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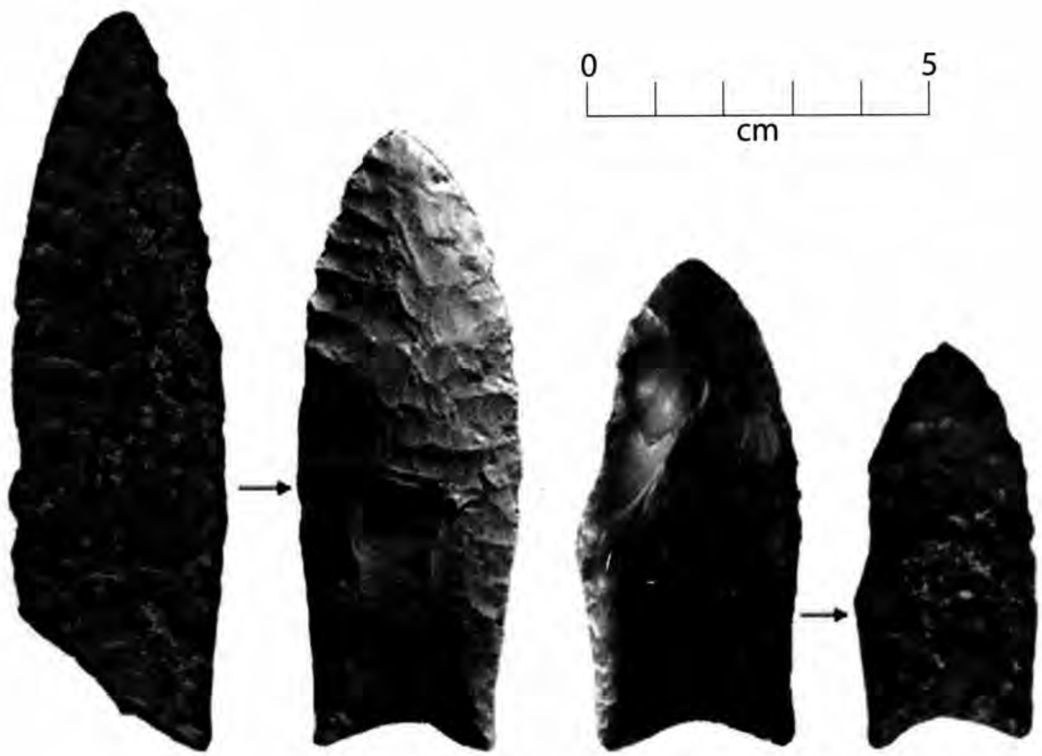

Representative Clovis Points Seriated by Extent of Resharpening

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Journal of the Southern Texas Archaeological Association

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The Southern Texas Archaeological Association

The Southern Texas Archaeological Association brings together persons interested in the prehistory of south-central and southern Texas. The organization has several major objectives: To further communication among avocational and professional archaeologists working in the region; To develop a coordinated program of site survey and site documentation; To preserve the archaeological record of the region through a concerted effort to reach all persons interested in the prehistory of the region; To initiate problem-oriented research activities which will help us to better understand the prehistoric inhabitants of this area; To conduct emergency surveys or salvage archaeology where it is necessary because of imminent site destruction; To publish a journal (*La Tierra*), newsletters, and special publications to meet the needs of the membership; and to assist those desiring to learn proper archaeological field and laboratory techniques for southern Texas.

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About the cover: Clovis points from the paper by Collins and Hemmings in this issue.

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An Overview of the Archaeology of Bandera County, Texas

Thomas R. Hester

PREHISTORY AND EARLY HISTORY IN BANDERA COUNTY

Ancient peoples first occupied the Bandera County area at least 11,500 years ago. From that early time, during the end of the Pleistocene (Ice Age), until the early 18th century, prehistoric American Indian cultures lived as hunters-and-gatherers, exploiting the abundant resources of this portion of the Texas Hill Country.

These peoples left behind a rich archaeological record. Their sites include the hundreds of burned rock middens ("Indian mounds" of fire-cracked limestone) most of which result from the earth-oven cooking of sotol bulbs and other wild plant foods (Black et al. 1997). These food-processing locales were usually just a part of their campsites, where large amounts of debris resulted from daily tasks. Most recognizable are their projectile points ("arrowheads") and other stone tools, along with the vast quantities of flint flakes that resulted from the making of such artifacts.

The archaeological past is easiest to examine in terms of the major time periods that have been defined by archaeologists: **Paleoindian** (9200-6500 B.C.), **Archaic** (6500 B.C.-A.D. 700), **Late Prehistoric** (A.D. 700-1700), and **Historic.**

Paleoindian

The earliest known occupations is referred to as the Clovis culture (9200 B.C.), peoples who hunted Ice Age mammals, including mammoth. They left behind distinctive fluted spearpoints at sites such as Pavo Real in Bexar County, 30 miles southeast of Bandera and at Kincaid Rockshelter, above Sabinal, 35 miles to the southwest. At these two sites, there were also Folsom occupations (around 8800 B.C.) typified by smaller fluted points used in hunting, among other things, a now extinct-form of Ice Age bison. The author has recorded the heavily patinated base of a Folsom point found north of the town of Medina. It is distinguished by long "ears" of the sort seen in the sample from Lubbock Lake (Sellards 1952:e, e') and one of the specimens from Kincaid Shelter (the specimen illustrated at the top of the web page "Discovery and Investigations" in *Texas Beyond History*; www.texasbeyondhistory.net).

The later cultures are more commonly represented in Bandera County, where spearpoints of this era have been collected. These include: Plainview (8200 B.C.), Golondrina (7000 B.C.) and Angostura (6800 B.C.; see Figure 1). Though the populations were still small, and highly nomadic, the climate had greatly improved after 8000 B.C., approximating today's environment by 7000 B.C.

This paper is a slightly edited version of a manuscript submitted for publication in *A Pictorial History of Bandera County* (Schumacher 2006). The editor shortened the manuscript as appropriate for the book's goals. However, the publisher in Virginia applied erroneous captions for every illustration in the paper. For example, on page 24, a photograph of charred acorns is described as "Pedernales points from Bander County."

Most of the observations in the paper have not been published before, and the illustrations have not appeared before, with the exception of a couple that are in Sharon Dornheim's (2002) thesis on 41BN63.

Figure 1. An Unfinished Angostura Point from Bandera County. From the Medina River drainage south of Bandera, Texas. Broken during late stages of manufacture. Length of specimen is 19 cm.

Archaic

By 6000 B.C., the Bandera County landscape could support larger populations and a long sequence (continuing until around A. D. 500) of hunting-and-gathering American Indian cultures can be chronicled. Because of the presence of streams and springs, deer and other animals, acorns and other plant foods, this was a rich area for ancient peoples.

Their campsites (cf. Hester and Evans 2000) represent a more settled way of life, in which groups of 100 or more people which, we think, would live at an occupation site for several months at a time. The Archaic cultures are easily recognized by their projectile points. The large flint points (mistakenly called "arrowheads") are of many shapes—shapes which change through time and which archaeologists can use to date different parts of the Archaic period. We do not know why these point styles changed through time, but excavations and radiocarbon dating have established them as important diagnostic items (see Turner and Hester 2002).They were used as tips for spears thrown with the spearthrower or atlatl, the major "weapons system" from Paleoindian times until the bow and arrow was introduced in the early centuries A.D. Some of the distinctive spear point (or dart point) types in Bandera County include: Gower (6000 B.C.), Martindale and Early Triangular (4000 B.C.), Andice (3500B.C.), La Jita (3100 B.C.), Pedernales (2000-1000 B.C.), Montell (800 B.C.) and Frio (300 B.C.-A.D. 500). In addition to the points, there are large numbers of unfinished chipped stone points, known as "preforms" and "blanks." Flint (chert) was so abundant that any errors during the flintchipping reduction process were simply thrown away. Formal tools, dating from various times within the Archaic, included butted bifaces (often called "fist axes"), whose thin blades and heavy wear-polish indicate their use in plant-processing, Clear Fork tools used in woodworking, drills or perforators, and corner-tang bifaces, mostly used as knives but some of which had ritual importance. Ground stone artifacts included manos and metates. Figure 2 illustrates an unusual metate from a site near Vanderpool.

Figure 2. Grinding Stone from Bandera County. From a site east of Vanderpool, Texas. There is a central grinding area, and several small "cupules" surrounding it.

Figure 3. A View of 41BN63. Looking east from the burned rock midden toward the west floodplain of San Geronimo Creek.

Edwards site near Pipe Creek, dug by the University of Texas in the early 1930s. The collection is curated at the Texas Archeological Research Laboratory (UT-Austin) and continues to this day to be an important research tool for many studies of the Archaic.

In 1985, I directed excavations at 41BN63 (41: Texas; BN: Bandera County; 63: 63rd site to be formally documented) with a field school from UT-San Antonio (Figure 3). Rudy Robbins of Bandera was one of the landowners at the time who provided great help to our project. The site was dominated by a large dome-shaped burned rock midden (Figure 4). The central part of the midden had been trenched with a backhoe prior to our project. However, we cleaned up the walls and those profiles, and along with our controlled excavations, revealed an earth-oven pit that had been used dozens of times. Pedernales and Montell points were found, dating the midden from 2000-600 B.C. (Figure 5). Underneath the midden, in a clay soil,

Archaic diet was based on the hunting of deer and other smaller game; buffalo were infrequent in the area, although appear to have been more common again around A.D. 600-800. The economy likely focused more heavily on plant foods, since these were in abundance. Acorns could be used when harvested—and they could be stored for processing later in the winter. Native pecans, walnuts and other nut and seed crops were also important. Prickly pear fruits (*tunas*) were gathered in summer months and the seeds in the tunas could be ground with a mano and metate. There were also bulbs of various sorts, the most important being that of the sotol plant. During much of the Archaic, and even into later times, sotol bulbs were dug up and baked in rock-lined earth ovens. The repeated building and emptying of the ovens over many centuries led to the formation of the "Indian mounds"—the burned rock middens. Recent experiments and careful excavations have clearly demonstrated the earth-oven function of the middens (Black et al. 1997).

The first Archaic site to be excavated in Bandera County is the J.W.

Figure 4. The Burned Rock Midden at 41BN63. View looking northwest. The trench had been dug by backhoe before archaeologists were notified. It was profiled and units excavated on the left side of the trench.

Figure 5. Pedernales Points from 41BN63. Scale is 5 cm.

Figure 6. Charred Acorns from 41BN63. Charred acorns pits occurred in cooking pits in matrix below the burned rock midden, associated with La Jita points.

were many small pits in which charred acorns were found (Figure 6). We do not know what type of cooking process was being used to process acorns at this time, around 3100 B.C., but these were perhaps predecessors to the earth ovens of later times. La Jita points (Figure 7) were being made at this time, and we also excavated a burial that is one of the earliest found at an Archaic site in central Texas. The primary camping area was on the north side of the burned rock midden on a low terrace overlooking a nearby creek. A Master's thesis by Sharon Dornheim (2002) details the discoveries at 41BN63.

Late Prehistoric

Around A.D. 700, the bow and arrow is introduced. The large spear or dart points are replaced by true arrow, often called "bird points" because of their tiny size. However, the bow and arrow is a weapon that relies on the deep penetration of the arrow shaft, in contrast to a heavy blow and bloody wound inflicted by a spear and spearthrower. Thus, these "birdpoints" were used to kill animals such as bison and deer, or in warfare with other groups. [There are many accounts in early Bandera history of arrow wounds involving early settlers. A study done by the late Adrian Benke, a skilled bowhunter who lived near Hondo, has demonstrated that the recorded arrow wounds in 19th century southwest Texas were usually not fatal, unless they hit a vital organ or led to subsequent infections. . . and such recorded episodes are actually quite rare! Mr. Benke theorized that hunting dogs were used by the Late Prehistoric Indians to follow animals that had been struck by arrows.]

At first, there was little change in the way of life from Archaic times. We can detect new styles of points from around A.D. 700, such as Edwards (Figures 8, 9), Scallorn, and Sabinal points. Burned rock middens were still being formed,

Figure 7. La Jita Points from 41BN63. Scale is 5 cm. La Jita points occurred below the burned rock midden.

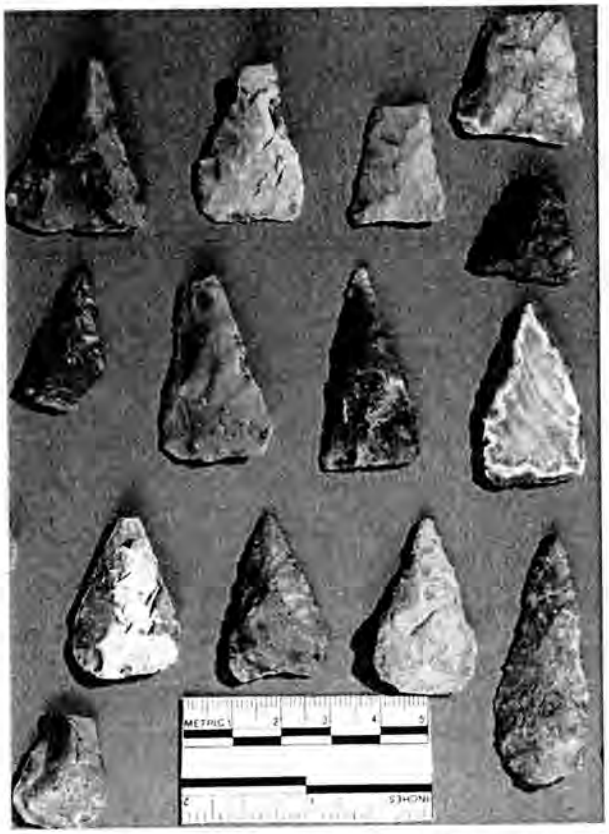

Figure 8. Arrow Point Preforms. Found at a site near Bandera. See also Figure 9. Photograph by Curt Harrell.

and campsites were located atop the older Archaic locales. An excellent study of a site from this time period was published by Houk and Lohse (1993). They excavated the Mingo site (41BN101), near Vanderpool, with a burned rock midden, Edwards, Sabinal and Scallorn arrow points, and a work-area with a large metate.

Nearby, a small sinkhole cave was excavated by archaeologists from the Texas Highway Department in the 1970s prior to the construction of FM337. Published by Henderson (2002), the Rainey Site (41BN33) was found to contain finely stratified layers of Late Prehistoric occupation which spanned almost the entire Late Prehistoric era. At the top of the deposits were artifacts of the final part of the Late Prehistoric, known as the Toyah Horizon. It dates between A.D. 1250/1300-1700 and is characterized by Perdiz arrow points, beveled knives, end-scrapers, and pottery. The Toyah Horizon represents an adaptation to buffalo hunting, as bison herds moved back into this region in some numbers after A.D. 1250. Across central and south Texas, and down to the Texas coast, the artifacts typical of the Toyah Horizon spread to the various Indian groups.

The knives and end scrapers were used for butchering and hide processing, and the pottery possibly for rendering and storing bison fat (there are also *ollas* or water jars represented in this plain orange-tan pottery).

Historic

There are many problems associated with studying the campsites of the early Historic Native Americans. For example, it is clear that many Toyah Horizon occupations continued well into early 1700s, but unless glass trade beads or other European goods are found, it is hard to be sure. For example, a Toyah Horizon occupation at the La Jita site south of Utopia bore traces of a totally prehistoric campsite—except for a crudely made possible metal arrow point found among the remains (Figure 10).

The native peoples were quickly displaced or eliminated by two factors: the Spanish Colonial period with its missions and the incursion of Indian groups from the Southwest and the Plains. Though the Comanches, Lipan Apaches, Tonkawas are often thought of as "Texas Indians," they are not originally. The Tonkawas arrived in central Texas around 1680 from a homeland in Oklahoma. The Lipans came in the 1720s from the southern Plains and Southwest, and the Comanches (who had been hunters and gatherers in southern Idaho before they obtained horses) did not appear on the scene until the 1750s.

Thus, the native peoples—who were not organized as tribes and whose band names are known to us only through Spanish records—were caught in a vise between the advancing Spanish frontier and the aggressive intrusive Indian groups. Those who were not killed by the Lipans or Comanches went into missions in San Antonio and elsewhere, and many perished there from epidemics of measles and smallpox. While the Historic

Indians of this part of Texas are often referred to as "Coahuiltecans," this is an incorrect label. "Coahuilteco" was one of at least seven distinct native languages spoken in south central and southern Texas, and there was never a "Coahuiltecan culture." Indeed,

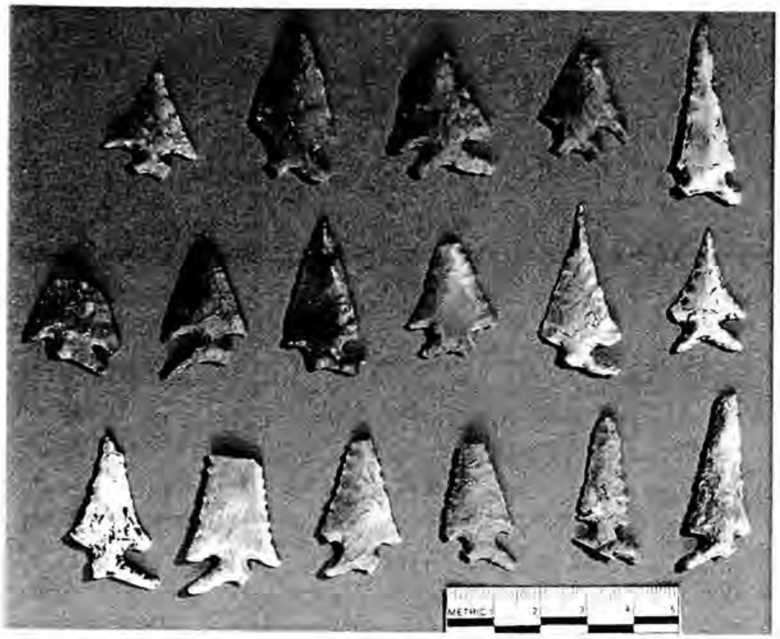

Figure 9. Edwards Points from a site near Bandera. Photograph by Curt Harrell.

studied through archival records (Headrick and Elllis 2002). Jose Policarpio Rodriguez, a major Tejano figure, built a massive cut-stone structure that was both a two-story home and fortification ("Polly's Fort") located on private property along Privilege Creek (Figures 12, 13; see Rodriguez 2006).

Indian raids continued as late as 1881 in Bandera County, as documented in studies by J. Marvin Hunter, A. J. Sowell and others. Most of the raids after the Civil War were by Kickapoos and other displaced Native American tribes living across the Rio Grande in Mexico. Again, archaeological traces of these raids are rarely found, and we have to depend

we do not know what language was spoken by most of the groups who lived in Bandera County.

Campsites of the Comanche, Tonkawa, and Lipan are almost impossible to find because these groups were always on the move. If found, such sites would be recognizable from the presence of colored glass trade beads, metal arrow points, bits of copper or other metals, knives (Figure 11) and gun or horse-gear parts. Such a site, containing a number of these traits, has been recorded by the author in northwest Medina County in recent years, and will be published at a later date. It dates to approximately 1780, and is probably Comanche or Lipan Apache.

We know from recent discoveries in the Tarpley area that Spanish explorers came into Bandera County as early as 1577 (the date engraved within a small rockshelter in a very remote area), but again they left few traces. There are a number of accounts of Spanish intrusions into the area, in a search for silver (a shaft related to such exploration is near the shelter). There are, of course, many houses and other structures from the early settlements of the 1800s. These need to be fully recorded before they are lost to development or the ravages of time. For example, in 1990, several historic structures in the Utopia area, some within Bandera County, were excavated and

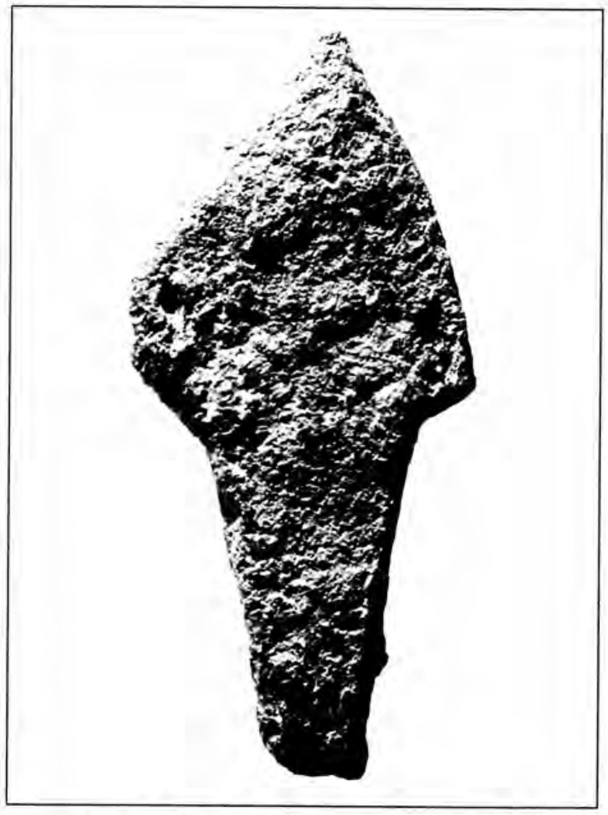

Figure 10. An Iron Arrow Point from 41UV21. This native-made metal point was found in excavations directed by Jeff Huebner at the La Jita site, 1989. Photograph by Kenneth M. Brown. Length, about 4 cm.

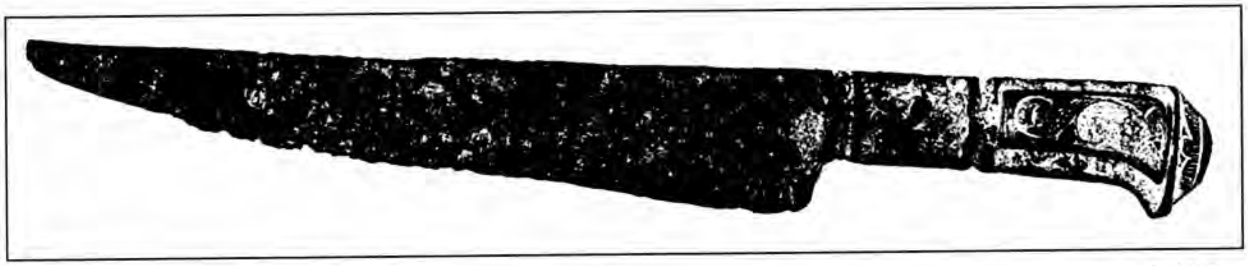

Figure 11. A Spanish Knife from Western Bandera County. Found on the Gazaway Ranch on Seco Creek, the knife has been identified as Spanish, dating to the mid or late 18th century. Length, 13 inches.

Figure 12. Polly's Fort, Bandera County. Front view, 2002.

on the historic accounts to examine the range and activities of these groups.

CLOSING COMMENTS

Although this broad outline of Bandera County prehistory can be sketched, the area remains one of the most poorly studied counties in the entire region. Very little scientific archaeology has been done (Simons and Moore 1997), and less than 200 of the county's thousands of prehistoric and historic archaeological sites have been documented for future generations. The location and description of each site is important, since once the site is destroyed by land development, roads, erosion—or dug into, whether by artifact collectors or by archaeologists—it is destroyed forever. The archaeologist uses scientific methods, makes extensive notes, records, and photographs. The site is usually published and the collections kept in secure research facilities for future studies. Of course, if the archaeologist works at a site on private property, the landowner can decide what the disposition of the artifacts will be. At 41BN63, we returned the projectile points to the landowners at their request after we had studied and photographed them, obtaining the scientific information that was important. A widespread misconception is that the recording of a site on private property can lead to intervention by the state or federal government, or that it will increase trespassing. From 40 years of working with ranchers and farmers in

Figure 13. Polly's Fort, Bandera County. Oblique view, 2002.

central and south Texas, I can vouch that this is simply not the case, unless the study is done as part of a highway project or some other governmental construction project about which the landowner already knows. The Rainey sinkhole site was destroyed, after excavation, by the construction of FM337. An invaluable record of human prehistory would have been lost except that State and Federal law required the Texas Highway Department to have the site excavated and studied before they removed it.

References Cited

Black, S. L., L. W. Ellis, D. C. Creel, and G. T. Goode
1997 *Hot Rock Cooking on the Greater Edwards Plateau: Four Burned Rock Midden Sites in West Central Texas.* Texas Archeological Research Laboratory, Studies in Archeology 22, and Texas Department of Transportation, Archeology Studies Program 2.

Dornheim, S. K. L.
2002 *The Archaeology of Site 41BN63, Bandera County, Texas.* MA thesis, The University of Texas at Austin. 125 pp.

Headrick, P. J. and L. W. Ellis
2002 *All Along the Valley: the Archaeology of Four Historic Sites in the Upper Sabinal River Valley.* Southern Texas Archaeological Association, Special Publication 9. San Antonio.

Henderson, J.
2001 *Excavations at the Rainey Site (41BN33), A Late Prehistoric Sinkhole Site in Bandera County, Texas.* Texas Department of Transportatin, Environmental Affairs Division, Archeological Studies Program Report 5. Austin.

Hester, T. R. and G. L. Evans
2000 The Broadray Creek Site: A Multiple Burned Rock Midden Locality in Bandera County, Texas. *La Tierra, Journal of the Southern Texas Archaeological Association* 27(1), pp. 2-12.

Houk, B.A. and J. C. Lohse
1993 Archeological Investigations at the Mingo Site, Bandera County, Texas. *Bulletin of the Texas Archeological Society* 61 (for 1990), pp. 193-247.

Rodriguez, R. R.
2006 Los Tejanos de Tejas. In *A Pictorial History of Bandera County,* ed. by M.J. Schumacher, pp. 32-37. Donning Company Publishers, Virginia Beach, VA.

Schumacher, M. J., editor
2006 *A Pictorial History of Bandera County.* Donning Company Publishers, Virginia Beach, VA.

Sellards, E. H.
1952 *Early Man in America.* University of Texas Press. Austin.

Simons, Helen and William E. Moore
1997 *Archeological Bibliography for the Central Region of Texas.* Office of the State Archeologist Report 36. Austin.

Turner, E. S. and Hester, T. R.
2002 *A Field Guide to Stone Artifacts of Texas Indians.* 2nd Edition. Rowman and Littlefield, Lanham, MD.

Lesser-known Clovis Diagnostic Artifacts I

The Bifaces

Michael B. Collins and C. Andrew Hemmings

ABSTRACT

Artifacts generally considered diagnostic of Clovis include primarily Clovis projectile points followed by blades and blade cores and, in some cases, end scrapers on blades. However, to the experienced eye, several other chipped stone tools and the patterned debris from their manufacture are almost as reliably diagnostic of Clovis as are the projectile points. These include Clovis point preforms, certain large bifaces, and some of the flaking debris from Clovis point and biface manufacture. Other bifacially-flaked objects are also indicative of Clovis, but not as unambiguously so. Among this group are discoidal cores, adzes, and choppers. A surface collection lacking in Clovis points but composed of several of these lesser-known kinds of artifacts can be assigned to a Clovis origin with considerable confidence.

INTRODUCTION

In the seven decades since American archaeologists began to recognize the large fluted points found in association with skeletal remains of mammoths at Dent, Colorado, and Blackwater Draw, New Mexico, as distinct from Folsom points, "Clovis points" and "Clovis culture" have been almost synonymous (Wormington 1944, 1957). Thus, a mammoth skeleton with associated large fluted points would be a Clovis kill site, or surface finds of Clovis points may go on the map as a Clovis site. Although these large fluted points had been known from surface finds for quite some time, they were first found in excavated contexts with mammoths at Dent in 1932 and Blackwater Draw in 1933, but not formally named "Clovis" until defined at the Santa Fe Conference in September, 1941 (Hurst 1942; Holliday and Anderson 1993). The name, "Clovis fluted point," and a formal description did not appear in print until Howard (1943) addressed the terminology of the "Folsom-Yuma Classification" in his Finley site report (see also Holliday and Anderson 1993).

With refined data recovery at numerous excavated Clovis sites in recent decades, tightly associated and often dated assemblages have extended the list of Clovis artifacts beyond the well-known points. Some of these artifact forms are shared with other prehistoric cultures, but a few are as completely or nearly as completely diagnostic of Clovis as are the points. In the analysis of the mixed assemblage of Clovis and Folsom artifacts at the Pavo Real site (41BX52) this observation was employed to sort as many of the 23,233 chipped stone pieces as possible into three interpretive groups, Clovis, Folsom, or indeterminate with the result that 145 pieces were attributed to Clovis, 57 items were identified as Folsom, and the indeterminate specimens consisted of 98 tools and 22,933 pieces of debitage (Collins 2003:90). Only two Clovis and two Folsom points are included in these numbers. This means that typological and technological criteria allowed affiliation to be inferred for 198 out of 300 (66%) of the less distinctive kinds of artifacts in this mixed assemblage.

In the hope that readers of La Tierra will recognize and report finds of these lesser-known kinds of distinctive Clovis artifacts, we present here descriptions of some of the more common, bifacially-flaked stone items recently recovered in good Clovis contexts at the Gault Site in Central Texas (Collins 2002) and elsewhere. There is a good precedent. A few years back, Clovis blades and blade cores were brought to the attention of archaeologists in Texas (Collins 1990; Turner and Hester 1993:36-39;Young and Collins1989) with the result that several informative articles on these distinctive artifacts subsequently appeared in the pages of La Tierra (cf. Birmingham and Bluhm 2003; Chandler 1992, 1999; Chandler and McReynolds 1996; Kelly 1992; Patterson 1993). This florescence of interest in Clovis blade technology occurred nearly 30 years after Green (1963) first identified prismatic blades as part of the Clovis ("Llano") complex.

Clovis knappers produced tools on bifaces, blades, and flakes. Bifaces were reduced from nodules, cobbles, and large flakes. Bifacial reduction produced such things as projectile points, large thin bifaces, adzes, choppers, discoidal cores, and early stage blade core performs. Much of the knapping strategy and technique employed in the production of these bifaces is almost unique to Clovis and produces bifacial artifacts and debitage with very distinctive attributes (Collins 1999a, 1999b; Bradley 1993; Huckell n.d.; Stanford 1991).

Blade production was based on two distinctive kinds of blade cores, conical and wedge-shaped. Very few specimens exist to indicate early stages of conical core manufacture, so their incipient form is not well known. The limited evidence suggests that these were made from large chert nodules. Wedge-shaped cores began as large, thick bifaces or as flattish cortical nodules (Collins 1999a; Collins and Lohse 2004).

Flakes for tool blanks were selected from the general debitage of blade and biface manufacture as well as from large, bifacial cores maintained specifically for the production of large, flat flakes.

This brief paper considers some of the more diagnostic Clovis bifacial artifacts and the distinctive debris from their manufacture. It is important to note that assemblage level patterns are of course easier to diagnose than one or a few artifacts.

DIAGNOSTIC CLOVIS BIFACES AND DEBITAGE

Bifaces highly distinctive of Clovis technology include projectile points (Figure 1), point preforms, certain large bifaces, and the distinctive bifacial knapping debris. To begin with, Clovis bifaces tend to be large, well made, and fashioned from high quality stone. The raw stone material found on any Clovis site is likely to have aesthetic appeal as well as good knapping qualities and it may have originated at distant geologic sources, such as the Clovis point in Kincaid Shelter (Uvalde County) made of obsidian from Queretaro in central Mexico (Hester et al. 1985) or a Clovis blade fragment from San Patricio County made of Alibates agate from the northern Texas panhandle (Chandler and McReynolds 1996). Clovis knappers made bifaces and point preforms from cores or from very large flakes. A majority of these are point preforms that show no signs of utilization. A minority of the bifaces consist of small tools, large flake cores, and large thin bifaces that at most show minor traces of use. The latter often occur in caches along with Clovis points and point preforms (Frison 1991).

Direct soft-hammer percussion was used in all but final edge trimming. Early stage bifaces were fashioned with minimal platform preparation and relatively few removals of large flakes. Platforms were often prepared by beveling the edge of the biface. These platforms were rarely ground. As flaking progressed, platforms for the removal of large thinning flakes were sometimes isolated and more commonly ground, resulting in bifacial thinning flakes with small, ground platforms. These thinning flakes are often very broad, and large bifaces typically exhibit four or fewer very broad flake scars on each face. A highly distinctive characteristic of this technology is the driving of flakes well past the midline of the biface, often in the form of controlled overshot flaking. Overshot flakes are found occasionally in the bifacial flaking debris of most other bifacial technologies, but almost always as unintentional errors that often ruined the biface being flaked. Controlled overshot flaking, on the other hand, is part of a purposeful Clovis knapping strategy and it was repeatedly done with amazing accuracy and skill.

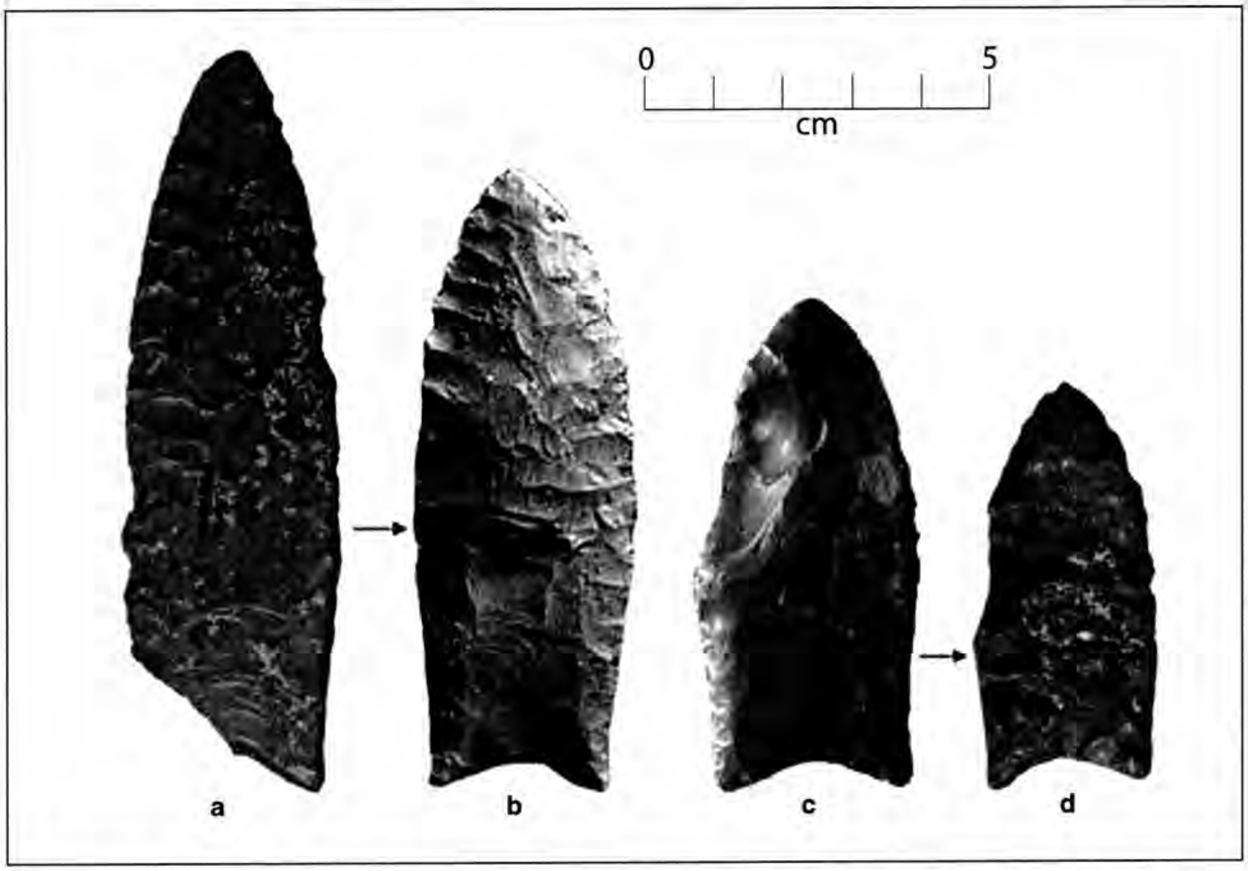

Figure 1. Representative Clovis points seriated by extent of resharpening. a- point with minor resharpening, probably abandoned because of break at basal corner. b- point with arrow showing lateral flake intended to reduce step at terminus of flute. c and d- resharpened points with blade edge damage.

Point Preforms

Clovis point preforms (Figures 2, 3) are large, generally being more than 10 cm in length. They are extremely straight in longitudinal section (Figure 3a) and biconvex in transverse section (Figure 2 b, c). Throughout their reduction, preforms have a lanceolate outline with bases that range from straight (Figures 2 a, c) to strongly convex (Figure 3 c, d). Preforms of both shapes are fluted (or basally thinned) multiple times in the course of reduction (Figure 2a, b, c, d; Figure 3 c, d). Those with straight to slightly convex bases are beveled across the base to form the fluting platform (Figure 2 a, b; Figure 3 a, b). After fluting of one face, the bevel is reversed to accommodate fluting the opposite face (Figure 2c). Strongly ovate preform fluting platforms are isolated and ground at the apex of the convex base (Figure 3c; Figure 4 a, b). Flute scars and channel flakes (Figure 4 b-e) exhibit the characteristics of direct, soft hammer percussion.

Point preforms attain the near final size and shape of the intended point primarily by percussion flaking (Figure 2d). They are rarely less than 10 cm in length (and can reach lengths in excess of 23 cm), most have flutes on both faces, and all exhibit the typical outline, longitudinal, and transverse sections of Clovis points. Final trimming is done with a mix of pressure and percussion flaking followed by grinding of the proximal lateral edges and the base (Figure 1). One task accomplished in this final trimming stage is centering the point on the flutes.

Final flute scars commonly terminate with an exaggerated ripple scar (Figure 1 b, d; Figure 4f). In many cases, one or more of the final lateral trimming scars indicate an effort to minimize this irregularity on the face of the finished point (Figure 4).

Failures in the reduction of Clovis point preforms include end shock (Figure 1b, d, and 4f), perverse fracture (Figure 3c), diving flutes (Figure 2b;

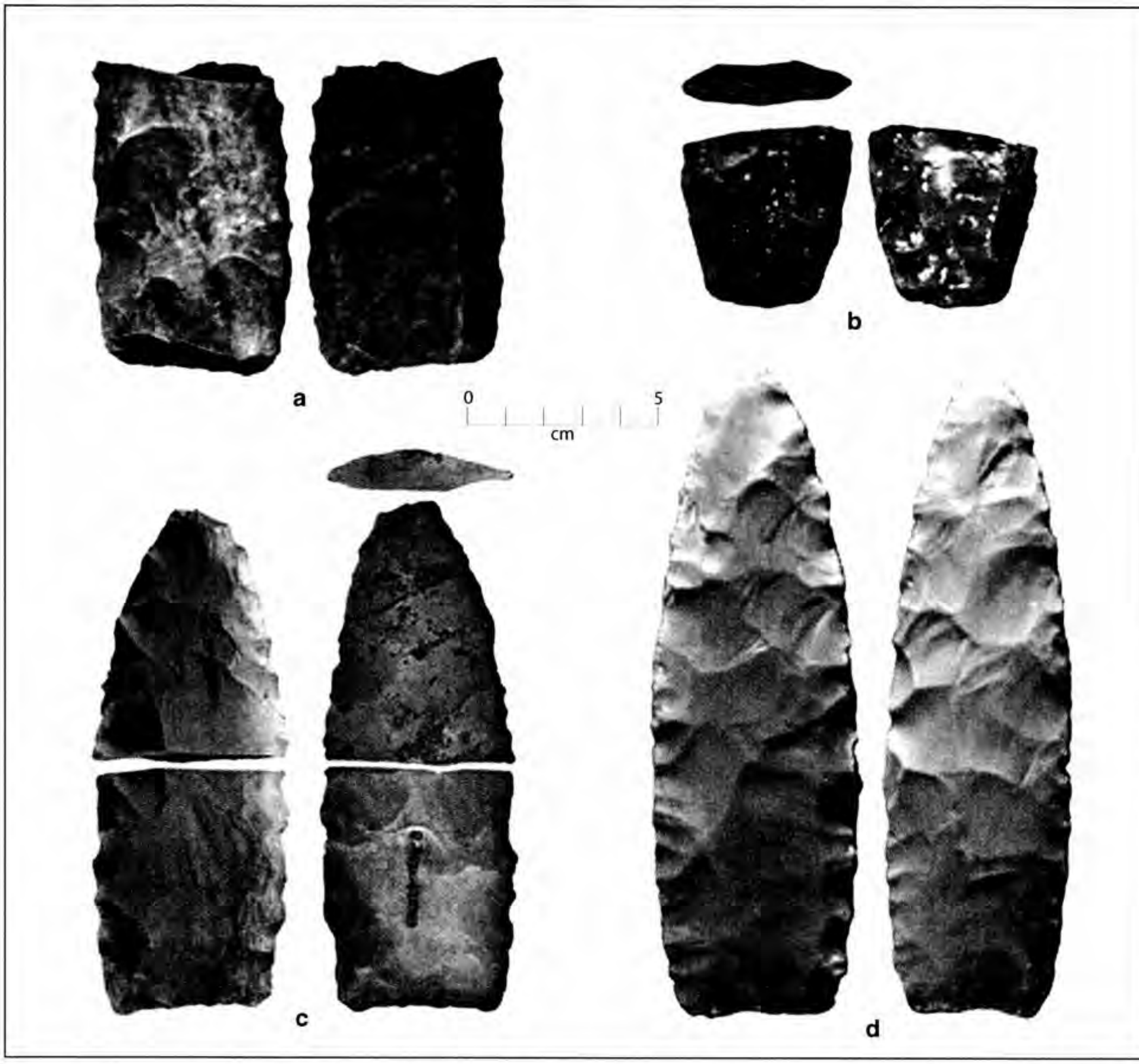

Figure 2. Representative late stage fluted Clovis point preforms. a- broken preform showing beveled fluting platform on obverse (arrow) and first flute on reverse. b- broken preform showing beveled fluting platform on obverse (arrow) and diving first flute on reverse that caused failure. c- snapped preform with second flute on obverse and first flute followed by beveled fluting platform on reverse. d- preform, fluted on both faces, lacking only final trimming and indicative of large size of pristine Clovis points.

Figure 3d; Figure 5c), bend breaks, and the occasional failure to thin, failed overshot, or other knapping errors. All of these result in distinctive aborted pieces among the knapping debris of Clovis workshops. Even when the flute does not dive through the preform, its terminus is often at or near the locus of breakage. It is not always possible to tell whether the fracture occurred at the time of fluting or afterwards, but distinctive tip fragments with remnants of the flute scar at the location of the fracture occur among Clovis biface fragments (Figure 5a, b).

Bifaces

Large, thin ovate bifaces without the flute scars, basal bevels, and biconvex cross sections characteristic of point preforms are part of the Clovis repertory (Figure 6). These are best known from such

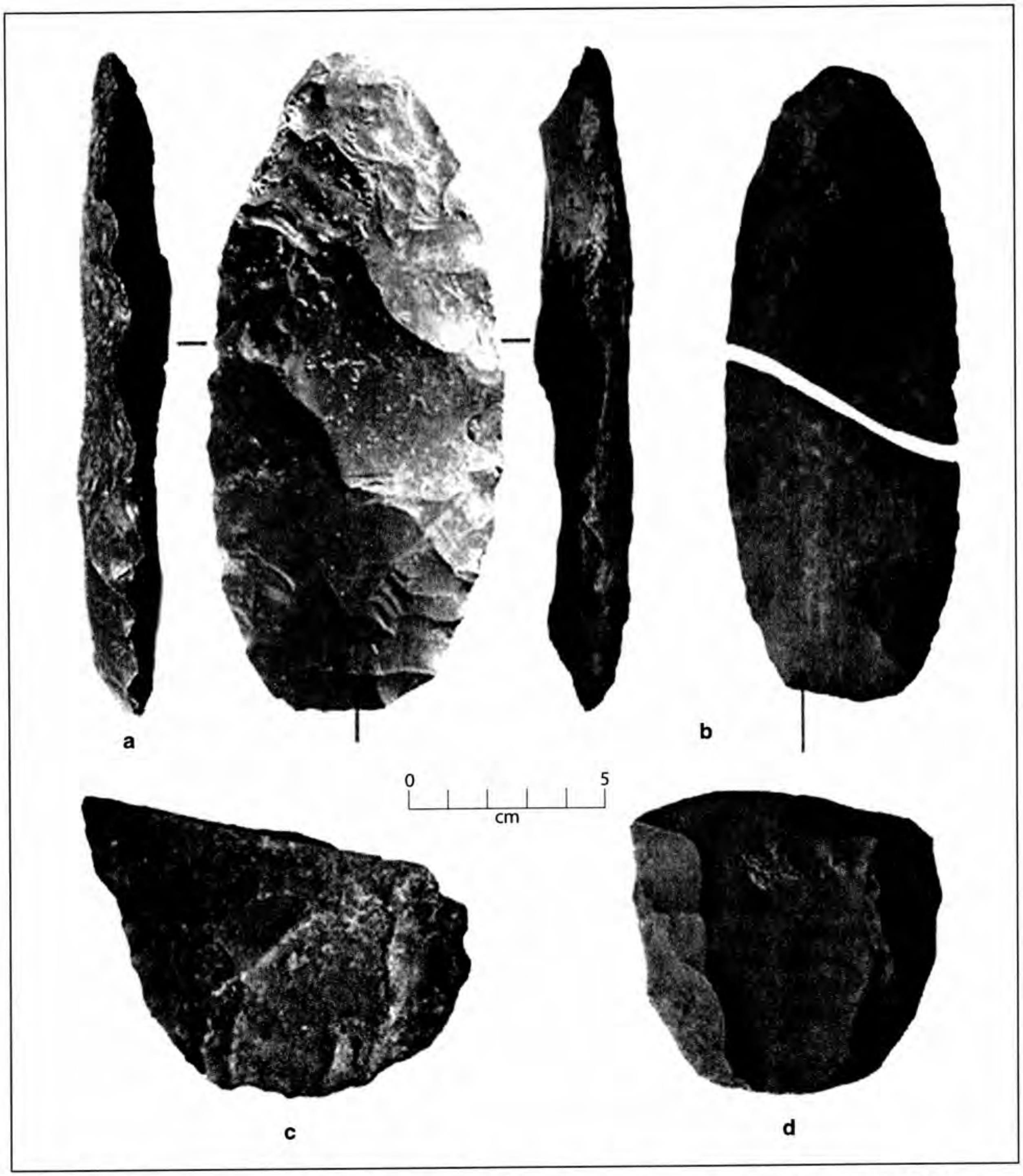

Figure 3. Early stage Clovis point preforms from Gault. a- large preform with square cortical edge and typical flaking scars extending well past the midline; note straight longitudinal section and beveled fluting platform at base (arrow). b- snapped preform with beveled fluting platform (arrow). c- preform broken by perverse fracture after unsuccessful fluting attempt. d- preform ruined by diving flute.

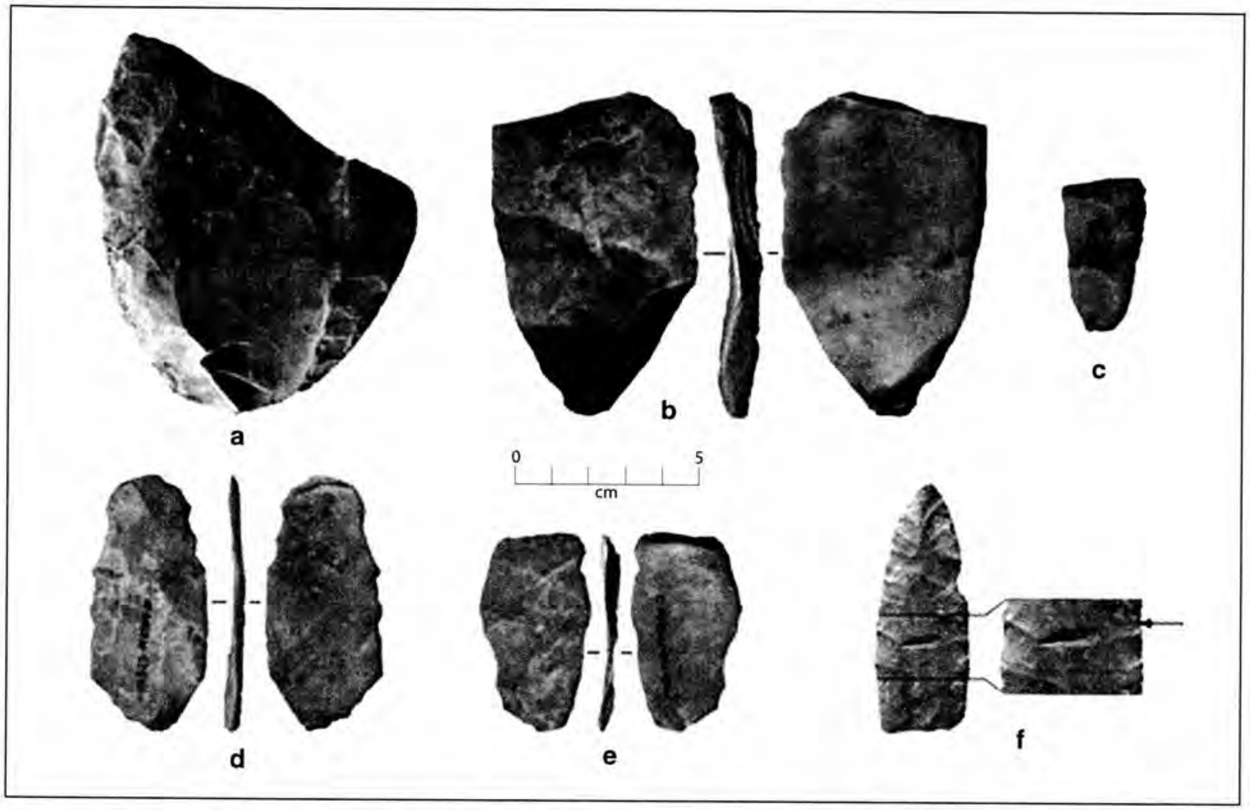

Figure 4. Fluted preform and channel flakes. a- very large preform with flute originating from isolated platform. b- very large channel flake evidently struck from isolated platform. c- late stage channel flake. d-e- channel flakes illustrating strong ripple near terminus and typical longitudinal profile. f- Clovis point with strong ripple scar at flute terminus and scar from lateral trimming flake (arrow) intended to reduce this irregularity.

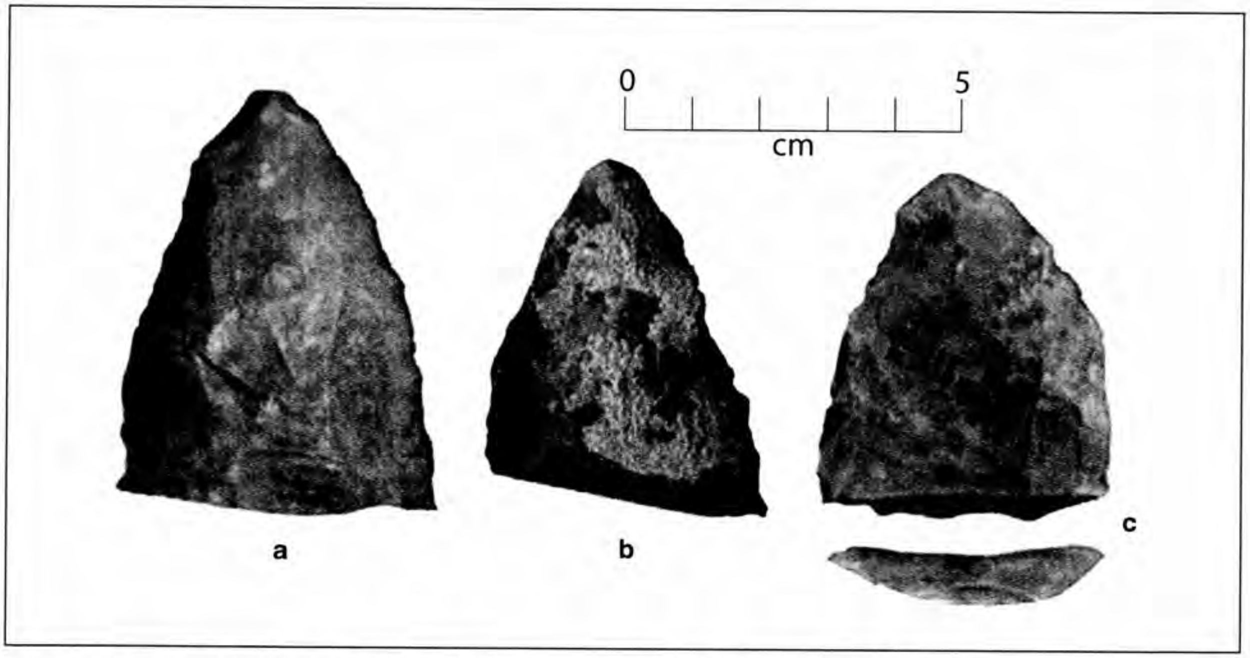

Figure 5. Tips of fluted preforms broken near flute terminus. a and b- short segments of flute scars remaining on unfinished point preform failures. c- distal preform fragment detached as part of diving flute failure.

caches as Anzick, Fenn, and Simon (Wilke et al. 1991, Figure 3 #88; Frison and Bradley 1999:99 #108; and Butler 1963:29 Figure 3f and 30, Figure 4a respectively illustrate these characteristics specifically). These typically do not exhibit well developed traces of use, and their functions are not entirely clear. They do share the attributes of controlled overshot flake removals, detachment of just a few broad flake scars on each face, and use of soft hammer direct percussion. Even though these lack the early stage fluting and are broader, thinner, and more strongly ovate than known point preforms, it is possible that points were made from at least some of these.

Bifacial Knapping Debris

Biface production results in flakes and various failed bifaces diacarded in all stages of reduction. In the case of the point preforms and large bifaces just described, the flakes include three forms that are highly distinctive of Clovis technology; these are controlled overshot flakes, bifacial thinning flakes, and channel flakes.

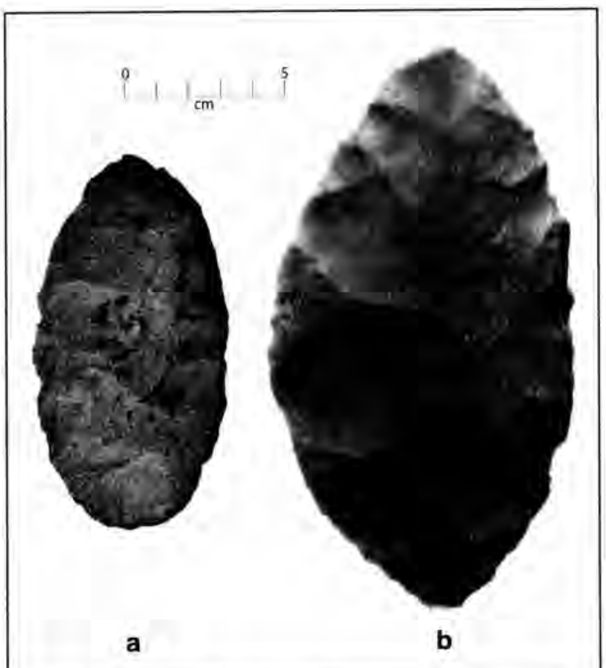

Figure 6. Large thin ovate Clovis bifaces. Note small numbers of large flat thinning flake scars.

Overshot flakes (Figure 7) are distinguished primarily by a remnant of the biface edge at the distal terminus of the flake. In contrast to knapping failures caused by overshot as an error which takes a wide chunk out of the far edge of the biface, controlled overshot flakes retain a very limited width of the biface from which they were removed. In some cases, the bifacial edge remnant on controlled overshot flakes among Clovis debitage is well trimmed (Figure 7c), but much more commonly, that distal edge reveals a near lack of trimming (Figure 7a, b, d-e). It is often a square edge (sometimes cortical) or quite irregular. As a technique, controlled overshot flaking is an expedient way to clean up a trouble spot on the edge of the biface. Most overshot flakes are broken, and the distinctive distal edge is the recognizable portion (Figure 7d-e). Many probably broke as they were detached. In addition to the bifacial remnant, Clovis overshot flakes exhibit the attributes of bifacial thinning flakes described next.

Clovis bifacial thinning flakes (Figure 8) include significant numbers with the following constellation of attributes: small platforms that are often ground, a flake body that expands rapidly from the platform, longitudinal curvature, and thin body (Figure 8a, d). Importantly, flake scars on the exterior of these thinning flakes are indicative of prior removals of small numbers of broad flakes with substantial overlap across the midline of the biface (Figure 8 a, d-f). Bulbs are small and flake interiors are quite smooth with ripple marks of very low amplitude (Figure 8 a, c, d). Except for the overshot flakes, Clovis bifacial thinning flakes most often terminate in a smooth feather edge. These characteristics are not exclusively restricted to Clovis, but when such flakes are found in quantity and with a consistent expression of all of these traits, Clovis knapping is likely to be indicated.

Clovis channel flakes (Figure 4) range from very large (Figure 4b) to moderate in size (but almost always larger than Folsom channel flakes). The primary clue that a flake is a channel flake are scars on its exterior converging from both sides and roughly perpendicular to the long axis of the channel flake. In the case of Clovis, scars may extend all the way across the channel flake because of the frequent removal of bifacial thinning flakes past the midline of

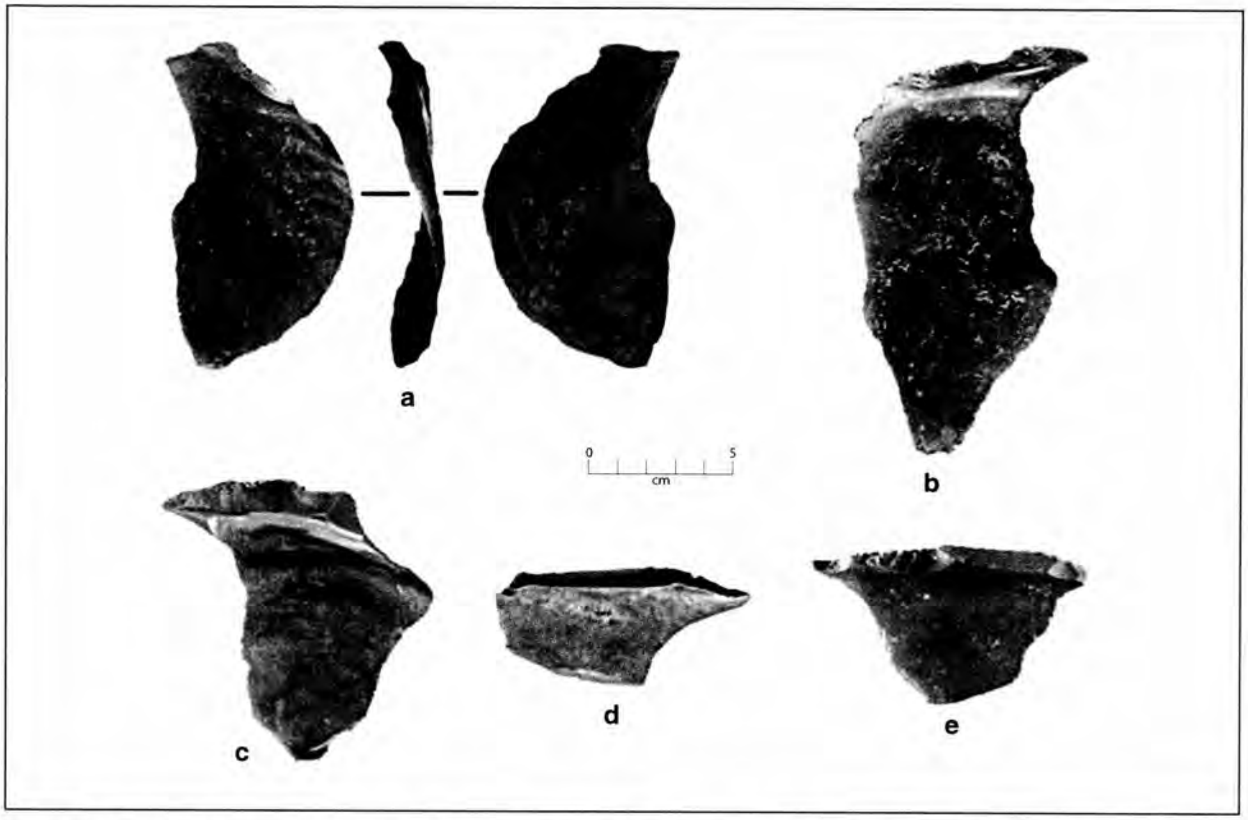

Figure 7. Controlled overshot trimming flakes. Note small platforms, curved longitudinal section, and distinctive lipped distal ends of overshot flakes.

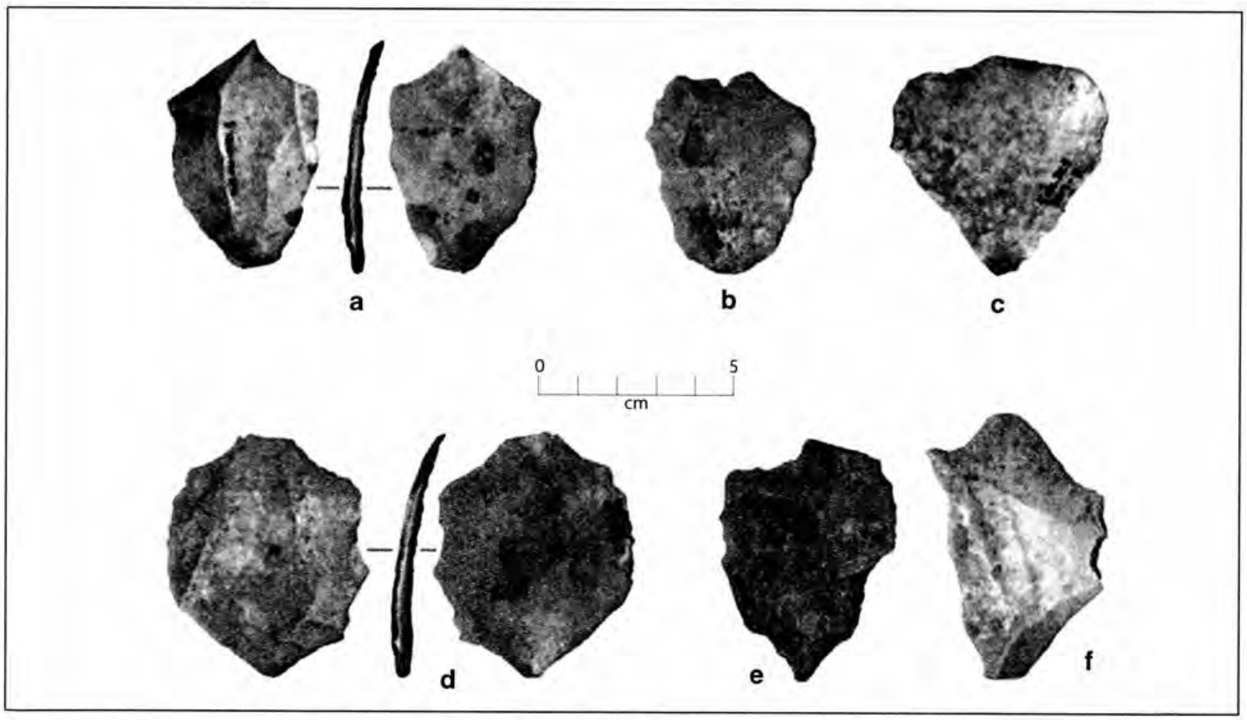

Figure 8. Typical Clovis bifacial thinning flakes. Note small platforms, expanding body widths, exterior flake scars, and longitudinal curvature.

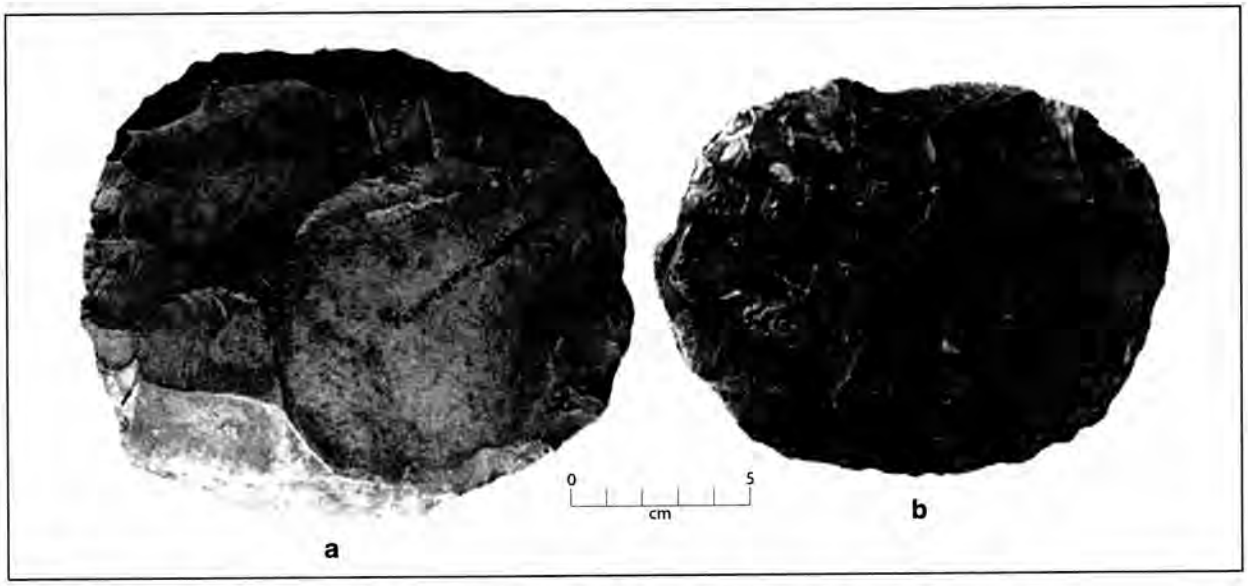

Figure 9. Large Clovis discoidal flake cores. Note broad flake scars and lack of overshot flake scars.

the preform. The flake scars on the exterior of Clovis channel flakes are typically less refined than that on Folsom channel flakes. In outline, complete Clovis channel flakes tend to have small platforms that may or may not be ground. Like the bifacial thinning flakes, the body of the channel flake expands abruptly from the platform but is roughly parallel sided over most of its length. On the interior, the bulbs are small and the surface is quite smooth except at the very distal end where there is often observed one or two higher amplitude ripple marks (Figure 4 d-e). In longitudinal section, channel flakes curve near the proximal end and then become very straight and thin toward the distal terminus (Figure 4 b, d, e).

Discoidal Cores

Clovis contexts at the Gault site have yielded several round, flat, moderately thin cores (Figure 9). Similar examples have also been recovered with the Fenn Cache and at Shawnee Minisink in Pennsylvania (Frison and Bradley 1999; McNett 1985). Flake scars on these cores suggest the removal of large, thin flakes with relatively little longitudinal curvature. Such flakes, found in the same contexts, exhibit modification into cutting and scraping tools. The recovered cores show to have been reduced using direct, soft hammer percussion, but differ from point preforms and the other Clovis bifaces in that the cores are producing flakes with relatively little longitudinal curvature. Also, no overshot flakes are in evidence.

Adzes

Three small bifacial adzes from Clovis or mixed Clovis contexts were found at Gault. Two of these resemble miniature Clear Fork tools (Figure 10a) and another has more of a tranchet bit (Figure 10b). This

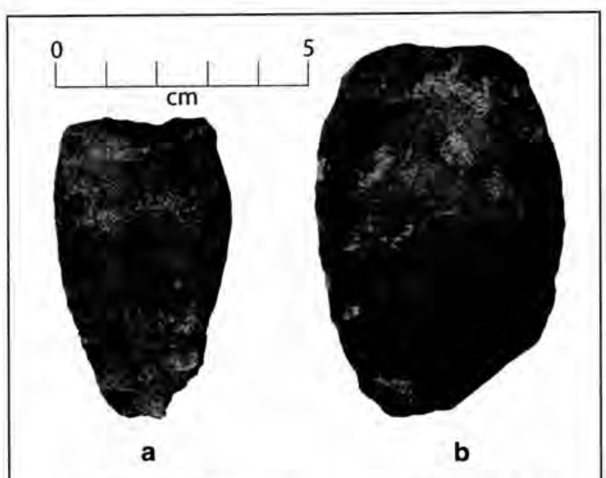

Figure 10. Clovis adzes with concave bit (a), and straight bit edge (b).

sample is too small to be definitive, but future investigations may isolate one or both of these forms as diagnostic Clovis bifacial tools. Microscopic use wear on these does reveal bit damage and wear consistent with use in wood working.

Choppers

Heavy bifacial chopping tools do not appear prominently in accounts of Paleoindian assemblages, especially Clovis; however, several were recovered in Clovis-age deposits at the Gault site (Figure 11). Found alone, these would not be particularly diagnostic, but on the other hand, it is important that investigators be alert to their presence in the Clovis tool kit. There is a range of variation among the Gault specimens and most of them resemble choppers found in all manner of Archaic assemblages (Figure 11a), however, there are a few specimens with an unusual form (Figure 11 b, c). These are flat pieces of chert with cortex on one or both faces simply trimmed bifacially at one end to form a bit. The resultant longitudinal section stands in contrast to the stronger taper of most chopping tools. Only future work will tell how diagnostic of Clovis these choppers may be.

CONCLUSIONS

Whenever archaeological materials are recovered from the surface or other uncertain context, the usual approach to deciphering the age and cultural affiliation of those materials is to formulate possibilities based on culturally or temporally diagnostic kinds of artifacts. The wider the array of artifact categories that can be used in formulating these hypotheses or inferences, the better they are likely to be. In this brief note, we hope to expand the range of lithic artifact types to be considered in diagnosing such assemblages as possibly of Clovis origin.

Clovis bifacial technology is distinctive and it produces distinctive artifacts and knapping debris. When these forms are found, it is possible, even in the absence of Clovis fluted projectile points, to infer Clovis cultural affiliation. The larger the assemblage and the more kinds of artifacts included, the stronger the interpretation.

Some of the items mentioned here (point preforms, bifaces, adzes) are among the forms that many collectors pick up and retain in their collections. Review of such collections will likely result in identification of Clovis specimens (and therefore sites). Other items, such as bifacial thinning, channel, and

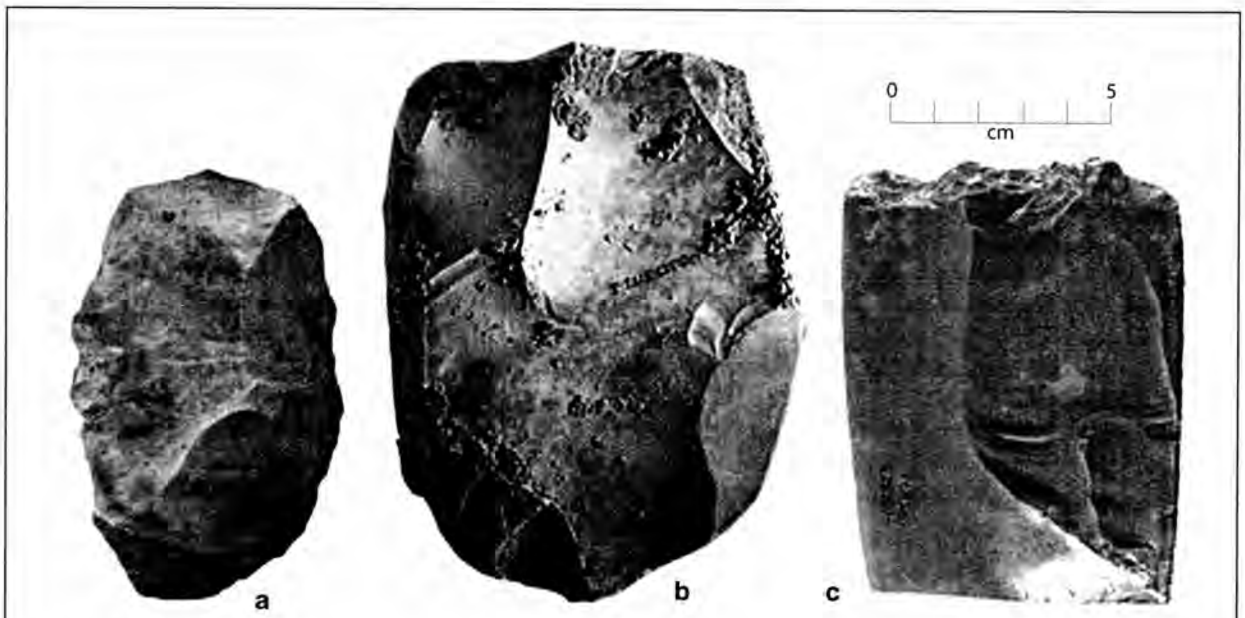

Figure 11. Clovis choppers. a- bifacial chopper with biconvex cross section and convex bit edge opposite cortical butt. b and c- large choppers with bi-planar cross section and nearly straight bit edges.

overshot flakes are not as likely to be found in existing collections, but because they are often passed over in the field, they are more apt to be found on sites and could be a clue to the presence of a Clovis assemblage.

ACKNOWLEDGMENTS

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REFERENCES CITED

Birmingham, W. W. and J. E. Bluhm
2003 A Clovis Polyhedral Blade Core from Northwest Victoria County, Texas. *La Tierra* 30(3 & 4):55-58

Bradley, B. A.
1993 Paleo-Indian Flaked Stone Technology in the North American High Plains. In *From Kostenki to Clovis*, edited by O. Soffer and N. D. Pravlov, pp. 251-262. Plenum Press, New York.

Butler, R.
1963 An Early Man Site at Big Camas Prairie, South-Central Idaho. *Tebiwa* 6(1):22-33.

Chandler. C. K.
1992 A Polyhedral Blade Core from Northeast San Antonio, Bexar County, Texas. *La Tierra* 19(4):20-25
1999 A Polyhedral Core from Hollywood Park in North-Central San Antonio. *La Tierra* 26(1) 14-17

Chandler, C. K. and R. McReynolds
1996 Artifacts of Alibates Dolomite from South Texas. *La Tierra* 23(3):7-9

Collins, M. B.
1990 Observations on Clovis Lithic Technology. *Current Research in the Pleistocene*, 7:73-74
1999a Clovis Blade Technology. University of Texas Press. Austin.
1999b Clovis and Folsom Lithic Technology on and near the Southern Plains: Similar Ends, Different Means. In: *Folsom Lithic Technology*, edited by Daniel S. Amick, pp.12-38. International Monographs in Prehistory, Archaeological Series 12. Ann Arbor.
2002 The Gault Site, Texas, and Clovis Research. *Athena Review* 3(2):4-8.
2003 Paleoindian Pavo Real. In: *Pavo Real (41BX52): A Paleoindian and Archaic Camp and Workshop on the Balcones Escarpment, South-Central Texas*, by Michael B. Collins, Dale B. Hudler, and Stephen L. Black, pp.83-190. *Studies in Archeology 41*, Texas Archeological Research Laboratory, The Univeristy of Texas at Austin and Archeological Studies Program, Report 50, Environmental Affairs Division, Texas Department of Transportation. Austin.

Collins, M. B. and J. C. Lohse
2004 The Nature of Clovis Blades and Blade Cores. In *Entering America*, edited by D. B. Madsen, The University of Utah Press. Salt Lake City.

Frison, G.
1991 The Clovis Cultural Complex: New Data from Caches of Flaked Stone and Worked Bone Artifacts. In *Raw Material Economics Among Prehistoric Hunter-Gatherers*, edited by A. Montet-White and S. Holen, pp. 321-333. University of Kansas, Lawrence.

Frison, G. and B. Bradley
1999 *The Fenn Cache: Clovis Weapons and Tools*. One Horse Land and Cattle Company, Sante Fe, NM.

Green, E. F.
1963 The Clovis Blades: An Important Addition to the Llano Complex. *American Antiquity* 29:145-165.

Hester, T. R., G. L. Evans, F. Asaro, F. Stross, T. N. Campbell, and H. Michel
1985 Trace Element Analysis of an Obsidian Paleo-Indian Projectile Point from Kincaid Rockshelter, Texas. *Bulletin of the Texas Archeological Society* 56:143-153

Holliday, V. T. and A. B. Anderson
1993 'Paleoindian,' 'Clovis,' and 'Folsom': a Brief Etymology. *Current Research in the Pleistocene* 10: 79-81.

Howard, E. B.
1943 The Finley Site, Discovery of Yuma Points, in situ, near Eden, Wyoming. *American Antiquity* 8(3):224-234.

Huckell, B. B.
n.d. *Clovis Lithic Technology: A View from the Upper San Pedro Valley*. Manuscript in possession of the author.

Hurst, C. T.
1942 The Folsom-Yuma Problem. *Southwestern Lore* 7(4):65-67

Kelly, T. C.
1992 Two Polyhedral Cores from Comanche Hill, San Antonio, Texas. *La Tierra*: 19(2)29-33.

McNett, C. W.
1985 *Shawnee Minisink: A Stratified Paleoindian Archaic Site in the Upper Delaware Valley of Pennsylvania*. Academic Press, Orlando.

Patterson, L. W.
1993 Prismatic Blade Technologies in Texas. *La Tierra* 20(2):36-39

Stanford, D.
1991 Clovis Origins and Adaptations: An Introductory Perspective. In: *Clovis: line missing Center for the Study of the First Americans, Department of Anthropology,* Oregon State University, Corvallis.

1999 Paleoindian Archaeology and Late Pleistocene Environments in the Plains and Southwestern United States. In: *Ice Age Peoples of North America,* edited by R. Bonnichsen and K. L. Turnmire, pp. 281-339. Oregon State University Press, Center for the Study of the First Americans, Corvallis, Oregon.

Turner, E. S. and T. R.Hester
1993 *A Field Guide to Stone Artifacts of Texas Indians.* Gulf Publishing Company, Houston, Texas.

Wilke, P. J., J. J. Flenniken, and T. L. Ozbun
1991 Clovis Technology at the Anzick Site, *Montana. Journal of California and Great Basin Anthropology* 13(2):242-272.

Wormington, H. M.
1944 *Ancient Man in North America.* Colorado Museum of Natural History, Popular Series 4, Second Edition. Denver 1957 Ancient Man in North America. Denver Museum of Natural History, Popular Series 4, Fourth Edition. Denver.

Young, B. and M. B. Collins
1989 A Cache of Blades with Clovis Affinities from Northeastern Texas. *Current Research in the Pleistocene* 6:26-28.

The Ceramic and Lithic Assemblage from a Late Prehistoric Site (41RT510) in the Post Oak Savanna, Robertson County, Texas

Timothy K. Perttula

ABSTRACT

Ceramic and lithic artifacts have been recovered in survey activities at site 41RT510 in the Navasota River Basin. This locale lies within the Post Oak Savanna of east central Texas. An analysis of the artifacts suggests that the site could have been obtained by hunters and gatherers from their Caddo neighbors.

INTRODUCTION

In this paper, I discuss a small assemblage of ceramic and lithic artifacts from a Late Prehistoric site in the Navasota River basin in the Post Oak Savanna of east central Texas (see Fields 2004: Figure 12.1). The site is on a toe slope overlooking a tributary of the Navasota River (Steele Creek) and the floodplain of the Navasota River to the east (Figure 1).

The site was recorded during a 1997 archeological survey for a proposed pipeline, and I was told about it by an environmental engineer working on the pipeline project. This individual had found artifacts at the site, along with many fragments of what appeared to be bison bones, and allowed me to document them. The collection was of interest to me primarily because of the relatively large assemblage of prehistoric ceramic sherds found there, as this part of the Post Oak Savanna is not known as an area where ceramics are particularly common (Fields 2004:360). A few of the sherds shown to me had decorations—horizontal and diagonal incised lines and fingernail punctated elements—that resembled those seen on prehistoric Caddo utility wares that date from ca. A.D. 900-1200/1300. Studying the sherds from 41RT510—especially how they were fired, the tempers used, and the surface treatment they received—might allow me to ascertain the cultural affiliation of the archaeological assemblage, particularly if there was

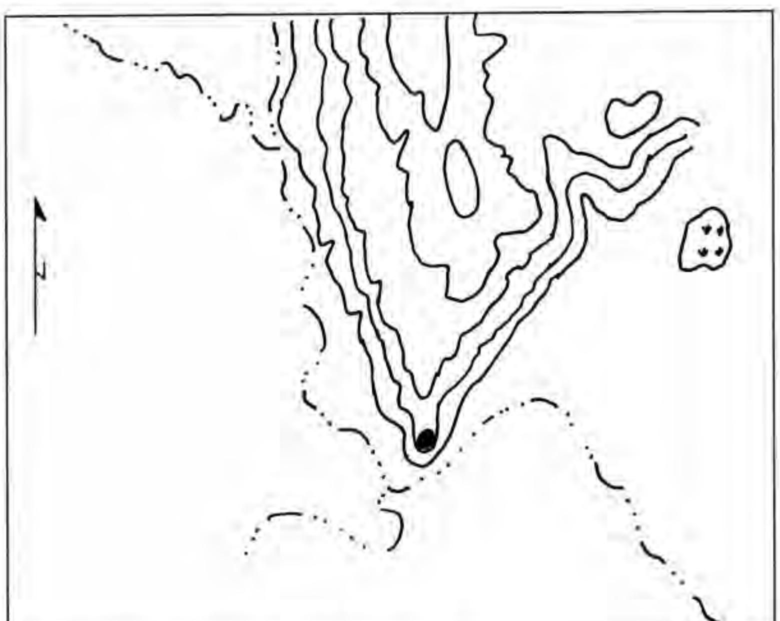

Figure 1. Topographic setting of 41RT510.

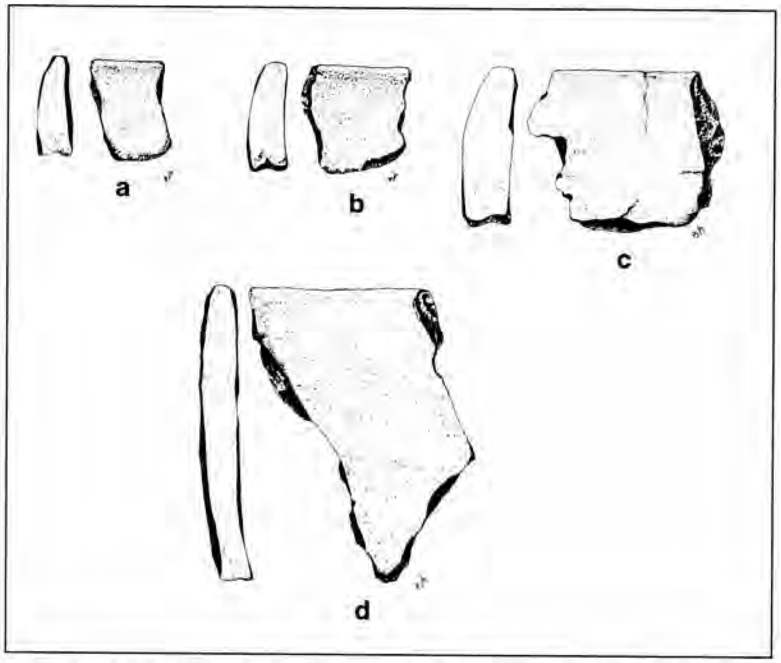

Figure 2. Plain ceramic rim sherds: a, c, direct rim and a flat lip; b, d, direct rim and a rounded lip. Length of d is 62 mm.

a relationship between the occupants of the site and the prehistoric Caddo groups living in East Texas or other parts of the Post Oak Savanna.

CERAMIC SHERDS

There were 36 sherds in the collection from 41RT510 that I was able to document, but at least another 50 sherds were unfortunately unavailable for study. The sherds include five rims (Figure 2a-d), 30 body sherds, and one base sherd. The sherds came from vessels that were quite thick, and probably relatively large, although no orifice diameter measurements could be obtained on the rims. The mean thickness of the rims is 8.50 ± 0.96 mm, while the body sherds have a mean thickness of 7.98 ± 1.36 mm. The one flat base is 11.0 mm in thickness.

The sherds are tempered with grit (or crushed pieces of hematite) (n=4), grog (n=19), bone (n=2), bone-grit (n=1), and grog-grit (n=2). The percentage of sherds with bone temper (8.3%) is quite a bit lower than those with some amount of grog temper (58.3%). Eight of the sherds do not have any obvious temper, but have a distinctive sandy paste. Many of the sherds with temper, particularly those with grog, also have a sandy paste (n=21, 58.3%). A sandy clay was probably used in the manufacture of the vessels found at 41RT510.

The great majority of the sherds (83%) are from vessels that were fired in a reducing or low oxygen environment, and have a dark vessel core. Many of these same vessels were pulled from the fire and allowed to cool in the open air: 68.6% of the sherds have distinctive thin oxidized zones along the inside and outside cores of the sherds. Only one sherd was fired and cooled in a high oxygen environment, and 14.3% of the sherds are from vessels that were incompletely oxidized during firing, probably a result of a low firing temperature or short firing period.

Most of the sherds are from vessels that had either been smoothed or burnished on interior and/or exterior surfaces. Almost 56% of the sherds have evidence of smoothing on the interior, and these are probably from cooking jars; 44% were smoothed on the exterior, and 16.7% were burnished on the exterior vessel surface. These sherds most likely come from bowls and carinated bowls meant to be used for serving foods. The plain rim sherds have direct profiles, with either rounded (see Figure 2b, d) or flat lips (see Figure 2a, c).

Turpin and Carpenter (1994:17) recovered similar thick and undecorated grog-tempered sandy paste sherds at 41RT285 on Walnut Creek near its confluence with the Brazos River. However, this was in a context postdating A.D. 1250, with Perdiz arrow points and a few pieces of bison bone.

Only one of the 36 sherds—a grit-tempered body sherd—in the collection is decorated: it had a hematite-rich slip on interior and exterior surfaces. But as I mentioned above, there are also an undocumented number of horizontal and diagonal incised and fingernail punctated sherds in the 41RT510 collection. The use of red-slipping as a form of decoration is common in prehistoric Caddo ceramic assemblages (especially those dating after ca. A.D.

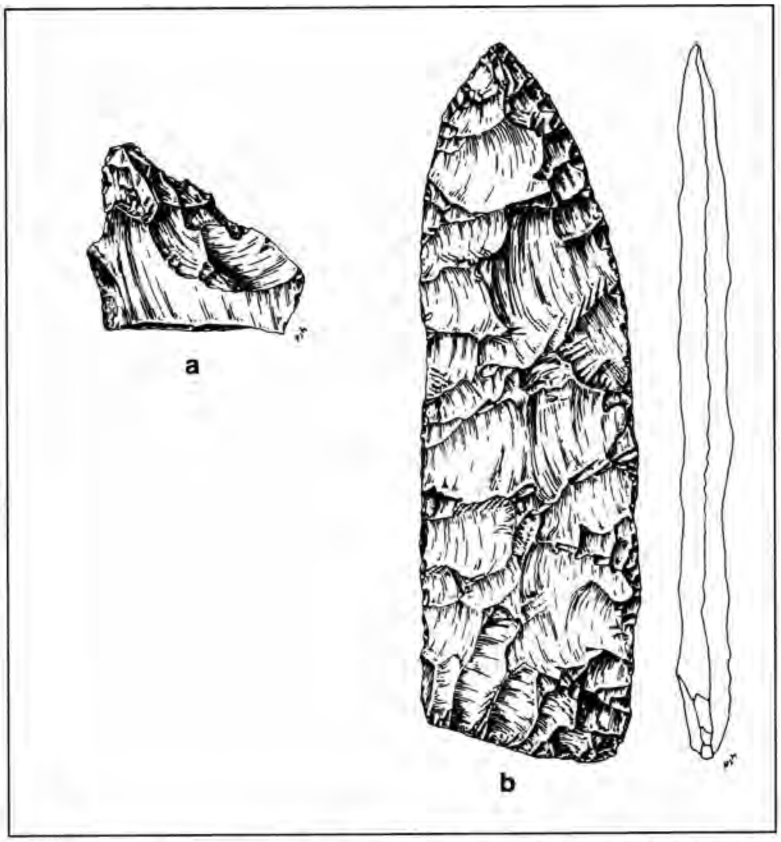

Figure 3. Chipped stone tools: a, utilized flake; b, large bifacial knife. Length of b is 110 mm.

1200) in some parts of East Texas, particularly in the upper Sabine and upper Big Cypress River basins. Doss Redware is sometimes found in Central Texas ceramic assemblages, but this distinctive ware is bone-tempered.

LITHIC TOOLS

The first tool (Figure 3a) is on a cortical flake (35 m in length, 28.5 mm in width, and 9.4 mm thick) of a gray to dark gray chert; the cortex is a chalky limestone. The raw material resembles Fort Hood Gray (Trierweiler 1994: Plate 2). The tool has fine retouching and use wear along the tip, with a second area of retouch and use wear on the edge opposite the cortical remnant.

The other tool is a large and well-chipped bifacial knife that is 109 mm in length, 33 mm in width near its base and mid-section (narrowing to 20 mm near the tip), and 6.4-8.7 mm in thickness (Figure 3b). It is made from a chert that ranges from light gray, yellowish-brown, to brownish-gray, and has a dull luster, and fossiliferous inclusions. The material resembles Anderson Mtn. Gary chert (Trierweiler 1994: Plate 1).

This large bifacially chipped tool has signs of use (micro-fractures along the edges) on the tip and one edge of the piece, and there is a slight bevel along one edge. The basal edge of the biface is relatively straight, with fine retouching and pressure flaking, and the lateral edges of the biface are not recurved like a Gahagan biface (Shafer 1973:Figure 19), but the lateral edges are parallel above the base; the biface is as wide at the base as it is along its mid-section.

DISCUSSION

Is 41RT510 a prehistoric Caddo site in the Post Oak Savanna? Perhaps it is related to the south Prairie Caddo sites discussed by Shafer (2005), although this would be difficult to prove because the age of the site is not known (although it is possible to speculate about this). Nor are there clear examples in the assemblage of the kinds of artifacts thought to characterize south Prairie Caddo sites, namely early Caddo pottery like that found at the George C. Davis site on the Neches River in East Texas (Perttula 2004:Figure 13.3; Story 2000); deer metapodial beamers, Bonham-Alba arrow points, and Gahagan bifaces (Shafer 2005:5).

Based on the kinds of decorated sherds reported from the site, the overall thickness of the ceramic vessel walls, which are much thicker than bone-tempered sherds in Toyah phase assemblages (Perttula 2001: Table 1), and the frequency of grog-tempered vessel sherds (as well as the rarity of bone-tempered vessel sherds), I do not think that 41RT510 represents either an Austin or Toyah phase manifestation. The incised, punctated, and red-slipped sherds known to be in the

41RT510 collection would not be out of place in an assemblage of decorated and grog-tempered Caddo pottery found in East Texas on sites dating from ca. A.D. 900 to A.D. 1300 or thereabouts. Instrumental neutron activation analysis (see Neff and Glascock 2005) and petrographic analysis of sherds and clay sources need to be carried out at other sites in the Post Oak Savanna to help establish whether the pottery found on prehistoric sites in this area of east-central Texas was made locally by relatively mobile hunter-gatherer groups, or had been obtained in trade with their Caddo neighbors.

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REFERENCES CITED

Fields, R. C.
2004 The Archeology of the Post Oak Savanna of East-Central Texas. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 347-369. Texas A&M University Press, College Station.

Neff, H. and M. D. Glascock
2005 Compositional Variation in Aboriginal Ceramics from Central Texas: Results of Instrumental Neutron Activation Analysis. In *Analysis and Reporting for 41FY135, the Sandbur Site, Fayette County, Texas*, by A. J. Kalter, R. M. Rogers, and M. N. Smith, pp. C-5 to C-35. Archeological Studies Program Report 73. Texas Department of Transportation, Environmental Affairs Division, Austin.

Perttula, T. K.
2001 Prehistoric Ceramic Sherds from 41MM341 on the Little River, Milam County, Texas. *Journal of Northeast Texas Archaeology* 15:37-41.

2004 The Prehistoric and Caddoan Archeology of the Northeastern Texas Pineywoods. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 370-407. Texas A&M University Press, College Station.

Shafer, H. J.
1973 Lithic Technology at the George C. Davis Site, Cherokee County, Texas. Ph.D. dissertation, Department of Anthropology, The University of Texas at Austin.

2005 People of the Prairie: A Possible Connection to the Davis Site Caddo. Ms on file, Texas Department of Transportation, Environmental Affairs Division, Archeological Studies Program, Austin.

Story, D. A.
2000 Introduction. In *The George C. Davis Site, Cherokee County, Texas*, by H. P. Newell and A. D. Krieger, pp. 1-31. 2nd Edition. Society for American Archaeology, Washington, D.C.

Trierweiler, W. N. (editor)
1994 *Archeological Investigations on 571 Prehistoric Sites at Fort Hood, Bell and Coryell Counties, Texas*. 2 Vols. Research Report 31, Archeological Resource Management Series. United States Army Fort Hood.

Turpin, J. and S. M. Carpenter
1994 *Continuing Cultural Resource Management at Calvert Mine: 1993 Prehistoric Site Testing, Robertson County*. Techical Series 42. Texas Archeological Research Laboratory, The University of Texas at Austin.

Biface Cache from Milam County, Texas

David L. Calame, Sr.
With illustrations by Ryan Fain

ABSTRACT

A cache of four small bifaces found on a prehistoric occupation site near Sugarloaf Mountain in northeast Milam County is reported and discussed. This cache is of the type representing point reduction activities at a campsite, most likely unrelated to the pattern of large biface caches involving the movement or trade of Edwards Plateau chert.

THE SITE

The locale at which this biface cache was found is an uplands occupation site on an unnamed tributary of the Little River in Milam County, approximately one mile north of the river. The geographical terrain is best described as being in the Post Oak Savannah. The site covers approximately four acres of sandy uplands over looking the Little River valley to the south with an excellent view of Sugarloaf Mountain, a very obvious landmark of the local area and on which is a recorded, heavily occupied site (41MM253).

The present site was occupied during the Early Archaic through Late Prehistoric based on time diagnostic dart and arrow point types. Projectile point types found at the site are as follows: Angostura, Axtell, Ensor, Pedernales, Wells, Darl, Carrolton, Yarbrough, Kent, Godley, Perdiz, Scallorn, Ellis, and Edgewood (Turner and Hester 1993). Various "gouge" and scraper forms were also found at this site. The collection also includes several large pieces of red ochre with many abrasion marks on them , as well as a possible burial placed in a pottery (to be reported at a later date). Lithic material are available near the site consisting of Uvalde Gravels from the bedload of the Little River.

The Cache

This cache of four small bifaces (Figure 1) was found in an uncontrolled excavation in the southwest quadrant of the site. The finder reports that the cache was found buried approximately 12 inches deep. The bifaces were stacked one atop the other, each being placed with the longitudinal axis perpendicular to the one above or below it. Specimens were placed in the presumed cache pit with Specimen #1 at the bottom to Specimen #4 which was on the top.

Specimen #1. The specimen (Fig. 1, A) is a pointed ovate biface of tan medium grade chert, and is biconvex in profile. It was probably made of a large flake spall. Flaking is random, soft hammer, percussion. Some edge grinding/dulling is evident. For its overall size, the specimen is still fairly thick. Length, 105 mm; maximum width. 55m, maximum thickness, 19 mm; width/thickness ratio, 2.89. The longest percussion flake on the specimen is 42 mm long.

Specimen #2 .This long ovate specimen (Fig. 1, B) is made from dark gray, medium grade chert. It was stacked second from the bottom in the cache pit. The

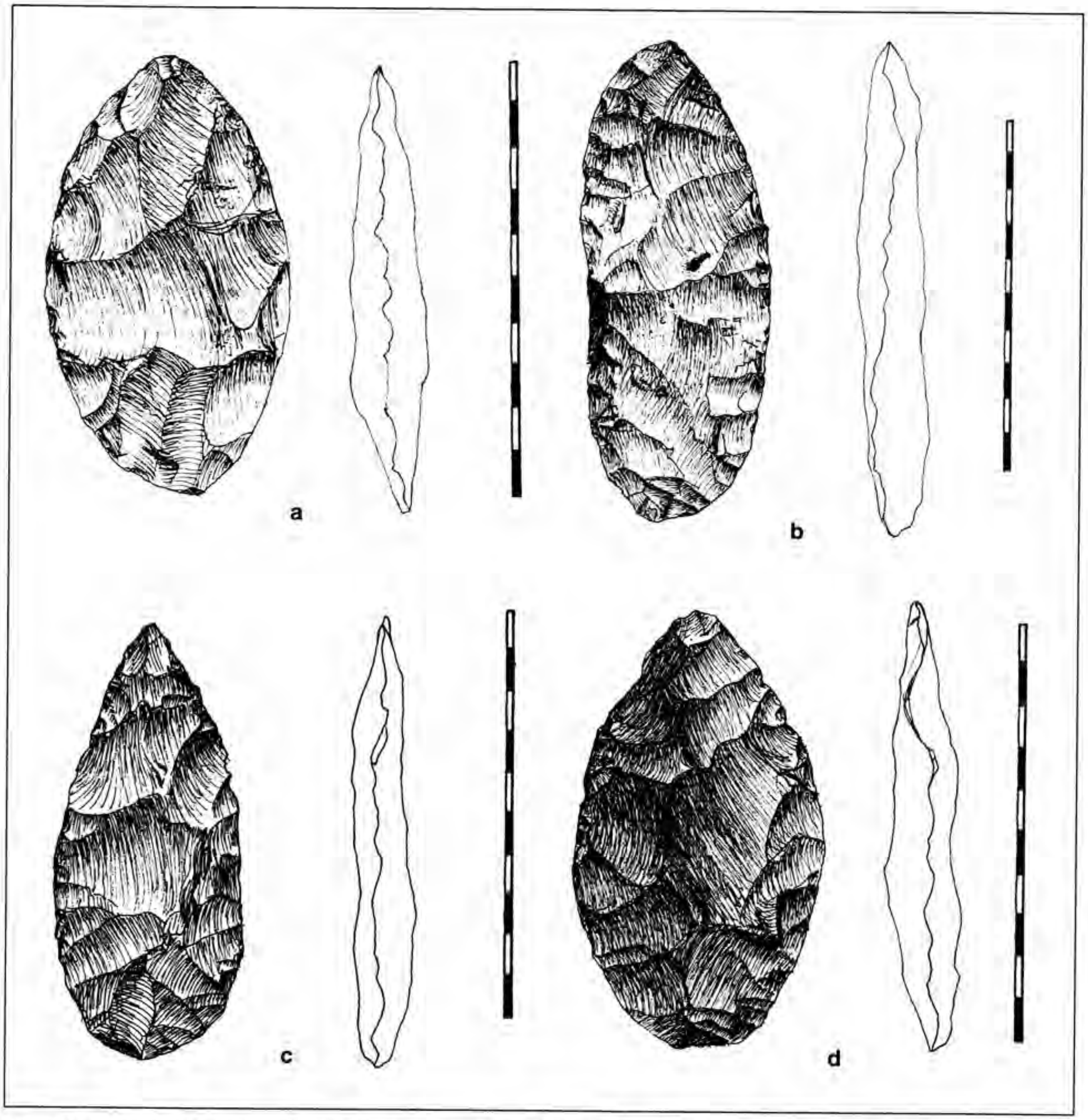


Figure 1. Biface Cache, Milam County, Texas. a) specimen 1; b) specimen 2; row, c) specimen 3; d) specimen 3. Drawings by Ryan Fain. Note separate scale (10 cm) for each biface.

biface exhibits a twisted profile created by alternate edge "beveling" or lowering in terms of platform preparation. No edge grinding ordulling is evident. Flaking is random soft hammer percussion with no basal thinning flakes. Specimen was probably made from a whole cobble. Length, 137 mm; maximum width, 42 mm; thickness, 20 mm, width/thickness ratio, 2.10. The longest percussion flake on the biface is 38 mm long.

Specimen #3. Made from tan, medium grade chert, the biface is pointed ovate in outline (Fig. 1, C) and biconvex in profile. When viewed from the sides, the lateral edges are very uneven and sinuous. It exhibits soft hammer percussion flaking and shows some edge dulling or grinding. The biface may have been made on a large flake. It had been stacked third from the bottom in the cache pit. Length, 105 mm; width, 55 mm, maximum thickness, 19 mm; width/thickness ratio, 2.89. The longest percussion flake on this artifact is 48 mm long.

Specimen #4. This is a bipointed ovate biface (Fig. 1,D), biconvex in profile. It is made of medium grade, light brown chert. A small amount of cortex remains near the distal tip. The biface is marked by some basal thinning and generally random soft hammer percussion. No edge dulling or grinding is apparent. Specimen may have been made a large flake spall. Specimen was stacked in the cache pit on top of the previous three bifaces. Length, 107 mm; maximum width, 48 mm, maximum thickness, 13 mm, width/thickness ratio, 3.69. The longest percussion flake on Specimen 4 is 43 mm in length.

DISCUSSION

As a general observation, most biface caches reported in this part of Texas, as well as in adjacent areas, are much larger in size (Miller 1993). Further, they are often triangular in outline and percussion flaked. Such caches are usually considered to be "banking caches," or isolated spots where a large number of bifaces were hidden or stored during –or after— the trading process.

In contrast, the four bifaces from this Milam County cache are similar in size and outline, and exhibit soft hammer flaking. In terms of context, they were found "cached" within a large occupation site. Most likely, these are preforms set aside to be used in dart point manufacture at some later date. Somewhat similar caches include one with three Castroville points, a Castroville preform, and a small marine shell at the Blue Hole site (41UV159) in Uvalde County. Mueggenborg (1994:62, 64) speculates that this cache may have had "ritual" importance; alternatively, it could have been more utilitarian in nature, such as finished points (or ones to be re-tipped) along with a preform, stored by the owner. At the Eckols site in Travis County (Karbula 2000), the 1992 field school from The University of Texas at Austin, uncovered two or three instances of two finished points "cached" together, especially a couple of the Bulverde type (Thomas R. Hester, personal communication, 2006). Bifaces of the form in the Milam Cache would fit into Karbula's biface stage 4, most of which he considers to be "knives," though Hester sees them mainly as final-stage performs.

The Milam County cache reported in this paper, and those noted above, have no link to the pattern of large biface caches resulting from ancient trade involving biface production on the Edwards Plateau and export to surrounding areas. But, they remain "biface caches" linked to ongoing, campsite activities involving projectile point manufacture.

ACKNOWLEDGMENTS

The author wishes to thank V.V. Turner for his confidence and trust in loaning this biface cache for study. Thanks also go to Ryan Fain, a student at UTSA, for his excellent illustrations of this biface cache. Many thanks and much appreciation to the editors of *La Tierra,* Dr. Thomas Hester and Dr. Harry Shafer, for guidance and suggestions.

REFERENCES CITED

Karbula, J. W.
2000 Investigations at the Eckols Site(41TV528): A Stratified Prehistoric Terrace Site on Barton Creek in Travis County, Texas. Unpublished doctoral dissertation, The University of Texas at Austin.

Miller, K. A.
1993 A Study of Prehistoric Biface Caches from Texas. Unpublished master's thesis, The University of Texas at Austin.

Mueggenborg, H. E.
1994 Excavations at the Blue Hole Site, Uvalde County, Texas. *Bulletin of the Texas Archeological Society* 62 (for 1991):1-74.

Turner, E.S. and T. R. Hester
1993 *Field Guide to Stone Artifacts of Texas Indians.* 2nd edition. Gulf Publishing, Houston.

A Clovis Manufacturing Failure from Real County, Texas

Bryant Saner, Jr.

ABSTRACT

This paper documents a Clovis projectile point manufacturing failure found in Real County, Texas. The steps in manufacturing a fluted Clovis projectile point are important to the analysis and understanding of this artifact form. The dimensions and a description of the artifact are given and the significance of the data collected are discussed.

INTRODUCTION

Clovis people lived on this land as long ago as 11,500 years before the present (BP) (Collins 1999). This culture produced a characteristic group of artifacts that included the Clovis fluted point. It is believed that Clovis people hunted and scavenged Late Pleistocene megafauna, including mammoth, but medium to small mammals were also hunted along with the gathering of plant foods part of their subsistence actitivites.

The Clovis projectile point was used for hunting and it is strongly suggested that they also served as tools to butcher and skin their prey. The manufacture of a Clovis projectile point started with a large flake or quarry blank that was reduced to a thick biface. The next step was to thin the biface. This was followed by trimming and shaping of the biface. At this stage in the process the biface was lanceolate in outline, the lateral edges convex, the base was usually straight and a dull rounded tip was seen. The next step was to prepare the base for removal of the two fluting flakes, one on each flat surface starting at the base. Removing of these flakes was a critical step in the process. If the removal of both flakes was successful, the final trimming and shaping of the edges was done. The last step in the process was grinding the base and the proximal lateral edges (Collins 1999). The final product had slightly convex lateral edges. It was often slightly wider at the mid portion than at the base. The cross section is lenticular. The base is concave and the tip is slightly rounded and dull. Lateral edges were ground from the base to about one-fourth to one-half of the way to the tip.

PREVIOUS INVESTIGATIONS

The best known Clovis site in Texas and perhaps in the Americas is the Gault Site in Williamson County, central Texas. Although most of the site has been destroyed or heavily damaged by pay-diggers, scientific work aimed at the Clovis occupations began in 1991, with the most productive work done between 1998-2002. Under the oversight of Michael B. Collins, various universities, and archaeological organizations have been involved (*Texas Beyond History* 2005). The Pavo Real Site in northwest Bexar County is also well known for its Clovis component (Collins et al. 2003).

In the mid 1980s, David Meltzer (1986) began the Texas Clovis Fluted Point Survey and reported 50 Clovis points in both published and unpublished reports. Nine years later 406 Clovis points were tallied, including the 50 from 1987 (Meltzer 1995). An additional 133 have been added since 1995. No Clovis points have been reported from Real County until the artifact described in this report was documented (personal communication, David J. Meltzer, April 2005). In counties that bordered Real County 11 Clovis points are reported. Clovis manufacturing failures were found at the Kincaid Shelter in Uvalde County (Collins 1989), and are similar to the one described in this paper. Meltzer (1995) reported one Clovis in Bandera County, one in Kimble County and seven in Uvalde County, including specimens from Kincaid Shelter. Two complete Clovis points were reported from Kerr County by Priour (1985) and Saner (1995).

ARTIFACT DESCRIPTION

The specimen described in this paper, surface-collected in Real County, Texas, is the proximal portion of a Clovis projectile point. The point was broken during the attempt to remove the second flute (Figure 1). Patina is seen on most of the surfaces, though is heavier on Side A than Side B. Three recent breaks can be observed, but the cause of these is unknown. These breaks reveal gray chert beneath the patina. Two of the recent breaks are on Side A. One of the breaks was in the upper left corner and the other on the lower left corner and base. The flute on Side A terminates at a remnant of a flake scar near the break. The left lateral edge on Side A has a flake removed that extends into the middle portion of the flute. The flute on Side B is not penetrated by flake scars. Viewed from the side the lateral edges were sinuous and uneven. Side B has one recent break in the middle of the lateral edge.

The failure occurred when the maker attempted to remove the flute on Side B. The shock wave created in the attempt to remove the flute flake on Side B traveled through the end of the flat surface then turned down into the body of the point causing the failure. On Sides A and B both lateral edges are steep. There is no grinding on the edges, except on the left portion of the base between the flute and corner of Side B.

The length of the artifact on the left of Side A is 32.2 mm and on the right is 38.7 mm. The width at the base is 32.9 mm and at the break is 39.2 mm. The maximum thickness is 8.4 mm. The thickness at the break was 7.9 mm and the mid-section it was 6.5 mm at the break on the corner the base was 3.7 mm. The flute on Side A is 23.4 mm and is 22.8 mm wide. The flute on Side B is 33.7 mm from origin to the break. It is 16.8 mm wide. The weight of the fragment is 17.5 g.

DISCUSSION

Clovis projectile point are rare finds. Meltzer (2005) states that a total of 539 Clovis points were documented in the statewide Texas Fluted Clovis Study. None of these were found in Real County. There were a total of 406 points report by Meltzer (1995) 10 years earlier. Of these, 109 were from central Texas. Only six of the 109 were manufacturing failures [a probable unfinished Clovis point is reported by Hester et al. (1993) near 41AT111 in Atascosa County].

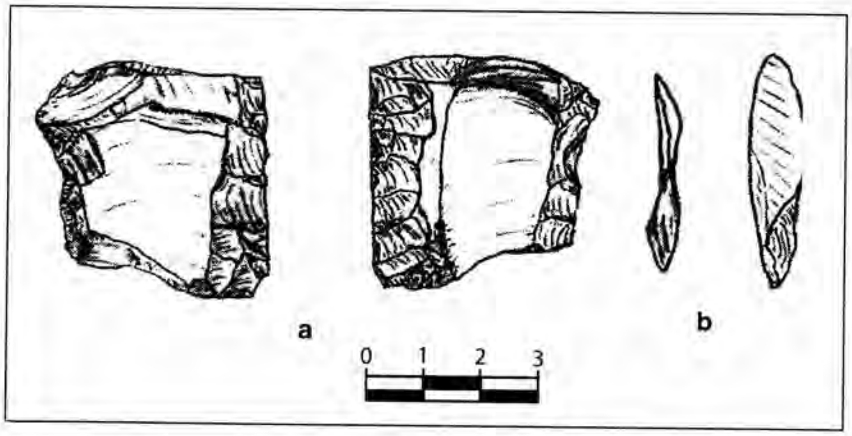


Figure 1. Clovis Manufacturing Failure, Real County, Texas. Side A (left) and Side B (right)are shown. The two cross sections on the right include a view of the base and a the view of the fracture. Drawings by the author.

Examination by noted flintknappers and lithic experts, Steve Tomka (personal communication, 2005) and Glenn T. Goode (personal communication, 2005) confirm that the errant fluting attempt caused the failure. Recent breaks exposed gray chert, likely Edwards chert derived from the local area. When the second flute failure caused the break the point was abandoned. This Clovis manufacturing failure from Real County, Texas adds yet another small bit of information to the database on Clovis technology.

ACKNOWLEDGMENTS

A debt of gratitude is owed T. D. Nasworthy for allowing the study and documentation of this important artifact. Thanks go to Joanna and Jett Smith for bringing Mr. Nasworthy and the author together. The evaluation of the artifact by Glenn T. Goode and Steve Tomka is greatly appreciated. Thanks to Karla Cordova for encouragement and suggestions to improve this paper.

REFERENCES CITED

Collins, M. B.
1995 Forty Years of Archeology in Central Texas. *Bulletin of the Texas Archeological Society* 66:361-400.
1999 *Clovis Blade Technology.* University of Texas Press, Austin.

Collins, M. B., D. B. Hudler, and S. L. Black
2003 Pavo Real (41BX52): A Paleoindian and Archaic Camp and Workshop on the Balcones Escarpment, South-Central Texas. *Studies in Archeology 41*, Texas Archeological Research Laboratory, The University of Texas at Austin. *Archeological Studies Program, Report* 50, Texas Department of Transportation, Environmental Affairs Division, Austin.

Collins, M. B., G. Evans, T. N. Campbell, M.C. Winans, and C. E. Mears
1989 Clovis Occupation at the Kincaid Shelter, Texas. *Current Research in the Pleistocene* 6:3-4.

Hester, T. R., B. D. Barber and P. Headrick.
1993 Insights into Clovis Technology: A Clovis Point from Atascosa County, Southern Texas. *La Tierra* 20(3):3-5.

Meltzer, D. J.
1987 The Clovis Paleoindian Occupation of Texas: Results of the Texas Clovis Fluted Point Survey. *Bulletin of the Texas Archeological Society* 57:27-68.
1995 Paleoindians of Texas: An Update On the Texas Clovis Fluted Point Survey. *Bulletin of the Texas Archeological Society* 66: 47-81.

Priour, D. J.
1985 A Clovis Point from Kerr County. *La Tierra* 12 (2):28-31.

Saner, B., Jr.
1995 An In Situ Clovis Point Find from Kerr County, Texas. *La Tierr*a 22 (3):20-23.

Texas Beyond History
2005 The Gault Site, Texas Archeological Research Laboratory, The University of Texas at Austin. Web site address: www.utexas.edu/research/tarl/research/gault/intro/intro.htm

A Technological Study of Arrow Shafts from New Mexico

William W. Birmingham, Richard McReynolds and E. H. Schmiedlin

ABSTRACT

In the 1950s, a small cave was found near Silver City, New Mexico, containing hundreds of arrows and other wooden artifacts. A sample of 38 arrow shafts from the site have been studied in detail, providing descriptive, decorative and technological information.

INTRODUCTION

In the early 1960s, Birmingham and Schmiedlin acquired 38 arrow shafts from the vicinity of Silver City, New Mexico. In the early 1950s, a man and his son on a fishing trip found a small cave said to be located "17 miles from any road." Black and white photographs of the area taken at the time show the cave near the base of sheer cliffs, with pine trees partially obscuring the entrance. The finder's diary indicated that a small cliff dwelling was about 200 yards from the cave. The cave was very small, described as being within a "large geode" and was about seven feet deep, seven feet wide and four feet high, with a low, narrow "crawl" opening. Inside were bundles of reed arrow shafts, as well as wooden bows and other wooden objects. A black and white photograph taken at the time shows a jumble of arrow shafts, some of the bundles having been scattered by packrats. There was no exact count of the arrow shafts recovered, although there must have been hundreds. Some of the arrow shafts were said to have had small flint arrow points still attached, but there were none in the sample described here.

From the total of 38 composite arrow shafts, 11 examples were selected to illustrate the differing aspects of their manufacture. The arrows are composed of several different parts and materials. They have or had hardwood foreshafts, hardwood nocks, cane main shafts and feather fletching. Most retain animal sinew binding and a resinous mastic. Many have painted designs on the proximal ends and several evidently were tipped with stone arrowheads. It is also fairly evident that a commonality of the artifacts is that all of them appear to have been damaged previous to being placed in the cache.

HARDWOOD FORESHAFTS

All the arrows in the collection were made with hardwood foreshafts; however one arrow is missing part of the reed main shaft and all of the foreshaft, a second arrow is missing only the foreshaft but retains the sinew binding which held it in place. Of the remaining arrows (36) which have the foreshafts attached, 27 are damaged due to impact breakage.

There are eight foreshafts which are slightly flattened towards the distal end and have small V to U

A note on the illustrations: The detailed drawings of 11 of the arrow shafts were prepared by Richard McReynolds. Each is referenced as an individual figure (Figures 1-11). Additional information on each of the illustrated arrow shafts (numbers 1-11) can be found in Tables 1 and 2, along with data on 27 additional specimens.

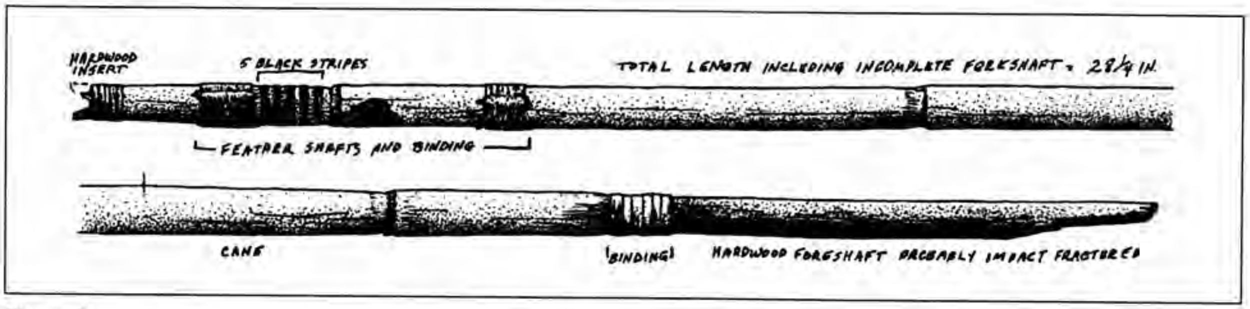


Figure 1.

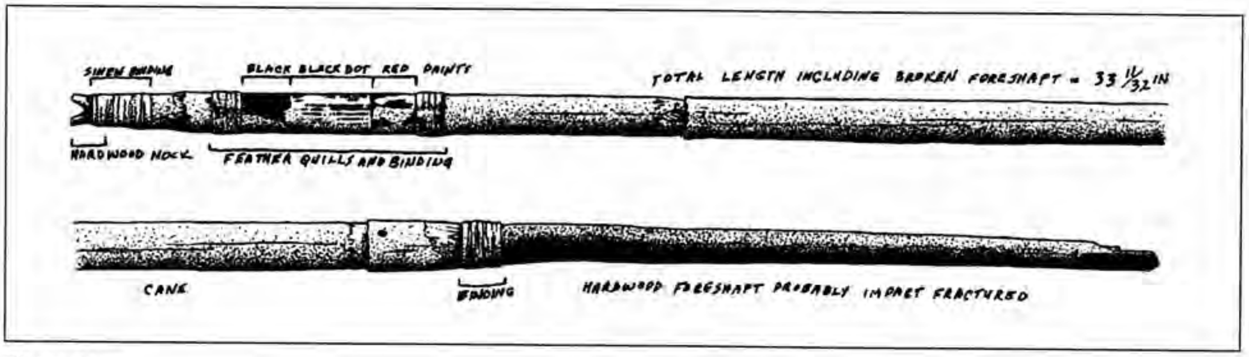


Figure 2.

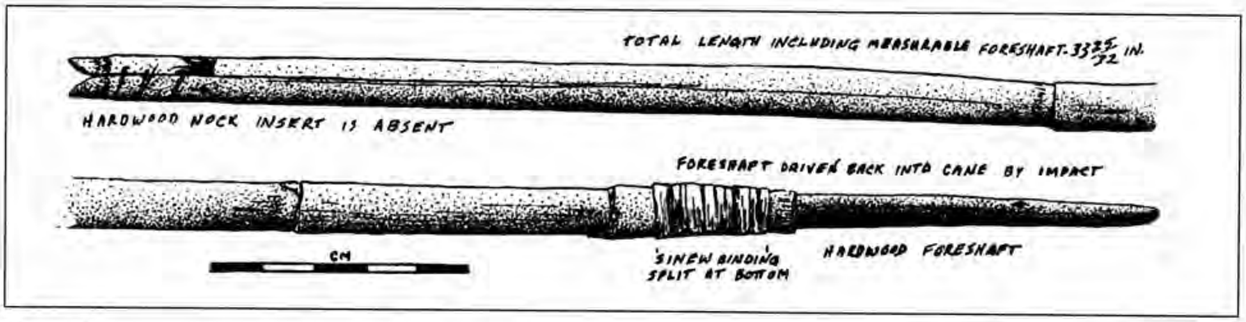


Figure 3.

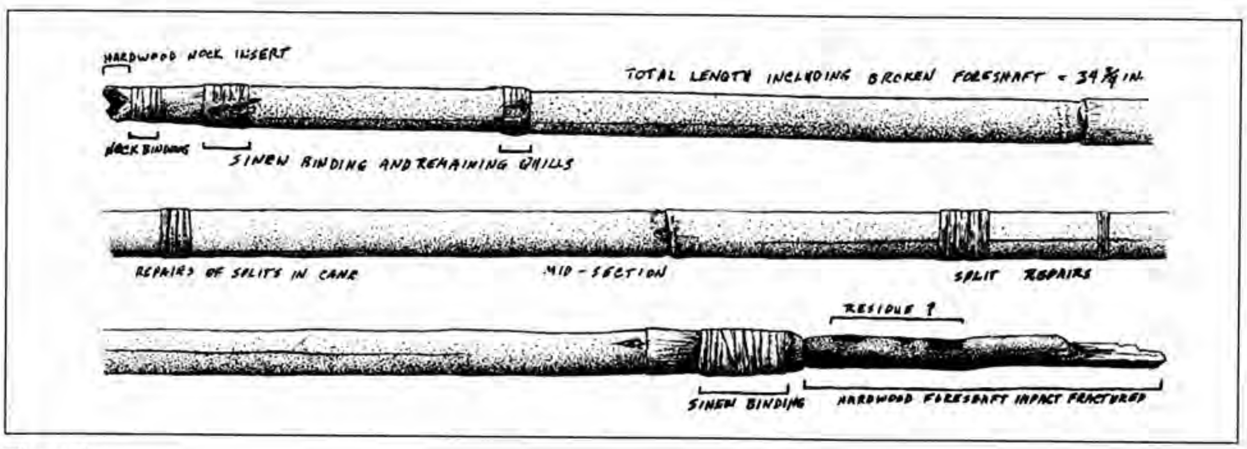


Figure 4.

shaped notches for seating chert or obsidian arrow points (Table 2, column R). Five of these retain the sinew wrapping which held and stabilized the stone points. Two retain only the wrapping marks. Seven of the eight notched foreshafts have resin within the point notch. Regrettably, none retain the stone arrow point.

The longest foreshafts in the group have been worked to a sharp point (Figures 10). Both of these wooden points were carefully shaped and appear to be very efficient tools. There is no evidence that any attempt at fire hardening was used. Arrow Shaft 15 (Table 2) has a diagonal fracture to the point. Arrow Shaft 10 (Figure 10) is essentially complete but has slight damage to the point. This point has three evenly spaced and slightly raised rings around it. The rings are somewhat lighter in color, as if they had at one time been protected by sinew bands or paint. There is a twig removal mark at one of the raised areas, but not at the other two. We do not know the reason for these inclusions on an otherwise smooth shaft.

Some foreshafts were shaped with great care (Figures 6, 7, 10) while others exhibit less attention. It is probable that several hardwood plants were used for foreshafts and not all were available in long straight lengths. Several have crooks and bends that combine with irregularities of branch removal.

Two of the arrows have foreshafts which can be removed to show the method of construction (Figures 8, 9). A shallow cut was made circling the foreshaft to form a shoulder which abuts the end of the reed main shaft. From the shoulder back to the end of the hardwood, the shaft was reduced by shaving to fit into the hollow internode of the reed mainshaft (Figures 8, 9). It appears that the shaved-down portion of hardwood usually extends nearly to or slightly past the first node of the reed. A resinous mastic was then applied to the male portion of hardwood and inserted into the reed, which was then wrapped with sinew at the joint. The hardwood shoulder, the mastic, and the sinew combine to prevent the foreshaft from being driven into and splitting the reed main shaft on impact. This, in fact, did not always work and there are two arrows in the ground that demonstrate this. Arrow 3 (Figure 3) is the example illustrated. On impact, the hardwood was driven back into the reed shaft eight mm past the shoulder. The foreshaft of arrow 35 was driven a full five cm past the shoulder back into the reed mainshaft.

REED MAIN SHAFTS

The main shaft is the cane or reed portion of the arrow which extends from the end of the nock to the foreshaft. The average length of the subject group of main shafts is 70.6 cm. The shortest in the group is 61.7 cm and the longest is 83.7 cm (Table 1, column B). The average diameter of the cane at the nock end is 7.1 mm. The smallest is 6.0 mm and the largest 9.0 mm. The average diameter at the foreshaft is 8. 7 mm. The smallest diameter at foreshaft is 7.0 mm and the largest is 11.4 mm.

One of the arrows was taken to Paul Cox, a botanist at San Antonio Botanical Gardens Conservatory. Paul, together with Steve Lowe and Scott Litchke, did several comparisons and identified it as *Phragmites australis*, our only native species. There are now many invasive species from many places which proliferate and pollute streams and marshes throughout the south and southwest.

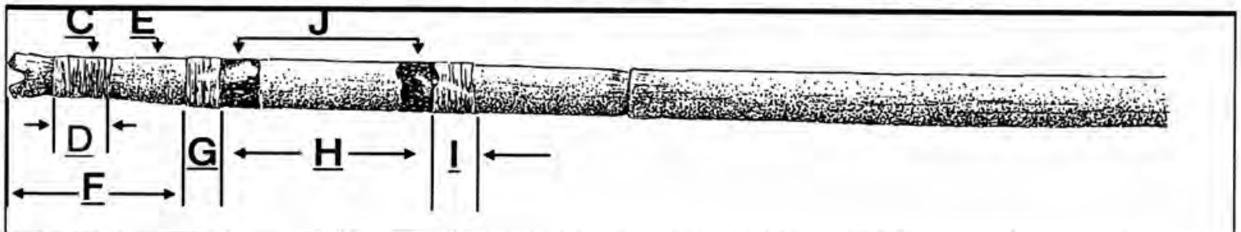
Five of the reed main shafts have repair bands of sinew along their length, where cracks or small splits developed in the internodes (see Figure 4 and Table 2, column K). The repairs consist of tightly wrapping a damp sinew strip around the cracked area to draw it closed. A resinous mastic was evidently used in applying some wraps but not all. It is also hard to asertain if the mastic was applied before the wrap as an added binder, or afterwards as a moisture proofing.

FLETCHING

The fletching consists of three feathers which were split at the midsection of quill and spaced approximately 120 degrees apart around the end of the cane shaft. All of the fletching is straight and none is spiraled.

The only intact remains of feathers are portions of the quills which have been preserved beneath the sinew binding and in some cases protrude at the ends of wrapping. At least six of the arrows have the split

Table 1. Specifications of Cane Arrow Shafts. Only Shaft No.'s 1-11 are illustrated.



	Shaft Total Length	Cane Length	Sinew Wrapping Dia. at Nock	Sinew Wrapping Width at Nock	Cane Dia. At Nock	Fletching Sinew Wrapping from Nock	Fletching Sinew Wrapping Width	Fletching Length	Fletching Sinew Width	Paint Bands
No.	A / cm	B / cm	C / mm	D / mm	E / mm	F / mm	G / mm	H / mm	I / mm	J
1	71.8	61.7	6.5	5	7	24	9.8	46.2	8.2	5
2	85	72	5.8	11	6.5/5.5	27.4	6	34.4	5.5	3
3	85.8	76.6	**	**	9	*	*	*	*	*
4	88.3	81.2	6	5.6	7.4	20	9.5	50	4.5	*
5	83.8	68.6	6.5	6.4	7.5	28	6.3	20.1	5 *	*
6	82.9	73.8	*	*	8.2	15.5	5	33.5	8	3
7	79.7	66.3	7	9.4	8	26.5	5.3	33.5	7.3	2
8	85.6	66.6	8.3	10.5	6.8	24.8	9.5	55.5	9.5	3
9	74.2	77.7	5	4	6	31.3	7.3	25.3	5	1
10	82.4	63.7	6.5	6	6.2	27.5	3.3	28.8	6	1
11	22 *	22 *	8.5	4.5	8.6	9	15.4	75	23.7	*
12	74.8 *	61.5 *	**	*	*	*	*	*	*	
13	80.5 *	71.6*	*	*	7.6	*	6	30	7.7	1
14	82.5 *	67.2	6	6.8	7	28.8	3.4	41.4	6.4	2
15	82.5	82.8	7.4	4.2	7.2	25.4	5.3	37.5	7	1
16	79.5	66.8	7	4.5	6.5	38	9.3	44.4	15.7	*
17	74.7 *	70.3	6.5	7	6.8	37	11.5	54.3	11.5	*
18	73.3 *	64.2 *	*	*	*	*	*	*	*	*
19	71.8 *	71.8	5 **	3.5	6.5	22	8	38.4	6.4	*
20	74.1 *	63.3	**	*	7	24.5	10	42.3	10.9	2
21	66.5 *	58.1 *	*	*	*	*	*	*	*	*
22	51 *	41 *	*	*	*	*	*	*	*	*
23	91.3 *	83.7	7	3	8.3	21.5	7	45	8.5	*
24	90.7 *	76.3	6	6	7	29.5	4	38	5.5	*
25	77.6 *	67.8	5.5	9	7.2 - 6	29	4.8	50.5	5.5	1
26	72.8 *	64.3	6.5	9.2	6.5	28.9	4.8	38.8	9	2
27	76.3	66.5	7.4	3.5	7	26.7	12	55	15	*
28	77.5 *	62.7	**	15	7.3	51.2	14	78	7.3	3
29	83.6 *	72.6	5.5	3.5	6.5	21	4.5	35	4.5	13
30	85.4 *	78.5	6	2.4	7.2	26.4	5.7	50.8	6.2	19
31	76.2 *	68.3	**	1.5	7	40.8	10.5	46.4	9.5	*
32	72.8 *	63.7	6.5	3	6.3	27.5	3.6	47	7.2	1
33	75.4 *	66.6	6	10.3	7.3	29	5.3	38	9	3
34	77.4	67.3	6.5	7	8	26.5	5.5	29	7	1
35	83 *	70	6.1	4.4	6.3	25	78	55	8	1
36	86 *	69	6	7.6	7	26.1	7	33	10	1
37	84.5 *	77	6	4.6	6.2	21.4	5	41.3	5.8	*
38	81.1 *	76.5	**	**	6.2	*	*	*	*	*
	* Incomplete	* Incomplete	* Incomplete ** Missing	*incomplete ** Absent	* Missing	* Missing	* Missing	* Missing	* Missing	* Not Present

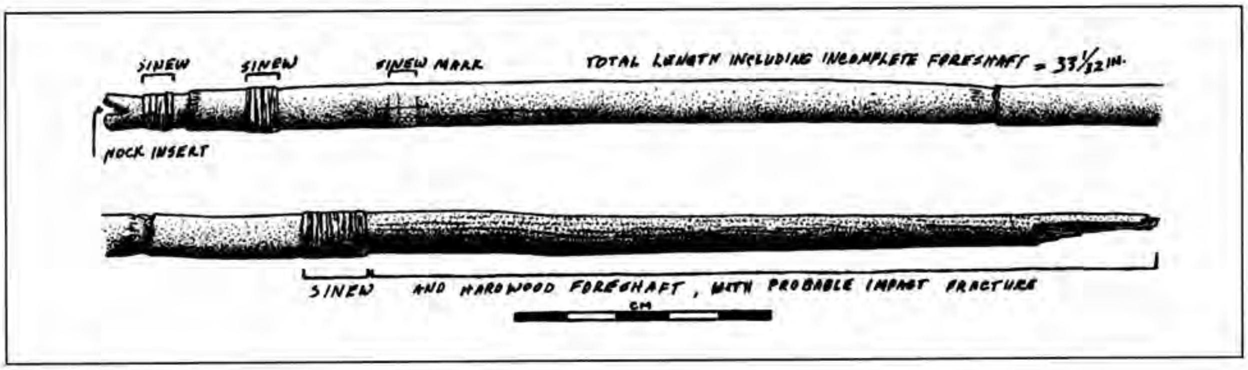
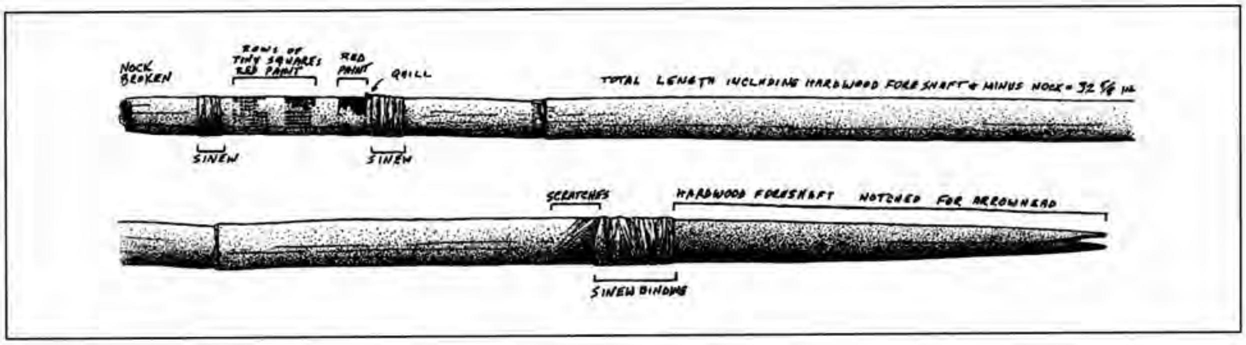


Figure 5.



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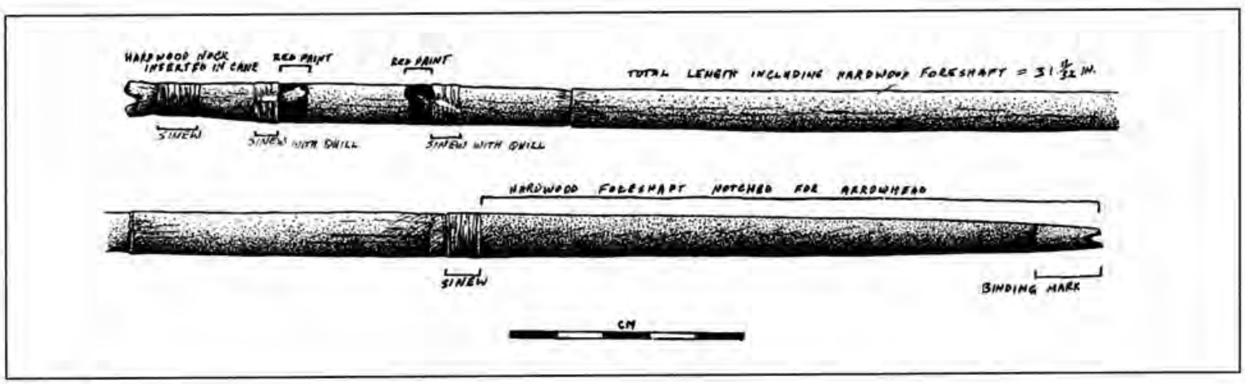

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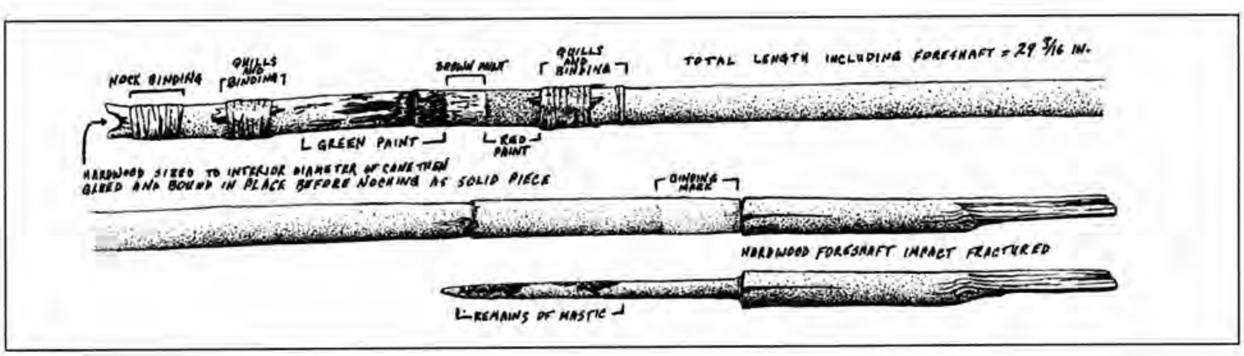


Figure 8.

quill doubled back and under the sinew binding (see Figure 4). Feather lengths do not include the portions of quills stripped of vanes and bound to the arrow shafts.The feathers used for fletching on this group of arrows do not appear to be from a large bird but the species could not be determined.

The lengths of the fletching feathers are surprisingly inconsistent. There are four arrows which have feathers only 2-3 cm long. Eleven others have feathering between 3-4 cm long. Eight have fletching between 4-5 cm. Seven have lengths between 5-6 cm and two have feathers as long as seven centimeters.

NOCK INSERTS

All of the arrows either have or had hardwood inserts in the reed shaftment where the nock is cut. They were apparently fitted as closely as possible to the interior diameter of the cane. In some cases the shaftment was thinned or reamed out near the end, and most reeds exhibit some constriction where the sinew wrapping was applied to hold the insert in place. Figures 10 and 11 are examples that are not constricted. The hardwood was inserted, with the addition of a mastic into the cane as far as the first node, when possible. After the cane and hardwood were united by the mastic and sinew binding, the end was trimmed smooth and the nock was cut. Many nocks show great care was taken in forming them to fit the bow string. On some arrows, it is difficult to determine where cane and hardwood join.

SHAFTMENT DECORATIONS

Painted bands and designs on the back end of arrow shafts possibly represent ownership markings. The designs on some are very intricate and must have been time consuming to apply so they were of some importance to the owner.

Some of the colors are surprisingly bright. There are several shades of red from light to dark. Other common colors are browns, blacks and yellow. Not so common is green and a metallic-like blue that sparkles as the arrow is moved.

Twenty-one of the 38 arrows included in this paper, have paint markings in the shaftment (back end of arrow) area. Eight of the 11 illustrated are decorated with paint. Six of the eight are decorated only between the feather binding points. Details can be seen in the illustrations, as itemized below:

Figure 1 has five black stripes, each 1.5 mm wide near the rear fletch binding sinew.

Figure 2 is a little more elaborate. It has a 9 mm red stripe meeting a 16 mm area composed of multiple parallel rows of tiny black dots. This is followed by a 9 mm black stripe.

Figure 6 has a 6 mm red stripe around the cane next to the forward binding. Following are two bands 5 mm and 7 mm wide, composed of multiple parallel rows of tiny squares less than 1 mm wide of red paint.

Figure 7 has a 6 mm red stripe abutting the forward sinew binding and a 6 mm red stripe next to the rear feather binding.

Figure 8 has a red stripe 11 mm wide at the forward feather binding which joins a 8.5 mm brown stripe. Following is a green paint that is 30 mm wide. It is possible that the green paint originally extended to the rear fletch binding

Figure 9 has seven 1 mm stripes of red paint next to the forward feather binding. Two arrows have paint between the feather binding points and beyond to the nock.

Figure 10 has a black band 11.5 mm wide near the rear feather binding. Outside the fletching area, the nock insert binding is painted black. It is possible that this is an adhesive rather than paint but it appears to be the same as the band in the fletching area.

Figure 11 is the proximal end of a broken arrow shaft which is the most elaborately decorated of the group. It has the longest fletching of the illustrated examples. It is the largest cane and it is not constricted at the nock area. Nine mm of the forward fletch binding is painted red, followed by 24 mm of a sparkling metallic-like blue paint. Next is a 1.5 mm band of blue, separated by 1mm blank spaces.

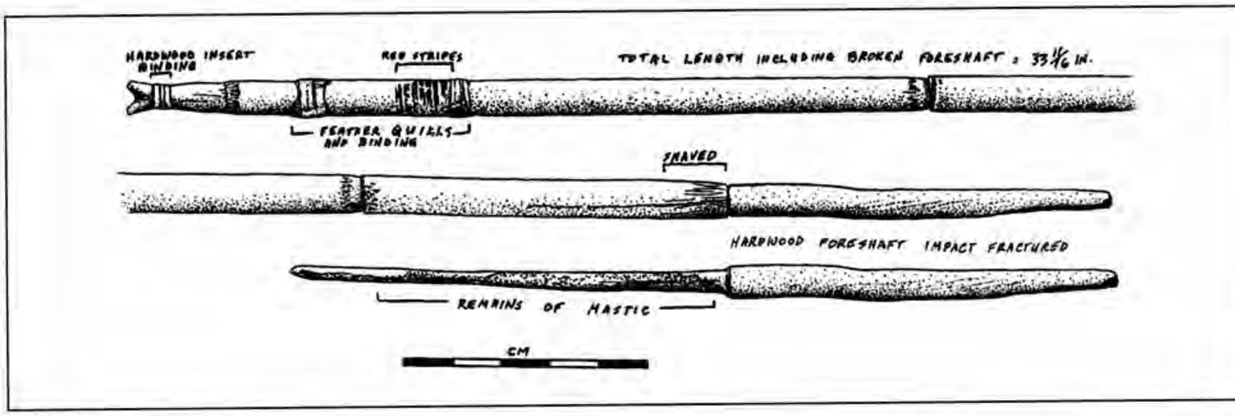


Figure 9.

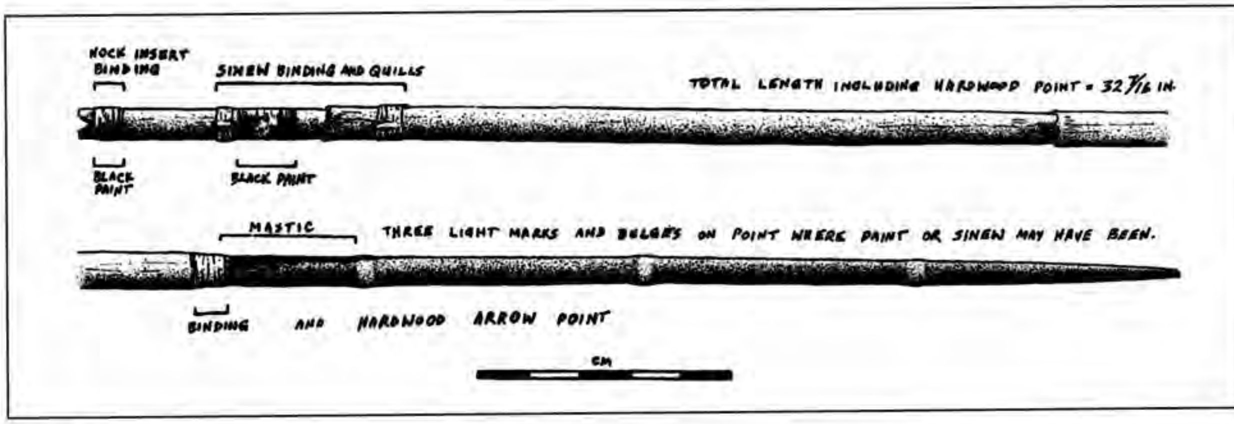


Figure 10.

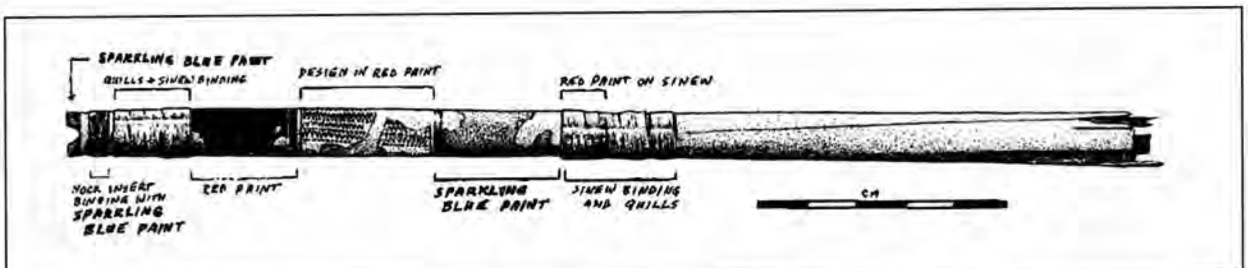


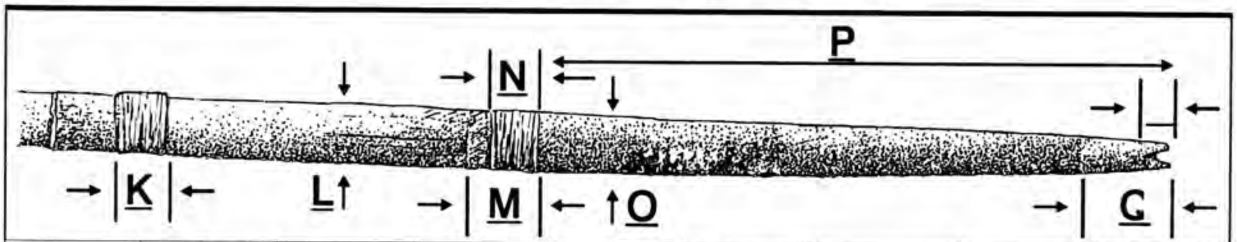
Figure 11.

Following the blank space is a 26 mm band of very fine red zigzag lines, in multiple rows running parallel with the cane. These are followed by a 1.5 mm red band, again separated by narrow blank areas from a 20 mm band of red paint. Most of the sinew fletch binding is unpainted, but the last 4 mm is covered with the blue colored paint. A 2 mm blank space follows the blue binding and the last 3 mm of the nock are also blue.

CLOSING COMMENTS

The concentrated deposit of arrow shafts (only 38 available for documentation) and other wooden artifacts in this small cave near Silver City, New Mexico, is part of a pattern of ceremonial caching that occurred in other areas of New Mexico and the Southwest. For example, Ellis and Hammack (1965) report the Arroyo Grotto, associated with

Table 2. Specifications of Cane Arrow Shafts. Only Shaft No.'s 1-11 are illustrated.



Shaft	No. Of Repair Sinew Bands And Width	Cane Dia. At Foreshaft	Cane Shaved to Forshaft Dia.	Sinew Wrapping Width at Foreshaft	Foreshaft Dia. at Cane & Point	Foreshaft Length	Sinew Wrapping at Foreshaft Point	Debth of Arrowhead Notch
No.	K / mm	L / mm	M / mm	N / mm	O / mm	P / cm	Q / mm	R / mm
1	*	9	17	12	7.4 / 6.3 *	10.4 *	*	*
2	*	11.4	15	8	8.3 / 6.4 *	12.8 *	*	*
3	*	10.7	*	22.5	6.8/4 *	7.12 *	*	*
4	2.3 mm W. 6 mm W. 9.5 mm W.	9	*	19.3	7 / 6.8 *	6.95 *	*	*
5	*	8.8	*	13.5	8 / 6.8 *	15.5 *	*	*
6	*	10	*	17	9.3 / Flat 3.4	9.2	19.4 Sinew Missing	7.4
7	*	9.4	12.5	7.5	8 / Flat 3.5	13.4	14 Sinew Missing	4.5
8	*	8.8	*	*	**8 / *	7.6 *	*	*
9	*	8	*	*	** 6.4 / 5.3 *	7.9 *	*	*
10	*	7	5.8	7	5.7 / 2	18.6	**	**
11	*	*	*	*	—	**	**	*
12	*	8.9	6.5	6.4	8.3 / Flat 5.4	13.4	20.9	3.9
13	*	Oval 7.9 - 9	*	7.5	8.4 / Flat 4	8.9	25	4
14	*	7.8	*	6	7.5 / 6.5 *	15.2 *	9 *	*
15	1/3.5 mm W.	8	*	7	8 / 3.3 *	19.7 *	*	**
16	*	7	*	21.5	7.3 / 4.7 *	12.6 *	*	**
17	*	7.4	*	27	7 / 6 *	4.5 *	*	*
18	*	9.7	20	8	7 / Flat 3.5	9.9	*	6
19	*	8.5	*	28.5	—	**	**	*
20	1 / 9.5 mm W.	7.5	*	5.9	7.5 / 6.2 *	10.8 *	*	*
21	*	10	33	16	6.3 / Flat 4.2	8.5	*	5
22	*	10	33	30	8 ** / 4 *	10.4 *	*	*
23	1 / 9 mm W.	9.4	*	27	7.2 / 5.4	7.5 *	*	*
24	*	8.7	*	12.8	8 ** / 5 *	14.4 *	*	*
25	*	9	*	8	8 / 7 *	9.8 *	*	*
26	*	8	*	6	7.6 / 6.2 *	8.4 *	*	*
27	*	8.5	*	7	8.2 / 5.7	9.8	22.5	4
28	*	9.2	*	29.4	9 / 5 *	12.1 *	*	*
29	3 / 5 mm W. 7 mm W. 16 mm W.	8.3	*	10.5	8.2 / 6.3*	10.9 *	*	*
30	*	8.8	*	19	6.6 / 6.5 *	6.9 *	*	*
31	*	8.2	*	25.4	7.5 / 5.5 *	7.8 *	*	*
32	*	7.6	*	6.5	7 / 6.5 *	9.1 *	*	*
33	*	8.5	*	6.4	8.3 / 7.4 *	8.6 *	*	*
34	*	9	*	8.5	8.6 / Flat 6	10	15	4.7
35	*	9	*	2 Wraps 12 mm ea.	6.5 / 6 *	13 *	*	**
36	*	8.5	*	9.4	8.5 / 5.9 *	15.6 *	*	**
37	*	7.7	*	15	6.8 / 6 *	7.5 *	*	*
38	*	7.9	*	18.2	7 / 5 *	4.8 *	*	*
	* Not Present	* Missing	* Not Present	* Absent	* Incomplete Impact Fracture ** Removable	* Incomplete Impact Fracture ** Missing	* Incomplete Impact Fracture ** Missing	* Absent **Pointed Wood Foreshaft

Feather Cave, in Lincoln County, New Mexico. Great numbers of arrows were cached in the grotto. One had an attached stone point; all of the other reed arrows had long wooden points. Along with the arrow shafts were miniature wooden bows, miniature reed arrows, and crook prayer sticks. Also found was a wooden kick-ball, leading Ellis and Hammack (ibid.) to initially suggest that this deposit, or cache, is related to the ceremonial equipment used for kick-ball racing—designed to produce rain. However, a later formal publication (Ellis and Hammack 1968) interpreted the deposit as relating to a "Sun Father and Earth Mother shrine" dating to Mogollon times.

Hibben (1938) also reported large numbers of wooden bows and arrow shafts in the Middle Gila region of southern New Mexico. Though most of the arrow shafts had been intentionally broken, he estimated that at least 4,000 specimens were present.

Another site with Mogollon-age shrine deposits is Ceremonial Cave in the Hueco Mountains of Texas (Cosgrove 1947). The Jornada Mogollon culture of this region of southern New Mexico and western Texas dates from around A.D. 800-1500.

While the sample reported here from the Silver City area is very likely a part of this caching/shrine pattern, we know too little about the context of the arrow shafts and other materials. We can offer these details on the technology of the arrows, and hope that researchers will find these of interest in future research on such sites.

REFERENCES CITED

Cosgrove, C. B.

1947 *Caves of the Upper Gila and Hueco Areas in New Mexico and Texas.* Papers of the Peabody Museum of Archaeology and Ethnology 24. Harvard University, Cambridge, MA.

Ellis, F. H. and L. Hammack

1965 Shrine of Ancient Warriors. *New Mexico Magazine*, September, pp. 6-8.

1968 The Inner Sanctum of Feather Cave, A Mogollon Sun and Earth Shrine Linking Mexico and the Southwest. *American Antiquity* 33:25-44.

Hibben, F. C.

1938 A Cache of Wooden Bows from the Mogollon Mountains. *American Antiquity* 4:36-38.

Plant Communities of the South Texas Plains:
Early Post-Settlement Conditions

Frederick H. Wills

ABSTRACT

This study used historic land survey records (field notes) to determine the nature of mid-19th century non-riparian plant communities of an area in the northeastern Rio Grande Plain of Texas. Two hypotheses about the vegetation were tested; one proposed that stands of trees at some density were present in ≥ 50 percent of the landscape, while the other asserted that > 50 percent of the landscape was grass-dominated. Neither hypothesis could be rejected. Six species of trees were present in the study area; trees occurred at 69.6 percent of all localities. Honey mesquite (*Prosopis glandulosa* Torr.) was the most abundant species (60.3% of observed individuals). In decreasing order, grassland, savanna, woodland, forest, and single trees were the vegetative categories capable of being discerned using the cadastral data. There was no information found in the survey notes bearing on the composition or abundance of shrubland. Ecological sites were variable in terms of species composition and plant community representation. Some sites or site groups had only mesquite; others were characterized by live oak (*Quercus fusiformis* Small) or post (*Quercus stellata* Wang.) and blackjack (*Quercus marilandica* Muenchh.) oaks. Tree density varied from 3.2 to 418.2 per ha. Blackland, Low Stony Hill, and Clay (site group) were apparently grass-dominated (savanna and grassland significantly > woodland and forest). Sand (site group) was > 50 percent wooded historically, and might have had more woodland than previously believed. The Ridge site group was probably shrubland in the past.

INTRODUCTION

The South Texas Plains (STP) constitute one of the 10 vegetation areas of Texas (Hatch et al. 1990) and the third largest natural region in the state, comprising ca. 8,500,000 ha. The STP, also known as the Rio Grande Plain, is bounded by the Rio Grande, San Antonio River, Edwards Plateau, and Gulf Coastal Zone. Land use in this semiarid subtropical area is predominantly (89%) rangeland, with some irrigated farming. The native vegetation of the STP is a diverse mix of shrublands, woodlands, and grasslands (Davis and Spicer 1965; McMahan et al. 1984; McLendon 1991). The majority of the STP now has a woody canopy cover of > 50 percent and only 40 percent of the region has ≤ 50 percent woody canopy (Hanselka and Archer 1998).

Woody plants, especially honey mesquite (*Prosopis glandulosa* Torr.), have apparently increased in density since European settlement due to heavy range use (Bogusch 1952; Johnston 1963; Archer 1989; Scifres and Hamilton 1993; Fulbright 2001). Sheep and cattle were the primary types of livestock contributing to an increase in shrubs and trees and a loss of carrying capacity (Lehmann 1969). However, the extent of this presumptive conversion of grassland to shrubland or woodland is not well known.

The northeastern part of the STP was traversed by a number of Spanish and Mexican explorers from the late 17th century to the early 19th century. Most relevant to an understanding of pre-agricultural vegetation conditions in the study area are the observations of Spanish expeditions between 1691 and 1722, including those of Teran de los Rios, Espinosa-Olivares-Aguirre, Ramon, and Aguayo (Inglis 1964; Foster 1995). They found a remarkable variety of plant communities in what is now southwestern Bexar and eastern Medina counties, namely grassy plains with few or no trees and shrubs, oak savanna, oak forest, and open stands of mesquite diversified with clumps (mottes) of oak. Mesquite was found both as scattered plants and as mottes (Inglis 1964).

Following an extensive review of these early written records, Inglis (1964) surmised that ≥ 50 percent of the uplands in the portion of the STP west of San Antonio had stands of mesquite and/or oak (*Quercus* L.) at some density during the Spanish exploration and settlement period (1675-1821). Settlement of San Antonio in 1718 marked the beginning of intensive (but rather localized) livestock grazing in the northeastern STP. In the middle of the 19th century, thin to moderate stands of brush were found on most of the uplands of southern Texas. However, the increase in density between the early 1700s and the mid-1800s was apparently slight, compared to that from about 1850 to 1900 (Inglis 1964; but see Berlandier 1980 for an example of vegetation change in the Rio Grande Valley of southern Texas prior to 1834). The anecdotal evidence provided by Lanier (1945) suggests that the increase in brushy cover near San Antonio began in earnest ca. 1842-1847. This chronology is supported by his statement that the majority of mesquite plants were 4-5 ft tall in 1872. Scifres et al. (1971) indicate that 27 year old mesquites are no taller than 4.9 ft [1.5 m].

According to Johnston (1963), these vegetation "changes [had] not been from mesquite-free prairie to brush, but from mesquite prairie to mesquite brush" (p. 464). Johnston asserted that such changes involved increases in stature and density of mesquite plants, rather than invasion of grassland areas previously lacking mesquite. Over time, mesquite trees served as nurse plants fostering the development of larger and increasingly diverse clusters of woody species that eventually coalesced to form continuous canopy woodland in some areas (Archer 1989).

Land survey data collected by Texas General Land Office (TXGLO) surveyors are available for the study area, covering a 20-year period from 1838 to 1857. These data provide a good source of information on the composition and structure of plant communities at the time of the surveys. Witness trees (bearing trees) called for by surveyors locating survey corners are reported in their field notes by common name, typically accompanied by the diameter, direction, and distance of each tree from the corner stake. Though the data are generally more limited than those in the U.S. Public Land (General Land Office) Survey performed in other western states (Galatowitsch 1990), they are quantitative and amenable to statistical analysis. Relatively few studies have used TXGLO data to answer questions concerning the nature of historical landscapes in Texas (Schafale and Harcombe 1983; Weniger 1984, 1988; Jurney et al. 2004; Wills 2005, 2006).

This paper describes the composition and structure of early vegetation in part of the South Texas Plains, based on the TXGLO survey data. In addition to presenting the descriptive data on tree cover and its distribution in ecological sites, two hypotheses were tested in this study. The first is that ≥ 50 percent of non-riparian sites (primarily uplands) in the study area were originally occupied by stands of mesquite and/or oak at some density (savanna, woodland, or forest) (Inglis 1964). The second is that most (> 50%) of the study area was open (grassland, single trees, or savanna) 100-200 years ago (Archer 1989).

STUDY AREA

The study area comprises 78,823 ha of the northern Rio Grande Plain west of San Antonio in southwestern Bexar and east-central Medina counties (lat 29°20'N, long 98°45'W). It is roughly bisected by the lower Medina River, between the gaging station below Diversion Dam and the river's confluence with Leon Creek. Thus, the study site includes land on both sides of the river, often > 8 km from its channel (Figure 1). Elevations range from 160 to 300 m. Mean annual precipitation is 73 cm. Mean minimum January temperature is 3.9°C. Mean maximum July temperature is 35.8°C.

Ecological sites occurring within the study area include Adobe, Blackland, Chalky Ridge, Clay Flat, Clay Loam, Clayey Bottomland, Claypan Prairie, Deep Sand, Gravelly Ridge, High Lime, Lakebed, Loamy Bottomland, Loamy Sand, Low Stony Hill, Redland, Sandy Loam, Shallow, Shallow Ridge, and Tight Sandy Loam. Climax vegetation of Adobe, Loamy Sand, Low Stony Hill, and Redland sites is oak (oak-hickory in Loamy Sand) savanna with 10–20 percent woody biomass. The climax of Blackland, Clay Flat,

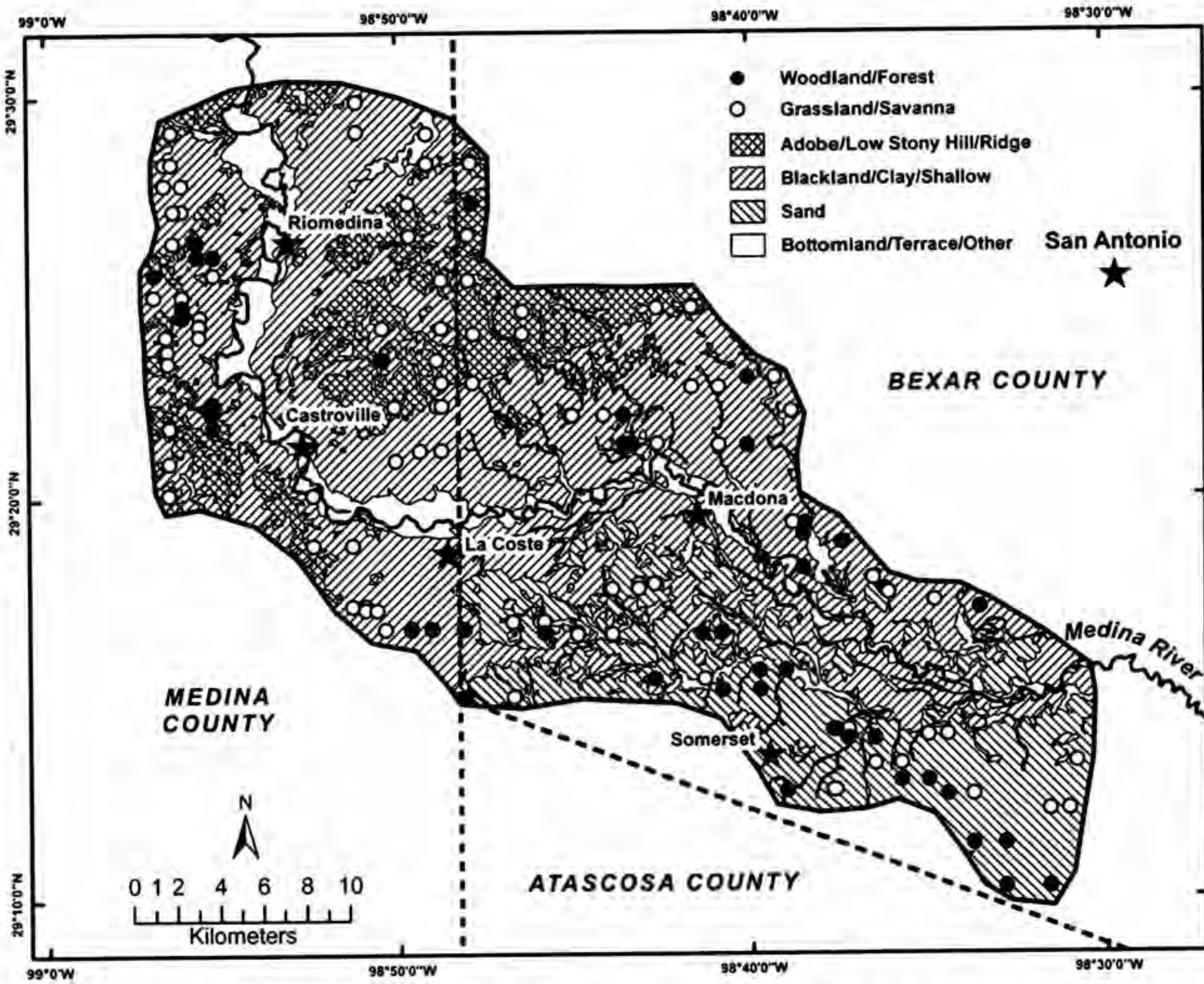


Figure 1. Distribution of generalized non-riparian plant communities in combined ecological sites of the study area.

Clay Loam, Claypan Prairie, Deep Sand, Lakebed, Sandy Loam, and Tight Sandy Loam is grassland with 0–5 percent woody biomass. That of Chalky Ridge, Gravelly Ridge, High Lime, Shallow, and Shallow Ridge sites is shrubby grassland with 5–25 percent woody biomass. Clayey Bottomland and Loamy Bottomland sites lacking typical riparian vegetation have climax vegetation characterized by large live oak (*Quercus fusiformis* Small), cedar elm (*Ulmus crassifolia* Nutt.), hackberry (*Celtis* L.) and other trees, and 20–25 percent woody biomass (Dittmar et al. 1977; Taylor et al. 1991; NRCS 2005a, 2005b).

Most (54.4%) of the study area is cultivated land or tame pasture and some (2.6%) is urbanized (USGS 2004). Native vegetation persists in the hilly portions north, east and west of the Medina River, and on much of the sandy lands south of the Medina River. Grassland (3.7%), shrubland (17.8%), and forest (20.0%) are present in these areas. Minor cover types include barren (< 1%), open water (< 1%), and herbaceous wetlands (< 1%). Except in areas mined for gravel, bottomland hardwood forest along the river is largely intact (USGS 1985).

METHODOLOGY

Bourdo (1956), Jones and Patton (1966), Schafale and Harcombe (1983), and Whitney and DeCant (2001) discuss the use of witness tree information in reconstructing historic vegetation patterns. Witness tree data were obtained from field notes of 70 original land surveys of the study area conducted during the years 1838–1857. These survey reports are held in the Archives and Records Division, General Land Office of Texas, 1700 N Congress Avenue, Austin, TX 78701 and a list is available from the author.

Data collected included survey number, year, tree species, tree diameter, bearing of tree from survey corner, and distance of tree from survey corner. Most surveys having shared corners agreed with respect to presence/absence of trees, tree species, diameters, bearings, and distances at a given corner. In the few cases where any of these data differed, information from the oldest survey was given priority. Abbreviations for tree species, as used by surveyors, were interpreted as follows: L.O. = live oak and P.O. = post oak (*Quercus stellata* Wang.). Other species included blackjack [oak] (*Quercus marilandica* Muenchh.), [honey] mesquite, [black] hickory (*Carya texana* Buckl.), and hackberry (*Celtis* sp.) (Hatch et al. 1990).

Diameters, recorded in whole inches, were converted to meters by multiplying by 0.0254. Distances, recorded by surveyors in fractional varas, were converted to meters by multiplying by 0.84667 (Reasonover 1946), and the tree radius (in meters) was added to the converted distance. The Texas General Land Office apparently did not specify how far surveyors should go from a survey corner to record witness (bearing) trees. Maximum tree distance reported for the study area was 222.7 m. Most survey corners with reported trees had two witness trees, but a few indicated one or three. Only those with two or three witness trees could be used in computing mean tree distance at a corner. Corners with a single tree were assigned to a separate category, essentially intermediate between open grassland and savanna. Corners with no reported trees were scored as open grassland. One hundred and thirty-eight corners were included in the analyses. Weniger's (1988) distance criteria were adopted to determine if a given survey corner (point) represented savanna (> 21 m), woodland (7–21 m), or forest (< 7 m). Trees per hectare were calculated according to the following formula: $10,000/d^2$ where d is the mean tree distance in meters (Smeins and Slack 1982).

Using ArcView 9.02 GIS, digital Texas General Land Office original Texas land survey (OTLS) maps provided by the Railroad Commission of Texas (RRC 2000; see also TXGLO 1862, 1878; Boggs and Giles 1932; Molina and Kilpatrick 1976) were superimposed on a digital ecological site map (NRCS 2006) to provide a basis for locating survey corners and their witness trees within ecological site types on the study area. This facilitated identifying potential differences in vegetation patterns among site types. Some ecological sites were combined into larger groups if they had similar climax (potential) vegetation and/or similar topographic positions (Dittmar et al. 1977; Taylor et al. 1991). Specifically, the following sites were combined into site groups: Chalky Ridge, Gravelly Ridge, and Shallow Ridge were combined into the Ridge site group. Clay Flat, Clay Loam, and Claypan Prairie were combined into the Clay site group. Deep Sand, Loamy Sand, Sandy Loam, and Tight Sandy Loam were combined into the Sand site group. This process reduced the number of sites or site groups from 19 to 12. In addition, two sites (Lakebed and Redland) were excluded from further consideration as they collectively comprised well under 1 percent of the study area and no survey points fell within them. This further reduced the number of sites and site groups to 10.

Two hypotheses concerning the early South Texas Plains landscape were tested using *z* scores. Comparisons of ecological sites/site groups with respect to amount of wooded vs. grass-dominated cover types within them were made using the same statistic.

RESULTS

Six species of witness trees were recorded by surveyors in non-riparian portions of the study area (Table 1). These included 3 species of oaks, mesquite, hackberry and black hickory. Mesquite was the most abundant species (60.3% of the trees in the sample). Live oak was common (23.4%), post oak (8.2%) and blackjack oak (6.0%) were uncommon, and hackberry (1.6%) and black hickory (0.5%) were rare. Live oak was the largest species, post oak was intermediate in size, and blackjack oak, mesquite, and hackberry were the smallest species. The single black hickory was smaller than the mean diameter of each of the other species. Post oak and live oak exhibited the largest ranges in size.

Trees occurred at 96 of 138 points (69.6% of sample points). Stands of mesquite and/or oak

Table 1. Non-riparian Witness Trees of the Lower Medina River Area, 1838-1857. Importance value (I.V.) is the sum of relative frequency and relative density.

Species	*n* trees	*n* dbh[1]	Range dbh[1] (cm)	Mean dbh[1] (cm)	Abs. Freq.	Rel. Freq.	Rel. Dens.	I.V.
Carya texana	1	1	20.3	–	1.0	0.9	0.5	1.4
Celtis sp.	3	3	10.2-30.5	21.2	3.1	2.7	1.6	4.3
Prosopis glandulosa	111	75	7.6-50.8	23.3	67.7	58.6	60.3	118.9
Quercus marilandica	11	10	15.2-30.5	23.9	7.3	6.3	6.0	12.3
Quercus stellata	15	15	7.6-76.2	33.2	10.4	9.0	8.2	17.2
Quercus fusiformis	43	22	10.2-76.2	40.9	26.0	22.5	23.4	45.9
Totals	184	126	–	–	115.5	100.0	100.0	200.0

[1]dbh = diameter at breast height.

occurred at 82 points (59.4% of sample points). A test of this proportion indicates that it is significantly greater than 50 percent ($z = 2.21$, $P < 0.02$), and the Inglis (1964) hypothesis ($\geq 50\%$ of the landscape with stands of these trees) cannot be rejected. These data show that trees were common in the study area, but do not have any bearing on the density of the stands.

In order of decreasing abundance, grassland, savanna, woodland, forest and single trees were found on the study area (Table 2). Grassland and savanna accounted for 58.7% of the total landscape. The savanna was quite low in overall tree density. Woodland was almost as common as savanna, but forest and single tree points were uncommon. Woodland and forest were most common in the Sand ecological site group (30.6% of all woodland points, 72.7% of all forest points). Grass-dominated communities (grassland, savanna, and other [single trees]) occurred at 91 points (65.9%), while wooded communities (woodland and forest) were found at 47 points (34.1%). A test of the grass-dominated proportion indicates that it is significantly greater than 50 percent ($z = 3.74$, $P < 0.0001$), and the Archer (1989) hypothesis ($> 50\%$ open landscape) cannot be rejected. These data demonstrate that, overall, tree density in the STP landscape was rather low. Mottes appeared to be rare, with only one savanna point indicative of a tree cluster.

Distribution of tree species within ecological sites/site groups is shown in Table 3. Mesquite was present in 8 of the 10 sites, and live oak was present in 7 of them. Where it occurred with other species, mesquite was often dominant (Blackland and Sand). Live oak was dominant over mesquite in the Ridge site group (mesquite known to be present there only in Gravelly Ridge), and it was the most common species in the Shallow site. Adobe and Low Stony Hill had only live oak. Clay, High Lime, and Loamy Bottomland had only mesquite. Collectively, 88.5% of all post and blackjack oaks occurred in the Sand group, as did the single black hickory. Within the Sand group, all blackjack oak (plus the hackberry and black hickory) were restricted to Deep Sand, all post oak and mesquite were restricted to Loamy Sand and Tight Sandy Loam, and all live oak were restricted to Loamy Sand.

Ecological sites and site groups appeared to vary with respect to the amount of grass-dominated versus wooded landscapes within them (Table 4). Adobe, Blackland, Clay, Low Stony Hill, Ridge, and Shallow had more grass-dominated points. Clayey Bottomland and Sand had more wooded points. No trends could be discerned for High Lime and Loamy Bottomland. Tests for significance of the proportions indicate that an open landscape was clearly dominant in Blackland ($z = 2.88$, $P < 0.01$), Clay ($z = 2.48$, $P < 0.01$), and

Table 2. Abundance and Tree Density of Non-riparian Plant Communities of the Lower Medina River Area, 1838-1857.

Community	*n*	Percent	Mean Distance (m) (range)	Mean Distance (m) (grand mean)	Mean Density (trees/ha)
Grassland	42	30.43	–	–	–
Savanna	39	28.26	21.2-192.4	55.6	3.2
Woodland	36	26.09	8.0-20.3	13.9	51.8
Forest	11	7.97	1.0-6.9	4.9	418.2
Other[1]	10	7.25	–	–	–
Totals	138	100.00	–	–	–

[1]single trees.

Table 3. Occurrence of Tree Species in Non-riparian Ecological Sites/site Groups of the Lower Medina River Area, 1838-1857.

Sites: A = Adobe, B = Blackland, C = Clay, CB = Clayey Bottomland, HL = High Lime, LB = Loamy Bottomland, LS = Low Stony Hill, R = Ridge, Sa = Sand, and Sh = Shallow.

Species	A	B	C	CB	HL	LB	LS	R	Sa	Sh
Carya texana									1	
Celtis sp.		2							1	
Prosopis glandulosa		32	44	2	2	3		2	23	3
Quercus marilandica									10	1
Quercus stellata				2					13	
Quercus fusiformis	2	10		2			15	7	3	4

Low Stony Hill (z=2.11, $P < 0.02$) ecological sites/site groups. These 3 landscape types account for 57.0 percent of the study area.

DISCUSSION

Investigations of historic vegetation conditions in the South Texas Plains have typically relied on written records, especially travel journals from the Spanish exploration and settlement period. Such qualitative records are relatively abundant, but users of these historical accounts will encounter problems related to nomenclature, location, and interpretation (Edmonds 2001). This paper is apparently the first to provide a quantitative examination of the STP landscape using data from TXGLO surveys.

Based on the data presented here, the northern South Texas Plains within the study area were dominated by open plant communities (grassland and savanna). However, the nature of the cadastral data allows few, if any, definitive statements to be made

Table 4. Occurrence of Non-riparian Plant Communities in Ecological Sites/site Groups of the Lower Medina River Area, 1838-1857.

Site (% of study area)	Forest	Woodland	Savanna	Grassland	Single Tree
Adobe (1.9)			1	1	
Blackland (18.4)		9	13	13	
Clay (32.2)	2	7	11	8	4
Clayey Bottomland (1.3)		2	1		
High Lime (3.5)			1		
Loamy Bottomland (6.8)		1			1
Low Stony Hill (6.4)		2	5	4	
Ridge (4.9)	1	2		3	2
Sand (20.1)	8	11	5	9	3
Shallow (4.0)		2	2	4	
Others (< 1.0)					
Totals	11	36	39	42	10

concerning the historical distribution and density of shrubby cover. Woody plants of all sizes apparently accounted for ≤ 25 percent of the climax biomass (Dittmar et al. 1977), and the assumption is made herein that grassland and other plant communities often had a shrubby component that varied in prominence. This limitation must be kept in mind when interpreting the data. It follows that some points reported here as grassland might have been shrubland. Any assertion of this kind should be tempered with the knowledge that hot summer burns swept the area with a return interval of 7–12 yr (Frost 1998; Taylor 2002). These fires must have rather effectively suppressed shrubby as well as arborescent vegetation, with two apparent exceptions. The first is that gravelly ridges in the STP have always been shrubland ("chaparral" of Tharp 1939). Any changes in the density of shrubs in ridge communities are likely to have been relatively minor, although the species composition might have changed in favor of less palatable plants. Secondly, the higher tree density of the Sand site group (52.8% woodland and forest) suggests that it did not fit the pattern for the remainder of the region. Edaphic conditions promoting growth of moderately fire-resistant post oak and blackjack oak (McBryde 1933; Brown and Davis 1973) must be a determining factor, and the site group might have had lower fine fuel loads leading to less fire damage to tree stems. This sandy portion of the study area is variously considered part of the South Texas Plains or a southwestern extension of the Post Oak Savannah.

The STP exhibits a historic landscape pattern much different from the nearby Edwards Plateau in Bexar County (Wills 2006). Wooded and grass-dominated landscapes were essentially equally abundant in the latter, and woodland was the most common community type. In contrast, grassland and savanna (assuming here that grassland is not just misinterpreted shrubland) were both more common than woodland in the STP. This pattern is not unlike that of another, more distant Edwards Plateau site (Kerr Wildlife Management Area) (Wills 2005) having relatively little relief and dominated by grassland.

General Land Office survey data do have their own limitations (Whitney and DeCant 2001). While the distribution of survey points over the landscape is fairly random, some regions, including the study area, may have survey tract geometries that result in relatively few points in some portions. Another potential problem is the accuracy of location of the survey corners (points) in relation to standard map datums. The TXGLO surveys were made using methods much less accurate than those currently employed by surveyors and cartographers. Their "datum" was the county courthouse. Thus there is an unknown amount of error involved in mapping the original surveys (RRC 2000). While the errors involved might be relatively small, they could easily be large enough to place a given survey corner within the wrong ecological site. Such placement will affect the interpretation of tree distribution and community distribution within ecological sites.

The amount of error in the surveys was briefly investigated by comparing the linear features (E–W fence lines presumed to be on actual survey lines) on DOQs along the Medina River between Diversion Dam and Rio Medina (town) with the digital survey lines. Offsets ranged from ca. 16–46 m with a mean of 35 m ($n = 9$). The accuracy in the other dimension was not examined, but might be considerably lower due to the greater distances involved in laying out long-lot survey lines perpendicular to the river's general course.

Some surveyor bias in selection of witness trees in terms of size is probably inevitable. This is suggested by the12-inch class being the mode for both mesquite and live oak (live oak is bimodal: 12 and 20 inches). However, the wide range of sizes reported (3-20 inches for mesquite; 4-30 inches for live oak) suggests that the biases were not too strong. While the sample of witness trees may not have been completely random, it undoubtedly was a fair representation of the stand of trees existing then (Whitney and DeCant 2001).

The problem of quantifying any change that occurred prior to the TXGLO surveys remains. While there are maps of the region that illustrate vegetation at various times during the Spanish and Mexican periods from ca. 1719 to 1829 (McGraw et al. 1991; De la Teja 1995), they are few and their interpretation and comparison are fraught with difficulties that may be insurmountable. Differences in scale (where known) and idiosyncrasies in symbolization are primary issues. It is suggested that these sources may help to clarify certain generalities (e.g., mesquite was present when San Antonio was founded; open landscape was common; trees were more abundant in hilly sites and along streams) that are found in exploration and pioneer accounts of the landscape. Some maps suggest that mottes may not have been rare. Resolution of this conflict with the survey data might be difficult as only two trees are normally reported at a point. If mottes were present in reasonable proximity to the survey corner, the surveyor might have reported one tree from each of two mottes. In that case, no evidence of mottes would appear.

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REFERENCES CITED

Archer, S.
1989 Have Southern Texas Savannas Been Converted to Woodlands in Recent History? *American Naturalist* 134(4):545-561.

Berlandier, J. L.
1980 *Journey to Mexico During the Years 1826 to 1834.* Texas State Historical Association. Austin.

Boggs, W. K. and J. B. Giles
1932 *Bexar County Sheet.* Texas General Land Office, Austin.

Bogusch, E. R.
1952 Brush Invasion in the Rio Grande Plain of Texas. *Texas Journal of Science* 4(1):85-91.

Bourdo, E. A.
1956 A Review of the General Land Office Survey and of its Use in Quantitative Studies of Former Forests. *Ecology* 37(4):754-768.

Brown, A. A. and K. P. Davis
1973 *Forest Fire Control and Use.* 2nd Edition. McGraw-Hill, New York.

Davis, R. B. and R. L. Spicer
1965 *Status of the Practice of Brush Control in the Rio Grande Plain.* Bulletin 46. Texas Parks and Wildlife Department, Austin.

De la Teja, J. F.
1995 *San Antonio de Bexar: a Community on New Spain's Northern Frontier*. University of New Mexico Press, Albuquerque.

Dittmar, G. W., M. L. Deike, and D. L. Richmond
1977 *Soil Survey of Medina County, Texas*. Government Printing Office, Washington, D.C.

Edmonds, M.
2001 The Pleasures and Pitfalls of Written Records. In *The Historical Ecology Handbook*, edited by D. Egan and E. A. Howell, pp. 73-99. Island Press, Washington, D.C.

Foster, W. C.
1995 *Spanish Expeditions into Texas, 1689-1768*. The University of Texas Press, Austin.

Frost, C. C.
1998 Presettlement Fire Frequency Regimes of the United States: A First Approximation. In *Proceedings of the 20th Tall Timbers Fire Ecology Conference*, edited by T.L. Pruden and L. A. Brennan, pp. 70-81. Tall Timbers Research Station, Tallahassee, Florida.

Fulbright, T. E.
2001 Human-induced Vegetation Changes in the Tamaulipan Scrub of La Frontera. In *Changing Plant Life of La Frontera: Observations on Vegetation in the United States/Mexico Borderlands*, edited by G. L. Webster and C. J. Bahre, pp. 166-175. University of New Mexico Press, Albuquerque.

Galatowitsch, S. M.
1990 Using the Original Land Survey Notes to Reconstruct Presettlement Landscapes in the American West. *Great Basin Naturalist* 50(2):181-191.

Hanselka, C. W. and S. Archer
1998 Rangeland Ecosystems of South Texas: The Keys to Sustainability. In *Proceedings of the Mexico-U. S. Workshop on Management of Grazing Land in Northern Mexico and South Texas*, edited by W. Hamilton, M. Lee, and A. Molina, pp. 1-11. Texas Agricultural Experiment Station, Texas A&M University, College Station.

Hatch, S. L., K. N. Gandhi, and L. E. Brown
1990 *Checklist of the Vascular Plants of Texas*. Miscellaneous Publication 1655. Texas Agricultural Experiment Station, Texas A&M University, College Station.

Inglis, J. M.
1964 *A History of Vegetation on the Rio Grande Plain*. Bulletin 45. Texas Parks and Wildlife Department, Austin.

Johnston, M. C.
1963 Past and Present Grasslands of Southern Texas and Northeastern Mexico. *Ecology* 44(3):456-466.

Jones, A. S. and E. G. Patton
1966 Forest, "Prairie," and Soils in the Black Belt of Sumter County, Alabama, in 1832. *Ecology* 47(1):75-80.

Jurney, D., R. Evans, J. Ippolito, and V. Bergstrom
2004 The Role of Wildland Fire in Portions of Southeastern North America. In *Proceedings of the 22nd Tall Timbers Fire Ecology Conference*, edited by R.T. Engstrom, K. E. M. Galley, and W. J. de Groot, p. 95-116. Tall Timbers Research Station, Tallahasseee, Florida.

Lanier, S.
1945 *Florida and Miscellaneous Prose*. Johns Hopkins University Press, Baltimore, Maryland.

Lehmann, V. W.
1969 *Forgotten Legions: Sheep in the Rio Grande Plain of Texas*. Texas Western Press, El Paso.

McBryde, J. B.
1933 The Vegetation and Habitat Factors of the Carrizo Sands. *Ecological Monographs* 3:249-297.

McGraw, A. J., J. W. Clark, Jr., and E. A. Robbins (editors)
1991 *A Texas Legacy: The Old San Antonio Road and the Caminos Reales—A Tricentennial History, 1691-1991*. Texas Department of Transportation, Austin.

McLendon, T.
1991 Preliminary Description of the Vegetation of South Texas Exclusive of Coastal Saline Zones. *Texas Journal of Science* 43(1):13-32.

McMahan, C. A., R. G. Frye, and K. L. Brown
1984 *The Vegetation Types of Texas, Including Cropland*. Bulletin 7000-120. Texas Parks and Wildlife Department, Austin.

Molina, R. V. and J. Kilpatrick
1976 *Medina County Sheet*. Texas General Land Office, Austin.

NRCS
2005a *Rangeland Productivity and Plant Composition: Bexar County, Texas*. Natural Resources Conservation Service, U.S. Department of Agriculture, Washington, D.C.

2005b *Rangeland Productivity and Plant Composition: Medina County, Texas*. Natural Resources Conservation Service, U.S. Department of Agriculture, Washington, D.C.

2006 Ecological Site Map, *http://datagateway.nrcs.usda.gov* [Accessed 1 April 2006].

Reasonover, J. R.
1946 *Land Measures: French, Spanish and English Land Measures of the United States and Canada, With Units, English Equivalents, Reduction and Conversion Factors*. Privately printed, Houston.

RRC
2000 *User's Guide: Digital Map Information*. Publication OGA094. Information Technology Services Division, Railroad Commission of Texas, Austin.

Schafale, M. P. and P. A. Harcombe
1983 Presettlement Vegetation of Hardin County, Texas. *American Midland Naturalist* 109(2):355-366.

Scifres, C. J., J. H. Brock, and R. R. Hahn
1971 Influence of Secondary Succession on Honey Mesquite Invasion in North Texas. *Journal of Range Management* 24(3):206-209.

Scifres, C. J. and W. T. Hamilton.
1993 *Prescribed Burning for Brushland Management: The South Texas Example*. Texas A&M University Press, College Station.

Smeins, F. E. and R. D. Slack
1982 *Fundamentals of Ecology Laboratory Manual*. 2nd Edition. Kendall/Hunt Publishing Company, Dubuque, Iowa.

Taylor, C.
2002 What Was the Fire Frequency Just Before European Settlement? *Grass Roots* 53(2):4.

Taylor, F. B., R. B. Hailey, and D. L. Richmond
1991 *Soil Survey of Bexar County, Texas*. Government Printing Office, Washington, D.C.

Tharp, B. C.
1939 *The Vegetation of Texas*. Anson Jones Press, Houston.

TXGLO
1862 *[Map of] Medina County*. Texas General Land Office, Austin.

1878 *Map of Bexar County*. Texas General Land Office, Austin.

USGS
1985 *San Antonio, Texas Sheet*. U.S. Geological Survey, Reston, Virginia.

2004 National Land Cover Database, *http://seamless.usgs.gov* [Accessed 1 April 2006].

Weniger, D.
1984 *The Explorers' Texas: The Lands and Waters*. Eakin Press, Austin.

1988 Vegetation Before 1860. In *Edwards Plateau Vegetation: Plant Ecological Studies in Central Texas*, edited by B. B. Amos and F. R. Gehlbach, p. 17-23. Baylor University Press, Waco.

Wills, F. H.
2005 Structure of Historic Vegetation on Kerr Wildlife Management Area, Kerr County, Texas. *Texas Journal of Science* 57(2):137-152.

2006 Historic Vegetation of Camp Bullis and Camp Stanley, Southeastern Edwards Plateau, Texas. *Texas Journal of Science* 58(3):219-230.