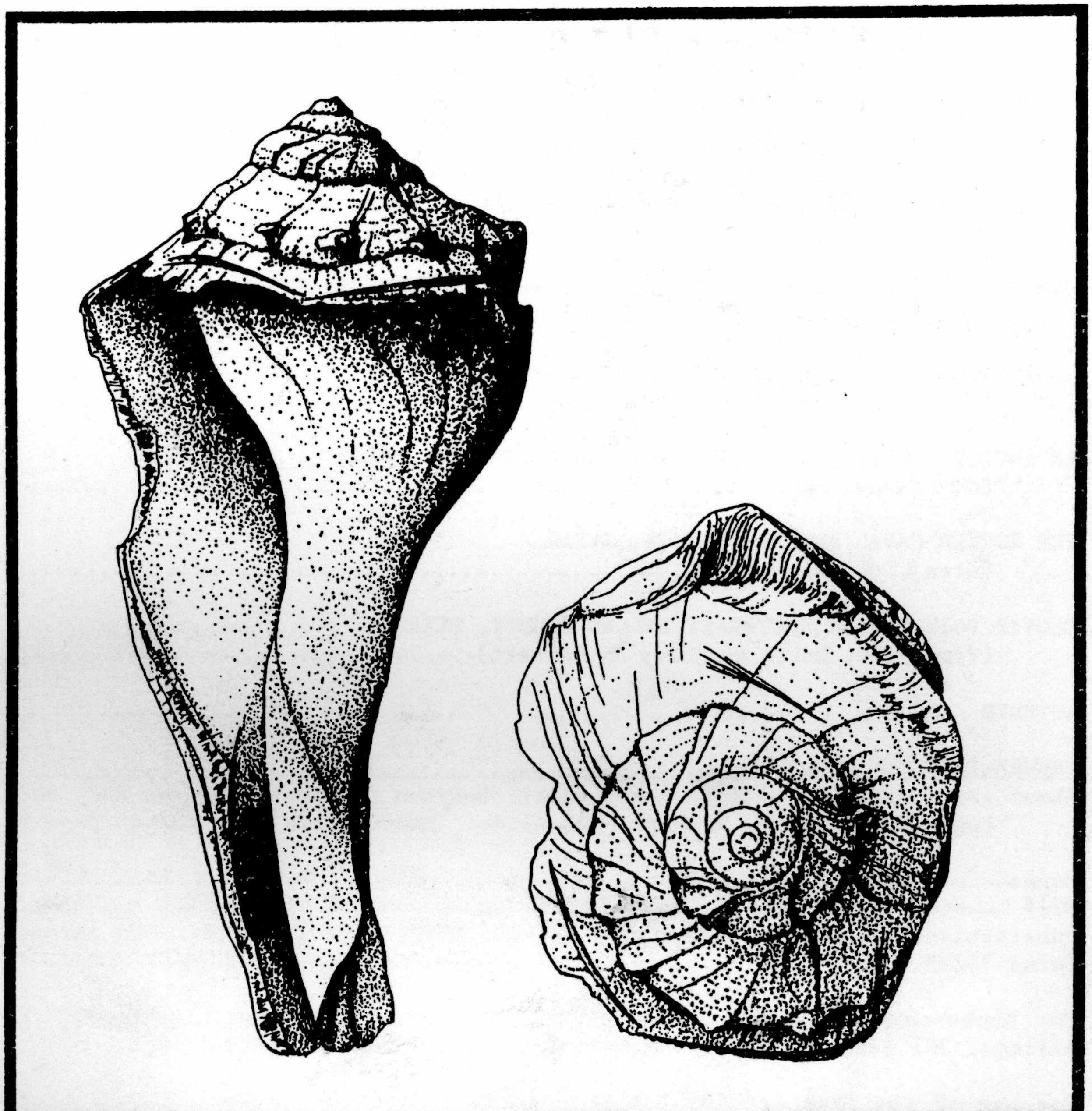
LA TIERRA



JOURNAL OF THE SOUTHERN TEXAS ARCHAEOLOGICAL ASSOCIATION

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LA TIERRA

QUARTERLY JOURNAL OF THE SOUTHERN TEXAS ARCHAEOLOGICAL ASSOCIATION

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January, 1991

About the Cover: A modified conch shell, *Busycon contrarium*, outer body whorl removed. Drawn by Richard McReynolds. See article starting on page 8.

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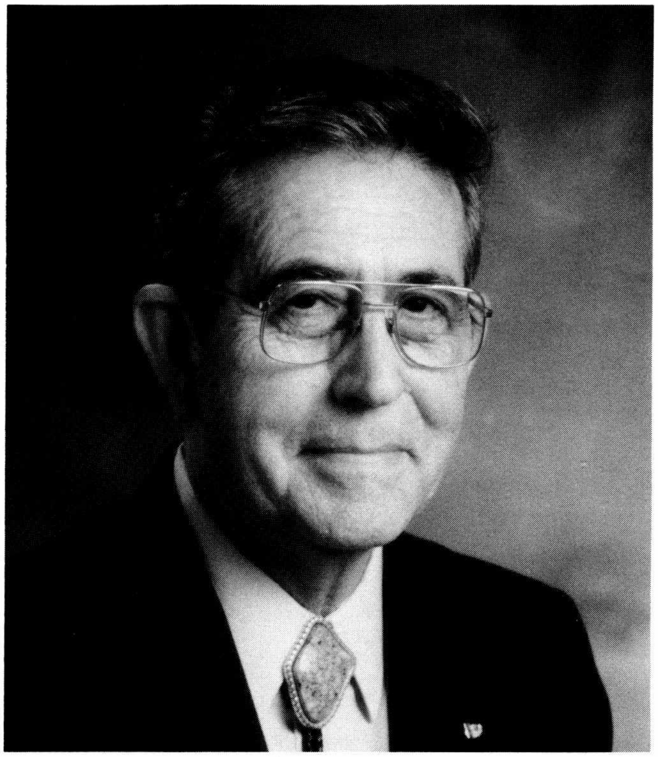
The ROBERT F. HEIZER MEMORIAL Award

FOR 1990

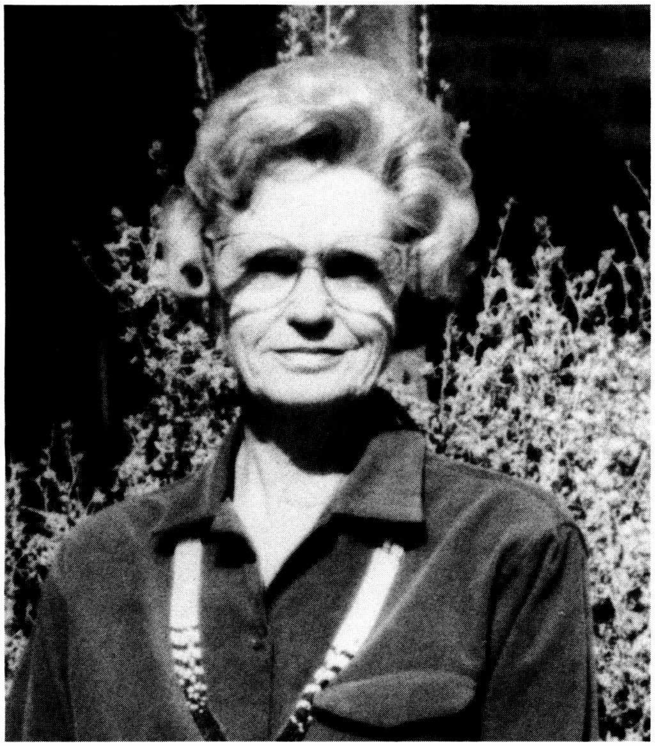


W. R. (Van) Van der Veer

In recognition of his outstanding contributions to the archaeology of Southern Texas, the 1990 Robert F. Heizer Memorial Award was presented to W. R. (Van) Van der Veer of San Antonio, Texas. Over the past year, Van has worked on a number of projects in support of STAA and its activities, ranging from assisting in archaeological surveys, to the continued excavations at the Dan Baker Site (41CM104), and to long evenings of photographing extensive collections of artifacts in order to document our Southern Texas heritage. Van is one of those quiet, behind-the-scene stalwarts whose contributions are generally not recognized but whose work is so necessary to the continued success of our group's programs. Van hosted one of our most successful quarterly meetings at Southwest Research Institute where he is employed. Prior to the STAA-hosted Texas Archeological Society Field School in Uvalde County, he (with the collaboration of son-in-law Joe Chadwell, also an STAA member) completely reconditioned, reconstructed, and repainted (with racing stripes and mag wheels!!!) the STAA field trailer to insure that our field equipment (screens, sawhorses, buckets, etc.) could be transported safely (and proudly) to Utopia. He assisted wife Shirley with setting up for Field School registration, and helped many others in any way he could to make the event a spectacular success. He and his wife continue to schedule and oversee the ongoing excavation work at the Dan Baker Site (41CM104). The site is used to demonstrate field archaeology for the STAA teachers' workshop, for Trinity students, for gifted and talented middle school students, and others. He is computerizing 41CM104 data files to facilitate future analysis. In all he does, Van is extremely professional and sincere; he gives every project his very best effort. Thus it is with pride that the Heizer Award committee selected Van for this 1990 award.

The DEE ANN STORY ARCHAEOLOGICAL CONSERVANCY Award

FOR 1990



Dorothy Lee Hindes

In recognition of her outstanding conservation of archaeological sites and materials in Southern Texas, the 1990 Dee Ann Story Award for Archaeological Conservation has been awarded to Mrs. Dorothy Lee Hindes, of Hindes, Texas. As a private landowner interested in our cultural heritage, Mrs. Hindes has generally restricted access to her 7,000-acre Greenbranch ranch in McMullen County, Texas, in order to protect a number of significant sites to discourage looting. However, she has granted limited access to qualified researchers. At sites eroding throughout several tributary watersheds which drain into the Nueces River or San Miguel Creek, Mrs. Hindes has recovered and documented a substantial collection of typical South Texas artifacts, an accumulation of several decades. She has permitted the analysis of this extensive collection by daughter-in-law Kay Hindes, Pete Saunders, C. K. Chandler, and Tom Kelly. Since the collection covers several extensive drainages, it serves as a comprehensive baseline for comparing various types of prehistoric artifacts found in other areas and other collections. Her collection of Lerma and Desmuke bifaces represents the largest and best documented assemblages of these types, and their analysis has, for the first time, generated a large enough data base to permit redefinition of these types (Tom Kelly's study of the so-called Lerma type will be published in a forthcoming volume of the *Bulletin of the Texas Archeological Society*). Thus, as a highly motivated, conservation-minded landowner and avocational (salvage) archaeologist, Dorothy has directly contributed to the goals of archaeology in Southern Texas and to the preservation of basic archaeological data in this area of the state.

EDITORIAL

Archaeologists today are seeing a constantly increasing range of new and improved techniques for studying the record of man's past. Invisible films of many organic residues can be viewed and chemically analyzed with an FTIR microscope. This permits the identification of many of the materials utilized in fabrication or decoration, or associated with man's activities.

Products extracted from ceramic, lithic, and stone artifacts are being analyzed by the very powerful combination of chromatography which separates the chemical components and mass spectrometry which can identify them. Ritual, cosmetic, food, and plant and animal residues are being identified and related to the artifacts which supplied them.

Stable isotope studies are shedding new light on paleodiets, paleoecology, and paleoclimates providing a substantial setting for changes in man's living conditions in the past.

These few examples of the many new and potentially useful sources of information for the archaeologist reinforces the question of how to incorporate "high-tech" into the world of travelling, screening and mapping. How can the archaeologist evaluate these powerful methods to determine their applicability and value to answering his questions?

In this issue of *La Tierra*, Jeff Huebner illustrates the problem in his updated survey of radiocarbon dating. He points out some of the refinements which are taking place in calibrating and correcting the raw (Carbon-14) measurements to provide much greater accuracy in establishing calendar dates. Moreover, the tandem accelerator method of dating uses very much smaller amounts of material than previous methods. Together, these improvements can allow archaeologists to date a much wider range of materials. An inevitable consequence, however, is that greater demands are placed on the archaeologist in comparing dates obtained by different technologies and at different times. As Jeff Huebner states, archaeologists will need better understanding of the physical sciences involved in the new methodology and close collaboration with physical scientists who specialize in archaeological applications. Indeed, it is only through meaningful interdisciplinary programs that the enormous possibilities can be realized.

Don Lewis
Associate Editor

NOTES ON SOUTH TEXAS ARCHAEOLOGY: 1991-1

An Overview of the Results of the Texas Obsidian Project

Thomas R. Hester

with the collaboration of Frank Asaro, Fred Stross, Helen Michel, Anne C. Kerr and Pamela Headrick

Earlier issues of La Tierra and previous "Notes..." (Hester 1986, 1988a) have reported some of the data obtained through the use of nuclear chemistry to determine the geologic source of obsidian artifacts in Texas. Obsidian is rarely found in most parts of the state and is thus of considerable importance in looking at ancient trade and exchange patterns. Since each volcanic outcrop of obsidian, whether in Mexico, New Mexico, California, Idaho or Wyoming, is chemically distinct, an artifact made of that obsidian -- and often found at long distances from the source -- can be "fingerprinted" and linked to its geologic origin. The "Texas Obsidian Project" (TOP) has been underway for almost 20 years. It began when I was a graduate student at the University of California, Berkeley, and through the late Professor Robert F. Heizer, I was put in touch with Robert Jack, a geologist who specialized in x-ray fluorescence (XRF) analysis of obsidian and other materials. Through the cooperation of a number of Texas avocational archaeologists, and especially with the help of Dr. Dee Ann Story at The University of Texas at Austin, we were able to secure a few Texas obsidian artifacts for analysis. However, the project expanded greatly in the late 1970s when I was at The University of Texas at San Antonio. This collaborative study was begun with Drs. Frank Asaro and Fred Stross, and Helen Michel, all of the Lawrence Berkeley Laboratory, University of California, Berkeley. These researchers were pioneers in the area of obsidian trace element studies and used both XRF (non-destructive) and neutron activation analysis (NAA). The latter required destruction of a portion of the artifact, and was both more precise--and more expensive--than XRF. Generally, artifacts were analyzed using XRF. However, if there were specimens or source samples that required analysis of greater precision, NAA was sometimes used.

We began to secure more and more specimens from throughout Texas, with help from a number of people--Dee Ann Story, Robert J. Mallouf, Elton Prewitt, Jimmy Mitchell, L. M. Green, J. W. House, Harvey Kohnitz, Al Redder, Robert Forrester, staff at SMU, Frank Weir and others. This enabled us to begin to "blanket" the state in terms of sampling obsidian occurrences. In the 1980s much of the analysis was funded through the Friends of Archaeology program at UT-San Antonio.

In 1988-1989, a research grant (No. 4137) awarded Hester through the Advanced Research Program (ARP) of the Texas Higher Education Coordinating Board, permitted the TOP to greatly expand the scope of obsidian analysis. More specimens from the collections of the Texas Archeological Research Laboratory (TARL) at UT-Austin were analyzed (with the aid of Dr. Darrell Creel), and numerous individuals from across the state provided provenienced specimens: Dr. Michael B. Collins, David Dorchester, Dr. Robert Ricklis, Nic Harrison, Ken Mikulencak, Alton Briggs, Robert J. Mallouf, Brian Miles, Jesse English, Randy Lipton, Dr. James Garber, Elton R. Prewitt, Kay Hindes, Bruce Ellis, and Joe Labadie of the National Park Service.

The TOP has been a collaborative project, in terms of the involvement of scientists from different backgrounds and universities. But it has been made possible in large part through the splendid cooperation of those friends and colleagues noted above. Some contributors to this effort have undoubtedly, and inadvertently, been omitted--but they will be formally thanked in forthcoming publications resulting from the TOP.

As of December 1990, we have pretty much concluded the work of the project. However, at this writing, three additional Texas specimens (from Willacy, Haskell, and Uvalde Counties) are undergoing analysis at Berkeley. Every time we "wrap" the project, important specimens pop up and dollars are ferreted out to allow their analysis!

There is a lot of interpretative work to be done now with the data obtained through the TOP. However, some general summary statements can be offered that will hopefully be of interest--as well as serving as an indication of the research findings that are soon to be published. For example, the TOP has analyzed 132 obsidian artifacts (with three others in progess). Other researchers have independently carried out trace element studies, but have kindly shared their results (the numbers of specimens are not included in the figure given above); these include Prewitt and Associates (Rio Grande Valley), archaeologists working at Ft. Hood (see Hughes 1989), Dr. Eileen Johnson of Texas Tech (Lubbock Lake site), and Dr. Chris Lintz of Mariah (Stacy Reservoir). It should also be noted that there is a substantial amount of obsidian in the Texas Panhandle; some has been analyzed (e.g. Mitchell et al. 1980, as well as Baugh and Nelson 1987), but since these materials are in such close proximity to the New Mexico sources, we chose to focus our efforts (and funds) on obsidians from other parts of Texas.

Where has the obsidian been found? From South Texas (and the South Texas coast), 12 samples; Central Texas, 65; Lower Pecos, 5; Trans-Pecos or West Texas, 13; Llano Estacado, 11; Panhandle, 4; north and west central Texas, 18; the Rio Grande Valley, 2; and East Texas, 6.

In what form does the obsidian occur (Figure 1)? Most of the specimens are flakes or flake fragments (93); others include biface fragments (7), unifaces (2), flake core fragments (2), pebbles (2), arrow points (10) and dart points (6). The dart points are mainly of Paleo-Indian age, including the Kincaid Rockshelter specimen of Clovis age, the Port Lavaca Clovis point, two lanceolate points from the Lower Pecos, and Paleo-Indian specimens from Lubbock Lake (see Hester 1988a,b for summaries).

What is the antiquity of Texas obsidian artifacts? They are overwhelmingly of Late Prehistoric (or in some cases Late Prehistoric/Transitional Archaic) age; only one clearly dates to the Middle Archaic, a couple to the Early Archaic, and three or four to the Late Archaic. As noted earlier several others are Paleo-Indian in age. Slightly over 12 percent are of unknown age and are likely to remain in that category. Others that we currently list of unknown temporal placement will be set in at least broad time frames as the data are further studied.

Where did all of this obsidian come from? The geologic sources that we have identified to date range from central Mexico to southeastern Idaho. Surprisingly few are from Mexican sources and an amazingly large number come from Malad (southeastern Idaho) and Obsidian Cliff (Wyoming). The other two dominant sources are Cerro del Medio and Cerro de Toledo (formerly referred to as the "Valles Caldera" source) in the Valles and Toledo volcanic calderas of the Jemez Mountains 56 km north of Santa Fe, New Mexico. Other sources represented include: Sta. Teresa, Mexico; El Paraiso, Mexico (the Kincaid Rockshelter biface of Clovis age); Otumba, Mexico; Mule Creek, Grants Ridge, and Polvadera Peak--all in New Mexico. However, not all of the specimens can be definitively linked to known obsidian sources. Currently, 29 specimens (20 percent) fall into that category.

A number of short papers have appeared over the years with some of the results of the TOP. Fortunately, the current results pretty well concur with our earlier claims! We have defined new sources, changed the names of one or two, and are otherwise tidying up the findings reported in the earlier papers. Since a number of colleagues have collaborated in this research, a number of papers will be forthcoming detailing the implications of the obsidian source data. One

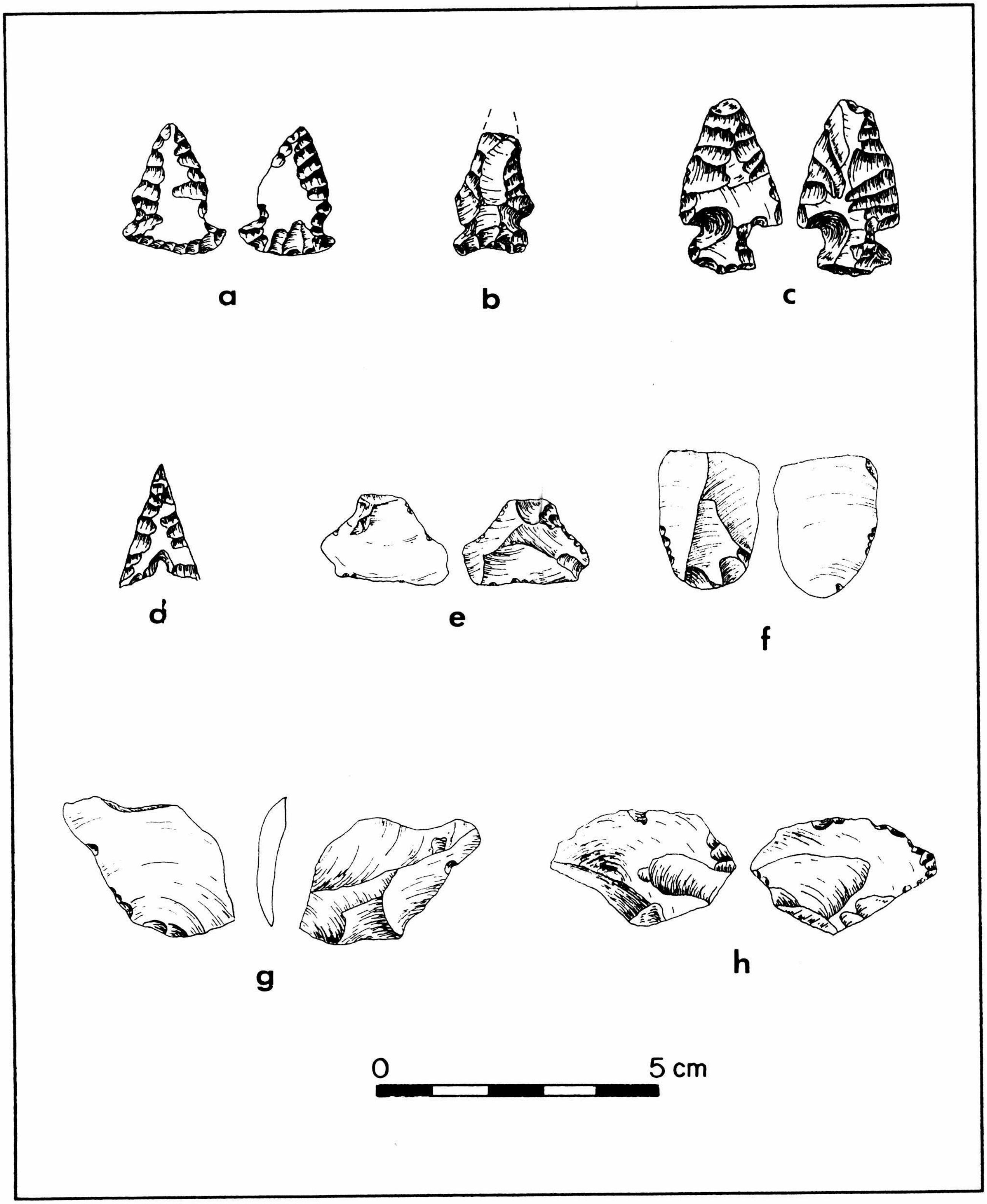


Figure 1. Selected Obsidian Artifacts from Texas. a, TOP 39 (Medina Co.; Malad ID); b, TOP 111 (41CK87, Coke Co.; Cerro del Medio NM); c, TOP 87 (41ME29, Medina Co.; Malad, ID); TOP 80 (41GR56, Garza Co.; Cerro del Medio NM); e and f, TOP 16 and TOP 25 (41SS2, San Saba Co.; Obsidian Cliff WY); g, TOP 101 (41WM763, Williamson Co.; Malad ID); h, TOP 60 (41RE69, Real Co.; Malad ID). Drawings by Pam Headrick.

such paper is currently in press at TARL, dealing with Late/Transitional Archaic obsidian flakes from Arenosa shelter (41VV99) in the Lower Pecos (Hester et al. 1991). A comprehensive publication on the Texas Obsidian Project will be forthcoming, hopefully shedding new light on prehistoric long-distance trade and cultural contacts in ancient Texas.

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MARINE SHELL ARTIFACTS FROM BEXAR AND MEDINA COUNTIES, TEXAS

C. K. Chandler

ABSTRACT

Conch shell artifacts from sites along the Medina River and its tributary drainages in Bexar and Medina Counties are documented and described. These marine shell artifacts are strong evidence of trade networks between coastal people and inland groups in prehistoric times.

INTRODUCTION

The presence of marine shell artifacts in inland Texas archaeological sites has been reported by a number of authors and the trading of coastal shell to inland groups was noted by Cabeza de Vaca in the early 16th century (Bandelier 1905).

Apparently this trade occurred all along the coast and far inland. Conch shell pendants and columella beads are often found with burials and were favorite ornaments of both coastal and inland people. They are reported from the Galveston Bay area at the Caplen site (Campbell 1957) and at the Harris County Boys School cemetery site (Aten 1976). Small pendants of conch shell columella were found with a female burial at the Albert George site in Fort Bend County (Walley 1955). On the Red River in northeast Texas a variety of conch shell ornaments and at least one conch shell dipper are reported from the Bentsen-Clark site (Banks and Winters 1975). Hall (1981) reports a large number of shell artifacts from 41AU36. All but three of these are believed to have served as ornaments. Most were found in the upper torso or neck area of skeletons with perforations positioned to suggest suspension from the neck.

Hall's (1981) Table 8 documents the recorded occurrence of probable Archaic marine shell artifacts in an 80-county region of Texas. This documentation does include Bexar County but not Medina (see Figure 1). Bexar County is not identified as having such artifacts of Archaic age. However, since that survey, there have been several reports of marine shell artifacts recovered from sites in Bexar County (Greer 1977; Lukowski 1988; McReynolds 1982). Greer reports a single columella bead, found on the northwest side of San Antonio, which is conically drilled from each end about 7 mm with an additional hole drilled from the outer surface at each end to intersect these holes at a near right angle. This type of drilling is common in the manufacture of long columella beads. McReynolds reports a single columella bead drilled full length, and a conch shell pendant from a site southwest of San Antonio. Lukowski reports seven conch pendants, a marine shell fragment and four columella pendants recovered with burials at 41BX1. All except one of these was associated with burials and all but one are decorated. Del Rio (1953) reports a large conch shell pendant from the mortuary cave of Candelaria, Coahuila, Mexico. There is a great deal of similarity among these artifacts throughout Texas and into northern Mexico.

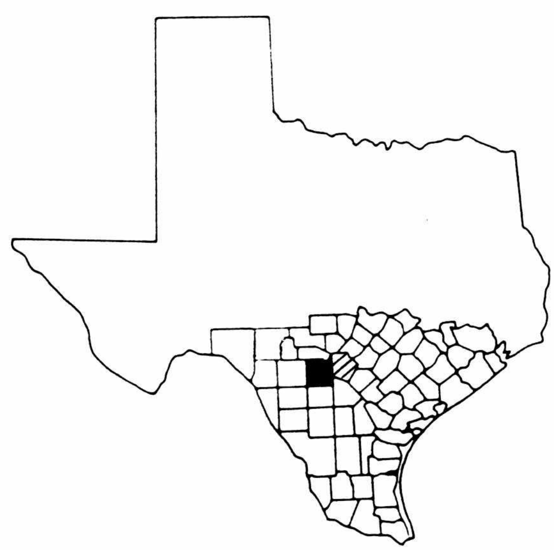

Figure 1. Texas map. Bexar County striped, Medina County solid.

ARTIFACT DESCRIPTIONS

The six artifacts reported here are illustrated in Figures 2 and 3. Figure 2 is of a modified conch shell (*Busycon contrarium*) with the outer body whorl removed. It is from 41BX528 near the Medina River in Bexar County. It is of particular interest because it is a left-handed whelk whereas the vast majority of identifiable conch shell artifacts in Texas reportedly are made of *Busycon perversum* (right-handed whelk) or of horse conch. It is also of particular interest because the method employed in the removal of the outer whorl is readily identifiable.

The surface of the spire below the apex, along and adjacent to the third suture, has been cut through with two successive cuts, each 47 mm long and 12 to 13 mm deep. These two cuts are quite deep and their vertical surfaces are very flat and have near parallel striations. The bottoms of these cuts are rounded. They appear to be too deep to have been done with a graver and may have been done with a serrated flake, a thin biface, or probably a thin sandstone saw. At the end of the second cut on the outer surface of the spire there is the beginning end of what appears to be a vertical groove along the length of the whorl to facilitate snapping it off. This would have produced a whorl fragment of triangular shape with a maximum width in excess of 94 mm, and quite possibly as much as 102 mm. The outer whorl of conch generally extends well beyond its attachment at the aperture and this extension is often as much as 8 cm beyond.

There are two additional cuts on the spire along the third suture. The third cut is 34 mm long and the fourth cut is 24 mm long. These two cuts are shallow and do not cut through the thickness of the whorl. The whorl is much thinner (2 mm) in this area and the whorl is broken along the third cut and just outside the fourth cut. This section of whorl was broken in a very ragged vertical line and there is no evidence of a vertical groove to guide this break along the long axis of the shell. This section of whorl would have been more rectangular in shape with maximum width in excess of 60 mm as indicated by the break beyond the last groove. The bottoms of the last two cuts are virtually flat and do not have visible striations. It appears the first cuts were done with a different tool, probably a sandstone saw, than the last two, and that there were two separate sections of whorl removed. There is no evidence of battering on the remaining portion that would indicate its possible use as a hammer or billet.

Two conch shell pendants, two columella beads, and an olivella shell tinkler are illustrated in Figure 3. Figure 3 A, A' is a triangular conch shell pendant from 41BX502. It is without decoration. It has one biconically drilled suspension hole in the small end and this hole is worn and rounded by the suspension cord. All edges are rounded and polished. The outer surface has been abraded and the surface ridges reduced. One long edge and both ends appear to have been grooved and snapped prior to being ground. The other long edge was broken without benefit of a groove to guide the break. This edge has been rounded and smoothed but not to the extent of obliterating the rough irregular break. It is 92 mm long; end widths are 25 mm and 76 mm, and its thickness is 5 to 6 mm. It weighs 62.5 grams.

Figure 3 B, B' is a conch columella bead with holes drilled in each end to a depth of 7 mm with a diameter of 5 mm at the surface. Each end is ground smooth. One side at each end is flattened and from this flat area a hole is drilled at an angle to intersect the end holes. The resulting hole is somewhat like an elbow and is more or less 90 degrees depending on how the angle is measured. All surfaces are well smoothed and polished. One lateral hole is broken out through the end hole and destroyed the means to suspend the artifact from this end. This artifact is 92 mm long, 13.6 to 14.3 mm in diameter at the center and 10 to 12.5 mm diameter at the ends. It weighs 33 grams.

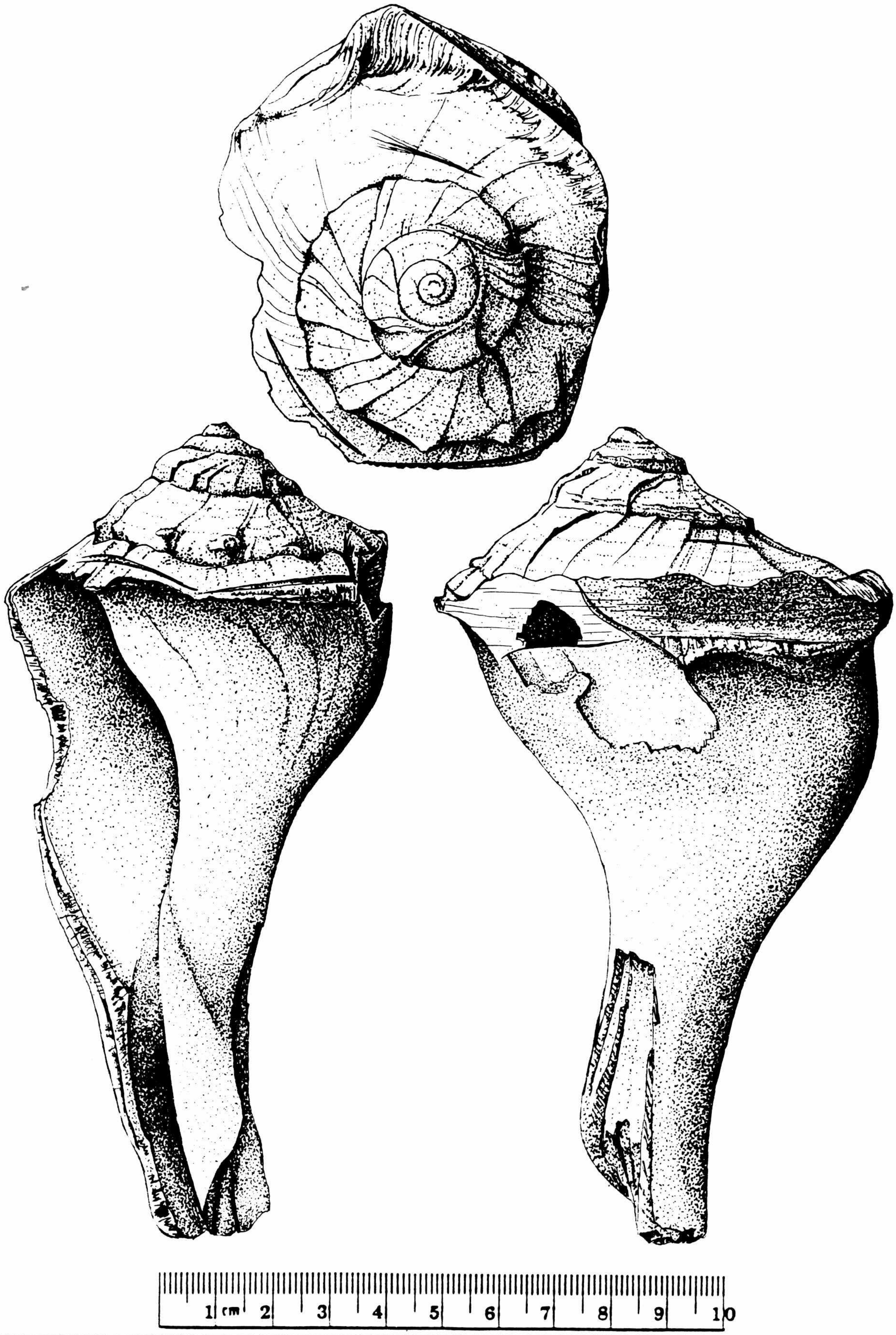

Figure 2. End view (top) and two side views of modified conch shell with outer whorl removed. From 41BX528 near Medina River in Bexar County. Drawing by Richard McReynolds.

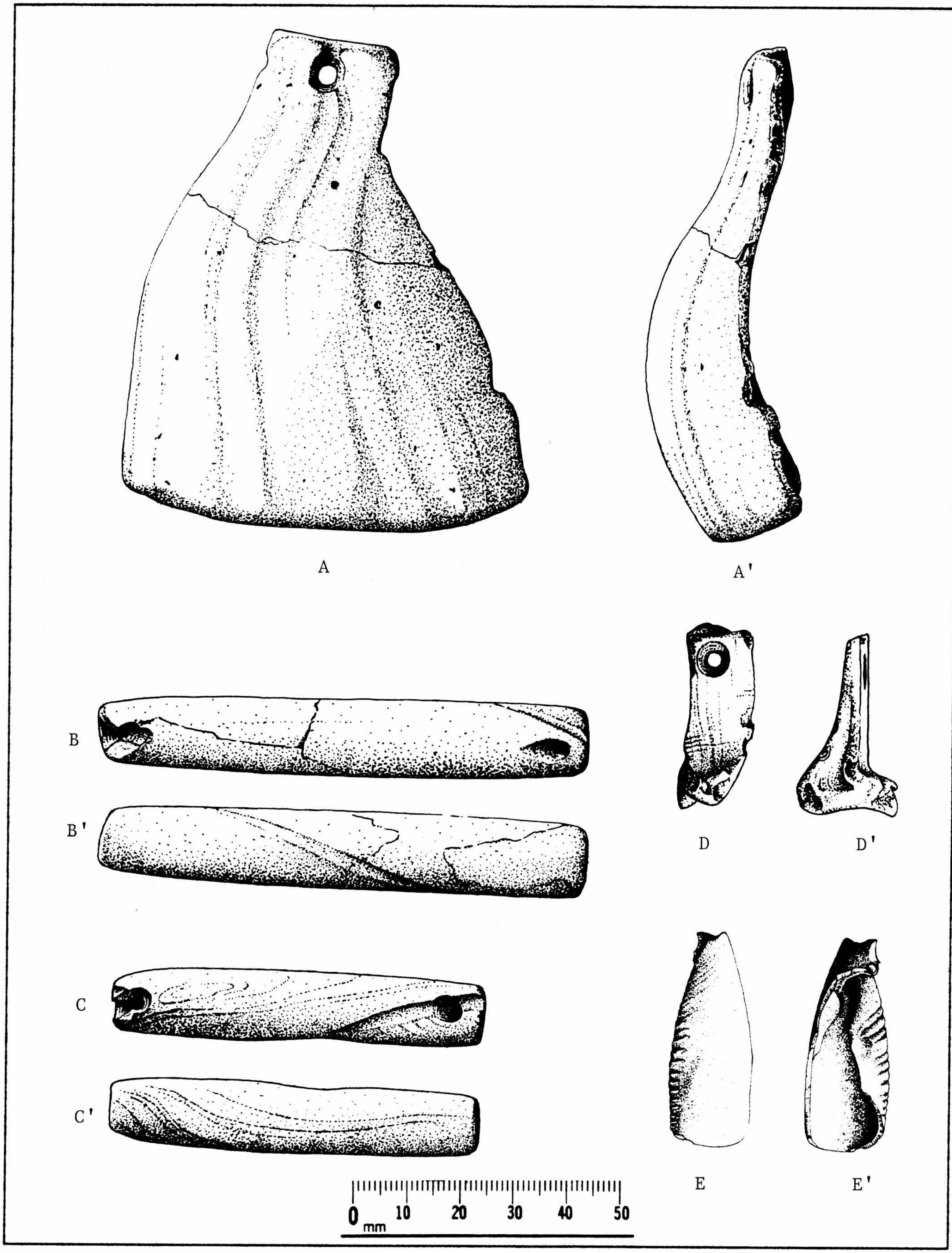

Figure 3. Conch shell artifacts from Bexar and Medina Counties, Texas. A,A', E,E', conch pendants from 41BX502; B,B', conch columella bead from 41BX43; C,C', conch columella bead from 41ME42; D,D', T-shaped conch pendant; E,E', *olivella* shell tinkler from Olmos Basin.

Both Greer (1977) and Hudgeons (1977) have suggested artifacts of this type were suspended horizontally in breastplate fashion. It is also quite possible to suspend them in line as beads. The difficulty in making and maintaining small diameter drills of sufficient length to drill through long beads (even when drilling from both ends) is probably the major factor in elbow style drilling of these artifacts.

This artifact was found on the surface of a low terrace site (41ME43) along San Geronimo creek in northeast Medina County. This area had been cleared of brush and prepared for cultivation. A large burned rock midden area was disturbed by this activity and the shell bead was found on the surface after a rain. Only one other artifact has been found on this site. It is a large thick metate found in three pieces.

Figure 3 C, C' is a columella bead made in the same fashion as the above bead and is drilled in the same manner. All surfaces are well smoothed but have very little polish. The ends are squared off and abraded smooth. One lateral hole is broken out through the end hole in the same manner as 3 B. It is from a large burned rock midden (41ME42) along the second terrace of San Geronimo Creek in northeast Medina County and was found when this site was leveled with a bulldozer in preparation for the building of a house. It is 69 mm long, and 12.5 to 13.4 mm in diameter. It weighs 21.4 grams.

Figure 3 D, D' is a small, basically T-shaped pendant made of conch shell. It has a biconically drilled suspension hole in one end and is without decoration. It appears to be a whorl fragment with a piece of the spire attached on the end opposite the suspension hole. All edges appear to have been broken without any intentional grooving to determine its size and shape. The rough broken edges and corner are rounded and polished and show considerable usewear. It is from 41BX502. It is 34 mm long, 12 mm wide with the T end being 19 mm wide. It weighs 6.5 grams.

Figure 3 E, E' is an *olivella* shell tinkler with a large portion of the whorl broken off. The complete spire has been cut or ground off. It is from Olmos Basin near 41BX1. It is 40 mm long and 16 mm in diameter.

CONCLUSIONS

While mollusks served as a primary food source along much of the Gulf Coast, through their shells they also served as raw material for the manufacture of artifacts (Steele 1988, for 1987). Of several varieties of shells used, whelk shells were among the largest and most used in making both utilitarian and ornamental artifacts. Obviously, many of these artifacts were traded inland. Whelk shells with much of the body whorl removed have been recovered from the Corpus Christi Bay area and Copano Bay area. These shells are battered, suggesting use as billets or hammers (Steele and Mokry 1985; Prewitt and Paine 1988, for 1987; Campbell 1947). Campbell suggests the large number of conch shell hammers could have been used to rough out other shell tools, to break mammal bones or skulls, and possibly to open mollusk shells. The portions of the removed body whorls were utilized in the manufacture of other tools and ornaments such as adzes and pendants. Campbell reported the manufacture of shell adzes at the Johnson site by roughly chipping them into shape with no evidence of grooving-and-snapping or sawing. Mokry (1980) described the manufacture of shell adzes by both the groove-and-snap technique and by rough hammer and chipping.

The conch shell from 41BX528 with evidence of the body whorl being removed by sawing and grooving-and-snapping indicates complete shells were being traded inland and some shell artifacts were being manufactured by inland people.

Utilitarian tools made of marine shell are not known to occur along the Medina or its tributary drainages in Medina and Bexar Counties. This strongly suggests the coastal shells being traded this far inland were being used for the manufacture of ornaments instead of tools. The availability of good quality Edwards chert for the making of all kinds of lithic tools probably accounts for the absence of marine shell tools this far inland.

ACKNOWLEDGEMENTS

I extend my sincere appreciation to the four owners of these artifacts for the gracious loan of the specimens for study and documentation and for access to their property to view some of the sites. It is through such cooperation that we are able to build on the knowledge of our prehistoric cultures with information that might otherwise not be known.

I also thank Richard McReynolds for his excellent drawings of the artifacts, and Dave Carlson, Kay Hindes and Grant Hall for their support and assistance.

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RADIOCARBON AND THE NORTH AMERICAN ARCHAEOLOGIST

Jeffrey A. Huebner

ABSTRACT

Radiocarbon, or ^{14}C, is no doubt the most accessible and oft used method of absolute dating for the archaeologist today. Despite this, most archaeologists have little idea of the process behind the method, and how to interact with the radiocarbon scientist to make the best use of data. In this paper, the approach taken will not deal with the chemistry and physics involved in counting and obtaining a date, nor will it cover theoretical issues in radio isotopes. Instead, it will cover the basics--what the archaeologist needs to know to critically evaluate radiocarbon assays from their sites.

Initially, the primary assumptions behind the method are reviewed in light of the experimental work that has improved the accuracy and reliability of radiocarbon assays. These are followed by brief discussions of applications in archaeology, types of samples, and how to choose a laboratory.

The second section of the paper discusses the techniques for collection and handling of samples in the field. This is the first step toward obtaining an accurate assay, and as such, attention to detail is important. Proper recording of provenience data, potential contaminants, and cultural associations are essential for establishing the samples' location in both time and space. These records will form the basis for communication between the archaeologist and the radiocarbon scientist, which is covered in the third section of the paper.

The archaeologist and the radiocarbon scientist are a team, and as such, communication is paramount. Through teamwork, the interests of both are served by the production of an accurate age determination from a wide variety of potential sample materials.

INTRODUCTION

Radiocarbon assays are the most commonly used analyses for archaeological dating in North America. Despite the fact that the method has been used since 1950, and that thousands of dates have been used to support countless regional chronologies, archaeologists, as a rule, are generally uninformed about techniques and methods of radiocarbon analysis. For too long, archaeologists have uncritically used radiocarbon assays to establish chronologies; when a date fit it was used and when it did not fit it was discarded. Thus, a major goal of this paper is to create a useful guide for the archaeologist on the subject of radiocarbon analysis. The topics covered will be those that are directly in the venue of the archaeologist--collection of samples, packaging, and pretreatment.

What is Radiocarbon?

Radiocarbon, or ^{14}C, is one of three natural carbon isotopes. This, the heaviest of the carbon isotopes, is radioactive; hence the name radiocarbon. The other two isotopes of carbon, ^{12}C and ^{13}C, are stable. As with other radioactive materials, the decay of ^{14}C is measured in terms of its half-life, or the time it would take for half of the ^{14}C isotopes in a given sample to decay. The standard reporting half-life is recognized as 5,568±30 years. The Sixth (1965) International Radiocarbon Dating Conference recognized a new, more accurate value of 5,730±40, but the older value was maintained to avoid confusion. To convert a date to the new value, multiply it by 1.029.

General Assumptions Behind ^{14}C Dating

Libby (1961) stated that five general assumptions must hold within narrow limits to assure reasonable precision in determining ^{14}C ages.

1) Organic matter that is alive is in equilibrium with all other living organisms in the biosphere. The concentration of ^{14}C in the carbon reservoir has remained much the same over time by cosmic ray production of ^{14}C in the atmosphere equalling the rate of disintegrations within the reservoir. As ^{14}C disintegrates in living organisms to form ^{14}N, fresh ^{14}C is assimilated through nutrition and equilibrium is maintained.

2) The distribution of ^{14}C through all the carbon reservoirs is uniform world-wide. New ^{14}C is rapidly and thoroughly mixed into the reservoirs to replace all disintegrations.

3) At death an organism ceases to be in equilibrium. There is no longer any means of acquiring fresh ^{14}C and assimilation stops. Thus the amount of ^{14}C in an organism at the time of death has not been altered except by radioactive decay.

4) The half-life of ^{14}C is constant and accurately known.

5) Measurements of natural ^{14}C can be accomplished within experimental levels of accuracy and precision.

These five assumptions, while still valid in a general sense, have been the subject of a great deal of the experimental research in radiocarbon dating. This research has enhanced both the precision and accuracy of radiocarbon assays which, for archaeologists, means better chronologies, as well as an increased range of materials that can be dated. The experimental developments in relation to the first three assumptions are discussed briefly in the following paragraphs.

Due to the variation in the number of cosmic rays bombarding the earth each year, the overall production of ^{14}C is not consistent. Through the dating of known age samples, such as 10-year sections of tree rings from an established dendrochronology, calibration tables have been created to account for these variations.

The second assumption of uniform ^{14}C distribution has been found not to be entirely uniform. A small group of plants, which include maize, sorghum, pineapple and numerous grasses, use a photosynthetic pathway known as C_4. These plants, and the animals that consume them, have a lower concentration of ^{14}C than the atmosphere through a process known as fractionation. Thus, radiocarbon assays on these materials will yield a date that is as much as 300 years too old. The amount of fractionation can be measured by a determination of the ratio of stable $^{12}C/^{13}C$ isotopes via mass spectrometry. The resulting ratio can then be applied to the radiocarbon age to correct for the effects of fractionation (cf. Stuiver and Polach 1977:Figure 1). The contamination of potential sample material in depositional environments has presented problems with the third assumption. Groundwater, which contains dissolved carbonates, can exchange its older carbon with that of the sample, leading to an assay that is too old. While most, if not all of these carbonates can be removed during pre-treatment of a sample, they tend to create problems with assays of sediments and the inorganic fraction of bone. Marine shells also suffer this problem because the radiocarbon content of the oceans can be as much as 430 years older than the actual sample. Correction tables can help somewhat with this, but it is difficult to completely assess the total contamination of any given sample of these types.

Taylor (1987) has added an assumption to this list. "There must be a known relationship or association between the sample to be analyzed and some specific event or phenomenon to be dated" (ibid.:3-4). This assumption is quite important for the archaeologist. First-hand knowledge of a sample's provenience and associations within the stratigraphy of a site is essential to building a correct chronology.

The Application of ^{14}C Analysis in Archaeology

Radiocarbon analysis has had many effects on archaeology, the most important being the establishment of an absolute, fixed time scale. By giving archaeologists a tool to measure elapsed time, ^{14}C allowed for the building of absolute chronologies in North America. Since the absolute range of the method, around 50,000 radiocarbon years, far exceeds the length of time man has been in the New World, it can be applied in all sites that contain proper samples. Establishing relative chronologies within sites is another important use of the ^{14}C method. Gaps in the cultural stratigraphy of the site can be established and the geomorphology of site structure and location can be identified. Radiocarbon assays can also be used to verify typologic or stratigraphic identifications.

Isolated sites containing human burials, occupational features, or paleoecological remains can be dated even in the absence of typological or stratigraphic evidence. Placing these sites into a known chronology allows us to better understand cultural manifestations and land use patterns of the occupants.

But ^{14}C assays are not a panacea; they cannot correct poor stratigraphic interpretations or poorly constructed typologies. Often, when a ^{14}C assay does not "fit," it is blamed instead on the site interpretation. In situations such as this the archaeologist must remember that the methods behind ^{14}C are scientifically sound. A sample will yield its accurate age within experimental limits, commonly referred to as the standard deviation (SD). When an assay falls out of the expected age range, it would be prudent for the archaeologist to discuss the data with the ^{14}C laboratory. Discussions should include, but not be limited to, problems of the sample contamination, size, type and provenience, site stratigraphy, bioturbations, and environmental perturbations. For archaeologists to effectively use ^{14}C assays in our data, we must learn about them and be as equally critical of them as we are of stratigraphy and typology. It is far easier to throw out, or blame the ^{14}C assay when it is not understood. To end this "radiocarbon naivete" the archaeologist and the ^{14}C scientist must work as a team, not as isolated researchers. A cogent argument for this use has been presented by Waterbolk (1983).

What Material Can be Dated

In theory, the ^{14}C method can be applied to any carbon-containing structure. For archaeological purposes, 80 percent of the ^{14}C assays are from samples of wood, charcoal and shell, the other 20 percent are run on bone, nonwoody plants, textiles, eggshell, and soil organics (Taylor 1987). These materials are most routinely sampled because they represent the most widely distributed and best preserved organics in archaeological sites. Most ^{14}C laboratories have the facilities to date these materials. For other sample types with low-carbon content, such as groundwater carbonates, iron, building mortar, or wattle and daub, the laboratory must be notified before shipping the samples. These nonroutine samples will require special procedures and special preparations by the laboratory.

Radiocarbon Laboratories

There are over 40 working ^{14}C laboratories in the United States and Canada. The laboratories fall in two general categories, research or commercial.

Research laboratories are funded by universities or governmental agencies. Commercial laboratories are private enterprises and are funded by the fees for their services. While there should be no difference in the results obtained from either type, each one has advantages and disadvantages. Commercial laboratories will provide rapid turnaround time for a price, whereas research laboratory samples wait their turn. The wait can be as much as a year for the busy laboratories using the new tandem accelerator mass spectrometry (TAMS) method; however they may be able to offer lower prices since they are not operated on a for-profit basis. A simple maxim for choosing a ^{14}C laboratory, all other things being equal, is, if you have more money than time--commercial laboratory; more time than money--research laboratory.

Prices for ^{14}C assays vary from laboratory to laboratory, as well do the costs of preparing certain kinds of samples. Prices may run from as little as $185.00 for an adequate sample of charcoal to $500.00 for analysis by TAMS. Dr. Jay Davis of Lawrence Livermore Laboratory in California has stated that the cost of TAMS data could be brought down to $50.00 if the sender could process and load the graphite pellet sample. But this may not be the proper approach to help reduce the cost of ^{14}C analysis because the chemical knowledge behind this task is not normally in an archaeologist's training. The difference in price does serve to illustrate that the costly part of the method is the sample processing, not the measurement itself.

To locate a ^{14}C laboratory the archaeologist can consult the journal *Radiocarbon*. A complete worldwide list of laboratories is published every other year in the last issue.

FIELD COLLECTION OF SAMPLES

The accuracy of a ^{14}C assay greatly depends on the collection and handling methods of samples in the field. During the planning state, prior to going afield, the archaeologist must answer three questions that pertain to ^{14}C samples:

1) How will the samples be collected?
2) How will the samples be packaged?
3) How much sample does the laboratory need for analysis?

The answer to the first question can be found in the regional literature. Reports on sites similar to the planned excavation should contain information on the sample types collected. This data can act as a guide for field expectations. If there is little or no data on ^{14}C in your region, which should be rare in North America, contact a laboratory and ask for the proper way to collect the samples.

The actual collection of the *in situ* sample should be done with clean metal tools. It is not essential that they be surgically clean, but they must be free of rust, grease, oil, and soil matrix. Dental picks, tweezers, and small metal scoops are the best tools for the recovery of small samples, and trowels are fine for larger samples. If samples must be collected by hand, attempt to limit the contact time. While skin oils are removed by sample pre-treatment, they are nevertheless an introduced contaminant and should be noted. Collect the samples cleanly and attempt to minimize the amount on nonsample material included with the sample. If the sample is bone, brush away as much of the site matrix as possible and then bag it. Do not apply any preservatives to the bone. Preservatives such as PVA, gelva, Elmer's glue solution or a plaster jacket will only add to the contaminants, and the expense of sample preparation.

Samples must be collected accurately and properly. Prior to collecting the sample, its provenience information must be accurately documented and the sample evaluated as to its size, quality, and applicability to an event in question. Documentation of *in situ* samples by map, photo, written notes, or profiles is imperative. This is because, much like other archaeological materials, the information is lost the moment it is collected. The evaluation of the sample needs to answer at least two questions before its collection:

1) Does the sample represent the event to be dated?
2) How tightly is the sample associated with the event to be dated?

It is important to remember that not all things found together represent the same time period. Important considerations are the reuse of building materials and the long term curation of material culture items, not to mention post depositional disturbance within the site.

The possibility of contamination must be considered. Contamination is any carbon present in the sample that was not there when the sample was deposited (Gillespie 1984:6). Common contaminants include rootlets, humic acids and carbonates. Rootlets are macro- and microscopic roots that have grown into the sample material. Humic acids are products of organic decay in the depositional environment, and carbonates can be leached from sediments by, or brought in with, groundwater. If these conditions are suspected, they need to be recorded and the radiocarbon laboratory notified of them at the time the sample is submitted.

Another form of contamination occurs when older or younger material of the same type is mixed with the sample. Pedologic processes such as alluviation, frost heave, eoliation, and erosion may introduce similar material of a different age into a sample. Burrowing animals such as gophers and worms can rework a great percentage of material within a site. Beware of the large charcoal sample accumulated in a rodent run.

Once collected, samples must be placed in an adequate container. It is best to have the proper materials in the field to minimize the chance of contamination. The best containers are aluminum foil pouches, polyethylene bags and small vials of glass, aluminum, or plastic. Aluminum foil is the most versatile container since it can be made into large or small envelopes to match the sample size. Polyethylene bags should be at least three mils thick, ziplock, and chemically inert. These are available through most pharmaceutical supply houses. Vials are good for tiny samples; polyethylene or aluminum is preferable over glass due to the possibility of breakage. The best vial will have a screw top instead of a snap top.

All sample containers must be clearly labeled. Provenience data can be written directly on the foil envelopes or plastic bags with a "Sharpie" pen or some other type of permanent marker. Vials need to be labeled with wire or string tags and then placed in a plastic bag on which the provenience data is recorded. Record information should be written on the container before the sample is collected; it is much easier to write clearly on a flat bag than on one half full of charcoal.

The amount of sample to collect will vary based on sample type and the ^{14}C laboratory's counting method (Table 1). If a sample is suspected to be contaminated, collecting a separate matrix sample from beside it may be helpful in identifying the contamination prior to laboratory processing. It might even be prudent to always collect a matrix sample, in case of unknown contamination. In cases where sample material is plentiful, the numbers in Table 1 should be considered the minimum amount to collect. Excess sample materials can be retained for future assays or used in other testing such as stable isotope ratios, trace elemental or paleoecological analysis,and Scanning Electron Microscopy (SEM).

TABLE 1. Optimum Sample Weights to Collect.

	APPROXIMATE WEIGHTS		
Sample material	Conventional (grams)	Minicounter (grams)	Accelerator (grams)
Charcoal	5-10	0.1-0.5	10-100
Wood, dry	10-20	0.5-1	50-100
Wood, wet	40-80	1-2	100-200
Bone	100-500	10-50	500-5,000
Shell	50-100	0.5-2	50-100
Carbonates	100-200	2-10	100-200
Peat, dry	50-100	1-3	100-200
Peat, wet	100-200	3-5	200-500
Sediment, dry	100-200	3-5	500-5,000
Sediment, wet	200-500	10-50	1,000-10,000

Note that these are only approximate weights for samples free of soil, sand, artifacts, etc.; in some cases smaller sized samples will be acceptable for dating but may cost more and have lower precision in the age. If the sample is likely to be contaminated and/or more than 20,000 years old, double the amounts given above. When in doubt, consult the laboratory.

BACK IN THE ARCHAEOLOGICAL LABORATORY

Once the ^{14}C samples are back in the office they need to be prepared for submission to the ^{14}C laboratory. This can involve cleaning samples, and will also involve paperwork. Preparation of the ^{14}C samples should be high priority once the archaeologist has returned from the field. The faster the samples are delivered to the ^{14}C laboratory, the faster they may be returned and the results can then be incorporated into the site report instead of appearing as an appendix. Getting dates back quickly can also be important when the results are not as expected; extra samples can then be run to confirm the dates, prior to report deadlines.

Presubmission Processing of Samples

Ultimately, the results of ^{14}C assays reflect the work of the archaeologist thus, some simple procedures prior to submission will aid in obtaining correct age estimates. Macroscopic rootlets can be removed with tweezers and low power magnification (≥10X). For charcoal samples, site matrix may be removed by sieving or flotation using distilled water. Both of these must be done carefully to minimize the size reduction of the charcoal pieces. The larger the chunks of charcoal, the better their chance of survival in the acid and alkali pretreatment done by the radiocarbon scientist. Bone samples may be ultrasonically cleaned in distilled water. This will remove rootlets and soil matrix from the cavities of porous bone structures. The ^{14}C laboratory should appreciate the cleaner samples but check with the laboratory first to be certain that your cleaning does not conflict with their pretreatment procedure.

Communications

Archaeologists and ^{14}C scientists need to work as a team and maintain open lines of communication. While telephone calls and letters allow for good communications, the best vehicle of communication is the ^{14}C laboratories standard data report. The forms should be solicited beforehand and completed for submission with the samples. It is a bad idea to submit a sample without proper documentation.

The information requested on these forms should be contained within the archaeologist's site notes and the data recorded with the ^{14}C sample. An example of a laboratory data report is shown in Figure 1 a,b. The Specimen Data Sheet from the Radiocarbon Laboratory at The University of Texas at Austin asks 12 questions about the site and ^{14}C sample. This form is simple to use and includes prompts. It is important that as much detail as possible be included in this report. Towards this end some additional prompts and comments are presented. These would generally apply to any laboratory's data reports but will be discussed here specifically in terms of the UT Specimen Data Sheet:

1) Nature of sample - a specific sample type: charcoal, bone, shell, etc. Identification of species would be helpful for charcoal, necessary for bone and shell. Describe the condition of the sample when collected. Weight of sample should also be included. Give any additional materials included in the sample: soil matrix, rootlets, known chemical contaminants, or preservatives that may have been used on bone or shell. For bone or shell samples state which fraction, organic or inorganic, is to be assayed.

2) Submitter's catalog number - use the entire identification code, be it as simple as "Charcoal Sample 3" or a complex project or regional code.

3) Name and number of site - include provisional field designations if the sample is submitted prior to receiving a permanent number.

4) Descriptive location of site - include a known permanent landmark in description of location. Keep measurements cited in a single system, not "the site 10 miles NE of Big Town and approximately 100 meters east of the Big River." Include type of site (occupation, quarry, mortuary, etc.) in relation to location (rockshelter, terrace, lacustrine, etc.) and geologic setting. Send a map with a site plotting along with the sample.

5) Latitude and Longitude - UTM coordinates are fine as well, but the journal *Radiocarbon* requires latitude and longitude for publication. Since the archaeologist has greater access to maps of the site, take the time to make this calculation for the laboratory.

6) Location of sample within site - a sketch of the site and a corresponding profile giving the position of the samples would be helpful.

7) Date of collection, name of collector - should also include the method of collection. When in the field, it is important to remember that the individual taking the sample starts the chain of events leading to a ^{14}C date. This procedure, which is not difficult, done improperly can start a progression of uncertainty that makes the problems of interpretation that much more difficult. If there are any questions about sampling procedure, consult a field supervisor.

8) Context - the dates for the artifact associations and cultural identification should be included.

9) Previous radiocarbon dates - include all other assays from this particular site. Other regional determinations that are related to this sample should be noted as necessary.

10) Variables affecting validity of date - these should be discovered in the field, not after the age determination is reported. Ideally, samples with these problems should not be assayed but realistically the archaeologist may have little choice in samples at any given site. Attempt to note any suspicions you might have of contamination. If the sample has been stored over a year, give the elapsed time since collection, as well as the nature of the storage facility and the potential for contamination during storage.

11) Significance of sample - This point cannot be over emphasized! ^{14}C assays should never be run without reason. Note the relationship of the sample to problem being solved. If there are any questions as to the significance of the sample they should be discussed with the ^{14}C scientist. Include any published references.

12) Estimated sample age - This should be the expected age range of the sample based on the associated diagnostic artifacts, stratigraphy, or previous radiocarbon assays.

Turnaround time on samples is variable. The UT-Austin laboratory states it can report results in approximately three weeks to three months, depending upon the commitment to the submitter and the backlog of samples. Some commercial laboratories promise results in days, at an added expense.

Communications should not stop once the sample is submitted. Any new data about the sample, discovered during the archaeological laboratory analysis of the site, should be reported to the ^{14}C scientist. Additionally, problems with the sample or requests for extra information by the radiocarbon laboratory should be discussed with the archaeologist. The bottom line on this point is cooperation and teamwork.

THE RADIOCARBON LABORATORY

Once a sample is accepted it is given a unique number identifying the laboratory and the sample number. The sample packaging is inspected and the sample is removed and placed in a large pyrex beaker for pretreatment. Chemical pretreatment is tailored to the requirements of each individual sample. Every laboratory has its own recipe for sample pretreatment but these only constitute minor variations in what is otherwise a fairly standard procedure. Because of these minor variations and the constant updating of procedures in light of current research, only a very general discussion will be given here. For more specific information contact your ^{14}C laboratory or see Berger et al. (1964), DeNiro and Weiner (1988), Michels (1973), Stafford et al. (1988) or Taylor (1987).

All samples will be manually cleaned of soil matrix, pebbles and rootlets, if not already done so by the archaeologist. All samples are given a hot acid wash to dissolve carbonates, rinsed until neutral with distilled water and then boiled in an alkali wash to dissolve out humic acids. This procedure will cause the loss of an appreciable amount of sample, so submitted samples should be as large as possible. With charcoal or wood, the integrity of large chunks should be maintained because the smaller pieces in the sample may dissolve completely. After the acid and alkali baths some samples still require further processing. Charcoal pretreatment would stop at this point but wood samples must be converted to cellulose by chemical oxidation of the lignin fraction.

Univ. of Texas-Austin **SPECIMEN DATA SHEET** Radiocarbon Laboratory

FOR LAB USE ONLY

Average ________________ X-No. ________________

Age ________________ Age ________________ Tx-No. ________________

$\delta^{14}C$ ________________ $\delta^{14}C$ ________________ Published ________________

$\delta^{13}C$ ________________ $\delta^{13}C$ ________________

Run # ________________ Run # ________________

Remarks ____

Submitter fill out the information below and on reverse side of sheet, in as much detail as possible. (Use a separate sheet for each sample.)

TYPE OR PRINT

1. Nature of sample: ________________

2. Submitter's catalog number, with identification of catalog (for instance, Univ. of Texas Dept. Anthro, no. 41AD72/219; C. H. Webb No. 16CD12/Log #6):

3. Name and number of site: ________________

4. Descriptive location of site (e.g., so many miles NE of a town, at such and such a place on a given stream):

5. Latitude & Longitude, at least to the minute: ________________

6. Location of sample within site, as precisely as possible: coordinates, elevation, zone, other specific provenience data:

7. Date of collection, name of collector (person or persons responsible for collection, rather than laborer or student:

(over)

Figure 1a. Specimen Data Sheet for the UT-Austin Radiocarbon Laboratory. (obverse)

(SPECIMEN DATA SHEET, page 2)

8. Context: For archeological samples--significant artifact association; cultural identification (phase, focus, period, or other), and other context (e.g., geologic) where pertinent. For geologic samples, stratigraphic assignment, etc. Similar data for other types of samples.

____

____

____

9. Previous radiocarbon dates, if any, bearing on the problem for which this sample is being dated. Give sample numbers assigned by dating laboratories, name of laboratory, and bibliographic references, if any:

____

____

____

10. Variables affecting validity of date: If the date turns out differently from what you expected, are there factors in the field or elsewhere which might help explain the discrepancy? (e.g., disturbance, intrusion, uncertainty of stratigraphic assignment, rootlet contamination, method of handling, use of preservative). If none are known, so state:

____

____

____

11. Significance of sample: What is the problem you are trying to solve? What part do you hope this date will play in its solution? In other words, why do you feel the sample is worth dating?

____

____

____

12. Estimated sample age: Your advance guess as to the age of the sample--may be stated as a range:

____

13. Signature of submitter: ______________________

Type or print name: ______________________

Address, institutional affiliation: ______________________

____

Date: ______________________

Figure 1b. Page 2, Specimen Data Sheet, UT Austin Radiocarbon Laboratory. (reverse)

Two different fractions of bone may be dated, the inorganic bone mineral carbonate associated with apatite or the organic collagen. Assays may be run on both fractions from the same sample, but generally only one is done. The apatite fraction is the least preferable of the two because of its propensity to exchange with modern carbon in groundwater. The collagen fraction does not exchange carbon with the environment which makes it more reliable, but collagen is one of the first losses in bone as it deteriorates, so often there is barely enough for a sample. A great deal of research has been done recently dealing with the dating of bone. Recent increasing interest in stable isotope research and Tandem Accelerator Mass Spectrometry (TAMS) have led to new methods to produce highly refined samples. Stafford et al. (1988) has briefly reviewed the history of bone dating from the original pronouncements of its unfitness, to recent TAMS measurements done on isolated amino acids which show high accuracy and precision.

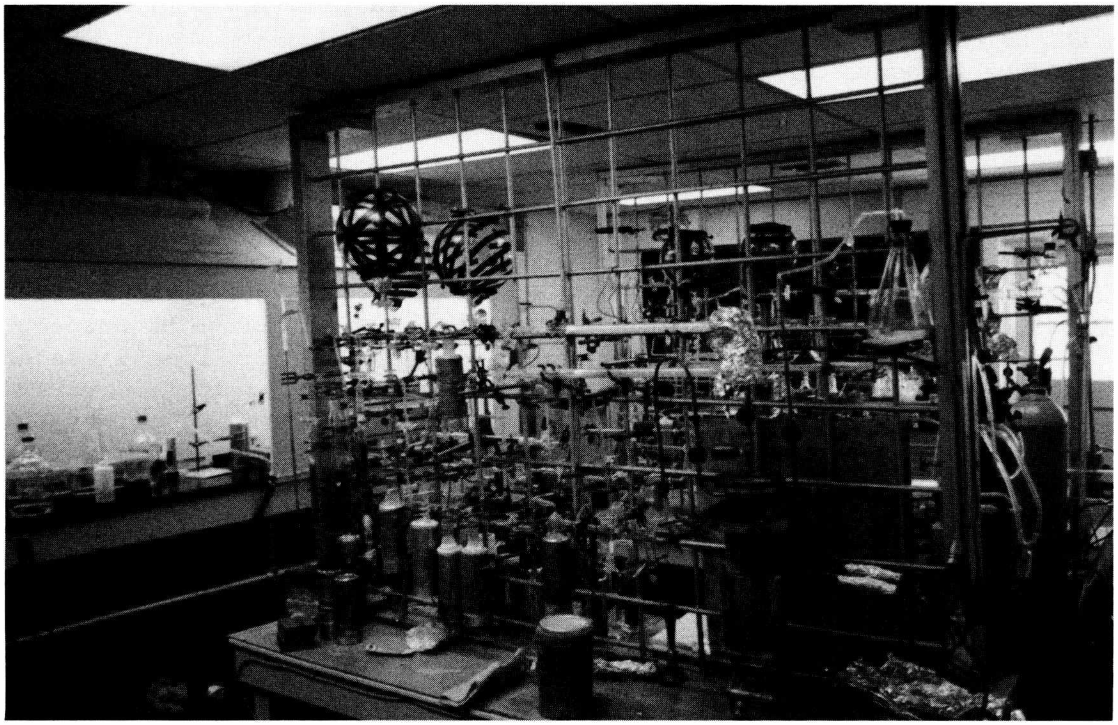
Shell is currently the most problematic type of sample, usurping the title once held by bone. River mussel and snail shell have been found to be unacceptable as ^{14}C samples because they exchange for old "dead" carbon from limestone at varying and unknown amounts (Michels 1973:161). The carbonate minerals in marine shells in buried sites exchange carbon much the same as the inorganic fraction in bone, while the tiny (less than 2%) organic fraction remains relatively unchanged. Samples need to be large in view of the fact that up to 50% of the outer shell must be ground or acid etched away. Marine shells need to be checked for recrystallization by X-ray diffraction. A recrystallized shell will yield an erroneous age.

Age assignments to sediments by ^{14}C method has recently shown success (Haas et al. 1986; Blum and Valastro 1989; Collins et al. 1989). Pretreatment must be tailored to the sediment type and its clay mineralogy. Assays are made on the organics or the carbonates in the sediment. Recent research in this area of ^{14}C age assignment will have a major effect on archaeological and geomorphological research in the near future.

After pretreatment to remove contaminants has been completed, the sample must be converted to an appropriate compound for measurement. There are three basic types of counting equipment: gas proportional, liquid scintillation, and direct (TAMS), which use carbon dioxide, benzene, and solid graphite compounds, respectively, for measurement (Figure 2, a,b). For more detail on measurement techniques see Taylor (1987:71-102).

After the sample is measured and the age calculated, the ^{14}C laboratory will report the result to the archaeologist. The information reported to the archaeologist will vary from laboratory to laboratory. The UT laboratory reports age in ^{14}C years with one standard deviation, sigma (σ), the isotopic fractionation, reported as the delta (δ) ^{14}C, and the delta ^{13}C if arranged for in advance. Beta Analytic commonly reports only the age and standard deviation.

There has been some debate among ^{14}C scientists about how much information should be given users. The argument flowed from two divergent points, one was that some ^{14}C scientists believed that archaeologists only wanted a date, and since they utilized that date so uncritically, why give them anything but what they want? The other side held that unless all the data were presented, how were the archaeologists going to learn? While archaeologists have become increasingly receptive to critical usage of ^{14}C in their site interpretations, there has been little response from the academic community to offer classes to foster this receptivity. One area of ^{14}C science that needs to be taught by the ^{14}C scientist is the correct use of calibration and correction tables. Often the two terms are freely interchanged in the archaeological literature when they are really two different things. Correction tables are arithmetic additions to the raw ^{14}C age to <u>correct</u> for isotopic fractionation and reservoir effects (cf. Stuiver and Polach 1977:Figure 1). Calibration tables on the other hand, <u>calibrate</u> corrected ^{14}C assays to the dendrochronology (cf. Ralph et al. 1973, Stuiver and Kra 1986, Pearson 1987). It has become very easy these days to load Stuiver and Reimer's (1986) computer calibration table into the P.C., enter the age and sigma (σ) and



a

b

Figure 2. a, ^{14}C chemical preparation apparatus: acetylene-benzene in foreground, CO_2 in background; b, Beckman LS 6000 IC liquid scintillation counters.

instantly receive a calibrated date. It is another thing altogether to understand how it was derived. This is where teamwork enters in; the collection, recording, handling, and processing can be taught by archaeologists at the field school level but the chemistry of samples, the statistics and the physical principles need to be taught by a ^{14}C scientist. An avenue that needs exploring would develop interdisciplinary studies, with applied science ^{14}C courses for the archaeologists, taught by the ^{14}C scientist.

Reporting ^{14}C Results

An age determination should be reported in corrected ^{14}C years before present (B.P. 1950) with one standard deviation or σ (i.e. 2000±100 B.P.). The A.D., B.C. calendar date may be noted parenthetically. If the 5730 year half-life age is calculated and reported, be sure to note which half-life age estimate you use in the interpretations. If calibrated dates are used, be certain to cite which table the calibrations came from. Current calibration tables use age ranges, some with multiple midpoints. These should be reported using the .95 or better confidence range, which is generally at 2 σ (cf. Stuiver and Reimer 1986). Provide provenience data and sample type with each assay. A tabular format makes the information easy to handle when you have more than a few assays.

CONCLUSIONS

In conclusion, I hope that this paper will enable other archaeologists to become familiar with the ^{14}C process and develop better relationships between themselves and ^{14}C scientists.

Considering that the ^{14}C assay process begins with the recognition and collection of sample materials by the archaeologist, the provenience and associations of these must be well documented. The careful and controlled collection of samples that relate to the event to be dated are essential for the ^{14}C scientist to carry out a meaningful analysis. Communication between the two sciences is paramount for the success of both. Any problems should be freely discussed before and after the analysis. As archaeologists become more knowledgeable about the ^{14}C process, either through classroom instruction or a bad experience (cf. Black 1986:146-154), they will find it easier to communicate and ask critical questions about their assays. Gone are the days when a "bad date" can be ignored and discarded. As archaeologists begin to use more applied science in their analyses, knowledge of the ^{14}C process will be a useful steppingstone to understanding these other archaeometric methods.

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AN INCISED STONE PENDANT FROM VAL VERDE COUNTY, TEXAS

C. K. Chandler

ABSTRACT

An incised stone pendant with an unusual design on both faces is documented and illustrated.

INTRODUCTION

This pendant was recovered from a dry rockshelter in a tributary canyon of the Pecos River in Val Verde County (see inset) by Howard and Marilyn Hunt. Several other artifacts such as fragments of woven matting, pieces of twisted vegetable cord, a painted pebble and a thin rectangular stone griddle also were recovered in this excavation. Except for the pendant, these kinds of artifacts are quite common in the dry shelters of this region.

It is important for its uniqueness of design and its evidence of extensive wear which may relate to some complex system of use.

THE ARTIFACT

This artifact (Figure 1) is made of fossiliferous limestone that is near marble. It is a dark tannish gray with darker mottling and is from the Boquillas Formation. It is 55 mm long, 37 mm maximum width, and is 6 mm thick. It weighs 22.3 grams. The single suspension hole is biconically drilled and is 5 mm in

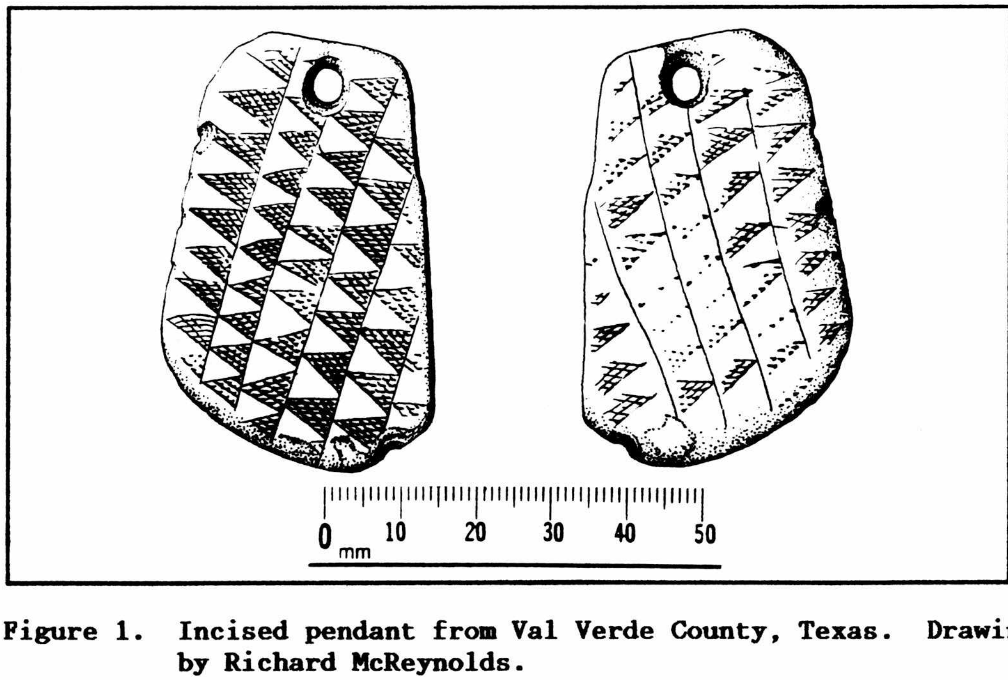

Figure 1. Incised pendant from Val Verde County, Texas. Drawing by Richard McReynolds.

diameter at the surface. The edges of this hole are extensively worn and reduced where the suspension cord wore into it. Both faces are covered with incised parallel bands of cross-hatched triangles which are connected at their bases. All surfaces are extensively worn and polished to the extent of obliterating some of the incising. This wear is more pronounced on the reverse which was probably against the body of the wearer. All surfaces, including the rounded edges,

have numerous multidirectional striations indicating the parent stone was abraded and shaped prior to incising. The extensive wear and polish indicate this was a favorite piece of jewelry worn over a long period of time and may have been handed down from one generation to the next.

On the end opposite the suspension hole there is the remnant of a biconically drilled hole in the edge. The artifact has been broken through this hole and the long edge adjacent to this hole has been broken in a nearly straight line to the opposite end. This edge was broken after the incised design was completed and three of the bands of cross-hatched triangles are interrupted along this edge. This break may have occurred during the drilling of the first suspension hole. This truncated edge is noticeably thicker than the other edges. Its corners are rounded and polished. It appears to be a recycled gorget which often break through the center hole.

DISCUSSION

Triangles are common in the rock art of the Trans-Pecos, but they rarely occur as single triangles standing alone. They are most often displayed in a sawtooth fashion (Figure 2, a) connected at their base and may be upright or inverted. They occur in solid painted colors of red, yellow and black and at one site in southeastern Presidio County there is a band (Figure 2, b) of alternating yellow and red triangles (Lowrance 1988). They rarely occur in the art of the Lower Pecos and are more plentiful in the western Trans-Pecos. The most triangles found at any site researched are at Payne Canyon shelter in Brewster County. These are in solid black and outlined black.

Connected triangles in the form of an X with closed ends (Figure 2, c) is a very elemental design that is sometimes used to depict human figures. These are found in the Big Bend area in solid black without appendages. They also occur in Chaco Canyon in New Mexico (Steed 1980), as petroglyphs with symbolic feet, legs, arms and heads (Figure 2, d, e). This style figure occurs often in the Hohokam petroglyphs at South Mountain, Arizona and along the Gila River to the west (Schaafsma 1989).

Human figures in black paint are depicted by closed end X's (which are really triangles connected at their apex) at the Abrigo Grande site in southeast Spain (Wright 1977), Figure 2 f, g. This site is carbon dated at 7200 B.P. and has a long period of occupation. These figures are said to be of unknown age but one is wearing a hat with a brim. The significance of this in Spain is unknown but if this occurred in the American Southwest, the painting would probably be interpreted as historic. The two figures illustrated (2 f,g) are holding atlatls and this might indicate their antiquity. The mention of these painted figures in Spain in no way infers a relationship in time or culture with similar figures in the American Southwest but does serve to indicate the widely separated use of this very elementary design to depict humans.

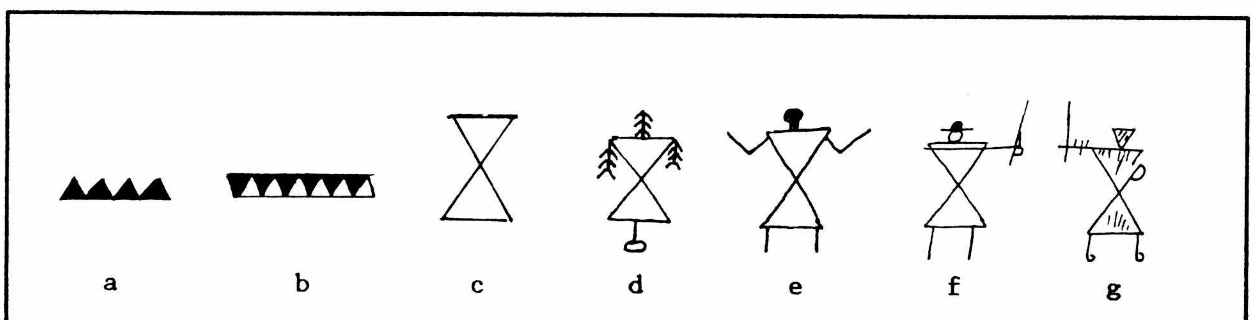

Figure 2. Various forms of triangle rock art of the Trans-Pecos. a, sawtooth; b, banded triangles; c, closed end X; d-g, X form with symbolic feet, legs, arms and heads. Drawings by the author.

Cross-hatching is rare in Texas rock paintings but does occur in black, orange and red (Kirkland and Newcomb 1967); Lowrance 1988). These cross-hatchings often stand alone and are not part of any identifiable figure. Cross-hatching is most often found in the petroglyphs of human and animal figures in the Jornado and Gobernador styles of the Southwest (Schaafsma 1989) and are reported by Kirkland and Newcomb (1967) at the Brownfield Ranch petroglyph site in Nolan County and at Paint Rock Springs on the South Llano River near Junction. They also report an unidentified fish-like petroglyph at Palo Duro Canyon with incised cross-hatching. A small broken pebble from Fate Bell shelter has an incised design of banded cross-hatching that encircles the pebble both laterally and longitudinally and forms a cross on each side.

None of the incised pebbles reported by Jackson (1938) have triangles or cross-hatching. Of the several hundred painted pebbles illustrated by Davenport and Chelf (n.d.) none have true triangles; however, one specimen from Parida Cave in Val Verde County is reported by Alexander (1970) with two solid black triangles attached to a straight line in the fashion of pennants.

Painted pebbles are quite common in the Lower Pecos and are generally considered to be involved in female fertility rites.

Both triangles and cross-hatching are common design motifs on Caddoan pottery vessels and on some coastal pottery (Suhm and Jelks 1962). This design is also widely found on long bone implements in Texas sites (Hall 1989) and the variations in the geometric design patterns incised on the surfaces of these bone implements are suggested as indications of individual ownership or identification of particular bands or lineages. That suggestion does not appear to be applicable to the pendant reported here.

The near total absence of triangles and cross-hatching in the rock art of the Lower Pecos area appears to have cultural implications. However, it is possible these designs may have been used in body painting, tattooing or painting of garments, but evidence for this has not survived.

Shaped stone ornaments have a long history in the southwestern desert cultures and were quite common in the Mogollon area (Mock 1987). However, ornaments of all kinds are rare in the archaeological record of the Lower Pecos compared to the numerous flint, bone and wooden artifacts of a more utilitarian nature. Bone beads are the most common items of adornment found in lower canyon sites. Small pendants of mussel shell or an occasional *Olivella* shell bead or stone pendant also occur, but none of these are numerous (Shafer 1986).

An extensive search of the literature has revealed only one other artifact with a design similar to the one reported here. It is an incised stone pendant that may have been triangular or teardrop shaped before it was broken. The incised design is two banded rows of cross-hatched triangles on each side and is very much like the Val Verde County specimen. It was recovered in a Texas Department of Highways excavation of the Squawteat Peak site in Pecos County, Texas (Young 1981). This site is about 75 miles northwest of where the Hunt specimen was found and is about 12 miles from the Pecos River.

CONCLUSIONS

The artifact reported here is unique for its decorative design and its extensive wear and polish. It is the only artifact with this design presently known from the Lower Pecos and apparently was an item of great personal value to its owner. It may have belonged to a visitor to the area or to a special person among the local people. Its uniqueness suggests that it belonged to an important individual who may have been a chief, shaman or medicine man.

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THE RUCKER CAVE, EDWARDS COUNTY, TEXAS

Glen L. Evans

In the spring of 1948 the late E. T. Rucker of Del Rio, Texas showed me a collection of large flint projectile points typical of types found in archaic burned rock middens throughout the Edwards Plateau region. He had found the points around an unusually large burned rock midden on his ranch in southwestern Edwards County, Texas. His interest in the midden at that time, however, was not because of the artifacts but because it suggested to him the probability of an unknown source of water in the vicinity--and he needed more water for his stock.

Other burned rock middens he had seen were located near springs and spring-fed streams, whereas this one was in a dry upland environment some two miles from the nearest known source of water. He reasoned that the large amount of midden debris must indicate that Indians had occupied the site for a very long time, and that they would not have done so without a convenient water supply.

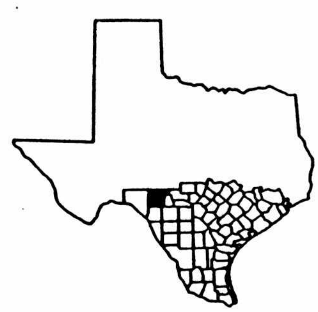
There were no playas and no intermittent streams of consequence in the area to furnish water, even in wet seasons. So he was confident that the Indians had obtained their supply from a nearby spring that had later become inactive. Now he hoped to relocate the site, intending to dig out the accumulated fill that, presumably, had long since choked off its flow. His own efforts to relocate indications of a defunct spring having failed, he thought that a field geologist might recognize evidence that he had not. So he asked my help and I agreed to try to find it.

Accordingly, several weeks later Jim Meadow, a young field assistant, and I went to the ranch, and Mr. Rucker drove us to the midden. It was, as he had reported, much larger than most, and its location within a substantial waterless area was indeed unusual, though not, I believe, unique. We scoured the surroundings on foot but found no indication whatsoever of a former spring, or of any other pre-existing source of water. By the time we had finished our disappointing reconnaissance it was past midday, and unseasonably hot.

When Mr. Rucker and I returned to the truck Jim, who had preceded us there, was standing a short distance east of the midden with an inexplicable broad grin on his face. I called to him that we were ready to leave, and he replied, laughing, "I just found the coolest spot in Texas to rest, and I hate like the mischief to leave it." Half-expecting some kind of practical joke I went over to where he was, and found, to my amazement, that he wasn't joking at all. A current of deliciously cool air was rising through the rocky soil at the exact spot where he was standing.

Clearly the air was coming from some kind of cavern system beneath us. And by some quirk of fate Jim had appeared at that exact spot at a time when the barometric pressure was such as to allow the cavern air to escape, and when the outside temperature was hot enough for him to feel the contrasting coolness.

The cool air, with its faint smell of moist underground places, so aroused our curiosity that we couldn't wait to learn more about its source. Forgetting about heat and hunger we brought tools from the truck and cleared off the rocky rubble and soil from an area that included Jim's cooling-off spot. When the bedrock was exposed we discovered that the cool air was emerging from minor vents, in a roughly rounded feature of the bedrock, some 30 inches in diameter. On closer inspection the feature turned out to be a plugged opening in the limestone roof of a cavern and our excitement was boosted again. The plug consisted of a number of limestone slabs fitted together so tightly that we had to pry them apart with a crowbar, an admirable piece of work that effectively closed and concealed the opening. Except for the flow of cool air through its vents, it might well have escaped our notice, even after the overburden had been removed.



The intelligent selection and arrangement of the slabs left no doubt that the plug had been emplaced by deliberate human effort. But when, by whom, and for what reason? The thoroughly settled condition of the plug slabs, and the considerable weathering stains on their upper surfaces, indicated that they had been in place and undisturbed for a very long time. We surmised, understandably, that the ancient Indians responsible for the adjacent burned rock midden had plugged the opening, and had done so to protect something they valued inside the cavern.

After removing the plug slabs we saw, about three feet beneath the opening, the top of a talus cone--a hill-like accumulation within the cavern of fallen rocks from the chamber roof. This made entering the cave a simple matter. So, with a supporting rope and a flashlight, I entered and worked my way down to the base of the talus cone resting on the limestone floor of the cavern's upper chamber. I had to keep reminding myself to slow down, having become quite excited and eager from hoping to find--half-<u>expecting</u> to find, really--archaeological treasures that had lain for perhaps a thousand years or more, sealed off from the world's prying eyes and greedy fingers.

But on that score I was in for a big disappointment, for I found no such treasures. What I did find in the accessible parts of the chamber was, to my astonishment, the partly-eaten carcass of a yearling goat, but no trace of man, ancient or modern. I realized that objects of archaeological significance might lie buried beneath, or within, the huge talus mound. If so, they almost certainly would never be found. However, I soon found that the cave was a source of cool limpid water, which may well have been what those who plugged its entrance were trying to protect.

The water dripped steadily from several roof fractures lined with slender living stalactites. On the chamber's limestone floor beneath the fractures, which here was free of talus, was a travertine lined basin about the size of a bathtub. The drip water filled the basin and overflowed in trickles down a steep drop of, perhaps, twenty-five or thirty feet, to a lower and much larger chamber. Having neither the equipment for descending into the lower chamber, nor the time needed to explore it, I had to leave it with only a very general impression of what it was like. But with the aid of my flashlight I saw that water was also dripping from one or more of its roof fractures.

Back at the surface I told Mr. Rucker what I had seen, and that I thought we had stumbled on to the source of the burned rock midden Indians' water supply--even though I had found no sign of the Indians themselves in the cavern.

As astonished as I had been to learn about the goat carcass, he suspected that it had been brought in by a female bobcat to feed her litter of kittens. But whatever brought it in had certainly used an entrance unknown to us; nothing larger than a field mouse could have squeezed through the chinks between plugging slabs discovered in the entrance. Mr. Rucker very much wanted to find that entrance, but to the best of my knowledge he never did.

Even though it was by a highly improbable accident rather than through use of geological methods, and underground instead of at the surface where he had expected it, I still believe that we found Mr. Rucker's hypothesized spring. At the time I saw it the cave was still making enough water for the needs of a small band of Indians, but not nearly enough to justify developing it for stock water.

A year or two later, in eastern New Mexico, we discovered a number of ancient Indian wells which, upon being abandoned, had been filled to the surface with earth, presumably to prevent them from being found and exploited by other Indians. Maybe the Rucker cave entrance had been plugged and concealed for the same reason. And maybe concealing of rare and widely separated water sources in dry regions was more generally practiced by nomadic aborigines than we have yet much reason to suspect.

CLOVIS POINTS FROM SOUTHEAST DALLAS COUNTY, TEXAS

Timothy D. Smith and Clay M. Garrett

ABSTRACT

This report describes and illustrates two Clovis type points and one possible Ross County Clovis type distal fragment from southeast Dallas County. All artifacts were recovered from sand and gravel pit operations and no longer in true stratigraphic context.

INTRODUCTION

A survey conducted several years ago (Meltzer 1987) revealed 205 Clovis points from Texas. In the three years following the report at least 14 additional specimens have been recorded (Chandler 1990:27; Preston 1990:3). To date, three Clovis points have been recorded from Dallas County, Texas (Meltzer 1987: Suhm and Jelks 1962; Crook and Harris 1955). Two additional specimens and one possible Ross County Clovis type (Prufer and Baby 1963:15) fragment from southeast Dallas County, are reported herein.

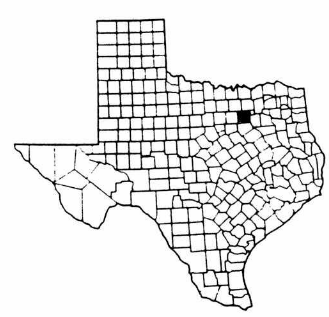
The site is situated on a T-2 terrace above the floodplain of the Trinity River system. Gravel pit operations afford the opportunity to recover artifacts from stratigraphy that would otherwise remain unexposed. While megafaunal remains (mammoth, mastodon, bison, camel and others) are relatively common in the area, no direct association with the artifacts has been established. Endemic late pleistocene megafauna, and the presence of numerous springs, may have attracted early man to the area. We tentatively suggest that there is a high possibility of site occupation at this location by Clovis man.

These artifacts were recovered following heavy precipitation during the spring of 1990.

ARTIFACT DESCRIPTIONS

<u>Clovis Type (Figure 1-A).</u> Specimen A is a complete artifact made from a glossy, caramel colored flint with white inclusions, typical of Edwards Plateau material. Lighter areas near the distal half may be a result of patination. The specimen is 55 mm in total length and has a maximum width of 26 mm at midbody. The base is 20 mm in width and has a concavity of 2 mm. The flute on the reverse face is 19 mm in length. One primary flake and two secondary flakes produced a channel 15 mm in width. The weight is 10.1 grams. Workmanship is of high quality. Slight reduction in width of the distal half is evidence of having been resharpened while still on the shaft. A shallow right-hand alternate bevel is present on this specimen. Basal smoothing is present. Smoothing extends to 25 mm on both lateral edges. It should be noted that lateral edge smoothing appears to be faceted, indicative of grinding against a flat surface at different angles.

<u>Clovis Type (Figure 1-B)</u>. Specimen B is a nearly complete artifact missing the very distal tip. The material is ivory colored, fine grained quartzite. The total length is 75 mm. The weight is 23.7 grams. The maximum width is 17 mm located at the base. The basal concavity is 2 mm. The flute on the obverse face is 23 mm in length. Two primary flakes produced a channel 14 mm in width. The flute on the reverse face is also 23 mm in length. One primary flake and three secondary flakes produced a channel 18 mm in width. The specimen has a flattened lenticular cross section,



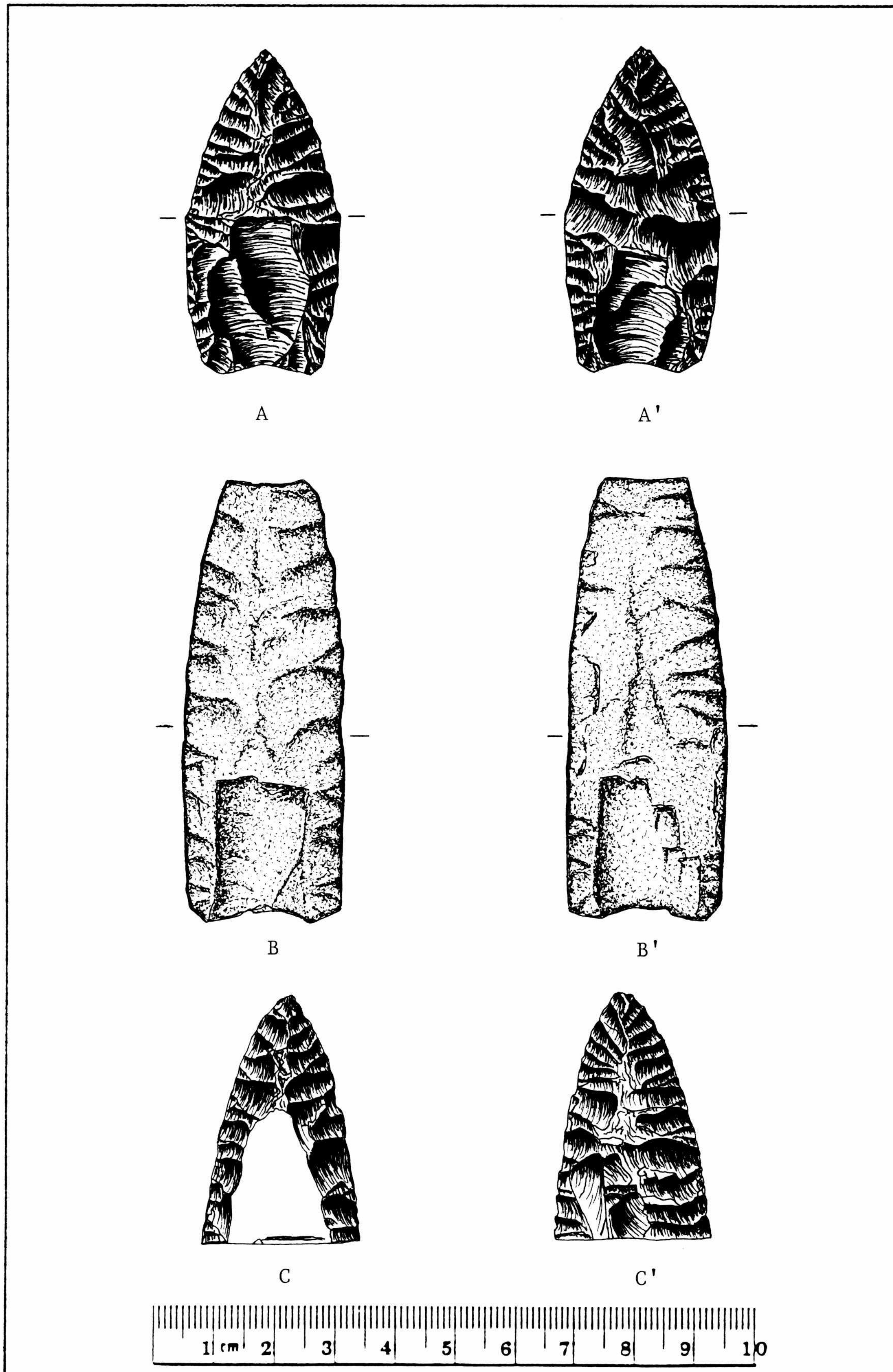


Figure 1. Paleolithic artifacts from southeast Dallas County, Texas. A, Clovis type; B, Clovis type; C, Ross County Clovis type.

and workmanship is of high quality. Basal smoothing is present. Smoothing extends to 30 mm on both lateral edges.

Ross County Clovis Type Fragment (Figure 1-C). Specimen C is a fragmentary distal portion, made from translucent amber colored flint of probable Central Texas origin. The obverse face exhibits what is believed to be the distal portion of a large shallow flute. No hinge fracture is present at the point of flute termination. This fluting or thinning technique is typical for the Ross County variant (Perino 1985:330). The specimen is 41 mm in length and 26 mm wide at the fracture. Maximum thickness is 8 mm, located medially at the point of flute termination. While evidence of fluting or thinning is present only on the obverse face, workmanship on both faces is of meritorious quality. Lateral edge smoothing is not present.

DISCUSSION

Clovis points are believed to have been multi-functional tools, serving as projectile points and as knives. Specimen A has been extensively resharpened. Meltzer (1987:49) states that only 12.8 percent (23/180) of Clovis points from Texas have been reworked. Specimens B and C both exhibit lateral snap fractures. Meltzer indicates that lateral snap fractures are possibly indicative of use as a knife. Lateral snap fractures were the most common breaks recorded in his survey.

It is interesting to note that Specimen A has a shallow right-hand bevel similar to a Clovis specimen reported from Kendall County, Texas (Chandler 1990a:31). Johnson (1989) suggests that this resharpening technique may have originated in the area.

These artifacts originate from a site that may have been occupied from Clovis times to the Late Prehistoric. A chronological continuum of diagnostic point types are represented at this site (i.e., Dalton, San Patrice, Scottsbluff, Gower, Wells, Kent, Gary, Rockwall, Bonham and others). Recovering artifacts from ongoing gravel mining operations should be considered a form of salvage archaeology not to be ignored. Diagnostic types recovered from disturbed stratigraphy still offer useful data concerning manufacturing technique, material, and general type distributions.

ACKNOWLEDGEMENTS

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C. K. CHANDLER, current Secretary and also Documentation Chairman of STAA, is a retired railroad management official and engineering consultant with an insatiable interest in Texas archaeology. C. K. was the 1985 Robert F. Heizer Award winner for his extensive work in south Texas archaeology (see Vol. 13, No. 1). Also, in 1985, he recorded more archaeological sites with the Texas Archeological Research Laboratory than any other individual. C. K. is a valued contributor of manuscripts to *La Tierra* and the *Bulletin of the Texas Archeological Society*, covering such varied subjects as metal points, rock art, and hearthfield sites in Terrell County. He is a TAS Fellow, and is now a Steward for the Office of the State Archeologist. The Chandlers reside in northern San Antonio.

GLEN L. EVANS is an "actively retired" geologist living in Austin, Texas. He conducted mineral resource surveys for the University of Texas Bureau of Economic Geology and led many archaeological and paleontological expeditions for the Texas Memorial Museum, including excavations at most of the major Early Man sites of the 1930s-1950s. He has maintained an untiring interest in natural history, particularly of his native Texas. Glen has guest-lectured to STAA on his work at Kincaid Rockshelter and was also a featured speaker at the summer 1990 TAS field school.

CLAY M. GARRETT is an Herpetologist for the Dallas Zoo. He is currently researching color polymorphism in tropical snakes, and studying the behavior and habitat utilization of new world pitvipers in Costa Rica. He is also an accomplished natural science illustrator having many published works; his most recent contribution being *The Venomous Reptiles of Latin America*, published by Cornel University Press. Clay's archaeological interest began several years ago, after finding lithic materials while on botanical collecting trips for the Chihuahuan Desert Research Institute. He is currently a member of the Dallas Archeological Society and the STAA.

THOMAS R. HESTER is Professor of Anthropology and Director, Texas Archeological Research Laboratory (TARL) at the University of Texas at Austin. Dr. Hester taught at the University of Texas at San Antonio from the time the University opened in 1973. He created the Center for Archaeological Research and was responsible for developing the B.A. and M.A. programs now available to students of Anthropology. He has done field work in Texas, the western United States, Belize and Egypt, and is the author of numerous books and papers on archaeology including *Digging Into South Texas Prehistory* (1980) and *A Field Guide to Stone Artifacts of Texas Indians* (with Ellen Sue Turner, 1985).

JEFFERY A. HUEBNER is a PhD student at the University of Texas at Austin, and Staff archaeologist with the Texas Archeological Research Laboratory. Last summer he directed excavation at the La Jita site (41UV21) for the Texas Archeological Society field school in the Sabinal Canyon. Jeff was recently awarded a research grant from Geochron Laboratory to study dietary patterns in the Lower Pecos using stable carbon isotope chemistry.

TIMOTHY D. SMITH is an avocational archaeologist whose family's 150-year span in northeast Texas helped to spark an interest in the area's history. Tim is a direct descendant of Daniel Montague, pioneer and surveyor for the Republic of Texas, and proprietor of an Indian trade store on the Preston Bend of the Red River (Montague County is named for him). While collecting biological specimens in the Trans-Pecos region of Texas, Tim noticed the volume of lithic debitage eroding out of the thin topsoil characteristic of the area. This led to an enduring interest in Texas prehistory. Tim's primary interests are: Pre-Archaic projectile point typology, the origin and distribution of lithic materials, and relationships between Texas and Mississippi Valley people in the Pre-Archaic.

INFORMATION FOR CONTRIBUTORS

La Tierra publishes original papers and selected reprints of articles involving the historic and prehistoric archaeology of southern Texas and adjacent regions. Original manuscripts are preferred. Articles involving archaeological techniques, methods, and theories are also considered.

Articles may be submitted in any form, although double-spaced typed copy is naturally preferred. However, we will review and work with material in any form to encourage those not comfortable with typewritten or other formal methods; we are more concerned that you submit your ideas and document your materials than the form of materials with which we have to work. If you can supply a 5 1/4" or 3 1/2" disk, IBM or compatible, in ASCII form, it will be very helpful.

Figure 1 of any manuscript should be a county or regional map to show the location of your sites. If you choose not to disclose the specific location of the site, show at least the county with its major river or creek drainages. A small Texas map showing the location of the county in Texas will be added, to provide our readers, who are not familiar with the area, some idea of the general location. Other figures can be line drawings or photographs; line drawings are preferred if they are good quality, since every photograph used costs an extra $50-$60 for a metal plate and set-up charges. If you need assistance with illustrations, please let us know--there are several STAA members who have volunteered to help with illustrations. For examples of good artifact and map illustrations, see those by Richard McReynolds and Ken Brown in previous issues.

All figures should contain an appropriate caption and, where necessary, identification of each specimen (a, b, etc. or 1, 2, etc.) to aid referencing individual specimens in the text. The suggested procedure is to photocopy your original drawing and write in captions and identification letters on the photocopy. This saves the original for our use in final preparation of camera-ready copy.

Citations of references should be embodied in the text, giving the author, date, and page (e.g., Hester 1980:33). All references cited should be included in a References list using normal archaeological form (see articles in this issue for examples). The Reference list should not include publications not referred to in the text. Personal communications are cited in the text (e.g., Anne Fox, personal communication 1977) but need not be included in the Reference list.

The main objective of this quarterly journal is to provide a way for STAA members and others interested in the archaeology of southern Texas to share the information they have with others. We encourage your full participation through submission of your information for publication; we are particularly interested in receiving manuscripts from those in the less well-known counties of our region, to document even surface finds and old collections. Only through such total member participation can we, as a group, build up a comprehensive picture of the archaeology of our area!

Be sure to indicate the author's name (or names, if more than one author) on the manuscript. Make a photocopy of the submitted material for your records before mailing to the Editor. Each author is mailed two "author copies" upon publication.

Manuscripts or hard copy of disk, if used or other information may be submitted to: Evelyn Lewis, Editor, *La Tierra*, 9219 Lasater, San Antonio, Texas 78250. Disk can be mailed directly to Shirley Van der Veer, 123 E. Crestline, San Antonio, TX, 78201, or to me. Let me hear from you soon.

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 quarterly journal, newsletters, and special publications to meet the needs of the membership; To assist those desiring to learn proper archaeological field and laboratory techniques; and To develop a library for members' use of all the published material dealing with southern Texas.