first to be made. In fact, Marcos dart heads are very much like dart points of the same age from the Southern Plains. And later in subperiod II, aborigines of the eastern Plateau used Frio and Ensor dart heads. Although some of the foregoing styles find parallels in the dart points of Southern Plains buffalo hunters (Hughes 1989), as said, evidence can also be identified in subperiod II (mainly in Ensor-point and Frio-point times) of social intercourse in an entirely different direction: with the eastern United States.

In subperiod II, evidence of spreading Eastern religious cults or ideas appeared on the Southern Plains, eastern Texas, the Gulf Coastal Plain, and in a small way even on the eastern Edwards Plateau. Some of the major markers are exotic burials, foreign copper, elaborate bone ornaments, Gulf whelk shells, and atlatl weights typically of exotic stone; most of these items were widely traded throughout the eastern half of North America. However, only the last two items are ordinarily reported for the Edwards Plateau[25] (though an engraved bone pin turned up nearby, in San Antonio), and the region's spear-thrower weights are often made of local rock. It is sometimes difficult to determine whether fancy Late Archaic grave goods are linked to developments in the eastern U.S., since elaborate Late Archaic I burial furniture apparently not so linked is known for the Texas Gulf Coastal Plain. For example, at Landa Park in New Braunfels, a large Archaic cemetery on the Locke farm (site 41CM25) produced a whelk gorget and a few other special artifacts in flexed burials (Texas Archeological Research Laboratory files). But one cannot know whether this "ceremonial" material has local Archaic roots or is connected to eastern U.S. religions and their spread.

Unfortunately, whelk shells and atlatl weights are hard to date on the Plateau, itself, since nearly all represent surface finds or goods excavated by collectors. However, a number of fancy bone and whelk-shell items have been found at San Antonio, directly below the Plateau's margin in Late Archaic II burials (Lukowski 1988). And, significantly, decorated whelk-shell pendants and

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[25] See Patterson (1937a). As an example of other recorded occurrences of atlatl weights and whelk shells, there is the whelk columella from site 41HY51 (Texas Archeological Research Laboratory files). And a limestone atlatl weight was found with "Darl" points at the Smith Rockshelter (41TV42) (Suhm 1957:38 and Figure 8B). Additionally, artifact collectors report a large number of whelk pendants and spear-thrower weights from the Leon River, in Bell and Milam counties, seemingly associated with Ensor and Marcos dart points. G. T. Goode reports that most of the atlatl weights are of local stone, although a few (including a specimen made of purple quartzite) are of foreign material.

atlatl stones are definitely associated with Late Archaic dart heads on the Southern Plains,[26] occurring also in Late Archaic II cemeteries near the central Texas Gulf coast. The cemetery of greatest interest is Burial Group 2 at the Witte site (41AU36; Hall 1981:83-90). As an important aside, it is noteworthy that Edwards Plateau people of Late Archaic II days contributed a strictly local product to the distinctive trading networks of the time: large and thin corner-tanged knives worked bifacially from Edwards flint (Patterson 1936, 1937b; Hall 1981). Additionally, many caches of bifacial preforms of Edwards flint, perhaps of this age, have been found far and wide, often beyond the Edwards Plateau on the southern edge of the Llano Estacado and at the western border of the Eastern Woodlands (Miller 1993). The notion of trading networks is reviewed by Johnson (1982:206-209).

In the eastern U.S., religious movements linked to the use of many of the above items, and their long-range transport, are well dated to some part of the time range from 200 B.C. to A.D. 500, which represents a major slice of the Middle Woodland (Hopewell or Marksville) period of the East. In the eastern Plateau, Ensor, Frio, and perhaps other dart points date within this time frame. In eastern Texas, there is little doubt but that the Mossy Grove people who built the Jonas Short burial mound (41SA101) were influenced strongly by this movement. Additionally, the elaborate bone and shell artifacts, and occasional atlatl weights of Arkansas stone, found with people buried around the time of Christ at the Ernest Witte site (41AU36) in Austin County, Texas, may comprise a peculiar regional expression of widely spreading Middle Woodland religious beliefs.

The important point is that the religious and ceremonial materials mentioned above, however locally varied, appear basically on one temporal plane. In itself, that fact supports the notion of a related batch of interconnected religious ideas involving the possession of special cult items eventually included with the dead at burial. Of course, some items of whelk shell and other conceivably ceremonial and religious objects were known on the Texas coastal plain during earlier periods, and in the East both before and after Middle Woodland (Late Archaic II) times. Yet that fact is largely immaterial to the present argument, for the Texas material highlighted here is all approximately contemporaneous, and is tied together at least by Middle Woodland atlatl weights (often of Arkansas stone) perceived to have been religious paraphernalia.

To explain the appearance of elaborate ceremonial goods in Texas just in terms of local economic developments, the growth of farflung trading networks, an increase in human population, the development of a hierarchical social organization or power structure, or the rise of a sedentary life style (e.g., Hall 1981) is

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[26] The best publications on the subject are those of Ray (1936), Parsons et al. (1979), and Redding and Parker (1991). The first article describes corner-notched dart heads, whelk pendants, and atlatl weights burned with a human corpse. The last reports a side-notched Late Archaic dart point found in a human cremation along with small shell beads and an elaborately worked atlatl weight of stone.

to misunderstand the issue. It may be true that a complex cult with a rich material expression only evolves within a complex social system like that of the Hopewell people; but it is also true that such a belief system can spread to almost any kind of society. Hence one finds whelk ornaments and atlatl weights of foreign stone in cremations of Southern Plains hunting people, and very occasionally in sites of the hunting-and-gathering aborigines of the Edwards Plateau.

Human skeletons probably dating to Late Archaic times have been found at three sites on or very near the eastern Edwards Plateau. The first is Bering Sinkhole (Bement 1991) at the western edge of the eastern part of the Plateau. The results of analyses done on human skeletal parts conceivably dating to subperiod I are engrossing. Teeth show a high rate of enamel hypoplasia, as well as a high caries rate. Stable-carbon isotope ratios argue for a much greater dietary reliance on C_3 plants than could be deduced for Early Archaic burials from the same sinkhole. Consequently there was considerable weaning stress for young children (the hypoplasia), as happens with large populations, and for most of the deceased a high carbohydrate or sugar diet is indicated which likely included either sotol/yucca/agave or acorns, in addition to animals eating C_3 plants.

Hitzfelder Cave (41BX26), with a sinkhole entrance, contained parts of 30 to 50 bodies, some of which must date to the Late Archaic I and II subperiods. A Pedernales projectile point and a Marshall point were among the few projectile heads that were observed (Givens 1968; Collins 1970), as were three Frio points of subperiod II. Considerably to the southeast of the Plateau, on the Gulf Coastal Plain, Late Archaic II cemeteries sometimes have burials with elaborate burial furniture that includes decorated whelk-shell pendants, incised bone wands and pins, and atlatl weights made of Arkansas stone (e.g., Hall 1981:29-92). Interestingly, the third Late Archaic burial site to be mentioned on or near the Plateau had burials resembling the elaborate Coastal Plain kind, although the limited excavations turned up the remains of only 12 or 13 bodies. The Olmos Dam site (41BX1; Lukowski 1988) is an open locale on a stream bank within the city of San Antonio, only a few miles south of the Plateau's escarpment. Most of the site's bodies had been placed in graves, resting on either side, in a flexed or semi-flexed position with head to the northeast or east. Importantly, the bodies of Burial Group 2 at the Witte site were oriented similarly, expressing a shared religious preference. Found with the Olmos Dam bodies, variously, were grinding slabs, whelk pendants and columellas, a mussel pendant, a bone awl or hairpin, and chert cobbles. Remarkably, piles of antlers rested over some bodies and covered all but the heads of adults. Burial goods and the well-associated radiocarbon dates indicate a Late Archaic II age for the cemetery, near the time of Christ.

The Post-Archaic Era

I provisionally stop the Late Archaic period around A.D. 600, just before arrowheads such as the Sabinal and Edwards styles arrived onto the eastern

Edwards Plateau or were developed there. If Edwards and similar points were indeed the first true arrowheads on the Plateau, the regional acceptance of the bow was only slightly tardy from a continental perspective. The date of the bow's advent in eastern North American is usually said to fall between A.D. 500 and A.D. 800 (Shott 1993:425), and Edwards points appeared around A.D. 700 or 800 at the Plateau's Rainey Sinkhole (41BN33; Henderson n.d.). Nevertheless, one should underscore the fact that some cultural and considerable economic continuity tied the end of the Late Archaic period with what came directly afterwards. In fact, of all the period boundaries set in the present paper, that for the ending of the Late Archaic II subperiod is the most subjective and bothersome. For one thing, human culture did not change *greatly* after the beginning of that interval down through the days when Scallorn arrowheads were in vogue. If the informed reader wishes to terminate the Late Archaic period at A.D. 1200, I will not argue. Or if the reader wants to stop the period at around A.D. 400 (or later), when very small "dart" points of the Darl and Figueroa sort appear in the region, that is another possibility. Those small points may actually represent the first arrowheads to materialize locally. The appearance of small dart points at this time is also documented for north-central Texas (Prikryl 1990:56) and other regions.

In any case, human life on and just below the eastern Edwards Plateau changed in small ways in the Edwards-Scallorn part of the Post-Archaic Era. First, my impression is that the population increased a bit, although I cannot prove it. If the human population grew, the cause may have been a quite mesic climate favorable for deer and mast. I doubt seriously that the acceptance of the bow, locally, had anything to do with it, although it is a clearly more efficient or effective hunting instrument than the atlatl and dart.[27] Some communities consequently came into competition and battled one another, so much so that the demise of quite a few people found in Scallorn-period cemeteries was due to a peppering of arrows. Prewitt (1982b:Table 4) lists a number of burials with bodies apparently pierced by arrows. Whatever else transpired, the material culture of the people who made and used Edwards and Scallorn arrowheads was not very different from that of Plateau people who lived during Late Archaic II days, although arrowhead-period knapping was a bit different from what went

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[27] For strong but exaggerated warnings against accepting the idea of an increase in the efficiency of bow hunting over dart hunting, see Shott (1993). I suspect, however, that the bow was indeed much more efficient that the atlatl for hunting. But this added efficiency may well have expressed itself in increased accuracy and the need for a given hunter to spend much less time on the chase than otherwise. There is no compelling need to assume a necessary increase in the number of animals killed (just because it became easier to hunt them), or an increase in acquired calories. Prehistoric Texan aborigines were unacquainted with Marx's notions about economic production and had not heard of "maximum foraging efficiency."

before it. Bifacial flint knives (with convex or straight bases) of early Post-Archaic age are smaller than many of their Late Archaic counterparts.

The climate continued to be mesic until around A.D. 1200, when a drought affected at least parts of the Edwards Plateau. Buffalo came back onto the Plateau soon thereafter and stayed, even after climatic conditions may have reverted to the region's near-mesic norm between A.D. 1300 and 1400.[28] The Archaic-seeming life style of the Scallorn folk was replaced by buffalo hunting and foraging by smallish groups of Toyah-culture people. The latter made true flint blades by direct percussion, manufactured a bit of pottery of seeming Southwestern shape and finish, and used bevel-edged knives and sandstone shaft abraders typical of the Southwest's eastern margin and of the Plains Village region. No Archaic Era blade industries are yet known on the Edwards Plateau (Collins and Headrick 1992:27), nor have many pottery vessels been discovered that are older than Toyah ceramics. The best example is a thick-walled beaker (Black and McGraw 1985:188-189 and Figure 41), from the Panther Springs Creek site (41BX228), built up by plastering the inside and outside of very thick clay ropes in Tchefuncte style. The present historical narrative concludes at A.D. 1600, near the end of Toyah days when Perdiz arrowheads were in vogue.

I close by affirming that the eastern Edwards Plateau has been the proscenium and stage for a basically low-key Native American drama unfolding between 6500 B.C. and A.D. 1600. The Plateau is just beyond the margin of the horticultural Eastern Woodlands, and gardening did not develop locally during this lengthy epoch except ephemerally among Post-Archaic buffalo hunters of the Toyah culture, as well as later Apaches.[29] As a wide transitional zone composed both of arboreal and prairie elements, the well-watered eastern half of the Edwards Plateau ordinarily furnished ample plant and animal food for a moderately sized human population practicing Archaic hunting and gathering methods. The success of local hunting-and-collecting economies is surely one

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[28] After a period of erosion perhaps in the twelfth or thirteenth century (inferred date), the Ford Alluvium (Member E) of Fort Hood was laid down during a moderately mesic period beginning sometime after A.D. 1300 (Nordt 1992:76-77). Nordt (1992:67) notes that ". . . radiocarbon ages from Fort Hood demonstrate that stream metamorphosis, and possible brief channel trenching, occurred shortly after 1000 B.P. and that channel and overbank filling has been proceeding since that time." This overbank filling indicates greater precipitation after A.D. 1300 (my dating).

[29] This statement is too strong. Apache-type ephemeral gardening could have been practiced here and there on the Eastern Plateau during Late Archaic times, without leaving many recognizable archeological clues. It is altogether too soon to disregard three pollen grains of *Zea mays* (Indian corn) recovered from water used to wash a Late Archaic milling stone from the Wild Turkey Midden (41MI8: Howard 1991:63). Holloway (1988:8) seems ready to do just that, but the occurrence of the grains on a grinding stone argues that they were original adherents.

reason why pottery was so tardily accepted by aborigines of the Plateau, and serious horticulture not at all.

Naturally, being a climatic and vegetational borderland, the Plateau was susceptible to changes caused by lengthy fluctuations in precipitation. More than at any other time, it was during the dry Edwards climatic interval, whose peak may have occurred around 1900 B.C., that aboriginal economics changed to a degree and an increasing population seemingly came to rely quite regularly on upland xerophytic and other plants as food staples—though they had sometimes been collected previously, as well. Few places, however, are ever insulated against all outside influence. During three periods and maybe more, bison came into the region, no doubt to the delight of aboriginal gourmands and talented (or cold) hide workers. And at another time Edwards Plateau people felt the touch of cultural and religious developments reaching them from the Coastal Plain below the Plateau and indirectly from the Eastern Woodlands. Additional regions such as the Great Plains also affected Plateau folk during (and maybe just after) periods of bison presence, and the stone tools of Plainsmen were occasionally imitated by Plateau artifact makers.

By temperately redefining the content and boundaries of local culture periods to accommodate recent knowledge, and by dating both the culture periods and the region's climatic episodes better than heretofore, human life and its history on the Plateau can be viewed in a clearer light. It is hoped that the stage is now set for increasing the candle power of that light with new research. Some day, acceptable and well-founded research will surely be done about prehistoric social and community organization on the eastern Edwards Plateau, although that day of fable lies (if anywhere) in a most uncertain future, somewhere over the rainbow.

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The Archeology, Physical Anthropology, and Ethnohistory of the Caddo in Northeast Texas

The Peerless Bottoms Site: A Late Caddoan Component at Cooper Lake, Hopkins County, Texas

Ross C. Fields, Eloise F. Gadus, and L. Wayne Klement

ABSTRACT

In 1991, intensive excavations were carried out at the Peerless Bottoms site (41HP175) at the Cooper Lake project in Hopkins County, Texas. The work was done by Prewitt and Associates, Inc. under a contract with the U.S. Army Corps of Engineers, Fort Worth District. The site lay in the upper 20-30 cm of a soil buried beneath ca. 70 cm of sterile alluvium. The excavations revealed that the cultural remains represent a single component occupation dating to the early part of the Late Caddoan period (the A.D. 1400s). A single hearth and several possible posts were identified, and large collections of lithic and ceramic artifacts and modest collections of faunal and macrobotanical remains were recovered. Most of the excavations sampled a hearth-centered outside activity area associated with a sedentary or multiseasonal occupation by hunter-gatherers who practiced limited horticulture.

INTRODUCTION

The Cooper Lake project in Delta and Hopkins counties, Texas (Figure 1), has been the scene of archeological work since 1951 when a reconnaissance survey was done by the River Basin Surveys of the Smithsonian Institution. Between 1951 and the final episode of work in 1993, nearly 30 projects dealing with prehistoric sites were completed by Southern Methodist University, the University of North Texas, and Prewitt and Associates, Inc. (see Fields et al. 1994 for a complete list). This work resulted in a large body of data, most of it pertaining to intensive use of the upper Sulphur River valley over perhaps a 1,000-year span beginning in the Woodland period and ending in the Middle Caddoan period at about A.D. 1300.

While artifacts indicating use during the Late Caddoan period have been found in small numbers at many sites, isolable late components proved elusive until 1991 when the Peerless Bottoms site, which was named for the nearby community of Peerless, was excavated by Prewitt and Associates, Inc. under contract with the U.S. Army Corps of Engineers, Fort Worth District (Fields et al. 1993). This site was unusual not only because of its age but also because it

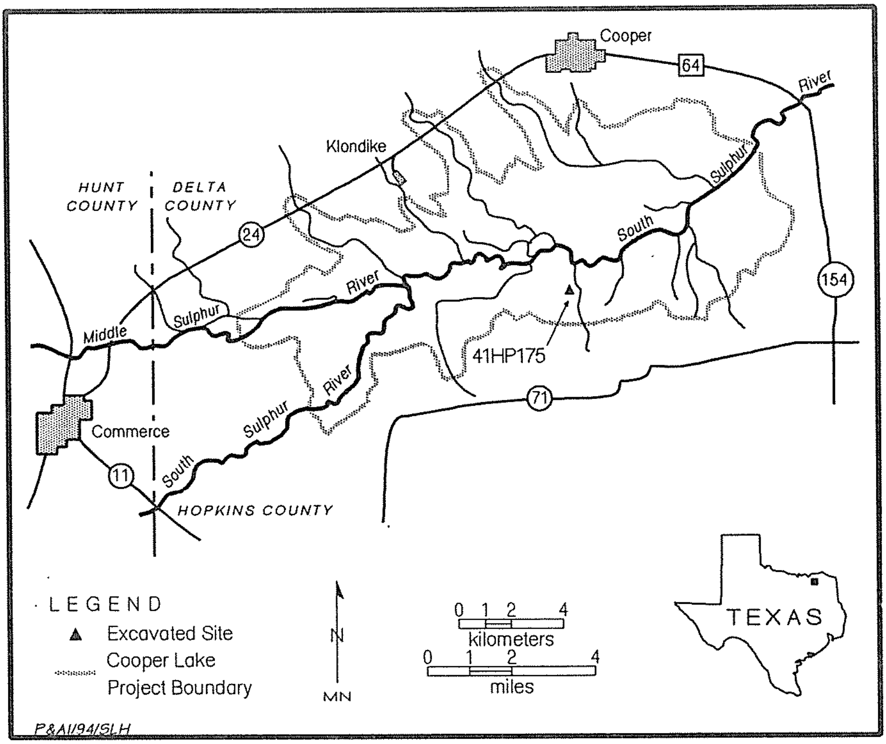

Figure 1. Cooper Lake project location map.

represented a single component occupation and because it contained well-preserved information on intrasite structure. While Peerless Bottoms cannot be considered typical of the kinds of Caddoan period sites that predominate at Cooper Lake, it does provide valuable information about a little sampled time period in the area, and it stands out as an important example of the value of single component sites in northeastern Texas. This paper summarizes the excavations; more detailed information, particularly for the artifacts, can be found in Fields et al. (1993).

SITE SETTING

The Peerless Bottoms site (41HP175) is located at 420 ft above mean sea level near the distal end of an alluvial fan extending northward along Finley Branch into the flood plain of the South Sulphur River (Figure 2). The river is 730 m to the north, and the flood plain proper lies at an elevation of 416 ft. The fan surface rises gently to an elevation of 440 ft at the base of the valley wall ca.

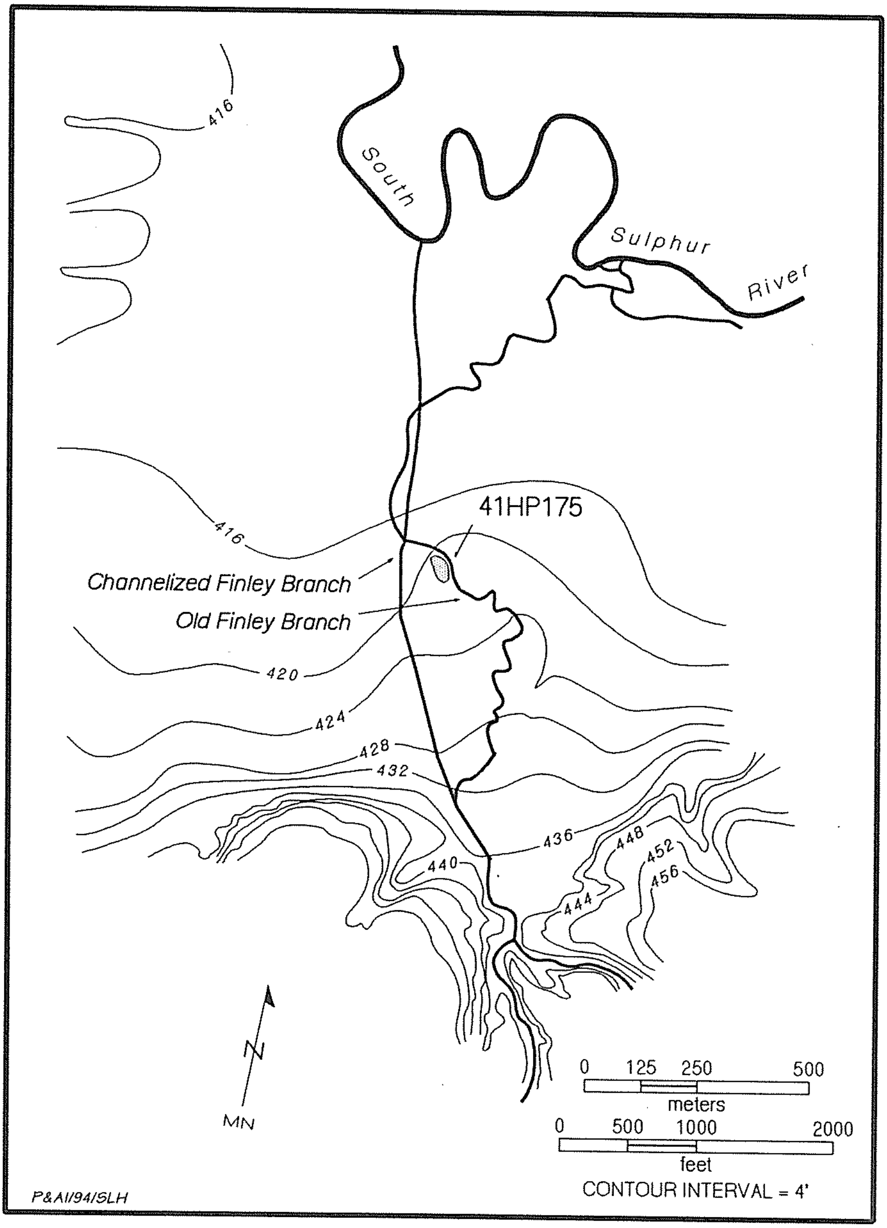

Figure 2. Topography of the vicinity of 41HP175 (adapted from 1924 State of Texas Reclamation Department 2-ft contour map).

500 m south of the site. Immediately to the northeast of the site is the old channel of Finley Branch, which was abandoned when the creek was channelized in the early part of the twentieth century. The channelized creek is ca. 80 m west of the main site area.

The site had been cleared shortly before the 1991 investigations. Prior to this, much of the site was in pasture, although the areas along old Finley Branch and just north of the site supported oak forest. This clearing and the subsequent burning of brush and timber piles did not disturb the site itself, but it did disturb parts of the fan just to the east and north. Other disturbances include an eroded gully 1-2 m deep just south of the site, which probably occurred after Finley Branch was channelized, and an eroded pasture road crossing old Finley Branch on the north edge of the site.

PREVIOUS INVESTIGATIONS

Site 41HP175 was first recorded in 1989 (Jurney and Bohlin 1993). At that time, a trackhoe was used to dig a trench 1-3 m deep between old Finley Branch and the channelized creek, and cultural materials were discovered in the backdirt near the eastern end of the trench. Two test pits were placed adjacent to the south wall of the trench, and four units were dug north and south of the trench. These excavations and screening of some of the trench backdirt yielded 331 chipped stone artifacts and 137 sherds and indicated that the cultural remains are restricted to a ca. 20 cm thick zone buried beneath ca. 70 cm of sterile alluvium. The temporally diagnostic artifacts suggested a Late Caddoan age, which was supported by a single calibrated radiocarbon assay of A.D. 1720 ± 90 (SMU-2326) on charcoal from an uncertain context.

The next effort at 41HP175 occurred in 1990 and consisted of a magnetometer survey (Bailey et al. 1991). This was done in anticipation of the 1991 intensive excavations. An area of 28 x 13 m south of the trackhoe trench was surveyed, and eight magnetic anomalies were found. These were interpreted as possibly representing modern metal or cultural features (e.g., small middens or hearths), but they were difficult to assess because most were situated around the edges of the surveyed area or near areas disturbed in the 1989 testing. Ultimately, this survey did not provide much information that was useful during the later intensive excavations because most of the magnetometer grid was effectively outside the boundaries of the site (Ellwood and Fields 1993).

EXCAVATION STRATEGY AND WORK ACCOMPLISHED

The 1991 excavations were intended to define the horizontal and vertical limits of the cultural deposits, obtain a systematic sample of the full extent of the site, and intensively sample one or more concentrations of cultural materials. This design focused on horizontal aspects of the site because of its geologic context, which suggested that a limited span of time was represented, and the likelihood that it contained a single component with the kind of preserved information on internal site structure (i.e., the spatial arrangement of activities) that cannot be recovered easily from multicomponent sites.

The first task consisted of cleaning out the 1989 trackhoe trench and relating the stratigraphy observed in this exposure to the recovery of archeological materials from the 1989 test units. This confirmed that the site is contained within a discrete zone 10-30 cm thick buried beneath sterile deposits, and it revealed that this zone is in the upper part of a generally conspicuous buried soil. Further, it showed that the buried soil in the eastern end of the trench is truncated by a filled channel of Finley Branch. With the buried soil as a stratigraphic marker, Backhoe Trenches 1-10 were dug to explore the horizontal extent of the cultural deposits, document the thickness of the sterile overburden, and follow the course of the filled channel (Figure 3). Then, Excavation Units 1-18 were placed at roughly 5-10 m intervals across the site area. The overburden was removed to within 10-20 cm above the buried soil in these units, at which point manual excavations began in 10 cm levels. To ensure sampling of the full thickness of the archeological deposit, these units extended an average of 63.3 ± 15.3 cm in depth (40-100 cm). This effort revealed that appreciable quantities of cultural remains were present in a restricted area of less than 500 m^2 south of the trackhoe trench, south and west of old Finley Branch, and east of Backhoe Trench 4 (see Figure 3). Only 3 percent of the 1,039 artifacts recovered from these initial units were from outside of this core area.

The second phase of the excavations consisted of the manual removal of Excavation Units 19-36 scattered across this core area (Figure 4). Most of these units were 5 m apart, and along with the initial units placed in this part of the site, they sampled most of the area on a staggered 5 m grid. Following removal of the overburden, the manual excavations were done in 10 cm levels and extended an average of 35.6 ± 6.2 cm in depth (20-40 cm). This effort located a single hearth (Feature 1 in Excavation Unit 21) and revealed that the core area of 41HP175 contained a single predominant concentration of archeological materials in its eastern half (around Feature 1) and a small part of a second concentration in its northwestern corner (see Figure 4). This second concentration was sampled only by Excavation Units 14 and 36, although it was roughly quarter-sectioned by the trackhoe trench and Backhoe Trenches 4 and 5.

The third phase of the excavations consisted of opening 66 additional units around Feature 1 (Figure 5). Following removal of the sterile overburden to ca. 5 cm above the buried soil, these full and partial units were dug manually in 10 cm levels to an average of 31.1 ± 3.1 cm in depth (30-40 cm). This block was expanded until the limits of the concentration of materials around Feature 1 were defined, except on the north where the block was bounded by the filled channel.

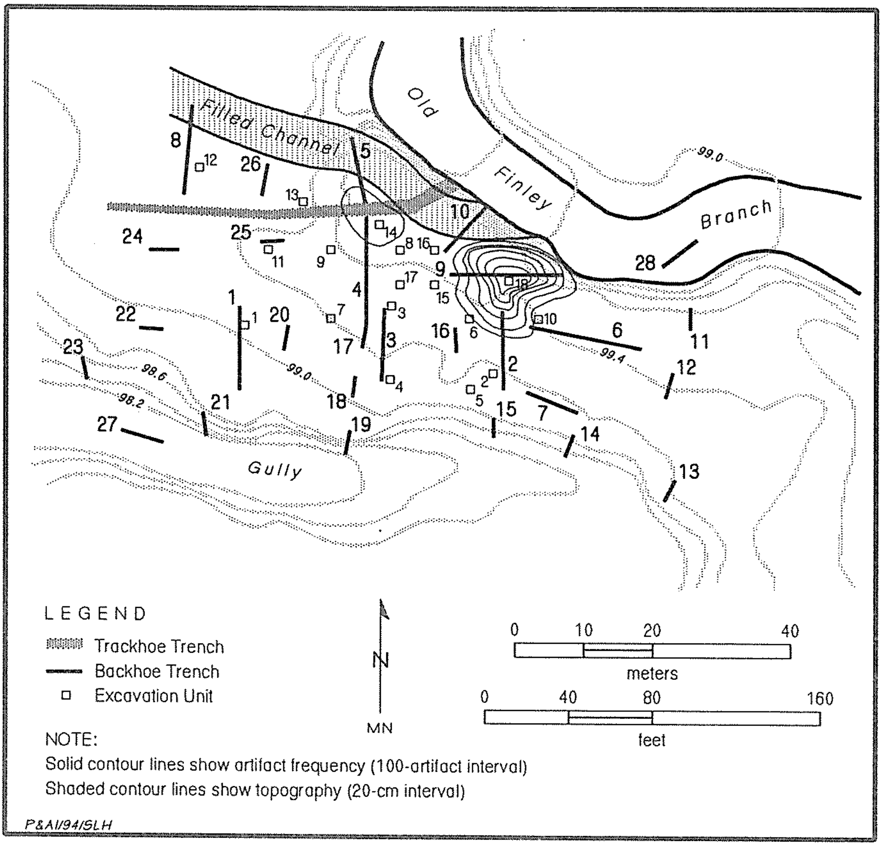

Figure 3. Plan of 41HP175 showing modern topography, the initial 1991 excavations, all backhoe trenches, and overall artifact frequencies (based on Excavation Units 1-18).

Counting the units dug in the first two tasks described above, the block covered a total of 67.7 m^2.

The final excavation task consisted of using a Gradall to strip ca. 78 m^2 of the site in five areas just southeast, south, and west of the block (see Figure 5). This was done to search for cultural features, but none were found. The sediments were removed to just below the cultural zone, and the floors were shoveled and troweled. Unlike the sediments from the other excavations, the sediments from the Gradall units were not screened.

Concurrent with all of the excavation phases were geomorphic investigations. This entailed examination and recording of backhoe and trackhoe trench walls, excavation of Backhoe Trenches 11-26 to document the extent and geometry of the deposit containing the archeological remains, and excavation of

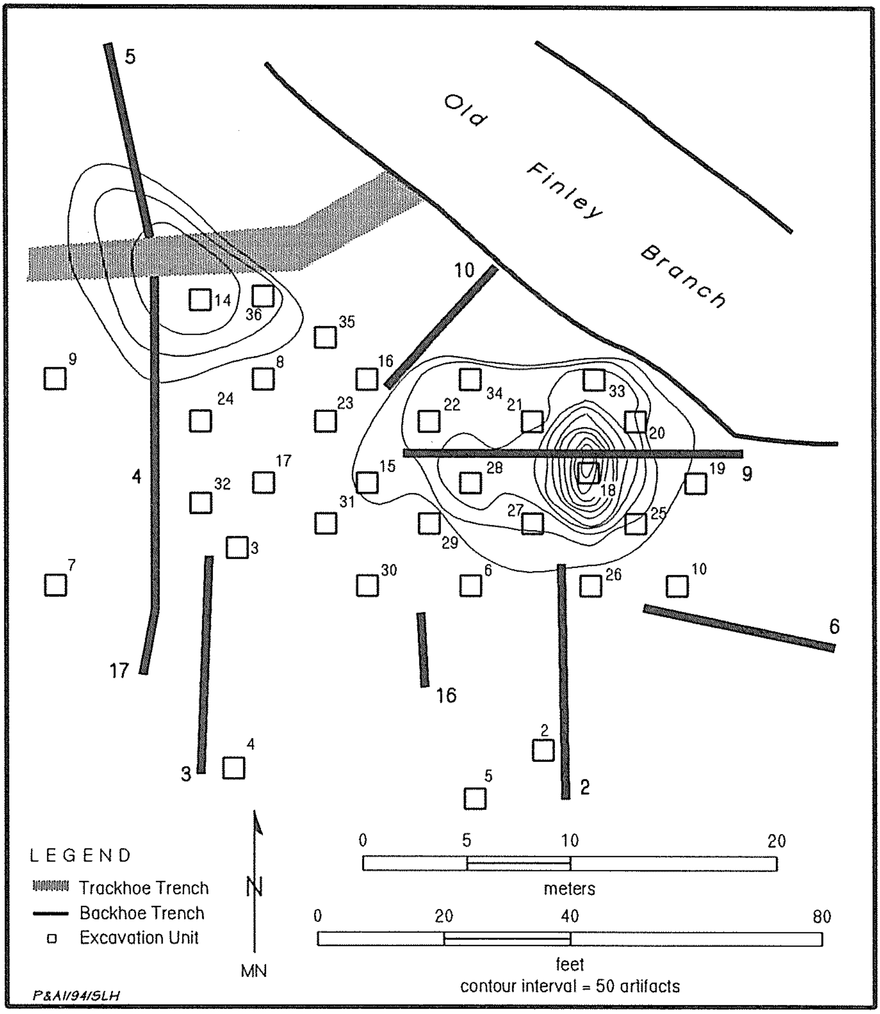

Figure 4. Plan showing first- and second-stage excavations and artifact frequencies in the core area of 41HP175 (based on Excavation Units 1-36).

Backhoe Trenches 27 and 28 in the bottom of the old Finley Branch channel and the gully southwest of the site to record the stratigraphy of the alluvial fan beneath the site (see Figure 3). Samples for sediment analysis and dating were taken from selected exposures, focusing on the eastern end of the trackhoe trench because of the view provided there of the relationships between the archeological remains, the buried soil, the deposits above and just below the buried soil, and the filled Finley Branch channel.

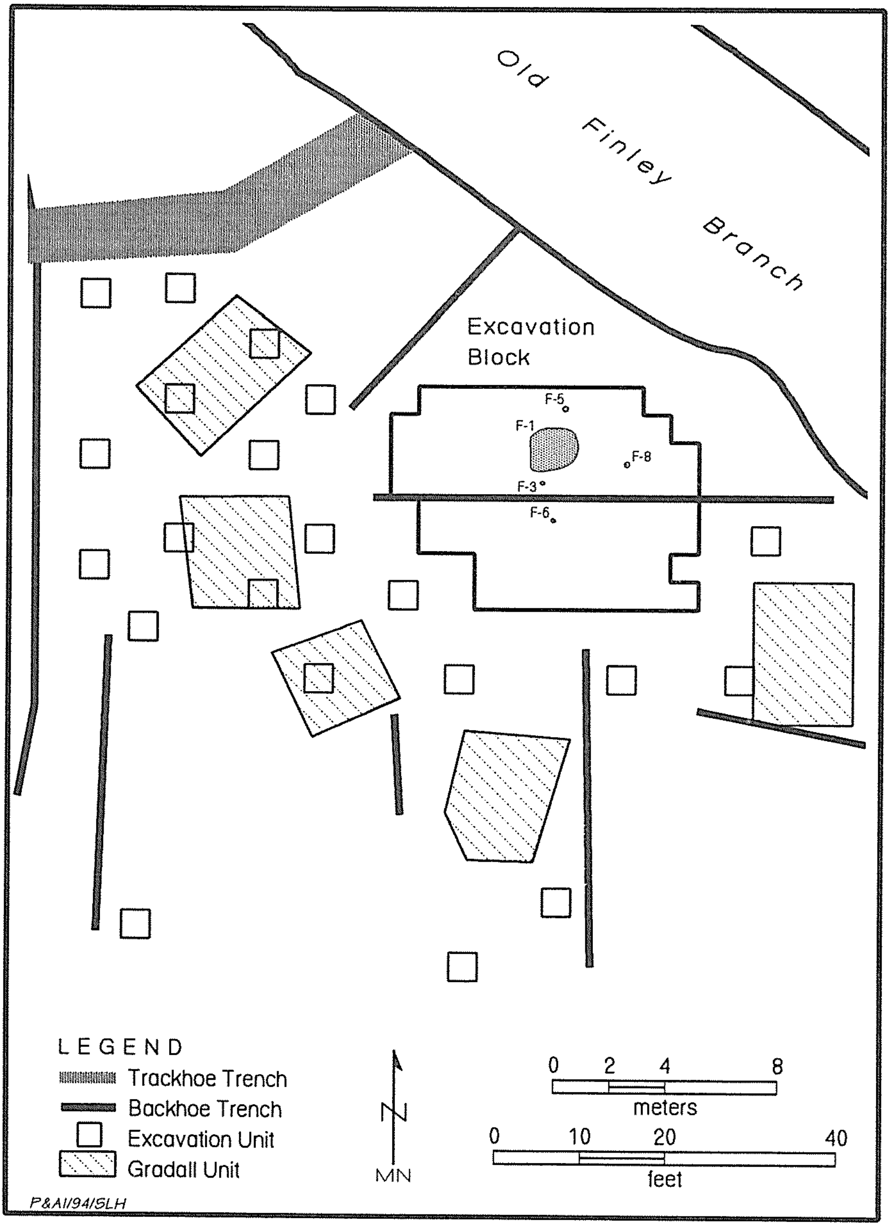

Figure 5. Plan showing all excavations in the core area of 41HP175 and features in the excavation block.

SEDIMENTS AND STRATIGRAPHY

Sediment Descriptions

Eight formal profile descriptions were done, three of which are summarized here to characterize the site sediments. Profile A, which was on the south wall of the trackhoe trench 1.7 m east of Backhoe Trench 4, typifies the upper deposits (Figure 6). The upper 15 cm consists of a brown friable silt loam to loam Ap horizon. An A horizon consisting of dark grayish brown firm loam underlies this at 15-35 cm. Between 35 and 67 cm is a very dark grayish brown firm clay loam to loam B horizon. The underlying zone, at 67-90 cm, contains the cultural deposits. It is a very dark gray to black clay loam to silty clay loam with moderate fine subangular blocky structure; it is classified as a 2A horizon. A radiocarbon assay on humates from this zone yielded a corrected age of 890 ± 60 B.P. (Beta-48210; raw ^{14}C age = 880 ± 60 B.P.; $\delta^{13}C$ = -24.3), which in conjunction with the dates on the archeological materials from the site (see Dating) suggests that this soil developed over a period of at least several hundred years.

A 2AB horizon was recorded between 90 and 115 cm, and it consists of a dark grayish brown friable silty clay loam with weak fine subangular blocky structure. The lowermost zone, at 115-130+ cm, consists of a black extremely firm silty clay loam to silty clay with moderate subangular blocky structure; it is classified as a 3A horizon. A radiocarbon assay on humates from this lower soil

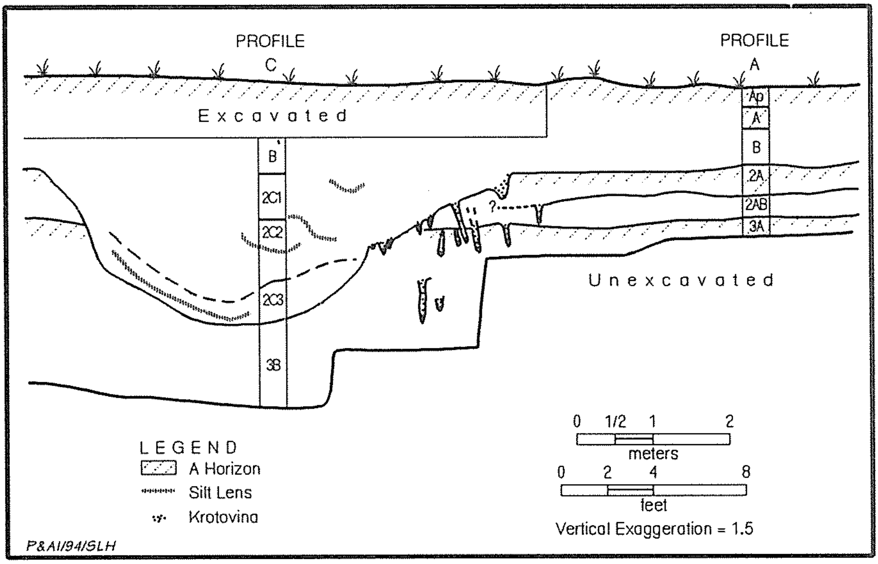

Figure 6. Profile of the eastern end of the south wall of the trackhoe trench at 41HP175; shows horizon designations for Profiles A and C and major stratigraphic units.

yielded a corrected age of 3620 ± 60 B.P. (Beta-48211; raw ^{14}C age = 3450 ± 60 B.P.; $\delta^{13}C$ = -14.7); this implies soil development over a long span of time and slow aggradation of the fan during much of the Late Holocene.

Profile C, which was on the south wall of the trackhoe trench 8.4 m east of Backhoe Trench 4, documents a filled channel, presumably an abandoned channel of Finley Branch, that cut through the upper buried soil and into the lower one (see Figure 6). The uppermost zone, at 50-80 cm below the modern ground surface (the upper 50 cm was excavated prior to recording of the profile), consists of a brown friable silt loam with a gradual lower boundary. This zone correlates stratigraphically with the B horizon of the surface soil in Profile A. The three underlying zones constitute channel fill deposits and are classified as 2C horizons. Zone 2 at 80-122 cm consists of a dark grayish brown firm silt loam, and Zone 3 at 122-177 cm is a dark gray firm loam. Both of these upper fill zones are heavily mottled and contain charcoal fragments, and silt lenses (the most conspicuous of which are shown in Figure 6) increase in frequency down-profile. The lowermost channel fill deposit, at 177-213 cm, consists of alternating lenses of very dark gray clayey sand and silt. These deposits are heavily mottled and contain rare burned rocks, bones, burned clay lumps, and charcoal fragments. A radiocarbon assay on charcoal from this zone yielded a corrected age of 590 ± 60 B.P. (Beta-48864/ETH-8896), which suggests that this channel began filling before or during the early part of the primary occupation of the site (see Dating). The abrupt lower boundary of this zone marks the base of the channel.

The primary sedimentary structures in the three channel fill zones become less distinct toward the edges of the channel, and this, along with the extreme amount of animal burrowing noted in the profile just west of the channel, makes it difficult to discern stratigraphic relationships precisely. Nonetheless, it is clear that the channel was abandoned and filled before the culturally sterile sediments above 41HP175 were deposited. Based on this, it is surmised that the upper sediments (i.e., the Ap, A, and B horizons in Profile A) were deposited by overbank flooding of Finley Branch flowing in a channel approximating the one that borders the site on the northeast.

The lowermost zone in Profile C, between 213 and 290 cm, is a dark gray very firm clay loam with moderate to strong subangular blocky structure. This is a 3B horizon associated with the lower buried soil documented in Profile A.

The lower alluvial fan deposits were exposed in Backhoe Trenches 27 and 28, with the latter providing the most informative view. The upper 168 cm in Backhoe Trench 28, which was in the bottom of the old Finley Branch channel, consists of alternating layers of brown loam and silt to fine sand; these represent channel fill modified by pedogenesis, and this zone is classified as an AC horizon. At 168-250 cm is a mottled yellowish brown and gray silty clay. This appears to be overbank deposits, and it is a 2C horizon. Between 250 and 282 cm below the bottom of the old channel is a mottled dark grayish brown and dark gray silt loam with medium moderate subangular blocky structure. This is classified as a 3A horizon. It lies ca. 445-477 cm below the modern ground surface in the core part of 41HP175. A radiocarbon assay on humates from this lowest documented soil yielded a corrected age of 9710 ± 110 B.P. (Beta-48212; raw ^{14}C age = 9570 ± 110; $\delta^{13}C$ = -16.5), which implies a moderate rate of sedimentation for this part of the fan during the Early to Middle Holocene. Beneath this soil at 282-326+ cm is a mottled yellowish brown to grayish brown loam 3C horizon.

Landform Geometry and Topography

The modern topography of 41HP175 is characterized by a low natural levee running along the left bank of the old channel of Finley Branch (see Figure 3). Thus, the modern surface and the immediately underlying deposits (i.e., the culturally sterile alluvium above 41HP175) are related to this channel. The buried soil containing 41HP175 shows a different topography consisting of a low, generally east-west ridge offset ca. 15 m south of the modern levee (Figure 7). While this ridge parallels the filled channel exposed in the trackhoe trench and Backhoe Trenches 5, 8, and 10, it is not adjacent to the channel. Hence, the ridge does not appear to be a levee associated with this channel. Rather, it appears that the depositional unit containing the site (except for perhaps its uppermost part) was laid down by flooding of an undocumented channel and that cutting of the filled channel postdated this depositional event. Figure 7 also shows that the main part of 41HP175 (the area of the excavation block and just to the northwest) was situated between the ridge crest and the creek channel, and a cross-section view of the landform reveals that the buried soil containing the site thickens in this area. This may indicate slightly more rapid deposition in this area than elsewhere.

DATING

The vertical distribution of the cultural remains, i.e., restricted to the upper 20-30 cm of the 2A horizon, and the geologic setting in an aggrading alluvial fan suggest that a limited span of time may be represented by the deposits, and this is supported by most of the 11 radiocarbon assays from archeological contexts (Table 1). Four of the radiocarbon assays are from features, two on nutshells from Feature 1 and two on wood charcoal from Features 3 and 8. The remainder are on composite nutshell samples from general fill contexts in various parts of the excavation block and from the secondary concentration of cultural materials northwest of the block (Excavation Unit 36).

While Figure 8 shows long 1-sigma ranges for some of the calibrated assays, most of the samples overlap to some degree between A.D. 1400 and 1450, and thus it appears that the site was used mostly during the early part of the Late Caddoan period. This is consistent with the very high ratio of arrow to dart

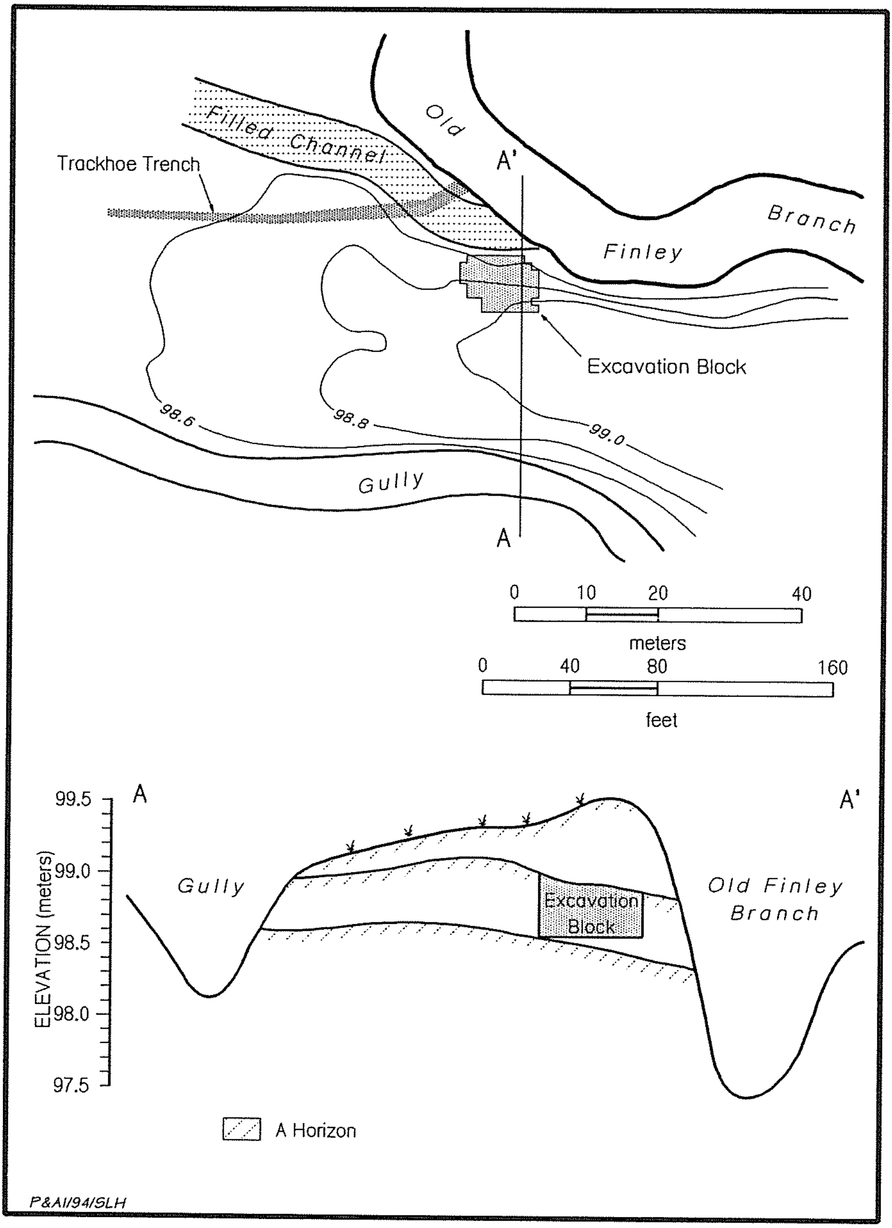

Figure 7. Topographic map of the buried soil containing 41HP175 and schematic cross section of the alluvial fan.

Table 1.
Radiocarbon Assays fromm Archeological Contexts at 41HP175

Sample No.	Provenience	^{14}C Age (B.P.)	Corrected Age (B.P.)*	Calibrated Age and Date, 1-Sigma Range**
Beta-52246	Feature 1	640 ± 80	630 ± 80 (-25.8)	546 (576, 585, 650) 673 B.P. A.D. 1277 (1300, 1365, 1374) 1404
Beta-51382	Feature 1	780 ± 50	780 ± 50 (-25.1)	678 (691) 729 B.P. A.D. 1221 (1259) 1272
Beta-51383	Feature 3	400 ± 70	390 ± 70 (-25.7)	320 (482) 514 B.P. A.D. 1436 (1468) 1630
Beta-51385	Feature 8	890 ± 70	860 ± 70 (-26.8)	697 (768) 907 B.P. A.D. 1043 (1182) 1253
Beta-51386	Excavation Unit 22, Level 2	500 ± 60	470 ± 60 (-27.2)	496 (516) 541 B.P. A.D. 1409 (1434) 1454
Beta-51387	Excavation Unit 33, Level 2	560 ± 70	540 ± 70 (-26.6)	516 (543) 639 B.P. A.D. 1311 (1407) 1434
Beta-51388	Excavation Unit 36, Level 2`	510 ± 70	490 ± 70 (-25.9)	501 (523) 550 B.P. A.D. 1400 (1427) 1449
Beta-51389	Excavation Unit 43, Level 3	400 ± 70	380 ± 70 (-26.5)	317 (476) 511 B.P. A.D. 1439 (1474) 1633
Beta-51390	Excavation Unit 74, Level 2	520 ± 80	490 ± 80 (-26.9)	496 (523) 552 B.P. A.D. 1398 (1427) 1454
Beta-51391	Excavation Unit 70, Level 2	410 ± 80	390 ± 80 (-26.4)	317 (482) 516 B.P. A.D. 1434 (1468) 1633
Beta-51392	Excavation Unit 83, Level 3	480 ± 70	470 ± 70 (-26.2)	489 (516) 544 B.P. A.D. 1406 (1434) 1461

*Ages uncalibrated; $\delta^{13}C$ values in parentheses.
**Calibrations use 20-year record of Stuiver and Reimer (1986).

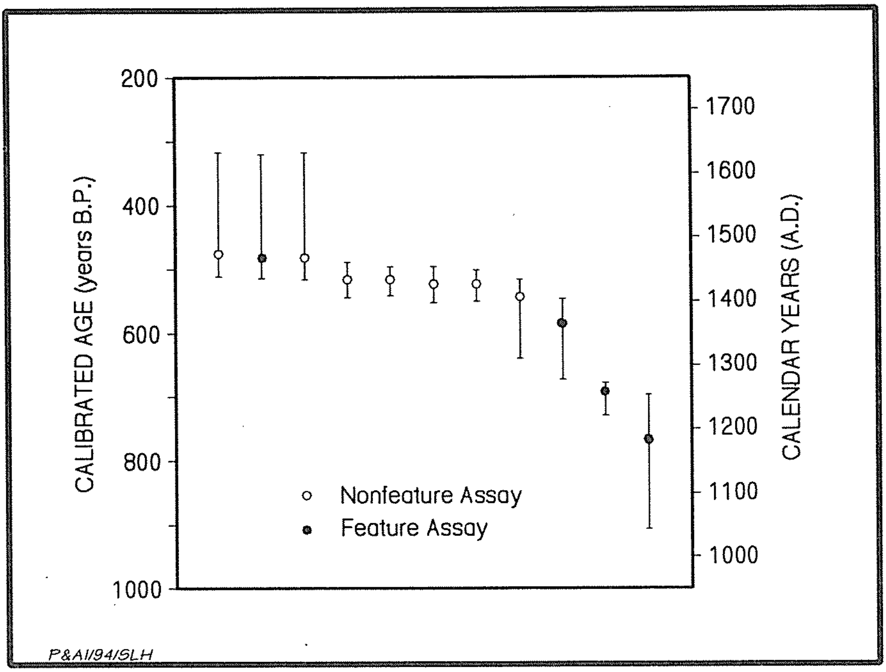

Figure 8. Plot of calibrated radiocarbon assays from archeological contexts at 41HP175; bars indicate 1-sigma ranges.

points (31.5:1), the relatively high percentage of ceramics with shell temper (40.6 percent), and most of the typeable arrow points (2 Bassett, 1 Catahoula, 8 Cliffton, 8 Fresno, 1 Homan, 31 Perdiz, 1 Rockwall, 1 Steiner, 4 Talco, and 33 Turney).

Three dates stand out as being earlier, however. The earliest one (A.D. 1043-1253) is from Feature 8. Given the likelihood that this feature represents a burned stump (see Features), this assay probably is not relevant to understanding the chronology of the site. The other two dates certainly are relevant, though, as they are from Feature 1, the hearth that lies at the center of the concentration of cultural materials sampled by the block excavation. These two assays may be interpreted in two primary ways: (1) Feature 1 dates to the latter part of the A.D. 1200s, based on the near-overlap in the 1-sigma ranges (A.D. 1221-1272 and 1277-1404); and (2) Feature 1 was used multiple times during the A.D. 1200s, 1300s, and 1400s. As presented below (see Distributions and Conclusions), however, there is evidence to suggest that neither of these interpretations is correct and that Feature 1 belongs with the A.D. 1400s occupation of the site. In brief, this evidence involves consistent distributional patterns indicating that 41HP175 represents a single component occupation with activities focused around the

Feature 1 hearth. Based on this interpretation, at least one of the radiocarbon assays from Feature 1 appears to be erroneous.

Two additional kinds of chronometric data were obtained, an archeomagnetic date from Feature 1 and three thermoluminescence assays on sherds. The archeomagnetic date provides some support for the contention that one of the radiocarbon dates from Feature 1 is too old, as one of the two possible date ranges (A.D. 1100-1150 and 1360-1380) is consistent with the later radiocarbon assay (Ellwood 1993). The thermoluminescence samples, analyzed by Dr. Robert C. Dunnell at the University of Washington, consist of two plain grog-tempered body sherds (A.D. 1251 ± 92 and A.D. 1251 ± 91) and a brushed grog-tempered body sherd (A.D. 1261 ± 64), with an assay on a shell-tempered body sherd yielding anomalous and unusable results. These dates are difficult to interpret given most of the radiocarbon assays. They may be consistent with the early date from Feature 1 suggesting use during the A.D. 1200s, but the large standard deviations extend their 2-sigma ranges into the late A.D. 1300s or early A.D. 1400s. Given the distributional evidence discussed below and most of the radiocarbon evidence, these thermoluminescence assays appear not to be fully reliable.

In short, there is limited artifactual evidence (the four Catahoula, Homan, Rockwall, and Steiner arrow points and perhaps the few dart points), radiocarbon evidence (at least one of the assays from Feature 1), and thermoluminescence evidence suggesting site use during the Early to Middle Caddoan periods. Nevertheless, the majority of the arrow points (50 percent are late triangular forms and 37 percent are probably late stemmed forms), the high incidence of shell tempering and the ceramic types represented (Avery Engraved, cf. Ripley Engraved, cf. Simms Engraved, cf. Taylor Engraved/Wilder Engraved, and Nash Neck-Banded/ McKinney Plain/Emory Punctated), and most of the radiocarbon assays indicate occupation during the Late Caddoan period.

FEATURES

Of the eight features recorded, two (Features 2 and 4) were later judged to be non-cultural, while one (Feature 7) was determined to be a fortuitous concentration of ceramics, bones, and other artifacts; these three are not discussed further here. Of the five other features, three are small semicircular to rectangular charred wood concentrations (Features 3, 5, and 6), one is a large piece of charred wood (Feature 8), and one is a large burned clay hearth (Feature 1).

Feature 1

Feature 1 consists of a large concentration of burned clay with associated soil oxidation, and it is identified as a burned clay hearth. This feature was encountered in Levels 2 and 3 of four adjacent units (see Figure 5), with some staining extending slightly into Level 4. The overall concentration is roughly oval in shape, encompassing ca. 160 x 180 cm area (Figure 9). It contains several smaller concentrated areas of burned clay, most of which appear to represent *in situ* burning, and burned clay lumps and nodules are scattered throughout. Ash deposits were not noted. Two primary soil zones exhibiting varying degrees of oxidation were observed in cross section (see Figure 9). No pit outline or prepared basin was observed, and it appears that the hearth represents fires built on the ground surface. The size of the feature and the presence of several areas of concentrated burning suggest multiple episodes of use.

A total of 2,265.5 g of burned clay and 1.0 g of burned clay with stick or grass impressions was recovered from the feature fill. Eleven burned mud-dauber nests and several nest fragments (total weight = 88.3 g) also were recovered. Six of the burned mud-dauber nests exhibit stick and/or grass impressions. The other materials recovered from the fill consist of 1 manufacture-broken distal biface fragment, 3 plain grog-tempered body sherds, 11 pieces of unmodified debitage, 2.8 g of burned rocks, 3.5 g of faunal remains (2 box turtle shell fragments and 2 unidentified bones), and 25.4 g of macrobotanical remains. The analyzed macrobotanical remains consist of 1 maize cupule, 1 squash rind fragment, 1 hackberry seed, 240 hickory nutshells, 348 unidentified nutshells, 23 *Pediomelum* (formerly *Psoralea*) root or cortex fragments, 18 pieces of *Carya* wood charcoal, and 7 pieces of unidentified wood charcoal. Among the more distinctive artifacts found immediately around Feature 1 are the following: five arrow points typed as Turney (n = 3), Bassett (n = 1), and Cliffton (n = 1), with one of the Turney points coming from Level 4 below the elevation of the feature and the other four points coming from Level 2 above or just within the upper limits of the feature; and parts of two Avery Engraved vessel sections (Vessels 22 and 23), three sherds of two Nash Neck-Banded vessel sections (Vessels 31 and 34), and one sherd of a red-slipped but otherwise undecorated carinated bowl with a crenelated lip (Vessel 26).

Features 3, 5, and 6

Features 3, 5, and 6 are pieces of charred wood that exhibit the cross-section grain of the wood in plan view. They are situated 0.3 m south-southwest, 0.8 m north-northeast, and 1.9 m south of Feature 1 (see Figure 5). In Feature 3, a single rectangular piece measuring 4 x 6 cm and extending 3 cm vertically was encountered first. About 9 cm beneath this, two crescent-shaped pieces measuring ca. 2 x 6 cm and 1 x 6 cm in plan and extending ca. 6-7 cm vertically were found lying 20 cm apart. Feature 5 consists of a single rectangular piece measuring 4 x 5 cm and extending only 1.5 cm vertically. Feature 6 is a single semicircular piece measuring 5 x 7 cm and extending 2.5 cm vertically. Outlines of disturbances (e.g., posthole margins) were not visible around any of these, and no associated staining or oxidation was observed. The only artifact recovered is a

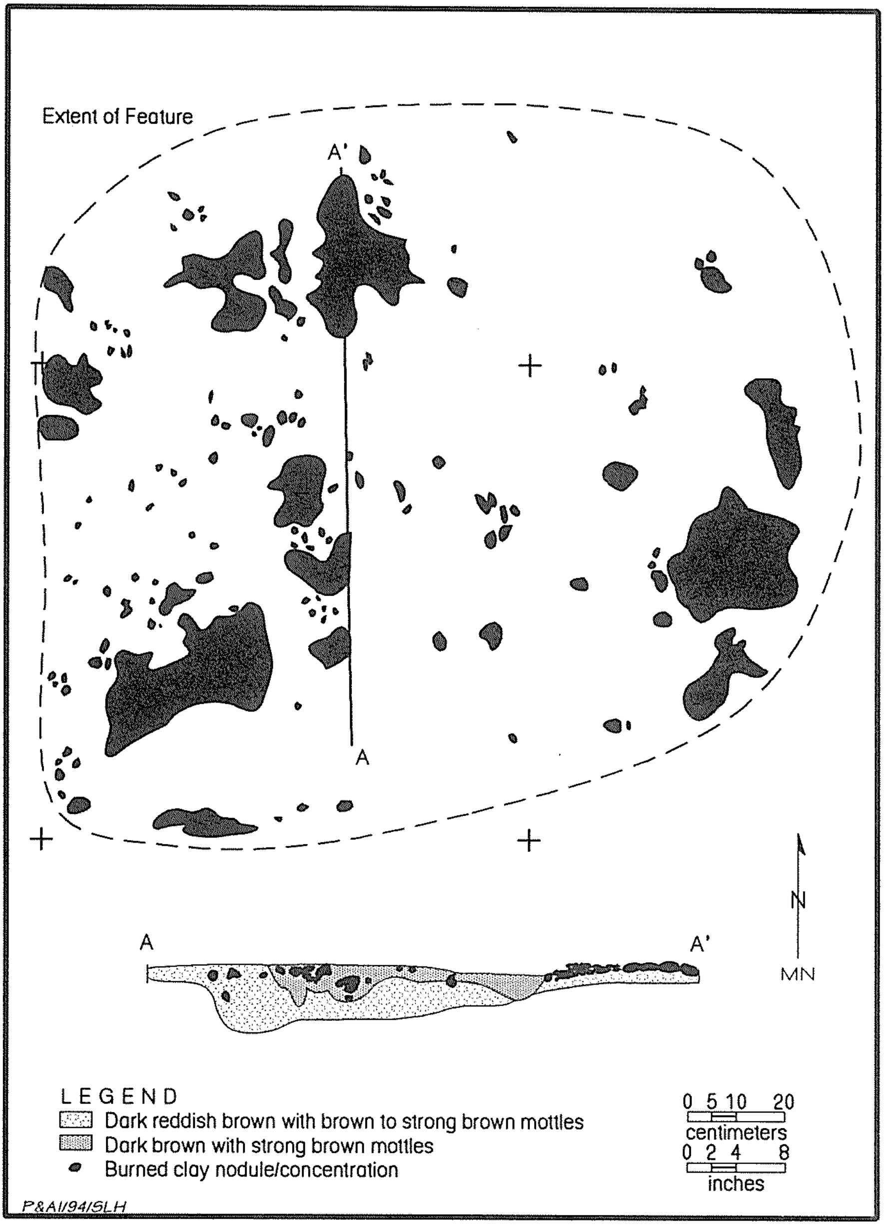

Figure 9. Plan and cross section of Feature 1 at 41HP175.

single red-slipped, grog-tempered body sherd from Feature 3. The radiocarbon assay on wood charcoal from Feature 3 has a 1-sigma range of A.D. 1436-1630, and this is consistent with most of the other radiocarbon dates from the block.

The indistinct nature of these features limits interpretations, but the visible wood grain in all three cases shows that they were oriented vertically, and thus they could represent the remains of posts or stakes that were charred prior to placement to retard rotting. Feature 3, with the most numerous pieces of charcoal, could be a single large (ca. 25 cm diameter) post or two small (ca. 7-9 cm, based on the curvature of the crescent-shaped pieces) posts or stakes. A cultural interpretation also is supported by the proximity of all three features to Feature 1. The absence of discernible postholes favors a non-cultural interpretation, however, and thus they may simply represent burned roots.

Feature 8

Feature 8, ca. 1.9 m east of Feature 1 (see Figure 5), consists of a large piece of charred wood that exhibits the cross-section grain of the wood in plan view. It measures 8 x 11 cm in plan, extends 10 cm vertically, and exhibits a roughly rectangular cross section. No posthole-like outline, soil staining, or oxidation were observed. The only recovered materials consist of 496.1 g of charred wood identified as oak root. A radiocarbon assay on this charcoal yielded a 1-sigma date range of A.D. 1043-1253. This early date and the identification of the charcoal as a root indicate that Feature 8 is non-cultural, but the distributional data suggest that this feature, in conjunction with others, served to structure the use of space at 41HP175 (see Distributions and Conclusions).

CHIPPED STONE ARTIFACTS

Arrow Points

Of the 126 arrow points recovered, 50 are complete and 76 are fragmentary. Fifty-four have use-related breaks, 22 have indeterminate breaks, one is exhausted, and 49 show no technological reason for discard. The majority (n = 94) are of fine-grained quartzite, followed by medium-grained quartzite (n = 26). The remaining points consist of three specimens each of coarse-grained quartzite and chert. Reworking is evident on 76 of the points.

Forty-seven of the complete arrow points and 43 of the fragmentary specimens can be typed, while three of the complete points and eight fragments can be grouped into five descriptive categories. The identified types (Figure 10) are Bassett (n = 2), Catahoula (n = 1), Cliffton (n = 8), Fresno (n = 8), Homan (n = 1), Perdiz (n = 31), Rockwall (n = 1), Steiner (n = 1), Talco (n = 4), and Turney (n = 33), while the descriptive groups are Broad Contracting Stem (n = 1), Basal-notched Contracting Stem (n = 5), Bulbar Stem (n = 1), Triangular with Concave Base (n = 3), and Triangular with Convex Base (n = 1). The remaining 25 specimens are too fragmentary to be typed or placed into descriptive groups.

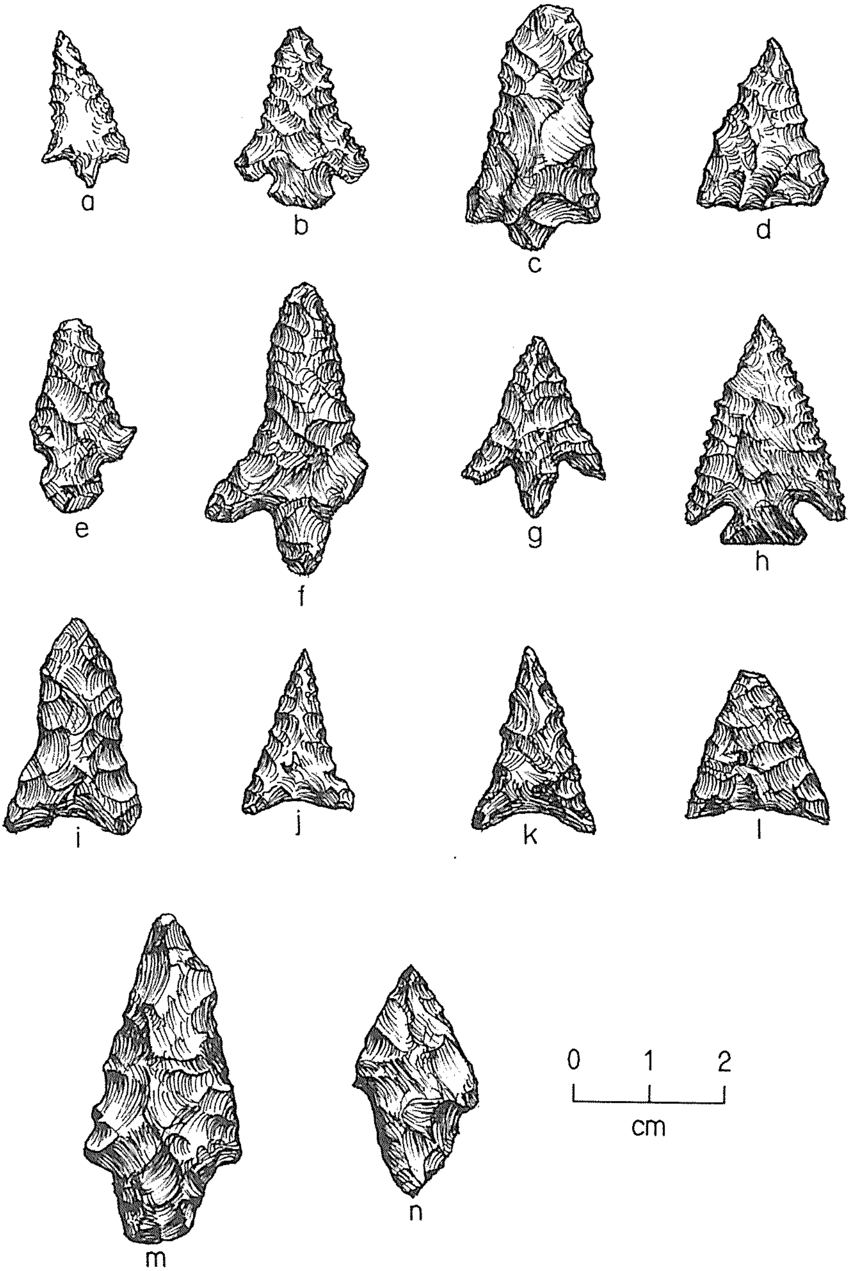

Figure 10. Typed projectile points from 41HP175: a, Bassett; b, Catahoula; c, Cliffton; d, Fresno; e, Homan; f-g, Perdiz; h, Rockwall; i, Talco; j-l, Turney; m-n, Gary.

Arrow Point Preforms

Included under this heading are 43 arrow point blanks and preforms and/or arrow points broken in manufacture. Of these, four are complete and 39 are fragmentary. The majority (n = 39) are of fine-grained quartzite, followed by two of medium-grained quartzite, one of coarse-grained quartzite, and one of chert. None exhibit evidence of reworking. Thirty-one were broken during manufacture, while eight have indeterminate breaks; of the remaining specimens, three were discarded due to manufacturing difficulties (e.g., step fractures, knots, etc.), and one shows no technological reason for discard.

Dart Points

Only four dart points were recovered. Two are complete, while the remaining two are a medial fragment and a barb fragment. Three are made of fine-grained quartzite, and the other is of medium-grained quartzite. Grinding is present on the stem of only one specimen, while reworking is evident on three. The two complete dart points are typed as Gary (see Figure 10n), while the remaining two are untypeable fragments.

Dart Point Preforms

Included in this category is a single specimen identified as a possible dart point preform. It is a proximal fragment of fine-grained quartzite, exhibits a manufacture break, and lacks any evidence of grinding or reworking.

Gouges

Twenty-nine gouges and gouge fragments were recovered. Sixteen are complete. Most (n = 21) are made of fine-grained quartzite, while six are of medium-grained quartzite, and two are of chert. Use wear was recorded on 15, while haft wear is evident on five specimens. Seven gouges exhibit use-related breaks, three have indeterminate breaks, and three were broken during manufacture; of the remainder, two appear to have been discarded as a result of manufacturing difficulties, one is exhausted, and 13 show no technological reason for discard. Three of the gouges contain a dark brown to black residue which may represent resin or asphaltum used in hafting. Five are small triangular forms with minimal shaping or ventral face resharpening (Figure 11a), 16 are small triangular forms with moderate to substantial shaping or ventral face resharpening (Figure 11b), two are small triangular forms with moderate to substantial shaping or ventral face resharpening and recurved lateral edges due to haft shaping, three are badly fragmented small triangular specimens, one is a large triangular specimen with minimal shaping or ventral face resharpening, and the remaining two are large

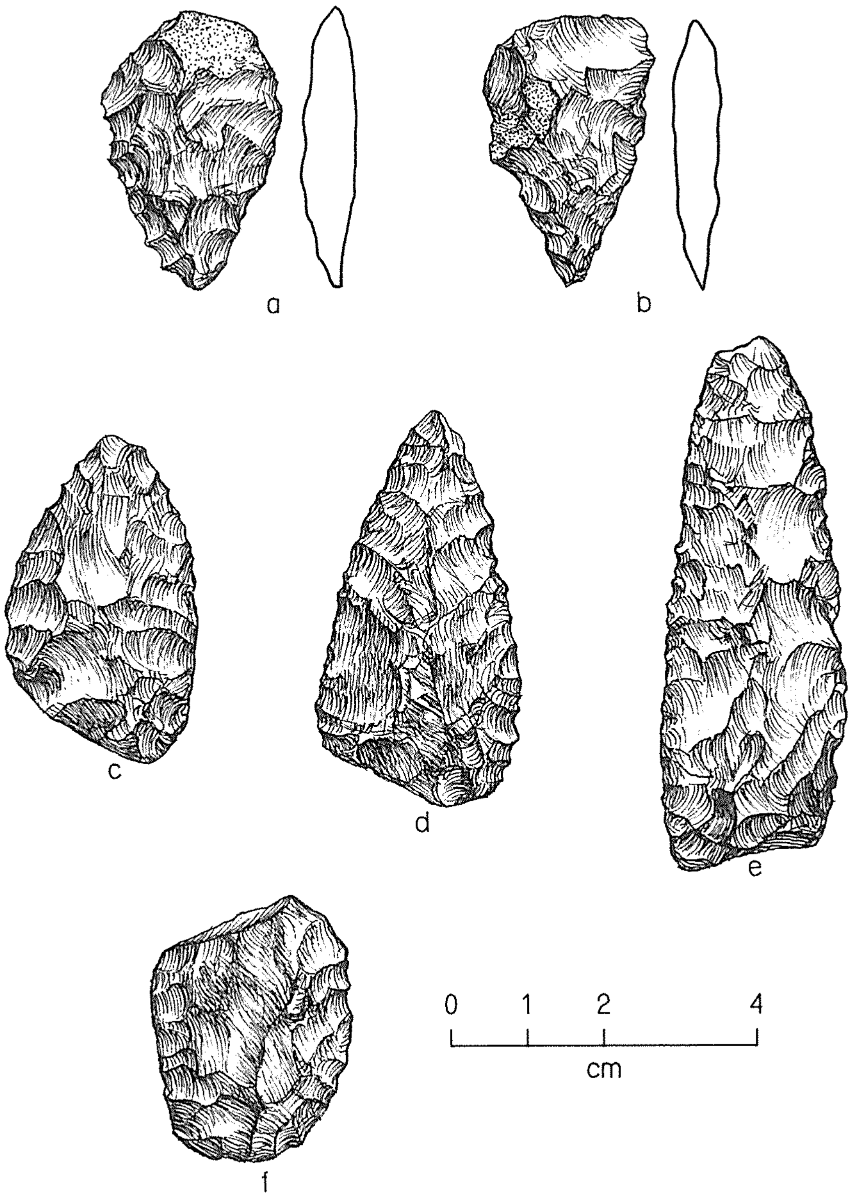

Figure 11. Gouges and bifacial tools from 41HP175: a, Small triangular gouge with minimal shaping; b, small triangular gouge with moderate to substantial shaping; c-d, asymmetrical bifacial cutting tools/knives; e, bifacial knife; f, bifacial cutting tool/scraping implement.

triangular forms with moderate to substantial shaping or ventral face resharpening.

Bifaces

A total of 103 bifaces and biface fragments that were discarded in the early to middle stages of reduction and four bifacial tools and tool fragments that could not be grouped into any of the other formal tool categories were recovered. Of the four tools, two are complete and two are proximal fragments. All of these are late reduction stage bifaces. The two complete specimens are of fine-grained quartzite. They are asymmetrically subtriangular to triangular in shape, with one lateral edge that is greater in length than the opposite edge (see Figure 11c, d). Both specimens show pressure flaking and use wear and no technological reason for discard. In addition, both exhibit evidence of haft wear, and both have traces of dark brown to black residue that may represent resin or asphaltum used in hafting. These items appear to have functioned as cutting tools or knives but also may have been used as scraping implements. The third tool is missing only a small portion of the distal end and appears to have been broken as a result of use (see Figure 11e). It is relatively long and narrow and is made of fine-grained quartzite. It exhibits use wear and evidence of haft wear, and the primary working edge has relatively well patterned pressure flaking. Small traces of possible asphaltum or resin were also noted. It appears to have been used primarily as a bifacial knife. The last tool is of medium-grained quartzite (see Figure 11f). This specimen exhibits use wear, pressure flaking, and an indeterminate break type. It may have been used as a cutting tool and/or scraping implement.

Most of the specimens under this heading (n = 103) are bifaces broken or aborted in the early or middle stages of reduction. Only nine of these are complete. Discard and break patterns indicate that 43 were broken during manufacture, and nine were discarded due to manufacturing difficulties; the remaining 51 have indeterminate breaks. The majority (n = 71) are of fine-grained quartzite, 25 are of medium-grained quartzite, six are of coarse-grained quartzite, and one is of chert. Forty-four exhibit edge grinding. Pressure flaking is present on 13 specimens, it is absent on most (n = 84), and it is indeterminate on six others. Given the nature of this group of bifaces, the presence of edge grinding and/or pressure flaking is likely related to platform preparation rather than use as tools. In addition, none of the bifaces in this group show evidence of use wear.

Unifaces

A total of 103 unifaces and uniface fragments was recovered. Most of these (n = 59) are classified as expedient unifaces, 30 are formal unifaces, and 14 are uniface edge fragments. Of the formal unifaces, 24 are end scrapers (Figure 12),

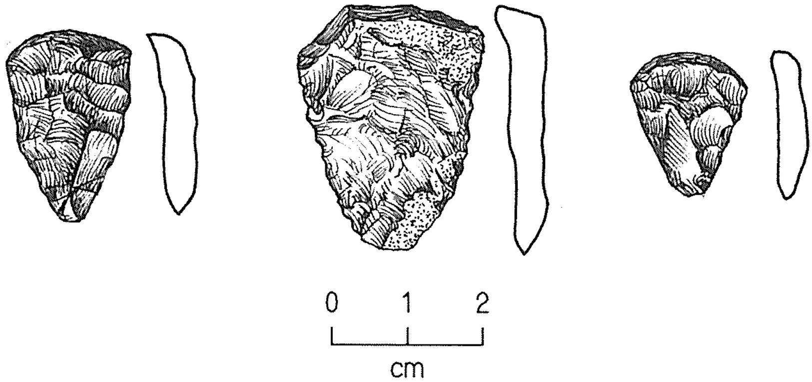

Figure 12. Unifaces (end scrapers) from 41HP175.

four are side scrapers, one is a combination end and side scraper, and one is an indeterminate uniface. Eighteen of the formal unifaces are complete. Most (n = 24) are made of fine-grained quartzite, and six are of medium-grained quartzite. All of the end scrapers and three of the side scrapers have single working edges, while the remaining three specimens have two working edges. An analysis of discard and break patterns indicates that seven are use broken, eight appear to be exhausted, five have indeterminate breaks, one was discarded because of manufacturing difficulties, and the reason for discard on the remaining nine could not be discerned. Use wear is present on 25 specimens. Most of these (n = 20) also have evidence of haft wear. In addition, 17 exhibit traces of possible asphaltum or resin that may have been used in hafting.

The majority of the expedient unifaces (n = 40) are classified as side scrapers, one is an end scraper, nine are combination end and side scrapers, and nine are gravers. Of the side scrapers, seven have pointed projections and may have functioned also as engraving tools, one has a concave scraping edge which suggests use as a spokeshave, and two have both pointed projections and concave scraping edges. Twenty-three of the expedient unifaces are complete. Thirty-seven are of fine-grained quartzite, 20 are of medium-grained quartzite, one is of coarse-grained quartzite, and one is of chert. Twenty-seven have single working edges, 17 have two working edges, 13 have three working edges, and two gravers have four or more working edges. One specimen exhibits a manufacture break, while the break type could not be assessed confidently on most (n = 35); the remainder show no technological reason for discard. Use wear is present on 43 specimens, and none have evidence of haft wear.

The remaining unifaces (n = 14) are edge fragments. Of these, nine are of fine-grained quartzite, two are of medium-grained quartzite, two are of coarse-grained quartzite, and one is of chert. Eleven have single working edges, and three have two working edges. Break causes could not be assessed confidently.

Use wear is present on 10, while haft wear could not be discerned on any of the fragments.

Cobble Tools

Seven cobble tools were recovered. Four are complete. One is of fine-grained quartzite, two are of medium-grained quartzite, three are of coarse-grained quartzite, and one is of silicified wood. All seven have single working edges. One has a use-related break, two have indeterminate breaks, and four show no technological reason for discard.

Four of the cobble tools are relatively large and appear to have been used in chopping tasks. One is cortex backed, and two exhibit battering on the proximal ends. All four are bifacially shaped, although the single complete specimen exhibits minimal modification from the parent core. Three of the chopping tools have step fracturing and rounding on the working edges. The remaining three cobble tools are smaller and appear to have been used as wedges. All three are complete and have cortex-backed proximal ends. In addition, all of the wedges have evidence of battering on the cortex-backed ends.

Edge-modified Flakes

Seventy pieces of edge-modified debitage were recovered. Of these, 28 are complete flakes, 21 are proximal flakes, 19 are chips, and two are edge-modified chunks. Most (n = 63) are of fine-grained quartzite, while six are of medium-grained quartzite, and only one is of chert. Secondary flakes (specimens that have cortex on 1-99 percent of their dorsal surfaces) make up 53 percent of the edge-modified flakes (n = 36), tertiary flakes account for 46 percent (n = 31), and a single edge-modified primary flake accounts for the remaining 1 percent. Of the two edge-modified chunks, cortex is present on one specimen and absent on the other. The majority of the edge-modified debitage (n = 52) exhibit single working edges, while 16 specimens contain two utilized edges, one has three utilized edges, and one has four working edges.

Cores

A total of 219 cores and core fragments was recovered. Almost all of these are of quartzite (n = 216); 149 are of fine-grained quartzite, 65 are of medium-grained quartzite, and two are of coarse-grained quartzite. The three cores of non-quartzite materials consist of two chert specimens and one of silicified wood. The mean number of flake scars is 3.0 ± 1.9 with a range of 1 to 14 scars.

Unmodified Debitage

The excavations recovered 13,365 pieces of unmodified debitage. A sample of 6,043 specimens was analyzed, consisting of all debitage from alternating units in the excavation block. A limited set of attributes (raw material, flake type, maximum dimension, dorsal cortex percentage, and chunk cortex presence/ absence) was recorded for 5,075 specimens. For the remainder of the analyzed sample, consisting of all 968 specimens from seven randomly chosen units, three attributes concerning platform characteristics (platform cortex, platform grinding, and platform facet count) were also recorded.

The analyzed debitage consists of 17 percent complete flakes, 14 percent proximal flakes, 69 percent chips, and 1 percent angular chunks. By far the most common material type is quartzite, with fine-grained quartzite representing 76 percent of the sample and medium-grained quartzite constituting 23 percent. Few specimens are of other raw materials, with only 1 percent being coarse-grained quartzite and less than 1 percent each being chert, silicified wood, novaculite, and miscellaneous materials. Most of the debitage is in the 11-20 mm size category (73 percent), and the next-largest class is 21-30 mm (20 percent). Relatively few specimens measure 1-10 mm (4 percent) and 31-40 mm (3 percent), and even fewer are 41-50, 51-60, and 61-70 mm (<1 percent each). Just over half (53 percent) of the complete flakes, proximal flakes, and chips are tertiary (have no cortex). Specimens with cortex on 1-50 percent of their dorsal surfaces constitute the second-largest category (31 percent), while 15 percent have 51-99 percent dorsal cortex and 1 percent are primary. Among the angular debitage, 82 percent retain some cortex. Of the fully analyzed flakes (n = 315), 86 percent have single-faceted platforms, 10 percent have two facets, and 3 percent have or three or more facets. Platform grinding and platform cortex each are present on 24 percent of the platforms.

The debitage from 41HP175 indicates that local quartzites, and especially fine-grained quartzites, were the favored materials for chipped stone tool production, almost to the exclusion of other materials. Differences in attributes between the raw materials are minor, the most notable being that the fine-grained quartzite debitage tends to be relatively small and decorticate compared to the coarser-grained materials. This reflects the more intensive reduction of the finer-grained materials (i.e., they tended to be carried further through the reduction sequence). The extreme infrequency of specimens of chert and novaculite indicates that tools of these materials probably were resharpened but not manufactured on site.

CERAMICS

A total of 3,823 ceramic sherds was recovered. Ceramic crumbs make up 1,868 of these, and due to their small size they were not analyzed. Eight non-vessel ceramic fragments also were recovered, and they are discussed separately below. The analyzed vessel ceramics number 1,947 sherds. They are described under two headings below. The first discusses the entire sherd collection, and the second discusses the vessels reconstructed from the more distinctive sherds.

Vessel Sherd Descriptions

The three primary types of temper in the sherds are grog, shell (most of which has been leached away), and bone. Grog is the sole tempering agent in over half (n = 1,108) of the sherds, while 773 sherds have only shell temper. Bone temper alone occurs in just one sherd; 41 sherd have grog and bone, 16 have grog and shell, and eight have no temper.

The maximum dimensions of the analyzed sherds range from 1.1 to 12.0 cm, but the majority (n = 1,566) are less than 4.0 cm. Sherds that exceed 4.0 cm total 381 and form 20 percent of the analyzed sample. This relatively large percentage of sizable sherds probably can be attributed to the discrete occupation and limited trampling. The sherds range in thickness from 0.30 to 1.78 cm ($\bar{x} = 0.66 \pm 0.17$). The majority (n = 1,646) fall between 0.40 and 0.80 cm. Most of the body/base and base sherds, however, are somewhat thicker ($\bar{x} = 1.10 \pm 0.29$ cm). Of these, those with leached shell temper are slightly thicker ($\bar{x} = 1.25 \pm 0.24$ cm) than those with grog temper ($\bar{x} = 0.91 \pm 0.23$ cm).

Body sherds make up the vast majority (n = 1,739) of the collection, rims number 176, and the remainder (n = 32) are base sherds. Over half of the rims are large enough to indicate form. Of these, 57 are everted, 24 are inverted, and 10 are straight. The inverted rim forms are dominated by exterior rolled lips (n = 10), with five rims having tapered lips, four having flat lips, and one having a rounded lip. The everted rims have a more even distribution of lip forms (18 exterior rolled, 14 rounded, 13 flat, nine tapered, and three indeterminate). Straight rims are evenly split between tapered (n = 4) and flat (n = 4) lips, with two sherds having exterior-rolled lips. Crenelated lips occur only on inverted rims (n = 4) and on one rim of indeterminate form. Most of the base sherds are too small to give an indication of form, but some of the more distinctive grog-tempered and leached shell-tempered specimens are flat bases with simple contours, while a few leached shell-tempered sherds are suggestive of flowerpot-shaped forms.

Sherds with red-slipped surfaces number 103, while three sherds have a white slip. Seventy-nine are body sherds, 26 are rims, and one is a body/base fragment. Most (n = 92) are slipped on both their interior and exterior surfaces, with 12 having only exterior slipping and two having interior slipping. An additional nine sherds have red pigment within incised or engraved lines.

Decorated sherds comprise 21 percent (n = 411) of the analyzed ceramics. Decorated shell-tempered specimens are relatively infrequent (n = 15), possibly because of the higher frequency of exterior surface erosion. Engraving (n = 167) and fingernail punctating (n = 113) are the most common decorative techniques, followed by brushing (n = 66), appliquéd fillets or nodes (n = 23), fingernail punctating with appliqué (n = 15), incising (n = 14), stick punctating (n = 6), cord impressing (n = 3), pinching (n = 2), and brushing/impressing (n = 2).

Vessel Descriptions

At least 54 vessels are represented. The 269 sherds assigned to vessels constitute 14 percent of the collection, and most of the remaining sherds probably represent portions of the undecorated bodies of the identified vessels. Thirty-nine vessels are represented by rim or body sections large enough for classification based on form. A variety of forms are identified, including carinated bowls, simple bowls, deep bowls, bottles, globular jars, and cylindrical jars (Figure 13).

Carinated Bowls

Twelve vessels are carinated bowls (Table 2). All but two are grog tempered, with one of the grog-tempered vessels also containing bone. The other two have leached shell temper and soft silty pastes with light gray to black cores and light gray to light yellow brown surfaces. The exterior walls of both vessels are eroded, but Vessel 42 does retain some evidence of smoothing on the interior wall. The grog-tempered vessels have moderately hard pastes with generally light gray to black cores. The core colors of Vessels 26 and 52 differ from those of the other grog-tempered vessels in that they are red brown and yellow brown, respectively. Wall colors vary from black to dark brown to yellow brown on most vessels. In a few instances, it is clear that post-depositional weathering has affected wall color, with eroded vessel walls exhibiting yellow to yellow brown coloration. In the cases of Vessels 15 and 17, light yellow sherds were refitted to chocolate brown vessel sections. Only Vessel 26 is red slipped. Burnishing is the most prevalent surface finish, occurring on both the interior and exterior surfaces of all but four (Vessels 12, 42, 43, and 52) of the grog-tempered vessels.

Everted, inverted, and straight rim forms are represented in the carinated bowls. Vessels 26, 42, and 52 (see Figure 13) stand out in that they have rims that tend toward the narrow, sharply inverted form characteristic of Simms Engraved (Suhm and Jelks 1962:141). The lip of Vessel 26 is also unusual in that it is crenelated (Figure 14a), and like the lip on Vessel 52, it is oriented almost at a right angle to the rest of the rim. The lips on the majority of the rest of the grog-tempered vessels are exterior rolled. There appears to be no correlation between lip form and rim orientation. Nine of the 12 vessels have rim sections large enough to permit a diameter measurement. These range from 11.0 to 38.0 cm, with seven (58 percent) ranging from 22.0 to 29.0 cm. Mean wall thickness for all the vessels in the group ranges from 0.48 to 0.79 cm. No association between the size of the vessel and the thickness of the vessel wall is apparent.

Rim decoration is similar in both technique and element/motif for the majority of the vessels in this group. All except the Simms-like bowls and the leached shell-tempered bowls, which are plain, have an engraved slanted scroll or scroll motif encircling the vessel from the lip to the carination. A slanted scroll

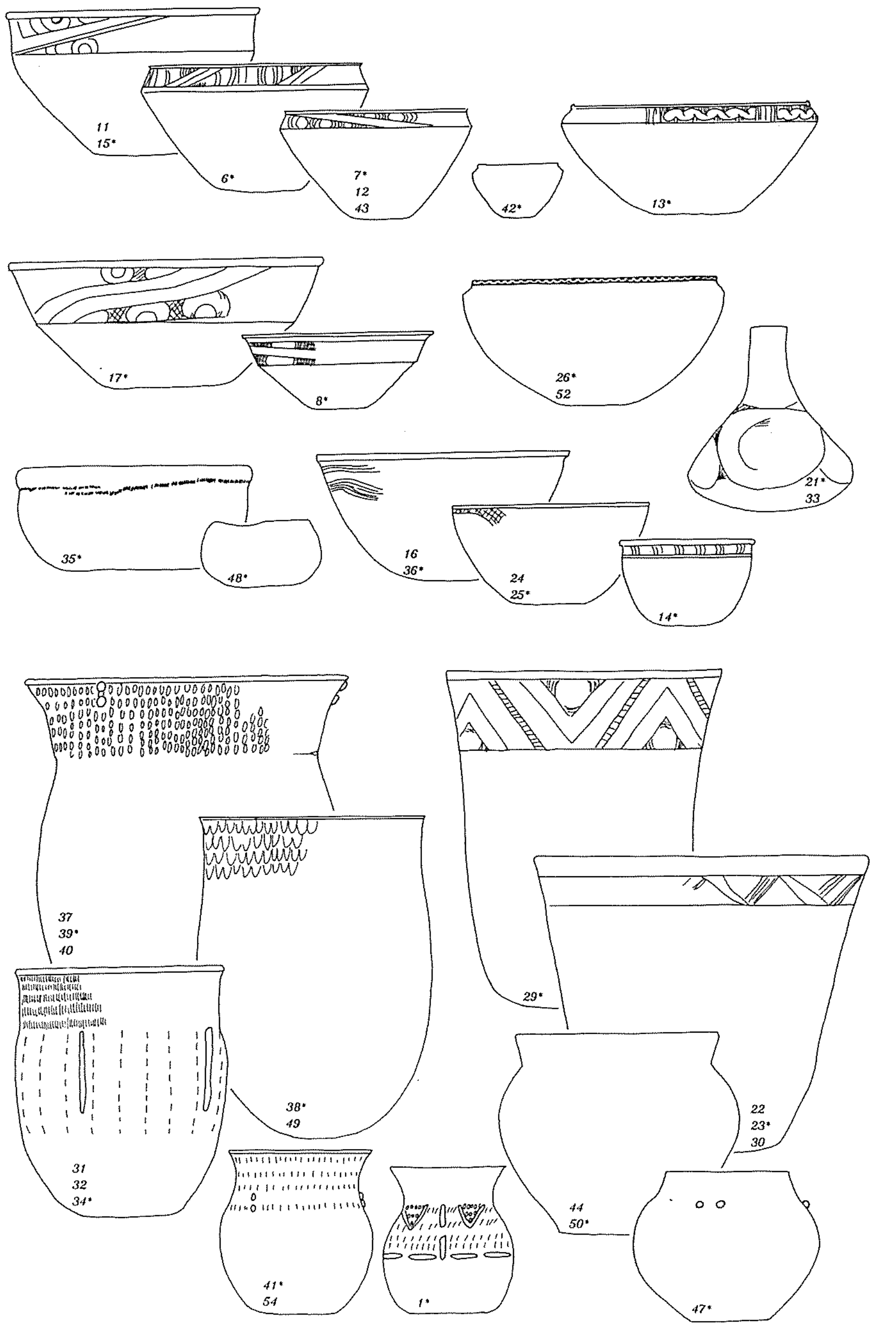

Figure 13. Vessel forms represented in the sherds from 41HP175; the numbers indicate vessel numbers (see Table 2). Vessel numbers with asterisks are those illustrated here, while those without are similar in form but not necessarily in size or motif.

Table 2.
Characteristics of the Ceramic Vessels from 41HP175

Form	Vessel Number	Rim/ Body	No. of Refits	Thickness (Cm)	Rim Diameter (Cm)	% of Rim Present	Rim Orientation	Lip Form	Motif/Element	Interior/ Exterior Slip	Temper
Carinated Bowls	6	3/6	5	0.61±0.04	26.5	13	Inverted	Exterior rolled	Slanted scroll	Absent/absent	Grog
	7	2/0	1	0.56±0.06	22.0	7	Inverted	Exterior rolled	Slanted scroll	Absent/absent	Grog
	8	1/1	1	0.48±0.03	22.0	7	Everted	Exterior rolled	Slanted scroll	Absent/absent	Grog
	11	3/2	0	0.57±0.09	-	-	Straight	Exterior rolled	Slanted scroll	Absent/absent	Grog
	12	4/3	2	0.49±0.05	27.0	10	Inverted	Exterior rolled	Slanted scroll	Absent/absent	Grog
	13	4/0	2	0.61±0.06	28.0	19	Inverted	Exterior rolled	Scroll	Absent/absent	Grog
	15	2/0	1	0.61±0.04	29.0	10	Everted	Exterior rolled	Slanted scroll	Absent/absent	Grog
	17	1/1	1	0.79±0.05	38.0	13	Everted	Rounded	Slanted scroll	Absent/absent	Grog
	26	5/0	3	0.55±0.04	26.0	10	Inverted	Crenelated	Plain	Present/present	Grog/bone
	42	3/1	1	0.61±0.05	11.0	40	Inverted	Tapered	Plain	Absent/absent	Leached shell
	43	1/0	-	0.67	-	-	Indeterminate	Indeterminate	Plain	Absent/absent	Leached shell
	52	1/0	-	0.64	-	-	Inverted	Indeterminate	Plain	Absent/absent	Grog
Simple Bowls	14	2/0	1	0.64±0.03	15.0	13	Straight	Exterior rolled	Horizontal band with vertical curved lines	Absent/absent	Grog
	16	1/0	-	0.50	-	-	Everted	Exterior rolled	Zoned crosshatching (slanted scroll?)	Absent/absent	Grog
	24	1/0	-	0.60	-	-	Everted	Rounded	Zoned crosshatching (slanted scroll?)	Present/present	Grog
	25	2/1	2	0.56±0.06	26.0	6	Everted	Rounded	Zoned crosshatching (slanted scroll?)	Present/present	Grog
	36	2/4	1	0.73±0.05	30.0	7	Everted	Rounded	Miscellaneous curved lines	Absent/absent	Grog
	48	3/0	1	0.62±0.02	11.0	38	Inverted	Tapered	Plain	Absent/absent	Leached shell
Deep Bowls	22	1/2	2	0.68±0.05	-	-	Everted	Tapered	Diagonal lines, ladders, and circles	Present/present	Grog
	23	8/6	9	0.66±0.04	31.0	22	Everted	Tapered	Diagonal lines, ladders, and circles	Present/present	Grog

Table 2 (Continued).

Form	Vessel Number	Rim/ Body	No. of Refits	Thickness (Cm)	Rim Diameter (Cm)	% of Rim Present	Rim Orientation	Lip Form	Motif/Element	Interior/ Exterior Slip	Temper
	29	3/5	1	0.71±0.04	35.0	12	Everted	Rounded	Horizontal band with diagonal lines	Present/present	Grog
	30	0/3	2	0.65±0.02	-	-	-	-	Diagonal lines, ladders and circles	Present/present	Grog
Collared Bowl	35	4/1	3	0.65±0.10	26.0	19	Straight	Tapered	Horizontal cord impressions	Absent/absent	Leached shell
Bottles	21	0/8	1	0.62±0.06	-	-	-	-	Curvilinear body motif	Absent/absent	Grog
	33	0/17	7	0.74±0.07	-	-	-	-	Curvilinear body motif	Absent/absent	Grog
Globular Jars	44	1/0	-	0.73	22.0	9	Everted	Flat	Plain	Absent/absent	Leached shell
	47	4/6	4	0.59±0.03	15.0	49	Inverted	Flat	Appliquéd nodes	Absent/absent	Leached shell
	50	1/1	-	0.56±0.06	-	-	Everted	Tapered	Plain	Absent/absent	Leached shell
Cylindrical Jars	31	5/1	0	0.64±0.07	37.5	10	Everted	Exterior rolled	Appliquéd fillets	Absent/absent	Grog
	32	6/4	0	0.64±0.04	27.0	15	Everted	Exterior rolled	Miscellaneous appliqué	Absent/absent	Grog
	34	1/21	0	0.55±0.05	-	-	Everted	Indeterminate	Rows of end-to-end punctations with appliqué	Absent/absent	Grog
	37	1/0	-	0.75	30.5	7	Everted	Rounded	Roughened horizontal punctations	Absent/absent	Grog
	38	1/0	-	0.80	27.0	6	Everted	Exterior rolled	Roughened horizontal punctations	Absent/present	Grog
	39	7/25	2	0.77±0.09	37.5	9	Everted	Flat	Roughened horizontal punctations with appliqué	Absent/absent	Grog
	40	1/1	0	0.90±0.08	-	<5	Indeterminate	Rounded	Pinched rows	Absent/absent	Grog
	49	7/17	7	1.10±0.08	30.5	26	Everted	Flat	Plain	Absent/absent	Grog

Table 2 (Continued).

Form	Vessel Number	Rim/ Body	No. of Refits	Thickness (Cm)	Rim Diameter (Cm)	% of Rim Present	Rim Orientation	Lip Form	Motif/Element	Interior/ Exterior Slip	Temper
Small Cylindrical Jars	1	0/10	4	0.38±0.02	-	-	-	-	Rows of slanted punctations with appliqué	Absent/absent	Grog
	41	1/1	0	0.64±0.03	16.0	8	Everted	Exterior rolled	Roughened horizontal punctations with appliqué	Absent/absent	Grog
	54	1/0	-	0.50	16.0	9	Everted	Exterior rolled	Roughened horizontal punctations	Absent/absent	Grog
Indeterminate	2	2/1	3	0.61±0.03	-	-	Everted	Rounded	Horizontal rows of punctations	Absent/absent	Grog
	3	1/0	-	0.87	-	-	Everted	Exterior rolled	Diagonal rows of punctations	Absent/absent	Grog
	4	0/3	0	1.00±0.09	-	-	-	-	Field of random punctations	Absent/absent	Grog
	5	0/1	-	0.65	-	-	-	-	Zoned stick punctations	Absent/absent	Grog
	9	0/2	0	0.61±0.04	-	-	-	-	Slanted scroll	Absent/absent	Grog
	10	1/0	-	0.81	-	-	Indeterminate	Flat	Miscellaneous straight lines	Absent/absent	Leached shell
	18	1/0	-	0.76	-	-	Everted	Rounded	Plain	Absent/absent	Leached shell
	19	0/1	-	0.64	-	-	-	-	Curved lines with triangular spurs	Absent/absent	Grog
	20	0/1	-	0.74	-	-	-	-	Curved lines with triangular spurs	Absent/absent	Grog
	27	1/4	0	0.63±0.10	-	-	Everted	Rounded	Border for circle/oval panel	Present/present	Grog/ Leached shell
	28	0/1	-	0.62	-	-	-	-	Border for circle/oval panel	Present/present	Grog
	45	1/0	-	0.57	-	-	Straight	Flat	Roughened horizontal punctations	Absent/absent	Leached shell
	46	1/2	0	0.69±0.08	-	-	Inverted	Rounded	Plain	Absent/absent	Leached shell
	51	2/0	0	0.65±0.06	-	-	Inverted	Exterior rolled	Plain	Present/present	Grog
	53	1/0	-	0.58	-	-	Everted	Exterior rolled	Roughened horizontal punctations	Absent/absent	Grog

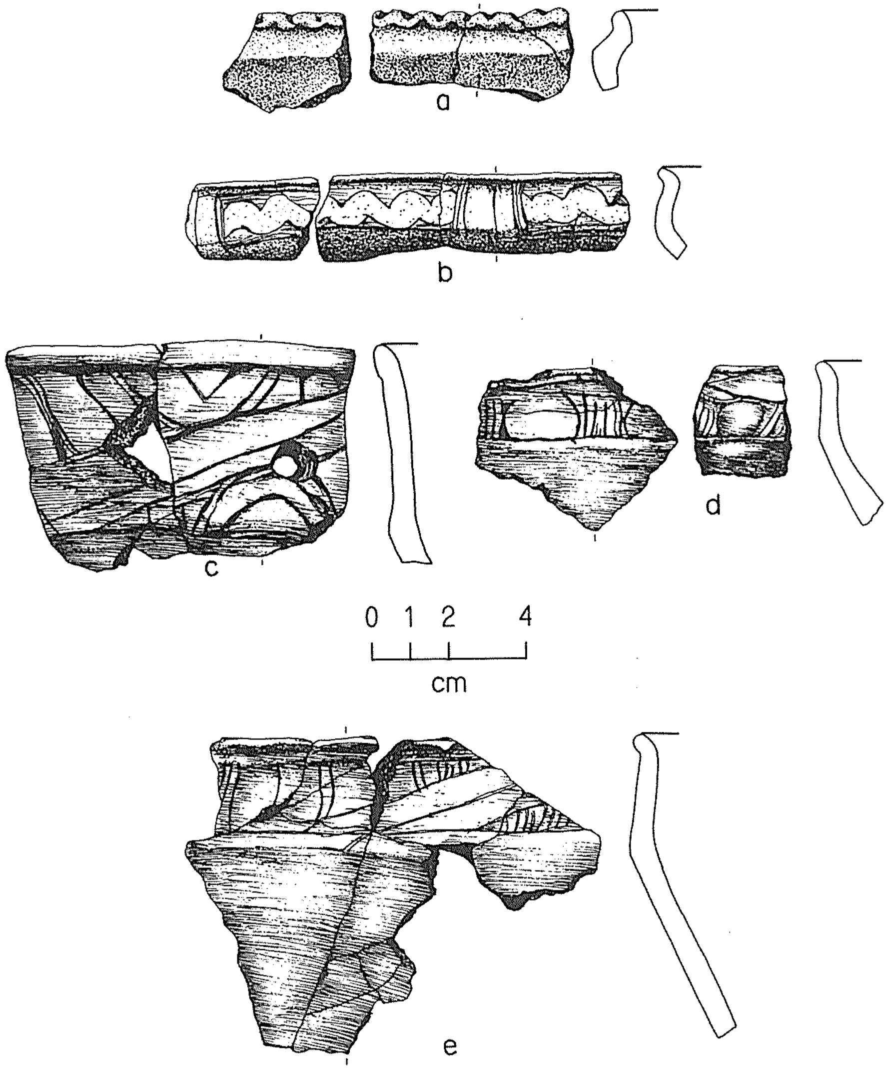

Figure 14. Carinated bowls from 41HP175: a, Vessel 26, plain with crenelated lip; b, Vessel 13, scroll; c, Vessel 15, slanted scroll; d, Vessel 11, slanted scroll; e, Vessel 6, slanted scroll.

is a derivation of the classic scroll, one example of which is found on Vessel 13 (Figure 14b). The slanted scroll consists of two parallel diagonal lines that define an empty space flanked by two areas filled with circular or linear elements. In some cases the diagonal empty space is bisected by a single diagonal line. The slanted scroll and its flanking areas form a rectangular panel which may have been repeated several times around the circumference of the vessel. Unlike some slanted scroll motifs such as those found on some Ripley Engraved and Taylor Engraved vessels (Suhm and Jelks 1962:Plate 64a and b, Plate 75i, l, and o), the slanted scrolls from 41HP175 appear to deemphasize spiral or circular elements at the ends of the scroll. On Vessel 15, where the end of the slanted scroll is preserved, the diagonal appears to terminate in a rectilinear fashion. In two other examples (Vessels 6 and 12), the diagonals end abruptly at the horizontal lines that define the edges of the decorated panel.

Three different element configurations are found as panel fillers flanking the diagonal scrolls on these carinated bowls. Vessels 15 and 17 have concentric semicircles separated by crosshatching or vertical lines and graded in size according to their position along the diagonal (Figure 14c). Another configuration is size-graded ovoid elements separated by curved vertical lines, straight vertical lines, or crosshatching. This is found on Vessels 7, 8, 11, and 12 (Figure 14d). The last configuration occurs only on Vessel 6, and it consists of curved vertical lines spaced at specific intervals (Figure 14e). Red pigment is contained in the engraved lines of the slanted scroll on Vessel 6.

Simple Bowls

Six vessels can be classed as simple bowls. Vessel 48 is the only one within this group to have a restricted orifice (see Figure 13). All except Vessel 48 are grog tempered, and all have moderately soft pastes. Vessels 14, 16, and 36 have exterior and interior surface colors of light gray to grayish brown and gray to black cores. Vessels 24 and 25 have red-slipped exterior and interior surfaces. Vessel 24 has a yellow brown core, and Vessel 25 has a light gray core. Vessel 48 has leached shell temper with a light orange brown exterior, a light yellow brown interior, and a light yellow brown core. The exterior surfaces of the grog-tempered vessels are burnished. The interior surfaces are burnished (Vessels 14 and 16), smoothed (Vessel 36), or too eroded to indicate treatment (Vessels 24 and 25). Vessel 48 is smoothed on the exterior and roughly smoothed on the interior. The rim forms follow the restricted or unrestricted nature of the vessel forms; only Vessel 48 has an inverted rim while the other five have everted or straight rims. Two have lips that are exterior rolled, three have rounded lips, and one has a tapered lip. Rim diameter could be determined for four vessels, ranging from 11.0 to 30.0 cm. Mean wall thickness for the six vessels ranges from 0.50 to 0.73 cm. The two smallest vessels in this group, Vessels 14 and 48, fall within the middle of this range.

All five of the grog-tempered bowls are decorated with engraving which starts just below the lip and appears to be confined to the rim. The decorative element on red-slipped Vessels 24 and 25, as well as on Vessel 16, consists of zoned crosshatching which probably is part of a slanted scroll motif. The zoned crosshatching on Vessel 24 surrounds a circular element (Figure 15a). Vessel 14 has a band of evenly spaced sets of three vertical curved lines encircling the

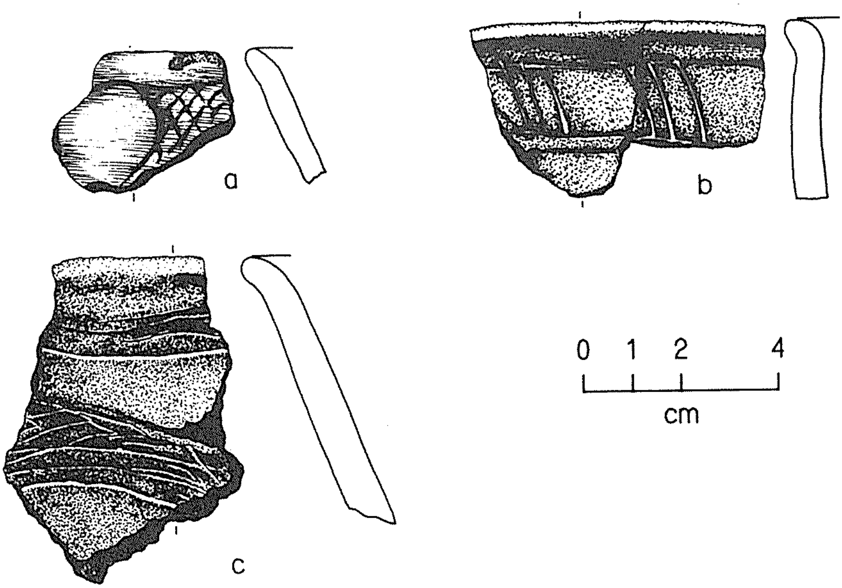

Figure 15. Simple bowls from 41HP175: a, Vessel 24, slanted scroll motif?; b, Vessel 14, horizontal band with vertical curved lines; c, Vessel 36, curved line motif.

vessel just below the lip (Figure 15b). The vertical curved lines offsetting panels of empty space are reminiscent of the motifs found on the carinated bowls described above. Vessel 36 has a decorative motif that appears to contain two roughly parallel bands of haphazardly executed horizontal curved lines encircling the rim (Figure 15c), but because less than 10 percent of the rim is present, it is difficult to identify the full design. The leached shell-tempered bowl, Vessel 48, appears to be undecorated. This vessel does have a curious uneven lip edge which, if repeated around the entire vessel, would have given the orifice a widely scalloped effect.

Deep Bowls

All four deep bowls are grog tempered, have moderately soft pastes, and are red slipped. The slipping on some of the sherds of Vessels 22 and 30 has faded to an orange color probably as a result of weathering. Core colors are dark gray on Vessels 22, 23, and 29, while Vessel 30 has a light brown core. The interior and/or exterior surfaces are burnished, polished, or finely smoothed; Vessel 29 has an eroded interior surface. Three of these bowls have everted rims, two with tapered lips and one with a rounded lip. No rim sherds clearly associated with Vessel 30 were recovered. Two vessels with everted rims are represented by sections large enough to establish rim diameter. In both cases, the median rim diameter is greater than 30 cm. Wall thicknesses range from 0.65 to 0.71 cm.

All four deep bowls are decorated with incised or engraved designs in a band 3-8 cm high that encircles the vessel just below the lip. Three have a similar motif within the band consisting of nested chevrons surrounding a circular element set off by hatching. The chevrons are also separated by ladder-like diagonals (Figure 16a). This motif is a rectilinear form commonly associated with the type Avery Engraved (Suhm and Jelks 1962:1-4; Perino 1983:52).

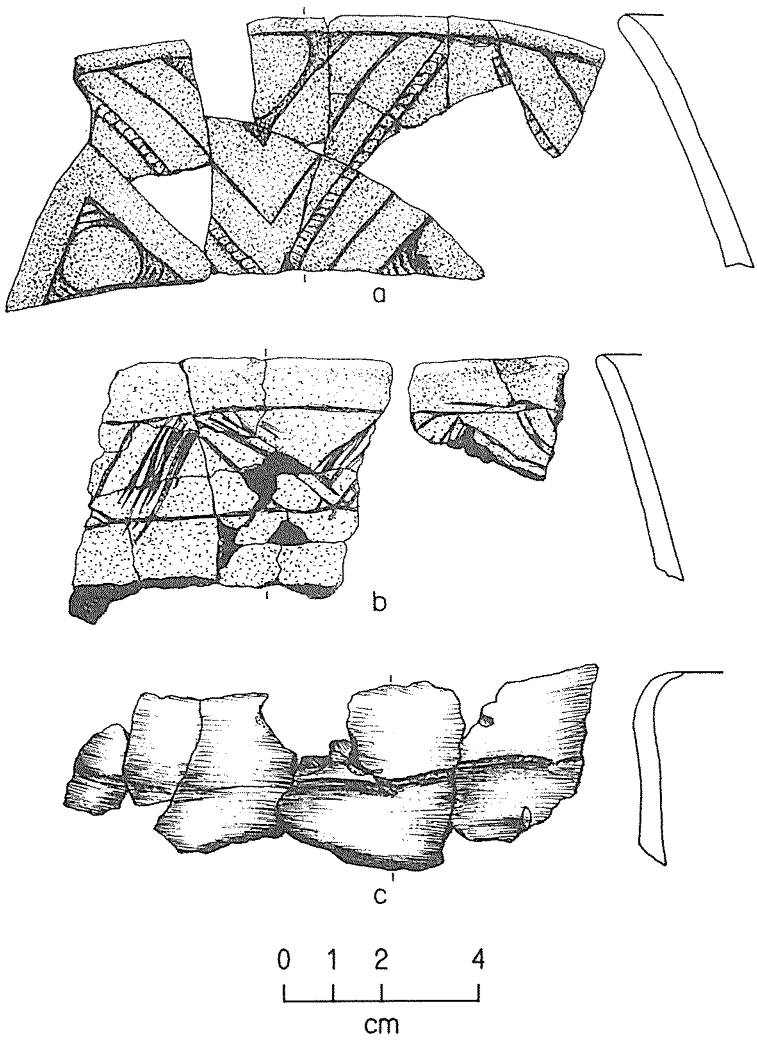

Figure 16. Deep bowls and collared bowl from 41HP175: a, Deep bowl Vessel 23, diagonal lines, ladders, and circles motif; b, deep bowl Vessel 29, horizontal band with diagonal lines motif; c, collared bowl Vessel 35 with horizontal cord impression.

Vessel 29 has a 3 cm wide decorative band encircling the rim with an unusual motif consisting of open rectilinear panels juxtaposed with areas of haphazardly executed diagonal lines (Figure 16b). This motif is vaguely reminiscent of the Avery Engraved chevrons.

Collared Bowl

Vessel 35 is a leached shell-tempered bowl whose form is unique among the vessels identified from 41HP175. It is represented by a 15.3 cm section of rim with a tapered inward-curving lip which is almost at a right angle to the straight rim (Figure 16c). The vessel section retains enough of the body wall to show a slight restriction just below the rim, thus forming a collared rim. The restriction does not significantly reduce the orifice size relative to the maximum diameter of the body, however. The paste of Vessel 35 is similar to that of the other leached shell-tempered vessels from the site in that it is moderately soft and dark gray to yellow brown on the outer surfaces and a gray core. The vessel has been smoothed on both the interior and exterior surfaces. Its diameter is 26.0 cm, and its mean wall thickness is 0.65 cm. The only decoration is a faint horizontal cord impression which encircles the vessel at the base of the collar.

Bottles

Only two vessels can be identified as bottles based on the arc of the shoulder and neck sherds present. All of the interiors are scraped but otherwise unsmoothed. Since few matches occur between the sherds of either vessel, the reconstruction of vessel shape is problematic (see Figure 13). A large shoulder section from Vessel 21 suggests, however, that at least this bottle had a short, squat body similar to those associated with Ripley Engraved or Wilder Engraved (Suhm and Jelks 1962:127-130, 155-156). Both vessels are grog tempered, but they differ in hardness and paste color. Vessel 21 is hard and has dark gray surfaces and a black core, while its exterior surface exhibits a high polish. Vessel 33 also has a black core, but its wall surfaces are gray on the interior and light yellow with gray clouding on the exterior and its paste is moderately hard. Its exterior surface is eroded, and a determination of exterior surface treatment is not possible.

Both vessels appear to have engraved curvilinear decorations; on Vessel 21, the decoration extends from just below the neck to over the edge of the shoulder. Small triangular excised areas occur where two curving lines intersect, although pendant triangles characteristic of Ripley Engraved are not present. Red pigment is present in some of the engraved lines on this vessel. Vessel 33 has large areas of excising between areas that have concentric curving lines. Although the designs on both vessels are fragmentary, they are suggestive of the concentric scroll designs found on Taylor Engraved and Wilder Engraved (Suhm and Jelks

1962:149-152, 155-156). Specifically, the excising at the intersection of curving lines of the scroll motif occurs on bottles from both of these types.

Globular Jars

Three vessels are globular jars (see Figure 13). All have leached shell temper and moderately soft pastes. Paste colors are light gray to yellow gray on the exterior surfaces with gray cores. Both Vessels 47 and 50 have eroded surfaces, and finishing treatment cannot be determined. Vessel 44, however, appears to have been smoothed on both its interior and exterior surfaces. These jars have both everted and inverted rim forms with flat or tapered lips. The vessels with rims large enough to provide measurements are 15.0 and 22.0 cm in diameter, and wall thicknesses range from 0.56 to 0.73 cm.

All three of the jars appear to be undecorated except for the occurrence of appliquéd nodes on Vessel 47. These nodes occur in pairs just below the juncture of the neck and the body. A sherd with paired nodes was recovered which appears to be part of this vessel but which could not be refitted to the vessel section, suggesting that paired nodes were spaced around the circumference of the vessel. These globular jars with inverted or everted rims, decorative nodes, and leached shell temper are suggestive of the Nocona Plain, Woodward Appliqué, and Woodward Plain types (Brown 1971:141-146; Suhm and Jelks 1962:115-116).

Cylindrical Jars

All eight of the vessels classed as cylindrical jars are grog tempered. Surface colors for most range from light to dark gray, although a few, such as Vessels 39 and 49, have orange brown exterior surfaces suggesting that they were fired in an oxidizing atmosphere. Cores are gray to black in all cases. Most have moderately hard pastes, but Vessels 31 and 32 are harder than the rest. Both of these have light gray exterior surfaces and dark gray interiors with brittle pastes. While the interior surface of Vessel 38 is the typical light gray color, its exterior surface is a cream color which, viewed in cross section, appears as a thin layer that is suggestive of a slip.

Six of the eight have roughened exterior surfaces. The interiors of these six are mainly smoothed, but Vessel 37 is burnished and Vessel 40 is polished. Vessel 34 has a smoothed exterior and a polished interior, and Vessel 49 is burnished on both its exterior and interior surfaces. All but one have everted rims, while the rim form for Vessel 40 is indeterminate. Flat, exterior rolled, and rounded lips are present on these vessels. The rim diameters range from 27.0 to 37.5 cm, with four diameters greater than 30 cm. Assuming that these jars were at least as tall as their maximum rim diameters, as is the case with Nash Neck-Banded jars (Skinner et al. 1969:55; Suhm and Jelks 1962:114), then these vessels appear to have been quite large. Wall thicknesses range from 0.55 to 1.10 cm.

The main decorative techniques used on the cylindrical jars are fingernail punctations, pinching, and appliquéd fillets or nodes. All except Vessel 49, which is undecorated, are punctated (Figure 17a), pinched, or appliquéd (Figure 17b) from the lip to the constriction of the rim. The punctated and pinched decorations have been smoothed to varying degrees to give a roughened texture. Body decoration can be confirmed for only one vessel in this group. Although highly fragmentary, it appears that Vessel 34 has vertical lines of punctations interspersed with vertical appliquéd fillets, both of which extend down the body from the rim constriction. These decorative treatments are common on vessels typed variously as Nash Neck-Banded, McKinney Plain, and Emory Punctated-Incised (Perino 1981, 1983; Skinner et al. 1969; Suhm and Jelks 1962:97-98, 111-112).

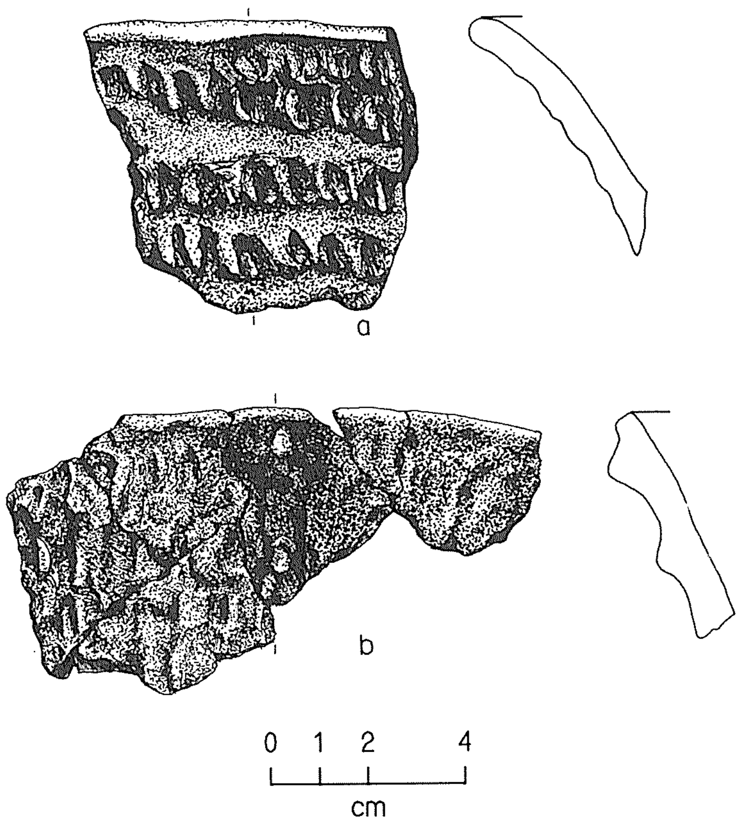

Figure 17. Cylindrical jars from 41HP175: a, Vessel 37, roughened horizontal punctations; b, Vessel 39, roughened horizontal punctations with appliquéd nodes.

Small Cylindrical Jars

Vessels 1, 41, and 54 are classed as small cylindrical jars (see Figure 13). All three are grog tempered with moderately hard pastes that are gray brown on the surface and gray to black at the core. The surface treatment of these vessels consists of smoothing on the exterior and burnishing on the interior. No rim was recovered for Vessel 1, but both Vessels 41 and 54 have everted rims with exterior rolled lips, and both have rim diameters of 16.0 cm. Wall thicknesses range from 0.38 to 0.64 cm.

The decorative elements common to these small jars are fingernail punctations and appliquéd fillets and nodes. Vessels 41 and 54 have fingernail punctations below the rim which have been smoothed to produce a neck-banding effect (Figure 18a). Vessel 41 also has an appliquéd fillet positioned at the juncture between the rim and the body. It appears from the straight horizontal break

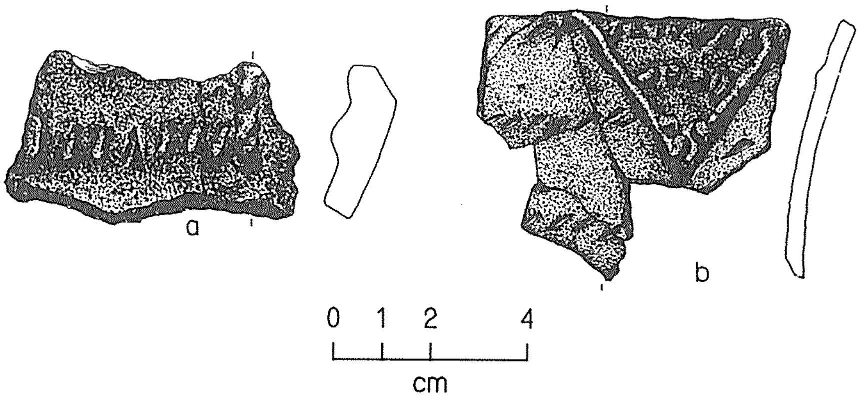

Figure 18. Small cylindrical jars from 41HP175: a, Vessel 41, roughened horizontal punctations with appliquéd fillets; b, Vessel 1, rows of slanted punctations with appliqué.

that the sherds recovered from Vessel 1 represent a section from just below the juncture of the rim and body. Two appliquéd fillets extend from the juncture to form a V-shaped area filled with three lines of appliquéd nodes (Figure 18b). A vertical fillet is also present to the side of this V-shaped area. It is likely that alternating V-shapes and vertical fillets encircled this vessel. In addition, horizontal rows of slanted fingernail punctations apparently encircled the vessel at regularly spaced intervals, and horizontal appliquéd fillets bounded the zone of punctations. The decorative elements on all three jars are found on vessels of similar form associated with the types Nash Neck-Banded, McKinney Plain, and Emory Punctated-Incised (Perino 1981, 1983; Skinner et al. 1969:43, 52; Suhm and Jelks 1962:97-98, 111-112).

Indeterminate Vessels

The size and shape of fifteen vessels could not be determined. Six are represented by body sherds alone, while nine are represented by only one rim or body sherd. Four have leached shell tempering. All of these have moderately soft pastes with light gray to yellow gray surfaces and dark gray cores. Where the exterior and interior surfaces are not eroded, they are smoothed. Rim forms that could be determined are inverted, everted, or straight, and lip forms are rounded or flat. The sherds of these vessels have a mean thickness ranging from 0.57 to 0.81 cm. Vessel 45 has two horizontal rows of roughened fingernail punctations around its rim, while Vessel 10 has an unidentified motif containing straight engraved lines. The characteristics of these vessels suggest that, given the recovery of larger vessel sections, they would probably be grouped with the globular jar vessel category.

Vessel 27 also has leached shell temper but with the addition of a small amount of grog. This red-slipped vessel has a light gray core and a moderately soft paste. Its interior surface is eroded, but the exterior appears to have been finished by smoothing. Decoration on Vessel 27 appears to be limited to the body, but it is possible that erosion of the surface of the rim has obscured decoration on that part of the vessel. The decorative technique used consists of curvilinear engraved lines and excised areas. The decorated area is too small for an identification of the motif, but a scalloped element offset by excising, apparently representing a border for a circular or oval panel, is present on one body sherd. This element is similar to those associated with a curvilinear motif found on the type Avery Engraved (Suhm and Jelks 1962:Plate 1).

The remaining vessels in the indeterminate category are grog tempered. Five of these (Vessels 2, 3, 4, 19, and 20) have gray brown exteriors and gray cores. Vessels 5 and 9 have gray to dark gray exteriors with black cores. Vessel 53 has a tan paste both at the surface and at the core, and Vessels 28 and 51 are red slipped while their cores are black and orange brown, respectively. The majority of the vessels have moderately soft pastes; the exceptions are Vessels 9 and 53 which have moderately hard pastes. Most of these vessels are more highly finished on their interior surfaces. Only four have associated rims; three of these are everted (two with exterior-rolled lips and one with a rounded lip), and one is inverted (with an exterior-rolled lip). The mean thickness of these vessels ranges from 0.58 to 1.00 cm.

The decorative techniques associated with the grog-tempered indeterminate vessels are fingernail punctations (Vessels 2, 3, 4, and 53), stick punctations with engraving (Vessel 5), and engraving or incising (Vessels 19, 20, and 28). Vessel 51 is represented only by undecorated rim sherds. Of the fingernail-punctated vessels, Vessels 2 and 53 have horizontal rows of punctations around the rim (with Vessel 53 having a roughened rim), Vessel 3 has diagonal rows of punctations extending from the lip, and Vessel 4 is represented by three body sherds that are covered by a field of random punctations. Vessel 5 appears to have zones of stick punctations demarcated by multiple parallel diagonal engraved lines. The single sherd representing this vessel has too little of the design to determine the motif or a specific ceramic type. Vessel 9 is represented by two body sherds which have intersecting sets of parallel lines probably representing a slanted scroll motif. Vessels 19 and 20 have parallel curved lines with pendant triangles. Although these vessels have the same element/motif, a difference in the design execution is evident. The elements on these vessels are similar to elements on Ripley Engraved vessels (Suhm and Jelks 1962:Plate 65e, g, and h). Vessel 28 is represented by one body sherd which has an engraved circular element above a horizontal line. This is similar to elements from curvilinear Avery Engraved motifs (Suhm and Jelks 1962:Plate 2a).

Non-vessel Ceramics

Seven pipe fragments and one ceramic bead were recovered. The pipe fragments consist of one stem and six bowl fragments. The stem appears to be complete, measuring 2.72 cm from its attachment point with the bowl and 1.06 cm in diameter (Figure 19a). The proximal end of the stem appears finished, and thus it is too short to be classified as a long-stemmed Red River pipe (Hoffman 1967; Newell and Kreiger 1949:147-149), unless the stem has been broken and reworked. This specimen appears to be tempered with shell, and it has a smoothed exterior finish. The bowl fragments consist of two grog-tempered specimens, two specimens with leached shell temper, and two temperless specimens. The grog-tempered fragments, which are the only bowl fragments with intact lips, have rounded lips. Both fragments are polished on the exterior. They measure 0.49 and 0.53 cm in thickness. The bowl fragments with leached shell temper have eroded or smoothed surfaces and measure 0.51 and 0.55 cm in thickness. The temperless fragments have eroded exterior surfaces and measure 0.33 and 0.36 cm in thickness. Most of the bowl fragments are too small to determine bowl orientation. One of the leached shell-tempered fragments is large enough to suggest that it was part of a flaring bowl of an elbow-shaped pipe. The stem of this pipe did not extend beyond the distal end of the bowl.

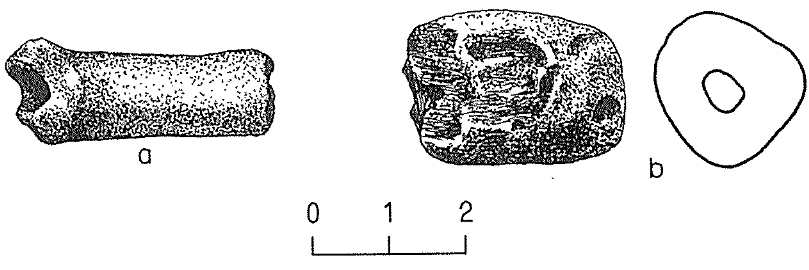

Figure 19. Non-vessel ceramic artifacts from 41HP175: a, Complete pipe stem; b, bead.

The single ceramic bead is 3.0 cm long and 1.9 cm in diameter (Figure 19b). The exterior surface is eroded and appears to have one broken end as a result of heat spalling. The long axis of the bead is pierced by an oval hole that is 0.6 cm in diameter. The paste is fine and temperless.

NON-CHIPPED STONE ARTIFACTS

Thirty non-chipped stone artifacts were recovered. These are fashioned from a variety of materials and exhibit several kinds of use wear or manufacture marks, including grinding, pitting, pecking, battering, and grooving. Often more than one kind of use wear or manufacture mark is evident on a single artifact suggesting that these tools served multiple functions. Six artifact types can be distinguished: grinding stones (n = 4), pitted stones (n = 9), hammerstones (n = 10), abraders (n = 5), a celt (n = 1), and a lump of worked kaolin (n = 1).

One of the grinding stones is an end fragment of a tabular ferruginous sandstone slab with one ground surface. Two are quartzite cobbles with single flat surfaces showing evidence of smoothing and polishing, suggesting use for grinding. The edges are also battered, suggesting that they were used as pulverizers. One of these is fragmentary, but both appear to be of a size that could have been hand-held. The fourth specimen is a large hematite metate. It is tabular with one concave working surface which exhibits extensive smoothing and polishing.

The pitted stones are tabular or rounded quartzite cobbles with large central pits on one or more flat surfaces. These stones may have been used as anvils for cracking hardwood nuts. Three have two pits, one on each opposite flat surface. The pits appear to have been made by pecking. Whether the pecking was done initially to establish the pit or whether the pit resulted from use is unclear. Two of these artifacts have striations or shallow grooves intersecting the pit. Again, it is unclear whether these striations helped to establish the pit or whether they are use related. The surfaces around the pits on three other artifacts exhibit evidence of grinding and polishing. All of the pitted stones have crushed spots around their edges. This evidence of crushing suggests that the pitted stones also were used for battering.

The hammerstones are cobbles with crushing and battering along their edges exclusive of any evidence of grinding, pecking, or polishing. Nine are quartzite and one is silicified wood. Four of the abraders are small chunks of ferruginous sandstone with one or more flat ground surfaces and one or more deep grooves. The fifth abrader differs in that it is tabular, and it has a concave working surface. Several shallow grooves cross the length of its working surface. A reworked portion of a quartzite celt was also recovered (Figure 20). It has been flaked on both its dorsal and ventral faces at the broken proximal end, perhaps to reduce its thickness and facilitate hafting. The lateral edges have been pecked while the bit edge has been finely ground. The final artifact under this heading is

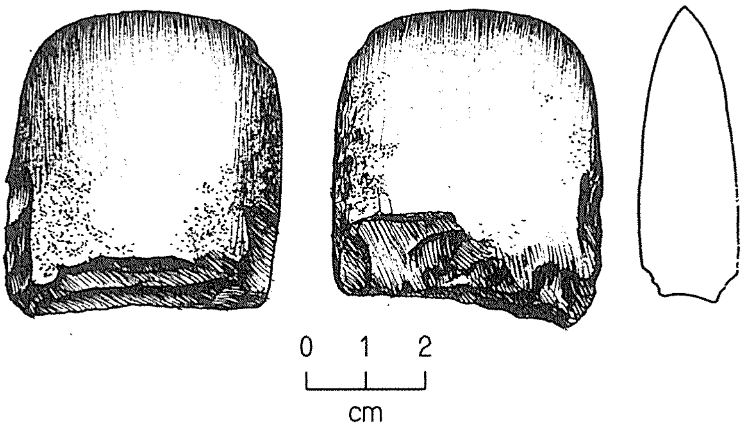

Figure 20. Celt from 41HP175.

a ground piece of kaolin; it is generally tabular with rounded and faceted edges, striations across the flat surfaces, and a shallow depression in the center of one flat surface.

FAUNAL REMAINS

A total of 2,062 vertebrate faunal remains was recovered; invertebrate remains were not found. Fourteen taxa are present in the 14 percent of the collection (n = 305) that is identifiable taxonomically (Yates 1993). The best-represented taxon is white-tailed deer (n = 155), with other mammals including deer/pronghorn (n = 46), large mammal (n = 21), cottontail (n = 3), opossum (n = 1), raccoon (n = 1), pronghorn (n = 1), bison (n = 1), and cow/bison/elk (n = 1). Also present are indeterminate turtle (n = 45), box turtle (n = 17), slider turtle (n = 7), mud turtle (n = 3), and large bird (n = 3). While small, the collection suggests primary reliance on animals taken from woodland, woodland-edge, and aquatic habitats within the Sulphur River valley. Grassland taxa are present only in small numbers. Modification indicating use as tools or ornaments is present on 22 specimens as follows: 11 grooved bison (?) rib fragments possibly representing a musical rasp (Figure 21a); two possibly worked antler fragments; five awl fragments; one beamer; two turtle shells with scrape marks; and one bone pin (Figure 21b).

MACROBOTANICAL REMAINS

A total of 1,098.2 g of macrobotanical remains was recovered from general fill contexts, from features, and from flotation column samples. Of these, 318.4 g are burned nutshells, 773.8 g are wood charcoal, and 6.0 g are other charred

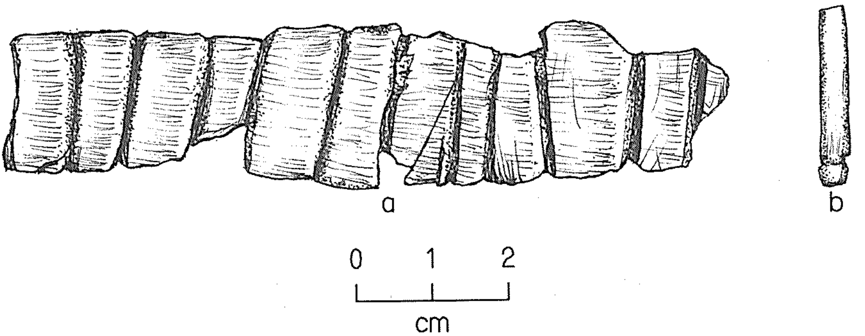

Figure 21. Bone tools from 41HP175: a, Musical rasp; b, pin.

materials. Submitted for identification and analysis were all materials from six units and 12 other general fill contexts in the block (155.0 g, excluding 15.2 g used for dating), all materials (525.4 g, excluding 28.0 g used for dating) from the screened fill of three features (Features 1, 3, and 8), the light fraction of the flotation sample from Feature 1, and the light fractions of two flotation column samples (Dering 1993).

Feature 1 yielded one maize cupule, one squash rind fragment, one hackberry seed, 240 hickory nutshells, 348 unidentified nutshells, 23 fragments of *Pediomelum* (formerly *Psoralea*) root or cortex, 18 pieces of *Carya* wood charcoal, and seven pieces of unidentified wood charcoal. The maize and squash are the only cultigens found at the site, and their sparseness suggests that subsistence pursuits focused on wild plant foods rather than cultivated ones. Feature 8 was found to consist of a large quantity of burned oak root wood, while the wood charcoal from Feature 3 was unidentifiable. The sample from general fill contexts contains three honey locust seeds, two water locust seeds, 931 hickory nutshell fragments, 33 pecan nutshells, four black walnut nutshells, two oak nutshells, and 126 unidentified nutshells. These remains support the conclusion that wild plant foods were of primary importance. The wood charcoal in the general fill samples consists mostly of oak (n = 159), with elm (n = 50), *Carya* (n = 29), locust (n = 12), yaupon (n = 8), and unidentified wood (n = 35) making up the remainder.

OTHER MATERIALS

Fire-cracked Rocks

A total of 27.6 kg (n = 1,860) of fire-cracked rocks was recovered from non-feature proveniences. Quartzite cobbles and cobble fragments make up the vast majority (27.1 kg, n = 1,833), while limestone (<0.1 kg, n = 7), sandstone (0.4 kg, n = 15), and unidentified materials (<0.1 kg, n = 5) are much less frequent. A single piece of burned quartzite weighing just 3 g was recovered from a feature context (Feature 1). Although these fire-cracked rocks were differentially distributed across the excavation block (see Distributions and Conclusions), they were not clustered into recognizable features, and it is presumed that they represent debris removed from Feature 1 or, perhaps more likely, from an undiscovered hearth or processing feature.

Burned Clay

A total of 4.7 kg of burned clay lumps was recovered. Most of these materials (3.9 kg) lack impressions, but the remainder (0.8 kg) exhibit grass, twig, or rarely stick or cane impressions. Almost none of the impressed specimens (1.0 g) but much of the unimpressed ones (2.3 kg) are from the Feature 1 hearth, with the remainder being from general fill contexts. The burned clay lumps from non-feature proveniences are generally small (1-3 cm in diameter), while those from Feature 1 are 1-7 cm in diameter. The bulk of these materials represent sediments incidentally fired during hearth use. Some of the impressed specimens could represent daub from a wattle-and-daub structure, but this is not clearly the case.

Mud Dauber Nests

Sixty-three fragments of mud dauber nests weighing 184.7 g were recovered. In all, 22 nest fragments (88.3 g), many of them large and well preserved, were associated with Feature 1, the hearth found near the center of the excavation block; most of the remainder were recovered just west of Feature 1. The preservation of the mud dauber nests is due to the fact that they had been fired, presumably within the hearth.

Mud dauber is an appellation for the common black and yellow wasp of the genus *Sceliphron*. This wasp is active from spring to fall constructing its nest of mud in which it lays its eggs. Mud for the nest is gathered from pools or stream edges and transported to the nesting site (Andrewes 1969:41-44). Nests are composed of 4-20 cells, each containing a single egg. The wasp places as many as 20 spiders in each cell to serve as food for its hatching larva. Once the wasp has provided an adequate food supply, it closes the cell with a cap of mud. The larva will hatch inside the closed cell, eat, and mature into the pupa stage, emerging as an adult wasp the following spring (Andrewes 1969:41-44).

In natural settings, mud daubers place their nests in hollow trees or under cliff overhangs (Evans and Eberhard 1970:102). Mud daubers select these nest sites because they provide shelter from the elements which would damage the nests and endanger the larvae during the several months they need to reach maturity. The shelters provided by overhangs and niches in human-built structures also are utilized by mud daubers. Construction of the nest begins with the wasp laying down a foundation of mud. This foundation fills in irregularities in the surface to which the nest is attached and provides a flat surface on which individual cells are built. Cells are built by adding concentric rings of mud. After a number of cells are built, the wasp smears a final coating of mud over them giving them a unified appearance (Evans and Eberhard 1970:104-106).

The nest fragments from 41HP175 have from one to seven cells, with most having two to four. The majority of the surviving cells are closed, which may suggest that the nests were burned after they were sealed and before the wasps emerged (i.e., late fall to early spring). Unsealed cells are probably more fragile than sealed ones, however, and thus they may be underrepresented because of poor preservation rather than the season at which they were deposited.

Most of the larger nest fragments from 41HP175 have impressions composed of two elements on one side. Specifically, they appear to have contained grass or small sticks, usually emerging from a series of scalloped depressions. These two elements are suggestive of a wattle-and-daub surface, with the sticks and grass representing wattle showing through deteriorating, pock-marked daub as represented by the scalloped depressions. A second alternative, that the stick impressions indicate that the nests were attached to brush piles or dead wood which was used as fuel, is inconsistent with the kinds of impressions observed, particularly the scalloped depressions from which the stick and grass impressions emerge. In addition, this interpretation does not take into account the nesting habits of *Sceliphron*, which, as noted above, prefer well-protected nesting sites. It is doubtful that brush piles would afford adequate protection from the elements.

While the impressions on the nests provide some positive evidence for a structure at the site, it is difficult to be certain about how the nests ended up in the Feature 1 hearth. Several explanations are offered here. First, it is possible that parts of a dilapidated wattle-and-daub structure were used as fuel in the hearth, thus resulting in the introduction of the mud dauber nests. Second, it is possible that the nests were intentionally thrown into the fire, perhaps as a result of structure cleaning and maintenance. And third, it is possible that the nests were attached to a non-domiciliary structure, such as a ramada, that stood over Feature 1 and that burned, thus preserving the nest fragments. While this last scenario would not explain the concentration of nests only in and adjacent to the hearth itself, it is consistent with the possible burned posts or stakes recorded around Feature 1 (see Features).

Unworked Rocks

Materials recovered from 41HP175 that may have been brought to the site through human activities but that do not display any evidence of alteration, use, or burning consist of hematite/limonite, sandstone fragments, and siliceous cobbles and pebbles. A total of 472.0 g of unworked hematite/limonite was recovered, all from non-feature proveniences. These range in weight from 0.5 to 217.5 g. Some of the smaller specimens may be naturally occurring concretions, but several proveniences produced fragments that appear to be the remains of larger chunks smashed during excavation, and these larger chunks clearly were transported onto the site, perhaps for use as pigment sources. Unworked and unburned sandstone, all from non-feature contexts, totals 268.5 g. Most are small fragments which range in weight from 0.5 to 9.5 g. The four largest fragments range in weight from 20.5 to 90.0 g and make up most of the collection. All of these are rounded and friable, and it is likely that they were once part of larger pieces brought to the site to be used as abraders or as hearthstones. The unmodified cobbles and pebbles consist of one cobble (>64 mm), one very large pebble (33-64 mm), and two small-medium pebbles (<17 mm). The two larger specimens are probably minimally used hammerstones or pulverizers used on soft materials; the small-medium pebbles may be natural or cultural.

DISTRIBUTIONS AND CONCLUSIONS

Because the cultural deposits at 41HP175 are restricted to the upper ca. 20 cm of a buried soil within a Holocene alluvial fan and yielded radiocarbon assays and artifacts suggestive of occupations primarily during the early part of the Late Caddoan period, the site was analyzed as a single unit. Although no midden staining was observed, the high frequencies of lithics and especially sherds, with the latter representing at least 54 ceramic vessels, point to intensive use. The lack of a midden comparable to those at many of the Early Caddoan components at Cooper Lake probably can be attributed to the shorter span of time over which 41HP175 was occupied and the limited number of occupational episodes. Limited reoccupation also is indicated by the large size of many of the sherds and the small size of the site.

Appreciable quantities of cultural materials are restricted to an area of less than 350 m^2, and within this small area there are two concentrations of remains. The first covers ca. 150 m^2 in the eastern part of the core area and was the focus of the excavations; most of the conclusions about the site are based on this eastern concentration. The second, which covered at least 25 m^2 and perhaps as much as 50 m^2 in the northwestern corner of the core site area, received relatively little attention. While little is known about this second area, the radiocarbon dates and the artifact distributions discussed below show that it was associated with the area sampled by the block excavations. At the time of the primary occupation, this core area was bounded on the north by a recently abandoned channel of Finley Branch, and it is likely that the channel bordering the site on the northeast was the active channel.

Only five potential cultural features were recorded in or around the excavation block sampling the eastern part of the core area. One of these, Feature 1, is a large unprepared hearth at the center of the eastern concentration. The other four are concentrations of wood charcoal located south, east, and north of the hearth. The visible wood structure in all four cases indicates that they were oriented vertically, but otherwise they are difficult to interpret. None are associated with disturbances interpreted as postholes, and the cultural origins of all four features are questionable. Nonetheless, it is surmised that three (Features 3, 5, and 6) could have been posts or stakes. The fourth, Feature 8, appears to represent a burned tree stump. Such a limited assemblage of features would appear to indicate that this part of the site was not used in an intensive fashion, but such an interpretation is at odds with the high densities of artifacts encountered. An explanation for this anomaly lies in the functional nature of the part of the site sampled by the block, and this can be explored by examining the horizontal distributions of the cultural remains.

Figure 22 shows the distributions of the chipped stone artifacts within the excavation block. The most striking distribution is that of the unmodified debitage, which has a crescent-shaped distribution encircling Feature 1 on the south and east and encompassing Features 5, 6, and 8. Most of the other categories display distributions that are at least partly similar, but there are notable differences. For example, cores are especially common south and southeast of Feature 1, but they are abundant also north and northwest of the hearth. Manufacture-broken shaped tools also are frequent southeast and south of Feature 1, but they are concentrated in an arc west of the hearth as well. Unbroken shaped tools are abundant east, southeast, and south of Feature 1, but they are also frequent near the western edge of the block and northwest of the hearth. Use-broken formal tools are similar to manufacture-broken tools in that they are common southwest and west of the hearth, but they are unusual in that they have high frequencies just northeast and east of Feature 1 and conspicuously low frequencies to the southeast. Finally, expedient tools (i.e., modified flakes and minimally modified unifaces) have a more patchy distribution, being especially common east, south, and west of Feature 1.

Burned rocks are distributed in a manner similar to some of the chipped stone artifact categories in that they have a high density arc around the eastern and southern sides of Feature 1, but they are also abundant north and west of the hearth (Figure 23). Conversely, the vertebrate faunal remains exhibit a distribution unlike that of any of the lithic artifact classes, being abundant only north, northwest, and west of the hearth. Burned nutshells are similar to the faunal remains in that they occur in high densities at the western edge of the block and to a much lesser degree just west and north of Feature 1, but they are notably infrequent elsewhere. Ground and/or pitted stones and hammerstones, while infrequent overall, also have distributions unlike the chipped stones. The former are concentrated west of Feature 1, especially at the western edge of the block (cf. burned nutshells) and northeast of the hearth, while the hammerstones occur most commonly along the north edge of the block. The vessel ceramics are similar to most of the chipped stone categories in that they exhibit a high density

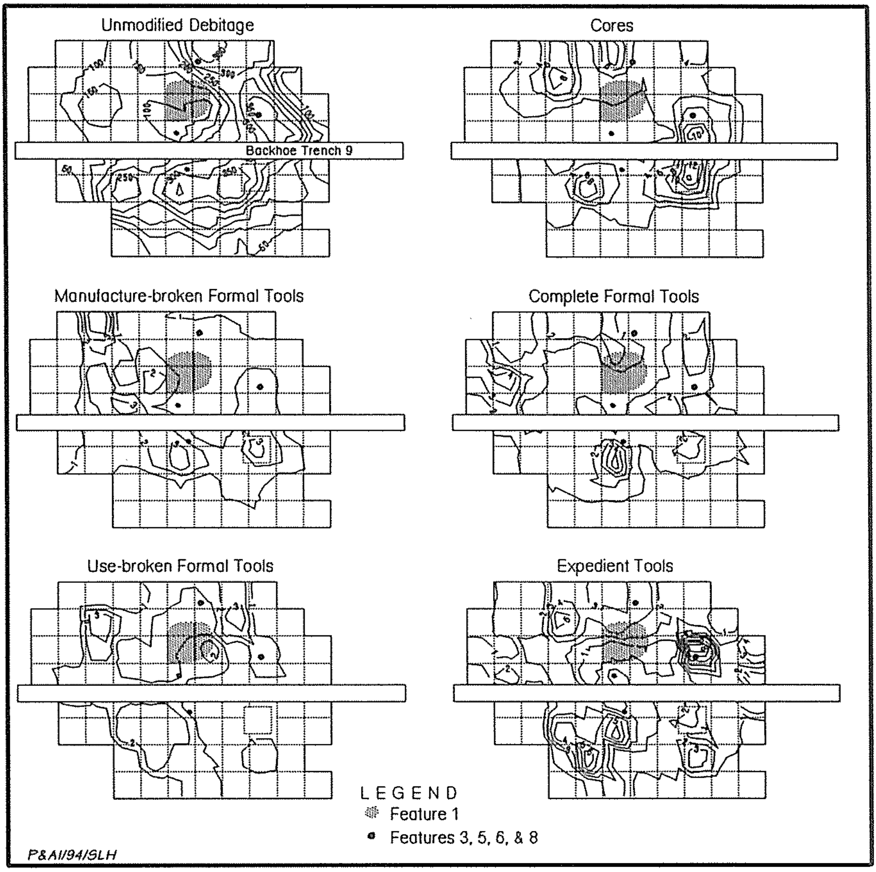

Figure 22. Isopleth maps of chipped stone artifact frequencies in the excavation block at 41HP175.

arc southeast and south of Feature 1, but they also are quite frequent west of the hearth.

More-detailed information on the ceramics can be gained by examining the distributions of some of the vessel batches. Figure 24 shows the distributions within the excavation block of the eight largest batches, in which the number of sherds ranges between 10 and 32. While most of the sherds in these batches are concentrated to a significant extent, most batches also contain sherds that are fairly dispersed. Vessel 49, a large plain grog-tempered cylindrical jar, has the most concentrated distribution, occurring entirely within the high density arc southeast of Feature 1. Most of Vessel 47, a shell-tempered globular jar with appliquéd nodes, was found in roughly this same part of the block, although a single sherd came from north of Feature 1. Vessel 33, an engraved grog-tempered bottle, also was concentrated in this area, but fair numbers of sherds were

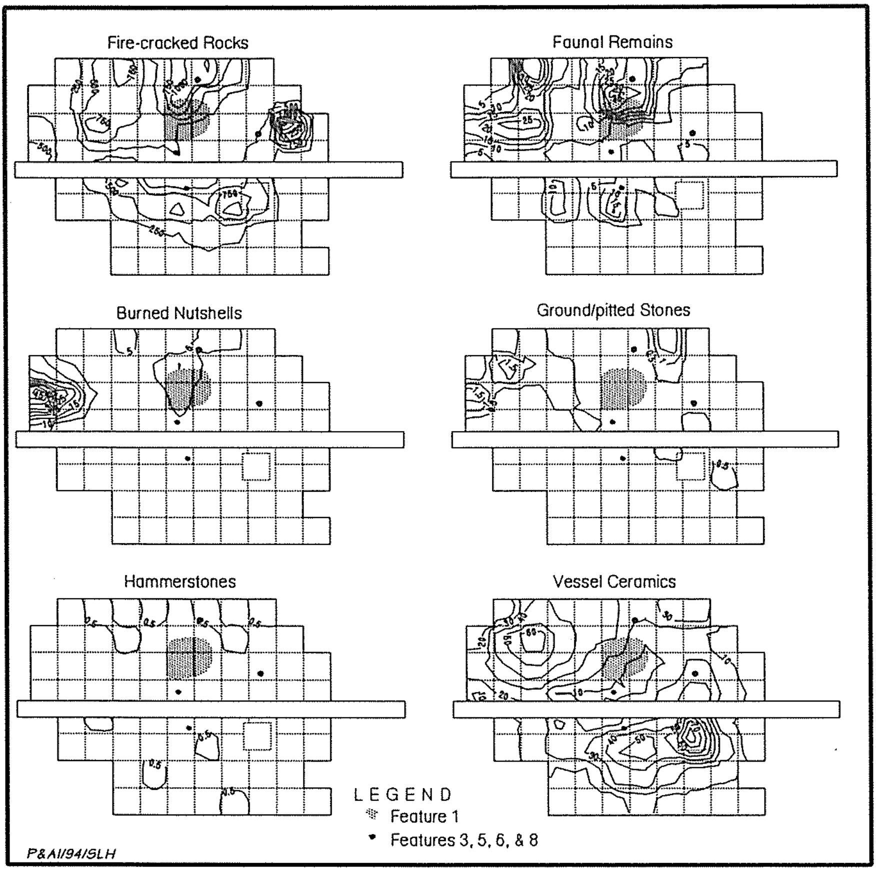

Figure 23. Isopleth maps of densities of fire-cracked rocks, faunal remains, burned nutshells, ground/pitted stones, hammerstones, and vessel ceramics in the excavation block at 41HP175.

found northward east of Feature 1; a single sherd in this batch came from the concentration west of Feature 1. Vessel 34, a grog-tempered cylindrical jar typed as Nash Neck-Banded, occurs almost solely west of Feature 1. Vessels 1, 23, 32, and 39 (a small grog-tempered jar typed as Nash Neck-Banded, a grog-tempered Avery Engraved deep bowl, a grog-tempered cylindrical jar with appliqué, and a grog-tempered cylindrical jar typed as Nash Neck-Banded) were found primarily in this area and secondarily in the concentration south or southeast of the hearth and/or in or just north of Feature 1.

These distributions show at least moderate movement of sherds across the site, including movement between the ceramic concentrations south and west of the hearth. This is indicated also by the fact that the mean distance over which the 16 vessel batches with five or more sherds from controlled excavations are

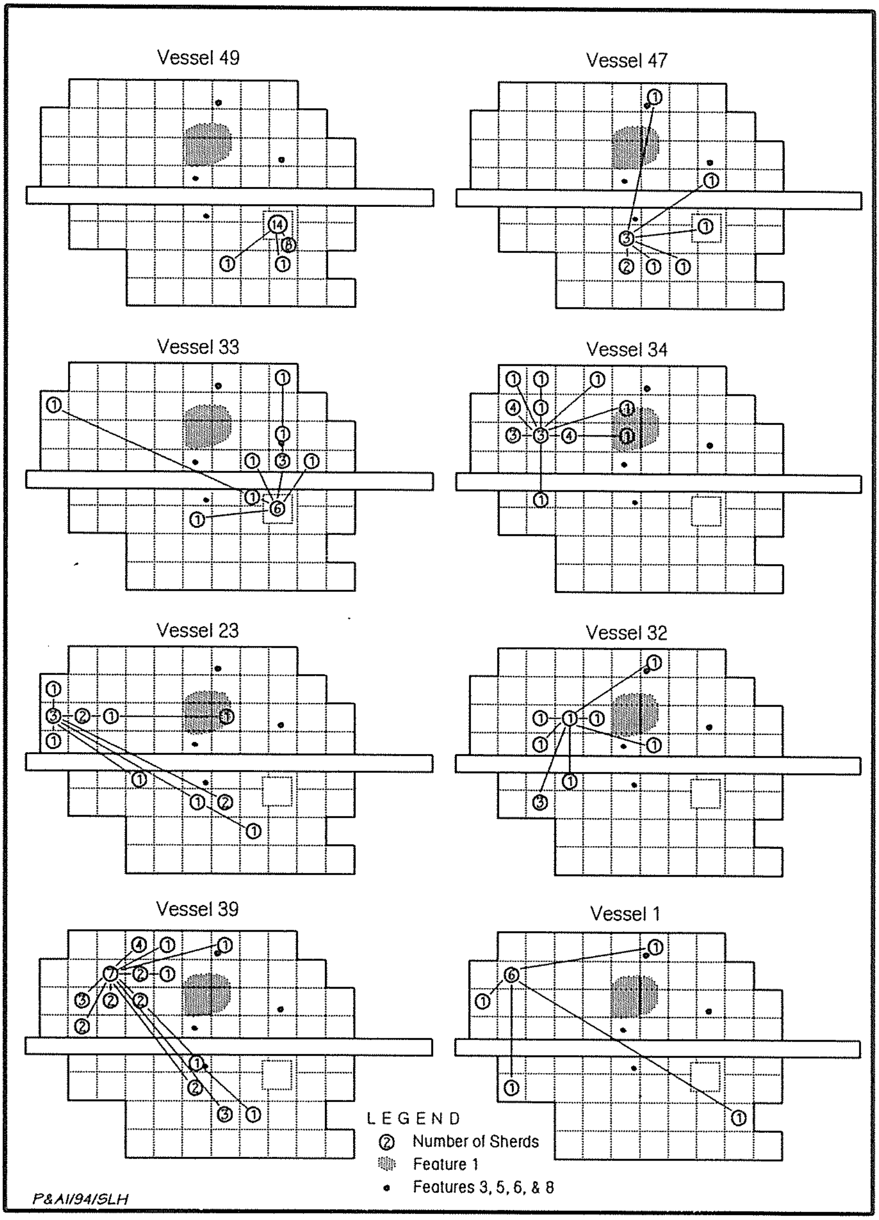

Figure 24. Distributions of selected ceramic vessel batches in the excavation block at 41HP175.

distributed is 6.9 ± 3.3 m. One of these batches (Vessel 11) contains sherds from Excavation Unit 36 in the northwest corner of the core site area, ca. 14-15 m from where the remainder of the sherds were found in the excavation block, and additional long-distance matches between the block and outlying units can be found in four of the smaller vessel batches (Vessel 17: Excavation Unit 30, 12 m; Vessel 27: Excavation Unit 14, 14 m; Vessel 40: Excavation Unit 4, 22 m; and Vessel 41: Excavation Unit 15, 11 m). Two other possible long-distance matches were found by comparing the ceramics from the 1989 test excavations with those reported here. One sherd probably belonging to Vessel 26 was found in the backdirt near a 1989 unit just northwest of Excavation Unit 8, ca. 13 m from where most of the Vessel 26 sherds were found in the excavation block. And a sherd probably belonging with Vessel 23 was recovered from the backdirt at the eastern end of the trackhoe trench (from the filled channel?), ca. 10 m north of most of the Vessel 23 sherds in the block.

In combination with the relatively large size of many of the sherds and the fact that only 3 of the 54 reconstructed vessels are represented by as much as one-third of their rim portions, these distributions lead to four main conclusions. First, they establish the relatedness of the two main concentrations of ceramics in the block. Second, they show that the concentration of materials in the northwest corner of the core area is associated with that sampled by the block. Third, they show that substantial quantities of the materials deposited on the site were not recovered in the excavations, with the most likely locations for these remaining deposits being the northwest corner of the core area, the area just west of the block, and the filled channel just north of the block. And fourth, they show that the occurrence of sherds across the site probably has as much to do with the transportation of parts of broken vessels for discard or reuse as it does with *in situ* pot breakage and dispersal by foot traffic.

In the aggregate, the distributional evidence suggests a high degree of spatial patterning within the block at 41HP175. All of the cultural materials appear to be distributed around the hearth, with especially high densities of many classes of remains occurring at a distance of 2-4 m from the edges of Feature 1, especially to the south and east. Such a pattern is strongly reminiscent of the sorts of hearth-centered activity areas documented in ethnoarcheological studies (Bartram et al. 1991; Binford 1978; O'Connell et al. 1991).

The ring of debris (i.e., debitage, cores, manufacture-broken tools, unbroken tools, use-broken tools, expedient tools, burned rocks, and vessel ceramics) situated 2-4 m from the southern and eastern sides of Feature 1 may represent a consistently used discard zone for activities performed immediately adjacent to the hearth. That this ring encompasses Features 5, 6, and 8 suggests that these features served to structure the use of space around the hearth, perhaps as supports for a brush arbor or other non-domiciliary structure. Certainly, the presence of burned mud dauber nests with grass and twig impressions supports the conclusion that some sort of structure stood over Feature 1, and the lack of postholes and the large size and unprepared nature of the hearth indicate that it was not inside a house. The possible association of Features 5, 6, and 8 with a structure such as a brush arbor is especially intriguing because Feature 8 appears to represent a burned stump rather than a post or stake (based on its identification as an oak root and the early radiocarbon assay). If both of these interpretations are correct, Feature 8 must represent a burned tree that was still standing and opportunistically used as a support post at the time 41HP175 was occupied. While this seems far-fetched given the substantially greater age of the Feature 8 radiocarbon assay compared to most of those from the site, the distributional patterns seem too consistent to be mere coincidence.

Interpreting the other distributional patterns within the block is somewhat more difficult because of the problems of relating behavior to specific classes of remains. Nonetheless, two suggestions are offered here. First, the concentrations of cores, manufacture-broken tools, burned rocks, ceramics, and faunal remains in the north part of the block may represent the intentional discard of bulky debris, including the by-products of butchering, along the edge of and perhaps even into the abandoned creek channel. While the channel was not exposed in this part of the site, the cross section in the eastern end of the trackhoe trench revealed that it does contain cultural materials, and this lends support to the conclusion that this part of the site was used for trash disposal. Second, the concentrations of manufacture-broken tools, complete tools, use-broken tools, expedient tools, burned rocks, faunal remains, nutshells, ground/pitted stones, and ceramics west of the hearth may represent the use of this area for a variety of processing and maintenance activities, as well as discard. Probably the most significant aspects about this part of the site, both of which point to a complex history of use, are the occurrence of high densities of so many classes of materials, excluding debitage, and their variable distributions between the edge of Feature 1 and the west edge of the block.

Based on the features and the distributional evidence, the excavation block appears to have sampled an outside activity area that was used intensively but for a limited span of time. It is for this reason that the lengthy occupational history implied by some of the absolute chronometric data is questioned. Judging from the abundance of cultural materials, especially the large number of ceramic vessels and the wide range of vessel forms (see Figure 13), and the presence of cultigens, it is surmised that the site was occupied on a permanent basis and that this outside activity area was associated with a house. No evidence for a house was found in the block, in the Gradall units around the block, or in the isolated 1-x-1-m units, but it is speculated that the house structure may be represented by the concentration of materials in the northwest corner of the core area.

Certainly, the distributions of the ceramic vessels tie these two areas together, and contemporaneity is suggested by the radiocarbon dates. If a house was located in the part of the site opposite the discard zone circling the hearth on the east and south, the house was separated from this outside activity area by a ca. 10 m wide expanse where relatively few artifacts were deposited and thus where artifact-producing activities were performed infrequently. Unfortunately, too little work was done in the northwestern concentration to interpret it with confidence.

As noted above, the abundance of ceramic vessels (>54) and the range of vessel and non-vessel forms (i.e., numerous jar and bowl forms of various sizes, a few bottles, and a few pipes) are interpreted as reflecting broad ranges of activities. The assemblage of chipped stones also seems to indicate a broad range of procurement, processing, manufacture, and maintenance activities. The tools and cores are dominated by arrow points (17 percent), bifaces (15 percent), expedient unifaces/edge fragments (10 percent), and modified flakes (10 percent), while arrow point preforms (6 percent), gouges (4 percent), and shaped unifaces (4 percent) occur in moderate percentages. The significantly higher frequency of shaped unifaces at this site compared to others at Cooper Lake suggests a greater emphasis on hide processing at 41HP175, but there is no evidence in the faunal remains to indicate that this was associated with increased use of bison (see below). Dart points (1 percent) and dart point preforms (<1 percent) are quite scarce, indicating that the dart and atlatl had been replaced by the bow and arrow by the early part of the Late Caddoan period. Otherwise, the tools that are least frequent (cobble tools, 1 percent) or absent (perforators and burins) at 41HP175 are the same forms that tend to be infrequent at other sites in the project area. Compared to other sites at Cooper Lake, ground/pecked/battered stones are relatively common at 41HP175, but unlike at the other sites, hammerstones and pitted stones are more frequent than grinding stones. This may reflect the increased use of wooden mortars for processing plant foods during the Late Caddoan period, or it could be due to a greater emphasis on the processing of hardwood nuts and perhaps core reduction at 41HP175.

The latter is supported by the fact that cores constitute 31 percent of the non-debitage lithic collection, and it appears that core reduction to produce expedient flake tools and flake blanks for arrow point manufacture was an important strategy. Intensive core reduction probably explains the relatively small size of the cores from 41HP175 (mean length = 13.7 ± 4.4 mm; mean width = 9.7 ± 3.6 mm; mean thickness = 6.0 ± 2.5 mm), and this, along with the importance of tool manufacture overall, may explain the high ratio of unmodified debitage to chipped stone tools (27.7:1). This site stands out in terms of lithic technology from other sites in the area also in that it has a high percentage of chips (69 percent) and low percentages of complete flakes (17 percent) and proximal fragments (14 percent), a high percentage of flakes less than 21 mm in maximum dimension (76 percent), and a high percentage of flakes with corticate platforms (24 percent), all of which may be related to a focus on unpatterned core reduction.

In terms of lithic raw material usage, 41HP175 is conspicuous for its very high percentages of fine-grained quartzite among the shaped tools (74 percent), modified flakes/expedient unifaces (76 percent), and unmodified debitage (76 percent). Non-quartzite fine-grained materials are even more scarce than at other sites at Cooper Lake, constituting just 2 percent of the shaped tools, 2 percent of the expedient tools, 1 percent of the cores, and less than 1 percent of the unmodified debitage. No artifacts of chalcedony were recovered, and there are only a few pieces of debitage of novaculite. The higher percentages of these materials in the tools than in the debitage suggest that most of the tools of chert were manufactured elsewhere and saw limited further reduction or resharpening at 41HP175. A strong focus on local lithic sources is further indicated by the extreme infrequency of artifacts made of materials non-local to the region, with just one shaped tool (source unknown), one modified flake/expedient uniface (Red River gravels), and two pieces of unmodified debitage (Red River gravels) being classified as non-local.

The collection of faunal remains is of limited interpretive value because of its small size and poor state of preservation, which probably account for the limited variety of taxa present and the lack of invertebrate remains. Nonetheless, it does provide some insights into subsistence practices. The identified vertebrate remains point to a focus on white-tailed deer (66 percent of the identified elements are deer or deer/pronghorn) and turtles (24 percent), and in this respect, Late Caddoan hunting strategies appear to have been quite similar to Woodland and Early Caddoan ones in the upper Sulphur River valley. While pronghorn and bison are present, they are not sufficiently frequent to indicate grasslands-oriented hunting strategies as has been proposed for the Late Caddoan period in parts of the western Caddoan area (Perttula 1990:Part I, 112-122).

Modified bones are not frequent, especially considering that half of the sample may represent parts of a single item. Nonetheless, the recovery of six functionally distinct kinds of artifacts–a musical rasp (?), worked antlers, awls, a beamer, a pin, and turtle shells with scrape marks–points to a diverse bone tool assemblage.

Macrobotanical remains are moderately abundant, although most of the wood charcoal is from Feature 8 and probably is not cultural. The economic remains identified in the analyzed sample consist predominantly of hickory nutshells, with pecan nutshells, black walnut nutshells, acorns, honey locust seeds, water locust seeds, maize, squash, hackberry seeds, and *Pediomelum* (formerly *Psoralea*) root or cortex fragments being present in much smaller quantities. These data suggest primary reliance on wild plant foods (e.g., hardwood nuts, fruits, seeds, and tubers) during the Late Caddoan period, with limited use of cultigens. The wood charcoal is relatively heavily dominated by oak, and this may indicate selectivity of fuel use.

Fire-cracked rocks are moderately abundant at 41HP175, but the relatively low ratio (5.7:1) of burned rock weight to number of chipped stone tools (multiplied by 100) indicates that processing activities using these rocks were much less important than they were at earlier sites in the project area. The low number of burned rocks per kilogram (68) implies relatively infrequent reuse of rocks, and this could reflect the limited number of occupational episodes. Burned clay and burned clay with impressions are not very abundant in spite of the presence of the large hearth, and this also could be a reflection of the limited occupation span. In contrast, burned mud dauber nests are relatively common, and they may indicate the presence of a structure.

In sum, 41HP175 is interpreted as a small hamlet that was occupied on a permanent, or at least multiseasonal, basis by hunter-gatherers engaged in limited horticulture for a brief interval during the early part of the Late Caddoan period. The argument for a limited span of occupation, which is not particularly well supported by the absolute chronometric data, hinges on four main lines of evidence. First, the site is too limited in size to represent a large number of overlapping occupations, and it is implausible to suppose that repeated use episodes over a long span would have centered in the same place (i.e., Feature 1). Second, the ceramic sherds tend to be large and can be placed into batches representing reconstructable vessel sections, the distributions of which are more suggestive of the transportation of parts of broken vessels for discard or reuse than *in situ* pot breakage and dispersal by foot traffic. Third, the artifacts and other cultural materials exhibit highly patterned distributions within the excavation block suggestive of a hearth-centered activity area, and it is unlikely that such patterning would have survived a large number of occupations. And fourth, the temporally sensitive artifacts are most consistent with occupations dating to the Late Caddoan period.

While the predominance of two distinct arrow point styles (i.e., Turney and Perdiz) could be used to argue for use over a fair length of time, the power of such an argument is diminished by the fact that a number of the graves at the Tuck Carpenter site in Camp County contained both triangular arrow points (typed as Talco and Maud) and contracting-stem points (typed as Perdiz and Bassett), implying contemporaneous usage of these distinctly different styles (Turner 1978:62). Further, Perttula's (1992:243-249) recent seriation of the burials from the Tuck Carpenter site and 11 other Titus phase cemeteries using arrow point types and Ripley Engraved decorative motifs indicates partly contemporaneous usage of stemmed (Bassett) and triangular (Maud) points.

The similarities in the arrow point assemblages from 41HP175 and the Tuck Carpenter site suggest some relationship between 41HP175 and the Titus phase sites found mostly in the Cypress Creek valley. This similarity extends only partly to the ceramics, however. While some of the bowls with scroll motifs, some of the punctated and appliquéd jars, and the engraved bottles are reminiscent of such Titus phase types as Ripley Engraved, McKinney Plain, and Taylor or Wilder Engraved, the 41HP175 assemblage overall, with its low incidence of brushing, high frequency of shell tempering, and prominent presence of Avery Engraved, is quite different from the Titus phase assemblages characterized by Thurmond (1990:228).

Closer similarities can be found with the burial assemblages illustrated for the Roitsch-Williams-Roden site complex on the Red River, where Avery Engraved deep bowls, bowls typed as Simms Engraved and less frequently as Ripley Engraved, and punctated and appliquéd utility jars typed as Nash Neck-Banded, McKinney Plain, and Emory Punctated-Incised are common (Perino

1981, 1983; Skinner et al. 1969). The ceramics from 41HP175 are different from these Red River collections in some notable ways, though, especially the lack of Avery Engraved vessels other than deep bowls, the predominance of bowl forms and slanted scroll motifs that are more typical of Ripley Engraved than Simms Engraved, and the presence of a few globular jars (especially Vessel 47) that are more reminiscent of Plains vessel forms than those found on the Red River.

Also, the moderate percentage of shell tempering (41 percent of the sherds and 20 percent of the vessels) at 41HP175 is at odds with the very low incidence of shell tempering (2 percent) indicated for the vessels from the burials at the Roden site (Perino 1981:47-54). Given the apparent predominance of shell tempering in the 1968 collection from the Roitsch site (Skinner et al. 1969:39-43), however, it is tempting to speculate that Perino's (1981:47-54) identification of bone as the primary tempering agent in the Roden site ceramics refers instead to shell. In fact, the nearly exclusive use of shell temper among the types represented in the 1968 vessel collection from the Roitsch site (i.e., Avery Engraved, Simms Engraved, Hudson Engraved, Keno Trailed, Nash Neck-Banded, and Emory Punctated-Incised) appears to contrast with the situation at 41HP175 where shell temper occurs primarily in a few utility jar forms and a few undecorated bowls. The significance of this difference remains unclear, however, since grog tempering is well represented in the sherd (as opposed to the vessel) collection from the 1968 work at the Roitsch site (Skinner et al. 1969:47-51, 64-67).

In any case, part of the ceramic assemblage from 41HP175 forms a subset of the collections from these Red River sites in terms of vessel forms and decorations, if not in terms of temper type percentages, while part (i.e., most of the carinated and simple bowls) is more typical of assemblages found in the Cypress Creek valley. Thus, the ceramics point to some connections with both the McCurtain phase and the Titus phase, while, as noted above, the presence of Perdiz points at 41HP175 hints at stronger connections with groups in the Cypress Creek valley than on the Red River.

Complicating the issue of phase affiliations is the scarcity of non-local lithic raw materials at 41HP175, which suggests extreme provincialism for the inhabitants of the site. Based on these data, it appears that the site was occupied by groups who had limited mobility outside of the Cooper Lake area into regions with higher quality lithic materials (e.g., the Red River) and/or limited interaction with groups occupying these regions. From this perspective, it appears that 41HP175 may represent an occupation by an indigenous group rather than a group intrusive from elsewhere.

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The Red River Caddos: A Historical Overview to 1835

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ABSTRACT

For 150 years the Red River Caddos, particularly the Kadohadacho tribe, were the dominant Native Americans on the Louisiana-Texas frontier which served as the boundary between various Euro-American empires. As such they used this position, and the influence they had over the other tribes of the region, to materially enhance themselves as well as gain prestige and respect from Euro-Americans and Native Americans alike. In doing so, however, the Red River Caddos paid a price; they became dependent on European metal goods and they were ravaged by disease. By the early nineteenth century, the population of the Red River Caddos had fallen so low that the tribe had lost its position of importance, especially with the removal of tensions between the border empires. In 1835, the tribe was forced to sign a treaty with the United States in which they sold their ancestral territory.

The Caddo Tribe of Oklahoma, which now maintains a small tribal complex in the western part of the state, once was one of the most important native groups of North America. For almost 150 years, the Caddos were the dominant tribe on the border between two Euro-American empires. As such, they used this opportunity to profit from their position, as well as influence the diplomacy of the region by playing the various empires against one another. However, since the Caddo lands lay on the boundary between the French and Spanish empires in North America, they have been neglected by the Anglo-centric historians of colonial America and have failed to receive the attention that other tribes— such as the Iroquois or Creeks who bordered the 13 English colonies—have received.

The Caddos also straddled other borders. Their villages were located on the boundary between the Eastern Woodlands and the Great Plains; thus, they were not only sedentary agriculturalists, but buffalo hunters as well. Long before the Europeans arrived, the Caddos were middlemen in the trade that took place between tribes of the plains and those of the forest. They eagerly continued this trade following the European intrusion. Probably the most important historical role the Caddos played, particularly those located on the Red River, was a diplomatic one; their proximity to French Louisiana, Spanish Texas, and finally the United States allowed them to act as negotiators with more numerous and powerful tribes that lived upstream. This gained the Red River Caddos great prestige and respect from Euro-American and Native American alike. It was not until the early nineteenth century, when the borders of empire disappeared and the tribe had been ravaged by disease, that the Red River Caddos lost their position of importance.

The population of the entire Caddo Indian tribe stood at ten thousand when René Robert Cavalier, Sieur de La Salle, and his party of nearly three hundred French colonists set in motion the permanent European intrusion into Caddo country by landing at Matagorda Bay in 1685. The Caddos lived in fixed, permanent farming villages located along two river systems, the Red and the Neches. The Red River Caddos were divided into two loose confederacies: the Kadohadachos and the Natchitoches. The Kadohadacho confederacy was located around the bend of the Red River near the Arkansas, Texas, and Oklahoma border. Three thousand five hundred Kadohadachos lived in four tribes: the Kadohadacho proper, Nanatsohos, Upper Nasonis, and Upper Natchitoches (Williams 1964:545). Further downstream were the Yatasis, who, with the Lower Natchitoches and Doustionis, formed the Natchitoches confederacy which consisted of perhaps two thousand tribesmen (Swanton 1942:12-13). To the west, along the upper reaches of the Neches River in East Texas, were the nine tribes that made up the Hasinai confederacy (Bolton 1908:249-276). Each individual tribe was led by a hereditary chief, or *caddi*, who presided over a well-defined chain of command which provided the tribe with strong, efficient government (Newkumet and Meredith 1988:56).

Both Caddo groups on the Red and the Neches were visited by remnants of La Salle's "lost" colony, as well as by Frenchmen from Canada in search of the *voyaguer*. Henri Joutel and seven Frenchmen passed through the Kadohadacho and Hasinai villages in 1687 as they made their way from the Texas coast to find help in Canada. Three years later, Henri de Tonti traveled among all three Caddo confederacies in a vain attempt to locate La Salle. The Caddos initiated friendly relations with the French by bartering horses in return for metal goods, including a few muskets (Weddle 1991:33-39).

The Caddo tribes desperately needed weapons to defend themselves from their enemies who already had access to firearms (or would soon obtain them): Athapascan-speaking Lipan Apaches to the west, Siouan Osages to the north, and Muskoghean Choctaws and Chickasaws east of the Mississippi River. When Spanish parties also searching for La Salle met the Hasinais a few years later, the natives eagerly accepted the offer to set up missions in their country for they believed it would mean greater opportunities to obtain guns and other metal goods (Weddle 1973:204-216).

In 1690, the Spaniards established two missions near the Neches River for the Hasinai tribes. (The following year, Governor Domingo Terán de los Ríos and Father Damian Massanet were thwarted by winter weather from establishing a mission among the Kadohadachos.) Much to the chagrin of the Caddos, the Franciscan priests came armed only with Jesus Christ and refused to distribute firearms to their hosts. The missionaries did, however, introduce European diseases to the Caddos and an epidemic swept the country in 1691 which killed perhaps three thousand tribesmen. Two years later, the Hasinais drove the few remaining priests from their village by threatening to kill them. The Spaniards retreated beyond the Rio Grande with all of the Caddo tribes violently opposed to their return (John 1975:187-193).

Despite the withdrawal of the French and Spanish from their country in the 1690s, the Caddos continued to feel the detrimental effects of the European presence in North America. All three confederacies were plagued by outbreaks of disease. In addition, the Red River Caddos were ravaged by the British-armed Chickasaws who attacked the Kadohadachos and Natchitoches to obtain slaves for their suppliers. By 1720, the deadly combination of warfare and disease had reduced the population of the Red River Caddos by more than two-thirds; only one thousand Kadohadachos and five hundred Natchitoches remained (Smith 1958:252-254).

Therefore, the Caddos welcomed the French and the promise of European weapons and goods back into their world in the early eighteenth century. Contact with the French was reestablished in 1700 by Louis Juchereau de St. Denis, who had been sent up the Red River by the founders of Louisiana, the brothers Le Moyne. Although a limited amount of trade was developed between the French and the Caddos, the amount of firearms obtained in return for salt and horses was not enough to stem the Chickasaw onslaught. As a result, the Natchitoches abandoned their Red River village and took refuge on the banks of Lake Ponchartrain to be nearer their French allies (John 1975:198).

Not until the second decade of the eighteenth century did the Red River Caddos obtain an ample supply of arms to defend themselves. In 1713, the Natchitoches accompanied St. Denis back to their old village, where, with the Doustionis' assistance, a French trading post was erected. In 1719, the Nasoni *caddi* sold Benárd de la Harpe a piece of land near his village within the Kadohadacho confederacy, upon which the French built a fort and trading establishment known as the "Nassonite post" (Weddle 1991:190-211). By the 1730s, when the French established yet another trading post at the Yatasi village halfway between the Natchitoches and the Kadohadachos, the Red River Caddos had established themselves as the dominant tribe on the border between French Louisiana and Spanish Texas .

The French settlements along the Red River caused the Spanish to return once more to the Hasinai villages. Eventually the Spanish set up three permanent missions between the Neches and the Red rivers, while at the same time establishing the capital of Texas at Los Adaes, only a few miles to the west of the French post at Natchitoches. The Hasinais tolerated the Spanish presence in their midst since it was minimal—less than one hundred soldiers and only a few, unsuccessful priests (Chipman 1992:105-131). Illegal (from the Spanish viewpoint) French weapons and metal goods flowed freely into Texas from the Red River Caddo villages and French settlements. Not only did these weapons (as well as Frenchmen themselves) allow the Caddos to end the threats from their Indian enemies, it also enhanced their position *vis à vis* the friendly tribes of the area. The Red River Caddos became middlemen in the trade with the larger, more warlike tribes who lived farther upstream from the Kadohadachos. These included their fellow Caddoan-speaking kinsmen of the Wichita confederacy—namely the Taovayas, Iscanis, Tawakonis, and Kichais—as well as the most recent newcomers to the region, the Shoshonean Comanches. These tribes (known by the Spanish as Norteños) used their Caddo-provided French weapons to fight their common enemies, the Lipan Apaches and the Osages.

The trade that was maintained between the French and the Red River Caddos gradually transformed the material culture of the tribe. By the mid-eighteenth century, the Kadohadachos and Natchitoches had almost completely forsaken the traditional crafts they had produced in favor of European-manufactured goods. The items procured by the Caddos to trade with the French—buffalo skins, deer *chamois*, and bear fat—were articles that the tribe had traditionally obtained for their own use. In addition to these three staples, the Red River Caddos supplied the French with surplus corn, horses, mules, and Indian slaves. In return for these items, the French supplied the Caddos with a variety of goods which came to affect all aspects of tribal life.

Weapons were the most important articles the Caddos received. Rifles, powder, and balls not only allowed the tribe to hunt more efficiently, but enhanced their military proficiency as well. In addition to guns and ammunition, the French supplied the natives with steel hatchets, tomahawks, and knives. The Red River Caddos also became dependent on European shirts, cloth, and blankets. Tools, such as scissors, awls, screws, and flints for fire, also became necessities. Beads, combs, vermillion, mirrors, copper bracelets, and strips of scarlet were all ornamental items that the French readily kept on hand to supply the tribe. By the mid-eighteenth century, life without the European goods had become incomprehensible to the Red River Caddos (Bolton 1914, Volume I:132-133)

Although trade with the French materially benefitted the Natchitoches and the Kadohadachos, close contact with them continued to reduce the tribes numerically. Unlike the previous epidemics which had so ravaged the Caddo confederacies, disease in the middle period of the eighteenth century was a subtle constant which reduced the tribe gradually. By the 1770s, the Kadohadacho population had fallen to about 750 while that of the Natchitoches dropped to about 225. The Red River Caddos were able to overcome the terrible loses and remain strong only through consolidation. The Kadohadachos were reduced by two tribes, leaving only the Kadohadacho proper and a smaller branch which the French called the Petit Caddos. The Doustionis merged into the Natchitoches tribe and the Yatasis reformed themselves as an independent tribe who lived halfway between the Natchitoches and the Petit Caddos (Smith 1989:107-108).

Despite the population decline, the Red River Caddos clearly recognized their dependence upon their French allies and firearms and were willing to take up arms against anyone, including the Spanish, who threatened to disrupt their intimate ties. In 1731, they rushed to the aid of the French soldiers at Natchitoches when the post was besieged by hostile Natchez warriors (O'Neill 1977:123–124). Halfhearted attempts by the Spanish in 1750 and 1752 to halt the flow of French trade into Texas were thwarted by the bold, aggressive stance adopted by the Caddo tribes. Throughout the period Spanish governors not only turned a blind eye to the illegal trade, a few engaged in it themselves (Smith 1989:115–120).

Actual attacks on the Spanish did not occur until 1758 when Caddo warriors joined a group of two thousand Norteños in an assault upon the mission the Spanish had set up for the Apaches on the San Saba River. Eight Spaniards were killed and the mission buildings burned. Although the Comanches and Wichitas led the attack, more than half of the warriors carried French guns obtained through the Red River Caddos (Weddle 1964:72-78). A Spanish punitive expedition, led by Diego Ortiz Parilla, attempted to punish the Wichitas in 1759, but met defeat at the well-defended Taovaya village on the Red River. The Taovayas were well-armed with French weapons, and flew the French flag over their fortified position (Allen 1939:60-70). Over the next few years, the Norteños continued their attacks on the Spanish presidio on the San Sabá, as well as upon new missions set up for the Apaches at El Cañon on the Nueces River (John 1975:362-363).

Thus, the Red River Caddos were not only dependent upon the French for metal goods and firearms when France abandoned North America in 1763, they were also seen as hostile by the Spanish inheritors of Louisiana. The Caddos, then, began to manuever to make peace with the Spanish in an effort to secure the same trade relationship with Spain that they had enjoyed with the French. Although the transfer of Louisiana took place in November 1762, the Spanish moved slowly, not taking formal possession of the colony until 1767.

Spanish officials were indecisive in formulating a firm course of action concerning the Indians of Louisiana. Initially, the Spanish governor of Texas attempted to halt the flow of commerce that was being conducted with the Indians of his province through the Red River Caddo villages. In response, the Yatasi headmen, Houhan and Cocay, gathered members of the Kadohadacho and Hasinai tribes at their village and threatened to attack the Texas capital of Los Adaes (Bolton 1914, Volume I:128-129). This convinced the Spanish officials—now advised by Athanase de Mézières, a French officer who had been stationed at Natchitoches since the early 1740s—to allow the trade to continue and to pursue a policy of peace in order to establish Spanish authority over the tribes of Louisiana and the Red River Valley which had acknowledged France. They also hoped to bar the intrusion and influence of the British, now poised on the east bank of the Mississippi River following the Treaty of Paris in 1763 (Nasatir 1976:15-18).

De Mézières (appointed lieutenant governor of Natchitoches in 1769) considered the allegiance of the Kadohadachos to be of the utmost importance to any peace plan, for the tribe occupied the "master-key of New Spain." Not only could the Kadohadachos serve as a buffer against British incursions on the northeast flank of Texas, but their influence over the other Norteños, especially the Wichitas, might help bring about peace with those tribes as well (Bolton 1914, Volume I:130-131).

De Mézières opened formal relations with all of the Red River Caddos in January 1770. To induce the allegiance of the tribes, he arranged for the Natchitoches, Yatasis, Petit Caddos, and Kadohadachos to receive annual presents; the latter three tribes were also permitted to have licensed traders at their village to supply them with European goods. Assured of the continuation of their trade goods, the Red River Caddos gathered at Natchitoches in April 1770 to establish formal ties with the Spanish. The Kadohadacho *caddi*, Tinhioüen, as well as Cocay of the Yatasis, received the high distinction of being designated medal chiefs by de Mézières, and both "solemly promised to show the same love and the same respect" for Spain as they had for France (Bolton 1914, Volume I:143-150, 157-158).

With the establishment of good relations with the Spanish, the Red River Caddos took measures, in conjunction with their new allies, to influence the rest of the Norteños to end their attacks. Tinhioüen and Cocay sent messengers to the Norteños informing them that the French had ceded Louisiana to Spain, and both promised to abstain from trading with the Norteños in an effort to show the Comanches and Wichitas that only friendly tribes would receive trade. In September 1770, Tinhioüen brought de Mézières and the Wichita headmen together at his village for preliminary peace talks, which led to an actual treaty being signed the following year (Bolton 1914, Volume I:140-142, 157-158, 204-208, 256-260).

Thus, within the first five years of Spain's actual occupation of Louisiana, the Red River Caddos had successfully used their important position to make peace with the Spanish as well as assuring themselves of continued trading privileges. They had controlled the potentially damaging effects of the transferal of Louisiana to Spain, and it seemed as if the future relations with the Spanish would only get better; for, in 1772 de Mézières, in conjunction with the governor of Texas, offered the Caddos and the Norteños a military alliance aimed at the destruction of their greatest enemies, the Osages and the Lipan Apaches (Bolton 1914, Volume I:310-312, Volume II: 24-27). Not only had the Red River Caddos successfully replaced France as a trading partner, it looked as if they might acquire a military ally as well.

The relationship between the Red River Caddos and Spain, however, faltered over the next few years for a variety of reasons. First, the Spanish did not follow up their plan for an offensive campaign against the Osages or the Lipans. Superiors of de Mézières in Mexico City neither trusted the Norteños nor wanted to incur the expense of a costly Indian war, and the Frenchman's plan was put on hold (John 1975:422-430).

Second, and most important, the Red River Caddos were wracked by a "cruel epidemic" in 1777-1778, the worst outbreak of disease since 1691. The

Yatasis and the Natchitoches were so ravaged by the sickness in the fall of 1777 that it became uncertain whether the two tribes would survive (Bolton 1914, Volume II:189, 231). By 1787, their numbers had declined so much that the commander of the post at Natchitoches decided they no longer needed to receive any presents. Five years later only two Yatasi families remained (Kinnaird 1949, Volume II:198, Volume III:98). By the beginning of the nineteenth century, the total population of the Yatasis and the Natchitoches had fallen to only 64 (Sibley 1832:721-724). The Kadohadachos and the Petit Caddos were not affected by the epidemic until the fall of 1778. The able Kadohadacho *caddi*, Tinhioüen, survived the disease, but witnessed the deaths of three hundred tribal members (Bolton 1914, Volume II:232-233).

The epidemics of 1777-1778 seriously altered the Caddo-Spanish alliance by furthering the Red River Caddos' dependence upon the Spanish at a time when Spain's weakness in North America increasingly became evident. Pressures mounted upon the tribe from all sides during the final two decades of the eighteenth century, but Spain proved unwilling and unable to provide the Caddos with the guidance, arms, or military protection that they desparately needed in their fragile state. Ironically, the peace that the Caddos had arranged between the Wichitas and the Spanish (which would be made to include the Comanches in the next decade), had served to make them relatively unimportant to the policy makers of Texas and Louisiana. During the last decades of the eighteenth century, then, the Red River Caddos increasingly were neglected and left to fend for themselves by the Spanish.

The worst pressures were brought upon the Red River Caddos by the Osages, who began full-scale attacks upon the tribe in 1777. Due to Spain's involvement in the war against Great Britain being carried on by the newly-founded United States and France, the Spanish were unable to control the Osages or provide the Red River Caddos with weapons (Din and Nasatir 1983:137-140). It was not until after the Treaty of Paris in 1783 that Spanish officials were able to mediate a treaty between the Osages and the Kadohadachos. In May 1785, Louisiana governor Estevan Miró had the head men of both tribes come to New Orleans and agree to make peace. Before the year was out, however, the Osages resumed their attacks upon the Red River Caddos. Although Governor Miró felt the Osages needed to be reprimanded for the attacks, he feared that depriving them of trade would only encourage them into dealing with the Anglo-Americans, who, following the Revolutionary War, were now established on the east bank of the Mississippi River. The Osages might also turn to the British and their trading station at Michilmackinac on the Great Lakes. Thus, the Spanish governor refused to take action against the Osages (Din and Nasatir 1983:153-155).

By 1788, the Osage onslaught forced the Kadohadachos to abandon their ancient village and move downstream to be closer to the Petit Caddos (Williams 1964:551). The following summer, Tinhioüen died and was succeeded by his son, Bicheda (Kinnaird 1949, Volume III:281). Unfortunately, the new *caddi* would prove unable to stem the tide of decline that continued throughout the rest of the century. In February 1790, five months after becoming the Kadohadacho *caddi*, Bicheda moved his tribe downstream once again to take refuge in the Petit Caddo village (Williams 1964:551). After a century of contact with the Euro-Americans, the four tribes of the Kadohadacho confederacy were finally reduced to one.

Added to the Osage threat in the 1790s were bands of Choctaw Indians who increasingly crossed the Mississippi River to raid the Red River Caddos and other Louisiana tribes (Kinnaird and Kinnaird 1983:189). Once again, the Spanish failed to contain either the Choctaw or the Osage threat to the Caddos. Although they attempted to fight back, the Kadohadachos were forced (for the third time in twelve years) to move their village in 1800; this time they took refuge near Caddo Lake about 35 miles west of the main branch of the Red River (Williams 1964:553). The new century did not bring the Red River Caddos a respite from disease either; in 1800 a smallpox epidemic ravaged the tribe, killing the Kadohadacho *caddi,* Bicheda (Sibley 1922:95).

His successor, Dehahuit, was afforded the opportunity to turn the fortunes of the Red River Caddos around. For, France reacquired Louisiana from Spain in 1800, but sold the huge expanse of land to the United States three years later without defining its borders. All of a sudden, with a few strokes of a pen, the Kadohadachos found themselves on a disputed boundary between empires. Both the United States and Spain claimed the allegiance of the tribe in an attempt to define the border more clearly. In addition, it was understood that in case of war—which was fully expected by both sides—Indian allies might tell the difference. The Kadohadachos, because of the great influence they had over the rest of the Caddos, the Wichitas, and other tribes in the area, were courted by both the United States and Spain. Realizing the situation, Dehahuit expertly played the two powers against one another and was able to obtain conditions favorable to the Kadohadachos' well-being and preeminence in the area.

The emergence of the Kadohadachos' dominance over the rest of the Caddo tribal groups is one of the most important trends of this period. Not only did the weak Yatasis and Natchitoches look to the Kadohadachos for guidance, the four remaining Hasinai tribes did as well. Dehahuit and the Kadohadachos also had influence over emigrant tribes from the southeast—such as the Apalachees, Pascagoulas, Biloxis, and the amalgamated Alabama-Coushatta tribe—who had begun to arrive on the Louisiana-Texas frontier in the late eighteenth century. Most importantly, the Kadohadachos still maintained close ties with the powerful Wichita tribes—especially the Taovayas—that resided further up the Red River (Smith 1991:178-184).

From the onset, both the United States and Spain understood that trade with the region's Indians would be crucial in winning their favor. The Kadohadachos were still dependent upon trade goods and actively pursued an alliance with whichever country could provide them with an ample amount of these necessary items. The United States, through skillful diplomacy and ample trade goods, quickly gained the edge over their Spanish rivals in Texas. The Americans, through their Indian agent at Natchitoches, John Sibley, treated Dehahuit and the Kadohadachos with great respect and showered them with presents and trade items. Sibley also negotiated a peace treaty in 1804 between the Kadohadachos and the Choctaws which was to be guaranteed by the Americans. Assured of the good intentions of the United States, Dehahuit began flying an American flag over his village in 1805, as the Spanish looked on helplessly (Smith 1991:185-188).

Spanish passivity ended the following year, however, due to an American expedition, led by Major Thomas Freeman and Doctor Peter Custis, which was designed to ascend the Red River to its source. Dehahuit met Freeman and Custis when they passed near his village in July 1806, and he provided them with guides for the rest of their journey. The Spanish responded to the Kadohadacho *caddi's* friendly attitude toward the United States by sending a large troop to his village which taunted him and cut down the American flag (Smith 1991:192-194). This action caused Dehahuit to travel to Natchitoches following the return of the American expedition—Freeman and Custis had been turned back by the same force which had invaded the Kadohadacho village—and to proclaim his tribe's formal allegiance to the United States (Rowland 1917, Volume IV:3-5).

Throughout the following decade the Kadohadachos and the United States maintained a close and fruitful relationship, personified by the friendship of Dehahuit and Agent Sibley. In the summer of 1807, Sibley not only forced the Choctaws to pay restitution for breaking their treaty with the Kadohadachos, he also disbanded a group of American horse thieves that had formed a camp near the Kadohadacho village (Smith 1991:197). In return, the Kadohadacho *caddi* arranged for a large group of Hasinais, Wichitas, and Comanches to travel to Natchitoches in August 1807 for a grand council with the American agent (Sibley 1922:48-60). This meeting proved to be mutally beneficial to both parties; with the aid of Dehahuit, Sibley succeeded in extending his country's influence well into Spanish Texas; likewise, Sibley's graciousness added to the Kadohadacho *caddi's* esteem.

Dehahuit's diplomatic successes not only enabled him to claim jurisdiction over the Yatasis and Natchitoches, but over the Hasinai tribes of Texas as well. Despite his ties with the United States, the Kadohadacho *caddi* kept diplomatic channels with the Spanish of Texas open and traveled to San Antonio to meet with the governor in the summer of 1809. As spokesman for the Hasinai, Dehahuit asked the governor to provide his kinsmen with an official trader, a request which was granted later that year (Smith 1991:198). Over the next few years Dehahuit continued to act as spokesman for all the Caddos in their relations with both Spain and the United States.

He also used his influence to maintain peace along the still-undefined boundary when threats of war begain to appear in 1810. The first threat was due to the Hidalgo revolt in Mexico which sparked a call in Texas for independence from Spain. Dehahuit used his prestigious rank to counsel the Caddos and Wichitas to stay out of the fray. Matters heated up along the Louisiana-Texas frontier two years later when the United States declared war on Great Britain, beginning the War of 1812. It was fully expected that the war would extend to a struggle with Spain as well and that an American invasion of Texas would result. At Agent Sibley's request, in the fall of 1812, Dehahuit successfully completed a mission to enjoin the Texas Indian tribes to remain neutral (Smith 1991:198-200).

A new threat to the peace materialized the following year from east of the Mississippi River in the form of the Creek Indians who were at war with the United States; these hostiles sent emissaries across the river to gain Indian allies by arguing that the Americans were ultimately inimical to all natives. Not only did Dehahuit lead the tribes under his influence to resist the Creek entreaties, he also got them to offer their services against the British in case of invasion. When the threat of a British landing in Louisiana actually materialized in late 1814, under the leadership of the Kadohadachos the tribes proved true to their word. In December, 150 Caddo warriors answered General Andrew Jackson's call-to-arms and arrived in Natchitoches, where they were held in reserve in case they were needed to secure the peace along the Spanish border (Smith 1991:200-203).

While the Kadohadachos had clearly sided with the United States in the southwestern border dispute with Spain, with the easing of tensions which accompanied the end of the War of 1812, Dehahuit attempted to reassume a position that was friendly to both powers. With the signing of the Adams-Oñis Treaty in February 1819, the boundary between Louisiana and Texas was finally officially determined as being the Sabine River from its mouth to 32 degrees longitude, then north to the Red River, and westward along the Red to the 100th meridian. However, the boundary line between the Red and the Sabine was not immediately surveyed, thus it remained unclear upon which side of the border the Kadohadacho villages lay. Once again, the tribe was afforded the opportunity of dealing with, and profiting from, both Spain (Mexico after 1821) and the United States. This time, however, the circumstances were different: with the border being calm, the Kadohadachos were not as important to the two powers, and less attention was paid to the problems that plagued the tribe in the 1820s.

Principal among these problems was the influx of Anglo-Americans into the area. Some were farmers who settled in the Kadohadachos' hunting grounds above their village on the Red River. Others were illegal traders who successfully diverted the tribe's trade from the official United States trading post by supplying the warriors with whiskey. Whereas Agent Sibley had acted quickly in removing interlopers—in fact, he was removed from his post in 1815, partly because the citizens around Natchitoches believed that he was more interested in the Kadohadachos' well-being than their own—his successors were far less diligent in protecting the tribe from intruders. As a result, the area's game was depleted, and the Kadohadachos developed a serious alcohol problem (Smith 1989:214-218).

Eastern emigrant Indian tribes also pressured the Red River Caddos after the War of 1812. Among these tribes were the Choctaws, Kickapoos, Delawares, Shawnees, and Cherokees. Although these tribes were most often friendly and aided the Kadohadachos in their ongoing struggle with the Osages, ultimately they caused Dehahuit to lose the preeminent position that he had forged among the tribes of the Louisiana-Texas frontier (Smith 1989:224-228). By the late 1820s the Cherokees, led by their civil chief, Duwali, had become the spokesman for the region's Indians in their relations with Mexico and the United States (Everett 1990:73).

Thus, the Kadohadachos, plagued by alcohol and want of game, and relatively unimportant to the region's diplomacy, became a prime candidate for removal when the official Indian policy of the United States shifted during the presidency of Andrew Jackson. Whereas, the federal government had attempted (often half-heartedly) to protect the Indians' lands from white incursion, the Indian Removal Act of 1830 implemented the program of buying native lands and moving the tribes to new territory in the west. President Jackson's appointee for the postion of agent for the Kadohadachos, Jehiel Brooks, fully concurred with this policy.

Brooks began pressuring the Red River Caddos to give up their land in 1833, when Captain Henry Shreve arrived in Natchitoches to begin the process of removing the Red River raft, a natural logjam which hindered navigation on the Red. Brooks realized that the only thing that had kept the Caddo lands from being swamped by white settlers was the lack of access to markets. With the Red River open to steamboats, it would only be a matter of time before cotton growers established plantations throughout the Caddo country.

At this crucial moment when the Kadohadachos needed strong leadership the most, their esteemed *caddi*, Dehahuit, died. He was replaced by Tarshar, a much less decisive man than Dehahuit, and one who had a fondness for liquor. In June 1835, Brooks intimidated Tarshar into gathering the entire tribe to discuss the sale of their lands. Five hundred tribesmen, including the few remaining Natchitoches and Yatasis, met with Brooks and agreed on July 1 to sell their lands for eighty thousand dollars. Unlike other tribes which sold their land under the Indian Removal Act, the Red River Caddos were not offered land in the Indian Territory, but were instead told to leave the United States and join their Hasinai kinsmen in Texas (Lange 1974:159-322).

The Caddos did not completely abandon their ancestral Red River villages until 1839. Eventually the Red River Caddos—now fully united under the leadership of the Kadohadachos—settled with the Hasinais on the Brazos River upstream from Waco. In 1859, hostile Texans forced the entire Caddo tribe to leave Texas and seek refuge in the Indian Territory. The Civil War caused the Caddos to take flight once more, but finally, in 1867, the tribe settled on the land where they still reside today. Fittingly, the Caddos once again live in the Red

River Valley; however, this time their land is on a tributary, the Washita, in an area far to the west of the region where the tribe experienced its greatest glory.

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Division of Labor and Stress Loads at the Sanders Site (41LR2), Lamar County, Texas

Diane Wilson

ABSTRACT

The incidence of degenerative joint disease (commonly termed osteoarthritis) was examined in the adult skeletal remains from the Sanders site. The location and severity of affliction were recorded and compared with documented cases of repeated action stress, and it was determined that the location of affliction coincided with other Mississippian maize agriculturalists. Activity patterns evident in the skeletal remains included carrying loads, ground clearing, hoeing, planting, paddling, skin scraping, grinding, weaving, and dancing. However, severity scores were considerably higher among males than females, an unusual circumstance among agricultural populations worldwide. The comparison of the results of this osteological study to Caddoan ethnohistoric and oral accounts, as well as to the archeological record, provide a test of methodologies used to understand the past. It is shown that these records provide both complementary and contradictory data, and it is only through careful use of all available sources that an accurate reconstruction of the past is possible.

INTRODUCTION

This study examines evidence on human bone of "occupational" stress to reconstruct the sexual division of labor for the prehistoric Caddoan occupation represented at the Sanders site (41LR2). Repeated stress is referred to here as occupational stress, as it typically denotes a habitual, culturally prescribed task (Merbs 1983). This study also attempts to demonstrate the occurrence of evidence for stress loads on the body associated with the division of labor and with particular sets of tasks.

Among the Sanders population, the division of labor was relatively traditional, although stress loads taken as a whole deviated from typical models for agricultural populations. The majority of women in the Sanders burial population experienced lower bodily strain during their lives than did the men from Sanders.

Because bone reacts to stimuli in a limited number of ways (through bone growth and bone destruction) many activities and/or stressors may result in the same bone response. This means that additional evidence of activities and/or stressors is required in order to accurately assess that individuals performed specific activities. In this archeological case, additional evidence has been found in the site's material culture remains (manos, metates, arrow points, etc.), Caddoan ethnohistoric accounts, and oral histories. In this study, the only direct link between the osteological remains and postulated activity patterns are the material culture remains. Historic documents and oral histories for the Caddo peoples do exist, but they are separated in time by several hundred years from the archeological evidence discussed here, as well as by possible differences in ethnic/inter-tribal affiliation.

DEGENERATIVE JOINT DISEASE

Primary degenerative joint disease is often termed osteoarthritis, however, the former term is more accurate in its description of the condition. The changes associated with primary degenerative joint disease (referred to as DJD) are mechanical, in that they are associated with wear and tear from repeated action and the aging process. The primary pathological response of DJD occurs in the articular cartilage and synovial membrane of the affected joint. The synovial membrane surrounds the space between articulating surfaces and is filled with synovial fluid that serves to absorb friction of articular cartilage during movement. Osseous reaction occurs in the form of marginal bone growth (osteophytosis, lipping, spurring, and exostosis), rarefaction (attrition, erosion), and eburnation (polishing).

For the archeologist, the only evidence of response to stimuli in teeth, bones, and joints is seen in the presence of new bone or the absence of normal bone. The presence of new bone is the most common and initial osseous response to repeated stress stimuli (Miller 1985:392). Osteophytosis is defined here as an abnormal bony outgrowth on an articular surface in response to stress (Merbs 1969; Ortner and Putschar 1981; Miller 1985; Kennedy 1989). Osteophytosis expands the osteological framework so the stress load may be thus dissipated and lowered per unit area (Kennedy 1989:134); DJD is therefore seen as a normal reaction to stress. Osseous involvement is secondary to considerable cartilage deterioration, and the condition occurs only after it has had some time to develop (Miller 1985:392). When stress has not been sufficiently reduced further cartilage breakdown results (Miller 1985:392). Additional cartilage breakdown may result in further osteophytic growth, or eburnation, and/or rarefaction.

These markers of activity patterns are rarely the result of one stress factor. Other influences that affect the condition's presence are age, sex, handedness, social status, life-style, nutrition, general health profile, and cultural practices (Sakoloff 1969; Kennedy 1989). Age is the most pervasive of these factors and involves both time-dependent molecular changes and a mechanical component associated with repeated insults to tissues. Sex has also been shown to be an important factor in post-menopausal females who seem to be more susceptible to DJD due to hormonal changes (Sakoloff 1969).

Duration of activity is also a factor influencing the expression of DJD. The clearest record left on bone results from either an abnormally large amount of stress over a short period of time (single event stress) or from a normal amount of stress occurring over an abnormally long period of time (activity patterns) (Merbs 1983:1). In other words, reconstruction of activities from osteological remains can only give an indication of the activities participated in, not the duration of time spent engaged in the activity.

THE ARCHEOLOGICAL SETTING

The term Caddo has historically been applied to at least 25 separate groups, bands, and/or tribes that inhabited the northeastern portion of Texas, adjacent portions of Oklahoma, Arkansas, and Louisiana. The northern Caddo groups spoke a different dialect than the southern groups (Parsons 1941:9). By 1690, these various groups loosely comprised three confederacies, named the Hasinai, the Natchitoches, and the Kadohadacho (Perttula 1993:94). The Hasinai occupied the Neches and Angelina River valleys in eastern Texas; the Natchitoches occupied the Red River Valley in the west-central portions of Louisiana; and the Kadohadacho occupied the Red River Valley in the Great Bend region during historic times (Perttula 1993:92).

Absolute dating of archeological sites within the Caddoan area has been rather limited to date. The Sanders site is no exception, as it has yet not been dated. However, it has been placed within the Gibson Aspect (Krieger 1946), and is thus felt to represent a relatively early manifestation of Caddoan culture. Current estimates are that the Sanders site may date between ca. A.D. 1200-1400.

The Sanders Focus is thought to represent one of the westernmost expressions of the Caddoan archeological culture. Components of the Sanders focus have been found along the Red River in Lamar and Fannin counties, Texas, in Choctaw County, Oklahoma, and from several sites in the upper Sabine and Cypress drainages in Northeast Texas.

The Sanders site is located approximately 1.6 km west of Direct, Texas, in the northwestern corner of Lamar County (Figure 1). The site consists of two mounds and a low ridge of habitation midden located on the edge of a river terrace on the eastern side of Bois d'Arc Creek. Bois d'Arc Creek is a tributary of the Red River, flowing some 5 km northeasterly from the Sanders site to the Red River. Excavation at the site took place in the summer of 1931 under the direction of A. T. Jackson and B. B. Gardener from the University of Texas. Jackson thoroughly excavated Mound 1 and trenched Mound 2 and the midden (Figure 2).

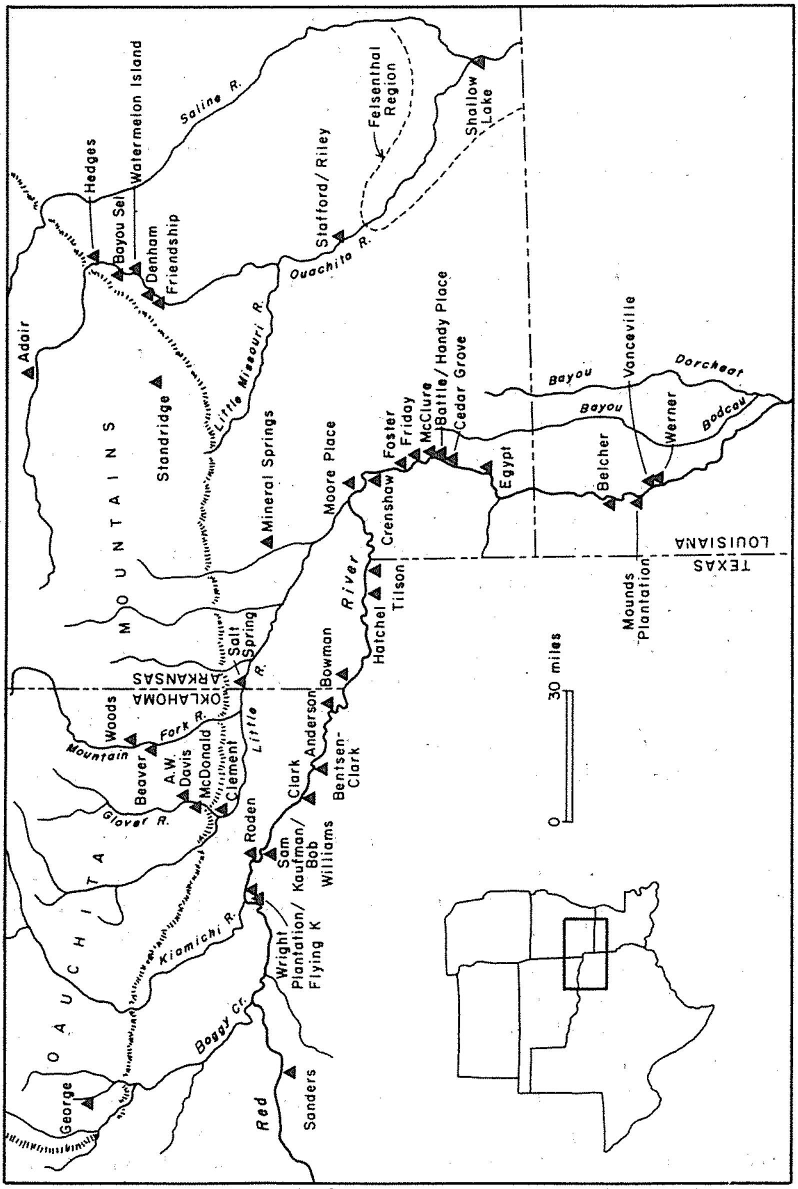

Figure 1. The Sanders site in relation to some other Caddoan sites along the Red River (from Pertula 1992:98).

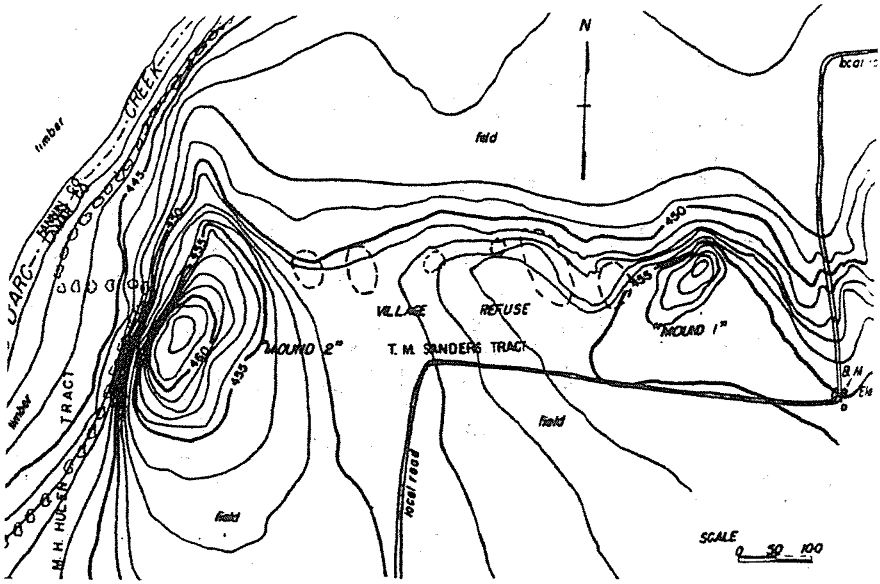

Figure 2. The Sanders site (from Krieger 1946).

The Sanders site is considered to have been the center of a large region of Caddoan interaction (Newkumet and Meredith 1988:39). Artifacts recovered from the site indicates its sporadic use up to historic times. Nevertheless, while the artifacts differ by depth, the graves are relatively homogenous in form and burial offerings, suggesting that the burials represent a discrete period of use during the Sanders focus. Jackson recovered some 90 individuals from two locations in Mound 1. One group was scattered over the top of the mound, while the other group was located on the eastern side of the mound (Figure 3). There was no difference between the two groups in burial form or offerings. Both single and multiple interments were found in both groups, and all individuals were in the supine, extended position, or lying on their side. All had their heads oriented to the east except one individual whose head was oriented to the west. Nearly all individuals exhibit frontal and occipital deformation. Demography within the burial population falls within the range of a normal population curve: 29 adult females, 25 adult males, 18 adults of indeterminate sex, and 20 children.

Artifact lists from the site were examined for an indication of the range of activities that might have been participated in by individuals interred at Sanders (Table 1). Unfortunately, due to the high number of multiple burials, no artifact category could be clearly associated with a particular class of individuals (i.e., females, males, older adults, young adults), burial locations, or burial form.

The ethnohistoric literature and published Caddoan oral histories were also consulted for evidence of activities that were possibly performed by the Sanders population (Table 2). Unfortunately, the use of ethnohistoric accounts assumes

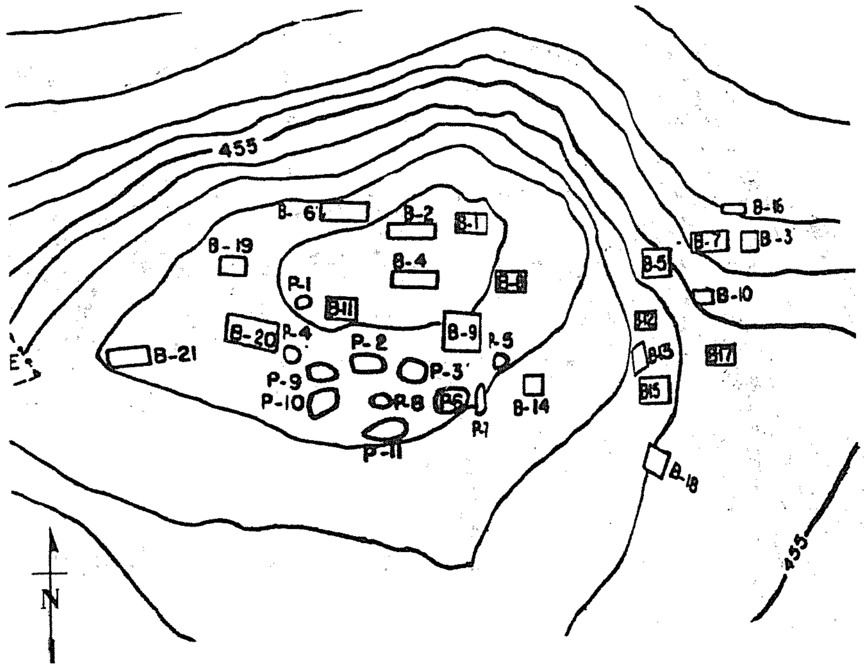

Figure 3. Mound 1 and the Sanders site burials (from Krieger 1946).

continuity over several hundred years between the archeological, ethnohistorical, and oral historical records. This problem is compounded by a lack of knowledge concerning the identification of ethnic identity among the Caddo from the archeological record. What this means is that ethnohistoric and oral histories can only be considered indicative of likely activity patterns for the Sanders population. DJD patterns in the osteological remains are then used to test these hypothetical activity models.

METHODS

All 55 adults from the TARL collections were examined. Juveniles were excluded from observation because DJD is primarily associated with repeated action stress and aging. Of the 55 adults examined, 43 were selected for use on the basis of representation of articular (joint) surfaces.

Of the adults aged less than 50 years that were examined, 12 were female, 15 were male, and nine were of indeterminate sex. Of the older adults utilized in this study, two were female, four were male, and one was of indeterminate sex.

All three categories of DJD expression were recorded and scored from 0-2, with 0 representing condition absent, 1 moderate expression, and 2 a severe expression of the specific condition. Once actual observations commenced, it

Table 1.

A Partial Lst of the Possible Activities that Members of the Sanders Burial Population may have Participated in as Indicated by Material Culture Remains

Artifact	Probable activity	Context
Bison scapula hoes	Soil tilling, manufacture, trade	Burials, midden
Stone hoes	Manufacture, soil tilling	Midden
Celts	Manufacture, ground clearing	Burials, surface
Manos and metates	Grinding	Midden
Pitted grinding slabs	Chopping, cracking, crushing	Midden
Deer mandibles with distal end removed	Food preparation, sinew stretching	Midden
Deer metapodials	Food preparation	Midden
Knives	Butchering, hide working, manufacture	Burials
Projectile points	Hunting, manufacture	Burials, midden
Fish-hooks	Fishing, manufacture	Midden
Conch dippers	Manufacture, trade	Burials, adult males
Pottery	Cooking, manufacture	Burials, midden, surface
Axes	Manufacture, wood procurement	Midden
Abrading stones	Sharpening	Midden
Pottery disks	Manufacture, sewing	Midden
Bone awls	Incising, sewing, weaving	Burials
Drills	Punctating, sewing	Surface
Shell beads	Manufacture, trade	Burials
Conch gorgets	Manufacture, trade	Burials
Earspools	Manufacture, trade	Burials
Pipes	Manufacture, smoking	Burials, adult males

was determined that these categories were not sufficient, hence fractions from 0-2 were added to the scoring system.

To collapse the data recorded for analysis only osteophyte (lipping) scores were quantified. Hence, in this report the term DJD is used synonymously with bone lipping. Since bone growth (osteophytosis) is normally the first reaction to cartilaginous destruction it may be the most useful form of DJD expression for determining past activity patterns.

Table 2.

Accounts of Caddoan Activities and Divisions of Labor

Activity	Females	Males
Plant	1, 3	1
Cultivate	1, 3	1
Hoe	1	1
Harvest		1
Husk maize	1	1
Manufacture bow and arrow		1
Manufacture arrow points		3
Hunt		1, 3
Accompany on hunt	3	
Process hide and fur	1, 3	3
Gather	1, 3	
Prepare food	1, 3	
Pound (maize, etc.)	3	
Produce clothing	1	
Carve wood		2
Chop trees		3
Construct residences		3
Construct birthing structures	3	
Basket weave	3	
Manufacture ceramics	3	
Sew moccasins		3
Participate in warfare		3
Gaming (foot races, wrestling, and hockey)		3

Sources: (1) Newkumet and Meredith; (2) Parsons 1941; (3) Swanton 1942

Nearly all distinct articular surfaces were examined; 113 in total (Table 3). By examining separate articular surfaces rather than regions a more accurate account of specific activities can be gained.[1]

[1] For example, the elbow was not scored as one region but the olecranon fossa, thochlea, unlar groove, capitulum, radial fossa, coronoid fossa, olecranon process, trochlear notch, supinator crest, coronoid process, radial notch, radial head, articular circumference of the radial head, and the radial tuberosity were individually scored.

Table 3.

Joint Surfaces Examined

Bone	Joint surface
Occipital	occipital condyle
Temporal	mandibular fossa
Mandible	mandibular condyle
Axis	dens
Vertebrae	inferior facets
	superior facets
	bodies
Cervical vertebrae	spinous process
Thoracic vertebrae	costal demifacet
	costal facet
Sacrum	centrum
	superior articular process
	auricular surface
Ribs	head
Sternum	clavicular facet
	costal notch
Scapula	glenoid cavity
Clavicle	sternal facet
	acromial facet
Humerus	head
	trochlea
	capitulum
	olecranon fossa
	coronoid fossa
	radial fossa
	ulnar groove
Ulna	olecranon process
	trochlear notch
	radial notch
	coracoid process
	head
Radius	head
	articular circumference of head
	radial tuberosity
	ulnar notch
	carpal articular surface

Table 3 (Continued).

Bone	Joint surface
Phalanges of fingers	proximal articular surface
	distal articular surface
Ilium	auricular surface
Femur	trochanteric fossa
	patellar articular surface
	tibia articular surface
	intercondylar fossa
Patella	lateral articular facet
	medial articular facet
Tibia	medial condyle
	lateral condyle
	superior fibular articular surface
	inferior fibular articular surface
	talus articular surface
Fibula	head
	lateral malleolus
Talus	Tibia articular facet
Calcaneus	posterior tuberosity

Interobserver error was avoided since only the author made observations and score determinations. Other experienced observers were randomly asked to view and score approximately 10 percent of the sample. All but one of these observations matched the author's determinations; the one discrepancy involved a slight reaction on the bone. In this instance it was difficult for both the author and the other observer to decide on a score, with one opting for a score of 0.25 and the other for a 0 score. In general, then, the observations reported herein are felt to be accurate.

Some of the joints highly affected by preservational and recovery biases were lumped into regional categories. Regional categories were utilized for the hands and feet. Since carpals and tarsals were rarely recovered they were omitted from analysis.

In the case of multiple bones with the same articular surface, such as ribs and vertebrae, observations were taken as to the overall representation of DJD, and then counted as one observation. Vertebrae were scored by region and articular surface, and ribs were scored by articular surface.

RESULTS

Representation

The incidence of osteoarthritis among the Sanders population was high. Of the 43 individuals examined only nine (22 percent) were not afflicted by the condition. This rate of occurrence was significant because so few older individuals were represented. This rate also seems high when one considers that osteological involvement is secondary to considerable cartilage deterioration (Miller 1985:392). Ortner (1992:5) has argued that only 15 percent of the entire population should be expected to exhibit pathological characteristics on bone.

The other factor that makes the high incidence of osteoarthritis among the Sanders population intriguing is that the Sanders site is a mound center. Mississippian and Caddoan mound centers are traditionally associated with elite individuals. Based on location and grave good assemblages, it was assumed that the individuals interred at the Sanders site were of high status.

Higher male scores and the severity of DJD are unusual compared to other Mississipian agriculturalists, regardless of social status. Pickering (1984) examined remains from both Mississippian mound center and village sites in Illinois and found higher incidence of DJD among all the examined females.

When all individuals were accounted for, the mean score per joint surface examined was 0.36 for females and 0.53 for males. Additionally, when considering the incidence of DJD as including those individuals exhibiting any evidence of the condition, males were more afflicted than females. Figure 4 compares the number of individuals with no sign of DJD to those with mean scores of more than 0. Not only did males have the highest number of individuals afflicted, but the lowest number of individuals that were not afflicted with DJD. This configuration shows that while there were more adult males than females examined, DJD affliction was not evenly distributed among the ratios of sex or age. If this were the case adult males would have had the highest number afflicted as well as the highest number not afflicted. Three adult females do not have any evidence of DJD as opposed to only one male with no evidence of DJD stress. This difference is significant at the 0.05 level in a Chi square test. Therefore, it was concluded that male stress loads were higher than female stress loads in the Sanders population.

However, in the old adult category the reverse seems to be true. Higher incidences were expected among older adult females due to post-menopausal hormonal changes that often result in increased osteoarthritis (Sakoloff 1969). The contradiction between adult males who had the highest incidence of DJD and older adult males who had the lowest incidence of DJD is not expected considering that DJD is a cumulative pathology. Figure 5 indicates that the problem is representational. Older adult males were considerably under-represented in terms of number of articular surfaces present (29 joint surfaces present

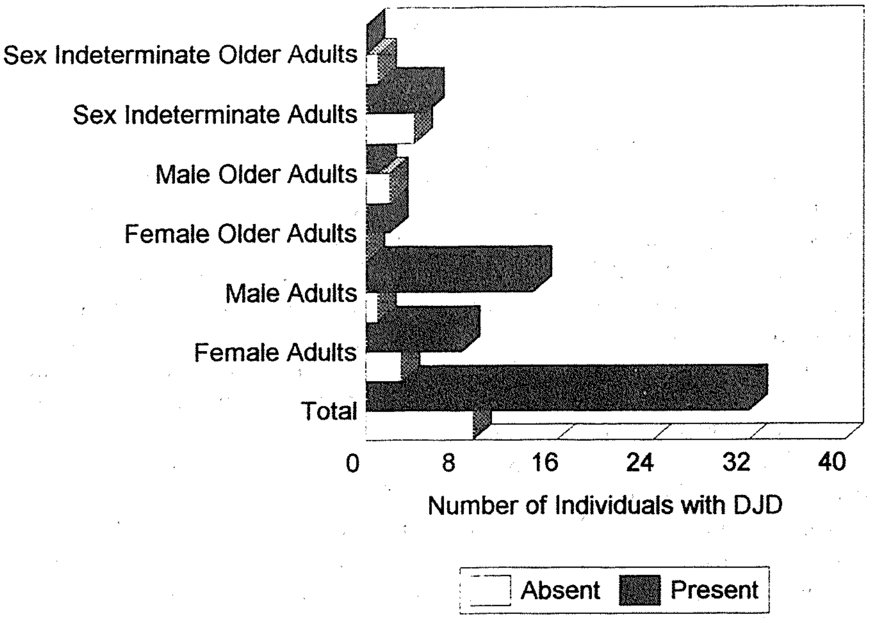

Figure 4. Incidence of DJD mean scores of 0 and greater than 0.

in three individuals examined, out of a potential for 339 joint surfaces). In fact, two of the older males were represented only by crania. Cranial joint surfaces were the least afflicted regions in the Sanders population.

Figure 5 also demonstrates that older females were the best represented group in terms of articular surfaces present (two individuals and 126 joint surfaces present). However, this is primarily due to the presence of an individual that was nearly complete; the other individual was poorly represented.

Stress Loads Among Individuals

Figures 6 and 7 show a bimodal distribution of DJD scores for all age and sex categories. Both figures demonstrate that there were relatively few joint surfaces with a moderate degree of DJD expression. As expected, the majority of joint surfaces examined were unaffected. However, a large number of joint surfaces were severely afflicted. This distribution suggests either that: (1) a majority of joint surfaces were not subjected to stress caused by activity patterns, while the joint surfaces that were influenced by such tasks were extremely taxed, or (2) that there were a majority of individuals within the population that were not afflicted with DJD, while those that were had severe expressions of the condition.

The high percentage of extreme DJD expression in adult males, and the low percentage in females (statistically significant at the 0.05 level), suggests

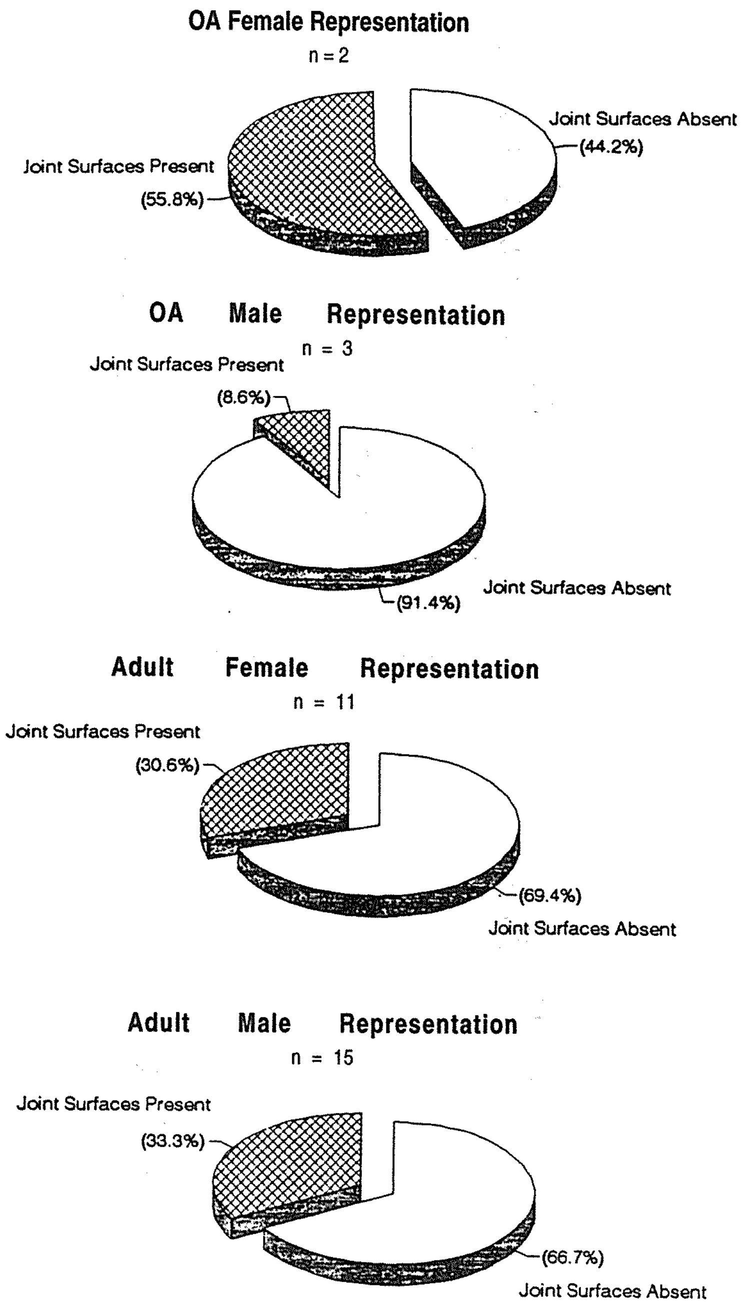

Figure 5. Representation of articular surfaces and individuals examined. There were a total of 113 joint surfaces that could have been present per individual.

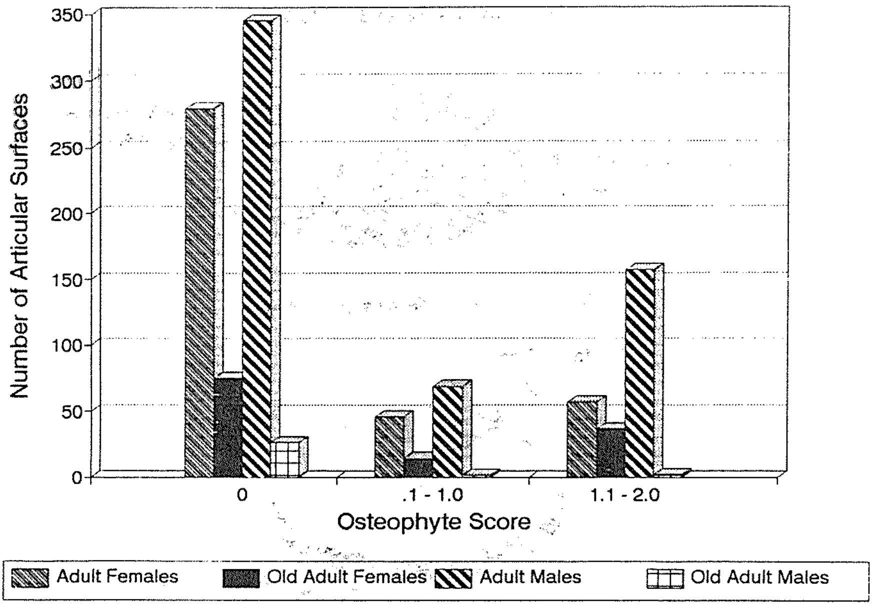

Figure 6. Osteophytosis scores for age and sex categories. The number of examined articular surfaces falling in each score category is also given.

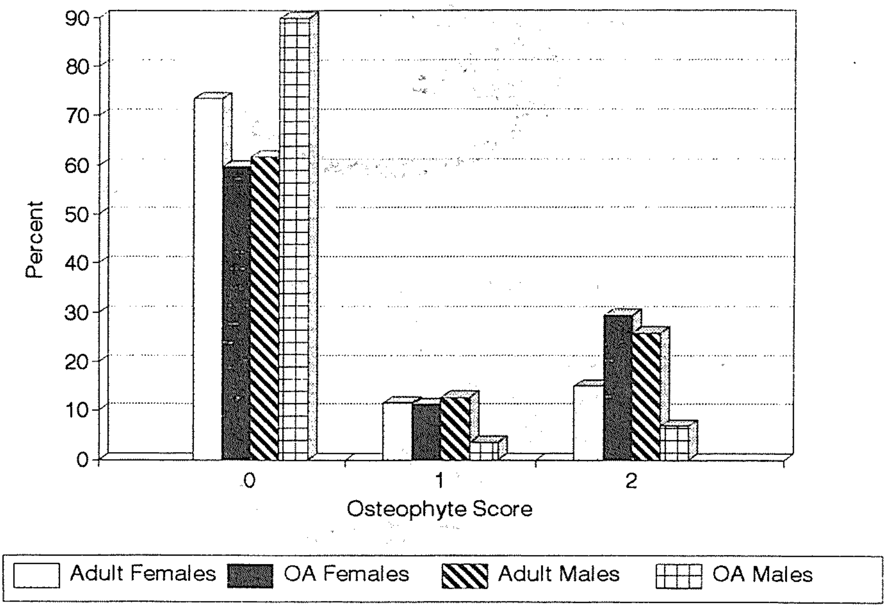

Figure 7. Osteophytosis scores for age and sex categories. Percentages are given on the y-axis.

differential distribution of activity stress within the population. However, Figure 8 demonstrates that differences within the population are not related to sex alone. Most average individual scores for both males and females fall within the 0 - 0.8 mean range. Among the outliers, males had much higher scores than females. This figure demonstrates that there was some variation by individual, however most individuals fell within a well defined range of values. It also suggests that there was considerable variation in affliction between joint surfaces.

Although not displayed in this figure, burial location as well as position within multiple burials were also considered in this investigation. Mean scores ranged from 0 to 1.49 among single burials. Individuals within multiple burials ranged from 0.4 to 0.69. Location within the graves did not correlate with individual stress loads.

Some difference in mean scores was evident in burial location within the mound, but this difference was not statistically significant. The mean score for burials on the top of the mound was 0.40, while the mean for burials located on the eastern slope was 0.56. Little social distinction was evident in grave inclusions between these groups, so it is not thought that the differences in stress loads correspond to a distinction of social status.

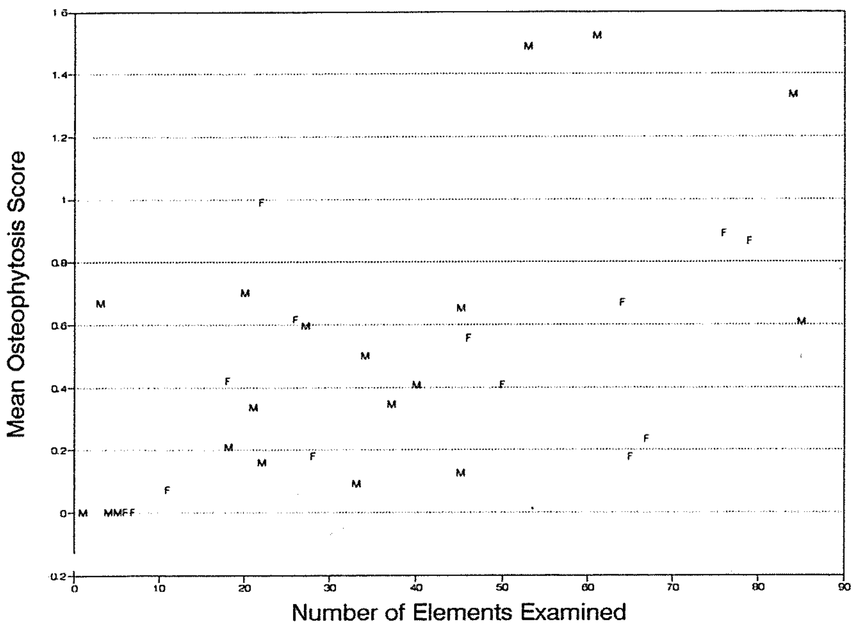

Figure 8. Mean individual osteophytosis score for females (F) and males (M). Number of joint surfaces examined is given along the x-axis.

Tasks and Bodily Distribution of DJD

Since no obvious distinction among categories of individuals could be discerned, body regions were examined to determine areas of the body most afflicted with DJD. Figure 9 suggests that there is considerable variation in the site of affliction. In order to demonstrate this, all joint surfaces were grouped into nine body regions: the jaw, back, chest, shoulder, elbow, wrist, hip, knee, and ankle. Because this simplification created an imbalance in the number of possible observations, articular surface representation was presented as a percentage of the number of joint surfaces examined in relation to the number of surfaces in each category. For example the shoulder region has eight possible observations (four on each side), while the knee has 26 possible observations.

Figure 9 shows that the back was the most stricken region of the body. It also demonstrates that the jaw region was not affected by usage stress. The DJD readings for the temporomandibular joint were extremely low, averaging 0.01 with 90 observations (36 percent of potential observations if all individuals were complete). This suggests that the Sanders population did not excessively process materials with their teeth. Although dental attrition was often severe, teeth lacked wear patterns specific to fiber processing behavior.

Figure 9. Mean osteophytosis score of body regions.

DJD in the Back and Agriculture

Osteoarthritis in the back is a manifestation of a generalized stress pattern caused by a variety of activities and aging. Nearly all archeological populations exhibit osteophytosis on vertebral bodies and articular facets (Ortner and Putschar 1981:40).

The overall pattern exhibited by the Sanders populations differed by sex. Females exhibited a pattern of decreasing stress from the lumbar, to upper cervical, lower cervical, upper thoracic, to the lower thoracic vertebrae. Interestingly, mean scores for the back region as a whole were higher among females than among males (0.75 versus 0.68, respectively). This difference was due primarily to high DJD scores in the upper cervical region found in females. Male scores decreased in severity from the lumbar to the lower thoracic, lower cervical, upper thoracic, to the upper cervical vertebrae.

Both patterns of back stress seem indicative of North American agricultural populations in that they are found among other Mississippian agriculturalists from both mound centers and village populations. The female pattern of high scores in the cervical region has been attributed to processing and transport costs associated with agricultural activities (Pickering 1984:122). The pattern exhibited by males has been attributed to activities other than participation in the agricultural economy (Pickering 1984:121). Both Caddoan traditional and ethnohistoric accounts described the participation of both sexes in agricultural activities, although European accounts described far less participation by males than females compared with the descriptions found in traditional Hasinai accounts (Newkumet and Meredith 1988; Swanton 1942).

Activities with Mean Scores of 1 or More

This category contains all activity patterns with average scores for all (or in a few cases the majority) joints involved of 1.0 or greater. In this way activities that were performed most often, and/or were most stressful, were specifically examined. Males had higher stress levels than females. In examining the adults, more than twice the number of joint surfaces were severely affected among males (19) when compared to females (9).

Carrying Loads on the Back

Osteophyte development at the sacroiliac facet has been shown to result from carrying heavy loads on the back (Trotter 1937). Many of the activities discernible with the highest scores (1 or more) were associated with supporting loads during transport. However, there was no ethnographic or ethnohistoric documentation regarding divisions of labor for these tasks. The DJD data indicates that males carried objects on their backs that were heavy, or were carried often enough, to leave lasting impression on their skeletal remains. Unfortunately, only four observations on the sacroiliac facet could be made to indicate males carrying loads during transport. Since only one of the four males had a score of 2, it is possible that only some members of the population participated in this type of activity, or that it was an infrequent activity in which one member of the population suffered an injury.

There is also evidence that females carried loads on their backs, although in a slightly different manner than males did. Carrying loads on the back also results in stress in the lower thoracic region of the back (Merbs 1986). Females exhibited considerable stress in this region with scores averaging 1 and also considerable representation (9 observations).

It is interesting that the osteophyte pattern differed by sex. This suggests that stress was dissipated across the lower back for females carrying loads, while among males, the stress was directed downward toward the sacroiliac facet. Perhaps devices used to transport items on the back also differed, and that this was related to the type of items being transported.

Supporting Loads on the Head

There was considerable osteoarthritic evidence in the Sanders population for carrying loads on the head. Use of the head in supporting objects has resulted in cervical vertebrae spinous process bone lipping (Pickering 1984:78, 97), anterior subluxation of the body (Scher 1978:97), body compression or shear stress (Pickering 1984:164), locked facets (Scher 1978:97), and dorsal body compression (Merbs and Euler 1985:389). The upper cervical vertebrae were highly affected among the Sanders adult female population, with a mean score of 1.00 (Figures 10 and 11). Males exhibited a mean score of only 0.25.

Figure 10. Second cervical vertebra (786) with left inferior articular facet exhibiting extreme osteophytosis (Drawing by Kaylee Stallings).

Figure 11. Above: fifth cervical vertebra (787) showing right superior articular facet bone lipping and erosion, while the left superior articular surface is normal. Below: lower cervical vertebrae (787) showing anterior vertebral bony lipping scored as 2 (Drawing by Kaylee Stallings).

Additional skeletal evidence for carrying loads on the head was found in the upper cervical vertebral bodies in females. Scores in this region increased with age (mean score for young adult females of 0.88, and 1.25 for old adult females). It is possible that this task increased with age, but it is more likely that the scores represent the cumulative effects of this pathology.

There was no evidence of tumpline use among the Sanders population. The osteoarthritic evidence was instead consistent with balancing a load on the head in an unaided manner. Tumplines pull the head and cervical vertebrae backwards. This motion causes the cervical vertebral joints considerable stress along the dorsal margins of the body and also affect the spinous process (Merbs and Euler 1985:389). Balancing a load on the head, however, tends to push the head foreword and into the chest. This posture often results in osteophyte development along the anterior margins of the cervical vertebrae, as well as anterior subluxation (Scher 1978:97). Osteophyte development within the Sanders population followed the latter pattern as no individual exhibited lipping on the posterior margin of the cervical vertebrae. Considerable anterior subluxation was noted among the population but could not be quantified by the scoring procedures used here.

Ground Clearing, Planting, and Hoeing

Another activity indicated by vertebral DJD is ground clearing and soil preparation. These low to the ground activities are associated with high levels of stress in the lower back (lower thoracic and lumbar vertebrae). There were many artifacts in the Sanders site assemblage indicative of these activities: bison scapula hoes, stone hoes, celts, and axes. These activities were also discussed in Hasinai oral histories (Newkumet and Meredith 1988) and in the ethnohistoric accounts (Swanton 1942).

Both joint surfaces examined were well represented, thus assessments were made with confidence. Differences between females and males were slight. Both sexes had higher mean scores in the lumbar region than in the thoracic region; males, however, had higher scores than females in the lumbar region, while females had higher scores in the thoracic region. Female lower thoracic vertebral body mean scores were 1.00, while male scores were 0.94 (Figure 12). Male lumbar vertebral body means were 1.33, while the female mean was 1.12.

Although these differences were slight, they may imply that females and males participated in slightly different agriculturally-related activities. As stated earlier, carrying loads across the lower back increase stress on the lower thoracic

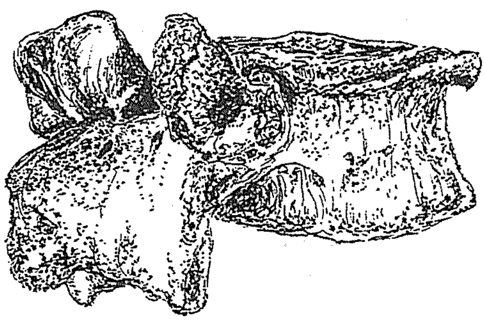

Figure 12. Lumbar vertebra (397) with lipping on the anterior vertebral body and right superior articular facet (Drawing by Kaylee Stallings).

vertebrae among females. The overall scores and locations affected also suggest that males may have participated in low to the ground agricultural activities that would have affected the lumbar vertebrae to a greater extent than among the females.

These scores do not indicate that males exclusively participated in soil cultivation and planting. Traditional accounts stated that both men and women planted and cultivated the soil (Newkumet and Meredith 1988), while ethnohistoric accounts stated that women primarily (not exclusively) cultivated the soil, women (exclusively) planted, and both women and men hoed (Swanton 1942). The DJD data from the Sanders site indicates that participation in these activities was not equal; additionally, mean scores indicate that they may not have been as female-centered as the ethnohistoric data imply.

Paddling

Evidence of paddling is inferred for the Sanders population because elbow region lipping scores are greater on the capitulum than on the trochlea of the same hand (Merbs 1983:151). This was the case for males from the Sanders site, with mean capitulum scores of 1.35 and trochlea means of 1.18. (Female scores are considerably lower, averaging 0.64 on the trochlea, and 0.50 on the capitulum.) Both are greatest on the left hand, a pattern consistent with a main grip being formed in the left hand (and guiding with the right hand).

Long Distance Walking, Running, or Dancing

The other high scoring activity pattern found in males is for running, long distance walking, or dancing. Females also exhibit this pattern, but with a more bilateral distribution of affliction. The posterior calcaneal tuberosity often produces a large bony outgrowth in response to long distance travel by foot (Dutour 1986:222) (Figure 13). On males, lipping occurred on the right calcaneal tuberosity. DJD also commonly occurred in the corresponding femur at the patellar articular surface (Figure 14), indicating considerable movement in the knee region, probably from running, walking, and/or dancing. The Caddo are known to have traveled great distances to attend trading fairs, but it is not known who or how many traveled. The Caddo may also have traveled some distance to hunt. Ethnohistoric accounts describe women accompanying men on the hunt (Swanton 1942), and the osteoarthritis data seems to support this.

On the left side of the body, mean scores were considerably lower than on the right. Means for the calcaneal tuberosity were 0 on the left side and 1.00 on the right; left patellar articular surface scores averaged 1.12, and a score of 1.75 on the right. It is unlikely that the sidedness of this pathology simply reflected handedness and consequent strength differences. Similarly, the unilateral distribution was not the result of few observations on the calcaneus (four left

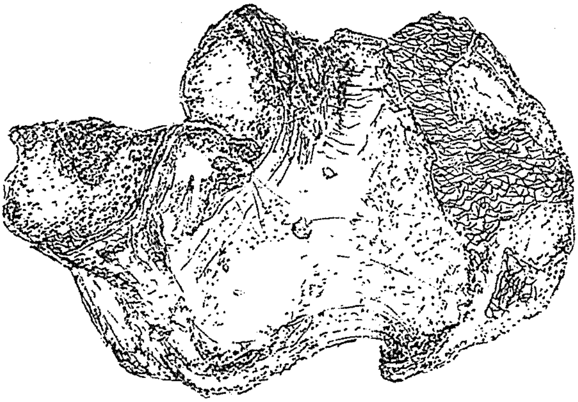

Figure 13. Right calcaneus (787) exhibiting large bony lip on the tuberosity, producing the hook- like projection where the bone would normally be smooth (Drawing by Kaylee Stallings).

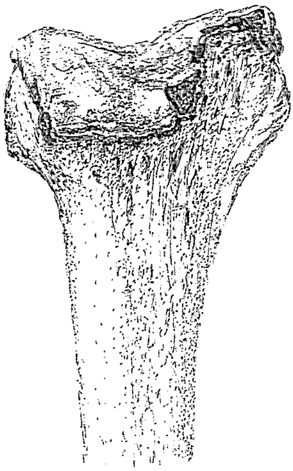

Figure 14. Distal right femur with patella articular surface displaying severe osteophytosis (scored as 2); normally this surface is smooth (Drawing by Kaylee Stallings).

and three right). When same individuals were compared, real differences were evident. Although most observations were on different individuals, the patella articular surface (four left and four right) supported findings of a unilateral distribution based on the calcaneus.

There is one ethnohistorically and traditionally documented activity that may account for the distribution of scores in this body region: dancing. Dancing with specific foot and leg movements may have caused the unilateral distribution of DJD within the feet and legs.

Osteophyte development on the calcaneal tuberosity followed the same pattern in old adult females from the Sanders site. Again the pattern observed is focused on the right side of the body. Observations were higher among females (10 right, and six left) and averaged 1.33 on the left and 2.0 on the right side of the body.

Since the patterns were different for males and females it is likely that they reflect the performance of different activities. Females are described in the ethnohistoric literature as gatherers (Swanton 1942). It is possible that considerable travel went into this activity, although again, the pattern does not fit long distance travel well enough to support this hypothesis. Again, it is more likely that the patterns resulted from an assumed posture in dance. In this case, postures would seem to have differed by sex.

Overall, lower body stress was greater for males than females among the Sanders population. Males exhibited mean osteophyte scores of greater than 0.50 on the patella (medial and lateral articular surfaces) and tibia articulation of the right femur (Figure 15 and 16). Interestingly, the distribution of DJD in the patella is bilateral, although slightly higher scores were recorded for the right medial facet (0.75 versus 0.67 on the left). Bilateral distribution is not, however, seen in the tibia articulation of the femur (right mean of 0.85, left mean of 0.40).

Activities with Mean Scores of 0.75 or Greater

As the level of significance decreases, activities are highlighted that were less stressful and/or performed less often. Again, the number of joint surfaces

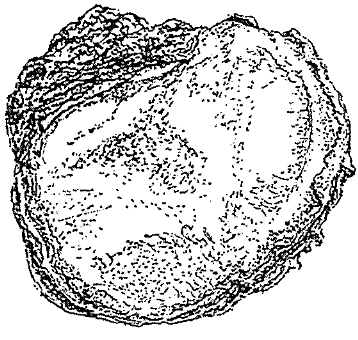

Figure 15. Right patella (786) with medial and lateral facets displaying extreme marginal osteophytosis (Drawings by Kaylee Stallings).

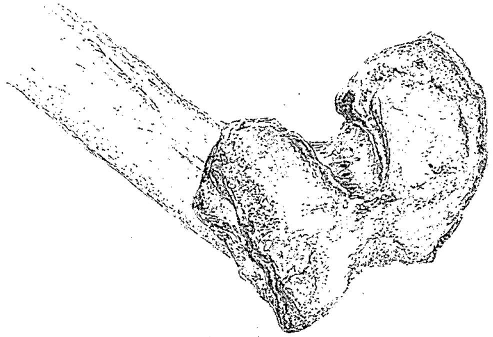

Figure 16. Distal right femur with marginal lipping on the tibia articular surface (Drawings by Kaylee Stallings).

with osteophyte scores greater than or equal to 0.75 was higher among males (38) than among females (16), implying greater male stress loads.

Wood Cutting

Evidence for ground clearing activities among males was found in a specific stress pattern not seen in females from the Sanders site. Osteophyte development on the olecranon process of the right ulna (0.83 mean) may indicate that males performed wood cutting activities. Olecranon process "spicule-like" bone growth has been correlated with wood cutting and other activities where the arm is horizontal and the elbow is flexed (Dutour 1986:222) (Figure 17). Woodcutting was documented ethnohistorically as a male task (Swanton 1942). Additionally, many stone axes were recovered from the Sanders site.

Carrying Loads with the Arms Bent

Males show some evidence of carrying heavy loads with their arms bent. This activity shows up in radial tuberosity degeneration (Dutour 1986:222) (Figure 18). Caddoan males were described as gathering wood for building structures (Swanton 1942). In general, stress on the radial tuberosity is the direct result of flexion of the elbow, and this could also have been associated with paddling and/or cutting and scraping skins (Merbs 1983:154, 156).

Interestingly the occurrence of this degeneration is found primarily on the right side (right mean of 0.75, left mean of 0.67). The difference is small enough to suggest that handedness may have caused this difference.

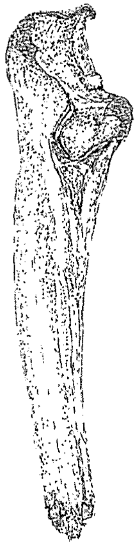

Figure 17. Right ulna (787) with hook-like osteophyte on the olecranon process (Drawing by Kaylee Stallings).

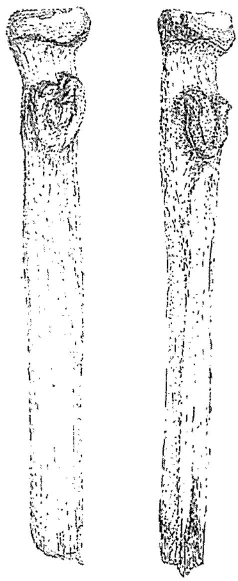

Figure 18. Right and left proximal radii (787) with degeneration in the form of bone erosion and marginal lipping on the radial tuberosities (Drawing by Kaylee Stallings).

Skin Scraping

There was some evidence for skin scraping activities among the males at the Sanders site. This is in contrast to the oral tradition of the Hasinai, which describes only women processing hides and furs (Newkumet and Meredith 1988). Furthermore, the ethnohistoric literature describes members of both sexes participating in hide work (Swanton 1942).

DJD data indicate that scrapers were held palm-down and used in a back and forth, trough-like motion. This type of motion affects the distal humerus (ulnar groove and trochlea), proximal ulna (olecranon and coracoid process, and trochlear notch), and marginal areas of the radial head (Merbs 1983:154, 156; Miller 1985).

Often the sternal and acromial facets of the clavicle are involved in the back and forth motion associated with skin scraping. The mean scores for both of these surfaces on the left side were greater than 0.75 (sternal facet mean of 0.9 and the acromial facet mean of 0.81), and on the right side were 0.67 and 1.67, respectively.

The above pattern could also be the result of wood working, which Parsons (1941) documents as a male activity. The motions would be the same back and forth movement as described for skin scraping.

Osteophyte development on the clavicular facets has been correlated with bow and arrow and atlatl use, as well as with grinding (Angel 1966:3). Since none of the other patterns of degeneration associated with bow and arrow use and grinding have been thus far illuminated, clavicular facet degeneration has been assumed to be related to skin scraping in a back and forth motion, to paddling, and possibly to throwing objects in an over-the-shoulder manner.

Sewing, Basket Weaving, Ceramic Production, Flint Knapping, and Shell Working

The DJD expression on the palmar side of the fingers was seen in adult females (mean of 0.94 [n = 6]) among the Sanders population. Four of the six females had severe expressions in this region. DJD in the finger region is associated with activities requiring fine finger manipulation of objects. It has been directly associated with sewing (Merbs 1983:155), an activity for which there is ample evidence among the Caddo; at the Sanders site several bone awls and drills were recovered. Pottery disks that may have functioned as spindle whorls were also present in the Sanders collection. Textiles have been recovered from other Caddoan archeological sites, including the Spiro site (Kuttruff 1993).

The only description of specific sewing in the ethnohistoric record is of moccasin sewing as a male activity. Mean osteophyte scores indicate that if males sewed their moccasins, it was a rare event (female mean of 0.94, male mean of 0.12). The Hasinai traditional history stated that women prepared the clothing (Newkumet and Meredith 1988). Additionally, females were described as wearing more clothing than males (Griffith 1954:105). It is logical, therefore, to assume that females did most of the sewing.

Ceramic manufacture and basket weaving require extensive manipulation of small objects and the use of fingers as tools. Both of these activities have been attributed to females (see Swanton 1942) and seem the most logical causes for the observed DJD pattern. Flint knapping is another possibility, although this task was not ascribed to females in any of the ethnohistoric literature studied. Additional activities suggested for the Sanders site that would require finger manipulation include husking maize, traditionally documented as performed by both females and males (Newkumet and Meredith 1988), and shell working, documented artifactually in the thousands of shell beads and many elaborate shell gorgets recovered from the Sanders site.

Activities Evidenced by Mean Scores of 0.5 or More: Grinding

The pattern exhibited by the Sanders females was consistent with the use of the manos and metates recovered from the site. Grinding was performed on small, circular grinding slabs with a small motion, so only a single hand was in use at a time, and the motion was circular, rather than back and forth, or by pounding. Degenerative patterns for this motion were found among females, and exaggerated in older females, on the right, presumably dominant, body side. The inclusion of the older female brought mean scores for the right capitulum, articular circumference of the radius, and radial head up to 0.65, 0.5, and 0.75, respectfully. The score distribution by age indicates that this activity was probably performed by most females, although perhaps to a lesser extent among younger females within the Sanders burial population.

Activities Not Evidenced in this Study

Several activities documented ethnohistorically, traditionally, and artifactually, were not evidenced in the DJD observations from the Sanders population. These include bow and arrow use and pounding. It is possible that these activities were performed rarely and did not much impact bone, or that they were not stressful activities. It is also possible that these activities were not visible simply because only bone lipping was quantified in this analysis, rather than bone lipping, erosion, and eburnation. However, since bone lipping is the first reaction to stress on the bone, it is doubtful that if these activities impacted the bone they would not have been visible in osteophyte development.

DISCUSSION AND CONCLUSIONS: ACTIVITY PATTERNS AND THE DIVISION OF LABOR

Perhaps the greatest use of skeletal studies in archeology is found in the integration of all available sources of data to test and refine hypotheses concerning ethnohistoric and archeological materials. The use of skeletal remains to detect activity patterns at the Sanders site allowed some corroboration of the behavioral record by lending support to specific activities not evidenced materially. For example, the use of boats among males from the Sanders site was detected through osteological evidence of paddling activities. Many activities described ethnohistorically for the Caddo were also evidenced in the physical remains from the Sanders site, with some refinements. For instance, the gathering activities of females were not found solely in females from Sanders.

The traditional accounts of the Hasinai were also predominately supported by this osteological analysis. For example, the manufacture of bows was documented as a male task (Newkumet and Meredith 1988). This activity could only be implied indirectly through its association with other tasks documented in DJD patterns. Males exhibit patterns consistent with chopping wood and hide work. Although a leap of faith may be required to claim that these activities are related to bow manufacture, this is not an unreasonable suggestion in view of the overall context of DJD patterns.

Unfortunately, neither the traditional history, ethnohistoric accounts, nor the archeological record indicate which individuals within the population endured hardships or enjoyed leisure. The only way to determine this at present is through skeletal study. Measures of stress can be used to determine underlying and fundamental relationships on which group social structure is based.

The burial population at the Sanders site was considered to be an elite one primarily due to its placement within a mound context, and secondarily due to the rich grave goods that accompanied these individuals. This study has demonstrated that task-oriented activities were participated in by the Sanders population. Participation in agricultural activities was found in both females and males; this included planting, cultivation, and hoeing. Craft work was also demonstrated among the females in sewing activities. However, participation by this population in hunting and in some food processing techniques is less clearly demonstrated through osteological analysis.

The DJD evidence of activity patterns may indicate the ritual importance of agriculture among the Sanders population. This would explain participation in activities associated with agriculture, but the limited evidence for food preparation and hunting activities. The ritual importance of agriculture among the Caddo was suggested in Newkumet and Meredith's (1988) depiction of men beginning each day by walking the fields of maize; agricultural activities were also described as communal.

The patterns of activity outlined by the DJD evidence also suggest a limited degree of differentiation between the elite and non-elite among the Caddo.

Unfortunately, a village population has not yet been analyzed for comparative purposes. Overall stress loads on joint surfaces were high, with 78 percent of the population affected by DJD. The conditions evident were secondary to considerable cartilage deterioration, representing a significant amount of time spent in these activities, or a considerable amount of stress.

Stress loads were examined for females and males. It was expected that females would exhibit greater stress loads than males, as has been found in other inland Mississippian populations (Bridges 1987; Pickering 1984). The opposite was true for the Sanders population. Males exhibited higher stress loads in terms of greater mean osteophyte scores, greater number of highly afflicted articular surfaces, and in the greater number of afflicted joint surfaces.

These results call into question the general assumption that agricultural adaptations result in a greater burden for females than males (Harris and Ross 1987). In the past, this idea has been used to infer gender status in agricultural populations (Harris and Ross 1987:44). Stress differentials at the Sanders site suggest that females enjoyed a comparatively high status. However, other evidence, such as material symbolism, and dietary reconstruction, are needed before sexual status can adequately be assigned in this Caddoan population.

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Vertebral Anomalies and Degenerative Lesions in the Caddoan Skeletal Population, Kaufman-Williams Site, Red River County, Texas

Carol J. Loveland

ABSTRACT

Vertebral anomalies and degenerative lesions, including spondylolysis, Schmorl's nodes, osteoarthritis, and osteophytosis are evaluated in 54 adult Caddoan skeletons from the Willams part of the Kaufman-Williams site (41RR16), Red River County, Texas. The anomalies are considered as possible effects of known sex-specific activity patterns. Males have a higher frequency of spondylolysis and Schmorl's nodes and an earlier onset and more severe evidence of osteophytosis and osteoarthritis of the vertebral articular facets, suggesting early, intense physical activity. Comparisons are made with other Caddoan populations.

INTRODUCTION

Congenital, developmental, and degenerative anomalies are frequently noted on the vertebral column. These conditions reflect the genetic inheritance of the individual and the effect of lifestyle and environmental stress on the skeleton. In this paper, vertebral characteristics and anomalies observed in Caddoan skeletal material from the Williams part of the Kaufman-Williams[1] site complex are documented and discussed. The anomalies, which occur with different frequency in males and females, may reflect sex differences in division of labor. Comparisons are made with information provided about other Caddoan populations. Ethnohistorical accounts, archeological reports, and paleopathological data will then be used to interpret the prehistoric Caddoan lifeway.

[1] The Kaufman site was renamed the Arnold Roitsch site in 1992.

MATERIALS AND METHODS

This paper reports on research conducted on vertebral columns from 26 male and 28 female Caddoan skeletons from the Williams part of the Kaufman-Williams site (41RR16), Texas. The Kaufman-Williams site is located on the southern bank of the Red River in northern Red River County.

The Williams part of the site, which was occupied from approximately A.D. 1550 to 1700, was excavated by Gregory Perino for the Museum of the Red River, Idabel, Oklahoma, between 1977 and 1979. The skeletal material is now part of the University of Tennessee collection (Loveland 1980).

Methods used to determine age and sex of the skeletons are discussed in Loveland (1980, 1984, 1985, 1988). The adult age distribution is presented in Table 1. The number of vertebral elements available for examination is presented in Table 2.

The vertebrae were placed in correct anatomical position and examined for the following features: spondylolysis, Schmorl's nodes, osteophytosis, and osteoarthritis. The presence of lipping (osteophyte development) indicated the presence of osteophytosis. In addition to lipping, the author used porosity, erosion, and eburnation (polishing) to classify osteoarthritis of the vertebral articular facets. The scoring procedure for both conditions was the same: + = slight,

Table 1.

Age Distribution of Adults From the Williams Portion of the Kaufman-Williams Site

Age Interval	M	% of Adult males	F	% of Adult Females
15-19.9	4	15.4	3	10.7
20-24.9	3	11.5	3	10.7
25-29.9	3	11.5	2	7.1
30-34.9	10	38.5	5	17.9
35-39.9	2	7.7	4	14.3
40-44.9	3	11.5	3	10.7
45-49.9	1	3.8	6	21.4
50-54.9	-	-	2	7.1

Table 2.

Number of Vertebrae Observed on Skeletons From Williams Portions of Kaufman-Williams Site

Males (N=26) Number Observed	Vertebra	Females (N=28) Number Observed
23	C1	20
24	C2	20
23	C3	21
23	C4	20
25	C5	20
25	C6	21
25	C7	20
23	T1	20
22	T2	20
22	T3	21
22	T4	20
22	T5	23
21	T6	23
22	T7	23
23	T8	23
23	T9	23
23	T10	23
23	T11	22
23	T12	21
24	L1	22
24	L2	22
25	L3	22
24	L4	23
24	L5	23
24	S1	24

++ = moderate, and +++ = severe. The author evaluated all conditions and anomalies on the basis of age, sex, and laterality.

Comparisons are made with data from other Caddoan populations, including reports by Butler (1969), Rose et al. (1981), and Rose (1984). Butler (1969) reported on 23 skeletons from the Kaufman portion of the Kaufman-Williams site. These burials were from three time periods: ca. A.D. 1000-1300 (Burial 1), A.D. 1300-1500 (Multiple and Shaft Burials), and A.D. 1500-1740 (Burial 6). All of the burials were reported as a single population, however, and since fifteen burials dated to about A.D. 1300-1500, the data mostly reflect that time period (Skinner et al. 1969).

The Roden site (Perino 1981) is located 2.8 km northeast of the Kaufman-Williams site on the north side of the Red River. Three periods of occupation occurred between A.D. 1300-1650. The majority of the skeletons, which dated to about A.D. 1500, were treated as one sample while the small number of remaining skeletons, which dated to the early occupation (A.D. 1300) and the late occupation (A.D. 1650) and included many potted burials, comprised a second group (Rose et al. 1981). Only those skeletons which dated to about A.D. 1500 are used for comparative purposes in this study.

Perino (letter from G. Perino to C. J. Loveland, July 23, 1990, on file Utah State University, Logan, Utah) suggested that the people living on various parts of the Kaufman-Williams site and at the Roden site probably represent a single population which moved from one area to another when the soil was exhausted or when the river changed course. Although the skeletons from the Kaufman and Williams parts of the Kaufman-Williams site and those from the Roden site probably represent a single population through time, this paper deals specifically with the skeletons from the Williams part of the Kaufman-Williams site since the other skeletons were examined by other researchers using different methods. Comparisons with those groups are made when possible, however.

The Cedar Grove site is located along the Red River in Lafayette County, Arkansas. Both historic and aboriginal components were located; the aboriginal occupation included Caddo IV (ca. A.D. 1500-1700) , and Caddo V (after A.D. 1700) occupations (Trubowitz 1984). Fifteen burials (six males, three females, and six subadults) and eight isolated finds of human bone from nonburial areas were recovered. Two of the three females were over 45 years old; five of the males were over 35 years of age.

ASPECTS OF CADDOAN LIFEWAY

According to ethnohistorical accounts, the Caddoans relied upon both domesticated plants and wild plants and animals for their food (Newcomb 1958; Griffith 1954). These reports have been substantiated by archeological recovery of maize, two varieties of beans, squash, gourds, and sunflowers as cultigens and the remains of wild plants such as hickory nuts, black walnuts, hazel nuts, and persimmons. In addition, cane, used for tools and/or as a building material, has been found on Caddoan sites (Wyckoff 1980; Skinner et al. 1969; Webb 1959; Stewart 1981; King 1984).

By using the faunal skeletal elements recovered at sites to calculate the amount of meat available, archeologists have established that white-tailed deer was of primary importance to the Caddos (Parmalee and Opperman 1983; Henderson 1978; Skinner et al. 1969; Hemmings 1982; Styles and Purdue 1984; Parmalee and Bogan 1981). Henderson (1978) suggested that the range of deer bones present indicated that the entire animal was returned to camp for butchering. Small mammal, bird, amphibian, reptile, and fish bones were also recovered (Parmalee and Opperman 1983; Hemmings 1982; Parmalee and Bogan 1981). Swanton (1942) reported that bison hunting occurred in the wintertime and assumed greater importance through time. Bear hunting yielded fat, used for flavoring in cooking (Swanton 1942).

The Caddoans practiced a sexual division of labor. Griffith (1954:50) states:

> Even when they were engaged on a common project, the two sexes worked separately. The women planted, cultivated, harvested, and stored the crops; collected food from natural sources; prepared the meals; gathered fuel; and attended to all the other details around the house. The men were employed chiefly in hunting, but they also performed the heavier routine living tasks such as breaking and preparing the soil for planting, and constructing houses.

House construction was predominantly a male activity and involved erecting posts in a circle and stabilizing the roof with interior supports. Women cut, carried, and placed the grass thatch used on the exterior surface (Hatcher 1927).

Preparation of the fields for planting was a communal project. Males cleared and broke the soil with hoes made of seasoned walnut or hickory. Women were responsible for all aspects of the domestic food supply after initial soil preparation (Swanton 1942; Glover 1935).

Perhaps one of the most strenuous activities performed by the women was grinding maize. Wooden mortars were made by burning the center of a large log. The pestle, also of wood, was about six feet long. A rounded-off end crushed the grain while the shaft and top provided additional weight and force in the pestle's descent. Two to four women worked together, each striking a pestle into the mortar in a rhythmic pattern (Swanton 1946).

Griffith (1954) reported that witnesses who observed the women working around their houses described them as little more than drudges. However, he later stated,

> In view of the evidence, it seems that a not inequitable division of labor existed between men and women. That of the women was probably

more incessant and more monotonous but that of the men was perhaps no less indispensable (Griffith 1954:122).

SPONDYLOLYSIS

Spondylolysis is a vertebral separation involving the interarticular area, the pedicle, or the lamina (Figure 1). Four males (15.4 percent) and two females (7.1 percent) from the Williams part of the Kaufman-Williams site had spondylolysis, and adults of all ages were affected (Table 3). One male and one female had bilateral separation at pars interarticularis; the bilateral separation in one male skeleton occurred posterior to the transverse processes. One female had separation on the right side at pars interarticularis on T12. Unlike the other

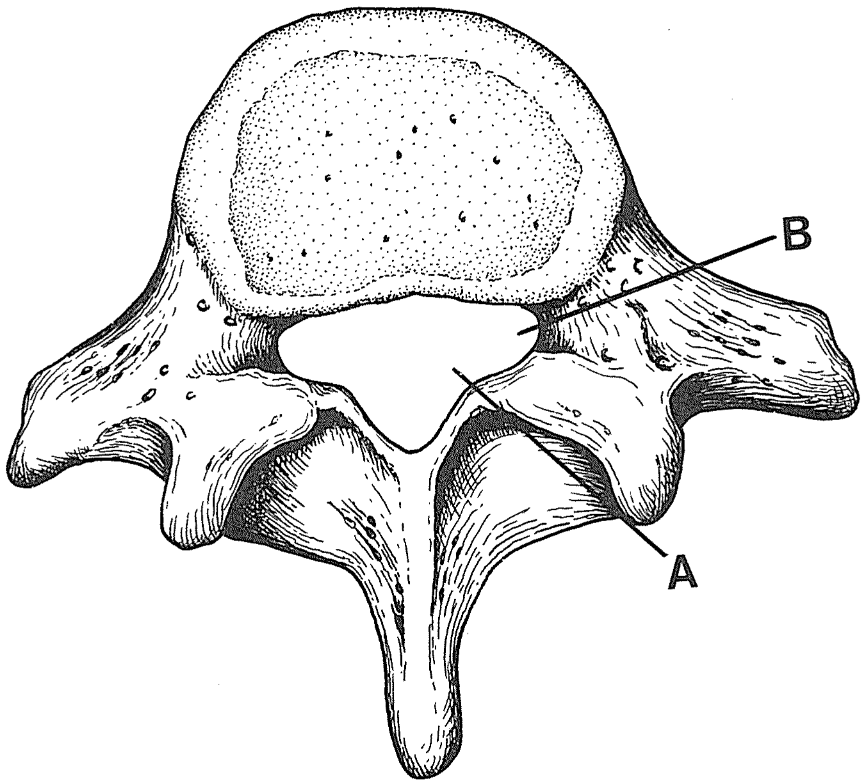

Figure 1. Spondylolysis usually occurs at the pars interarticularis (A) although it may occur through the pedicle (B). The fourth or fifth lumbar vertebrae are most commonly affected.

Table 3.

Spondylolysis

Burial #	Age	Location of Defect	No. of Individuals in Age/Sex Category Affected
		MALES (n=26)	
4	18-21	L5-separation on left side at pars interarticularis and on pedicle at midline	1/4
11	20-25	L5-separation on left side at pars interarticularis (congenital hip dislocation)	1/3
14	25-30	L5-bilateral separation posterior to transverse process	1/3
58	30-35	L5-bilateral separation at pars interarticularis	1/3
		FEMALES (n=28)	
3	30-35	T12-separation on right side at pars interarticularis (possibly traumatic because of bony buildup)	1/5
36	45-55	L5-bilateral separation at pars interarticularis	1/8

cases of spondylolysis, a considerable buildup of new bone accompanied this defect. It is possible, therefore, that this separation was of traumatic origin.

The separation occurred on the left side at pars interarticularis on two male skeletons. One of these individuals was a 20-25 year old male who had a congenital hip dislocation on the right side. This anomaly affected all of the leg and foot bones as well as the vertebral column, and the stresses imposed upon the vertebral column by the hip defect may have resulted in spondylolysis.

Spondylolysis was not reported in the comparative populations (Butler 1969; Rose et al. 1981; Rose 1984).

According to the clinical literature, spondylolysis appears to be very rare in children before they learn to walk. It then increases in frequency, but not at a regular rate. The sharpest increase appears to occur during middle to late adulthood (Merbs 1983). The condition seldom occurs except in the lumbar region with the fifth lumbar being most frequently involved (Moreton 1966). Nathan (1959) reported that the neural arches in the lower lumbar region transmit the compressive forces of the spinal column, whereas in the upper column the forces are directed through the vertebral bodies and intervertebral discs. Thus, the differential thrust on the lower lumbar region creates stresses which lead to the development of spondylolysis in the lumbar vertebrae.

Although the condition was first thought to be congenital, a variety of evidence has since disproven this theory. Spondylolysis also lacks the characteristics of a true fracture, including evidence of attempted repair. Nathan (1959) attributed the lack of bone repair to the persistence of the stresses responsible for the initial lesion.

Spondylolysis is currently believed to be of developmental origin; however, there may be a genetic predisposition since affected individuals frequently exhibit other abnormalities as well (Roche and Rowe 1952). Furthermore, Wiltse et al. (1975) showed that the incidence of spondylolysis was higher in families of affected patients. Although he could not isolate the exact mode of inheritance, he felt the trait was recessive and sex-linked. On the other hand, Wynne-Davises and Scott (1979) postulated autosomal dominant inheritance for spondylolysis; however, the genetic predictibility factor was below expected values. They attributed this to the action of several genes, or to reduced penetrance, which means that the effect of the gene may be quite variable, sometimes resulting in the condition passing unnoticed.

Vertebral morphology may predispose certain individuals to the condition. Nathan (1959) noted that large superior and inferior articular facets crowd the isthmus in afflicted columns, making separation more likely. A narrow isthmus is more susceptible to separation than a wide one.

In an attempt to evaluate morphological features of the vertebrae which might lead to the development of spondylolysis, Stewart (1956), who attributed spondylolysis to stress, found several characteristics that occurred in slightly greater frequency in affected individuals. These strain-related features included a long prearcuate spine, an acutely inclined proximal sacral surface, increased lumbar lordosis, and reduced depth and curvature of the superior sacral articular facets.

Structural weakness of a vertebra increases the likelihood that a fatigue fracture might develop as a consequence of strenuous activity or lifting of heavy objects. In a study of the bony structure of the neural arch, Krenz and Troup (1973) found that changing posture varies the shearing forces affecting the articular processes and, hence, the amount of stress placed on pars interarticularis. While Stewart (1953) attributed spondylolysis in Eskimos to their practice of working in stooping positions, Krenz and Troup (1973) suggested that activities such as running, jumping, or marching, which impose repetitive lateral flexor movements on the extended spine, would be most likely to create the stresses leading to the condition.

Wiltse et al. (1975) reported that 13 of 14 patients with spondylolysis had participated in vigorous athletics at the time back pain started. They attributed the defects to fatigue fractures, which differ from other fractures in that: (a) the defect seldom heals, (b) periosteal callus formation seldom occurs, (c) there is a hereditary predisposition, (d) it develops following repeated minor trauma, and (e) it occurs at an early age.

In a comparison of spondylolysis occurrence in Archaic and Mississippi period populations in northwestern Alabama, Bridges (1989) noted a much higher incidence in the Archaic group. She suggested that different activity patterns caused the disparity. Although males and females were equally affected by the anomaly, the condition developed earlier in the males. Bridges (1989) postulated that osteoporosis among older females may have led to weakening of pars inarticularis, whereas strenuous motion or unusual postures may have led to earlier development of the condition in the males.

SCHMORL'S NODES

Schmorl's nodes result when the nucleus pulposus herniates into the body of a vertebra. The herniation is believed to result from developmental defects in the cartilage between the disc and the cancellous tissue of the vertebral body. Often these nodes represent the channels through which blood vessels once supplied the disc. Typically Schmorl's nodes are asymptomatic; however, extremely large nodes may cause the disc to narrow and impede the growth of the vertebral bodies causing kyphosis (Hollinshead 1982).

Six males (38.5 percent) and two females (14.3 percent) had Schmorl's nodes (Table 4). One male had nodes on two vertebrae and two separate nodes on the superior surface of the sacrum, while a female had nodes on three vertebrae. The youngest individual was 17-19; the oldest was 45+. Five of the six males with Schmorl's nodes were 30-35 years of age. These individuals represent 50 percent of the male members of that age category. Schmorl's nodes were not documented in the comparative poulations (Butler 1969; Rose et al. 1981; Rose 1984).

Schmorl's nodes appear more frequently in individuals who have engaged in unusually hard labor during adolescence (Hollinshead 1982). The individuals affected in the Williams portion of the Kaufman-Williams population probably had engaged in strenuous work or exercise activities involving both thoracic and lumbar vertebrae.

According to Merbs (1983), development of Schmorl's nodes usually precedes compression fracturing. However, careful examination of the Kaufman-Williams vertebrae produced no evidence of compression fractures.

Table 4.

Schmorl's Nodes

Burial #	Age	Vertebra	Location	Number of Individuals in Age/Sex Category Affected
		MALES (n=26)		
30	30-35	T8	inferior	5/10
		T12	superior	
45	30-35	T12	superior	5/10
58	30-35	L1	superior	5/10
59	40-45+	L3	superior	1/2
60	30-35	T10	inferior	5/10
		T11	superior	
		S1 (2)	superior	
66	30-35	L3	inferior	5/10
		L4	superior	
		FEMALES (n=28)		
39	17-19	T6	inferior	1/3
		T7	both surfaces	
		T8	inferior	
68	25-30	L3	superior	1/2

DEGENERATIVE JOINT DISEASE

Degenerative joint disease of the vertebral column has been differentiated as osteophytosis and osteoarthritis; different types of articulation are involved in the development of each condition. Osteophytosis is associated with amphiarthrodial articulations between the vertebral bodies while the diarthrodial joints present in the remaining vertebral articulations develop osteoarthritis (Figure 2). The development of the two conditions is very similar given the difference in joint structure (Merbs 1983). Osteophytosis develops as a result of tension in the ligaments; the greatest periosteal bone formation occurs in vertebral segments which have considerable mobility in relation to adjacent segments (Thieme 1950).

Figure 3 presents the incidence of osteophytosis; percentages were calculated based on the number of vertebrae observed (see Table 2). In both males and females the lower lumbars, followed by the cervical vertebrae, were most

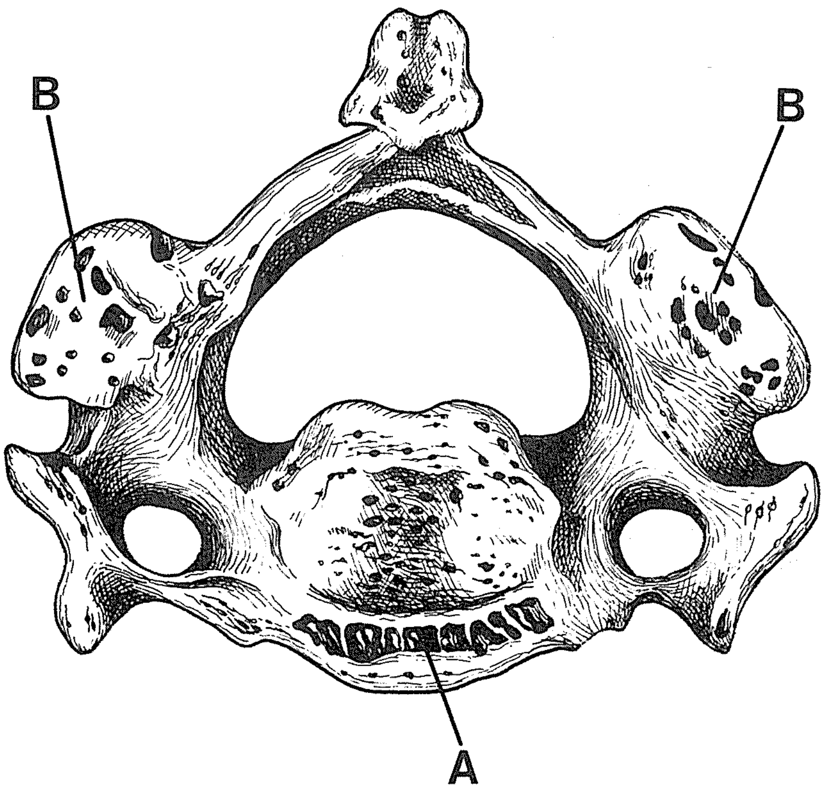

Figure 2. Degenerative joint disease may affect vertebral bodies (osteophytosis) (A) or the articular facets (osteoarthritis) (B). It is characterized by bone growth (lipping) and surface porosity.

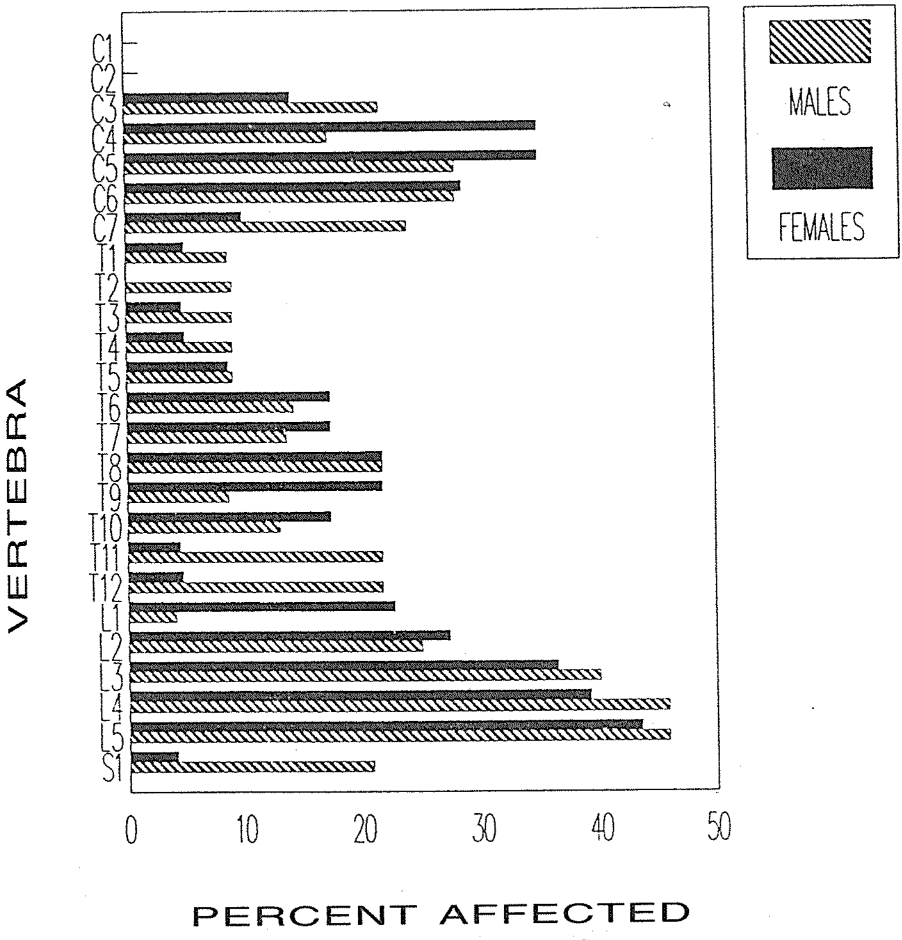

Figure 3. Incidence of osteophytosis in the Williams portion of Kaufman-Williams population. Lumbar and cervical vertebrae were most seriously affected in both sexes; note distribution differences between sexes in thoracic vertebrae.

seriously affected by osteophytosis. In the thoracic vertebrae, T11 and T12 were most seriously affected by osteophytosis in the males, while the mid-thoracics were most affected in the females.

Fifteen male (57.7 percent) and thirteen female (46.4 percent) skeletons exhibited evidence of osteophytosis. One male was less than thirty years of age; thirteen of fifteen individuals over forty (four males and nine females) were affected. In males the condition was not only more prevalent, but also occurred earlier in life (Table 5).

Table 5.

Incidence of Osteophytosis By Age and Sex, Williams Portion, Kaufman-Williams Site

	MALES		FEMALES	
Age	Number Affected	% of Individuals in Age Group Affected	Number Affected	% of Individuals in Age Group Affected
15-19.9	0	0	0	0
20-24.9	1	33	0	0
25-29.9	0	0	0	0
30-34.9	8	80	3	60
35-39.9	2	100	1	25
40+	4	100	9	82

I observed osteoarthritis of the articular facets on the vertebrae in six males (23.1 percent) and four females (14.3 percent), all of whom were over 30 years of age (Figure 4 and Table 6). Osteoarthritis affected the cervical vertebrae of males more seriously, with limited erosion in the thoracic and lumbar regions. Osteoarthritis was pronounced in both the cervical and lumbar areas and to a lesser extent in the thoracic vertebrae in the females. Interestingly, two females had osteoarthritis in the mid-thoracic region, whereas male thoracic vertebrae were only affected in the upper and lower areas. This pattern parallels that already mentioned for osteophytosis. Merbs (1983) noted a similar distribution of osteophytosis and osteoarthritis among Sadlermiut females from Southampton Island in Hudson Bay, which he attributed to heavy lifting, including carrying a child.

Table 6.

Incidence of Vertebral Osteoarthritis by Age and Sex, Williams Portion Kaufman-Willams Site

	MALES		FEMALES	
Age	Number Affected	% of Individuals in Age Group Affected	Number Affected	% of Individuals in Age Group Affected
15-19.9	0	0	0	0
20-24.9	0	0	0	0
25-29.9	0	0	0	0
30-34.9	2	20	1	20
35-39.9	0	0	1	25
40+	4	100	2	18

Comparative data from other Caddoan populations regarding the incidence of osteophytosis is limited. Rose (1984) provided the most complete information in his comparison of Fourche Maline, Caddo II (ca. A.D. 1200-1400), and Caddo IV-V sites with that of the Cedar Grove site in southwest Arkansas. The incidence of osteophytosis dropped between the pre-horticultural Fourche Maline populations (18.4 percent) and the Caddo II horticulturalists (11.6 percent); however, in the later Caddo IV and Caddo V (Cedar Grove) populations the incidence of osteophytosis rose dramatically, 30.5 percent and 33.3 percent, respectively. Rose (1984) attributed this increase to activities such as a heavier agricultural workload or a different pattern of wild food procurement, which placed greater stress on the vertebrae.

Rose (1984) noted the presence of osteoarthritis and/or osteophytosis on upper and lower thoracic vertebrae in four of five affected males; this is the same pattern found in the Kaufman-Williams males. The lumbar vertebrae of the fifth male exhibited osteophytosis. All of the thoracic vertebrae of two females were affected with osteoarthritis and/or osteophytosis; the cervical vertebrae of one of those individuals were also involved (Rose 1984).

At the Roden site in Oklahoma, Rose et al. (1981) found a combined osteophytosis rate of 54.5 percent among ca. A.D. 1500 burials. Vertebrae exhibited only slight to moderate involvement.

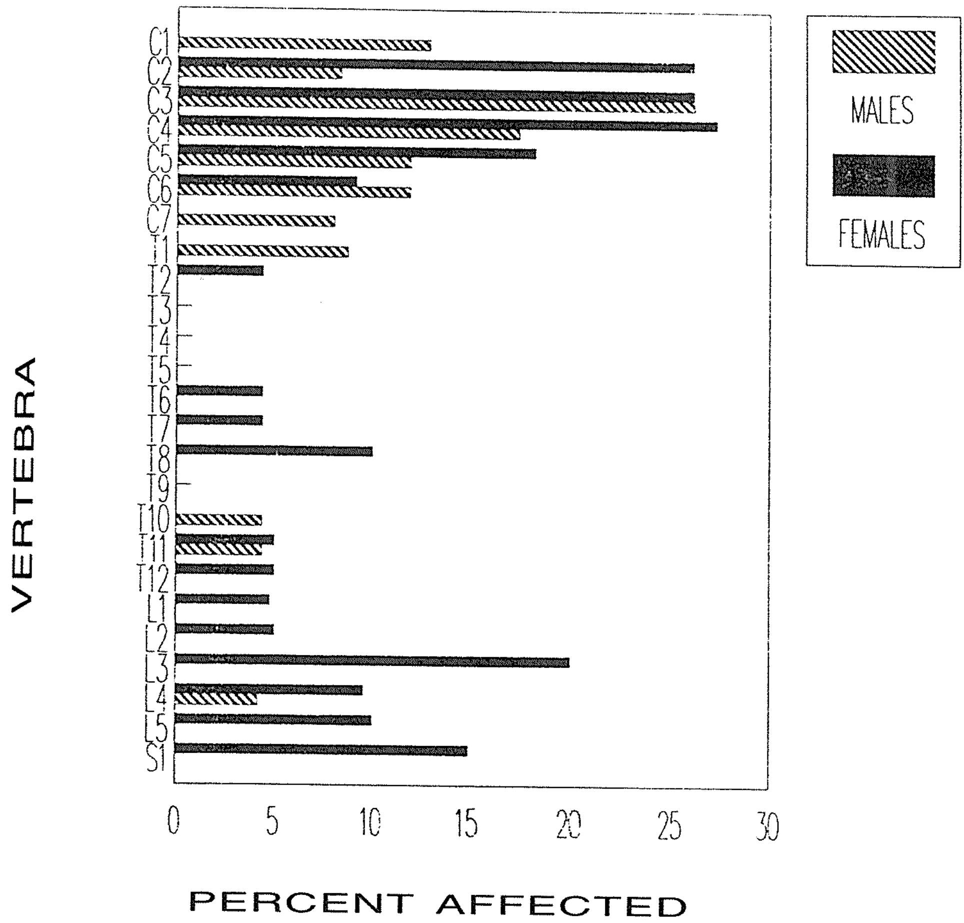

Figure 4. Incidence of osteoarthritis in the Williams portion of Kaufman-Williams population. The condition was most pronounced in the cervical vertebrae among males. Cervical and lumbar vertebrae were most seriously affected in the females.

Eight adult females (72.7 percent) and five adult males (71.4 percent) from the Kaufman portion of the Kaufman-Williams site exhibited "lipping and bony additions" (Butler 1969:131). There were 20 adults in the population: seven males, 11 females, and two of unknown sex. The lumbar and cervical vertebrae were most commonly affected. One middle-aged female also had severe pitting and eburnation on the articular facets of the vertebrae. Fifteen of the 20 adult skeletons were over 36 years of age (Butler 1969), which is probably the reason for the high incidence of osteophytosis. The combined osteophytosis rate (counting those of unknown sex) is 65 percent (Table 7).

The frequency of occurrence of osteophytosis at the Williams and Kaufman portions of the Kaufman-Williams site and at the Roden site (Period 2, A.D. 1500) is comparable. This suggests similar activity patterns among these Red River Caddoan populations.

Table 7.

Frequency Comparison of Osteophytosis at Kaufman-Williams and Roden

COMBINED SEXES					
Williams Portion Kaufman-Williams (ca. A.D. 1550-1700)		Kaufman Portion Kaufman-Williams (ca. A.D. 1300-1500)		Roden Period 2 (ca. A.D. 1500)	
#	% of Individuals over 15	#	% of Individuals over 15	#	% of Individuals over 15
29	51.9	13	65.0	11	54.5

DISCUSSION AND CONCLUSION

Erect posture and bipedalism, characteristics of all *Homo sapiens*, produce spinal stress which may lead to vertebral problems. In addition, pregnancy may place stress on the lower thoracic and upper lumbar regions. Thus, vertebral anomalies may develop aside from any particular activities in which members of a group participate. However, vertebral stresses also result from daily, regularly repeated work activities.

The workload precipitated by heavy reliance upon horticulture resulted in debilitating vertebral injuries among female food producers (e.g., Rose 1984). Similarly, Pickering (1984) found that the incidence of arthritis in the upper back increased among Late Woodland females in the Lower Illinois River valley as they began to invest more energy in maize cultivation.

The manner in which women dried food for storage would also have created stress on the vertebral column. According to Griffith (1954), the Caddo dried maize on large outdoor platforms, raised ten or twelve feet above the ground. The activity of lifting the maize to that height and rotating it frequently to assure that it dried adequately would have stressed the upper vertebrae.

The women engaged in other regular strenuous activities, including gathering and carrying firewood, carrying water, and, importantly, carrying children in cradleboards positioned in a way that strained the mid-thoracic vertebrae. Thus, the women's daily activities would have initiated rather constant strain upon the vertebral column, through a combination of bending, lifting, and carrying.

In contrast, male activities produced somewhat sporadic, but probably more intense stress on the vertebrae. Clearing and preparing the fields for planting, using hand implements, was strenuous work involving significant movement and flexion of the vertebral column. This entailed not only tilling activities, but also heavy lifting of logs and other debris. Hunting was also a vigorous activity involving running, walking long distances, and frequently carrying heavy loads. The intense reliance on white-tailed deer, coupled with lack of a pack animal, meant that hunters frequently carried considerable weight for prolonged distances. These tasks produced serious strain on male vertebrae. These stresses explain the greater incidence of spondylolysis, Schmorl's nodes, and earlier development of osteophytosis and osteoarthritis in males. These conditions all reflect intense strenuous activity.

Evidence of vertebral stress is found in adolescent males as well, suggesting their early initiation into adult male activities. The Caddoan females did not incur disabilities as early, perhaps because their workload was not as strenuous or because they did not experience high stress episodes.

Analysis of vertebral anomalies provides information about the stresses imposed on prehistoric populations. The incidence in Caddoan populations of osteophytosis and osteoarthritis of the vertebral articular facets, as well as the frequency of spondylolysis and Schmorl's nodes, suggest that while the activities of both males and females placed considerable strain on the vertebral column, the males engaged in the most stressful activities during the period from about A.D. 1300-1700.

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Other Reports

Small Sites in Western Texas and Southern New Mexico

Raymond Mauldin

ABSTRACT

Small sites are ubiquitous in western Texas and southern New Mexico. Because of the low number of material culture items and the lack of diagnostic artifacts, researchers seldom choose them for detailed study. This paper discusses the results of recent projects that have focused on this under-studied site class. Data from a variety of projects conducted on a portion of Fort Bliss Military Reservation suggest that features on small sites generally date between 3600 and 1050 B.P. The number of radiocarbon dated features, and by extension the number of features, declines after 1350 B.P. While it is impossible to rule out erosion as a contributing factor in this decline, the pattern may suggest a decline in use of the study area for activities involving features. Other data document a continued use of the study area after 1350 B.P. for non-feature related activities. These patterns, which are not discernible from a focus on larger sites, suggest a major change in adaptive strategies.

INTRODUCTION

Small sites are ubiquitous in the semi-arid region of western Texas and southern New Mexico. These sites contain few artifacts, seldom have temporally diagnostics items, and only occasionally have more than one feature. Typically they are less than 0.25 hectares in size, with most being less than 0.01 hectares. The small number of artifacts present and the lack of temporally diagnostic artifacts often leads researchers to argue that small sites are less significant than sites that have larger artifact assemblages, more features, as well as diagnostic artifacts. As a result, small sites are often assigned a low analytical priority, and researchers rarely select these occupations for detailed recording, testing, or excavation. Little is known about this class of site, although they frequently comprise close to 90 percent of the sites identified on surveys in the region (Carmichael 1986; Whalen 1977, 1978).

This paper discusses the results of several recent survey and excavation projects that have focused on this small site class. Most of the data come from projects conducted on Fort Bliss Military Reservation, a 4500 km^2 training facility located near El Paso, Texas. Using intensive survey data, distributional data on temporally diagnostic artifacts, over 100 radiocarbon dated features, and numerous obsidian hydration dates, I argue that patterns in small site data suggest significant changes in landuse strategies over time. The details of these changes were not evident in the region where attention has previously focused on larger sites thought to be more "significant."

In the Central Basin (Figure 1), a large expanse of mesquite stabilized dunes, radiocarbon dates from features on small sites fall primarily between 3600 and 1050 B.P., revealing a substantial Late Archaic and Early Formative occupation in the region. From a peak at 1350 B.P., the number of dated features declines slowly until 1050 B.P., when the rate of decline accelerates. By about 800 B.P., there are few radiocarbon dates from isolated features on the small sites that dominate the Central Basin. These data suggest an abandonment of the Central Basin for activities that involved features on small sites after 1050 B.P. Yet, other data suggest that prehistoric populations continued to use the region for non-feature activities well after 1050 B.P. (Mauldin et al. 1993).

This pattern of radiocarbon dates from small sites in the Central Basin is distinct from the current, regional culture history sequence that suggests the greatest occupational intensity occurs in the late Pithouse and Pueblo time frames (post-800 B.P.). The regional culture history sequence is built on patterns detected in larger sites, and employs a framework that views sites as representing packages of behavior that are characteristic of the norms of the entire culture under study (see Lehmer 1948). In that perspective, large sites are deemed more significant because they have a larger sample of artifacts that can be studied in investigating past cultures. However, if prehistoric systems conducted disparate activities in different areas at various times, then a site, or area within a site, provides information on different aspects of past cultural systems. When viewed in this perspective, the significance of an occupation must be judged not by the absolute quantity of artifacts or features present, but by the role of that occupation in relationship to other sites, and within the overall adaptation. The data presented here suggest that small sites may contain data which are not easily gathered from larger occupations, data that reflect a significant component of past cultural systems.

THE STUDY AREA

The study area is within the Mexican Highlands section of the Basin and Range physiographic province (Hawley 1975). The Central Basin, an intermontane desert lowland that extends from central New Mexico, through far West Texas, and into Northern Mexico, forms the primary landform in the study area. Figure 1 outlines the region and provides relevant boundaries. Most of the archeological data used here comes from Fort Bliss Military Reservation.

Presently, the region outlined in Figure 1 has warm to hot days, cool nights, and low humidity. Temperatures range from a high monthly average of 35.2 degrees C in June to a low of 13.5 degrees C in January. The frost-free period, from March through October, averages over 230 days a year.

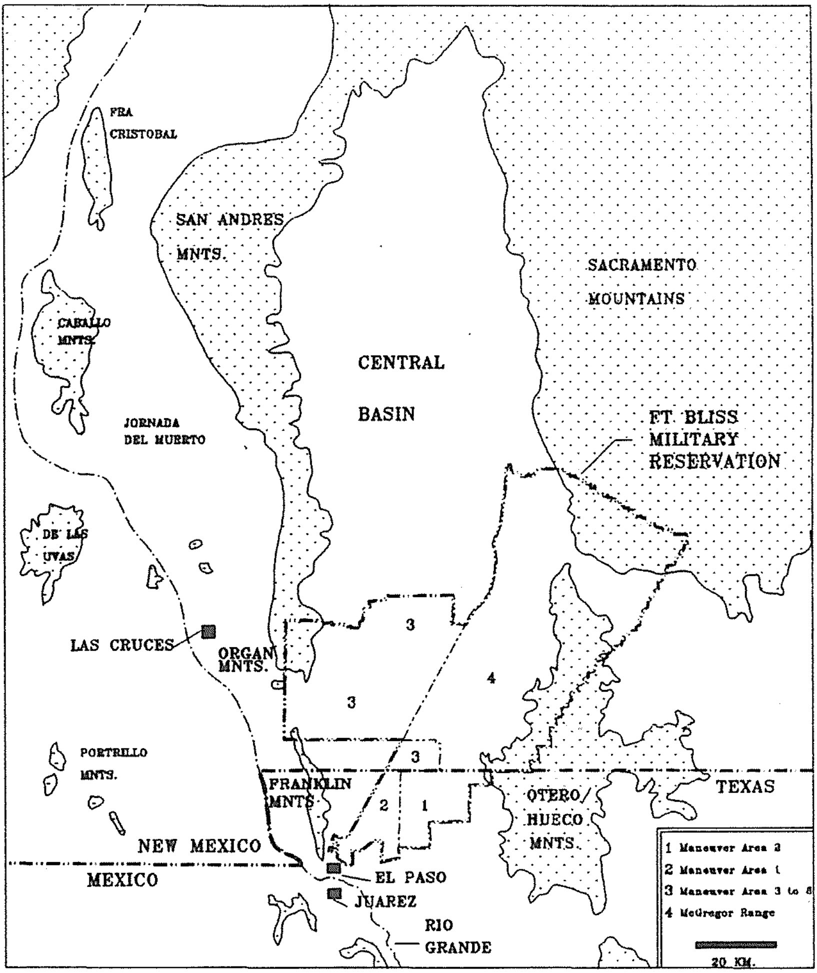

Figure 1. The west Texas and southern New Mexico Study Area. Numbers within Fort Bliss boundaries refer to survey projects identified in the text.

The mean annual rainfall is 20.1 cm, with more than half falling during the months of July, August, and September (Bradley 1983; Reynolds 1956). Late summer rainfall is often intensive and highly localized. These events saturate soils and result in considerable runoff. On occasion, these summer thunderstorms result in standing water in some of the playas that dot the region. The driest months of the year are March, April, and May, with less than 3 cm of rain falling during this period. As late spring and winter rainfall events are less intense then those of the summer, substantial runoff does not result.

There is considerable year to year variability in rainfall, and potential evapotranspiration is high as a function of sparse vegetation and warm temperatures. These factors result in a substantial water deficit throughout much of the year.

The major source of surface water in the region is the Rio Grande. Minor sources of surface water in the area are present in springs in the mountains. As a function of runoff from the mountain ranges, and the soil characteristics of the lower alluvial fans, the mountain periphery has a higher probability of having both standing water and higher soil moisture. The Central Basin lacks any major water source.

As in most desert environments, soil moisture limits energy transfer within the ecosystem. Soil moisture is a function of rainfall and runoff (Noy-Meir 1973; Satterwhite and Ehlen 1980). So, while a variety of flora and fauna are available in the region, the resource base is highly seasonal. Resources are primarily available in the late spring, in the late summer, and the early fall.

The most plentiful plant food available for exploitation include mesquite, yucca, sotol, agave, and annuals. Rabbits, rodents, deer, and antelope are the principal animals. Many of these resources occur near the mountains. However, mesquite, yucca, rabbits, and other rodents are present in the Central Basin in some quantity.

We do not know the degree to which these modern environmental conditions replicate prehistoric conditions. Clearly, the environment has, since the Middle Holocene, been characterized by desert shrub vegetation (Monger 1993; Van Devender 1990; Van Devender and Spaulding 1979). There have, however, been several major erosional events that suggest some level of climatic change (Monger 1993). The most recent erosional event occurred in the late 1880s, probably as a result of ranching activities. This appears to have resulted in a higher density of mesquite in the area, and a decrease in grass cover (Buffington and Herbel 1965; York and Dick-Peddie 1969).

PREVIOUS ARCHEOLOGICAL RESEARCH

The region has a relatively long, but spotty, history of archeological research (see Carmichael 1986). Lehmer (1948) produced the first major synthetic report on the archeology of the region. He relied on his work at La Cueva, a rock shelter in the Organ Mountains, Los Tules, a large pithouse site near Las Cruces, New Mexico, and earlier studies of adobe Pueblos (e.g., Bradfield 1929) and other rock shelters (Cosgrove 1947). Lehmer outlined a developmental sequence for the area which he termed the Jornada. This sequence was tied to changes in ceramics and architecture. He defined four major phases for the southern Jornada area: a preceramic Hueco Phase (pre-A.D. 900), a brownware and pithouse occupation (Mesilla Phase; A.D. 900-1100), a transitional Dona Ana Phase (A.D. 1100-1200), and the El Paso Phase (A.D. 1200-1450). The latter was marked by adobe pueblo structures and El Paso Polychrome ceramics.

Lehmer developed his sequence from excavations at large, dense, occupations and was working under the culture history paradigm. Sites were seen as representing the behavior in toto of prehistoric groups, and differences between sites were seen as reflecting different degrees of influence exerted by other groups. Like changes in space, changes in time were explained by reference to differing degrees of influence. Thus, the development of the Dona Ana phase from the Mesilla Phase, defined on the basis of new ceramic types, was "brought about by contact with Anasazi groups to the north" along with borrowing from the "Mimbres people already in the area" (Lehmer 1948:78). Although the explanatory focus in the region has shifted away from a diffusionist position to focus more on cultural ecological concerns, researchers still use Lehmer's culture history sequence to describe the archeological remains of the area.

While there have been changes to the sequence since its publication, such as the extension of the Mesilla phase back to A.D. 250, there was little reason to doubt the veracity of the overall sequence before the mid-1970s. Excavations between the 1940s and the mid-1970s continued to center primarily on pueblos (e.g., Brook 1967), rockshelters (e.g., Human Systems Research 1973), and larger pre-pueblo sites (e.g., Aten 1972). These sites fit easily into the basic phase system outlined by Lehmer.

Yet, in the mid-1970s, as a result of cultural resource management legislation, Fort Bliss Military Reservation began to conduct a series of archeological surveys of that portion of the post that the military uses for maneuvering (roughly 1500 km^2). These surveys include Whalen's (1977) work in Maneuver Area 1 (see Figure 1, Number 1) and 2 (Whalen 1978) (see Figure 1, Number 2), and Carmichael's (1986) survey of Maneuver Areas 3-8 (see Figure 1, Number 3). A series of quadrant surveys have also been conducted on the northern portion of the post (see Figure 1, Number 4) (Beckes et al. 1977). These surveys have documented extensive cultural resources on Fort Bliss, many of which are small occupations that do not fit well in Lehmer's original framework.

Figure 2 documents the distribution of "small" sites as revealed by Whalen's Maneuver Area 1 and 2 surveys, and Carmichael's Maneuver Area 3-8 survey. These sites are less than 0.25 hectares in size, often lack any temporally diagnostic artifacts, and may have only one or two hearth features. Transect spacing varied somewhat between the two projects, with the 1977 and 1978 surveys using wider transect intervals (about 46 m) than the 1986 survey (33 m). This, in conjunction with minor differences in the definition of what constitutes a site, resulted in a much greater density of small sites in Carmichael's (1986) survey. Yet, Figure 2 clearly suggests that these early surveys recorded many small sites that researchers could not easily fit into a temporal phase. Roughly 86 percent of the nearly 10,000 sites recorded fell into this small site class.

The actual number of small sites in the maneuver areas, however, may be substantially greater than even Figure 2 suggests. Figure 2 is based on wide transect spacing that may underrepresent the actual number of small sites. Figure 3 presents data on the number of sites per km^2 for the earlier surveys compared

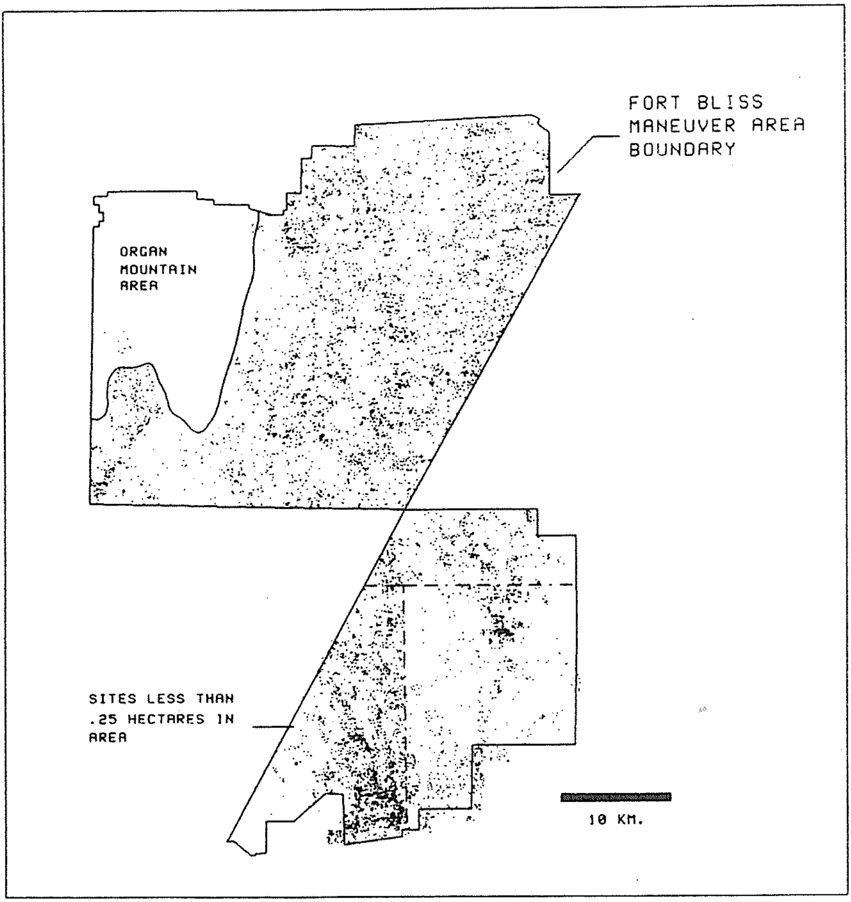

Figure 2. The distribution of archeological sites that are less than 0.25 hectares in area within the Fort Bliss maneuver area.

with several recent surveys conducted on Fort Bliss. All recent surveys used transect spacings at 16 m or less. This is a dramatic reduction in crew member spacing from the 46 and 33 m spacing used in the earlier inventory surveys. As demonstrated in Figure 3, these recent surveys record substantially higher site densities. In each case, site definitions are roughly comparable.

An overall average site density of 24/km^2 is noted for all three recent surveys, and sites less than 0.25 hectares in size make up the majority of the recorded sites. While concentrated in the southern portions of Fort Bliss, each project covered a different topographic area. Yet all have roughly the same density of small sites. An overall density of 15 to 20 small sites per km^2 is not unreasonable in the Central Basin setting. Based on this density range, the Central Basin (see Figure 1) may contain close to 200,000 small sites.

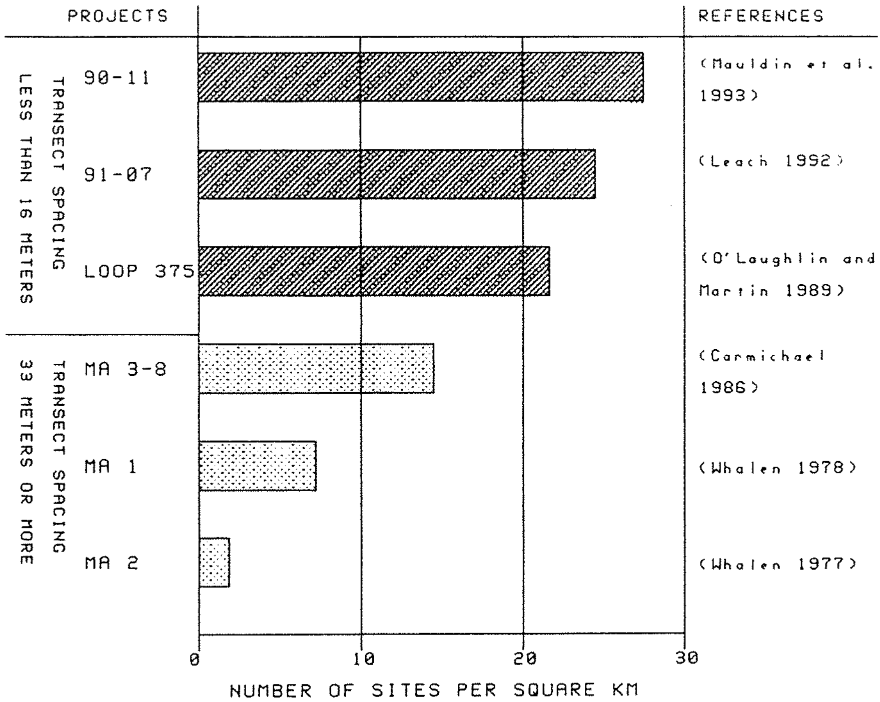

Figure 3. The average number of sites within a km² for six projects conducted on Fort Bliss relative to their survey intensity.

When we combine these results with the possibility that many such occupations are masked by reoccupation, collapsed into larger sites by erosional processes, and obscured by deposition, the actual number of small sites is probably much greater than even this substantial number. Whatever the true number, it is safe to conclude that these types of occupations form a significant component of the Fort Bliss archeological record.

The failure of these small sites to fit readily into the standard culture history sequence has had several results. First, many researchers suggest that the extensive number of small sites represent limited activities or special purpose sites generated from the larger "villages" (Whalen 1977, 1978) or "residential" sites (Carmichael 1981). Others argue that small sites are the remains of a different adaptive strategy focused on hunting and gathering in contrast to the more sedentary agricultural sites (Carmichael 1985; Johnson and Upham 1988). Still others argue that they represent a fluctuating settlement/subsistence strategy with a highly mobile, hunting and gathering economic system dominating during some periods, and a sedentary agricultural strategy dominating at other times (Carmichael 1983). However, there were few attempts to develop ways to decide between these alternatives, and almost no testing was conducted on any of these small sites. As a result, almost nothing was known archeologically about these occupations before the late 1980s.

SMALL SITE RESEARCH IN THE STUDY AREA

These small sites have been the focus of several recent projects. The bulk of the archeological data used in this paper comes from recent efforts conducted on Fort Bliss by the Cultural Resource Management Branch of the Directorate of Environment.

Whalen (1980, 1986) conducted the first project to focus on small sites as a group. He tested 79 "small camps" in the southern Central Basin. A second data set used here comes from recent survey, testing, and excavation projects conducted in conjunction with the construction of a highway (Loop 375) through the Military Installation. While several preliminary reports are available for the Loop 375 Project (see O'Laughlin et al. 1988; O'Laughlin and Martin 1989), no synthetic volume has yet appeared. The third data set comes from a project designed and conducted by Fort Bliss to generate additional archeological data on small sites. This project (Fort Bliss Project 90-11) involved survey, surface collection, testing, and excavation, primarily in a 3.5 km^2 area in the southern Central Basin. The work was recently completed, and a summary report is available in draft form (Mauldin et al. 1993). This small site focus on Fort Bliss, initiated by Whalen (1980), is ongoing. Fort Bliss is currently conducting testing in the southeastern Central Basin near the Hueco Mountains (see Figure 1). While no final report has been completed on this most recent effort (Fort Bliss Project 91-07), preliminary summaries of the survey (Burgett and Leach 1993) and aspects of the surface collection (Leach 1992) are available.

When seen in total, the data provided by these various projects suggest several patterns regarding the role that small sites may have played in regional landuse strategies. These patterns come from radiocarbon dates and distributional data on temporally diagnostic artifact types and obsidian hydration dates.

Occupational Patterns in Small Sites: The Radiocarbon Data

Using aspects of the projects discussed above, as well as other smaller projects that have generated chronometric dates (e.g., Kauffman and Batcho 1988), 117 radiocarbon dated features are now available from small sites in the Central Basin. These features are primarily small fire-cracked rock hearths, hearth stains, and a few pit structures. Figure 4 presents a histogram of 114 of these dated features. The three remaining dates all fall before 5000 B.P. and are not used in this paper.

The 114 feature dates come from over 140 individual radiocarbon assays. All dates have been tree-ring calibrated (see Stuiver and Pearson 1986) and most

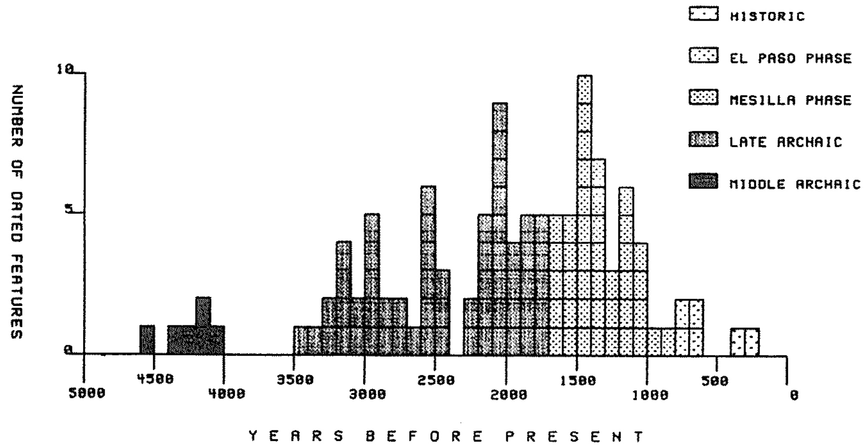

Figure 4. The age distribution and phase assignments for 114 radiocarbon dated features from the Central Basin. Intervals are 100 years.

have been corrected for different rates of carbon fractionation. Multiple dates from the same feature were averaged when their standard deviations overlapped at one sigma, and dates were eliminated which did not overlap, or had sigmas larger than 100 years. The feature dates in Figure 4 are plotted using the midpoint of the date range at two sigmas, and grouped at 100 year intervals.

The feature dates come from several projects located in different areas. They come from sites located on the eastern and western edge of the Central Basin, as well as from sites in the middle of the Basin. The patterns revealed in Figure 4, then, can be used as a measure of the timing of feature use on small sites in the general area (see Wills 1988:58-69). The standard biases that can be expected in a sample of dates, such as (1) a project specific focus on a given time period or (2) a selection bias concerning which features to submit for dating, are not significant in this sample. None of the projects focused on any single time period, and most features with sufficient charcoal were dated. Thus, I suggest that the data base in Figure 4 represents a reasonable sample of the underlying population of feature production in the Fort Bliss area. While the number of dates in specific intervals may change with new dates, these additions probably will not significantly alter the overall temporal patterns.

An examination of Figure 4 shows that most features date within the Late Archaic period as well as early in the Mesilla phase. There is a declining Late Mesilla (1200-800 B.P.) occupation, and almost no El Paso Phase dates. This pattern contrasts with that expected in the standard culture history framework, which suggests that the post-800 B.P. period represents the most intensive use of the region (Carmichael 1986; Whalen 1978). It seems that when our focus is on larger occupations with temporally diagnostic artifacts, we fail to see the substantial Late Archaic and Early Ceramic occupation suggested by the pattern of feature use in the Central Basin.

The overall trend of dates in Figure 4 also suggests a fluctuating pattern of feature use and production. There are periods when hearths are frequent, but separated by periods when few or no features are produced. If we minimize the smaller fluctuations, there is a general increase in the number of features between 3500-1350 B.P. After 1350 B.P. the number of feature dates then begins to decline. This decline is rapid until 1050 B.P., after which almost no feature dates are present in the Central Basin for these small site features. As with the summation of the dates at a phase level, these patterns of fluctuation and the apparent abandonment have not been considered, much less noted, in the standard culture history framework.

To further assess the date fluctuations seen in the Figure 4 sample from the Central Basin, I compiled a region-wide sample of dated features (Figure 5). These 471 dated features come from a variety of reports, and represent nearly 600 individual radiocarbon assays. Mauldin and Graves (1992a) provide a list of individual dates and projects (see also Katz 1992). The features come from all environmental zones in the Jornada area. The Figure 5 sample also incorporates the 114 features from the Central Basin used in Figure 4. As with the Figure 4 sample, all dates were corrected, dates with large sigmas were eliminated, and multiple dates from a single feature were averaged when appropriate. Figure 5 plots the dates by the midpoint of the 2-sigma range. These are grouped at 150 year intervals rather than the 100 year intervals used previously (see Figure 4).

Unlike the chronological patterns seen in the Central Basin dates, the data used in Figure 5 probably contains several project specific biases. The most obvious of these is the generally low number of dates from the Pueblo Period (post-750 B.P.). Pueblos have been the focus of many excavations, but these have frequently been conducted by organizations such as the El Paso Archaeological Society that lack the financial resources to invest in radiocarbon dates. Also, as the period is roughly 300 years in length, and as radiocarbon dates frequently have sigmas of ± 100 years, radiocarbon dating has not been the method of choice for the temporal placement of pueblos. The Figure 5 data come from a variety of projects conducted by several researchers over the last 25 years and the sample size is large. While acknowledging the potential biases, I use the pattern of dates as a rough indication of the intensity of feature use and production as was done previously for Figure 4.

When considered as a group, the chronological patterns in Figure 5 suggest that the greatest number of dates at the regional level, and by implication the greatest number of features used and produced, is in the 900-750 B.P. range (A.D. 1050-1200). The pattern revealed is a fluctuating but increasing frequency of dates through time up to the 900 to 750 B.P. interval. As noted previously, the rapid dropoff of dates late in time probably reflects a hesitancy to obtain radiocarbon dates for pueblos rather than any real decline in occupation in the region.

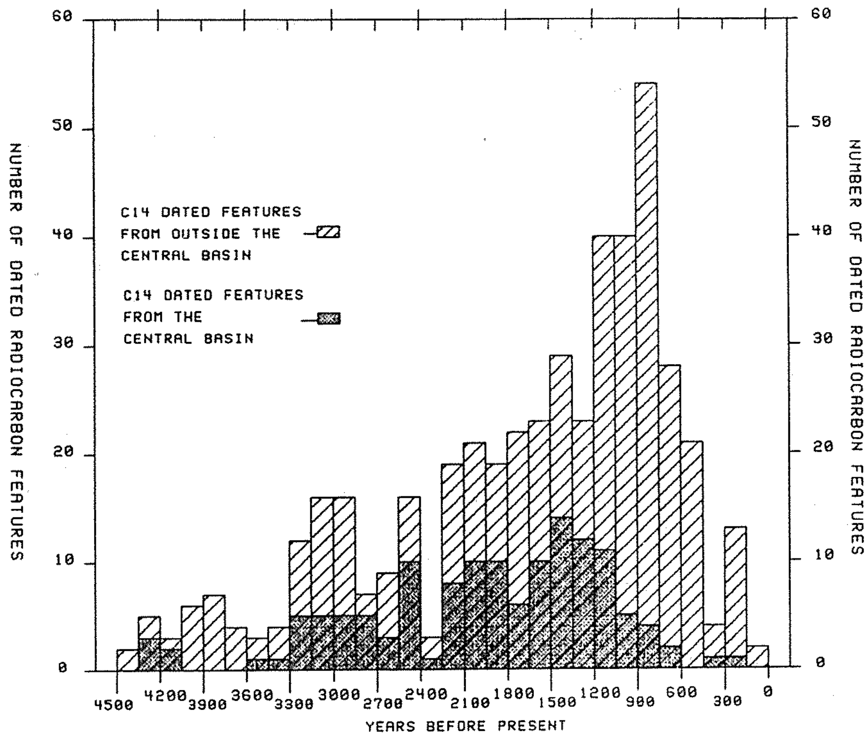

Figure 5. The age distribution of 471 radiocarbon dated features from the Jornada area. Features within the Central Basin, used previously in Figure 4, are identified by dark hatching. Intervals are 150 years.

Included in Figure 5 are those dates used previously in Figure 4 that come from features associated with small sites in the Central Basin. These have a dramatically different pattern than the regional sequence. While following, to some degree, the regional pattern from 4500-1200 B.P., the production of features in the Central Basin begins a rapid decline after that time. This decline occurs at the same time that the regional chronological pattern of feature use increases.

Most of the features with dates in the 1200-1050 B.P. interval in Figure 5 are located along the alluvial fans and near the river (see Leach 1993; Mauldin and Graves 1992b) rather than in the Central Basin. In the 900-750 B.P. interval, while there are over 50 dated features in the region, there are only four Central Basin dates (see Figure 5). The decline in feature dates in the Central Basin, initiated at around 1350 B.P., is continuous. After about 750 B.P., feature dates are virtually nonexistent in this area. This pattern is distinct from the regional pattern, especially if it is recalled that the regional series probably underrepresents the later time periods.

Occupation Patterns in Small Sites

Obsidian Hydration and Artifact Data

When examined both in isolation (see Figure 4) and in comparison to the regional dates (see Figure 5), the chronological pattern of feature use suggests that populations increasingly avoided the Central Basin after about 1200-1350 B.P., with an apparent abandonment during the late Mesilla and through the El Paso phases. The generation of features associated with small sites, then, reveals a pattern not seen in the regional radiocarbon dates, a data set dominated by features from larger sites. These small site feature dates produce a pattern not expected by traditional models of regional cultural development.

Radiocarbon dates are our best temporal indicator of occupation, but they are not the only source of dating available in the Jornada. When we consider these additional sources, such as obsidian hydration dates and temporally diagnostic projectile point types, the pattern of use and abandonment of the Central Basin, seen in the radiocarbon dates, is not confirmed. These other dating methods suggest that prehistoric populations did not abandon the Central Basin after 1050 B.P. as indicated by the radiocarbon dates, but continued to use the area throughout the sequence. If both data sets are accurate, these non-feature data suggest that rather than an abandonment of the Central Basin, the type of use may have changed. That is, the different dating techniques may be tracking different aspects of behavior, one associated with features and another associated with non-feature related activities.

Obsidian hydration dates form the primary non-radiocarbon data set used to examine occupation patterns in both the region and the Central Basin. Obsidian hydration dating in the region has a long and tattered history (see Miller 1990). A variety of obsidian sources are present in the area, but no independently established hydration rate is available for these sources. The obsidian hydration rates used in the region were developed using source specific experimentally induced hydration methods (see Michels et al. 1983). While such an approach has proven successful elsewhere (Lynch and Stevenson 1992), the results in the El Paso area are difficult to interpret.

The hydration rate used for the obsidian in this study comes from a regression analysis using a small number of rim measurements on obsidian artifacts which were recovered in association with radiocarbon dates (Mauldin et al. 1993), rather than the induced hydration method. Only eight samples, located throughout the region, were used to develop the regression-based hydration rate. These eight samples were selected from a larger data set by performing a series of regressions and eliminating extreme outliers until no significant outliers remained. The resulting equation has a high coefficient of variation (.98) and there are no extreme outliers.

Despite the relatively good fit of the regression, the rates derived from this procedure should be viewed with caution. The development of a hydration rim

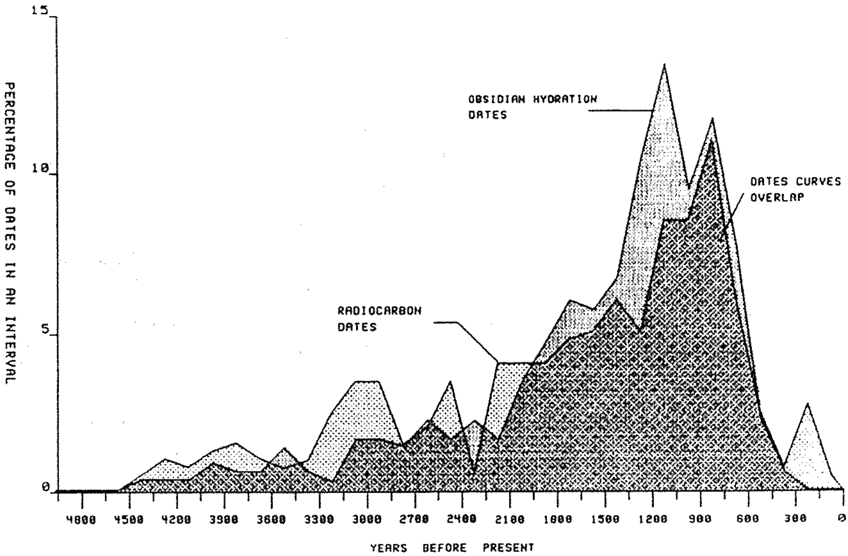

Figure 6. The percentage of obsidian hydration dates (n=316) and radiocarbon dated features (n=471) in the Jornada area. Intervals are 150 years.

on a given obsidian artifact is a complex process, dependent on the chemical composition of a specific obsidian source, the inherent water content in a given specimen, and the temperature and relative humidity that the artifact was exposed to after its production (Stevenson and McCurry 1990; Stevenson, 1991 personal communication). Given the unknown pattern of deposition and exposure of an individual piece in the study area, and the substantial effect that exposure has on temperature and relative humidity, the regression rim rate should be viewed only as an estimate of chronology, subject to revision as additional obsidian samples with associated radiocarbon dates become available.

In spite of the inherent problems associated with obsidian hydration in the region, and the small number of radiocarbon dated obsidian rims, the regression-derived rate of hydration used here is thought to provide reasonable estimates of time. This optimism is justified by Figure 6 which contrasts the regional radiocarbon dates with 316 obsidian dates. The obsidian dates are calibrated using the regression-derived hydration rate mentioned above. Rim measurements come from throughout the region, and all rims were read by Dr. Chris Stevenson of Diffusion Labs. Only a single source of obsidian (Rio Grande Group 2) is used in this analysis (see Stevenson and McCurry 1990) to minimize the impact of chemical differences in the obsidian source as such.

The obsidian and radiocarbon date patterns in Figure 6 differ in that the peak in the obsidian hydration dates is approximately 300 years earlier then the peak in radiocarbon dates. This gap may be influenced, in part, by the "old wood" problem (Schiffer 1987:308-321), but it is unlikely to account for all of the temporal differences (see Mauldin et al. 1993). Despite the 300 year gap, the regional radiocarbon and obsidian hydration curves have a similar shape, suggesting that the obsidian dates derived from the regression equation may provide an approximation of the "true" obsidian date. While this is not too surprising given that the obsidian regression is built on radiocarbon dates, recall that only eight dates were used in the regression analysis.

Figure 7 provides a comparison of 143 obsidian dates with radiocarbon dates of 61 features from the Central Basin. The obsidian dates and the radiocarbon dates are from Fort Bliss Project 90-11 (Mauldin et al. 1993). Because of the smaller number of both obsidian and radiocarbon dates available, Figure 7 groups dates at 200 year intervals. Here, the two curves differ significantly. The peak in obsidian dates occurs several hundred years later than the peak in radiocarbon dates, a pattern different from the regional comparison where the obsidian peak was earlier than the radiocarbon peak (see Figure 6).

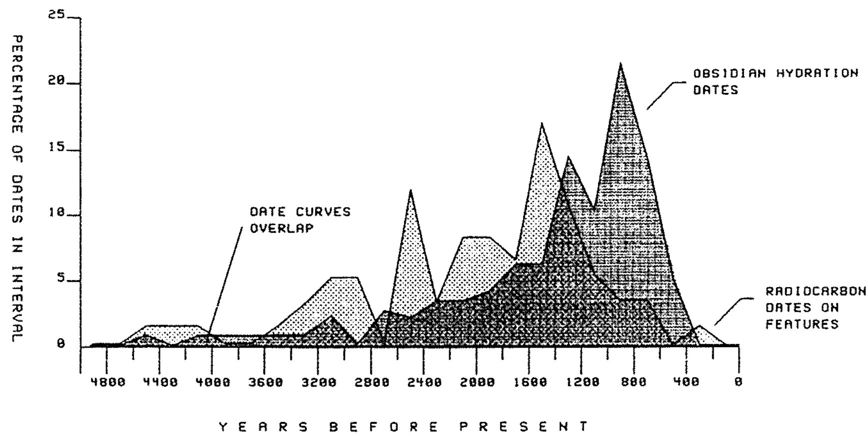

Figure 7. The percentage of obsidian hydration dates (n=143) and radiocarbon dated features (n=61) from Fort Bliss project 90-11, conducted in the Central Basin (Mauldin et al. 1993). Intervals are 200 years.

The Central Basin date pattern in Figure 7 suggests that the feature dates and the obsidian dates may reflect different aspects of behavior. Radiocarbon dates are necessarily limited to features, while obsidian dates are associated with the production of lithic tools that may or may not have been discarded around features. These two activity sets, although they may show some co-association, are not necessarily related. That is, there is no necessary relationship between feature dates and the production of obsidian projectile points and debitage. The two patterns could well be telling us about the frequency of different types of activities: those that involve the use of features and those that involve the use of lithics without an association with features.

Of course, the regression-derived dates on obsidian may be incorrect. Even though they have some relationship with the radiocarbon curve at a regional level, this may be fortuitous. Yet, if the two different dating techniques identify different aspects of behavior, the patterns may provide evidence for a shift in the way that prehistoric populations used the Central Basin. Early on, activities that involve the production of features are common. These activities begin to drop out after 1050 B.P., but populations do not abandon the Central Basin. After this time, activities that minimally involve the deposition of obsidian artifacts, and that probably also involve the deposition of artifacts made from other materials, become increasingly common.

Additional support for this late, non-feature use comes from the distribution of diagnostic projectile points. Project 90-11 recovered 30 diagnostic projectile points (Mauldin et al. 1993). While the total sample size is small, six of these (20 percent) probably date after 800 B.P. This percentage of late points is similar to the percentage of post-800 B.P. obsidian dates from the same project (17 percent), but radically different from the percentage of radiocarbon dated features in this time block; only 3 percent of the radiocarbon dated features fall after 800 B.P. Both the obsidian dates and the percentage of diagnostic points, then, suggest a later use of the Central Basin that does not seem to involve the production of features.

Several researchers, starting with Whalen (1977, 1978, 1980), have suggested that settlement patterns also change between the Mesilla and El Paso phases. Mesilla sites are located throughout the region, while El Paso phase sites are concentrated near the Rio Grande and along the alluvial fans. This is essentially the same pattern identified here, with a shift in sites out of the Central Basin. However, the radiocarbon and obsidian dates indicate that this shift began several hundred years before the close of the Mesilla Phase at 800 B.P., and that the Central Basin was still used after the close of the Mesilla Phase, but in a different manner. Settlement pattern data also document the presence of El Paso phase ceramics in the Basin, but in much lower frequencies relative to the alluvial fan settings. Again, a low frequency of El Paso phase ceramics is consistent with the projectile point and hydration data. That is, these patterns suggest that there was not an abandonment at 800 B.P., but a change in the way the Central Basin was used at that date.

DISCUSSION

This shift from feature-centered activities to non-feature centered activities may represent a significant change in the way that populations used the region. Prior to 1350 B.P., much of the archeological record in the Central Basin is associated with the use of features. Between about 1350-1050 B.P., the number of features in this data set declines, while the number of obsidian dates increases. After 1050 B.P., obsidian dates dominate the chronological record, but few features are present. We have, then, evidence for a fundamental change in the way that populations used the Central Basin, with a shift away from feature-centered activities to a more extensive landuse strategy.

It is possible, of course, that the patterns of declining feature dates are unrelated to human behavior. As noted previously, the region has been subjected to a series of erosional events, the most recent of which is probably associated with the introduction of cattle in the late 1880s. This most recent event could have destroyed many of the recent features, thus accounting for the decline in dates seen in Figures 4 and 5. However, the data used here are from a variety of projects conducted in several different geomorphic settings, and the patterns are quite consistent with settlement pattern changes identified by other researchers at a regional level. While, given our current data, it is impossible to rule out historic period erosion as a contributing factor in the patterns of declining feature dates, it is unlikely to be the determining factor in the observed chronological patterns.

If these changes are the result of prehistoric behavior rather than erosional processes, a variety of scenarios can be envisioned to account for this shift in landuse. The critical point for this discussion is that the timing of the shift, and the change in the nature of the adaptation, is not discernible by a focus on the larger sites. Both the substantial nature of the Late Archaic and Early Ceramic occupations, and the shift in landuse strategies between 1350-1050 B.P., is not identified by reliance on traditional culture historical periods or by a focus on large sites (see Carmichael 1990; Upham 1984 for additional perspectives on this issue). Small sites account for the vast majority of occupations in the region. If additional work on these occupations continues to reveal a substantial Late Archaic/Early Ceramic occupation, and confirms the changes seen here, then the archeological record of the Jornada must be seen as dramatically different from that suggested by the traditional culture history framework.

Sites in the Jornada have traditionally been viewed as representing discrete packages of behavior that are characteristic of the entire cultural system under study. In that perspective, sites with large quantities of artifacts, features, and structures are thought to be more significant than small sites because they have a larger sample of items that can be studied in investigating past cultural patterns. Such a position is internally consistent if a culture, and the archeological record it produced, is viewed as an undifferentiated whole. However, if sites, and areas within sites, are viewed as representing different aspects of a cultural system, then the significance of any given assemblage changes. As prehistoric systems conducted different activities in different areas at various times, the significance of any single occupation must be judged in relationship to other sites, rather than by reference to the absolute quantity of recovered remains. Sites, and areas within sites, thus provide glimpses into different components of the system, and their relevance must be evaluated by their relationship to that systemic whole.

When viewed in the traditional perspective, small sites have been considered less significant than their larger counterparts. However, when viewed in a systemic perspective, small sites provide data that may be completely unavailable in their larger counterparts. In the Jornada, these small site data show dramatic changes in landuse over time that have not been revealed by the exclusive focus on larger occupations.

SUMMARY

Small sites are the most commonly represented class of sites in the Jornada. Yet they are the least understood. They appear to be especially common in the Central Basin, though I suspect that they are frequent throughout the area but have often been masked by later deposits (Linse 1993:20-26). They do not fit into the standard culture history sequence. That sequence is built on larger sites and rockshelter excavations. Under the culture history framework, research priority is based on the assumption that artifact quantity or uniqueness defines significance. Here, I have attempted to place small sites in a larger systemic framework. Radiocarbon dates on these sites suggest a substantial Late Archaic/ Early Mesilla phase occupation that the traditional culture history framework has not identified. On Fort Bliss, the difference in the relative frequency of feature dates on small sites seems to show that populations gradually abandoned the basin for activities that generated features. This abandonment started around 1350 B.P. and was all but complete by about 1050 B.P. Obsidian dates, diagnostic projectile points, and the distribution of ceramics, do suggest that people still used the basin after 1050 B.P., but used it in a different manner. While it is impossible to rule out erosional processes as accounting for the lack of feature dates late in the sequence, taken as a whole these changes may suggest a dramatic shift in landuse strategies.

The sites discussed here are not pretty. They often have only a few artifacts, no painted pottery, no recognizable architecture, and few formal tools. Frequently, these sites are ignored in favor of more substantial sites, which, as a function of their size, are traditionally considered to have greater significance. The patterns identified in this paper suggest that these small occupations are a significant component of past adaptive systems. In fact, if the chronometric patterns identified in this paper are confirmed by additional research, the vast majority of these sites are Late Archaic and Early Ceramic in age. To ignore them, then, is to ignore over 3000 years of regional prehistory. While any given small site may provide little data, when we consider small sites as a group, they begin to form patterns that have behavioral significance. More critically, they provide data that are either unavailable at large sites, or are masked by larger occupations. If sites continue to be viewed as representative of the typical behavior of a given group, rather than as differentially informative about variability in that group, the focus on large sites to the exclusion of their smaller

counterparts will continue. This exclusion, in turn, will assure that significant aspects of the adaptations that we strive to document and explain will be missed.

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Lemens Rockshelter (41SV60), A Late Prehistoric Site in Somervell County, Texas

James E. Smith II

with a contribution by
Patricia M. Landau and Gail A. Colby

ABSTRACT

Two Late Prehistoric burials, one with grave goods, were recovered from a small rock shelter in Somervell County, Texas, by a Steward of the Office of the State Archeologist. The grave goods consisted of bone and lithic tools, polished pebbles, modified mussel shell, and a broken Scallorn projectile point. Additional excavations in the shelter suggested that the primary use of the shelter was as a hunting camp. A cache of flint cores and flakes that are associated with a Toyah occupation was also recovered.

INTRODUCTION

In the fall of 1990, Mr. Don Lemens contacted the Office of the State Archeologist (OSA) concerning a human burial with grave goods that he had discovered in a rockshelter located on the property owned by his brother Mr. O. Z. Lemens. Bob Mallouf, State Archeologist, contacted the author, who is part of the Stewardship network of the OSA, to investigate the find.

During the initial site visit, it was learned the Mr. Lemens was excavating the shelter in 6-inch levels, but had maintained no formal horizontal provenience. It was also understood that Mr. Lemens wanted the burial removed, but intended to continue his excavations in the shelter. The importance of documenting a burial containing grave goods, as well as the potential loss of that information, led to the decision by OSA to excavate the burial and then for the author to continue with the excavation of the shelter.

LOCATION

The Lemens Rockshelter (41SV60) is located about 15 km west of the town of Glen Rose in Somervell County, Texas (Figure 1). The site is located in a small overhang on the west side of a small header stream that drains into Brushy Creek. The creek empties into the Bosque River, which in turn empties into the Brazos River just north of Waco. The small stream valley is moderately covered with juniper and live oak trees, with various prairie grasses covering the open areas.

GEOLOGY AND NATURAL ENVIRONMENT

Somervell County is in the Western Cross Timbers (Dyksterhuis 1948; *Texas Almanac* 1990). It is a high rolling and hilly area with limestone formations deeply cut by the Brazos and Paluxy rivers. Average rainfall is 32 inches per year, and the average temperature ranges between 32 and 98 degrees F (*Texas Almanac* 1990).

The geological setting for the Lemens site is different from the nearby Brazos and Paluxy river valleys. In the northern part of Somervell County, the prominent geological stratum is the Glen Rose formation. This is a part of the Trinity Group (100 m.y. ago), assigned to the Comanche series of Cretaceous age. The Trinity Group was deposited as the muddy bottoms of warm, shallow coastal seas. These muds have solidified into marl and limestone that have been eroded to form the topography of the valleys.

In the southwest corner of the county, where the Lemens site is located, the Fredericksburg Limestone formation is preserved. Erosion has removed the upper Cretaceous, and much of the lower Cretaceous, but part of the Fredricksburg formation remains overlying the Trinity Group. The preservation of the Fredricksburg formation in the higher areas is due to the very hard limestone that protects the underlying shales and marls from erosion (Sheldon 1979:115). This gives rise to the topography of flat-topped hills where the site is located. The Edwards Formation within the Frericksburg produces Edwards chert, the primary lithic resource for the site. This is one of the northernmost occurences of the Edwards chert (Sellards et al. 1932:339).

DESCRIPTION OF SITE

The site is located on the west side of a small gully that has eroded through the limestone cap approximately 20 m from its head. The gully has also eroded a small depression into the bedrock which holds water for a short period of time after rainfall.

The gully at the shelter is approximately six m wide. The shelter is ten m long (due north) and a maximum of four m wide in an east-west direction (see

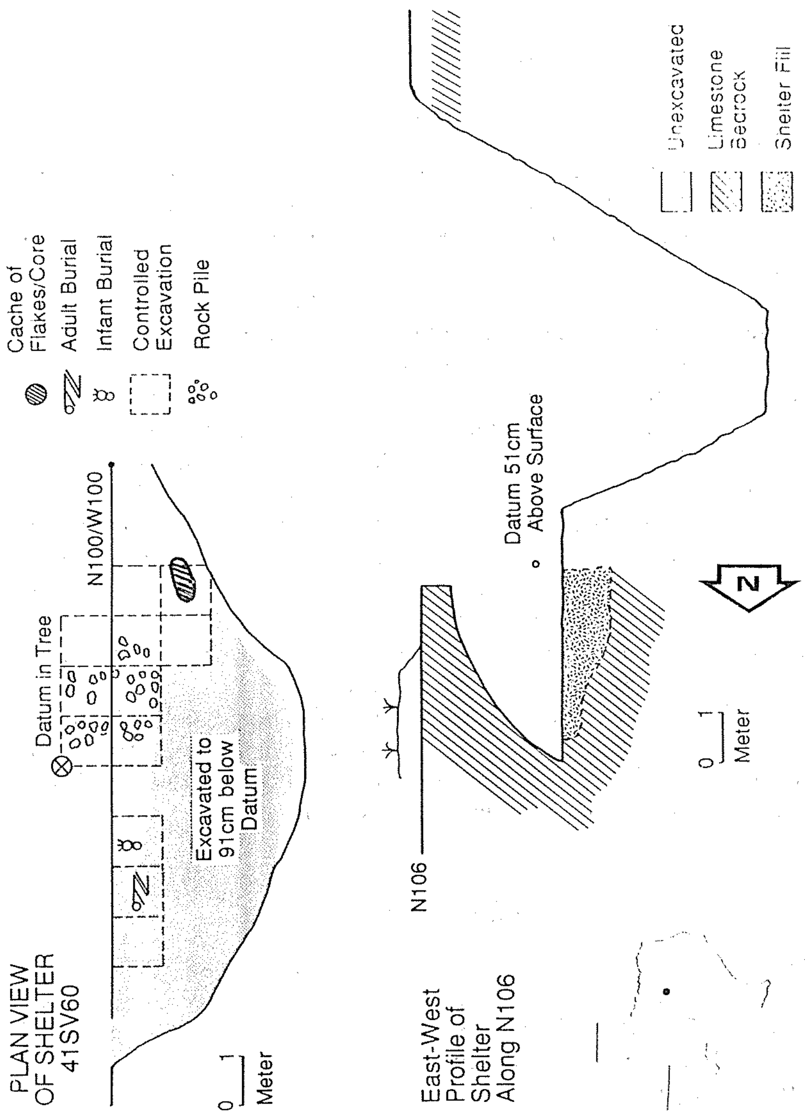

Figure 1. Plan and Profile View of Lemens Rockshelter.

Figure 1). The ceiling of the shelter is 2.2 m above the present ground surface. The bedrock floor of the shelter slopes outward with an average deposit depth of 85 cm along the drip line.

EXCAVATION

When controlled excavations were begun by the author, one skeleton, along with four items associated with the burial, had already been exposed by Mr. Lemens. Since the rockshelter opens to the east, the base line was established with a north-south orientation (see Figure 1). An arbitrary N100/W100 point was established in the southern end of the shelter. The grid was adjusted to completely include the first burial in a 1x1 m unit. The northeastern corner of all units was used as the unit designation. A vertical datum of 100.00 m was established using a temporary datum driven in a large juniper tree adjacent to the shelter. The surface of the shelter was established at 99.49 m in elevation. All soil matrix in the units was screened through one-quarter inch hardware mesh.

Mr. Lemens had been excavating the shelter's deposits in in 6-inch levels, screening all the dirt through one-quarter inch screen, and saving all materials. However, only the recognizable projectile points and stone tools had been separated by levels. Approximately 60 percent of the shelter had been excavated in this manner prior to our removal of the burial. Since vertical control had previously only been approximate, the remainder of the excavations were done using the metric system in 10 cm arbitrary levels (the initial excavation levels were converted into metric measurements for purpose of discussion). No natural or cultural zones were observed in the shelter's deposits.

The top 20 cm of the shelter fill was essentially sterile, with only the occasional recovery of lithic debris. Temporally diagnostic artifacts (arrowpoints and dart points) were found between 20-60 cm; level 7 was reached in only one unit, but no temporally diagnostic material was recovered.

FEATURES

Two separate burials, one adult and one child (see Appendix A for osteological analyses), were discovered along with a large rock concentration and a lithic cache (see Figure 1). The burials were 1 meter apart in the northern end of the shelter. Both burials occur in deposits that are thought to date to the Late Prehistoric Austin phase.

The large rock concentration was in the southern half of the shelter, with the cache of cores and flakes just to the south. The age of the rock concentration is unknown, but the cache appears to be associated with a Toyah phase occupation of the shelter. Although burned rock was present in the shelter, no formal hearth areas were discovered.

Burial 1

Burial 1 was an adult male, 35-45 years old, uncovered by Don Lemens and excavated by the author and the Steward Action Team. It was located in unit N109/W100, with the top of the skull at 98.86 meters in elevation, about 63 cm bs. The burial was in a flexed position with the head to the north and face to the west (Figure 2), with the rest of the body lying between 98.53-98.67 m. It had been placed on the bedrock of the shelter and covered with an extremely large rock cairn. Although evidence for a burial pit and matting was searched for, none was found.

The cairn had been entirely removed before the author became involved in the excavations. However, the four largest rocks identified as part of the cairn ranged in size from 70 x 90 cm to 20 x 45 cm. One of these had been in a vertical position east of the burial but its burial placement could not be determined. In addition, an undetermined number of smaller rocks were removed from the cairn.

Burial 1 was excavated as a feature with vertical measurements taken as needed to describe the character of the feature, but with no arbitrary division of the fill into levels. During the excavation of the burial, a cache of grave offerings was discovered adjacent to the flexed right tibia (see Figure 2) at an elevation of 98.66-98.70 m. The cache included 11 stone, antler, and bone tools. In addition, a broken Scallorn point was found lying flat 5 cm from the right tibia, and two polished stone pebbles were found lying near but behind the spinal column. A bone fishhook found prior to formal excavations may also have been part of the grave offerings given its proximity to the burial.

ADULT BURIAL GRAVE GOODS

Lithic Tools

Bifacial Tools

Three bifacial tools were recovered in association with Burial 1; one was directly on top of the right tibia while the other two were between the femur and tibia of the right leg (see Figure 2). All appear to have been made from a gray Edwards Chert material from the same source (Larry Banks, 1993 personal communication).

Biface 1 (Figure 3a): Maximum thickness, 4.8 mm; Maximum width, 38.1 mm; Maximum length, 83.3 mm; Weight, 27.4 g.

Description: Well-chipped but with knots on both sides due to the poor quality of the chert material. Several attempts were made to try to remove the knots, but they were not successful. There is no indication of use along the biface edges.

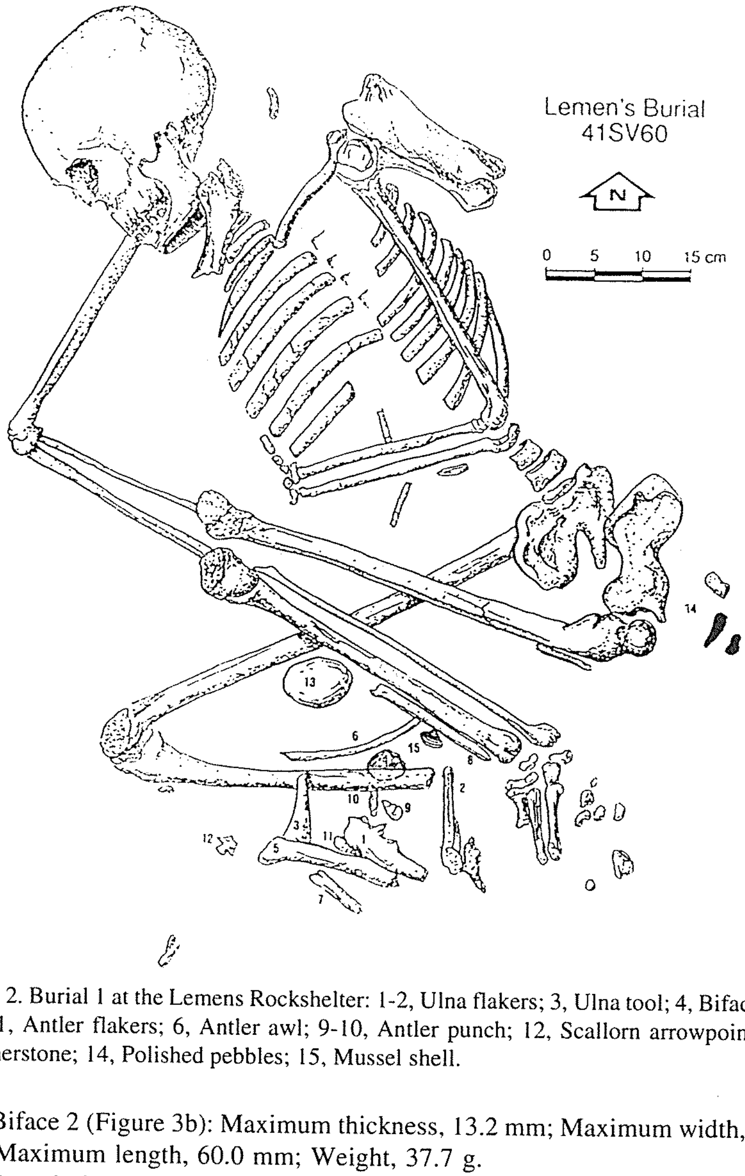

Figure 2. Burial 1 at the Lemens Rockshelter: 1-2, Ulna flakers; 3, Ulna tool; 4, Bifaces; 5, 7-8, 11, Antler flakers; 6, Antler awl; 9-10, Antler punch; 12, Scallorn arrowpoint; 13, Hammerstone; 14, Polished pebbles; 15, Mussel shell.

Biface 2 (Figure 3b): Maximum thickness, 13.2 mm; Maximum width, 3.85 mm; Maximum length, 60.0 mm; Weight, 37.7 g.

Description: This biface appears to be unfinished but closer examination reveals wear polish on one basal corner and step flaking on the other edge of the piece.

Biface 3 (Figure 3c): Maximum thickness, 12.0 mm; Maximum width, 33.0 mm; Maximum length, 58.0 mm; Weight, 20.7 g.

Description: This tool has one used edge along one side of the specimen.

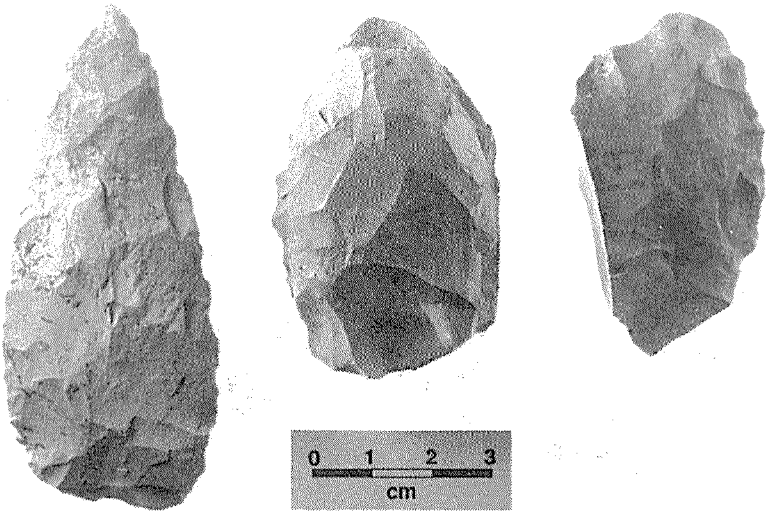

Figure 3. Bifacial Grave Goods: a, Biface 1; b, Biface 2; c, Biface 3.

Scallorn Point

A broken Scallorn point (Figure 4a) was found 5 cm from the tibia of the right leg and 2 cm from the nearest tool associated with the grave offerings (see Figure 2). The projectile, missing the tip, was lying flat on the bedrock at 98.69 m in elevation. Maximum length, unknown; Maximum width, 14.0 mm; Maximum thickness, 2.9 mm; Stem width, 6.3 mm; Basal width, 10.1 mm.

Polished pebbles

Two highly polished pebbles (Figure 4d-e) were recovered from an area approximately 8 cm behind the skeleton's pelvic region at an elevation of 98.57 m. One pebble is triangular in shape while the other is roughly rectangular. Both have polish over all pebble surfaces, except for the deepest irregularities, and such a high degree of polish on such small stones suggests constant wear. The pebbles may have been rattle stones (or possibly fetish stones) attached to a pouch and worn at the waist. The pebbles weigh 2.5 g and 2.9 g.

Hammerstone

A purple quartzite cobble used as a hammerstone was found on top of the left leg (elevation of 98.68 m). Wear patterns on both ends occurred predominantly on one side of the hammerstone. To hold the tool and strike an object in such a way as to produce this use pattern would require holding the tool in the left hand (Figure 5b). Damage along one edge of the hammerstone appears to

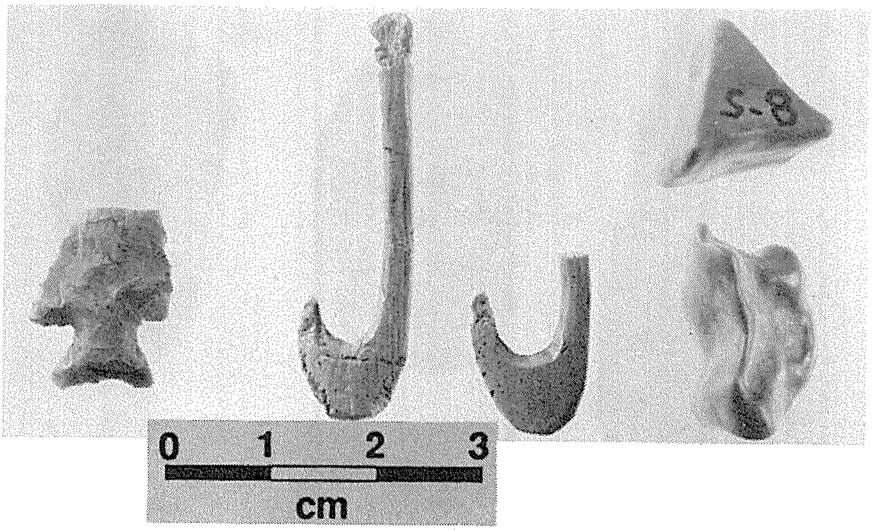

Figure 4. Other Grave Goods from Burial 1: a, Scallorn arrowpoint; b-c, fishhooks; d-e, polished pebbles.

be from abrading, due probably to dulling the striking edge before using it to remove a flake. Maximum length, 77 mm; Maximum width, 50 mm; Weight, 194 g.

Bone/Antler

Antler Tines

Seven antler tines were recovered in the tool cache around the lower legs of the adult burial. Although rodent gnawing has removed the tip from one of the tines all are classified as tools. These specimens may have been held in a pouch that was placed in the grave at the time of the burial since they were all oriented with their beak to the east.

Awl: One antler awl has high use polish on the tip (Figure 6b). Curved length, 176 mm; Maximum diameter, 17.6 mm; Weight, 23.1 g.

Punches: Two tines appear to have been used for punching activities. Both tines have spalls removed from the proximal end that may have been a result of blows from some type of "hammer." These ends have a flattened appearance (Figure 7b, c). Spalls have also been removed from the distal ends, possibly from impact on the target object. Both distal ends contain smoothed, slightly polished areas around the circumference of the artifact. The polishing extends 11 mm from the tip on Punch 1 and 21 mm from the tip on Punch 2.

Punch 2 has a 2 mm wide quartzite or chert chip tightly imbedded in the bone 25 mm from the distal end. No attempt has been made to remove it. The proximal end of this tool is heavily battered and compacted.

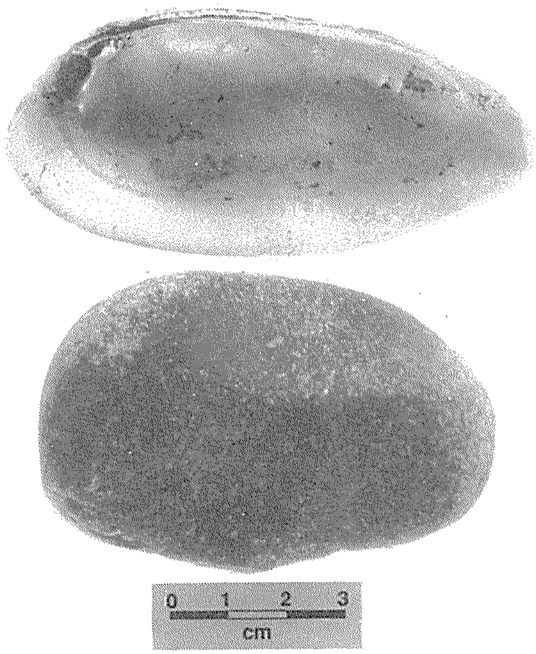

Figure 5. Grave Goods: a, freshwater mussel shell; b, hammerstone.

Figure 6. Antler Grave Goods: a, c-d, antler flaker; b, antler awl.

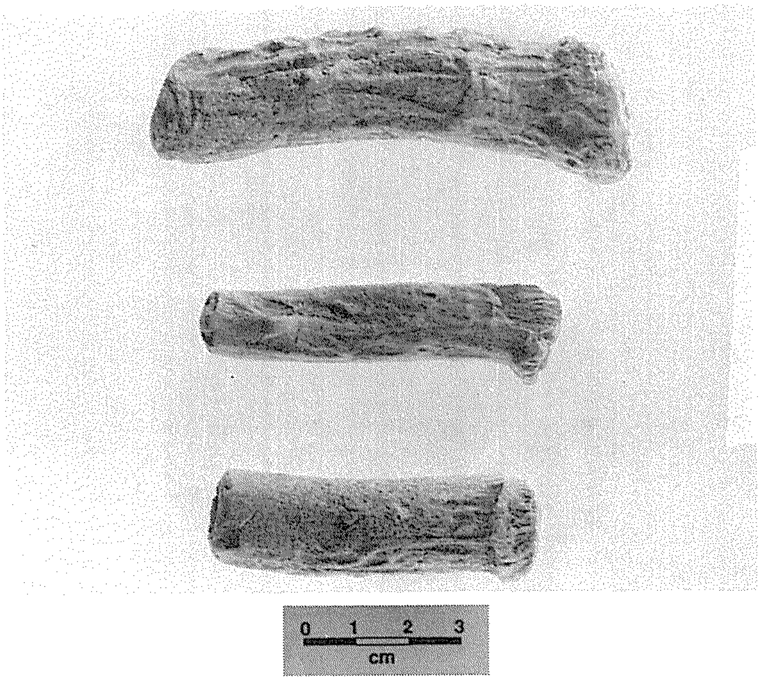

Figure 7. Antler Grave Goods: a, antler flaker; b-c, antler punches.

Punch 1 (Figure 7b): Length, 67 mm; Maximum diameter, 16.1 mm; Weight, 9.7 g.

Punch 2 (Figure 7c): Length, 61 mm, Maximum diameter, 19.2 mm; Weight, 14.1 g.

Antler Flakers: Two definite and two probable antler flakers were among the burial offerings. Two of the tines (Flaker 1 and 2) show wear at the tip consistent with use as flaking tools. A third (Flaker 3) is very similar in size and shape but had the tip removed by rodent gnawing. The fourth possible flaker tool has wear on the distal end but it is not battered nor does it have spalls removed from either end. Two cut marks are present between 20 and 30 mm from the distal end, and have a "v" shaped profile that may be intentional.

One tine has a very straight edge along the proximal end where it had been detached. This may be the result of a groove and snap method of detachment. No such straight breaks are present on the other flakers.

Flaker 1 (Figure 7a): Curved length, 154 mm; Maximum diameter, 18.3 mm; Weight, 17.9 g.

Flaker 2 (Figure 6d): Curved length, 128 mm; Maximum diameter, 17.3 mm; Weight, 14.7 g.

Flaker 3 (Figure 6a): Curved length, 118 mm; Maximum diameter, 18.3 mm; Weight, 17.7 g.
Flaker 4 (Figure 6c): Curved length, 89 mm; Maximum diameter, 21.5 mm; Weight, 26.9 g.

Bone Tools

Ulna Tools: Two deer ulna flakers and one unidentified left ulna tool were also among the bone implements recovered from the Lemens site. The tips were uniformly gnawed off, however some polish wear was evident along the edges of the pieces. The unidentified ulna (Ulna 3) is rather thin to have been a flaking tool, but its function is unknown.

Ulna 1 (Figure 8a): Thickness at tip, 3.9 mm; Weight, 9.5 g.
Ulna 2 (Figure 8b): Thickness at tip, 4.6mm; Weight, 11 g.
Ulna 3 (Figure 8c): Thickness at tip, 1.9 mm; Weight, 4 g.

Figure 8. Bone Grave Goods: a, c, ulna flaker; b, ulna tool; d, unmodified bird bone found under ulna flaker 1.

Fishhook

One complete fishhook made from a deer phalange (see Figure 4c) was found by Mr. Lemens directly behind the neck area of Burial 1. Whether this was part of the grave offerings or part of the burial fill is unknown. Maximum length, 39 mm; maximum width, 6 mm.

Freshwater Mussell Shell

One freshwater mussell shell was lying vertically inside the flexed left leg. Its edge had been reduced, presumably through use, along the entire margin, and may have been used as a hide scraper (see Figure 5a). Maximum length, 91 mm; Maximum width, 43 mm; Maximum thickness; 15 mm; Weight, 19.1 g.

Burial 2

Burial 2 is an infant approximately four years old. It was located in unit N108/W100, 1 m to the south of Burial 1, between 98.65-98.72 m elevation, about 75-84 cm bs. The burial appears to be a very careful reburial with possible grave offerings.

The remains were incomplete, consisting of portions of the skull, jaw, ribs, and long bones. The bones were not placed in a bundle, but rather positioned to approximate the correct skeletal orientation; that is, the fragmented skull was placed to the west, the jaw fragment was in the middle, and the long bones, ribs, pelvis, and other skeletal materials were placed together to the east (Figure 9).

From the appearance of the remains, the infant had died elsewhere, and had been exposed to the elements until the bones were clean. The remaining skeletal material was then collected and buried in the shelter as a secondary interment. How most of the bones were lost is not known, although there was no indication of rodent chewing on the bones.

The burial was carefully laid out on the bedrock. Six fist-sized rocks were placed together to support two large flat rocks that overlay the skull and jaw (at an elevation of 98.92 m) and prevented these being crushed. Various small rocks that were part of the cairn were placed around the lower portion of the infant to form a "cup" in which the lower bones were placed. No burial pit outline was observed.

An unbroken and unmodified freshwater mussel shell was recovered lying on the bedrock adjacent to the rock cairn. It may be associated with the child burial. A broken Scallorn arrowpoint was recovered from the same area but was not found *in situ* and thus cannot be directly associated with Burial 2.

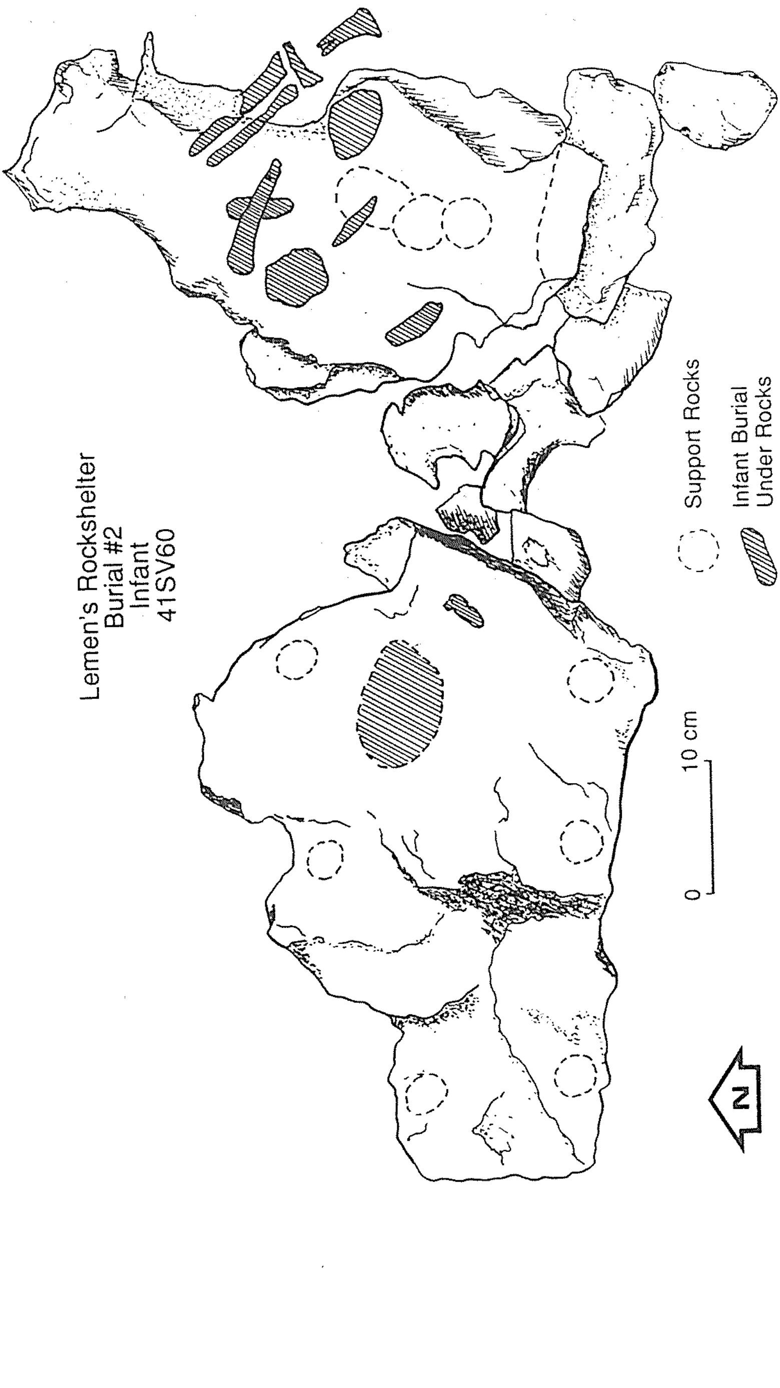

Figure 9. Burial 2 at the Lemens Rockshelter.

Lithic Cache

A cache of cores and flakes was located in level 3 of units N102W101 and N101W101 (see Figure 1). The cache consisted of nine cores and 44 flakes. The cores had been deposited in a 30 cm diameter circle with the flakes placed in two layers inside the circle. Each of the cores had one to three flakes removed, but none of these were among the ones found in the cache. The cache flakes appear to have been removed from a minimum of eight other cores that were not recovered in the shelter excavations. The cores in the cache are river cobbles of Edwards Chert.

A scraper beak had been formed on the end of one flake, and two others exhibited intentional retouch along one margin. The shallow depth of the cache suggests an association with a Toyah phase zone found in the north end of the shelter although no diagnostic artifacts were found near the cache. A complete report on this feature is in preparation by the author.

Rock Concentration

In the south end of the shelter a very large limestone rock concentration covered about six m^2. The depth of the concentration varied according to the distance to bedrock with the top exposed about 24 cm bs, and it became thicker as the floor of the shelter sloped outward. The maximum depth of the feature was 70 cm bs in unit N105N99. This unit was along the drip line of the shelter (see Figure 1), but was not excavated to bedrock due to lack of time; little cultural material was recovered.

Most of the feature volume was rock, along with one burned sandstone metate fragment in Unit N105W99 near two large upright rocks. The metate was utilized on one face and measures 12 x 9 x 4 cm in size. A single human tooth was recovered at the base of the second vertical slab.

The purpose or function of this rock concentration is unknown. It is not a natural accumulation from rock fall or washing from the top of the shelter. There is no evidence that it post-dates the aboriginal occupation of the shelter, and in fact it appears to have been placed there during the Austin Phase. (Prehistoric burials found in the Abilene area are sometimes found covered with enormous rock cairns. The cairns were so large that the excavators were convinced that they were not cultural. Further investigations were necessary to find the burials under the cairns.)

ARTIFACTS

The chipped stone artifacts recovered from Lemens were made from a source of Edwards chert that outcrops in the hills near the site and is also available in the form of river cobbles in Paluxy and Brazos river gravels. There is no indication that the raw material was heat treated. The major artifacts recovered, other than debitage, were projectile points and spall scrapers.

Arrowpoints

Perdiz

A total of nine identifiable Perdiz arrowpoints were recovered from the site (Figure 10b, j, w-x). Seven of the Perdiz were found in level 3 while the others came from levels 4 and 5 (Table 1). Many of the Perdiz arrowpoints show breakage typical of point impacts (Cox and Smith 1991). Mean Length: 24.03 mm; range:18.7-27.9 mm. Mean width: 15.33 mm; range: 13.4-17.3 mm. Mean thickness: 3.09 mm; range: 1.8-3.7 mm. Maximum stem width: 5.33 mm; range: 4.4-7.0 mm.

Scallorn

A total of 40 Scallorn arrowpoints were recovered from the site (Figure 10a, f-g, i, l, o, u, z). Of these, 34 were from levels 4 and 5. Four Scallorn were also apparently associated with the adult burial; one was in direct association (see above) while three were in the grave fill immediately above the skeleton. One specimen is made out of a well-worked gray quartzite, and the others were from Edwards chert. Many show unintentional thermal fracturing. The majority are broken in a manner consistent with impact damage. Mean Length: 26.12 mm; range: 20.8-34.6 mm. Mean width: 14.13 mm; range: 10.5-20.3 mm. Mean thickness: 3.40 mm; range: 2.5-4.1 mm. Neck width: 6.03 mm; range: 3.7-8.6 mm. Basal width: 8.37 mm; range: 6.5-11.4 mm.

Bonham

Three specimens were found in levels 2-4. All of the Bonham arrowpoints have the slightly bulbar stem characteristic of the type (Figure 10m, n, y). Mean length: 22.95 mm; range: 21.9-24.0 mm. Mean width: 12.93 mm; range: 11.7-14.0 mm. Mean thickness: 4.0 mm; range: 2.8-5.9 mm. Neck width: 5.13 mm; range: 4.5-5.9 mm. Basal width: 5.47 mm; range: 4.4-6.4 mm.

Washita

Two Washita points were recovered in levels 3 and 4 (Figure 10e). One appears to be of Edwards chert while the other is a tan chert. The latter specimen is made on a flake with portions of the flake scar remaining on the piece. Mean length: 21.8 mm; range: 19.4-24.2 mm. Mean width: 11.4 mm; range: 10.7-12.1

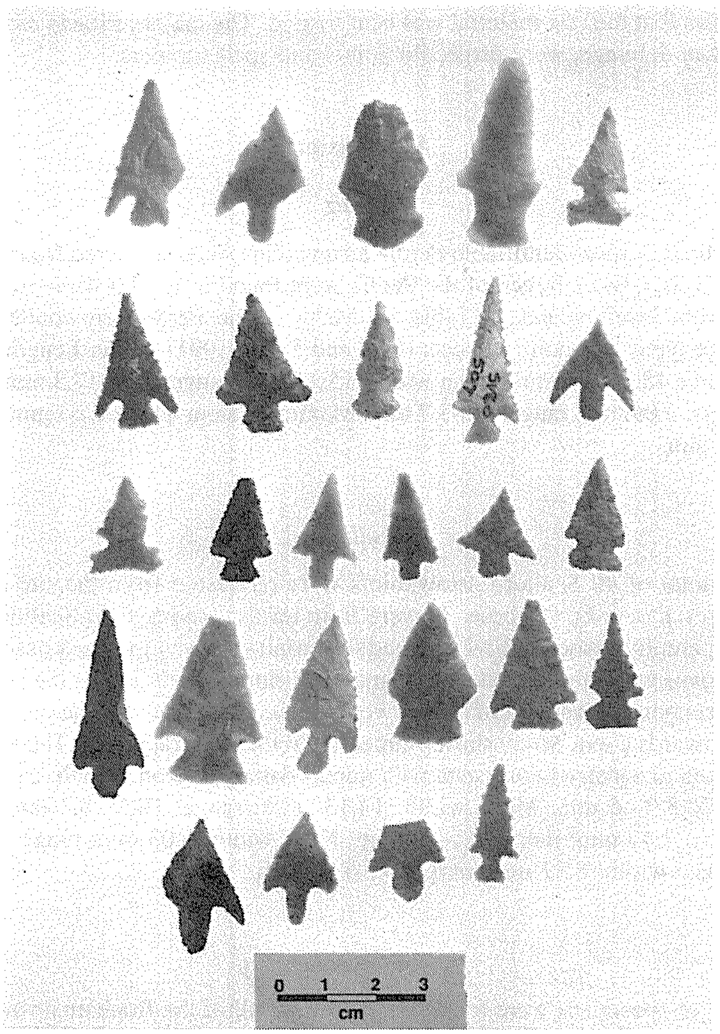

Figure 10. Projectile Points: Scallorn, a, f-g, i, l, o, u, z; Perdiz, b, j, w-x; Bonham, m-n, y; Washita, e; side-notched, h, k, v; Hayes-like, q; Asymmetrical, s; Godley, c-d; Ellis, r, t; corner-notched, p.

mm. Mean thickness: 3.45 mm; range: 3.1-3.8 mm. Neck width: 7.05 mm; range: 6.7-7.4 mm. Basal width: 14.5 mm; range: 13.6-15.4 mm.

Side-Notched

Of the eight specimens in this category, seven were very similar in morphology (Figure 10h, k, v); the eighth was possibly a Washita variant. The group of

Table 1.

Artifacts recovered from the Lemens Rockshelter.

Artifacts	Lv. 1	Lv. 2	Lv. 3	Lv. 4	Lv. 5	Lv. 6	Lv. 7	No Provenience	Burial	TOTALS
Arrowpoints										
Perdiz	-	-	7	1	1	-	-	-	-	9
Scallorn	-	-	1	17	17	1	-	-	4	40
Bonham	-	-	1	2	-	-	-	-	-	3
Washita	-	-	1	1	-	-	-	-	-	2
Side-notched	-	-	-	5	3	-	-	-	-	8
Corner-notched	-	-	1	-	-	-	-	-	-	1
Hayes-like	-	-	-	-	-	1	-	-	-	1
Asymmetrical	-	-	-	-	1	-	-	-	-	1
Miscellaneous	-	-	-	2	-	-	-	-	-	2
Broken	-	-	-	8	1	-	-	2	-	11
Arrowpoint totals	0	0	11	34	23	2	0	2	4	78
Dart Points										
Ellis	-	-	-	-	-	2	-	-	-	2
Godley	-	-	-	1	-	1	-	-	-	2

Table 1. (Continued)

Artifacts recovered from the Lemens Rockshelter.

Artifacts	Lv. 1	Lv. 2	Lv. 3	Lv. 4	Lv. 5	Lv. 6	Lv. 7	No Provenience	Burial	TOTALS
Dart Point totals	0	0	0	1	0	3	0	0	0	4
Stone Tools and Artifacts										
Preform	-	-	1	5	2	-	-	3	-	11
Biface	-	-	-	6	3	1	-	11	3	24
Scraper/Drill	-	-	-	-	-	-	-	4	-	4
Spall Scraper	1	8	37	21	67	30	3	281	-	448
Perforator	-	-	1	3	-	-	-	-	-	4
Burin	-	-	-	-	-	-	-	1	-	1
Retouched pc.	-	-	-	-	-	-	-	3	-	3
Core	-	-	-	-	-	-	-	3	-	3
Hammerstone	-	-	-	-	-	-	-	2	-	2
Metate	-	-	-	-	-	1	-	-	-	1
Ochre	-	-	-	-	-	-	-	1	-	1
Quartz crystal	-	-	-	-	-	-	-	1	-	1
Polished pebble	-	-	-	-	-	-	-	-	2	2
Debitage	7	14	137	233	361	164	79	2665	-	3680

Table 1. (Continued)

Artifacts recovered from the Lemens Rockshelter.

Artifacts	Lv. 1	Lv. 2	Lv. 3	Lv. 4	Lv. 5	Lv. 6	Lv. 7	No Provenience	Burial	TOTALS
Stone tools and artifacts totals	8	22	176	268	433	196	82	2975	5	4185
Bone/Shell Artifacts										
Fish hool	-	-	-	-	1	-	-	-	1	2
Ulna Flaker	-	-	-	-	-	-	-	2	5	7
Awl	-	-	-	-	-	-	-	-	1	1
Punch	-	-	-	-	-	-	-	-	2	2
Antler Flaker	-	-	-	-	-	-	-	-	3	3
Unidentified Bone	-	-	-	-	1	-	-	-	-	1
Mussel Shell	-	-	-	-	-	-	-	-	1	1
Bone/Shell totals	0	0	0	0	2	0	0	2	13	15

seven had triangular blades with convex edges and straight to convex bases. On six of these seven, the side-notches were shallow. The seven had notches more angled just above the corner of the piece; this may be a Scallorn variant. Mean length: 23.43 mm; range: 20.0-25.0 mm. Mean width: 10.48 mm; range: 9.4-12.3 mm. Mean thickness: 3.38 mm; range: 2.7-3.8 mm. Neck width: 6.99 mm; range: 5.4-8.0 mm. Basal width: 9.79 mm; range: 5.4-11.9 mm.

The side-notched points came from levels 4-5 (see Table 1), the same levels that produced the majority of the Scallorns, and may generally be associated with the Austin phase occupation. The side-notched point resembling a Washita arrowpoint came from level 5.

Corner-notched

This point generally resembles the side-notched points described above except that it has notches originating at the corners (Figure 10p). It is 20.9 mm in length, 11 mm in width, 3.5 mm thick, 5.5 mm in neck width, and 10.0 mm in basal width.

Hayes-like

The point is corner-notched with a bulbar to diamond shaped base and straight sides (Figure 10q). The specimen was made from a brown chert that may not be Edwards. It has been thermally altered, producing "pot lid" fractures on both faces. A color difference noted on the proximal third of the artifact may be a result of differential heating. A fracture along the lateral edge of the blade may be a result of impact. Length: 38.4 mm; Width: 5.0 mm; Thickness: 4.5 mm; Neck width: 7.3 mm; Basal width: 3.8 mm.

Asymmetrical

One point has a triangular blade, deep corner notching, and a bulbous stem. It is basically similar to the Perdiz type except for the bulbous stem. The body of the artifact is noticably curved along its central axis of symmetry when lying flat (Figure 10s). Length: 33.8 mm; Width: 5.1 mm; Thickness: 3.7 mm; Neck width: 4.2 mm; Basal width: 6.4 mm.

Miscellaneous

The first miscellaneous specimen has been deeply serrated. There are morphological resemblances to the Livermore type. Similar arrowpoint examples have been identified in local collections from the Trinque (41ER27) and Rodeo Hill sites.

The second miscellaneous arrowpoint is badly burned, but its form is similar to the previously discussed arrowpoint.

Broken

Seven distal arrowpoint fragments were found in the excavations, six of which were from level four. Two midsection arrowpoint fragments were found in level four, and of unknown provenience were two proximal sections.

Dart Points

Four dart points were recovered from the Lemens site: two of the Ellis type and two Godley points. Three of the four dart points came from level 6, and the other was found in level 4 (see Table 1).

Godley (Figure 10c-d)

Measurements: Thickness range: 5.5-6.1 mm; Length: both broken; Width range: 19.0-19.3 mm; Neck Width range: 10.6-12.5 mm; Base Width range: 13.5-14.9 mm.

Ellis (Figure 10r, t)

Measurements: Thickness: 5.5-5.7 mm; Length: 28.5-37.0 mm; Width: 22.4 mm; Neck Width: 7.4-11.0 mm; Base Width: 14.5-16.4 mm.

Preforms

Eleven small and thinned bifacial preforms of Edwards chert were recovered (see Table 1 and Figure 11d-e). Three were ovate in outline, six were triangular, and two were broken in manufacture and are unidentifiable as to form. One ovate preform came from level 3; two ovate, two triangular, and one of undetermined shape were recovered in level 4. The two preforms in level 5 were of triangular and undetermined shapes. Thickness and width measurements (in mm) are summarized below:

	Thickness Range	Thickness Average	Width Range	Width Average
Triangular	2.8-5.0	3.2	12.9-21.6	18.8
Ovate	2.5-4.3	3.4	14.0-19.9	17.1
Combined	2.4-5.0	3.3	12.9-21.6	18.2

In addition to the bifacial preforms, two unifacial preforms were recovered from unknown proveniences at the site. One had been roughly shaped to a form resembling the Cliffton type. This may be an initial attempt to form a preform for a Perdiz arrowpoint. The second unifacial preform has only the base formed by flaking while the distal portion and mid-section of the specimen were not flaked.

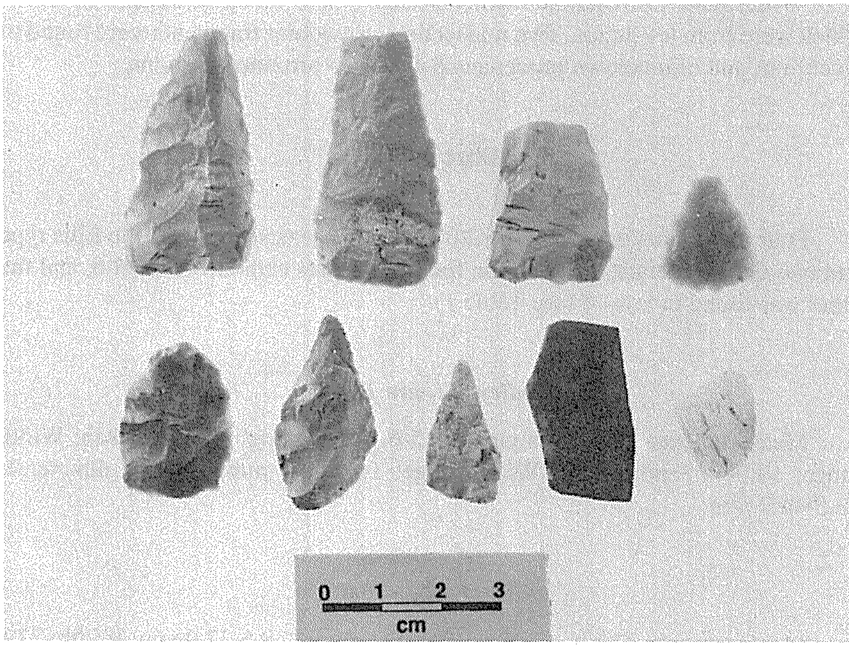

Figure 11. Lithic Artifacts: a-c, bifaces; d, triangular preform; e, ovate preform; f-g, drill/ perforator; h, ochre; i, quartz crystal.

Bifaces

A total of 24 bifacially flaked artifacts were present. These artifacts have large, deep flake scars on both faces. They do not appear to represent finished tools and are presumed to represent initial stages in lithic reduction. All of these bifaces are of Edwards Chert.

Seven are proximal fragments, three are portions of midsections and ten were represented only by distal fragments. Three of the complete bifaces came from level 4 and the fourth from level 5.

Scrapers

Four scrapers were recovered in uncontrolled excavations in the north end of the shelter. Relevant measurements for each of the specimens are: Scraper No.

1: Flake length, 20 mm; Bit length, 13 mm. Scraper No. 2: Flake length, 20 mm; Bit length, 11 mm. Scraper No. 3: Flake length, 31 mm; Bit length, 11 mm. Scraper No. 4: Flake length, 30 mm; Bit length, 13 mm.

Drills/Perforators

Four drills or perforators were recovered during the Lemens rockshelter excavations (see Figure 11f-g). One of the drills/perforators (from level 4), a tip fragment, was well flaked to form the drill bit. The other two from that level were unbroken flake drills that had minimal retouch/bifacial flaking to form the drill bit; step flaking is evident along the bit margins on both drills. The drill from level 3 was bifacially flaked to form an oval that came to a point at the drill tip. The bit shows extensive step flaking along both lateral edges. All drills/perforators are made from Edwards Chert.

Burin

One burin was found from unknown provenience. The specimen had a negative bulb of percussion along the thickest (4 mm) part of the flake, and exhibited polish (visible under low power magnification) on one of the corners.

Retouched Flakes

Three flakes in the tool assemblage were intentionally retouched. Their provenience is unknown. The retouched flakes are separated from the spall scrapers by the length of the retouching along the flake edge. The specimens were unifacially flaked with scars running 8 to 10 mm from the edge toward the spine of the flake, and flaking was uniform along the worked edge.

Cores

Three exhausted cores were recovered with unknown provenience. Two were from a local gray Edwards chert, and the third, a river cobble with red cortex, was of a dark gray Edwards chert. All exhibit multidirectional flaking and are extremely small, averaging 39 x 30 x 19 mm in size. Nine additional cores were recovered from the lithic cache (see above).

Hammerstones

Two hammerstone fragments were recovered, both of unknown provenience. One, a 50 mm diameter spall, is from a quartzite cobble. It is heavily battered and has been burned to a gray color. The second is also a spall; it is of a chert material. It measures 38 x 30 x 13 mm and has extensive edge damage from battering.

Ochre

One thin (3.2 mm) and small (30.1 x 6.9 mm) piece of smooth red ochre was recovered from the rock shelter by Don Lemens. The ochre is flat on both sides with one surface exhibiting what appears to be peck marks (see Figure 11h). No evidence of rubbing was observed on either face.

Quartz Crystal

A flat, pie-shaped quartz crystal was recovered from unknown site provenience (see Figure 11i). The fragment, with an 11 mm radius, resembles one quadrant of a circle. It is flat on both sides and 8 mm thick.

Bone Artifacts

Fish Hook

One broken fish hook (see Figure 4c) was recovered from level 4 in the shelter. The hook portion is identical to the one recovered by Mr. Lemens in possible association with the adult burial. Most of the shank is missing from the piece; it is 7 mm in maximum width.

Unidentified Bone Tool

A broken and 37.2 mm long bone tool was recovered from level 5. The tool is smoothed and shows polish over its modified surface. The tip also has some use damage. The thickness at the tip is 3.2 mm and the maximum thickness of the recovered portion is 4.2 mm. The bone is unidentifiable to element, but a natural depression in the bone may indicate that the tool was formed from a metapodial.

Ulna Flakers

Two deer ulna, one with the tip broken, were recovered from unknown provenience in the shelter. The smaller shows use modification. The tip of the larger ulna flaker is broken and consequently no modification is visible on the piece.

Debitage

Three thousand six hundred eighty pieces of discarded chipping debris (here termed debitage) were recovered from the site (Table 2). These represent the various stages of tool manufacture and maintenance that occured at the site. The following definitions were used in the analysis:

Flake	Having a bulb of percussion or force
Chip	Bulb of percussion or force missing
Primary	Cortex covering 100 percent of exterior
Secondary	Cortex covering less than 100 percent of exterior
Tertiary	No cortex remaining on flake.

Debitage classified as flakes were described using four parameters: size, platform type, lipping flake, and thermal alteration:

Size:

Measurement was taken along the major axis of the spall
Very Small: Less than 1 cm
Small: Greater than or equal to 1 cm. and less than or equal to 2 cm
Medium: Greater than 2 cm and less than or equal to 4.5 cm
Large: Greater than 4.5 cm

Platform type:

Single — Platform with a single facet
Dihedral — Platform with two facets
Multihedral — Platform with more than two facets
Ground — Platform was ground, forming a rounded margin. Any of the other platform types could also be ground.
Cortex — Natural Platform completly covered with cortex
Crushed — Remnants of the platform were present, but not enough to further categorize.

Lipped Flake:

The presence or absence of a lip containing part of the striking platform of a biface. This flake typically has a multiple faceted platform and edge grinding to prepare the striking platform.

Debitage showing no bulb of percussion are classified as chips. The only parameters recorded for this category is the sequence of removal from the parent core (Table 3) and whether the material has been thermally altered.

All flakes and chips were examined under low power (14-20X) magnification for edge damage due to use. Debitage found to have edge damage was classified as spall scrapers (following Jelks [1962]).

Table 2.

Debitage from Controlled and Uncontrolled Excavations

	Uncontrolled Excavation	Controlled Excavation
Chips	952	491
Spall Scrapers (on chips)	49	35
Total Chips	***1001***	***526***
Flakes	1213	576
Spall Scrapers	247	117
Total Flakes	***1460***	***693***
Total Debitage	2461	1219
Total Spall Scrapers	296	152

Table 3.

Sequence of Removal

				Percent	
	Primary	Secondary	Tertiary	Thermal	Lipped
Chips	86	383	1058	135	0
%	5.62	25.09	69.29	8.84	-
Flakes	96	685	1372	286	88
%	4.46	31.82	63.72	13.28	4.09

The thermal alteration category includes any form of heat alteration, whether it is intentional or not. Only 39 (2.55 percent) of the chips and 105 (4.88 percent) of the flakes may have been intentionally heat treated. Even the specimens that were classified as heat treated may only have been unintentionally subjected to heat, and thus this technology was not significantly utilized by the occupants of the Lemens shelter.

The low percentage of primary flakes suggests that the raw material being brought into the shelter had already had some preliminary reduction (See Table 3). That only three cores were recovered from the main excavation also support this suggestion.

Lipped Flakes

A total of 88 or 4.09 percent of the total flakes were classified as lipped flakes. Of these, 56, or 63.64 percent, of the lipped flakes were ground to some degree. Table 4 shows the types of platform preparation relative to the total number of lipped flakes.

Table 4.

Lipped Flake Platform Type

Single Facet	Double Facet	Multi-Facet	Ground No Facet	Total
22	6	32	28	88

Experiments have shown that lipped flakes are produced at significantly higher rates by soft-hammer percussion than by hard-hammer percussion (Watson 1982:63-64). Therefore, the relative frequency of lipped flakes may be an indicator of the use of a soft hammer in the assemblage. With only 4.09 percent of the flakes being lipped, it appears that the use of a soft hammer was not an important aspect of the lithic technology.

Table 5.

Size Of Debitage

	VERY SMALL	SMALL	MEDIUM	LARGE	Total
Flakes	168	1601	378	6	2153
%	7.80	74.36	17.56	0.28	100.00

Very few large or medium-sized flakes were noted in the debitage (Table 5). This probably indicates that the chert source was not a nearby outcropping, or that they possibly curated the larger flakes for later use.

Table 6.

Flake Platform Type

TYPE	NUMBER	PERCENTAGE
Cortex	332	15.42
Single Facet	760	35.30
Double Facet	183	8.49
Multifacet	240	11.15
Ground	173	8.04
Crushed	236	10.96
Broken	229	10.64
Total	2153	100.00

An analysis of flake platform types indicates that single facet and cortex types are most common (Table 6). In addition to the platforms that are ground to obliterate the flake scars, other platform types exhibited grinding: 1.0 percent of the single facet platforms, 13.7 percent of the double facet platforms, 24.6 percent of the multifacet platforms, and 63.6 percent of the lipped flakes. The large percentage of single facet platform flakes suggests that a flake technology was used by the shelter occupants to produce flakes for shaping into finished flake tools.

Spall Scrapers

Of the 3680 pieces of recovered debitage, 448 (12.17 percent) were found to exhibit use edge damage. With this category of tool representing the most frequent type of tool, it was thought that there may be a relationship between the main activity (or activities) that took place at the shelter and the utilized debitage. This debitage was analyzed using the criteria established by Tringham et al.

(1974) and Gallagher and Bearden (1976). As a more detailed study of this tool type is beyond the scope of this paper, the general results of the replication and functional studies are only summarized herein.

A total of 443 pieces of debitage had edges that had been utilized in some activity by the Lemens site occupants. The other five were boring tools (see Tringham et al. 1974:189, 192). Each edge was analyzed as a separate tool (Table 7).

Table 7.

Tools/Edges Analyzed

Number of	Number of Tools	Edges Edges Analyzed
One Edge	286	286
Two Edges	116	232
Three Edges	33	99
Four Edges	4	16
Five Edges	3	15
Six Edges	1	6
Total	443	654

Activities Observed in the Flake Tools

Scraping/Planing

Model: Unifacial edge damage with a short, non-scalloped bit.

A total of 365 tool edges had unifacial damage. Of these, 287 (78.7 percent) had bit lengths less than 16 mm. Tools with unifacial edges have the largest percentage of step flaking (45.8 percent) and unscalloped edges (69.9 percent). There is no dominant microflaking type although 40.8 percent of the tools had some form of small, shallow flakes.

There were 185 tools with both model attributes. Of these scraping/planing tools, 90 or 48.6 percent had single or multiple step flaking present.

Some tools had step flaking only on the bottom edge of the piece that would have been in contact with the target medium. This was a noticeable contrast to other scraping/planing tools. Although no systematic attempt was made to differentiate these tools from the other scraping/planing tools, these differences may represent contrasting activity types based on the position of the step flaking.

Sawing

Model: Bifacial edge damage with irregular, scalloped edges. Bit lengths are longer, and flake scars are larger and deeper, than scraping/planing tools.

A total of 176 tool edges have bifacial edge damage. Of these, 112 (63.6 percent) have bit lengths over 15 mm. Step flaking is not common (28.4 percent), and the tools have scalloped (48.3 percent) or even (36.4 percent) edges. Microflakes removed through sawing tend to be irregular with semi-circular flaking. Forty nine tools from Lemens have all the characteristics of the model.

Cutting

Model: Bifacial edge damage with smaller, more irregular flake scars than sawing tools.

Twenty-six of the specimens may represent cutting tools. As the model suggests, they have bifacially flaked edges, and have smaller and shallower flakes; bit lengths are over 15 mm.

Whittling

Model: Unifacial edge damage with uneven micro-flaking and frequently scalloped edges.

Fifty-three edges (8.1 percent) have characteristics of whittling. Of these, 26 had random unifacial flaking while an additional 10 had larger, deeper flakes removed from one surface.

Undefined Use

An activity not described by either Tringham et al. (1974) or Gallagher and Bearden (1976) was tools with attrition perpendicular to the flake edge. Forty specimens had this characteristic, as well as evenly flaked and small, shallow, evenly distributed edges. Another 43 tools had either one or the other of these edge attributes.

Five other small specimens (average major axis length of 15 mm) are classified as mini-spall scrapers. Two of the small scrapers have perpendicular flaking along the edge, two more are unifacially flaked, and the other has a bifacially flaked edge. These small scrapers may have been used on detail and delicate tasks.

Tools Used on Soft Material

Flakes with nibbled edges (N=59) may represent tool work on softer materials (e.g., Tringham et al. 1974:189). Some 38 (64.4 percent) of these flakes have unifacial edges. Forty-one (69.5 percent) had bit lengths under 15 mm and 53 (89.8 percent) had no step flaking. Almost 97 percent of the specimens had very small patterned microflaking.

Wood-working tools

A total of 182 of the used tool edges had convex edges possibly used in working wood. The concave edge is a by-product of tool use, in many cases, rather than an edge chosen for a particular function.

Notching saws

Eleven specimens were identified as notching saws (e.g, Sollberger 1969). These tools were not over 3 mm in thickness (along the utilized edge) and had a scalloped working edge. All of these specimens had some bifacial flaking and scalloped edges.

Notches

Sixty-four of the spall scrapers were classified as notches. They ranged from 3-29 mm in notch diameter, but they clustered at 4-7 mm with 36 (56.3 percent) of the specimens in this range. Multiple step flaking was common in the notched tools. The size of most of the notches is consistent with the diameters of arrowshafts and may represent a tool used at the final stage in finishing the shafts.

FAUNAL REMAINS

No in-depth analysis of the faunal remains from Lemens has been completed. A total of 1203 bone fragments were recovered from both the controlled and noncontrolled excavations. Of that total only 283 or 23.5 percent of the bone could be identified to vertebrate class. Animals present in the shelter include deer (N=167), turtle (N=12), small animals such as squirrel, rabbit, and racoon (N=60), and an assortment (N=44) of turkey, as well as small and large birds (including a heron). Two fragments are large and thick enough to be bison, but absolute species identification was not possible.

A total of 497 (41.3 percent) of the faunal assemblege was burned. During the controlled excavations, one area (Unit N106W99, level 3) exhibited a significantly higher amount of burned faunal material than other parts of the site. Intra-site activity areas may have been isolated if all the units had been excavated in a controlled manner, but under the circumstances it was impossible to identify these activity areas.

SHELL

Land snail shells were present in large numbers throughout the shelter deposits. Representative examples were collected but no absolute shell counts were made. *Rabdotus alternatus* was the most frequent land snail. *Polygyra texasiana* was also present, but not in large quantities, nor was it as widely distributed as the *Rabdotus*.

Freshwater mussel shell was saved only from the controlled excavations. Fifteen fragments were recovered, but as previously mentioned, the only two complete halves were found in association with the burials.

DISCUSSION AND INTER-SITE COMPARISONS

Site Typology and Settlement Patterns

Site typology and settlement pattern studies for the Brazos River area of Central Texas have been discussed by Skinner (1971; Gallagher and Bearden 1976:82-107), and Henry et al. (1980:512-520). Their characterization of site types is pertinent to determining the place of the Lemens rockshelter in regional settlement systems.

Skinner (1971:265) suggests that sites in the DeCordova Bend Reservoir (now Lake Granbury) project fit a "central-based wanderer" model. In this model there are three site types: a multi-seasonal base camp, special activity lithic procurement/chipping stations, and temporary hunting/gathering sites used by nuclear or extended families.

Skinner's (1971) chipping stations (such as the Pirate site) were located on the limestone bluffs where chert was available. Gravers, notches, and utilized flakes were the only common chipped stone tools (Table 8).

Seasonal hunting/gathering camps were situated along the intermittent tributaries of the Brazos River where game, plant foods, and freshwater mussels were seasonally available. Chipped stone tools other than utilized flakes were found in low percentages. Analysis of the lithic debris indicates that initially-flaked materials were brought to the site for further reduction (Skinner 1971:161). Skinner (1971:265) also suggests that rockshelters in the Whitney Reservoir were utilized as seasonal hunting/gathering camps.

Table 8.

Percentages of Chipped Stone Tools from Selected Central Texas Sites

SITE	TYPE (M^2)	AREA	SCRAPER	BIFACE	PP	UTIL	NOTCH	OTHER
Base Camps								
Blum	RS	146	3.7	10.3	60.1	20.5	-	5.5
Buzzard	RS	275	9.8	8.8	48.3	27.3	-	5.9
Kyle	RS	336	1.0	15.5	36.3	45.9	-	1.3
Pictograph	RS	104	5.5	10.8	47.4	30.4	-	5.9
Sheep	RS	456	8.4	8.0	39.4	42.6	-	1.6
Lowden	OP	2000	3.3	23.3	5.0	65.8	-	2.5
Bowling Pin	OP	2000	3.8	18.1	25.2	44.3	-	8.3
Indian Springs	OP	2300	3.2	30.3	18.1	47.0	-	1.6
Circulating Primary Unit Sites								
Five Goat	RS	32	2.6	29.7	35.3	24.9	5.3	2.2
L. E. Robertson	RS	210	1.4	29.9	23.9	31.8	8.8	4.2
Stone	RS	65	2.9	27.1	25.6	31.6	7.9	4.9
Windy	RS	225	1.2	30.9	31.5	29.0	5.1	2.3
Dam	OP	375	2.5	14.2	16.3	49.8	13.4	3.8

Table 8. (Continued)

Percentages of Chipped Stone Tools from Selected Central Texas Sites

SITE	TYPE (M^2)	AREA	SCRAPER	BIFACE	PP	UTIL	NOTCH	OTHER
Temporary Usage Sites								
Bear Creek	RS	525	2.1	11.5	24.7	59.9	0.5	1.4
Pirate	OP	1000	0.9	8.6	1.0	72.0	13.2	4.4
Bluebonnet	OP	2000	0.4	20.0	6.3	72.1	0.4	0.8
Aiken	OP	200	-	29.0	14.8	54.0	-	2.3
LEMENS	RS	40	0.6	5.5	12.6	68.8	9.9	2.6

RS = Rockshelter; OP = Open Site; PP = Projectile Point; UTIL = Utilized Flakes

Base camps such as Lowden were located on alluvial terraces of major streams and rivers. Grinding tools and projectile points are thought to be common, although the projectile point frequency is rather low from the Lowden site (see Table 8).

For our purposes, some of the best comparative data within the Lake Whitney reservoir comes from the Bear Creek Rockshelter (Lynott 1978). The shelter is located on a tributary to the Brazos River, and Lynott suggests it was a temporary habitation site for small groups. The primary activity in the shelter was tool manufacturing as well as hunting and animal food processing (Lynott 1978:97).

Henry et al. (1980:516-519) indicate the "central-based wanderer" model does not fit the types of sites found near Waco in the Hog Creek valley. They propose a "dispersed mode circulating model." In their model, there are no base camps used by large numbers of people during the yearly cycle. Rather, there are primary unit camps that exploit the resources of the valley on a year-round basis.

Rockshelters are proposed as the primary unit camps for small groups of people in the Hog Creek area, including Five Goat Shelter, Stone Rockshelter, Windy Shelter, and L. E. Robertson. Windy Shelter has a northern exposure, and may not have been utilized during the winter months. The inference that rockshelters were primary encampments is based on their tool diversity, which are dominated by bifaces, utilized pieces, and projectile points (see Table 8). Groundstone artifacts, an abundance of faunal remains, and burials also indicate that a variety of activities occurred in the shelters. The initial reduction of lithic raw materials was not conducted at the Hog Creek rockshelters.

Open sites in the Hog Creek valley, such as the Dam site, are quite similar to the rockshelters in tools, and are thus also suggested to be primary unit camps for perhaps nuclear or extended families (Henry et al. 1980). Scrapers, denticulates, notches, and utilized pieces are common at both kinds of sites, but bifaces and projectile points are not as frequent. Analysis of the lithic debris seems to indicate that initial stages of tool reduction were carried out more often in open sites than in the rockshelters (Henry et al. 1980:507).

Gallagher and Bearden (1976:90-94) note problems of intersite comparisons using Skinner's (1971) model within an overall discussion of the difficulty in Central Texas site typology assignments. They suggest that the central-based wandering model is too rigid since it views the DeCordova Bend Reservoir unrealistically as a self-contained unit. A more pervasive problem noted by Gallagher and Bearden (1976) is that of site chronology. Whether sites were actually contemporaneous, and part of a behaviorally meaningful settlement system, was not attempted; rather, contemporaneity was simply assumed to be the case.

Noting significant differences between Whitney Reservoir sites in tool assemblages, Gallagher and Bearden (1976) also question the validity of lumping sites into categories such as short-term or base camp sites. In their opinion, too many variables are poorly controlled to adequately and fully evaluate the data for settlement pattern studies. They conclude that:

> [t]he definition of total site size, total area of the site excavated, density of the various morphological artifact types, total faunal assemblages and vertical distribution of the various types . . . need to be reported before a morphology of sites can be produced.

Artifact Assemblages and Site Characterization

While recognizing the difficulty in identifying site types and settlement patterns from rather limited sets of archeological data, some examination of lithic tool assemblages for Central Texas sites by possible "site types" is warranted since diachronic tool kit changes have been found to be site-specific in some cases; activity variation within sites seems to have also played a more important role in determining tool-kit variability than did environmental change through time (e.g., Henry et al. 1980:507). Henry et al. (1980:507-509) also noted a strong correlation between site tool-kit variation and the fauna present in some of the Hog Creek shelters.

Based on Skinner (1971), Lynott (1978), and Henry et al. (1980), a base camp would serve a large group of people, possibly on a year-round basis. Those kinds of sites would show that a wide range of activities occurred there. A circulating primary unit site would be a seasonal base camp for smaller, perhaps extended, family groups. They should also evidence a wide range of activities, but be distinguished from a more permanent encampment only by the presence/absence of certain features, seasonal activities, or by the density of artifactual remains. A temporary site, primarily used for hunting/gathering, or lithic procurement, would not have had a wide range of activities. In addition, the frequency in which some activities that would have occurred in both temporary and permanent camps would be significantly different. For example, if working arrowshafts was a major activity in a temporary site, the percentage of woodworking tools would be higher than in a base camp that had a wider assortment of activities.

The Late Prehistoric tool assemblage data from the above-mentioned sites were selected for comparison. Three predominantly Late Archaic sites were also included because of their suggested use as either base camps or temporary use sites: Aiken, Bluebonnet, and Indian Springs. In each of the site assemblages, scrapers, bifaces, projectile points, edge-utilized flakes, and notches comprise over 91 percent of the flaked tools (see Table 8), and are considered the major tool groups. The remaining tools consist of burins, drills, perforators, gravers, etc., and are grouped in the "other" category.

The most noticeable difference in these data is in the frequency of utilized flakes compared to the remainder of the stone tool assemblage(s). Possible temporary sites have high utilized flake frequencies (over 64 percent) (Figure

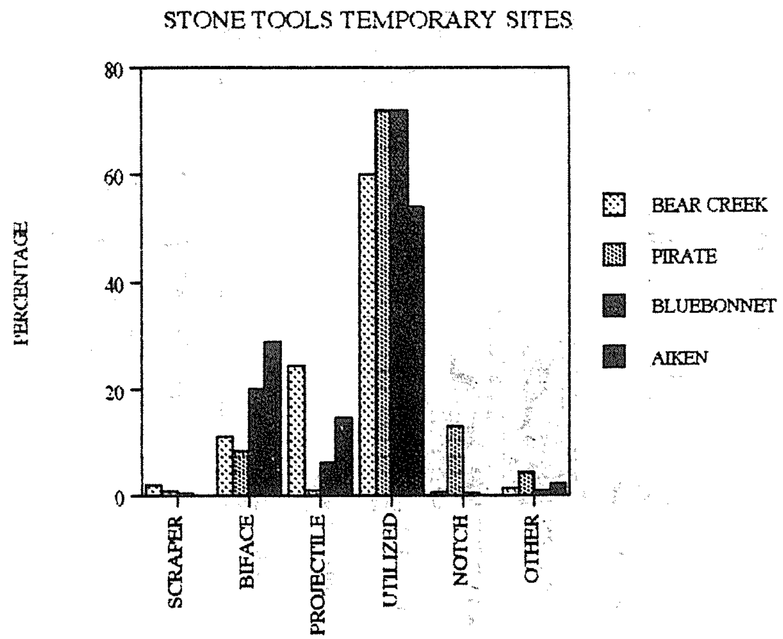

Figure 12. Stone Tool percentages from temporary sites.

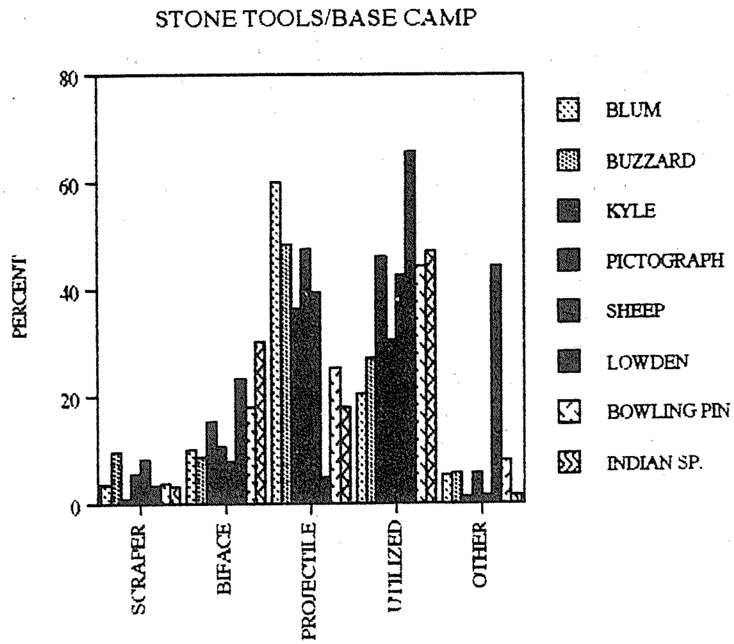

Figure 13. Stone Tool percentages from base camps.

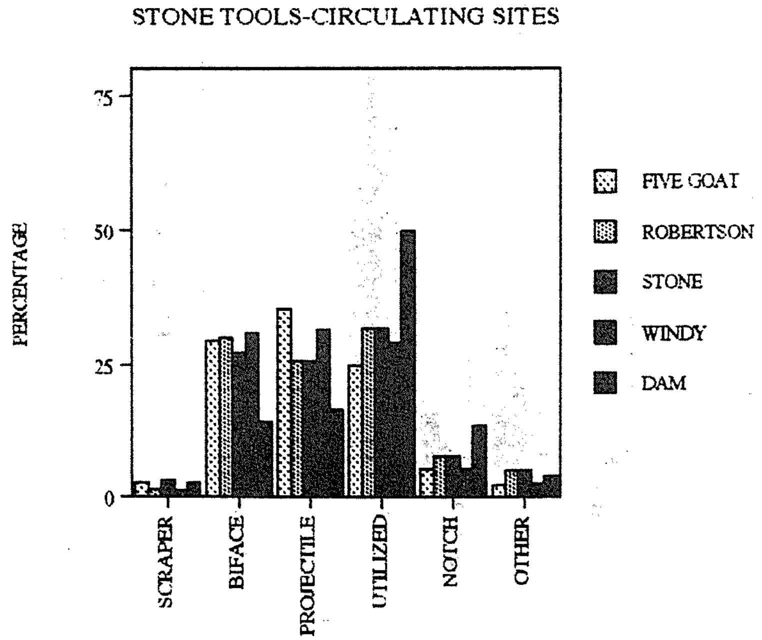

Figure 14. Stone Tool percentages from circulating sites.

12). Aiken, an Archaic site, had the lowest percentage (53.98 percent). Base camps and circulating primary unit sites generally had utilized flake frequencies between 25-46 percent; Lowden was the exception with 65.8 percent of its tool assemblage consisting of flakes (Figure 13 and 14). The Lemens rockshelter tool data is similar to temporary use sites (see Table 8).

Another significant difference between the sites is in projectile point frequency. Projectile points are rather scarce in possible temporary sites, generally representing less than 15 percent of the flaked tool assemblage; Bear Creek is an exception with a projectile point frequency of 24.7 percent. Sites suggested to be base camps had projectile point frequencies averaging about 31 percent, with Lowden and Indian Springs having much lower percentages (see Table 8). Circulating sites from Hog Creek fell between these two groups, with projectile point frequencies of about 26 percent of the overall assemblage. Significantly, Lemens had a projectile point frequency of 11.99 percent.

The third tool category that is notably different between these site groups is the scraper. Temporary sites have scraper frequencies of 0.83 percent; Bear Creek is the exception with 2.05 percent scrapers in its tool assemblage (see Table 8). Sites suggested to be base camps, on the other hand, had scraper frequencies ranging between 0.95-9.77 percent. Circulating primary unit sites have frequencies ranging from 1.23 percent at Windy Shelter to 2.91 percent at

Stone Shelter (see Figure 14). Scraping tools at Lemens accounted for only 0.6 percent of the tools.

The frequency of bifaces does not clearly correlate with the site type groupings, although circulating sites generally have a higher percentage of bifaces (and biface thinning flakes) than either temporary or base camps. The frequency of bifaces may not be an accurate indication of either the temporary or more permanent nature of sites, but more closely reflects an expedient activity that was important at specific sites. Only 3.7 percent of the tools at Lemens were bifaces.

Table 9 depicts pottery frequencies, as well as the ratio of cores to debitage and groundstone to chipped stone tools from rockshelter assemblages. The presence of pottery, and the higher numbers of grinding implements, is a noticeable difference between Late Prehistoric base camps and temporary sites. Of the possible temporary use sites, only Bear Creek had pottery sherds. All five of

Table 9.

Pottery, Core:Debitage ratios, and Groundstone:tool ratios from Rockshelter Sites

SITE	POTTERY	CORE:DEBITAGE	GROUNDSTONE:TOOLS
Base Camps			
Blum	88	N/A	1:18
Buzzard	39	N/A	1:82
Kyle	49	N/A	1:70
Pictograph	15	N/A	1:15
Sheep	39	N/A	1:50
Circulating Primary Unit Sites			
Five Goat	-	1:228	1:136
L. E. Robertson	10	1:91	1:106
Stone	6	1:208	1:112
Windy	-	1:375	1:27
Temporary Usage Sites			
Bear Creek	3	1:358	1:584
LEMENS	-	1:1840	1:642

the suggested rockshelter base camps had pottery sherds in some quantity. Possible base camps also have groundstone:lithic tool ratios of 1:82 or less. The temporary sites, however, have very high groundstone:lithic tool ratios, while the circulating primary unit sites have intermediate ratios ranging between 1:27 and 1:136. At Lemens, the groundstone:lithic tool ratio is 1:642 (see Table 9).

Use of Rockshelters

Several rockshelter sites have been excavated within 50 miles of Lemens that contain Toyah and Austin phase cultural materials. Comparisons of the recovered materials from these sites may also provide a better contextual understanding of the nature of the occupations at the Lemens rockshelter.

In the Lake Whitney area, Jelks (1953:189-207, 1962) reported on excavations at the Blum and Kyle rockshelters. Stephenson (1970) reported on the Sheep, Pictograph, and Buzzard shelters at the same reservoir.

Pictograph Shelter had a living area of approximately 100 m^2. Fourteen hearths, 3 slab-lined cists, 2 burials, wall pictographs, corn cobs, and perishable materials were documented in the excavations. In addition to lithic tools and debris, pottery, grinding implements, and a large quantity of bone tools were recovered. Due to the wide range of features and activities represented at the site, I suggest that Pictograph Shelter was occupied as a semi-permanent base camp.

Kyle had a living area of approximately 330 m^2. Numerous features (17 hearths, 1 firepit, 2 mat/wood features, and 3 burials), perishable materials, and 11 painted pebbles were recovered in the excavations (Jelks 1962). The Blum Rockshelter had a living area of approximately 150 m^2. Jelks (1953) reported numerous ash lenses, piles of fire-cracked limestone rocks, masses of charcoal, and concentrations of snails and mussel shell; no formal hearths were identified. Sheep Shelter deposits had 3 hearths, 2 slab-lined cists, and 5 burials in the 450 m^2 living area. Buzzard Shelter, with a living area of approximately 275 m^2, had four features: 3 hearths and 1 work area. The artifacts from each of these four sites are similar to the asssemblage from Pictograph Shelter, and they are also thought to represent semi-permanent base camps.

Other than burials, the Hog Creek shelter deposits contained no obvious features other than burned areas with charcoal and ash (from Five Goat, Windy, and L. E. Robertson shelters) (Henry et al. 1980). These shelters were also small compared to those discussed from Lake Whitney, with areas of occupation ranging from 32-225 m^2 (mean = 133 m^2, sd = 94 m^2), with Windy Shelter the largest occupied shelter.

The noticeable absence of pottery in the Lemens site assemblage (see Table 9) may be the result of either a short occupation during Toyah times, or perhaps it is due to the lack of contact and trade with the ceramic-producing Caddoan groups of East Texas. Also of interest is the presence of fishhooks or fishhook blanks in several of these sites. Forrester (1985) reports the presence of a fishhook at the Horn Shelter. Other than Lemens, these sites are all on or near the Brazos River.

Age of the Deposit

Prewitt (1985:Table 1) lists uncorrected radiocarbon dates for the Austin and Toyah phases. The range of dates for the Toyah Phase falls between A.D. 1180 ± 100 and A.D. 1560 ± 130. For the Austin Phase—the major occupation period for the Lemens site—the dates fall between A.D. 560 ± 150 and A.D. 1000 ± 50. Prewitt (1985:227) illustrates a southward progression in the dates of both the Austin and Toyah phases with the Austin Phase shifting to the south as the Toyah Phase encroaches in the north.

The last part of the Archaic period is the Driftwood phase. Prewitt (1981:82) reports relevant dates of A.D. 570 ± 100 to A.D. 610 ± 60 from the Bear Creek Shelter. These dates overlap the beginning dates for the Austin Phase of the Late Prehistoric period. No diagnostic cultural material from this phase was found at Lemens, although the Godley and Ellis points found in the shelter may represent a Transitional Archaic period occupation that corresponds in time to the Driftwood Phase. These points are often found associated with Darl points, the diagnostic points for the Driftwood Phase (Forrester 1964:Figure 6; Stephenson 1970:136).

Burial Treatment

Of the 20 burials found in the above rockshelter sites, seven or possibly eight of them date to the Austin Phase. Two others dates to the Toyah Phase, and the others may be both Late Archaic and Late Prehistoric in age. None of these burials were covered by rock cairns.

At Kyle, one of the burials was a Toyah phase cremation wrapped in a mat and possibly covered with a single limestone slab. One semi-flexed adult and one flexed child burial were found in an Austin phase context. The adult was covered with burned rock, but no mention was made of a rock covering on the child; no grave goods were associated with any of the burials.

One infant burial at Little Buzzard Shelter had an associated bone awl, and a child burial had Scallorn and Fresno points (Long 1961). Sheep Shelter had five burials with six individuals. One semi-flexed adolescent burial probably dated to the Toyah phase. The four remaining burials (flexed and semi-flexed) were from an Austin phase context, and included one adult, two child, and one adult/adolescent burials. They had no grave goods.

Two burials were recovered in a mixed Austin-Toyah phase stratum at Pictograph Shelter. One flexed child was buried in the pit of a hearth and covered with the surrounding matrix while the other burial was scattered; none had any grave goods.

The Bear Creek Shelter (Lynott 1978) excavations reported one Late Archaic burial. It had no grave goods or associated stone covering.

One Austin phase burial was found at the Greenwade Shelter, also on Lake Whitney. No stones were used for covering, but an atlatl hook may have been associated with the burial (Stephenson 1970:263-264).

In the Hog Creek Valley, three burials, containing six individuals, were interred in a similar manner to those at Lemens. All, however, date to the Late Archaic period. The L. E. Robertson Shelter had a single adult burial covered with limestone slabs, and a chert core was resting on the rib cage. Five Goat Shelter had three burials, although only one was professionally excavated. It was a secondary burial of an adult that was covered with a cairn of limestone slabs. Bones from at least four individuals were recovered in a multiple secondary burial in the Stone Rockshelter. The bodies were placed against a natural shelf and covered with pieces of limestone; no artifacts were found in association with the burial.

Forrester (n.d.) also reports four burials from the Horn Shelter, one of which was an 18 month old infant placed in a box-like crypt of rocks open at the west end. The burial dates to the Toyah zone at the shelter and had a shell animal effigy pendant as a burial offering. A Late Archaic adult burial in the shelter was covered with two limestone slabs, and had no offerings. The third and fourth burials were infants; the latter, a Late Archaic burial, had a bone awl as a possible association.

Immediately to the west of the Lemens Rockshelter, an infant burial at the Trinque site had been covered with limestone slabs (Cloud and Smith 1993). No artifacts were associated with the burial; however, its stratigraphic position suggests that it dates from the end of the Late Archaic period to the beginning of the Late Prehistoric period (Cloud and Smith 1993:316).

This summary suggests that covering burials with limestone cairns or slabs is most common in Late Archaic to Toyah phase burials to the south of Lemens. From the burials closest to Lemens in the Lake Whitney area, only those at the Kyle site had any type of stone coverings and those were not described as massive as the cairns from Lemens.

Turning to sites to the west, in the Abilene area, there are prehistoric mortuary practices reported that are similar to the burial treatment at Lemens. Little work has been done in the Abilene area since Cyrus Ray published his findings during the 1930s and 1940s in the *Bulletin of the Texas Archeological and Paleontological Society*. Of the 65 burials or so reported to have been excavated by Ray, 50 were placed in slab-lined, box-like structures. Ray (1939:226) states that he had found stone slab cist mounds 175 miles east to west and 60 miles south to north centering on Abilene.

Ray (1931:76) describes such stone graves as oval or circular structures with an enclosure of vertically set flat stones with the center filled with flat rocks. The burial rested under one of the flat rocks, forming a box-like, stone lined cist.

These stone cists were not simply rock cairns. Others excavated by Ray included eight burials covered by rocks, but the rocks did not include vertical slabs forming a cist. Such burial treatment is similar to the adult burial at Lemens. Other burials are reported in the Abilene area that had no associated stones.

Little evidence was recorded about the time period of the burials that can be used today. Cyrus Ray was more interested in the antiquity of the skeletons than in the artifact assemblages associated with them. He believed changes in morphological shape represented evidence for evolutionary change; consequently, most of his articles on Abilene area burials simply described the skeletons, with little space or illustrations devoted to detailed descriptions of the artifacts or their context.

Ray (1933:Plate 8, 1936:Plate 1, and 1939:Plate 5) illustrates projectile points found associated with three stone cist burials he identifies as part of a "Sand Dune Culture." The illustrated points include Perdiz, Scallorn, Fresno, and Garza types, as well as the Moran type. The Moran type, defined by R.E. Forrester (1987:131-136), dates in part to the Austin Phase since it is found in association with the Scallorn point in two burials. At least three other stone cist burials are reported by Ray to have contained serrated points similar to the Moran or Scallorn types. Ray (1929:12) also states that the "Sand Dune Culture" is a pre-pottery complex. The occurrence of Scallorn arrowpoints in these burials suggests then that they may have been contemporaneous with at least a part of the Austin Phase.

It is worthwhile to examine the grave offerings associated with the burials from this area. Of the nine burials reported by Ray to have had grave goods, only two contained large quantities of such items. The majority of the burials contained isolated offerings of awls, beads, or more commonly, complete freshwater mussel shells. Projectile points were sometimes associated with burials, but they may not have been intended as offerings since the descriptions given by Ray were not always clear on matters of context.

The first of the two major grave offerings reported by Ray (1933:14-17) was found at the Hollis Roberts Mound Complex (Mound 1) on the Clear Fork of the Brazos River in Jones County. The burial consisted of a woman and a child that were found in a typical stone slab structure. With these two individuals was a tool kit very similar to that recovered from the Lemens adult burial. It consisted of 15 items, including five large mussel shells, three antler tine flakers, three deer ulna flakers, one bone awl, one used quartzite stone, one crude side scraper, and one thin unidentified chert projectile point.

A total of 19 burials were reported by Ray (1937:194) from the four rock mounds on the Roberts property. Each was enclosed in a separate slab-lined cist. At least three other burials from the site were reported to have had isolated grave offerings.

The second major concentration of grave goods reported by Ray (1936:9-16) was found on the E.W. Douthit ranch in Mitchell County. The burial was a child cremation. It was discovered under a rock cairn of tightly wedged large flat rocks. Ray (1936:11) notes that the cremation was placed in a circular hole (three feet in diameter) that had been cut one foot into the underlying bedrock. The grave goods (Ray 1937:Plate 1) consisted of a large gray stone pendant, a small shell pendant, one stone gorget, one stone ring, two half-moon shaped serrated stones (lunate stones?), four oval stone pendants, several polished bird bone beads, a great number of polished quartz pebbles (suggested to be rattlestones), and three unidentified projectile points. The points were described as larger than arrowpoints, and thus may have been Late Archaic forms.

Forrester (1951:132-143) describes a cemetery site in Shackelford County that contained one burial marked by vertical flat slabs similar to those described by Ray. This burial (Forrester 1951:138) contained five associated items: two complete freshwater mussel shells, two deer ulna tools, and a snake skeleton without the skull. In a second burial at that site, Forrester (1951:137-138 and Figure 5) notes a grave offering of seven items bundled in a compact mass. In the mass were one antler tine, three deer split radii, one unfinished awl, one polished deer radius awl, and one deer ulna flaker. A broken Moran projectile point was also found associated with the burial.

Hughes (1942:48) reports one flexed burial placed in a stone box-like structure at the Harrell site. The structure consisted of upright stones on three sides with a layer of stones on the top. This burial was one of 32 individuals found in the site's cemetery. Some of these burials had Scallorn points associated with them in ways that would indicate they were the cause of death. Overall, very few burial offerings were placed with the burials, and these include isolated mussel shells, bone beads, chert tools, and a bone hairpin.

SUMMARY

The Lemens shelter was probably occupied on a short-term basis as a campsite. The size of the shelter and the distance from a major water source would support this suggestion. The large cairn in the southern part of the shelter would have further reduced the usable interior space. No intact hearth areas were found in the shelter that would indicate a more sustained use of the site. The large shelter complex at the nearby Panther Cave (41SV105) may have been the base camp location.

The number of projectile points and spall scrapers in the artifact assemblage suggests that the principal activity was the working of wood (utilizing flakes and notches) for such items as bows and arrow shafts; rehafting of shafts also likely occurred. Lithic procurement or bifacial tool production were minor activities at Lemens. Taken together, all these activities in turn suggest that the shelter may have been used mainly as a temporary hunting camp.

The primary occupation of the Lemens shelter occurred during the Austin Phase— sometime between ca. A.D. 600 and A.D. 1050. Material evidence from the site also indicates that it was utilized during the Toyah Phase; this phase probably ended ca. A.D. 1400 A.D. in the area. Whether the shelter was utilized prior to the Austin Phase is uncertain.

While it is common to find burials covered with rock cairns throughout the western part of Texas, the specific method of cairn burial at Lemens is not common. Considerable manpower was required to bring the rocks to the shelter, while other burials in this area do not have massive rock coverings nor a large amount of offerings. The care taken by constructing a cist to protect the infant remains from being crushed is much the same as burial treatments found to the west in the Abilene area. Grave offerings of a similar nature are also seen in some of these same area burials. It is unknown whether the grave offerings for the Lemens adult burial indicate that this individual was a person of stature. Future investigations at sites such as Lemens should add to the corpus of information known about the Austin Phase.

APPENDIX A

A BRIEF ANALYSIS OF SKELETAL MATERIAL FROM LEMENS ROCKSHELTER, SOMERVELL COUNTY, TEXAS

Patricia M. Landau and Gail A. Colby

The analyzed material from Lemens Rockshelter consisted of two individuals: an adult male 35-45 years of age, and a subadult 3-5 years of age but of indeterminate sex. Although preservation of the recovered skeletal material is relatively good, some of the bones are broken and fragmentary, and evidence of rodent gnawing is noted, particularly on the long bones and the clavicles of the adult.

Parts of each individual are represented by only a few elements (a complete inventory of identified elements is on file at the Department of Anthropology, Texas A&M University). For example, much of the subadult material was not preserved; the vertebral column and most of the cranium is represented only by fragments. The viscerocranium of the adult was very fragmentary and fragile; due to the substantial deterioration that occurred in this area prior to excavation, most of the facial region is represented only by fragmentary bone.

GENDER, AGE, AND STATURE ASSESSMENT

Adult male

The adult is determined to be male by the inverted triangular shape of the pubic body and the contribution of the greater sciatic notch (Steele and Bramblett 1988). Using the McKern and Stewart (1957) and Suchey et al. (1988) methods, the adult male individual was determined to be 35 to 45 years old at death. Since none of the femora or tibiae are complete, the stature of the adult was determined by using measurements of segments of the left femur to estimate the length of the complete femur (Steele 1970). In turn, the estimated length of the complete femur was used to estimate the adult stature of the individual (Steele and Bramblett 1988, after Trotter 1970). The estimated stature of this individual is 160.3-172.49 cm.

Subadult

The age of the subadult was determined to be 3 to 5 years old from the state of its dental development and eruption (Ubelaker 1978). It was not possible to determine the gender or the stature of the subadult individual.

DISORDERS

Adult Male

Some elements of each hand of the adult are present, although neither hand is completely represented by all skeletal elements. No obvious difference exists between the minimum circumference of the diaphyses of the left and right humerii, radii, and ulnae that might indicate the preferential use of one hand or the other. However, the deltoid tuberosity of the right humerus is more marked than that of the left; while this may indicate that the individual was right handed, it certainly demonstrates that the right arm of the individual was probably not impaired. There is no evidence of traumatic injury to the arms or hands. Additionally, carpals from both left and right hands were recovered, indicating that this individual did not suffer premortem loss of either hand.

Arthritic lipping on the right side of the superior surface of the first sacral body is marked, and the median sacral crest exhibits a slight curvature to the right. Marked arthritic growth in the lumbar region of the vertebral column is consistent with normal degenerative changes.

The right iliac fossa exhibits hyperplastic bone growth that may be the result of the evulsion of the iliacus muscle, which originates in this region. Additional bone growth along the right pectineal line is also probably associated with this injury.

Indications of a periosteal infection are present on one intermediate phalange and the right clavicle of the individual.

Moderate wear is present on all of the mandibular molars. There is evidence of moderate periodontal disease on the mandible; additionally, small fenestrae are present in the alveoli for RM_1, LI_1, and LI_2. There is no evidence of caries on the mandibular dentition. The maxilla also exhibits evidence of periodontal disease, and wear is slightly more pronounced. A carie and a fenestra are visible in the alveolus of LM^1. A large carie is present on the RM^1 and the adjacent RM^2; a very large abscess can be observed in the vicinity of these teeth in the right maxilla.

Subadult

No evidence of any disorders were present on the subadult.

ACKNOWLEDGMENTS

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Special thanks go to Don Lemens for notifying the OSA, and for later assisting in the controlled excavations at the site. Thanks also go to the landowner, O.Z. Lemens and his family. Without their cooperation, much information from the site would have been lost.

Several individuals assisted in the excavations and lithic analyses. These include Laurie and Julia Moseley, Bill and Jean Parnell, Jerry and Deana Grubis, Lorna, Jamey, and Eric Smith, and Jan Pitcock. Thanks also to Sallie Taylor, who produced the drawings of the burials and assisted in the field work.

Dr. Harry Shafer arranged for the analysis of the burials by Dr. Gentry Steele and his staff at Texas A&M University. Patricia Landau and Gail Colby conducted the physical anthropological analyses. The faunal material was identified by Bill McClure. Thanks also go to Larry Banks, who examined the lithic materials and supplied needed information on lithic raw material sources.

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The Galena Sites (41HR61-41HR70): A Late Archaic to Late Prehistoric Complex in Harris County, Texas

E. Raymond Ring, Jr.

ABSTRACT

The Galena sites on the upper Texas coast were occupied from the Late Archaic into the Late Prehistoric period, with major use in the Clear Lake Period (ca. A.D. 100-425). These sites were explored over thirty years ago, but are officially reported now in order to preserve for posterity their interesting archeological record.

INTRODUCTION AND BACKGROUND

This report presents a summary of the archeological findings at the Galena shell midden (41HR61) and nine adjacent campsites (41HR62-41HR70) located near the mouth of Hunting Bayou in the incorporated city of Galena Park, Harris County, Texas. This is approximately ten miles east of the central downtown Houston business district (Figure 1).

The shell midden was discovered in 1956 by a 12-year old boy, Millard M. Smith, Jr. and his friends. They found several chert dart points and numerous pottery sherds in a small erosional gully at the site. These youngsters kept the site location secret until knowledge of it leaked into a Houston newspaper in the latter part of 1957. The boys obligingly showed the author the midden and also a small collection of artifacts derived from the site. Because of the author's interest in investigating the site further, the site owner (the Houston Port Commission) and leasee (Mr. Troy Allison) were contacted; they graciously permitted the excavations to be conducted.

It was feared that the Houston newspaper story might attract site looters. Also, the small erosional gully, however narrow, had cut rather deeply into and below the important shell layer and was destined, ultimately, to dump the entire midden down a sharp embankment into a freshwater pond 5.5 meters below it (Figure 2). These two factors weighed heavily in the author's decision to excavate the shell midden.

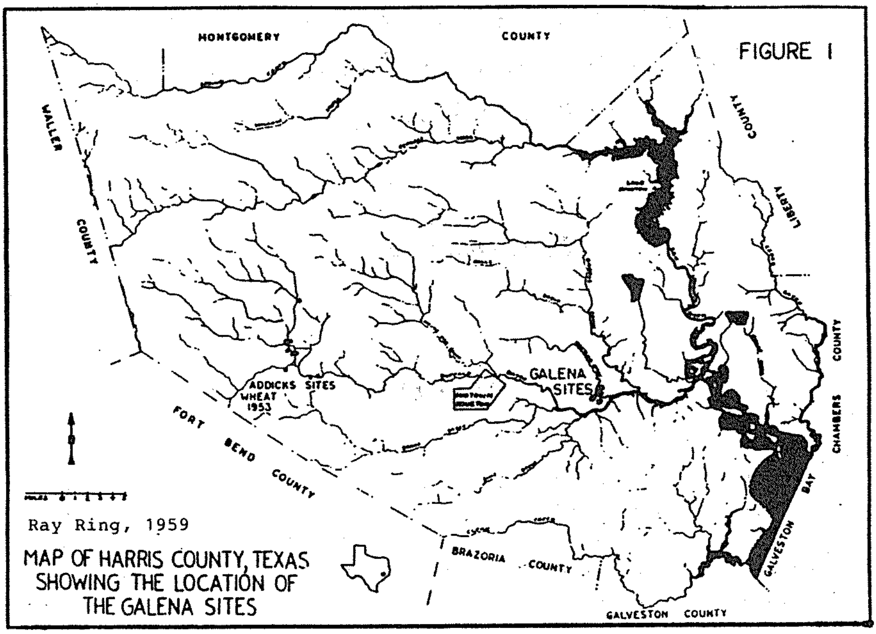


Figure 1. Map of Harris County, Texas, showing the location of the Galena sites.

The shell midden excavation and a full preliminary report were completed in December 1958 (Ring 1958) with a copy being presented to the Department of Anthropology, University of Texas, Austin. The author later returned to the site with a Brunton compass and tape to recheck certain data, and detected a small, barely discernible rise some 150 meters northeast of the midden.

A shovel test brought up a Goose Creek sherd, and a four square foot (1.2 square meter) test pit identified Galena campsite "A" (41HR62). Ultimately a total of eight other sites were discovered ca. 107-350 meters from the shell midden (see Figure 2), and these were explored by 27 test pits. The testing of the nine Galena campsites was completed in early 1959, with a separate report of these investigations also presented to the University of Texas in February 1959 (Ring 1959). In June 1959, Humble Oil and Refining Co. completed two radiocarbon tests of *Rangia cuneata* shell in the Galena shell midden (Ring 1961a).

In September 1963, the author delivered the entire Galena collection, including site notes, maps, profiles, and diagrams to the Department of Anthropology at the University of Texas to be retained in perpetuity. The purpose of this paper, after more than three decades, is to consolidate the findings in the Galena shell midden report of 1958 with the findings from the nine adjacent sites and, hopefully, to establish some possible temporal correlations between these archeological sites.

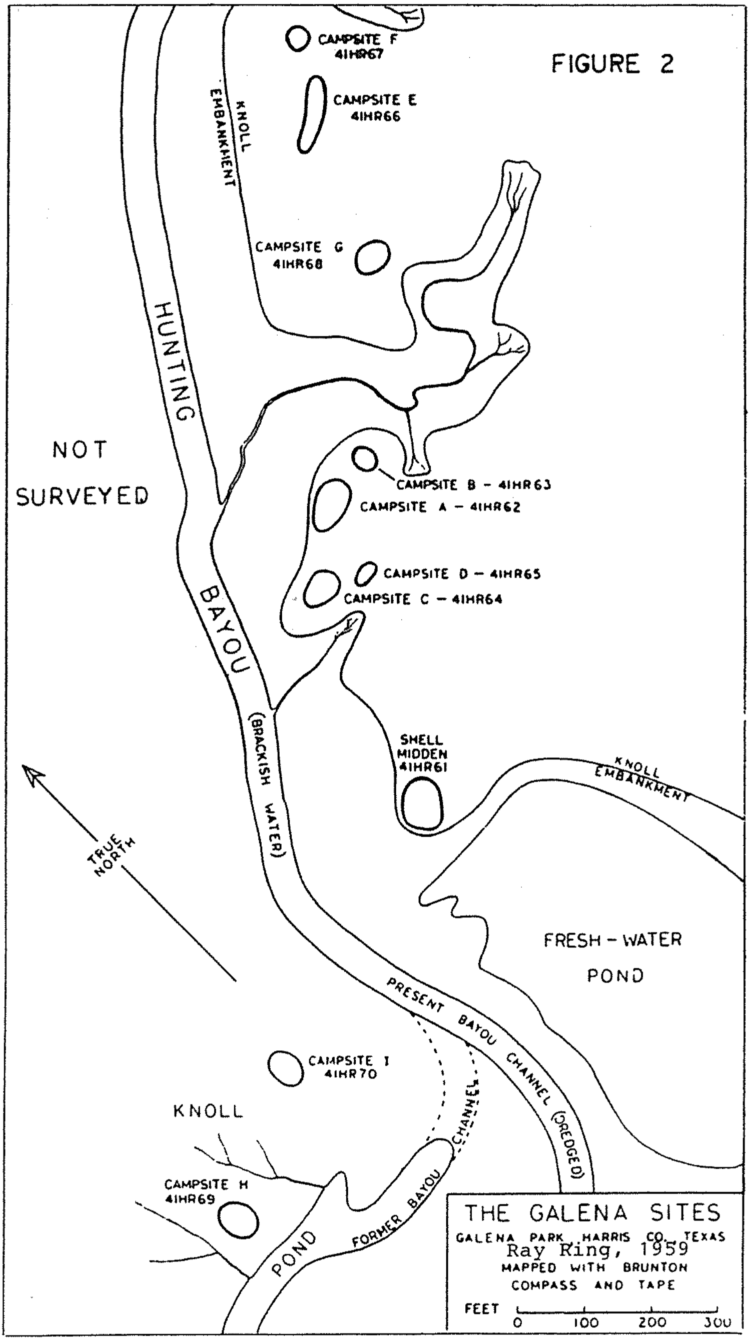


Figure 2. Galena sites map.

Perhaps the extreme tardiness of this paper could be likened to the Rip Van Winkle legend. But in this case, Rip Van Ring dozed off in 1959 and awakened 33 years later with a craving to finalize some unfinished business—in a world filled with newer archeological and technological discoveries.

REGIONAL TOPOGRAPHIC AND GEOLOGIC FEATURES

The area of investigation lies in the West Gulf Coastal Plain, a vast region of topographic flatness following the present shoreline of the Gulf of Mexico from the mouth of the Mississippi River to the Republic of Mexico. The monotonous flatness of the coastal plain is interrupted only by the valleys and floodplains of the various rivers and tributaries that flow across them.

The basement sediments of clay, silt, and sand that today lie in a monoclinal attitude have been deposited since early Tertiary period time by fluviomarine action during periods of fluctuation between shoreline emergence and submergence. In the late Tertiary period, the landmass experienced extended emergence that caused sediments to be laid down by fluvial action. The present coastal plain is covered by a soil of clay and sandy clay of Quaternary age and of river origin, with the exception of the shoreline itself that has formed through the combined forces of fluviomarine action and wind deposition. The youngest Quaternary sediments contain an appreciable amount of calcium carbonate in the form of calcareous concretions and platy caliche.

DRAINAGE

The older and larger rivers in the southeast Texas portion of the Gulf Coastal plain, such as the Sabine, Neches, Trinity, Brazos, and Colorado, head considerably north of the coastal plain area, but cut deeply into and completly across it. The newer rivers formed since late Tertiary land emergence, such as Oyster Bayou, Cedar Bayou, Clear Creek, the San Jacinto River, Buffalo Bayou, and its tributary Hunting Bayou, find their headwaters within the coastal plain. They have shallow and less extensive valley cutting. In general, the entire region around the Galena sites is poorly drained.

FLORA AND FAUNA

Due to the sluggish drainage, to heavy rainfall, and to climatic conditions, the area supports an abundant growth of vegetation and, in the drainage systems, fairly heavy stands of trees. The Galena site is quite densely forested, principally with oak and pine.

In 1958, an elder informant stated that, some 40 years before, the Hunting Bayou area supported considerable animal life, principally deer, wolves, raccoon, opossum, armadillo, rabbit, fox, and other small animals. He further stated that the mouth of Hunting Bayou was considered a good fishing spot, particularly in dry seasons when the salinity of the water increased. During these times good catches of redfish and trout were taken along with an occasional flounder.

GALENA SITES:LOCATION AND DESCRIPTION

The Galena shell midden (41HR61) is located on the east bank of Hunting Bayou 3.2 km from where it joins Buffalo Bayou. The elevation of the site is approximately 34 feet amsl.

The site is situated on the edge of a Beaumont Formation clay knoll that overlooks the relatively narrow Hunting Bayou floodplain (Figure 3). A shallow freshwater pond is 5.5 meters below the site; it parallels Hunting Bayou for about 180 meters. Hunting Bayou runs its southerly course 61 meters from the midden site. Its brackish water flows sluggishly in a channel 1.8 meters below the pond water level. A natural levee, somewhat bolstered by dredging in 1948, separates the two bodies of water. It is partially breached in three places, forming spill troughs from pond to bayou. Thus, the waters of the two bodies join during very heavy rainfall when the pond spills over, and comingle during times of extreme flood.

The shell midden is essentially elliptical in shape, with its long axis running southwest-northwest. The southwest end of the site, near a steep edge of the

Figure 3. Galena Shell Midden (41HR61).

Figure 4. Galena Campsite "A" (41HR62).

knoll, was breached by a narrow erosional gully that had cut into the loam midden mantle and the two layers below.

The site's upper loam layer covers the entire site, measuring 22.9 by 18.3 meters, comprising some 410 square meters. Its middle zone of shell extends 16.8 meters by 14 meters, an area of 235 square meters. The lower clay layer, probably a reworked Beaumont Formation deposit, covers an area comparable to the upper loam deposit. In aggregate, the three layers average about 0.61 meters in thickness at the center of the site, gradually diminishing on the flanks and perimeter of the site.

As previously mentioned, the nine Galena campsites (41HR62 through 41HR70) were located on both banks of Hunting Bayou 106.7 to 350 meters from the shell midden (see Figure 2). As with the midden, all campsites rested on the Beaumont clay. These sites ranged in shape from roughly round to ovate and oblong. Lengths varied from about 10.7 meters to 35 meters, with widths from about 7.6-15.2 meters. Surface expressions of these features were barely discernible to the eye (Figure 4). None of the nine Galena campsites showed stratigraphic layering, due to the mixing and redeposition of materials of different ages.

Mapping and Excavation

For a number of reasons, the Galena shell midden was not excavated by the metric grid system, principal among them being opportunity, time, and the difficulty of maintaining broad vertical control in the principal cultural layer of compacted shell valves. The site was excavated, mapped, and profiled employing a Brunton compass and steel tapes. Coincidentally, a large tree near the center of the midden served as a temporary datum for lateral measurements. While much of the midden was screened, the large volume of compact shell made this method difficult. A blow sufficient to dislodge shell valves tended to break bone, antler, pottery, and chert artifacts. Thus, it was found more satisfactory to excavate cautiously with small picks, trowels, and brushes. Records of artifacts and stratigraphic findings were kept in a field notebook and then transferred to a larger file after each dig.

The nine Galena campsites were explored by 27 test pits, either four or five square feet (1.2 or 1.5 square meters) in size, excavated in 6-inch (15.2 cm) levels from the surface. The lowest level was always from 30.5 cm below surface (bs) to whatever depths the sterile Beaumont Formation was reached—whether at 40.6 cm or at 53.3 cm. The clean, homogeneous, very sandy clay passed easily through 1/4-inch screens. Most of the exploratory work was first done with small tools. All test pits were backfilled immediately, by agreement with the land leasee, but even this proved a cattle hazard because the backfill took the character of quicksand after a heavy rain. This brought the test excavations to an end in 1959.

Galena Site Stratigraphy

At site 41HR61, numerous stratigraphic pits and occasional section trenches were dug to examine and measure the shell midden layers and to record their contents. The midden accumulation consisted of three layers, the upper two of which were very distinctive (Figure 5). These are described below, with brief mention of artifact content; thicknesses are those in the central area of the site except as otherwise designated.

Upper Loam: A dark brown to almost black, sandy, unconsolidated organic loam. This layer was 15.2 cm thick over most of the midden; however, it thickened considerably on the flanks. This was probably caused by gradual erosion and redeposition of the knoll's soil matrix. The upper 7.6 cm of the upper loam contained only a few artifacts, but the lower 7.6 cm (particularly at the contact with the shell layer below) contained considerable animal bone, antler, pottery sherds, and occasional shellfish valves. Some chert debris, two hammerstones, and an occasional calcareous concretion were also present.

Middle Shell: A fairly compact layer of shell in a matrix of very dark brown, organic, sandy loam. This shell layer averaged about 30.5 cm in thickness over the central midden area, but diminished along the flanks of the knoll.

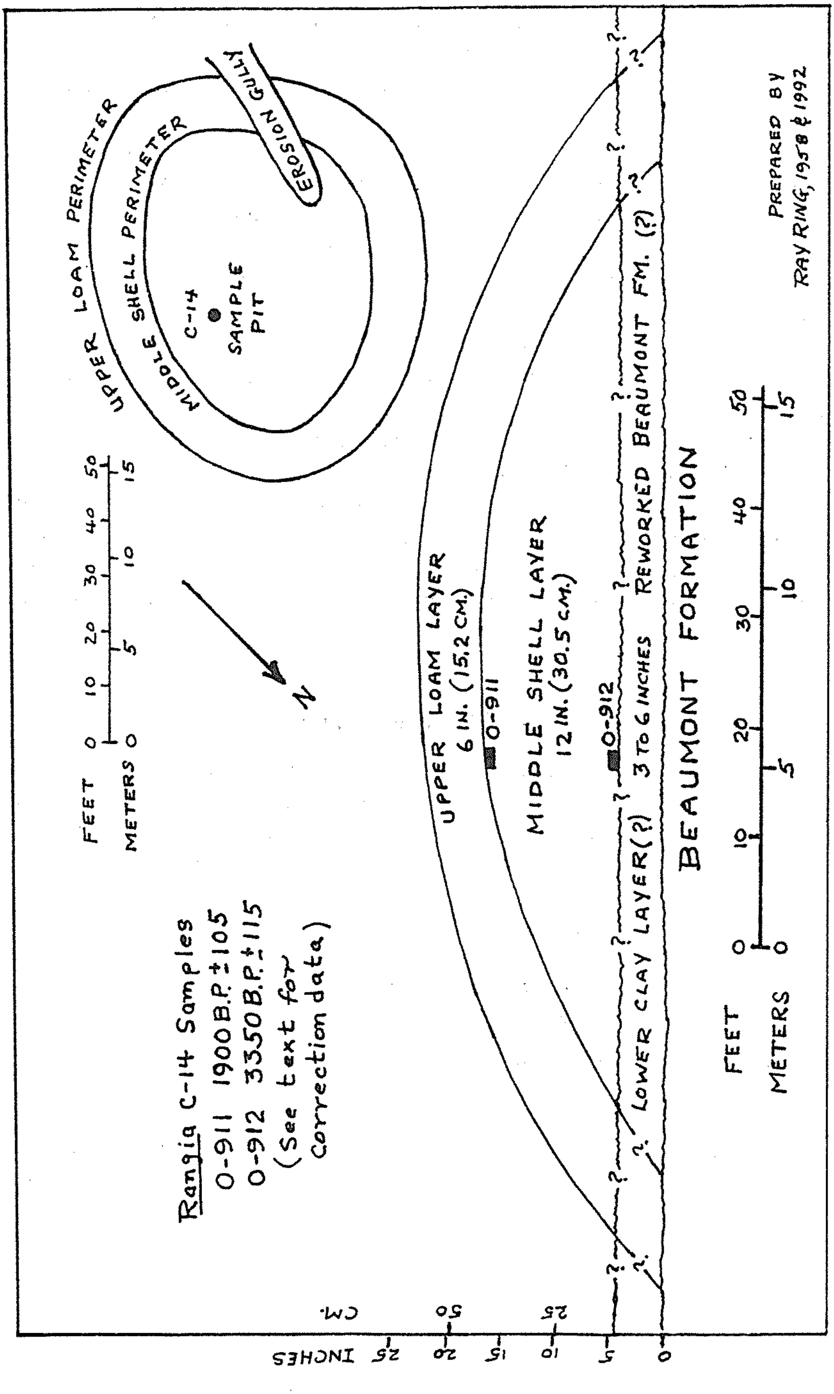


Figure 5. Idealized profile of the Galena Shell Midden (41HR61).

The shell interstices were filled not only with loam, but also with animal bones, antler, chert debris, pottery sherds, calcareous concretions, sandstone fragments, and probable pigment stones. The shellfish valves, the principal constituent of this layer, ranged in environment from freshwater mussels to marine organisms.

Lower Clay: A fairly compact brown to reddish brown, slightly sandy, sticky clay—not entirely dissimilar to the underlying Beaumont clay. This layer (?) measured from 7.6 to 15.2 cm in thickness, but appeared to wedge out on or near the perimeter of the upper loam layer. It is also possible that it may have merely blended into the original Beaumont Formation subsoil. This lower clay contained a scattering of fragmented animal bones, turtle carapaces, and shellfish valves, along with chert dart points and an abundance of calcareous concretions. While the shell valves were few and scattered, two areas that were 0.6 to 0.9 meters in diameter were found where shell valves were found in 2.5 to 5 cm thick layers. Both "patches" were at the base of the layer. This lower clay rather resembled the underlying Beaumont clay except that it was less sticky and more reddish in color, this being perhaps the result of ancient oxidation. This is to say, the lower clay layer may represent the weathered top of the natural Beaumont Formation on which the first Galena residents camped.

Beaumont Clay: A reddish brown to locally gray, sticky, sandy clay; completely devoid of artifacts. This is the Quaternary age Beaumont Formation.

The nine Galena campsites (41HR62-41HR70) completely lacked discernible stratification. The cultural deposits were a light tan-brown sand mixed with clay; they were homogeneous in texture and easy to excavate and screen. The upper 2.5-5 cm of the deposits showed some organic staining from the decay of modern forest material. Of 27 test pits excavated in these nine sites, most encountered the sterile Beaumont clay at ca. 46 cm bs; depths ranged from 40.6 cm to 53.3 cm. Although the contact with the Beaumont clay was flat, there were narrow, shallow furrows and gullies within it that contained an occasional artifact to as deep as 66 cm bs.

SHELL REFUSE

The Galena shell midden is estimated to have contained some 457 cubic meters of shellfish valves, most being in the middle layer of shell. The lower clay contained randomly scattered *Rangia cuneata* shells, except for the two or three "patches" mentioned above. These appeared to be evidence of either a large meal or a short stay. The upper loam layer contained very little shell, and this was found at or near the contact with the middle shell layer.

The different shell species from the site ranged from freshwater mussels to marine organisms (Figure 6):

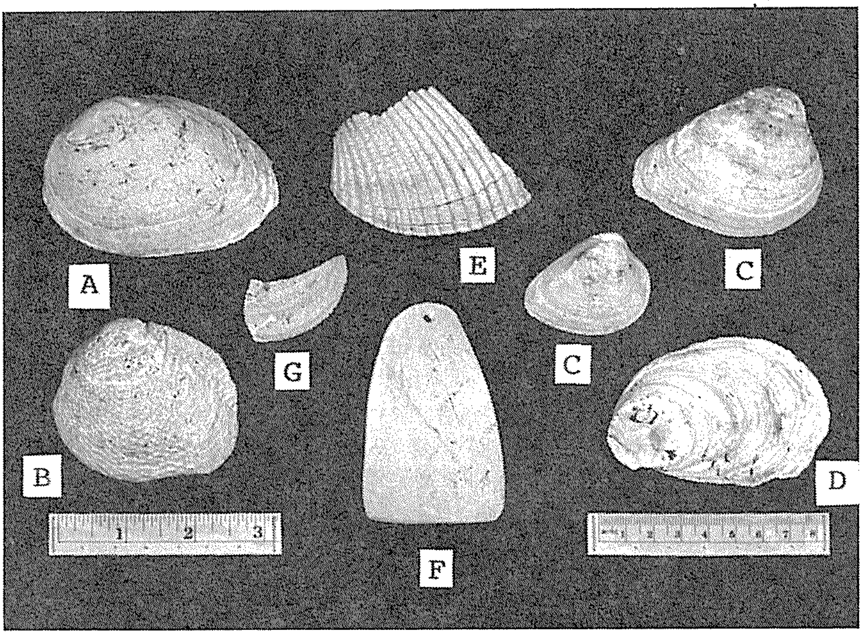


Figure 6. Raw Shell and Shell Artifacts from the Galena Shell Midden: a, *Glebula rotundata*; b, *Quadrula speciosa*; c, *Rangia cuneata*; d, *Crassostrea virginica*; e, *Dinocardium robustum*; f, perforated conch shell pendant, probably *Busycon perversum*; g, a notched and decorated *Glebula* valve.

Rangia cuneata, an edible brackish water, hard-shelled clam found in inlets between bays and fresh water; represents 98 percent of the total midden shell accumulation.

Quadrula speciosa, an edible, soft, pearly-shelled freshwater mussel found in creeks, rivers, bayous, and lakes of the Gulf Coast; represents about one percent of the midden shell.

Glebula rotundata, an edible, soft, pearly-shelled freshwater mussel of the same environment as *Quadrula*; represents about one percent of the midden shell.

Crassostrea virginica, an edible, medium hard-shelled oyster found in mid-salinity environments in or near bays; represented by only 58 total valves, all found in the midden. Uncommonly, *Crassostrea* will grow and mature in low-salinity waters so long as it is not suddenly exposed to heavy rains and freshwater floods.

Dinocardium robustum, a large, edible, high-salinity environment hard-shelled clam found in ocean waters or occasionally in a bay near a pass or ocean inlet; represented by 10 valve fragments.

Busycon perversum say, an edible, high-salinity, hard-shelled conch (whelk) found in ocean waters; represented by a single specimen which was cut, drilled, and polished into a pendant (see Figure 6f).

The freshwater mussels, *Glebula* and *Quadrula*, could have been obtained from the nearby freshwater pond. The low-salinity *Rangia* would have been obtained from Hunting Bayou, only 61 meters away.

It is difficult to know where the *Crassostrea*, the common table oyster of today, was gathered. It would have been present in Galveston Bay during the occupation of the Galena sites, whose closest point is at present Morgan Point, at the mouth of the San Jacinto River, some 27 km by land and 34 km by water. In view of the fact that two of the recovered oyster shells had *Rangia* valves in growth attachment, and that only 58 oyster shells were found, it seems more reasonable to assume that the oysters were gathered near the mouth of Hunting Bayou in Buffalo Bayou about 3.2 km away. This might have been during an uncommon period of less rainfall that permitted *Crassostrea* to reach maturity in a locale normally of lower salinity water. The *Dinocardium* clam and the *Busycon* conch pendant might have been obtained at Bolivar Pass, the eastern inlet on Galveston Island, some 66 km as the crow flies, but double the distance by walking water courses. These species were surely transported such great distances for their ornamental value.

The foregoing comments regarding the mussel shell pertain exclusively to the Galena shell midden. The 27 test pits in the nine Galena campsites found only 285 shell valves, mostly fragmented; 280 brackish water *Rangia* valves and five freshwater *Glebula* and *Quadrula* shells. Most of these were found on one rare pocket at the depth of 40.6-45.7 cm; pottery sherds and a few animal bone fragments were found in association.

SHELL ARTIFACTS

Despite the fact that the shell refuse accumulation in the Galena shell midden was substantial, shell artifacts were scarce. A number of smooth, pearly *Glebula* valves were broken roughly in half either by accident or intent; in some cases the broken edges appeares to have been used as tools. A broken *Glebula* shell (measuring 3.8 by 6.4 cm), its exterior surface removed to make both sides pearly, was found with a hole in it. If intentionally perforated, this was probably a pendant. Another broken *Glebula* fragment (see Figure 6g) measured 4.4 by 2.5 cm in size. It was delicately notched around the shell lip. Parallel fine-line incisions were cut from the lip notching inward toward the crown. It may have been used as either jewelry or as a pottery-impressing tool.

It is possible that the 10 *Dinocardium* ocean clam shells were carried to the site either to decorate pottery or to manufacture ornaments; however, none of these pieces were worked. An undamaged, perforated, and polished *Busycon* conch shell pendant (see Figure 6f) was excavated from the Galena shell midden at 35.6 cm bs in the middle shell layer. It was either carried in raw and fabricated, or traded in from the Gulf of Mexico. None of the 58 oyster valves were used as tools or ornaments. Similarly, none of the 285 shellfish valves from the nine Galena campsites showed human modification.

ANIMAL BONE REFUSE

An abundance of animal bone from a variety of species were found in the Galena shell midden. Deer represented the major mammal species hunted by the site occupants, and the bones from no fewer than 66 individuals were present at the site. This is based on the recovery of 132 deer astragalus bones of which there is one in each hind leg of all ungulates such as deer.

A number of well-preserved muskrat mandibles were also recovered from the shell midden. Other small animals present included rabbit, raccoon, skunk, opossum, and possibly badger. Parts of a bear were found, and a well-preserved mandible of a member of the *Canidae* family showed the presence of either a coyote, a wolf, or a dog.

The shell midden also produced a number of unidentified bird bones. Three large fish vertebrae and two catfish fin spines were also identified. A great deal of turtle plastron and carapace was recovered from all midden layers. While the principal use of turtle was probably for food, the notable absence of "rib" structure inside the fragmented carapaces suggest these were ground out to render the shell suitable for use as cups, dishes, or rattles.

Several thousand animal bones were recovered from the Galena shell midden while only 324 bones, 29 deer teeth, and four small antler fragments were recovered from the nine adjacent Galena campsites. Most of this bone was found at 41HR62 in one deep pocket or narrow gully in the otherwise sterile Beaumont clay.

Eighty percent of the animal bones in the Galena campsites were recovered between 30.5-53.3 cm bs. Another 15 percent derived from 15.2-30.5 cm bs, but only 4 percent of the animal bone came from the top 15 cm of the sites.

All animal bones at the Galena sites which contained recoverable amounts of marrow were broken and splintered as if for marrow extraction. Both the uneven, conchoidal breakage of bone ends, and the irregular scattering of pieces, show that these marrow bones were broken when fresh rather than by later ground pressure.

At 41HR61, animal bone and turtle shell were found distributed throughout all the midden layers. Fish and bird bones were not present in the lower clay, perhaps due to poor preservation. The heaviest concentration of animal bone refuse extended from the top to the middle of the shell layer.

The Galena occupants were skilled hunters as inferred by the heavy bone refuse in the midden. The degree of wear seen on the mammal teeth showed that the hunters were most adept at killing the very young and the very old game, while the prime individuals may often have escaped the stalk and chase.

BONE ARTIFACTS

Only one bone implement was found in all the nine Galena campsites. This was a socketed bone projectile point packed with asphaltum recovered from 41HR62 at the depth of 43 cm.

A number of bone artifacts were found in the Galena shell midden (Figure 7): eight cut awls (four incised), two cracked awls, 14 spatulate awls, one deer ulna spatulate tool, 18 socketed projectile points, one polished fish spine or pin, three rectanguloiud cut pieces, and one cut spatulate end piece.

The cut awls were prepared by cutting and/or splitting long bones and then shaped and smoothed with abraders. Four were incised with a simple pattern of parallel horizontal lines and/or parallel incised lines. As suggested by Walley (1955), this type of bone incising bears a striking resemblance to some of the decoration patterns found on Goose Creek Incised pottery rimsherds. Two fragmentary awls were highly polished and fire-hardened (see Figure 7o).

Three small rectanguloid, polished, cut bone objects were found of uncertain function (Figure 7f-h). Carved from three distinct pieces of split deer bone, two measured 2.24 cm in length; the other was 2.46 cm long. Widths ranged from 1.69-1.90 cm. Figure 7f' and g' show abraded and polished lengths of split bone from which this type of item was taken.

Dr. T. N. Campbell (1959 personal communication) suggested that these three problematical objects might have been gaming pieces had they been marked in any way by incisions, pits, or paint, but they were not. The Galena pieces do resemble unfinished bone dice similar to those from the Harris County Boy's School Cemetery (Aten et al. 1976:Figure 11e-j) that had been neatly marked by incised and/or punctated marks. One (see Figure 7g) had a black, shapeless, two-pronged stain on one side that appeared to be a splash of spilled asphaltum. Two animal bone fragments found nearby also showed spilled asphaltum.

One flat bone piece is unquestionably the broken tip (or sawed-off end?) of a spatulate deer ulna awl or flintknapper (see Figure 7d). Its cut end had been carefully abraded to a smooth, polished finish and the hollow interior of the bone

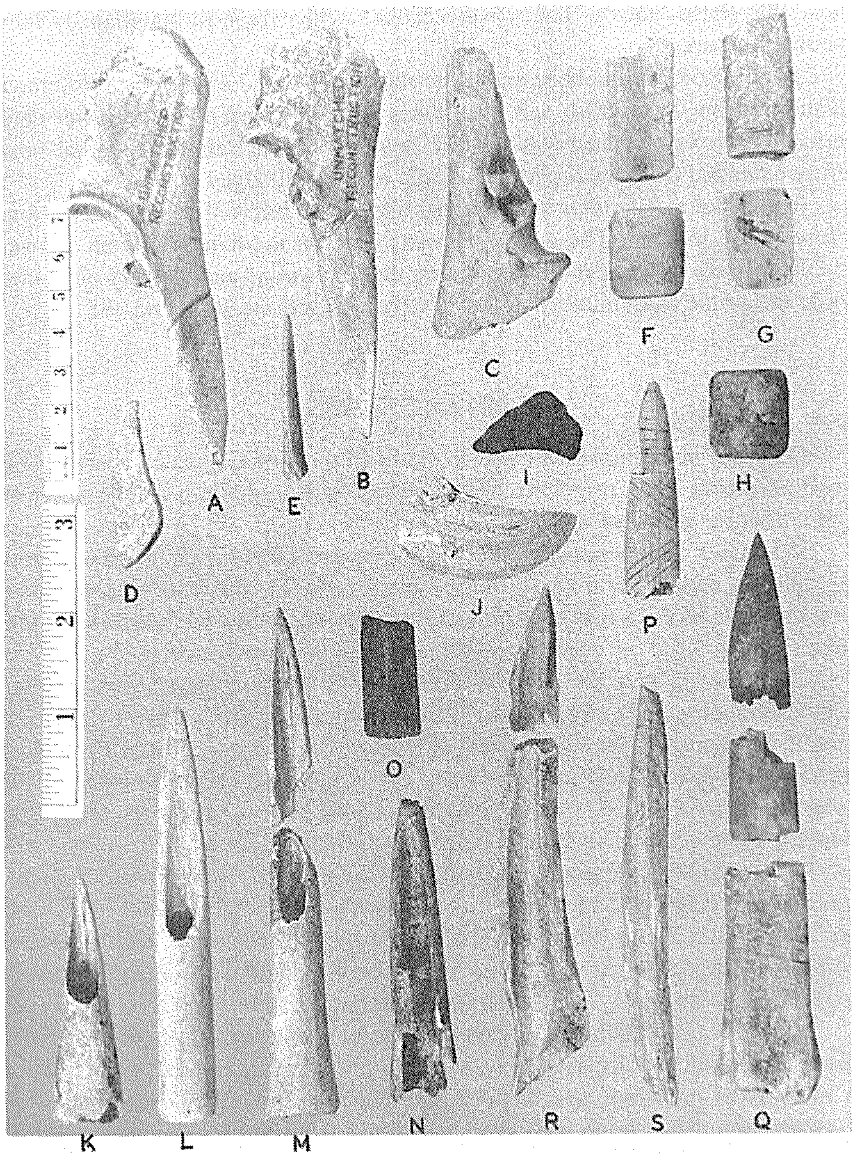


Figure 7. Bone Artifacts from the Galena Shell Midden: a-b, deer spatulate awls; c, deer ulna spatulate knapper; d, spatulate ulna end, asphaltum-packed; e, polished catfish spine (pin?); f-h, bone plates with cutting stock; i, graphite schist; j, ornamental shell; k-n, socketed bone projectile points; o-q, cut bone awls; r-s, cracked bone awls.

had been packed with asphaltum. One edge near the abraded end showed five thinly incised notches that did not extend to the flat part of the bone.

No bone tools were found in the lower clay layer of the midden. No clear evidence of bone implements was seen below the middle of the shell strata. As with the antler artifacts, the bone tools were heavily concentrated at the contact between the upper loam layer and the middle shell layer.

ANTLER MATERIALS

The nine Galena campsites produced only four small deer antler fragments in the lowest level (30.5-45.7 cm) of the 41HR62 deposits. The Galena shell midden, however, yielded 101 pieces of antler, 60 of which were used as tools: 33 flaking tools, 26 antler tines, and one socketed projectile (bunting) point.

The socketed antler point was packed with asphaltum; Figure 8i shows the packed asphaltum at the antler stem. All antler implements were smoothly abraded; however, they generally lacked the polish of the bone artifacts. It is speculated that the antler smoothing may have come principally from human skin friction whereas the bone tools may have been stone-honed. The chert-knapping antler tools ranged in length from 6.48-14.35 cm; maximum handle thicknesses varied from 1.27 cm to 2.41 cm. The tips of most of the antler tools were somewhat rounded and blunted from use.

Fourteen of the 26 antler tines were fire-hardened. The non-fired antler was tan-brown in color, soft, soggy *in situ*, and surficially powdery when dried. The fire-hardened tines ranged in color from light to dark gray and rarely black. These were hard, brittle, and shiny. Several showed what appeared to be thermal shrinkage fractures (see Figure 8a-d, g). When tested with a penknife, the non-fired antler were easily gouged, while the fired tines could not be penetrated with any reasonable amount of pressure.

The antler tines in the total collection were 2.8-4.6 cm in length, 0.8 cm to 1.3 cm in basal width, and were rather pointed. The curvature of most Galena antler tines would seem to render them rather unwieldy as projectile tips; however, Ford and Quimby (1945:42 and Figure 12g, j) show curved-tip antler projectiles from Tchefuncte Culture sites in South Louisiana. The Galena fire-hardenening of antler tines would improve their usefulness for flesh penetration as projectile points, however awkward they were, but would render the antler too brittle for knapping chert.

At the Galena shell midden, a single piece of raw antler was recovered from the lower clay layer where a small scattering of deer bone was also noted. Antler was most common from the base of the middle shell layer to the middle of the upper loam layer. The heaviest concentration of both raw and tooled antler was in the loam deposit overlying the shell layer.

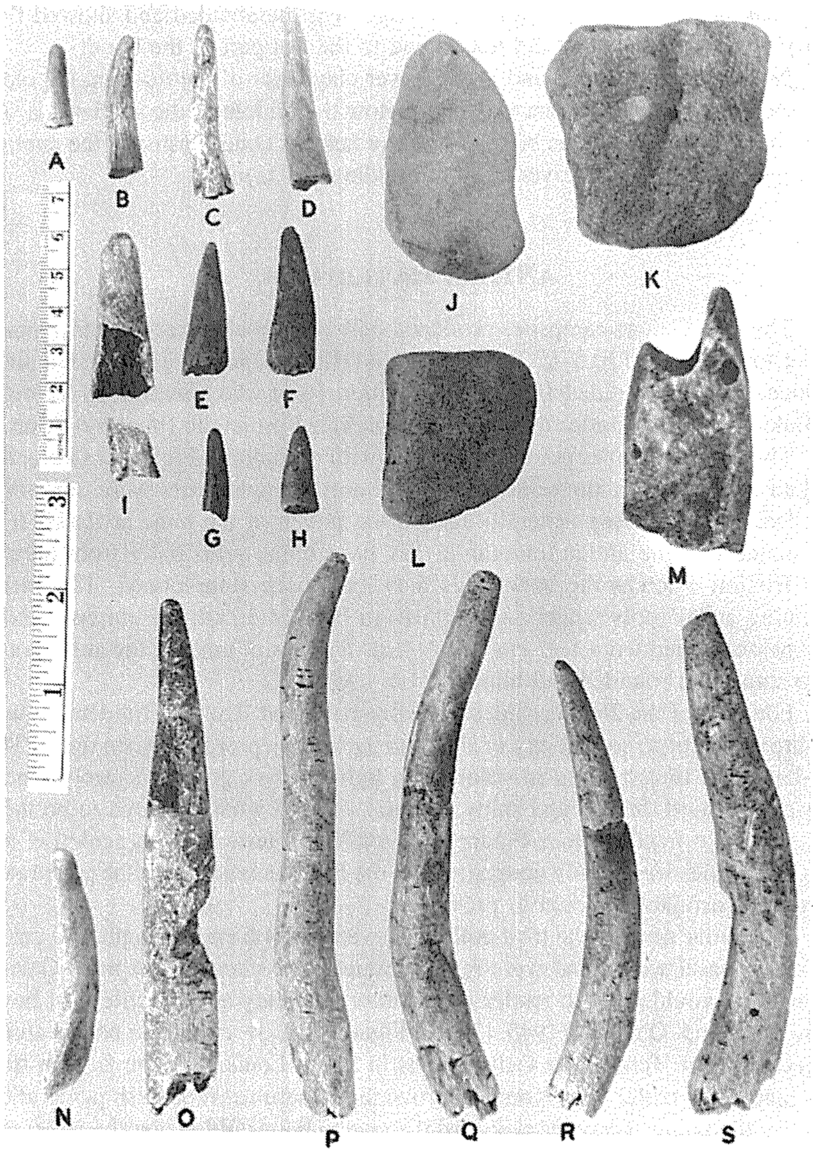


Figure 8. Antler Artifacts from the Galena Shell Midden: a-h, antler tines (all fire-hardened except e, f, and h); i, socketed antler bunting projectile point (socket opened to show packed asphaltum); j, thin sandstone saw; k-l, sandstone abraders; m, sandstone shaft abrader; n-s, antler knapping tools.

CHERT ARTIFACTS

The Galena shell midden excavations produced 291 chert and two quartzite artifacts, of which 41 were utilized. The other 250 pieces consisted of three unworked chert cobbles, two cores of chert and quartzite, 20 chert core fragments, and 225 pieces of chert debris.

The provenience of projectile points and other chert artifacts from the Galena shell midden is listed in Table 1. The five unprovenienced dart points were found by the youngsters who found the site. These probably washed out of the middle shell layer into the small erosion gully on the southwest flank of the site.

The chert projectile types from the Galena shell midden were first identified using Suhm et al. (1954). Later revisions were checked using Turner and Hester (1985). Figure 9 shows a sample of projectile points from the shell midden.

Table 1.

Galena Shell Midden Lithic Artifacts

	Upper Loam	Middle Shell	Lower Clay	Unprovenienced
Arrowpoints				
Perdiz	1			
Dart Points				
Gary		5	1	1
Kent	2	6	2	2
Palmillas		2	3	
Morhiss	1	1		
Lange				1
Unidentified		2		1
Gravers	1	2		
Drills		2		
Stemmed End Scraper		1		
Knives		1	1	
Choppers		1	1	
Chert cobbles				3
Cores & fragments				22
Chert debris				225

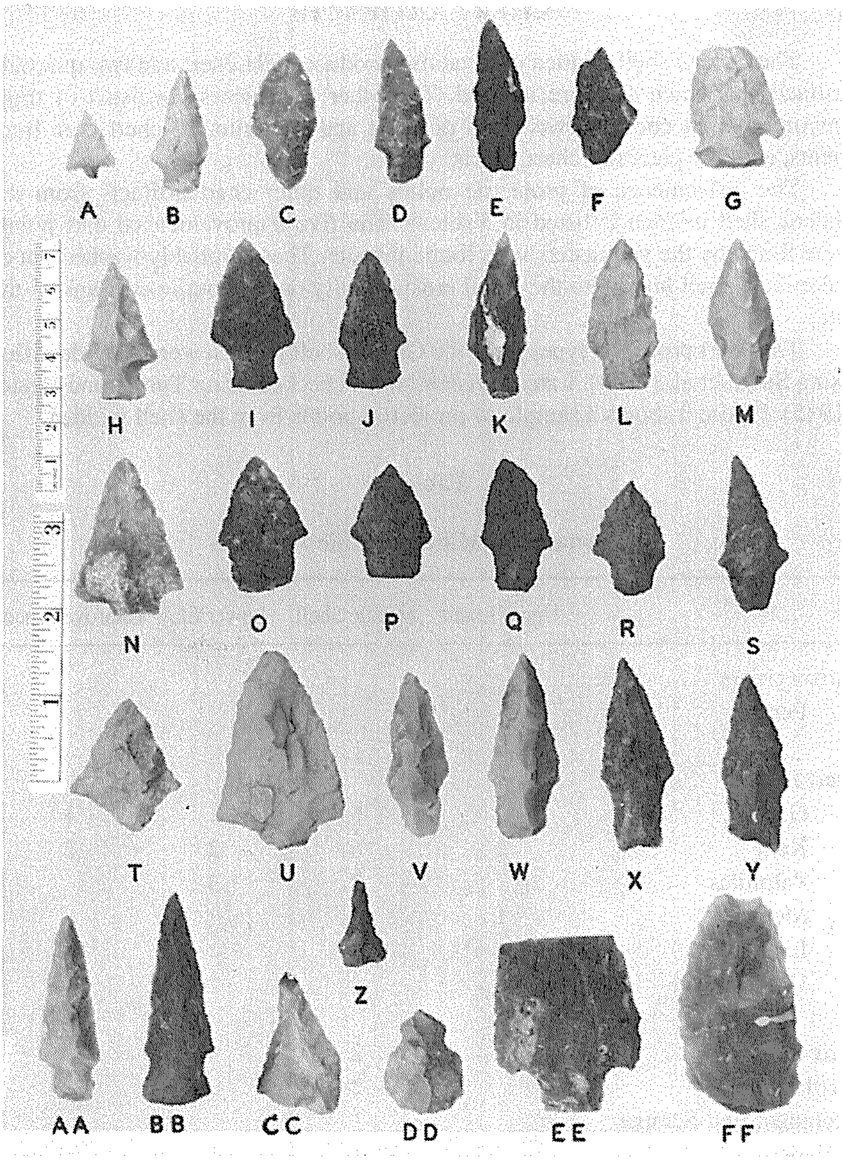


Figure 9. Projectile Points and Stone Tools from the Galena Shell Midden: a, Perdiz; c, f, m, s-u, Gary; b, d-e, k-l, q-r, v-y, Kent; h-j, aa-bb, Palmillas; o-p, Morhiss; g, Lange (?); n, ee, unclassified dart points; z, cc, drills; dd, stemmed end scraper; ff, knife/flesher.

The 27 test pits in the nine Galena campsites produced 35 identifiable arrowpoints, 95 dart points (78 identifiable to type), a variety of lithic tools, 39 unidentifiable chert artifacts (mainly dart point fragments), and 1139 pieces of chert debris (Table 2). Samples of projectile points from the Galena campsites are illustrated in Figure 10.

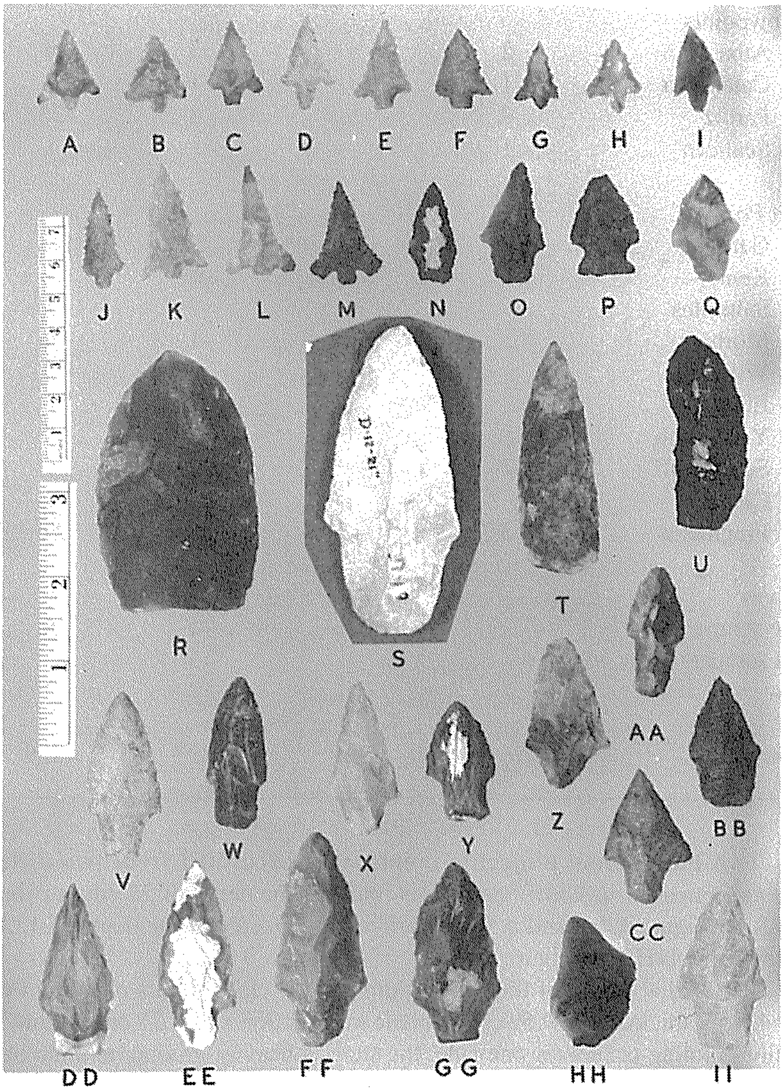


Figure 10. Projectile Points and Stone Tools from the Galena Campsites: a-k, Perdiz; l, Alba; m, Catahoula; q, v, x, z, aa, cc, Gary; n-o, w, ee, ff, Kent; s, bb, ii, Morhiss; y, dd, Yarbrough (?); p, Ellis; gg, unidentified dart point; r, t, u, knives; hh, retouched flake.

Table 2.

Chert Artifacts from the Nine Galena Campsites

	0-15 cm	15-31 cm	31-46 cm	Total
Arrowpoints				
Alba	2	1	3	6
Catahoula	1	1	1	3
Perdiz	8	9	8	25
Scallorn	1			1
Dart Points				
Gary	1	5	22	28
Kent	2	3	24	29
Palmillas			7	7
Morhiss		3	1	4
Williams			3	3
Ellis			2	2
Yarbrough		1	2	3
Scottsbluff	1			1
Clovis		1		1
Fragments	3	17	36	56
Knives			5	5
Side scrapers		1	5	6
End scrapers			3	3
Gravers		1	2	3
Debris	261	341	537	1139

Two Paleoindian projectile points were excavated from two different Galena campsites. A Clovis point was found at the depth of 28 cm in campsite 41HR64 (Figure 11b), and a Scottsbluff was recovered at the depth of 12.7 cm in campsite 41HR69 (Figure 11c).

The medial length of the Clovis point is 8.05 cm while its maximum width is 3.43 cm; thickness is 0.69 cm in blade mid-section and 0.51 cm in stem mid-section. Fluting occurs on one side, the stem is heavily ground, and the base is moderately ground. The entire blade is finely resharpened. Its color is a two-tone lustrous brown with a light orange tint and a white crystalline quartz inclusion near the tip. The chert is definitely exotic and a Texas source can likely be ruled out; its true source, however, has not been determined.

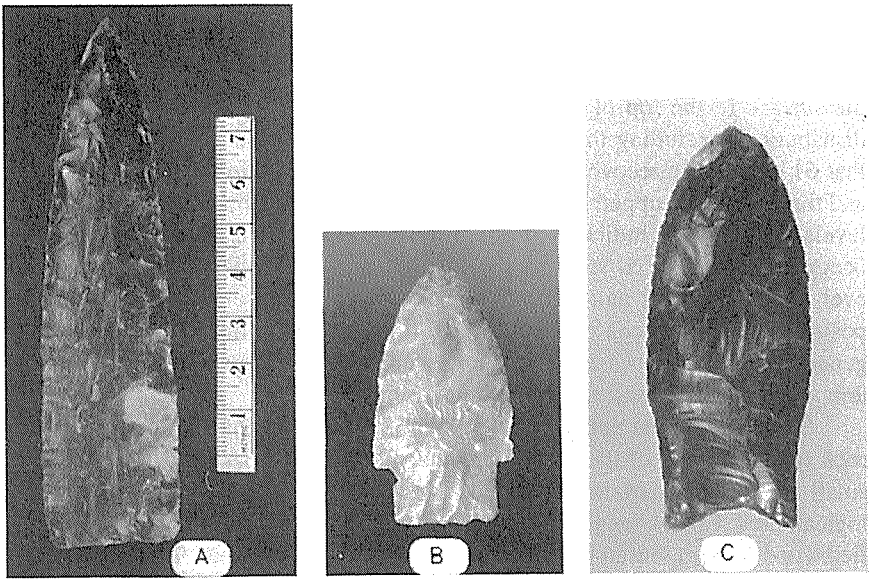


Figure 11. Selected Stone Tools: a, knife later found in the upper half of the middle shell layer (depth of 26 cm) of the Galena Shell Midden; b, Scottsbluff point from 41HR69, found at depth of 13 cm; c, Clovis point from 41HR64, 29 cm.

The Galena Clovis point bears a strong resemblance to the so-called Ross County (Ohio) Clovis point style seen in surface and cave collections in Ohio, Illinois, Iowa, Missouri, Kentucky, Tennessee, Arkansas, and Louisiana. Waldorf and Waldorf (1987:32) state that the "Ross County Clovis type is said to have a distribution from Ohio southward to Florida and even into Texas (Prufer and Baby 1963 and Perino 1971)."

The Galena Scottsbluff point bears a small notch high on the stem (see Figure 11b) caused by a reckless shovel. All other features are natural. The artifact is 5.46 cm long and 2.92 cm wide; stem width is 2.16 cm and stem depth is 1.22 cm. The stem, if ground at all, may be slightly abraded, but the base shows no grinding. The color is a lustrous pale yellow-brown or tan-yellow. This chert too is exotic, and not from Texas. Like the Clovis point, its rock source has not been determined. Current dating places the Scottsbluff at about 8400-9500 years B.P. and the Clovis at about 11000-11500 years B.P. But here both Paleoindian points were found mixed with lithic materials dating from the Late Archaic, Early Ceramic, and Late Prehistoric periods.

The single Perdiz arrowpoint found in the Galena shell midden upper loam layer (at a depth of 13 cm) represents the only chert tool dating to the Late Prehistoric period. The various dart points from the middle shell layer of the midden reflect an occupational span from the Late Archaic through the Early Ceramic period.

The nine Galena campsites evidence stratigraphic mixing. The arrowpoints, representing the Late Prehistoric period (the Alba, Perdiz, Catahoula, and Scallorn types), were found in equal amounts in each of the 15.2 cm levels from the surface to the top of the sterile Beaumont clay formation. The dart point distribution (excluding the two Paleoindian points) listed in Table 2 indicates that 61 darts were recovered from the lowest levels, 12 from the middle level, and three from the uppermost level; potsherds were distributed throughout these levels. This surely indicates that Late Prehistoric and Early Ceramic period occupations are mixed stratigraphically. There was no visible evidence, however, that burrowing animals had moved arrowpoints from shallow to deeper positions in the Galena campsites. The nine Galena campsites had the same general dart point types as the shell midden, and thus they were occupied contemporaneously at least from the Late Archaic.

Setting aside the unknown chert source of the two Paleoindian points, the rock types of most of the other Galena artifacts were chert, along with a very small amount of quartzite. These materials are typically found in area archeological sites. Colors ranged from brown, tan, red-brown, to gray-brown. Petrified wood was present in low frequencies at all 10 Galena sites. These rock types can be found in river gravels of the West San Jacinto River.

A few of the finished artifacts were a gray to gray-brown, sometimes speckled, chert commonly known as Edwards chert. It has its source on the Edwards Plateau of Central Texas but is sometimes found in gravels downstream on the lower courses of both the Colorado and Guadalupe rivers.

One Edwards chert artifact, a medium-gray, speckled, ovate knife or flesher, provide a clue to possible contemporaneity between the Galena shell midden and the nine adjacent campsites. This knife had been thermo-fractured into three pieces, perhaps from accidental fire exposure, although it was neither darkened nor reddened. The first two conjoins were found (many weeks apart) in the middle shell layer of the midden at depths of 35.6 cm and 40.6 cm, and were separated by 16.2 meters. Months later, a third piece was found at the depth of 45.7 cm in Galena campsite 41HR62, some 152.4 meters distant. It was not a conjoined piece but the chert type, color, flaking pattern, and thermo-fracture angle indicates that it is a third part of the artifact. The three pieces represent some 60-70 percent of the original artifact, but the breakage pattern indicates that at least two more pieces were missing.

SANDSTONE ARTIFACTS

The nine Galena campsites had only five sandstone implements, all in 41HR62. Two thin sandstone saws were found between 30.5-45.7 cm below surface. Three sandstone abraders were also recovered, one in the 15.2-30.5 cm level, and the others in the aforementioned lower level.

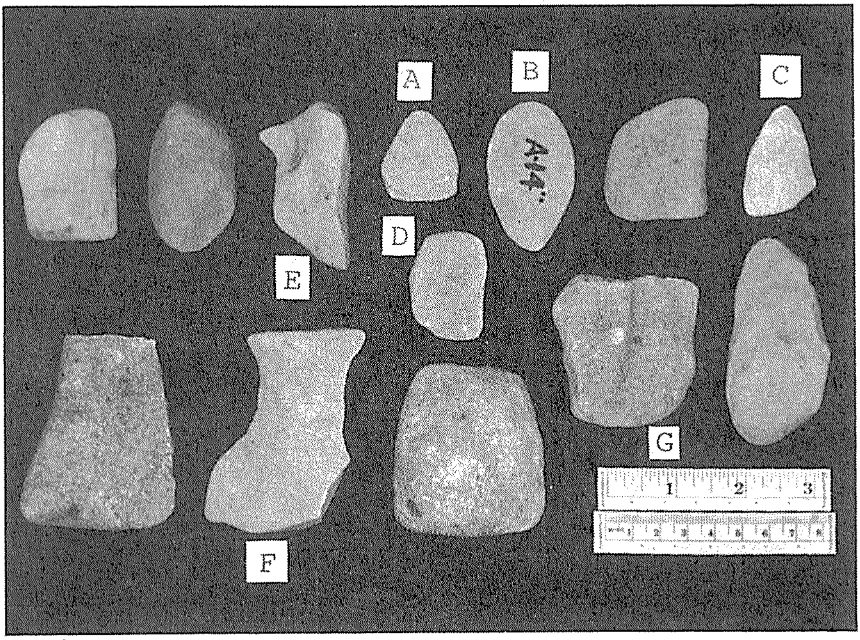


Figure 12. Sandstone Abraders and Saws: a-d, thin saws; e-f, thin-edged abraders; g, grooved abrader. Unlabelled others are thick abraders. All are from Galena Shell Midden, except b from 41HR62.

A total of 90 sandstone implements were recovered from the Galena shell midden. The majority of the sandstone implements were generally flat; however, a few were rather massive and rounded. Most were used for abrading and cutting activities since they had smooth and worn areas, grooves, cut-shaped depressions, channels, and cutting edges (Figure 12).

About a dozen small, delicate pieces were classified as sandstone saws (see Figure 12a-d). These were thin, flat, and had sharp working edges. They ranged from 2.49 cm to 8.26 cm in length and from 0.42-1.27 cm in thickness. Another group is identified as finger-size abraders. These also were about the same length as the saws (2.5-7.6 cm) but were considerably thicker and more rounded than the saws. A few of these stones had sharp honed cutting edges (see Figure 12e-f). Many were rounded, sometime grooved, and sometimes cupped for rather delicate shaping work. A single fragmented sandstone piece bore the deep, rounded channel of a shaft abrader (see Figure 8m).

A third group of about 50 sandstone implements ranged up to 17.8 cm in length. Some were large enough to have been placed on the ground to use. A number of these had grooves and cup-shaped depressions, and some were distinctly plate-shaped.

Chronologically, a single shell midden sandstone tool was found at the base of the middle shell layer. Only a few sandstone pieces were recovered from the middle of the shell layer. The heaviest concentration of sandstone implements was found in the uppermost part of the middle shell layer.

MISCELLANEOUS STONE ARTIFACTS

Two oblong, stream-rounded quartzite cobbles, one 11.7 cm in length and the other 6.7 cm in length, were recovered near the base of the upper loam layer of the Galena shell midden. Both had smoothly worn surfaces over part of the circumference, and showed spall marks on or near the ends, and to some extent, in the middle of the cobbles. The wear patterns may have been a result of milling activities, however, it was possible these stones were also used for honing a fine polish on bone and antler implements. The spall marks on these tools are also indicative of hammerstone use.

PIGMENT (?) STONES

The Galena shell midden yielded about 35 pieces of red to orange-red nodules containing limonite and/or low-grade hematite. Six of the pieces were clearly a red, ferruginous fine-grained sandstone. The nine Galena campsites produced only a few of these possible pigment stones. Despite a generally rough texture, these pieces when moist or wet created a red coloration on the skin; when dry, the pieces ground to a gritty red powder.

In archeological sites the evidence of raw, unapplied pigments is usually seen where "paint" pouches have decayed or where stained mortar and pestle grinding pots are found. No such evidence was seen at the Galena sites, however.

A small, flat, thin, and partially abraded black metamorphic rock, measuring 2.72 cm by 1.57 cm, was found in the middle shell layer at 41HR61 (see Figure 7i). Stephen E. Clabaugh (1959 personal communication) of the Department of Geology at the University of Texas identified this as graphite schist "exactly like some of that in the Packsaddle schist in the Llano uplift, central Texas." He further stated that "no rock of this type occurs closer to Houston than southeastern Llano County, but fragments of it are carried by the Colorado River and probably can be found with enough searching in any of the present or older river gravel deposits." The closest old river is the Brazos River; however, the nearest point of the Brazos River to the Galena sites is the big south bend in Fort Bend County some 50 km to the southwest. Thus, the graphite schist piece may have been carried by human hands at least this distance to reach the Galena midden.

Wheat (1953:228) found "a lump of black, micaceous schist" in one

Addicks Reservoir site. It had been "abraded into a somewhat cupped shape, perhaps to obtain a low-grade black pigment."

FIRED CONCRETIONS

More than 1,000 calcareous concretions, many of them fire-burned, were recovered from the Galena shell midden. Only 16 of these concretions were found in the 27 test pits completed in the nine adjacent Galena campsites. The size of these specimens ranged from marble-sized to 8.9 cm in diameter, with the majority around 5.0 cm. The shapes were generally amorphous, although many were roughly ovate or potato-shaped (Figure 13). The color of these specimens ranged from light gray to very dark gray, and differences in color appear to be a function of the frequency of fire exposure.

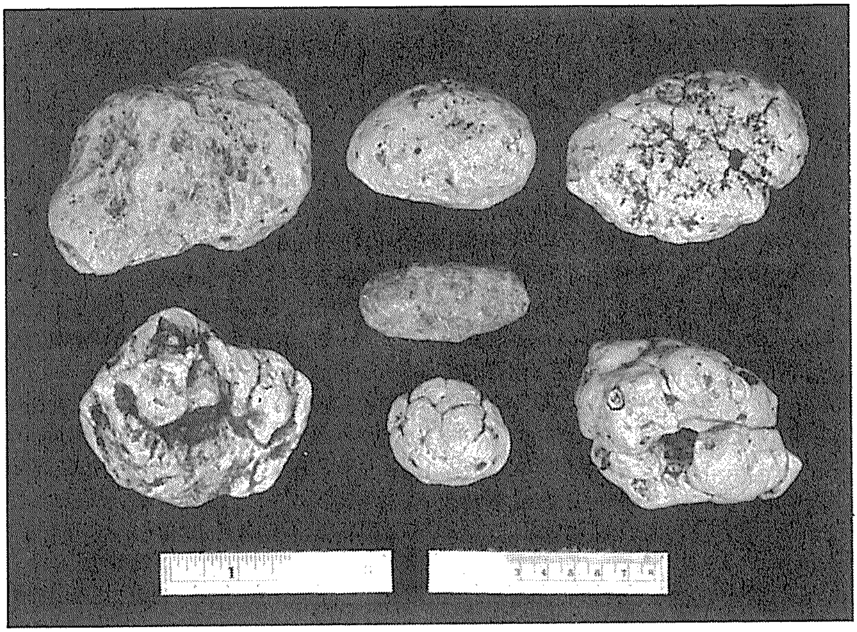


Figure 13. Calcareous Concretions from 41HR61 used as cooking stones.

These stones were natural calcareous concretions. The carbonate content in the stones was sufficient to cause active effervescence when hydrochloric acid was applied to them. Calcium carbonate was probably the principal cementing agent holding the rock together, as evidenced by the fact that when a piece of the stone was pulverized and bathed in acid until bubbling had long ceased, the dried residue exceeded more than half the original rock volume; the residue consisted of insoluble clay. Fire-scorching on many specimens suggested these had been used as roasting stones for cooking; perhaps in some instances they were immersed in ceramic cooking vessels.

Calcareous concretions occur naturally in the Beaumont clay formation (Aten 1983:134), as does caliche, a chemically comparable substance. Both are the result of leaching and oxidation, being mobilized by groundwaters during cycles of fluctuation between meteorological drought and high precipitation. Concretions "grow" around a nucleus; caliche is a flat, platy, crustal precipitate. The Galena sites contained no flat, calcareous plates.

It is certainly a significant difference that over 1,000 concretions, many fire-darkened, were found in the Galena shell midden, the only distinct kitchen or cooking deposit in the complex, whereas a mere 16 were excavated from the nine Galena campsites. These sites also had no organic staining and few shell concentrations.

In addition to the many fired calcareous concretions in the Galena shell midden, a few fire-darkened, rounded, argillaceous sandstone pieces were also found in association. These had seen heavy use as evidenced by fire-scorching, desiccation, and occasional networks of thermo-shrinkage fractures over the surface. Presumably these too were cooking/roasting stones.

POTTERY

The ten Galena sites produced 11,636 Goose Creek pottery sherds (Table 3). A very few of the incised rim sherds also had punctated marks. Three unprovenienced cord-impressed rim sherds (Figure 14a), probably from a single vessel, were detected by Thomas N. Campbell, E. Mott Davis, and Edward B. Jelks in March 1959 at the University of Texas at Austin. Based on temper, texture, and lip incisions, all three concluded these were also Goose Creek wares. A fourth cord-impressed rim sherd from a second vessel was recovered from the upper half of the midden shell layer (between 20-30 cm) in secondary radiocarbon sample A-7. As far as the author is aware, these four cord-impressed sherds were the first ever reported in the area.

Characteristics of the ceramics from the Galena sites are described below:

Method of Manufacture: Coiled. A single, straight, rod-shaped length of pottery coil (Figure 14b) was found that measured 48.2 cm in length and 0.80 cm in diameter. It was in the upper part of the midden shell layer associated with ceramics of similar temper and texture. One end of this sand-tempered clay rod was pointed, the other was rounded; the object appeared unbroken. It is not known whether this coil was fired accidentally or intentionally; if intentional, its purpose is unknown. Wheat (1953:190) found four of these pottery coils at the Addicks sites.

Table 3.

Galena Site Ceramics

Sherd Types	Galena Shell Midden	Nine Galena Campsites
Body Sherds	5234	5398
Plain Rims	386	228
Incised Rims*	145	157
Cord-Impressed Rims	4	0
Pointed & Rounded Bases	28	34
Flat Bases	17	4
Clay Coil	1	0

* Includes other types of decoration as well

Temper: Sand or sand combined with clay; rarely pulverized bone. A few sherds showed a white to light gray mineral temper on the exterior, perhaps a calcium phosphate also noted by Wheat (1953:184) for some of the Addicks Reservoir ceramics.

Texture: Fine to fairly coarse; the latter generally being sandy and somewhat friable like a loosely-cemented sandstone. Those sherds of fine texture appeared to be siltstone particles embedded in clay.

Color: Ranges from orange-red to reddish-brown; from light brown through gray-brown to dark brown; and from light gray through dark gray to essentially black.

Surface Finish: Generally smooth on both interiors and exteriors. A few sherds had been smoothed sufficiently to resemble a semi-glazed surface. Occasional interior surfaces were striated with parallel lines, generally parallel to the vertical axis, probably as the result of using grasses for smoothing. One midden sherd was grass brushed on both the interior and exterior surfaces.

Wall Thickness: Ranges from 0.267 cm to 1.316 cm; wall thickness average is 0.625 cm, but wall thicknesses generally were not uniform on any single sherd.

Rim: Usually vertical, but quite a few were slight to fairly pronounced outcurving or everted.

Figure 14. Incised Rim Sherds from Galena Shell Midden: a, cord-impressed; b, fire-hardened pottery coil; c, rim with drilled suspension hole; d-e, rims with incised lips.

Lip: Normally a fairly sharp edge, sometimes flat, or sometimes rounded, and rarely interior beveled to a sharp edge. A few specimens had lips turned diagonally outward, and one had been pinched to form a scalloped lip (see Figure 17b). Lip notching is a very common trait, mostly on the interior, sometimes on the exterior, but occasionally completely across the lip.

Body: No whole vessels were encountered, but several sherd groups could be conjoined to allow partial vessel reconstructions. Five basic vessel styles (Figure 15) are present in the site's ceramic assemblage.

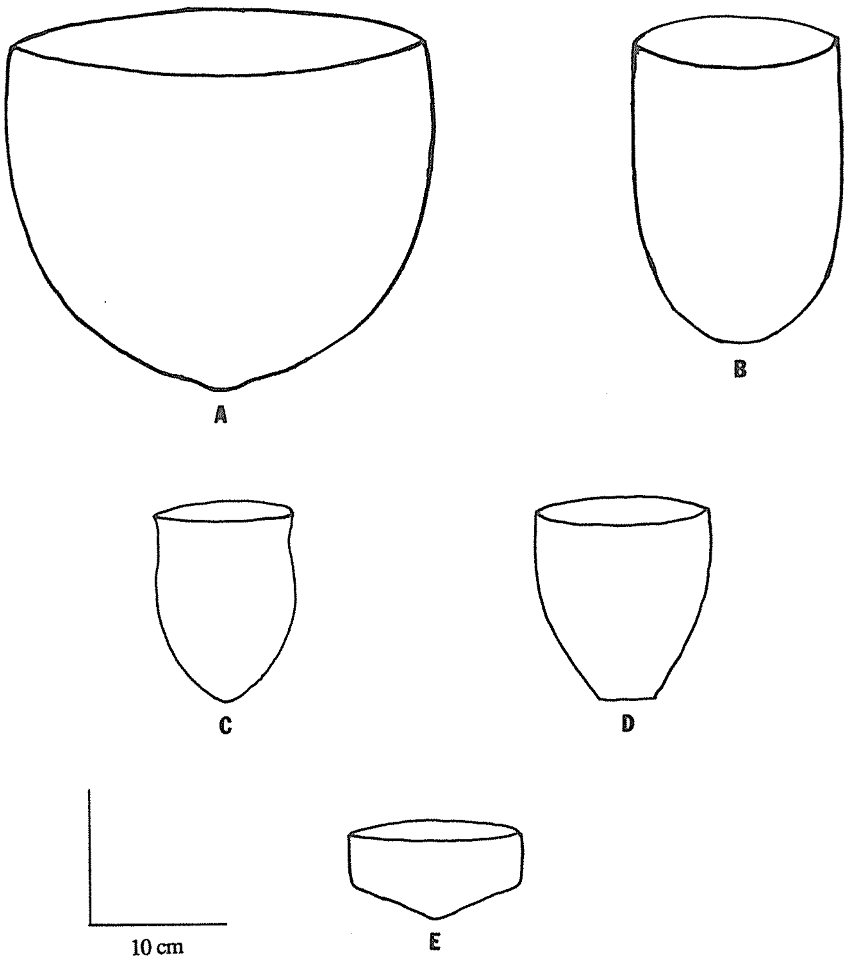


Figure 15. Galena Midden Vessel Shapes.

Size: Projected rim curvatures indicate a minimum diameter of 7.6 cm and a maximum diameter of 35.6 cm. Vessel heights range from 12.7 cm for a single small diameter bowl to 25.4 cm for a large hemispherical bowl.

Bases: Most common base forms (Figure 15a-c and Figure 16) varied from pointed to round and these usually showed thickening at the center; some had a nodal form (see Figure 15e). A number of flat-bottomed bases (Figure

16a, b) were also identified in the Galena sites, particularly from the midden.

Perforations: Drilled holes, sometimes in pairs, appeared just below the lip on a number of sherds (see Figure 14c and Figure 17c). This may have been done in some cases for suspension and in other instances for the repair of vessel cracks.

Decoration: Aside from lip notching (see Figure 14d, e), which was associated equally with both plain and decorated rim sherds, incised decorations occurred on about 33 percent of all recovered rim sherds (see Figures 14 and 17). Decoration consisted of simple horizontal designs incised into wet clay with a sharp instrument. These incisions were confined to the upper margins of the rim, generally within 1.27 cm of the lip; however, a few were found to extend 2.54 cm below the lip, and one sherd was incised to 3.17 cm below the lip. A few sherds showed horizontal incisions coupled with punctation, the latter being small solid triangles that may have been made by blunted catfish spines (see Figure 17d).

The common incised design was from one to 11 lines running parallel to the lip of the vessel. From this basic design the incised element also included vertical cross-hatching, both upright and inverted lineal triangles, diagonal crossed lines, parallel zig-zag lines, parallel wavy lines, cross-hatching between parallel lines and within lineal triangles, and other combinations of these various elements (see Figure 14 and 17). Generally the incisions were rather thin, delicate, and shallowly cut.

Provenience: No pottery sherds could be clearly associated with the lower clay layer at the Galena shell midden. Sherds were, however, found at the immediate contact of this stratum with the overlying middle shell layer. Goose Creek pottery occurred throughout the middle shell layer, but the heaviest ceramic concentrations were noted in the upper part of this shell layer. Pottery sherds were found throughout the upper loam layer, however, the majority of the sherds occurred in the lower half of this layer.

Table 4 depicts the vertical provenience of ceramic sherds from the nine Galena campsites. This does not include 624 sherds that came from a wide, irregular excavation to expose the human burial encountered in campsite 41HR62. No cord-impressed sherds were found in any of the nine Galena campsites. An occasional sherd was impressed with serrated shell lips in both the midden and campsites; otherwise, the decorated sherds from the midden and campsites were indistinguishable (see Figures 14 and 17).

Distribution of Goose Creek Ceramics: The geographic distribution of Goose Creek wares is fairly well established today. It is known to be very widespread along the upper Texas coast and inland to an appreciable extent

Figure 16. Galena Shell Midden Ceramics: top row, body sherds; bottom row, vessel bases; a, b, flat-bottomed bases.

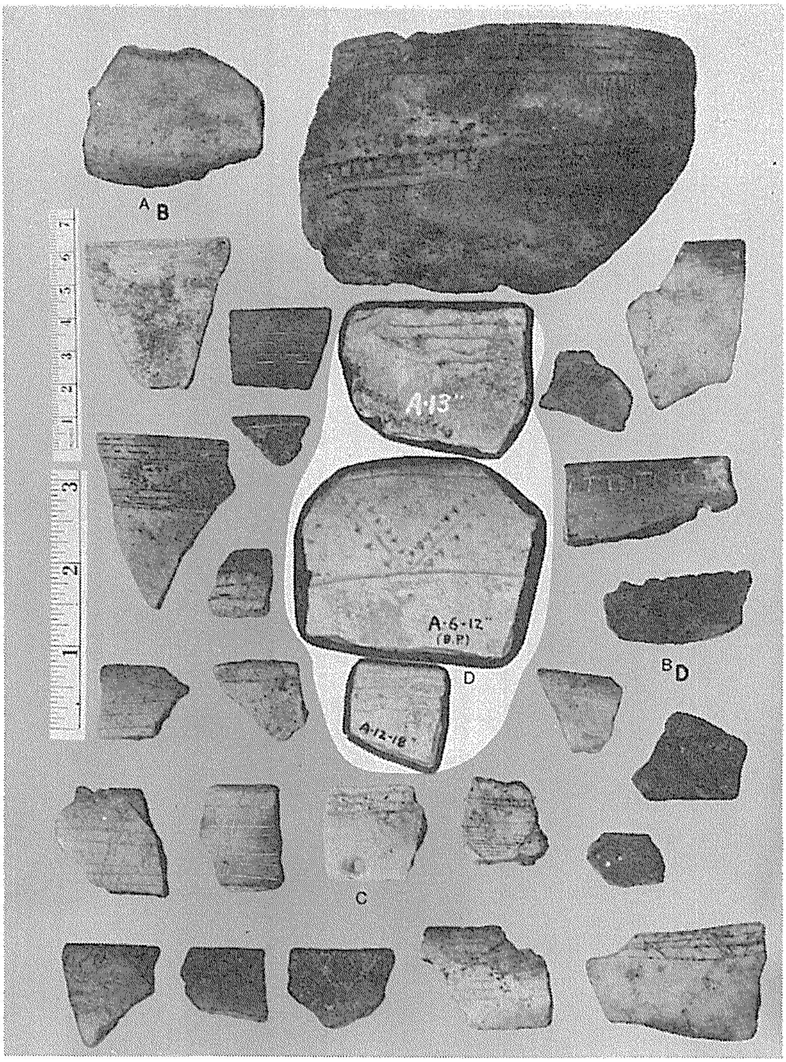


Figure 17. Incised Ceramics from the Nine Galena Campsites: a, vessel with incurving wall; b, scalloped rim sherd; c, incised rim with suspension hole; d, incised-punctated rim sherd.

(Aten 1983:231-237). Aten (1983:237-238) also describes the distribution of Mandeville and Techefuncte wares in the area.

The two preliminary Galena site manuscripts were filed in December 1958 and February 1959; the first covered the Galena shell midden findings and the latter the excavations at the nine Galena campsites (Ring 1958, 1959). In both

Table 4.

Provenience of Pottery from the Galena Campsites

Sherd Type	0-6" level	6-12" level	12-18" level	Total
Body	988	1879	1967	4834
Plain Rims	40	70	77	187
Decorated Rims	30	48	62	140
Round and Pointed Base	5	15	12	32
Flat Base	1	0	3	4
SUM	1064	2012	2121	5197

manuscripts, all pottery was described as Goose Creek ceramics of the Galveston Bay Focus. Today, over three decades later, with knowledge gained in the upper Texas coast from new archeological investigations, scores of published reports, and from over 50 times as many radiocarbon dates, different ceramic concepts have been developed by current researchers. In updating conclusions regarding the Galena ceramics, the author accepts the findings of Lawrence E. Aten (1983), who has not only done exhaustive field work on the upper Texas coast but has incorporated the observations of a multitude of others in his writings.

Aten (1983:192 and Figure 14.2) examined the Galena site pottery sherds, now curated at the Texas Archeological Research Laboratory at Austin. He concluded that the collection consists of Goose Creek Stamped, Tchefuncte Plain, and Mandeville Plain, all types characteristic of the Clear Lake period. The Clear Lake period extends from about A.D. 100 to about A.D. 425, and represents the period when pottery is introduced in the Galveston Bay area (Aten 1983:275, 284, 291).

It is not necessary here to thoroughly discuss the physical similarities and differences of the Goose Creek, Tchefuncte, and Mandeville ceramics. Aten (1983:219-220, 231-238, and Figure 12.1) has described them adequately and judged them to be generally contemporaneous.

Pottery sherds were found in direct contact with both *Rangia cuneata* radiocarbon samples from the Galena shell midden. The upper sample, Humble O-911, taken at the very top of the middle shell layer, yielded an uncorrected date of 1900 ± 105 years B.P. (A.D. 50 ± 105). The lower sample, Humble O-912, came from the very base of the middle shell layer and yielded the date of 3350 ± 115 years B.P. (1400 ± 115 B.C.). Aten (1983:275) corrects the O-911 sample date to A.D. 285 ± 103, still within the Clear Lake period. He offers no correction factor for the O-912 radiocarbon sample date as this sample was in contact with the Beaumont Formation and would have been permeated with "dead carbon" mobilized by groundwaters (Aten 1983:193, 341).

CORDAGE

The use of twisted cord was noted from the Galena shell midden as four cord-impressed pottery rims from two different vessels were recovered. The one provenienced sherd came from the upper half of the middle shell layer.

ASPHALTUM

The presence of asphaltum was observed among the artifacts recovered from the Galena sites. It was used principally as a glue for hafting chert, bone, and antler projectile points. In the nine Galena campsites, asphaltum was noted on the stem of a Kent dart point, on a Catahoula arrowpoint stem, and inside a socketed-bone projectile point from 41HR62; these artifacts were all found in the basal cultural deposits. Additionally, a rounded asphaltum pellet was found in the uppermost 15.2 cm in one of the Galena campsites.

In the Galena shell midden, asphaltum occurred primarily in the middle shell layer, but was also present in the upper loam layer. A socketed-antler bunting point was heavily packed with asphaltum (see Figure 8i), leaving the tapered impression of the former shaft. A socketed-bone projectile point contained a film of asphaltum inside the socket (see Figure 7n). Three dart points recovered from the middle shell layer, two Kent and one Gary (see Figure 8q-s), contained numerous asphaltum specks that were the remains of heavy coatings.

The middle shell layer also yielded a deer ulna spatulate awl tip (see Figure 7d) that was cut off and smoothly abraded on the cut end, notched on the edge, and then packed with asphaltum in its natural-hollow center. The processing of this artifact would have taken considerable time and care but the practical use of this object is not presently understood.

A few other artifacts from the Galena shell midden evidenced use of asphaltum. Several bone fragments and shellfish valves had asphaltum patches, and an asphaltum splash was also seen on a polished cut-bone artifact (see Figure 7g).

A stout gray pottery sherd contained several thick asphaltum globules attached to the exterior, as confirmed by carbon-tetrachloride testing. Two of seven conjoined pottery rim sherds had splotches of asphaltum on their exteriors, in part covering the decoration.

The distribution of asphaltum in archeological sites along the Gulf Coast shoreline, extending from Louisiana to Mexico, is quite widespread. The source of this asphaltum is undoubtedly the prehistoric black oil seeps from fractured Cretaceous limestones in the Tampico-Tuxpan Embayment (Ring 1960).

FEATURES: PITS AND HEARTHS

Several features were found in the Galena site investigations. These include fire pits and a possible hearth.

The three fire pits were uncovered in the Galena shell midden. The most prominent, in the site's north quadrant, originated in the upper loam layer. It was noted that darker and ashy deposits were common in the upper loam layer for a few feet away from the pit. The pit had a cylindrical form, 52 cm in diameter, that was rounded at the bottom. The pit's vertical walls pierced the shell and lower clay layers where the rounding of the base began, and it bottomed out 2.5-5 cm into the sterile Beaumont Formation.

No stones were present as a pit lining. Rather, the pit fill consisted of a loosely consolidated loam intermingled with gray ash. Few artifacts were observed in the upper part of the pit; however, the lower part contained seven darkly scorched *Rangia* shells, about an equal number of carbonized bone fragments, and a number of charcoal particles and pieces.

A second pit was found in the south quadrant. It was shaped the same as the first fire pit, and was 38.1 cm in diameter and 48.3 cm in depth. It appears to have originated at or near the top of the middle shell layer, and extended into the lower clay layer. The pit fill was a mass of debris consisting of shell, bone, and pottery sherds, along with ash and carbonized remains. The walls of the pit could be distinguished by the alignment of the debris in the pit. Instead of being layered horizontally, the shellfish valves and other artifacts were cross-bedded, and in some instances were vertically aligned. This pit may have been used briefly as a fire pit before it was later filled with garbage.

A third fire pit was found in the extreme northeast edge of the shell midden. At the depth of 15.2 cm below surface, in the upper loam layer, a fairly substantial layer of charcoal was identified over a 45.7 cm diameter area. Some lightly carbonized pieces of charcoal in the pit indicated the wood might have been cypress. The charcoal was completly enveloped in the upper loam's root system, and appeared to rest in the loam layer.

In the nine Galena campsites, only one possible hearth or fireplace was identified in site 41HR62. This consisted of a fairly dense and ovate accumulation of charcoal about 20.3 cm by 30.5 cm in size and between 2.5-5.0 cm in thickness. No evidence of a pit was noted, however.

About 770 charcoal fragments were found scattered throughout the soils at the nine Galena campsites. Approximately 50 percent of the charcoal pieces were recovered in the 0-15.2 cm level, another 27 percent in the 15.2-30.5 cm level, and the remainder below 30.5 cm+. Since the charcoal fragments occurred throughout the campsite soils, forest fires or burned housing does not appear to be responsible for their distribution. Rather, undergrowth fires seem more plausible as charcoal producers in this dense forest of large trees and small undergrowth.

EVIDENCE OF HOUSES

No post molds were seen at the Galena shell midden. Due to the very dark color of all organic soil in the cultural deposits, they are probably not readily discernible.

At the approximate center of Galena campsite 41HR67, a clearly identifiable post mold was encountered. The extremely dark organic color of the post mold was detected at five cm bs after the organic deposits of more recent forest material had been cleared from the surface. The post mold formed an oval measuring 22.9 cm by 30.5 cm to the base of the cultural deposit (ca. 41 cm bs). The post mold began to taper just below this point and was 15.2 cm by 20.3 cm in dimension at 91.4 cm in depth. At 119.4 cm below the surface the mold ended in an abrupt point. The depth of the post mold was 78.7 cm below the top of the Beaumont clay surface into which it was anchored.

The post mold fill at its base was a very dark, finely-divided, sandy material entirely unlike the light gray-brown, dense, sticky Beaumont clay enveloping it. The margins of the post mold contained considerable charcoal. At the depth of 66 cm bs in the post mold, or 25.4 cm into the sterile Beaumont Formation clay, two large Goose Creek plain rim sherds and one small Goose Creek body sherd were recovered.

This large post hole was apparently dug into the ground by hand, the post placed in it, and then dirt was thrown in and packed around it. The presence of pottery sherds far below the cultural deposits supports this. The charcoal at the circumference of the post mold may represent the original firing of the post to thin and taper it. A post of such large dimension is suggested to have been the center post of a structure. Unfortunately, the author was not able to excavate further at the site to locate other possible structural post molds.

Two adjacent test pits in campsite 41HR64 had possible small post molds measuring 10.2 cm in diameter. One extended to at least a depth of 91.4 cm bs. Neither mold was fully investigated, however.

HUMAN REMAINS

The only human skeletal remains found in the ten Galena sites consisted of a burial excavated from campsite 41HR62 in March 1960. Due to the homogeneous character of the campsite soil, the level at which the grave was excavated was not discernible, but the base of the grave extended into the Beaumont Formation. In fact, except for a portion of the skull, all bones lay in the Beaumont clay.

The skeletal material was oriented approximately true north-south, with the head facing to the north (Figure 18). The individual was buried face down with the remainder of bones beneath the head. This burial may be a bundle burial, or perhaps a tightly laced burial with the head placed face down. Since the burial was in the Beaumont clay, the skeletal remains were not well preserved. Photographs were taken by Alan R. Duke under adverse lighting conditions and a torrential downpour during the night put an end to any further photography. No burial offerings were found with the burial.

Dr. T. W. McKern, a forensic anthropologist at the University of Texas, identified the individual as a "robust, fairly short male, an old adult probably in his early fifties. From all indications, the remains were tightly flexed. It simply does not look like the secondary disarticulated burials I have seen elsewhere" (Dr. T. W. McKern, November 1960 personal communication).

RADIOCARBON DATING

In May 1959, the Geochemical Laboratory, Exploration Department, of the Humble Oil and Refining Company (now Exxon) agreed to conduct two radiocarbon tests on *Rangia cuneata* shells from the Galena shell midden. The results were:

Humble Run No. 911	1900 ± 105 years B.P. (A.D. 50 ± 105)
Humble Run No. 912	3350 ± 115 years B.P. (1400 ± 115 B.C.)

The specific radiocarbon samples came from pit A-7-A about 3.1 meters east of the approximate center of the Galena shell midden. The vertical strata in the pit were as follows: Upper Loam Layer, 0-17.8 cm, Middle Shell Layer, 17.8-43.2 cm, Lower Clay Layer, 43.2-53.3 cm, and the Beaumont Formation below 53.3 cm. The shells from Humble Run No. 911 were gathered from the top three cm (17.8-20.3 cm) of the middle shell layer. In direct association with the *Rangia* sample were six Goose Creek pottery sherds, chert debris, bone refuse, and the distal tip of a socketed bone projectile point. Humble Run No. 912 shells were collected at the depth of 40.6-43.2 cm at the base of the middle shell layer. Artifacts associated with this *Rangia* sample included chert debris, bone refuse, and six Goose Creek pottery sherds, one the base of a flat-bottomed vessel.

These two radiocarbon samples do not necessarily represent either the oldest or the youngest occupations in the shell midden because a small amount of scattered cultural material was observed below the oldest sample and a considerable amount of cultural material was found above the youngest sample. The samples were purposely selected to try to obtain the oldest and youngest dates of

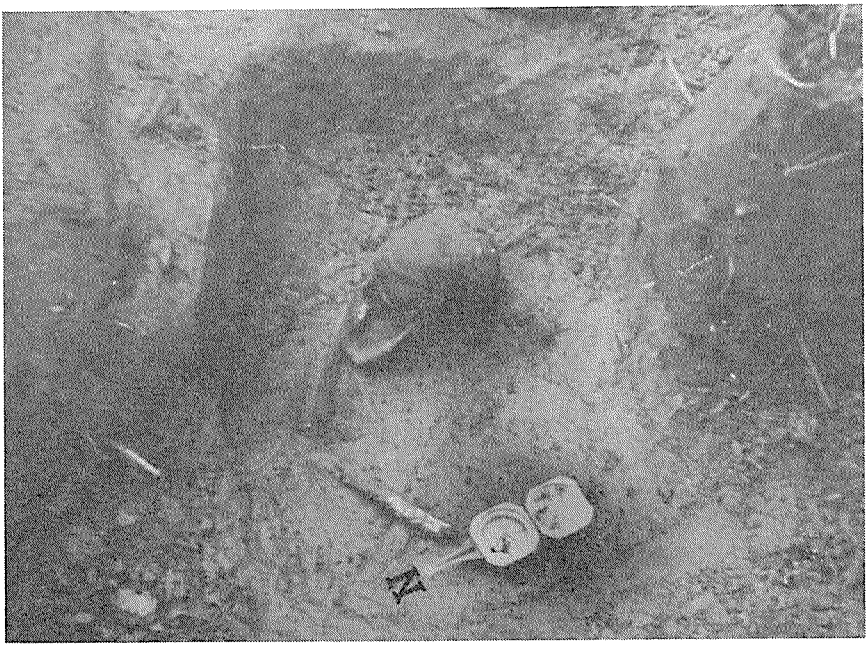
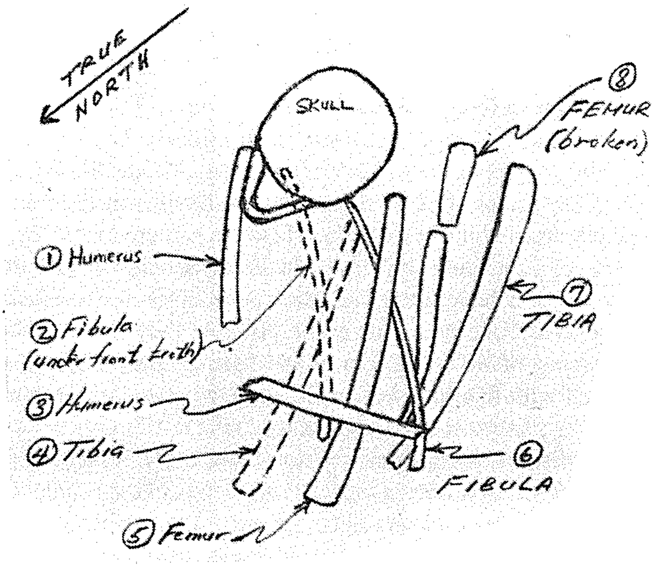


Figure 18. Burial from 41HR62. Brunton compass points true north.



intensive shellfish consumption at the site, and also to obtain information on the temporal span of Goose Creek ceramics.

Both the great antiquity, and the long time span the radiocarbon dates indicated for Goose Creek pottery at the Galena shell midden, compelled the author to make an exhaustive search of the coastal archeological literature covering pottery types and dates (Ring 1961b). The O-912 sample date of 3350 years B.P. led to the speculation that southeastern Woodland pottery might have been adopted on the upper Texas coast much earlier than then believed. In 1959, the two Galena radiocarbon dates of 1900 and 3350 years B.P. were the only existing radiocarbon dates from the upper Texas coast. Today there are more than 100 radiocarbon dates (Aten 1983:273-281) and the considerable age of *Rangia* sample O-912 has since been reassessed by Aten (1983:192-193, 275, 341).

As previously mentioned, Sample O-912 was gathered at the base of the middle shell layer at its contact with the lower clay layer. This layer was often suspected of being the extreme top of the Beaumont Formation that had perhaps been reworked by precipitation or human feet; it seemed to be a cultural "zone" rather than a distinctive natural depositional layer. Aten (1983:341 and Table 14.1) shows that all of the seven *Rangia* samples tested in the upper Texas coast that were in contact with the Beaumont Formation, including Galena sample O-912, have produced abnormally ancient dates. He attributes this to the "dead" carbon of this geological formation having permeated the *Rangia* shells after the carbon has been mobilized by groundwaters (Aten 1983:193, 341). Consequently, Aten did not propose a correction factor for sample O-912.

Now, some three decades later, the illusion of 3350 year old Goose Creek pottery is dispelled; however, the upper Galena *Rangia* sample O-911, at 1900 years B.P., comfortably equates with the initial introduction of ceramics in the Clear Lake period on the upper Texas coast. Aten (1983:275) has corrected this radiocarbon date to A.D. 285 ± 103.

SUMMARY AND CONCLUSIONS

When the Humble Oil and Refining Company radiocarbon dates were received in June 1959, dating the upper and lower cultural layers in the Galena shell midden at 1900 years B.P. and 3350 years B.P., respectively, the author was startled by both the great antiquity of their dates and their long time span. Then, too, sand-tempered Goose Creek pottery sherds had been found in direct contact with both *Rangia cuneata* samples, thus apparently sharing in both the apparent antiquity and cultural longevity shown by the radiocarbon results.

During research for this paper (Ring 1961a, b), the author found that sand-tempered pottery had been around for a very long time in the southeastern U.S. woodlands. Webb and DeJarnette (1948a-d) had investigated four fabulously thick shell middens along the Tennessee River in northern Alabama. They found fiber-tempered and sand-tempered pottery sherds so thoroughly mixed above pre-ceramic levels that it was not possible to clearly distinguish which type of pottery antedated the other. Later, however, fiber-tempered pottery was established as the older ceramic ware, but the 1940s observations of Webb and DeJarnette for these Tennessee River shell middens led the author to wonder if Goose Creek pottery might have been used at the Galena sites some 3000 years or so ago as suggested by the Humble radiocarbon sample O-912 (Ring 1961b).

Today in the upper Texas coastal region, three more decades of research have led to a better understanding of pottery chronology than at the time of the Galena site investigations. As to the Galena shell midden sherds having been in direct contact with both *Rangia* radiocarbon samples, reassessments are necessary because of technological developments. The older Humble radiocarbon sample O-912 has been set aside because it was in contact with the Beaumont Formation that has been found to contaminate *Rangia* shell due to infiltration of "dead" carbon in the groundwater (Aten 1983:193, 341). Also, a certain amount of stratigraphic mixing was indicated at the base of the middle shell layer at its contact with either natural or reworked Beaumont clay.

Humble radiocarbon sample O-911 has been adjusted to A.D. 285 ± 103 by Aten (1983:275). This indicates that the Goose Creek, Tchefuncte, and Mandeville pottery found in association with sample O-911 falls into the Clear Lake period defined in the Galveston Bay area (Aten 1983:285 and Figure 14.4). Aten (1983:233) also shows that Goose Creek sherds extend from the Clear Lake period to the Old River period (dated about A.D. 1350-1725), and possibly into the later Orcoquisac period (A.D. 1725-1810).

The author has purposely refrained from discussing the later San Jacinto (grog-tempered) pottery because of uncertainties about its presence at the Galena sites. The San Jacinto pottery type was proposed by Richard B. Worthington (1959) shortly after the final preliminary Galena site report was prepared (Ring 1959). It is perhaps significant that Aten (1983:192) does not specifically mention the presence of San Jacinto sherds in his examination of the Galena ceramics at the Texas Archeological Research Laboratory. Even more significantly, Aten et al. (1976:78) state that in their examination of the Galena shell midden that "ceramics were common but grog-tempered wares were conspicuously absent."

Other artifacts recovered from the Galena shell midden, particularly the chert tool assemblage, do not contradict the radiocarbon dates of 1900 and 3350 years B.P., even though the latter date has since been set aside. The dart points fall into Aten's pre-ceramic period, dating from ca. 1600 B.C.-A.D. 100, and the single Perdiz arrowpoint probably equates with the Round Lake or Old River periods of the Late Cultures (Aten 1983).

In general, the nine adjacent Galena campsites, 41HR62-41HR70, seemed to be "younger" in age than the shell midden because of the presence of equal numbers of arrowpoints in all levels. These were intermingled with dart points, however. In the final reckoning, the chert tools in the campsites paralleled that of the Galena shell midden, as was the case with the pottery assemblage. Based on the chert tools, the nine Galena campsites spanned the same time as the shell midden, from ca. 1600 B.C. to ca. A.D. 1600.

In terms of stratigraphy, all 10 Galena sites were established atop the Beaumont Formation clay; for all practical purposes, the deposits averaged 46 cm in thickness. The lower clay layer in the midden was perplexing. At times, the layer seemed to represent the original Beaumont Formation clay with occasional episodes of a few shells, bones, and dart points having been stomped into a "gummy" surface, but it contained sufficient materials suggestive of being a distinctive cultural deposit. In any case, the base of the middle shell layer represented the first intensive occupation of the midden.

Pottery use was well established when the nine Galena campsites were occupied. The sherds at the lowest depths were found with both dart points and arrowpoints, signifying some soil/artifact mixing. In the shell midden, pottery first occurred at the base of the middle shell layer, dominated by dart points, and became more common through time. This, too, tends to suggest that the intensive occupancy of the Galena shell midden began at the base of the lower shell layer, with scattered episodes of pre-ceramic occupation below the shell layer. In all 10 Galena sites, pottery continued to be used until the last occupants permanently abandoned them.

Although a *Rangia cuneata* shellfish sample was gathered from the lowest cultural deposits at campsite 41HR62 for radiocarbon dating by an agency other than Humble Oil Company, the sample was lost. In all likelihood, it would have been contaminated from having been in direct contact with the Beaumont Formation's "dead" carbon. Thus, there is no radiocarbon dating from any of the Galena campsites for comparison with the shell midden dates. The conjoined Edwards chert knife or flesher from the shell midden (the middle shell layer) and 41HR62 suggest that the latter was also occupied during the Clear Lake period.

The Galena shell midden and the adjacent campsites may represent an associated but functionally distinct group of settlements. There may have been more campsites in the immediate area but no other shell midden is known. An apparent house center-post mold was identified at campsite 41HR67. It is suggested that the post was planted in Late Prehistoric times since it became apparent almost immediately below the mantle of modern forest debris.

As to the human interment at 41HR62, no direct evidence was found to indicate when the body was introduced to the grave, due principally to the homogeneous character of the cultural deposits. The tightly-flexed, face-down burial was entombed in sterile Beaumont clay except at the back of the head. The head lay above the rest of the body, and this means that the grave cavity was located near the middle or top of the deposits. This suggests the burial may date to Late Prehistoric times (cf. Aten 1983:155).

The chert tool assemblage reflects a period of occupation from ca. 1600 B.C. to after A.D. 1000. The significant recovery of dart points at pre-ceramic depths in the Galena sites suggests occasional episodes of short visits in Late Archaic times. It appears the sites were intermittently occupied over a fairly long time span, perhaps for as many as 2500 years, possibly between 1500 B.C. and A.D. 1000. These nomads probably departed the sites as game and shellfish resources diminshed along Hunting Bayou.

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Prehistoric Sandals from the Ocampo Region, Coahuila, Mexico

Solveig A. Turpin and Stephen M. Carpenter

ABSTRACT

Fifty-seven sandals unsystematically collected from dry rock shelters in the Ocampo region of Coahuila provide evidence of variability in the northern Mexican fiber industry approximately 1000 years ago. The assemblage is dominated by 27 braided sandals, a type defined at Frightful Cave, some 60 km to the southeast near Cuatro Ciénagas, where only six specimens were recovered. One braided sandal fragment from the El Fuste collection produced a stable carbon isotope corrected radiocarbon date of 1110± 60 B.P. (TX-7814) which calibrates to the range from A.D. 870 to 990. Braided sandals reflect a break in the chronological and spatial continuum usually attributed to the cultural complexes of northern Mexico and southwestern Texas.

INTRODUCTION

An assortment of fiber artifacts unsystematically collected from dry rock shelters in the Ocampo region of Coahuila, Mexico, was analyzed to determine their scientific value and their relationship to similar assemblages from the Cuatro Ciénagas Basin, 60 km to the southeast, and the Lower Pecos region of Texas, 280 km to the northeast (Figure 1). The 57 complete and partial sandals that make up the bulk of the collection proved to be the most informative and are the focus of this report. Descriptions and photographs of these specimens, the few items of basketry, miscellaneous cordage, and other artifacts will be filed at the Texas Archeological Research Laboratory, The University of Texas at Austin, and with the Instituto Nacional de Antropología y Historia in Mexico.

NATURAL SETTING

This collection can be generally attributed to three dry rock shelters on the western flank of the Sierra el Fuste, a small mountain range that follows the same northwest-southeast trend as its northeasterly neighbors, Sierra de la Encantada, Sierra de la Carmen, and Serranías del Burro (Smith 1970; Abbott 1905). The majority of the sandals came from one shelter, Red Arrow Cave, that faces south from the palisaded wall of a tributary canyon that enters the Potrero Cuervo

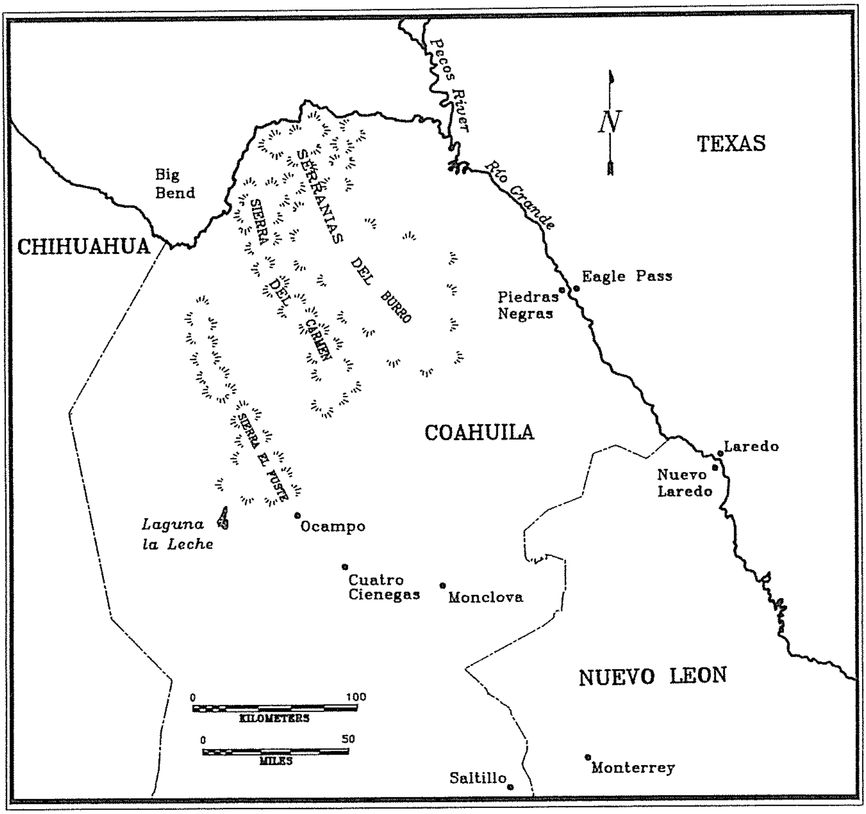

Figure 1. Map of Coahuila, showing general relationship between Ocampo, Cuatro Ciénagas, the Big Bend, and the Lower Pecos region.

Chico (Figure 2), a small basin surrounded on three sides by mountains that form the southeastern boundary of the Llano el Macho.

On a larger scale, the Sierra el Fuste is one of the small mountain ranges included in the Bolson de Mapimí, best known as the arid sanctuary from which hostile native people retaliated against Spanish expansion into the desert north. The area is also on the northern periphery of the Laguna District, so named for the numerous playa lakes that cover large portions of the valley floors. Visible from the passes that lead to the Potrero Cuervo Chico is the broad barren expanse of the Laguna la Leche, a dry lake bed that supports an abundance of saline-tolerant plants when it intermittently fills with runoff. The shelter dwellers, however, would have been supplied potable water by springs that seep from the mountainsides or casual water retained in natural cavities in the limestone bedrock. One deep tinaja was reported in the bottom of the canyon, below the El Fuste caves, and another, in an adjacent canyon, had apparently collapsed in relatively recent times.

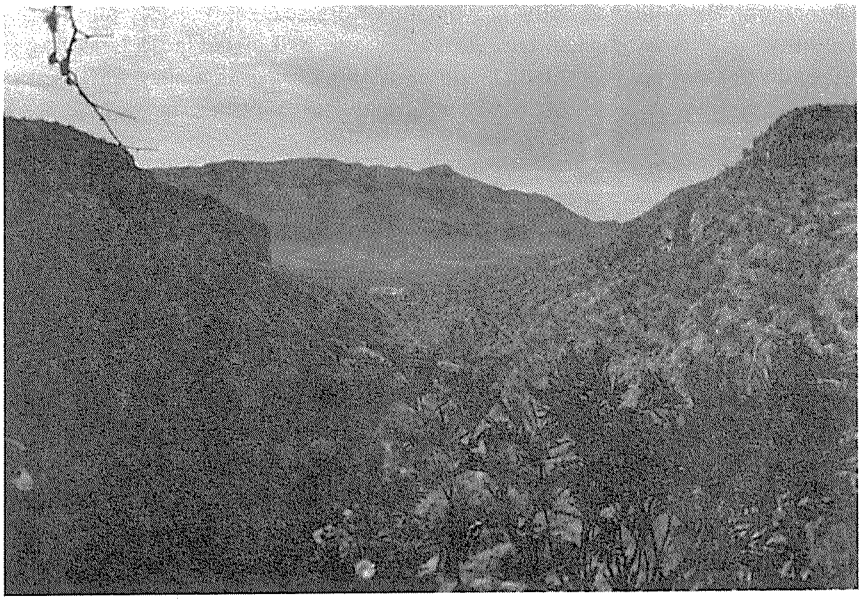

Figure 2. View of the local topography; note rockshelter on right wall of canyon.

Another possible source of the mesic vegetation seen in the collection is suggested by a large reservoir that was created by damming a small gap in the foothills that is the only outlet of Potrero Cuervo Chico. Runoff from the encircling mountain slopes may have been impounded there naturally in prehistoric times as well, supporting the sedges and reeds used by prehistoric people in the El Fuste caves.

The area is classified as Chihuahuan desert scrub with semidesert grasslands flourishing at higher elevations (Brown and Lowe 1980; Smith 1970:Figure 20). The modern vegetation is dominated by creosote bush and cacti on the plains and in the basins (Bryant and Riskind 1980), giving way to grasslands with scattered agave, yucca, and cacti on the slopes. In the Potrero Cuervo Chico, the desert scrub grades into the piedmont scrub of the Sierra Madre Oriental vegetational community (Bryant and Riskind 1980) above the elevation of the rock shelters, ca. 1550 meters amsl. The most important attribute of the Chihuahua Desert, in terms of human occupancy, is the wide variety of plant communities in proximity (Bryant and Riskind 1980:11-12).

The shelters all appear to be relatively small and shallow. Burned limestone and ashy fill reflect a long history of site use but stone tools and debitage are not abundant. All of the lithic material was collected from the surface of one site. A splintered fragment of highly polished wood that bears battering and scrape marks on its burnished point, reflecting its hard use as a digging stick, and a smoothed deer bone weaving tool complete the inventory of non-fiber artifacts.

Also among the collected items is a bundle of dry sedges, probably bull rushes, that grow only in marshy habitats, such as the nearby Laguna la Leche during its intermittent ponding. Reportedly, one unoccupied cave that may have served only mortuary purposes also held large quantities of *tules*, or generic reedy plants, and a dehydrated peyote bud was observed in Red Arrow Cave but not kept.

The overall impression of the El Fuste caves is of sheltered sites occupied sporadically for short periods when it would not be too uncomfortable to have interior fires in small spaces. A number of geometric and abstract pictographs painted on the walls and ceilings of the various shelters, however, point to more than a simple expediency of occupation. Polychrome zigzag lines, herringbones and diamonds, an intricate multi-colored maze design, a number of monochromatic "tally marks," and a solid, red contracting stem barbed dart or arrow point, are the most discernible designs. The bulk of the El Fuste collection can be attributed to Red Arrow Cave where the maze pictograph so intrigued treasure hunters that they dug a huge hole directly beneath it, exposing a number of artifacts. Random linear cut marks have been incised into the dense smooth indurated skin of the limestone in at least one of the sites. All of these designs would fit well within the desert geometric tradition of the north central Mexican states (Heartfield 1976) and the Lower Pecos region of Texas (Turpin 1986).

CULTURAL CONTEXT

Although no formal archeological work has been carried out in the immediate area of the Sierra el Fuste, in the 1940s Walter W. Taylor (1988) excavated or collected specimens from Frightful, Fat Burro, and 14 other caves near Cuatro Ciénagas, 60 km to the southeast. In large part, these data formed the basis for his cultural chronology, settlement pattern model, and artifact typologies (Taylor 1964, 1966). Although only a few of his findings have been published, fortunately for this study Taylor (1988) reported the sandal component of the fiber industry in great detail.

Subsequently, considerable research in the Laguna Mayran district, southwest of the Sierra el Fuste, concentrated on open sites (where perishable artifacts could not survive), mortuary caves, and rock art (Heartfield 1976). The analyses of the textile industry from the most famous cave in Coahuila, Candelaria, unfortunately did not include a description of the more mundane specimens such as sandals (Weitlander-Johnson 1977). In his popular descriptions of Coahuilan prehistory, Cardenas (1978:n.p., 1990:26) illustrates sandals which he collected or observed in the Ocampo region, but details of their construction are difficult to reconstruct from the figure reproductions.

The topographic constraints exercised by the many small mountain ranges of the Bolson de Mapimí suggest that cultural similarities would follow the northwest-southeast trend of the valleys, leading to the Big Bend region of

Texas. However, the few early descriptions of sandals from dry rock shelters in that region lack the detail necessary for meaningful comparisons (Smith 1933).

Some 280 km north of Ocampo, the dry caves of the Lower Pecos River region provide a comparative collection of basketry, matting, cordage, and other perishables (Andrews and Adovasio 1980; McGregor 1992). This includes a large number of sandals that have been analyzed in detail (Collins 1969; King n.d.; Maslowski 1978; Schuetz 1956, 1963; Thomas 1933; Williams-Dean n.d.). Based on his extensive experience with the fiber industry in northern Mexico, especially Frightful Cave, and the Lower Pecos region, as represented by Hinds Cave, Adovasio (1980:97-98; Andrews and Adovasio 1980:368) proposed that a broad tradition, evidenced by shared technology, environment, and economy, persisted from about 7500 B.C. until European contact in the sixteenth century. The sandals from the Sierra el Fuste, however, illustrate one deviation from this remarkably uniform prehistoric technological trajectory.

THE SANDALS OF SIERRA EL FUSTE

This collection includes 49 complete and 8 fragmentary sandals that were divided into groups, following where possible typological categories established by Taylor (1988) and Schuetz (1956). The types added to Schuetz' classificatory system by King (n.d.), based on her analysis of the Hinds Cave materials, are not represented in the El Fuste collection. The general characteristics of 56 specimens, omitting one fragment that was destroyed during radiocarbon assay, are tabulated for ease of reference (Table 1).

Table 1.

Sandal Characteristics

Group	Type[1]	Length[2]	Toe Width	Heel Width	Ties	Material Type
1	Pl	25.5	8.3	5.5	A[3]	L[4]
1	Pl	23.0	10.0	7.5	P	L
2	T	18.0	8.5	7.5	A	L
2	T	15.5	7.0	6.0	A	L
3	B	25.0	8.5	7.5	A	L
3	B	23.0	8.0	7.5	P	L
3	B	29.5	10.5	9.5	P	L
3	B	24.0	7.5	8.0	A	L
3	B	24.0	9.5	8.0	P	L & H
3	B	29.0	9.5	7.5	P	L & H
3	B	28.5	9.5	9.0	P	L
3	B	27.5	11.0	8.0	P	L

Table 1. (Continued)

Sandal Characteristics

Group	Type[1]	Length[2]	Toe Width	Heel Width	Ties	Material Type
3	B	24.5	9.0	9.0	P	L
3	B	18.0	7.5	5.5	P	L
3	B	26.0	9.5	7.5	A	L
3	B	28.5	8.0	6.5	P	L
3	B	18.5	7.5	7.0	P	L
3	B	26.0	9.5	9.5	P	L
3	B	23.0	8.0	7.0	P	L
3	B	19.0	8.5	-	P	L
3	B	27.5	7.5	7.0	P	L
3	B	20.0	7.0	5.5	P	L
3	B	25.0	7.5	8.0	P	L
3	B	26.5	8.5	7.0	P	L
3	B	23.0	8.5	-	P	L
3	B	25.5	8.0	6.5	P	L
3	B	26.0	8.0	10.0	P	L
3	B	28.5	10.0	9.5	A	L
3	B	26.5	8.0	9.5	P	L
3	B	27.5	10.0	9.0	A	L
4	T	24.0	10.5	8.5	P	L
4	T	24.5	9.0	7.0	P	L
4	T	30.0	11.0	9.5	P	L
4	T	10.0*	-	9.0	A	L
5	C	22.5	12.0	11.5	A	L
5	C	22.0	11.5	10.5	P	L
5	C	22.5	11.5	11.0	A	L
5	C	22.5	10.0	10.0	P	L
5	C	20.5	7.5	-	P	L
5	C	9.5*	-	7.5	A	L
5	C	18.0	-	9.0	A	L
5	C	19.0	-	10.5	A	L
5	C	22.5	10.5	8.0	P	L
5	C	24.0	9.0	7.5	P	L
5	C	21.5	10.5	9.5	A	L
5	C	24.0	11.5	10.5	P	L
5	C	21.0	9.0	9.5	P	L
5	C	18.0	9.5	-	A	L
5	C	10.0*	-	-	A	L
5	C	26.5	10.5	8.5	P	L

Table 1. (Continued)

Sandal Characteristics

Group	Type[1]	Length[2]	Toe Width	Heel Width	Ties	Material Type
5	C	13.5	-	10.0	A	L
6	T	27.5	-	-	P	L
6	T	23.5	10.0	9.0	P	L
6	T	11.0*	-	8.0	A	L
6	T	-	-	-	A	L
6	T	14.0	-	7.0	A	L

1 Pl=Plaited; T=Two Warp; B=Braided, and C=Checker Pad

2 All Measurements in cm

3 A=Absent; P=Present

4 L=*Lechuguilla*; H=*Hesperaloe*

* Indicates incomplete specimen

Group 1 (Figure 3a) includes two specimens that correspond to Taylor's (1988:44) *Flai*, a subtype of his more general category of plaited sandals:

> . . . plaited, two warp [sandals]. The warp frame is made of two elements laid parallel to form the lateral margins and to support the wefts; each warp element is turned inward to the opposite side at the toe-end and is turned around the warps ("plaited") in figure eights back toward the heel, forming the wefts; ties and padding are added to complete the construction.

Plaited sandals dominate Taylor's assemblage through time; 596 examples of subtype *Flai* were recovered from four sites with the majority, 570, coming from Frightful Cave. Plaiting is considered one of the characteristics of the Big Bend sandal industry (Smith 1933).

The two specimens in Group 2 (see Figure 3b) do not correspond to any of Taylor's types but they do conform to Scheutz' Type C (Williams-Dean n.d.:11):

> . . . construction has a double frame in which lecheguilla strands are loosely woven back and forth. When completed, the sandal is simply folded in half at the toe. The two halves are held together by tie-strings (Schuetz 1956:130).

Adovasio discusses one poorly provenienced specimen of this type from Moorehead Cave in the heart of the Lower Pecos region (Maslowski 1978: 247). King (n.d.) identified eight Type C sandals in the perishable materials from the

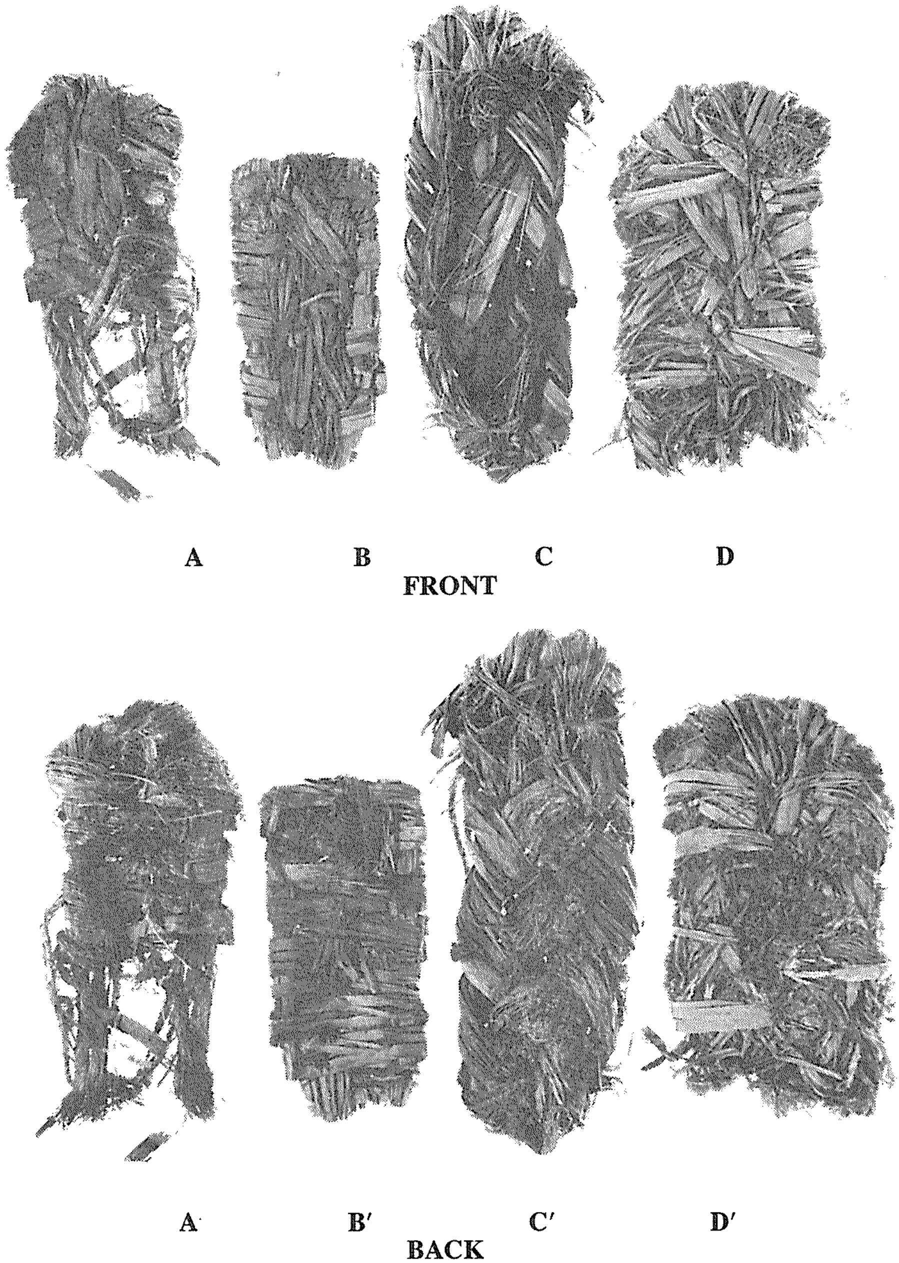

Figure 3. Four of the basic sandal types, front and back: from left to right, Group 1, plaited; Group 2, Schuetz's Type C; Group 5, checkerpad; and Group 6, untyped two-warp.

lower levels of Hinds Cave, suggesting to her that they are a very early style unique to the Lower Pecos region.

Group 3 (Figure 4), the largest and most informative in the El Fuste sample (n=27), was the rarest of Taylor's types. He recovered only six braided sandals, five from Frightful Cave and one from Fat Burro Cave. He describes them as "footgear made of two bundles of fiber doubled over each other and braided from toe to heel, where they are turned over and woven back up the sandal to form the padding" (Taylor 1988: 103). From the standpoint of manufacturing technique, Taylor considered these distinctive sandals to be unique and unrelated to the plaiting process by which the majority of the Coahuila foot gear was made. Braided sandals have no warp frames or pads; rather, they rely upon a single set of fiber elements and a single step of manufacture. None of his specimens

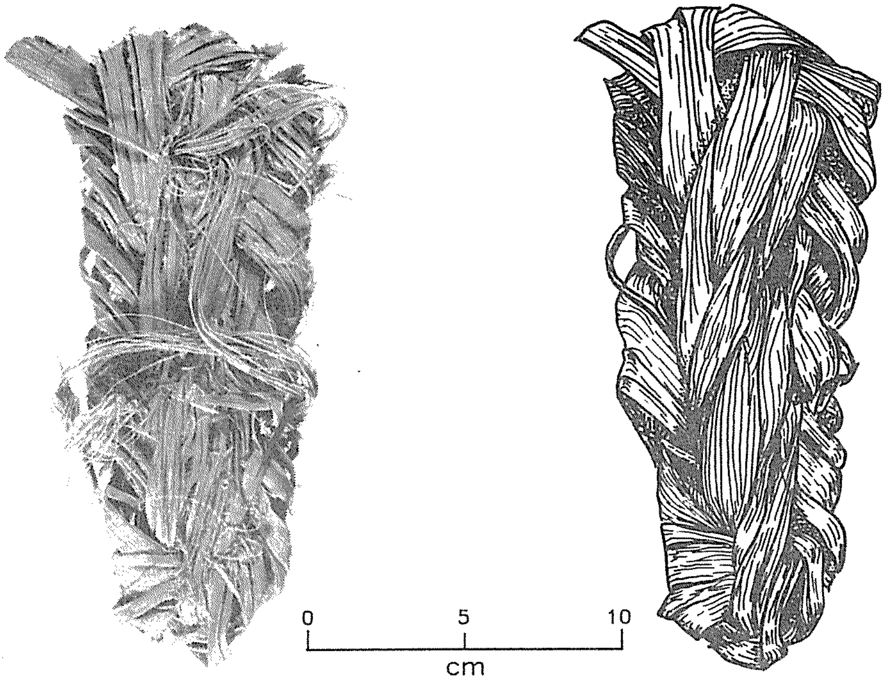

Figure 4. Photograph and schematic view of a Group 3 braided sandal, showing manufacturing technique.

retained toe strings, but he felt that they too would be unlike any of the ties he had observed on the plaited sandals.

Group 4 consists of three complete sandals and one heel fragment. It seems to be an elaborate form of the braided type (Group 3) which has been folded in half and stitched together.

Sixteen sandals were assigned to Group 5 (see Figure 3c), which equates to Coahuila type *F1c* (Taylor 1988:96), checker-pad sandals or "footgear made by sewing reinforcing and padding elements through the sides and across the ground side of a checker-plaited fabric" (Taylor 1988:96). Although Taylor (1988) recovered only seven checker-pad sandals from Cuatro Ciénagas, all from Frightful Cave, he considered this technique to be culturally related to twill padding but later in time.

Group 6 is miscellaneous untyped specimens. This group includes four untyped square-toed sandals whose warp, if present, is undetectable (see Figure 3d), and one fragment that is too deteriorated to classify.

DISCUSSION OF SANDAL TYPES

Comparing the 57 sandals from the Sierra el Fuste to Taylor's collection of over 1000 from the Cuatro Ciénagas Basin identifies both variability and complementarity in areas such as chronology, technology, raw materials, and the distribution of types. Group 1, with only two specimens or 3.5 percent of the El Fuste collection, contrasts dramatically with the 884 examples that constitute 92.2 percent of the Frightful Cave inventory. Group 2 also consists of only two specimens of a type not found in Taylor's assemblage, but is represented in the Lower Pecos region by Schuetz' Type C. The 17 checker-pad sandals of Group 5 comprise 29.8 percent of the El Fuste collection as opposed to less than 1 percent at Frightful Cave. The most dramatic difference, however, is in the relative percentage of braided sandals, Group 3 and possibly Group 4. Taylor (1988) recovered only six braided sandals, again less than 1 percent of his total inventory, contrasted with 31, or 54.4 percent of the El Fuste sandals. This much larger sample contributes to a better description of this type and permits some speculation on the variable distribution of the different styles.

Chronology

The five braided sandals in Frightful Cave were attributed to the Top Level, which postdates 1900 B.C. or 3850 years ago (Taylor 1988:Table 4-2). A braided sandal fragment from the Sierra el Fuste assemblage has a stable carbon isotope corrected age of 1110 ± 60 B.P. (TX-7814; C^{13} ratio of -11.0). Calibrated, there is a 97 percent probability that this date falls between A.D. 870 and 990 or the range from 960 to 1080 years ago (Stuiver and Reimer 1987). Twelve two-warp sandals from Frightful Cave and others from Fat Burro and Nopal caves were radiocarbon-dated to the range from approximately 1400 to 6200 years ago (Taylor 1988:Appendix B), so the differences in the two collections may be partially attributable to the disparate ages of these two styles. A basket fragment from another El Fuste cave, not associated with sandals of any type, produced a stable carbon isotope corrected radiocarbon date of 1340 ± 80 B.P. (TX-7804; C^{13} ratio of -11.2) which calibrates to the range from 1177 to 1312 years ago (Stuiver and Reimer 1987), adding another two centuries to the span of occupation at El Fuste.

Technology

In the stratigraphic sample from Frightful Cave, which spans several millennia of sandal construction, the braiding technique represents a distinct rupture in what might be perceived as a stylistic evolutionary continuum. Nearly all the sandal types in Cuatro Ciénagas and the Lower Pecos region use some variation of warp and weft construction in which the warp is a passive or stationary element around which the weft, or active element, moves. In the braided sandal type, all the elements are active; there are no warps. The fibers are first braided to create the top of the sandal, then folded over and interbraided from toe to heel to form the sole (see Figure 4). The tightness of the fabric indicated to Taylor the use of an awl, such as the one recovered from the caves in the Sierra el Fuste (Figure 5), in backweaving the padding. These sandals are well-made, of innova-

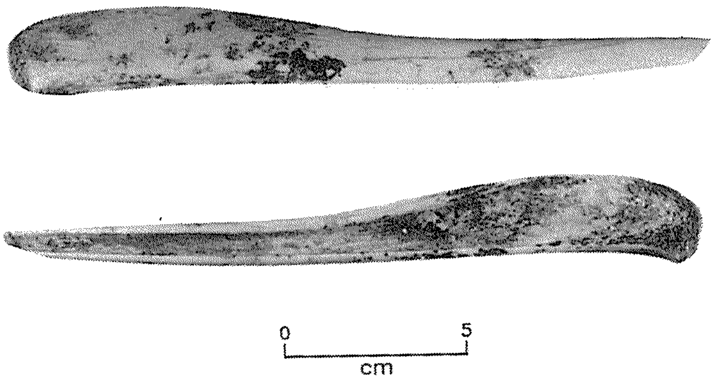

Figure 5. Deer bone awl associated with fiber artifacts in the El Fuste caves.

tive design, and show none of the cultural devolution sometimes attributed to the later phases of the Coahuilan Archaic period.

The braided sandals from Frightful and Fat Burro caves are missing their toe strings, a loss Taylor attributed to rodent gnawing. The few remaining parts indicated to him, however, that the style of toe strings was unlike any of the complete specimens in the Cuatro Ciénagas collection. Twenty-one of the braided sandals from El Fuste have intact or partial ties.

The sandal ties are generally made from two strips of lechuguilla that converge at the toe but, unlike most of the other sandal types, do not cross (Figure 6). They are drawn through the sole and tied off or, in some instances, brought back up through the padding to be knotted together on top. From the toe, each strip runs to the middle of the sandal where it loops around the side elements of the pad, from inside to outside, and continues back to form the heel loop. The two elements are interlooped at the heel, like the links of a chain, and brought back to tie onto the toe strap near its midpoint. The heel strap is attached by a loose granny knot that slides along the toe strap, making it adjustable. In a few of the more complete specimens, the dextral (right element) passes across the arch in front of the ankle, connecting to the sinistral (left element). Considerable ingenuity went into the design of this tie style.

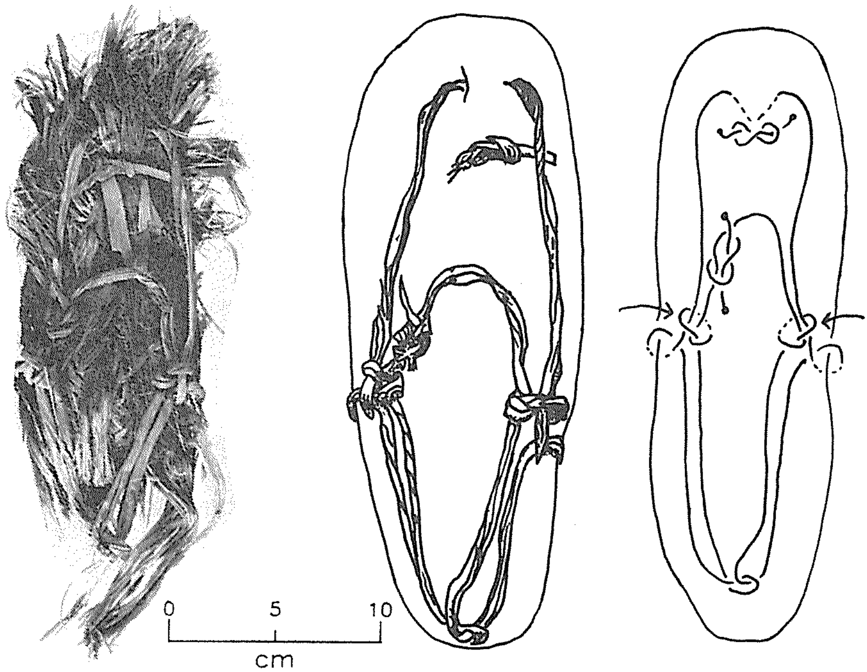

Figure 6. Photograph and diagrams of the most elaborate and complete examples of the adjustable tie string style found on braided sandals.

Raw Material Selectivity

The Frightful Cave sandal makers displayed an obvious preference for *Hesperaloe funifera*, or zamandoque, the raw material used in 93 percent of the plaited sandals. The few made of *Agave lechuguilla* were more prevalent in the Bottom Level, leading Taylor (1988:67) to suggest that selectivity changed over time. Five of his braided sandals are of zamandoque; the one example from Fat Burro Cave is yucca.

Lechuguilla was the mainstay of the El Fuste *sandaleras* who used it almost exclusively. Williams Dean (n.d: 33) noted that the Lower Pecos people were among the few who used lechuguilla rather than yucca in their sandal industry and suggested that the contrast may be an example of cultural bias. The Hinds Cave sandals were constructed primarily of lechuguilla, with some use of yucca, sotol, and beargrass (King n.d.:10). The Chihuahua Desert has such a high degree of topographic and edaphic diversity, however, that differences in construction materials may be a simple matter of expediency rather than purposeful selectivity. Certainly, today the slopes of the Potrero Cuervo Chico abound in lechuguilla in contrast to the more limited distribution of zamandoque.

IMPLICATIONS OF THE EL FUSTE COLLECTION

Only two sources provide a cultural context for the variability introduced into prehistoric Coahuilan sandal assemblages by the collection from the Sierra el Fuste. Fortunately, both Taylor (1966, 1988) and Adovasio (1980; Andrews and Adovasio 1980) emphasized the fiber industry, especially as present at Frightful Cave, only 60 km southwest of the current study area.

Based on his long experience in Coahuila, Taylor defined four complexes that differ from the usual cultural-historical sequences in that they encompass three basic traditions or industries: wood, plant fiber, and stone (Taylor 1966:67). The Coahuila Complex, which is roughly analogous to the Archaic stage in North American parlance, endured from the beginning of human occupation until well into the post-European contact period. In the last 1000 years of prehistory, congeries of new traits define the Jora and Mayran complexes chronologically, but they remain overlays on the main corpus which was the enduring traditions of the Coahuila Complex.

The two radiocarbon dates derived from fiber artifacts, a braided sandal 1110 years old and a coiled basket 1340 years old, place the El Fuste collection in Taylor's (1966: Figure 30) Mayran or Jora complexes, temporally equivalent to the Late Prehistoric period in the Texas chronology. Taylor (1966:Figure 17) attributed braided sandals to the late Coahuila, Jora, or Mayran complexes since he had no absolute dates from specimens of this type. The latter is primarily a mortuary complex and may encompass the basketry in the El Fuste collection that was associated with a child burial (Turpin et al. 1993). No item exclusively mentioned on Taylor's Jora Complex trait list securely attributes the El Fuste collection to that tradition but the variability in sandal design and technology is consistent with his impression of an overall increase in diversity. To Taylor, the Jora Complex was signalled by a number of introduced traits, possibly of foreign origin.

Adovasio (1980; Andrews and Adovasio 1980) treated the spatial parameters of the Coahuilan fiber industries, especially as manifested in basketry, matting, and cordage. The similarities between the northern Mexican assemblage, largely from Frightful Cave, and the Lower Pecos samples, such as that from Hinds Cave, were so close that Adovasio postulated that the latter must have been directly derived from the former. This tradition was, in his opinion, remarkably stable and ultra-conservative, reflecting the "essential immutability of the socio-economic milieu" within which the artifacts were produced (Andrews and Adovasio 1980:361).

Although the El Fuste collection of perishable artifacts is small when compared to the massive amount of material recovered from Frightful and Hinds caves, the rarity of fiber assemblages from the Ocampo region, and Coahuila in general, gives it a significance beyond that warranted by its size. The most important observation is the distribution of sandal types within each of the inventories. The dominant type at El Fuste, the braided sandal, appears to be of local design and manufacture. This particular style has not been identified in any collections from the Lower or Trans-Pecos, the Greater Southwest, the Great Basin, or adjacent areas of Mexico. Outside of the El Fuste collection, only six specimens have been reported in other areas of Coahuila. Thus, the braided sandals constitute one class of fiber artifacts not shared with the Lower Pecos region of Texas and perhaps not with adjacent areas of northern Mexico.

Secondly, the braiding technique represents a break in a stylistic evolutionary continuum that was the driving force behind sandal production in Frightful Cave for over five millennia. This variability is perfectly consistent with Taylor's recognition of a number of new traits that he called the Jora Complex. The quality of construction and the innovative design, especially of the adjustable tie strings, is also consistent with what Taylor considered to be a reintegration of Coahuilan culture during the last millennium of prehistory. However, the localized distribution as it is currently known mitigates against external influence as the impetus for the adoption of this style.

Inferences about the processes that fostered diversity in the last 1000 years of northern Coahuilan prehistory become baseless speculation in the total absence of information about the context in which they operated. Taylor's (1964, 1966) settlement pattern model has not been tested or improved upon in the last quarter of a century. No paleoenvironmental reconstructions have been attempted in this part of Coahuila. Prior to this study, all the radiocarbon assays were obtained from the Cuatro Ciénagas collections where the development of a lithic typology was frustrated by theft of the specimens. Ceramics are so poorly represented that no serious effort has been devoted to their analysis. The information contained in the El Fuste collection underscores the need for a comprehensive program of archeological research in the Ocampo region.

ACKNOWLEDGEMENTS

This collection was excavated without scientific controls and brought back into the United States. The collection, despite its lack of exact provenience, offers information not previously obtained from this region of Mexico that warrants dissemination. The publication of this analysis should not be construed as condoning the illegal importation of artifacts from Mexico by the authors or the Texas Archeological Society. The Instituto Nacional de Antropología e Historia has been informed, and details of the analysis have been provided to the Monterrey regional center for the use of Mexican researchers.

Kenneth M. Brown and Christine Ward generously contributed their experience in analyzing perishable artifacts from Lower and Trans-Pecos collections. David Riskind, Texas Parks and Wildlife Department, provided information on plant communities and their distribution in the Chihuahua Desert. Carole Medlar photographed the artifacts for publication and for the archives, while David G. Robinson drew the schematic illustrations of sandals and ties.

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The McFaddin Beach Site on the Upper Texas Coast

Ellen Sue Turner and Paul Tanner

ABSTRACT

McFaddin Beach (41JF50) is a section of beach on the Upper Texas Gulf Coast that extends from Sabine Pass to High Island, approximately 35 km to the west. The importance of the McFaddin Beach site lies in the relatively large quantity of Paleoindian to Late Archaic projectile points, tools, and Pleistocene faunal remains that have been documented from beach collections.

INTRODUCTION

This paper attempts to provide an overview of the McFaddin Beach area (Figure 1), its historical environment and geomorphology, and a discussion of the artifacts observed in the 27 collections brought to a conference held on November 15-16, 1991, in Port Arthur, Texas (Hester et al. 1992). Year around, artifacts are collected from the narrow beach from the water line to the grass line. Wind speed and direction, combined with tides and the physical condition of the beach, have a profound effect on the deposition of artifactual material, and hurricanes can alter the physical makeup of the beach dramatically. For years, the cattle pen area was the area where most artifacts were washing up on shore (Figure 2). Hurricane Alicia (1983) changed the cattle pen to a secondary collection area. Longshore currents and storm activity have caused considerable erosion of the beach through the years, as "each changing tide makes a new beach" (Long 1977:5); this makes it impossible to predict the conditions of the beach on any one day. Discovery of artifacts is by chance or as a result of tenaciously walking the beach day after day, and year after year.

The condition of the artifactual materials collected, sometimes little altered and minimally wave-worn, suggests that the artifacts redeposited on the beach have eroded from a relatively short distance offshore. Most of the artifacts collected from McFaddin Beach appear to be close to two tributary streams between High Island, 35 km west of Sabine Pass, and north of the ancient east-west section of the submerged Sabine River valley (see Figure 1 and 2). Similar types of artifacts have also been collected on the south side of Bolivar Peninsula, although they are not as numerous as at McFaddin Beach. Two known Clovis points have been found in the Bolivar Peninsula area, specifically including one

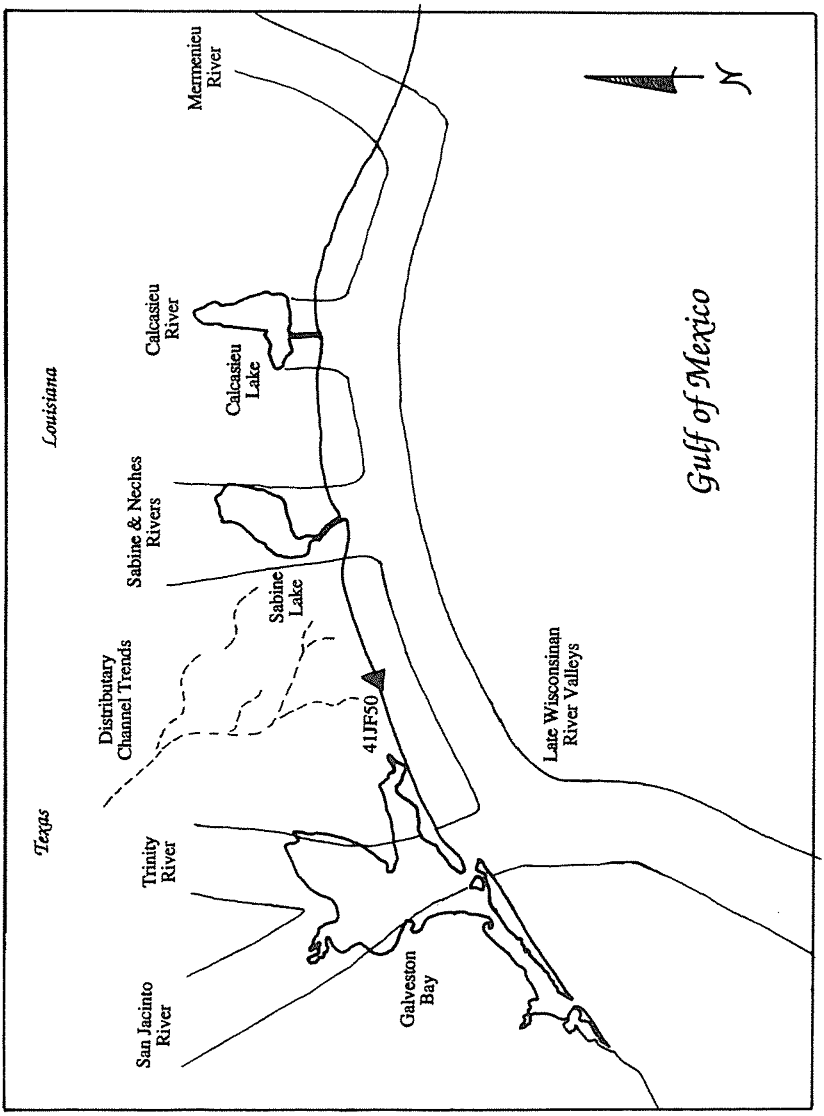

Figure 1. Map of the study area.

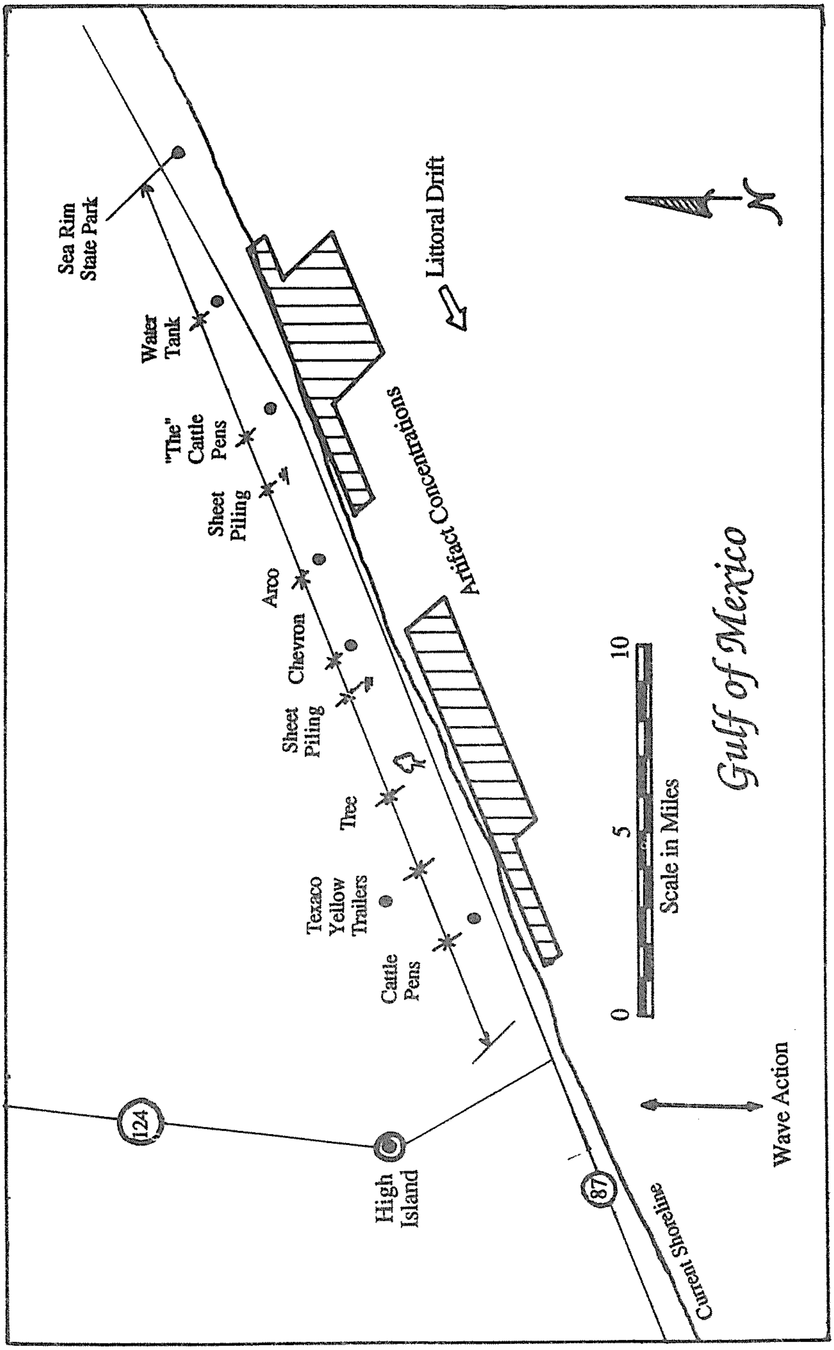

Figure 2. McFaddin Beach Collection Areas.

on the east side of Rollover Pass, Gilchrist, Texas (D.S. Hubert, 1992 personal communication).

ENVIRONMENT

McFaddin Beach must be viewed within the context of environmental changes that have occurred in this area since first occupied by human populations. The geography, natural habitats, plant and animal life, climate, and human settlement around any archeological site on the upper Texas coast have changed significantly over the time span considered in this paper.

Geography and Habitat

Any effort at Paleogeographic reconstruction of the upper Texas coast continental shelf of the Trinity estuary must take into consideration the significant changes in configuration of the terrain over past millenia. Lawrence E. Aten (1983:137) says:

> Paleoindian or Early Archaic archeological data found on the present terrestrial margin of the coast generally will represent human activities conducted in an interior environment—not a coastal environment—and the observed adaptive technologies, population densities and site types will correspond to the original environment, not to the present environment.

Site function will influence the kinds of lithic tools used and discarded at any given site, and thus the Clovis points and blades from McFaddin Beach suggest that hunting at or near the area was a major activity in Paleoindian times. However, there is no way of knowing if coastal resources were being utilized because most coastal habitat dating earlier than the Middle Archaic period is either buried or submerged. Fishing camps would show only very limited evidence of lithic tool production. Therefore, without stratigraphic control on the stone tools, a Paleoindian tool assemblage at McFaddin Beach cannot be defined at this time, nor is it possible with the site data to make an evaluation of the place of McFaddin Beach within the fundamental patterns of hunter-gatherer settlement along the upper Texas coast. Nevertheless, "[i]t seems reasonable to assume that it was the scene of hunting forays emanating from either the coast or from the interior woodland to prey on herding animals" (Aten 1983:149).

Climate

Changes in climate on the upper Texas coast are also evident. Geologic and vertebrate paleontological data indicate that the Late Pleistocene environment was cooler and wetter with differences minimized between winter and summer. This weather pattern evolved into an environment with warmer, drier, and more varied seasons of temperature and precipitation. Finally, the subhumid, seasonal environments of the present day evolved some 3000 years ago (Aten 1983:154).

Geology

The major river valleys in the region are the Sabine and the Neches (see Figure 1). Nelson and Bray (1970:55) discovered that the Sabine, Neches, Calcasieu, Trinity, and San Jacinto rivers, plus their coastal plain tributaries, constituted a coordinate river system between 13,000-11,000 years B.P. In the period between 18,000-9000 years B.P., sea level rose as much as 9 m/year, inundating the former Sabine River valley (an alluvial habitat presumably heavily utilized by man). The inundated valley is now about 32 km south of the present shoreline, making a long, brackish-water estuary of the valley (Nelson and Bray 1970).

Seismic work and core sampling of the sea bottom by geologist John Anderson of Rice University discovered that beginning about 6000 years ago, the coast of Galveston moved as much as 20 miles inland; this took between 200-1000 years (Nichols 1989). Underwater sandbanks off the Texas coast, ancient barrier islands that were submerged virtually intact rather than eroded, indicate that sea level at times has risen rapidly. The submerged barrier islands would have disappeared through erosion if sea level had risen gradually. "We can tell it happens pretty fast because there's nothing in the way of a coastal barrier between Sabine Bank and the present shoreline" (Nichols 1989:40A). Anderson also noted that a "steady rise of about 1 mm per year may have been interrupted by surges of tens of feet in a few hundred years" (Nichols 1989:40A).

Detailed studies of geomorphological change and sea level rise at McFaddin Beach (Pearson 1983; Aten 1983) place the coastline during Clovis times about 80 km to the south and 120-140 m below the present sea level. The continental shelf was cut by a deeply entrenched Sabine River, flowing through earlier deltaic deposits formed by the Trinity River, which had abandoned the area around 20,000-25,000 years ago. The geology of the locality known as McFaddin Beach:

> consists of transgressive barrier beach sand overriding a 3 m thick section of Middle Holocene marsh sediment which, in turn, overlies the Pleistocene Beaumont Formation at a depth of about 1 1/2 m below mean Gulf level. The Beaumont Formation and the Middle Holocene marsh are being exhumed all along the shoreface which extends downward to more than 6 m below mean Gulf level and is about 1 km wide . . . McFaddin Beach is a locality of considerable potential which probably is associated with a Late Wisconsin-Early Holocene valley wall scarp setting and related drainage formed by extension of the

Sabine-Neches river system out onto the continental shelf (Aten 1983:152).

ARTIFACTS

Russell J. Long's (1977) report is the primary source of information on the artifacts from McFaddin Beach. A retired biology professor from Lamar University, octogenarian Long still gives mini-courses on avocational archeology combined with collection, classification, and identification of specimens from the beach. His dedication has enhanced the importance and scientific worth of the extensive beach collections.

The McFaddin Beach archeological and paleontological artifacts are presently eroding from submerged relict deltaic landforms: an upland area not fully inundated by rise in sea level until 2800 years B.P. (Pearson 1983). Wave action transports the dislodged materials and deposits them on the present-day beach. The older artifacts tend to be little wave-worn whereas the younger types are heavily rolled, implying that erosion has relatively recently cut into older deposits. Since the artifacts are found in an environmental setting substantially different from that in which they were formed, it is difficult to organize the collections in terms of conventional archeological classifications. The available data are also too limited for describing distributional patterns. Nevertheless, there is value in viewing Paleoindian, Archaic, and Late Prehistoric occupations as broadly characterizing the three most recent phases of Texas' northern Gulf Coast history (Aten 1983:142).

Chronology

Paleoindian

The earliest known inhabitants of Texas during the Pleistocene (correlating geologically with the Late Wisconsin to Early Holocene periods) can be linked to the Clovis Complex dating around 9200 B.C. Paleoindian artifacts from McFaddin Beach include over 70 Clovis points (Figure 3a-d), some of great length, and a single Folsom point. Three of the large (120+ mm in length) Clovis points are very similar in workmanship and raw material. These were found in close proximity on the beach, and two were found within days of each other; this raises the possibility that a cache was disturbed and at least some of its contents washed onto the beach (Hester et al. 1992).

The distinctive Clovis fluted point is widespread in the state and was, at least in some cases, used in mammoth hunting. The Folsom Complex, dating around 8800-8200 B.C., is characterized by Folsom fluted points and is known from sites where now-extinct forms of bison were killed and butchered (e.g., Bonfire Shelter in Val Verde County [Dibble and Lorrain 1968]). Although

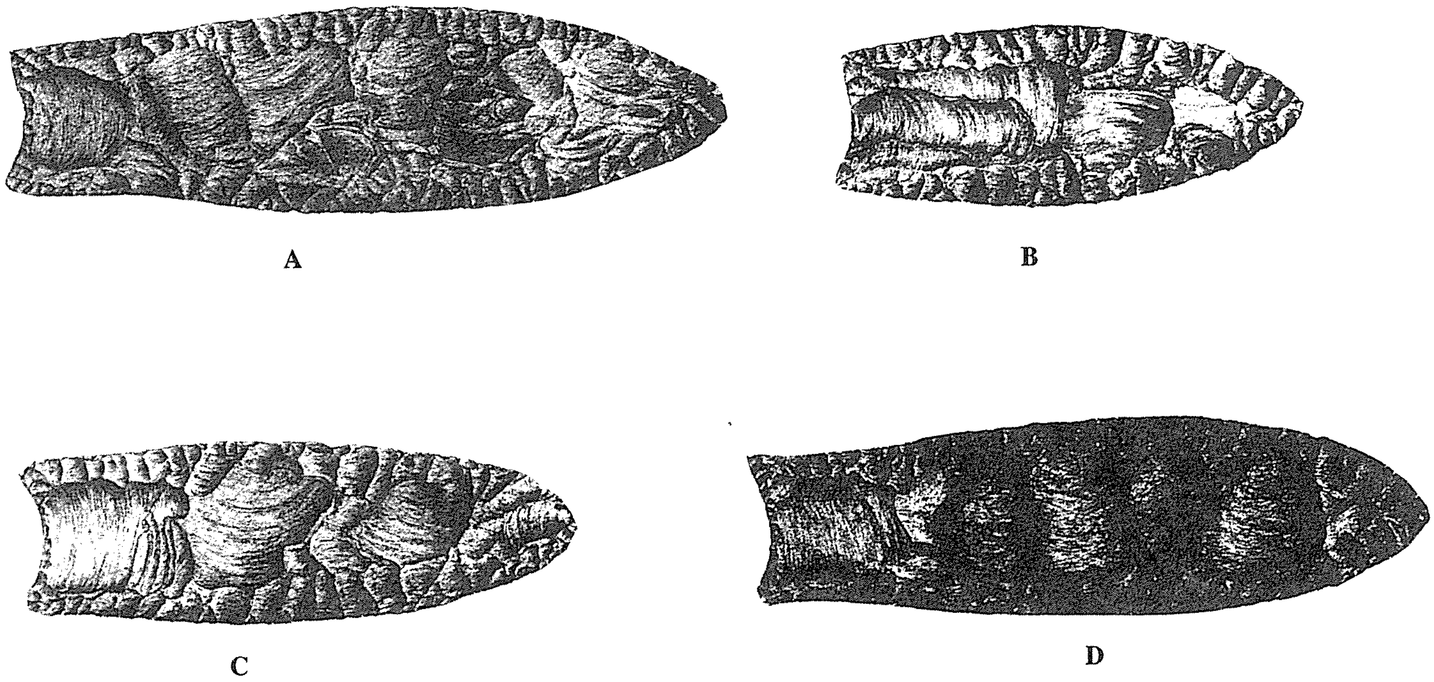

Figure 3. Clovis points from McFaddin Beach: a, J. W. Coen collection; b, R. J. Long collection; c, Paul Tanner collection; d, Tod Clark collection, Museum of the Gulf Coast. Drawn by Paul Tanner.

fluting ceases to be an important Paleoindian point trait after Clovis and Folsom, later Paleoindian points maintain an overall lanceolate, parallel-sided form; they often have careful parallel-flaking with the basal edges dulled to facilitate hafting (Turner and Hester 1993).

Other Paleoindian diagnostics from McFaddin Beach include Scottsbluff, San Patrice, Dalton, Pelican, Golondrina, Plainview, Angostura, and untyped lanceolates—several of which cannot be precisely dated (Figure 4a-f). Dalton and San Patrice, found in all McFaddin Beach collections, may date around 8000 B.C. in East Texas. Another projectile point type from 41JF50, Pelican, is found in both Northeast and Southeast Texas, possibly contemporaneous with San Patrice (Turner and Hester 1993:174). Plainview points are found in South Texas at around 8200-8000 B.C., and are associated with kills of extinct bison at the Plainview and Bonfire Shelter sites. By around 8000 B.C., animals of the Pleistocene era such as mammoth, bison, camel, horse, and sloth had disappeared. In East Texas, Scottsbluff points are common, and are thought to date to around 6500 B.C. In lower South Texas, hunters and gatherers used Golondrina points that have been radiocarbon dated at 7000 B.C. (Turner and Hester 1993).

Archaic

Much of Texas prehistory is subsumed within the long span of hunting-gathering cultural patterns known collectively as the Archaic. It begins around 6000 B.C., and is notable for changes in projectile point styles and tool types, different site distributions and kinds of sites, and the adoption of grinding implements and groundstone ornaments; all these changes reflect increasing populations utilizing the abundant plant and animal resources of environments similar to that of modern times.

While details of the Archaic sequence vary from region to region within Texas, it is generally divided into Early, Middle, and Late Archaic periods. Each period is defined by specific projectile point styles (Turner and Hester 1993). The Early Archaic (6000-2500 B.C.) at McFaddin Beach is represented by such types as Bell (see Figure 4g), Trinity, and Carrollton (Table 1). During the Middle Archaic (2500-1000 B.C.) in Texas, certain regions are typified by a few distinctive projectile point types. In Southeast Texas, Gary and Kent dart points are major types in the McFaddin Beach collections, although they continued to be made through the Late Prehistoric period (Patterson 1993:265). Other Middle Archaic forms include Pontchartrain, Evans, Pedernales, and Tortugas types (Turner and Hester 1993). The Late Archaic projectile point forms found in the McFaddin Beach collections include Ellis, Desmuke, Lange, and Yarbrough types.

Table 1 lists the types of projectile points found in 39 collections from McFaddin Beach. The majority of the 2000+ projectile points from the collections are Archaic forms such as Big Sandy, Bell, Gary, Evans, Pedernales, and Poverty Point-related specimens such as Pontchartrain, Epps, and Delhi.

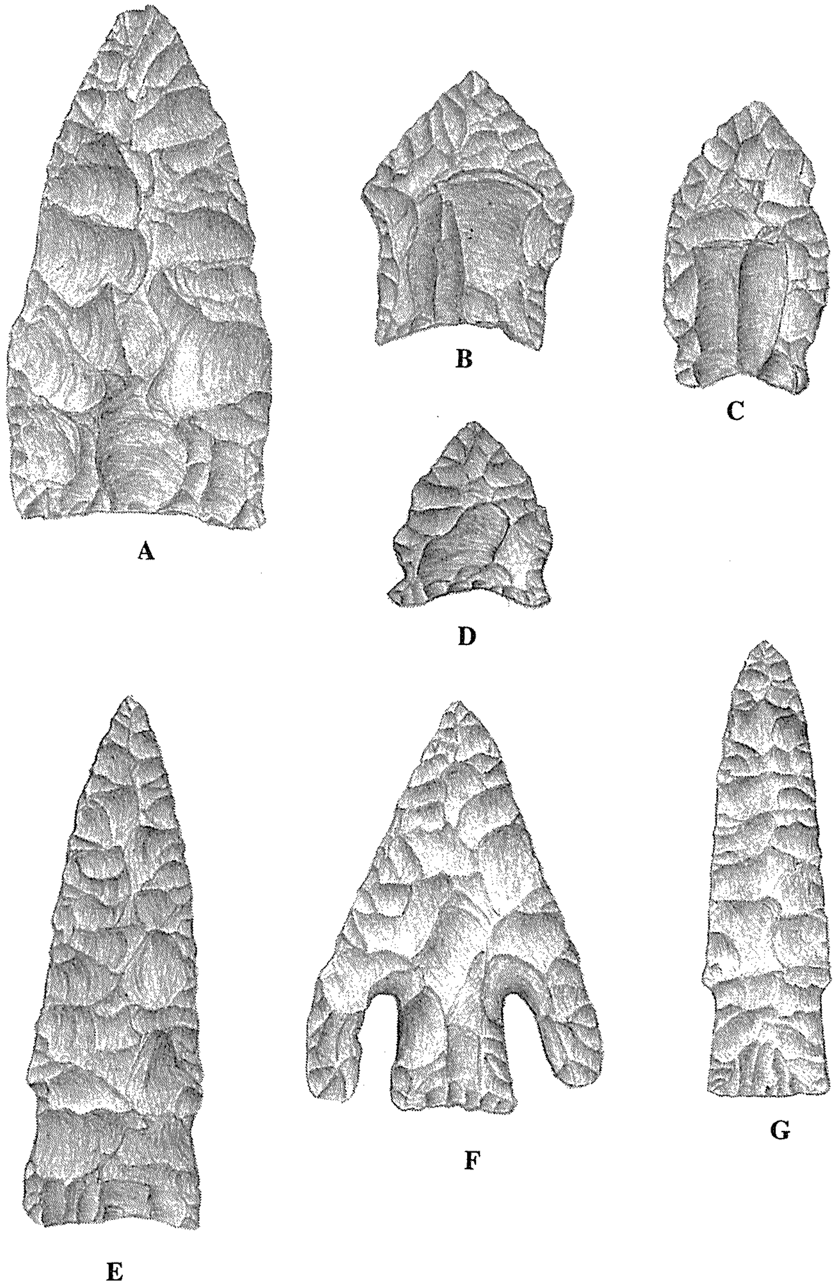

Figure 4. Paleoindian and Archaic dart points from McFaddin Beach: a, Dalton, Paul Tanner collection; b, Pelican, R.J. Long collection; c-d, San Patrice, Paul Tanner collection; e-f, Scottsbluff, Paul Tanner collection; g, Bell, Paul Tanner collection. Drawn by Paul Tanner.

Table 1.

Projectile Point Types Identified at McFaddin Beach

Angostura (1)	Frio	Pelican (3)
Bell (1)	Gary (13)	Perdiz
Big Sandy (5)	Godley (5)	Plainview (7)
Bulverde (1)	Hardin	Pontchartrain (2)
Carrollton (12)	Hell Gap	Pryor Stemmed
Clovis (5)	Keithville	San Patrice (9)
Dalton (9)	Kent (11)	Scottsbluff (12)
Delhi (1)	Kirk	Tortugas
Desmuke	Lange (6)	Trinity
Early Stemmed (1)	Marshall	untyped lanceolate (3)
Early Stemmed lanceolate	Milnesand	Williams (4)
Edgewood	Morhiss	Woden (7)
Elam	Motley	Yarbrough (9)
Epps (3)	Palmer (5)	
Evans	Palmillas (6)	
Folsom	Pedernales	

The junior author has some 300 dart points and tools collected from the beach over the past 11 years. While it is not possible to quantify the archeological data from all 39 collections, Tanner's specimens are indicated in parentheses to give some idea of the diversity in a single collection.

Of the 160 projectile points in Tanner's collection, approximately 34 percent are Paleoindian types, with the remainder Early to Late Archaic projectile point forms. Also in the collection are 45 Archaic projectile point fragments, two preforms, and a bone dart point.

A wide variety of stone tools are also found in McFaddin Beach collections (Table 2; those in Tanner's collection are designated in parentheses). A few comments are in order on these artifacts. Recent studies have shown that core-blade technology was important in Clovis times (Collins 1990; Collins and Headrick 1993). The distinctly curved Clovis blades (Figure 5a) were evident in a number of McFaddin Beach collections. Young and Collins (1989) describe a cache of Clovis blades found near the Trinity River in Navarro County.

Groundstone tools such as bola stones and gorgets (Figure 5b-c) are characteristic of Archaic to Late Prehistoric assemblages along the upper Texas coast.

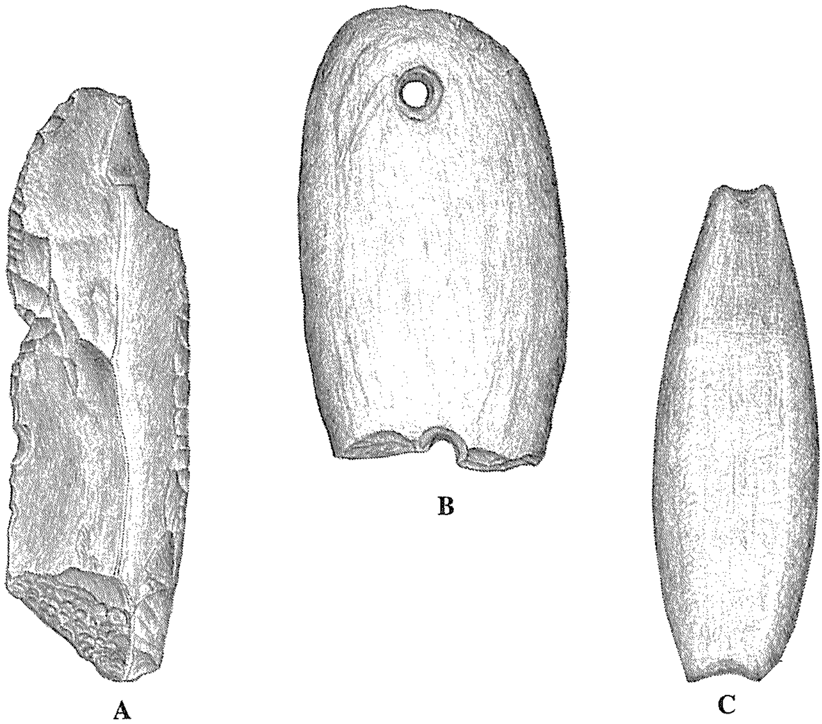

Figure 5. Stone Tools from McFaddin Beach: a, Clovis blade, Paul Tanner collection; b, Gorget, Paul Tanner collection; c, Bola Stone, Bobby Broussard collection. Drawn by Paul Tanner.

Bola stones and gorgets are well known artifact types in the Poverty Point Culture (Ford and Webb 1956).

Very little lithic debris has been found in the McFaddin Beach area. However, it is difficult to spot small flakes in the beach gravel and broken seashells that have become mixed with old road bed material, construction debris, refuse-like ship ballast stones, concrete debris, and broken beer bottles. Only a few arrowpoints and pottery sherds have been found at McFaddin Beach.

No naturally occurring deposits or outcrops of chippable stone are native to this part of the upper Texas coast, and all of the points and tools are made of chert and fossil hardwood that had to have been imported from other areas (Larry

Table 2.

Stone Tool Types found at McFaddin Beach

Albany Bifaces	Backed blades (1)	Spall blades (4)
Small blades (7)	Blade cores (1)	Bola Stones (4)
Gorget (1)	Graver (1)	Gunflints
Hammerstones (12)	Grooved hammerstones (2)	Pitted Stones (2)
Two and Four Beveled Bifaces (3)	Utilized Flakes (10)	Petrifed Wood Tools (8)
Stone Awl (2)	Crescent-shaped Biface (1)	Scottsbluff drill (1)
Dalton Drill (1)		

Banks, 1991 personal communication). Two Clovis points found at 41JF50 are made of a tan fossil palmwood. Banks also observed that 90-95 percent of the raw materials are Central and East Texas cherts and petrified wood. The single Folsom point found was of Keokuk variety, Boone Chert, from eastern Oklahoma. X-ray Fluorescence analysis at the Lawrence Berkeley Laboratory found the source of one obsidian Archaic-style contracting stem biface to be Zacualtipan, Hidalgo, Mexico, more than 1000 km to the south (Hester, Asaro, Stross, and Gianque 1992).

FAUNAL MATERIAL

Many large Pleistocene vertebrate fossils, some associated with man elsewhere in North America, are found on the beach. Fossils from this area range in color from yellow to brown to ebony. Tannin from organic matter gives a dark hue to fossil remains, suggesting they were deposited in a river oxbow filled with organic matter. Some fossil teeth are blue, indicating they were imbedded in Beaumont Formation deposits, which represent Trinity River delta formations at the end of the mid-Wisconsin interglacial stage. Teledyne gave a radiocarbon date of 11,100 ± 750 B.P. on a piece of elephant tusk, either mammoth or mastodon, collected from the beach (Long 1977:7). This denotes a megafaunal presence at McFaddin Beach during the Clovis occupation.

Fossil turtle shell is the most common specimen found in the McFaddin Beach collections. Foot bones and molars of horses are also common but hoof cores are very rare. Deer remains are next in frequency with antler elements most commonly represented. Mammoth molars are more common than those of mastodon; however, a complete mastodon or mammoth molar is rare, and both are usually fragmented by wave and surf action. No prehistoric human remains have been found to date at McFaddin Beach.

Long (1977:16) lists a few fossils that were possibly human-modified: a notched turtle shell fragment, a highly polished awl (Figure 6a), and a sliver with a chipped edge (Figure 6b). Recently, two mammoth teeth with modified sides (possibly used as scrapers) have been found at McFaddin Beach (Figure 7).

The tooth enamel has been worn to the level of the dentine on the modified mammoth teeth. Point A-A' in Figure 7 shows abrasion marks, and a shallow groove has been worn in this section of the piece; both sides have apparently been used.

The following Pleistocene fossils have been identified by Russell (1975) from McFaddin Beach:

giant armadillo	alligator	bear	beaver	bison
camel	capybara	catfish	cotton rat	coyote
deer	gar	horse[1]	jaguar	llama
mammoth	manatee	mastodon	opossum	otter
peccary	prairie dog	rabbit	raccoon	snake
saber-toothed cat	tapir	turtle	sloth[2]	

DISCUSSION

The present land area is slowly subsiding and the ocean is rising about 1 mm each year along the upper Texas coast. These factors, combined with storms, the construction of jetties, and the dredging of the Sabine-Neches ship channel, have interrupted the natural flow of solid material carried from rivers and longshore currents. The amount of beach sand in the collection areas has diminshed, exposing beach gravel and artifacts. In recent years, the County Highway Department has used beach material and natural sand dunes for road fill and some industrial concerns have used beach material for flood protection structures. The Texas Department of Transportation has driven sheet piling in this area to help stabilize the beach.

The practical difficulties for investigating the submerged prehistoric archeological deposits in the gulf environment are formidable. Eventually, investigation of offshore deposits may be warranted, but it is likely that most archeological data to be acquired in the foreseeable future will come as a

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[1] *Equus* cf. *fraternus*; *Equus complicatus*; *Equus* cf. *pacificus*. See Gidley 1901, Quinn 1957, and Lundelius 1972.

[2] *Megalonyx jeffersoni* and *Eremotherium*. See Leidy 1853, Stock 1925, and Gazin 1957.

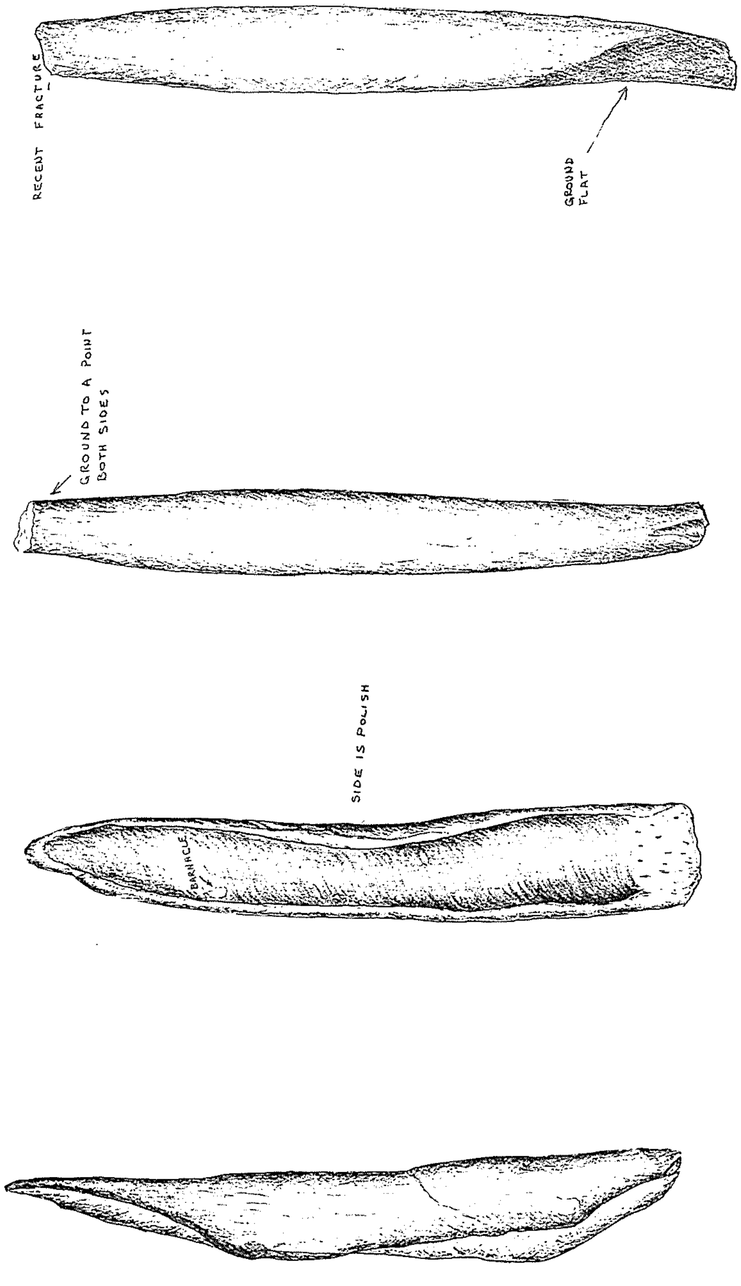

Figure 6. Bone Tools from McFaddin Beach in the Paul Tanner collection. Drawn by Paul Tanner.

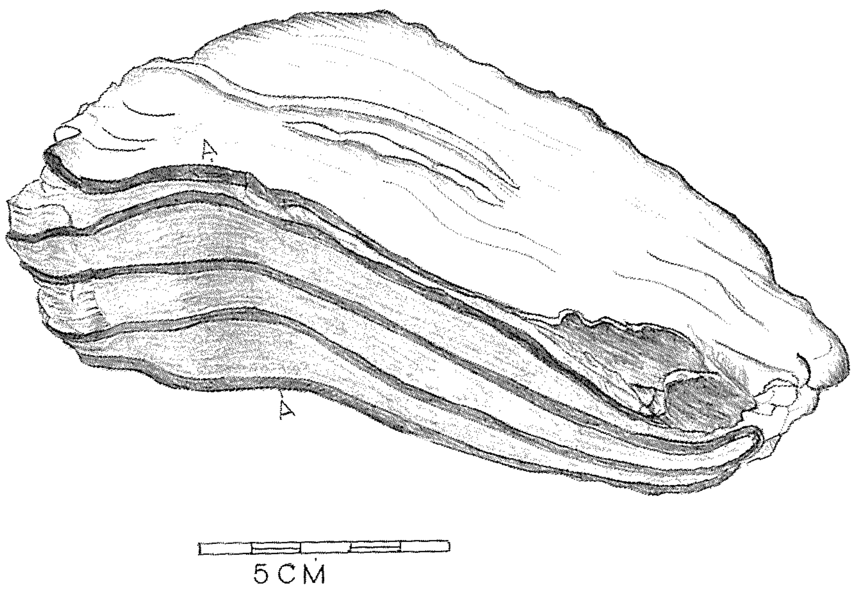

Figure 7. Mammoth tooth from McFaddin Beach with modified sides (A-A'), Paul Tanner collection. Drawn by Paul Tanner.

consequence of environmental protection activities by offshore oil and gas industry. Until there is some idea of what material remains exist—by discovering sites with materials that demonstrably constitute Paleoindian and Archaic period assemblages—we cannot develop hypotheses about the relationships between tool assemblages, habitats, territories, and the social and natural environments of early upper Texas coast inhabitants (Aten 1983).

In spite of the obvious difficulties in investigating the McFaddin Beach site, the carefully documented collections in existence do make a tremendously useful resource for the study of stone projectile point typology and technology on the upper Texas coast. A large body of data from McFaddin Beach is already in the archives; avocational archeologists and collectors from the area have completed drawings, measurements, and source determinations for over 500 projectile points for the Texas Archeological Research Laboratory (TARL) archives at The University of Texas at Austin. Dee Ann Story, Lawrence E. Aten, Kenneth M. Brown, Thomas R. Hester, and the authors have taken extensive photographs of collections from the site that can also be found on file at TARL.

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Radiocarbon Date for a Red Linear Style Pictograph

Wayne A. Ilger, Marian Hyman, and Marvin W. Rowe

ABSTRACT

The age of Red Linear pictographs in the Lower Pecos River region of Texas is not yet well defined. Here we report the first radiocarbon date on a sample of this pictograph style using an oxygen plasma extraction technique and accelerator mass spectrometry. The sample, taken from site 41VV162A, dates to 1280 ± 45 years B.P. The background organic carbon in an unpainted rock sample taken near the pictograph indicated that 9 percent of the sample carbon may be contamination. This increases the standard deviation to ± 135 years B.P. As always with a single radiocarbon date, caution is advised pending further studies.

INTRODUCTION

One of the five recommendations suggested by Dibble and Prewitt (1967:121) for further study of rockshelters in the Lower Pecos River region of Texas was the need to obtain absolute ages of the various styles of pictographs often found on the shelter walls: "These [pictographs] represent one of the most outstanding features of Amistad archeology but, as yet, remain undated by archeological evidence." This has been our focus. Since 1990, it has been possible to directly date pictographs by analysis of the radiocarbon content of the organic matter used to make the paint (Russ et al. 1990:710-713).

Pictographs painted before the arrival of the Spanish in the Lower Pecos are generally divided into four styles: the polychrome Pecos River style, five samples of which were radiocarbon dated between 3,000-4,200 years B.P. (Russ et al. 1990:710; Russ et al. 1992:871; Chaffee et al. 1993:70); the polychrome Bold Line Geometric style, more recent than the Pecos River style, but which is otherwise not well placed in time (Turpin 1986b:159); the Red Linear style, with an age range not yet satisfactorily established (Grieder 1966:715; Turpin 1984:195); and the Red Monochrome style, where figures are sometimes shown with bows and arrows, suggesting they date from approximately A.D. 600 to 700 to historic times (Kelley 1950:72; Turpin 1986a:124). We present here the first direct radiocarbon date on a Red Linear style pictograph.

The pictograph sampled is at Cueva Quebrada (41VV162A). Cueva Quebrada lies about two miles north of the confluence of the Rio Grande and Pecos Rivers. It is situated high on the north wall of a small dry canyon near the rimrock (Lundelius 1984:457-458). Only three radiocarbon dates had previously been obtained from this shelter, all three on wood charcoal associated with extinct fauna (Valastro et al. 1977:309). The three dates are: 14,300, 13,920, and 12,280 years B.P. None are of value in interpreting the dates of the pictographs at this site, however.

Two styles of pictographs are represented at Cueva Quebrada. Red Linear style images overlie several faded Pecos River style pictographs. The former are miniature stick figures ranging in color from red to orange red. These Red Linear images include a dog, a number of human-like figures, and 17 depictions that Grieder (1966:715) interpreted as running animals, perhaps deer or bison. Turpin (1984:186, 188, 193, 196 and Figure 7) further interpreted the scene as bison being herded towards a precipice, as represented by a crack in the surface of the wall. If this interpretation is correct, the image represents jump hunting: bison were run off the edge of a cliff, killed either by the fall or the hunters, then butchered where they fell.

Archeological evidence for this type of hunt is found in the Lower Pecos region at Bonfire Shelter (41VV218) (Dibble and Lorrain 1968). There the animals fell about 23 m to the floor of the shelter. The upper bison bone bed was radiocarbon dated with associated scorched bone to 2310 ± 210 and 2810 ± 110 years B.P. (Tamers et al. 1964:153-154) and with charcoal dates of 2780 ± 110 (Tamers et al. 1964:154) and 2510 ± 110 years B.P. (Pearson et al. 1965:304). Further evidence of bison presence in the Lower Pecos River region is scarce. However, some bison bones were reported from Eagle Cave (Raun 1966:213) and Arenosa Shelter (Collins 1976:111). Alexander (1974:27-28) stated that:

> Absence of bison bone may not indicate absence of bison hunting, however. There are indications in the ethnohistoric data from the general region of northern Mexico and southwestern Texas that Indian groups may have traveled some distance north of their usual territories in order to hunt bison, bringing back with them only the dried meat (e.g., Bolton 1916:296-297). If this were true of the Amistad Archaic, then their subsistence system would include an item which goes largely unrecorded even in the preserved rockshelter deposits.

One of the running animal pictographs seemed a particularly apt sample to radiocarbon date, first to directly establish the time during which Red Linear pictographs were painted, and second to test the bison jump hypothesis. If the date obtained on the sample coincided with a known period of occupation by modern bison in the Lower Pecos region, the idea that the pictograph panel represents a bison jump would gain credence.

EXPERIMENTAL PROCEDURE

Radiocarbon dating of pictographs, other than those with charcoal as the pigment, presupposes that an organic binder/vehicle was added to the pigment by the prehistoric painters, both to enhance adhesion to the shelter wall, and to improve spreadability. The red and yellow pigments used in the Lower Pecos pictographs are iron oxide and/or iron hydroxides, and therefore cannot themselves be dated. The black pigments used in the Lower Pecos are manganese oxides; charcoal use has not been demonstrated in the region. As only 0.1-1 mg of organic carbon from the binder/vehicle is typically extracted from Lower Pecos pictograph samples, care is required to avoid contamination of the sample with extraneous carbon.

The walls of 41VV162A are heavily blackened, in some places almost completely obscuring some badly deteriorated Pecos River style pictographs (Turpin 1984:185-186). The pictograph we sampled, however, was not blackened. Fifty-four and one-tenth mg of pale red, finely powdered pigment was scraped off one of the running animal images. The scraped-off sample was examined microscopically for contamination from organic sources such as roots and fibers. Before insertion of the sample into the system, the plasma chamber was cleaned thoroughly with oxygen plasmas to ensure negligible contamination of the sample from the instrument.

After insertion of the sample in the reaction chamber, the system was evacuated with liquid nitrogen sorption and ion pumps. These pumping techniques were employed because they do not use oil that could back-stream into the system and introduce contamination. The sample and chamber were then cleaned by argon plasmas. The argon plasma bombards the interior surfaces with excited, high velocity, argon atoms and ions, thus loosening any adsorbed carbon dioxide that is then pumped away. Six argon plasmas were performed to clean both the chamber and sample. The final cleaning plasma generated a mere 0.7 micrograms of carbon (a microgram, μg, is one-thousandth of a milligram).

We then performed a vacuum integrity check to ensure that leakage into the chamber from the atmosphere was neglible. The vacuum integrity check resulted in a final pressure of 1.2×10^{-6} torr of gas. If all the residual gas were carbon dioxide, this pressure would represent about 0.0015 μg of carbon, which would decrease the reported age of the sample by only 16 days if the carbon were modern.

At this point, the system was deemed ready for extraction of the organic carbon from the pictograph sample. The oxygen plasma extraction of the organic carbon was performed for 50 minutes. It generated about 0.9 mg of carbon as carbon dioxide that was sealed into a 6 mm glass tube and sent to the University of Arizona AMS facility for radiocarbon dating. Additional information on the instrumentation and experimental procedure can be found in Chaffee et al. (1993: 67-70).

A portion of unpainted limestone wall taken from near the pictograph was also similarly treated to ascertain the extent of organic carbon inherent in the limestone itself. The 212 mg sample was mostly a cream-colored powder, but also included several small lumps of similar color. Two small black particles were removed during the microscopic examination and discarded. After cleaning the reaction chamber as described above, the unpainted limestone was inserted into the plasma chamber. Four argon plasmas were then run to ensure desorption of carbon dioxide from sample and chamber surfaces, with the last generating only 0.3 μg of carbon. A vacuum integrity check was performed for six hours. The pressure at completion was 9.8 x 10^{-5} torr, which would represent about 0.1 μg of carbon. If all the gas were modern carbon dioxide, this amount of contamination would decrease the reported age of this sample by about 60 days, a negligible effect. The limestone contamination was then oxidized in the plasma, yielding the equivalent to 79 μg of carbon after normalization of the weight of the unpainted limestone sample to that of the pictograph sample.

RESULTS AND DISCUSSION

The carbon extracted from the 41VV162A pictograph sample was dated at 1280 ± 45 years B.P. by the University of Arizona AMS facility (AA-10549). Although the source of contamination generated from the unpainted cave wall is unknown, the most extreme possible effects on the reported age of the sample can be calculated by assuming either (1) that all the contaminant carbon is modern (1950 carbon) or (2) that it is all dead.

The calculations were done using the following equations (Mook and Waterbolk 1985:27). Equation 1 is used to convert the fractional activity of a sample to a radiocarbon age:

$$^{14}a = e^{-(T/8033)} \qquad (1)$$

where ^{14}a is the fractional radiocarbon activity of the sample, and T is the age of the sample in years. Equation 2 is used to calculate the effect of a known amount of contamination on the reported radiocarbon age:

$$X = (^{14}a - {}^{14}a_s)/(^{14}a_c - {}^{14}a_s) \qquad (2)$$

where X is the fraction contamination of the sample, $^{14}a_s$ is the fractional radiocarbon activity of the assumed "true" age of a sample, and $^{14}a_c$ is the fractional radiocarbon activity of the contamination. The value of $^{14}a_c$ is 1 for modern, and 0 for ancient (dead carbon) contamination. Applying these equations to our data, we calculate that the AMS date is too young by 135 years if the contamination is modern; thus the corrected age in this case is 1415 years B.P. Conversely, if the carbon is dead, the amount generated from the limestone contamination would have the effect of decreasing the AMS date by 660 years; this would change the result to 540 years B.P. Given the above, in the most extreme cases, the age would fall between 540 and 1415 years B.P.

However, measurement of the degree of mass fractionation of carbon of the samples permits constraining these extreme values of the age. $\delta^{13}C$ values of both the background limestone and the pictograph carbon dioxide were obtained in an attempt to better understand the source of the carbon extracted from the sample, and the contamination. $\delta^{13}C$ is defined as:

$$\delta^{13}C = \frac{(^{13}C/^{12}C)_S - (^{13}C/^{12}C)_{PDB}}{(^{13}C/^{12}C)_{PDB}} \times 1000\ ‰ \qquad (3)$$

where the standard used (PDB) for $^{13}C/^{12}C$ measurements is carbonate obtained from fossil shells of Cretaceous belemnite (*Belemnitella americana*) from the PeeDee rock formation in South Carolina, and S refers to the sample in question (either the unpainted limestone or the pictograph sample). Most $\delta^{13}C$ values measured on our other pictograph samples have been between -20 to -26‰; the 41VV162A pictograph sample was within this range at -20.2‰. The $\delta^{13}C$ value of the limestone sample carbon dioxide (from the unpainted limestone) was –23.1‰.

Isotope fractionation, a consequence of the thermodynamic properties of atoms, depends upon the mass of the atoms involved in various reactions. Therefore, it is possible to use the degree of mass fractionation (i.e., the value of $\delta^{13}C$) to identify materials that have gone through different geochemical or biological processes (see Boutton 1991:173-183). The processes that produce limestone result in a $\delta^{13}C = 0‰$; those which are typical animal and vegetable organic material yield $\delta^{13}C$ values of -19 to -25‰; those producing atmospheric carbon dioxide result in a $\delta^{13}C = -7.8‰$. The mass fractionation value of the background contamination on the unpainted limestone sample, $\delta^{13}C = -23.1‰$, indicates that it is neither atmospheric CO_2, the most likely contaminant source of modern carbon in our procedure, nor limestone decomposition CO_2 (dead carbon). Rather it is presumably from contaminant organic carbon of unknown age.

The fundamental underlying premise of the plasma-chemical dating technique is that the organic material extracted from the pictrograph itself was contemporary with the time it was painted. This is based on the argument that live carbon was mixed into the paint as a binder/vehicle. That may not be strictly true when charcoal is used as a pigment as charcoal is subject to the "old wood" problem; that is, the charcoal may be old at the time of painting (Schiffer 1986). However, the pigment of this Red Linear pictograph was not charcoal. Some time after a pictograph is painted a new accretion layer forms over the painting. The outermost layer of the accretion is at any given time comprised of modern carbon.

In practice, the organic matter that is extracted from a pictograph sample is a composite of the pictograph organic matter and the contamination organic matter in the accretion. The latter was probably deposited during a time interval beginning somewhat before the application of the pictograph and continuing up to modern time. This conclusion is based on the following simple model. A limestone surface is a continually and uniformly changing chemical system, developing by the buildup of accretionary minerals and periodically spalling off due to physiochemical processes such as the freeze-thaw cycle. The spalling process may also be hastened by biological activity. We have sometimes noticed biological growths underneath a sample when removing seriously disjointed pieces of pictographs for dating/chemical studies. This biological activity, although speeding the spallation process, is not likely responsible for the contamination carbon in a pictograph sample. All evidence of biological material is carefully removed before subjecting a sample to the plasma treatment. Thus, we assume that the background contamination we note is initially due to live carbon in organic matter that is constantly being trapped from the air, and from surface algae and bacterial growths in the accumulating accretion layer. In this model, the outer microscopic surface layer constantly grows and is modern carbon at any given moment until the surface spalls off. If the spall depth is large enough, the remaining limestone surface will then be of infinite radiocarbon age, >40,000 years B.P.

The essential assumption of this simple model, then, is that accumulating limestone surface layers continuously and uniformly incorporate ambient live carbon as the layers are formed. Thus, the depth of a given layer is directly proportional to the radiocarbon age of the contamination incorporated in that layer. However, at any moment in time, the outside layer always corresponds to live modern carbon. Only two situations would expose a truly ancient surface (dead carbon) for a pictograph to be painted upon: a pre-treatment of the limestone face (intentional removal of the surface) to provide an improved base for painting, or a naturally spalled surface that fell off relatively shortly before the pictograph was painted. To expose an ancient surface, whether intentionally or through natural processes, it is essential that enough of the surface be removed in the evolving accretionary layer to reach underlying ancient ones. We have seen no indication of prepared surfaces in the Lower Pecos River region. Instead, sections often show that pictographs are painted on top of clearly existing accretionary mineral growth (Figure 1). It is also unlikely that many pictographs were painted soon after natural spallation exposed an ancient surface. We conclude that most pictographs in the Lower Pecos River region were painted on top of evolving, and thus relatively young, surfaces. The microscopic layer lying immediately beneath the pigmented layer would be virtually the same age as the pigmented layer. If the above suppositions hold true, then contamination carbon observed in the unpainted limestone by the plasma chemical treatment would be a time-averaged composite of the relatively contemporary surficial layers which were sampled.

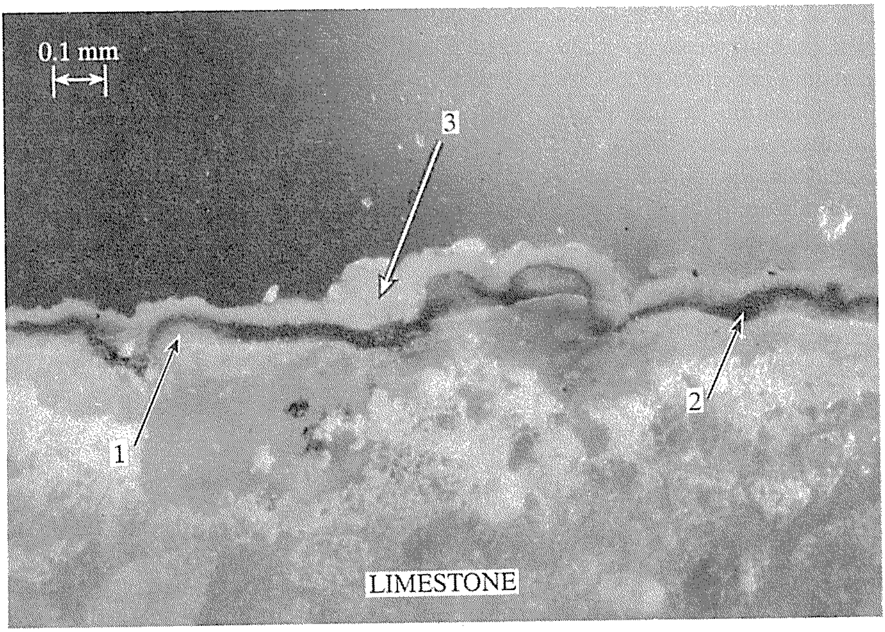

Figure 1. Section of a pictograph from 41VV75. It shows the limestone rock with an underlying, previously existing, accretion layer upon which the pictograph was painted (1), a red pigment layer (2), and finally an outer accretion layer which accumulated over the paint (3).

For the Red Linear style pictograph date discussed in this paper, we scraped off only a thin layer (<1/2 mm) of the pictograph and unpainted limestone surfaces; therefore, contamination is expected to be relatively recent. Conservatively, therefore, the total limestone contamination carbon can be represented by an age twice the nominal age of the outermost surface at the time of painting the pictograph (i.e., the pictograph date). This is conservative because the plasma technique would extract the carbon from both the oldest layer the plasma reaches up through the most recent layer. The age of the contaminating carbon would be a weighted average of those ages and, therefore, would be half the age of the oldest sampled layer. That is to say, if it is assumed that the average age of the contamination is twice the nominal pictograph age, the sampling goes deeper, down to the layer that is four times the pictograph age (5120 years B.P.). This means that the extreme limit on the more recent age of 540 years B.P. is probably much too modern. A more realistic calculation of this age can be attempted.

To recalculate the limit, it is assumed that the extreme on the more recent age is represented by a contamination of nominally twice the pictograph age (i.e., 2560 years B.P.). In that case, the corrected lower limit age becomes 1165 years B.P. An estimate of the age, and its uncertainty, after considering the effect of the background is an age lying between 1165 and 1415 years B.P. Since the measured age of 1280 years B.P. is near the midpoint between these ranges, the date may best be represented by 1280 years B.P. with an uncertainty that includes the counting uncertainty (± 45 years), as well as the uncertainty introduced by the contamination (± 125 years). Statistically propagating the two uncertainties produces an uncertainty of ± 135 years. Thus, the effect of the background contamination in this case is to increase the uncertainty given by counting statistics alone by a factor of three without altering the estimation of the age itself. Though we have presented a highly idealized model, we conclude that the age uncertainty derived is approximately correct.

Until further information is available, the age of the Red Linear pictograph dated here, 1280 ± 135 B.P., best represents the time of painting of the Red Linear style. We can convert this age into a calendar date by using the Stuiver and Reimer's (1993) ^{14}C Age Calibration Program: a 1 sigma age range of cal A.D. 649-892 and a 2 sigma age range of cal A.D. 541-1020.

SUMMARY

Grieder (1966:718) interpreted a Red Linear style pictograph scene at 41VV162A to be seventeen running animals, possibly deer or bison. Turpin (1984:193) later suggested that this pictograph may represent bison being herded toward a crack in the wall, symbolically depicting a bison jump. Bison were known to be present in the Lower Pecos region in abundance in three different periods (Dillehay 1974:181): Period I, from 10,000 to 6,000-5,000 B.C.; Period II, from 2500 B.C. to A. D. 500; and Period III, A.D. 1200-1300 to 1550. If it is assumed that the background-corrected age is 1280 ± 135 years B.P. (an uncorrected A.D. 670 for comparison with Dillehay's dates), the pictograph age nearly overlaps within the one standard deviation error with the more recent end of Dillehay's Period II.

Clearly, more data on pictograph dates are needed, and additional dates will be required to validate our results. Caution should be exercised in the interpretation of this date until further studies are completed. Our laboratory is involved in ongoing studies of the Red Linear style pictographs at other sites in the Lower Pecos region of Texas.

ACKNOWLEDGMENTS

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New Data on Clay Figurines from the Lower Pecos Area, Texas

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ABSTRACT

In recent years, four clay figurines have been documented in private collections from the Lower Pecos-Lake Amistad region of Texas. All are from the Mexican side of the reservoir and are the first specimens to be reported from that portion of Lake Amistad. Descriptions and measurements are provided and comparisons are made with figurines previously documented in the Lower Pecos region.

INTRODUCTION

Over the past several years, we have been made aware of four fired clay figurines from the Lake Amistad-Lower Pecos area of Texas. A number of unfired clay figurines have been previously reported from this area, but only one is thought to have been fired.

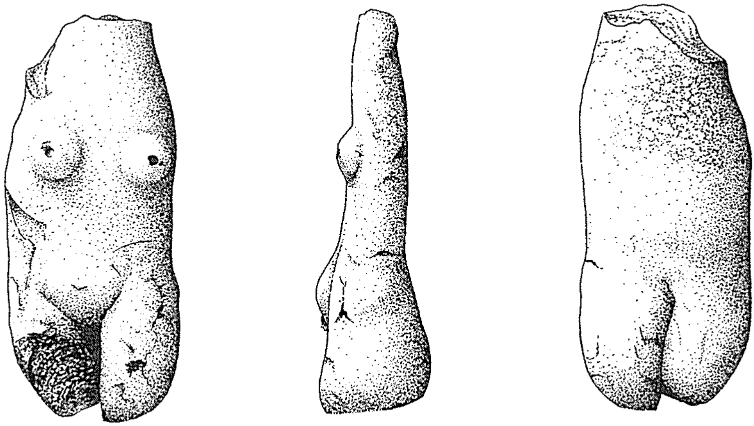
Shafer (1975) synthesized all of the reported findings of anthropomorphic clay figurines from the Lower Pecos area and illustrated some of them. Davenport (1938) reported 12 specimens from Eagle Cave and described them as all being cigar-shaped, without temper, and probably sun-baked. Four of these are illustrated by Shafer (1975) and one is very similar in shape and decoration to Specimen 2 reported in this paper.

SPECIMEN DESCRIPTIONS

Specimen 1

This specimen is a nearly complete torso of a human figure and is the most complete of the four figurines (Figure 1 and 2). It is elegantly shaped compared to other figurines from the Lower Pecos area. Prominent breasts are clearly shown with a hole in the center of each nipple (Figure 1a, 2a). The lower abdomen protudes significantly, perhaps indicative of pregnancy (Figure 1b, 2b). The upper legs or thighs are stylized and rounded off. The prominent buttocks are marked with a distinct cleft 17 mm long and about 2 mm deep (Figure 1c, 2c).

The back is slightly concave and slopes inward toward the shoulders, and the upper area of the torso is largely missing (see Figure 1b). Specimen 1 does not seem to have had a head although this cannot be established with certainty.



A B C

Figure 1. Specimen 1, a fired clay figurine from the Mexican side of Lake Amistad: a, front view; b, left side; c, back. Drawn by Richard McReynolds.

Overall, it has a nicely smoothed and rounded appearance, although it is tabular and somewhat elongated in the upper broken area. The specimen is various shades of gray to grayish brown, ranging from gray (5Y-6/1) on the front to gray-dark gray (10YR5/1-4/1) on the back. One spalled area on the right abdomen and pubic area shows a tan brown interior. It appears to be untempered but clearly has been fired.

Maximum dimensions of Specimen 1 are: length, 67 mm; width, 28 mm at breasts; thickness, 10 mm at the waist, 15 mm at the stomach, and 20 mm in the buttocks. Other artifacts from the rockshelter where this specimen was found included a painted *Rabdotus* snail shell (Chandler 1987) and a digging stick, broken into halves (currently being studied by Kenneth M. Brown). The figurine was in a private collection in Del Rio when the authors studied it.

National Park Service archeologist Joseph H. Labadie has established the location of the rockshelter on the Mexican side of Lake Amistad where this

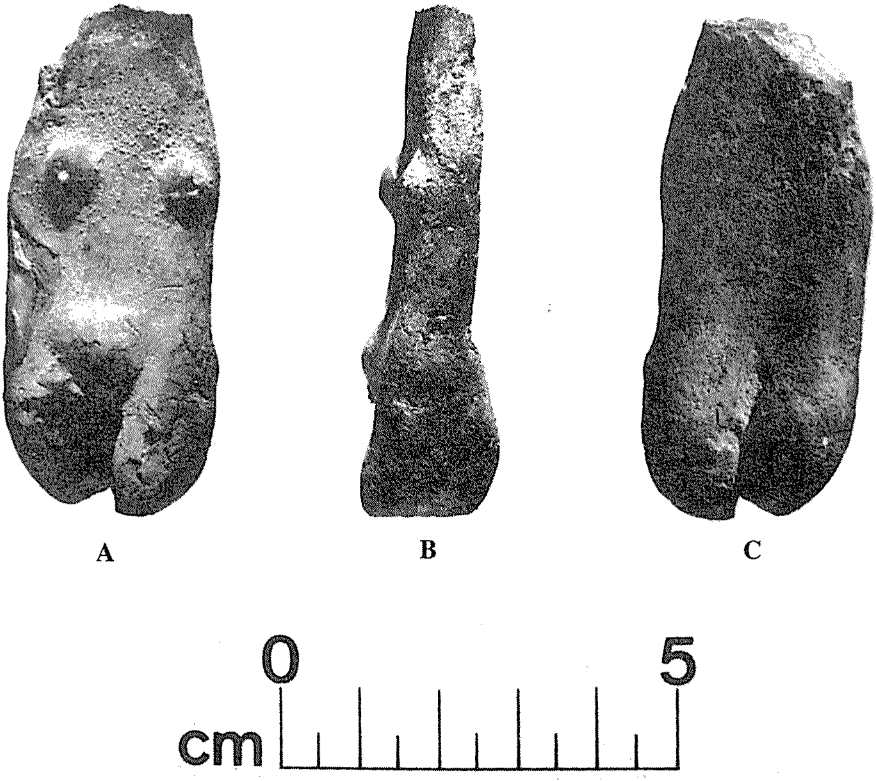


Figure 2. Photograph of Specimen 1 from front, left side, and back views.

figurine (and possibly the others) was found. Its location is on file with the National Park Service and the Texas Archeological Research Laboratory.

Specimen 2

This artifact represents the lower torso of a human figure (Figure 3). The leg areas are rounded off into well-formed, protruding buttocks, and genitalia are shown on the front. A series of rather straight but curving lines begin on the lower front and converge above the genitalia (Figure 3a). Vertical zigzag lines are on the sides and back (Figure 3b-d) and extend onto the bottom of the piece (Figure 3e). The mid-back area is marked by a series of four concentric incised lines just above the buttocks (see Figure 3c). These lines were made while the clay was very plastic and they may represent ancient tattoing practices. The upper portion of the torso is broken off and there is no evidence of breasts; however, this specimen is considered to represent a feminine figure.

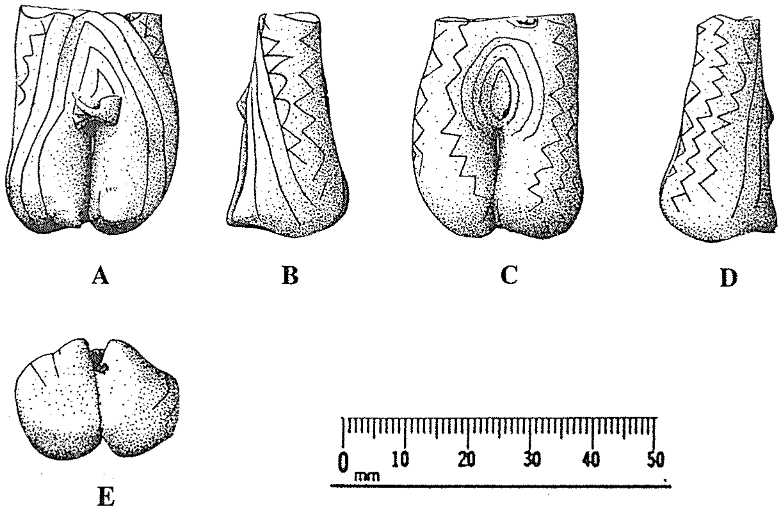


Figure 3. Specimen 2: a, front view; b. left side; c, back; d, right side; e, bottom. Drawn by Richard McReynolds.

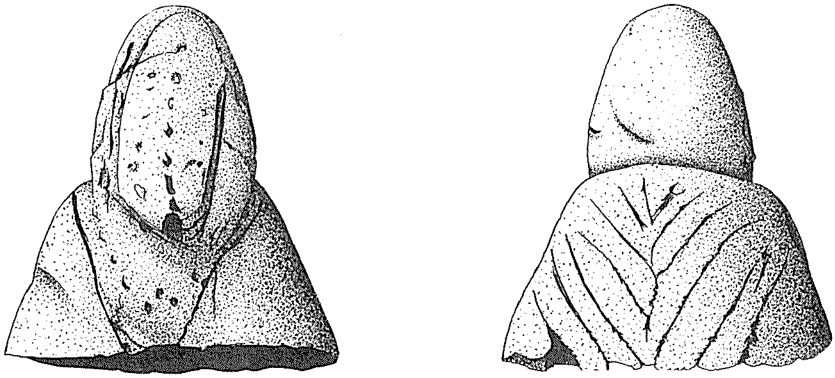
Specimen 2 is 37 mm long, 21 mm thick at the buttocks area, and 10 mm thick at the break. Maximum width is 27 mm across the buttocks and 23 mm at the break; it weighs 29 g. Its surface is medium to dark gray in color, and this color is uniform throughout the paste. It has no temper.

Portions of the figurine's surface are burnished. This may be due, however, to recent handling after the figurine was recovered from deposits in a rockshelter on the Mexican side of Lake Amistad. At the time of study, it was in a private collection in San Antonio. This figurine is clearly of baked clay and is one of the very rare baked clay specimens from the Lower Pecos-Rio Grande area.

Specimen 3

This figurine (Figure 4a, b) was brought to our attention by a private collector in the Dallas area. It, too, was found by an untrained digger in a Mexican side rockshelter at Lake Amistad. We have not personally examined this specimen, but have been provided with color photographs and the dimensions of the specimen.

This specimen represents the head and upper torso of a figurine. Based on the photographs it is a brownish color and appears to have been fired. The head seems to have the hairline outlined, and there are three vertical rows of punctations on the face. Additional punctations are found on the chest, where they are limited within two converging V-shaped lines positioned much like a necklace. On the back of the figurine are a series of converging straight, to slightly curved lines. Available dimensions are: length, 31 mm; width at the break, 27 mm; thickness, 11 mm.



A **B**

Figure 4. Specimen 3: a, front view; b, back. Drawn by Richard McReynolds.

Specimen 4

This specimen (Figure 5) is a very fragmentary portion of a fired clay figurine recovered from a damp shelter along the Mexican side of the Rio Grande in the Lower Pecos-Rio Grande area. It is a flattish oval shape with a large portion of the upper area broken off. One of the abbreviated legs and much of that side and back is also broken off and missing.

It is made very much in the style of Specimen 2 but is wider and thicker. It had two stylized legs with a deep cleft 17 mm long and 6 mm deep. This cleft extends to the pubic and stomach area, which is depressed all across the frontal portion. It is medium gray in color with no evidence of temper or any kind of paste inclusions; the paste is laminar and not well-compacted. It is undecorated and does not have defining feminine characteristics. Dimensions for Specimen 4 are: length, 51 mm; width, 41 mm; and thickness, 23 mm. It weighs 36.4 g.

DISCUSSION

A number of anthropomorphic clay figurines have been discovered and reported over a period of many years of archeological work in the Lower Pecos, Rio Grande, and Big Bend areas of Texas. All specimens from these areas

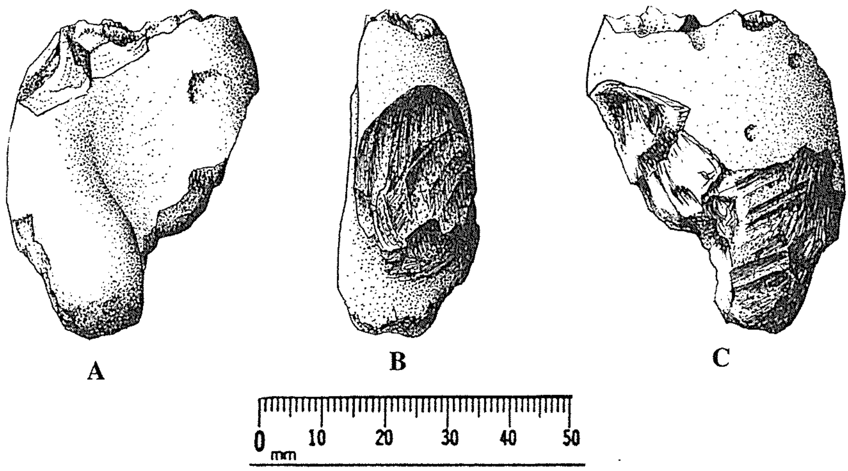


Figure 5. Specimen 4: a, front view; b, left side; c, back. Drawn by Richard McReynolds.

described in the literature, with one possible exception, are identified as unfired. The four specimens reported here, however, are fired and two of them (see Figure 3 and 4) have incised decorations.

Shafer's (1975:153) synthesis of all of the known anthropomorphic clay figurines from the Lower Pecos area of Texas concluded that they "are basically similar in that the torso is emphasized; with arms, legs, and distinguishable heads lacking." That appears to be true for three of the fired clay specimens reported in this paper, although one specimen (see Figure 4) has a head with face and body decorations. Several of the earlier reported figurines have cone-shaped breasts; thus, they are interpreted as female forms.

Some of the figurines also have incised or painted body decorations, as do Specimens 2 and 3 described here. Shafer (1975:153) states that "where sexual identifications are possible, linear designs are restricted to female forms." On that basis, we conclude that two of the four fired clay figurines in our sample represent females.

A group of 24 unfired clay figurine fragments and two complete specimens were excavated from a large rockshelter in Bee Cave Canyon in Brewster County by Coffin (1932). These are described as "grotesque human figures" made of untempered and unfired clay. They have torsos and heads with long, sharp noses and mouths defined by round punctations, and with eyes part of the black paint decoration that covers the upper parts of the figures. One fragment had sharp pointed breasts. Another had traces of a red, yellow, and black painted decoration. The lower parts of the torsos are round, and they would probably not remain upright when set on a hard surface. The backs are incurved and some have the natural indented line down the buttocks. With their emphasis on the head and facial characteristics, these figurines from Brewster County are markedly different from the Lower Pecos and Lake Amistad figurines.

SUMMARY

The fired clay figurines reported in this article were dug up by relic collectors from sites on the Mexican side of Lake Amistad and are the first specimens reported from that side of the lake. Because of their distinctive nature, it is important that information on them be reported in the literature. It is hoped that the problem of illicit digging being done on the Mexican side of Lake Amistad will be highlighted by this paper. Motorboat relic collectors are doing untold damage to the sites on the Mexican side, ruining hopes for scientific studies of those sites. While we can point to unique features of the specimens recorded here, unfortunately they lack any sort of suitable context that would aid in their further interpretation.

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Source Identification of Obsidian from 41HX44, Medicine Mounds Ranch, Hardeman County, Texas

Thomas R. Hester, Frank Asaro, Fred H. Stross, Robert D. Giauque, Patricia Mercado-Allinger, Nancy A. Kenmotsu, Timothy K. Perttula, and James E. Bruseth

ABSTRACT

An obsidian flake from site 41HX44 at the Medicine Mounds locality in Hardeman County has been analyzed using precise x-ray fluorescence analysis. The geologic source has been identified as Cerro del Medio, in the Jemez Mountains some 650 km to the northwest. Studies of Pueblo-Plains trade networks suggest that this artifact may have reached Medicine Mounds ca. A.D. 1450-1750, perhaps through Apachean or Comanche groups.

A recent publication of the Texas Historical Commission (Kenmotsu et al. 1994) describes archeological and documentary research, along with oral interviews, designed to shed light on the importance of the "Medicine Mounds" of Hardeman County. Located north of the Pease River in the Rolling Plains of northern Texas, the "Medicine Mounds" are erosional remnants of the Permian-age Blaine Formation, and stand out today as four distinct knolls in a flat prairie setting. The research by the Texas Historical Commission staff has concluded that these features were "once a sacred site for the Comanche" (Kenmotsu et al. 1994:3), an assessment based largely on interviews with local individuals, with members of the Comanche tribe, and on an overall assessment of Comanche belief systems.

During their archeological survey of the "Medicine Mounds," the Texas Historical Commission team recorded 13 archeological sites, none of which could be conclusively linked to the Comanche or any other historic tribe. Chipped stone artifacts appeared to be mostly of Archaic and Late Prehistoric age.

However, at site 41HX44 (the Saddle Site), between "Big Mound" and "Cedar Mound," a concentration of archeological remains was recorded (Figure 1). These include a possible rock cairn, a number of chert flakes and tools, several quartzite and sandstone mano fragments, burned caliche fragments, and two pieces of obsidian (Kenmotsu et al. 1994:73). The larger obsidian flake was submitted to Hester by the Texas Historical Commission for trace element analysis at the Lawrence Berkeley Laboratory. Analysis there was done by Frank Asaro, Fred Stross, and Robert Giauque, using precise x-ray fluorescence (PXRF), a technique recently described in detail by Giauque et al. (1993). Analysis was part of the ongoing Texas Obsidian Project (TOP) and a specimen number of TOP-171 was assigned.

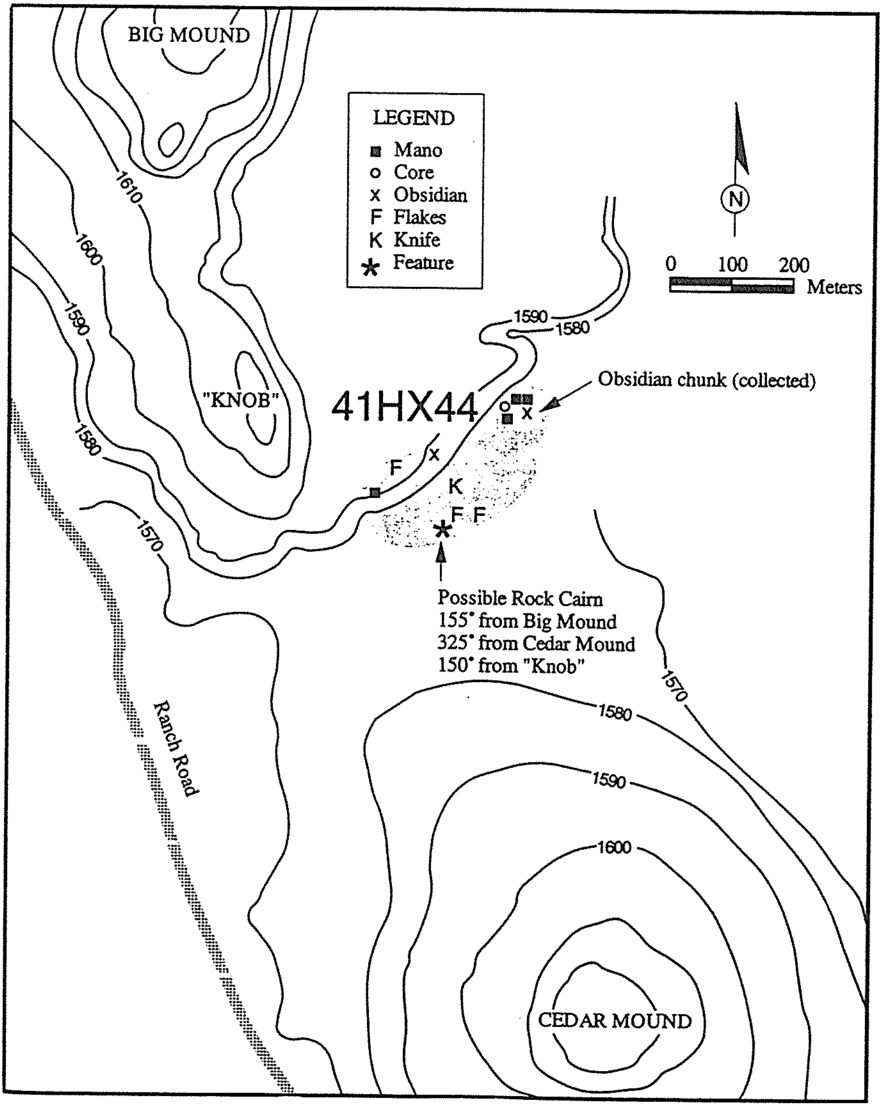

Figure 1. Map of 41HX44, showing location of analyzed obsidian artifact (from Kenmotsu et al. 1994:Figure 7).

The artifact (Figure 2) is a medial section of a blade-like flake, plano-convex in cross-section. Parts of the dorsal surface are opaque and are apparently cortical remnants. It is translucent smoky-gray in color. Length of the fragment is 18.5 mm, maximum width is 19.5 mm, and maximum thickness, 8.5 mm.

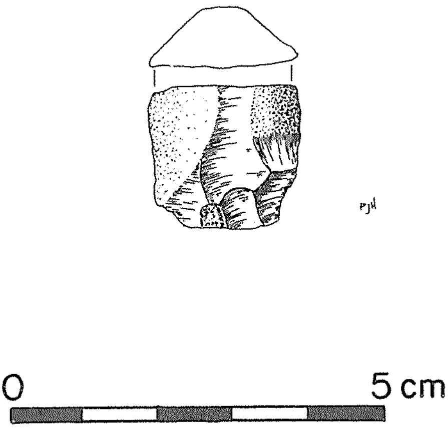

Figure 2. Obsidian Artifact (TOP 171) from 41HX44. Dorsal view shown and transverse cross-section indicated. Drawing by Pamela Headrick.

With the use of PXRF, it has been possible to conclusively assign the obsidian specimen to the Cerro del Medio source (Table 1), a well-known obsidian outcrop in the Jemez Mountains 56 km north of Santa Fe, New Mexico. As Table 1 indicates, the average deviation for eight of the most precisely-measured trace elements is only 1.7 percent. This compares with the best analysis done by Asaro and Stross using neutron activation analysis. Thus, there is no doubt of the attribution of this specimen to the Cerro del Medio source, approximately 650 km northwest of 41HX44.

Based on studies reported in Hester (1993), Cerro del Medio is a fairly common New Mexico obsidian in Texas, especially in the Panhandle region, dating mostly to Late Prehistoric times. Additionally, Baugh and Nelson (1987) suggest that the Jemez Mountain obsidians, including Cerro del Medio, were part of a Pueblo-Plains exchange system (see also Spielmann 1983) dominant from around A.D. 1450-1750. Our Texas research has shown that the Cerro Toledo obsidian (or rhyolite), its source located very near the Cerro del Medio outcrop, has a quite different distribution, found scattered widely across Texas and used as early as the Archaic (e.g., the Late Archaic at Arenosa Shelter in the Lower Pecos [Hester et al. 1991]).

It is impossible, of course, to link this piece of obsidian to an ethnic group. However, it is conceivable that Apachean or even early Comanche groups

Table 1.

Comparison of Trace Element Data:
41HX44 Sample and Cerro del Medio Source[a]

Element	S=41HX44 (PXRF)	Reference (Ref)=Cerro del Medio PXRF[b]	NAA[c]	(S-Ref)/Ref (%)	
Generally reliable elements with precision of less than 5%					
K (%)	3.81 ± 0.08	3.88 ± 0.10		-1.8	
Fe (%)	0.757		0.755 ± 0.01	±0.3	
Mn	446 ± 20		432 ± 9	±3.2	
Rb	164.5	161.3 ± 2.7		±2.0	
Y	44.3 ± 0.6	42.9 ± 0.7		±3.3	
Zr	167.5	168.8		-0.8	
Nb	58.6	59.4		-1.3	
Ga	27.8 ± 1.3	28.1 ± 1.8		-1.1	
		Average deviation (8 elements)			***1.7%***
Generally reliable elements with precision of 5-15%					
Sr	5.0 ± 0.3	4.7 ± 0.2		±6.4	
Ti	724 ± 108	663 ± 127		±9.2	
Th	18.1 ± 1.6[d]		18.8 ± 0.2	-3.7	
		Average deviation (3 elements)			***6.4%***
Other generally reliable elements					
Ba	18 ± 11	31 ± 6	45 ± 11		

[a]Abundances and errors are given in ppm unless otherwise indicated after the chemical symbol. Listed errors are counting errors for individual samples and the larger of counting errors or standard deviations for groups of samples. When errors are not listed, the counting errors or standard deviations are less than 1%, but the precisions may not be that good. PXRF measurements were made with the computer program OBSID 26.

[b]Three samples of diverse shapes with a known origin of Cerro del Medio were used as a reference.

[c]The Cerro del Medio NAA reference is sample TEX 27 (TOP 64).

[d]The minimum error for Th abundance is taken as the larger of the counting error, standard deviation, or 1.6 ppm, because of uncertainties in the interference corrections.

obtained this specimen derived from Cerro del Medio through this late trading pattern and it was eventually discarded, lost, or ritually deposited at 41HX44.

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Reviews

Reviews

Early Archaic Life at the Sleeper Archaeological Site, 41BC65 of the Texas Hill Country, Blanco County, Texas, by LeRoy Johnson, Jr. Texas State Department of Highways and Public Transportation, Publications in Archaeology, Report No. 39. 1991. xii + 190 pp., figures and plates.

Reviewed by S. Alan Skinner, AR Consultants

The Sleeper site was excavated in 1976 as part of the Texas Department of Transportation (TXDOT) archeological program. As has been the case with some of TXDOT's other field investigations, analysis and report production was not done as expeditiously as the fieldwork and the materials remained in storage until Dr. Johnson took and completed these tasks in 1986 and 1987. The final document is a contribution to Texas archeology not only because of the subject, a unique Early Archaic site, but also because of the attention that was given to the production of a well illustrated and readable document. The graphic illustrations complement the text and are well done throughout the report.

The Sleeper site is an Early Archaic campsite buried in terrace deposits along West Walnut Creek, a tributary of the Colorado River. Excavation of most of the site located within the highway right-of-way created a block unit that covered more than 900 ft^2 and revealed a somewhat undulating natural living surface on which fire-cracked rocks were found. The surface was littered with individual stones as well as stone baking heaps, stone-lined hearths, numerous milling stones (including two milling stone caches), along with food processing residue and discarded chipped stone tool manufacturing debris. Analysis focused on daily maintenance activities and revealed that plant collecting and milling, baking by means of stone heaps, and some hunting were carried out at the site. Flint knapping focused primarily on the reduction of bifaces and final-stage shaping and resharpening of dart points. The site is unique in the archeological literature because single component sites in Texas have rarely been as thoroughly excavated (a credit to TXDOT), and because the activities represented are not those typically isolable at the many repeatedly reoccupied base camps and seasonal hunting camps that have drawn the attention of many researchers in the past.

Johnson does an impressive job of extracting more from the data than simply description as he explores the site as it relates to the microenvironmental niche which it occupied. At the same time, he places the Sleeper site in a regional perspective that goes beyond projectile point styles and lithic technology description to daily and seasonal activities. No doubt the site itself helped in this process but researchers need to look at the Sleeper site report as a model of what can be done at many single component sites through a focused analysis.

Rather than analysis and description for their own sake, the reader is shown that the Sleeper site was occupied by real people who were living off the land and who left behind for us to read a page out of their life's story book.

In an interesting discussion of Early Archaic regional patterns in an area described as "The Crescent," Johnson highlights five activity sets and relates them to nine well-studied sites with Early Archaic components in the Crescent. He then goes on to revise his description of the Early Archaic San Geronimo Cultural Patterns beyond his 1987 (Johnson 1987:8) revision of Weir's (1976) phase description. This is just one example of many in the report where new ideas are offered and can be tested by researchers who, like Johnson, want to push our understanding beyond the present *status quo.*

Two vehicles are recommended here to further our knowledge of Johnson's target area; these are also applicable throughout the state. These are the analysis of WPA archeological collections/records and systematic surveys of large areas by amateur archeologists working under professional guidance.

The Sleeper site report has been a sleeper in that it was delayed in production, and it has been rarely cited, but it should be a standard reference for anyone working in the Texas Hill Country. It also provides a good example of archeological literature that can be read and understood by the general public as well as the archeological community. Johnson's writings have historically been ahead of their time as was his lithic analysis at Canyon Lake, the use of the type-variety concept with Gary points, the broad area stylistic patterns described for Southwest Texas, his questioning of the use of telephone booth archeology, and his tirade about the archeological folk community. At a time when the public wants to know more about what archeologists are finding, the report on the Sleeper site fills a valuable niche which many of us should explore.

The only drawback to the report is that I was unable to determine just where the site name came from. Despite this, I heartily recommend that *Early Archaic Life at the Sleeper Archaeological Site* be purchased and its contents be thoroughly digested by all Texas archeologists.

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Rediscovering Our Past: Essays on the History of American Archaeology, edited by Jonathan E. Reyman. Worldwide Archaeology Series, Ashgate Publishing, Brookfield, Vermont. 1992. 264 pp, figures.

Reviewed by Maynard B. Cliff, Geo-Marine, Inc.

As is pointed out by Jonathan Reyman in the introduction to this volume, archeologists have always been interested in the history of their own discipline, but the last five or six years have seen an increase in such interest, in part as a reaction to what Reyman argues was the almost "anti-historical" bias of the New Archeology after 1960 (Reyman, p. xi). Whether or not one agrees with Reyman's estimation of the effect which the rush toward the New Archeology had on historical studies of the development of the archeological discipline, it does seem true that the last several years has seen the emergence of the history of archeology as a viable sub-discipline with its own scholarly specialists. Whether or not this trend continues will be at least partly determined by the reception this volume, and others like it, receive from the archeological community at large.

The 16 essays included here have various origins, but most were originally presented at three symposia held between 1987-1989. These include one paper from "Explaining Archaeology's Past: The Method and Theory of the History of Archeology" held at Southern Illinois University in 1987; seven papers and a commentary from "Rediscovering Our Past: The First Annual Symposium on the History of Archeology" held at the 87th annual meeting of the American Anthropological Association in 1988; and four papers and a commentary from "Women in Archaeology: The Second Annual Symposium on the History of American Archaeology" held at the 54th annual meeting of the Society for American Archaeology in 1989. Reyman has organized them into three main parts with Part One focusing on theoretical and methodological issues, Part Two on women in archeology (all from the symposium of that name), and Part Three on specific biographical case studies dealing with the history of archeology. Reyman's revised commentary to the 1988 symposium makes up a concluding Part Four.

Part One has essays by Alice Kehoe ("The Paradigmatic Vision of Archaeology: Archaeology as a Bourgeois Science"), Don Fowler ("Models of Southwestern Prehistory, 1840-1914"), Sergio Chávez ("A Methodology for Studying the History of Archaeology: An Example from Peru (1524-1900)"), and Douglas Givens ("The Role of Biography in Writing the History of Archaeology"). As a series of theoretical papers, the essays point out the high degree of variability presently abroad in historical studies of archeology, and seem to reinforce the fact that this emerging sub-discipline is still experiencing a high degree of flux in regard to its paradigm definition.

In her paper, Kehoe looks to the 19th century in Europe and America to argue that the emergence of archeology as a distinct science was due to two factors: "continuing state support for archaeology as an instrument for legitimizing the nation and its dominant political system; . . . [and] presentation of archaeology through the mode of discourse of science, including a form of demonstration (field excavation) that fulfilled science's demand for witnessed objective experiment" (p. 3). Of these two, Kehoe seems to view the effect of the dominant political system, "industrial-capitalist bourgeois democracy" to use her words, as the most important. This theoretical view dovetails nicely with the methodological essay of Chávez, who proposes the use of "a period framework derived from external historical events, the consideration of the social and economic contexts of the people involved, and the intellectual developments within the emerging discipline," to organize the history of a discipline (p. 35). He stresses that this methodology permits a "more complete" interpretation of the history of archeology than does the "purely intellectual histories organized in a stage framework" such as that used by Willey and Sabloff (1974). Fowler follows a more traditional approach in discussing the development of Southwestern archeology in terms of the various models which guided research, but he also points out the relation between internal and external factors in the development of archeology as an intellectual discipline, noting also that "all history is contemporary history, shaped by the paradigms of the day" (Reyman, p. 246).

This emphasis on the importance of "the interaction between internal and external cultural factors, . . . on the history of archeology" emerges as one of two "conceptual themes" running throughout many of the essays in the volume (Reyman, p. 244). The second theme, as Reyman points out, is "the importance of biography," which is emphasized in Givens' paper in this section. He argues that since archeology is made up of individuals, and its history is laregly guided by the relationships between individuals, and between individuals and institutions, then the writing of biography is a valuable tool for charting these relationships, and by extension, the development of archeology as a discipline. Givens' discussion of the methodology of writing biography emphasizes what Reyman sees as common methodological issues which run through most of the papers: the necessity of using unpublished data (such as letters, diaries, etc.), and the construction of detailed chronologies in regard to the writing of archeological history (Reyman, pp. 243-244).

Part Two is limited to papers given at the 1989 symposium on "Women in Archaeology," and includes essays by Reyman ("Women in American Archaeology: Some Historical Notes and Comments"), Jane Kelley ("Being and Becoming"), Carol Mason ("From the Other Side of the Looking Glass: Women in American Archaeology in the 1950s"), Frances Mathien ("Women of Chaco: Then and Now"), and Dena Dincauze ("Exploring Career Styles in Archaeology"). These papers are far more focused and problem-oriented than the ones that precede or follow them, concentrating on various aspects of the role of women in the development of North American archeology. The papers by Reyman, Mason, and Mathien concentrate on the role of women as a whole in North American archeology, while those by Kelley and Dincauze are more personal, even autobiographical or anecdotal, in nature, and examine the general role of women as epitomized in the career choices of individuals. What most emerges from these papers is that women have been important in the history of American archeology (their role is made abundantly clear by Reyman and Mason), but why this fact has become obscured within the recent past, almost as if the history of North American archeology had been rewritten to edit out the part played by women.

Mason suggests that the present discrimination experienced by women in archeology began in the 1960s and was "less a matter of what women did or were doing and more a reflection of changes in the composition of the population of male archeologists" (p. 99). She notes that the pre-war generation of "gentlemen" archeologists had been raised during the "first serious wave of the women's movement in the United States," and thus "had considerably less reason to discriminate against women; their mothers, sisters, grandmothers, and other female kin were role models for their perceptions of women." In contrast, she argues that the "democratization" of education after World War II led to "professionals whose backgrounds had not included exposure to tenets of sexual equality and who were less likely to have mothers or sisters who expressed such ideas," and that by the 1960s these new professionals had become dominant. While this may have played some role in the development of the present situation of discrimination in American archeology, it is equally likely that the changes which Mason sees as occurring in the 1960s were related to the decreasing number of available academic positions for archeologists of either gender in relation to the increasing number of professionals available to fill them—a situation bound to promote increased competition accompanied by feelings of anger and resentment toward competing groups. The fact that male archeologists remained in positions of dominance throughout this period left them in control of the scarce resources (jobs) and led to increased discrimination against women.

The articles in Part Three are more eclectic than those in the two previous sections and cover a range of topics and interests. Included are essays by Givens ("Sylvanus G. Morley and the Carnegie Institution's Program of Mayan Research"), Donald McVicker ("The Matter of Saville: Franz Boas and the Anthropological Definition of Archaeology"), Valerie Pinsky ("Archaeology, Politics, and Boundary-Formation: the Boas Censure (1919) and the Development of American Archaeology during the Inter-War Years"), Richard Daggett ("Tello, the Press and Peruvian Archaeology"), E. Mott Davis ("Effect of Pioneers on Regional Archaeology: The Texas Example"), and Lawrence Jackson and Paul Thacker ("Harold J. Cook and Jesse D. Figgins: a New Perspective on the Folsom Discovery").

The papers by Givens, McVicker, and Pinsky all relate to the early part of this century and are concerned with the early development of North American archeology in both museum and academic settings. Givens examines the early years of the Carnegie Institution of Washington's program in Mayan archeology and the circumstances behind the initial choice of Morley to head it. The papers by McVicker and Pinsky are both concerned with the role which Franz Boas played in moving anthropology from a museum to an academic base, and with the effect competition between the two had on the development of American archeology. McVicker examines all this from the relationship between Boas and Marshall Saville, the museum archeologist who dogged Boas, first at the American Museum of Natural History and later at Columbia, until 1916 when Saville's time became entirely devoted to the Museum of the American Indian. McVicker concludes by discussing the culmination of the animosity caused by Boas' attempts to subordinate museum archeology to academic archeology: the so-called "Boas censure of 1919."

Pinsky discusses the censure in more detail, tracing its context and development and its significance for the early history of archeology. In 1919, Boas wrote a letter to *The Nation* in which he denounced four men who had used anthropology as a cover for political spying in Central America for the United States during World War I. As a result of this, and at the instigation of several prominent Smithsonian Institution anthropologists, Boas was censured by a vote of 20 to 10 (the majority of those voting against him being archeologists) by the American Anthropological Association (AAA) at its December 1919 meeting, removed from office on the governing council of the AAA, and forced to resign from the National Research Council. On the basis of the censure, and on what happened before and after, Pinsky suggests that "archeology was not particularly well-established within the Boasian program, either before or during the inter-war years, and . . . its dominant character was formed more directly as the result of its close association with museums into the 1930s, and . . . survey and salvage work undertaken throughout the 1920s and 1930s" (p. 176).

The essay by Daggett is a very specific study of the utility of non-academic sources, in this case the South American popular press, in evaluating the work of Julio C. Tello in Peruvian archeology during the first part of this century. The essay makes the case that in some instances, newspaper sources can be added to letters and diaries as valuable data sources for writing a history of archeology. To me, it provides an important caveat to the modern profession to take more care in regard to what is published in newspapers and other popular sources, since all too often such information becomes garbled in the transition from the archeologist to newsprint.

The final two papers in this section, by Davis and Jackson and Thacker, both deal in some way with the role of the pioneer or non-professional in the early development of North American archeology. Davis takes the cases of James E. Pearce and Cyrus N. Ray in the early development of Texas archeology. Pearce, trained as an historian and later as an anthropologist, was a high school teacher and principal in Austin before becoming chairman of the Department of Institutional History (later to become the Department of Anthropology) of the University of Texas at Austin in 1917. For the next 20 years, Pearce oversaw the University's program of archeological excavation throughout Texas and essentially laid the base for the future structure of Texas archeology. Cyrus

N. Ray was trained as a physician, with only a non-professional's commitment to Texas archeology, but after 1926, he became increasingly active in researching the prehistoric remains of the Abilene area. He was instrumental in founding the Texas Archeological and Paleontological Society (today's TAS) in 1928, and within the year began publishing and editing the *Bulletin*. Davis summarizes by saying that Pearce and Ray's contributions were not to "formulate concepts, but to draw attention to local antiquities and the need to study them, and to manipulate local institutions to create a base" (p. 212).

The paper by Jackson and Thacker examines the nature of the Folsom discovery in New Mexico in 1926. They show that instead of being an "accidental" discovery, it was the result of "a determined palaeontological field program . . . which carefully watched for early human associations between 1924 and 1926" (p. 217). It is clear from this essay that even though Cook and Figgins were paleontologists, not archeologists, they understood the requirements of "archeological proof" and deliberately set out to fulfill those requirements in order to convince skeptics of the reality of Pleistocene man in North America. In this sense, a great deal more is owed to Cook and Figgins than just the "accidental" discovery of the Folsom site.

As might be expected, given their diverse origins, the papers included in this volume cover a range of topics but can provide something of interest for almost everybody. The essays on the role of women in archeology should be required reading in any history of archeology course; the two papers on Boas should be read by anyone interested in why American anthropology assumed an academic, and not a museological, base in the early part of the century, while the papers by Davis, and Jackson and Thacker will be of interest to avocationalists as well as anyone interested in the development of Texas archeology. Unfortunately, the high cost of the volume ($59.95) would probably put it beyond the reach of any casual reader with an interest in only one or two of the essays, but the book is definitely a worthwhile addition to a municipal or university library.

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The Archeology of 41NU11, The Kirchmeyer Site, Nueces County, Texas: Long-Term Utilization of a Coastal Clay Dune, by Pamela Headrick, 1993. Studies in Archeology 15. Texas Archeological Research Laboratory, The University of Texas at Austin, xi + 91 pp.

Reviewed by Amy C. Earls, Prewitt and Associates, Inc.

This report, a revised Master's thesis, describes 14,320 prehistoric/contact and 9,465 historic artifacts recovered from the Kirchmeyer site (41NU11) and curated at the Texas Archeological Research Laboratory. The site is in a clay dune south of the Nueces River on the western shore of Oso Bay, approximately 7 km inland from the Corpus Christi Bay shoreline. Unlike sand dunes, clay dunes are stable and would have offered a highly compacted occupation surface, well-drained and elevated above the surrounding lagoon. Clay dune formation in this area postdates 2500-4000 years B.P., and artifacts were recovered from the dune surface to 40 cm deep; most artifacts were collected from the surface.

The first portion of the report contains introductory environmental and archeological background sections and describes the projects contributing to the site collection. Surface collections at the site were made in the 1930s-1940s and 1960s-1970s. In 1969, University of Texas at Austin students Tom Hester and Jim Corbin and volunteers from the Coastal Bend Archeological Society re-excavated a prehistoric/contact period hearth feature, as well as four historic features, thirteen 2x2 m units, two trenches, and five shovel tests. Only the hearth feature is described in the report, and few artifacts were recovered from the excavations.

The bulk of the report consists of descriptions of the prehistoric and historic artifact assemblages. As is appropriate for a descriptive report centered on artifact analysis, the report is well-illustrated. Thirteen figures, primarily drawings by the author, illustrate the prehistoric artifacts: including all dart points and the range of arrowpoint types, as well as the polyhedral core coastal blade technology and other chipped stone tools; shell points, adzes, awls, beads, and pendants; ceramic decoration motifs and rim sherd profiles; and miscellaneous artifacts.

The prehistoric component is dominated by Late Prehistoric artifact types, although possible Archaic and contact period artifacts (five blue-green glass beads and two fragments of a bronze bell) also occur. Charcoal from a hearth containing Late Prehistoric or possibly contact period materials, including a Rockport Black-on-gray vessel, the bronze bell fragments, and an edge-modified Sunray clam fragment, dates 380 ± 70 B.P. (Tx-7217) with a calibrated range of A.D. 1436-1635.

The assemblage of 159 arrowpoints includes Perdiz and Bulbar Stemmed points (49 percent), Starr and Cameron points (26 percent) characteristic of the Brownsville complex along the Rio Grande delta, and Lozenge and Padre points (8 percent) of the Corpus Christi to Baffin Bay and Padre Island areas. The nine dart points consist of Catan and Matamoros types from the dune surface. The author attributes these points to a possible Archaic occupation but also suggests they may represent preforms or dart points contemporaneous with the Late Prehistoric occupation. The projectile point metrics could have been presented more effectively in tables than in the text.

All of the 12,628 prehistoric sandy paste sherds, most of which are small and, thus, difficult to type, were grouped based on presence/absence of asphaltum coating and presence/absence of obvious bone temper, and then further classified according to attributes of interior scoring and decoration. The ceramics fall within the Rockport ceramic complex and probably primarily represent Rockport Plain/Crenelated and Rockport Black-on-gray vessels. No Rockport Incised, Goose Creek Plain, Goliad, or Leon Plain types were identified.

The site may have been used in historic times for grazing land or outbuildings by ranches, such as the 640 acre Rancho Tulosa shown on an 1853 map, beginning in the 1830s. Another possible use is by Mexican War soldiers since Zachary Taylor's 4,000 member army was in the Corpus Christi/Oso Bay area between July, 1845, and March, 1846. Military artifacts include a bayonet part, charge flasks, and two brass buttons, one an 1835-1850 2nd Dragoons button probably from a member of Taylor's army.

Other temporally diagnostic historic artifacts dating to the second and third quarters of the nineteenth century could derive from ranching or military occupations of the tract. Artifacts such as armaments and horse tack may be from military or ranching occupation or from hunting activities. The glass assemblage consists primarily of olive, aqua, and green bottles, including at least 65 wine/champagne or liquor bottles. Coins are an 1838 United States half dime and an 1845 Mexican quarter peseta piece.

Refined earthenwares dominate the kitchen assemblage, and the estimated 442 vessels reflect intensive use of the site. The single identified pattern among the 40 transfer-printed vessels is Sirius, dating 1839-1841. The 86 hand-painted vessels include fineline, sprig, and berry patterns dating to the 1840-1860 period. Makers' marks include 1842, 1844, and 1861 Minton and Hollins marks, an 1849 registration mark, and 1830s and 1840s Davenport marks.

Twenty-one figures illustrate the historic artifact types. Drawings are used to render ceramic makers' marks, vessel profiles, miscellaneous stoneware and redware vessel portions, and stoneware pipes; glass bottle finishes, seals, and base profiles; metal artifacts; and gunflints. Black-and-white photographs are used to illustrate ceramic shell-edge, transfer-print and flow blue, annular, and sponge-spatter patterns; metal coins; and buttons. Color photographs are effectively used to illustrate ceramic transfer-printed and hand-painted patterns.

With the exception of the coins and the flow blue patterns (the latter, due to their intentionally blurred patterns, are extremely difficult to illustrate even using macrophotography), these figures are informative and provide the necessary support for the type descriptions in the text since differences in historic artifact terminology exist. The color photocopy of the hand-painted ceramics is particularly effective in showing the palette of polychrome colors, and in eliminating the need for cumbersome captions listing the colors.

This report is written and presented well. Despite the lack of good stratigraphic context for most of the artifacts, so few reports on prehistoric and historic assemblages are available from the Corpus Christi Bay area that the artifact descriptions alone constitute a meaningful research contribution. The report is worth the $9.00 cost for anyone interested in Late Prehistoric or mid-nineteenth century sites along the central Texas coast.

Proboscidean and Paleoindian Interactions, edited by John W. Fox, Calvin B. Smith, and Kenneth T. Wilkins. Baylor University Press, Waco. 1992. 233 pp., figures.

Reviewed by Michael B. Collins, Texas Archeological Research Laboratory.

Twelve contributions of variable quality are assembled in this volume which grew out of the symposium, "Mammoths, Mastodons, and Human Interaction" hosted by Baylor University in Waco at the 1987 meeting of the Texas Archeological Society. Not all chapters in this book represent papers read at the symposium, and not all papers read at the symposium are included.

Human interaction with proboscideans in Prehistoric America as a research focus is deceptive in its apparent simplicity, as the papers in this collection show. Neither human nor proboscidean behavior is very well known for that brief time they had together in this hemisphere. The human capacity for highly adaptive cultural behavior is rivaled by the wide array of behaviors that might characterize adaptations of the several species of mammoths, mastodons, and gomphotheres that coexisted with humans. This, in the context of our imperfect knowledge about diverse and rapidly changing Late Quaternary Beringia and North, Middle, and South America environmental conditions, makes the topic vast, complex, important, and very engaging. Unfortunately, this volume does not bring focus, direction, or insight to the topic, even though individual authors say important and interesting things.

Chapters 1 and 12 (both by John W. Fox and Calvin B. Smith) introduce and conclude the volume, respectively. Human behavior as it relates to proboscideans is the topic of chapters 8 (by Jeffrey J. Saunders), 9 (by David L. Carlson and D. Gentry Steele), and 11 (by Tom D. Dillehay). Chapters 2 (by S. David Webb), 5 (by Pat Shipman), 6 (by Richard S. Laub), and 7 (by Gary Haynes) touch upon aspects of proboscidean evolution, biology, and behavior. Late Quaternary environmental context is addressed in Chapters 3 (by Ernest L. Lundelius, Jr.) and 10 (by Joel Gunn). Chapter 4 (by Fox, Smith, and David O. Lintz) is devoted to the Waco Mammoth locality, the discovery and investigations of which prompted this symposium.

The introductory chapter by Fox and Smith ("Introduction: Historical Background, Theoretical Approaches and Proboscideans") offers a spotty, error-ridden history of Paleoindian studies and rambles indecisively over several "theoretical" topics. Lindenmeier is not a mammoth site (p. 1). Excavations at Murray Springs, Arizona, in the 1960s could hardly be considered part of the "fledgling field of Paleoindian studies" (p. 1). The Cooperton (Oklahoma), Dutton (Colorado), and Selby (Colorado) sites do not increase the likelihood of the presence of diverse technologies on the North American High Plains " . . . such as flaked bone (i.e. expediency tools) or lithic industries of flake tools, the Levallois and Mousterian-like traditions, or even East Asian split-pebble tools predating blade industries with bifoliate points" (p. 2). Furthermore, it is not clear what is meant by "blade" or by "bifoliate points." The statement (p. 2) that "[t]he Waco site also served as a springboard for discerning climatic and biome distinctions between the mid-Wisconsinan interglacial and the subsequent pluvial of the full glacial at about 28,000-25,000 years before present" bears little resemblance to accepted Pleistocene systematics and dating. It is hard to see how Miocene Proboscideans in the New World had "Pliocene African savannah origins" (p. 3). The statement is wrong that Monte Verde, Chile, was in the "humid subtropics" 30,000 years ago (p. 5). Other problems detract significantly, but the chapter's greatest failing is the missed opportunity to draw the 10 topical contributions together, thereby leaving the whole no greater than the sum of its parts.

Saunders ("Blackwater Draws: Mammoths and Mammoth Hunters in the Terminal Pleistocene") infers aspects of mammoth behavior from that of modern elephants. He doubts, with reason, the usefulness of ethnographic accounts of elephant hunting for understanding Clovis-age techniques and argues, unconvincingly, that bison hunting practices may offer better analogs. A useful, critical review of various models of human mammoth-hunting behavior that have been proposed for American prehistory concludes that no single model has been scientifically proven or disproven. Perhaps, as Saunders reiterates (p. 138) from an earlier conclusion, "Clovis Paleoindians, although capable hunters, appear to have been opportunistic scavengers," but he seems to now favor the "herd confrontation" model (p. 143).

Carlson and Steele ("Human-Mammoth Sites: Problems and Prospects") address one of the more urgent issues in Paleoindian studies: those sites that ". . . lie at the edge of our ability to reconstruct the past . . . " (p. 149) because of low visibility ("low-profile" is their term). Small sites with evidently butchered faunal remains and few or no obvious artifacts are important in filling out the archeological record, yet it is not always possible to unequivocally establish that humans were involved in spite of recent theoretical advances, greater concern with processes of site formation, and insights gained from taphonomic analogy. These points are carefully and thoroughly made by considering the Duewall-Newberry mammoth remains found along the lower Brazos River. Contextual and taphonomic evidence—especially low-energy environment of deposition, bone stacking, and high-impact fractures to fresh bone—implicates humans as exploiting the carcass either as successful hunters or as scavengers. The messages can hardly be overemphasized: (1) low-visibility sites are escaping our attention, (2) full understanding of context (including formation processes) is essential for interpreting such sites, (3) we must continue to improve observational and experimental analogs in taphonomy, and (4) some sites may be dismissed too quickly as non-cultural simply because an alternative interpretation is possible.

Dillehay ("Humans and Proboscideans at Monte Verde, Chile: Analytical Problems and Explanatory Scenarios") reviews the setting, site context, and nature of mastodon remains from the ca. 13,000 year old component at Monte Verde. Details not usually seen in the taphonomic processes are revealed because excellent preservation allows detection of subtle variations in the condition of ivory, teeth, bone, hide, and other animal parts. Dillehay identifies complexities inherent in the "causal chain" from life-and-death cycles of mastodons in wetland environments through human logistical strategies shaped in response to the availability, distribution, composition, and suitability of animal products. The thoroughness of Dillehay's approach is exemplary in taphonomic inquiry, Monte Verde is remarkable for its preservation, and the combination is compelling.

In his contribution, Webb ("A Brief History of New World Proboscidea with Emphasis on Their Adaptations and Interactions with Man") provides an authoritative and comprehensive primer on the taxonomy, evolution, ranges, and dietary adaptations of New World proboscideans. Not surprisingly, since he is a paleontologist, Webb offers a less convincing portrayal of the human record when he postulates a rapid peopling of the hemisphere by bands of highly mobile hunters, but this detracts little from his important point that humans found different species of mammoths and mastodons occupying different ranges in the Americas. Each species presented new challenges for would-be hunters, a fact that certainly contributes to the mosaic of Paleoindian adaptations.

In her chapter ("Body Size and Broken Bones: Preliminary Interpretation of Proboscidean Remains"), Shipman argues that great size is the characteristic of proboscideans that may best explain both their extinction and much of the use humans made of their carcasses. The question is whether all of the extinct proboscideans share some characteristics that might be related to their extinction which is not shared by the surviving loxodonts of Africa. With large body size go certain fundamental physiological and ecological factors critical to survival of a species.

Shipman uses allometric equations to estimate weights from skeletal element sizes. Her results show the surviving African loxodonts to be roughly half as large as the extinct African genus Elaphas and the American mammoths and mastodons. With large body size go greater age at first reproduction, longer gestation, reduced average birth rate, increased birth interval, greater life span, and longer life expectancy, which lessen a species' ability to respond to any increase in mortality, whether by human predation or by environmental changes.

In another vein, Shipman notes that long bones of mammoths and mastodons, with their great size, cortical thickness, and density, are by far the best suited for tool manufacture of any in the Americas. Shipman poses a number of questions which stem from the implications of proboscidean size to the manner in which humans would have interacted with them, including: with so much flesh, how could hunters really make use of it; is cold-weather caching indicated? Does large size explain why the familiar butchering marks are rarely found on proboscidean bones and why worldwide a majority of claims for bone tools are based on proboscidean materials?

Laub ("On Disassembling an Elephant: Anatomical Observations Bearing on Paleoindian Exploitation of Proboscidea") was one of eight persons who butchered a zoo elephant in 1990. The very thick and tough skin presents the problems of penetration in killing or butchering, difficulty in cutting, and immense weight in removal. Fat and muscle tissue are easy to cut and remove, once the animal has been skinned. Several of the removable skeletal elements are heavy and could be lifted only by several individuals together. Laub concludes that confronting a healthy mammoth or mastodon with thrusting spears does not seem a plausible model for Paleoindian hunting, although with spear-throwers, the prospect might be somewhat better.

As Laub emphasizes, 20th century scientists dissecting an African elephant is an imperfect analog to hunters or even scavengers enculturated in the butchering of wooly mammoths or mastodons, but much was learned from the experience, the implications of which are tied to selected references from the Paleoindian literature. If Shipman's size calculations for mammoths and mastodons are roughly correct, Laub's concerns fall far short of the true mark.

Haynes ("The Waco Mammoths: Possible Clues to Herd Size, Demography, and Reproductive Health") cautiously draws upon what is known about selective pressures and adaptive responses among living elephants to posit interpretive possibilities for the Waco Mammoth site, particularly home range, biological and social relatedness, risk of premature death, and replacement rate. Haynes found no unweaned individuals and a low (20-30 percent) proportion of subadults. If this is a catastrophic death assemblage, these numbers indicate that the herd group was either incompletely sampled or under severe reproductive stress. One wonders if thin-sections of bones and tusks along with isotopic signatures from bone might afford independent tests of these alternative hypotheses.

Proboscideans are only mentioned in the chapter by Lundelius ("Quaternary Paleofaunas of the Southwest"), but in reviewing the Late Quaternary faunas from numerous localities in western Texas and eastern New Mexico, he provides glimpses of habitats in and near proboscidean ranges. Lundelius describes the composition as well as the temporal and geographic nature of the data base, explains the concept of disharmonious faunas, reviews the paleoenvironments indicated by the faunal record, critiques competing theories on Late Pleistocene extinctions, and makes clear his reading of this evidence. All of the faunas in the Southwest in the Late Pleistocene were diverse, contained now extirpated taxa, and included disharmonious associations of taxa that are now allopatric, implying more equable climates and more patchy environments. The disappearance of associations among smaller animals at the same time as the extinction of the large mammals indicates loss of niches, a more likely cause of megafaunal extinction than human predation.

Gunn's chapter ("Regional Climatic Mechanisms of the Clovis Phase on the Southern Plains") should be required reading for everyone studying early Paleoindian adaptations. Principles drawn from the theory of global energy balance and climate are employed to retrodict aspects of regional climate during the Late Pleistocene. Gunn sees the cooling effects of increased volcanic activity as increasing rainfall which supported proboscidean populations upon which Clovis hunters preyed. Carefully selected paleoclimatic data are arrayed to fit this model (but interpretations such as the "Clovis Drought" posited by C. Vance Haynes [1985, 1991] are conspicuously absent). More important than the particulars of Gunn's model is that by example he demonstrates the kinds of questions to be asked, indicates the scale and scope of inquiry necessary for addressing those questions, and presents a hypothesis in need of empirical testing.

In 1992, it had been 14 years since work began at the Waco Mammoth Site, and this interim report ("Herd Bunching at the Waco Mammoth Site: Preliminary Investigations, 1978-1987") by Fox, Smith, and Lintz is a welcome step toward disseminating the particulars of this important find. Fifteen or so adult female and juvenile mammoths died closely together in space and apparently in time in shallow, turbid water of the Bosque River roughly 28,000 years ago; the placement of the carcasses may reflect a defensive formation. Drowning, miring, electrocution, asteroid bombardment, sudden freezing, animal predation, and predation by humans with wooden spears are discussed and mostly rejected as possible explanations. Seasonality and range are discussed without contributing much to the account of the site.

This chapter is flawed with several errors; for example, Blackwater Draw and Domebo are referred to as mammoth herd kill sites (p. 61) when the evidence at Blackwater Draw is for long term accretion and there is but one individual at Domebo. And, mammoth demography is described as having a 40:1 juvenile-to-adult ratio at the site of Friesenhahn Cave in support of the proposition that mammoths wintered in the area. Friesenhahn was the den of large predator cats who selectively introduced young mammoths and the ratio says nothing about mammoth demography, seasonality, or migration.

In the final chapter ("Conclusion: Historical Perspectives") Fox and Smith touch upon the history of Paleoindian research in the Americas, advocate use of comparative data from good contexts, consider the implications of proboscidean natural history to the adaptive radiation(s) of humans into the Americas, address proboscidean seasonality and migration, discuss the notion that proboscidean reproductive patterns were ill suited for stresses on populations at the end of the Pleistocene, and conclude with thoughts on human exploitation of proboscideans.

Though better than the introductory chapter in developing themes and integrating the several contributions, this chapter contains far too many errors and misconceptions. Among the more substantive are allusions to Beringia during warm interstadials (pp. 211-213), an ill-developed notion of "mid-Wisconsinan" peoples in the Americas who were "broad spectrum foragers with unsophisticated middle Paleolithic split-pebble and flake tools (Llevallois [sic]/Mousterian) as well as with bone and wood industries" (p. 211) but whose "mid-Wisconsinan date would preclude all lithics except perhaps anvils and hammerstones" (p. 220), uncritical acceptance of such claims as "mammoth bone fragments . . . recovered in association with lithics at approximately 42,000 years before present" [at China Lake, California] (p. 214), and an incomprehensible discussion of seasonality and migration among proboscideans (pp. 216-218).

This collection would have benefitted from a more thorough discussion of the central issues raised by the individual papers. For example, all ten chapters touch upon the crux of humans hunting proboscideans, particularly in reference to understanding the exploitation of mammoths by the makers of Clovis points. Consistently, these people are portrayed as being band-level foragers or hunter-gatherers engaged in scavenging mammoth carcasses, hunting mammoths, or both. Repeatedly it is suggested that nursery herds of adult female mammoths with juveniles could be confronted, bunched, and multiple individuals systematically killed by experienced hunters—the "herd confrontation model." Why would hunters from a band probably no larger than a few tens of people risk attacking precisely the mammoth social unit evolved for defense? What would such a band do with anywhere from one to two metric tons of meat from the successful take of a single adult mammoth, much less the yield of multiple individuals? Processing and storage in very cold latitudes was probably feasible, but what about for the majority of Clovis territory? At many Clovis sites, remains of smaller animals are numerous, raising the question of really how integral mammoth exploitation was to the Clovis subsistence mode(s).

Technically, this is an attractive book with pleasing print and layout; photographic plates are generally good. However, the line figures appearing on pages 24, 125, 133, and 158 did not reproduce well, typographical errors are present in low numbers through the volume (for example, Chile is misspelled with an accent on the e throughout) and the index has many omissions and errors. The most significant problem is with discrepancies between text and references-cited sections of several chapters (from 10-18 percent discrepancy in chapters 1, 4, and 12).

Issues raised by the papers in this volume certainly need further attention. It would not be expected that the symposium or this book could resolve those issues, but it certainly could have brought them into sharper focus and capitalized on the multiple-disciplinary expertise seen in the collected papers.

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The *Bulletin of the Texas Archeological Society* publishes original papers in the field of American archeology. Emphasis is placed on Texas and adjoining areas in the United States and Mexico; papers on other areas also are considered. Articles concerning archeological technique, method, or theory are accepted. Preference is given to members of the Society.

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Cover illustration:

Figure 14 from Fields, Gadus, and Klement, "The Peerless Bottoms Site: A Late Caddoan Component at Cooper Lake, Hopkins County, Texas"