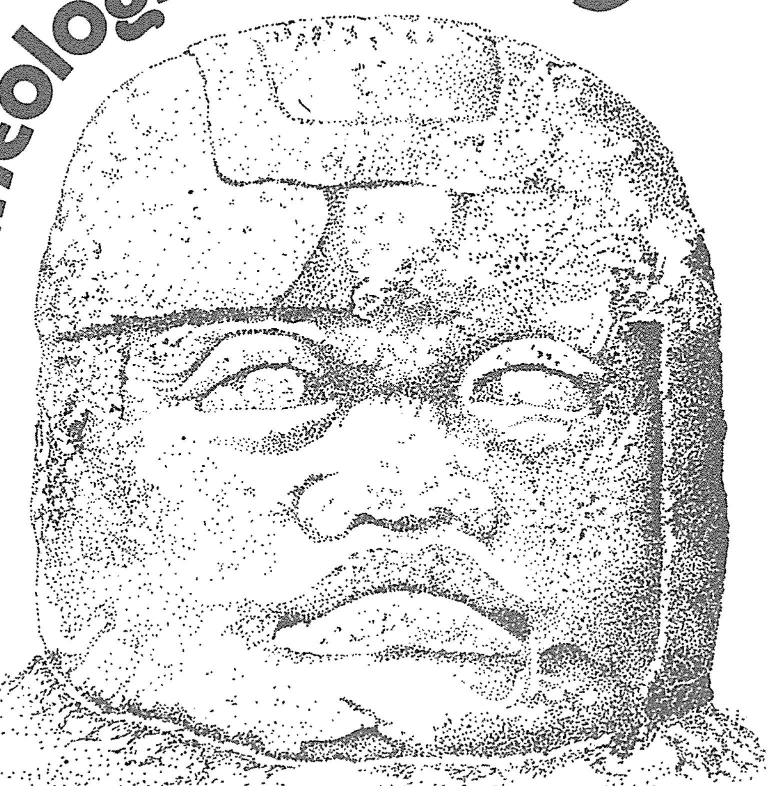
Bulletin of the Texas Archeological Society



VOLUME 47

Published by the Society
Austin, Texas 1976

TEXAS ARCHEOLOGICAL SOCIETY

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

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

Officers of the Society 1975-1976

Membership and Publications

Membership in the Society is for the calendar year. Dues are as follows: Regular—$7.50; Chartered Societies and Institutional—$10.00; Contributing—$25.00; Life—$150.00. All members of the Society receive the *Bulletin*, which is published annually, and *Texas Archeology*, a newsletter that is mailed out about four times a year. A monograph series, *Special Publications*, is also published by the Society. Back issues of the *Bulletin*, up to and including Volume No. 39, that are still in print may be obtained for $5.00 per volume. Subsequent volumes are available at a cost of $7.50.

Address orders for publications and membership applications to Secretary-Treasurer, Texas Archeological Society, Southern Methodist University, Box 165, Dallas, Texas 75275.

Bulletin of the
TEXAS ARCHEOLOGICAL SOCIETY

Volume 47/1976

Thomas R. Hester, Senior Editor
Harry J. Shafer, Co-Editor

Nancy Reid, Cover Design

PUBLISHED BY THE SOCIETY AT AUSTIN, TEXAS
1976

TABLE OF CONTENTS

NOTES

BOOK REVIEWS

LA VENTA: A CRADLE OF MESOAMERICAN CIVILIZATION*

ROBERT F. HEIZER

ABSTRACT

The site of La Venta, on the Gulf coast of Mexico, has yielded a wealth of information on the Olmec, the earliest known manifestation of high culture in Mesoamerica. The paper traces the history of archeological research at this important site. Past and present interpretations of the site's age, function, and significance are reviewed.

Before Hernando Cortés and his handful of fighting men equipped with horses, guns and steel swords conquered the Aztec nation in 1519, there had developed, and then disappeared, a number of civilizations in the culture sphere which anthropologists call Mesoamerica. By the word "civilization" I am referring to a qualitative level of cultural development which is difficult to define strictly, but in general terms can be applied to societies with large populations with a highly developed division of labor, a stratified or hierarchial social structure with ranking ranging from low to high, with some broad governmental apparatus, cities or large urban communities, an organized religion, monumental architecture, technically good sculpture or some other form of fine art, an economic base resting on agriculture, a calendar, mathematics, and some kind of writing. Not every one of these features must be present for a culture to be classed as civilized, but most of them should occur. There is no disagreement that the Maya of two thousand years ago, the people who built the city of Teotihuacan in the valley of Mexico in the first centuries of the Christian era, the Toltecs whose capital lay at Tula, not far distant from Mexico City, and the Aztecs whose state Cortés destroyed were bearers of civilization. Where and when this continuum of civilizations of Mesoamerica began we cannot be certain, but as of this moment, it appears to have generated among an older people to whom the name Olmec has been given. By that I mean to say that the search by archeologists for the earliest manifestation of high culture in Mesoamerica can take us back no further in time than the great sites of the Omecs which were founded on the Gulf

*Annual lecture given on October 30 to the Texas Archeological Society in San Antonio.

EDITOR'S NOTE: The first scientific report of the major 1955 excavations at La Venta was published by Professor Heizer in Vol. 28 (1957) of the *Bulletin*.

Coast in the first few centuries before the beginning of the first millennium B.C.—around 1100 or 1200 B.C.—some 3000 years ago.

Agriculture began around 5000 B.C. in Mesoamerica, and as the plants were improved and increasing dependence was placed on crops for basic subsistence, the populations practicing farming also grew. Settled village life, trade, aesthetic expression in pottery and stone sculpture develop as integral elements of the gathering elaboration or enrichment of life. At some point in time, as all the essential ingredients for what seems to be a kind of quantum jump are assembled, there occurs a cultural revolution, presumably a peaceful one, from which a new kind of society arises. An analogy would be an explosive chemical reaction which is effected by adding a bit of this compound and a little of that one until suddenly everything comes together with a loud bang. It is supposed that the elements of the civilizational explosion in Mesoamerica were developing over time until they reached the proper mixture of population numbers, assured food supply, level of social and political organization, technological know-how, and many other features, and that about 3000 years ago in the lowland area of the Gulf of Mexico the break-through occurred.

The Olmec culture is known to us from the substantial excavation of two major sites: La Venta and San Lorenzo in southern Veracruz and northern Tabasco, and two other equally large but less well studied sites named Tres Zapotes and Laguna de los Cerros. Until 50 years ago this was a little known part of Mexico. There was no industry, populations were not large, there were few roads, and as a result scarcely nothing was known of the archeology there. In 1925 Oliver La Farge and Frans Blom made a trip through this country, and hearing of sculptures on an island of dry ground rising above the swampy lowland along the Tonala River, went there and were shown a number of unusual stone carvings. Their visit to La Venta island was brief and their study was necessarily superficial. The monuments they saw they thought looked vaguely Mayan in type, though later work showed this to be wrong. Not until 1939 was the site next visited, this time by Matthew W. Stirling, now recently deceased, who saw not only the sculptures earlier viewed by Blom and La Farge, but found many others.* He recognized these as quite different in style than anything known from the Maya area, but resembling a limited number of others from the same general Gulf

*Stirling's work in 1939 was the first of a long series of research expeditions financed by the National Geographic Society to investigate the Olmec culture. Drucker and I were supported by the NGS in 1955, and on several subsequent occasions up to 1969.

lowland region. Here apparently was a different kind of culture, at least as expressed in its art style, which was highly developed and quite distinctive. Stirling thought, quite naturally, that the sculptured art belonged to the Classic period which ran from the second or third century A.D. to about A.D. 1000. In 1940 and 1942 some stratigraphic excavations were carried out in the mounds at the La Venta site, and various carved jade objects and pottery were recovered. All of this was attributed to the Classic period. This was understandable because these were the first collections of small Olmec material, and there was little to compare them with. In the meanwhile Mexican archeologists such as Miguel Covarrubias were saying that the recently discovered Olmec materials from La Venta did not belong in the Classic period, but rather in the Preclassic, but North American archeologists gave this opinion little credence. The stage of cultural development as expressed in the stone sculpture and the large size of the site seemed to best correlate with the imposing Maya ruins and sculptures in Guatemala and Yucatan as well as with the largest of the Mesoamerican sites, Teotihuacan. In 1955 Philip Drucker and I carried out a five months excavation at the La Venta site and found a number of new sculptures, a literal treasure of jade objects, and worked out the complicated stratigraphy from which we concluded that the site had originally been laid out, and a patterned series of earth mounds built, which were then enlarged on three occasions, apparently at more or less regular intervals. We could not even guess whether the interval between the rebuildings was to be measured in decades or centuries. Among other things we did was to make careful collections of wood charcoal from layers of earth fill assignable to the first, second, third, or fourth building period, and in 1957 these were dated by the radiocarbon method at the University of Michigan. Much to our surprise, and even to the disbelief of a number of our American colleagues, but not to our Mexican colleagues such as Covarrubias, the radiocarbon dates told us that the site had been first built about 800 B.C. The site was 1000 years older than nearly everyone had assumed it was. La Venta **was** a Preclassic site, as Covarrubias had long maintained, and not a Classic period site as most people, ourselves included, had wrongly assumed. At La Venta, it seems, we had excavated a very large site with big mounds and monumental sculpture which appeared to be of Classic type, but which chronologically fell comfortably in the preceding period of the Preclassic where sites of this size and degree of development were, by definition, not supposed to exist.

The La Venta site is nearly a mile long, oriented north and south, and about a third of a mile wide. In this rectangle are a large number of earth mounds, an earth pyramid which dominates the scene measuring 420 feet in diameter and rising 110 feet into the air and with a cubic mass of about 4 million cubic feet. That mound of clay impressed us as having represented a great deal of human labor to carry and pile up the earth, but in 1968 we were really surprised to learn that a large rectangular flat-topped elevation (now known as the Stirling Acropolis) lying southeast of the pyramid which we assumed was a natural hillock which had been levelled off was entirely man-made and contains about 17 million cubic feet of earth. These immense shaped piles of clay—one can scarcely dignify them as architecture—clearly point to an enormous expenditure of human labor to procure and pile up. Over a hundred stone sculptures, of which dozens weigh over ten tons and a few approach 50 tons in weight also imply a sizeable labor force to move them—all the more so when it is known that the source of the stone lies some 80 miles away on the southern slope of the Tuxtla Mountains (Velson and Clark 1975). It is obvious that a lot of people did a lot of work at the La Venta site, and that this work was not directly connected with maize farming or the daily living routine. If there had been a large urban population at La Venta, you might suppose that there was some form of public levy on the labor of the inhabitants to do so many days of work per week, or month, or year. But, since the small island of La Venta which has a surface area of only two square miles and which will support not more than 150 persons by the tropical slash-and-burn farming system, shows no evidence of having held a large population, we must conclude that the site was an isolated center whose support came from people living some distance away (Heizer 1960; Drucker and Heizer 1960; Drucker 1961). That the La Venta site was a ceremonial or religious center and not a city is made certain by the way it is laid out, the nature of the mounds, the abundance of precisely and ritually placed buried offerings of jade objects of great value, the positioned stone sculptures, and the persons portrayed on those stone monuments. La Venta, in short, was a religious capital of the people we call the Olmecs. The elaborately costumed persons shown on the monuments can be taken either as priests or secular rulers, but more probably religious heads not only by reason of their elaborate costumes, but also because these monuments dominate the site. We can see in these sculptures, if we assume them to be portraits, the very persons who were the chief officers of the religious precinct. Perhaps also similarly important persons are represented in the colossal stone heads that occur at La Venta and other Olmec sites in Veracruz and Tabasco. In short, if the site itself was built to serve for ritual activities, the immense labor required for mound

FIGURE 1. *Reconstructed Low Relief Scene on Stela 3, La Venta Site.*

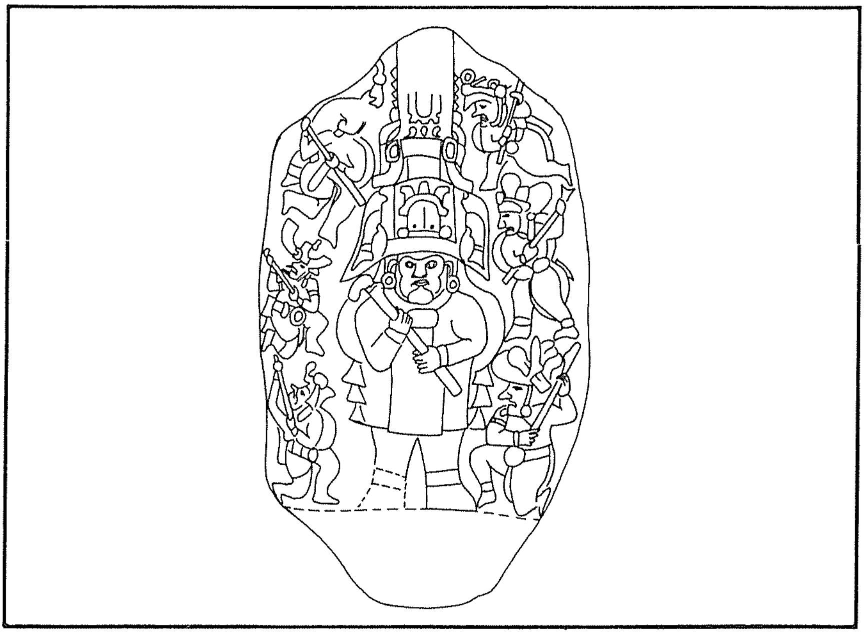


FIGURE 2. *Low Relief Sculpture on Stela 2, La Venta Site.*

construction and moving the great stones from the Tuxtla Mountains to embellish the site must have been done at the order of the people in charge of the site—that is, the priests. So from all this comes the clear suggestion that the La Venta priesthood was vested with great power and authority over a large general population whose time and energy it could call on when desired. The picture we get of La Venta society is that of a theocracy or rule by the priesthood (cf. Heizer 1961). The site, we think, was the nerve center of a society whose main efforts were directed toward the maintenance and benefits of a religious cult—in other words, the capital of a theocratic society, analogous to western Europe in the time before the Reformation when the popes ruled both politically and religiously from the Vatican.

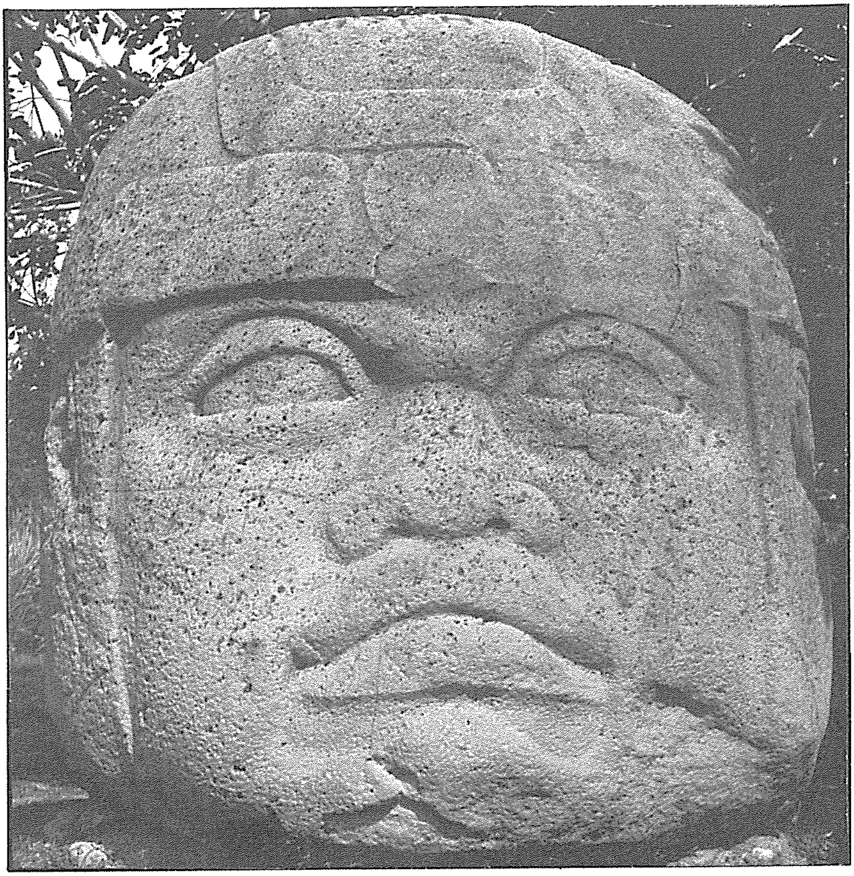


FIGURE 3. *Colossal Head No. 1, La Venta Site.* 2.41 m. high; weight 24 tons.

We know nothing certain about the origin of the Olmec culture itself, but we are in possession of some facts which allow us to speculate about this. I have devised a theory of how Olmec civilization came into being. I do not know whether that theory is correct, and I know of no way to prove it. And I know of no hard evidence which makes my theory invalid. Yet, it may be incorrect. When one formulates a theory of this sort he is rather like the judge who said that while he was often wrong he was seldom in doubt. There were people in the Olmec area before the great religious centers such as San Lorenzo and La Venta were founded. In these earlier archeological deposits we see Preclassic farmers living out their lives without any religious architecture or stone monuments. Whoever the mound-building, jade-carving and stone sculpturing people were who conceived of and built such centers as La Venta or San Lorenzo, it appears that they must have moved to these spots from some other locality. The most likely source area may be the Tuxtla Mountains which lie about 80 miles to the west, where stone is abundant, and the volcanic soils are very favorable to maize agriculture. The main purpose of the La Venta site and its activities I think, without going into the details of the proposition, was to carry out ritual activities directed toward agricultural fertility. We may suppose that in the Middle Preclassic period, between 1500 and 1000 B.C., the village farmers, perhaps those living in the Tuxtla Mountains, got talked into supporting an emerging religious elite, a body of people who were calendrical and weather experts, and who promised, in return for labor and goods, to exercise control of the weather through intercession with the deities of the sky and earth, and to guide the farmers in the yearly round of activities connected with farming—to tell them when to clear the forest for new fields, when to burn the dry slash at the very end of the dry season, when to plant the new fields just before the onset of the rainy season, and when to harvest the crops. Any miscalculation of these necessary elements of the agricultural cycle in this area, even today, may mean that the farmer will not succeed in growing an adequate crop. If the farmer is over-anxious and fires the dry field cuttings too soon he does not get a good clean burn, and in the interval before the rains start weeds and suckers from the field cleared from the forest may sprout so rapidly that the crop yield will be reduced. Planting too early can be a costly error since the seed may be eaten by insects, and planting too late after the rains have begun may discourage germination of the seed. The uncertainties of producing a crop large enough to feed your family are many, and it seems possible that an informed group of people who had studied the weather and knew how to correlate seasonal changes with an exact calendar might offer to the farmers a most attractive bargain of crop management in return for their support in building the sacred center where the necessary rituals could be carried out. Both parties got something out of such a social contract—the farmers were spared the uncertainties of producing the crop which was necessary for their survival, and the priesthood got their temple center and a pretty good living on the side. Once this contract was entered into between the religious elite and peasant farmers, larger and larger mounds and ceremonial precincts could be made, and if the system really worked the corps of specialists at the sacred centers could be expanded to include stone sculptors, engineers and architects to lay out new plans and supervise the considerable work of bringing the multi-ton stones to the centers to be carved. All of this formative process which I am suggesting did take place may have occurred in the Tuxtla Mountains. Then perhaps around 1200 or 1100 B.C. there occurred some major event, perhaps a devastating volcanic eruption in the Tuxtla Mountains—a volcanic cataclysm such as we know happened in 1793 in the Tuxtlas (Mozino 1913) when the earth shook, the San Martín volcano spewed out lava, and great clouds of hot cinders and ash were ejected so that the whole area was buried under many feet of cinders. All of the fields were buried, roofs were crushed by the ash, and some parts of the zone became no longer liveable. If one of these events had occurred not long before 1000 B.C., the population may have had to clear out in order to survive, and it may be that the population, already operating under a theocratic system, moved out into the coastal plain and established a new series of settlement zones, each with its ceremonial center or capital which was in time equipped with mounds, temples, sculptures of colossal heads, and the like. It is almost certain that the unusual form of the La Venta pyramid can be traced back to a prototype which exists in the Tuxtla Mountains, but more about this later.

In any case, whether or not you subscribe to the hypothesis of how the Olmec theocracy was born, where it spent its infancy, and how it happened to be transferred to the major sites of Tres Zapotes, Laguna de los Cerros, San Lorenzo and La Venta, at least we know these several major sites were established at about the same time and that they were all participating in the same distinctive style of sculptured art. After about 500 years the whole operation came to an end at these great sites—they were abandoned and never again used for the same purposes. Why the system failed we do not know—it is one of those genuine mysteries of archeology which archeologists cannot yet, and perhaps never can, answer. Possibly the lowland zone was invaded by another people who killed off the priesthood and thus deprived the large mass of simple farmers of leadership and direction. Perhaps there happened a series of bad weather years with too short or too long dry seasons, or unseasonably early rains, or plagues of pests which attacked the crops, and since these events could not be controlled or anticipated, the reputation of the priesthood declined to the point where they no longer commanded the support of the larger population for whom they worked in return for other services. Natural disasters, in brief, may have been the cause of disrupting what I earlier called the social contract between the priests and the farmers.

Why the Olmec culture developed its distinctive art style; why the rituals which we can get hints of in the great pits with their stone offerings at the La Venta site took the form they did; what was the inspiration for the distinctive art style which we label Olmec, and a half-hundred other questions that can be asked, are ones for which we have no answers. Olmec culture in its material expression of architecture, art and ritual, and in its more dimly perceived sociological aspects, is one which seems not to have been copied from, modelled after, or adapted from some other and earlier known culture; rather it is one which is rich in originality and inventiveness. What may be the explanation of Olmec culture in its developed form as seen at La Venta is as the climax of an essentially self-contained experiment in cultural creativity, one led by a newly organized religious elite which was endowed with great energy and innovative genius. Perhaps that dynastic group died out after five or six centuries and their successors were unable to maintain the formula which had for so long worked effectively. Or, perhaps the persuasions of political power and its application were so great that the temptations of the excessive use of that power came to be seen as a misuse of authority. Something very like that happened in the United States in the last few years with Watergate. But whatever the course of events was, and the reasons for these, the scene of creativity shifted away from the Gulf Coast Olmec area to other regions, and to other people, in Mesoamerica. But at this moment the complex continuum of Mesoamerican civilization, shifting from time to time with geography and the human bearers, seems to first come into sharp focus in the lowland Gulf region of southeastern Mexico around or just before 1000 B.C.

In 1959 we published our full report on the 1955 excavations and in 1963, with funds provided by the National Science Foundation, made a 30-minute movie from live footage and still pictures of the excavation and interpretation of the La Venta site. We now know that some of what we said in 1959 and put on film in 1963 is wrong because we have learned more. Here is some of the newer information.

The radiocarbon dates we secured in 1957 from the University of Michigan showed that the site was established about 800 B.C. and abandoned about 400 B.C. (Drucker, Heizer and Squier 1957). In 1964 William R. Coe and R. Stuckenrath of the University of Pennsylvania who were then engaged in the excavation of the lowland Maya site of Tikal in the Peten District of Guatemala read the report which Drucker and I had published in 1959 on our 1955 excavation of La Venta. When I say that Coe and Stuckenrath read our report, I mean they **really** read it, and after doing so sat down and wrote a 44 page review (Coe and Stuckenrath 1964) in which they stated that our work was not only badly done as far as excavation went, but also that we were guilty of misinterpreting a lot of evidence, and furthermore our radiocarbon dates were not to be trusted. In 1967, stimulated in part by Coe and Stuckenrath's challenge of our abilities as stratigraphers and of the radiocarbon datings we had secured ten years earlier, we made a short return trip to La Venta, hired a few of our old crew who were able to locate, dug some new trenches to expose the construction layers, got arrested and put for a few hours in the worst jail I was ever in, and made new collections of wood charcoal from the deposits we could identify as having been laid down in building phases 1, 2, 3, and 4 (Heizer, Drucker and Graham 1968). In the meanwhile we learned that the Michigan laboratory had not used up all the charcoal we collected in 1955 and which it had dated in 1957, and we were able to secure the remainder of this original material from Professor James B. Griffin. The UCLA radiocarbon laboratory in 1967 provided us with several dozen radiocarbon dates which were much more accurately dated than it was possible to do in 1957 as a result of more precise instrumentation. It turned out that while the Michigan dates were accurate enough in terms of the limitations of the radiocarbon dating method in 1957, much more precise or accurate dates could be secured ten years later. By the usual methods of interpreting what such dates mean, we concluded in 1967 that La Venta was established about 1000 B.C., perhaps as early as 1100 B.C. and abandoned about 600 B.C. (Berger, Graham and Heizer 1967). Those two hundred years of extra age do not mean very much as such, and in speaking of that I am reminded of what Agatha Christie, the wife of Max Mallowan, the Near Eastern archeologist said. She said, "It is wonderful to be married to an archeologist—the older it is the more interested he becomes."

The extra 2 centuries of La Venta's age seem to make the Olmec cultural florescence on the Gulf Coast even more removed in time

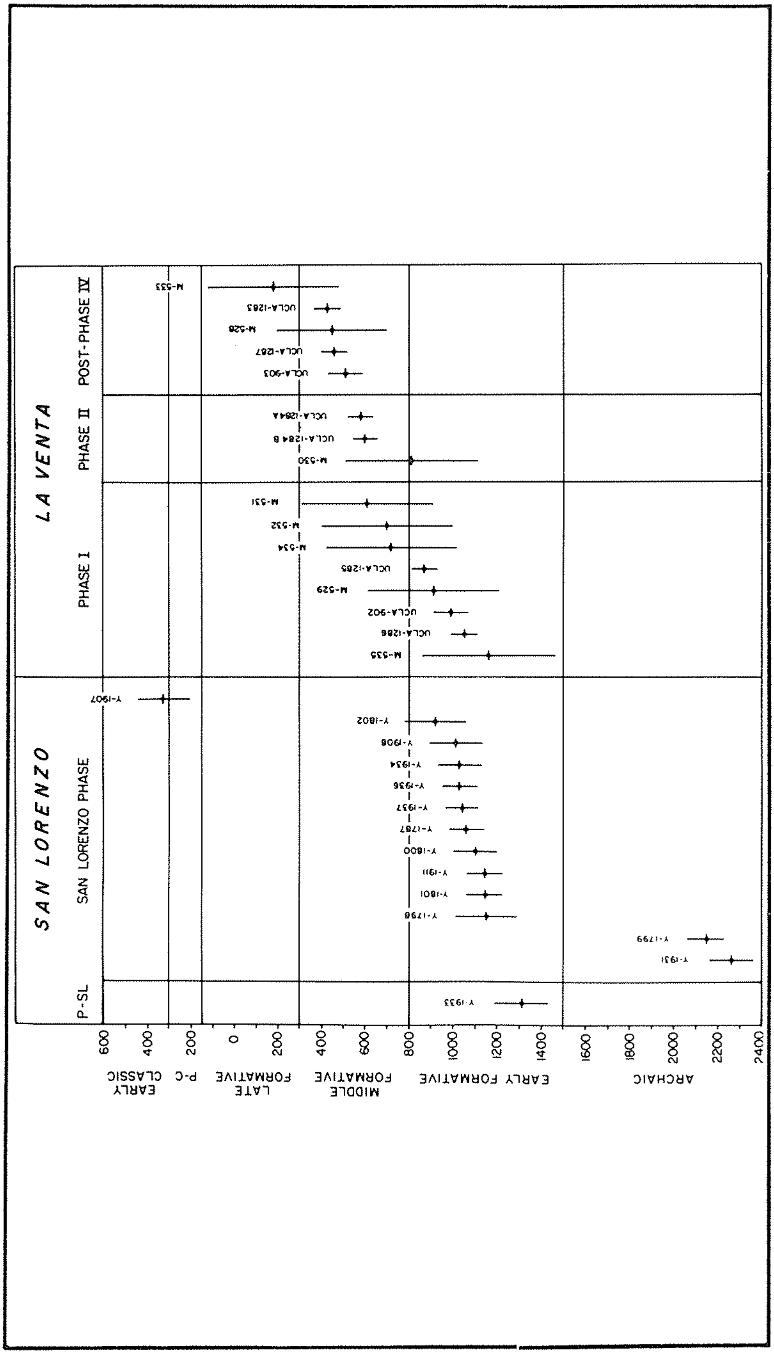


FIGURE 4. *Radiocarbon Dates from San Lorenzo and La Venta Sites.* Dates with M numbers were run at Michigan in 1957; those with UCLA prefix were determined at University of California, Los Angeles in 1967.

from that of the Maya further south, and they also indicate that San Lorenzo and La Venta were both occupied at the same time, thus allowing the correction in 1967 of a view which was then gaining currency that San Lorenzo had been built and abandoned before La Venta and that many of the La Venta sculptures had been moved there from San Lorenzo.

A second correction I have already briefly mentioned. That is the form of the big earth mound which is referred to as the La Venta pyramid. In 1955 we did not clear the heavy jungle growth from this man-made mountain because we had no intention to try to excavate it since it would have strained our funds and manpower to have done so. Our surveyor was busy recording the excavations, and when he found time to make the map of the site as a whole it proved to be a difficult job because of the heavy tree growth over the entire area. He did correctly determine the position of the base of the pyramid, and when he drew its form he assumed, along with us, that it had a rectangular base plan and four flat sloping sides rising to the truncated top—the form that any proper Mesoamerican pyramid could be assumed to have. But in making that apparently simple assumption we could not have been more in error. In 1967 when Drucker and I spent two weeks excavating for additional charcoal, we noted that most of the large trees covering the pyramid had been cut off, and while casually looking at it one day while walking past we saw a sizeable depression or valley on the north slope running from

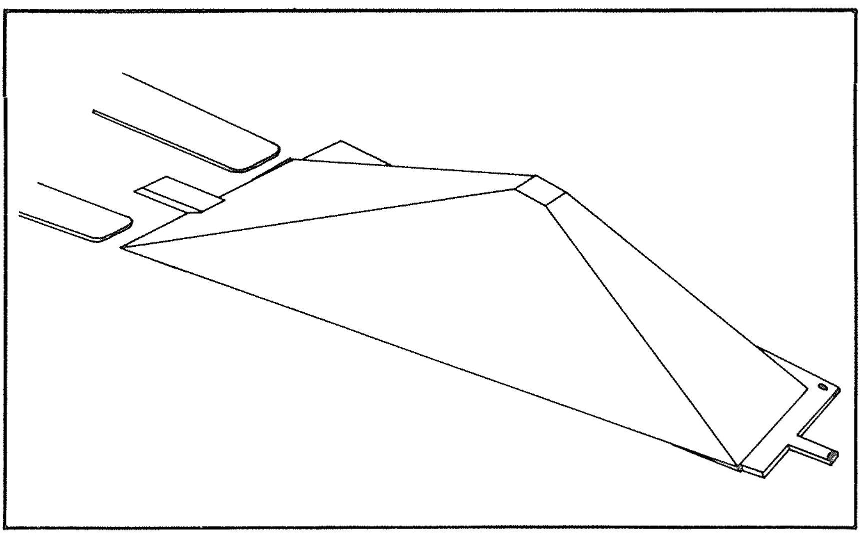


FIGURE 5. *The La Venta Pyramid as Imagined to be in 1955.*

the top to the base. Drucker's first answer to my question about what that meant was to say that it must have been where some treasure hunter had gouged into the side of the hill, but he did agree with my observation that it was a mighty big and long trench that someone had dug into the slope, and even if they had, where was the dirt pile, of which there was no sign, which must have resulted? Something was apparently going on with that pyramid which we had not noticed 12 years earlier, so we went over to look at it more carefully. Then we saw to our surprise that not only were the sides of the pyramid not flat at all, but were distinctly convex or outward curving, and also that the slopes of the mound consisted of an alternating series of ten long valleys with ten ridges separating one from the other. In short, and quite by accident, we discovered that the La Venta pyramid was a round cone, and that its sides were fluted like a cupcake mold. No

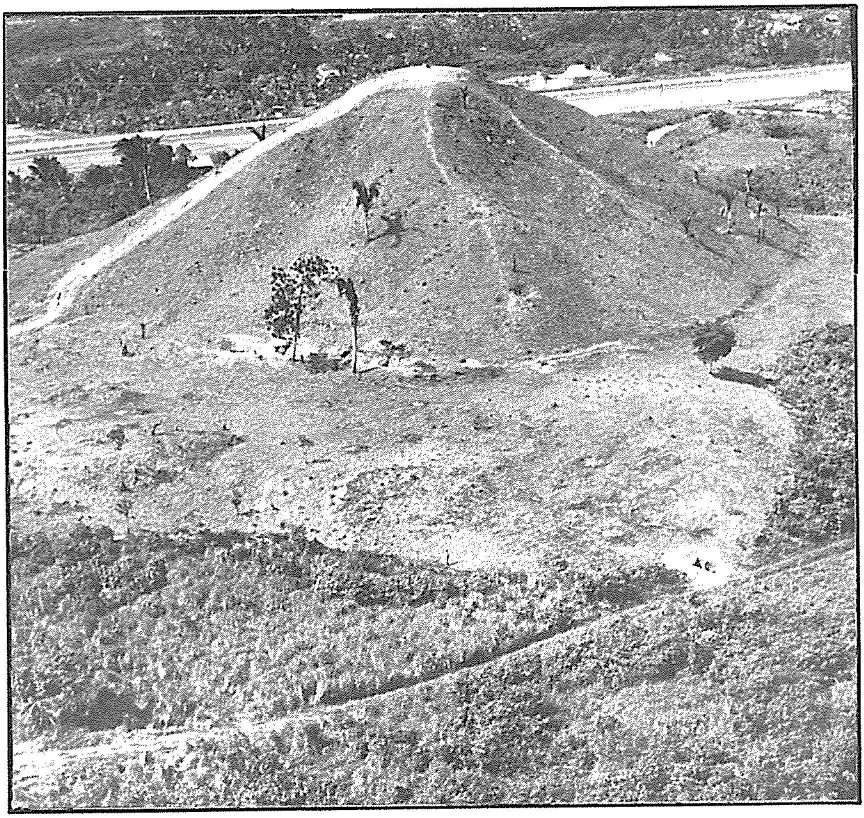


FIGURE 6. *The La Venta "Pyramid" Photographed from the Air in 1968.*

pyramid like it was known from any part of Mexico, or anywhere else, for that matter. Dr. Ignacio Bernal of the Institute of Anthropology and History in Mexico still refers to this anomalous structure as the "monster" which Drucker and I brought to light. There were several things about our surprising discovery of the form of the pyramid. One was its uniqueness which may be connected with the fact that it is the oldest pyramid (if that term can be correctly used) known from Mesoamerica. Second, Drucker and I were very pleased to have been able to correct our own error.

In 1968 we returned to La Venta once more (Heizer, Graham and Napton 1968), got arrested again, cut off all the growth on the pyramid, made a contour map, borrowed a helicopter from Petróleos Mexicanos, and photographed the pyramid from the air. Diagrammatically the pyramid looks like this. In 1969 a magnetometer survey was made of La Venta pyramid with interesting results (Morrison, Clewlow and Heizer 1970). One, probably two, sizeable stone constructions exist within the pyramid near its peak. These have not been excavated. While the pyramid itself has not been removed, the site area is now covered by the town of 5000 people who work in the major oilfield of La Venta which has over 100 producing wells.

On the point of the local civil officials being somewhat less than cooperative, one might even say they acted downright unfriendly. In 1968 the local mayor took one look at our official permit to excavate and declared that all of the signatures on it were false. The Minister of Education of the Republic of Mexico and President Hitch of the University of California were not there, unfortunately, in our hour of need, to swear that their signatures were genuine, and so the mayor had us dead to rights. He ordered us not to dig. We obeyed for a while but finally decided to take the plunge. That was an error—our error. He showed up with a bunch of deputies, each armed with a .45 automatic, and announced he was confiscating all the sculptures, some 20 in all, we had dug up. I said that we had an agreement with the Mexican federal government to turn over everything we found to the museum in Villahermosa and that if he seized them we would need a list signed by him. So he said, "Not only am I taking these, and not signing anything, but what is more, you are going to haul them to the jail in your truck." So I said we would not do that, but he was so persuasive that in the end we, of course, bowed to his wishes. Now, eight years later, it sounds amusing, but at the moment it seemed like a Mexican version of "Gunsmoke"—with real guns.

I have already suggested that the Tuxtla Mountains may have been the earlier homeland of the Olmec populations who seem to make

FIGURE 7. *Helicopter of Petroleos Mexicanos in 1968 at La Venta.* Left to right: John A. Graham, Patrick S. Hallinan, helicopter pilot, R. F. Heizer.

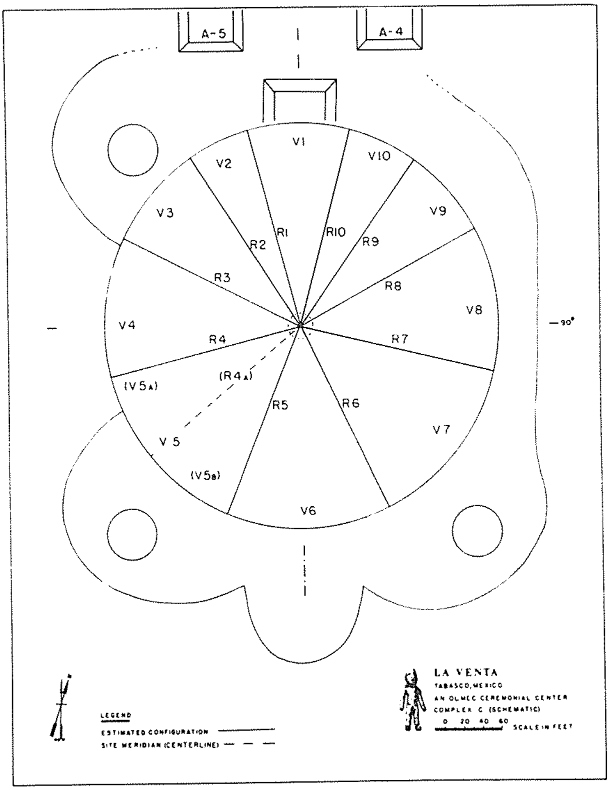


FIGURE 8. *Schematic plan of the La Venta pyramid abstracted from the contour map made in 1968 by Lewis K. Napton and his aides.* V stands for valley; R for ridge. Compare with photograph in Fig. 6.

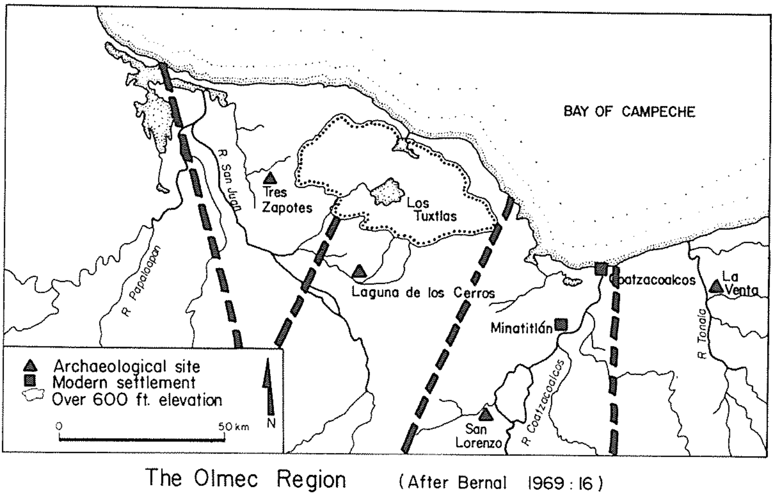


FIGURE 9. *Southern Veracruz Gulf Coast Showing the Tuxtla Mountains Area and the Four Major Olmec Sites.* The relatively regular geographical distance of each site encourages the hypothesis that these are district "capitols" or administrative-religious centers of a single society. The Tuxtlas have not been "apportioned" because we know so little of Olmec occupation of this highland zone.

their presence known at the same time out on the Gulf coast plain in such sites as Tres Zapotes, Laguna de los Cerros, San Lorenzo and La Venta. Perhaps these were district capitals, each distant about 50 miles from its neighbor, founded by a population forced out of the Tuxtla Mountains by some event such as a major volcanic eruption with a heavy fall of ash. Each of these four sites is somewhat different from the others, but there are also some features of similarity. Unique to the La Venta site, so far as we know, is the great conical pyramid with its ridged and valleyed exterior. What could be the model for such a structure? The answer is that a very good model is the cinder cones which are abundantly present in the Tuxtla Mountains, and which not only exhibit the same kind of erosional channels and ridges, but also the precise slope angle which we see on the La Venta pyramid (Mayer Peréz Rul 1962). The model, therefore, may have been a natural cinder cone somewhere in the Tuxtla Mountains which was of ritual significance to the people who founded La Venta, and when they established this retreat they laid out the series of mounds on the plan of the ritual center which they had lately abandoned, and, lacking their sacred mountain, they built an imitation one of earth and clay. It is a pretty theory which fits some of

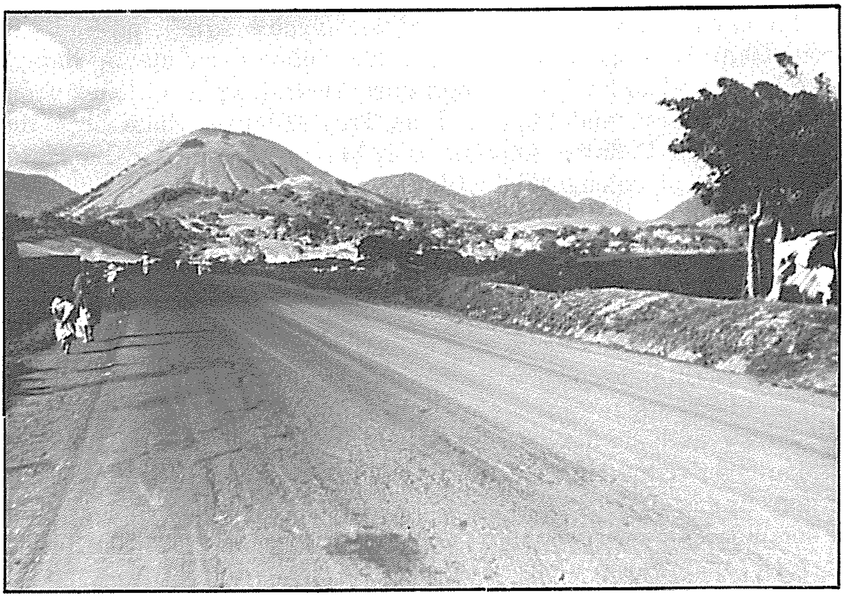


FIGURE 10. *Cinder Cone near Lake Catemaco in the Tuxtla Mountains.* Compare erosional valleys and angle of slope with the La Venta pyramid shown in Fig. 6.

the things we know, but it is the purest speculation. But like Mark Twain, who said, "I do not vouch for the truth of that statement; I merely believe it," I like my theory of why La Venta appears where and when it did. The alignment of the centerline of the La Venta site has recently been investigated by Hatch (1971) who has provided powerful arguments in support of her conclusion that the La Venta Olmecs were expert astronomers who used the La Venta pyramid as an observation platform or observatory and as a means of gaining sufficient height above the tropical forest to see the true horizon to the north on the water of the Gulf of Mexico. Some of the decorative designs or symbols which occur in Olmec art at La Venta and elsewhere, she interprets as glyphs or signs which symbolized certain aspects of ritual, heavenly bodies, and the like, and which in a special sense can be considered a kind of writing. There are no actual hieroglyphic texts from La Venta in the form of a consecutive series of these symbolic designs which form a record of some celestial occurrences. In a sense these could be called texts—even hieroglyphic texts—but they are a long way from constituting the complex texts which appear about seven centuries later on Maya monuments.

The oldest known lowland Maya hieroglyphic date is on Stela 29 from Tikal. It is equivalent to A.D. 292. Other early stelae, though engraved in something other than pure Maya form are Stela 2 from Chiapa de Corso and Stela C from Tres Zapotes which bear the equivalent of B.C. dates. Another early Maya text is the Leyden Plate, a green jade piece engraved with Maya hieroglyphs and dating from about A.D. 320. There are somewhat similar Olmec engraved axes (Hatch 1971), presumably of earlier date, and they may represent the oldest known Mesoamerican evidence of the beginning of writing.

So, while we now know a good deal about the Olmecs there remains a good deal we do not know, and much which we can probably never hope to learn or recover about these people who, some 3000 years ago, suddenly appear into view with a knowledge of how to keep track of time by studying the heavens, who were perhaps making fumbling attempts at writing, whose society was divided into an upper class of priests and rulers, or perhaps priest-kings, whose religion was surely a complex one and probably concentrated on insuring agricultural fertility, and whose jade carving and monumental stone sculpture was technically and aesthetically equal to anything produced in Mesoamerica in the centuries and millennia following the Olmec disappearance.

In October, 1492, when Columbus discovered the New World, the inevitable day when Old and New World civilization would come into contact did occur. And when Cortés in Mexico, imbued with the less refined aspects of medieval chivalry and equipped with steel-armored horsemen and guns which gave his fighting men an overwhelming advantage, brought down the Aztec state, not only were a lot of cultured Native Americans killed off, but there also came to a sudden end the greatest American achievement of all times, namely the invention and development of true civilization, an achievement which in the end came to naught because it was overwhelmed and destroyed by the bearers of a superior technology in the form of better military tactics, better transport in the form of the horse, and better offensive and defensive weapons in the form of steel armor, steel swords, and guns. In earlier times similar disappearances or cultural extinctions on a smaller scale must have occurred, as we know by the examples of the once-vigorous Olmecs of the Mexican Gulf lowland who suffered a decline about 600 B.C., or the Maya of Guatemala and Yucatan whose Classic Period heyday had passed by A.D. 1000, but whatever the cause or causes of the passing of these people from the scene, their decline or even disappearance did not affect the general continuation of the Native American style of civilization since no single society anciently became, as did that of the Spaniards in the sixteenth century, so overwhelmingly effective as a destructive force. To what heights Native American civilization might have developed we can never know because this process was suddenly truncated with the Spanish conquest. It is only through archeology that culture historians in the form of archeologists can hope to learn how, and where, and when, the civilizational level of New World culture emerged, and that is the principal reason, in my opinion, why there is something important in the study of the site of La Venta.

Neither the La Venta nor San Lorenzo sites are the probable spots where Olmec civilization first came into focus. The Tuxtla Mountains strike me as a good place to look for the birthplace of this society, but thus far we know of no pre-La Venta, pre-San Lorenzo sites there. Perhaps if these exist they are hidden under a mantle of volcanic ash which has been laid down in the last 3000 years.

Meggers (1975) has recently proposed that the Shang culture of China may have, after being carried in some fashion across the Pacific, sparked the origin of Olmec culture. The Phoenecians have also been proposed as the stimulators of this early and unusual Mesoamerican culture. So there is no lack of parental candidates from other continents. It is much more probable, I think, that Olmec is merely an early, perhaps the earliest, Mesoamerican high culture. It is conceivable that the little-explored south coast of Guatemala may have been the Olmec nursery. Some Olmec sculpture occurs there, not the least interesting of these pieces being a remarkable low-relief sculpture shown here (Fig. 11) and which comes from the Pacific

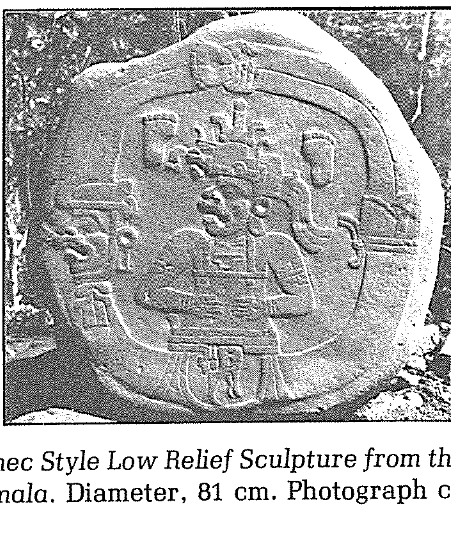


FIGURE 11. *Olmec Style Low Relief Sculpture from the South (Pacific) Coast of Guatemala.* Diameter, 81 cm. Photograph courtesy of E. M. Shook.

coast zone. Either some Tabascan Olmec sculptor got a long way from home or there were things going on in that area some 400 kilometers (240 miles) to the southeast of La Venta that we do not yet know about.* So, we have to admit that we do not really know where the Olmecs appear first. It is possible that some clue as to origins lies in the stone drains which occur both at the La Venta site (Fig. 12) and the San Lorenzo site.

I do not know whether we can shape our future from the lessons of the past. Probably not, because there are certain forces built into any system which tend to inhibit deviation, even though these seem to take a counter-productive direction. In this country we are preparing to celebrate the bicentennial of American independence. We are still strong, but also in a state of disarray. There was Watergate, and more recently two attempts to take the life of still another President. And there was Vietnam—a war we clearly lost and at great cost in treasure and human life. Three thousand years ago the Olmec at La Venta may have celebrated their centennial, or their bicentennial founding. And they were to last for about 400 more years before they disappeared from view. One wonders whether the United States will be a recognizable entity four centuries from now. I hope it will, but since I am not a fortune-teller, I do not even have an opinion on this. So, while I know nothing about how to predict the future, I have spent a lot of time studying the past. And I think there are some lessons to be learned here. Perhaps it would be important to us today if we could learn how Maya society operated, and how it managed to keep going for eight centuries; or how the Olmec civilization succeeded for four to six centuries; or how the Teotihuacanos of the Valley of Mexico managed to keep it together for seven or eight centuries. Those are respectably long cultural lifetimes, it seems to me, and it would be comforting to be able to make an informed guess that the USA was still going to be around and in reasonably good shape in, say four or five centuries from now. Is it possible that we might learn something of the art of national survival by studying these defunct Mesoamerican civilizations? I think it is probable that when the Europeans came to the New World and destroyed some twenty million people with disease and guns that they may have, however

*Since writing this the author and John Graham have conducted preliminary excavations in the site of Abaj Takalik, Depto. Retalhuleu, on the south (Pacific) coast of Guatemala. There we have at least six pure Olmec sculptures and a large number of proto-Classic or Early Classic Maya stelae and altars, some of which are older than any other Maya sculptures with hieroglyphic dates. Abaj Takalik is the only site known to date where a substantial corpus of Olmec and Maya sculpture occur together.

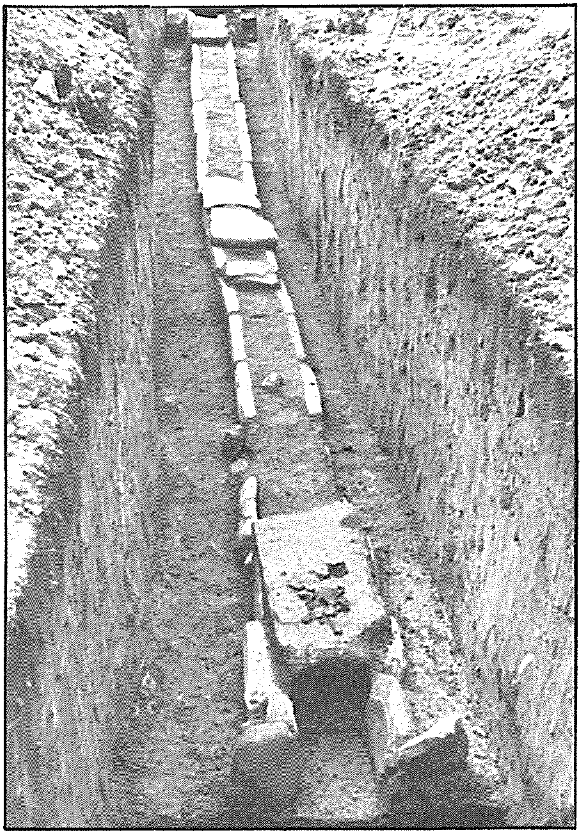


FIGURE 12. *Trough-shaped Stone Block Drain Discovered in 1968 in the Stirling Acropolis at the La Venta Site.*

unwittingly, erased some very important persons who knew a lot about how to keep cultures going for an extended period of time. In the end (and I remind you that I am no soothsayer) the New World that Columbus discovered may have really been the Old World.

If we do not yet know the answers to such questions as where, and in what manner Olmec culture began we will keep looking for the evidence of that spot and the process. In the meanwhile we devise theories which are based on facts at present known. Such theories are always short-lived because new facts invalidate them, either wholly or in part. That is how we learn. Mark Twain understood that, and he summed it all up when he wrote: "There is something fascinating about science. One gets such wholesale returns of conjecture out of such a trifling investment of fact."

References Cited

Berger, R., J. A. Graham and R. F. Heizer

1967 A Reconsideration of the Age of the La Venta Site. *Contributions of the University of California Archeological Research Facility*, No. 3: pp. 1-24.

Coe, W. R. and R. Stuckenrath

1964 A Review of La Venta, Tabasco, and its Relevance to the Olmec Problem. *Kroeber Anthropological Society Papers*, No. 31: pp. 1-44.

Drucker, P.

1961 The La Venta Support Area. *Kroeber Anthropological Society Papers*, No. 25: pp. 59-72.

Drucker, P. and R. F. Heizer

1960 A Study of the Milpa System of La Venta Island and Its Archeological Implications. *Southwestern Journal of Anthropology*, Vol. 16: 36-45.

Drucker, P., R. F. Heizer and R. Squier

1957 Radiocarbon Dates from La Venta, Tabasco. *Science*, Vol. 126: pp. 72-73.

Hatch, M. P.

1971 An Hypothesis on Olmec Astronomy, with Special Reference to the La Venta Site. *Contributions of the University of California Archeological Research Facility*, No. 13: pp. 1-64.

Heizer, R. F.

1961 Inferences on the Native Olmec Society Based Upon Data from the La Venta Site. *Kroeber Anthropological Society Papers*, No. 25: 43-57.

1960 Agriculture and the Theocratic State in Lowland Southeastern Mexico. *American Antiquity*, Vol. 26: pp. 215-222.

Heizer, R. F., P. Drucker and J. A. Graham

1968 Investigations at La Venta, 1967. *Contributions of the University of California Archeological Research Facility*, No. 5: pp. 1-34.

Heizer, R. F., J. A. Graham and L. Napton

1968 The 1968 Investigations at La Venta. *Contributions of the University of California Archeological Research Facility*, No. 5: pp. 125-154.

Mayer Perez Rul, F.

1962 *Estudio Vulcanológico de la Región de los Tuxtlas, Ver.* Facultad de Ingineria, U.N.A.M., Mexico.

Meggers, B. J.

1975 The Transpacific Origin of Mesoamerican Civilization: a Preliminary Review of the Evidence and Its Theoretical Implications. *American Anthropologist*, Vol. 77: pp. 1-27.

Morrison, F., C. W. Clewlow and R. Heizer

1970 Magnetometer Survey of the La Venta Pyramid, 1969. *Contributions of the University of California Archaeological Research Facility*, No. 8: pp. 1-20.

Mozino Suarez de Figueroa, J. M.

1913 Noticias de Nutka, diccionario de la lingua de los Nutkeses, y descripción del volcán de Tuxtla. *Sociedad Méxicana de Geografía y Estadistica*, Mexico.

Velson, J. S. and T. C. Clark
1975 Transport of Stone Monuments to the La Venta and San Lorenzo sites. *Contributions of the University of California Archaeological Research Facility*, No. 24: pp. 1-39.

ARCHEOLOGICAL INVESTIGATIONS AT THE JETTA COURT SITE (41 TV 151) TRAVIS COUNTY, TEXAS

AL B. WESOLOWSKY, THOMAS R. HESTER AND DOUGLAS R. BROWN

ABSTRACT

During the course of several weekends in 1968 and 1969, students from The University of Texas at Austin carried out test excavations at the Jetta Court site in Travis County, central Texas. These investigations constituted a salvage effort designed to obtain information on this site before it was destroyed by construction activities in a housing development. The terrace deposits at Jetta Court yielded a long Archaic sequence, including a deeply buried occupation which occurred stratigraphically below Early Archaic materials. The results of the excavations are described, and detailed analyses of the lithic debris and faunal remains are presented.

INTRODUCTION

The Jetta Court site (41 TV 151) is located within the city limits of Austin, Texas, buried in terrace deposits on the west side of Walnut Creek (Figs. 1-3). The site was brought to the attention of the Texas Archeological Research Laboratory (TARL) of The University of Texas at Austin in the fall of 1968 by reports of pothunting in an area slated for a housing subdivision. Inspection of the site by TARL personnel indicated that it should be tested before the planned construction activities were begun.

Excavations, directed by graduate students in anthropology at The University of Texas at Austin, were carried out with volunteer help. Work was done on weekends during a period from December, 1968, to February, 1969. Since the site was unprotected during the week, numerous instances of vandalism occurred. One unit of excavation was eventually ruined, but the others were not seriously damaged. This combination of weekend excavation and weekday vandalism limited effective investigation to stratigraphic testing and backhoe trenching. Exposures of horizontal tracts were not done partly because of fear that it would lead to more extensive depredations on the part of the pothunters, and partly because the site was considerably deeper than was anticipated.

The writers would like to acknowledge the assistance and understanding of Mr. Cecil Lamour, representing Conann Construction, Inc., in permitting the excavations. His patience with our backhoe operations, in particular, was most helpful. We would also like to thank the volunteer crew for their industry and enthusiasm; the

FIGURE 1. *Location of the Jetta Court Site (41 TV 151), Travis County, Texas.*

Texas Archeological Research Laboratory and the Texas Archeological Salvage Project for equipment, vehicles, laboratory facilities, and artifact processing; and, Dee Ann Story, Elton Prewitt, and Harry J. Shafer for advice, criticism and help.

NATURAL SETTING

The Jetta Court site is located at N30°23'15", W97°40'40", in the eastern part of the Balconian biotic province defined by Blair (1950:112). The topography of the area is rugged, and most of the Balconian lies on Cretaceous limestone which has been much dissected by several river systems. The reader is referred to Blair's

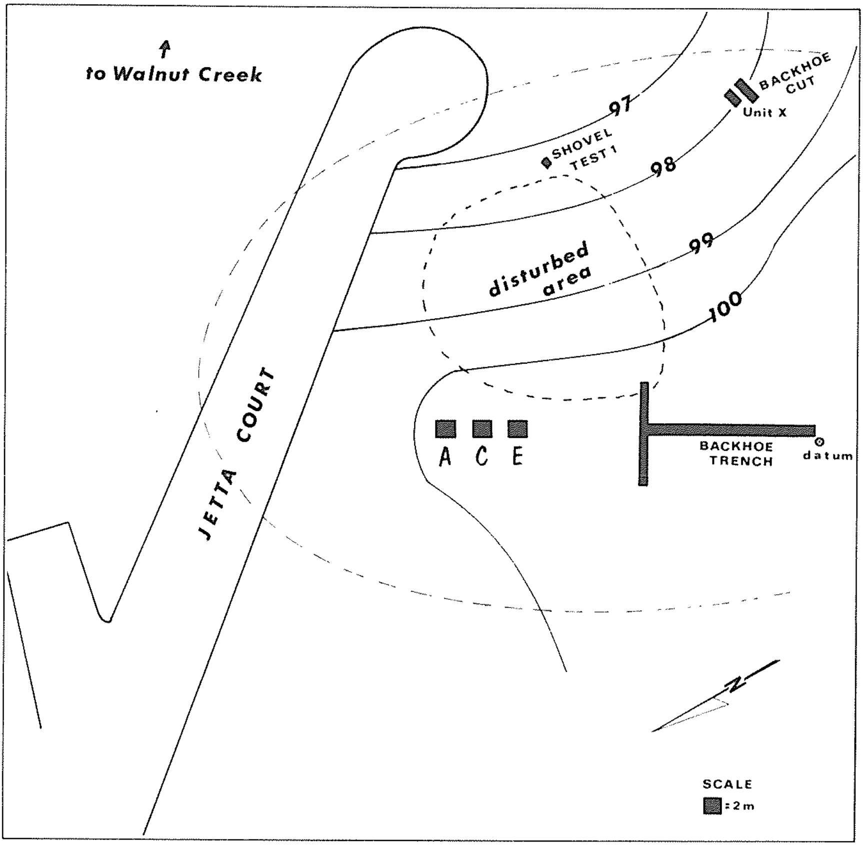


FIGURE 2. *Map of the Jetta Court Site* (41 TV 151). One-meter contour intervals are indicated within the site area. The dotted line represents the known extent of aboriginal occupation.

work for details of physiography, flora, and fauna within this province.

The site is located on a terrace situated on the inside of a bend in Walnut Creek. The slope from the site to the creek is gentle, with a much steeper slope found on the opposite side of the creek. A short distance downstream there is a deep, entrenched gully cutting back into the limestone outcrop that forms the bedrock of the immediate area.

It has been traditional in central Texas archeology to treat the ecology of prehistoric sites by a reference to whatever biotic provinces they belong, supplemented by a list of plants and animals that are to be found in the area. Thorough and detailed ecological surveys designed to illuminate archeological questions are sadly lacking (the work of Witter, 1971, in the Robert Lee Reservoir of west central Texas is an exception; cf. also Eddy 1974). The relation of man to his environment, and changes in settlement and subsistence patterns through time, should be of continuing interest to archeologists in the region. At an informal level, the types of studies we envision are directed at asking, and perhaps eventually answering, the questions "Why did the Indians camp here?" and "Why did they move elsewhere at various times of the year?". The answers of availability of local subsistence resources at certain times of the year is simply not adequate. Specific information is needed to explain patterns in settlement archeology, which has not, as of yet, been attempted in central Texas (cf. Skinner 1971:256-260).

The following commentary on the vegetation and topography of the Jetta Court site is based on notes taken by Dan Witter while excavations were in progress.

Four zones of vegetation were observed during a brief inspection in January, 1969, of the site area:

a. flood plain woodland
b. alluvial slope woodland
c. alluvial slope shrubland
d. limestone bluff shrubland

The floodplain is a woodland of small-sized trees approximately 50-60 feet high with a fairly continuous canopy. Sycamores *(Platanus occidentalis)* were occasionally seen along the stream bank itself, while elms *(Ulmus spp.)*, hackberry *(Celtis spp.)*, pecans *(Carya illinoensis)*, sumac *(Rhus spp.)* and *Baccharis sp.* were observed among the plants on the flood plain. The elms and hackberries formed the main portions of the canopy with the pecans usually occurring in groves. Sumac and *Baccharis* were understory shrubs.

The site itself is in a localized woodland that has developed on slope wash from a nearby bluff located to the south of the site. The alluvial slope woodland is a stand of small trees usually 40-50 feet high and is composed primarily of two species of oak; elms, pecans, and hackberries are also present. The oaks are identified as *Quercus stellata var.* (a local variant of post oak) and *Q. schumardii var. texana* (the Shumard oak). Buckeye *(Aesculus sp.)* and juniper *(Juniperus ashei)* were also noted.

To the north of the site, where the slope was exposed and the ground rocky, a juniper shrubland prevailed.

Above the site was an exposed limestone bluff which displayed juniper shrubland as the main form of vegetation. Prickly pear *(Opuntia spp.)* was also common.

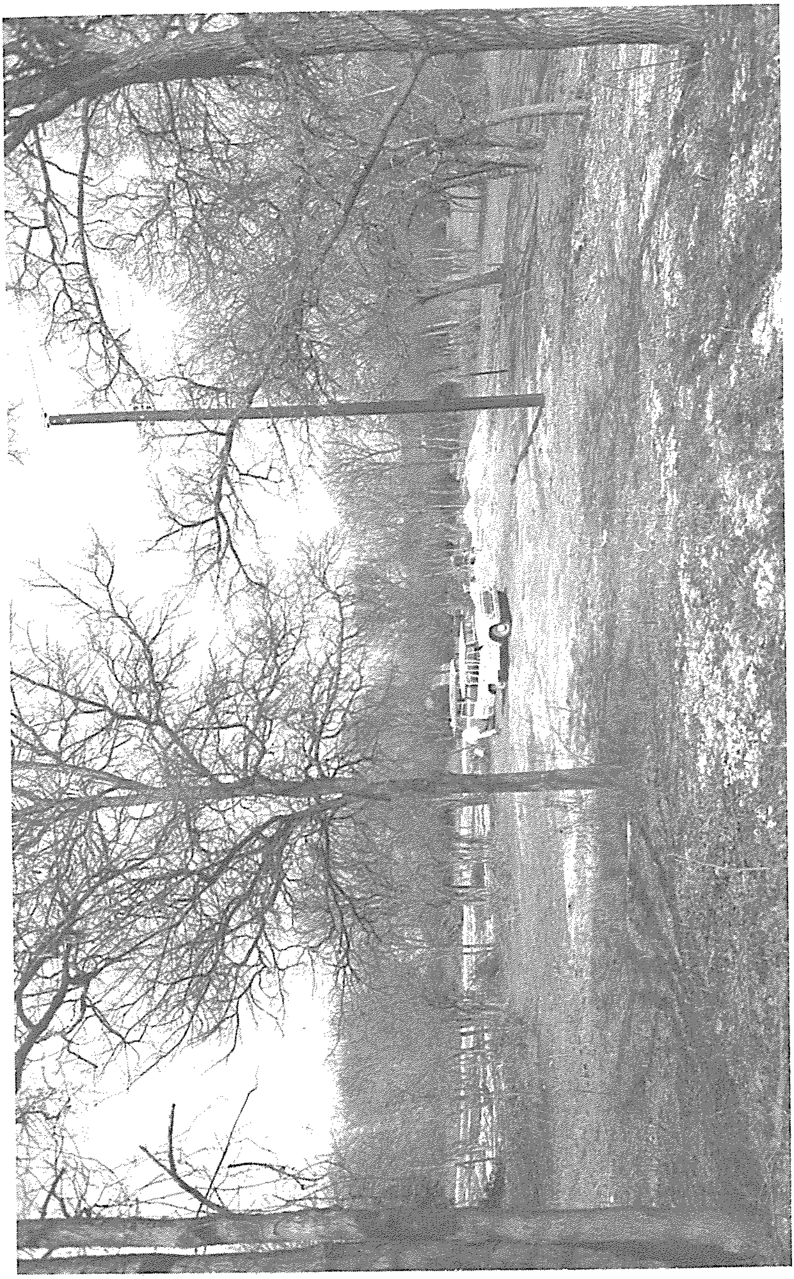


FIGURE 3. *The Jetta Court Site (41 TV 151).* View of site, looking northwest. Units A, C, and E are to the right of the trucks.

In general, the vegetation is typical of the Balcones Escarpment, having two broad types of environments:

1) Limestone outcrops and rocky slopes with shrubland vegetation.

2a) Little enclaves of hardwood woodlands where the trees are given some protection from the wind and sun and

2b) Woodlands on the floodplains of streams and canyons which have cut into the Cretaceous limestone of the Edwards Plateau.

We suggest that the aboriginal occupation was located on the alluvial slope for several reasons: water is available and there is some protection from the wind afforded by the bluff; the trees also serve as wind breaks as well as giving some relief from the sun. The actual flood plain presently has few trees on the site side of the creek, whereas the other side has numerous trees but is on quite a steep slope.

EXCAVATION PROCEDURES

For all practical purposes, controlled excavations consisted of three two-meter square units. In addition, a one-meter by two-meter unit was begun, and two backhoe trenches and a small shovel test were made (see Fig. 2). A north-south base line, originating at the arbitrary point North 200/West 200 (N200/W200) was extended north and the two-meter square units were placed along its east side at two meter intervals. These three units are referred to as Units A, C, and E (from north to south), and their grid designations are N200/W200, N196/W200 and N192/W200 respectively. A one-meter by two-meter test pit, labeled in the field as Unit X, was begun to the southeast at approximately N165/W200, but was destroyed by vandals after a day of excavation. It was then abandoned, and consequently its contribution to our knowledge of the site is negligible. Shovel Test 1 (a one-meter square) was performed at approximately N192/W170. Two backhoe trenches (see Fig. 2), dug very near the completion of controlled excavations, gave us an extensive view of the internal structure of the site before its ultimate destruction.

A large nail driven into a telephone pole served as a horizontal datum point, arbitrarily designated as 100 meters. Controlled excavations were carried out in arbitrary 20 centimeter levels. Units A, C, and E had their levels measured from the northwest corner stake. After the excavations were finished, the arbitrary levels could, with a reasonable degree of certainty, be correlated with the natural strata that were recognized.

The site area appeared quite featureless on the surface. The decision on where to locate the excavation units was based on avoiding (1) a disturbed area in the northeast portion of the site, (2) the trees which dotted the terrace, and (3) the sloping ground to the east.

The two topmost levels (0-40 centimeters) were passed through 1/4" mesh hardware cloth. The lower levels were screened through 1/2" mesh because of the necessity to accelerate the salvage activities due to continuing vandalism of the units. Digging was done primarily with pick and shovel, and recognized features were exposed with trowels and smaller tools. Soil samples were taken.

The decision to limit excavations to stratigraphic tests involved several considerations: (1) the vertical extent of the site was unknown; (2) it was not known how long the site would be accessible before house construction began, leading to the destruction of the site; (3) wider horizontal exposures would slow work with respect to (1) and (2) above, and might have been more of an invitation to pothunters and vandals during the week.

In summary, the excavations at the Jetta Court site consisted of a salvage effort. Three two-meter squares were dug to at least 2.60-2.80 meters below the surface. They were intended to give information on the stratigraphic distribution of archeological materials with only incidental disclosures of horizontal associations. In retrospect, we suspect that this was not the best way to sample the site, but recalling our limited resources and time deadlines, we are convinced that these excavations have recovered worthwhile information which would have otherwise been lost.

STRATIFICATION AND INTERNAL STRUCTURE

Broadly speaking, the internal structure of the site consists of a basal clayey alluvium, with a similar deposition separating a higher and lower zone of dark soil and burned rock. In the lower reaches of the deposit the basal soil became more calcareous, but there were no layers of gravel or other recognized changes to indicate a complicated depositional history of the terrace for its topmost 4.5 meters. To be sure, some three meters of fill have been deposited since the beginning of aboriginal occupation, but no radical natural depositional changes seem to be involved for this time span. The T-shaped backhoe trench revealed that the deposits slope down to the east and north, toward the edge of the terrace. The terrace edge is not sharply defined, but slopes over some 20 meters to the floodplain of Walnut Creek.

Five stratigraphic zones ("A" to "E", from bottom to top) were recognized on the basis of changes in color and matrix, including alterations resulting from human activity (see Figs. 4,5). Although we are not entirely certain that the maximum depth of cultural debris was reached, the paucity of cultural materials from the bottom 40 centimeters of each unit suggest that deeper excavation would have only defined the lowest elevations of occupation more precisely without appreciably increasing our understanding of the earliest occupations. An auger test in Unit C reached 95.5 meters below datum, and no significant soil change was noted.

Description of the Zones

Zone A: Zone A was the deepest zone investigated during excavation, but its lowest depth was not reached at any point during the work. It may continue down to meet bedrock (most likely a limestone formation that outcrops in the vicinity) at some presently unknown depth; or there may be other zones intervening between Zone A and bedrock. Should the latter by the case, we do not think that it would change our current understanding of the human occupation of the site.

Zone A is a light brown mixture of sand and clay, with caliche nodules increasing in frequency lower down in the exposed sections. Cultural remains are sparse, as compared to upper levels of the site, and consist of lithic debris, a few animal bone fragments, and a small amount of burned rock. In unit A, this zone seems to extend from about 98.75 meters to the floor of the excavation at 97.20 meters without interruption except for a concentration (lens?) of snail shells (see Fig. 4). This concentration may correspond to Zone B in Units C and E, but this is not at all certain. In Units C and E, Zone A extends from the floor of the units to approximately 98.20 meters, where it contacts Zone B.

In Unit C, an auger test was made to a depth of 95.5 meters below datum (4.5 meters below the surface) and revealed no recognized important change in composition (Fig. 5). It should be noted that there seemed to be a band of slightly higher clay content from approximately 96.50 meters to 96.30 meters. At some time during the deposition of Zone A, the earliest human occupation of the Jetta Court site occurred.

Zone B. Zone B, also referred to in this report as the "Lower Midden", is definitely recognized in Units C and E. It is a midden deposit composed of dark gray to black soil with numerous burned limestone rocks, snail shells, and cultural debris. Approximately 40 centimeters thick, it extends across all profiles of Unit E between ca. 98.0 meters to 98.40 meters below the datum. To the north, in Unit C, it is clearly evident only to about the North 194.80 line on the east profile. Only some 25 centimeters thick at the North 194 line, it pinches out to the north and past the North 194.80 line it is visible only as a sparse scattering of burned rocks. The south profile of Unit C shows that Zone B thins out also towards the east and west. In Unit A there are two lenses of snail shells, the lower of which contains a few burned rocks. The lower lens may correspond to Zone B by virtue of its elevation, and by the amount of cultural debris recovered from it and adjacent levels.

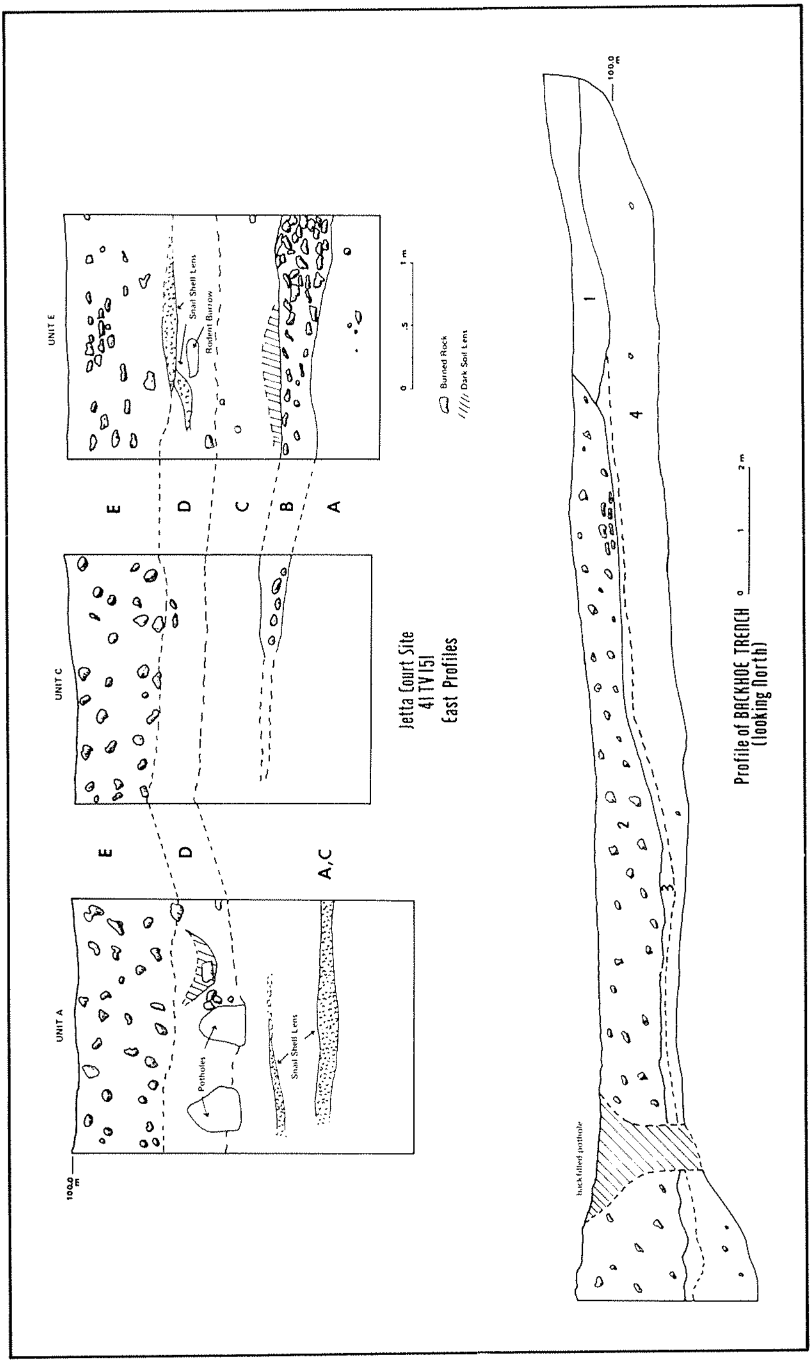


FIGURE 4. *Stratigraphic Profiles, Jetta Court Site (41 TV 151).*

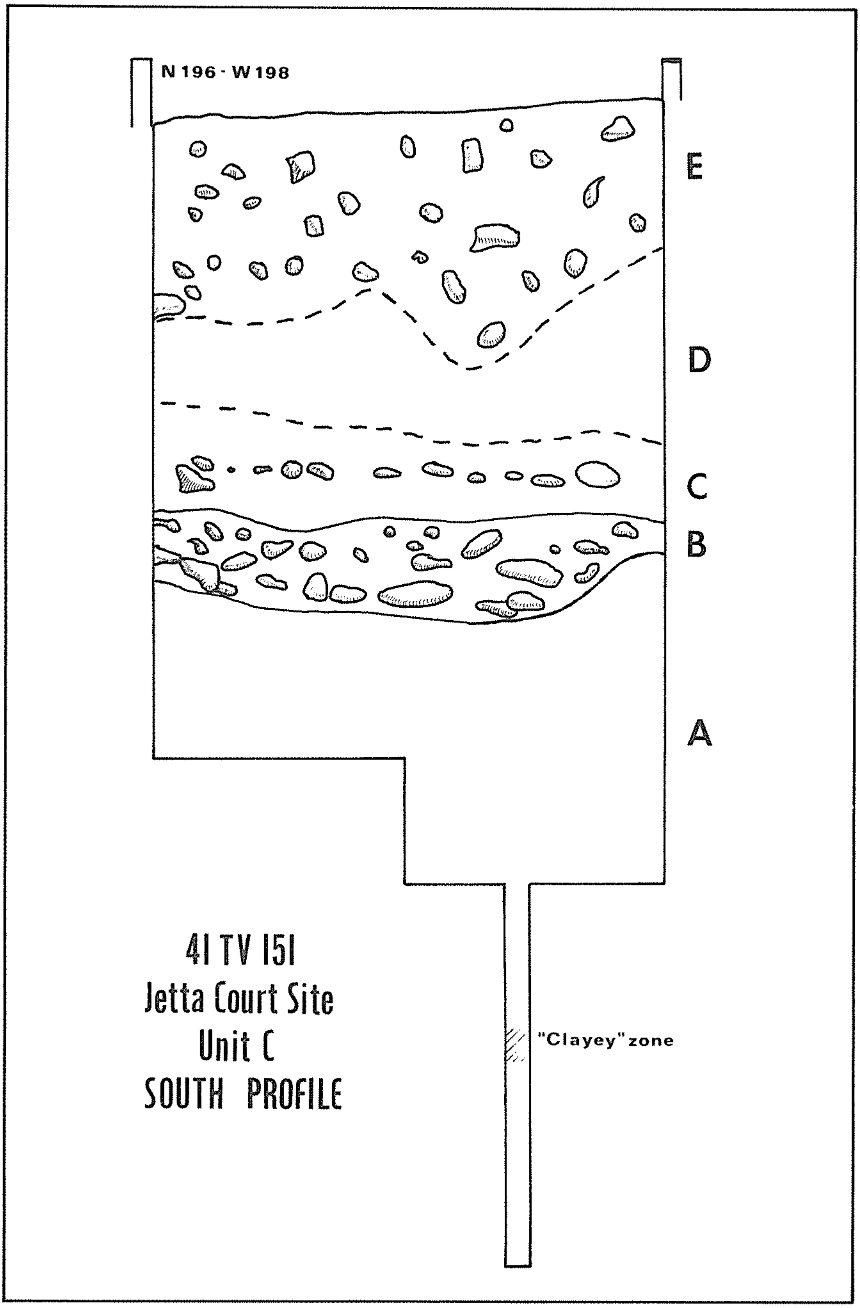


FIGURE 5. *South Profile of Unit C, Jetta Court Site (41 TV 151).*

Zone B is of particular interest since it is a buried midden deposit separated from Zone E (also referred to as the "Upper Midden") by a very different soil. The Lower Midden may represent either a fairly intensive human occupation or a stable surface early in the human history of the site.

Zone C: The certain presence of Zone C is identified only in Units C and E, since there is no sure evidence of the Lower Midden in the section of Unit A. With this lack of evidence, there is no way to assess a contact between Zones A and C in Unit A. In appearance, Zone C is quite similar to Zone A: light brown to tan sandy clay with snail shells and a few burned rocks. However, there was a greater abundance of cultural materials in Zone C than in Zone A.

Zone D: The boundaries of this zone are indistinct, but it would seem to represent a transition between Zones C and E. Zone D consists of tan and gray sand-clay mixture with a few burned rocks and occasional concentrations of black midden soil. This zone varies in thickness from about 35 centimeters to 75 centimeters.

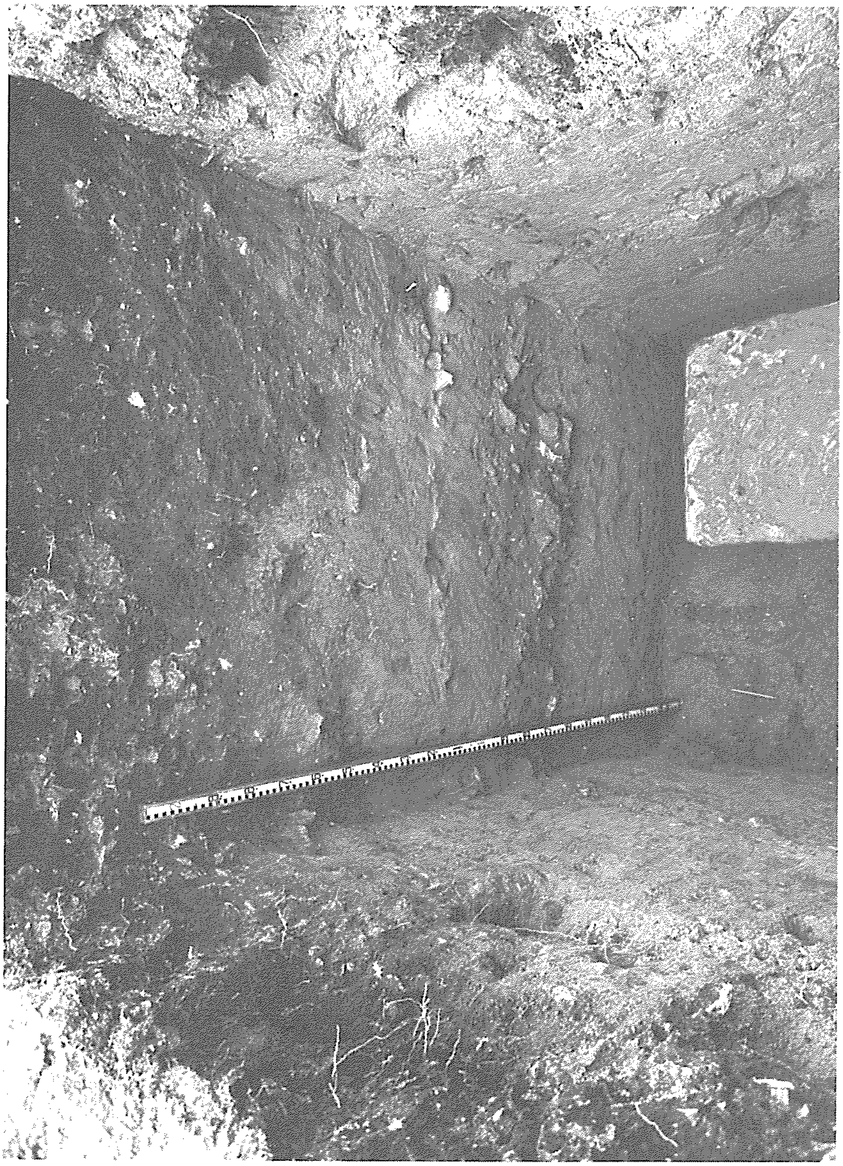
Zone E: Zone E, also referred to as the "Upper Midden", is quite similar to Zone B (the Lower Midden). It is composed of a dark gray to black soil with considerable quantities of burned rocks, snail shells, and other cultural debris. It is evident in all three units, and extends up to the grass roots.

It should be mentioned that the notes for the abortive Unit X record a matrix similar to Zone E for the extent of that unit's excavation. It may be assumed that Zone E extends over most of the site and that the materials from Unit X correlate with Zone E (as exposed in Units A, C, and E) although we cannot demonstrate an observed stratigraphic link.

In Fig. 4 we have illustrated the stratification exposed in the north wall of the east-west backhoe cut. In Fig. 4, stratum 1 is a humus-stained topsoil, stratum 2 correlates with Zone E, stratum 3 appears to equate with Zone D, and stratum 4 apparently correlates with Zones A-C as defined for Units A, C and E.

Stratification: The Characteristics of the Two Middens

The stratification of the Jetta Court site is marked by the presence of two zones of "intensive" occupation. The profiles of Units C and E (Figs. 4-6) show two dark midden accumulations separated by intervening light-colored soil. In Unit A, the Upper Midden is evident enough in the wall of the excavation, but there is no dark Lower Midden deposit. However, the Lower Midden is present to the extent of sharp peaks in the percentages of flint flakes and animal bones at an elevation comparable to that of the Lower Midden in the other



A

B

FIGURE 6. *Profiles of Excavation Units, Jetta Court Site (41 TV 151).* A, Unit C, South Profile (see Fig. 5); B, Unit A, East Profile (see Fig. 4); note vandalism.

two units. In all three units there is a marked relative scarcity of animal bones and flint flakes in the levels immediately above the Lower Midden.

The midden zones proper are characterized by the type of contents seen at so many other central Texas sites: dark-brown, gray and black soil with considerable quantities of angular burned limestone rock, lithics, and other occupational refuse. The artificial levels used during excavation concided with the natural borders of the middens reasonably well.

The Lower Midden. The Lower Midden is of particular interest to central Texas archeologists since it seems to indicate an occupation which is similar in projectile point styles and stratigraphic position (relative to the rest of the site) to the occupational phases III and IV (and perhaps II) at the Landslide site (Sorrow, Shafer and Ross 1967), as well as the earlier levels of the Youngsport site (Shafer 1963), the La Jita site (Hester 1971), Granburg II (Hester 1975; Hester and Kohnitz 1975), and several other central Texas sites (cf. Sollberger and Hester 1972). We refer specifically to the presence of *Bell* and *Gower* points, plus our *Miscellaneous I* (corner notched) and *Miscellaneous II* (triangular) forms in the Lower Midden or immediately below it. The early occupations at Jetta Court stratigraphically predate the previously defined "Early Archaic" of central Texas (cf. Johnson, Suhm and Tunnell 1962). The diagnostic point styles of the "Early Archaic", particularly *Bulverde* and *Nolan*, all occur higher in the site deposits. None of these early occupations, incidentally, have the characteristic artifacts assigned to the earliest known occupation of central Texas during Paleo-Indian times. These artifactual remains found between Paleo-Indian and Early Archaic at Jetta Court and several other central and Trans-Pecos Texas sites have been attributed to a transitional "Pre-Archaic" phase by Sollberger and Hester (1971; the "Transitional Early Archaic" of Prewitt 1974: Fig. 7).

Diagnostic artifact forms from within the Lower Midden, as mentioned above, are *Gower* and *Bell*, and two stemmed points similar to *Bell* (these from the area of contact between Zones B and C). From below the Lower Midden, in Zone A, a single *Gower* point was recovered. In addition, a number of untyped dart points (Miscellaneous I and II, and specimens a-g in Fig. 15) are from the Lower Midden.

Absolute sample size of diagnostic artifacts within the Lower Midden is not particularly impressive. However, the stratigraphic discreteness of certain projectile point styles, we feel, provide good evidence for this stratum representing an occupation stratigraphically, and therefore chronologically, older than the previously defined central Texas "Early Archaic". As we view it, the Lower Midden of the Jetta Court site parallels and replicates to some degree the early occupations at Landslide, Youngsport, La Jita and other sites, in a morphological and stratigraphic sense. We have no reason to suspect that this early occupation at Jetta Court was substantially different in subsistence patterns as compared to the later Archaic occupations. Certainly there is a change in the artifacts (else how could we recognize it), but no data were recovered that showed any changes in economy or deposition of materials. We are able to see changes in the lithic technology as reflected in the relative proportions of flake categories, but remain uncertain as to the cultural significance of such changes.

The Upper Midden

The Upper Midden, which can be traced with certainty in all three units, represents nothing greatly out of the ordinary for the later occupation of Central Texas. The observation that several specimens of projectile points are "out of place" stratigraphically may indicate some instability of the soils and consequent mixing of deposits. The two specimens of *Travis* in Level 3 and the two *Ensor-Fairlands* in Level 3 are the cases in point.

Although Zone D is a "transitional zone" of dark soil lacking the burned rocks of Zone E (the Upper Midden), it has some artifactual continuity with the Upper Midden. For this reason it will be included in our discussion of the Upper Midden. The diagnostic materials from Zone D include *Bulverde, Nolan,* and *Pedernales*. Both *Bulverde* and *Pedernales* continue up into Zone E. In the contact zone between zones D and E were one specimen each of *Darl* and *Montell,* as well as *Pedernales* and *Bulverde*.

Recovered from Zone E were *Pedernales, Montell, Darl, Travis, Castroville, "Ensor-Fairland", Lange, Scallorn,* and *Perdiz*. In addition, there were Untyped dart points 7, 8, 9, 10, 13, 14, 16, 18, 21, 22, and an Untyped arrow point 17.

The diagnostic projectile point sequence from the Upper Midden is in general agreement with data from Stillhouse Hollow and Canyon Reservoirs. The proverbial "thin veneer" of Neo-American occupation is present in Level 1 in all three units: five *Scallorn* points which are considered diagnostic of the Austin phase; and one *Perdiz* point which is associated with the Toyah phase (Shafer 1971). Another major trait of the Toyah phase, bone-tempered pottery, was not found at Jetta Court.

Since only 43 diagnostic projectile points were recovered in the Upper Midden, and these are distributed among 11 types, it seems remarkable that the sequence should be as consistent as it is, within itself and with reference to other sites.

The value of the stratigraphic data from the Jetta Court site is not for new information on the relative placement of various point styles in the later Archaic, but in the presence of a "pre-Archaic" phase as a viable stratigraphic entity in its own right.

FEATURES

Of the seven intrasite structures, or features, recognized at Jetta Court, only one is from the Upper Midden (Zone E) and none were recorded for the Lower Midden (Zone B), although one may have been on the upper surface of the latter.

All are concentrations of burned rock that are traditionally referred to as "hearths" in central Texas archeology. It is difficult to say whether any features could have been recognized in the dense concentrations of burned rock in the Upper and Lower Middens, but the techniques of salvage excavation employed were not particularly sensitive to features likely to be encountered in burned rock midden deposits. Excavations directed at revealing features of occupation would have been primarily horizontal exposures, while the excavations at Jetta Court were more concerned with vertical, stratigraphic cuts. This is not to say that the two different techniques are mutually exclusive for the information they recover, but vertical tests are less sensitive than other techniques. Ideally, once the two midden zones were identified, there should have been a sizable horizontal tract cleared and the two studied as lateral collections of associations. Because of the conditions under which we operated, this could not be done. Consequently, we have only a partial record of the occupational features at the site.

Feature 1 (Unit C, Level 5, Zone D)

This feature was a small concentration of burned limestone rocks resting on an essentially flat surface. Most of the rocks were about fist-sized, and the exposed portion of the feature was ca. 25 centimeters thick. This concentration extended into the south and east walls of the unit. A few charcoal flecks were noted among the rocks but were too few for a radiocarbon sample. Except for two flint flakes, no artifactual associations were observed.

Features 2 and 4 (Unit C, Levels 7 and 8, Zone C)

These features (Fig. 7) were identified in the field as parts of the same concentration of burned rock, while the arbitrary level technique of exca-

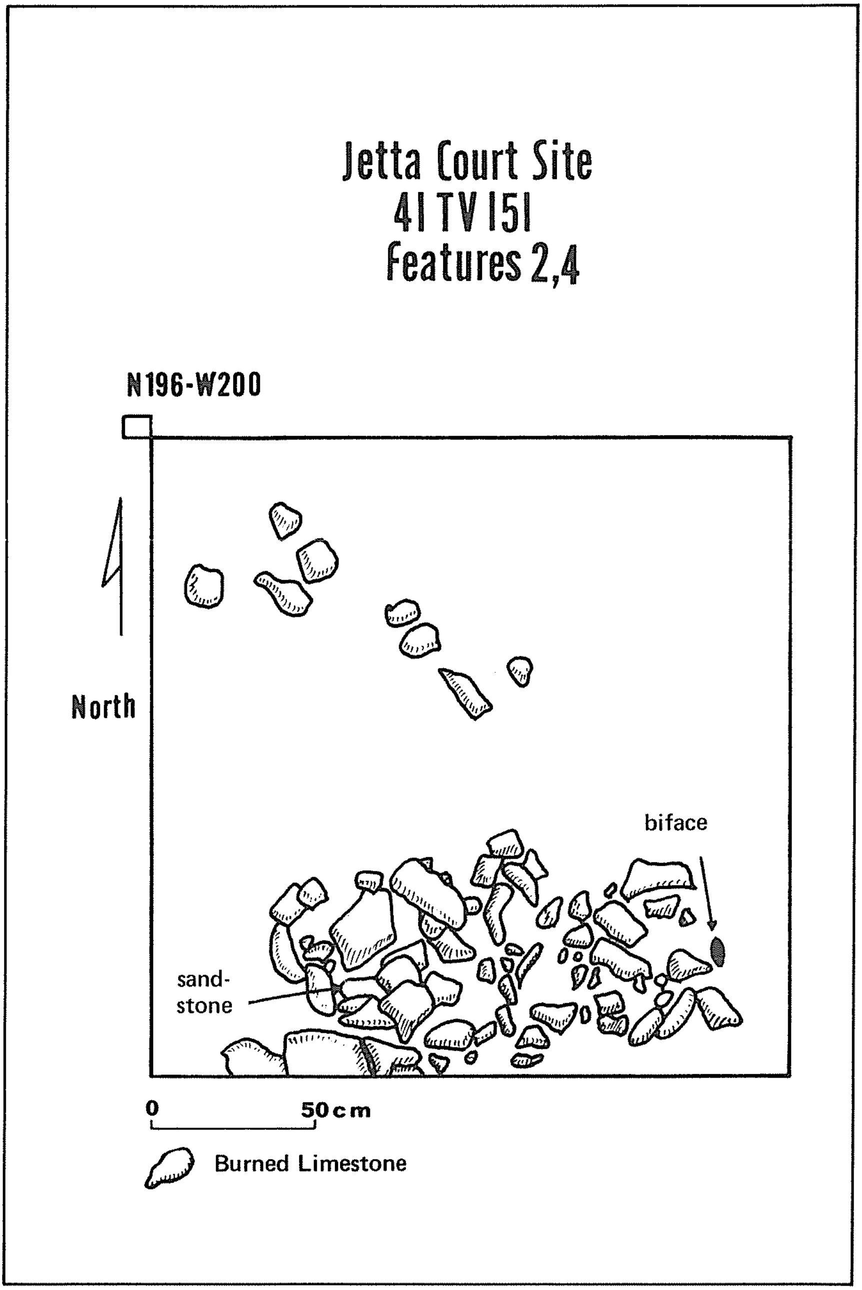


FIGURE 7. *Features 2 and 4, Jetta Court Site (41 TV 151).* See description in text.

vation inadvertently resulted in two separate feature designations being assigned. This feature was a semi-circular concentration of burned rocks in the southern portion of the unit, and it appeared to continue into the south face of the unit. Several additional rocks were scattered across the northern half of the unit and were not definitely linked to the feature. With the exception of a single piece of sandstone, the burned rocks were limestone. A biface and a single flint flake were thought to be in association. Only a few bone fragments were found in Level 7, apparently not associated with the feature, and no bone was found in Level 8. At its thickest point, the rock concentration measured only 16 centimeters, with the components appearing to rest on a fairly flat surface.

Feature 3 (Unit X, Levels 1 and 2, probably Zone E)

This feature was a concentration of burned, and possibly some unburned, limestone rocks at 14-21 centimeters below the surface (Fig. 8). Although no certain stratigraphic link can be demonstrated between Units A, C, E and the ill-fated Unit X, Zone E (the Upper Midden) surely extends across most of the site, and we therefore think that this feature can be assigned to it.

The portion exposed was a semi-circular cluster of limestone rocks and two associated deer metapodial fragments. The feature was approximately 75 centimeters in maximum diameter and was primarily one layer of rocks thick (some of the rocks were up to 30 centimeters in length). A large triangular biface was found in Level 2, but was at the opposite end of the unit and probably not in association with the feature.

Feature 5 (Unit A, Level 6, at the contact between Zones C and D)

Feature 5 was a small accumulation of burned rocks, among which several flint flakes were recovered. Measuring approximately 50 centimeters in maximum horizontal dimension, there is no conventional geometric shape that can be used to describe it. The concentration was only 8 centimeters thick. Most of the stones were slightly tilted in various directions, but all appeared to be resting on a flat surface.

Feature 6 (Unit E, Level 7, the contact between Zones C and D)

Feature 6 consisted of several small concentrations of burned limestone rocks strewn between 120-129 centimeters below the surface (Fig. 9). This elevation is approximately the contact between Zones C and D. Many of the rocks overlapped one another and the flatter ones were tilted in various directions. There was no discernable structure to these accumulations and they may very well have been fire-cracked rocks scattered about on a living surface. A few animal bones were recorded from this level, but none appear to have been in definite association with the rock clusters. However, two flint flakes and a mano fragment were found among the rocks.

Feature 7 (Unit A, Level 11, Zone A)

Feature 7 was an elongated, loose accumulation of burned limestone rocks possibly representing a hearth (Fig. 10). The rocks were on a sur-

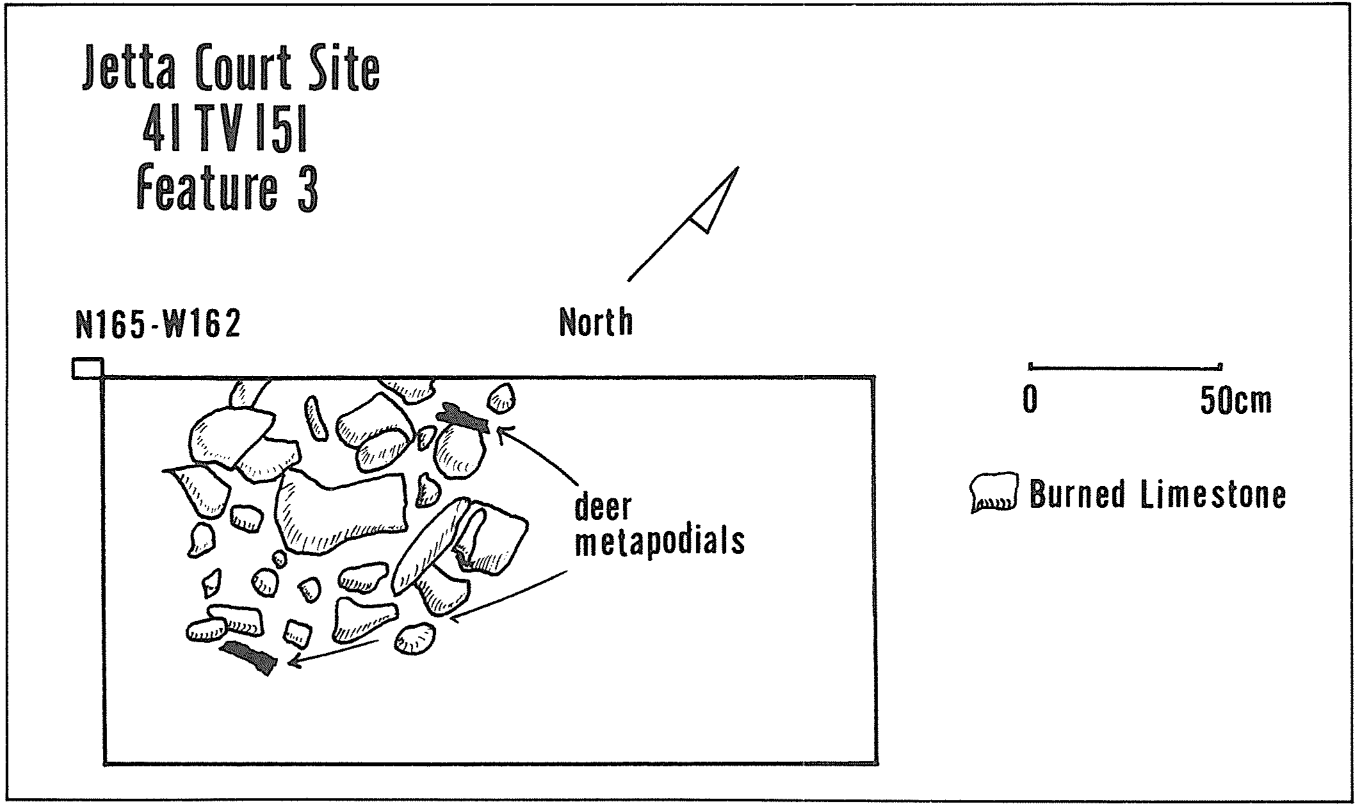


FIGURE 8. *Feature 3, Jetta Court Site* (41 TV 151). See description in text.

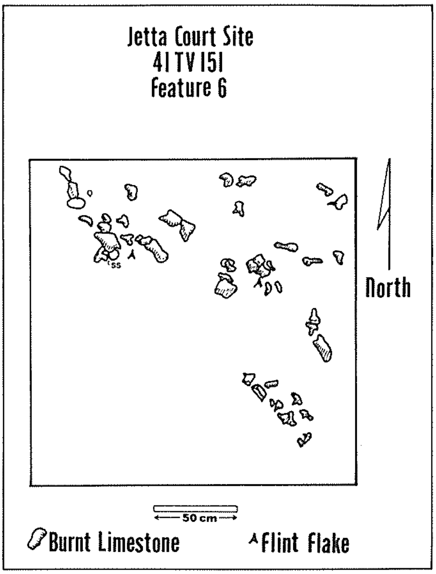


FIGURE 9. *Feature 6, Jetta Court Site (41 TV 151).* In the northwest corner, Q indicates a quartzite cobble, and SS, a piece of sandstone. See description in text.

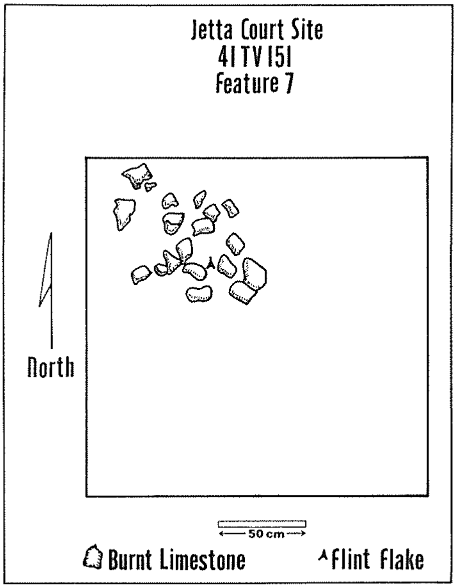


FIGURE 10. *Feature 7, Jetta Court Site (41 TV 151).* See description in text.

face ranging from 203-210 centimeters below the present surface. The only associated object was a large, unretouched flint flake.

DESCRIPTION OF THE ARTIFACTS

With the exception of one polished bone, all artifacts found at the Jetta Court site were lithic. What little shell was found was extremely friable, as was a large portion of the recovered bone. Both bone and shell were carefully examined in the laboratory, but no other artifacts other than the previously mentioned bone specimen were recognized.

The following artifact descriptions are highly abbreviated because of space limitations. The projectile point typology used is largely that of Suhm, Krieger and Jelks (1954). Since most of the artifacts are illustrated, we have omitted data on their dimensions. This information is on file at the Texas Archeological Research Laboratory (Austin) and at the Center for Archaeological Research, University of Texas at San Antonio. Similarly, detailed provenience data have been placed on file at these two institutions, and only general comments regarding provenience are provided in the artifact descriptions.

PROJECTILE POINTS

The section describing projectile points is divided into two groups based on the stratigraphic location of the specimens in reference to the two midden zones. The Lower Midden points will be described first, followed by a discription of the specimens from the Upper Midden.

LOWER MIDDEN

Bell (2 specimens; Fig. 11, a,b)

This type was originally defined by Sorrow, Shafer and Ross (1967:12). The stems of the two specimens expand slightly. The lateral edges of one specimen (Fig. 11, a) are straight, while the other (Fig. 11, b) has more jagged edges. Three barbs have been broken off of the two specimens, but one (Fig. 11,a) has a large barb characteristic of this type.

Bell-like (2 specimens; Fig. 11,c,d)

The stem of one of these specimens (Fig. 11,c) is slightly expanding, while the other (Fig. 11,d) is straight. Specimen 11,c has a straight base and 2,d has a slightly concave base. Both examples have thin stems, which are broken off, and straight lateral edges. One specimen is missing the distal tip.

We have classified these as *Bell-like* as it is highly likely that they are simply variants of the *Bell* type.

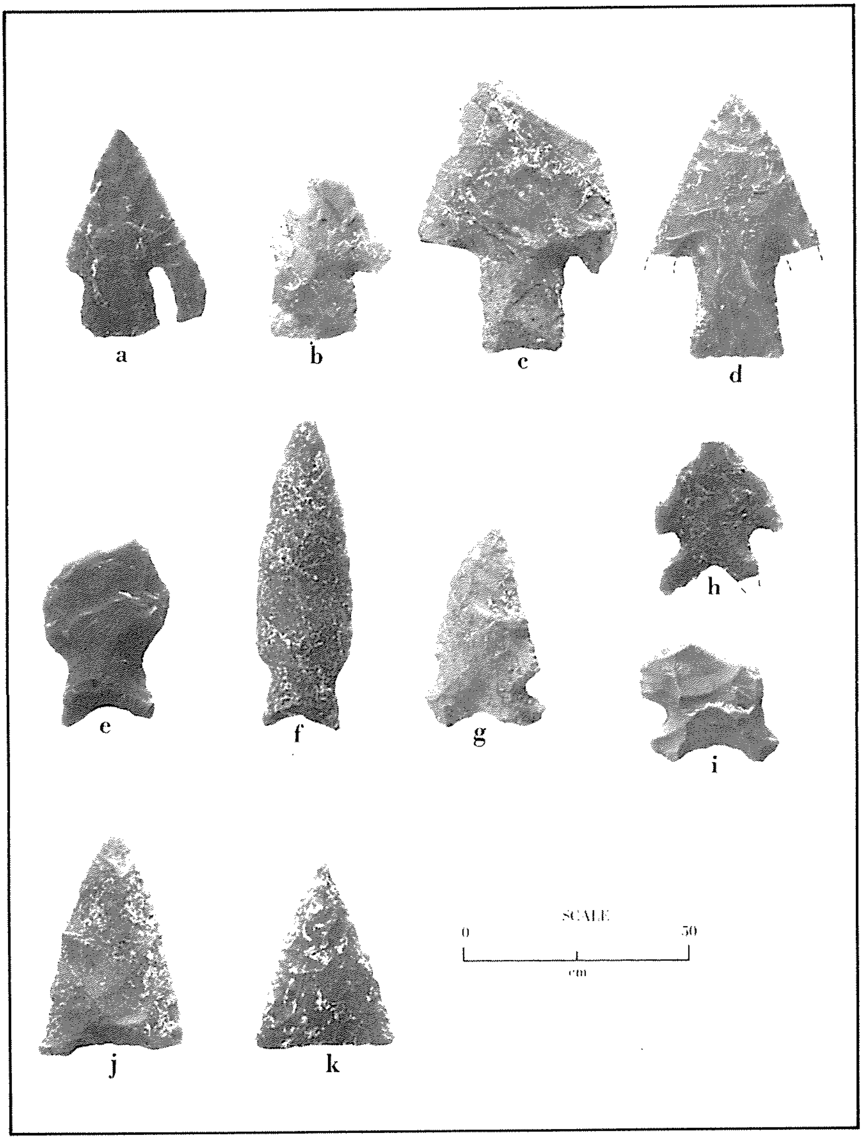


FIGURE 11. *Artifacts from the Jetta Court Site (41 TV 151).* a, b, *Bell*; c, d, *Bell*-like; e, f, *Gower*; g-i, *Miscellaneous I*; j, k, *Miscellaneous II*. All specimens are from the Lower Midden.

Gower (2 specimens; Fig. 11, e,f)

The type was originally described by Shafer (1963). Both of these specimens have expanding stems with indented bases and rounded shoulders. One specimen (Fig. 11,e) has about one-half of its distal end broken off. The other specimen (11,f) has lost a small portion of its tip.

Miscellaneous I (3 specimens; Fig. 11,g,h,i)

All three specimens are corner-notched and have pronounced concavity in the base. Only one seems to be the original length (Fig. 11,g), and it has one convex and one straight lateral edge. The others are fragmented. They are morphologically similar to the *Early Corner Notched* point form found in a stratigraphically equivalent situation at the La Jita site (Hester 1971).

Miscellaneous II (2 specimens; Fig. 11, j,k)

These specimens are large triangular bifaces. They are very similar to the *Tortugas*, except for the lack of beveled lateral edges. Hester (1971) has termed similar specimens *Early Triangular* at the La Jita site; other such triangular points have been found in early contexts at Granburg II in Bexar County (Hester and Kohnitz 1975; Hester 1975).

UPPER MIDDEN

Bulverde (3 specimens; Fig. 12,a-c)

The stems of two of these specimens are slightly contracting and flat across the base (Fig. 12,b,c). On the third specimen (Fig. 12,a) the stem is straight and the base is slightly concave. All three have squared shoulders. Two of them (Fig. 12,a,b) are complete, and display convex lateral edges. The third (Fig. 12,c) lacks about one-third of the distal tip.

Castroville (3 specimens; Fig. 12, d,f)

All three specimens have expanding stems with straight bases. One specimen (Fig. 12,d) seems exceptionally long (10 cm); it has convex lateral edges. The other two specimens have relatively straight lateral edges. All three are barbed.

Darl (4 specimens; Fig. 12,g-j)

Two of the specimens (Fig. 12,g,h) have concave edges on their stems. Of the others, one (Fig. 12,i) has a straight stem, and an other (Fig. 12,j) a slightly convex stem. Specimens h and j have concave bases with the base of i being straight, and the base of g slightly convex. The lateral edges of all the bodies are straight to slightly convex. One specimen (Fig. 12,h) is badly thermal fractured.

Ensor-Fairland (3 specimens; Fig. 12,k-m)

The stems of all three specimens expand greatly. The bases are slightly concave. On two the lateral body edges are slightly convex. One specimen (Fig. 12,m) has been reworked in such a manner as to give a short, squat appearance.

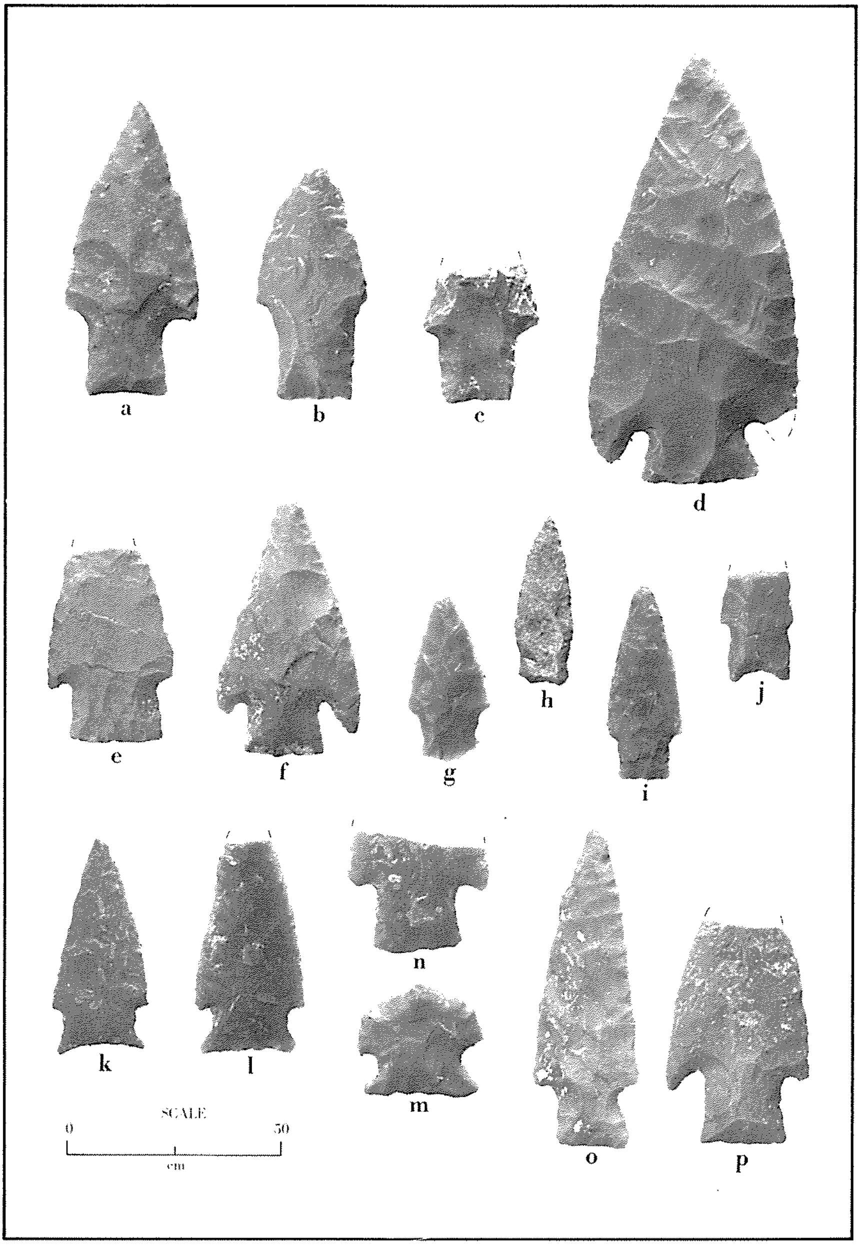


FIGURE 12. *Artifacts from the Jetta Court Site (41 TV 151).* a-c, *Bulverde*; d-f, *Castroville*; g-j, *Darl*; k-m, *Ensor-Fairland*; n-p, *Lange.* All specimens are from the Upper Midden.

Lange (3 specimens; Fig. 12,n-p)

The stem of each specimen is expanding with a straight base. The lateral edges of the bodies are straight to slightly convex. Only one specimen (Fig. 12,n) is complete.

Montell (2 specimens; Fig. 13,a,b)

The stems of these specimens are expanding and are notched near the middle of the basal edge. The distal tips of both specimens are broken off; however, enough can be seen of the lateral edges to indicate that they were straight.

Nolan (1 specimen; Fig. 13,c)

This specimen has a straight or slightly contracting stem with a mildly convex base. The shoulders are sloping. The lateral body edges are convex and the distal tip is broken.

Pedernales (15 specimens; Figs. 13, 14,d-m)

The stems of the specimens vary considerably as can be seen in Fig. 13. All have the characteristic notch or concavity in the base. One specimen consists only of a stem (Fig. 13,m). The bodies are roughly triangular with the lateral edges varying from concave to straight to convex. Only three specimens were complete enough to get both length and width measurements.

Travis (2 specimens; Fig. 14,l,m)

The stems of these specimens are different. One (Fig. 14,l) has a slightly contracting stem to a convex base. The other (Fig. 14,m) has an almost parallel stem with a straight base. The complete specimen has lateral edges that are convex, coming to a sharp point.

Perdiz (1 specimen; Fig. 14,e)

This specimen has a contracting stem with a rounded base. The lateral edges are slightly convex and the shoulders are barbed.

Scallorn (6 specimens; Fig. 14,f-k)

These specimens are easily identified by their corner-notched stems and long narrow bodies. The bases are straight or slightly concave. None of the recovered specimens is complete.

Untyped Individual Projectile Points

The specimens in this category are individual projectile points that do not fit into any of the previous categories. All but one of the specimens (a fragmentary contracting stem dart point) are illustrated in Figures 15 and 16. Specimens in Fig. 15, a-g, are from the Lower Midden; those in Fig. 15, h-o, and in Fig. 16, are from the Upper Midden.

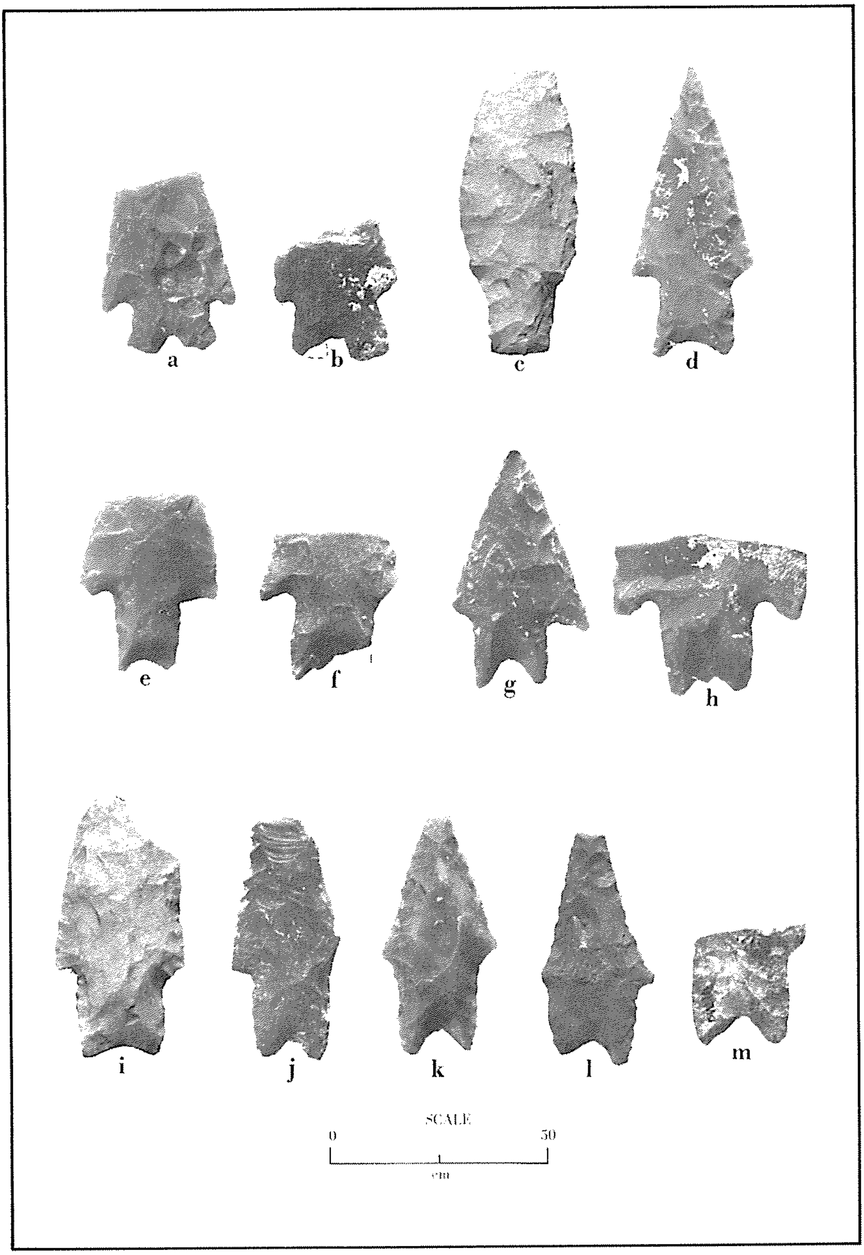


FIGURE 13. *Artifacts from the Jetta Court Site (41 TV 151).* a-b, *Montell*; c, *Nolan*; d-m, *Pedernales*. All specimens are from the Upper Midden.

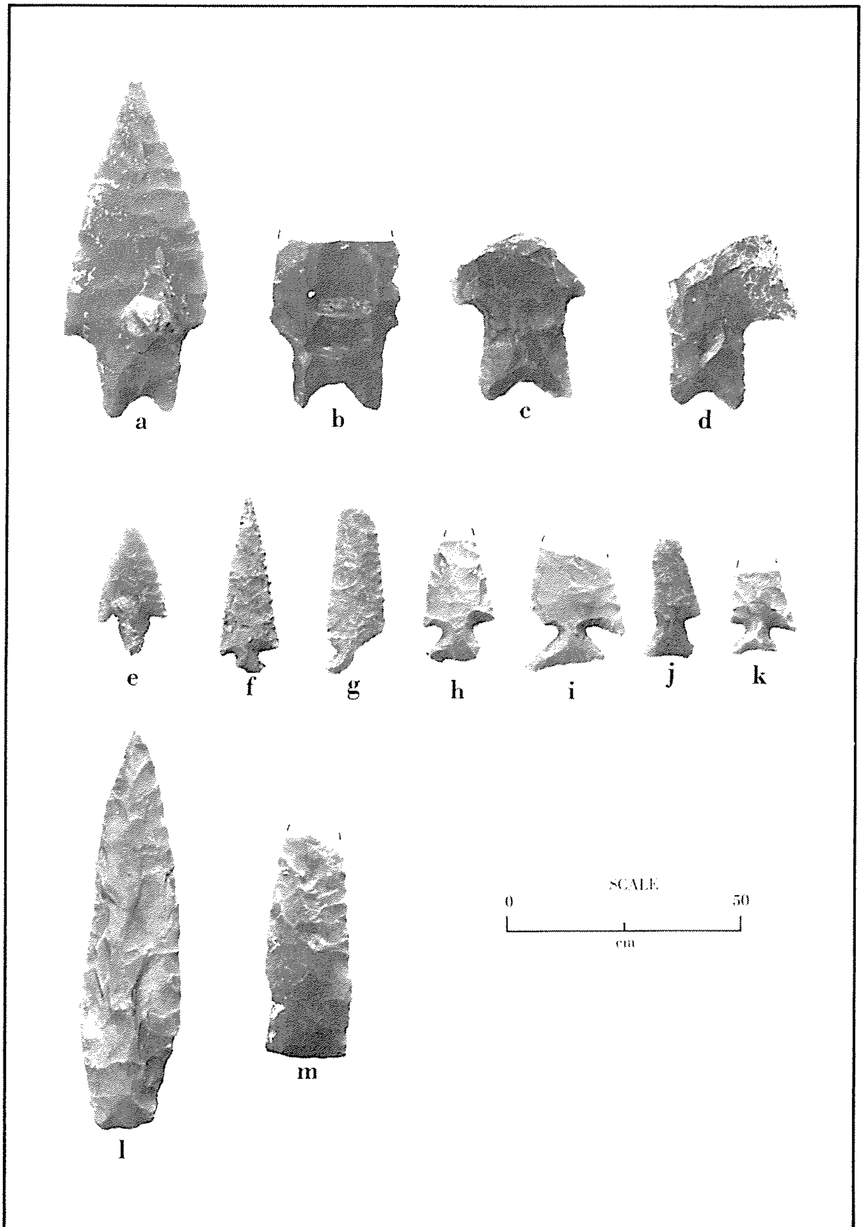


FIGURE 14. *Artifacts from the Jetta Court Site (41 TV 151).* a-d, *Pedernales*; e, *Perdiz*; f-k, *Scallorn*; l, m, *Travis*. All specimens are from the Upper Midden.

TABLE I.

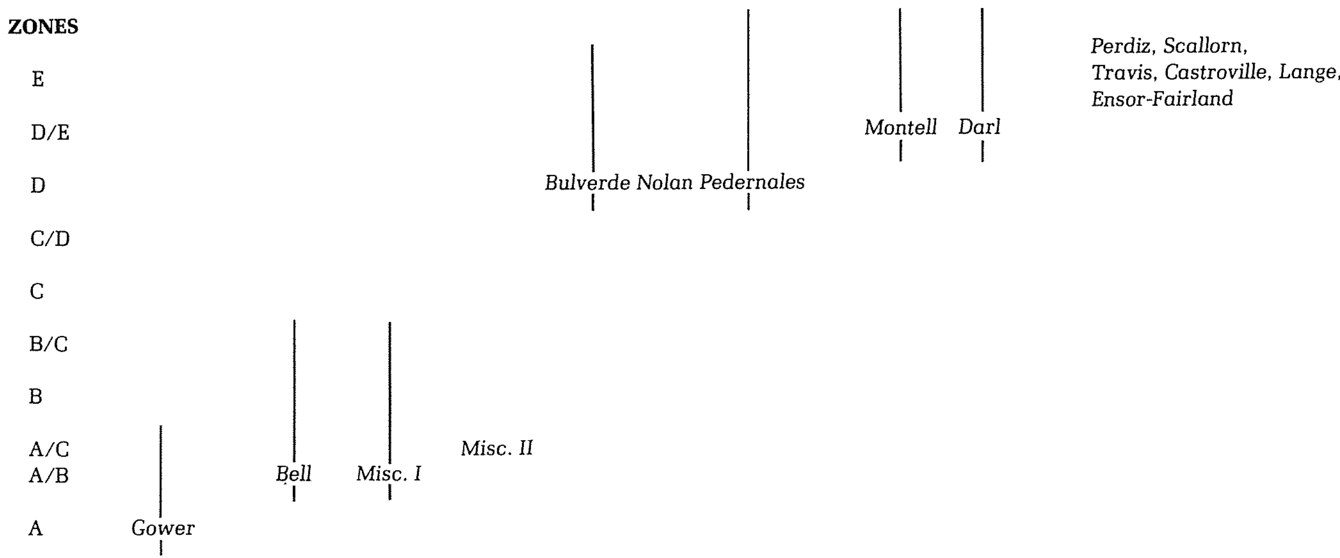


Table 1. Distribution of Diagnostic Projectile Points by Zone.

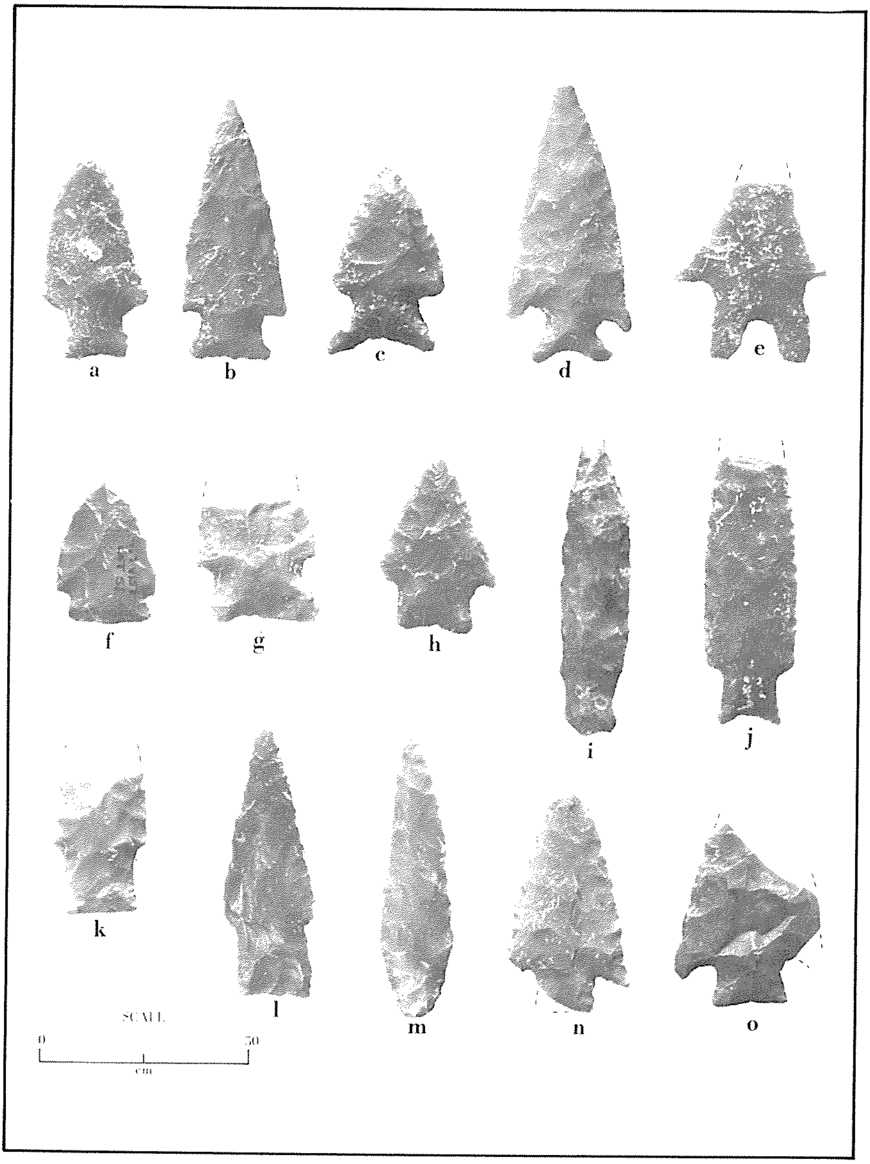


FIGURE 15. *Artifacts from the Jetta Court Site (41 TV 151)*. Untyped projectile points. a-g, Lower Midden; h-o, Upper Midden.

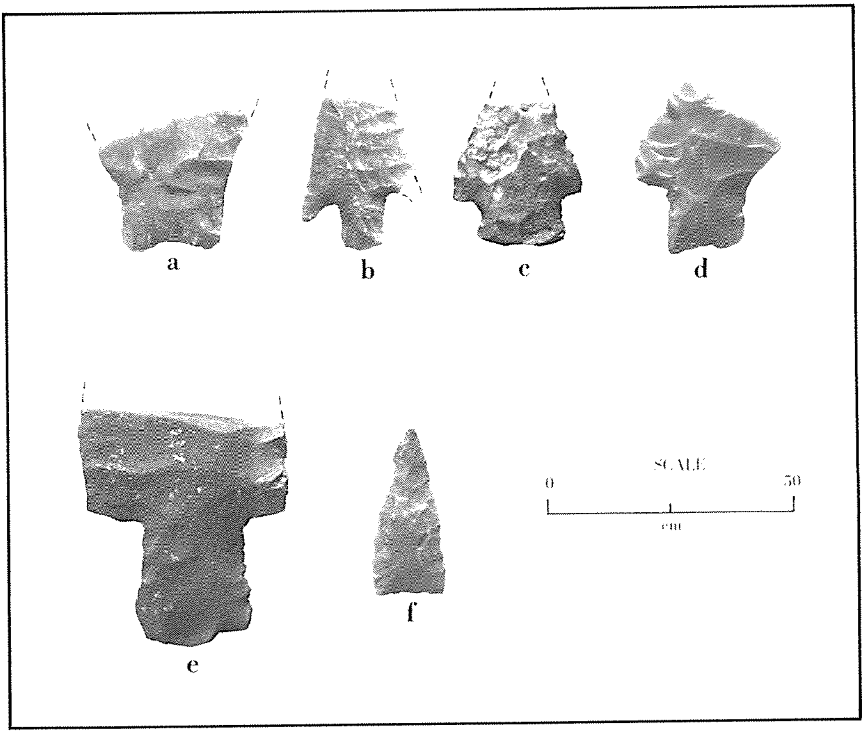


FIGURE 16. *Artifacts from the Jetta Court Site (41 TV 151).* a-f, Upper Midden.

Probable Dart Point Fragments

Because of their workmanship (thinned and retouched), 36 specimens are believed to be distal fragments of projectile points. Six are from the Lower Midden, and the remainder, from the Upper Midden.

OTHER BIFACES (FIGS. 17, 18)

A number of other, non-projectile point bifaces were recovered. These include two thinned bifaces (Fig. 17,a, Upper Midden; Fig. 17,b, Lower Midden) which may be either preforms or knives.

Thirty-nine percussion-flaked bifaces, mostly fragments, were also found, 28 in the Upper Midden and 11 in the Lower Midden. These specimens are of varying shapes and sizes. Many have been totally bifaced and perhaps were preforms or knives. Others are only partially worked and appear to have been broken during the bifacing process. No technological differences were apparent in the samples from the two midden zones.

Perforators (Fig. 17,,c,d)

Both specimens have long, narrow bits. The base of one is similar to a *Castroville* point (Fig. 17,c), while the base on the other specimen is rectangular (Fig, 17,d). Both specimens are from the Upper Midden.

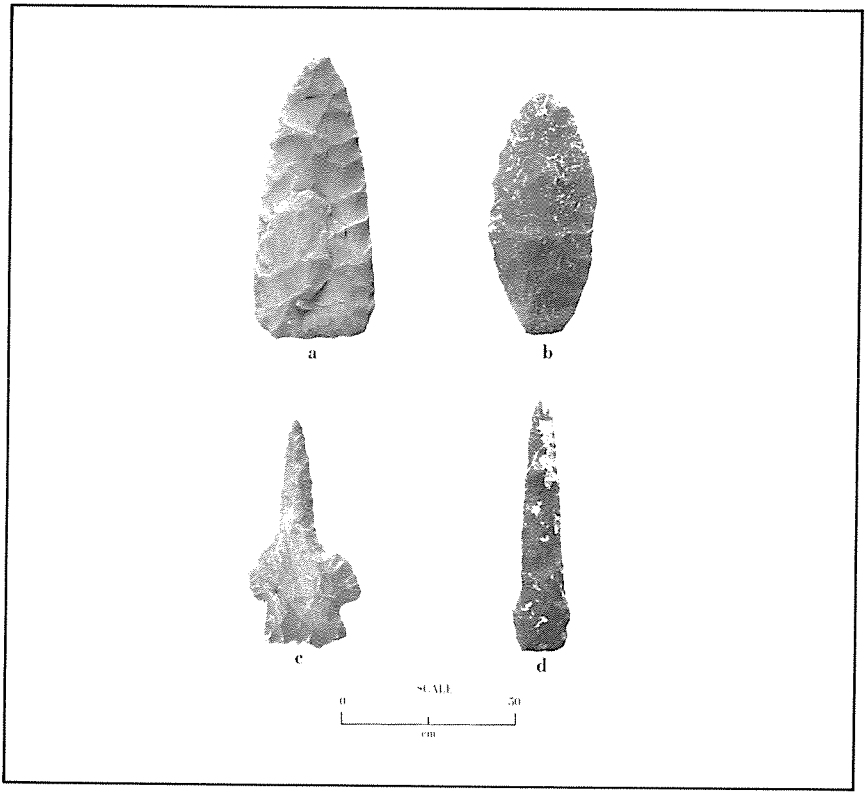


FIGURE 17. *Artifacts from the Jetta Court Site (41 TV 151).* a, b, bifaces; c, d, perforators.

GROUND AND PECKED STONE ARTIFACTS

Gorget (1 specimen; Fig. 19,a)

This specimen was found in the Upper Midden and appears to be a fragment of an ovate gorget. Along the broken edge is a smoothed notch which is suspected to be the first of a line of perhaps three holes. The gorget is made of a reddish stone. Gorgets of this form are known from other Archaic sites in central Texas (cf. Shafer and Corbin 1965: Fig. 12,c; Hester 1971: Fig. 22,g).

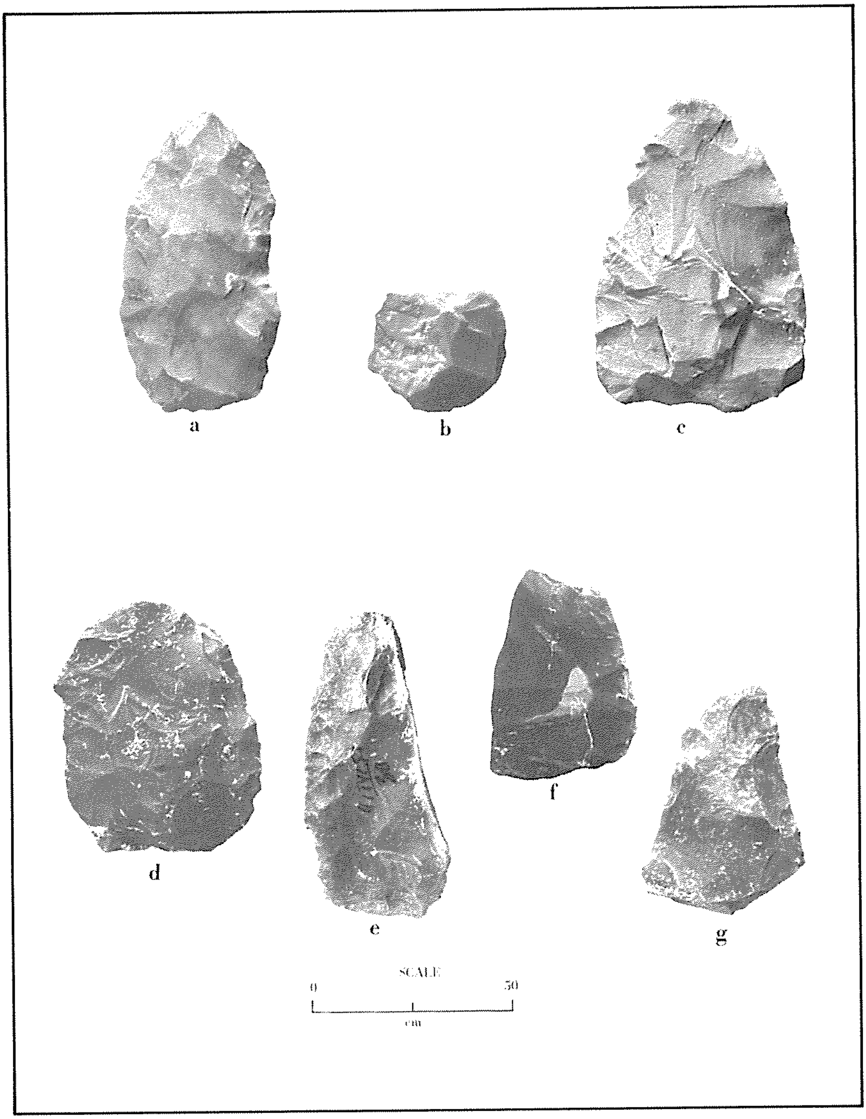


FIGURE 18. *Artifacts from the Jetta Court Site (41 TV 151).* a-g, bifaces and biface fragments; a-c, Upper Midden; d-g, Lower Midden.

Manos (16 specimens; Fig. 19,c,d)

All of these specimens show grinding wear on at least one face. Most are fragmentary; none of the complete ones are larger than 10.5 centimeters in length and none are more than 7 centimeters in width. Only two of the specimens are from the Lower Midden; the remaining 14 are from the Upper Midden.

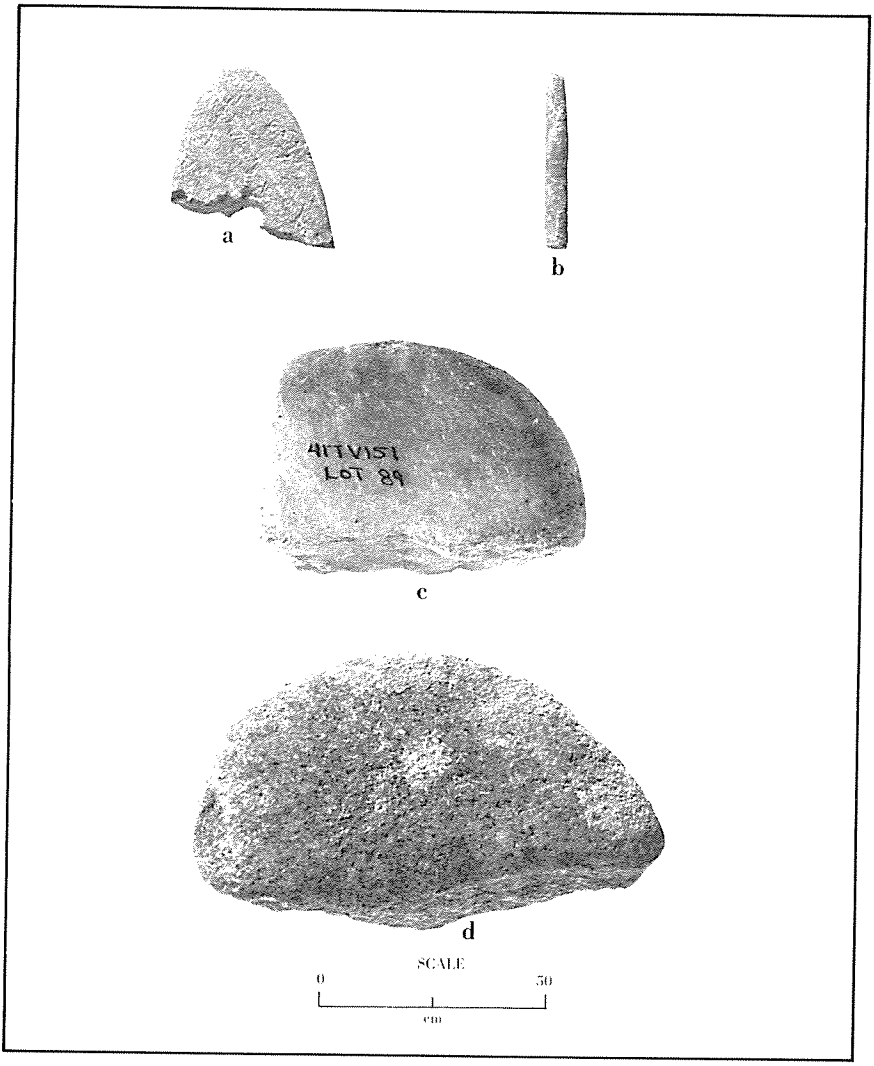


FIGURE 19. *Artifacts from the Jetta Court Site (41 TV 151).* a, gorget; b, bone artifact; c, d, manos.

Metates (15 specimens; Fig. 20,a,b)

All of the metates or grinding slabs were broken. The fragments showed signs of a smooth grinding basin characteristic of this artifact form. Of the 15 specimens 12 were from the Upper Midden, and the others, from the Lower Midden.

Hammerstones (not illustrated)

Two hammerstones were found in the Upper Midden. Both are approximately 8 centimeters long and roughly 5 centimeters in diameter.

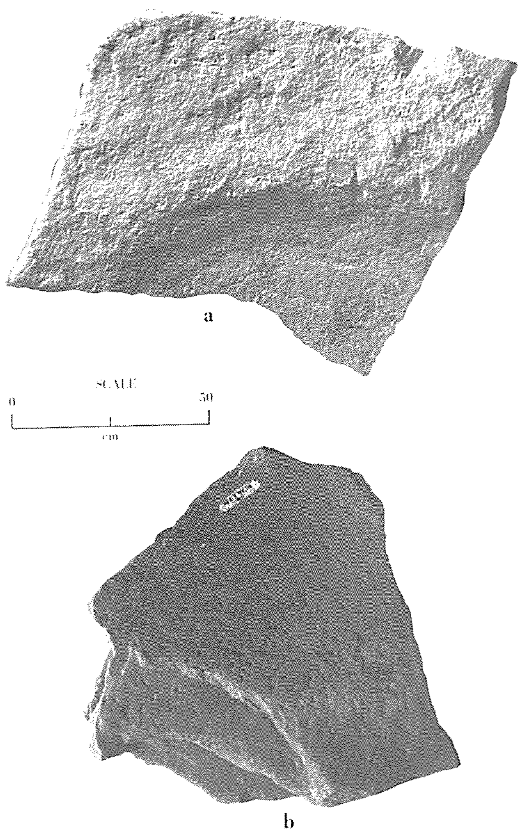


FIGURE 20. *Artifacts from the Jetta Court Site (41 TV 151).* a, b, metate fragments.

Hematite (not illustrated)

One small piece of hematite, possibly used as a source of pigment, was found in the Upper Midden. It was less than 1.5 centimeters square.

ARTIFACT OF BONE

Awl or Pin (1 specimen; Fig. 19,b)

The only non-lithic artifact found at Jetta Court was a small bone specimen from the Lower Midden. It is a highly polished, rod-shaped bone that could be a fragment of an awl or pin. It is 4 centimeters long, and has a diameter of .5 centimeters tapering slightly to .4 centimeters at the other end.

ARTIFACTS FROM AREAS OF LIMITED CONTROL

There were areas at the site where artifacts were collected without complete control and therefore the information received from these artifacts was not included in the main body of artifact descriptions. The limited control areas were surface collections, backhoe trenches, Unit X (destroyed by pothunters), and a one meter by one meter test pit (called Shovel Test 1) which was also aborted. The artifacts from these various proveniences are listed and briefly described below; some are illustrated in Fig. 21.

Surface

Thirteen specimens are from surface contexts (Fig. 21,a,b). There were four bifacially worked fragments, three fragmentary unifaces-(these were the only unifacial implements found at the site) and three possible core or chopper fragments. In addition, there were two projectile points, one *Nolan*-like and the other, non-diagnostic (Fig. 21,a,b).

Backhoe Trenches

Seventeen artifacts were collected during the digging of the backhoe trenches (Fig. 21,c). These include 10 bifacially chipped pieces, four chopper-like implements, and three projectile points. The points are: a *Travis* specimen (Fig. 21,c), found at a depth of 74 centimeters; a *Scallorn* arrow point (not illustrated) found at 16 centimeters; and, a possible *Angostura* (not illustrated) from an undetermined depth.

Unit X

Before Unit X was destroyed, eight artifacts were found. These materials consist of three biface fragments, four projectile points, and one knife-like biface (Fib. 21,h). One specimen is a portion of a corner-notched point (Fig. 21,d), another is a probable *Langtry* (Fig. 21,e), and two are *Bulverde* points (Fig. 21,f,g).

Shovel Test 1

There were five specimens. Four are biface fragments, and the fifth, a rectangular stemmed dart point (Fig. 21,i).

ANALYSIS OF LITHIC DEBRIS

Lithic debris, a category which here includes retouched flakes, was recovered mainly during the screening of the soil from excavations. The use of 1/4" mesh screen for the two levels of Units A, C, and E (0-40 cm below the surface) and 1/2" mesh for the remainder of the excavations surely had some effect on sampling for smaller flakes. The top two levels produced the following percentages of the entire sample of flakes from each unit: Unit A (19%), Unit C (27%), Unit E (36%). Such high percentages could be a function of more intensive occupational deposition rather than differential sampling procedures, but we suspect that the smaller mesh of the screen was probably a contributing factor.

The following categories, drawn from Shafer (1969: 3-5), were used in sorting the flakes and to investigate any changes in the relative frequencies of flake categories through time. We also noted whether or not retouch was present, hoping to get an idea of the amount of "waste" flakes as compared to those which were retouched and presumable utilized.

flake: A chip or spall removed from a nodule (the parent stone) by force.
initial (primary) cortex flake: A flake with cortex covering the dorsal surface.
secondary cortex flake: Cortex is retained somewhere on the dorsal surface of the flake, but the amount may vary greatly. At least *one* flake facet must be present on the dorsal surface.
interior flake: No cortex is retained on the dorsal surface, but the striking platform may retain cortex.
lipped flake: Typically, these flakes have multifaceted, lenticular-shaped striking platforms and a characteristic lip or ridge which is at right angles to the axle of removal on the ventral side. The striking platforms are bifacially prepared and multifaceted. The dorsal side of the flake is multifaceted and rarely exhibits cortes. Lipped flakes are characteristically thin and arched. Similar flakes have been referred to as "billet flakes" (Epstein 1963:29) or flakes of bifacial retouch (Frison 1968: 149,150). Lipped flakes do occur in retouch of unifacials (cf. Shafer 1970) but these specimens reveal remnants of the flat ventral surface of the uniface on one side of the platform angles.

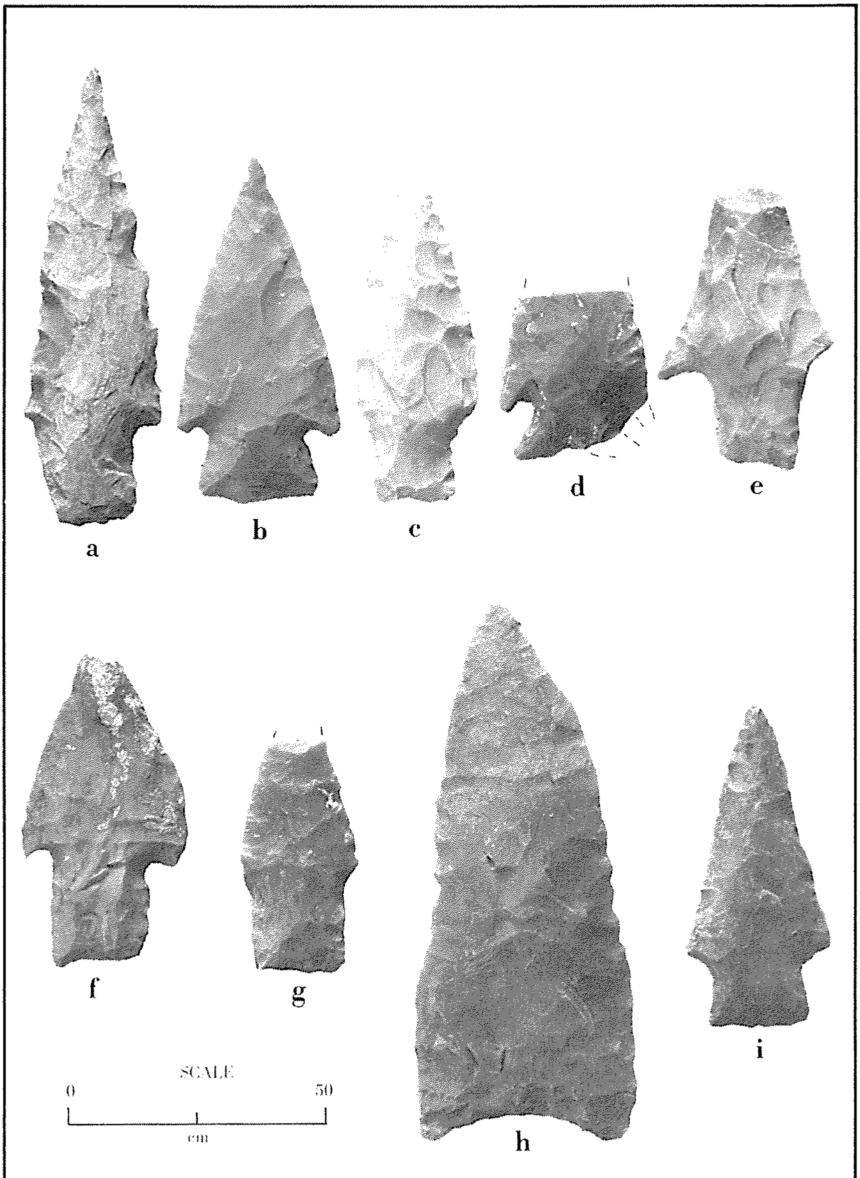


FIGURE 21. *Artifacts from Areas of Limited Control, Jetta Court Site (41 TV 151).* a, b, surface; c, backhoe trench; d-h, Unit X; i, Shovel Test 1.

retouched flakes: Those flakes which display "nibbling" (small flake scars) along one or more edges. These are also known as "utilized flakes", but we prefer to keep the designation of a technological rather than a functional basis.

Other terms employed in the analysis are as follows:

striking platform: A surface (surfaces) on a core from which flakes are removed. A remnant of this striking platform is also detached when the flake is removed and is retained on the bulbar end of the flake.
natural striking platform: The cortex (patinated) surface of a core used without modification as the striking platform.
dorsal surface: That surface of a flake opposite the bulb of percussion.
ventral surface: That side possessing the bulb of percussion.
proximal end: The bulbar end.
distal end: That end opposite the bulbar end.
chunk: Simply a piece of flint that cannot be fitted into any of the other categories, but which is apparently derived from the lithic process (cf. Deacon 1969).

Five categories and a number of sub-categories were used in the sorting. A number of categories were set up to assist in computation and illustrations.

1A: Primary cortex flake — bulb present — unretouched.
1B: Primary cortex flake — bulb not present — unretouched.
1C: Primary cortex flake — bulb present — retouched.
1D: Primary cortex flake — bulb not present — retouched.

2A: Secondary cortex flake — bulb present — unretouched.
2B: Secondary cortex flake — bulb not present — unretouched.
2C: Secondary cortex flake — bulb present — retouched.
2D: Secondary cortex flake — bulb not present — retouched.

3A: Interior flake — buld present — unretouched.
3B: Interior flake — bulb not present — unretouched.
3C: Interior flake — bulb present — retouched.
3D: Interior flake — bulb not present — retouched.

4A: Lipped flake — bulb present — unretouched.
4B: Lipped flake — bulb not present — unretouched.
4C: Lipped flake — bulb present — retouched.
4D: Lipped flake — bulb not present — retouched.

5A: Chunk — unretouched.
5B: Chunk — retouched.

Figure 22 shows the distribution of all flakes by level from each of the Unites A, C, and E. Of interest is the coincidence of "peaks" in the percentages at the elevations of the Upper and Lower Middens. Although the dark staining and burned rock of the Lower Midden was not apparent in Unit A, there is a peak comprising some 30% of the sample from that Unit in Levels 8, 9, and 10. This suggests that the cultural activities associated with the characteristic configuration of the Lower Midden in Units C and E extended into Unit A.

The jump in level 9 of Unit C is attributed to the Lower Midden, but the slightness of the peak in levels 9 and 10 of Unit E is puzzling. The Lower Midden peak in Unit A and the apparent lack of one in Unit E is replicated in the faunal collections. The scarcity of faunal remains in the lower levels of Jetta Court was initially thought to be a function of differential preservation. The testimony of relatively imperishable flint flakes suggests that the scarcity of animal bone in the lower levels may not be so simply explained away.

It could be that the materials from the Lower Midden in Units A and C represent activity areas, and the relative lack of such materials from Unit E might be explained by the absence of any activity area at this spot in the site. We certainly cannot assume, as the analysis of the distribution of the chipping debris will show, that three units of excavation can sample as large a site as Jetta Court adequately. To summarize, the picture presented by Units A and C is one of two peaks in the distribution of flakes (corresponding to the Upper and Lower Middens). Unit E shows a more-or-less gradual increasing percentage of flakes as the present is approached.

Several worksheets were prepared to organize the raw data dealing with the distribution of the various categories as well as percentages for each level. These are too lengthy for inclusion here, but are on file at the Texas Archeological Research Laboratory, Austin. Below level 10 in each unit, each level contributes only .01 to .02 to the unit. These lower levels (11-14) yielded between 3 and 43 flakes apiece, with a mean of 21.75 flakes per level. The following illustrates the proportion of flakes in these lower levels to the flakes from the remainder of the levels:

levels in all below level 10 produced a total of 210 flakes.

x = 21.75 flakes, range 3-43 flakes.
261 flakes = .0457 of 5707 flakes (total for all 3 units)
3 flakes = .0005 of 5707 flakes
43 flakes = .0075 of 5707 flakes

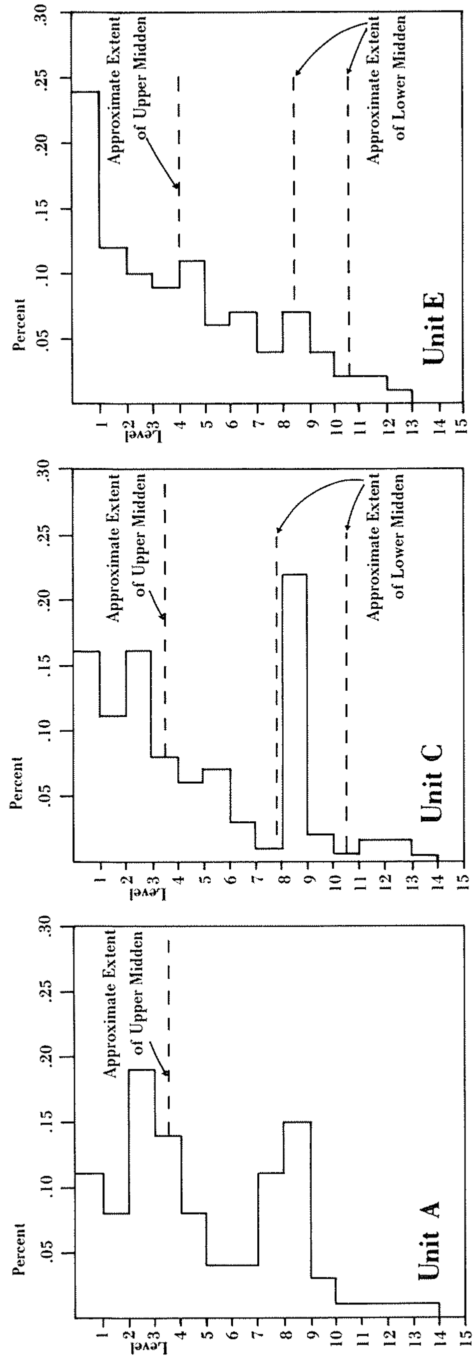


FIGURE 22. *Distribution of Total Flakes Within Each Unit, Jetta Court Site (41 TV 151).*

The foregoing should serve to illustrate that the levels below level 10 are contributing very little to the total assemblage. The fluctuations in relative proportions of flake categories in the levels 11-14 as compared to those fluctuations in levels 1-10 may be a product of small sample sizes, and therefore, sampling error. However, the apparent stability of the proportions in the lower levels is surprising.

The relative proportions of the various flake categories through time were tabulated for each unit (on file, Texas Archeological Research Laboratory). Figure 23 shows the relative frequencies of flakes in the combined Units, A, C, and E. Categories 1 and 5 (primary cortex flakes and chunk, respectively) are so rare as to be virtually negligible. Category 2 flakes appear to change little through time, while Categories 3 and 4 show an inverse relationship in their relative proportions through time.

There are two explanations which may be presented to account for the scarcity of initial cortex flakes:

1) Perhaps very little initial working of flint cobbles was done at the site.
   A) Flint cobbles were collected from spots some distance from the site and initial flaking took place at some other point than the site.
   B) Perhaps very little flint was available in cobble form at all. Rather, flint in ledge outcrops was used. Since ledge flint has no cortex, obviously no cortex flakes could be produced. Such an explanation may also account for the apparent scarcity of Category 2 flakes (Secondary Cortex Flakes).
2) Initial working of flint cobbles was done at the site, but the initial cortex flakes were only rarely discarded. Rather, they were worked into other forms. It does not seem likely that only 28 flakes out of 5707 could have escaped alteration.

At the La Jita site in Uvalde County (Hester 1971), one of the few central Texas sites at which extensive debitage analysis has been conducted, there was a similar rarity of initial cortex (Category 1) flakes throughout the site's history. We suspect that the lack of Category 1 flakes at Jetta Court (as at La Jita) indicates that the initial phases of lithic reduction were carried out at quarry-workshops away from the occupation site.

For analyzing the changes in the relative proportions of Categories 2, 3 and 4, statistical techniques were used to test the significance of some of the differences suggested by simple inspection.

Tests of Homogeneity

A series of x^2 tests were performed to examine various aspects of homogeneity of the lithic debris sample. These tests were mainly

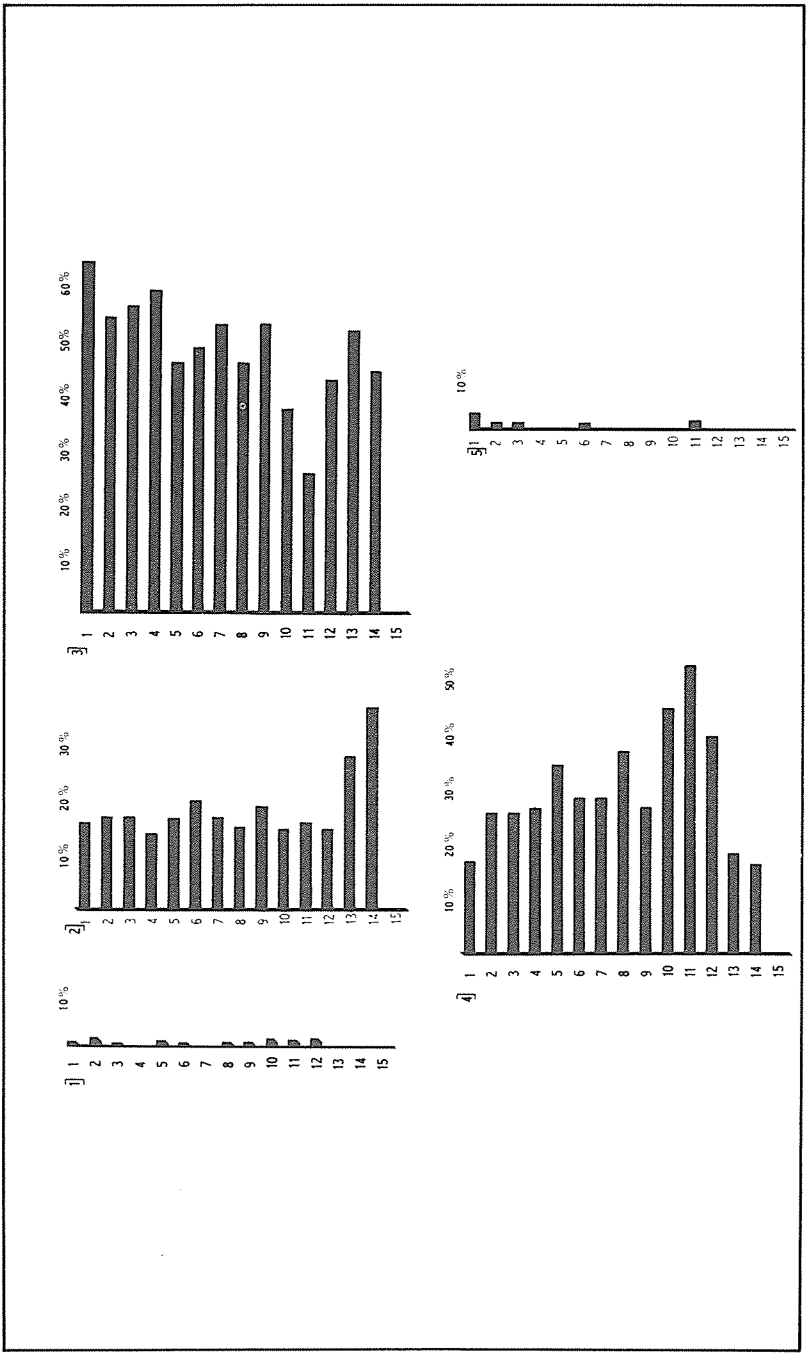


FIGURE 23. *Relative Frequencies of Flake Categories 1-5 for Units A, C and E Combined.*

directed at observing the statistical difference between the Upper and Lower Middens with respect to relative proportions of flake categories 2, 3, and 4. In addition, Spearman rank correlation coefficients were run to see if the observed "trends" in category 3 and 4 flakes (3 becoming more common in the later levels at the expense of 4) had any statistical significance (see below: *Tests of Correlation*).

The Upper Midden Versus the Lower Midden

In the study of the lithic debris comparing the two main occupational deposits recognized, several questions were asked:

1) Are there differences between the two middens if the flake counts from all three units are combined?
2) If there should be significant differences under 1 above, is it possible that one or more of these categories is not statistically different between the two middens? In other words, could category 2 be contributing no significant difference while 3 and 4 do contribute?

CATEGORY	2	3	4	Total
Upper Midden	481	1757	703	2941
Lower Midden	205	588	392	1185
Totals	686	2345	1095	4126

With 2 degrees of freedom, a x^2 value of 5.99 was needed to indicate that the proportions are dependent of provenience, and that the lithic debris assemblages from the two middens were "different" in a statistical sense. A value of 42.47 was obtained, indicating that there is considerably less than a chance in a thousand that the observed proportions are the result of chance. Simply stated, the assemblages from the two middens are different with respect to relative frequencies of flake categories.

The next question was "Do all flake categories contribute to the differences between the two middens, or might one or more categories be distributed with insignificant differences between the middens?" Accordingly, x^2 tests were run comparing the Upper Midden to the Lower Midden on the basis of proportions of Category x flakes versus non-Category x flakes. The results were as follows:

Flake Category	2	3	4
x^2	3.539	35.269	36.485

(__________ = x^2 significant at 3.84 at .05 level of significance with 1 degree of freedom)

Choosing the .05 level of significance, we see that Categories 3 and 4 are different, but not Category 2. This suggests that changes in lithic technology — if such changes can be measured by the changing relative frequencies of the flake categories recognized — are confined to Categories 3 and 4. Category 2 flakes appear to have a more constant relative frequency.

A functional approach might suggest that the origin of the Secondary Cortex Flakes remained constant through time and that there was no "need" for the lithic assemblages to respond to any postulated environmental or cultural changes as far as Category 2 flakes were concerned. This does not say, however, that the lithic technology remained undifferentiated through time with respect to other kinds of flakes. Indeed, it appears that there are certain trends through time in the relative frequencies of Categories 3 and 4, which are considered below ("Tests of Correlation").

Since it appears that there are differences of statistical significance between the Upper and Lower Middens for the site as a whole (read "for Units A, C, and E"), tests were made to see if these differences existed at the level of the Unit. In other words, is the sample from each unit consistent with the total assemblage? Can we talk about changes in lithic technology in a statistical sense for the sample from one unit of excavation; or are the units inconsistent, and must they be totaled in order to speak of changes in flake category frequencies?

x^2 tests were made for each unit comparing Categories 2, 3, and 4 in their Upper and Lower Middens:

Unit	A	C	E
x^2	51.47	10.40	36.85

(__________ = x^2 significant at 5.99 at .05 level of significance with 2 degrees of freedom)

All are significantly different, indicating that the differences noted when Units A, C, and E were combined are not the product of differences in only one unit.

In addition, we tested the notion that one or more categories of flakes may be contributing little to the differences as Category 2 was seen to do earlier in this paper. x^2 tests were made comparing Category x in the Upper and Lower Middens versus non-Category x in the Upper and Lower Middens for each unit. The x^2 values are presented below:

		Unit	
Category	A	C	E
2 vs n/2	1.59	2.98	2.21
3 vs n/3	43.32	1.03	36.09
4 vs n/4	42.83	9.21	25.35

(________ = x^2 significant at 6.64 at .01 level of significance with one degree of freedom)

With one exception, Category 3 in Unit C, Categories 3 and 4 show considerable degrees of difference while Category 2 appears to be quite stable from unit to unit. The next logical step would be to test for differences comparing one unit to the others.

Interunit comparisons were performed to see if the lithic debris assemblage from the Upper Midden was consistent in its proportions from unit to unit. The same was tested for the Lower Midden. A sample table is given below for the Upper Midden:

		Category		
Unit	2	3	4	Total
A	151	640	169	960
B	175	578	137	890
C	155	539	397	1091
Totals	481	1757	703	2941

The resulting x^2 scores were as follows:

Upper Midden	154.557
Lower Midden	84.592

(both of these are significant at the .001 level of significance (x^2 = 18.46).

Clearly, in the above cases, the distribution of flakes within a midden zone is dependent upon the unit, but we also tested to see if only one unit was contributing most of the difference. The x^2 values are presented below:

	A vs C	A vs E	C vs E
Upper Midden	5.626	<u>92.559</u>	<u>109.898</u>
Lower Midden	<u>17.588</u>	<u>35.592</u>	<u>83.226</u>

(__________ = x^2 significant at 5.99 at .05 level of significance with 2 degrees of freedom)

All the differences are highly significant at the .05 level except the Upper Midden of A versus that of C, which lacks 0.374 of being significant. In all except one instance, then, the individual units are contributing considerable amounts of difference. By the same token, the units are inconsistent in the evidence each presents of the lithic debris of this site.

As we have seen, the middens are different from one unit to the next, indicating that proportions of flakes is not independent of unit. We tried two tests for levels within the Upper Midden, with the null hypothesis that midden levels within a unit show no significant change. For each unit we tested level 1 against level 4 (the topmost and bottommost levels of the Upper Midden) and level 3 against level 4.

		Units	
Levels	A	C	E
1 vs 4	<u>48.22</u>	<u>8.75</u>	4.126
3 vs 4	2.536	0.061	<u>8.441</u>

(__________ = x^2 significant at 5.99 at .05 level of significance)

The results of these and other x^2 tests performed on the flake distribution from individual levels are not clear-cut. Reduced sample size is certainly a potential source of error, and using two contiguous levels (or levels within the same recognized stratigraphic unit) may very well be violating independence of samples.

Summary of Tests of Homogeneity

In summary, it appears that there is considerable diversity between the two middens with reference to Category 3 and 4 flakes. The same type of test also shows that there is a considerable amount of variation among the three units with respect to the same stratigraphic entity, the middens.

Tests of Correlation

If we accept (1) the premise that the two middens are significantly different in their proportion of flakes and (2) that this difference is a function of changing patterns of lithic technology through time, what can we say about the existence of any statistically significant trends? Since we have two ordinal scales — the percentage of any category in a level, and a time scale from level 1 through level 10 — the Spearman Rank Correlation Coefficient $\underline{r}$ was applied.

Ideally, the Pearson product-moment correlation coefficient $\underline{r}$ would give us the clearest indication of the correlation between changing flake proportions and time. But the Pearson test is a parametric test and requires a fixed-interval scale and certain assumptions about the population from which the sample was drawn. The archeologist's task would be simplified considerably if we could assume a constant rate of deposition of soil. Then we could say, for instance, that the time span represented by level 3 is equal to that represented by level 4 or level 10, and that changes in lithic technology could be correlated to the time scale with more precision than we can here.

However, we must regard our relative dates (our arbitrary levels and our recognized strata) as an ordinal scale. The null hypothesis is that there is no association between the two variables of level number and percentage of a given flake category. That is, there is no statistically significant trend in increasing or decreasing proportions of any flake category through time. From simple inspection of the percentages, it appears that category 2 shows no obvious trend, but category 3 appears to increase in proportion as we come nearer the present in time, while category 4 decreases.

Levels 1 through 10 were tested in each of the units A, C, and E. In addition, the flake counts were totaled up for the three units, percentages calculated anew, and these total percentages were tested.

$$\underline{r}_{\underline{s}} = 1 - \frac{6 \sum d^2}{n\,(n^2 - 1)}$$

where:
d = differences between ranks
6 = a constant
n = number of ranks (for these calculations, there always are 10 ranks and 10 relative percentages)

The equation used in the calculation of $\underline{r}_{\underline{s}}$ (rank correlation coefficient) is taken from Snedecor and Cochran (1967:195).

	Categories 2	Categories 3	Categories 4
Unit A	-0.151	$\underline{\underline{0.903}}$	$\underline{0.721}$
Unit C	-0.100	0.369	0.791
Unit E	0.394	0.430	0.357
Total ACE	0.046	$\underline{0.713}$	$\underline{\underline{0.921}}$

(______ = significant at 0.683 at .05 level of significance.
______ = significant at 0.833 at .01 level of significance).

Category 2, in all cases, is seen to have values so low as to indicate that their relative frequencies are scattered almost randomly through time (a value of 0.000 would indicate complete independence of relative frequency and level; -1.000 would indicate a perfect negative association). Categories 3 and 4 are significant 3 out of 9 times when considered by unit. Both are significant when all three units are grouped. Accordingly, we can say that the shifts seen in the relative frequencies of Categories 3 and 4 are statistically significant when all three units are combined.

Distribution of Retouched Flakes

The lithic debris was examined on the basis of retouched flakes versus unretouched flakes to see if this particular category of artifacts was consistent in its distribution throughout the occupation of the Jetta Court site. First, the individual levels from the Units were totaled and we compared the Upper Midden versus the Lower Midden on the basis of retouched flakes versus unretouched flakes for all three units. This produced a x^2 value of 7.3252, which is significant at the .01 level of significance.

The individual categories of flakes produced the following x^2 values for the two middens:

	Category		
	2	3	4
Combined A,C, and E	0.1365	11.3904	2.3831
Unit A	0.1032	16.9036	9.4435
Unit C	0.2501	3.0248	1.3598
Unit E	0.1027	3.0849	0.0025

(__________ = x^2 significant at 3.84 at .05 level of significance)

For the combined assemblage from all three units, only Category 3 is significantly different in its proportions between the two middens. When we examine the individual units, Categories 3 and 4 in Unit A show significant differences.

Spearman rank correlation coefficients were determined for each occasion that the x^2 value was significant in the above table. The results were not significant in any test:

	r_s
Category 3 from Units A, C, E	-0.2212
Category 3 from Unit A (levels 1-10)	-0.4667
Category 4 from Unit A (levels 1-10)	-0.1125

In conclusion, there are some differences in the distribution of retouched flakes versus unretouched ones, but there appears to be no discernable pattern in their occurrence.

Summary and Conclusions to the Analysis of the Lithic Debris

The statistical analysis of the lithic debris from the Jetta Court Site has produced the following observations:

1a. There is a statistical difference between the proportions of flakes for the Upper Midden versus the Lower Midden for the total flakes from the Upper Midden and the Lower Midden (combined totals from Unit A, C, and E.)

1b. The difference in proportions under la remains present if we examine the collections from each individual unit.

2. There are statistically significant differences for the proportions when one unit is compared with another.

3. x^2 values for category 2 are generally low, suggesting that proportion of category 2 flakes is independent of provenience.

4. Proportion of category 2 flakes is not correlated with provenience to a significant degree. Categories 3 and 4, however, show correlations with provenience only part of the time when studied by individual units. When the total flake counts for the units are combined and percentages recalculated, the proportions of categories 3 and 4 flakes are significantly correlated with provenience. Category 3 flakes (interior flakes) become more common from the bottom levels to the top levels of the site at the expense of category 4 flakes (lipped flakes).

The observations listed above are still at the descriptive level of scientific investigation and have no explanatory value. Referring to the study of the European Paleolithic, Binford (1968:49-50) comments

> The most impressive schemes for the *description* of differences and similarities in flint assemblages have developed in Old World prehistory . . . Problems arise, however, in the *explanation* of differences and similarities and in understanding changes through time. All too often prehistorians view flint industries "evolving" through time, as though they contained genetic materials and were capable of mutation. It is on the explanatory level that anthropological concepts are particularly valuable. Our basic concept is culture, and it is to the understanding of functional variability and change within culture systems that we wish to direct attention . . . the description, however detailed, of assemblages does not constitute an *explanation* of differences and similarities.

The paper by Binford quoted above deals with changes in tool categories rather than chipping debris, but the same logical processes of explanation are involved. The present study, because of a number of difficulties (not the least of which is the lack of sufficient comparative data) was unable to generate any testable hypotheses about the cultural of functional importance of the observed changes in flake categories. Partly this study was attempted in the hope of stimulating other work with similar data to see if any patterns of flake proportions can be determined for Central Texas. If it should result that the pattern of flakes at the Jetta Court site is consistent with the pattern for Central Texas sites, then we may be dealing with a very stable set of functions for lithic materials over a considerable geographic area and through several millenia. If, however, various patterns should be identified for various sites, we might attempt to postulate reasons for these differences:

1) Different cultural traditions in various parts of the same currently — recognized "culture area" (in the sense of Willey and Phillips 1958:20, 47-48).
2) Differences in the seasons of occupation of various sites. Different sites could have been occupied at various times of the year in order to exploit the sources of food or raw materials that were ripening at the time. Different subsistence activities may have required different tool kits. In order to investigate this possibility, a very extensive survey of tools from various sites would have to be examined and tabulated to see if there might be differences from one area to another. In addition, ecological surveys of the areas of the sites would have to be carried out (see "Natural Setting" section of this paper).

At any rate, several comments may be offered on the study of the chipping debris from the Jetta Court Site:

1) The fact that differences between middens do exist is of interest since it appears to reflect changes in lithic technology other than stylistic changes in projectile points.
2) The observed differences among the Units is not altogether unexpected since one would not expect the site to be homogeneous throughout. Activity areas are certainly present, although they may have been scattered to the point that we were unable to recognize them during excavation. However, they were not scattered enough to create homogeneity in the site. As a unit is excavated, one level may intersect several such activity areas and acquire uneven samples from each. A solution to such a problem as this would be careful horizontal excavation of sites, which might give the excavators better control over sampling techniques.
3) Finally, we submit that the differences between the Upper and Lower Middens are "real" in the sense that they are not products of the analysis, partly because of the demonstrated trends for Categories 3 and 4. This does not say, however, that the differences are *not* the results of a very small sample from a large site.

FAUNAL REMAINS

Sampling procedures for the faunal remains consisted of collecting all bones and mussel shells that appeared on the screen or the few fragments that were collected *in situ*. For snail shells, collection consisted of gathering about 250 milliliters from each level. Since screen sizes of 1/2" and 1/4" were used (mainly the former) larger mammals are surely over-represented by virtue of the size of their bones and bone fragments. Although animal bones decreased in lower levels of the site (partly as a factor of preservation, we think), we are confident that had more refined collection techniques been employed we would have a more representative sample of the faunal assemblage.

Dan Witter, formerly of the Vertebrate Paleontology Laboratory at Balcones Research Center, graciously identified the faunal remains and suggested the following categories for analysis of the mammalian remains:

Category A: mammals of 200 pounds or more (horse, bison, cow)
Category B: mammals within the range of 20 pounds to 200 pounds (deer, beaver, coyote, dog, etc.)
Category C: mammals weighing between 2 ounces and 20 pounds (rabbit, mice, opossum, etc.)

Since the faunal remains from Unit X were only from the top 80 centimeters of a one by two meter square, and since they were consistent with those from Units A, C, and E and produced no new taxa, this analysis will consider in detail only the remains from Unit A, C, and E. The faunal remains from the backhoe trenches are without provenience and produced no species not present in Units A, C, or E.

From Units A, C, and E a total of 868 bone fragments was recovered. The upper one meter of the excavations produced 81% of the remains, and the frequency of the remains tends to decrease with depth. Although more intensive collecting of animals during the later occupations is a possibility, we feel that poorer preservation in the older deposits is also operating. The individual specimens from the lower deposits are more friable, are more pitted and corroded, and their edges are rounded. An exception to the decreasing frequencies in the lower levels is somewhat greater frequencies between approximately 150 to 210 centimeters below the surface, roughly corresponding to the Lower Midden (Zone B). This might suggest either more stable surfaces or more frequent occupations at these levels, resulting in a more intensive deposition of debris.

In the main, the animal bones were quite fragmented and difficult to assign to definite taxonomic categories. In addition, not a single articulation was recognized in the field. Consequently, only 66 fragments, mostly deer, could be identified.

Since only 7.5% of the animal bones could be assigned to some taxonomic category, it is necessary to use the "size of animal" categories to achieve some meaningful picture of the faunal remains. Figure 24 indicates the relative percentages of mammal bone fragments (by size category), and unidentified fragments. Category B mammals contribute 56% of the total amount of animal bone, category A some 17%, and category C contributes only 5%.

At best, these frequencies are only very rough approximations of the economic importance of these groups because: a) these percentages are partly a function of bone breakage; and, b) small mammals, because of sampling techniques and the possibility of differential preservation, are surely under-represented. Accepting Figure 25 at face value would support the notion that category B mammals constituted a very important source of food.

Skeletal elements present for category A and B mammals were mostly portions of the appendicular skeleton. Of the 89 category B bone fragments that could be identified as to anatomical position, 27% were of the axial skeleton (skull, teeth, mandible, scapulae, and vertebrae) while the remaining 73% were of the appendicular skeleton. Again, such distributions are partly a function of bone breakage and are only rough estimates of the relative percentages of axial versus appendicular elements. It does suggest, however, that the meat associated with the appendicular skeleton was more likely to be brought back to the site while the remainder of the bones were left at the place of killing or dressing out.

The relative percentages of size categories by levels were calculated for only the top meter of Units A, C and E. This accounted for 81% of the total faunal assemblage. The rapid decrease in the occurrence of animal bones below the top one meter made the sample size for calculation of relative frequencies rather small.

Category B mammal bone fragments vary between 77% and 45% of the total for each level. Excepting unidentified bone fragments, the most striking change is the 42% of category A mammals in level 2. This is caused by a concentration of 85 category A bone fragments, mainly small rib fragments, in Level 2 of Unit A (incidentally, these 85 fragments represent 63% of all category A bone fragments from the upper meter of Units A, C, and E). Fifty-seven of these fragments were burned, indicating that human activity was involved, but we are unable to identify the animal involved.

Examination of the percentages of the faunal assemblage in each level reveals several items of interest (Fig. 25). First, approximately 68% of all animal bone fragments are from the top 80 centimeters, for the most part from the Upper Midden. There is a consistent low frequency for the lower levels except for the levels that correspond to

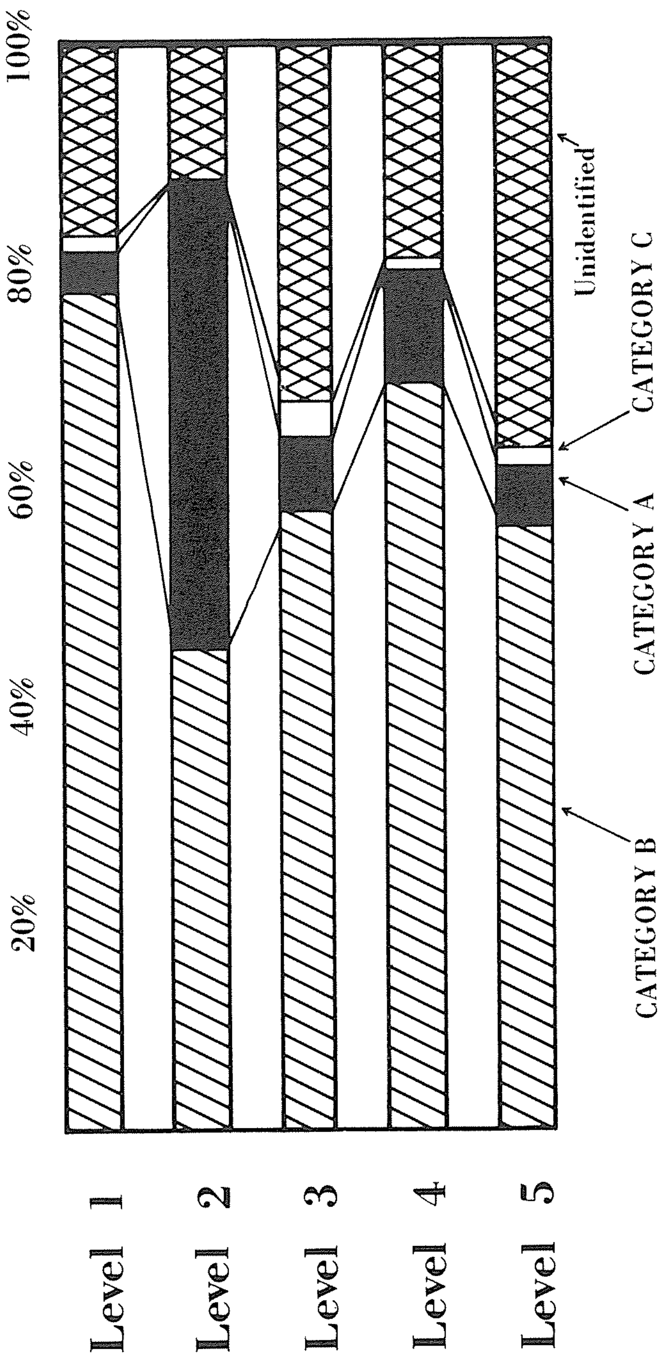


FIGURE 24. *Distribution of Animal Bones by Size Categories in the Top Meter of Units A, C, and E.*

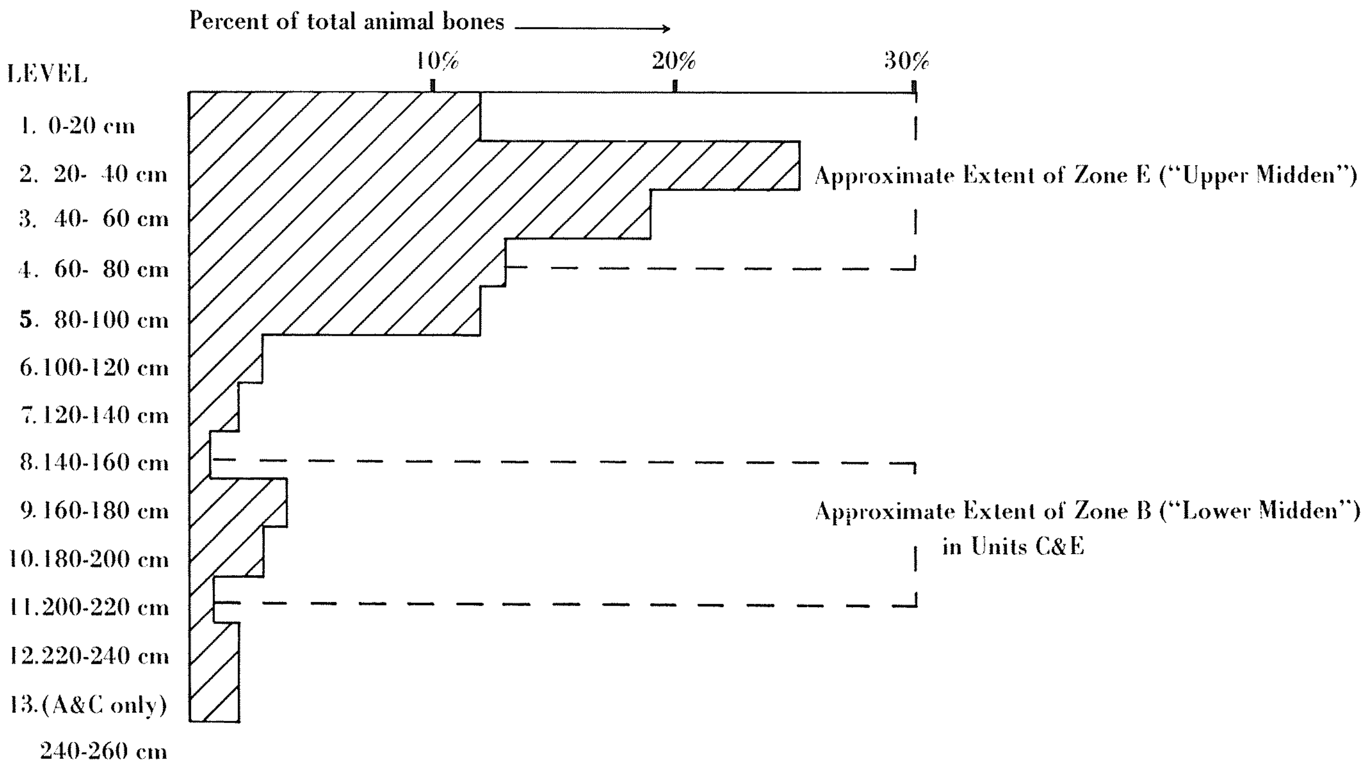


FIGURE 25. *Vertical Distribution of Faunal Remains, All Levels Combined.*

the Lower Midden. There is a slight but perceptible increase at that zone.

Since the Lower Midden was not apparent in the section of Unit A, the distribution of faunal remains in each unit was calculated to see if the increase in bone fragments between Levels 8 and 11 was restricted to Units C and E. The results were not entirely as expected. All three units had between 62% and 72% of their animal bones in the top four levels, corresponding to the Upper Midden. Unit A had an increase at the general Lower Midden levels, but this increase was duplicated at even lower depths. Unit C performed as expected, showing a considerable increase at the Lower Midden levels; but Unit E showed no really significant increase at a similar elevation. Assuming relatively consistent preservation across any given elevation in the site, such differences as mentioned above indicate that the three units are not similar to the point of homogeneity. Such dissimilar distributions from unit to unit are characteristic also of the flint flakes. For the Jetta Court site, then, we cannot assume that each unit will give us an identical picture of the contents of the site, despite similarities in observed stratification. In summary, the vertebrate remains from Units A, C, and E are characterized as the following:

1) They are highly fragmented and, accordingly, are quite difficult to identify.

2) Approximately 81% of the faunal assemblage was from the top one meter of the site, and frequency decreased with depth. Differential preservation is surely a factor here, but "intensity of occupation" may well be involved also.

3) Category B mammal bone fragments are the most common, but Category C mammals are surely under-represented because of sampling procedures.

4) Skeletal remains that could be identified anatomically for the Category 2 mammals indicated that fragments of the appendicular skeleton were the more common. This suggests that the bones of the axial skeleton were more commonly left at the site of the kill or butchering.

MOLLUSCAN REMAINS

Snail shells collected at Jetta Court have not yet been subjected to analysis. Of the many thousands occurring in the deposits, most are land snails of the *Rabdotus* (formerly *Bulimulus*) family. The presence of snails in such great numbers, as well as in lenses or concentrations (see Fig. 4), suggest that the gathering of snails was part of the

TABLE 2. IDENTIFIED FAUNA AT JETTA COURT (41 TV 151)

	Number of fragments identified	Provenience*
CLASS: REPTILIA		
ORDER: Chelonia		
FAMILY: Testudinidae (turtle)	8	A2(1) 3 frags. A9(10) 1 frag. C2(4) 2 frags. E2 (27) 2 frags.
CLASS: MAMMALIA		
ORDER: Marsupilia		
FAMILY: Didelphiidae		
Didelphis virginiana (Virginia oppossum)	1	E5(90)
ORDER: Rodentia		
FAMILY: Cricetidae		
Neotoma sp. (wood rat)	1	A7(17)
Sigmodon hispidus (hispid cotton rat)	1	E5(90)
FAMILY: Geomyidae		
Geomys bursarius (Plains pocket gopher)	1	E5(90)
ORDER: Lagomorpha		
FAMILY: Leporidae		
Lepus californicus (black-tailed jackrabbit)	2	C12(88) A13(86)
Sylvilagus cf. *floridana* (cottontail rabbit)	1	A6(7)
ORDER: Carnivora		
FAMILY: Procyonidae		
Procyon lotor (raccoon)	1	E4(36)
FAMILY: Canidae		
Canis familiaris or *latrans* (dog or coyote)	1	A9(72)
ORDER: Artiodactyla		
FAMILY: Cervidae		
Odocoileus virginianus (white-tailed deer)	93	See Table 3 for distribution of *Odocoileus* fragments
FAMILY: Antilocapridae		
Antilocapra americana (pronghorn)	1	E5(90)
FAMILY: Bovidae		
Bos taurus (teeth only) (cow)	3	E1(2) E2(27) C2(4)
Bison bison (identification supported by stratigraphic location)	4	A12(37) A4(8) E5(90) E7(12)

*Provenience is indicated by the unit designation (A,C,E), followed by the level (10,11, 12...), and, in parentheses, the lot number assigned during cataloging.

TABLE 3.

UNIT		A	C	E
LEVEL	1	-	1	7
	2	3	5	9
	3	12	3	7
	4	4	2	10
	5	3	-	9
	6	4	-	2
	7	-	2	2
	8	1	-	-
	9	-	-	-
	10	2	3	1
	11	-	-	-
	12	-	-	1
	13	-	-	-
Total		29	16	48

Table 3. Distribution by level of deer bone fragments. The provenience of 93 fragments is indicated. All are definitely identified as *Odocoileus virginianus*.

food-collecting regime (Hester and Hill 1975 have noted ethnohistoric evidence for the eating of land snails by southern Texas Indian groups).

Mussel shells occurred infrequently, and were usually highly fragmented. Only in eight instances could the fragments be assigned to the family level (*Lampsilis* spp. or *Proptera* spp.) and for only two examples could a species be identified (*Lampsilis tampicoensis*).

Mussel shells were found in all levels in Units A, C, E, except for levels 8 and 11. The two *Lampsilis tampicoensis* specimens were in levels 1 and 2.

CONCLUDING COMMENTS

Finally, we must assess the contributions of the Jetta Court site to the archeology of central Texas, and suggest some directions for future research. We have to first point out that "future research" at the Jetta Court site is impossible; houses are now constructed over the area of the prehistoric occupation. Thus, the opportunity of obtaining any additional information from this important locality has been lost to central Texas archeologists. Our hurried excavations in 1968-1969 were salvage tests of a site that was of unknown age and unknown horizontal or vertical extent. Within the limited time constraints under which we worked, the excavation goals were quite restricted. The best we could hope to achieve was the examination of the contents, depth, and cultural sequence of the site before it was rendered inaccessible by construction activities.

With these caveats in mind, what can we say that the Jetta Court excavations have added to the understanding of central Texas prehistory? We were able to establish the depth of human habitational refuse in the terrace deposit, and it was possible to determine the age and relative sequence of diagnostic artifacts conforms tolerably well to the defined central Texas chronology (Johnson, Suhm and Tunnell 1962; Sorrow, Shafer and Ross 1967; Prewitt 1974). It has been argued by some that the cultural chronology of central Texas is so well-known that further concern with the succession of diagnostic artifacts is not a viable research goal. While we realize that there is a lot more to archeology than culture history, it is becoming increasingly apparent that as the number of excavated sites in the region increases, the more our chronological framework has to be modified and adjusted. The refinement of temporal control is, to our way of thinking, essential to the pursuit of more sophisticated problems in archeology, including studies of site function and seasonality, settlement and subsistence, aboriginal technology, paleoenvironmental reconstruction and so forth. One example of the continuing adjustments and correlations necessary in the central Texas chronological framework is presented by Prewitt (1974: Figure 7). Another area in which refinement is required is exemplified by the discoveries at Jetta Court. At this site, in the Lower Midden, we have a discrete horizon representing a very early phase of human occupation in central Texas. These materials are stratigraphically below the diagnostics of the presently defined "Early Archaic" of the region (see Johnson, Suhm and Tunnell 1962). The "Early Archaic" is represented by such horizon-markers as *Bulverde, Nolan* and *Travis* dart points. *Bulverde* and *Nolan* are present in the Jetta Court sequence, as indicated in Table 1. However, occurring below them, in the Lower Midden, are distinctly different forms, including *Bell*, *Bell*-like, *Gower*, corner notched (*Miscellaneous I*) and triangular (*Miscellaneous II*) dart points.

The presence of this horizon pre-dating the "Early Archaic" is not unique at Jetta Court. In fact, a considerable literature already exists which notes its occurrence at other central and Trans-Pecos Texas sites (Shafer 1963; Sorrow, Shafer and Ross 1967; Word and Douglas 1970; Hester 1971; Sollberger and Hester 1972; Prewitt 1974). A review of the various sites in Texas in which the "pre-Archaic" horizon is found has been published by Sollberger and Hester (1972).

Since their compilation of data on these sites is published in a readily available major journal, we will not re-examine it here. Suffice it to say that the existence of a "very Early Archaic", or "pre-Archaic", "Transitional Archaic", or whatever appellation one chooses to use, is firmly established. Lithic traits include triangular, corner-notched, *Gower*, and *Bell* dart points, along with *Guadalupe* and unifacial *Clear Fork* tools in some areas, such as south-central Texas (Hester and Kohnitz 1975).

No one has yet determined, through chronometric means, the temporal boundaries of this early cultural unit. As work continues and more components are discovered, we may find that there will be problems of internal sequence which will further modify our present concepts of this horizon (cf. Sorrow, Shafer and Ross 1967; Prewitt 1974: Figure 7).

The extensive analysis of Jetta Court lithic debris produced some interesting results, described in detail earlier in the paper. There appear to be changes in relative proportions of various flake categories through time. The changes in the frequencies of interior flakes versus lipped flakes (biface thinning flakes) can be correlated with level to some degree. It is impossible to evaluate these recognized changes in the lithic debris due to the lack of comparable analyses in the central Texas area; the presently published flake analysis data comes from a variety of far-flung sites.

In addition, the analysis of lithic debris at Jetta Court reveals considerable diversity from unit to unit, even though the same stratigraphic entities are being examined. Several possible explanations for this come to mind: (1) small sample sizes from large sites are unreliable in presenting the range of lithic debris from the entire site; (2) the same stratigraphic unit (the Lower Midden, for example) is not homogenous throughout its extent; rather, there may be certain activity areas located here and there in the midden, and a square unit of excavation has a good chance of intersecting (or even missing) several of them in any one level. Therefore, there may be little value in horizontal comparisons of flake samples from scattered units in a large site. Vertical comparisons, aimed at elucidating certain changes in lithic technology through time, may be more useful in such circumstances but even here there are obvious limitations.

Although we believe that the occupants of Jetta Court were mobile hunters and gatherers, presumably with some regularly-replicated yearly round of subsistence activities, we see no evidence for establishing the position of this site in their subsistence regime. Such knowledge would have to be obtained from a thorough analysis of surviving faunal and organic remains, and from a detailed acquaintance with the prehistoric settlement pattern of Walnut Creek and surrounding areas. We have meager data for the first, and almost no information on the latter. The problem of settlement pattern data can be solved through the use of a regional approach to archeological inquiry (cf. Hester, Heizer and Graham 1975:15), rather than with an over-concern with specific, productive sites. As far as the analysis of organic debris, it is apparent that such materials are very poorly preserved in most of the terrace and burned rock midden sites of central Texas. Further, the interpretation of the faunal and organic evidence will never reach sophisticated levels if we continue to extract it from the ground with traditional techniques, such as those employed in our salvage work at Jetta Court. The recovery of significant data on artifact distributions, associations of materials with functionally-specific activity areas, and the relationships of functional units within a site, call for different kinds of excavation technologies. Open-area, or horizontal, excavations are one such approach (cf. Shafer 1971: Figure 18,a). Furthermore, it might be more useful to concentrate such investigations in small, easily delineated sites where behavioral patterns may be better preserved than in thick, repeatedly-occupied localities like Jetta Court.

In closing, we would like to suggest that the techniques we used in "salvaging" Jetta Court not be implemented in similar situations in the future. We did obtain, perhaps mostly through luck, some significant information. But, might not we have done better by grouping our units in a block excavation, thereby getting a good sample from a particular area, an area in which at least some minor spatial analyses could have been accomplished? As a bit of further retrospection, could we have learned more by having the backhoe remove the overburden from a sizeable portion the Lower Midden, thus allowing us to examine its horizontal composition more fully? We do not wish to engage in an extensive exercise in "hindsight archeology", as we still believe that we did the best we could, given the available time, funds and manpower, and the state of our own archeological training at that period. We would recommend, however, that future student archeologists, when faced with a similar challenge, try to assess and determine certain regional problems of prehistory that could be attacked through rapid salvage work, and then devise the appropriate strategies for the investigation.

References Cited

Binford, S. R.
1968 Variability and Change in the Near Eastern Mousterian of Levallois Facies. In: *New Perspectives in Archeology* (S. and L. Binford, eds.), pp. 49-60. Aldine, Chicago.

Deacon, H. J.
1969 Melkhoutboom Cave, Alexandria District, Cape Province: a report on the 1967 investigation. *Annals of the Cape Provincial Museum, Natural History*, Vol. 6, No. 13. Grahamstown, South Africa.

Eddy, F. W.
1974 Resource Management and Locational Strategies of Certain Prehistoric Sites in Central Texas. *Plains Anthropologist*, Vol. 19, No. 64, pp. 99-106.

Epstein, J. F.
1963 Centipede and Damp Caves: Excavations in Val Verde County, Texas, 1958. *Bulletin of the Texas Archeological Society*, Vol. 33 (for 1962), pp. 1-129.

Frison, G. C.
1968 A Functional Analysis of Certain Chipped Stone Tools. *American Antiquity*, Vol. 33, pp. 149-155.

Hester, T. R.
1971 Archeological Investigations at the La Jita Site, Uvalde County, Texas. *Bulletin of the Texas Archeological Society*, Vol. 42, pp. 51-148.

1975 A Chronological Overview of Prehistoric Southern and South-Central Texas. Paper presented at the conference "The Prehistory of Northeastern Mexico and Texas", Monterrey, Mexico, April.

Hester, T. R., R. F. Heizer and J. A. Graham
1975 *Field Methods in Archaeology*. 6th revised edition. Mayfield Publishing Company, Palo Alto.

Hester, T. R. and T. C. Hill, Jr.
1975 Eating Land Snails in Prehistoric Southern Texas: Ethnohistoric and Experimental Data. *The Nautilus*, Vol. 89, No. 2, pp. 37-38.

Hester, T. R. and H. Kohnitz
1975 The Chronological Placement of *Guadalupe* Tools. *La Tierra*, Vol. 2, No. 2, pp. 22-25.

Johnson, L., Jr., D. A. Suhm, and C. D. Tunnell
1962 Salvage Archeology of Canyon Reservoir: The Wunderlich, Footbridge and Oblate Sites. *Texas Memorial Museum Bulletin*, No. 5.

Prewitt, E. R.
1974 Archeological Investigations at the Loeve-Fox Site, Williamson County, Texas. *Texas Archeological Survey, Research Report*, No. 49.

Shafer, H. J.
1963 Test Excavations at the Youngsport Site A Stratified Terrace Site in Bell County, Texas. *Bulletin of the Texas Archeological Society*, Vol. 34, pp. 57-81.

1969 Archeological Investigations at Robert Lee Reservoir, West Central Texas. *Papers, Texas Archeological Salvage Project*, No. 17.

1970 Notes on Uniface Retouch Technology. *American Antiquity*, Vol. 35, pp. 480-487.
1971 Late Prehistory of Central Texas: 500 B.C. to A.D. 1700. Paper presented at annual meeting, Texas Academy of Science, Nacogdoches.
Shafer, H. J. and J. E. Corbin
1965 An Appraisal of the Archeological Resources of the North Fork, South Fork, and Laneport Reservoirs, Williamson County, Texas. Report submitted to the National Park Service. Austin.
Skinner, S. A.
1971 Prehistoric Settlement of the DeCordova Bend Reservoir, Central Texas. *Bulletin of the Texas Archeological Society*, Vol. 42, pp. 149-270.
Snedecor, G. W. and W. G. Cochran
1967 *Statistical Methods*. Iowa State University Press, Ames.
Sollberger, J. B. and T. R. Hester
1972 The Strohacker Site: A Review of Pre-Archaic Manifestations in Texas. *Plains Anthropologist*, Vol. 17, No. 58, Pt. 1: 326-344.
Sorrow, W. M., H. J. Shafer and R. E. Ross
1967 Excavations at Stillhouse Hollow Reservoir. *Papers, Texas Archeological Salvage Project*, No. 18.
Suhm, D.A., A. D. Krieger and E. B. Jelks
1954 An Introductory Handbook of Texas Archeology. *Bulletin of the Texas Archeological Society*, Vol. 25.
Witter, D.
1971 Environment and Vegetation of the Robert Lee Reservoir Basin. In: Investigations into South Plains Prehistory (by H. J. Shafer), pp. 145-163. *Papers, Texas Archeological Salvage Project*, No. 20.
Willey, G. R. and P. Phillips
1958 *Method and Theory in American Archaeology*. Phoenix Books, Chicago.
Word, J. H. and C. Douglas
1970 Excavations at Baker Cave. *Texas Memorial Museum Bulletin, No.* 16.

NEO-AMERICAN OCCUPATION AT THE WHEATLEY SITE, PEDERNALES FALLS STATE PARK, BLANCO COUNTY, TEXAS*

JOHN W. GREER

ABSTRACT

Scallorn and Perdiz arrowpoints and pottery were found in discrete clusterings of cultural debris interpreted as single occupation activity areas. The site probably dates about A.D. 1150-1300, the suggested overlap period for the Austin and Toyah foci.

INTRODUCTION

The Wheatley site was initially discovered in 1962 by members of the Travis County Archeological Society of Austin and was found to contain artifacts of Neo-American age. It was named after C. A. Wheatley, the landowner, and designated 41 BC 114. Intensive surface collection and surface stripping were conducted in 1971 in order to verify observations made during the original survey concerning the presence of *Scallorn* and *Perdiz* arrowpoints and pottery in discrete areas. Work was carried out under a Permit to Conduct Archeological Investigations, No. 8, issued by the Antiquities Committee of the State of Texas, and funds were provided by the State Archeologist's Office of the Texas State Historical Survey Committee (now the Texas Historical Commission).

THE SITE

Pedernales Falls State Park is on the Pedernales River in eastern Blanco County, 30 miles west of Austin and 10 miles east of Johnson City (Fig. 1). The park is typical of the hilly regions near major rivers in central Texas. Small dry, perennial and intermittent creeks begin as low valleys winding between eroded Cretaceous hills, becoming slightly steeper as they approach the river. Then, typical for most of the Pedernales River east of Johnson City, the creeks plunge suddenly into rather impressive, though not exceptionally large, steep-walled limestone canyons. These contain springs, flowing water, and an abundance of vegetation (including cyprus trees and ferns) and small

*This is a revised version of the manuscript, "Archeological Investigations at the Wheatley Site, Blanco County, Texas" (J. W. Greer, 1974), on file with the Texas Historical Commission, Austin.

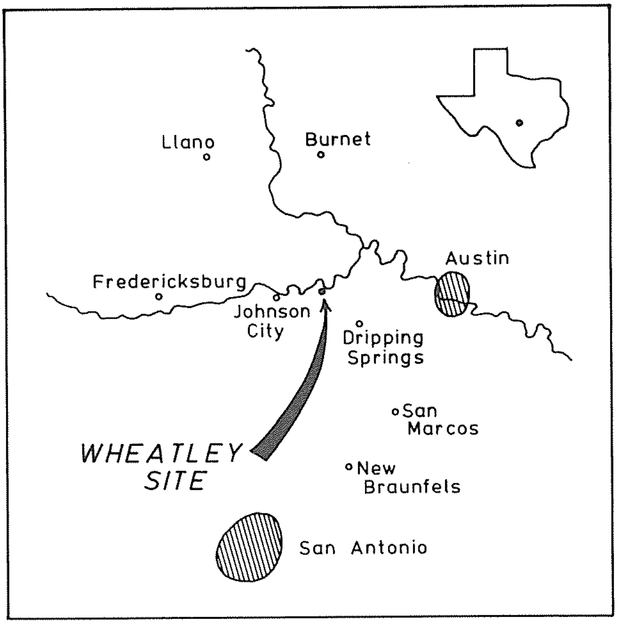


FIGURE 1. *The location of the Wheatley site, Blanco County, Texas.*

animals. Entry into these canyons often is somewhat limited, though not prohibitive. Flats (erosional areas physiographically similar to terraces) above the canyons are covered mainly with small oaks, various grasses, and juniper.

The rate of juniper spread in the area is astonishing and has ramifications for modern archeological interpretation. Much of the area which was sparsely covered or clear of juniper during the 1962 survey today supports very thick growth. Few places remain, aside from the canyon rimrock area, where one can see any appreciable distance, and in many places even foot passage is seriously hampered.

The Wheatley site is on the second large flat above and 500 yards west of the Pedernales River canyon rimrock, and between the canyons of Bee Creek and Mescal Creek (Fig. 2). At the eastern edge of the site is a steep clay drop-off of about 20 feet, while low limestone hills rise slowly from the site's western edge (Fig. 3). The relatively level and featureless surface is a windblown and slightly washed reddish to beige sand, which overlies a compact red clay containing a fine rolled quartz and chert sand. This is at an elevation sufficiently above the Pedernales River and tributary canyons to prohibit the

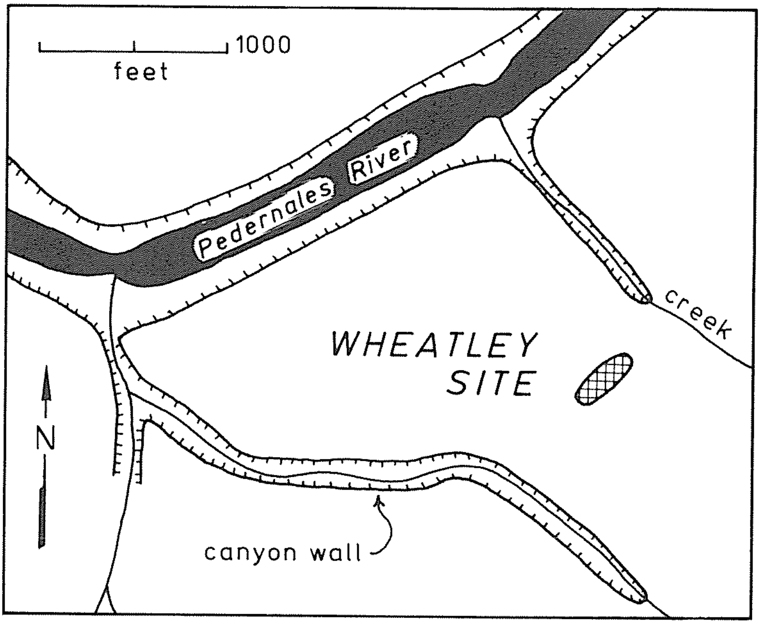


FIGURE 2. *The Wheatley site relative to geographic features.*

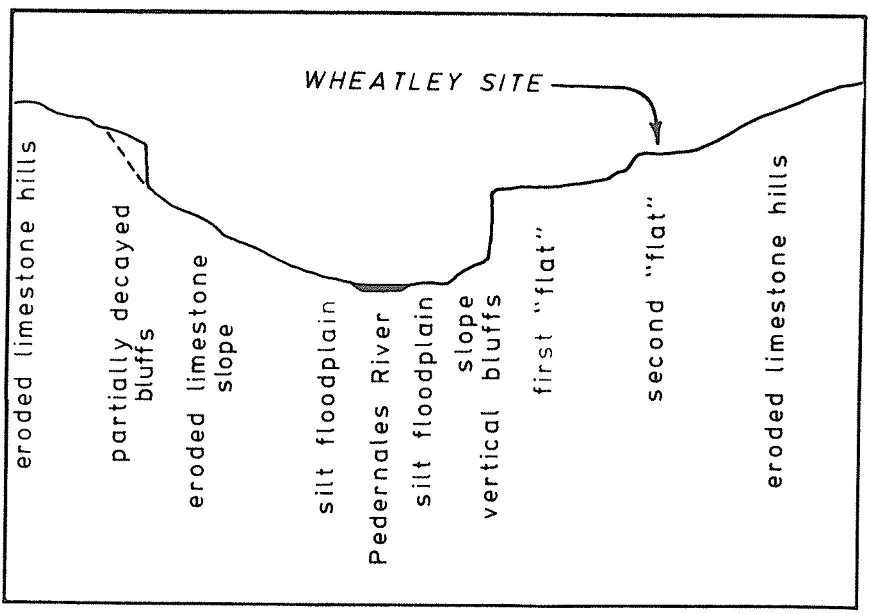


FIGURE 3. *Sketch profile looking northeast across the Pedernales River, showing location of the Wheatley site.*

possibility of creek-generated alluvium. The deposition on this basically windblown sand is presumed to be very slow, and the present surface is probably much the same as it was 800 years ago. Occupational debris, consisting mainly of Neo-American artifacts and small flint flakes, is scattered over an area about 150 x 550 feet, with a few isolated clusterings of Archaic debris outside the main limits of the site. Within the site, occupational materials occur on the surface and in the surface sand and are concentrated in relatively isolated clusters (Fig. 4). Although areas between the clusters of

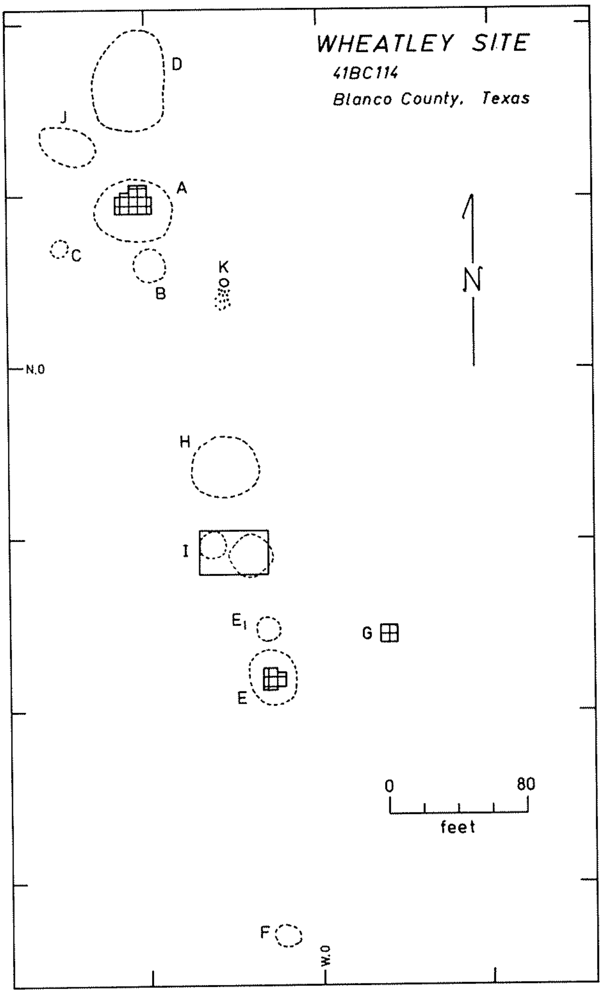


FIGURE 4. *Site map of the Wheatley site, showing position of activity areas.* Area F is considered outside the Wheatley site limits.

surface chipping debris were not tested, it seems unlikely that subsurface concentrations of detritus exist where surface indications are absent. Grass cover was minimal, and the surface in all areas was visible.

THE INVESTIGATIONS

A North-West grid system measured in feet was employed; lines were set up on magnetic north with N 0/W 0 in the center of the site and N 100/W 100 in Area A, a pottery-producing area. South and East grid extensions were employed. Collection units generally were five-foot squares (or portions thereof) numbered by the southeast corner.

Attention was directed toward a total collection of materials, and artifact locations were recorded as precisely as practicable. Pottery areas A and E were stripped for as near a total collection as possible. A limestone cobble hearth in Area G was totally excavated. All recognized artifacts were collected, and total flake collections were made from the surface of most areas. Areas between recognizable artifact clusterings were essentially void of occupational debris (e.g., flakes) and therefore were not excavated. The lack of materials on the surface at this site seemed to preclude any major unrecognizable subsurface concentrations, since wash sand or other post-occupation depositing is minimal.

Stripping involved careful removal by trowel of the upper surface sand (usually 2 cm thick) and the upper part of the underlying, very compact reddish clay, to a total depth of 1.5-6 cm. Occasional artifact intrusions into the clay layer appear to be due to burrowing by small animals, vertical dessication cracks formed during dry periods, or animals or people walking across the site when it was wet. Excavated matrix was placed in burlap bags and water-screened in the laboratory through ¼-inch mesh hardware cloth. Selected samples were additionally passed through fine window screen. Although time and labor did not permit all materials to be passed through window screen, thereby undoubtedly losing such small arrowpoint fragments as *Perdiz* stems, the recovered sample should adequately reflect the distribution of artifacts.

Approximately half the sherds and flint flakes recovered from carefully troweled areas were found during water-screening (Table 1). Sherds found during troweling total 47% of the total excavated sherds in Area A (range 30-60% of the total excavated sherds for samples of ten sherds or more) and 67% in Area E (range 30-72%). Flint flakes, grouped according to size, show comparable results. From stripped squares in Areas A and E, only 35% of the flakes less than 25 mm in maximum dimension were found during troweling (31% in Area A, 40% in Area E), as were 65% of the larger flakes over 25 mm in maximum dimension (60% in Area A, 69% in Area E). The percentage variation by size is as would be expected. Of the total flakes recovered from stripped squares, however, only 38% were found during careful troweling. In general, it was very surprising to find such a large proportion of sherds and flakes being missed, although the specimens usually were very small and the soil very compact. This demonstrates the need for screens during the most careful excavation as a check or control device.

TABLE 1

TROWELING: %	*Area A*	*Area E*	*Total*
Sherds	47%	67%	55%
Flakes, d $\leq$ 25mm	31%	40%	35%
Flakes, d $>$ 25mm	60%	69%	65%

Table 1. Sherd and flake recovery from squares troweled and the deposit wash-screened. Entries indicate the percent recovered during troweling, of the total excavated sample from the area. Surface material is excluded.

DESCRIPTIONS OF ACTIVITY AREAS

The following individual activity or collection areas were recognized by occupational debris lying on the surface. All flint materials were collected from each area. Brief descriptions of the areas are given here; evaluations are given in the *Discussion* section.

AREA A (Fig. 5)

This somewhat circular area contained abundant flake debris, chipped stone artifacts, and plainware potsherds. It was probably the main activity area in the northern part of the site. A hearth in the southeast part of the area is indicated by thermally fractured gravel and flint flakes and a few well-burned limestone pebbles 2-3 in. in diameter. A few mussel shell fragments were around the burned area. Dug into the clay on the west side of the hearth was a very shallow, circular, sand-filled depression 17 in. in diameter and 2 in. deep. It contained most of the flint and all of the cores from this part of the stripping. A total area of 287.5 square feet was stripped, and all surface materials were collected.

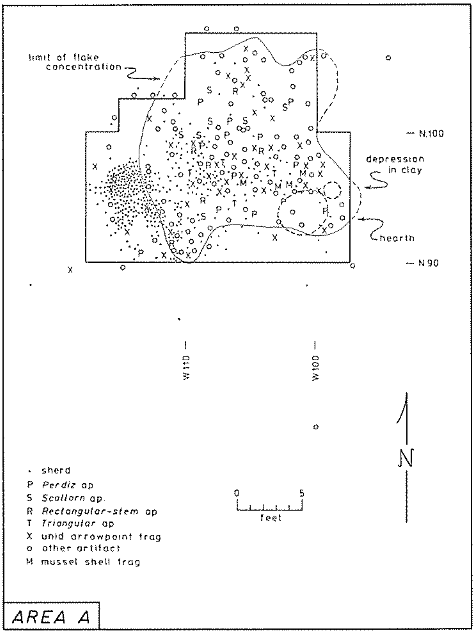


FIGURE 5. *Distribution of artifacts in Area A, showing extent of stripped area.* Composite graph of materials recorded *in situ* and those from screened debris (exact locations of screened materials estimated from *in situ* distribution).

AREA B

A diffuse scattering of considerable debris was just south of Area A. This includes mainly Neo-American artifacts (e.g. two arrowpoint fragments, two sherds), although a Pedernales dart point, a large scraper, and a mano fragment, all found within a three-foot area, may date to Archaic times. All tools and a sample of flakes were collected.

AREA C

Chipping debris was found just west of Area B on a very small eroded and partially burned (grayed and fractured into gravel) limestone outcrop. This was only about 10 feet across and barely higher than the surrounding soil. All flakes and tools were collected.

AREA D

An area of about 40 x 75 ft., north of Area A, contained diffusely scattered flakes, but no tools were observed. A sample of flakes was collected.

AREA E (Figs. 6, 7, 8)

This small area contained numerous chipped stone artifacts and plainware potsherds. No features or distributional differences in artifact classes were recognized in the area. An area of 131 square feet was stripped, and all surface materials were collected.

AREA E_1 (Figs. 6 and 8)

Surface debris increased in an area about 12-15 feet in diameter just north of the Area E concentration. All the sparsely scattered flakes and artifacts were collected. Flakes were essentially absent outside this area.

AREA F

A relatively isolated dense concentration of chipping debris and chipped stone artifacts was on a small rimrock erosional area in dense juniper growth 150 feet south of Area E. Vegetation precluded definition of the limits of the occupation, and an area only about 5 x 10 feet was clear. A total collection of materials was made, including a few mussel shell fragments, many flint flakes, and several artifacts, among which is the only large *Cliffton*-like arrowpoint found at the site. The isolation and impressionistic differences in the area's chipping debris (size and color of the flint flakes) and artifacts suggest that the area is the result of Neo-

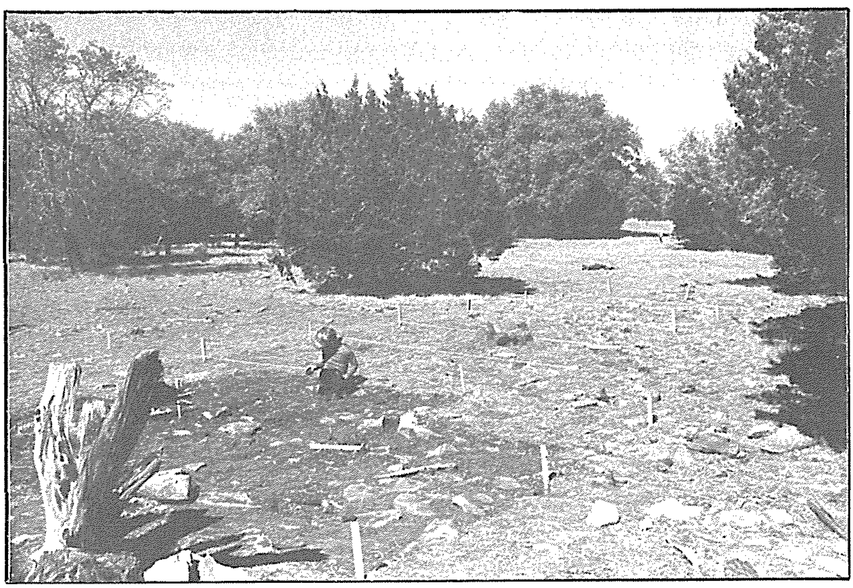


FIGURE 6. *View of Wheatley site.* Area E stripped area in foreground; grid superimposed over Area E_1; Area I in background.

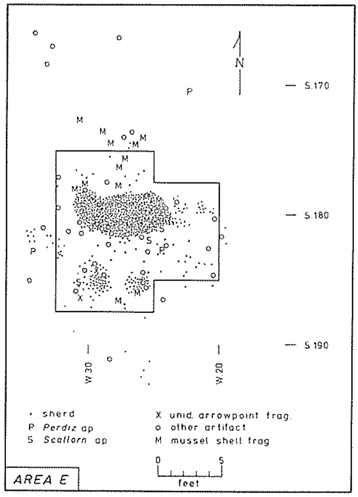


FIGURE 7. *Distribution of artifacts in Area E showing extent of stripped area.* Composite graph of materials recorded *in situ* and those from screened debris (exact locations of screened materials estimated from *in situ* distribution).

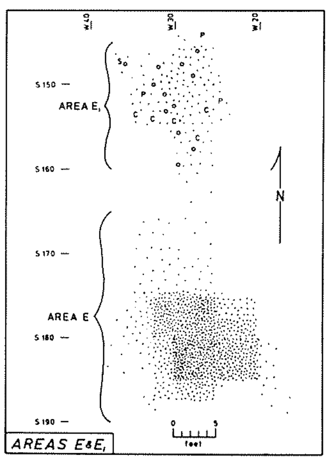


FIGURE 8. *Distribution of flint flakes in Areas E and E_1 and artifacts in Area E_1.* Composite graph of materials recorded *in situ* and those from screened debris (exact locations of screened materials estimated from *in situ* distribution). P, *Perdiz* arrowpoint; S, *Scallorn* arrowpoint; X, unidentified arrowpoint fragment; C, core; o, other artifact; dots, flint flakes. See Fig. 7 for distribution of artifacts in Area E.

American activities distinct from the main part of the site. It is, therefore, considered a separate site not related to the other activity areas discussed here.

AREA G (Figs. 9 and 10)

A limestone hearth was 90 feet east of Area E and distinctly separated from other activity areas. On the surface it appeared as a dense concentration of angular fire-cracked limestone cobbles or slabs. Excavation indicated that the burned deposit was 5 feet in diameter and 6 inches thick. The flat limestone bedrock in the center of the hearth was covered with thin limestone slabs. Bedrock showed no signs of having been burned, although the uppermost cobbles were burned nearly to the point of disintegration. Construction apparently was mostly of limestone slabs 6-12 inches wide and about 1.5-2 inches thick, but at the time of excavation, all except the bottom ones were broken, and the appearance was that of a burned rock midden (a common site form in the area). Fractured limestone was most concentrated in the center of the hearth, where the soil contained tiny bits of charcoal and was black and very dense—the "greasy" texture often used to describe a particular kind of burned rock midden soil in central Texas. Excavation totaled 100 square feet. Charcoal collection for radiocarbon dating was initiated but abandoned since the sample was very small and full of rootlets.

On the surface of the hearth and next to it were thick sherds of a brushed-ware jar (Fig. 14) and the stem of a *Scallorn* arrowpoint (Fig. 16 g). Large sherds from the same vessel, some of which were burned after breakage, were also in the center of the hearth, resting directly on the lower slab lining (one sherd presumably from this vessel was also found 170 feet northwest in Area H). Four small flakes (all less than 25 mm in diameter) were scattered next to the hearth. No other occupational debris was in the area.

AREA H (Fig. 11)

An area of sparsely scattered flakes and artifacts was in the center of the site between Areas A and E. Among the artifacts were a few plainware and brushed sherds similar to those of Areas A (one specimen), E (2), and G (1), beveled biface fragments, and other tools. All debitage was collected.

AREA I (Fig. 12)

A grid of 40 five-foot squares north of Area E was set up over an area of scattered flakes as an exercise in studying debris distribution. All materials were collected, but the sample was too small for conclusive results. Two possible use areas seem to be represented by flake and artifact distributions. The eastern area contained three small biface fragments and one utilized flake, and the western area, one flake end scraper and three utilized flakes. Almost no chipping debris was immediately outside the grid area.

FIGURE 9. *Area G hearth during excavation.*

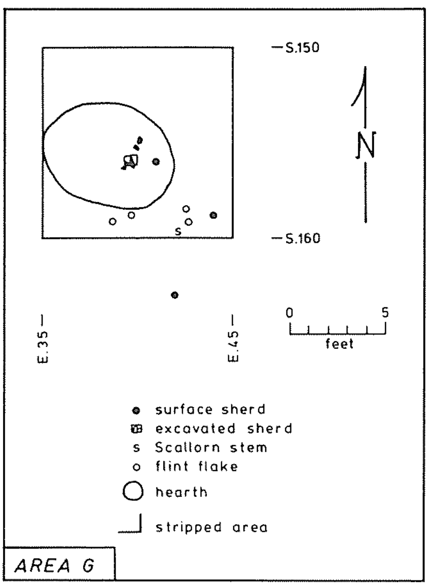


FIGURE 10. *Area G, showing locations of artifacts, hearth boundary, and limit of stripped area.*

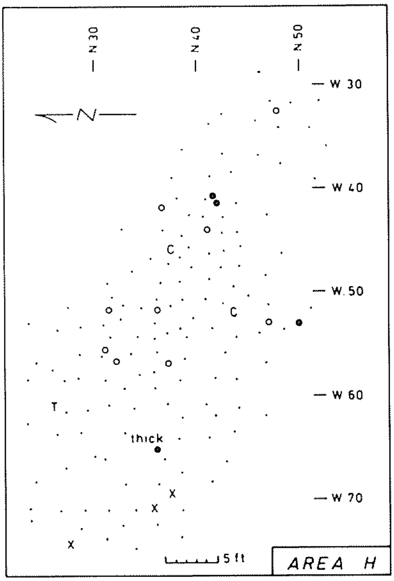


FIGURE 11. *Distribution of artifacts in Area H.* 'T, triangular (unnotched) arrowpoint; X, unidentified arrowpoint fragment; C, core; o, other artifact; dots, flint flakes; ●, sherd.

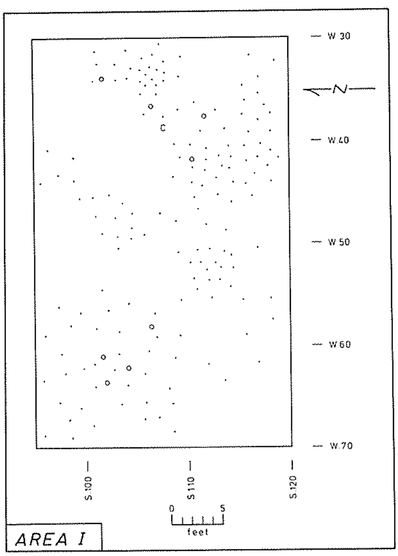


FIGURE 12. *Distribution of artifacts in Area I, showing extent of collected area (almost no materials were outside this boundary).* C, core; o, other artifact; dots, flint flakes.

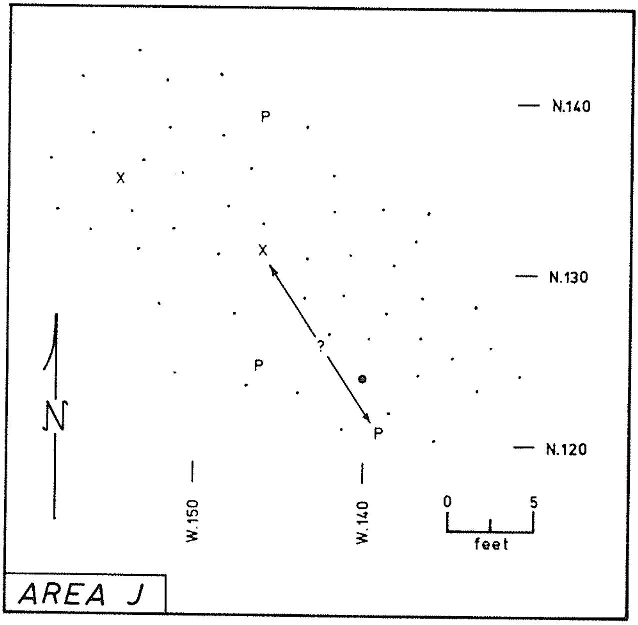


FIGURE 13. *Distribution of artifacts in Area J.* P, Perdiz arrowpoint; X, arrowpoint blade fragment (probably part of the Perdiz point at bottom of distribution); dots, flint flakes; ●, sherd.

AREA J (Fig. 13)

A small concentration of thinning flakes, arrowpoints, and a single sherd just northeast of Area A may represent a separate activity area. Arrowpoints include two *Perdiz* points, a *Perdiz* stem, and a distal fragment. Two fragments appear to be from the same specimen.

AREA K

East of Area B is a small, isolated, partially buried limestone hearth about five feet in diameter. Several very small fired clay lumps on the surface of the hearth, and extending down into the burned rocks, appear to be similar in composition to that of the pottery from the site. Some chipping debris was scattered south of the hearth (Fig. 4). Time did not allow additional investigations.

THE ARTIFACTS

Artifact descriptions are generally separated from their discussion and evaluation, which are in the discussion section of the report. Measurements are presented in tabular form as an appendix. The

TABLE 2

	A	B	C	D	E	E_1	F	G	H	I	J	K	Unk.	TOTALS	# Blue	% Blue
Pottery (total)	418	2			794			15	4		1			1234		
Plainware A	418	2			708				3		1			1132		
Plainware B					86									86		
Brushedware								15	1					16		
Fired clay lumps												46		46		
Arrowpoints (total)	50	3	2		18	3	3	1	3		5	1		89	28	32
Contracting stem	11		1		4	3	1				3	1		24	2	8
Expanding stem	4				8			1						13	7	54
Parallel stem	5													5	3	60
Unnotched (total)	9	2	1						1		1			14	4	29
Finished (?)	1													1		
Unfinished (?)	7		1								1			9	3	33
Large	1	2							1					4	1	25
Fragments (total)	21	1			6		2		2		1			33	4	12
Barbed medial	8				3									11		
Medial, finished	1				3				1					5		
Medial, unfinished	3	1												4		
Distal	9						2		1		1			13	4	31
Dart points (total)		1									1		4	6	1	17
Ensor-Frio														1	1	
Fairland														1	1	
Marcos													1	1		
Pedernales		1												1		
Gower													1	1		
Unidentified											1			1	1	
Beveled Knives	1				1				2				2	6		
Thin Bifaces (total)	23	1			12	5	3		1	3			2	50	4	8
Identifiable	3	2			3	1	1		1					10	1	10
Fragments	20				9	4	2			3			2	40	3	8
Scrapers (total)	10	4	3		3	3			1	1			7	32	1	3
End	2	3	2		1	2			1	1			5	17		

	A	B	C	D	E	E_1	F	G	H	I	J	K	Unk.	TOTALS	# Blue	% Blue
Side	3		1		1	1							1	7		
Circular (?)	1												1	2	1	50
Diagonal		1											1	2		
Edge fragments	4				1									5		
Flake drills	2				3		1							6	2	33
Burins	2				2									4	2	50
Utilized & edge-retouched flakes (total)	61	9	2	2	10	4	9		10	4	1	3	4	119	8	7
Utilized flakes, minimal use	22	6	1		2	1	5		3			1	2	43	4	9
Utilized flakes, extensive use	7	1					1		1	3			1	14		
Minimally edge-retouched flakes	21	1	1		4	1			2	1				31	3	10
Evenly edge-retouched flakes	11	1		2	4	2	3		4		1	2	1	31	1	3
Choppers	1				1	1							3	6		
Unfinished tools (total)	5		1		5	2							8	21	2	10
Initial stage, on cores	2				3	1							2	8	1	13
Initial stage, on flakes	2				1	1							1	5	1	20
Secondary stage	1		1		1								5	8		
Cores (total)	14	1	1		8	2			3	1			2	32	13	41
Blue	7				6									13	13	
Non-blue	7	1	1		2	2			3	1			2	19		
Single- and double-flake cores	1				3									4		
Hammerstones	1				3									4		
Manos													1	1		
Sandstone slabs		1						1						2		
Unaltered flakes																
Flint (total)	3349	nc	71	44	884	95	nc	4	138	200	48	nc		4833		
Blue	509	nc	20	4	162	8		1	10	54	nc	nc		768		
Non-blue	2840	nc	51	40	722	87	nc	3	128	146	nc	nc		4017		
Biface retouch flakes (total)	13				3		1							17		
Utilized	4						1							5		
Non-utilized (?)	9				3									12		
Quartz	1				5									6		
Unaltered chert cobble	1													1		

Table 2. Distribution of recovered artifacts by area. Each flint artifact is counted only once, regardless of how many pieces represent that object. For pottery, each sherd is counted (see text for discussion of vessel number). *nc* = not counted.

distribution Table 2 gives the order of described artifact categories. Type names are from Suhm, Krieger, and Jelks (1954) and Suhm and Jelks (1962) unless otherwise specified. Projectile point names are used here more as descriptive form designation, since cultural affiliation is not entirely certain.

POTTERY

Sherds from three kinds of pottery were found within use areas at the site. At least two plainware vessels are present; another single sherd from Area J may be from a vessel or a pipe. Sherds from a large brushed jar were also found. Sherds of the unreconstructible plainware vessels average about 15 mm in diameter. The reconstructible portion of the brushed jar is about 170 x 105 mm. Analysis was done with the aid of a 10-30x zoom binocular microscope and comparative laboratory materials.

PLAINWARE A

Location: Area A (418 sherds), Area E (708), Area B (2), Area H (3), Area J (1).

Number of vessels: Uncertain, possibly two.

Paste:

Clay. Semi-compact, friable, fractures, easily, somewhat laminated. Profusely impregnated with rounded quartz sand grains, probably a natural component of the clay.

Temper. Exceedingly sparse finely ground white material, probably bone—very soft, flakes off, color ranges to light gray mottling, minor effervescence with HCl (identical to bone samples tested under laboratory conditions), physical appearance and warping identical to burned bone.

Hardness. On Moh's scale, ca. 3.5

Color. Core probably naturally pink to orange; central core usually dark gray, probably reduced. Outer portions of core usually light gray to orange-tan. On many sherds the core changes from darkest just inside the interior surface (medium gray) to lightest (orange-tan) near the outer surface.

Form:

Overall shape. Uncertain, probably a wide-mouth globular jar with a very slightly constricting neck, a wide mouth, and a rounded base. The slightly everted rim tapers to a somewhat pinched, barely flattened lip (Fig. 14).

Dimensions.

Height: Unknown, possibly about 15-30 cm.

Width: Unknown, possibly about 18-30 cm.

Wall thickness:

Area A (20 sherds measured). Range 3.7-4.9 mm, mean 4.1 mm.

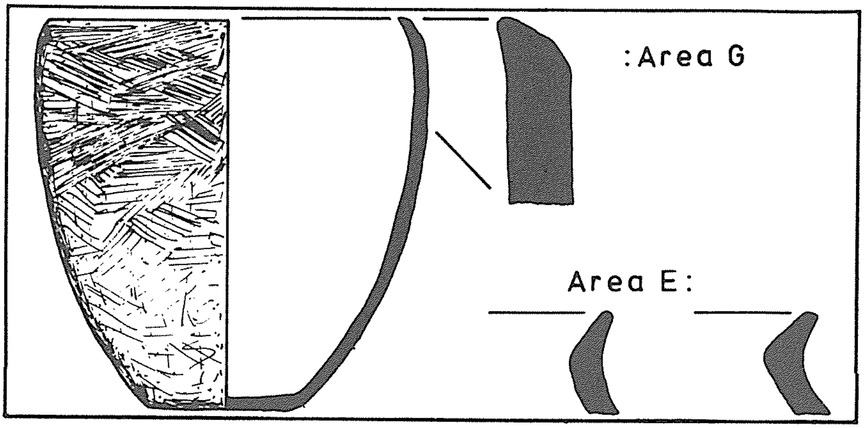


FIGURE 14. *Rim profiles and hypothesized vessel reconstruction from Area G, and rim profiles from Area E.*

Area E (20 sherds). Range 4.0-5.3 mm, mean 4.5 mm.
Area B (2 sherds). 3.9 and 4.1 mm.
Area H (3 sherds). 3.7, 3.9-4.6, and 5.8 mm.
Area J (1 sherd). 5.8-6.0 mm.

Surface finish: Interior and exterior well smoothed. Interior retains a few smoothing marks.

Remarks: Sherds from areas A, E, B, and H appear to be from the same clay mixture and may even be from the same vessel. The three sherds from Area H vary more in thickness than do the larger samples from areas A and E, though possibly not beyond the normal range within a single vessel. More than one vessel may be represented in Area H, however.

The sherd from Area J is also probably from the same clay source, but may be from a different vessel. Impressionistically it seems that this tiny sherd (9 x 13 mm) may be from a pipe. It is slightly thicker than the others, has a greater curvature (also different from the Area E rimsherds), seems to have more fragments of a shiney black material (limonite?) seemingly inherent in the clay (also present in sherds from other areas), and the surface appears slightly different, both macro- and microscopically.

PLAINWARE B

Location: Area E (86 sherds)
Number of vessels: One.
Paste:

Clay. Very fine-grained but noncohensive, soft. Looks almost like coastal sand.

Temper. Very sparse finely ground white material, probably shell—very soft, flakes off, profusely effervesces in HCl, but seems to lack characteristic layering of shell.

Hardness. On Moh's scale, ca. 1.0-1.5.

Color. Dark gray to beige on interior surface, ranging to bright orange to beige on the exterior surface.

Form:

Overall shape. Unknown. Presumably a small globular jar.

Dimensions.

Height: Unknown, possibly about 15-20 cm.

Width: Unknown, possibly about 15-20 cm.

Wall thickness (20 sherds measured): Range 3.0-4.3 mm., mean 3.7 mm.

Surface Finish: Interior and exterior apparently moderately well smoothed, but difficult to assess because material is so soft and prone to weathering.

Remarks: Paste appears to be different from the other plainware sherds, and the walls are thinner. It seems either insufficiently fired or the clay is not condusive to the "normal" hardening when fired.

BRUSHED WARE (Fig. 12)

Location: Area G (15 sherds, all but one fit together), Area H (1).

Number of vessels: One.

Paste:

Clay. A beige matrix impregnated with a very fine-grained stream-rolled quartz sand. It is a little finer grained and has more even grain size than the plainware sherds.

Temper. Uncertain, possibly grog. The reddish-orange clay inclusions in the matrix may instead by from incomplete mixture of two or more clays and not actually an intentionally added tempering agent. At present no information is available on clay mixing, and the identification of the clay inclusions as grog is not definite.

Hardness. On Moh's scale, ca. 3.9.

Color. The core is a discontinuous dark gray toward the interior surface, lighter gray to orange-tan or buff toward the exterior surface. Interior surface is a grayish buff, exterior pinkish buff.

Form:

Overall shape. Apparently a globular, nearly spherical jar with a wide mouth and no neck. Rim is direct-incurved; there is no separable rim. The lip is an essentially unmodified, slightly smoothed coil line, from which the succeeding coil was removed during the plastic stage. This produced a slightly rounded lip planar on the interior and a curved bevel to the exterior. Basal form is unknown.

Dimensions.

Height. Probably about 31-33 cm.

Width. 26.5-28 cm.

Mouth diameter. 26-27 cm.

Wall thickness (20 measurements). Range 7.7-9.8 mm, mean 8.7 mm.

Surface finish:

Interior. Well smoothed. Faint, nearly horizontal smoothing lines remain.

Exterior. Well smoothed, then brushed with a fine brush, probably a bundle of grass stems. Brushed with a slightly curved motion (center of the curve downward) at a slight angle of about 5-10 degrees to the rim, in either direction (upper right-lower left, or the reverse). The resulting surface is fairly smooth, but completely covered with brushing.

Remarks: The vessel conforms to the type *Boothe Brushed* (Suhm 1955: 16-20; Sorrow 1970). The Area H sherd does not fit on the Area G sherds, but it is likely from the same vessel. The brushed sherd is flat and may be from the base; if so, the base was flat, brushed, and 8.9 mm. thick.

FIRED CLAY LUMPS (46 pieces)

Small rounded pieces of fired clay were found in the Area K hearth. All are reddish-orange clay impregnated with rounded quartz sand and tiny black limonite (?) grains. It appears identical to the plainware pottery from the site, except for the exclusion of the white specks (presumably tempering material). The clay is most likely local. Most pieces are less than 10 mm in diameter; the largest is 25 x 20 x 15 mm.

ARROWPOINTS (89 specimens)

The descriptions of the arrowpoint sample provided methodological problems. Since this was a manufacturing area in which other processing activities were also performed using small flake tools, it was often the case that arrowpoint fragments, unfinished arrowpoints, edge-retouched flakes, and utilized flakes overlapped in morphological characteristics. A categorization is here employed, however, which describes in as much detail as possible the kind of fragment involved and where that fragment likely falls within the manufacturing process. The initial divisions essentially are **finished** (contracting stem, expanding stem, parallel stem, and unnotched forms, and barbed blade fragments); **uncertain** (distal blade fragments, medial blade fragments); and presumably **unfinished** (probably unfinished, medial fragments, and large unnotched). In other words, medial fragments are presumably finished and possibly unfinished. This gives the reader minimally an impression of the degree of certainty he may place on the data. Likewise, unnotched forms include probably finished, probably unfinished, and large forms (possibly arrowpoint preforms or even small knives). As confusing as this system may seen initially, it is hoped to prove more useful in detailed comparative analysis or reevaluation than would a "lumping" approach.

Contracting stem (24 specimens; Fig. 15)

This is a heterogeneous grouping of points mainly comparable to *Perdiz* forms. They generally have dully pointed bases (rarely sharply pointed or straight), nearly straight blade edges, and long flaring barbs. Most are made on thin flakes with flake scars covering the entire dorsal surface and only the ventral edges. Stems are equally flaked on both surfaces.

A relatively large, bifacially flaked *Cliffton* (Fig. 15 p) appears to be a finished point and not a preform. It is from Area F and likely is unrelated to materials on the main part of the site.

Expanding stem (13 specimens; Fig. 16 a-m)

This is a heterogenous grouping of points generally comparable to *Scallorn* forms.

Parallel Stem (5 specimens; Fig. 16 n-r)

This is a heterogeneous grouping of points overlapping the descriptive extremes of *Perdiz*, *Scallorn*, *Cuney*, and *Bonham*.

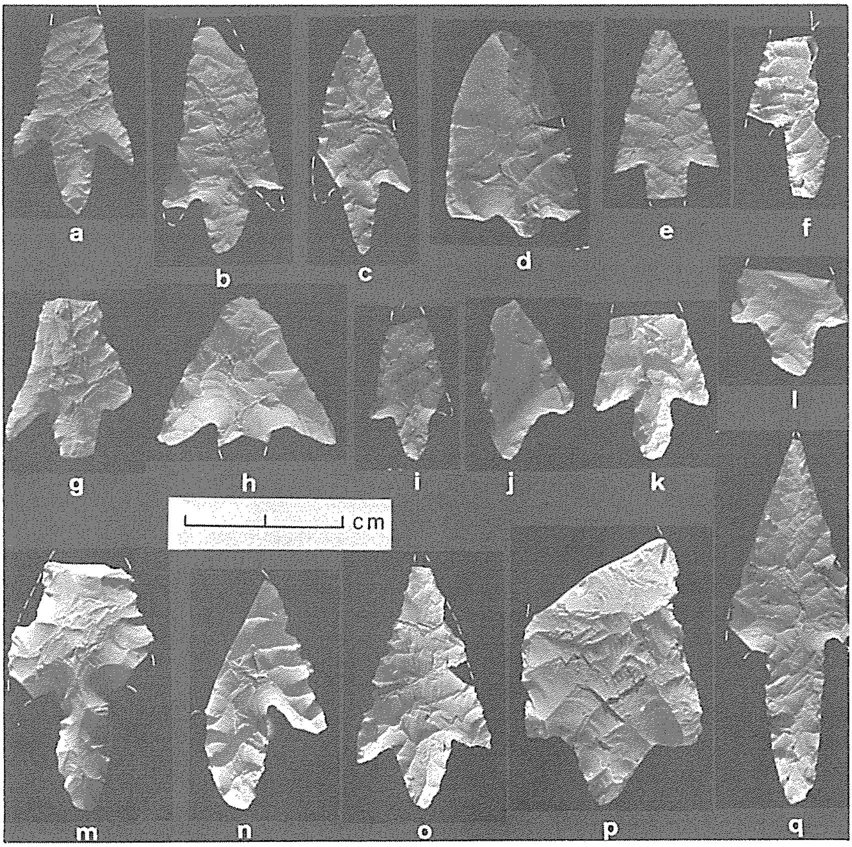


FIGURE 15. *Contracting-stem arrowpoints (Perdiz, Cliffton).*

Unnotched (14 specimens)

Probably finished (one specimen; Fig. 16 s). This finely chipped basal fragment is totally worked on the dorsal face and the margins of the ventral face.

Probably unfinished (9 specimens; Fig. 17 a-f). These are intentionally shaped, but not to the extent of being stylistically classifiable as a formal type. The flaking was stopped before the form became apparent. Although they appear to have been abandoned during manufacture, they also could have served on arrows.

Large (4 speciments; Fig. 17 g-j). These are larger than most other arrowpoints from the site and generally appear to be finished products. They are, however, likely arrowpoint preforms, or some might be very small knives.

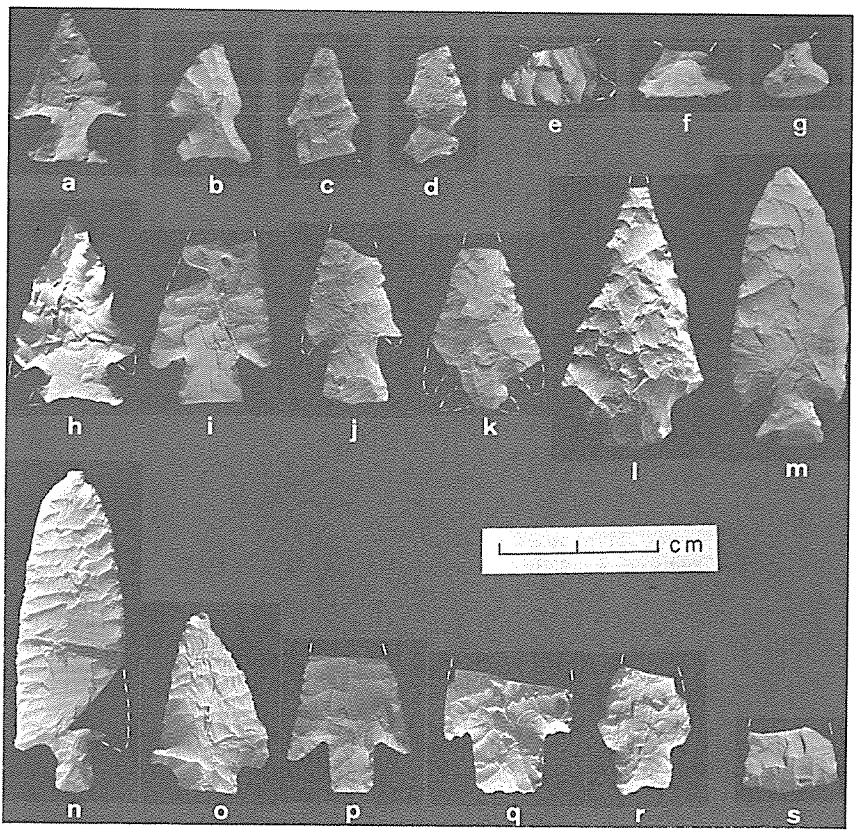


FIGURE 16. *Arrowpoints.* a-m, expanding-stem (*Scallorn*); n-r, parallel-stem; s, unnotched probably finished.

Fragments (33 specimens)

Barbed medial fragments (11 specimens; Fig. 17 k). These are fragments retaining a portion of a barb or notch. They are presumably from completed or nearly completed points.

Medial fragments, finished (5 specimens; Fig. 17 1). These are well worked and thin and are believed from complete or nearly complete arrowpoints.

Medial fragments, unfinished (4 specimens). These are less well flaked and appear to have been broken and/or abandoned somewhere during the manufacturing process.

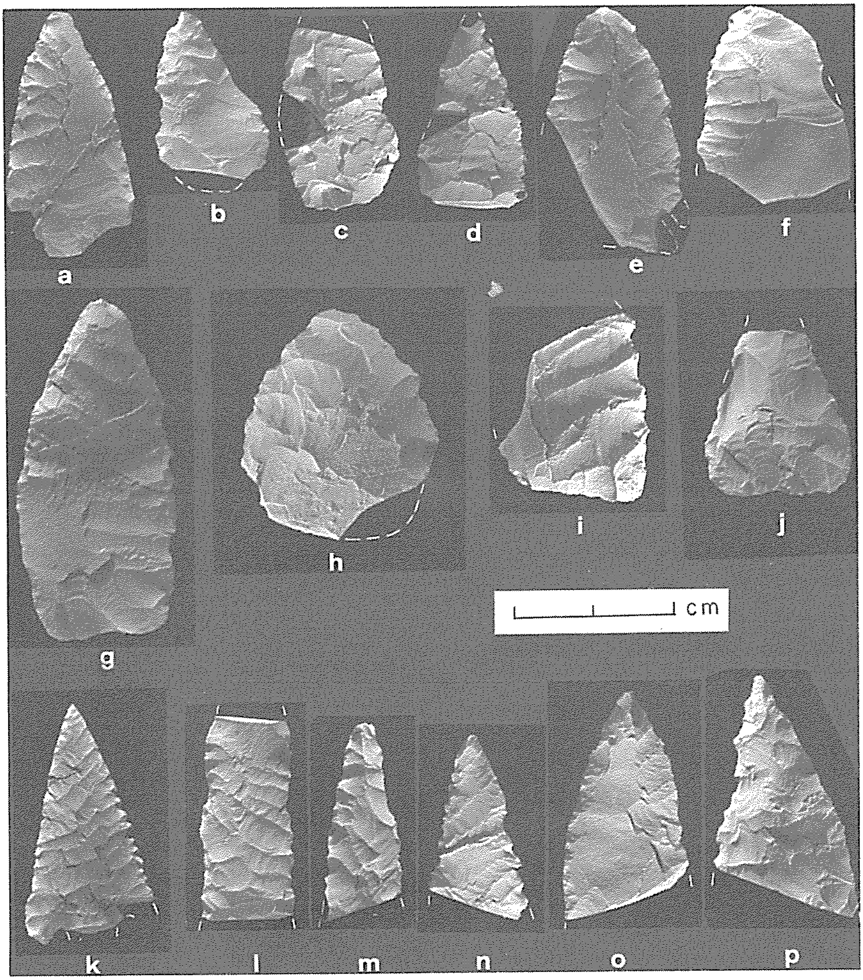


FIGURE 17. *Arrowpoints.* a-f, unnotched probably unfinished; g-j, large unnotched; k, barbed medial fragment; l, medial fragment; m-p, distal fragments.

Distal fragments (13 specimens; Fig. 17 m-q). These are well flaked, thin tip fragments from presumably finished or nearly finished arrowpoints.

DART POINTS (6 specimens; Fig. 18)

The following points (one of each type-form) were collected from the site, mainly during the initial survey (during which time exact locations were not recorded). Most, if not all probably are the result of adjacent Archaic occupations and are not part of the Neo-

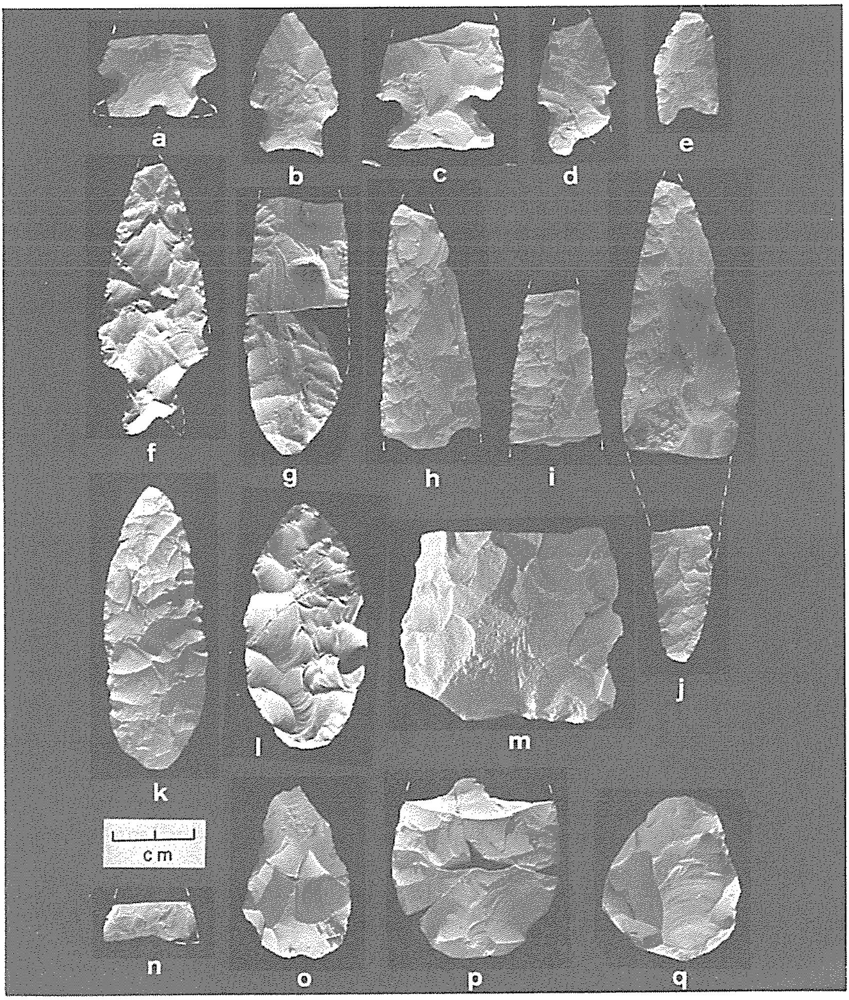


FIGURE 18. *Chipped stone artifacts.* a-f, dart points; g-i, beveled knives; j-p, thin bifaces.

American assemblage here. The small blue point from beside Area J is the only point with known provenience and may belong to the main assemblage at the site.

Ensor-Frio (Fig. 18a)

This seems to be a common form in central Texas and has been described in detail by such workers as Tunnell (1962: 88-90). It is essentially a wide side-notched *Ensor* with a notch in the center of the base. Burin type facets have removed both barbs in a medial direction (Form 5 facet of Greer 1965). This type of facet is common on points of this general style and age in central and southwestern Texas.

Fairland (Fig. 18 b)

Marcos (Fig. 18 c)

Pedernales (Fig. 18 f)

This lightly patinated point was found near the south side of Area B.

Gower (Fig. 18 d)

This is probably related to the early Archaic forms named by Shafer (1963: 64-65) and found in various sites in central and southwestern Texas. It is heavily patinated, and the base and lateral stem edges have been intentionally well smoothed.

Unidentified (Fig. 18 e)

This small point of nonpatinated blue flint is all that remains after the blade was battered nearly down to the top of the stem. It was found isolated 17 ft west of Area J at N 130/W 177.

BEVELED KNIVES (6 specimens; Fig. 18 g-i)

These fragments are alternately beveled along the distal portion of the left blade edge. The proximal end (two specimens) is dully pointed and not beveled. Estimated length is about 90-125 mm. Though these specimens presumably are from beveled knives, the medial fragments could be from beveled dart points (no beveled points are reported from this or nearby sites). Beveled knives have been included as a class separate from the descriptive grouping **thin bifaces** because the beveled forms appear to be a culturally significant trait for the Southern and Central Plains (Lehmer 1971: 108) and most Plains-influenced parts of Texas (Sollberger 1971).

THIN BIFACES (50 specimens; Fig. 18 j-p)

These are thin, usually pointed, well worked bifaces (10 specimens) estimated to have been less than 120 mm long. Use pattern studies have not been done, but most are presumed to have served for cutting.

Thin biface fragments (40 specimens) are presumed to be from similar specimens and are thought to be mainly complete tools. Many, however, were likely advanced preforms, or altered tools abandoned well along the route of artifact alteration.

SCRAPERS (32 specimens)

These are characterized by unifacial, usually rather steeply beveled retouched edges presumed to have been used or intended for some scraping activity. Artifacts conventionally referred to as **flake scrapers** are described mainly under the heading **evenly edge-retouched flakes**. Use studies have not been conducted to determine how the specimens were used.

End scrapers (17 specimens; Fig. 19 a-h)

These all have convex to rounded scraping edges opposite the bulb of percussion. The bulb on one specimen was removed by ventral thinning from the striking platform. The distal retouched edged on one specimen is

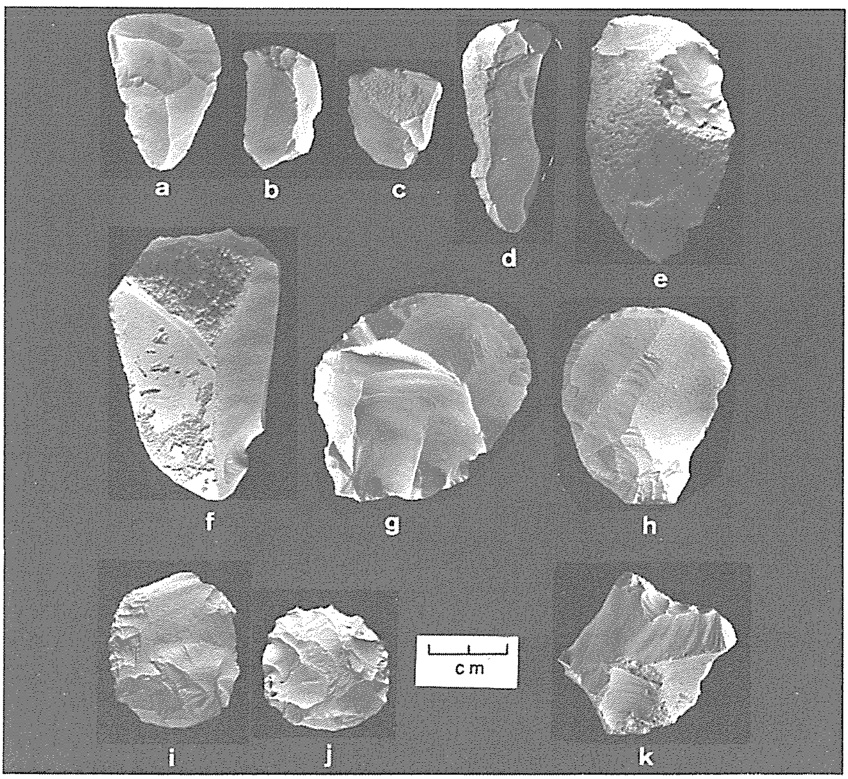


FIGURE 19. *Scrapers.* a-h, end; i-j, circular; k, diagonal.

ventrally or "reverse" flaked. Since these tools are formed on flakes removed from the outside of pebbles or small cobbles (secondary cortex flakes and large interior flakes), the ventral surface is longitudinally slightly concave, thus producing better scraping characteristics than would a flat ventral face (e.g. from tabular flint).

Side scrapers (7 specimens; Fig. 20)

These are generally larger than the end scrapers from this site and not so well made. An edge essentially parallel to the largest dimension of the flake is steeply retouched. These too are made on secondary cortex flakes and large interior flakes.

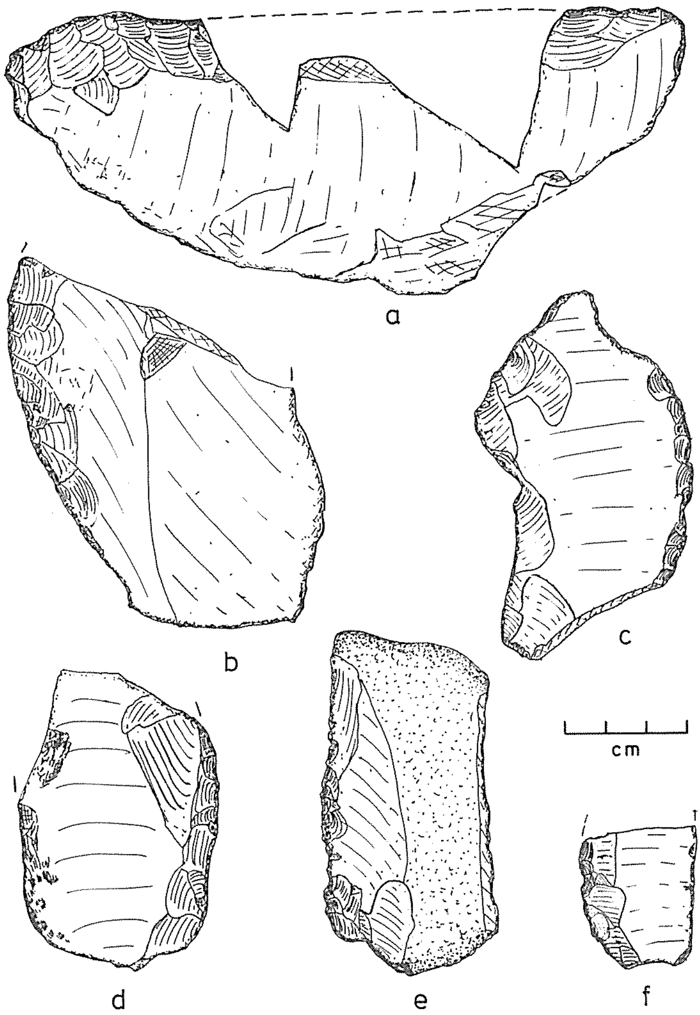


FIGURE 20. *Side scrapers.*

Circular scrapers (?) (2 specimens; Fig. 19 i-j)
Discoidal artifacts about 30 mm in diameter seem quite distinctive. They are generally unifacially flaked, but the cross section is barely plano-convex to very thinly bi-convex (at the edge). Their inclusion in a scraper class is questionable, and their function is not known.

Diagonal scraper (1 specimen; Fig. 19 k)
The distal right diagonal edge is strongly unifacially retouched into a slightly concave scraping edge 33 mm long. It is made on a secondary cortex flake.

Scraper edge fragments (5 specimens)
These are curved edge fragments from fractured scrapers in the general size range of the end scrapers. Edge orientation is not obvious.

FLAKE DRILLS (6 specimens; Fig. 21)
The thin, fine shafts are bifacially flaked and have biconvex cross sections (one plano-convex). Bases are minimally altered.

BURINS (4 specimens; Fig. 22 a-b)
A small cortex flake of blue flint (Fig. 22a) has two chisel edges, each produced by intersecting burin facets. The upper burin edge is squared; the chisel edge has been used, and apparently also one corner of the chisel edge and one upper lateral edge. The lower burin edge has become slightly rounded from use; use marks appear on the chisel edge indicating a gouging motion.

Each of two small flakes (one blue, one gray) has a very narrow chisel edge, possibly produced by a burin facet originating from a natural break. The delicate chisel edge is slightly smoothed and bears minute use scars.

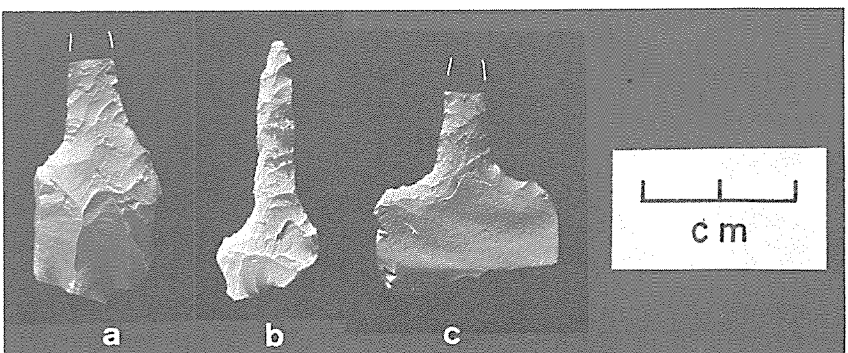


FIGURE 21. *Flake drills.*

On a fourth specimen (Fig. 22 b) a chisel edge is again produced by a burin facet originating at a natural break. Use marks occur in the center of the chisel edge, which is larger than on the preceeding specimens.

UTILIZED AND EDGE-RETOUCHED FLAKES (119 specimens)

Since various groups forming these two classes freely intergrade, it was decided to describe them as arbitrary divisions within a continuum of edge alteration from extremely minimal and due to use, to fairly extensive, even, and intentional. Sortings and the following descriptions are given as separate entities in order to attempt to minimally quantify the degree of edge alteration.

Utilized flakes: minimal use (43 specimens)

The edge bears little evidence of use (smoothing, minute hinge fractures, etc.), probably from a single, very short, rapid cutting job. Scraping undoubtedly was also done.

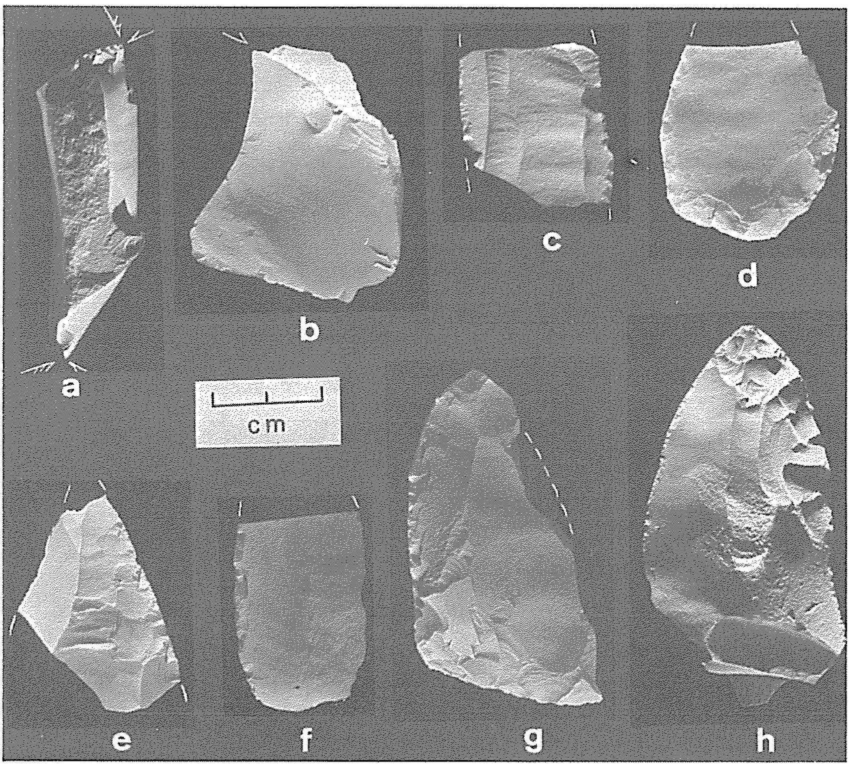


FIGURE 22. *Chipped stone artifacts.* a-b, burins; c-h, evenly edge-retouched flakes.

Utilized flakes: extensive use (14 specimens)

The edges bear evidence of use (smoothing, minute hinge fractures, areas of intensive and sometimes extensive edge retouch from use), probably from a more intensive cutting or scraping job or multiple jobs.

Minimally edge-retouched flakes (31 specimens)

These seem to have been intentionally unifacially retouched and may be fragments of either finished or unfinished flake knives, flake scrapers, or arrowpoints. Many instead may be utilized flakes or flakes simply tested for flaking characteristics and never intended as tools.

Evenly edge-retouched flakes (31 specimens; Fig. 22 c-h)

These obviously overlap with the above groups, but are intended to help isolate more intensive and extensive retouch which produces a larger, more even unifacial edge. Retouch still is very slight and is limited to the edge—usually single, thin, and slightly convex. These would usually be placed in a **flake scraper** category. Flakes more intensively edge-retouched than these would be more steeply beveled; these have been described as a separate **scraper** class.

CHOPPERS (6 specimens; Fig. 23)

These are mainly larger pebbles bifacially chipped to form strong bi-convex chopping edges. One specimen is plano-convex; the lower face is formed by two large concave flake scars, the upper face by small short flakes. Use edges are dully pointed, convex, or nearly straight. The degree of decortication is variable (20-100%).

UNFINISHED TOOLS (21 specimens)

Initial stage (13 specimens)

These are cores (8) and flakes (5) which show a minimal degree of initial flaking or shaping. Manufacture was terminated before any distinguishing shape was achieved.

Secondary stage (8 specimens; Fig. 24)

These are fairly thick, crude unfinished bifacial tool forms. They have been shaped beyond the "initial" stage, and probably can be considered a preform stage essentially intermediate between the unretouched core and a finished tool.

CORES (32 specimens; Fig. 25)

Small cobbles to medium-size pebbles served as cores. The cortex was removed to produce a platform for the removal of additional flakes, which in turn produced platforms for the removal of subsequent flakes from almost any available edge. These more or less decorticated chunks do not appear to be unfinished core tools although in many cases the removed flakes seem much too small to have been planned for effective artifacts of the types found here. It

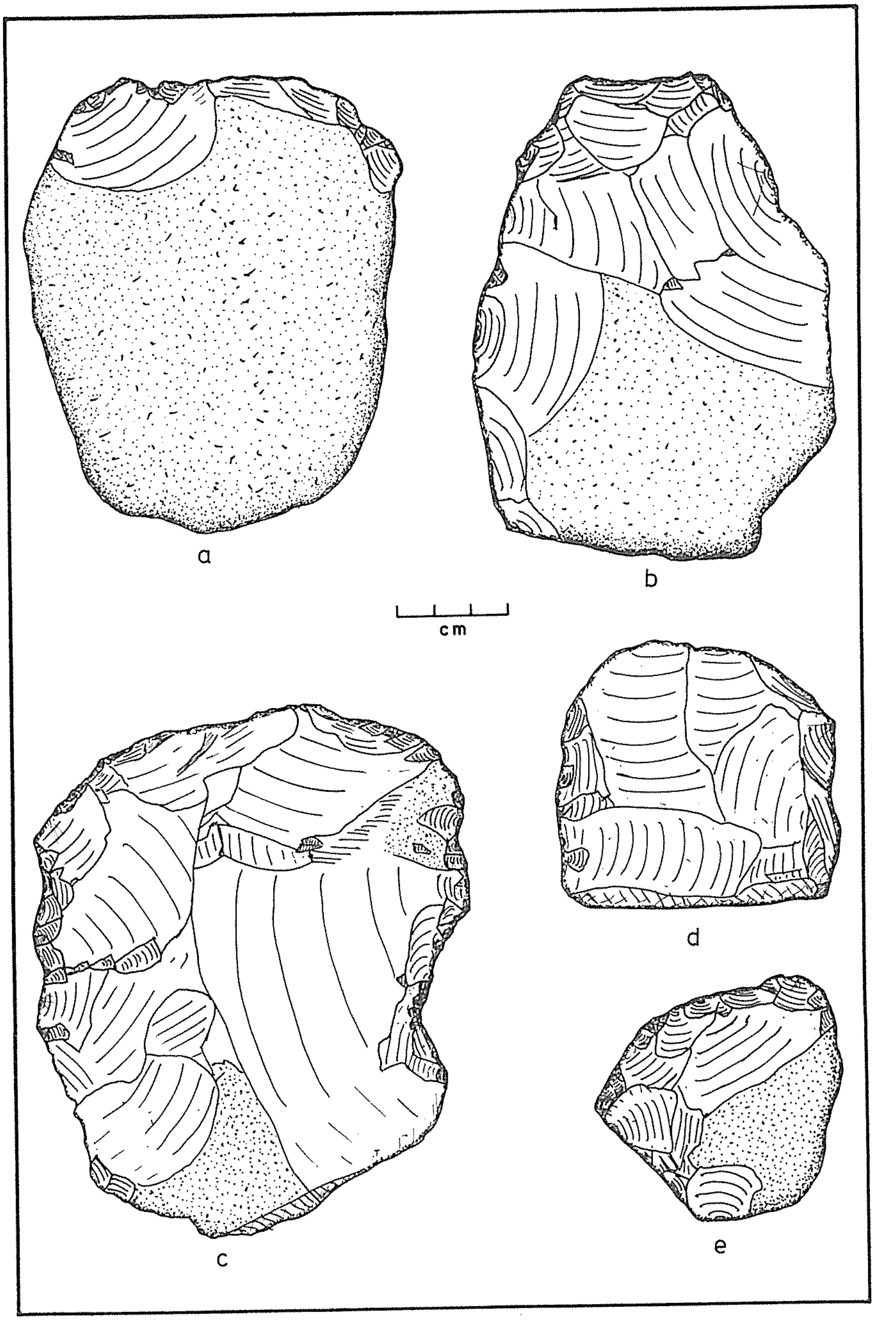


FIGURE 23. *Choppers.*

simply seems more effective to call these "cores" than anything else. The materials appear to be mainly from local sources (cf. Ing and Kegley 1971).

Blue (13 specimens; Fig. 25 a-c)
Medium-size pebbles ca. 30-60 mm in diameter vary in color from light to dark blue. The fairly thick cortex is white with an orangish surface. All are from Areas A and E.

Non-blue (19 specimens; Fig. 25 d-f)
These are mainly medium to large pebbles with a large range of colors in browns and grays. Most are from Areas A and E, although nearly all areas are represented.

SINGLE- AND DOUBLE-FLAKE CORES (4 specimens)

These are small chert pebbles covered with cortex. On one end one or two flakes have been removed, forming an edge, either unifacially (steeply beveled) or bifacially. None is obviously utilized as a tool, and the initial cortex flakes thus removed probably were too small to be of much use. Possibly the objects were simply rejected as unfit for further consideration. If so, the reason for such a decision is not

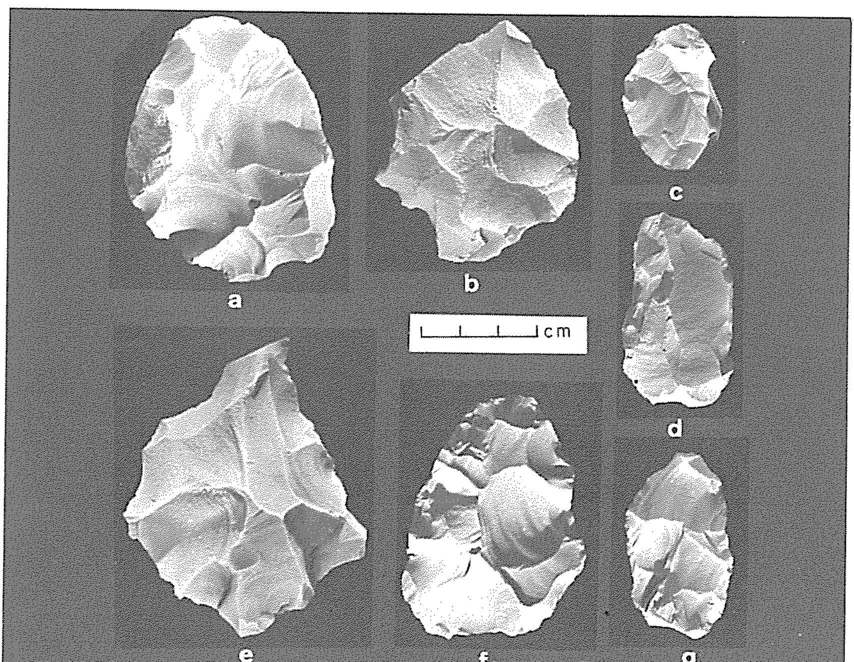


FIGURE 24. *Unfinished tools.* Secondary stage (preforms).

apparent. Alternately, the pebbles could have served as chert hammerstones, and the flakes could have been inadvertently removed during flaking of other pebbles.

HAMMERSTONES (4 specimens)

Locally gathered medium-size quartz (3 specimens) and chert (one) pebbles averaging 50 mm in diameter have been battered on one end. These were probably used to remove flakes from cores, and reduce crude preforms to shapes and sizes demanding smaller flaking tools.

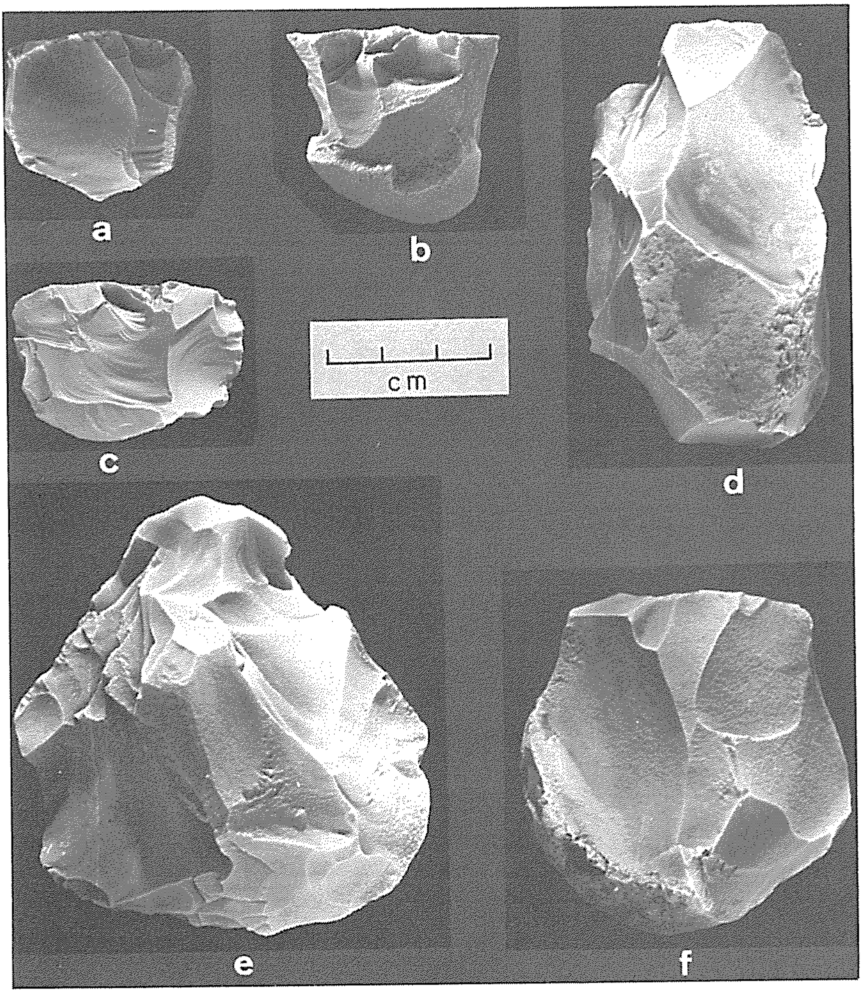


FIGURE 25. *Cores*. a-c, blue flint; d-f, non-blue flint.

The abundance of associated debitage indicates that such activities were carried out at the site.

MANO (one specimen)

A circular bifacial mano has one flat and one slightly convex face and steeply rounded sides. It has been completely, intentionally shaped, but only the convex face was ground smooth; the upper face is prepared but unused. The material is a pink granitic sandstone from the Llano uplift area of Burnet or Llano counties.

SANDSTONE SLABS (2 specimens)

These fragments are from naturally eroded slabs of fine-grained rust-colored sandstone fused into an elementary quartzite. The surfaces, though presumably naturally smooth, would serve admirably as grinding platforms (i.e., small milling slabs). Such material was similarly used archeologically throughout central Texas.

TABLE 3

Area	*Color*	*d ≤ 25mm*	*d > 25mm*	*Sample Size*
Area A	blue	94%	6%	509
	non-blue	91%	9%	2840
	entire sample	92%	8%	3349
Area C	blue	80%	20%	20
	non-blue	82%	18%	51
	entire sample	82%	18%	71
Area D	blue	100%	–	4
	non-blue	55%	45%	40
	entire sample	59%	41%	44
Area E	blue	98%	2%	162
	non-blue	91%	9%	722
	entire sample	92%	8%	884
Area E_1	blue	100%	–	8
	non-blue	64%	36%	87
	entire sample	67%	33%	95
Area H	blue	90%	10%	10
	non-blue	80%	20%	128
	entire sample	81%	19%	138
Area I	blue	89%	11%	54
	non-blue	84%	16%	146
	entire sample	85%	15%	200

Table 3. Percentage of flint flakes by size. The two size groups are defined according to maximum dimension (d). Rows total 100%.

UNALTERED FLAKES

Flint (4785 specimens)

Chipping debris was sorted according to size of the flakes (Table 3) and color of the material (Table 4). An arbitrary division point of 25 mm in maximum dimension was chosen for the size sorting: 90% of the total flakes were less than or equal to 25 mm (d≤25 mm) and 10% were greater than 25 mm in diameter (d > 25 mm). Flakes of the distinctive blue color totaled 16% of the sample, and 84% were non-blue. Most of the flakes (3349) were from Area A.

Biface retouch flakes (17 specimens, partial sample)

This is a sampling of the most obvious edge retouch flakes produced during the sharpening or edge alteration of thin to relatively thick bifaces. Of the 17 sharpening flakes, five are from presumably edge-utilized bifaces (as evidenced by edge smoothing, which also could have been intentionally produced preparatory to flake removal), and 12 are from non-utilized

TABLE 4

Area	*Color*	*d ≤ 25mm*	*d > 25mm*	*Entire Sample*
Area A	blue	16%	11%	15%
	non-blue	84%	89%	85%
	sample size	3068	281	3349
Area C	blue	28%	31%	28%
	non-blue	72%	69%	72%
	sample size	58	13	71
Area D	blue	15%	–	9%
	non-blue	85%	100%	91%
	sample size	26	18	44
Area E	blue	19%	6%	18%
	non-blue	81%	94%	82%
	sample size	812	72	884
Area E$_1$	blue	12%	–	8%
	non-blue	88%	100%	92%
	sample size	64	31	95
Area G	one blue and three non-blue, all d 25mm			
Area H	blue	8%	4%	7%
	non-blue	92%	96%	93%
	sample size	112	26	138
Area I	blue	28%	20%	27%
	non-blue	72%	80%	73%
	sample size	170	30	200

Table 4. Percentage of flint flakes by color. The two size groups are defined according to maximum dimensions (d). Columns total 100%.

bifaces or presumably non-utilized portions of bifaces. Many flakes are lipped, and in most cases, the striking platform (i.e., the biface edge) is the widest point.

Quartz (6 specimens)

Six small thin quartz flakes less than 25 mm in maximum dimension are thought to be from quartz hammerstones, fractured during the removal of flakes from cores. Quartz may at times have been intentionally selected for small artifacts, although no retouch alteration is evident on these flakes.

UNALTERED CHERT COBBLE (1 specimen)

This is an unused, unaltered small cobble of fine-grained gray chert. It is not native to the site and presumably was collected as potential chipping material.

DISCUSSION

Previous to about 1950, *Perdiz* and *Scallorn* points generally were thought to be contemporaneous and associated with ceramics—the main difference being their overall geographic ranges. During the 1950's, however, sites were excavated which indicated differences in temporal ranges for *Scallorn* and *Perdiz* (Jelks 1953, 1962; Suhm 1957). Since that time there is a tendency to believe that *Scallorn* and *Perdiz* forms never were contemporaneous, and that ceramics are not culturally associated with *Scallorn* points in central Texas. Certainly these beliefs seem to be supported by most excavations in the region.

A detailed review of the literature, however, leaves open an alternate explanation—that although *Scallorn* forms were introduced earlier than *Perdiz*, and *Perdiz* forms outlived *Scallorn*, there was a temporal overlap between the two styles. In addition, there is a likelihood that pottery first came into central Texas while *Scallorn* points were still in use. These subjects will be reviewed later in the discussion.

It was at that point in the archeological development that the Wheatley site was located in 1962 and studied in 1970. The situation here appears to be a short-term camp with well-defined activity areas on a site cluttered with a minimum of extraneous debris. *Scallorn* and *Perdiz* arrowpoint forms and potsherds were found together in small, isolated use areas. Nearly all material lay relatively undisturbed on or just under the surface. It appears then, that the Wheatley site was occupied at a time when *Scallorn* and *Perdiz* forms and pottery were in use together. This remains the present interpretation, and the following discussion and evaluation revolve around this thesis. Alternate hypotheses are considered but seem inconsistent with the observed situation here.

Camp Design

The site occupies a fairly large open flat area, probably essentially clear of trees during the time of occupation, with only a few scattered oaks. The juniper spread is demonstrably recent. Aside from scattered cultural debris, the site is nearly featureless. The deposit consists of dark red clay overlaid by a veneer of beige sand; these soil characteristics usually designate a site in the area. The camp overlooks steep-walled canyons to either side and is near the Pedernales canyon rimrock, though not directly on it.

The nature of the site is such that occupational debris is mainly on the surface and extends underground only into the thin layer of surface sand. Debris also is concentrated in, and in most cases limited to, relatively small, separate clusterings about 15-30 feet across. The lack of complexity and the general rarity of flint debris suggests that the occupation was a single one and that clusterings of flint flakes and artifacts represent individual activity areas.

Fortunately, the site apparently was not collected from in the past (according to the land owner), and it is not cluttered by the abundant Archaic debris so often present on central Texas sites. The exact provenience of the few Archaic artifacts collected during the initial survey is uncertain, though probably most came from near Area H. Small scatterings of Archaic debris also occur off the site northeast of Area D, northeast of Area K, and west of Area E. The degree to which artifacts have become scattered since their initial deposition is evident from the locations of reconstructable artifacts. Fragments were mainly 0-10 feet apart; fragments of only one artifact were 15-18 feet apart. There is the possibility that artifacts were carried from one activity area to another, but for the most part this seems unlikely. Pottery likely presents a special case; sherds seemingly from the same vessels appear in different areas (A and E, G and H).

It is therefore possible that small use areas could increase greatly in size. If artifacts were to scatter to a maximum 10 feet distance, a five-foot diameter hearth area might today be an area 25 feet in diameter of scattered artifacts, presumably with artifact density increasing toward the center. Likewise, a 30-foot scattering of flakes might be the remains of a 10-foot chipping station. Two activity areas originally less than 20 feet apart today could be overlapping and appear as one large area, possibly, though certainly not necessarily, with subareal distributional variation for different kinds of debris or artifacts.

A few hypotheses can be made regarding size and use of activity areas. Using the foregoing information on debris scattering at this site, we can estimate the original sizes of the activity areas (see Fig. 26):

Areas	Present Size	Computed Original Size
A	40 feet	20-40 feet
B	20	0-20
C	10	0-10
D	40	20-40
E	30	10-30
E_1	12-15	0-15
G	5	5 (hearth)
H	40	20-40
I	15 (?)	0-15
	15 (?)	0-15
J	20	0-20
K	5	5 (hearth)

Additionally, artifactual debris suggests various activities, though neither conclusive nor especially beyond the normal range of camp activities. Following are hypothetical uses of the various activity areas.

Area A was a living area, probably 25-35 feet in diameter, possibly with a temporary structure. Plainware potsherds were scattered throughout

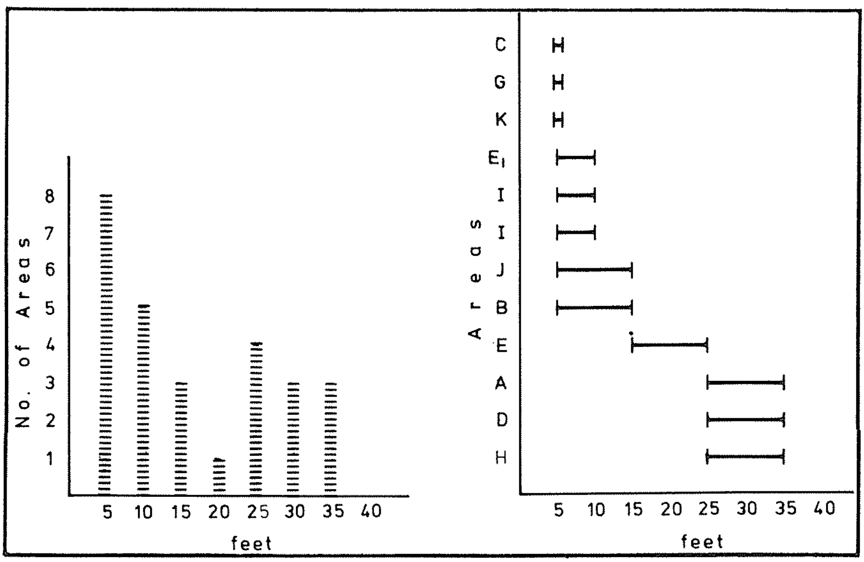


FIGURE 26. *Graph of suggested initial sizes of activity areas before artifact scattering.* The five-foot extremes have been omitted from each range to weight the central portions.

but were more concentrated in the western portion as if the broken pieces had been pushed aside there, or a pot was broken there (Fig. 5). Flint cores, flakes, and micro-flakes (1-5 mm long), representing final retouch as well as initial flaking, were especially abundant in other parts of the area and result from in-place chipping activities. Mussel shells and a small fragment of burned bone (deer?) around the small fire presumably are food remains. The use of the shallow basin in the clay beside the fire (if a result of the occupation) is unknown, and the chipping debris contents therein are inexplicable. The fire was on the southeast edge of the area, the sherd concentration on the west edge, and the densest concentration of flakes around the northeast edge. The center was cluttered mainly with fragments of arrowpoints, utilized flakes, flake scrapers, and other small flake tools.

Area B is near Area A and contains detritus, a few tools (e.g., arrowpoints and scrapers), and two sherds in an area probably originally 5-15 feet across. This may have been an outdoor activity area linked with Area A.

Area C probably was a chipping station beside a small fire, judging from the many small flakes found on an apparently burned limestone outcrop. Its actual use and relationship to other areas are unknown.

Area D is a relatively large, featureless area, originally probably 25-35 feet across, of small scattered flakes. Although some flaking was done here, the scarcity of micro-flakes suggests a minimum of final retouch. The lack of utilized flakes limits an interpretation of a large processing area.

Area E, probably originally 15-25 feet in diameter, apparently was the main activity area in the south part of the site and is the second area to contain a substantial concentration of chipped stone artifacts and plainware potsherds. Presumably it was a habitation area similar to Area A, but less chipping debris and the rarity of micro-flakes suggest more shaping of artifacts and less final retouch than in Area A.

Area E_1 probably was an outdoor area next to the Area E habitation and originally was about 5-10 feet across. Only a few artifacts and flakes were found (Fig. 8), which seems to indicate a minimum of activity.

Area G was a hearth east of Area E (Fig. 10). The fire was built on thin slabs covering the bedrock, and slabs were used throughout. Other details of its structure and use are unknown. The large brushed jar presumably was used here during cooking, during which time it broke, and the broken peices were left in the fire. Chipping was not done at this station, or was extremely limited (e.g., minimal retouch). The horizontal relation of the Area G hearth to occupation Area E seems comparable to that of the Area K hearth to the Area A complex.

Area H is an area of sparsely scattered debris, with the main activity probably originally in an area 25-35 feet across (Fig. 11). A few sherds probably from Areas A, E, and G are scattered about as are arrowpoint fragments, fragments of beveled knives and other thin bifaces, and flake debris. There is no obvious center, and the appearance is totally different from the concentrations in Areas A and E. The general inventory, however, including the sherds presumably imported from other activity areas on the site, together with its location in the center of the site suggest that a dwelling or some other camp feature may have existed here. Some chipping was done, but apparently very little final retouch.

Area I was a large flat area containing possibly two groupings of chipping debris and a few artifacts (Fig. 12). Originally the areas were possibly about 5-10 feet in diameter, and both were used for some rough shaping of tools but not for delicate retouch. Recognition of two semi-distinct artifact-flake clusterings is impressionistic and may not be significant.

Area J is next to Area A and had only two arrowpoints, a small sherd, and a few flakes in an area originally probably 5-10 feet across (Fig. 13). Its proximity to Area A suggests Area J was closely affiliated with Area A.

Area K is notable for its small, partially buried limestone hearth containing many small fired clay lumps, probably residue from some cooking technique. The hearth is small, five feet in diameter, and presumably had some special purpose away from the habitation areas. Although scattered flakes indicate minor resharpening, the near absence of chipping debris seems to preclude its use as a living station or as an area of intensive processing. This appears similar to the Area G hearth, but details of its construction and associations are unknown because it was found during a post-project trip to the site. It is, nonetheless, considered one of the more important features here.

From the above evaluations of activity areas, a general camp layout can be hypothesized. It would appear that at least three living areas (Areas A, H, and E), possibly with temporary brush shelters, occupied a somewhat north-south line parallel to the edge of the terrace-like flat. Chipping debris and tools were scattered on and around these living areas. Nearby areas were used for various activities, which often must have included flint flaking, presumably percussion resharpening. Delicate secondary retouch was done mainly in Area A. Small fireplaces were in the living areas, while larger limestone hearths were some distance to the east. Plain and brushed pottery vessels were used, broken, and discarded here. Pieces of a small broken plainware jar (though possibly more) were seemingly carried to various activity areas or living stations (Areas A, B, E, and H; see pottery descriptions), and a sherd presumably from the Area G brushed jar was found in Area H. Hypothesized area interactions, based mainly on these interareal pottery distributions, are suggested in Fig. 27. The amount of debris at the site suggests that occupation was relatively brief, possibly for only a few weeks during a collecting period for pecans or some other locally abundant resource, or during an extended trip.

The Assemblage

Artifacts at this site appear to be almost entirely from the Neo-American period as defined for central Texas. The few Archaic materials probably represent localized one-stop situations mainly around the perimeter of what here is considered the site area.

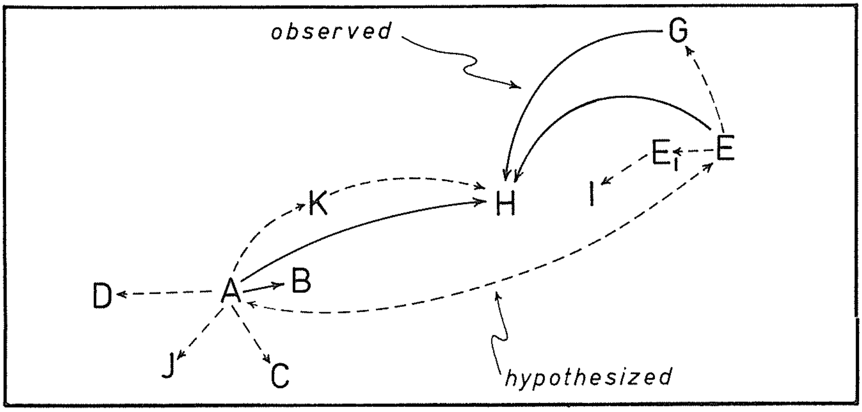


FIGURE 27. *Schematic view of area interaction.* Solid lines supported by ceramic distributions, dotted lines conjectural.

Archaic material is present all along this section of the Pedernales River, and it is not surprising to find scattered amounts here also.

Most Neo-American artifacts could be considered representative of the Toyah focus (Jelks 1962): *Perdiz* point forms, pottery, beveled knives, flake drills, and other fine flake tools. *Scallorn* forms constitute the only artifacts found at Wheatley seemingly diagnostic of the Austin focus. Pottery includes probably one or two small undecorated brownware jars, and a large brushed jar of the type *Boothe Brushed* (probably a local copy of Frankston focus forms).

Although several arrowpoint forms are present, the morphological characteristics seem similar. Heterogeneous groupings of expanding, contracting, and parallel stem forms (descriptively referred to as *Scallorn* or *Perdiz* forms) consist of small arrowpoints with usually straight to very slightly convex blade edges, prominent barbs, narrow stem "necks," plano-convex blade cross sections flaked mainly on the dorsal face (the ventral face usually is minimally flaked around the edges), and bifacially flaked stems. The distal end of the point was usually formed at the proximal end of the flake, i.e., the bulb of percussion. If nothing else, this should insure the thinnest possible stem to go into the foreshaft notch.

Many, if not most, of the artifacts have been exposed to heat. Detailed analysis has not been done to determine what percentage of artifacts were intentionally heat-treated preparatory to flaking, and which were presumably inadvertently burned. It is obvious, however, that heat-treating at this site was a common practice. The small depression filled with and surrounded by flakes and cores on the south side of Area A could have served in such a practice.

Several artifacts were made from a distinctive bluish flint (Table 2). An inspection of available survey materials from the Pedernales Falls State Park, collected both by the Travis County Archeological Society in 1962 and later by the Texas Parks and Wildlife Department in 1970 (Ing and Kegley 1971), indicates that blue flint was used mainly during Neo-American times, possibly with large-scale utilization beginning in the Transitional period, corresponding roughly to the supposed beginning of intensive pressure flaking in the area. Although this part of the artifact sample at Wheatley is too small for more than simple observations, it is interesting that half the expanding stem and parallel stem points and flake drills, and only two contracting stem points were made from blue flint. Ignoring the small sample size, 54% of the *Scallorn* points, 40% of the parallel stem points, 40% of the flake drills, and only 8% of the *Perdiz* were made from bluish flint. Possibly the difference is due only to the material a person had on hand when making various tools. More likely, however, this very fine-grained, somewhat glassy flint was selected when pressure-flaked tools were needed. The small nodule size of the raw material precludes its use for larger dart points and knives, but not for the small pressure-flaked arrowpoints and delicate flake tools.

Chi-square tests on blue and non-blue flakes viewed according to size indicate that the two classes differ significantly from chance. In fact, nearly the entire deviation to less than a .001 level of significance is accounted for by large blue flakes, the observed being far less than would be expected by chance. There are also significantly more small blue flakes than would be expected. There are two possible explanations: (1) Blue flint was selected for the purpose of producing smaller flakes, presumably for making smaller artifacts, and (2) Blue flint comes from its source in forms (nodules, chunks, etc.) too small to have produced many large flakes suitable for fashioning into artifacts, and served instead to produce small core tools. Gray flint, on the other hand, has many more large flakes than would be expected, and, indeed, it appears that the cores are much larger and were used for the removal of flakes to be fashioned into tools. All larger tools, including both flake and core tools, are from gray flint. Blue flint, then, was selected for small core tools and delicate flake tools; gray flint was used for larger flake tools and large core tools.

MANUFACTURING PROCEDURE

A problem encountered during description of the Wheatley materials involves how to sort a sample when all levels of manufacture are represented, and fragmentary tools often cannot be distinguished from unfinished artifacts. The general conception of the dynamic processes is as follows (see Fig. 28).

There are many possible avenues in the formation of chipped stone tools. The basis for distinctions in the manufacturing procedure is the presence or absence of alteration of various kinds at various levels. One inevitably begins with a chunk of stone variously classified as chert, flint, quartzite, quartz, dolomite, obsidian, agate, jasper, basalt, rhyolite, felsite, hardened limestone, and more. At the beginning of the process, the raw material may serve as a core, intended either to be altered into a core tool, or for the removal of flakes to be made into tools. The raw material may, however, be minimally altered, such as the removal of one flake or singly fractured to form an edge, and used as a tool. This, of course, could be considered a core tool in its most primitive sense. The chunk of raw material can also be used without alteration, for example, as a hammerstone, a maul, or a chopper utilizing a natural edge. Once a core exists, it can be used directly, spontaneously as a tool (e.g., a chopper), or it can be intentionally altered (through a possible "preform" level) into an artifact with specific desired characteristics. Likewise, a core may serve for the removal of flakes. A flake can be removed without any sort of special preparation, or the core can be specially prepared to produce a specific kind of flake,

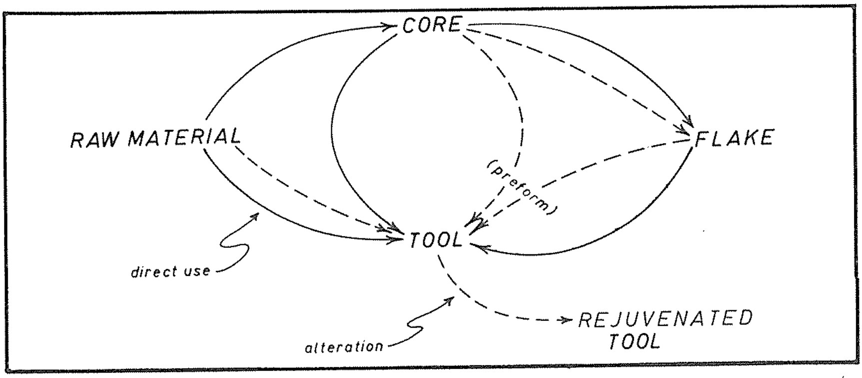


FIGURE 28. *Suggested model for material manufacture and use.* Discard or storage can occur at any point. Solid lines indicate direct use without alteration; dashed lines indicate alteration of some kind to physically transform an object from one level to another.

such as Levallois flakes, sequent or series flakes, or such blades as come from carefully prepared obsidian polyhedral cores in central Mexico. Such carefully produced flakes essentially serve as preforms, which can be either altered into a desired form, or used simply as is. The same is true for flakes removed from a core without special preparation: They may be altered to produce particular characteristics (possibly through a preform stage) or simply utilized as they come from the core without additional retouch.

The preform stage mentioned here is simply a level within the alteration of a core or flake into a desired tool form. For projectile points and knives, the preform stage is usually considered an oval biface form before final thinning, shaping, possible notching, and edge retouch is done. In most cases, probably, the level is more or less arbitrary and theoretical. It appears that sometimes, however, preforms were specifically produced as unfinished artifacts to be stored for later shaping, or for trade items to other groups needing the raw material. These forms are occasionally found in supposed storage contexts in piles suggesting mass manufacture of preforms.

Once a tool is formed, presumably it is used. Regardless of the class of tool involved, some kind of wear is bound to be produced. Flakes utilized as knives become dull. Bifaces become dull. Scraper edges become rounded. Projectile points break. And so on. At this time, the person using the tool may opt to rejuvenate it through additional alteration, either edge retouch or more extensive shaping. This may result in renewing the old tool form to its original condition, obviously with some alteration of its original attributes, such as relative thickness, edge angle, or overall dimensions (cf. Sollberger 1971). Or it might result in the formation of a new tool form distinctly different from the original. This might be the result of (1) the demand for a new tool, or (2) attributes (such as size restrictions) of the original which preclude its reformation into itself. In practice, probably, the distinction between original and rejuvenated retouched tool forms would be impossible, at least most of the time.

There are then the materials with which one works. Chunks of raw material, cores, flakes, tools, rejuvenated tools, and preforms form an interlocking system of chipped stone (and other manufactured stone tools, for that matter). From the manufacturing standpoint, a constant decision is available either to alter or prepare the piece at hand, or to arrive at a new level of manufacture without alteration of the piece. The exception, of course, is the rejuvenation procedure, which precludes alteration.

At least as important as the materials and manufacturing processes are the "non-manufacture" processes, **discard**, **use**, and

storage. Discard, including intentional discard, loss, and presumably unintentional abandonment (e.g., utilitarian and nonutilitarian objects found on excavated house floors, neither intentionally discarded nor lost, but apparently abandoned) may occur at any time for any reason. All objects recovered by the archeologist are by-products of this process; otherwise they would not be found. **Use** presumably would occur only at a tool level, since use would distinguish raw material chunks, cores, and unaltered flakes as tools. Likewise, tools may be thought of as utilized tools, and as potential or nonutilized tools. The third process, **storage**, can occur at any point within the scheme, including at a preform-unfinished level during an alteration process.

A problem encountered during the Wheatley analysis was how to distinguish between the various manufacturing levels while producing some kind of understandable description of the artifacts in a meaningful classification. For example, When does a core which is to be fashioned into a core tool cease to be a **core**, and become a **preform**? After how much flaking does a piece of worked flint become a preform? What would be the possible distinction between an arrowpoint preform and an unfinished arrowpoint? How does one distinguish between a well-chipped preform and a finished tool (especially relevant with thin bifaces or knives)?

It is apparent that arbitrary levels in artifact manufacture intergrade to such an extent in the Wheatley sample that divisions should be viewed only as a suggestion of classification units. They are quite arbitrary. Such is also the case with minimally altered flakes, utilized flakes, and arrowpoint fragments. Fragmentary specimens cannot be adequately distinguished, and separation is quite subjective.

Contemporaneity

The physical association of expanding-stem arrowpoint forms with both contracting-stem forms and pottery is of particular interest at this site. The association is believed to be valid, and the artifacts are therefore considered both contemporaneous and culturally related. There is considerable support for this explanation.

Nature of the Site

First, the nature of the site is conducive to such an interpretation. The occupied area is large and relatively flat and featureless. There is, at least at present, no obvious reason to occupy one part of the site in preference to another. Cultural materials are clearly visible on the surface and extend into surface below and wash sand only about 5 cm. Debris occurs mostly in discrete clusterings of flake material and artifacts, presumably constituting localized assemblages and not the result of either random distributions nor the reoccupation of previously occupied areas. There also is no evidence for clustering due to erosion or other natural processes.

The Artifacts

Physical attributes of the arrowpoints suggest that forms are closely related. The heterogeneity within the types, however, precludes detailed intertype comparisions. Primarily, several arrowpoints, flake drills, and other artifacts were made from a distinctive dark variety of bluish flint, some possibly from flakes from the same core and with nearly identical workmanship. This is particularly suggestable with *Scallorn* and *Perdiz* points and a flake drill found together in Area E. It is equally likely, however, that the use of the blue flint simply corresponds with an intensified use of pressure flaking.

Expectation Probabilities

Since *Scallorn* points, *Perdiz* points, and pottery occurred in several activity areas, it was decided to use distributional data to indicate the actual relationships in the form of probabilities or expectation indices. These percentages describe the coexistence of these artifacts and also predict what one would expect to find if new activity areas were discovered in terms of combinations of artifact groups.

In order to help explain the relationships between expanding-stem (abbreviated E) and contracting-stem (C) arrowpoint forms and pottery (P), areal locations are used without accounting for frequencies (see Fig. 29):

Perdiz	K	C	E_1	J	A	E			
Pottery				J	A	E	G	B	H
Scallorn			E_1		A	E	G		

Unidentifiable arrowpoint fragments also were found in pottery Areas B and H, and in Area K with burned or fired clay. The three classes were absent in Areas D and I.

The following symbols are used: **A⟶B** for "A implies B" or "If A, then B"; and **Pr(A⟶B)** for "What percent of the time does B occur with A" or "If A is present, what is the probability that B also will be present." This quantity is equal to the number of areas in which both

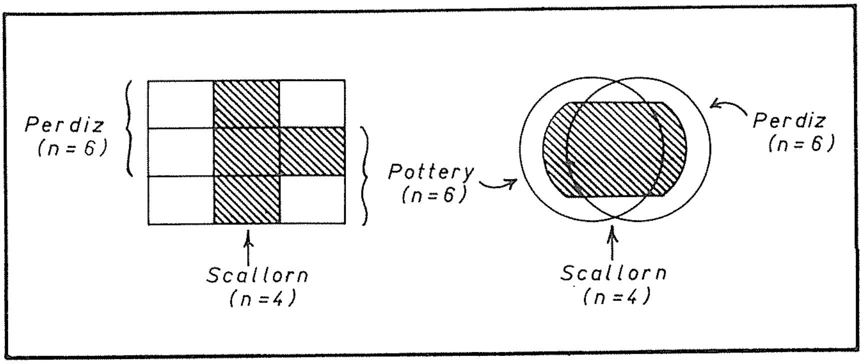


FIGURE 29. *Two ways to portray the codistributional relationship of the three artifact groups Scallorn, Perdiz, and pottery in the nine recognized activity areas containing at least one of these groups.*

groups occur together ($\cap$ is the symbol for **intersection**) divided by the number of areas containing group A. Thus,

$$\Pr(A \longrightarrow B) = \frac{N(A \cap B)}{N(A)} \quad ;$$

or the probability that C also will occur when A and B are found together,

$$\Pr(A \cap B \longrightarrow C) = \frac{N(A \cap B \cap C)}{N(A \cap B)} \quad .$$

These formulae describe how often two things occur together in terms of one of the classes or class combinations. "Pottery implies Scallorn, Pr $(P \longrightarrow E)$ [7] .50" means that *Scallorn* occurs in 50% of the areas containing pottery; or that if a new pottery area is found, there is a 50% chance that *Scallorn* also will be found there, according to the observed archeological trend at this site. This does not take into account arrowpoint fragments in Areas B and H, which, if *Scallorn*, would increase the probability of finding *Scallorn* in entirely new pottery areas.

The probabilities consist of the following:

Pottery implies Scallorn, Pr$(P \longrightarrow E)$ = .50
Scallorn implies Pottery, Pr$(E \longrightarrow P)$ = .75
Pottery implies Perdiz, Pr$(P \longrightarrow C)$ = .50
Perdiz implies Pottery, Pr$(C \longrightarrow P)$ = .50
Scallorn implies Perdiz, Pr$(E \longrightarrow C)$ = .75

Perdiz implies Scallorn, Pr(C ⟶ E) = .50
Pottery and Scallorn together imply Perdiz, Pr(P ∩ E ⟶ C) = .67
Pottery and Perdiz together imply Scallorn, Pr(P ∩ C ⟶ E) = .67
Perdiz and Scallorn together imply Pottery, Pr(E ∩ C ⟶ P) = .67
Pottery implies both Perdiz and Scallorn together, Pr(P ⟶ C ∩ E) = .33

Thus, a third of the pottery is found with *Perdiz and Scallorn* **together** (P ⟶ C ∩ E), and it occurs two-thirds of the time when *Perdiz* and *Scallorn* are together (C ∩ E ⟶ P). This seems to indicate an equal affiliation of pottery with *Perdiz* or with *Scallorn*: *Perdiz* occurs in half the pottery areas (P ⟶ C) and occurs with pottery (C ⟶ P) half the time; while *Scallorn* also occurs with half the pottery (P ⟶ E), and pottery is found in 75% of the areas containing *Scallorn* (E ⟶ P).

Theoretical Distributional Probabilities

Next an evalution of the coexistence of the three types is made from the standpoint of theoretical distributional probabilities. In these tests, the probabilities of chance co-occurrence are computed following procedures outlined by Parzen (1960: 84). The null hypothesis that artifact classes (groups) are distributed randomly and occur together only by chance is tested, and in all cases rejected.

The procedure involves determining (1) the probability that a class would occur in any one part of the site, knowing in how many possible areas the class would occur, then (2) the probability for classes occurring together in one area, and finally (3) the probability that the classes would occur together in the number of areas in which they were actually found.

In order to make the Wheatley situation applicable to distributional formulae, the site was theoretically partitioned into 50-foot squares, each square large enough to include any use area determined by the concentration and extent of cultural debris. The site was assumed to consist of 30 such grid units or cells. Each of the culturally defined Areas A-K theoretically occupies a different cell.

Area F is excluded also from these computations. Inclusion of Area F would increase the site boundaries to such an extent that probabilities for chance codistributions would be so infinitesimally small as to be nearly nonexistent. The area between Areas E and F also was quite overgrown and precluded the certainty that additional use areas were not present.

Parzen's (1960: 84) general formula for the probability of an artifact class to appear in one cell,

$$\Pr(A)_1 = \frac{\binom{M-1}{n-k}}{\binom{M}{n}},$$

can be simplified in cases of exclusion (the situation at Wheatley) to

$$\Pr(A)_1 = \frac{n}{M},$$

or, the number of areas in which an artifact occurs divided by the total number of areas for the entire site, simply the percentage which a particular artifact class occupies of the total possible areas. The probability that elements of two or more sets will occur in *one particular cell* is equal to the product of the probabilities for each separate set:

$$\Pr(A \cap B \cap \ldots)_1 = \Pr(A)_1 \cdot \Pr(B)_1 \cdot \ldots$$

The probability that an element or combination of elements would occur by chance in a given number of cells (subscript; here the number of actually occupied cells) is the above formula raised to the power of the number of occupied cells. This is, for one class,

$$\Pr(A)_{n_a} = \left(\frac{n_a}{M}\right)^{n_a} \quad ;$$

for two classes,

$$\Pr(A \cap B)_{n(A \cap B)} = [\Pr(A \cap B)_1]^{n(A \cap B)} = \left(\frac{n_a \cdot n_b}{M^2}\right)^{n(A \cap B)} \quad ;$$

or for three classes,

$$\Pr(A \cap B \cap C)_{n(A \cap B \cap C)} = \left(\frac{n_a \cdot n_b \cdot n_c}{M^3}\right)^{n(A \cap B \cap C)}$$

The general formula, then, is,

$$\Pr(A \cap B \cap \ldots X)_{n(A \cap B \cap \ldots X)} = \left(\frac{n_a \cdot n_b \cdot \ldots \cdot n_x}{M^{(n \text{ of classes})}}\right)^{n(A \cap B \cap \ldots X)}$$

where, $A, B, \ldots X$	=	classes (here pottery, *Perdiz*, and *Scallorn*).
$A \cap B \cap \ldots X$	=	the distributional intersection of classes A, B, ... X.
$n(A \cap B \cap \ldots X)$	=	the number of cells in which classes A, B, ... X intersect.
$n_a, n_b, \ldots n_x$	=	the total number of cells occupied by classes A, B, ... X.
M	=	number of possible cells in the grid; at Wheatley the constant 30—the number of 50-ft square grid units comprising the site area.
n of classes	=	number of classes being considered in the problem.
$\cap$	=	symbol for intersection.

The following indices were thereby calculated, describing the probability that the observed codistributions would happen by chance (figures are presented in this form for convenience only; significance to the fifth decimal digit is not insinuated):

Pottery with Scallorn in three areas = .002 percent
Pottery with Perdiz in three areas = .006 percent
Scallorn with Perdiz in three areas = .002 percent
All three classes together in two areas = .003 percent.

These figures fall well below the arbitrary 5% minimum for accepting the explanation of chance occurrence and strongly suggest that the associations are valid. All indicate that the likelihood that the observed event would happen by chance is extremely slight.

It must be stressed that this is an entirely theoretical construct. The test can not be used as explicitly contributing data against the hypothesis of chance coexistence, since the number of areas within the site might be questioned; the total site was not excavated, and unrecognized activity areas might be present which would significantly alter the results. More important, the size of the areas not only is arbitrary, but the occupation of a cell by an activity area is theoretical and was chosen after the site was dug, and then only as an informal part of the analysis. The results are interesting only in that they may be used as a general guide to the chance probabilities. Persons wishing to use this technique in future work should realize the weaknesses in the Wheatley analysis and construct a stronger research design and applicable statistical models anticipatory to field work and data collection.

Actual Distribution Frequencies

The above theoretical chance figures can be compared with the actual distribution (still from a totally theoretical point of view because of the post-collection selection of cells), by viewing the percent of the co-distributional relationships actually present in relation to the total site (30 possible cells). These are,

Pottery with Scallorn in three areas, 10 percent
Pottery with Perdiz in three areas, 10 percent
Scallorn with Perdiz in three areas, 10 percent
All three together in two areas, 6.7 percent.

This means that binary relationships each occur on 10% of the site, and all three occur together on nearly as much. Also viewing the site as a whole, one or more of the chosen types is found in 30% of all available cells, and all three types occur together in 18% of the occupied portion of the site.

Summary

Briefly summarizing the supporting evidence for contemporaneity, there are generally four areas. The nature of the site suggests intentional groupings of artifacts—a nearly flat, featureless site with materials limited to the surface in discrete clusterings interpreted as activity areas within a camp. Erosional clustering seems impossible here. The physical attributes of the arrowpoints—overall shape, technology, and the use of the distinctive blue flint—suggest that they are closely related. Actual relationship figures or expectation probabilities, based on a theoretical construct, describe the coexistence of types in the same areas as most common and show that *Scallorn* points usually will be accompanied by *Perdiz* and/or pottery. And finally, theoretical distribution probabilities indicate that the types almost never would occur together by chance, and therefore that their occurrence together is most likely intentional.

Age

The next problem is that of assigning an age to the occupation. Certainly most of the assemblage conforms well to a full-fledged

Toyah focus. The *Scallorn* forms, however, may indicate some time within early Toyah focus times and likely a time during the overlap of the Austin and Toyah temporal ranges.

Unfortunately, the Wheatley site was not conducive to charcoal collection for radiocarbon dating. The sample taken from the Area G hearth—the only charcoal-bearing feature excavated at the site—was both too small and too full of modern rootlets to produce a reliable date.

Published radiocarbon dates, therefore, are used to help approximate the age of the occupation. Although the designation of the Wheatley occupation as Austin or Toyah is uncertain, a temporal placement within the Central Texas aspect at the boundary of the Austin and Toyah foci, at least as they have thus far been identified on the basis of distinctive artifact styles, seems most reasonable, for the most part, from a comparative-developmental standpoint. The literature reveals Central Texas aspect dates from the following sites:

Site	RADIOCARBON Listing	Excavation Report
Blum	Stipp *et al.* 1962: 49 (TX 10)	Jelks 1953
Punkinseed	Stipp *et al.* 1962: 49 Tamers *et al.* 1964: 151 (TX 8,75)	---
Penny Winkle	Tamers *et al.* 1964: 150-151 (TX 70-72)	Shafer *et al.* 1964: 78-85
Oblate	Tamers *et al.* 1964: 149 (TX 29)	Tunnell 1962
Kyle	Tamers *et al.* 1964: 145-156 (TX 98-99; C1-2,4-6,8)	Jelks 1962
Smith	Tamers *et al.* 1964: 145-146 Valastro and Davis 1970a: 271-273 (TX 504-517, 21-28)	Suhm 1957
Pohl	Pearson *et al.* 1965: 306 (TX 123)	---
Britton	Pearson *et al.* 1966: 461 (TX 233-234)	Story and Shafer 1965
Barton Springs Road	Valastro *et al.* 1967 (TX 74)	Lundelius 1967
La Jita	Valastro and Davis 1970b: 633 (TX 664-665,681,684-685,687)	Hester 1971
Dobias-Vitek	Valastro and Davis 1970b: 633 (TX 804,806)	Eddy 1974, ms.

First standard deviation ranges for dates from these sites were combined so as to indicate the temporal range for each focus. Dates were plotted on a scale of 25-year intervals, each multiple of 25 falling within the range of a published date receiving one entry: 226 entries from 31 published dates attributed to the Austin focus, and 90 entries from 12 published dates attributed to the Toyah focus. The resulting percentage graph showing the total ranges of the two foci was made from the number of first standard deviation ranges within which a particular date fell (Fig. 30). For example, A.D. 900 fell within 10 of the 31 Austin focus dates and therefore was graphed as 32 percent. Ranges were additionally computed from the central 66% of the total entries of the analysis graph.

There seem to be three methods for viewing the ranges of the two foci and the overlap period thus formed. These include the overall range, the range of the central 66% of the individual date entries, and the dates on which 20% (more or less arbitrarily chosen) or more of the samples fall:

Range (A.D.):	**Austin**	**Toyah**	**Overlap**
Overall	425-1800	1125-1800	1125-1800
Central 66% of samples	800-1375	1225-1700	1225-1375
Dates on which 20% or more of samples fall	800-1175	1150-1450 1575-1775	1150-1175

It would seem, therefore, that the Wheatley site probably was occupied about A.D. 1150-1300 (Fig. 30). The dates obviously, from the

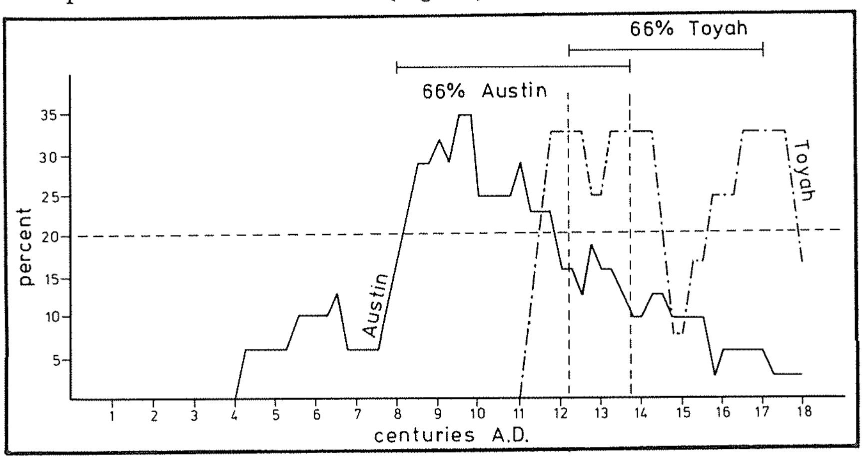


FIGURE 30. *Temporal ranges of the Austin and Toyah Foci taken from published radiocarbon dates.*

very nature of their origin, are not restrictive, and the occupation could have been either before or after this suggested period. The main problem is that field investigations from which published dates originated probably were oriented toward isolating components, and mainly samples from as near a pure component as possible (i.e., one arrowpoint type) were dated. This means that particular temporal areas were tested at the expense of other parts of the total range. This method of analysis, then, is meant only to arrive at a crude simplifed approximation of the core range for the two foci, and their most reasonable overlap period. A clear overlap for the two foci is indeed indicated.

Extra-Site Comparisons

At this point a review of the archeological literature seems justified for two problems at hand: (1) What is the evidence for an overlap either temporally or culturally between the Austin and Toyah foci, and (2) Is there evidence suggesting that pottery was introduced into central Texas during Austin focus times? Neither question is answered definitely in the negative, and the affirmative seems to be a strong possibility. They will be taken in order, followed by some comments on the use of focus and type names in central Texas.

Scallorn and *Perdiz* Contemporaneity

Before about 1950 *Scallorn* and *Perdiz* were thought to be contemporaneous and attributable to different ethnic groups with different geographical ranges, overlapping especially in central Texas. It is probably safe to assume that hundreds of sites were excavated, either well or poorly, by more than a handful of experienced field archeologists. Yet apparently no one realized that the two forms were not contemporaneous. Indeed, all evidence seems to have indicated that they were. Had any of the sites been at all sensitive to the temporal division of the two types, most likely someone would have recognized this possibility. The older literature is full of equivalent intuitive explanations in comparable situations.

There appears to be no evidence of unquestionable association of the two types in a single feature. Miller and Jelks (1952: 198-201) describe a burial excavated in Belton Reservoir in Coryell County which contained five *Perdiz* points and five or six *Scallorn*. Although the points were found in the fill of a single grave, the probability that they were intentionally placed in the grave as actual grave goods is very slight. D. B. Hill, who excavated the shelter, stated that the points were randomly placed in the grave fill; and Harry Shafer, who has also dug there, states that the extreme richness of the deposits suggests that it would be impossible to dig in any part of the shelter without finding a mixture of types (Harry J. Shafer, personal communication 1970). No other similar features are known.

Evidence up to this time, then, consisted of the uniformity of the assemblage and the near consistent occurrence together of *Scallorn* and *Perdiz* points, the most diagnostic indicators for the two foci. Miller and Jelks (1952: 202-205) best summarize the thinking:

> ". . . there is nothing to suggest the presence of two different foci in the Belton components of the Central Texas aspect, and since *Scallorn, Perdiz,* and *Cliffton* are consistently associated with one another in these sites it does not seem completely feasible to separate them on a focal basis. In analyzing the Belton sites, then, *Scallorn, Perdiz,* and Cliffton, together with the associated complex of other artifacts, are all considered traits of the Austin Focus."

The first clear evidence that *Perdiz* tended stratigraphically to overlie *Scallorn* was found during excavation of the Blum Rockshelter on the Brazos River northwest of Waco. Jelks (1953: 199) comments that "it was readily apparent—both in the field and in the laboratory—that *Perdiz* occurred principally in the upper levels of occupation while *Scallorn* was found, for the most part, at greater depths." Unfortunately, distributional data are not completely clear. Recovered during excavation were 69 *Perdiz* and *Cliffton*, 28 *Scallorn*, and 6 *Alba*, distributed primarily in two cultural strata, 1 lower and 2 upper. Stratum 1 contained six *Scallorn* and no *Perdiz*. Five *Alba* were recovered from Stratum 1-2 contact levels at the base of the deposits. In Stratum 2 were 47 *Perdiz*, one *Scallorn*, and one *Alba*. This means that no distributional data are presented for 32% of the Perdiz and 75% of the *Scallorn*. Apparently, then, the principal ranges of the two types were different, but there could have been a temporal overlap. Pottery (possibly a Titus focus vessel, others unknown) occurred only in Stratum 2 with *Perdiz* and *Cliffton* points, although *Alba* and *Yarbrough* points in the lower levels indicate that contacts have been directed eastward over a considerable length of time (Jelks 1953: 206).

The next site to provide information on the problem and the only excavated site showing evidence for total distributional separation between *Scallorn* and *Perdiz*, is the Smith Rockshelter (Suhm 1957) on Onion Creek, a Colorado River tributary in Travis County, about 33 miles east of the Wheatley site. At Smith, several feet of *Scallorn*-bearing deposits were separated from the single, totally *Perdiz* zone by a sterile layer (Zone X) about 9 inches thick. All *Scallorn* were below Zone X, and all *Perdiz* and *Cliffton* above. A group of more or less rectangular-stem points (4 Eddy, one *Alba*, 2 *Cuney*-like), both distributionally and descriptively intermediate between *Scallorn* and *Perdiz*, were found just below (2 specimens) and just above (3 specimens) the sterile zone and thus overlapped both major types. Ceramics were found with *Perdiz* points entirely above the sterile zone, and none with *Scallorn*.

The distributional data from the Smith Rockshelter do not indicate contemporaneity for *Scallorn* and *Perdiz*. Two possible explanations come to mind, however. First, the period of contemporaneity could have been very short and the shelter was simply not occupied during that period, when the sterile Layer X was perhaps deposited. A second hypothesis is that post-Layer X occupations were by people making only *Perdiz* points, but that groups making Scallorn points were present, even if periodically, nearby. The absence of *Scallorn* in the uppermost Layer XI could thus be explained as (1) *Perdiz*-using people were not in contact with *Scallorn*-using groups, or (2) *Perdiz*-using people **were** in contact with *Scallorn*-using groups but brought neither the groups nor their *Scallorn* points to the shelter. Obviously an unquestionable explanation for this site is impossible, but the situation here should be regarded not only as unique, but as incomplete in view of other investigated sites in central Texas.

The last of the three "classic" sites showing *Scallorn-Perdiz* temporal separation is the Kyle Site (Jelks 1962), on the Brazos River northwest of Waco, and in the same general area as the Blum Rockshelter. Vertical distributional data for points of known provenience indicate clearly that *Scallorn* initially appeared well before *Perdiz* in Strata 1 and 2, and that *Perdiz* and *Cliffton* continued in Stratum 5 after the discontinuation of *Scallorn*. Both *Perdiz* and *Scallorn*, however, along with rectangular-stem forms *Alba, Bonham*, and "Short Rectangular Stem," occurred together in Stratum 3 (the Intermediate Zone) and Stratum 4 (the lowest stratum of the Toyah focus zone and suggested by Jelks to be possibly "Toyah-Austin transition") in a mixed context with pottery (Jelks 1962: 78-79, Table 1). These two strata combined account for 22% of the *Scallorn* points of known provenience, 57% of the *Perdiz/Cliffton*, 98% of the sherds (mainly in the Intermediate Zone, Stratum 3), and 80% of the flake drills (included here because of their interesting distributional correspondence). The Intermediate Zone is also interesting by itself, since it is considered to be neither Austin nor Toyah focus, but contained 16% of the *Scallorn* of known provenience, 12% of the *Perdiz*, and 91% of the sherds.

Thus it appears that at the Kyle Site, there are sufficient distributional data to suggest a possible temporal overlap between *Scallorn* and *Perdiz*, a period during which most of the pottery and flake drills were left at the site. Jelks alludes to such an explanation several times (1962: 96, 97, 98) and seems to feel (p. 98) that the Toyah focus somewhat gradually replaced the earlier Austin focus.

Following the excavations at Blum, Smith, and Kyle, archeologists were keenly aware of the vertical separation which had eluded them for so long and pushed ahead in their excavations with the knowledge of this separation. The failure to demonstrate at new sites the separation of the two types is important. The following sites (and many more) were excavated and/or analyzed with that data specifically at hand and considered in the analysis.

The Oblate Site (Tunnell 1962: 96, Table 4), a rockshelter in the Guadalupe River hill country of Comal County about 27 miles south of the Wheatley site, was carefully excavated with hopes of finding a vertical separation between *Scallorn* and *Perdiz* distributions. Of the excavated specimens of known provenience, 87% (34 specimens) of the *Scallorn* points (39 points total) overlapped the entire *Perdiz* sample (23 points). In a slightly more restrictive sense, 85% of the *Perdiz* were in the uppermost excavated half-foot level, along with 36% of the *Scallorn*. Assuming that the deposits were not radically mixed, this distribution suggests only that the beginning of *Scallorn* occurred before the introduction of *Perdiz*, and that *Perdiz* was in use after the discontinuation of *Scallorn*. It seems, however, that Oblate does not suggest a total separation of the two arrowpoint styles, but rather supports a period of overlap during which both types were in use.

Very much the same situation exists at the Boy Scout Shelter (Pollard *et al.* 1963) in the hill country of western Travis County on the Colorado River about 27 miles east of the Wheatley Site. At that site the most careful recording in the field of *Scallorn* and *Perdiz* locations failed to even delicately suggest any sort of distributional separation, either horizontal or vertical—most of the arrowpoint sample came from a relatively isolated deposit 2.5 ft. thick in a limestone trough (*ibid* p. 40, Fig. 5). During the excavation, the trough deposit appeared to be undisturbed, and at least intuitively it appeared then, as now, that all the excavated materials—*Scallorn* and *Perdiz* points, flake drill, etc.—were contemporaneous and were deposited during a very short period of time.

Excavations have been conducted at several sites in Belton Reservoir in Bell County (Shafer *et al.* 1964). At the Garth Site, an open terrace site, both Austin and Toyah focus artifacts were found together with Caddoan pottery, although the authors intuitively feel that the lack of separation was due to shallowness of the deposit (*ibid*: p. 77). Caddoan sherds also occurred in the same zone and levels with both Austin and Toyah focus materials at the Penny Winkle Site (*ibid*: pp. 83-84).

Early excavations of rockshelters in the Whitney Reservoir on the Brazos River northwest of Waco (the Blum and Kyle sites area) were reported more recently by Stephenson (1970). Artifact distribution tables clearly indicate overlapping distributions of *Scallorn* and *Perdiz* points, although Stephenson interprets his data as indicating that Perdiz is generally earlier and Scallorn generally later. However, he feels that in Buzzard Shelter, the entire occupation is attributable to "peoples of the same general cultural complex" and that "The predominance of the *Perdiz* Points [256 points] through all levels and the relatively rare appearance of *Scallorn* Points [60 points] would indicate that this was the Toyah Focus" (*ibid*: p. 175). He also describes Pictograph Cave as having "some blending of Austin Focus traits into the occupations above," i.e., Toyah focus (*ibid*: p. 157).

Hester, working in the lower Nueces River drainage of Zavala County in south Texas, believes he has found evidence of contemporaneous point styles. At the Tortuga Flat site, *Scallorn, Perdiz*, and triangular arrowpoint forms have been found in "surface manifestations," apparently interpreted as single component activity areas (Hill and Hester 1973: 10-11). Points found together are thought to be in direct association, not just fortuitous codistributions. Hester (1974: 19-20) describes a similar situation at Chaparrosa Ranch, where he notes the co-occurrence of *Perdiz, Scallorn*, triangular, and other point forms. Again he feels this represents direct association.

In summary, various workers have expressed opinions regarding the possibility that the two foci were ever contemporaneous. In her review of central Texas archeology, Suhm (1960: 83) points out that at Belton Reservoir, Miller and Jelks (1952) found that "*Perdiz, Scallorn*, and *Cliffton* arrow point types were regularly associated with one another." She mentions that at Belton (Miller and Jelks 1952) and at the Collins site in Travis County (Suhm 1955) diagnostic arrowpoints for each focus were apparently in direct association with one another. The association would seem entirely reasonable if the Toyah focus developed out of the Austin focus, and thereby a possible period when *Scallorn* and *Perdiz* points were simultaneously in use by the same group (Suhm 1960: 83). She is very reserved about the possibility, and more recently has denied the likelihood that the two foci were ever contemporaneous (Dee Ann Story, personal communication 1970).

Stephenson (1970: 244-248) believes that at his Whitney Reservoir rockshelters the two foci have different distributions, with Austin early and Toyah later. His artifact distribution tables do not indicate such an ordering. He views the change from Austin to Toyah as evolutionary in theory, Toyah gradually replacing the Austin focus, but probably also actually representing an influx of new and different people. This is indicated by abrupt stylistic changes and the introduction of new tool forms, such as the long-shafted flake drills, four-edge beveled knives, small snub-nose end scrapers, and ovate and bipointed knives. During this time there was greater contact with east Texas, initially probably with the Alto and Sanders foci, as indicated by *Alba* points, imported Caddoan pottery, and locally-made pottery probably influenced from the east.

Shafer (1971) has presented an excellent overview of the Central Texas aspect, during which he discusses the Austin and Toyah units as phases. He, like Stephenson (1970), seems to view the Austin focus (phase) essentially as the indigenous late Archaic population with the introduced bow and arrow and a more limited geographic range than the later Toyah phase. The Toyah phase is marked by the introduction of a Plains-like tool assemblage (end scrapers, four-edge beveled knives, flake blades, flake drills, large bipointed thinned bifaces), locally made pottery (brushed, plain, painted, polished, etc.), and with economic emphasis on horticulture and bison hunting. Base camps were fairly large semi-permanent villages with seasonal dispersal to exploit the environment. He believes the orientation toward bison hunting is responsible for the Toyah focus traits and suggests that "The Plains-like assemblage is a likely expression of an ecological adjustment by indigenous populations—not necessarily genetically related to the Austin phase populations."

Shafer probably is correct in his assessment of the north-central Texas area around Waco, but the picture farther south is not so clear. In the south there are no known Alto focus sites like Chupek and the east Texas trade wares are quite rare, the converse of the Waco situation. The large wattle-and-daub villages and maize seem to be absent in the south (Thomas R. Hester, personal communication 1975, reports the recent recovery of a corn cob from a rockshelter in Hays County by members of the Southern Texas Archaeological Association). The big stylistic and content schism between the Austin and Toyah foci is not nearly so obvious in the southern and western regions.

Shafer seems to view the two foci as distinct and separated in time. He suggests, however, that there could have been a very brief transition, possibly during which people from both phases were living in the same areas and presumably in contact with each other. Actually he seems to view the Transitional period as one represented by some sort of diagnostic artifacts and distinct from both Austin and Toyah:

> "The Toyah phase appears quite suddenly. If there is a transitional period between the Austin and Toyah phases, it is not well accounted for archeologically. Suhm (1957) gets a hint of a transition at Smith Rockshelter, but this is the only stratified site where a transition might be interpreted.
>
> It is clearly possible that transitional sites have not been recognized because they do not often occur in stratified context. Also, the temporal span was obviously much shorter than the duration of either the Austin or Toyah phases. Therefore, since most Toyah phase deposits are archeologically represented merely as a thin veneer overlying those of the Austin phase, a transitional period between the two would be even less discrete. It could be that the duration was so short that it is archeologically indistinct or inseparable."

In summary, then, there seems to be good evidence that *Scallorn* and *Perdiz* did in fact overlap in central Texas. We know they did on the coast (Corbin 1974: 43). Most excavations and detailed interpretative discussions support the idea of co-occupation in time, in space, and possibly even of the same sites by people of the two foci. The evidence at Smith is believed incomplete and not representative of the total occupation in the area. The separation of the two forms at that site, however, should not be forgotten.

During this review of the literature, a possibility came to mind which deserves further consideration. Most of the work on the Central Texas aspect, principally the problem of the Austin and Toyah foci, has been done in north-central or northeast-central Texas. This is the area around Waco and Belton, principally the Brazos River drainage and surrounding area, the region in which Caddoan influences were the greatest, particularly from the Alto, Sanders, and Frankston foci. This is the area in which the Toyah focus appears most suddenly as a Plains trait-impregnated complex probably economically oriented toward bison hunting. The focus appears to come in around A.D. 1200 with a full array of new assemblage traits, including intensified contacts with east Texas. Dillehay (1974: 184-185) has pointed out the absence of bison remains during Austin focus times and their sudden appearance around A.D. 1200. This date corresponds closely with Plains traits introduced not only with the Toyah focus but also in its contact areas throughout the Fulton aspect range and probably northward and westward as well (see Dillehay for references and more complete discussion).

The point of interest is that if the Toyah focus represents an influx of new people into the hill country and rolling grassland country occupied by Austin focus groups, there was undoubtedly contact. This, of course, assumes that Austin focus people did not mysteriously die out or inexplicably vacate this choice area previously, and also that the Austin focus did not simply change its material culture as part of an economic adjustment toward bison hunting when these animals moved back down into the area. The contact could have been of a friendly nature in which the two groups persisted side-by-side, probably for a long time, and perhaps even lived together. New groups moving into the area, however, would have increased the population density, and would have created not just a population pressure but also a directional flow—a convection— for group movement southward. An even stronger, more abrupt and drastic impetus for movement would have been caused by incompatability between the two peoples. If the Toyah focus groups were at all warlike (cf. Kelley 1955: 989 on the Tonkawa; to my knowledge only *Perdiz*, and not *Scallorn*, points have been the obvious cause of death in Central Texas aspect burials indicating violent deaths) or for any reason became enemies with the indigenous groups and were perhaps stronger than they were, there likely would have been considerable movement of Austin focus groups southward, perhaps southwestward, perhaps toward the coast. These migrating groups could have settled unpopulated or minimally populated areas and/or combined with other groups, i.e., become integral units of other villages, bands, or even tribes. In such refuge situations, it is very reasonable that material traditions in the culture would continue to persist with minimal change, if any. Such being the case, it would be entirely within reason to discover remains of remnant Austin focus groups in south Texas or perhaps along the southern coast. *Scallorn* points, along with other tools of the complex, could easily have been used continuously into proto-historic or historic times. Contacts between groups with stylistically different material assemblages, such as during times of seasonal harvest like the big tuna gathering festivities of south Texas (Newcomb 1960: 4), might easily result in sites containing single component features (activity areas) with different artifact styles.

Pottery and the Austin Focus

Another related subject for review is the possibility of pottery occurring in the Austin focus. As has been pointed out, the Austin focus is believed, on the basis of radiocarbon dates, to occupy the period from about A.D. 900 to at least 1300. During this time, pottery was in use, and had been for some time, in more or less adjacent areas, particularly to the northeast with the Alto focus (Gibson aspect) and to the east in various coastal areas.

There seems to be evidence of influence from Alto focus groups into central Texas, and for that reason the complex is singled out for discussion here. Its choice, however, is by no means restrictive. It has long been pointed out that Frankston focus pottery is widely distributed across central Texas and occasionally farther west. "Because of its position on the southwestern periphery of the Caddoan area during Fulton Aspect times, Frankston Focus plainly reveals more contact with the non-Caddoan people to the west than any other Caddoan foci" (Suhm *et al*. 1954: 185; see also Krieger 1946: 166-167). The Frankston focus is characterized by *Perdiz* arrowpoints and brushed pottery.

In general terms, the Alto focus is an agricultural and ceramic complex with well-defined sedentary villages and a religious component demonstrated in part by impressive earthworks sometimes containing elaborate burials (Newell and Krieger 1949; Suhm *et al*. 1954: 161-167; and recent excavations at the Davis Site by D. A. Story, Texas Archeological Research Laboratory, Austin). Ceramics include a variety of engraved, incised, and plainware forms (brushed pottery is absent) with bone, clay-grit, or sand temper (no shell). The predominant arrowpoint form is *Alba*, a small point reminiscent of the central Texas form *Eddy* (Suhm 1955: 23-24; 1957: 36; 1959: 228) or *Scallorn eddy* (Jelks 1962: 28-30). Knives of the very distinctive *Copena* type also are diagnostic of this complex.

Recent dates from Story's work at the Davis Site indicate a principal range from about A.D. 700 to sometime after 1200 (Valastro and Davis 1970b: 629). This is remarkably close to the estimated range of A.D. 900-1300 for the Austin focus. The possibility for interaction between the two foci, then, is compatable with temporal data.

From a material standpoint, evidence of direct contact is scarce and usually questionable. Artifacts of seemingly Alto focus origin in Central Texas aspect sites are found in contexts which in almost all cases could be assigned to either the Austin or Toyah focus or to both (either in naturally or mechanically mixed deposits or in occupational debris of a culturally mixed complex).

Most of the work on the Central Texas aspect has been in the northern part of central Texas, or from Belton north. Early work in the Belton Reservoir in Coryell County produced several sites with evidence, albeit indirectly, of the Alto focus (Miller and Jelks 1952). At the Urbankte Site, Alto focus sherds were found with both *Scallorn* and *Perdiz* arrowpoints. At the Grimes-Houy Shelter, *Scallorn* and *Perdiz* arrowpoints were found on sites with *Copena* knives. At the Grimes-Houy Midden, *Scallorn* and *Perdiz* were found with *Holly Fine Engraved* pottery (Alto focus) and *Copena* knives. At the Johnson Hole Site, *Scallorn* and *Perdiz* were found with *Holly Fine Engraved*, *Copena* knives, and *Alba* points. At the Ament Shelter, *Scallorn* and *Perdiz* points were found in deposits also yielding an unknown type of Caddoan pottery, a Fulton aspect pipe, *Copena* knives, and obsidian flakes.

Later work in Bell County produced additional correlations (Shafer *et al.* 1964: 66). At the Penny Winkle Site, seven sherds seemed to be associated with the Austin focus occupation. These were plainware with clay-grit temper, and clay and bone temper. Six sherds from a zone that yielded primarily (but not exclusively) Toyah focus material are brushed, engraved, and plain. These include types *Dunkin Incised* (Alto focus, Gibson to Fulton aspects) and *Canton Incised* (Sanders focus, Gibson aspect). One sherd from the Domino Site may be in Austin focus context (Shafer *et al.* 1964: 66) although it is not definitely assignable to either Austin or Toyah (*ibid*: p. 104). The sherd appears to be *Kiam Incised*, an Alto focus (Gibson aspect) type surviving with *Dunkin Incised*, a related type, into the Fulton aspect.

From his work in the Whitney Reservoir basin, Stephenson (1970: 246) believes that toward the end of Austin focus times there were beginnings of intensified contact with east Texas, particularly the introduction of Caddoan pottery. Pottery trade vessels are evidenced in Austin focus zones at Pictograph Cave (*ibid*: p. 154).

Watt (1953) has indicated that in the central Brazos valley, near Waco, there is abundant evidence of Caddoan contact in Central Texas aspect sites. Pottery includes sherds and vessels from the Alto and Sanders foci of the Gibson aspect, Frankston and Titus foci of the Fulton aspect, shell-tempered plainware sherds possibly from the Gulf Coast, and sherds of what may be *Doss Red Ware*, a presumably indigenous pottery of the Toyah focus (see Kelley 1947: 123; Suhm *et al.* 1954: 388). Following information supplied by Watt, Newell and Krieger (1949: 195-196) believe that Alto focus people actually lived at the Chupek site near Waco. This being the case, Alto focus influence into adjacent areas, especially southward down the Balcones escarpment, seems a reasonable possibility.

Roberson (1971) also has studied sherds from the Waco area of east-central Texas in the Texas Archeological Research Laboratory collections in Austin. His results compare favorably with those of Watt (1953), although again, he does not discuss the association or co-occurrence of the pottery with other artifact types. His materials, undoubtedly, were very limited and did not allow for strongly supported conclusions of that sort. He sees the area being settled during early Gibson aspect times, and the descendants persisting, at least in small numbers, until the Historic period. From the beginning, the people had a knowledge of pottery-making and continued the tradition until the Historic period. This was a transitional area between basically sedentary horticultural groups in eastern and northeastern Texas and hunting peoples to the west in central Texas. Contact with people to the south and southeast along the Gulf Coast probably was slight until late proto-historic or historic times when pressures from central Texas groups precipitated some migration southeastward toward the coast (see Campbell 1960: 148).

Roberson also believes that the pottery from central Texas is not just imported tradeware. He feels that it is very unlikely that all of the types in the area were imported into a culture (or cultures) without knowledge of pottery making. More likely, local residents also made their own pottery and copied designs and techniques. The early domestic pottery is very similar to Alto focus forms, but they are also slightly different and are probably copies. Frankston focus vessels also were undoubtedly imported and then copied locally. This, of course, includes, among other forms, wide-mouth brushed jars.

Farther south, Sorrow (1970: 15) reports pottery from the Barker Site on the North San Gabriel River in Williamson County. His Vessel 1 is very similar to some Alto focus jar forms. It is a reddish-brown incised jar (29 sherds) of sandy paste, tempered with angular quartzite sand and burned bone. Other pottery includes one brushed vessel (2 sherds) and three plainware vessels (24 sherds), all bone tempered. Arrowpoints (mostly surface collections) include 11 *Perdiz* points, 3 *Cliffton*, 6 *Young*, 7 unclassified fragments, and one medial section with part of the expanding stem (resembles *Scallorn eddy* of Jelks 1962). Other artifacts include four dart points (1 *Ensor*, 2 *Fairland*, one miscellaneous form), 41 end scrapers, 17 side scrapers, and one circular scraper. The assemblage argues closest for affiliation with the Toyah focus. Alto focus influence may be the expanding-stem arrowpoint form of a style similar to the Alto focus *Alba* type and the incised jar. Later Frankston focus related elements could be the single brushed vessel and the Perdiz arrowpoints. The expanding-stem point could be representative of terminal Austin focus times, but its direct association with the pottery is uncertain.

In south Texas, as mentioned previously, Hester has found evidence of plainware pottery directly associated with *Scallorn, Perdiz,* and triangular arrowpoint forms in what he considers single-occupation activity areas. This relationship has been reported from the Tortuga Flat site (Hill and Hester 1973) and at Chaparrosa Ranch (Hester 1974). The co-occurrence of *Scallorn, Perdiz,* and pottery has been recorded for several additional sites (Hester and Hill 1971).

Corbin (1974: 45) points out that in sites on the Central Coast, pottery has been found in good association with *Scallorn,* and sometimes to the exclusion of *Perdiz* (Story 1968; Martin n.d.). He also believes (Corbin 1974: 47) that pottery was introduced to the Texas coastal areas during the period in which *Scallorn* and early *Fresno*-like arrowpoint forms were in use. *Scallorn* then continued in use in the area well after the acceptance of *Perdiz* as the predominant form, and the pottery went through a number of local changes.

In summary, the evidence is mostly suggestive. In central Texas rockshelters where pottery is found in levels or zones containing Scallorn points, the association might be accidental, that is, not direct or intentional. Although ample evidence exists for pottery within Central Texas aspect sites in the general Waco-Belton areas, there is no unquestionable association of pottery with *Scallorn* points. Evidence for an influx of Alto focus materials in undoubtedly present, and on the basis of radiocarbon dates, we may propose that the influx began during Austin focus times. The two foci are at least in part contemporaneous. Frankston focus materials continued to come into the area during Toyah focus times. In fact, it is possible (though unlikely) that Toyah focus groups received all the contact with east Texas, and that the Austin focus, although possibly present, did not receive either contact or imported objects. The reported co-occurrence of *Scallorn, Perdiz,* and pottery in activity areas in south Texas, and the association of Scallorn with pottery on the Central Coast are perhaps the best evidence for Scallorn-pottery association. The full acceptance and understanding of these data relative to the core central Texas area, however, must await further study, suntheses, comparisons, and inter-regional summaries.

Foci and Types in Central Texas

The means of identification of the Austin and Toyah foci and *Scallorn* and *Perdiz* arrowpoints is based on the interrelationship of foci and types. It is a problem of seeming inconsistency between a theoretical approach and an interpretation of observed findings.

Traditionally, in central Texas, and indeed in most other parts of the state, expanding-stem arrowpoints are called "*Scallorn*," and contracting-stem points, "*Perdiz*". Thanks to an overwhelming acceptance of projectile point type names, "*Scallorn*" points are found and reported northward into Canada and southward well into Mexico. "*Perdiz*" share a similar fate and occupy at least most of Texas. Apparently type names are not always used in a purely descriptive manner, which adds fuel to the fire for opponents of the use of this typology. Although the types were originally defined on the basis of cultural distinctiveness—e.g., being geographically and temporally limited or restricted—their use in distant areas could be condoned if specimens were described as being "*Scallorn*-like forms" or "*Scallorn* forms" and not of the "*Scallorn* type". Such an approach is intended in this report, since focal designations are uncertain.

Within Texas, the use or misuse of type names seems a little more justifiable. It is assumed that expanding-stem points found in central Texas belong to the *Scallorn* type because they are found in central Texas; i.e., they conform generally to the type description and suggested distribution. Perdiz share a similar fate, but their range is extended at least to all the borders of the state. Likewise, *Scallorn* points in central Texas designate the Austin focus, and *Perdiz*, the Toyah focus.

One problem is, first, what are the boundaries of the Austin focus? Certainly the answer cannot be "everywhere that expanding-stem arrowpoints are found" (i.e., *Scallorn*), even if the presence of the points in similar assemblages designates a similar time period and similar level of organization and economy. Many workers have reported *Scallorn* points all over south Texas and the Gulf coast (e.g. Hester 1969; Hill and Hester 1971; Corbin 1974). Presumably these are not representatives of the Austin focus, and the *Perdiz* points reported from the same areas not Toyah focus remnants. Such is possible but seemingly unlikely. The areas and environments are just too distant from those originally defined for the Central Texas aspect. *Perdiz* points are diagnostic of several foci in Texas, including the Livermore focus (and Bravo Valley aspect) of west Texas, the Frankston focus of east Texas, and the Galveston Bay and Rockport foci of the Gulf coast. Cultural affiliation, then, is somewhat equatable with geographic area, and is at present very difficult. The problem is compounded with the problem of trade and other types of contact between areas or cultures with similar lithic assemblages. In other words, *Perdiz* points on a central Texas site with beveled knives of Alibates dolomite from the Amarillo area, Frankston focus pottery, a few coastal sherds, a couple of pieces of obsidian, and perhaps an expanding-stem arrowpoint, do not necessarily indicate a Toyah focus occupation simply because the site is in central Texas. Perhaps the best focus (or phase) designation for such a site at present would be a simple "unknown".

A directly related facet to the problem is the decision of what constitutes "central Texas" in a cultural sense. Certainly everyone would agree that the occupational debris in which *Scallorn* points are found near Dallas might very well be attributable to peoples (in the cultural sense) distinct from those leaving *Scallorn* points south of San Antonio, east of Smithville and LaGrange, or west of Kerrville or Uvalde. The entire area is considered central Texas, but approaching the total area and all the included sites as a single cultural unit should be cautioned. Such a single-unit assumption is essentially the basis for the investigations at the Wheatley site in the first place, the evidence of *Scallorn-Perdiz*-pottery contemporaneity and use within a single camp.

Thus, a problem seems to be what defines a type, and can types be used to distinguish cultural units? Brew's (1946: 44-66) conception of a type being an artificial construct of the analyst is of little use if that construct is defined in insufficient detail and distinctiveness to distinguish it from other similar forms in other cultures. Krieger (1944; Newell and Krieger 1949: 71-74; Suhm *et al.* 1954: 3-5) argues for subtypes or varieties being newly defined or "discovered" as the need arises and as new data become available to distinguish these new constructs in time and space, and therefore have cultural distinctiveness. At present, these two arrowpoint forms might be thought of as essentially on the *series* level—equivalent to a ware in pottery studies—a group of morphologically similar types which occupy a particular time span (Nunley, Duffield, and Jelks 1965; Parsons 1965; Ross 1965). In other words, there exists a *Scallorn* series, a grouping of arrowpoint types of a somewhat limited temporal range, probably about A.D. 900-1200, occupying some sort of restricted, definable geographic area, and distinguishable primarily on the basis of their stem shape (i.e., expanding). This is the general approach to a series, a "super-type" which is useful to show broad, general patterns, but not restricted enough to adequately contribute to detailed comparative studies.

Alternately, the need could be stated as the ultimate definition of formal varieties, such as the kinds attempted by Jelks (1962), which should be studied the same as types. No matter on which level of taxonomy these sub-*Scallorn* and sub-*Perdiz* forms are placed, the obvious need for such a study exists. The artifact groups thus formed will be usable in defining cultural units—the Austin and Toyah foci, and any others in which these forms occur.

Cultural units, on the other hand, whether referred to as complexes, foci, or phases, must be defined not just on the basis of a single projectile point style or a couple of pottery types, but on the basis of the total assemblage configuration (Suhm *et al.* 1954: 3, 10). This assemblage may consist of several types of weapons, utensils, skinning and sewing implements, a particular burial practice, special pipe forms, ornaments, houses, village locations, and the like. Any one of the components of the assemblage, any single type or a group of diagnostic forms, will continue through geographic space in any number of directions and for variable distances. In other words, several different tribes living over a large area may have shared in the manufacture of a particular type of artifact. The type could be borrowed by one cultural group after another, having spread by trade or any other kind of transmission. A valid identifiable complex, then, is a particular configuration of recognizable and describable traits, each of which may be distributed throughout an area containing several culturally different groups. The cultural unit thus defined is limited in time, and is distinct in some ways from the total assemblage of traits of any other tribe or cultural group.

This concept of a cultural unit being defined in terms of a core area of overlapping component distributions is excellently portrayed by Clarke's (1968: 246, 300) polythetic model of cultural dispersion. It is only when as assemblage of traits exists in its entirety, however, or "enough" of its entirety as judged by the archeologist to be representative, that the particular focus or phase can be thought of as existing in its pure form, or at least as originally conceived. In addition to Clarke (1968), Rowlett and Pollnac (1970) have also shown the applicability of culture unit definition (more or less equivalent to the "phase") based on core areas of attributes, the geographic boundaries and degrees of directional influences arrived at by computer-assisted studies. A similar study (Groube and Chappell 1973) was done using a great number of attributes of artifacts of a single class, and plotting these attributes over a very wide area to discern where attribute clustering would occur. The separated areas of maximum overlap indicated culture areas.

It stands to reason that modes governing the production of material aspects of a culture will not be so strong and so formal as to totally repel all stylistic change through space as that culture comes in direct contact with adjacent cultures. This, of course, is the basis for the geographic "variants" of cultural phases on the Great Plains

(Krause 1969). These modes, however, would determine the correctness or desirability for the cultural attributes, the tools of the culture, to assure duplicability. And this duplicability of material patterning is what becomes the bread and butter of archeological interpretation and reconstruction through comparative studies. But likewise, adequately detailed phase distinctions cannot be made if the archeologist fails to distinguish between significantly different forms or styles. Grouping distinct styles obscures these differences, and the interpretations can do no more than suffer.

At present, the Central Texas aspect has been divided into two foci, the Austin and the Toyah. Other complexes (Nueces, Tradinghouse, and maybe others) have been suggested but have not been adequately described and are not generally used (Suhm *et al.* 1954: 113). The most complete published descriptions of the Austin and Toyah foci are those of Jelks (1962), based mainly on his 1959-60 excavations at the Kyle rockshelter north of Waco. Geographical differences within the two foci remain unknown, as is the adequacy of the descriptions themselves. The areas from Austin southward, westward, and eastward remain practically unknown. The Smith (Suhm 1957) and Collins (Suhm 1955) sites are the main exceptions.

In practice, archeologists continue to identify any archeological assemblage containing *Scallorn* points in central Texas as the Austin focus (or phase), and one with *Perdiz* points as the Toyah focus (or phase). Various problems inherent in such a practice—geographic differences, cultural differences, unknown age, incompletely defined assemblages, unrecognized distinctive artifact forms or styles, and the need to consider total assemblages—have been discussed. Probably enough information exists at this point that a large-scale study of the Neo-American stage in most of Texas would be possible and very rewarding. Until then, caution must be used in assigning materials to presently existing cultural units, i.e., foci or phases. In practice, due more to necessity than preference, the Wheatley report continues to refer to *Scallorn* and *Perdiz* forms as types designating the Austin and Toyah foci. The errors involved in such use of these names is understood.

SUMMARY AND CONCLUSIONS

Previous to investigations at the Wheatley site, data were accumulating stressing the temporal dichotomy between *Scallorn* and *Perdiz* arrowpoints. At reported stratified sites in central Texas, such as Smith and Kyle, *Scallorn* points were generally below both *Perdiz* and pottery. To some workers, this suggested that ceramics were introduced sometime within the Toyah focus after *Scallorn* points had been discontinued. Since *Scallorn* and *Perdiz* arrowpoints are the primary indicators of the Austin and Toyah foci, temporal separation of the points meant that the foci did not exist at the same time, at least not in central Texas. This can be compared to work in south Texas by Hill and Hester (1973) and by Hester (1974) in which *Perdiz, Scallorn,* and triangular arrowpoint forms are found together and interpreted as culturally associated. Similar situations exist on the coast (Corbin 1974).

Data from the Wheatley site indicate an overlap period for *Scallorn, Perdiz,* and pottery in the Pedernales River area of central Texas. The Wheatley artifacts appear to be culturally associated with one another and form a single assemblage. Evidence for contemporaneity issues from (1) the nearly flat, featureless nature of the site with artifacts limited to the surface and grouped in discrete clusters not attributable to erosion, (2) the similarity of physical attributes of different types of arrowpoints, (3) the use of a distinctive blue flint on different arrowpoint forms, (4) actual relationship figures or expectancy probabilities, and (5) the rejection of chance occurrence explanations from theoretical distributional probability tests.

The overall appearance of the site is that of a medium-sized, dispersed camp with at least three habitation areas (with or without structures) surrounded by chipping stations and other activity areas. Small fires were in the living places, while larger limestone hearths were separate. Apparently there was considerable material interaction between different activity areas, and artifacts presumably were taken from one area to another (as in, presumably, the case of broken pottery). It is assumed that the group was small, probably three or four families or a fairly small group of men, and that they occupied the site for a fairly short period of time, perhaps a week or so. The site probably served as a temporary base camp from which the occupants hunted and gathered foodstuffs. Hunting activities are suggested by the many flint arrowpoints, which could have been used either for mammals (deer, rabbits, raccoons, etc.) or fish. The single bone fragment in Area A presumably represents the remains of a butchered deer. No other bones were found, but their absence is most likely due to preservation factors. In addition to the bow-and-arrow oriented hunting techniques, small nocturnal animals (ringtail, raccoon, fox, etc.) could have been taken with snares. Fish were available in the river either in pool traps or by spear in the deeper pools, as well as grappling catfish by hand under the dirt banks. It is not certain whether beaver were present along the river in the past as they are today. Mussels were collected from the river, as evidenced by the numerous shell fragments in the activity areas. Mussels are still abundant directly below the site. Water for drinking, cooking, and processing is readily available a short distance to either side of the site without descending the canyons. Firewood is abundant overall. Flint is available throughout the area, though not in the immediate vicinity of the site. The source of blue flint is undoubtedly local, but its exact source is unknown.

Most artifacts are good examples of a Toyah focus assemblage—*Perdiz* arrowpoints, pottery, flake drills, beveled knives, small scrapers (small "turtle-back" end scrapers are absent), utilized flakes, etc. Most knives, scrapers, utilized flakes and other tools appear to have been made or used for a variety of purposes, rather than conforming to a recognizable typology as they occasionally do in other sites. Expanding-stem arrowpoints are the major exception to the Toyah focus traits, and these are believed to be remnant forms from Austin focus groups. The obvious possibility exists that these points are not tools from groups culturally the same as those responsible for Austin focus materials at other excavated sites in central Texas. The age of the site, therefore, is considered to be within the overlap period of the Austin and Toyah foci, sometime after the introduction of pottery. Previously published radiocarbon dates indicate this overlap may be about A.D. 1150-1300.

ACKNOWLEDGEMENTS

The W. L. Richmond family deserves special recognition for their continuous help in field work, artifact processing, analysis, and illustration preparation. Funds and general advice were provided by Curtis Tunnell, State Archeologist (Texas Historical Commission). Laboratory space was provided by D. A. Story (Texas Archeological Research Laboratory), David S. Dibble (Texas Archeological Salvage Project, now Texas Archeological Survey), and the Department of Anthropology of the University of Missouri-Columbia. Additional technical suggestions and moral assistance were provided by H. J. Shafer (Texas A&M University), W. M. Sorrow (Texas Historical Commission), Earl Green and J. D. Ing (Texas Parks and Wildlife Department), B. J. Harrison (Panhandle Plains Historical Museum, West Texas State University), R. A. Benfer, A. N. Benfer, Pat Treat, and W. R. Wood (University of Missouri-Columbia), T. R. Hester (University of Texas at San Antonio), Miguel Tarrab, F. A. Moseley, and D. E. Lasher (Department of Mathematics, West Texas State University), Barbara Wolf, and the very tolerant park personnel of Pedernales Falls State Park.

APPENDIX A. Artifact measurement and attribute tables

Abbreviations

L	Length. Measured in a proximal-distal direction when possible, otherwise the maximum dimension. Scrapers are measured along the flake axis when possible.
W	Width. Perpendicular to length.
T	Thickness. Maximum thickness, measured to two significant digits.
SL	Stem length.
SW	Stem width.
BW	Basal width.
REL	Retouched edge length. Measured in a straight line.
SPW	Striking platform width.
MAT	Material. Mainly color.
FIG	Figure reference in the text.
-	Unknown.
*	Approximated measure.
+	Total measurement is unknown, but fragmentary measurement is given as a minimum figure.

ARROWPOINTS, CONTRACTING STEM

AREA	L	W	T	SL	SW	MAT	FIG	REMARKS
A	30*	26	2.1	9	6	GR-RED	15A	
A	32*	17	2.1	7	6	GRAY	15B	
E	29	15*	1.9	9	5	BLUE	15C	
A	26	17	2.3	2.5	4	TAN	15D	
A	27*	14	2.1	9*	6	PK-YEL	15E	STEM BROKEN
A	35*	16*	2.5	9	6	GRAY	15F	BW=3, STRAIGHT BASE
E	32*	13*	3.1	10*	6	BROWN	15G	
A	27*	23	3.6	9*	7	GRAY	15H	STEM MISSING
A	22*	12*	2.4	6	5	GRAY	15I	
C	20	10	2.0	6	5	GRAY	15J	MARGINAL RETOUCH ONLY
E1	26*	15	2.3	7	5	GRAY	15K	
E	22*	15	2.0	6	6	GRAY	15L	
J	36*	19*	3.9	14	6	GRAY	15M	
E1	37*	23*	3.4	12	8	GRAY	15N	
A	31	28	2.3	8	7	GR-RED	15O	
F	45*	22	4.1	7	9	GRAY	15P	CLIFFTON
E1	47	17	3.0	20	8	GRAY	15Q	
A	-	-	2.6	6	5	GRAY		STEM & BATTERED BLADE
A	-	-	1.7+	3	5	GRAY		STEM
A	38*	9+	2.6	9+	5	TAN		STEM & DISTAL TIP
E	-	-	1.6	9+	6	BLUE		STEM
J	38*	16	3.3	11*	6	GRAY		
J	-	-	2.9	9	5	GRAY		STEM
K	29*	14	2.7	9*	5	GRAY		STEM MISSING

ARROWPOINTS, EXPANDING STEM

AREA	L	W	T	SL	SW	BW	MAT	FIG	REMARKS
E	20	15	2.7	5	5	16	BLUE	16A	
E	16	10+	3.0	5	6	10	BLUE	16B	
A	15	10	1.7	4	7	8	GRAY	16C	
E	18*	9	1.7	5	5	8	GRAY	16D	
E	-	-	2.8+	8	8	16	BLOWN	16E	STEM
E	-	-	2.8	6	6	13	BLUE	16F	STEM
G	-	-	3.4	7	4	9	BLUE	16G	STEM
E	25	16	3.7	5	8	12	GRAY	16H	
A	28*	16	2.0	5	6	9	BLUE	16I	
A	27*	13	2.2	8	6	9	BLUE	16J	
E	26*	16*	2.9	4*	6	-	BLUE	16K	
E	34	18	5.5	6	11	12	GRAY	16L	
A	37	15	2.3	6	5	9	GRAY	16M	

ARROWPOINTS, PARALLEL STEM

AREA	L	W	T	SL	SW	BW	MAT	FIG
A	41	14*	2.4	6	4	5	BLUE	16N
A	23	15	3.4	3	8	8	BLUE	16O
A	27*	16	2.4	6	6	6	GRAY	16P
A	32*	16	2.2	7	9	9	BLUE	16Q
A	27*	13*	2.1	6	7	7	GRAY	16R

ARROWPOINTS, UNNOTCHED, PROBABLY FINISHED

ARLA	L	W	T	MAT	FIG
A	27*	12	1.8	BRN-PNK	16S

ARROWPOINTS, UNNOTCHED, PROBABLY UNFINISHED

AREA	L	W	T	MAT	FIG
A	32	17	2.0	PINK	17A
J	23	14	2.1	BLUE	17B
A	30*	15	2.3	GRAY	17C
A	24	14	2.7	BLUE	17D
C	32+	20*	2.7	TAN	17E
A	28*	19	2.8	GRAY	17F
A	26	21*	2.6	BLUE	
A	39*	25*	4.9	GRAY	
A	18+	13+	3.0	TAN	

ARROWPOINTS, LARGE UNNOTCHED

AREA	L	W	T	MAT	FIG
B	44	20	3.1	GRAY	17G
A	30	25	5.5	BROWN	17H
B	24+	19+	3.6	TAN	17I
H	27*	18	3.7	BLUE	17J

MANO

AREA	DIAMETER	THICKNESS AT EDGE	THICKNESS AT CENTER
-	93X118	38X61	62

ARROWPOINTS, BARBED MEDIAL FRAGMENTS

AREA	L	W	T	SW	MAT	FIG	REMARKS
A	31	18*	2.5	7	GRAY-PINK	17K	PERDIZ?
A	30	17*	2.6	5	GRAY-PINK		PERDIZ?
A	17*	14*	2.0	6	ORANGE		PERDIZ?
A	20*	15*	2.3	5	GRAY		
A	-	13	2.2	-	GRAY		
A	-	14*	2.4	-	GRAY		
A	-	-	2.0+	-	PINK		BARB
A	21	14*	2.0	6	GRAY		PERDIZ?
E	20*	14	2,2	-	GRAY		
E	25*	18*	2.8	6*	TRANSLUSCENT		
E	24*	18*	2.5	-	GRAY		

ARROWPOINTS, MEDIAL BLADE FRAGMENTS
(L, W, AND T OF FRAGMENT ONLY)

AREA	L	W	T	MAT	FIG
E	26+	12	3.6	GRAY	17L
A	11+	6	1.8	BROWN	
E	13+	-	1.9	GRAY	
E	-	-	2.7	GRAY	
H	21+	18*	2.5	GRAY	

ARROWPOINTS, MEDIAL FRAGMENTS, POSSIBLY UNFINISHED

AREA	L	W	T	MAT
A	25+	12+	2.2	GRAY
A	10+	12+	1.6	GRAY
A	-	-	1.9	GRAY
B	11+	11+	2.9	GRAY

ARROWPOINTS, DISTAL BLADE FRAGMENTS

AREA	L	W	T	MAT	FIG
H	24+	10+	2.8	WHITE	17M
A	24+	13+	1.9	GRAY	17N
F	29+	16+	3.3	GRAY	17O
F	21+	18+	3.6	GRAY	17P
A	17+	11+	1.8	BLUE	
A	22+	11+	1.8	TAN-PINK	
A	24+	14+	2.6	GRAY	
A	30+	14	2.1	BLUE	
A	23+	16+	2.6	BLUE	
A	19+	13+	2.0	BROWN	
A	12+	6+	1.3	BLUE	
A	18+	12+	2.0	GRAY	
J	18+	14+	2.5	GRAY	

DART POINTS

AREA	L	W	T	SL	SW	BW	MAT	FIG	TYPE-FORM
-	56*	30	5.2	8	19	29*	GRAY	18A	ENSOR-FRIO
-	37	22	5.6	9	15	17	BROWN-GRAY	18B	FAIRLAND
-	64*	32	6.6	12	18	27	GRAY-PINK	18C	MARCOS
-	38*	20	6.6	13	15	17*	GRAY	18D	GOWER
J	28	16	5.9	10	15	15	BLUE	18E	
B	68	28	7.2	14	12	16*	GRAY	18F	PEDERNALES

BIFACE RETOUCH FLAKES FROM UTILIZED BIFACES

AREA	L	W	T	SPW	MAT
A	23+	30+	6.2	22	GRAY
A	23+	28	5.3	12	GRAY
A	12	16	4.6	13	GRAY
A	29	18+	5.3	12+	GRAY
F	28+	25	3.1	11	GRAY

BIFACE RETOUCH FLAKES FROM NONUTILIZED OR UNKNOWN BIFACES

AREA	L	W	T	SPW	MAT
A	19+	21	4.7	17	GRAY
A	12	29	9.7	29	BROWN
A	15	21	3.6	21	GRAY
A	14+	11	2.9	10	GRAY
A	13	16	6.1	16	GRAY
A	12	12	2.2	6	BROWN
A	9	14	2.2	11	GRAY
A	19	18	3.5	15	GRAY
A	24	23	4.8	12	GRAY
E	9+	30	9+	30	GRAY
E	6	26	7.5	26	GRAY
E	23+	34	11	34	BROWN

THIN BIFACE FRAGMENTS

AREA	L	W	T	MAT
A	-	-	5.2	ORANGE
A	-	-	4.6	ORANGE
A	-	-	3.8	GRAY
A	-	-	3.4+	TAN
A	-	-	1.7+	BLUE
A	-	-	4.8+	BROWN
A	-	-	2.8	BLACK
A	-	-	5.0	GRAY
A	-	-	3.9	GRAY
A	-	21+	6.2	BLUE
A	-	-	6.4	GRAY
A	-	25	7.2	GRAY
A	-	-	6.5	WHITE
A	-	20+	4.8	GRAY
A	-	-	4.1	GRAY
A	-	25+	6.1	GRAY
A	-	23+	5.7	GRAY
A	-	31+	8.0	GRAY
A	32+	25	6.0	PINK-GRAY
A	-	28+	4.4	ORANGE
E	-	-	9.5	WHITE
E	-	24*	7.6	GRAY
E	-	-	2.6	GRAY
E	-	-	8.7	GRAY
E	-	-	5.2	GRAY
E	-	24+	8.7	WHITE
E	28+	26	9.0	GRAY
E	-	26+	9.0	GRAY
E	-	38+	6.4	GRAY
E1	-	-	4.2	GRAY
E1	-	-	9.3	GRAY
E1	-	22+	7.1	GRAY
E1	-	21	5.9	BLUE
F	-	20+	5.7	GRAY
F	-	32+	7.9	GRAY
I	-	-	4.0	GRAY
I	31+	13+	5.7	GRAY
I	-	30+	9.8	GRAY
-	51+	26	10	GRAY
-	53+	50	6.0	GRAY

END SCRAPERS

AREA	L	W	T	MAT	FIG	REMARKS
I	42	30	5.6	GRAY	19A	REVERSED FLAKED
B	33	20	10	GRAY	19B	
E1	26	25	9.3	BROWN	19C	
-	57	40*	10	GRAY	19D	
A	65	38	15	BROWN	19E	
-	70	45	11	GRAY	19F	
-	54	55	9.7	BROWN	19G	
C	51	45	7.5	GRAY	19H	
A	57	45*	8.3	BROWN		
B	63	51	13	GRAY		
B	51	50	7.0	TAN		
C	-	34+	7.8+	WHITE		
E	-	40*	6.8+	TAN		
E1	89	74	17	GRAY		
H	63	54	17	GRAY		
-	70*	55*	15	GRAY		
-	105	60	20	GRAY		

SIDE SCRAPERS

AREA	L	W	T	MAT	FIG
A	165	65*	23	GRAY	20A
C	130*	65	27	GRAY	20B
E1	93	55	7.1	GRAY	20C
-	35+	30	7.5	TAN	20F
E	90*	60*	15	GRAY	20D
A	80	42	24	GRAY	20E
A	50	38	18	GRAY	

CIRCULAR SCRAPERS (?)

AREA	L	W	T	MAT	FIG
-	39	33	9.6	GRAY	19I
A	36	33	7.6	BLUE	19J

BEVELED KNIVES

AREA	L	W	T	MAT	FIG
A	90*	26	5.1	GRAY	18G
-	120*	26	7.0	GRAY	18H
-	-	23+	7.6	GRAY	18I
H	125*	30	6.6	BROWN	18J
E	-	28+	7.2	GRAY	
H	-	25+	6.7	PINK	

THIN BIFACES (IDENTIFIABLE)

AREA	L	W	T	MAT	FIG
A	71	26	7.1	GRAY-PINK	18K
F	61	31	6.5	GRAY	18L
B	110*	54	11	GRAY	18M
A	-	24	4.2	GRAY	18N
E	44	27	7.2	GRAY-TAN	18O
E	65*	43	8.0	GRAY	18P
E1	39	33	9.4	BLUE	18Q
A	50	21	3.7	GRAY-PINK	
E	-	29*	6.8	GRAY-PINK	
H	15+	27*	5.3	GRAY	

DIAGONAL SCRAPER

AREA	L	W	T	REL	MAT	FIG
B	42	45	11	25	GRAY	19K

SCRAPER EDGE FRAGMENTS

AREA	MAT
A	BROWN
A	BROWN
A	GRAY
A	GRAY
E	GRAY

FLAKE DRILLS

	-----SHAFT-----			-----BASE------				
AREA	L	W	T	L	W	T	MAT	FIG
E	11+	7	2.8	21	17	6.3	BLUE	21A
E	22	5	2.7	12	14	4.2	BLUE	21B
F	11+	6	3.0	17	25	6.8	GRAY	21C
A	28	7	3.6	-	-	-	GRAY	
A	15+	5	3.0	-	-	-	GRAY	
E	13+	7	3.2	-	-	-	GRAY	

BURINS

AREA	L	W	T	BURIN FACET WIDTH	TECHNIQUE	MAT	FIG
E	57	20	12	3.8	BURIN	BLUE	22A
				5.7	BURIN		
E	45	48	15	7.8	UNCERTAIN	GRAY	22B
A	26	14	5.9	1.5	UNCERTAIN	BLUE	
A	20	14	3.5	1.8	UNCERTAIN	GRAY	

UTILIZED FLAKES, MINIMAL USE

AREA	L	W	T	MAT	
A	18+	11	3.1	BLUE	
A	10+	10+	1.9	GRAY	
A	19+	13+	3.8	GRAY	
A	29	23+	5.1	GRAY	
A	16+	14	2.8	PINK	
A	22+	26	4.3	TAN	
A	28	18	2.8	PINK	
A	17+	32	5.2	GRAY	
A	35+	22	5.2	GRAY	
A	32	20	4.7	BLUE	
A	30	21	7.8	BLUE	
A	28+	20	6.1	GRAY	
A	19+	21	4.7	GRAY	
A	22	20	4.0	GRAY	
A	43	40	8.1	GRAY	
A	30+	23	5.3	GRAY	
A	24+	32+	11	BROWN	
A	45	24	8.1	TAN	
A	32	21	3.0	TAN	
A	30+	28	3.8	GRAY	
A	60+	71	11	GRAY	
A	44+	39+	3.9	GRAY	
B	25+	15	4.7	TAN	
B	25+	27	4.3	TAN-PINK	
B	28+	23	7.5	GRAY	
B	18+	23	2.7	GRAY	
B	55	37	7.9	GRAY	
B	65+	46	11	GRAY	
C	19+	14	2.9	BLUE	
E	11	10	4.0	GRAY	
E	35+	27+	6.8	GRAY-PINK	
E1	70+	49	8.3	GRAY	
F	31	19	2.8	GRAY	
F	10+	15	2.5	GRAY	
F	31+	28	12	GRAY	
F	43	25	8.1	GRAY	
F	65	23	11	GRAY	
H	32	32	4.0	GRAY	(SERIES FL., AGATIZED PETRIFIED WOOD)
H	20+	17+	3.4	GRAY	
H	56	31	11	GRAY	
K	40+	34	6.7	GRAY	
-	45	30	8.2	GRAY	
-	46+	43	12	GRAY	

UTILIZED FLAKES, EXTENSIVE USE

AREA	L	W	T	MAT
A	31+	20	3.9	PINK
A	20+	32	2.9	GRAY
A	26+	25+	2.7	GRAY
A	33	38	8.2	BROWN
A	13+	14	5.0	BROWN
A	60	46	15	GRAY
A	55	41	12	GRAY
B	50+	32	8.0	GRAY
F	37+	25+	5.0	GRAY
H	50	47	8.7	GRAY
I	32	19	3.5	GRAY
I	46	66	9.3	GRAY
I	60	37	14	GRAY
-	113	67	27	GRAY

MINIMALLY EDGE-RETOUCHED FLAKES

AREA	L	W	T	MAT	EDGE RETOUCH
A	-	-	5.5	GRAY	-
A	21+	20+	2.6	GRAY	SIDE
A	-	-	0.9+	BLUE	-
A	23+	16+	2.2	TAN	SIDE
A	-	-	2.8	GRAY	SIDE
A	-	-	2.6	GRAY	-
A	-	-	2.8	BROWN	-
A	-	-	2.3+	GRAY	-
A	-	-	3.8	BROWN	-
A	21+	15+	7.3	PINK	-
A	-	-	2.2	GRAY	-
A	-	-	2.8	GRAY	-
A	5+	7+	5.4	GRAY	-, CONCAVE (10 MM WIDE, 3 MM DEEP)
A	-	-	1.3	TAN	-
A	-	-	2.5	ORANGE TRANSLUSCENT AGATE	SIDE
A	-	-	1.8	GRAY	-
A	-	24+	7.8	GRAY	2 SIDE
A	15+	9+	2.1	GRAY	SIDE (BIFACIAL)
A	-	-	1.2	BLUE	SIDE
A	-	-	6.8	TAN	-
A	45+	31	6.2	GRAY	2 SIDE
B	19+	15+	3.6	BLUE	SIDE
C	38	25	8.0	TAN	2 SIDE (CONCAVITY 11 MM WIDE, 2 MM DEEP)
E	20+	14	4.6	GRAY	SIDE
E	27+	13+	2.3	BROWN	SIDE (REVERSE)
E	28+	28+	9.7	GRAY	2 SIDE
E	100	42	18	GRAY	SIDE
E1	13+	16	2.2	PINK-GRAY	SIDE
H	24+	11+	3.3	GRAY	SIDE (BIFACIAL)
H	-	-	3.1	BROWN	SIDE
I	30+	35	7.1	GRAY	SIDE-END

EVENLY EDGE-RETOUCHED FLAKES

AREA	L	W	T	MATERIAL	EDGE RETOUCH, REMARKS	FIG
A	-	-	5.3	GRAY	SIDE	
A	-	-	2.3	GRAY	SIDE	
A	22+	19	4.8	GRAY	SIDE	
A	15+	22+	3.6	GRAY	2 SIDE	
A	38+	25	7.0	GRAY	SIDE, REVERSE	22F
A	24+	17+	4.2	TAN	SIDE, REVERSE	
A	-	27+	3.6	GRAY	SIDE, SEQUENT FLAKE	
A	23+	21	3.1	GRAY	SIDE, REVERSE	
A	46	34	8.4	GRAY	SIDE	
A	75	40	11	GRAY	SIDE	22H
A	55+	37	8.8	GRAY	2 SIDE	
B	35+	35+	12	GRAY	SIDE?	
D	69	40	15	GRAY	SIDE	
D	62	35	9.6	GRAY	SIDE	
E	-	-	3.0	BLUE	-	
E	-	-	1.6	TAN	SIDE	
E	37	22	7.1	TAN	SIDE	
E	26	20	4.0	GRAY	2 SIDE	
E1	-	-	7.0	GRAY	SIDE	
E1	40+	33	11	GRAY	2 SIDE, ALTERNATE	
F	22+	15	6.0	GRAY	SIDE	
F	29+	23	3.5	GRAY	2 SIDE	
F	58	36	9.2	GRAY	SIDE	22G
H	30+	46+	6.4	GRAY	SIDE-END	
H	36+	28	5.7	GRAY	2 SIDE, END	
H	32+	30	3.9	GRAY	2 SIDE, ALTERNATE	22C
H	27+	24	5.4	GRAY	2 SIDE, ALTERNATE	
J	15+	23+	4.3	GRAY-PINK	SIDE, REVERSE	
K	33+	34	6.4	GRAY	SIDE, REVERSE; BULB REMOVED	
K	38+	35	5.1	GRAY	SIDE, END; REVERSE FLAKING	22D
K	38+	35	5.1	GRAY	SIDE, END	
-	42+	30+	6.0	TRANSLUSCENT WHITE TO ORANGE AGATE	SIDE; BULB REMOVED	22E

CHOPPERS

AREA	L	W	T	MAT	FIG
E	113	92	35	GRAY	23A
-	120	90	41	GRAY	23B
E1	134	115	37	GRAY	23C
-	70	71	30	GRAY	23D
A	56	64	38	BROWN	23E
-	97	110	33	GRAY	

UNFINISHED TOOLS, INITIAL STAGE (ON CORES)

AREA	L	W	T	MAT
A	43	20	17	GRAY
A	65	28	20	GRAY
E	27	18	12	BLUE
E	55	39	21	GRAY
E	40	24	10	GRAY
E1	33+	40+	16	TAN
-	65	52	26	GRAY
-	58	50	27	GRAY

UNFINISHED TOOLS, INITIAL STAGE (ON FLAKES)

AREA	L	W	T	MAT
A	50	39	18	TAN
A	44	22	10	BLUE
E	51	50	17	GRAY
E1	80	61	18	GRAY
-	54	50	12	GRAY

UNFINISHED TOOLS, SECONDARY STAGE (PREFORMS)

AREA	L	W	T	MAT	FIG
-	71	55	13	TAN	24A
-	65	53	14	GRAY	24B
C	37	25	9.9	TAN	24C
-	53	20	10	GRAY	24D
E	80	65	26	GRAY	24E
-	66	48	27	GRAY	24F
-	48	27	7.0	GRAY	24G
A	39	27	8.8	GRAY	

CORES

AREA	L	W	T	MAT	FIG
A	39	28	15	BLUE	25A
E	32	34	18	BLUE	25B
A	42	29	14	BLUE	25C
A	50	34	20	BLUE	
A	40	37	22	BLUE	
A	32	22	20	BLUE	
A	32	25	21	BLUE	
A	43	28	29	BLUE	
E	44	26	24	BLUE	
E	43	20	22	BLUE	
E	66	30	25	BLUE	
E	50	26+	25	BLUE	
E	28	19	18	BLUE	
A	55	38	34	GRAY	
A	48	43	31	GRAY	
A	40	37	23	GRAY	
A	38+	65	40	GRAY	
A	70	70	35	GRAY	
A	38	44	28	GRAY	
A	30	30	21	GRAY	
B	39	37	21	GRAY	
C	105	73+	35	GRAY	
E	46	27	25	GRAY	
E	44	39+	18	GRAY	
E1	53	42	23	GRAY	
E1	33	50	22	GRAY	
H	77	43	36	GRAY	25D
H	70	34	31	GRAY	
H	48	42	20	GRAY	
I	80	72	33	GRAY	25E
-	64	50	38	GRAY	
-	53	55	44	GRAY	25F

SINGLE- OR DOUBLE-FLAKE CORES

AREA	L	W	T	MAT
A	55	47	26	GRAY
E	56	37	33	TAN
E	75	32	30	GRAY
E	80	40	25	GRAY

HAMMERSTONES

AREA	L	W	T	MAT
A	53+	33	25	QUARTZ
E	50+	45+	25+	QUARTZ
E	36	48	32	QUARTZ
E	57	44	36	CHERT

SANDSTONE SLABS

AREA	L	W	T
B	86+	55+	20
G	105	57+	20

UNALTERED CHERT COBBLE

AREA	L	W	T	MAT
A	113	90	59	GRAY

References Cited

Brew, J. O.
1946 Archaeology of Alkali Ridge, Southeastern Utah. *Papers of the Peabody Museum of American Archaeology and Ethnology*, No. 21. Harvard University.

Campbell, T. N.
1960 Archeology of the Central and Southern Sections of the Texas Coast. *Bulletin of the Texas Archeological Society*, Vol. 29, pp. 145-175.

Clarke, D. L.
1968 *Analytical Archaeology*. Methuen and Co. Ltd. London.

Corbin, J. E.
1974 A Model for Cultural Succession for the Coastal Bend Area of Texas. *Bulletin of the Texas Archeological Society*, Vol. 45, pp. 29-54.

Dillehay, T. D.
1974 Late Quaternary Bison Population Changes on the Southern Plains. *Plains Anthropologist*, Vol. 19, No. 65, pp. 180-196.

Eddy, F. W.
1974 Resource Management and Locational Strategies of Certain Prehistoric Sites in Central Texas. *Plains Anthropologist*, Vol. 19, No. 64, pp. 99-106.
ms Salvage Archeology in the Laneport Reservoir District, Central Texas. Unpublished manuscript on file at the Texas Memorial Museum, The University of Texas at Austin.

Greer, J. W.
1965 A Typology of Burin Facets on Projectile Points. *El Palacio*, Vol. 72, No. 2, pp. 34-37.

Groube, L. M. and J. Chappell
1973 Measuring the Difference between Archaeological Assemblages. In: *The Explanation of Culture Change*, by C. Renfrew (ed.), pp. 167-184. University of Pittsburgh Press.

Hester, T. R.
1969 Archeological Investigations in Kleberg and Kenedy Counties, Texas in August, 1967. *State Building Commission Archeological Program, Report*, No. 15.
1971 Archeological Investigations at the La Jita Site, Uvalde County, Texas. *Bulletin of the Texas Archeological Society*, Vol. 42: pp. 51-148.
1974 Some Observations on Archaeology at Chaparrosa Ranch, 1974. *La Tierra*, Vol. 1, No. 3, pp. 19-22.

Hill, T. C., Jr., and T. R. Hester
1971 Isolated Archaic and Late Prehistoric Components at the Honeymoon Site (41ZV34), Southern Texas. *Plains Anthropologist*, Vol. 16, No. 51, pp. 52-59.
1973 A Preliminary Report on the Tortuga Flat Site: A Protohistoric Campsite in Southern Texas. *Texas Archeology*, Vol. 17, No. 2, pp. 10-14.

Ing, J. D. and G. Kegley
1971 An Archeological Survey of Pedernales Falls State Park, Blanco County, Texas. Texas Parks and Wildlife Department, Interpretative Planning Section. Austin.

Jelks, E. B.
1953 Excavations at the Blum Rockshelter. *Bulletin of the Texas Archeological and Paleontological Society*, Vol. 24, pp. 189-207.
1962 The Kyle Site, A Stratified Central Texas Aspect Site in Hill County, Texas. Department of Anthropology, The University of Texas at Austin, *Archaeology Series*, No. 5.

Kelley, J. C.
1947 The Lehmann Rock Shelter: A Stratified Site of the Toyah, Uvalde, and Round Rock Foci. *Bulletin of the Texas Archeological and Paleontological Society*, Vol. 18, pp. 115-128.
1955 Juan Sabeata and Diffusion in Aboriginal Texas. *American Anthropologist*, Vol. 57, No. 5, pp. 981-995.

Krause, R. A.
1969 Correlation of Phases in Central Plains Prehistory. In: Two House Sites in the Central Plains: An Experiment in Archaeology, by W. R. Wood (ed.). *Plains Anthropologist, Memoir*, No. 6, pp. 89-96.

Krieger, A. D.
1944 The Typological Concept. *American Antiquity*, Vol. 9, No. 3, pp. 271-188.
1946 Culture Complexes and Chronology in Northern Texas. *The University of Texas Publication 4640.*

Lehmer, D.J.
1971 Introduction to Middle Missouri Archeology. *Anthropological Papers*, No. 1. National Park Service, U.S. Department of the Interior.

Lundelius, E. L., Jr.
1967 Late-Pleistocene and Holocene Faunal History of Central Texas. In: *Pleistocene Extinctions: The Search for a Cause*, by P. S. Martin and H. E. Wright, Jr. (eds.). Proceedings of the VII Congress of the International Association for Quaternary Research, No. 6, pp. 287-319. Yale University Press.

Martin, G. C.
n.d. Preliminary Archeological Survey of a Portion of the Texas Coast Made by George C. Martin and Wendell H. Potter in 1927-1928-1929. Privately printed.

Miller, E. O. and E. B. Jelks
1952 Archeological Excavations at the Belton Reservoir, Coryell County, Texas. *Bulletin of the Texas Archeological and Paleontological Society*, Vol. 23, pp. 168-217.

Newcomb, W. W., Jr.
1960 Indian Tribes of Texas. *Bulletin of the Texas Archeological Society*, Vol. 29, pp. 1-34.

Newell, H. P. and A. D. Krieger
1949 The George C. Davis Site, Cherokee County, Texas. *Memoirs of the Society for American Archaeology*, No. 5.

Nunley, J. P., L. F. Duffield, and E. B. Jelks
1965 Excavations at Amistad Reservoir, 1962 Season. *Miscellaneous Papers of the Texas Archeological Salvage Project*, No. 3.

Parsons, M. L.
1965 1963 Test Excavations at Fate Bell Shelter, Amistad Reservoir, Val Verde County, Texas. *Miscellaneous Papers of the Texas Archeological Salvage Project*, No. 4.

Parzen, E.
1960 *Modern Probability Theory and Its Applications*. John Wiley and Sons, Inc. New York. (9th printing, 1967).
Pearson, F. J., Jr., E. M. Davis, and M. A. Tamers
1966 University of Texas Radiocarbon Dates IV. *Radiocarbon*, Vol. 8, pp. 453-466.
Pearson, F. J., E. M. Davis, M. A. Tamers, and R. W. Johnstone
1965 University of Texas Radiocarbon Dates III. *Radiocarbon*, Vol. 7, pp. 296-314.
Pollard, J. C., J. W. Greer, and H. F. Sturgis
1963 Archeological Excavations at the Boy Scout Rockshelter (41TV69), Travis County, Texas. *Bulletin of the Texas Archeological Society*, Vol. 34, pp. 31-56.
Roberson, W. R.
1971 Surface Collected Sherds from East Central Texas (A Description and Study of Sherds from the Counties of Navarro, Limestone, Leon, Freestone, Madison, and Robertson). Typescript on file at the Texas Archeological Research Laboratory, Austin.
Ross, R. E.
1965 The Archeology of Eagle Cave. *Papers of the Texas Archeological Salvage Project*, No. 7.
Rowlett, R. M. and R. B. Pollnac
1970 Multivariate Analysis of La Tene Cultural Groups. In: *Mathematics in the Archaeological and Historical Sciences*, by F. R. Hodson, D. G. Kendall, and A. P. Tautu (eds.), pp. 46-58. Edinburgh University Press.
Shafer, H. J.
1963 Test Excavations at the Youngsport Site: A Stratified Terrace Site in Bell County, Texas. *Bulletin of the Texas Archeological Society*, Vol. 34, pp. 57-81.
1971 Late Prehistory of Central Texas: 500 B.C.-1700 A.D. Paper presented at the 74th Annual Meeting of the Texas Academy of Science. Nacogdoches. Typescript courtesy of the author.
Shafer, H. J., D. A. Suhm, and J. D. Scurlock
1964 An Investigation and Appraisal of Archeological Resources of Belton Reservoir, Bell and Coryell Counties, Texas: 1962. *Miscellaneous Papers of the Texas Archeological Salvage Project*, No. 1.
Sollberger, J. B.
1971 A Technological Study of Beveled Knives. *Plains Anthropologist*, Vol. 16, No. 53, pp. 209-218.
Sorrow, W. M.
1970 Archeological Investigations at the Barker Site. *Research Reports of the Texas Archeological Salvage Project*, No. 1.
Sorrow, W. M., H. J. Shafer, and R. E. Ross
1967 Excavations at Stillhouse Hollow Reservoir. *Papers of the Texas Archeological Salvage Project*, No. 11.
Stephenson, R. L.
1970 Archeological Investigations in the Whitney Reservoir Area, Central Texas. *Bulletin of the Texas Archeological Society*, Vol. 41, pp. 37-286.

Stipp, J. J., E. M. Davis, J. E. Noakes, and T. E. Hoover
1962 University of Texas Radiocarbon Dates I. *Radiocarbon*, Vol. 4, pp. 43-50.

Story, D. A.
1968 Archeological Investigations at Two Central Texas Gulf Coast Sites. *State Building Commission Archeological Program, Report*, No. 13.

Story, D. A. and H. J. Shafer
1965 1964 Excavations at Waco Reservoir, McLennan County, Texas: The Baylor and Britton Sites. *Miscellaneous Papers of the Texas Archeological Salvage Project*, No. 6.

Suhm, D. A.
1955 Excavations at the Collins Site, Travis County, Texas. *Bulletin of the Texas Archeological Society*, Vol. 26, pp. 7-54.
1957 Excavations at the Smith Rockshelter, Travis County, Texas. *Texas Journal of Science*, Vol. 9, No. 1, pp. 26-58.
1959 The Williams Site and Central Texas Archeology. *Texas Journal of Science*, Vol. 11, No. 2, pp. 218-250.
1960 A Review of Central Texas Archeology. *Bulletin of the Texas Archeological Society*, Vol. 29, pp. 63-108.

Suhm, D. A., A. D. Krieger, and E. B. Jelks
1954 An Introductory Handbook of Texas Archeology. *Bulletin of the Texas Archeological Society*, Vol. 25.

Suhm, D. A. and E. B. Jelks (eds.)
1962 Handbook of Texas Archeology: Type Descriptions. *Texas Archeological Society Special Publications*, No. 1, *Bulletin of the Texas Memorial Museum*, No. 4.

Tamers, M. A., F. J. Pearson, Jr., and E. M. Davis
1964 University of Texas Radiocarbon Dates II. *Radiocarbon*, Vol. 6, pp. 138-159.

Tunnell, C. D.
1962 Oblate: A Rockshelter Site. In: Salvage Archeology of Canyon Reservoir: The Wunderlich, Footbridge, and Oblate Sites, by L. Johnson, Jr., D. A. Suhm, and C. D. Tunnell. *Bulletin of the Texas Memorial Museum*, No. 5.

Valastro, S., Jr., and E. M. Davis
1970a University of Texas at Austin Radiocarbon Dates VII. *Radiocarbon*, Vol. 12, No. 1, pp. 249-280.
1970b University of Texas at Austin Radiocarbon Dates VIII. *Radiocarbon*, Vol. 12, No. 2, pp. 617-639.

Valastro, S., Jr., F. J. Pearson, Jr., and E. M. Davis
1967 University of Texas Radiocarbon Dates V. *Radiocarbon*, Vol. 9, pp. 439-453.

Watt, F. H.
1953 Pottery Diffusions of the Central Brazos Valley. *Central Texas Archeologist*, Vol. 6, pp. 57-85.

TECHNOLOGICAL CHANGES IN HARRIS COUNTY, TEXAS*

L. W. PATTERSON

ABSTRACT

Technological changes through time for prehistoric sites in Harris County, Texas are reviewed, for a time interval from the Middle Archaic to the late prehistoric. Significant changes occur in flake tool sizes, ceramic usage, and the frequency and size of sites. A number of artifact types are also considered where little change occurs with time. Information presented is based on 26 sites, and demonstrates the value of intensive surface survey work.

INTRODUCTION

This paper will review changes in technology among various Indian populations occupying inland Harris County, Texas, from the Middle Archaic period until late prehistoric time. There seems to be little change in the general cultural pattern over this time interval, with a hunting and gathering lifeway practiced, and no evidence of agriculture. According to the account of Cabeza de Vaca (Covey 1972), a nomadic hunting and gathering pattern was still being practiced in this area in early historic period. Since a nomadic way of life is involved, the technology to be discussed probably reflects seasonal use of campsites.

A survey by Wheat (1953) represents the most significant published work done in this inland area of Harris County. McClure (1975) is continuing to publish a series of site surveys along inland White Oak Bayou in Harris County. The writer is also continuing to publish a series of site surveys for Harris County (Patterson 1975d). Shafer (1968) has published information on inland sites in nearby Montgomery County and Aten (1967) has reported in Jamison site in Liberty County. Most studies in the general area have concentrated on littoral sites (cf. Aten 1971; O'Brien 1971). Littoral sites are rich in shell, bone and ceramics, but relatively poor in lithic materials, except for a site reported by Duke (1970, 1971). In contrast, inland sites have large quantities of lithic materials, smaller amounts of pottery, poor bone preservation, and little shell. Some inland sites in Harris County do have enough bone preservation, however, to give a picture of which animals were utilized (Wheat 1953: Table 8; Smith 1975). No information is yet available on plant remains. Although shell fish occur in fresh-water streams, there is little evidence to indicate that they were an important food source. Seasonal

*Based on revision of paper given at annual meeting, Texas Archeological Society, Dallas, November 1974.

subsistence patterns and the relationship of inland to littoral sites remain poorly known. Dillehay's (1975) study on coastal subsistence is practically the only problem-oriented work done to date. Shafer (1974:2-3) has pointed out that most work in southeastern Texas has been subject to the vagaries of salvage archeology, without a designed research plan. This paper is a summary of a number of sites of various dates, and demonstrates the value of intensive surface survey work, especially when resources are not available for a large excavation program.

CHRONOLOGY

In considering changes in material technology through time, it is necessary to establish a basic chronology related to artifact types. A synthesis of chronology for this specific area indicates three basic periods, which will be called Archaic, Woodland (cf. Shafer 1975), and late prehistoric. The Archaic is the earliest period considered here and is preceramic, the Woodland period has ceramics and dart points, but few bifacial arrow points, and the late prehistoric period has predominantly bifacial arrow points and few dart points. It should be made clear that names for these periods on the upper Texas coast do not have the same cultural meaning as in other areas, since the basic living pattern remained essentially in the Archaic tradition until historic time.

The stratigraphy at the Doering site (Wheat 1953) has been used to establish the relative chronology of artifact types, but Wheat established no absolute dates. Aten (1971: Fig. 10) gives a date of 200 A.D. for the earliest ceramics in this area, and A.D. 600 for the start of bifacial arrow points, which can be used to define the terminal Archaic and Woodland dates. A starting date of about 3000 B.C. for the earliest materials discussed here in the Archaic period is taken from the estimates of Suhm and Jelks (1962: 1969,171) for the start of *Bulverde* and *Carrollton* dart points. There is a Carrollton focus radiocarbon date (Smith 1969: 5) related to these point types with special note taken of ground bases on *Carrollton* and *Trinity* points during this period.

It may be seen in Table 1 that a number of projectile point types are found over long time periods. Several of Wheat's provisional types have been reclassified, using current terminology. *Bulverde, Trinity, Carrollton,* and *Williams* are among the earliest types of Archaic dart points shown. Except for *Perdiz* points, Wheat shows a well defined starting time for bifacial arrow points, including *Catahoula, Fresno,* and *Scallorn.* The *Perdiz* point will be discussed further with the chronology of the bow and arrow. *Gary* contracting stem dart points are found throughout the entire time interval under discussion, of perhaps 4,500 years, and are most numerous in the Woodland period.

A number of dart points that Wheat illustrates as *Gary* (1953: Pl. 36) should probably be classified as *Kent* type.

There are a number of dart point types that start in the middle to late Archaic period, and continue into the Woodland period. These include *Ensor, Ellis, Elam, Pedernales, Palmillas, Yarbrough, Trinity,* and *Wells*. Since a number of dart point types seem to have long time spans, they are not very useful as specific time markers, except to note that they are earlier than the late prehistoric period. *Carrollton*- and *Williams* dart points may be specific to the Archaic period, as is perhaps the practice of basal grinding. Various combinations of arrow points, dart points and ceramics can be used to identify the three broad time periods under discussion. Fig. 1 shows basally ground *Williams, Trinity,* and *Carrollton* dart points from site 41 HR 206 in inland Harris County. Ground base dart points are characteristic of the middle Archaic period, and are the earliest artifacts found in this survey. *Gary* dart points tend to become smaller in later time, as noted by Ford and Webb (1956) for Poverty Point. This is true for Harris County sites, with *Gary* points generally of 50 to 70 mm length in the Archaic period, and 30 to 45 mm length in the Woodland period. Table 4 summarizes projectile points found in this survey in relationship to time periods.

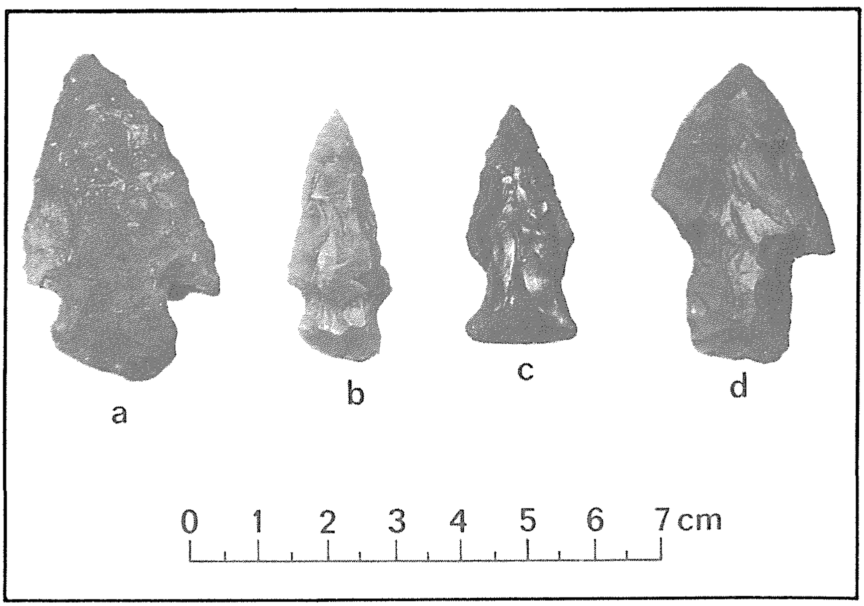


FIGURE 1. *Dart Points from Site 41 HR 206*. a-d, basally-ground points of the *Williams, Trinity,* and *Carrollton* types.

SITE PATTERNS

Archeological materials from 48 sites in inland Harris County were reviewed. There were 26 of these sites with projectile points, and these were selected for this study. There are nine late prehistoric, six mixed late prehistoric/Woodland, five Woodland, one mixed Archaic/Woodland, one pure Archaic, and four mixed with all time periods. The multi-component sites are predominantly mixed Archaic/Woodland, and will be treated as such in the statistical summaries. By time periods, then, there are 19 sites with late prehistoric components, 16 Woodland, and six Archaic. As shown in Fig. 2, sites with only late components tend to have fewer lithic artifacts. It is concluded that a larger number of small sites were used in late time, with less use frequency, compared to a few large sites in the Archaic and early Woodland.

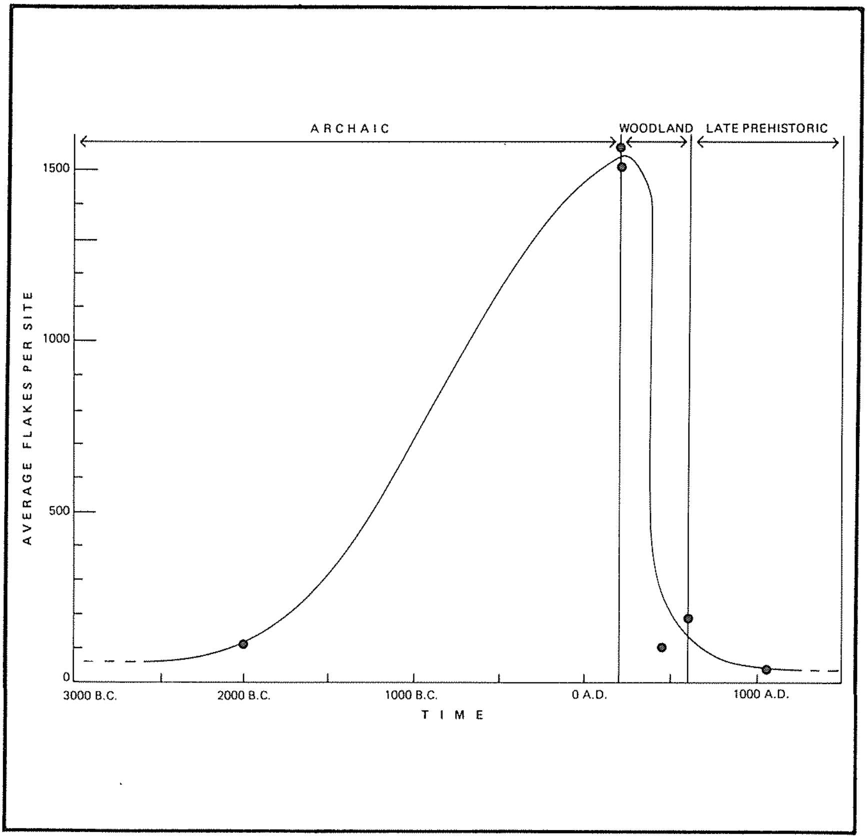


FIGURE 2. *Lithic Flake Distribution in Time.*

If a time period of 4,500 years is used for the range of sites under discussion, both Wheat's work and more recent surveys by the writer show that projectile point production was fairly constant with time. This may be an indication of roughly constant population density over long time periods, although population density could vary considerably at specific times. The period of A.D. 600 to 1500 for bifacial arrow points is 20% of the total time interval considered. Referring to Table 2, Wheat (1953: 198-199) showed that arrow points were 16.5% of total projectile points, and recent work by the writer gives 19.7% of total points as bifacial arrow points. If there is any indication at all of a population maximum, it would be during the late Archaic and Woodland periods.

CERAMICS

Wheat (1953) developed information on pottery for this area, and Aten (1971: Fig. 10) has added further details and dating. Plain ceramics start at about A.D. 200, there is also a stamped design type, which is rare and probably has rather short duration. Then *Goose Creek* sandy paste pottery starts and continues through late prehistoric time. Both Wheat and Aten note some use of bone tempering in late time, and this is confirmed on more recently found sites, such as 41 HR 248. Because of its short duration, stamped pottery in Harris County is a good time reference, and possibly matches the starting times of sites 41 HR 6, 7, and 267. Incised pottery has wide time distribution, but is fairly scarce, as noted by Wheat (1953: Table 1), and this more recent survey. A summary of incised patterns has been given by O'Brien (1971: 345), which possibly applies to this area. The most common pattern found in recent survey work is single line interior incising. Only 2.8% of all sherds examined had any type of incising. O'Brien (1974: 57) has commented on the possible significance in time of incised patterns and rim shapes. Few rim sherds were found in survey work for this report.

Wheat (1953: 191) noted that there was a lower amount of pottery in late strata, and recent survey sites seem to confirm lower amounts in the late prehistoric period on inland sites. This could mean less use of pottery and/or a lower frequency of site use. It is felt that less pottery was used in the late prehistoric period because the ratio of potsherds to flakes decreases then. Together with the information that sites tended to be smaller and more numerous in late time, this may indicate a shift in subsistence pattern after the Woodland period. Fig. 3 is a plot of sherd-to-flake ratio versus time, and definitely shows a peak at the end of the Woodland period. Potsherd counts probably have value in a relative comparison of sites of different ages, but on an absolute basis sherd counts are probably low. Due to poor firing techniques used in the manufacture of local pottery, there is some disintegration of potsherds. During wet weather the author has observed potsherds in the process of total disintegration on several sites, including 41 HR 215. As mentioned previously, pottery on inland Harris County sites is not as plentiful as on littoral sites.

There are no noticeable differences in ceramic thicknesses with time. Sites in general have a range of thicknesses for potsherds from 4 to 9 mm. The average of 4 late prehistoric sites is 6.0 mm and the average for Archaic/Woodland site 41 HR 206 is 6.3 mm.

THE BOW AND ARROW

In previous papers (Patterson 1973a,b), the writer has hypothesized that the bow and arrow diffused to Texas from the far

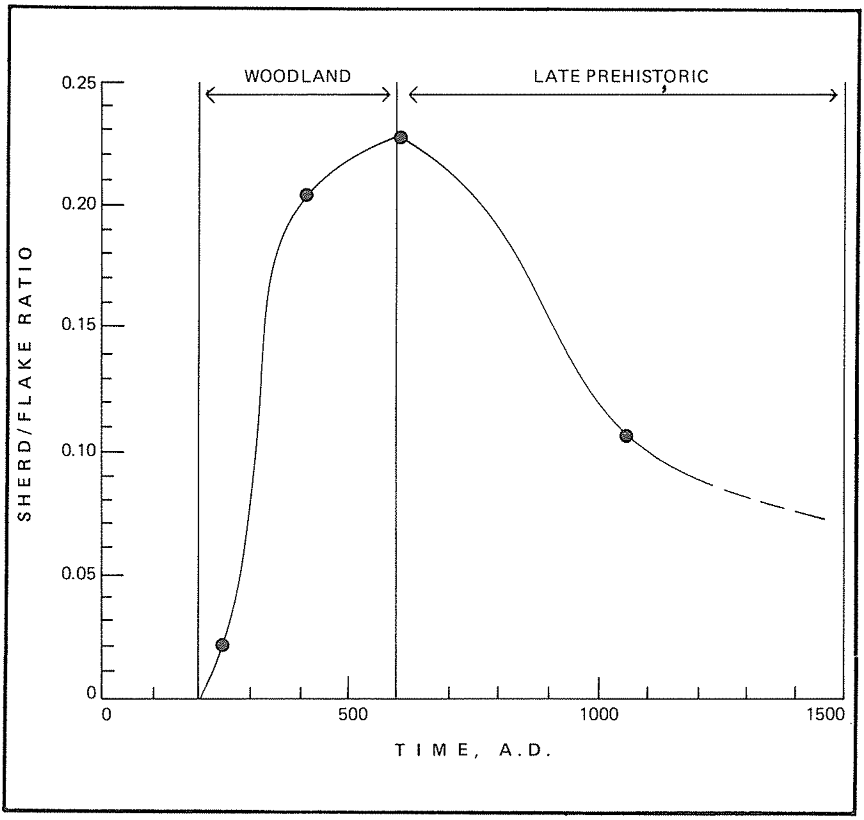


FIGURE 3. *Pottery Distribution in Time.*

north during the Archaic period, together with small prismatic blade technology, using the Mesolithic type compound point. The presence of the compound point in Alaska has been demonstrated by Larsen (1968: 54). Another example of early use of the bow and arrow, closer to Texas, is the occurrence of crude unifacial arrow points at the LoDaisKa site in Colorado (Irwin and Irwin 1959: 34-37), earlier than bifacial arrow points. Possible elements for compound arrow points occur throughout the various time periods being reviewed for Harris County. The side blades are similar to Eurasian microliths, in that they are unifacial segments of prismatic blades, have a straight edge for hafting, and have the other lateral edge trimmed to a rough geometrical shape. Unifacial end blades are both stemmed and unstemmed (Patterson and Sollberger 1974).

The writer has elsewhere speculated (Patterson 1973c) that the *Perdiz* arrow point evolved from the *Gary* dart point, as there is a roughly continuous grading in size from *Gary* dart points to *Perdiz* arrow points. As shown in Table 1, Wheat found *Perdiz* points starting much earlier than other bifacial arrow points, but he tended to dismiss this data. It is felt that this evidence should be considered as an example of a development period for an arrow point form from a dart point form, with the bow and arrow already in use with simpler unifacial points. There are a number of other arrow point/dart point similarities in this area, such as *Almagre/Cliffton, Ellis/Scallorn,* and *Matamoros/Fresno*. Sollberger (1967, 1970) has noted similar relationships.

TABLE I

DOERING SITE PROJECTILE POINT DISTRIBUTION
(FROM WHEAT 1953, TABLE 5)

Period	Late Prehistoric		Woodland			Archaic		
Excavation Level (cm)	0-15	15-30	30-45	45-60	60-75	75-90	90-105	105-120
Arrow Points								
Perdiz	x	x	x	x	x	—	—	—
Scallorn	x	—	—	—	—	—	—	—
Catahoula	—	x	—	—	—	—	—	—
Fresno	—	x	—	—	—	—	—	—
Dart Points								
Gary/Kent	x	x	x	x	x	x	x	x
Pedernales	—	x	—	—	—	x	—	—
Palmillas	—	x	x	x	x	x	x	—
Ensor	—	—	x	—	x	x	x	x
Yarbrough	—	—	—	x	x	x	x	—
Ellis	—	x	—	x	x	x	—	x
Trinity	—	—	x	—	x	x	x	—
Wells	—	—	—	x	x	x	x	—
Carrollton	—	—	—	—	—	—	x	—
Williams	—	—	—	—	—	x	x	—
Elam-like	—	—	—	x	—	—	x	—
Refugio	—	—	—	—	x	x	—	—
Bulverde	—	—	—	—	—	—	*	—

* possible lower level (Wheat 1953, Table 9)

Study of the weight distribution for contracting stem points in Harris County also suggests evolution of arrow point forms from dart point forms, as shown in Fig. 4. Dart points weighing over 6.5 grams are found in Archaic context, and smaller dart points weighing 3.5 to 6 grams are found in late Archaic and Woodland contexts. There is a discrete group of points found only on Woodland and later sites, weighing 2 to 3 grams, which suggest a multi-purpose use for both dart and arrow points. Bifacial arrow points found mainly on late prehistoric sites form another discrete group under 2 grams in weight.

Since possible unifacial elements for compound arrow points exist even on later prehistoric sites, the compound arrow point or at least unifacial end blades may have been in use concurrent with bifacial arrow points. This is not too surprising, when consideration is given to some of the crude, almost unifacial *Cliffton* points found together with well made *Perdiz* points. A possible example of transition to

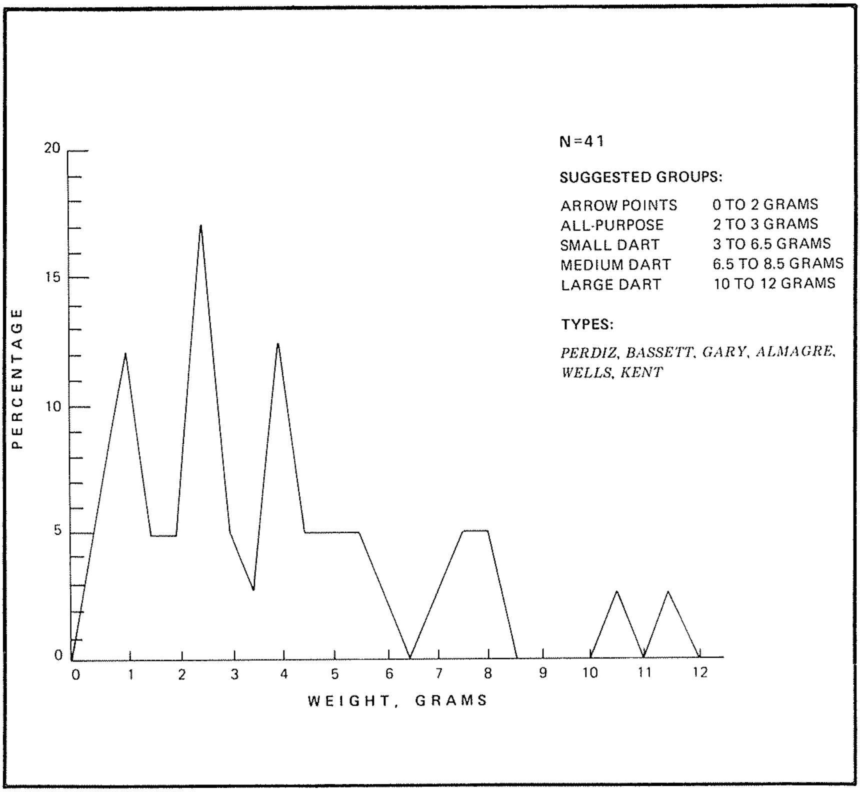


FIGURE 4. *Distribution of Contracting Stem Points: Harris County.*

more refined arrow points is a tanged unifacial prismatic blade point from site 41 HR 6, which is a mixed Woodland/late prehistoric site. An enlarged drawing of a unifacial microlithic end blade, hafted with asphalt, has been shown for site 41 HR 210 (Patterson 1975c: Fig. 1).

TABLE II

Time Distribution of Projectile Points

	Patterson *		Wheat	
	No.	%	No.	%
Bifacial Arrow Points	39	19.7	210	16.5
Dart Points	159	80.3	1065	83.5
	198	100.0	1275	100.0

	Period	Years	Time, %
Archaic/Woodland	3000 BC-AD 600	3600	80
Late Prehistoric	AD 600-AD 1500	900	20
		4500	100

* see Table 4

PRISMATIC BLADE TECHNOLOGY

Small prismatic blade technology in Harris County exists in fairly constant quantities for all time periods under discussion. Blade cores, blades, and retouched blade tools have also been found for all time periods. Since blade technology is so generalized (Patterson 1973a,b), with a variety of blade core types, it has not been possible to relate blade core types to specific time intervals, possibly because small blade technology diffused in a generalized form. Wedge-shaped and semi-conical cores seem to start early, and conical cores have been found in all time periods. A unique example of a discoidal blade core, with four striking platforms, was found on a mixed Woodland/Late Prehistoric site, 41 HR 248. This core is close to one illustrated by Montet-White (1968: Fig. 6) for the late Archaic/early Woodland period in Illinois.

Prismatic blades from Harris County are referred to as a "small blade technology," distinct from larger Paleo-Indian blades. Most Harris County blades are under 20 mm in width, while published examples of Paleo-Indian blades generally average over 20 mm in width (Converse 1973: 14; Hammatt 1969). A starting time of 3000 B.C. for small blade technology in Texas would be consistent with Borden's chronology for southward diffusion of small blade technology from Alaska, and the early Magic Mountain, Colorado date of 3500 B.C. (Irwin-Williams and Irwin 1966: Fig. 59) for microblades. Various prismatic blade traditions have been discussed in a separate paper (Patterson 1975b).

Prismatic blade technology follows a general tendency of lithic flakes to become smaller on late sites. Microblades of under 11 mm width are found on even the earliest sites, however. Table 3 shows that prismatic blades, and microlithic side and end blades occur throughout the entire time interval under consideration. The percentages of prismatic blades shown are higher than in a previous report (Patterson 1973b), because more material has been found, and small irregular flakes below 15 mm square are no longer counted.

FLAKE TOOLS

By far the most important artifacts in number on these sites are utilized general-purpose flint flake tools. As Sollberger (1969) has shown, sharp unretouched flake edge make excellent cutting tools. A number of flakes and prismatic blades occur, without definite time significance, with unifacial marginal retouch that could be classified as side and end scrapers. Noticeable heavy retouch by pressure flaking is not frequent. Most utilized flakes simply display use retouch. Wheat's collection of selected artifacts from this area at the Smithsonian Institution was examined, with the same conclusion as more recent finds.

What is really significant about flake tools is the tendency toward smaller size in later time. As may be seen in Fig. 5, this becomes pronounced in the Woodland period and later, after 200 A.D. Size change appears to be evolutionary, rather than sudden. Through the Archaic period, the three size ranges used for this study occur in about equal proportions. After the start of the Woodland period, there are increases in the percentage of smaller flakes of 15 to 20 mm square, and decreases in the percentages of the two larger flake categories, of 20 to 25 mm and over 25 mm. Shafer (1974: 14) has noted the shift to smaller lithic tools in late prehistoric time in southeastern Texas, and Dee Ann Story (personal communication) notes this same tendency in other parts of Texas.

Flake size categories are arbitrary selections, and a rapid accurate method was used to measure the large number of flakes. A size range of 15 to 20 mm indicates that a flake is larger than a 15 by 15 mm square and will fit inside of a 20 mm square. Other size ranges use larger squares for measurement. No special flake orientation or tedious use of calipers is required. A rapid method becomes a necessity when large numbers of flakes are involved.

Harris County has what could be called a "thin flake industry," with most flakes ranging from 2 to 5 mm in thickness. Few thick flake tools are present. Use of smaller flake tools in later time possibly indicates a shift in technology, more efficient use of a scarce

TABLE III

FLAKE AND SHERD DISTRIBUTIONS

SITE TYPE	SITE	15-20mm	20-25mm	OVER 25mm	BLADES	SIDE BLADES	END BLADES	TOTAL FLAKES	TOTAL SHERDS	S/F
		PERCENT OF TOTAL FLAKES*								
3	HR98	59.5	10.8	8.1	10.8	2.7	8.1	37	23	.622
3	HR183	50.0	13.8	0	24.1	6.9	5.2	58	3	.052
3	HR208	50.0	10.0	5.0	20.0	5.0	10.0	20	1	.050
3	HR213	57.1	7.1	14.3	21.5	0	0	14	0	0
3	HR247	57.5	12.8	10.6	17.0	2.1	0	47	2	.043
3	HR252	100.0	0	0	0	0	0	3	0	0
3	HR253	100.0	0	0	0	0	0	2	0	0
3	HR254	90.9	9.1	0	0	0	0	11	0	0
3	HR255	45.5	7.8	5.2	26.0	11.7	3.8	77	0	0
3	AVG.	67.8	7.9	4.8	13.3	3.2	3.0	29.9	3.2	.107
2,3	HR6	55.4	8.1	2.1	24.0	7.2	3.2	334	174	.521
2,3	HR7	59.4	4.7	4.7	15.6	10.9	4.7	64	13	.203
2,3	HR185	56.9	7.5	6.3	24.2	3.5	1.6	318	17	.053
2,3	HR209	63.1	12.9	9.8	10.4	2.2	1.6	317	45	.142
2,3	HR214	56.3	25.0	12.5	6.2	0	0	16	0	0
2,3	HR248	48.7	16.3	2.5	20.0	7.5	5.0	80	8	.100
2,3	AVG.	56.7	12.4	6.3	16.7	5.2	2.7	188.2	42.8	.227
1,2,3	HR5	45.2	22.1	7.7	16.3	5.8	2.9	104	6	.058
1,2,3	HR182	52.2	14.3	8.6	22.2	1.9	0.8	474	13	.027
1,2,3	HR184	45.5	20.0	12.2	16.9	4.7	0.7	5,136	100	.019
1,2,3	HR210	44.4	15.3	7.1	19.0	10.2	4.0	295	27	.092
1,2,3	AVG.	46.9	17.9	8.9	18.6	5.6	2.1	1,502.2	36.5	.024
2	HR215	45.2	19.4	3.2	22.6	9.6	0	31	6	.194
2	HR217	55.6	33.3	0	11.1	0	0	18	5	.278
2	HR244	43.9	15.6	8.7	24.1	5.8	1.9	378	81	.214
2	HR249	75.0	10.0	5.0	10.0	0	0	20	0	0
2	HR267	57.8	5.3	10.5	15.8	5.3	5.3	19	4	.211
2	AVG.	55.6	16.7	5.5	16.7	4.1	1.4	93.2	19.2	.206
1,2	HR206	35.4	20.9	15.0	21.1	5.7	1.9	1,591	36	.023
1	HR250	28.4	17.5	22.9	14.7	14.7	1.8	109	0	0

1: Archaic (Preceramic)
2: Woodland (Ceramics and Dart Points)
3: Late Prehistoric (Bifacial Arrow Points)

*Flakes smaller than a 15 x 15 mm² not counted; same for sherds resource, or possibly even increased mobility in lifestyle. If more hafting was used with smaller flakes, it is not directly apparent, as no special preparation for hafting, such as notches, is generally present.

LITHIC MATERIALS

A previous paper (Patterson 1974) has commented on types of lithic materials used in Harris County. In general, there does not appear to be any time significance in materials used for lithic artifacts. Assemblages reflect what would be expected of flint sources within 25 to 100 miles, with an occasional find of possibly more remote origin. The uses of petrified wood and red jasper for projectile points are exceptions. For dart points, petrified wood was over-utilized and jasper was under-utilized, compared to the amounts of these materials occurring on various sites. Harris County itself has no significant lithic resources. For arrow points, the situation is reversed. Petrified wood is practically never used, and red jasper begins to be used with a frequency close to its general distribution on sites. There is some use of jasper for small late dart points.

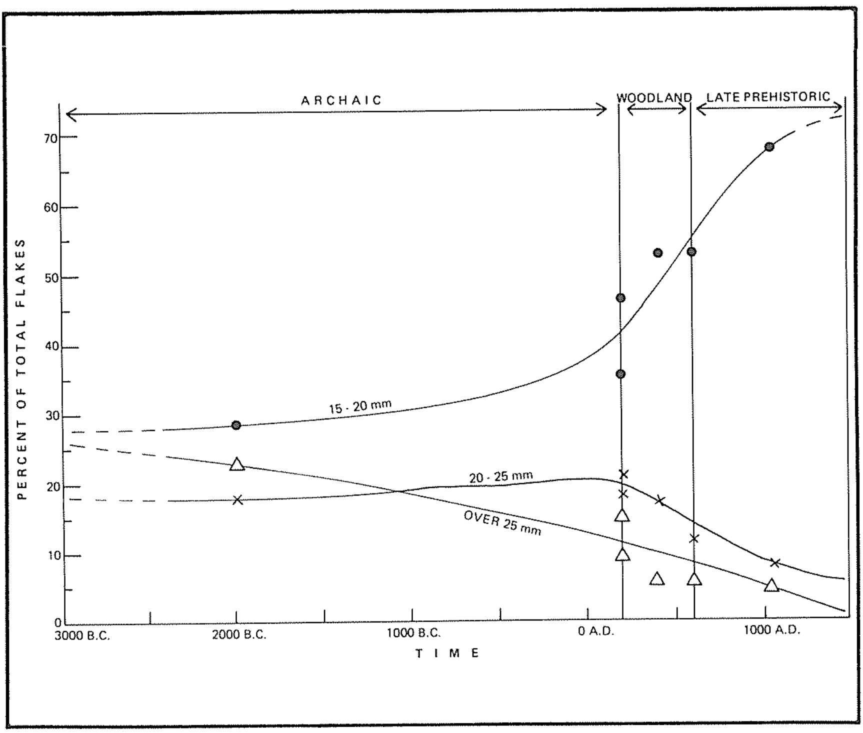


FIGURE 5. *Lithic Flake Size Distribution in Time.*

CLAY BALLS

Roughly shaped clay balls or "blobs" are found on Archaic and Woodland sites in Harris County. Smith (1969: 6) has noted the presence of this type of material in the Archaic period of the Dallas area. Late prehistoric sites in Harris County have few clay balls. Aten (1967: 39), Ambler (1967: Table 3), Patterson (1975a: 13, 1975c: 18), and Shafer (1968: 74) have made comments on the occurrence of clay balls in this general area. The function of clay balls has not been fully determined, although most appear to be fire-baked. Perhaps they were used for cooking, as the more precisely shaped Poverty Point examples, Huxtable, *et al* (1972) have dated clay balls in the Mississippi Valley to both Archaic and Woodland periods. As with clay balls, fire-cracked rock does not seem to occur on late sites.

BIFACIAL TOOLS

Bifacial non-projectile point tools are not time-diagnostic in Harris County. This has been shown by Wheat (1953: Table 6) for a wide time range. Contrary to Wheat's information on the Doering site, bifacial tools do not occur as high percentages of lithic assemblages on Harris County sites. Wheat seems to have struck a cache of bifacial tools on the Doering site, not duplicated by his other sites, or by the writer's later survey work. After examining Wheat's collection at the Texas Archeological Research Laboratory, it is concluded that a number of Wheat's bifacial tools are actually projectile points or preforms, resembling, in a morphological sense, the *Lerma*, *Tortugas*, and *Refugio* types. Thus, Wheat's count of bifacial tools is on the high side. Finer pressure flaking is observed on what few bifacial tools occur on late sites.

CONTINUITY

Most of this paper has been devoted to examining technological changes. There are a number of traits that may demonstrate some continuity of the Archaic lifeway, in contrast to changes being considered. For this specific area, over the approximately 4,500 years under discussion, traits with more or less continuous time distribution include: bifacial tools, bone tools, notched lithic tools, gravers, perforators, prismatic blades, blade cores, microliths, choppers, drills, scrapers, and lithic heat treating. The persistence of traits over long time periods has been noted by Lorrain (1968: Table 1) for stone tools, and by Preston (1969) for projectile points, in other areas of Texas. The occasional finds of drilled stone pendants and incised bone on Harris County sites has not been resolved in respect to time.

Some possible examples of burins have been found on Harris County sites, but are few in number, and without time significance. Bandi (1969: 177) has noted that burins have only a subordinate role in

TABLE IV

PROJECTILE POINT DISTRIBUTION *

	Period						Grand Total	
	Late Pre.	**L.P./ Wood.**	**Wood-land**	**Archaic/ Wood.**	**Archaic**	**All Period Sites**	**No.**	**%**
Arrow Points								
Alba	2	1	—	—	—	—	3	1.5
Bassett	1	—	—	—	—	—	1	0.5
Catahoula	2	1	—	—	—	—	3	1.5
Cliffton	3	3	—	—	—	—	6	3.0
Fresno	—	2	—	—	—	—	2	1.0
Perdiz	1	10	—	—	—	5	16	8.2
Scallorn	1	1	—	—	—	1	3	1.5
Toyah	—	1	—	—	—	—	1	0.5
Unclassified	1	1	—	—	—	2	4	2.0
Subtotal	11	20	0	0	0	8	39	19.7
Dart Points								
Abasolo	—	—	—	—	—	1	1	0.5
Almagre	—	1	—	—	—	1	2	1.0
Bulverde	—	—	—	1	—	1	2	1.0
Carrollton	—	—	—	1	—	1	2	1.0
Catan	—	—	1	—	—	2	3	1.5
Darl	—	—	1	—	—	1	2	1.0
Edgewood	—	—	—	—	—	1	1	0.5
Elam	—	—	—	1	—	—	1	0.5
Ellis	—	1	1	1	—	5	8	4.0
Ensor	—	—	—	—	—	2	2	1.0
Gary	—	1	6	—	1	11	19	9.7
Kent	—	2	1	—	—	11	14	7.2
Kinney	—	—	1	—	—	—	1	0.5
Matamoros	—	—	—	—	—	1	1	0.5
Meserve (?)	—	—	—	—	—	1	1	0.5
Palmillas	—	—	2	—	—	2	4	2.0
Pedernales	—	—	—	1	—	1	2	1.0
Refugio	—	—	1	—	1	2	4	2.0
Travis	—	—	—	1	—	—	1	0.5
Trinity	—	—	—	2	1	—	3	1.5
Wells	—	—	—	1	—	1	2	1.0
Williams	—	—	—	1	1	—	2	1.0
Yarbrough	—	—	—	—	—	5	5	2.5
Unclassified	—	5	9	13	1	48	76	38.4
Subtotal	0	10	23	23	5	98	159	80.3
Total	11	30	23	23	5	106	198	100.0

*L.W. Patterson Harris County survey to August 1974

Alaskan microblade industries. It is suggested here that there is no real need for burins in thin flake industries, as other tools are easier to make from thin flakes that will function just as well for graving as burins. Burin-like tools can be made very easily by simply snapping thin lithic flakes or removing a few pressure flakes. In contrast, in thick lithic flake industries, a burin blow is probably one of the easiest methods of making a graving tool.

MAJOR CONCLUSIONS

The major conclusions reached as a result of this research are listed below:

1. Sandy paste pottery was the principle type used over the entire ceramic period, with some late use of bone tempering.
2. Late sites reveal less pottery than earlier ceramic sites.
3. Late sites are smaller, but more frequent.
4. Over the time interval considered, there was a trend toward smaller lithic artifacts in later time.
5. Small prismatic blades were probably in use for the entire time period of roughly 4,500 years.
6. The bow and arrow may have been in use for the entire time period, with early use of unifacial point elements.
7. A number of artifact types do not have time-diagnostic value, which may indicate continuity in some technology over long time periods.
8. Taken together, the tendencies in later time to use smaller sites in greater numbers, use smaller lithic tools, and use less pottery may indicate a drift to a more mobile type of existence. However, these changes could simply indicate technological changes together with less use of specific campsites. Tom D. Dillehay (personal communication) has suggested that a more mobile type of lifeway may be associated with an increased ability to schedule use of a wider variety of food resources. People would be moving more to take advantage of greater subsistence opportunities.

References Cited

Ambler, J. R.
1967 Three Prehistoric Sites Near Cedar Bayou, Galveston Bay Area. *State Building Commission, Archeology Program, Report*, No. 8.

Aten, L. E.
1967 Excavations at the Jameson Site. *Houston Archeological Society, Report*, No. 1.
1971 Archeological Excavations at the Dow-Cleaver Site. *Texas Archeological Salvage Project, Technical Bulletin*, No. 1.

Bandi, H.
1969 *Eskimo Prehistory*. University of Alaska Press, Fairbanks.

Borden, C. E.
1969 Early Population Movement from Asia into Western North America, *Syesis*, Vol. 2, Nos. 1-2, pp. 1-13.

Converse, R. N.
1973 Ohio Flint Types. *Archaeological Society of Ohio, Special Publication*.

Covey, C.
1972 *Cabeza de Vaca's Adventures in the Unknown Interior of America*. Collier Books, New York.

Dillehay, Tom D.
1975 Prehistoric Subsistence Exploitation in the Lower Trinity River Delta. Texas, *Texas Archeological Survey, Research Report* No. 51.

Duke, A. R.
1970 Analysis of Ceramic and Bone Artifacts from 41 HR 73. *Houston Archeological Society Newsletter*, No. 34, pp. 3-4.
1971 Analysis of Lithic Material from 41 HR 73. *Houston Archeological Society Newsletter*, No. 36, pp. 3-6.

Ford, J. A. and C. H. Webb
1956 Poverty Point, *American Museum of Natural History, Anthropological Papers*, Vol. 46, Part 1, pp. 1-136.

Hammatt, H. H.
1969 Paleo-Indian Blades from Western Oklahoma. *Bulletin of the Texas Archeological Society*, Vol. 40, pp. 193-198.

Huxtable, J., M. J. Aitken and J. C. Weber
1972 Thermoluminescent dating of Baked Clay Balls of the Poverty Point Culture. *Archaeometry*, Vol. 14, No. 2, pp. 269-275.

Irwin, H. J. and C. C. Irwin
1959 Excavations at the LoDaisKa Site. *Denver Museum of Natural History, Proceedings*, No. 8.

Irwin-Williams, C. and H. J. Irwin
1966 Excavations at Magic Mountain. *Denver Museum of Natural History, Proceedings*, No. 12.

Larsen, H.
1968 Trail Creek. *Acta Arctica*, Fasc. 15. Copenhagen.

Lorrain, D.
1968 Archeological Excavations in Northwestern Crockett County, Texas. *State Building Commission Archeology Program, Report*, No. 12.

Montet-White, A.
1968 The Lithic Industries of the Illinois Valley in the Early and Middle Woodland Period. *Museum of Anthropology, University of Michigan, Anthropological Papers*, No. 35.

O'Brien, M. J.
1971 The Fullen Site, 41 HR 82. *Bulletin of the Texas Archeological Society*, Vol. 42, pp. 335-361.
1974 The Armand Bayou Survey and Excavations, in Archeological Investigations along Armand Bayou, Harris County, Texas. Edited by Frank Hole, *Houston Archeological Soceity, Report*, No. 2, pp. 29-77.
Patterson, L. W.
1973a Far Northern Influences on the Upper Texas Coast. Paper presented at the Texas Archeological Society annual meeting, Lubbock.
1973b Some Texas Blade Technology. *Bulletin of the Texas Archeological Society*, Vol. 44, pp. 89-111.
1973c A Possible Arrow Point Development Example. *Texas Archeology*, Vol. 17, No. 3, pp. 8-9.
1974 Harris County Flint Sources. *Houston Archeological Society Newsletter*, No. 46, pp. 3-4.
1975a A Two Component Site, 41 HR 185. *Houston Archeological Society Newsletter*, No. 48, pp. 13-14.
1975b Evidence of Prismatic Blade Technology in the Texas Archaic. In: The Archaic of Texas (T. R. Hester, editor) *University of Texas at San Antonio, Center for Archaeological Research, Special Report*, No. 2 (in press).
1975c 41 HR 210, A Multicomponent Site in Harris Co., Texas. *La Tierra*, Vol. 2, No. 4, pp. 17-22.
1975d Bibliography of the Prehistory of the Upper Texas Coast. *Houston Archeological Society, Special Publication*.
Patterson, L. W. and J. B. Sollberger
1974 Lithic Shaping Retouch. *Texas Archeology*, Vol. 18, No. 3, pp. 13-16.
Preston, N. E.
1969 The McCann Site. *Bulletin of the Texas Archeological Society*, Vol. 40, pp. 167-192.
Shafer, Harry J.
1968 Archeological Investigations in the San Jacinto River Basin, Montgomery Co., Texas. *Papers of the Texas Archeological Salvage Project*, No. 13.
1974 Archeology and Indians of Southeast Texas. *In: Participants Handbook, The Big Thicket, Contemporary Science Seminar*, University of Houston and Houston Museum of Natural Science.
1975 Comments on Woodland Cultures of East Texas. *Bulletin of the Texas Archeological Society*, Vol. 46, pp. 249-254.
Smith, B. W.
1975 An Analysis of Faunal Remains from 41 HR 210. *La Tierra*, Vol. 2, No. 4, pp. 23-28.
Smith, C. A.
1969 Archeology of the Upper Trinity Watershed. *The Record*, Vol. 26, No. 1.
Sollberger, J. B.
1967 A New Type of Arrow Point with Speculations As to Its Origin, *The Record*, Vol. 23, No. 3, pp. 12-22.
1969 The Basic Tool Kit Required to Make and Notch Arrow Shafts for Stone Points. *Bulletin of the Texas Archeological Society*, Vol. 40, pp. 231-240.

1970 Preforms Are Not Projectile Points. *Bulletin of the Oklahoma Anthropological Society*, Vol. 19, pp. 151-154.

Suhm, D. A. and E. B. Jelks
1962 Handbook of Texas Archeology: Type Descriptions. *Texas Archeological Society Special Publication*, No. 1, and *Texas Memorial Museum Bulletin*, No. 4.

Wheat, J. B.
1953 An Archeological Survey of the Addicks Dam Basin. *Bureau of American Ethnology, Bulletin*, No. 154.

FUSED VOLCANIC GLASS FROM THE MANNING FORMATION

K. M. Brown

ABSTRACT

Fused volcanic glass from the Manning Formation of southeast Texas was formed when combustion of the underlying lignite beds in localized areas melted the tuff deposits. This distinctive material was used as a minor source of raw material for making chipped stone artifacts since the Early Archaic and is found at various sites in the Gulf Coastal Plain.

INTRODUCTION

Virtually none of the raw materials used to manufacture chipped stone artifacts in the Gulf Coastal Plain of Texas can be traced to a specific outcrop. There are no beds of chert in east Texas sediments, which consist of sandstones and poorly consolidated clays, shales, sands, and tuff deposited during the Eocene and later. Most raw material for chipping was obtained from relict sheets of stream terrace gravels that were deposited high above the present river beds during the Pleistocene and have since been extensively eroded. These patchy gravel deposits can be found fringing east Texas river valleys inland from the deltaic deposits of the coastal area. Chert, quartzite, and petrified wood were selected as chipping material from these gravels, but since essentially the same kinds of rock are found both along and among different drainages, it is impossible to trace artifacts to specific gravel deposits.

This paper will report one kind of raw material, fused volcanic glass, which stands as an exception to the usual anonymity of chipped stone resources in east Texas. Because this rock (1) is distinctive in appearance, and (2) can be related to a known outcrop, it may be possible eventually to define resource distribution patterns by studying the occurrence of the material in archeological sites, even if we cannot determine whether the material was acquired through trade or through special extractive expeditions.

GEOLOGIC CONTEXT

Mode of formation

Near the end of the Eocene epoch, large amounts of volcanic ash were ejected into the atmosphere by erupting volcanos that may have been located in the Trans-Pecos area. Volcanic ash is a finely divided chalky dust composed of microscopic, angular volcanic glass shards. These dust showers settled down either in the contemporaneous

Eocene Gulf coastal region, or (more likely) in the headwaters of streams draining into the coastal region, or both. As a result, significant amounts of volcanic ash are present in the lignitic sands and clays of the Manning Formation. Some ash beds deposited in aquatic environments have been altered to bentonite (Renick 1936: 42); elsewhere deposits with pyroclastic material vary from tuffaceous sandstones, siltstones, and shales to massive tuff (consolidated volcanic ash). Where relatively pure tuff beds overlie relatively pure lignite beds, the appropriate conditions exist for melting of the tuff by combustion of the lignite, and in fact King and Rodda (1962) present evidence to support the hypothesis that fusion of the tuff at various localities in the Manning Formation was caused by the heat generated by burning of the underlying lignite beds (perhaps due to spontaneous combustion) at some time during the geologic past. The degree of fusion varies and where it was most intense, actual melting of the microscopic glass shards has produced small aggregates of brightly colored glassy material. King and Rodda estimate that tempertatures of at least 1125^{0}C were required for melting (*ibid*: 269).

Fused tuff is, like obsidian, a volcanic glass and has a similar fracture, but the mode of formation of the two is considerably different. Figures 1 and 2 contrast diagrammatically the mode of formation of obsidian and fused tuff.

Location of outcrops

The Manning Formation crops out in a narrow band across the Gulf Coastal Plain of southeast Texas, about 190 km inland in Polk, Trinity, Walker, Grimes, Brazos, Burleson, Washington, Lee, Fayette, and Gonzales counties, and on into south Texas (Fig. 3). However, fused volcanic glass is known only from eight localized exposures within the outcrop: one each from Fayette, Washington, Brazos, and Grimes

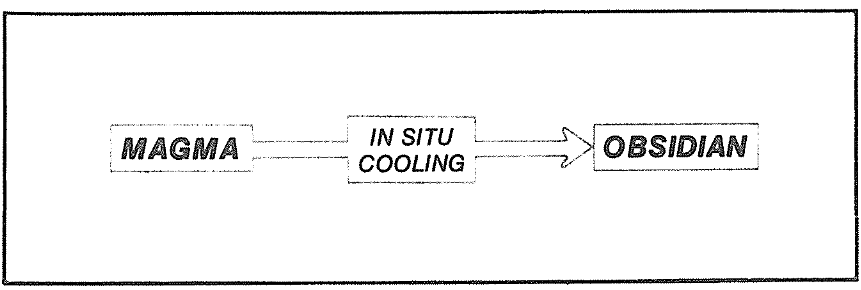


FIGURE 1. *Mode of formation of obsidian.*

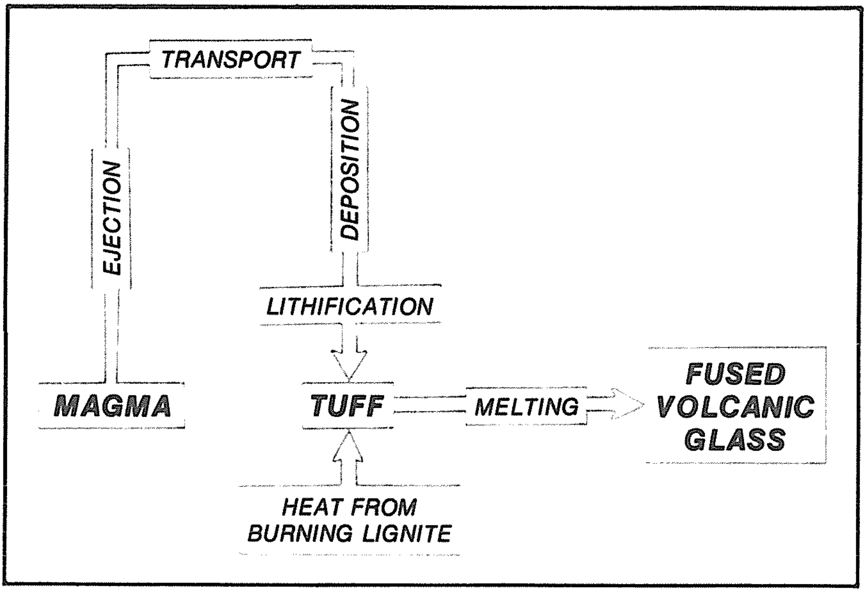


FIGURE 2. *Mode of formation of fused volcanic glass.*

counties, and two each from Walker and Trinity counties (one of the Trinity County localities I recorded in 1970 and is not reported by King and Rodda). These known exposures are indicated on Figure 3 by crosses.

The best exposure of fused tuff in the Manning Formation is an active quarry known as the "Chalk Pit" (Bur. Econ. Geol. sample locality 235-T-2, Texas Arch. Res. Lab. rock sample locality M41WA1), located between Dillard Creek and Chalk Creek in northern Walker County. King and Rodda report the following stratigraphic section as recorded in 1960:

> Three units are exposed in the pit. The upper unit is a light colored tuff, up to 4 feet thick, which overlies the middle unit with a marked erosional unconformity . . . . Locally the upper tuff has been fused or partially fused, but is otherwise unaltered. The middle unit is 10 to 12 feet thick, and consists mostly of massive tuffaceous siltstone with a few sandstone beds and channels up to 5 feet thick. A bentonite bed 1 to 2 inches thick is present in the lower part of this unit, and is exposed along the base of the north wall of the quarry. Fragments of silicified wood were found in the lower part of the middle unit. Most of the tuff and tuffaceous siltstone has been baked, hardened, partially fused, and colored shades of red, brown, and orange. The lowest unit is a lignite of unknown thickness which is exposed in the quarry floor (King and Rodda 1962: 266).

Fused volcanic glass is so abundant in archeological sites surrounding this locality as to suggest a surface exposure must have existed prehistorically as well. Most of the other localities were probably also exposed then, but whether they were known is uncertain. There are also undoubtedly other as yet undiscovered localities with fused rocks in the Manning Formation.

Baked and fused rocks in the Wilcox Group

Baked shales produced by lignite combustion are also known from the Wilcox Group in Freestone County, near Donie (Lonsdale and Crawford 1928; TARL rock locality M41FT1) and, apparently, in Titus County near Winfield. Samples from the Titus County locality

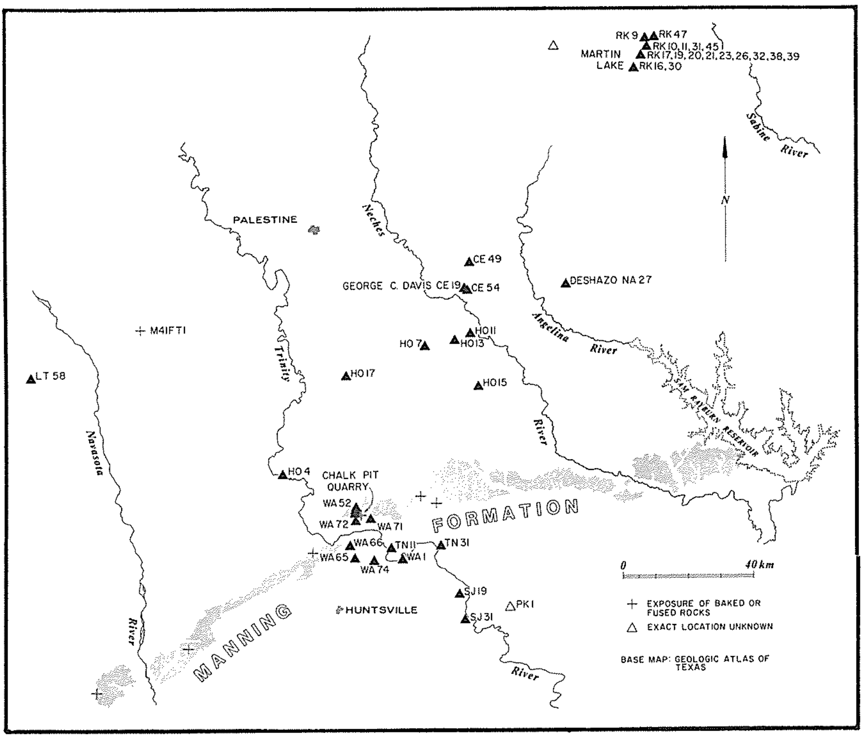


FIGURE 3. *Distribution of sites with fused volcanic glass from the Manning Formation (except 41 LT 58, which has one baked shale fragment only).* Crosses represent localities with baked or fused rocks. Open triangles are sites whose exact location is unknown. One site at Martin Lake (41 PN 14) is not indicated.

were collected in 1971 by Olin McCormick and they appear nearly identical to baked shales from the Chalk Pit quarry.

Rocks from the Freestone County locality tend to be either slaglike or friable, porous, baked siltstones. Lonsdale and Crawford report some glassy, porcelanite-like material, but since I was unable to visit all of the exposures they recorded I have not seen it and cannot judge how comparable it might be to the fused glass in the Manning Formation. I doubt that it occurs in massive aggregates.

A large chunk of baked shale is present in a surface collection from 41 LT 58, west of the Freestone County locality, but it appears identical to the Manning baked shales, and does not resemble those from Freestone County.

Petrography of altered rocks from the Manning Formation

Rocks from the sample localities vary all the way from unaltered tuff, tuffaceous sandstone, siltstone, and claystone or shale to partially baked or fused examples of these rocks, to glassy, completely fused tuff. The degree of fusion depends on two factors: (1) the relative amounts of silica and clay minerals, carbon, or other contaminants; (2) the temperature and duration of firing.

Fused tuff

Completely fused tuff has a vitreous luster similar to milk glass or opal. At 30x magnification tiny gas bubbles (from gas produced during lignite combustion) can be seen in the interior of some specimens. On archeological specimens, gas bubbles that are exposed on the surface may fill with soil; some artifacts from the George C. Davis site are lightly speckled with red from being buried in the red Amite fine sandy loam at the site. Small fault planes with infiltrated iron oxide are frequently present, and aggregates of glass often break along these faults, leaving a reddish-brown covering that simulates weathering cortex but is very thin. Fused glass has an excellent conchoidal fracture and would rival obsidian in terms of chipping properties except for the fact that fault planes, voids, and inclusions are common, making it difficult to manufacture anything except small implements. Fused volcanic glass apparently patinates rapidly since many archeological specimens are patinated, some heavily, and could easily be mistaken for chert artifacts. Patination produces a very dull, sometimes pitted luster and a surface color that is generally lighter than the interior. The most common color of geological specimens is a light blueish gray (Navy gray, Munsell chroma 0, value 6 to 7), often with burnt sienna (5YR4.5/6) colored streaks. Less common colors include charcoal gray (chroma 0, value

5), Indian red (3YR3.5/6), and sienna (5YR5.5/7). White and black occur very rarely; black specimens could be mistaken for obsidian. There are also one or two specimens, from the George C. Davis site, with a flow structure that simulates petrified palm wood, but these are also rare.

> Thin sections of the fused tuff are homogeneous glass which encloses rare grains of the same types of quartz, zircon, and plagioclase found in the partially fused and unfused tuff and tuffaceous siltstone. Most shard edges have fused together and the outlines of individual shards cannot be seen. Vesicles are numerous and range in size up to 2 mm, but mostly are less than 0.5 mm. The index of refraction of the glass varies from 1.486 to 1.501 in eight samples for which the index was measured, but mostly is close to 1.490 (King and Rodda 1962: 268).

Distinguishing fused volcanic glass from chert

Fused volcanic glass can easily be mistaken for chert, especially if it is patinated. The following guidelines may help in discriminating between the two.

1. Luster. The most diagnostic macroscopic attribute is the luster, which on a fresh break is much more glassy and bright than that of chert. The contrast between fresh and patinated surfaces is also generally more pronounced than for chert.
2. Isotropism. Fused volcanic glass is an *isotropic* or noncrystalline substance, like obsidian, opal, or artificial glass, and a tiny chip of the rock placed on the stage of a petrographic microscope will extinguish under crossed nicols. Chert, a crystalline rock, will not behave this way.

These are the simplest tests that can be applied to discriminate between chert and fused volcanic glass, neither requiring extensive damage to the specimen. More detailed studies might include measuring the index of refraction and comparing it to the data given by King and Rodda; or preparing thin sections, which would be especially diagnostic for partially fused specimens, but would require sacrificing the specimen.

Baked and partially fused rocks

Associated with the fused glass is baked, hardened, and partially fused tuff and tuffaceous siltstone and baked claystone or shale. The partially fused tuff has a chalky luster and occurs in pastel shades of lavender, pink (10YR5.5/6-7), yellowish-orange (5YR7.5/7), yellowish beige (7.5YR8/6) and gray. In thin section,

> This rock is composed almost entirely of nearly uniform (about 2 to 4 microns) glass shards. Corners and edges of shards are fused together, but

> the separate outline of each shard can be clearly distinguished. The few vesicles range in size up to about 2 microns. There are rare grains of quartz with beta quartz forms, euhedral to subhedral, pink to violet zircon and euhedral plagioclase (King and Rodda 1962: 266).

Siltstones and claystones, with a lower ash content, have been baked and oxidized into a hard, bricklike yellowish beige (7.5YR8/6) material. Volume reduction of the lignite beds due to combustion has caused collapsing and extensive shattering of this rock (King and Rodda 1962: 266). Chunks of this rock occur in collections from sites that also have fused tuff chipping debris and artifacts. I suspect that this material was not imported intentionally but was simply brought in adhering to chunks of fused tuff as "cortex," although at the Davis site the specimens indicated removal by percussion (Shafer 1973: 149-150).

At some of the sites there are also soft, friable siltstones and tuffs that have been baked only enough to oxidize to shades of pink, beige, and orange. These probably did not adhere to glass aggregates but may have been collected as pigment sources; they resemble pigments recovered from burials at various east Texas sites. They also resemble baked siltstones from the Freestone County locality. Two partially finished earspools recovered from the fill of feature 119, a deep shaft grave in Mound C at the George C. Davis site, are made of a similar siltstone (cf. Shafer 1973: 287-288), and two earspools worn by the single individual buried in feature 118, another shaft grave, are made of a white material resembling unfired or lightly fired tuff from the Chalk Pit locality (cf. Shafer 1973: 283).

Other rock types

King and Rodda report two other kinds of rock that have not yet turned up in archeological collections, but could conceivably be found. These are a sandstone injected with fused tuff, resembling a glass-cemented sandstone, and grayish black to olive-black, clinker-line pseudo-basalt. The latter is a crystalline (magnētite, plagioclase, and pyroxene) rock with about 30% interstitial glass (King and Rodda 1962: 268).

ARCHEOLOGICAL CONTEXT

The use of fused volcanic glass from the Manning Formation began as early as the Early Archaic period, for several *San Patrice* points made of this rock are known to exist. One *San Patrice st. johns* point from the C. W. Ellis site (41 PK 1) in Polk County is probably made of Manning fused glass (Fig. 5, A). Another *San Patrice st. johns* point

(Fig. 5, B) of Manning fused glass was found by Jack Hughes in Rusk County but it is not certain which of the sites in the area it came from (the approximate location is indicated by the open triangle west of the Martin Lake area, Fig. 3). Both points are heavily patinated, and the one from Rusk County resembles the heavily patinated specimens from Martin Lake. In addition to these two specimens in the TARL collections, at least two more *San Patrice* points are believed to exist in private collections (Harry Shafer, personal communication).

No further use of the material is demonstrable with the evidence at hand until the early Caddoan period. Fused volcanic glass artifacts and chipping debris appear at the George C. Davis site, in both surface and excavated samples, and in surface collections from the Westerman site (41 HO 15), which is undated but could be contemporaneous with the Davis site. Both of these are major sites with constructed mounds. Manning fused glass also occurs at other possible early Caddoan sites for which we have only small surface or test pit collections; these include 41 CE 49 and 41 CE 54 in the Davis site vicinity, and some sites in the Martin Lake locality (41 RK 30, 32, 47, and possibly 23). These, however, are only tentatively recognized as having early Caddoan components, and they may have earlier or later components as well.

Archeological context at the Davis site

According to Shafer (1973: 55), fused volcanic glass from the Manning Formation accounts for about 2.28% of the sample of about 6500 flakes and cores from the site. My survey of the collections lists 178 artifacts, flakes, and cores of fused glass, plus four fragments of baked siltstone. In general, we can say that this material appears to have been used as a minor lithic resource throughout the Caddoan occupation of the site, and seems to occur in all parts of the site except the special mortuary, Mound C. It is well represented in the Early Village (800-1000 A.D.) and Middle Village (1000-1200 A.D.) phases as defined by Story and Valastro (1975; dates based on radiocarbon assays with Arizona dendrochronological correction). One flake was recovered from a midden deposit underlying feature 108, an elongate late 11th or early 12th century structure underlying Mound B (Tx 915, Tx 916, Valastro and Davis 1970: 627). Another flake fragment came from the vicinity of feature 112, an adjacent circular, late 11th or early 12th century structure (Tx 910, Tx 919, Tx 924, Valastro and Davis 1970: 628) also underlying Mound B.

Other artifacts and chipping debris are associated with dated parts of the village, but not in contexts that can be related to single depositional events. Many parts of the village seem to have been used or reused over long periods. Fifty-three pieces of chipping debris and one small eccentrically chipped object were recovered from the plow zone in Unit 10, with four pieces of chipping debris *in situ* at the base of the plow zone; this is the largest sample of Manning fused glass from any excavation unit (probably mostly due to intensive screening at this unit; Story, personal communication). It is therefore associated in a general way with feature 125, a circular structure probably dating from the 10th century (Tx 1201, Tx 1202, Tx 1204, Tx 1307, Tx 1308; Valastro, Davis, and Varela 1975: 72-73) although none of the *in situ* flakes and cores were found inside the structure.

In addition to these items there are others from parts of the village that have been dated, but where the association is so nonspecific as to be uninformative. In view of this it is perhaps more pragmatic to look at the entire Manning fused glass sample and the entire radiocarbon series and to state simply that use of the material occurred during all or part of the span from 800 to 1200 A.D. and perhaps somewhat later.

In order to study the distribution within the site, Carolyn Spock and I plotted all of the Manning fused glass artifacts and chipping debris for which we have records. We were particularly interested in testing the hypothesis that since the material had to be imported from an outcrop about 75 km distant, it might have qualified as a "scarce good" in the prehistoric economy of the Davis site and therefore might have been distributed differentially among different social segments (and different parts of the site). We were hampered in this undertaking by our inability to evaluate the contribution of different amounts of screening to the different unit frequencies, but we can say that fused volcanic glass seems to occur in all parts of the site except Mound C. Its absence from the special mortuary I suspect has to do with the physical properties of the material itself rather than with the economy of extraction and transport. I have tried informal chipping experiments and have found that the material tends to fracture unexpectedly along minute fissures where aggregates have not completely fused, so that it would be difficult to produce the finely chipped Alba points (all of which are chert or quartzite) deposited in Mound C as grave goods.

Evidence for continued use of Manning fused glass after the 13th century comes primarily from the Martin Lake locality in northern Rusk and Panola counties, about 120 km from the Manning Formation. None of these sites have been radiocarbon dated, but the decorated pottery from some of them is similar to that from dated sites excavated in the Lake O' The Pines locality farther to the north, and this probably furnishes a basis sufficient for at least an approximate cross-date. Two sites at Martin Lake, 41 RK 19 and 41 RK 21, have components that can be guess-dated at about the 14th century A.D., and another site, 41 RK 39, has a component that may date from the same period, as well as a probable Archaic component. The small sample of Manning fused glass from 41 RK 19 consists of five flakes or flake fragments, with two fragments of baked tuff or siltstone, most of which were recovered from a midden deposit on the east side of the excavated area. The samples from 41 RK 21 and 41 RK 39 are surface and test pit collections and include chipping debris and arrow points, none of which can be identified with established projectile point types.

Petrography of specimens from the Martin Lake locality

The arrow points and chipping debris from Martin Lake are of particular interest because they form a group that is petrographically homogeneous and distinct from almost all of the other east Texas archeological specimens. Almost all of the Martin Lake specimens are very heavily patinated, to an extent that is duplicated only by the San Patrice points mentioned earlier. The patina has formed over flake scars on the arrow points, cores, and flakes, indicating that rapid weathering of the surface took place after the items were discarded. In many cases the dorsal surfaces of flakes are more heavily weathered than the ventral surfaces, just as in "cortex flakes" of chert, indicating that considerable weathering, probably at the outcrop, had already taken place before the material was chipped.

The rapid weathering of the Martin Lake artifacts is presumably due either to incomplete fusion, a lower silica content, a greater abundance of small gas bubbles in the rock, or some combination of these factors. In any case, it seems fairly certain that virtually all of the Martin Lake specimens were obtained from the *same* exposure and that this exposure is *different* from that which furnished raw material for the other east Texas specimens. More detailed lithologic studies will be required to verify this hypothesis and pinpoint the sources. The unweathered rock is probably most comparable to that from locality M41TN1, an exposure with partially fused rocks in Trinity County. Along with the chipping debris there are chunks of soft, chalky, light blue-gray to pink, slightly baked tuff at some of the Martin Lake sites. This material does not closely resemble any of the Chalk Pit rocks I have seen.

There is one exception to the preceding discussion: a single unweathered flake fragment from 41 RK 19 that is identical to the fused glass from the Chalk Pit.

The most recent aboriginal site at which there is good evidence for use of fused volcanic glass from the Manning Formation is the Deshazo site (41 NA 27) in the Bayou Loco drainage near Nacogdoches. This site appears to have minor Archaic and possibly later prehistoric Caddoan components, but the principal component is a protohistoric (presumably Hasinai) hamlet and cemetery. Trade goods are very scarce in the domestic portion of the site, suggesting it predates entry of Europeans into the immediate area. Glass trade beads from the site correspond to the Harris' Period 1 (1700-1740 A.D.) beads (Harris and Harris 1967: 130; Dee Ann Story, personal communication). Several hundred flakes, cores, and chipped stone artifacts were recovered in excavations by the Texas Archeological Survey and the Texas Archeological Research Lab in 1975, and among these were four flakes and one flake or shatter fragment of fused volcanic glass from the Manning Formation. One was found in a midden deposit inside structures 1 and 2, another in the plow zone in the same area, another inside structures 1 and 3, another in a midden deposit adjacent to and just outside structures 5 and 6, and the fifth was found on the surface 40 meters east of the main excavations.

Some speculations about extractive technology

We can only speculate about what sort of exposures of fused rocks may have existed prehistorically, and what methods were used to recover raw material for chipping. Recent quarrying, pine plantations, and firebreaks have extensively disturbed the Chalk Pit locality, which I suspect was the primary source locality. On a recent trip there I saw thoroughly fired and fractured rocks extending to the base of the A soil horizon in the northern part of the quarry, but no glass aggregates were present. Baked shales could be obtained there simply by scraping off the topsoil. Most of the fused glass, however, occurs in the middle unit (King and Rodda 1962: 266), generally well below the surface (below the light-colored stratum in Fig. 4). It seems likely that recovery techniques were limited to collecting glass aggregates exposed by erosion.

Manufacturing technology

Flakes and cores of fused volcanic glass are found at all but five of the sites considered here, indicating that artifacts were not introduced from the outcrop area in finished form. Instead, small nodules were brought to the sites and there reduced to flakes and shatter fragments, with some of the flakes being selected for shaping into finished tools. At the George C. Davis site, for example, the reduction process is represented by cores, flakes and shatter

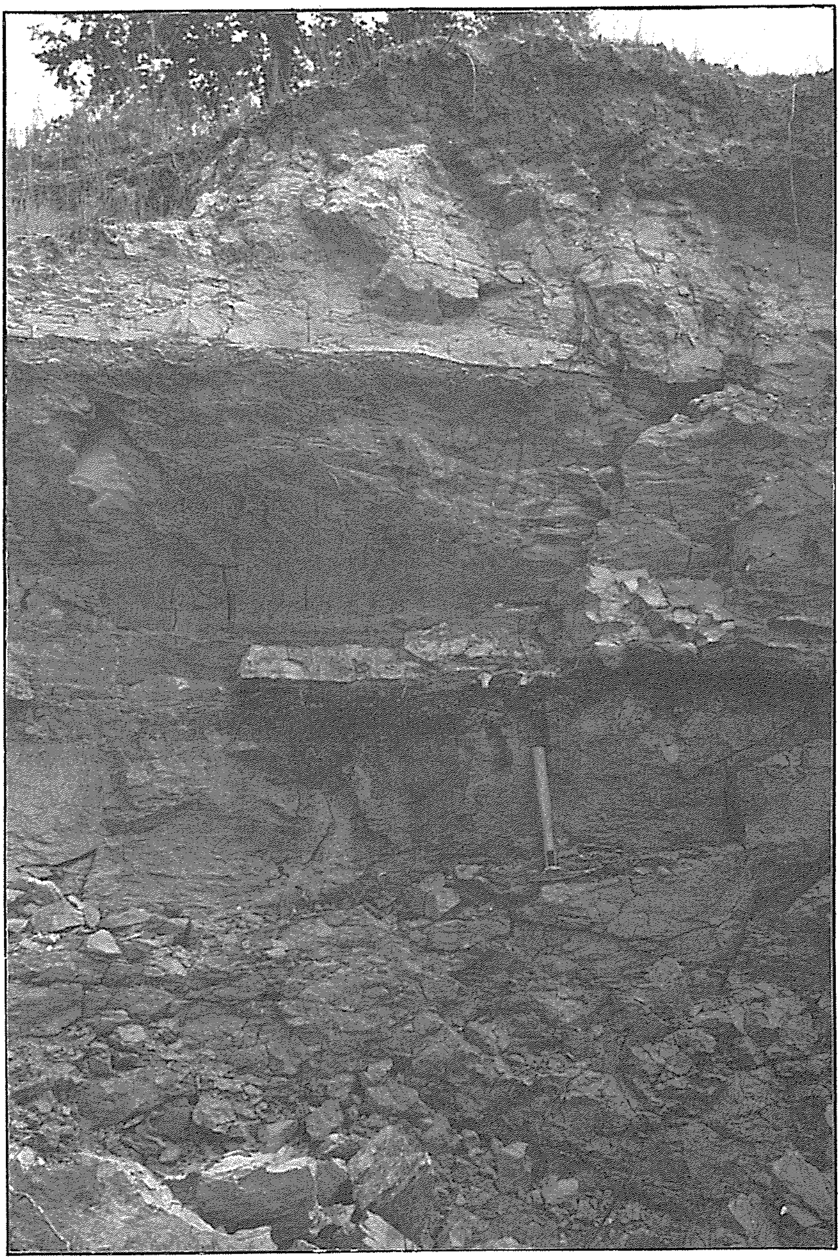


FIGURE 4. *Exposure of fired tuff and tuffaceous claystone in the east wall of the Chalk Pit quarry.* Glass aggregates occur at about the same level as the rock hammer, but none are visible in this photo.

fragments, arrow point preform failures (Fig. 5, H-K, this paper, and Shafer 1973: 147, Fig. 14, D2, E2), and finished Alba points (Fig. 5, G).

The only tool forms presently known are *San Patrice* points, arrow points (*Alba*, possibly *Catahoula*, and unclassified), and a small biface.

Although Shafer found in his study of Manning fused glass chipping debris at the Davis site that the particular percussion technique could not be conclusively identified on many flakes and cores, his experiments with core reduction suggested that anvil (bipolar) percussion was a major reduction technique for Manning fused glass at the Davis site (Shafer 1973: 149). Shafer classified the chipping debris as follows:*

Hard hammer percussion	
bipolar flake debitage	
opposed ridge flakes	2
miscellaneous	7
bipolar core debitage	
opposed ridge	2
point-base	1
miscellaneous	3
Technique uncertain	
miscellaneous flake debitage	61
flake fragment debitage	59
miscellaneous core debitage	20

*Taken from Shafer, 1973, table 2; does not include some items tabulated in this paper.

A surface collection of chipping debris from the Chalk Creek #1 site (41 WA 71) made by Bill Moore provides us with an opportunity to look at the byproducts of tool manufacture at a site near the source area. The Chalk Creek site is a small site located on a sandy ridge about 3 kilometers away from the Chalk Pit quarry. As would be expected at a site so close to the source area, fused volcanic glass makes up a larger proportion of the chipping debris and frequently occurs in the form of larger flakes than at the Davis site. Manning fused glass comprises about 60% to 70% of the Chalk Creek surface collection.

This assemblage of manufacturing debris is quite different from the George C. Davis sample and suggests that manufacturing processes differed at the two sites. It might not be legitimate to treat this surface collection as an assemblage, since both heavily patinated and unpatinated or lightly patinated flakes are present, but sorting of the flakes by degree of patination shows that patination does not covary

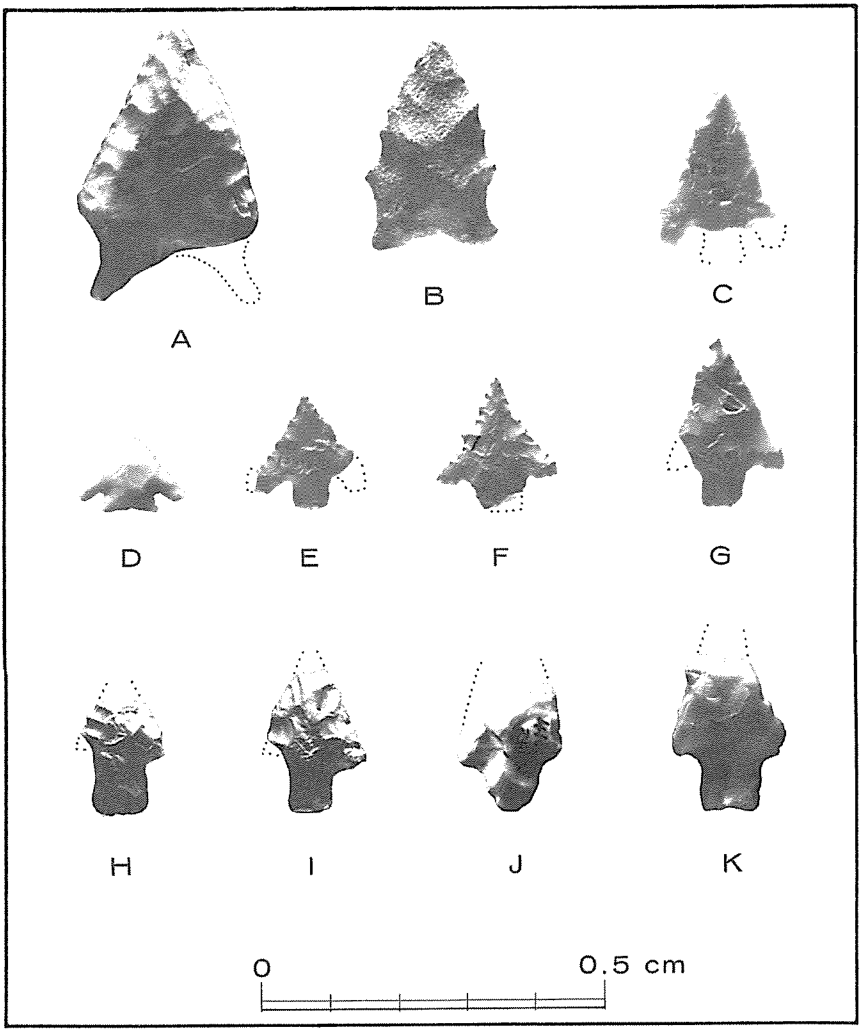


FIGURE 5. *Projectile points made of fused volcanic glass from the Manning Formation* A, *San Patrice*, C. W. Ellis site (41 PK 1); B, *San Patrice*, Rusk County; C, *Catahoula* (?), Houston site (41 SJ 19); D, unclassified arrow point, 41 TN 11, surface; E. *Alba* or *Catahoula*, Claude Riley collection, Madison County; F, *Alba*, Robbin's Ferry site (41 HO 4), surface; G, *Alba*, George C. Davis site (41 CE 19), WPA excavations, sub-Mound A wash, near features 12, 13, 14, depth 14 inches; H-K, arrow point preform failures, George C. Davis site; H, K, surface southeast of Mound B; I, plow zone over Mound B; J, surface, east of Highway 21.

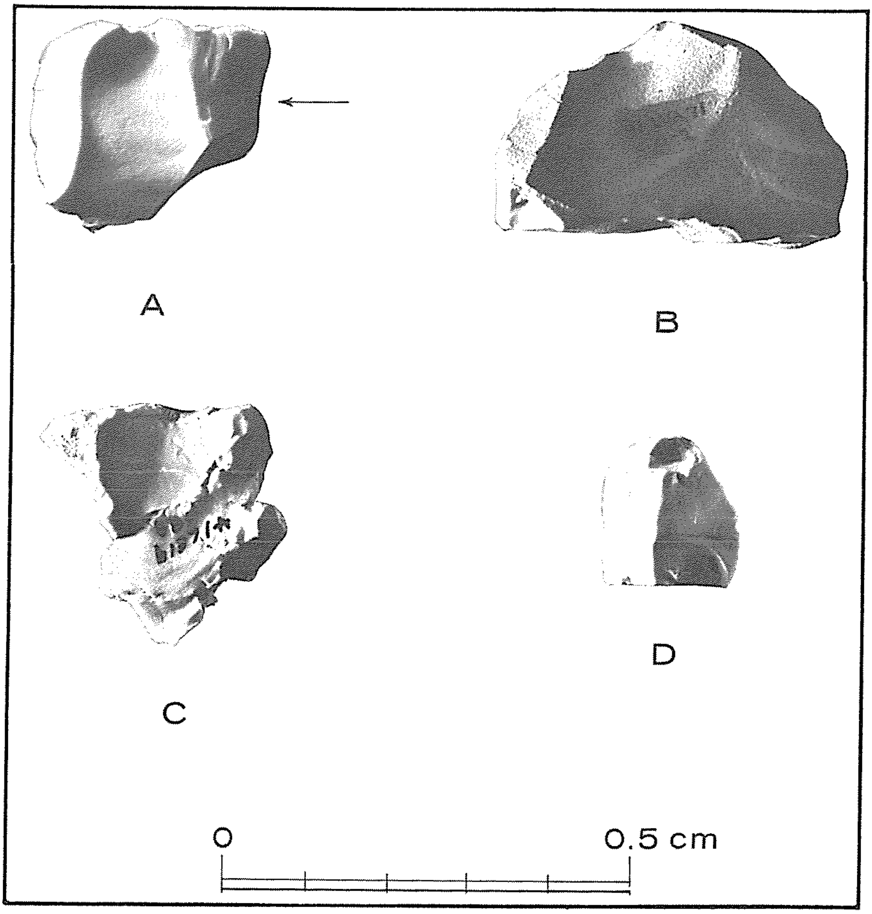


FIGURE 6. *Cores of fused volcanic glass from the Manning Formation* A, free-hand/bipolar (?) core remnant, Chalk Creek site, surface; arrow indicates direction of possible bipolar percussion blow; B, core, technique uncertain, Chalk Creek site, surface; C, core remnant, technique uncertain, George C. Davis site, Unit 6 plow zone; D, bipolar core, George C. Davis site, surface east of Highway 21, area M5.

with the descriptive categories presented below. The Chalk Creek sample can be partitioned into the following categories:

1. Flakes with intact platform remnants and moderately developed bulbs of percussion (N = 42). This group of flakes is almost certainly the result

of percussion with a hard hammer on cores that were not supported on a hard anvil. These flakes have platform remnants that are in many cases quite broad; many flakes are short, wide, and expanding in shape, others elongated, a few irregular; these tend to be thick in cross-section, tapering toward the distal end, but most are not markedly arched. Nine are snapped near the distal end.

2. Flakes from early stages of biface thinning? (N = 15). These have narrow, frequently battered platform remnants and are elongate and very thin, often with a reticulate scar pattern on the dorsal surface. Platform remnants are similar to the direct impact percussion flakes, but the elongate shape and marked thinness suggests hard hammer percussion from early stages of biface thinning. One has a faceted platform remnant and falls within the range of variability of soft hammer thinning flakes, but none have lipped platform remnants.

3. Flake fragments possibly from thinning flakes (N = 3). The proximal ends of these are snapped off but their shape and thinness suggests they are broken examples of flakes in the preceding category.

4. Direct impact percussion flakes (N = 92). *Direct impact percussion* is a useful term introduced by Shafer (1973: 114) to describe flakes that result from blows delivered head-on at a 90^0 angle to the striking platform, but lacking the definitive attributes of anvil percussion (such as bipolar battering). Direct impact flakes can result either from anvil or free-hand percussion. These flakes are characterized by well developed cones of percussion or by platform remnants that are shattered, often with a jagged, ridgelike edge, or are extensively battered. The *columnar-faceted* shape characteristic of bipolar percussion is absent, however, and none of the flakes show bipolar battering. Fourteen of these flakes have cones of percussion, including 5 snapped near the distal end. Seventy-eight have shattered platforms, including 28 snapped near the distal end and 10 hinged through toward the dorsal surface. These flakes have attributes that could result either from free-hand or anvil percussion, but as a group they do not closely resemble debris from experimental bipolar reduction of Manning fused glass cores.

5. Flake fragments (N = 130).

6. Angular shatter fragments (N = 28).

7. Cores (N = 5). Three are exhausted core nuclei (Fig. 6A, B); one has what looks like a free-hand percussion scar on one face, with extensive battering on a lateral edge, perhaps from anvil percussion (Fig. 6, A). One is a spall from what may be a crudely worked biface.

8. Unclassified fragments (N = 3).

TOTAL: 318

This classification of the chipping debris seems to indicate that manufacturing processes at the Chalk Creek site were directed less toward bipolar reduction of small cores than at the Davis site and more toward free-hand reduction of larger cores, possibly indicating production of thinned bifaces. Aside from the possible biface fragment mentioned above in category 7, no definite examples have been discovered at the site. One elongate biface fragment and one possible dart point blade fragment are made of unidentified material that could be fused volcanic glass. In summary, the chipping debris at Chalk Creek seems to indicate both greater availability of Manning fused glass and the manufacture of tool types different from those being made at the Davis site.

SUMMARY

Fused volcanic glass is a highly localized natural resource that apparently occurs, at least in chippable form, only at a few localities within the Manning Formation (baked shales are less readily identifiable since they also occur at localities in the Wilcox Group). There is clear evidence that one or more of these localities was known as early as the Early Archaic, and by the early Caddoan period, fused volcanic glass was being distributed as far north as the middle Sabine drainage, 120 kilometers away, although the material was never used in quantity except in the vicinity of the outcrop. It seems unlikely that knowledge of the material was lost during the Middle and Late Archaic, since many of the sites at which fused volcanic glass chipping debris occurs also have Middle or Late Archaic dart points made of chert, quartzite, or petrified wood. It is also worth mentioning that many of the sites also have sandy paste pottery and some have Catahoula sandstone, both items that could also have been obtained in the Kisatchie Escarpment region.

While most of the sites included in this study are either undated or poorly dated, the evidence from the Davis site and the Martin Lake area indicates minor use of fused volcanic glass over fairly long periods of time, suggesting some sort of long-standing resource distribution pathway connecting these areas and the Kisatchie Escarpment region. At the Davis site occasional use of fused volcanic glass over a period of several centuries may be indicated.

Even more interesting, though, is the evidence already presented to support the hypothesis that the Martin Lake fused glass was derived from a source locality that was probably different from that (presumably the Chalk Pit) supplying other east Texas sites. This implies *two* distribution pathways, one supplying the middle Sabine drainage and the other supplying the Trinity, Neches, and Angelina drainages. Careful petrographic studies are needed to investigate and verify this relationship.

Knowing that fused volcanic glass would have been more difficult to obtain with increasing distance from the outcrop, we might predict that sites farther away from the Manning Formation would show more thorough reduction of cores, resulting in smaller exhausted cores, smaller flakes, more reliance on anvil percussion, and more recycling of chipping debris. In general this seems to be true, partly illustrated by differences in chipping debris at the Chalk Creek and George C. Davis sites. Ultimately it may be possible to plot, for each site, weights of flakes and cores against distance from the outcrop in order to form a regression estimate of intensified reduction with transport distance. This might allow us actually to identify *distribution centers* (positive residuals) and *consumer sites* (negative residuals) within the distribution networks.

ACKNOWLEDGEMENTS

The research reported here was begun in 1970 and continued in 1975 with encouragement and material support from Dee Ann Story, Director, Texas Archeological Research Lab. Mr. Gail L. King, Jr., of Crockett first took me to the Chalk Pit quarry in 1970. Bill Caskey and L. D. Stewart of Houston made their collections available for study. Bill Moore of Huntsville made his collections available for study, took me to some of the sites he has reported, provided hospitality during my stay in Huntsville, and donated chipping debris from some of the sites to TARL. Carolyn Spock assisted in plotting chipping debris at the Davis site. Others who have provided information or assistance include Harry Shafer (Department of Sociology and Anthropology, Texas A&M University), S. E. Clabaugh (Department of Geology, University of Texas at Austin), Ed Garner (Bureau of Economic Geology), and Milton Bell (Texas Highway Department).

References Cited

Davis, E. Mott and Salvatore Valastro, Jr.
1970 University of Texas Radiocarbon Dates VIII. *Radiocarbon*, Vol. 12, No. 2, pp. 617-639.

Harris, R. King and Inus Marie Harris
1967 Trade Beads, Projectile Points, and Knives. In: Robert E. Bell, Edward B. Jelks, and W. W. Newcomb, *A Pilot Study of Wichita Indian Archeology and Ethnohistory*. Final Report for Grant GS-964, National Science Foundation, pp. 129-162.

King, E. A., Jr. and Peter U. Rodda
1962 Fused Rocks in the Jackson Group (Eocene), Texas. *Transactions, Gulf Coast Association of Geological Societies* No. 12, pp. 265-270.

Lonsdale, John T. and David J. Crawford
1928 Pseudo-Igneous Rock and Baked Shale from the Burning of Lignite, Freestone County, Texas. In: *Contributions to Geology, 1928, University of Texas Bulletin*, No. 2801, pp. 147-158.

Renick, B. Coleman
1936 The Jackson Group and the Catahoula and Oakville Formations in a Part of the Texas Gulf Coastal Plain. *University of Texas Bulletin*, No. 3619.

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

Story, Dee Ann and Salvatore Valastro, Jr.
1975 Radiocarbon dating and the George C. Davis site. Paper presented at the 40th Annual Meeting of the Society for American Archeology, Dallas.

Valastro, Salvatore, Jr., E. Mott Davis, and Alejandra G. Varela
1975 University of Texas Radiocarbon Dates X. *Radiocarbon*, Vol. 17, No. 1, pp. 52-98.

ANALYSIS OF MATRIX SAMPLES FROM A CROCKETT COUNTY SHELTER: A TEST FOR SEASONALITY

J. PHIL DERING AND HARRY J. SHAFER

ABSTRACT

Four matrix samples collected from a thin fiber lens in Gobbler Shelter, Crockett County, Texas are analyzed in an attempt to determine seasonality. Analyses of the artifacts, plant and animal remains are also reported. Problems of plant identification are discussed and preliminary techniques for identification of the plant materials are described. Insufficient knowledge of plant flowering behavior and prehistoric plant distribution prevented the determination of seasonality. A more inclusive approach which involves placing the seasonality question in its proper ecological context is suggested.

INTRODUCTION

"No material relicit of a former population can be discarded as irrelevant" (Heizer and Cook 1956:230).

Archeologists have found the analysis of plant remains to be indispensible to the reconstruction of prehistoric subsistence patterns. Although many reports emphasizing analysis of plant remains have been printed recently, archeologists have overlooked one of their best data sources, southwest Texas. In this paper we report the analysis of well preserved plant material from a small, dry rockshelter in Crockett County, Texas. The data were used in an attempt to determine which season or seasons[1] the site was utilized by prehistoric hunter-gatherer groups.

Literally hundreds of small rockshelter sites occur in the limestone canyons of west central, southwest, and west Texas. Many of these shelter sites once contained dessicated plant remains left by aboriginal inhabitants. The cultural deposits in an alarming number (perhaps most) of these rockshelter sites have been destroyed by relic hunters for the sake of a few chipped stone artifacts. In other instances, amateur archeologists have attempted to obtain controlled samples of artifacts from these sites. However, by discarding the dried plant materials they overlooked perhaps the largest potential source of information about the lifeways of the prehistoric inhabitants.

[1]For the purposes of this paper, "season" is used in the chronological sense to denote one of the four astronomical periods of the year: spring, summer, autumn, and winter.

For the most part, the amateur archeologists cannot be faulted for this inappropriate sampling technique, for they were using precisely the same methods of collecting employed by professional archeologists. At the time of this writing, partial excavations at 11 rockshelter sites have been reported from Crockett County (Lorrain 1968; Riggs 1968a, 1968b, 1969, 1974; Word 1971). Several of these shelters contained dried plant remains but the materials were neither systematically collected nor analyzed.

OBJECTIVES

Many hunter-gatherer groups follow a seasonal migratory path in search of food (Lee and Devore 1968: 12). Since the prehistoric populations who inhabited the Live Oak Creek area were hunters and gatherers and since the dry deposit at Gobbler Shelter was 10 cm. or less in thickness, the analysis of the botanical materials in the fiber lens could yield data on seasonality. We felt that there was a good chance the shelter was visited intermittently by late prehistoric groups during one or more seasons of the year. A demonstration of seasonality could be used to advance hypotheses regarding the subsistence settlement models of Late Archaic populations in the area.

DESCRIPTION OF THE SITE

Gobbler Shelter is a westward-facing rockshelter located on a small tributary canyon of Live Oak Creek in Crockett County, Texas (Fig. 1, A,B). The rockshelter is about 23 meters wide, 7 to 9 meters deep, and 2 to 3 meters high at the drip line. The site was recorded in 1974 by Texas Highway Department archeologists during the course of their work along the proposed right-of-way of Interstate 10. Prehistoric cultural activity was evident from the outside by a thin burned rock talus on the slope in front of the shelter and remnants of soot deposits on the ceiling. A badly disturbed dark gray ashy deposit was evident under the overhang near the drip line; dessicated plant remains could be seen in the edges of several potholes in the central portion and near the southern end. Much of the floor at the back of the shelter was exposed limestone bedrock. It is estimated that approximately 70% of the aboriginal deposit was destroyed by artifact collectors.

The fill exposed in the walls of several shallow potholes revealed a stratified deposit averaging 20 to 25 cm. thick. The upper portion of the deposit consisted of 4 to 6 cm. of compacted sheep dung overlying a thin layer of white limestone dust weathered from the shelter wall.

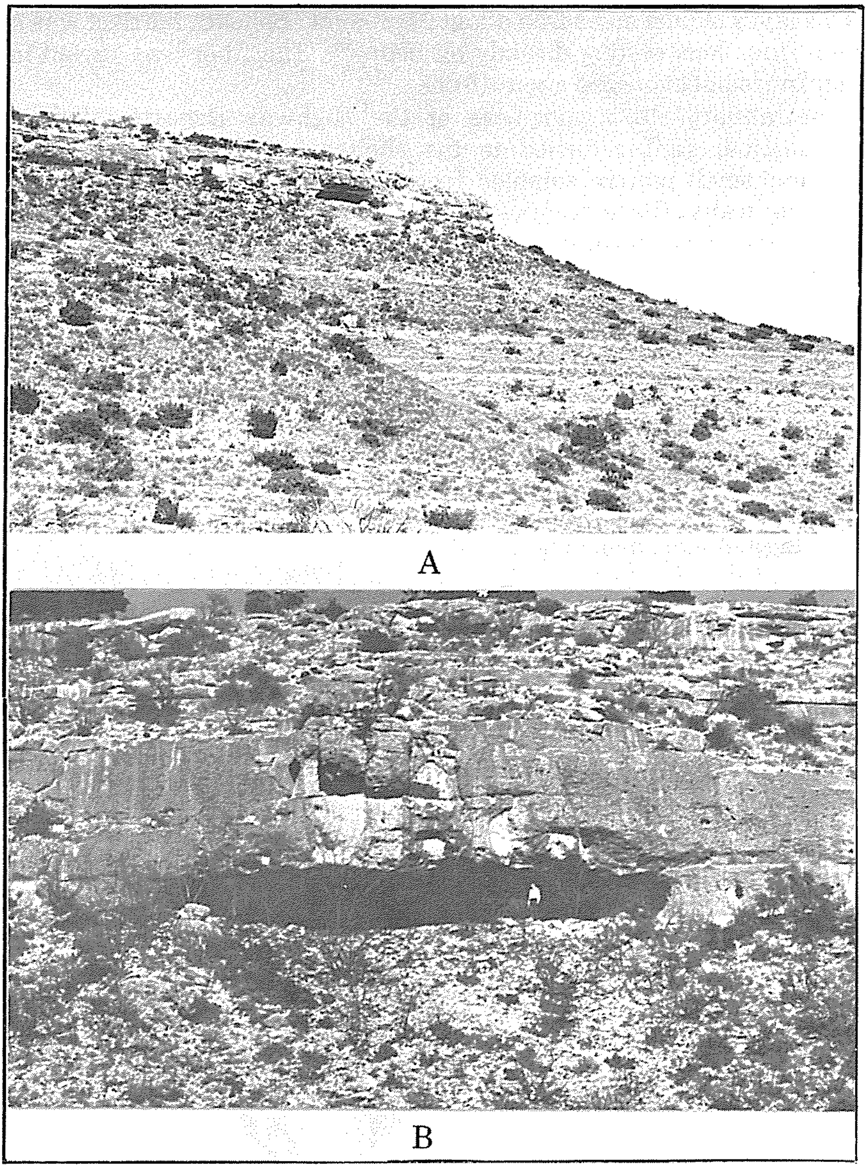


FIGURE 1. *Views of Gobbler Shelter.* A, View of shelter setting, Gobbler Shelter (41 CX 117) located on the right; site 41 CX 113 to the left. B, View of Gobbler Shelter (41 CX 117).

This layer of dust measured about 6 cm. thick. Beneath the dust was a thin fiber lens resting directly on bedrock. The fiber lens varied in thickness but averaged about 10 cm.

In January, 1975, members of the Highway Department's archeological staff returned to the shelter for the purpose of obtaining small matrix samples from the fiber lens exposed in the pothole walls. These samples were sent to the Texas A&M University Anthropology Laboratory for analysis.

This study reports the contents of four of these samples together with a small collection of artifacts obtained from the surface of the shelter.

ARTIFACTS

The small sample of artifacts collected from the surface and pothole backdirt during the two trips to the site is described below.

Cordage (6 specimens; Fig. 2, D-F)

There are 5 examples of 2-ply, Z-twist yarn in the sample. The diameter of the smallest is 1 mm., while the largest twist measures 4 mm. The fibers

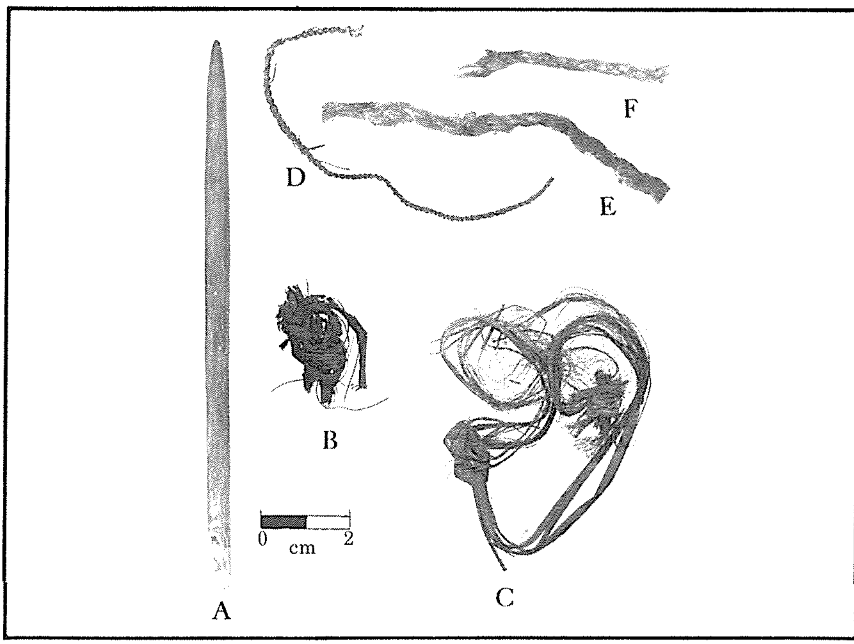


FIGURE 2. *Perishable artifacts.* A, pointed stick; B, C, knotted fiber; D-F, cordage.

of three examples are from unidentified plants. One specimen of cordage is a 4-ply yarn with S-twist fibers twisted into a 2-ply Z-twist which was then S-twisted into a 4-ply yarn. Two specimens (one shown in Fig. 2, F) are of combined plant fibers and hair. Identification of the hair was made by Glendon H. Weir (ms.) on the basis of structural data using the Scanning Electron Microscope. He compared the archeological specimens with fur samples in the mammalian reference collection in the Wildlife and Fisheries Department at Texas A&M University. Weir's findings indicate that the hair is jackrabbit (*Lepus californicus*).

Knotted Fibers (5 specimens; Fig. 2, B, C)

Four of these are square knots and one is an unidentified fragment. Three are tentatively identified as *Yucca* sp. on the basis of the cell morphology in traces of the epidermis (see methods section for description of this technique). Two of these knots are on the same fiber strip (Fig. 2, C). The fourth square knot is made with *Agave lecheguilla*; here again, the identification was made on the basis of epidermal cell shape. The fifth and fragmentary specimen is unidentified.

Modified stick (1 specimen; Fig. 2, A)

This artifact is 12.3 cm. long and 5 mm. in diameter at the maximum. The entire surface of the stick has been presumably scraped with a sharp edged stone tool, and one end is tapered to a point. The point appears to have been fire-hardened and is polished from use. Traces of polish extend up the stick approximately 2 mm. from the tip. The opposite end exhibits a series of hack or cut marks, the largest of which appears to have severed the stick from a larger piece. Owing to the polished tip, it is doubtful that this stick functioned as a foreshaft as one might suspect from a cursory glance. The polished tip suggests that it may have served as a wooden awl.

Lithic Artifacts

Several stone artifacts were recovered from the disturbed fill in the front portion of the shelter. This sample includes unmodified flakes, an unretouched chert nodule or core, a chert core-hammerstone, modified chert flakes, and a mano fragment.

Two of these flakes were removed during the course of retouching a biface. Three were removed from cores by hard-hammer percussion during early stages of core reduction.

One specimen (Fig. 3, C) is a flake fragment which is unifacially retouched along one edge. Traces of charred organic material adhere to one end. Another specimen (Fig. 3, A) is a burned fragment of a unifacially retouched tool. The flake's ventral surface exhibits a high gloss resulting from extensive use along and near the retouched edge. This gloss plus the unifacial retouch indicates that this specimen was used as a knife. The angle of the modified edge is 48 degrees.

Utilized Flake (1 specimen; Fig. 3, B)

A hard-hammer flake exhibits bifacial edge nicking around much of the lateral margins; traces of edge polish can also be detected in two areas. The edge angles are sharp, measuring 40 degrees or less.

Hammerstone (1 specimen; Fig. 3, F)

A fragment of a chert nodule has been battered along a thick portion of the edge. The battering is not extensive.

Core Fragment (1 specimen)

This item is a tabular chert nodule 71 cm. long and 37 cm. wide that exhibits two flake facets. It has not been altered otherwise.

Mano Fragment (1 specimen; Fig. 3, G)

This specimen is of coarse-grained quartzite, a material which is clearly foreign to this predominantly limestone region. The mano was bifacial and extensively used. There does not appear to be any clear evidence of use subsequent to its breakage. Therefore, it was likely broken at the site. Traces of unidentified organic material adhere to the pits in both faces.

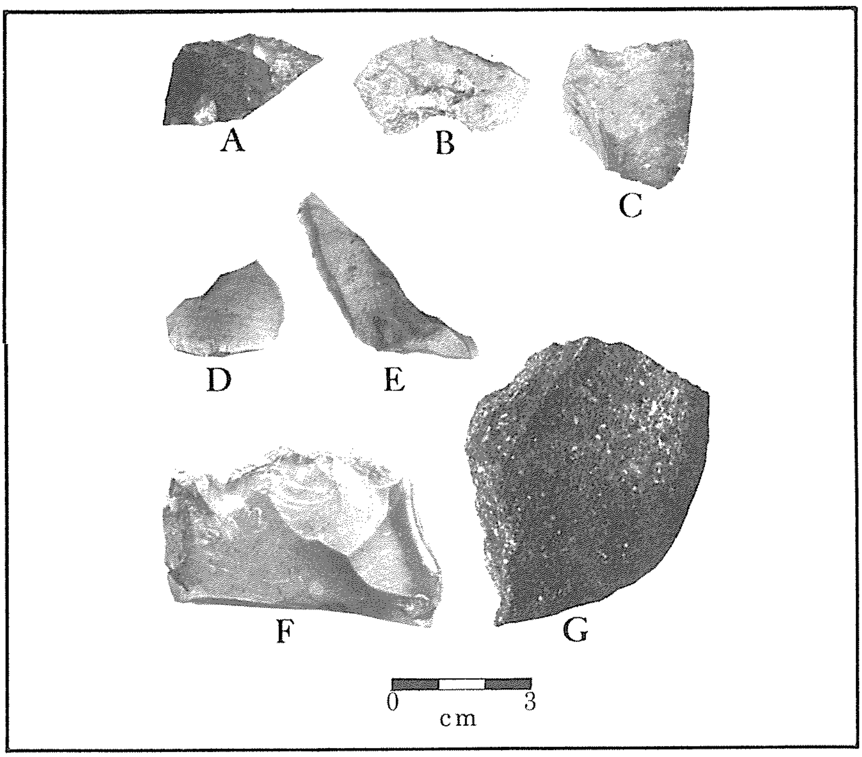


FIGURE 3. *Lithic artifacts.* A-C, retouched flakes; D, E, unmodified flakes; F, hammerstone; G, mano fragment.

Comments on the Artifacts

This small artifact sample is not considered sufficient to be representative of those activities at the site that are manifested in material remains. The sample is, however, indicative of the diversity of activities carried out here, such as those involving manufacture and use of chipped stone tools, use of ground stone tools, use of various artifacts requiring the manufacture and/or use of cordage, knotted fibers, perhaps weaving, certainly food preparation, and cooking. Taken together, the range of functions at the site strongly suggests that Gobbler Shelter served as a camp site.

This sample is also lacking temporally-diagnostic specimens. However, based on findings from other small rockshelter sites in Crockett County (Lorrain 1968; Word 1971), we expect that the deposits date some time after 500 B.C., either during the Late Archaic or post-Archaic periods.

PLANT ANALYSIS

A. Methods

Each of the four Gobbler Shelter matrix samples filled a 20-pound paper bag about two-thirds full. The samples were sifted through a window (1/16-inch) screen to remove the cave dust. The material which passed through the screen was examined for very small seeds and then discarded. The rest was hand sorted, identified and separately packed for storage.

Because of the small sample size, the seeds were simply counted. Measurement of bulk volume is a more satisfactory indication of relative abundance. The vegetative remains of sotol, lechuguilla, and yucca were weighed. Plant remains were identified using seed identification manuals, illustrated floras, and available reference collections.

In dry areas of southwest Texas fibrous remains of lechuguilla, sotol, and/or yucca often comprise the bulk of the dry midden contents. Sandals, matting, baskets, and cordage which were made of the leaves and fiber of these plants have often been recovered. Charred and/or chewed leaf parts (quids) are often an abundant midden component. In separating these three genera archeologists have tried to rely on differences in external appearance. However, this method has not been adequate since the altered condition of most plant remains obscures the more obvious morphological characteristics. Recent investigations into the prehistoric subsistence patterns in the lower Pecos River area (Alexander 1970; Moore 1975; Shafer 1975) have created a need for a convenient and more nearly accurate means of identifying these genera in all stages of processing, including the final product, whether it is a quid or a basket.

The problems of accurate identification of these fibrous remains can be illustrated by reviewing previous reports from the lower Pecos area. Irving (1966: 61-88) reported fibrous plant remains from six shelters in the Amistad district. He found that lechuguilla was the dominant economic plant, yet sotol was not mentioned. This is contradictory since at Fate Bell Shelter, one of the sites Irving studied, two sotol cooking pits with fragments of sotol had been reported earlier by Pearce and Jackson (1933: 16-17). At Baker Cave in Val Verde County, Word and Douglas (1970: 12-13) reported that quids were present but made no attempt at identification. Remains of lechuguilla were the most abundant midden component in Parida Cave (Alexander 1970: 63) and Conejo Shelter (Alexander 1974: 220), both in Val Verde County.

In Crockett and Pecos Counties, upstream from the Val Verde County sites virtually no macrofossil analyses have been made. Holden (1941: 33) found many quids in McKenzie Cave in Pecos County that he said were "perhaps sotol." Near Iraan in Crockett County, Lorrain (1968: 43) reported only a few knotted sotol leaves and several cut lechuguilla leaves from Meadows Shelter H and she found no perishables at the Sotol Site. At Red Mill Shelter, Word (1971: 306) identified cut leaves of sotol, sacahuisti (*Nolina texana*) and lechuguilla. He found two types of quids which he speculated were of sotol and lechuguilla (Word 1971: 307).

None of these reports substantiate their plant determinations by detailing identification methods. Anyone trying to synthesize prehistoric subsistence patterns in the lower Pecos River area is faced with a mixture of conflicting data.

Recognizing the need for dependable means of identifying sotol, yucca, and lechuguilla, we began testing different analytical techniques. Of the methods attempted, the one involving the comparison of the cuticular features of the three genera has proved the most promising. Thin pieces of the leaf's epidermis are placed on a clean glass slide with a drop of clearing solution over which is placed a cover slip. Microscopic identification is made by comparison to known reference specimens. Photographs taken by Glenna Williams-Dean of a lechuguilla quid epidermis and lechuguilla, sotol and yucca reference leaf cuticle are shown in Figures 4 and 5.

This technique is preliminary, but refinement and expansion of the process could insure quick and dependable identification of even highly modified plant remains. We believe this technique will be

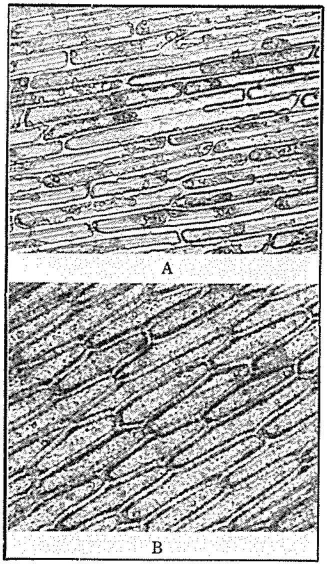


FIGURE 4. A, photograph of the epidermal cells of sotol (*Dasylirion texanum*); B, epidermal cells of lechuguilla (*Agave lecheguilla*).

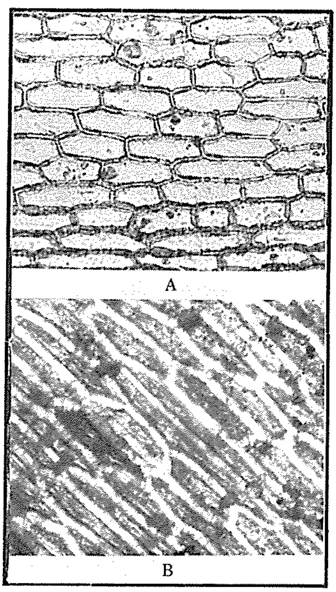


FIGURE 5. A, photograph of the epidermal cells of Yucca (*Yucca* sp.); B, epidermal cell of cut leaf base from Gobbler Shelter identified as *Agave lecheguilla* (compare with Fig. 4, B).

especially helpful in determining the specific plants used in manufacturing material culture elements, and have already demonstrated its potential in artifact analysis by identifying the genera of the split and knotted leaves from Gobbler Shelter.

B. Results

The results of the quantitative analysis of macrofossils from Gobbler Shelter are listed in Tables 1 through 4. The sample size was

TABLE 1. CONTENTS IN MATRIX SAMPLE #1

Scientific Name	**Common Name**	**Number or Amount**
Leaves:		
Quercus virginiana	Virginia Live Oak	35 leaves
Quercus pungens	Vasey Shin Oak	29 leaves
Juniperus sp.	Juniper, Cedar	24 leaf fragments
Seeds, Bulbs:		
Prosopis sp.	Mesquite	13 seeds
Juniperus sp.	Juniper, Cedar	102 seeds
Opuntia sp.	Prickly Pear	205 seeds
Allium drummondii	Onion	13 bulb fragments
Quercus pungens	Vasey Shin Oak	11 acorn fragments
Juglans microcarpa	Walnut	4 fragments
Setaria lutescens		3 infloresence stalks, numerous seeds
Diospyros texana	Texas Persimmon	1 seed
Other Plant Remains:		
Dasylirion texanum	Sotol leaf & caudex fragments	27.8 grams
Agave lecheguilla	Lechuguilla leaf & caudex fragments	191.9 grams
Yucca sp.	Yucca leaf & caudex fragments	32 grams
Gramineae		5 culms
Faunal Remains:	**Number**	
fish vertebrae	8	
scales	3	
gill covers	1	
small bone fragments	3	

small and indicates the contents of only a fraction of the Gobbler Shelter midden. Leaf and caudex fragments of Yucca (*Yucca* sp.), lechuguilla (*Agave lecheguilla*), and sotol (*Dasylirion texanum*), constituted the largest portion of preserved botanical material. Fruits of mesquite (*Prosopis* sp.), juniper (*Juniperus* sp.), prickly pear (*Opuntia* sp.), oak (*Quercus pungens*), walnut (*Juglans microcarpa*), and persimmon. (*Diospyros texana*), indicated that other plant resources were exploited when ripe.

TABLE 2. CONTENTS IN MATRIX SAMPLE #2

Scientific Name	**Common Name**	**Number or Amount**
Leaves:		
Quercus virginiana	Virginia Live Oak	11 leaves
Quercus pungens	Vasey Shin Oak	5 leaves
Diospyros texana	Texas Persimmon	35 leaves
Seeds, Bulbs:		
Allium drummondii	Onion	4 bulb fragments
Opuntia sp.	Prickly Pear	52 seeds
Juniperus sp.	Juniper, Cedar	85 seeds
Prosopis sp.	Mesquite	25 seeds
Quercus sp.	Oak	8 acorn fragments
Juglans microcarpa	Walnut	5 walnut fragments
Diospyros texana	Texas Persimmon	1 seed
Gramineae	probably three unknown species	
Other Plant Remains:		
Dasylirion texanum	Sotol leaf & caudex fragments	(including 5 quids) total wt. 65 grams
Opuntia joint fragments	Prickly Pear pads	3.5 grams
Agave lecheguilla	Lechuguilla leaf & caudex fragments	58 grams
charcoal		10 grams
Faunal Remains:	**Number**	
beetle	1	
rabbit bone	1	
charred bones	2	

The remains of plant and animal resources are listed in Table 5. No attempt will be made to explore all of the uses of the plant and animal parts identified in the matrix samples. The samples were collected mainly to seek an answer to the problem of seasonality and not to provide a definitive statement concerning the much more encompassing problem of plant use. However, using information derived from this study we can tentatively list those plants which we feel served as food and material for manufacturing products.

Coprolite analyses from other locations in the lower Pecos River area have provided a substantial list of plant foods actually consumed by peoples of the Lower Pecos Archaic (Riskind 1970;

TABLE 3. CONTENTS IN MATRIX SAMPLE #3

Scientific Name	Common Name	Number or Amount
Leaves:		
Quercus virginiana	Virginia Live Oak	3 leaves
Quercus pungens	Vasey Shin Oak	7 leaves
Juniperus sp.	Juniper, Cedar	20 leaf fragments
Fouquieria splendens	Ocotillo	7 leaves
Diospyros texana	Texas Persimmon	53 leaves
Seeds:		
Prosopis sp.	Mesquite	21 seeds
Quercus sp.	Oak	6 acorn fragments
Juniperus sp.	Juniper	85 seeds
Allium drummondii	Onion	58 bulb fragments
Diospyros texana	Texas Persimmon	1 seed
Opuntia sp.	Prickly Pear	37 seeds
Other Plant Remains:		
Dasylirion texanum	Sotol leaf & caudex fragments	54 grams
Agave lecheguilla	Lechuguilla leaf & caudex fragments	58 grams
Yucca sp.	Yucca leaf & caudex fragments	17 grams
Opuntia sp.	Prickly Pear pads	4.4 grams
Unidentified Quids		48 grams
Unidentified fiber mass (Lechuguilla, Sotol, or Yucca)		23 grams
Charcoal		7.8 grams

Bryant 1974). This information, combined with ethnographic data on historic Indian adaptations in the American Southwest (Shafer, *et al* 1975) serves as the basic reference in our interpretations of the uses for some plants. The economic uses of other plants or plant parts not used for food are more certain since they occurred in the artifactual remains at the site.

TABLE 4. CONTENTS IN MATRIX SAMPLE #4

Scientific Name	Common Name	Number or Amount
Leaves:		
Quercus virginiana	Virginia Live Oak	19 leaves
Quercus pungens	Vasey Shin Oak	41 leaves
Berberis trifoliolata		1 leaf
Juniperus sp.	Juniper	86 leaf fragments
Diospyros texana	Texas Persimmon	94 leaves
Seeds, Bulbs:		
Prosopis sp.	Mesquite	11 seeds
Juniperus sp.	Juniper	37 seeds
Opuntia sp.	Prickly Pear	33 seeds
Allium drummondii	Onion	4 bulb fragments 2 bulbs
Celtis sp.	Hackberry	1 seed
Diospyros texana	Texas Persimmon	1 seed, 1 calyx
Juglans microcarpa	Walnut	7 fragments
Quercus sp.	Oak	4 acorn fragments, 2 acorns
Sophora segundiflora	Mountain Laurel	1 seed, 1 pod fragment
Other Plant Remains:		
Dasylirion texanum	Sotol leaf & caudex fragments	90 grams
Agave lecheguilla	Lechuguilla leaf & caudex fragments	65 grams
Yucca sp.	Yucca leaf & caudex fragments	22 grams
Agave lecheguilla	Lechuguilla quids (5)	14 grams
Dasylirion texanum	Sotol quids (3)	12 grams
Unidentified Quids	(21)	73 grams
Opuntia sp.	Prickly Pear pad fragments (13)	38 grams

The listing in Table 5 is representative only of the matrix samples themselves and not necessarily the shelter as a whole. A more comprehensive and informative listing of economic plants and animals will be possible only after the completion of additional sampling of the shelter. Nevertheless, the contents of the samples may be viewed as random selections and therefore give some indication of the range of plants and animals exploited by the aboriginal populations who frequented Gobbler Shelter.

C. Discussion

The prehistoric hunter-gatherers of the lower Pecos River area utilized plants extensively in their diet and in their subsistence technology. As emphasized earlier, dry conditions in many of the area's rockshelters have saved otherwise perishable plant remains in midden deposits for thousands of years. While analysis of the perishable artifacts has contributed much to the understanding of these aboriginal populations, the bulk of the dry shelter middens is composed of plant refuse, the by-product of implement making and food preparation.

Although plant macrofossils comprise the bulk of deposits in many of the lower Pecos area rockshelters, few people have systematically collected and examined them. There are only four reports which seriously treat plant remains from the lower Pecos River area (Irving 1966; Alexander 1970, 1974; Shafer, *et al* 1975). All of these papers dealt with plant macrofossils found in caves downstream from Crockett County, in or near the Amistad Lake district. The earliest paper was a partially quantified checklist of plant parts recovered from six rockshelters in the Amistad district (Irving 1966:89). Irving's (1966:89) only significant remark about his data was that plant usage differed among the six sites. Shafer, *et al* (1975) reported ten of the most abundant plant species recovered from 41 VV 456. Interpretation of data was confined to cautious speculation about the utility of these plants. Both of the studies by Irving and Shafer, *et al*, were preliminary reports.

Alexander's observations on vegetal remains from Parida Cave (41 VV 187) constituted the first significant interpretation of plant macrofossils from the lower Pecos area. He reported that vegetal parts of lechuguilla, sotol, and prickly pear occurred in "overwhelming proportions" which "Occupied important positions in the prehistoric diet" (Alexander 1970: 61). This component of the vegetal refuse was probably available on a year-round basis, raising the possibility of long-term shelter occupation. Therefore Parida Cave may have been retained as a campsite, or permanent base, from which long range foraging was conducted (*ibid*: 63).

TABLE 5. SUGGESTED USES FOR PLANT AND ANIMAL PARTS

FOOD

Plants

- Sotol bulbs, leaf bases (*Dasylirion taxanum*)
- Lechuguilla caudex fragments, leaf bases (*Agave lecheguilla*)
- Yucca bulbs (*Yucca* sp.)
- Mesquite beans (*Prosopis glandulosa*)
- Prickly pear fruit, pads (*Opuntia* sp.)
- Onion bulbs, stems? (*Allium drummondii*)
- Vasey shin oak acorns (*Quercus pungens*)
- Walnuts (*Juglans microcarpa*)
- Hackberry seeds (*Celtis* sp.)
- Texas persimmon fruit (*Diospyros texana*)
- Live oak acorns (*Quercus virginiana*)
- Juniper berries? (*Juniperus* sp.)
- Grass seeds (*Gramineae*)

Animal

- Fish (unidentified)
- Rabbit (unidentified, probably both jackrabbit and cottontail)
- Deer-size animal

FIBER, CORDAGE

Plant

- Lechuguilla (split and knotted leaves)
- Sotol (cordage)
- Yucca (split and knotted leaves)

Animal

- Jackrabbit fur (cordage, twisted with sotol fiber)

WOOD

- Unidentified wooden awl
- Unidentified firewood (charcoal)
- Unidentified twigs, limb fragments

BEDDING OR FLOORING?

Plant

- Leaves and small boughs of:
  - Live oak
  - Vasey shin oak
  - Texas persimmon
  - Juniper
- Leaf bases, quids, or outer bulb elements of:
  - Sotol
  - Lechuguilla
  - Yucca

HALLUCINOGENIC?

- Mountain laurel (*Sophora segundiflora*) (cf. Campbell 1958)

The first quantitative analysis of plant macrofossil remains from this area was reported four years later (Alexander 1974). The plant material came from Conejo Shelter, located two miles north of the confluence of the Rio Grande and the Pecos River. Alexander used macrofossil data to test a hypothesis explaining prehistoric cultural stability in the lower Pecos area. Because the environment changed very little over a period of about 4,000 years, he believed that the people had a chance to adapt very efficiently and maintain this cultural pattern for a long time. We shall focus on his treatment of seasonality for the purposes of this paper.

Using seasonal flowering and fruit ripening data from Vines' (1960) book on woody vegetation in the American Southwest, Alexander determined the time of year when the fruits of nine economic plants would ripen. He placed them in chronological order of the seasons hoping to find evidence of a similar order in the midden deposits of Conejo Shelter. Instead, he found that most of the plants occurred in varying abundance throughout the midden (Alexander 1974: 197-198). As a result of this broad distribution within the midden, Alexander's conclusions from Conejo Shelter differ from those in his Parida Cave report. Instead of stressing the possibility of year-round shelter occupation, he (1974: 198) states:

> It appears from this [data distribution] that lenses represent the residues from long seasonal occupations which lasted perhaps from early summer through late fall . . .

Alexander's evidence could lead to this conclusion. However, there are many variables which complicate the determination of seasonality from plant macrofossil data.

It is indisputable that many plant resources are available on a short term basis during the year. Seeds and fruits can be excellent examples. If prehistoric peoples in the lower Pecos area made seasonal rounds, they probably left remains of the plants which were available at the time of the year they visited Gobbler Shelter. We were tempted to use these plants as an indication of what season of the year shelters were occupied. Unfortunately we have found that these indicator plant parts are not always available in southwest Texas during the same season of every year. In Table 6 we have demonstrated this problem by comparing Alexander's source of seasonality (Vines 1960) to the flowering and fruiting observations which we made in the summer of 1975. This illustrates the fact that flowering of many plants in the lower Pecos is not directly governed by the "seasons," but by factors such as photoperiodism, temperature, and soil moisture. True, seasons generally exhibit certain levels of light, temperature, and moisture. However, abundant rainfall can result in a double flowering/fruiting of some plant species as we noted during the wet summer of 1975. We realize that any area in the world is subject to this variation. But in southwest Texas rainfall is so erratic and plant response to moisture is so pronounced that archeologists seeking clues to seasonality should not overlook these factors.

The problem is easily illustrated by applying our reasoning to the Gobbler Shelter data. As shown in Tables 1 through 4, we recovered seeds, fruits, or flower parts representing nine plant genera. One must remember that these plant remains were available to human populations because the plants had produced fruits in response to local environmental conditions.

The left column in Table 6 shows when the plants might normally flower. However, if the winter is mild and rainfall is heavy, flowering can occur much earlier and extend late into the fall. In fact, any combination of rain or drought and warm or cold could produce flowering or fruiting which is idiosyncratic to a given year or series of years. In the case of Gobbler Shelter, we have evidence of occupation from late summer to early fall *only if* we follow Vines' (1960) schedule of flowering. If we compare our data to the observations made in a wet year (See Table 6, right column) occupation is shifted to earlier in the summer and extends later into the winter. Moreover, one cannot

TABLE 6. POSSIBLE SEASONAL OCCURRENCES OF GOBBLER SHELTER FLOWERING

Plants	**Vines 1960 Months of Flowering**	**Observations of 1975**
Prosopis sp.	August-September	Fruits in July, same trees still flowering
Opuntia sp.	June-September	
Celtis sp.	September-October	Fruits in July
Quercus pungens	September-November	
Juglaus microcarpa	September-November	Fruits in July and August, second flowering in August
Diospyros texana	August-February	Fruits in July, fruit still ripening in late August

exclude the possibility that the shelter was occupied in the winter because an absence of most plant fruits would be a normal winter occurrence. To say that Gobbler Shelter was unoccupied in the winter because of an absence of seasonal indicators would involve the use of negative evidence.

An oversimplified approach has kept us from detecting seasonal occupations at Gobbler Shelter. We lack the information needed to place the problem of seasonality in its proper context. Environmental factors which encourage flowering of each plant species in southwest Texas are not well known. Neither are we certain of the prehistoric distribution of these plants. Six years ago Alexander (1970: 61) emphasized that post-contact changes have occurred in the vegetation of the area. More accurate knowledge of plant distribution in relation to microenvironments will enhance the accuracy of our statements about plant behavior and prehistoric human procurement patterns.

The establishment of an ecological context in southwest Texas for the study of prehistoric human behavior is currently underway at Texas A&M University. The project has two immediate goals: (1) to reconstruct vegetation changes which have occurred in southwest Texas since initial European settlement and (2) to determine the feasibility of selecting certain seasonal indicator plants based on a thorough understanding of their flowering behavior. When we know what makes these plants flower and approximately where they were flowering, our stories of prehistoric lifeways in southwest Texas will become both more informative and more accurate.

CONCLUDING STATEMENT

The results of the analysis of four matrix samples from a small rockshelter containing dessicated plant remains are neither representative nor conclusive with regards to what can be learned from such studies. We do feel, however, that these results indicate the potential of such data sources as plant macrofossils.

The major objective of the study was to determine which season or seasons of the year the shelter had been utilized. To this end, all plant, animal, and lithic materials were sorted and a quantitative list of all components was compiled. During the analysis new plant identification techniques were explored. Refinements of the method will be reported later. Thirteen genera of plants commonly listed as lower Pecos food sources were identified. This represents the largest compilation of potentially economic plants reported from archeological sites in Crockett County. Nine genera of plants were listed as potential seasonal indicators. Wood, fiber, and cordage artifacts made from at least four different plant sources and one animal source were also recovered.

However, in attempting to determine seasonality the question of plant behavior and unpredictable weather conditions complicated the issue. Reliable data on seasonal flowering of plants in the lower Pecos are not available. Field observations by the authors have shown that erratic rainfall can cause very early or very late flowering by plants in semi-arid regions such as the lower Pecos. Because of this highly variable behavior, the assumption that plants flower on a seasonal basis has proved misleading. We conclude that a determination of seasonal occupation at Gobbler Shelter is premature, given the available information. This by no means nullifies the value of plant macrofossil data in interpreting prehistoric subsistence patterns. The problem is merely expanded to include a detailed consideration of both plant and human behavior.

ACKNOWLEDGEMENTS

The authors would like to thank several individuals for their contributions to this study. Gary L. Moore, Glen Goode and Frank A. Weir of the Texas Department of Highways and Transportation directed the authors to Gobbler Shelter and provided the matrix samples for study. The photographs used in Figure 1 were also made available by Frank Weir. Glenna Williams-Dean worked with the senior author on developing methods of identifying leaf fragments of yucca, lechuguilla and sotol. Glendon H. Weir provided the identification for the animal and plant fibers in cordage specimens. Williams-Dean, Vaughn M. Bryant, Jr., Gary L. Moore and B. J. Strode critically reviewed earlier drafts of this paper. However, we assume sole responsibility for any error of fact or interpretation.

REFERENCES CITED

Alexander, Robert K.
1970 Archeological Excavations at Parida Cave, Val Verde County, Texas. *Papers of the Texas Archeological Salvage Project*, No. 19.
1974 The Archaeology of Conejo Shelter: A Study of Stability at an Archaic Rockshelter Site in Southwestern Texas. Ph.D. Dissertation, The University of Texas at Austin.
Bryant, Vaughn M.
1974 Prehistoric Diet in Southwest Texas: The Coprolite Evidence. *American Antiquity*, Vol. 39, No. 3, pp. 407-420.
Campbell, T. N.
1958 Origins of the Mescal Bean Cult. *American Anthropologist*, Vol. 60: pp. 156-160.
Heizer, Robert and Sherburne Cook
1956 Some Aspects of the Quantitative Approach in Archaeology. *Southwestern Journal of Anthropology*, Vol. 12, pp. 229-248.
Holden, W. C.
1941 McKenzie Cave and Adjacent Sites in Pecos County. *Bulletin of the Texas Archeological and Paleontological Society*, Vol. 13, pp. 46-57.
Irving, Robert S.
1966 A Preliminary Analysis of Plant Remains from Six Amistad Reservoir Sites. In: Dee Ann Story and Vaughn M. Bryant, Jr. (assemblers), *A Preliminary Study of the Paleoecology of the Amistad Area. Report of Research*, National Science Foundation, GS-667, Austin.
Lee, Richard B. and Irven DeVore
1968 *Man the Hunter*. Aldine Publishing Company. Chicago.
Lorrain, Dessamae
1968 Archeological Excavations in Northwestern Crockett County, Texas, 1966-1967. *State Building Commission Archeological Program*, Report No. 12.
Moore, Gary L.
1975 Scheduled Hunting and Gathering in the Trans-Pecos. Paper presented at the Symposium "Prehistoric Adaptations in the Chihuahuan Desert." Annual meeting of the Society for American Archaeology, Dallas.
Pearce, J. E. and A. T. Jackson.
1933 A Prehistoric Rockshelter in Val Verde County, Texas. *University of Texas Publication* No. 3327, *Anthropological Papers*, Vol. 1, No. 3.
Riggs, Aaron D.
1968a A Crockett County Shelter (41 CX 10). *Transactions of the Third Regional Archaeological Symposium for Southeastern New Mexico and Western Texas, South Plains Archaeological Society*, pp. 41-50.
1968b A Preliminary Report on a Crockett County, Texas Shelter: 41 CX 12. *Transactions of the Fourth Regional Archaeological Symposium for Southeastern New Mexico and Western Texas, Iraan Archaeological Society*, pp. 2-18.
1969 Rattlesnake Shelter: 41 CX 29. *Bulletin of the Texas Archaeological Society*, Vol. 40, pp. 107-117.
1974 Nan's Shelter: 41 CX 109. *Transactions of the Ninth Regional Archaeological Symposium for Southeastern New Mexico and Western Texas, Midland Archaeological Society*: pp. 25-38.

Riskind, David H.
1970 Pollen Analysis of Human Coprolites from Parida Cave. *Papers of the Texas Archeological Salvage Project*, No. 19, pp. 89-101.
Shafer, Harry J.
1975 Art and Territoriality in the Lower Pecos Archaic. Paper presented at the Symposium "Prehistoric Adaptations in the Chihuahuan Desert." Annual meeting of the Society for American Archaeology, Dallas.
Shafer, Harry J., Phil Dering, Glenna Williams-Dean and Vaughn M. Bryant, Jr.
1975 A Preliminary Report of Hinds Cave, Val Verde County, Texas. *Anthropology Laboratory, Texas A&M University*, Report No. 8.
Vines, Robert A.
1960 *Trees, Shrubs and Woody Vines of the Southwest.* University of Texas Press, Austin.
Weir, Glendon H.
ms. Mammalian Hair from Gobbler Shelter, Crockett County, Texas. Manuscript on file at the Texas A&M Anthropology Laboratory, College Station.
Word, James H.
1971 The Dunlap Complex in Western Central Crockett County, Texas. *Bulletin of the Texas Archeological Society*, Vol. 42, pp. 271-318.
Word, James H. and Charles L. Douglas
1970 Excavations at Baker Cave, Val Verde County, Texas. *Texas Memorial Museum Bulletin* No. 16.

ANCIENT FISHING TECHNOLOGY ON THE GULF COAST OF YUCATAN, MEXICO

JACK D. EATON

ABSTRACT

Except for the introduction of metals and plastics, modern fishing technology on the coast of Yucatan has apparently changed little since ancient times. Handlines with baited hooks, and weighted nets, are still the most common implements used by individual fishermen on the Gulf coast today.

Notched stones and potsherds, interpreted as fishing line sinkers and net weights, have been found at several ancient sites along the Yucatan coast. A comparison in weight range with modern fishing sinkers favorably support the interpretation. Association of these notched objects with coastal settlements dating from the Formative period lend material evidence for a fishing technology which can be traced to the earliest known occupation of the Yucatan coast.

INTRODUCTION

Man has lived beside the sea and obtained much of his subsistence from it since very early times. The practice of fishing, probably as a supplementary source of subsistence, evidently dates to at least the Upper Paleolithic. Fishing societies can be traced back to the Mesolithic and were contemporary with advanced hunting and gathering societies (Lenski and Lenski 1974). Fishing societies, like hunting or agrarian societies, are environmentally specialized; and therefore specialized equipment and techniques were developed to effectively exploit the environment. It appears to have been during the Mesolithic that true fish hooks, nets, traps, and boats with paddles were first used.

Fishing technology was well developed in ancient Egypt, Assyria, China, and by the Greeks and Romans (Radcliffe 1974). In the New World, fishing was practiced by some of the earliest known Americans who arrived during the Pleistocene, and subsequently through all later periods (Willey 1966).

The sea coast in many parts of the world is a rich and varied ecological zone well suited for subsistence exploitation by man. One such zone settled by early man is the Gulf Coast of North America and Mexico. Although sites earlier than the Archaic stage have not been commonly identified on the Gulf Coast, man was almost certainly there much earlier.

During the Pleistocene the sea level was considerably lower than today because of the vast amount of the earth's surface water being trapped in gigantic ice caps. Subsequent melting of the ice due to warming of the earth's atmosphere caused the sea level to rise, thus flooding and covering the earlier coastal habitation sites, and by about 3500-4000 years ago the rising water reached the approximate level at where it is today (Coleman and Smith 1964). This, of course, is an over-simplification of the events, but serves to explain why Pleistocene fishing community sites have not been found on the present coast.

On the Texas Gulf Coast the earliest sites recorded which were associated with marine exploitation belonging to the Archaic stage, possibly as early as around 3000 B.C. and continuing much later in time (Campbell 1956, 1958; Fritz 1972; Hester 1971; Story 1968). There are also later sites occupied into the historic era. Essentially these are shell middens representing the habitation sites of coastal people who subsisted, at least to a large degree, upon marine resources. Little in the artifact collections from the Texas coastal sites clearly demonstrate the actual technology used in fishing, although the faunal remains indicate that fishing techniques were used. Perforated oyster shells, described as possible net weights, are reported from certain Archaic sites (Campbell 1958; Story 1968) and might indicate the use of fish nets or weighted lines. Also reported (Story 1968: 57) are fragments of worked bone which might have been compound fish hooks.

Fishing community sites belonging to the late pre-ceramic period (Archaic) have been reported on the Gulf Coast in the Mexican State of Veracruz (Wilkerson 1975). Included in the artifact collections is an object (not illustrated) described as a net sinker, suggesting the use of fishing nets.

On the Yucatan coast the earliest occupation so far uncovered belongs to the Middle to Late Formative period (*ca.* 400 B.C.). Not all sites found on the coast were communities dependent upon a fishing economy. Some were established to collect salt, and there were trade ports, but it would seem reasonable to expect that all seashore communities derived at least part of their subsistence through fishing. This would probably include the use of spears and arrows, nets and traps, and weighted lines with hooks.

This report deals with small notched stones and notched potsherds believed to have been used to weight fishing lines and nets. These were found at several ancient village sites along the north coast of Yucatan (Fig. 1), dating from the Formative until the Colonial period, and which appear to represent a fishing technology of long tradition (Eaton 1974, 1976). The coastal collections include 168 samples of notched stones from four sites, and 58 samples of notched potsherds from four other sites. The collections, which were the result of selective sampling, do not necessarily represent a comprehensive distribution pattern for the coast, as they are undoubtedly to be found at other coastal sites. The notched stones and sherds will be described separately, although their basic functions were probably the same.

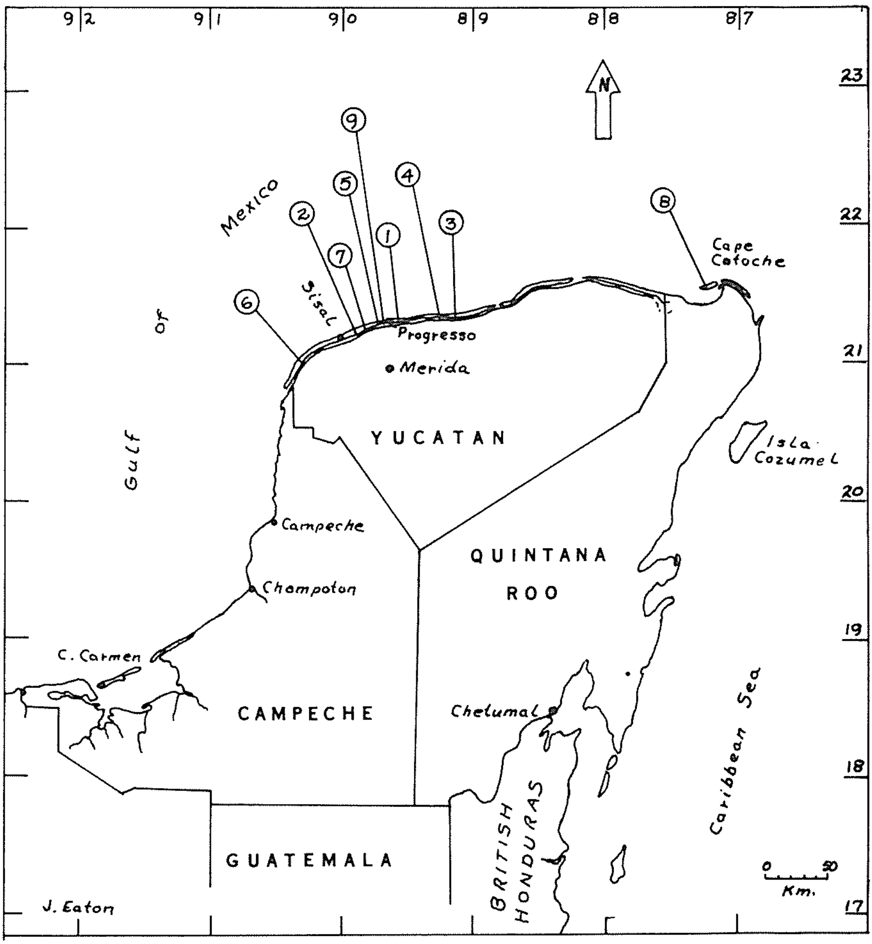


FIGURE 1. *Yucatan peninsula.* Location of archaeological sites where fishing weights were found.

DESCRIPTION OF THE SPECIMENS

Notched stones (Fig. 2).

These are essentially small flat stones of roughly square to rectangular forms and have notches chipped, and occasionally cut, into two opposing sides. Most of the stones tend to be slightly rectangular, or oblong, in outline, and notching is about equally found at the ends or at the mid-sections. Essentially, the stones appear to have been selected for their natural forms; however, there are a few samples which might have been chipped and ground to desired shape. Although some of the edges appear to have been intentionally ground, this may have actually been the result of use-wear. The notches had been chipped in most samples, but there are at least three specimens in which the notches were clearly cut with a sharp blade. The notching of the stones was evidently done to facilitate tying securely to a line, and the notches are always positioned in-line with the long or short axis to provide balanced tying (Fig. 4).

Most of the samples collected are medium to coarse grained local limestone. Some of the smaller ones, however, are beach pebbles, and there are some fashioned from small flint nodules and core flakes. There is one specimen which is fine-grained limestone, and another which is coarse volcanic stone. These appear to be reused fragments of imported stone implements.

The stones in the collection range in size from 1.7 by 1.7 cm and 0.2 cm in thickness, to 5.6 by 7.4 cm and 2.2 cm in thickness. They range in weight from 1 gram to 128 grams.

Notched potsherds (Fig. 3).

In the collection are six rim sherds and the rest are body sherds. Unfortunately, most of the sherds are too eroded to identify the wares. Five specimens are fragments of Colonial period Spanish olive jars, but the rest appear to be precolumbian wares of unidentified types.

The sherds are worked to an ovoid, square, or rectangular form, apparently by breaking and grinding. Each has a notch cut in two opposing sides as described for the notched stones. The notches are usually V-shaped, were obviously cut with a sharp blade, and with only one exception all rectangular and ovoid forms are notched on the ends.

The sherds range in size from roughly 2.0 by 2.0 cm square, to rectangular form 8.5 cm long and 4.5 cm in width. The average thickness is around 1.0 cm. The weights of the notched sherds in the collection range from 5 grams to 51 grams.

PROVENIENCE

A total of 168 notched stones was collected from middens of four coastal village sites which span the Maya Late Formative to Modified Florescent periods (Ball and Eaton 1972; Eaton 1976). Six samples were collected from Chicxulub site, an early phase Late Formative occupation dating somewhere between 50 B.C. to A.D. 150. One hundred and ten samples were collected from Yapak site, a later phase Late Formative into Early Period I occupation dating sometime

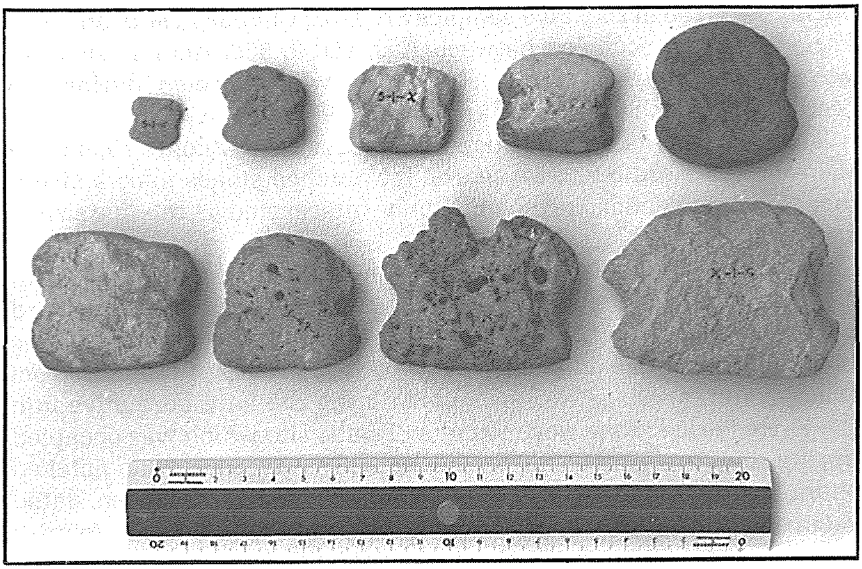


FIGURE 2. *Notched stones.* Upper row (l-r): 1, 10, 20, 30 and 40 grams. Lower row (l-r): 50, 68, 90 and 128 grams.

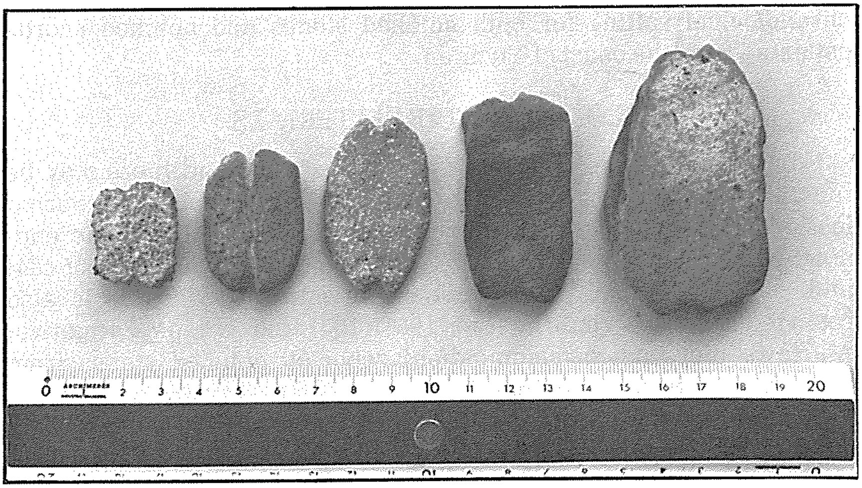


FIGURE 3. *Notched potsherds.* (l-r): 6, 11, 13, 22 and 46 grams.

during A.D. 150 to 250. Five samples are from Chuburna site, an Early Period I village occupied between A.D. 450 to 550. And, 47 samples were collected from Xcopte site which was occupied during the Modified Florescent period of around A.D. 900 to 1200.

The relatively large collections from Yapak and Xcopte sites were the result of more intensive search for notched stones to establish a larger type collection and should not be interpreted as relative size of sites or occupations.

A total of 58 notched potsherds was collected from four coastal middens and from the shallow water of a lagoon. One notched sherd was recovered from San Crisanto I site which was occupied during the Late Formative into Early Period I. One was recovered from Dolores site, a village also occupied during the Late Formative into the Early Period. Four were found at Tambo site which was occupied during the Pure Florescent period (roughly A.D. 800). Nine notched sherds were found at Río Copul site, which has not been dated securely but is probably Decadent period, just before Spanish contact. The remaining 43 notched sherds were found scattered along the edge of Laguna Chuburna. In the Laguna collection are sherds of eroded precolumbian wares, and there are sherds of Spanish Colonial ware.

Table I lists the locations, quantities, weight sizes, and chronological setting for both notched stones and notched sherds collected from the coast of Yucatan.

COMPARATIVE MATERIALS

Notched stones, as opposed to grooved stones (and there may be functional differences here), are relatively rare, or simply reported less frequent than notched potsherds in the Maya area. One end-notched stone is reported from Barton Ramie (Willey *et al* 1965: 484) and is probably Late Classic. A small end-notched stone is also reported from La Victoria (Coe 1961: 106) and is Late Formative. Andrews (personal communication) reported notched stones from Dzibilchultun in early context.

Notched potsherds in abundance are reported from Tulum and other Decadent period sites on the Quintana Roo coast (Sanders 1960: 261). Andrews (personal communication) mentioned finding notched sherds which might be Late Formative period on Isla Cancun, at Decadent period Xcaret, and many at Dzililchultun. Proskouriakoff (1962: 402) reports them from Decadent period Mayapan. They are reported from Barton Ramie (Willey *et al* 1965: 408-409) in Late Classic to Postclassic context, and Coe (1961: 101,105) reports them

TABLE I

NOTCHED STONES AND SHERDS FROM NORTH COAST OF YUCATAN, MEXICO

SITE	SITE CHRONOLOGY	NOTCHED STONES	NOTCHED SHERDS	WEIGHT RANGE (GRAMS)
1. Chicxulub	(Early Phase) Late Formative	6		4-18
2. Yapak	(Late Phase) Late Formative	110		1-111
3. San Crisanto 1	Late Formative - Early Period 1		1	Unknown
4. Dolores	Late Formative - Early Period 1		1	Unknown
5. Chuburna	Early Period 1	5		3-25
6. Tambo	Pure Florescent		4	Unknown
7. Xcopte	Modified Florescent	47		1-128
8. Rio Copul	Decadent		9	Unknown
9. Laguna Chuburna	(Probably Colonial Period)		43	5-51
	TOTALS	168	58	1-128

from La Victoria during Early and Middle Formative stages. Matheny (1970: 98,100) reports eight notched sherds which range in weight from 1.5 to 99 grams from the Campeche coast, but the dating is unknown. Notched sherds are also reported from Altar de Sacrificios (Willey 1972: 84) which are Late Classic to Early Postclassic.

All of the above mentioned archeological sites, which are located in widely separated places in the Maya lowlands, and beyond, are situated on or near the sea coast or major river drainages.

DISCUSSION

The probable use of the notched stones and sherds was for fishing line sinkers and net weights. It has not been determined if there were functional differences between those notched in-line with the long axis and those notched in the short axis. The smaller weights, for example those weighing under 20 grams, were probably used to weight fishing lines in shallow water. The heavier weights could have been used for sinkers on lines to be dropped in deeper water, or for weighting small nets. Seine and cast nets were probably in common use on the coast of Yucatan since very early times as they are well suited to shallow water fishing. Tozzer (1941: 156) mentions the use of "trammel" nets by the Indians around the time of the conquest, and these might also have been used much earlier.

Seine nets, cast nets, and hand lines with baited hooks are the most common implements for fishing the shallow coastal waters of Yucatan by individual fishermen today. Hand lines are frequently cotton, but synthetic lines are also used, most notably for leaders. Cotton lines are easier to handle and do not cut the hands as the synthetics all too often do. By contrast, most cast nets and some seine nets noted today are made of synthetic lines, usually nylon, and occasionally monofilament, while cotton cord nets are becoming increasingly rare. Nets made with synthetic lines last much longer than cotton. A cotton net will rot and is usually not dependable for more than one or two years. A synthetic net will not rot and will give good service for several years, providing it is rinsed after each use and maintained. In ancient times lines and nets were probably of cotton cord or other spun fibers. Yucatan produced a great deal of cotton which was exported in quantity in pre-conquest times (Roys 1972:53).

For weighting nets and lines today, lead is used almost exclusively. This, of course, refers to equipment used by those whose livelihood is fishing, and does not take into account the occasional small boys seen fishing in the lagoons and off the side of piers with a hand full of string, a bent pin for a hook, and an old rusty machine screw for a sinker.

The collection of notched stones and sherds, considered as sinkers, is remarkably similar in weight range to the lead sinkers I carry in my own fishing tackle box. I have split-shot which weigh 1 gram each, and hollow leads that weigh 3 grams and 14 grams. These are for weighting lines in shallow water, for example to fish for Gray Snapper in the mangrove waterways. There are also heavier lead weights of around 54 grams and 117 grams to weight drop lines into deeper water. It is not unlikely that fishermen in ancient times kept and maintained a fishing kit which included sinkers of various weights. As any fisherman knows, when you get a snag and the tackle is lost, you are out of business unless you have replacement gear.

Modern cast nets are weighted with lead. For a net of around 2 to 3 meters in diameter, the lead weights are usually 2-4 cm long, weigh 20-30 grams each, and are spaced about 5 cm apart on the lead line (Dahlem 1968: 14-15). These are usually hollow weights which are slipped onto the lead line and tied or crimped in place. There are, of course, a variety of other weight sizes and spacing used by individual net makers who are frequently required to make do with what is available. The weighting of cast nets varies not only with the size of the net used, but also with the depth of the water fished. Nets for fishing shallow water close inshore are lightly weighted compared to nets used in deeper water. Heavy weighting is not necessary when casting into shallow water. Also, when a fisherman is wading up to his waist, perhaps working with a weighted net that has to be held high, making the cast becomes very tiring. Working deeper water from a dock or boat allows a heavier net to be used, and the net can hang down before the cast, thus reducing fatigue. The heavier the net, the faster it will sink in any given depth of water; and rate of descent becomes important when casting into a school of fish. All of these factors are taken into consideration by the experienced fisherman and his equipment is generally designed for his specific method of fishing.

There are basically two kinds of casting nets used on the Yucatan coast. One, the most frequently used, is the English style net that has brails and a hand line allowing the net to be pulled in after each cast. This causes the net to close up trapping the fish within. It can be used in any depth of water since it closes over the fish as it is pulled in.

The other type is the Spanish net. It does not have brails to close the net into a pouch as it is pulled in. This kind of net is cast into shallow water and left there until the fisherman wades to it and takes the fish out by hand, reaching under the net.

Seine nets, which hang vertically in the water, having floats at the upper edge and sinkers at the lower, were probably also used by the ancient coastal fishermen of Yucatan. A perforated thick disk fashioned from buoyant light volcanic pumice was collected from a Formative site (Alegria 1) on the coast and appears to have been a net float. Fragments of light pumice were found at other sites along the coast and many of these might have served as floats. Most floats, however, were likely fashioned from a light wood, as modern fishermen often do, but these would not survive for any great length of time.

The construction and weighting of the seine nets are essentially the same as for cast nets, only the form differs. Seine nets are constructed to foul the fish in the netting, whereas cast nets are usually of tighter weave and totally capture the fish. Both net types have their uses for specific fishing. The cast net is generally thrown into schools of fish and captures all but the tiniest fish. The seine net is hung, frequently at waterway entrances, but also used for sweep netting, and catches only the fish of certain minimum size, depending upon the spacing of the netting.

The notched stones and sherds collected from ancient sites along the coast might well have served as weights for lines and nets much in the manner of modern usage as described above.

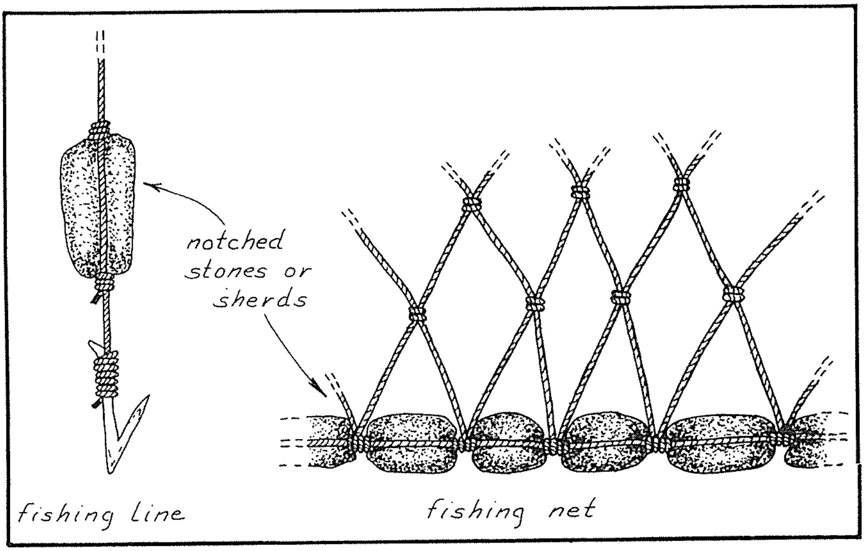


FIGURE 4. *Suggested use of notched stones and sherds as fishing weights.*

CONCLUSIONS

The collection of notched stones and sherds from the Yucatan coast seem best described as weights for fishing lines and nets. The notching of the objects is placed in direct line with the long or short axis which provides for best in-line balanced attachment to a linear cord, as suggested in Fig. 3. The sizes and weights of the notched stones and sherds fall within a usable range, as compared with modern sinkers, and the finding of these objects at seaside habitation sites helps to support this view.

The size and weight range of the notched stones and sherds suggest that they could be used equally well and interchangeable as sinkers for drop lines or nets. The actual material used by the fishermen, whether small stones or potsherds might have simply been preference. Sherd material might be easier to work, but stone would be much more durable, particularly considering the rough handling to which the weights would be subjected. It is interesting to note, however, that although both notched stones and notched sherds were found at sites representing occupations ranging from the Formative to the Colonial period, no individual site sampled had both worked materials represented. At Yapak site, for example, the collection included 110 notched stones, yet not a single notched sherd was noted. This is surprising since the site contains a large amount of pottery fragments. The same was true for Xcopte site where a relatively large collection of notched stones was made.

In the total collections from the coast there are nearly three times the number of notched stones compared to notched sherds. This contrasts with the overall pattern as noted for the greater Maya area where, in general, far more notched sherds are reported than notched stones. The actual significance this may have regards ancient fishing technology on the Yucatan coast is not apparent to me at this time.

Fiber cord has not survived at the sites, and there is only meager evidence remaining of net floats. No fish hooks were identified in the coastal collections (although shell hooks reported to be from Isla Jaina are on display in the Campeche museum) and this possibly suggests that they were mostly made from perishable materials, such as small pointed sticks, bone, or thorns. The notched weights described in this report do, however, provide us with some tangeable evidence of a fishing technology that can be traced back to at least the Formative period in Yucatan.

ACKNOWLEDGEMENTS

The objects described as fishing weights in this report were collected by me during an archaeological reconnaissance of the west and north coasts of Yucatan in 1968. The survey was part of a research program being carried out in Yucatan by the Middle American Research Institute of Tulane University and under the general supervision of the late Dr. E. Wyllys Andrews IV. I express my gratitude for all of the aid and encouragement received from Dr. Andrews during a long and demanding field season.

Dr. Joseph W. Ball is thanked for his review and identification of the coastal pottery which supplies the chronological background.

Funds to do the coastal survey were provided by the American Philosophical Society, to whom I express gratitude.

REFERENCES CITED

Ball, J. W. and J. D. Eaton
1972 Marine Resources and the Prehistoric Lowland Maya: A Comment. *American Anthropologist*, Vol. 74, No. 3, pp. 773-776.

Campbell, T. N.
1956 Archeological Materials from Five Islands in the Laguna Madre, Texas Coast. *Bulletin of the Texas Archeological Society*, Vol. 27, pp. 7-46.
1958 Archeological Remains from the Live Oak Point Site, Aransas County, Texas. *The Texas Journal of Science*, Vol. 10, No. 4, pp. 423-442.

Coe, Michael D.
1961 *La Victoria, An Early Site on the Pacific Coast of Guatemala*. Peabody Museum, Vol. 53. Harvard University.

Coleman, James M. and William G. Smith
1964 Late Recent Rise of Sea Level. *Bulletin of the Geological Society of America*, Vol. 75, pp. 833-840.

Dahlem, Ted
1968 *How to Make and Mend Cast Nets*. Great Outdoors. St. Petersburg, Florida.

Eaton, Jack D.
1974 Shell Celts from Coastal Yucatan, Mexico. *Bulletin of the Texas Archeological Society*, Vol. 45, pp. 197-208.
1976 Archaeological Reconnaissance of the Coasts of Yucatan, Mexico. Middle American Research Institute, Tulane University (Manuscript submitted for publication).

Fritz, Gayle
1972 *Pilot Archeological Field Survey of Cox Bay, Calhoun County, Texas*. Texas General Land Office, Austin.

Hester, Thomas Roy
1971 Loyola Beach: An Example of Aboriginal Adaptation to the Maritime Environment of the Lower Texas Coast. *Florida Anthropologist*, Vol. 24, No. 3, pp. 91-106.

Lenski, Gerhard and Jean Lenski
1974 *Human Societies: An Introduction to Macrosociology*. McGraw-Hill, New York.
Matheny, Ray T.
1970 The Ceramics of Aguacatal, Campeche, Mexico. *Papers of the New World Archaeological Foundation*, No. 27.
Proskouriakoff, Tatiana
1962 The Artifacts of Mayapan. *Carnegie Institution of Washington, Publication* 619, pp. 321-442.
Radcliffe, William
1974 *Fishing from the Earliest Times*. Ares Publishers, Chicago.
Roys, Ralph L.
1972 *The Indian Background of Colonial Yucatan*. University of Oklahoma Press, Norman.
Sanders, William T.
1960 Prehistoric Ceramics and Settlement Patterns in Quintana Roo, Mexico. *Carnegie Institution of Washington, Publication* 606, *Contribution* 60.
Story, Dee Ann
1968 Archaeological Investigations at Two Central Texas Gulf Coast Sites. *State Building Commission Archeological Program*, Report No. 13.
Tozzer, Alfred M.
1941 *Landa's Relacion de las Cosas de Yucatan: A Translation*. Peabody Museum, Vol. 18. Harvard University.
Wilkerson, S. Jeffrey K.
1975 Pre-Agricultural Village Life: The Late Prehistoric Period in Veracruz. Studies in Ancient Mesoamerica, II. Contributions of the University of California Archaeological Research Facility, No. 27, pp. 111-122. Berkeley.
Willey, Gordon R.
1966 *An Introduction to American Archaeology. Vol. 1, North and Middle America*. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.
Willey, Gordon R. *et al*
1965 *Prehistoric Maya Settlement in the Belize Valley*. Peabody Museum, Vol. 54. Harvard University.
1972 *The Artifacts of Altar de Sacrificios*. Peabody Museum, Vol. 64, No. 1. Harvard University.

THE SUGAR INDUSTRY AT MISSION SAN JOSÉ Y SAN MIGUEL DE AGUAYO

JOHN W. CLARK, JR.

ABSTRACT

Archeological and historical investigations connected with archeological testing of foundations at Mission San José conducted in December of 1974 revealed details of the first sugar refinery in the bounds of the State of Texas. As early as 1755 San José had a sugar mill and cane fields. By 1794 the mill was associated with a water powered grist mill.

INTRODUCTION

The Mission San José y San Miguel de Aguayo was established on the left bank of the San Antonio River by Fr. Antonio Margil in 1720. By 1740 it had been moved to the right bank and moved again to its final location before 1755. During much of its history the mission served as the administrative center of the Texas missions. It was widely recognized as an efficient and aesthetically pleasing mission.

The mission had several significant aspects to its function. Of course, the best known and most publicized function was the christianizing of the Indians. Other functions included the inculcation of Spanish social values and customs, teaching the Indians useful industrial arts so that they could become independent members of a hispanized community and to provide a hispanized community to enhance Spanish claims to the frontier.

To facilitate these activities or functions the missionaries developed a major architectural and industrial complex. The complex naturally included a church and sacristy with a convent for the resident priests and for the offices connected with the administration of the Texas missions. Additionally there was a wall for defense from raiding "wild" or noncongregated Indians with a "Pueblo" or Indian quarters built on the interior perimeter of the compound wall. Within the compound were the granary and a number of shops associated with the varied industrial activities of the mission Indians. The interior of the compound was divided into eight plazas surrounded by structures. In addition to the structures within the compound were a small number of structures on the outside of the compound and the mission ranch located several miles from the mission. The mission farm was located near the mission, irrigated by an acequia deriving its water from the dammed San Antonio River. Drinking water for the mission was provided in wells excavated within the compound.

Morfi (1935: 97) provides a list of the crops which included maize, beans, lentils, cotton, watermelons, other kinds of melons, sweet potatoes, peaches, and sugar cane. Cattle, sheep and goats were raised on the ranch, a few being kept at a corral at the mission for weekly butchering.

There were several shops both within and without the compound. They included a carpentry shop (Marmolejo 1755, Salas 1785 and Muñoz 1794), a textile shop (Marmolejo 1755, Salas 1785, and Muñoz 1794), a masonry shop (Marmolejo 1755), a tailor's shop (Solis 1931: 20), and an armory (Morfi 1935). Outside the compound were the blacksmith shop, corral, sugar mill and by 1794, the grist mill.

The location of the blacksmith shop is provided by Salas (1785) as on the opposite side of the granary from the carpentry shop. The foundations of the carpentry shop were partially exposed by restoration architect Harvey P. Smith, Sr., in 1933 on the interior of the compound adjacent to the granary. Thus the blacksmith shop is outside the compound on the west wall adjacent to the granary.

Likewise, the location of the grist mill is known. It was located in 1934 when the reservoir inlet was encountered during the cleaning of the acequia for the restoration project. The structure was then excavated and restored.

Also when cleaning the area around the mill, another feature was encountered. This feature consists of a bottomless stone box. This will be discussed in connection with the sugar processing at the site.

18TH CENTURY SUGAR PROCESSING

Little information is available on the technology of the sugar industry of New Spain especially on the frontier. One of the best descriptions is one found in the Archivo General de la Nacion in Mexico City quoted by Sandoval (1951: 158) describing the sugar refinery at Cocoyotla, Veracruz:

> ". . . se componía de anden, casa de calderas, trapiche con paredes de cal y canto y techo de tejamanil,un trapiche en corriente y armado de cuatro castillos, dos capirotes, teleras, banco, cuatro calderas, tres moledoras de teguague, canales para el caldo con más tres moledores chicos en bruto. Y en dicha casa de calderas sentadas y puestas cuatro calderas de cobre fundidas casi nuevas. Un tanque para recibir el caldo, un cazo que sirve de resfriadero, otro mediano para paradera, cuatro espumaderas, una bomba de cobre, dos remillones de lo mismo, dos espátulas de fierro."
>
> ". . . It is composed of a loading dock, a house of cauldrons, sugar refinery with walls of masonry and a shingle roof, a water powered sugar mill having four towers, two hoods, cutters, bench, four cauldrons three teaguague [stone] grinders, channels for the syrup and three additional small, rough grinders. And in the said house of cauldrons are placed and set four nearly new copper cauldrons. There is a vat to receive the syrup, a pan which serves as a cooler and another medium size one serving as a

reservoir, four skimmers, a copper pump, two syrup extractors for it and two iron spatulas."

From this description it is clear that there are several steps involved in the processing of the sugar. First the cane was cut and fed into the mill to crush the cane and extract the juice. The juice was collected and cooked in a vat (Fig. 13) or large flat cauldron to near a carmelized state then cooled and poured into molds to make piloncillo.

SUGAR PROCESSING AT SAN JOSÉ

The question arises as to the comparability of the San José sugar *ingenio* or sugar refining complex.

Marmolejo (1755) described the *ingenio* at the mission as being 15 varas long, 6½ varas wide roofed with tule or native cane. It had wooden moledoras for crushing the cane, three cauldrons for boiling the syrup and a trough for conducting the syrup from the mill to the vats. Additional information was provided by Muñoz (1794). The items associated with the sugar industry listed in his inventory (slightly out of original sequence) include the following:

"Un dicho [molino] en corriente para moler caña.

Un fondo de metal con peso de trese arrobas nueve libras con payla de cal y canto para cocer el caldo de la caña de castilla para hacer piloncillo.

Un perol grande de cobre para lo mismo con peso de seis arrobas.

Quinientas y cinquenta y quatro formas para pilocillos.

Se les entregaron y recibieron dos cientos siete mil ciento ochenta y seis cañas de castilla en ciento ochenta y seis surcos que ocupan quatro tablas."

"One of the said [mill] powered by water to grind cane.

A vat of masonry with a metal basal grate weighing 338.9 pounds for the cooking of sugar cane syrup to make sugar cones.

A large copper vat for the same (the masonry vat) weighing 159 pounds.

Five hundred and fifty four molds for sugar cones.

They were given and they received 207,186 sugar canes in 186 rows occupying 4 fields."

These descriptions point out striking similarities with the *ingenio* at Cocoyotla and provide a detailed description of the equipment used.

LOCATION OF THE SAN JOSÉ INGENIO

The physical location of the sugar refining complex has remained in question until recently. It has been thought by some that the *ingenio* was on the interior of the compound. The earliest suggestion is a report by governor Jacinto Barrios y Jáuregui (1758) which states:

> "Y hay otras quatro plazas que formalos quarteles, carpintería, troje y obraje sin otras oficinas como el yngenio donde se haze el piloncillo y la miel . . ."
>
> "And there are four other plazas formed by quarters, the carpentry shop, granary and workshop except others such as the sugar refinery where they make piloncillo and syrup."

This would suggest that the sugar mill was not associated with the eight plazas composing the compound. This is enhanced by the inventory of governor Muñoz in 1794. In his document he discusses all of the shops and items associated with the interior of the compound then discusses the blacksmith shop, the grist mill and the sugar mill. The smithy and grist mill are known to have been on the outside of the compound. The grist mill, "Un molino para moler trigo en corriente con la falta de una cortina" (a water powered mill for the grinding of wheat, lacking one wall), was built adjacent to the acequia to make maximum use of the available water to drive the mill. In the next sentence (Muñoz 1794) the sugar mill was described.

There are two points to be noted here:

1. Both mills are described as "en corriente," that is, powered by a current of water, and
2. The mill lacked a wall. The excavation in 1934 of the mill revealed the reservoir, three walls, a vaulted turbine chamber and the millrace. The missing wall apparently was the same missing wall described by Muñoz.

Thus, there are two documents suggesting that the sugar mill was outside the compound, the Barrios y Jáuregui report and the Muñoz inventory. Furthermore, if Muñoz was proceeding clockwise around the compound as he appears to have been doing, then the sugar mill was east of the grist mill.

ARCHEOLOGICAL EVIDENCE OF AN *INGENIO* AT SAN JOSÉ

During the 1934 excavation of the acequia and mill complex Harvey P. Smith, Sr., encountered the remains of a stone box (Fig. 2). He identified this structure as a leather tanning vat. It did not have, however, a sealed masonry base. On the north wall of the structure he found an opening into a small cylindrical chamber oriented vertically. The south wall of the structure was found to be somewhat broken down.

The major portion of the structure (Fig. 1) measures 2.23 meters by 1.49 meters by 0.95 meters deep (interior measurements). It consists of walls approximately 18 cm thick. The cylindrical chamber is 0.99 m in diameter, 69 cm deep and set away from the main rectangular structure 23 cm. The walls are constructed of "cal y canto" or limestone and lime mortar. The walls are laid up with irregularly shaped limestone cobbles with much mortar on the exterior sides of the walls. The interiors are smooth plaster. The bases of the walls are flat and level.

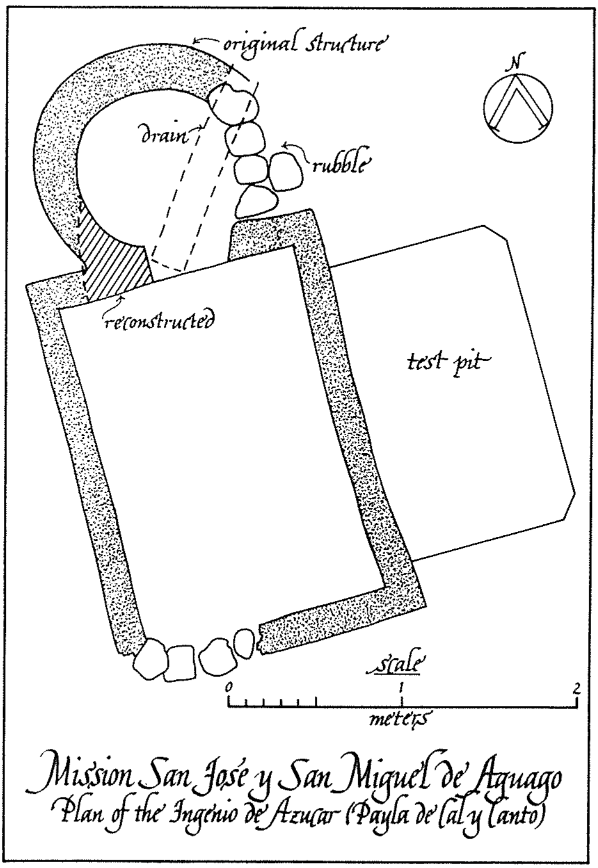


FIGURE 1. *Plan of the Ingenio de Azucar (payla de cal y canto).*

Archeological excavations in December, 1974 were conducted at the mission, and one 1 x 2 meter pit was excavated adjacent to the east wall of the structure. The fill adjacent to the wall consists of horizontal zones of calcium carbonate (caliche) suggesting that the structure was constructed in a pit using the walls of the pit as a form. This appears to be true at least for the east wall. There appears to have been no attempt at coursing the stones. The wall and mortar fill masks the exterior face of the wall.

Much of the fill above the structure had been removed in the 1934 excavations leaving the structure in an internally drained pit so that a drain had to be placed in the structure to reduce water concentrations. Even so, water levels are generally high in this area and shade provided by the many trees in the area reduces the evaporation rate. This has resulted in the weakening of the structure and the possible obliteration of evidence of firing in the structure.

COMPARISONS WITH 19TH AND 20TH CENTURY *INGENIOS*

An effort was made to locate small scale sugar operations of the 19th and 20th centuries as a point of reference for the archeological remains at San José. It was quickly found that sugar and sorghum presses and refineries were not especially uncommon. Five selected examples will be discussed, one in Hays County near Buda, one in Kendall County near Sisterdale, one in Jasper County near Kirbyville, one near Rabun Gap, Georgia, and one at Bustamante, Nuevo Leon, Mexico. All four are very similar in construction and their internal relationships.

The *ingenio* near Buda (Fig. 3) consists of a cast iron "trapiche" sitting on a wooden platform operated by an arm moved by a horse or other draft animal and a syrup cooker (*payla*) consisting of a rectangular stone and lime mortar (*cal y canto*) and brick and lime structure. The rear half of the structure, including the rectangular chimney is made of stone and the front made of brick. The top is open and the base is the unmodified ground surface. The front (brick) half has an iron grate (*fondo de metal*). In addition there is a metal door built into the front of the *payla* (Fig. 4) with the following inscription in raised letters:

D. M. COOK
PAT JUNE 22 '58
DEC 20 '59.

The total length of the *payla* structure including the chimney is 3.85 meters with the chimney being .77 cm wide. The structure is 1.21 m

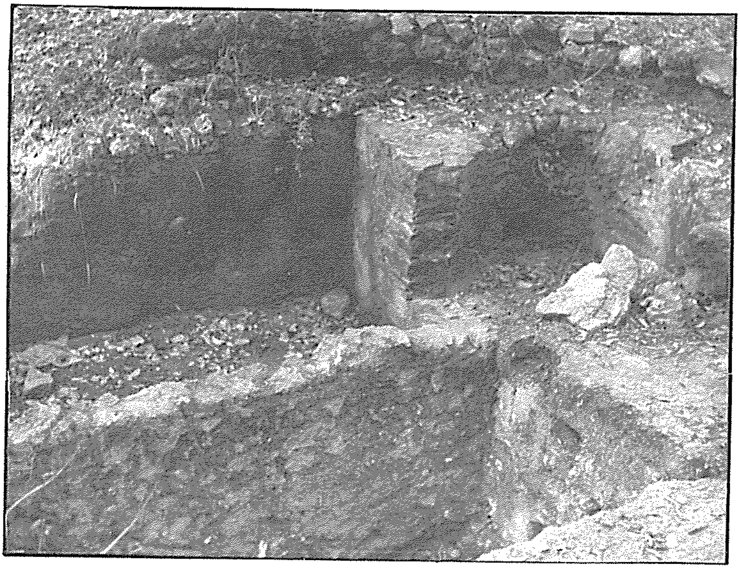


FIGURE 2. *View of the payla de cal y canto at San José looking northwest.* The photo shows the original structure, the test pit and the chimney structure.

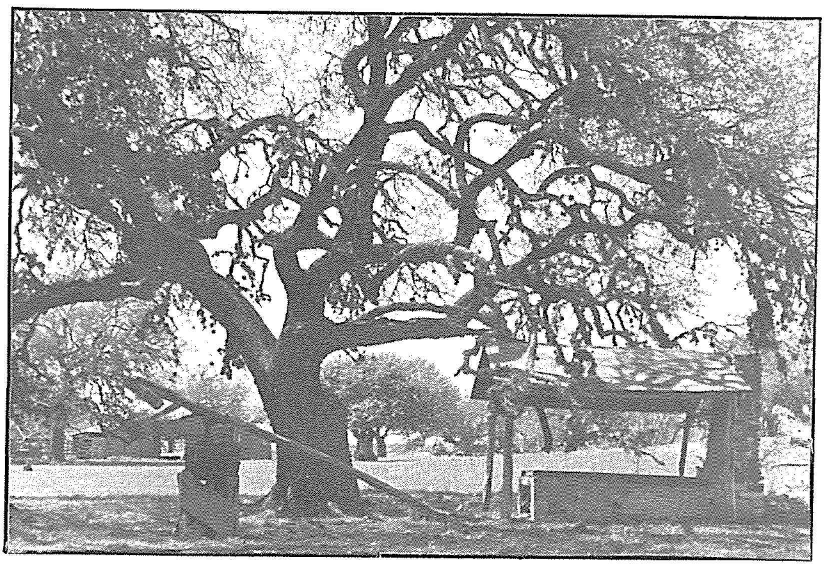


FIGURE 3. *General view of the sugar refinery (ingenio) near Buda, Texas, consisting of a metal mill (trapiche) and syrup cooker (payla de cal y canto).*

wide and 67-70 cm high. On the structure is a vat or cauldron (*perol*) made of wood and galvanized sheet metal. This *perol* is 2.9 m long, and 1.11 meters wide.

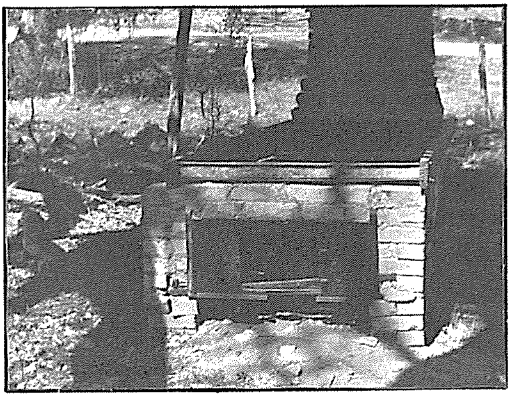


FIGURE 4. *A detail of the Buda refinery showing the iron grate, cast iron door and cooking vat on the top of the payla de cal y canto.*

Constructed over the *payla* is an open walled pitched galvanized iron roof 3.1 m wide and 3.5 meters long. The chimney of the *payla* projects beyond the rear of the roof.

The *ingenio* near Sisterdale (Fig. 5) is evinced by a simi-subterranean *payla* made of stone and mortar lined on the interior with brick. It is similar to the Buda *ingenio* but does not retain the-*perol* or the metal door at the front. Also unlike the Buda example, the

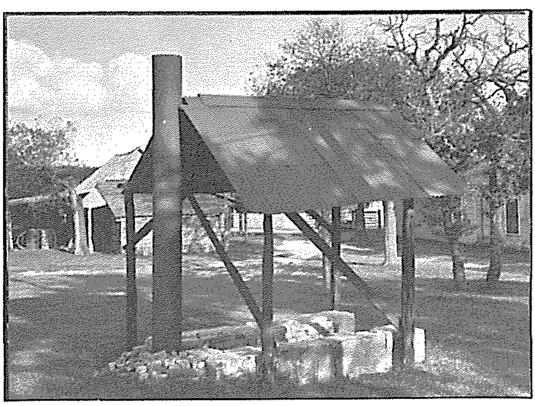


FIGURE 5. *A general view of the semi-subterranean payla de cal y canto at Badenthal near Sisterdale having a round pipe chimney.*

chimney appears to have been round rather than square. The chimney had apparently collapsed and was replaced by a sheet metal tube. Like the Buda example it is protected by a galvanized pitched roof.

The *ingenio* near Kirbyville is similar to that at Buda and the one near Sisterdale. It had an iron *trapiche* with two vertical cylindrical grinders (*moledoras*). The *payla* consists of an above ground rectangular brick structure with a chimney made from round metal culvert pipe. It has a removable rectangular metal *perol* and a shelter having a galvanized pitched roof.

Additional information on the structure was provided by Elton R. Prewitt of the Texas Archeological Survey who has seen this *ingenio* in operation. The *trapiche* was operated by a mule. Canes were fed into the *trapiche* and the juice of the crushed canes ran from the grinders (*moledores*) to a metal trough (*canales para el caldo*) and then to a wooden trough or vat (*tanque para recibir el caldo*). It was then transferred to the cooking vat (*perol*). In the *payla* pine wood was used for fuel. A skimmer (*espumadores*) was used to remove the froth and foreign material in the syrup (*caldo*).

The most complete information available on current use of an *ingenio* is provided by Wiggington (1975: 424-436) in discussing the process of making sorghum syrup. In this process the cane is fed into the fill and the juice filtered through coarse cloth into a barrel (Fig. 6). When a sufficient quantity of juice is collected it is again filtered

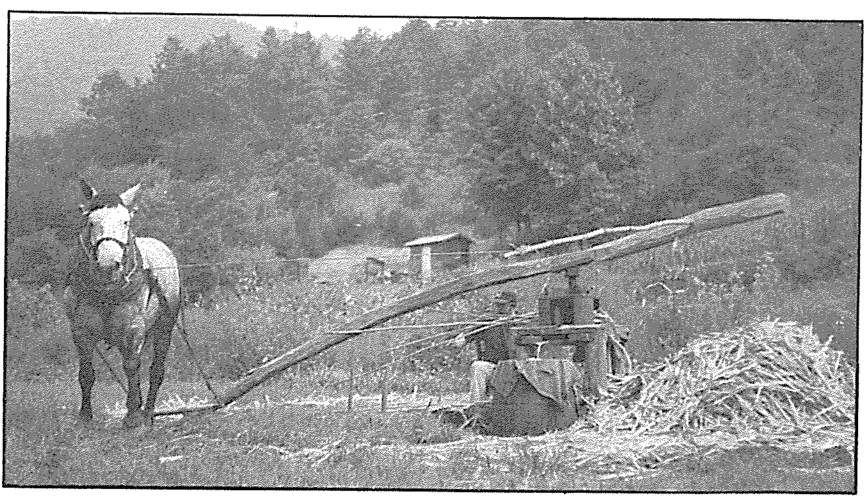


FIGURE 6. *The mill near Rabun Gap, Georgia grinding cane.* Courtesy, Foxfire Fund, Inc.

and then placed in a vat over a boiler or firebox. There it is thickened and foam is removed by skimmers (Fig. 7). It is then collected in buckets and jars for storage. This operation is virtually identical to the sugar making. The principal difference is that the sugar cane syrup would be placed in molds to crystalize.

The fifth mill examined is located at Bustamante, N.L., México north of Monterrey. The complex consists of a large rectangular firebox with a substantial chimney and having a large rectangular var for preliminary cooking of the syrup (Fig. 10). An adjacent smaller firebox (below ground level) with a circular vat for final cooking of the syrup, a shed roof over both structures and a mill powered by a mule. The smaller firebox appears to be virtually identical to the feature at San José (Figs. 9, 11), having a rectangular box connected to a circular (Fig. 12) chimney-like feature for the final cooking of the syrup. It has a subterranean vent similar to the vent hole shown of the drawings of Harvey P. Smith, Sr. Virtually the entire structure is subterranean, like the feature at San José, except the upper portion of the support for the cooking vat.

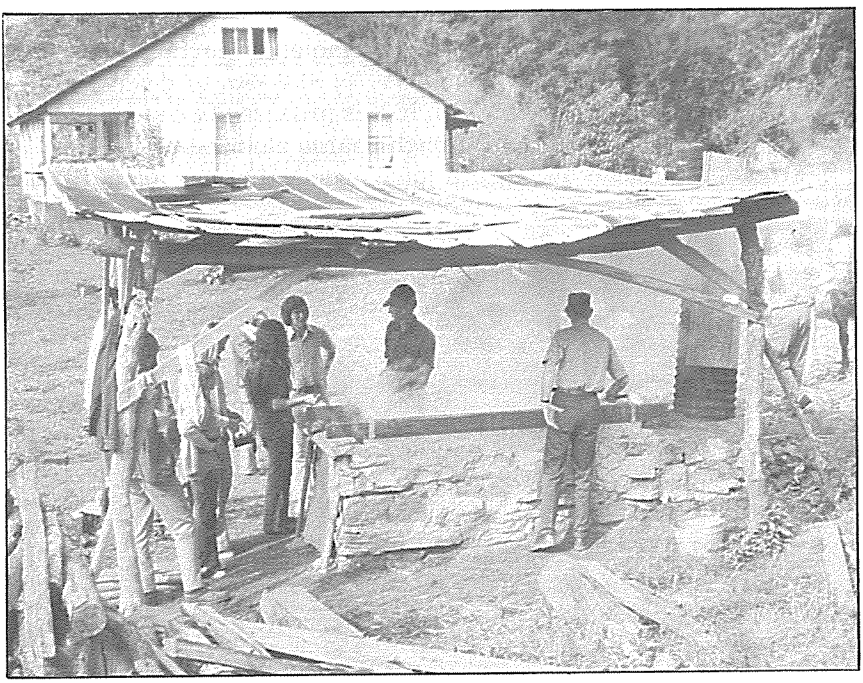


FIGURE 7. *Cooking the juice of the cane and skimming off the foam in a payla de cal y canto near Rabun Gap, Georgia.* Courtesy, Foxfire Fund, Inc.

RECONSTRUCTION OF THE SAN JOSÉ *INGENIO*

Archeological excavations, historical documentation and comparison with other *ingenios* allow a tentative reconstruction of the sugar industry at San José (Fig. 8). Documentary sources suggest that the *trapiche* was outside the main compound possibly east of the grist mill. Archeological investigations have revealed the location of the grist mill and a *payla de cal y canto* or masonry and mortar vat. Since both the grist mill and the sugar mill were water powered it stands to reason that both would use the same power source, namely the acequia north of the compound wall.

An interesting facet of the 1794 description of the grist mill is that it lacked one wall. Also, interestingly, the Harvey P. Smith, Sr., excavation did not find evidence for an east wall (as indicated in his architectural drawings). This may suggest that the *trapiche* was driven from belts using the same shaft and turbine as the grist mill. Thus the *trapiche* would necessarily be near the grist mill. There is certainly historical precedent for the use of water-power to run *trapiches*. By the middle 16th century a water-powered mill was built at Yaguate in Española, West Indies by technicians from the Canary Islands (Sauer 1966: 210).

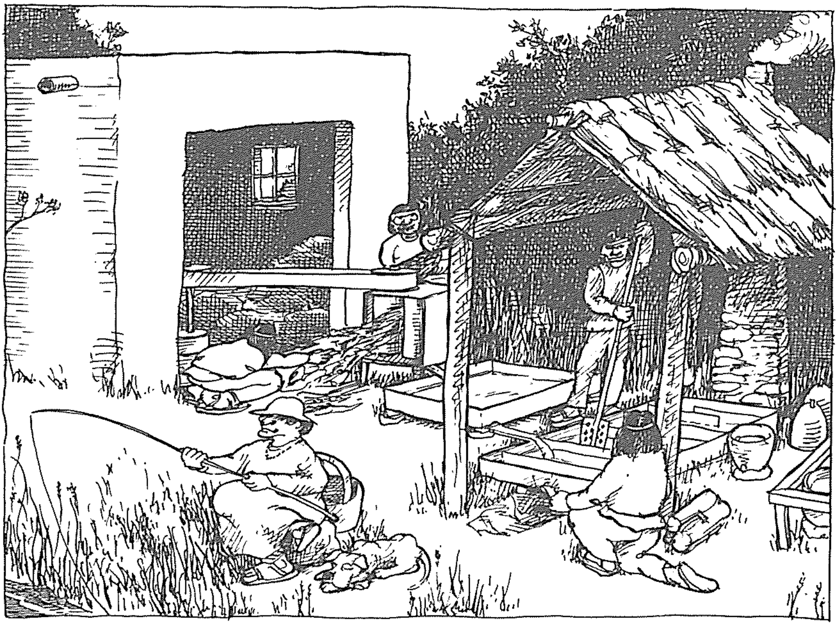


FIGURE 8. *Hypothetical reconstruction of the ingenio de azucar at San José Mission as it might have appeared in 1794.* Drawing by Jim Bonar.

The *trapiche* at San José consisted ". . . of three, sometimes [possibly] only of two, vertical cylinders which may be smoothed tree trunks, the cane being crushed as it passed between the cylinders . . ." (Sauer 1966: 210). It probably was mounted on thick posts sunk fairly deeply in the ground.

Leading from the *trapiche* at a shallow angle there would have been a trough to conduct the juice from the *trapiche* to the metal tank (*tanque*) where the juice (*caldo*) was collected. The tank was probably located adjacent to the *payla* so that by removing a plug would allow the juice to flow into the pan or *perol grande de cobre* by gravity. There the *caldo* would be cooked into thick syrup.

The *payla* was protected by a pitched roof open walled structure (Marmolejo 1755) 15 varas (12.54 meters) by 6½ varas (5.43 meters using the Castilian vara of 0.835905 meters [Haggard 1941: 85]) with roof thatched with tule or native cane. Associated with the sugar production were 554 *piloncillo* molds (*formas*) (Fig. 14). These molds were almost certainly conical and had a bunghold in the base to drain off the molasses from the crystallized sugar (Diderot 1559: Plate 39 and 41).

CONCLUSIONS

Archeological, documentary and comparative investigation of the "leather tanning vat" feature at San José Mission suggests that the feature is the *payla de cal y canto* described in the San José documents associated with a sugar refining complex. This complex included a mill run by water power as of 1794, an open walled structure roofed with native cane and a number of pieces of equipment particular to the sugar industry.

An intriguing aspect of the situation is that the sugar industry in the West Indies as developed in the early 16th century was introduced by Canary Islanders (Sauer 1966: 210). In the San Antonio area Canary Islanders formed the core of the secular community beginning in 1731. Thus Canary Islanders, *isleños*, were available as consultants for several civil engineering projects such as the acequia systems and the sugar industry at San José.

FIGURE 9.

FIGURE 10.

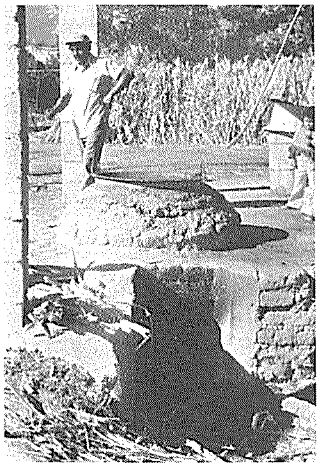


FIGURE 11.

FIGURE 9. *The Ingenio de Azúcar at Bustamante, N.L., Mexico demonstrates the semi-subterranean nature of the structures.*

FIGURE 10. *The refining process begins with the initial cooking of the sugar cane juice cooked in this large rectangular vat.*

FIGURE 11. *After preliminary cooking the syrup is reduced to caramel in this device consisting of a rectangular firebox and circular support for a large copper caldron.*

FIGURE 12.

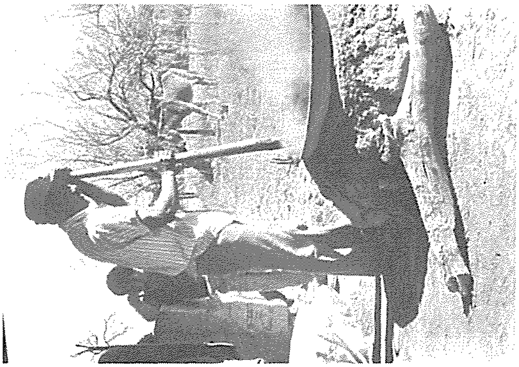


FIGURE 13.

FIGURE 14.

FIGURE 12. *The support for the caldron is circular in form with a vent at the rear to conduct the smoke and heated air away.*

FIGURE 13. *While being cooked the caramel must be stirred with tools similar to those mentioned by Sandoval (1951: 158).*

FIGURE 14. *The final result is piloncillo (brown sugar cones) formed in conical clay molds.* Currently piloncillo is made with nuts added to make a sweet candy. The piloncillos are sold wrapped in paper.

ACKNOWLEDGEMENTS

This paper could not have been written without the aid of my field assistant on the 1974 test excavations at San José, James E. Ivey. David McDonald, a translator working at the Old Spanish Missions Historical Research Library at San José provided help in finding the Barrios y Jáuregui report. Father Benedict Leutenegger provided access to records in the library and always proved to be a valuable source of information. Elton R. Prewitt of the Texas Archeological Survey provided information on his father's sugar processing in Jasper County. Dan Scurlock of the Texas Historical Commission accompanied me on a trip to examine the *ingenio* near Buda and provided valuable data and sources.

References Cited

Barrios y Jáuregui, Jacinto
1758 Informe del governador sobre la mision de San José. Archivo de San Francisco el Grande, Biblioteca Nacional de Mexico. Photostat on file at the University of Texas at Austin, Vol. 12, pp. 59-61, Barker Texas History Center Archives.

Diderot, Denis
1959 *A Diderot Pictorial Encyclopedia of Trades and Industry*. Edited by Charles C. Gillispie. Dover Publications Inc., New York.

Haggard, J. Villasana and Malcolm D. McLean.
1941 *Handbook for Translators of Spanish Historical Documents*. Semco Color Press, Oklahoma City.

Marmolejo, Yldephonso
1755 Inventory of the mission and the increase gained in the year and ten months which elapsed before I took charge. Translated by Fr. Benedict Leutenegger. Old Spanish Missions Historical Research Library, San Antonio.

Morfi, Fr. Juan Agustín de
1935 *History of Texas, 1763-1779. Part 1*. Translated by Carlos Eduardo Castañeda. Quivira Society Publications, Vol. 6. New York.

Muñoz, Manuel
1794 Inventory of the material goods of the Mission San José. Typescript from the Archivo de Govierno, Legajo 7, Expediente 448, Saltillo, Coahuila.

Salas, Josef Maria
1785 Inventory which I, Fr. Josef Agustin Falcón Mariano received in this mission of Señor San Josef of the province of Texas from Fr. Josef Maria Salas. Translated by Fr. Benedict Leutenegger. Old Spanish Missions Historical Research Library, San Antonio.

Sandoval, Fernando B.
1951 *La industria del Azúcar en Nueva España*. Universidad Nacional Autónoma de Mexico, Instituto de Historia, Mexico.

Sauer, Carl Ortwin
1966 *The Early Spanish Main*. University of California Press, Berkeley and Los Angeles.

Solis, José de
1931 The Solis Diary of 1767. Translated by Peter P. Forrestal. *Preliminary Studies of the Texas Catholic Historical Society*, Vol. 1, No. 6.

NOTES

BIFACING PATTERNS ON PRISMATIC FLAKES

J. B. SOLLBERGER

ABSTRACT

The bifacing of prismatic flakes and blades provides a constraint to pressure flaking that results in various predictable diagonal flake scar patterns. These flake scar patterns, together with cross sectional studies of flakes, generally identify prismatic blade production for the purpose of biface manufacture. Diagonal flaking removes longitudinal ridges, permitting complete bifacing, and also produces a superior cutting edge for use against soft materials. It is proposed that diagonal flaking patterns are the result of technological considerations, rather than simply being a matter of esthetics on the part of individual craftsmen.

INTRODUCTION

Various patterns in pressure flaking to produce thin bifaces for knives and projectile points have been recognized for some time (e.g. Crabtree 1972:87) and these patterns have generally been attributed to cultural traditions and choices by individual craftsmen, rather than to technological considerations. While specific flaking patterns may have esthetic relationships, this report will discuss the technological considerations for using diagonal flaking and the resulting patterns such as chevron, half chevron, opposed oblique, and diagonal ribbon flaking.

Experiments by the writer have shown that longitudinal dorsal face ridges on flakes impose a restraint to bifacing the dorsal faces, if economically-sized flakes are being used. "Economically-sized" flakes are ones that have been produced to maximize yield from raw material and minimize labor in producing finished tools. In other words, these flakes are of minimum size to produce desired finished biface sizes. It will be shown that the presence of diagonal flaked bifaces and unfinished prismatic flakes on an archeological site can serve as an index that the lithic technology was oriented toward the production of bifaces selectively from prismatic flakes, rather than the bifaces being random reductions of irregular shaped flakes and cores. It is generally recognized that prismatic blades make ideal blanks for the production of lithic tools (Bordaz 1970).

DISCUSSION

Prismatic blades and flakes have one or more, usually prominent, parallel longitudinally oriented dorsal face ridges, with the ridges sometimes called "arrisses" (Crabtree 1972:34), as shown in Fig. 1. The term "blade" is generally reserved for flakes with lengths at least twice widths. Horizontally, dorsal face surfaces are concave between lateral edges and ridges (Fig. 1,c). Such faces cannot be initially flaked in a random style or directly across the dorsal ridges to accomplish complete bifacing if minimum reduction in blank size is desired.

In complete bifacing of a prismatic blade, there is a technological constraint on initial flake removal from the dorsal face. A conchoidal-shaped flake always results from flaking into a planar surface, with little control of flake width expansion. This problem is greatly amplified in flaking across the concave surfaces of ridged flakes. Fig. 1,a illustrates the general expansion in flake width, when flaking directly across a blade lateral edge from a platform location such as points 1 and 2. In cross section, such a flake removal would start at a

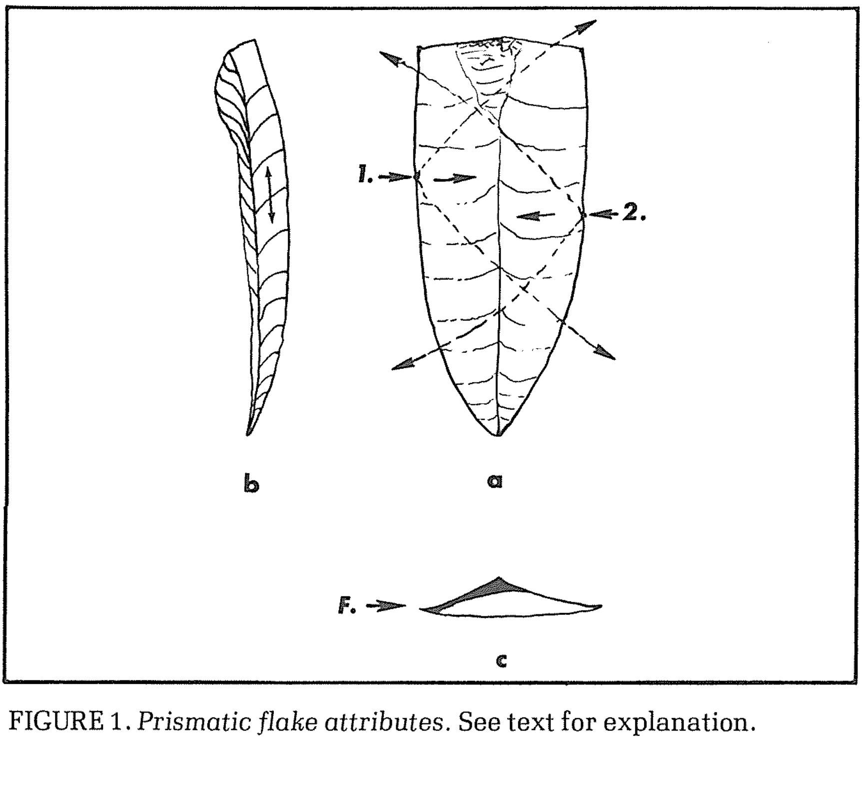


FIGURE 1. *Prismatic flake attributes*. See text for explanation.

thin fragile platform and then become even thinner as the fracture proceeded from the lateral edge to the dorsal ridge. The flake would be required to thicken if a portion of the dorsal ridge were to be successfully removed. Finally, the bifacing flake would be required to thin again to terminate. With flake removals having rapidly expanding widths, this fracture sequence is not possible. In actual practice, flaking directly across the unscarred original surface of a prismatic blade will result in flake removals stopping short of the dorsal ridge, or in the worst case, ruinous snapping of the prismatic blade.

As shown by the side view of a prismatic blade (Fig. 1,b) dorsal ridges and corresponding concave face surfaces are longitudinally straight or convex. Complete bifacing of economically-sized prismatic flakes is possible if: (1) the diagonal flaking angle is sufficiently acute to the dorsal ridge line that individual flakes removed will not be concave dorsally except immediately short of the dorsal ridge, and (2) the individual bifacing flakes are narrow elongates, where each flake removal establishes a ridge to strengthen and guide the next flake removal to and beyond the dorsal ridge. If the individual craftsman is willing to have a greater loss in original prismatic blade dimensions, a more random flaking pattern can be used to produce bifaces.

Diagonal flaking becomes patterned according to the location of the dorsal ridge in relation to flake center. Some of these patterns are shown in Fig. 2,a-c. In all such diagonal flaking patterns, the first series of oblique flakes from one lateral edge of a flake tool blank must extend beyond, and remove a portion of, the dorsal ridge. Flake direction from the opposite lateral edge then determines the flaking pattern type.

The half chevron flaking pattern (Fig. 2,a) is diagonally flaked first from the lateral edge nearest to an off-center dorsal ridge. It is usually necessary to execute this series of flakes first, because this short face surface is more horizontally concave than the wider dorsal surface on the other side of the ridge. These narrow oblique flakes remove and round off the dorsal ridge. Termination of these flakes occur at the near-edge of the "far side" concave face surface, thereby flattening the concave face surface on the other side of the ridge. It is then possible for flake removals from the wider opposite face surface to be made horizontal, directly across the dorsal ridge axis. These final bifacing flakes from the opposite side of the original flake blank can be both longer and wider than the first series of flakes that removed the dorsal ridge.

This flaking description is confined to prismatic blades having one dorsal ridge. Half chevron flaking patterns are therefore one method of identifying bifacing of economically-sized prismatic flakes. The writer has seen large numbers of this type of artifact that are commonly not completely flaked on the ventral surface. The cross section of the biface will be a flat triangle.

In producing a stemmed biface from a prismatic blade, the bulbar proximal end can be flaked first to thin and straighten the blank. Diagonal and then other random flakes are used to remove the dorsal ridge and then thin and shape the basal stem area. Diagonal flaking proceeds on the middle and distal portions of the still ridged blank to obtain complete bifacing.

The chevron pattern of flaking results from the use of a prismatic blade with an isosceles triangle cross section, therefore having a well-centered dorsal ridge. This flaking system can also be used on prismatic blades having two dorsal ridges, and a trapezoidal cross section. The chevron pattern is identified by oblique flakes from both lateral edges that are directed toward the stem end of the biface. This pattern can be executed in two sequences: (1) a complete series of flakes is removed from the lateral edge on one side, with each flake

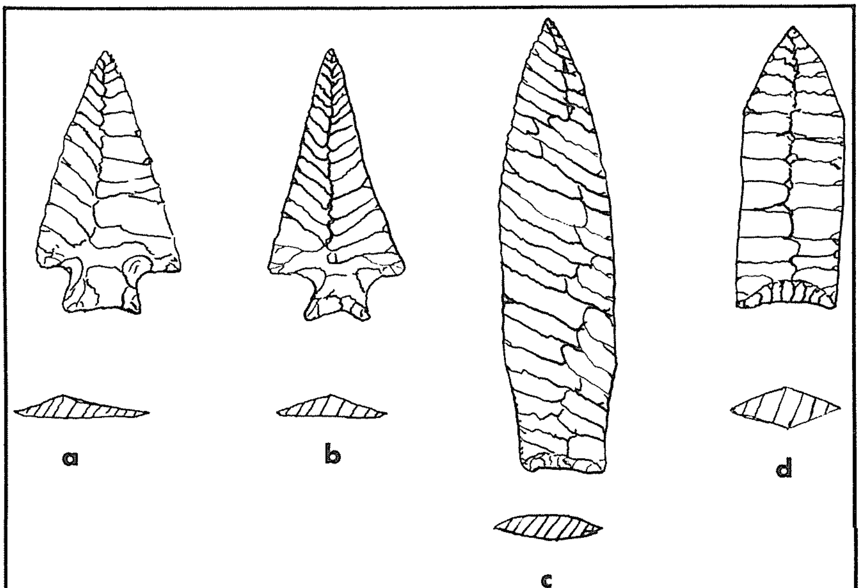


FIGURE 2. *The dorsal face of bifaced prismatic flakes showing normal cross sections and flake scar pattern. a,* Half Chevron; *b,* Chevron; *c,* Diagonal Ribbon. The point shown as *d* cannot be the normal for initial bifacing of an economically-sized prismatic flake.

removing some of the dorsal ridge, and then the flaking process is repeated on the opposite lateral edge; or, (2) one flake removal from one lateral edge is followed by a flake removal from the opposite lateral edge to consecutively remove portions of the dorsal ridge until bifacing is complete. If two dorsal ridges are present, a series of consecutive flakes must be detached from each lateral edge to remove portions of each ridge.

Oblique opposed and diagonal ribbon flaking are two other variations in diagonal flaking patterns that can be used to biface prismatic flakes with a minimum in overall size reduction. In both cases a series of diagonal flakes is removed from a lateral edge, and diagonal flaking from the opposite lateral edge is done in a parallel opposed manner. Oblique opposed flaking generally results in a biface with a central ridge. In diagonal ribbon flaking, wider and thinner flake removals are obtained. The wider flakes give terminations farther beyond the dorsal ridge, and the resulting cross section of the biface is more gently convex than with oblique opposed flaking.

Ventral faces of prismatic blades and flakes are typically flat to slightly convex. Such a surface is easily flaked by any desired scar pattern, and results in a slightly convex surface. If a strong ridge is present on both faces of a biface, this means that more material than necessary was removed from the ventral face to effect bifacing, and size reduction of the original raw material piece was more than minimal; or that the original biface has been resharpened along the lateral edges (Sollberger 1971). Economically-sized prismatic flakes do not have the necessary thickness along the lateral edges to sacrifice in order to form a ridge on the ventral face.

The technological constraints in bifacing of economically-sized prismatic flakes described in this report are the result of actual lithic flaking experiments by the writer, and demonstrate the usefulness of replicative experimentation, now recognized as an important archeological method (Hester and Heizer 1973; Coles 1973). A number of references are available in the literature where archeological lithic assemblages are described with use of diagonal flaking methods, with wide distribution in space and time.

Frison (1970: 36-38) has described a lithic industry that produced half chevron patterned arrow points:

> "Most are made on percussion flakes of prismatic cross section. The median ridge of the flake was removed by careful pressure flaking. The flake scar pattern is usually such that the flakes extend toward the center at right angles from one blade edge; on the opposite side the flake scars extend downward towards the center at less than a right angle with the blade edge."

Except for the name and actual flaking sequence, Frison has described half chevron flaking technology.

King (1969: 78) made the following observation for the Sam Kaufman site in Red River County, Texas: "There are two categories of arrow points—those made on flakes and those made on flake blades". From King's illustrations and from personal examination of some of these points, I would comment that of those made on blades, ventral face flaking is largely limited to the proximal and distal ends of the points. The dorsal faces of these points have chevron, half chevron, opposed oblique, and diagonal ribbon flake scar patterns.

Chard (1956: Figs. 133,134) illustrates clearly for Siberian examples that dorsal faces of prismatic blades were not completely bifaced by horizontal flaking. The original blade cross sections and ridges are essentially unaltered, except for the projectile point tips and tapered stems. The only illustrated dorsal face that approaches being completely flaked has oblique opposed flaking.

Giddings (1951) illustrates weapon tips made on prismatic blades for the Denbigh Flint Complex where complete bifacing was usually obtained. In his Fig. 64,1,5,6,7 he shows half chevron flake scar patterns. Fig. 64,2 illustrates opposed oblique, and Fig. 63,b shows the diagonal ribbon pattern. Chard's Fig. 61,a-5 is a poorly executed example of the full chevron pattern. Fig. 60,b-3 illustrates a fine example of converting true blades to diagonal ribbon pattern bifaces.

From the foregoing discussion, it is evident that flake scar patterns for completed bifaces on prismatic blades are not so much a matter of choice, but rather a flint knapper's set of required flaking techniques. These techniques were not developed solely for esthetic purposes, but to overcome constraints inherent to various blank forms produced for bifacing. The constraints examined here are those that apply to prismatic flakes, that due to economical size, have a greater reliance on pressure flaking than on percussion. Flakes without prismatic cross sections can be, and were, bifaced with wide flake removals in random direction and sequence. Economically sized prismatic flakes must be bifaced with some diagonal flaking pattern, to remove dorsal ridges without undue sacrifice of artifact size. Thus, diagonal flaking patterns are diagnostic attributes for the bifacing of prismatic blades and flakes.

By inference from the above, fine horizontal opposed flaking (Fig. 2,d) that forms ridged cross sections also probably does not represent an esthetic choice by the craftsman, but instead may represent economical multiple edge resharpenings. Repeated edge resharpenings on this bifaces, where flakes extend beyond mid-width, rapidly convert the biface to be too thin and fragile for utility.

Either ridges must be formed, or beveling resorted to, for repeated economical usage (Sollberger 1971).

ACKNOWLEDGEMENT

I am grateful to Leland W. Patterson for his interest and organizational help in the preparation of this paper.

REFERENCES CITED

Bordaz, J.
1970 *Tools of the Old and New Stone Age*. Natural History Press, Garden City, New York.
Chard, Chester S.
1956 The Oldest Sites of Southeast Siberia. *American Antiquity*, Vol. 15, No. 4, pp. 405-409.
Coles, J.
1973 *Archaeology by Experiment*. Charles Scribner's Sons, New York.
Crabtree, Don E.
1972 An Introduction to Flintworking. *Occasional Papers Idaho State University Museum*, No. 28.
Frison, George
1970 The Glenrock Buffalo Jump. *Plains Anthropologist*, Vol. 15, No. 50, Pt. 2, pp. 1-66.
Giddings, J. L., Jr.
1951 The Denbigh Flint Complex. *American Antiquity*, Vol. 16, No. 3, pp. 193-203.
Hester, Thomas R. and Robert F. Heizer
1973 Bibliography of Archaeology I: Experiments, Lithic Technology and Petrography. *Addison-Wesley Module in Anthropology*, No. 29.
King, H. Gill
1969 Chipped Stone. In: Archeological Investigations at the Sam Kaufman Site, Red River County, Texas. *Southern Methodist University, Contributions to Anthropology*, No. 5.
Sollberger, J. B.
1971 A Technological Study of Beveled Knives. *Plains Anthropologist*, Vol. 16, No. 53, pp. 203-218.

THE ARCHEOLOGIST AS PARTICIPANT OBSERVER*

WILLIAM J. MAYER-OAKES

INTRODUCTION

In recent years there are two discernible major trends that have been important in archeology, that towards the fully "Anthropological" archeology as well as one towards "Scientific" archeology. This has been particularly evident during the 1960's and 1970's—a time when the growth of the field of archeology in terms of the number of its practitioners as well as the growth in numbers of archeological methods and techniques and the development of them has been an important characteristic. This latter series of developments we might very well term the increasing "sophistication" of the field of archeology. In a recent review (Mayer-Oakes 1974) of a book purporting to present the field of "new archeology", I have presented the concept of a "spectrum" as a useful and realistic way to view the current status of activities in archeology. In Fig. 1, concerned wiht the objectives of archeology, is presented a summary of the comments that I have made in the review with regard to the development of a variety of objectives for modern archeology. In this paper my emphasis will be on a series of developments in the area of objective which I list in Fig. 1 as the area of "function". It is my particular concern here to take a look at the nature of current achievements of understanding function by means of lithic studies.

INTEREST IN FUNCTION IN LITHIC STUDIES

Stemming at least indirectly from Walter Taylor's "Conjunctive" approach, the interest in reconstruction of past human behavior via the most direct route has also been influenced by the rise of "behavioral science", e.g., ethology and behaviorism in various fields. In archeological lithic studies this behavioral interest has been coupled with interest in and use of an experimental approach. This behavioral interest is expressed most clearly in the formulation of problems where the objectives are "functional" and the method of approach or operations are "micro-analytical".

If we look first directly at the interest in function, we can see that this has been expressed most clearly in the concern to replicate probable past manufacturing processes (i.e., behavior). This interest

*Revised version of a paper presented at 1973 meeting of the Texas Archeological Society, October, Lubbock, Texas.

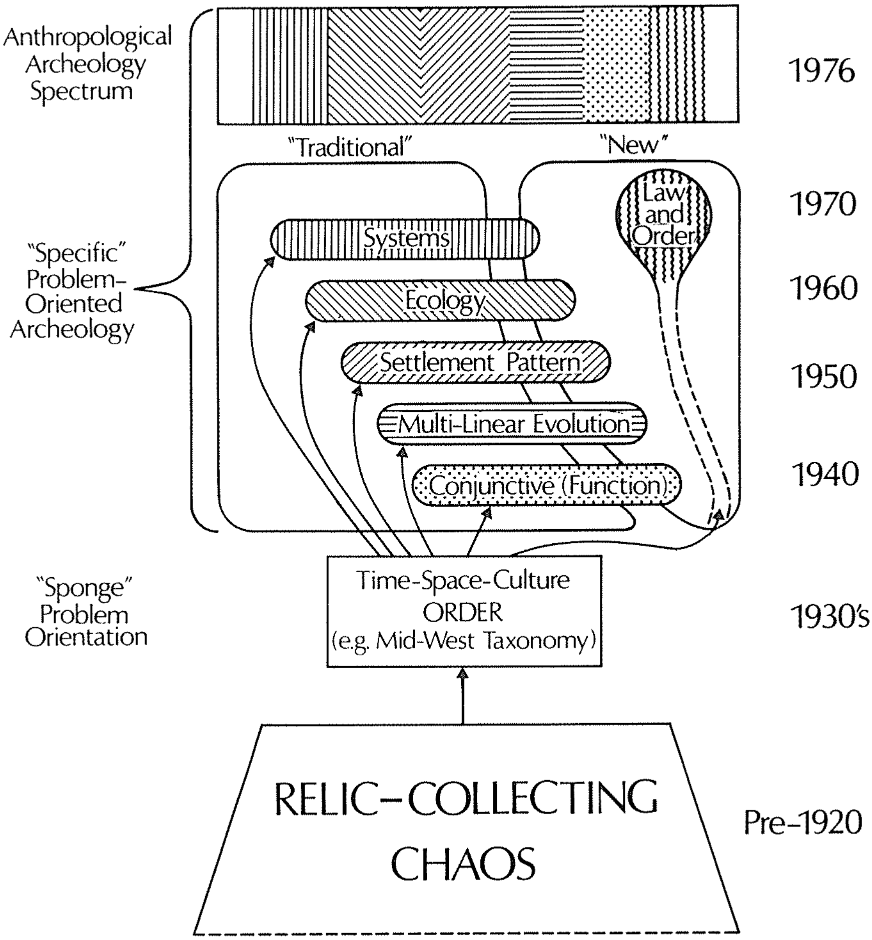


FIGURE 1. *Schematic View of U.S. Development of Archeological Objectives (Problem Orientation).*

in function is most widely recognized, and is now an accepted part of the thinking of many lithic analysts, due to the work of a growing number of chipping specialists led by Francois Bordes, Don Crabtree and others. The procedures involved here are correctly described as "experiments" but they are essentially crude or inelegant kinds of experiments.

A second expression of this interest in function, (less well known and less advanced as yet) is the experimental usage of stone tools in an attempt to replicate the various processes of prehistoric behavior with the tools.

From each of the above experimental approaches to replicate prehistoric function or prehistoric human behavior—tool manufacture and tool use—have developed refinements and extensions. With regard to tool manufacture, a major direction of new work is in the carefully controlled and rigorous context of laboratory experiments, for example with machine rather than live chipper, as done by A. Faulkner (1973) for pressure-made blades. With regard to tool usage the most promising developments, I feel, are the extension into the wider arena of "living archeology", for example as in the recent experiments in survival under conditions of prehistoric technology as carried out by E. Callahan of Virginia (1973). This general interest in function I would characterize as "anthropological". It is clearly part of the attempt to make archeology more explicitly and more broadly a kind of anthropology.

INTEREST IN MICRO-ANALYSIS

In the above-mentioned studies concerned with function, the style or method of approach has been what I call "micro-analytical". By this term I refer to both the scale and scope of attention to detail as well as the particular kind of analytical activity or operation. Attention has been directed to a wide range of details by means of the concepts of attribute and attribute systems. The manipulation of these concepts has been increasingly sophisticated, utilizing statistical and sometimes computer analysis techniques.

In the "stone chipping" or manufacturing area of interest, both the chipper and the analyst of end products are actively looking at minutiae of the materials used, the context of force (support, angles, quantity) and the force media (hammers, anvils, punches, pressers) in order to understand and explain relationships between results and technology applied (e.g., Henry, *et al* 1976). In the "stone tool use" area of interest attention has been focused on tool purpose, efficiency and signs of wear or damage that indicate use. This general interest in micro-analysis I would label scientific.

OTHER APPLICATIONS OF FUNCTIONAL OBJECTIVE

Outside of lithic studies this interest in function has been expressed in studies of settlement patterns, environmental exploitation patterns and in general by the whole "systems" approach to understanding cultural stability and change. The attempt to understand the processes of past manufacture and use of tools thus is one example of the general interest in getting realistically back (not speculatively back) into the past of real human behavior.* This is a good series of examples of the "practical" aspect of important current research. It is guided by a pervasive consensus on what is important to do in archeology. Far from being an example of "young fogies" some of the most impressive advances in knowledge these days are coming through this kind of work. I think of it as a realistic, productive and very tangible interest in "process".

RESULTANT NEW PERSPECTIVES IN CURRENT LITHIC RESEARCH

A field school in lithic technology held annually since 1969 by Don Crabtree is a most explicit example of the interest and accomplishments in the study of past human behavior. When asked for his feelings Crabtree said:

> Certainly, we cannot live without theory in this profession but "theory" is still derived from the Greek word meaning speculation which can sometimes be ambiguous and give little clue to the actual manufacture or intended functional use of a specific stone tool. So it is my contention that by actually trying to manufacture the stone tools, the students become aware of the importance of proper preforming, thinning, platform preparation, ridge control, angles of platform and applied force; use of proper billet, hammer, percussor, compressor; coordination of eye and application of force, muscular motor habits, choice of suitable materials for specific tools, dampening or acceleration of applied force and other factors too numerous to list here. They also become aware of the diagnostic value of debitage for, as you are aware, most of the clues to manufacture go with the detached flake and only by the study of this debris can we calculate such steps as the angle of the platform—whether it was isolated by flaking, faceting, grinding, polishing—angle of force, control of the length and width and termination of the detached flake or some of the 100 or more definitive characteristics.
>
> It is not my intention to make a flintknapper of every lithic tech student and they need not become proficient at the art, but I feel an attempt to replicate by actual manufacture will improve their typology. And, certainly, it makes the future study of debitage more interesting and beneficial (personal communication, 1973).

Two of the students who were involved in this summer field school also had important comments to make. Carl Phagan of Ohio State

*See the "behavioral archeology" paradigm being developed by J. Reid and M. Schiffer (1974).

University, one of the participants in the second field school of 1970, says in his report submitted to Crabtree:

> Ethnographers have long profited by a personal involvement with the objects of their study, feeling that the gain in understanding made possible by a certain degree of actual participation is worth some loss in complete objectivity. Prehistorians have felt that since their subjects are no longer alive, such participation is impossible. This flintworking school is, however, a definite first step in the involvement of prehistorians in the lives of their subjects, and as such makes a significant contribution to the study of early man. One—and only one—who has sweat and bled over the production of a projectile point has a new understanding, a new feeling, a new perspective. He is better able to sense the significant elements in its production which are perhaps only subtly evident in its final form. He may also be able to treat as properly insignificant some aspect which appears obvious. As a suggestion for a further step in this process of involvement in prehistory I would suggest for a selected group of students an extensive period of study not only in the production of aboriginal tool kits by various techniques, but their use in a complete pattern of subsistence.

Irwin Rovner, then of the University of Wisconsin, in his report made the same points in a somewhat different way.

> In general, anthropologists have always used informants; archaeologists have used ethnographic analogy. The two combine when, as has happened so many times, a native worker identifies as typical in his cultural inventory, some artifact which the archaeologist has labeled "problematic" or "ceremonial". The "alien" professional can hope, at best, for a reasonable insight, an analytical sensitivity to the objective material he recovers. It is this analytical sensitivity, in the final analysis, that is the most important thing learned at your flintknapping school—more than all the field work and lab analysis I have done in the past. A review of my own ideas and the reports of others leave me with one conclusion—to begin to understand stone tools, you must start by learning to break stone, to experience first-hand the problems and methods for success and reasons for failure.

ARCHEOLOGICAL "PARTICIPANT OBSERVATION"

From the two main kinds of interest that lithic technologists have had in function (manufacturing and use of stone tools) has come a recognition that this is an important way to attempt realistic time travel, i.e., recreating possible past chipping behaviors is like going back to a hunk of the past behavioral context, "as if" being there as a participant observer. In fact, this operational technique is now the best candidate for the establishment of a traditional and distinctive anthropological method—participant observation—as a central element in contemporary archeology. As such, this is in accord with some of the goals of the so called "new" archeology, but if these new goals limit anthropology to being a field of Science, it must then be seen to be in conflict with those goals. Because this is not strictly a "scientific", but is a craftsman approach to gaining knowledge, I see the above described kind of work in lithic technology as an example of the importance of personal and unique factors (that is, the contribution of creative individuals) to the field as a whole. Yet I think it is undeniable that the work in and the replicative study of past tool manufacture and past tool usage is an important contribution to the field of anthropological archeology.

At this point the critical observer can say, "so what!" What we have been discussing is simply another way of looking at the subject matter of archeology, an attitude that has been stressed by Binford and others. We are specifically concerned with the re-evaluation of the nature and possibilities for usage of the archeological record. In the lithic studies mentioned here we have a good example of a way that changes in approach to the study of the archeological record are being carried out. New aspects of the record (for example, debitage location, new artifact attributes) become important and useful as a result of the replicative and analytical lithic studies. An excellent overview of the directions of lithic research as of 1973 is presented by Swanson (1975).

By making this stress on participant observation an explicit attempt to get back to an understanding of past human behavior we may very well go in a number of new directions. No doubt we could derive useful new information based upon ideas about site location; or ecological knowledge; or economic or social behavior (for example hunting, fishing, agriculture). This then I see as fruitful ground for the careful and explicit formulation of new problems. Often these may be set up as hypotheses for testing or they may simply be problems which demand some kind of experimental activity. And really, we would but be making explicit and rigorous the kind of casual and informal approach to the "thinking" of prehistoric people characteristic of some archeological work.

I suggest, in conclusion, that we archeologists professing also to be anthropologists explicitly accept "participant observation" as a methodological goal. With such a goal we must bend ourselves to the task of ingeniously devising techniques for adapting the method to our data and our problems. By so doing we may in fact develop a truly "behavioral" archeology.

REFERENCES CITED

Callahan, Errett
1973 *The Old Rag Report: a practical guide to living archeology.* Department of Sociology and Anthropology, Virginia Commonwealth University. Richmond.

Faulkner, A.
1972 Mechanical Principles of Flintworking, Ph.D. dissertation, Washington State University. Pullman

Henry, Don O., C. V. Haynes and B. Bradley.
1976 Quantitative variations in flaked stone debitage. *Plains Anthropologist*, Vol. 21, No. 71, pp. 57-62.

Mayer, Oakes, William J.
1974 Review of "Contemporary Archeology: A Guide to Theory and Contributions." *American Anthropologist*, Vol. 76, pp. 651-657.

Reid, J. Jefferson and M. B. Schiffer
1974 Behavioral archaeology: Four strategies. Paper presented at 1974 SAA meeting. Washington.

Swanson, Earl (editor)
1975 *Lithic Technology*. Mouton, The Hague.

BOOK REVIEWS

The Presidio: Bastion of the Spanish Borderlands. by Max L. Moorhead. University of Oklahoma Press, Norman. 1975. xii + 288 pp., 21 illus., 5 maps. $9.95.

Max Moorhead has compiled information about the presidios of the Provincias Internas in a concise well documented volume invaluable to students of the Spanish Colonial period, including archeologists and anthropologists as well as historians. The book is the result of seven years of research in Mexico and Seville, Spain, and the British Museum. The research was to define what the presidio was and how fully it influenced the course of regional history, and to determine "more fully its impact on the human environment." Moorhead also aimed to date the presidios and to fix their locations more precisely than had previously been done. He seems to have succeeded in these aims, although many locations are not exactly pinpointed.

The scope of the study is limited to Spanish Provincias Internas, including what is now Texas, New Mexico, and Arizona, and the Mexican states of Coahuila, Chihuahua, Durango, Sonora, and Sinaloa. The presidios of California and Florida were not included because they were situated on the sea coasts and did not fall under the uniform regulations of the 18th century. To compensate for this lack several important studies of these presidios are listed.

The illustrations are excellent reproductions of the 21 drawings made by Urrutia during the Rubí inspection of 1766-68. The originals of these drawings are in the British Museum. The five maps are line drawings which show the locations of the presidios of northern New Spain during 1570-1600, 1600-1700, 1700, 1700-1771, 1772-1800.

The book is in two sections: Part I traces the historical development of the presidio, and Part II, in the author's words (p. vii), "attempts to analyze the institution in its several facets and functions."

The five chapters of Part I: Historical Development, are: 1. Origin and early development; 2. The Reglamento of 1729; 3. The Reglamento of 1772; 4. Teodoro de Croix and the Commandancy General, 1776-84; and, 5. The Instrucción of 1786 and the Final Phase, 1783-1810. Throughout the development of the presidial system the struggle for communication and regulation along a widespread front to control the Indians and the presidio itself is evident in periodic attempts to reorganize the entire system. The presidios of Texas, their changing patterns with the shift of Indian threat and foreign encroachment along the eastern frontier are brought into focus as to their role in the entire system.

Part II: Descriptive Analysis, contains chapters entitled: 1. The Fort; 2. The Presidial Company; 3. The Payroll; 4. The Civilian Settlement; and, 5. The Indian Reservation. It is in this part that the processes of operation and the lasting effects of the presidial system are brought out.

Moorhead characterizes the presidio as primarily a military installation; but, he states (p. 3) "it came to exert a pervasive influence on the political, economic, social, and even demographic development of its environment." He notes it served its purpose well, because it was never seriously challenged by the Indians and rarely by European forces. He also suggests the most lasting influence of the presidio is found in the associated civil settlements which outlasted the military establishment, some to the present day. Furthermore, he suggests the presidio as an Indian agency, more so than the mission, formed a precedent and began a process which was to be completed with the Anglo-American Indian Reservation.

As in any work, errors are bound to creep in, and here few were noted. One that I cannot let go unnoted, however, is the author's statement (p. 53) that the San Xavier missions (in central Texas) were established for the Apaches; these were instead established mainly for the Mayeye, Deadose, Yojuane, and Orcoquisa Indian groups. It was the unsuccessful and ill-fated Mission Santa Cruz de San Sabá which, it was hoped, would tame the troublesome Apache.

Regretfully, Moorhead does not seem to be aware of, or at least did not take advantage of, archeological studies made of several Texas presidios. Another regret is that translations or transcripts were not published of some of the primary documents not available in this country. Many details in these documents would be potentially useful to ethno-historians, anthropologists, and archeologists.

Kathleen Gilmore
Institute of Applied Sciences
Denton, Texas

The Payaya Indians of Southern Texas. T. N. Campbell. Special Publication No. 1, Southern Texas Archaeological Association, San Antonio 1975. 30 pp. $2.50.

T. N. Campbell's long period of research into the ethnohistory of Texas Indians is well known and the published results are being anticipated by many. Thus it was with more than casual interest that I took up this modest volume published by the Southern Texas Archaeological Association; would that every other 30 pages published on native Texas cultures contained as much sound scholarship and usable information. Moreover, the Southern Texas Archaeological Association is to be highly commended for the scholarly and technical quality attained in their first "Special Publication"; hopefully, they will be able to sustain this level in the future.

Campbell's volume is instructive in two respects: (1) it represents new information as well as a current synthesis of Payaya ethnohistory; and (2) it is an object lesson on the use of ethnohistoric information by other specialists.

Research and publication on the ethnohistory of Texas Indians has not been vigorous in recent decades and consequently most archeologists have continued to rely upon the limited body of primary data that has been available and upon the numerous secondary sources that for the most part are now quite dated. This report presents information that alters several previously held notions about the Payaya, one of the most important of which has to do with the pre-mission territory of this band and with likely areas in which Payaya archeological sites might be found and studied. Campbell also stresses the larger historic setting wherein his redefined territory of the Payaya was unenviably situated between two approaching frontiers: the Apaches from the north and the Spanish from the south. This circumstance is then seen as having a profound influence upon the Payaya in the 17th and 18th centuries with respect to trends in occurrence of settlements shared with other bands, on ecological zones available for exploitation, on the initiation and course of settlement at missions, and upon population bioanthropology. Collateral issues are also raised such as territory changes, acculuration in the mission settlements, and a critique of Ruecking's interpretation of the Payaya band-cluster. Considering the range of archeological and documentary evidence potentially available, Campbell surely is correct in his conclusion that "Southern Texas is a good area for studying the decline and fall of fragile hunting and gathering societies."

There is more, however, for Campbell rather clearly demonstrates that the earlier ethnohistoric literature is not only limited, but fallible as well. The "old standards" among secondary sources—e.g., Hodge, Bolton, and Swanton—have served us well but much work has been carried out since their day and many primary sources yet remain to be examined for new data. When Campbell published his researches on this and other Texas groups in their final form we hope that the narrative will be supplemented with maps, tables of demographic data he has gleaned from mission records, and translated texts of relevant new documents he has discovered. The present result, nevertheless, is a significant new synthesis of Payaya ethnohistory.

Lawrence E. Aten
National Park Service
Washington, D.C. 20240

Archaeological Excavations at Lake Lavon 1974. Mark J. Lynott, *Southern Methodist University Contributions in Anthropology*, No. 16. 1975, 136 pp.

A funny thing happened to salvage archaeology on the way to the Moss-Bennett Bill—it became "cultural resource management." It just took a second or two to scratch out the offending word "salvage" and pencil in "CRM" but, ah, it was time well-spent. In that magic moment the burrower, the hippy, the cowboy-archaeologist in all of us faded away and we became "managers," heir to all the privilege connoted by that title in this businessman's society of ours. Don't get me wrong, I have salvaged with the best of them and I know that there is plenty in a name. A noted colleague of mine informs me, for example, that while a certain government agency is unwilling to spend a nickel on archaeological "testing" they balk not a whit at sponsoring the same operation if one will only call it "subsurface evaluation." No, the name change is fine with me. My beef is simply this: the name has been changed—to protect the innocent, I suppose, or maybe the guilty—but with a number of very notable exceptions, salvage archaeology or cultural resource management or old what's-its-name, has yet to be transformed in **substance**. Specifically it has yet to effect the historic, and I believe, inevitable, wedding of the old-line, nuts-and-bolts field research that brought it to prominence in the first place with the newer, problem-oriented, radically deductivist archaeology that is rapidly co-opting the mainstream at least of the American branch of our discipline.

Now as the man says, such things are easier said than done. But we don't get there just by following the bulldozers around. Heaven knows we all have done plenty of that, and the likelihood is great that we will have to continue doing it. We will have to continue letting the agencies pick **where** we dig. We will have to let the agencies' construction, destruction, impounding, blasting, flooding and scraping schedules dictate largely **what** we dig. But, we do not have to let the agencies tell us **how** we dig or what we do with data once recovered. The work done by Mark J. Lynott and his collaborators from Southern Methodist University at Lake Lavon (and here at last is the review) is a good example of just exactly this. "Where" and to some extent "what" belonged to the National Park Service. "How" belonged to SMU.

Lynott chose to use the excavations of two Wiley Focus sites scheduled to be destroyed by the enlargement of the lake as a laboratory in which to test, among other things, a number of hypotheses about the prehistoric function of the anomalous "pit" features known from this time range in the area. As Lynott admits in the report, the test results were not entirely conclusive and more remains to be done. Nonetheless, with no sacrifice in the recovery of standard kinds of culture historical data, an effort was made at systematically collecting evidence about Wiley Focus culture process.

This is not to say that the effort was flawless. I balk, for example, at Lynott's (p. 18) bland assertion that a controlled surface collection provides a "representative sample" of the artifactual and temporal variety at the site at minimum cost. Such an assertion is not God's truth, but a testable hypothesis in itself and judging from the results obtained by the originators of the technique (Redmon and Watson 1970), it is a questionable one at that. But more importantly, I would have preferred to see Lynott state his hypotheses in a more rigorous, formal manner. In doing this one is first called upon to state the general theory or theoretical proposition from which the hypothesis is drawn, the antecedent conditions or special circumstances surrounding its application in the instance at hand, the hypothesis itself, and finally, a list of the test implications of that hypothesis. Such test implications are of course nothing more than the explicit statements about what kinds of evidence one would expect to find if the hypothesis were true. Ideally such implications should be framed in a manner allowing the hypothesis to be tested statistically. This procedure is particularly adapted to the generation of hypotheses about function in the prehistoric record (cf. Hill's 1970 use of the method in assessing Pueblo room function in the Southwest). The internal logic inherent in the method is so powerful that, if it is applied with rigor, the rapid construction of exhaustive hypotheses and test implications generally results. Instead, by operating more informally, Lynott ends up testing hypotheses that the pits are "community council chambers," burial areas for high status individuals or open-air-ritual feasting centers (p. 39). This is not really a comprehensive list of possibilities. Why not borrow pits or ersatz-Mesoamerican ball courts, to name a few other possibilities not investigated.

But, putting aside the specific explanations which might be offered for these pits, the point remains that Lynott's effort is definitely in the right direction. Like him, we should all cease boring each other with endless streams of preliminary reports chuck full of less-than-memorable particularisms. Instead, we should seek ways of enlarging the significance of our work by generalizing it and rendering it useful for the ends of anthropology, and yes, of science, as a whole.

D. Bruce Dickson
Texas A&M University

References Cited

Hill, J. N.
1970 Broken K Pueblo: prehistoric social organization in the American Southwest. *Anthropological Papers of the University of Arizona*, No. 18.

Redman, Charles L. and Patty Jo Watson
1970 Systematic, intensive surface collection. *American Antiquity*, Vol. 35, pp. 279-291.

THE AUTHORS

Lawrence E. Aten is Deputy Chief of the Interagency Archeological Services Division of the National Park Service, Washington, D. C. He received his B.S. in Geology from the University of Houston and is presently a Ph.D. candidate at The University of Texas at Austin. His study of the prehistoric cemetery site at the Harris County Boys' School (authored with C. K. Chandler and others) is *Special Publication*, No. 3, of the Texas Archeological Society. Address: Interagency Archeological Services Division, Office of Archeology and Historic Preservation, National Park Service, U. S. Department of the Interior, 18th and C Streets, N. W., Washington, D. C. 20240.

Douglas R. Brown received a B.A. degree in Anthropology from The University of Texas at Austin, and is presently an archeologist at the Western Archeological Center (National Park Service, Tucson). Mr. Brown has carried out archeological investigations in Texas and the Southwest, and has a continuing interest in the development of field methodologies. Address: National Park Service, Western Archeological Center, P. O. Box 49008, Tucson, Arizona 85717.

Kenneth M. Brown has been a member of the Texas Archeological Society since 1963. Since that time, he has attended several of the Society's field school. Additionally, he has conducted archeological studies in the Caddoan area of eastern Texas. Address: 5211 Eilers Avenue, Austin, Texas 78751.

John W. Clark, Jr. is a staff archeologist with the National Register division of the Texas Historical Commission. He received his B.A. in Anthropology at The University of Texas at Austin and has done graduate work at the University of Arkansas. Clark has conducted excavations at a variety of historic and prehistoric sites in Texas. His publications include "Archeological Investigations at Fort Lancaster Historic Site, Crockett County, Texas" (*Texas Archeological Salvage Project, Research Report* 1972) and "Rock Art of the Guadalupe Mountains National Park Area" (*Bulletin of the Texas Archeological Society* 1974). Address: Texas Historical Commission, P.O. Box 12276, Austin, Texas 78711.

J. Phil Dering received his B.A. degree in Anthropology from Texas A&M University. He has co-authored several research reports for the Texas A&M University Anthropology Laboratory. Presently, he is a research assistant at Texas A&M, where he is working on an M.S. degree in Botany. His primary interests are paleoecology and prehistoric hunter-gatherer subsistence patterns. Address: Department of Biology, Texas A&M University, College Station, Texas 77843.

D. Bruce Dickson received his Ph.D. from the University of Arizona in 1973 and is currently Assistant Professor of Anthropology at Texas A&M University. Dr. Dickson has conducted archeological fieldwork in Central America as well as the American Southwest and Southeast. His major research interests include archeological method and theory, paleogeography and the prehistory of southern North America and Mesoamerica. Recent publications include "Archaeological Test Excavations at the Sam Houston Schoolhouse, Maryville, Tennessee, 1973" (*Tennessee Archaeologist*, 1975), and "Settlement Pattern Stability and Change in the Middle Northern Rio Grande region, New Mexico: A Test of Some Hypotheses" (*American Antiquity*, 1975). Address: Department of Sociology and Anthropology, Texas A&M University, College Station, Texas 77843.

Jack D. Eaton is Faculty Associate at The University of Texas at San Antonio. In recent years, he has conducted excavations along the coast and in the Rio Bec region of Yucatan. In 1975 he studied the prehistoric salt industries of coastal Yucatan under the sponsorship of The University of Texas at San Antonio. Presently, he is deputy field director of UTSA excavations at the Spanish Colonial missions near Guerrero, Coahuila. Among his publications is "Ancient Agricultural Farmsteads in the Rio Bec Region, Mexico" (*Contributions, University of California Archaeological Research Facility*, 1975). Address: Center for Archaeological Research, The University of Texas at San Antonio, San Antonio, Texas 78285.

Kathleen Gilmore received her Ph.D. in Anthropology from Southern Methodist University, and is currently associated with the Institute of Applied Sciences at North Texas State University. Gilmore's major research interests are ceramic analysis and Spanish colonial archeology. Publications include "The San Xavier Missions: A Study in Historical Site Identification" (*State Building Commission, Arhceological Program*, 1969) and "Mission Rosario Archeological Investigations" (*Texas Parks and Wildlife Department, Historic Sites Restoration Branch, Report* 14, Parts 1 and 2, 1974, 1976). Address: Institute of Applied Sciences, North Texas State University, Denton, Texas 76203.

John W. Greer is currently working toward a Ph.D. in Anthropology at the University of Missouri, Columbia. He has done field work in Texas, the Southwest, the Plains, in Mesoamerica, and in Europe. He has published the results of these studies in several journals, including several papers which have appeared in the *Bulletin of the Texas Archeological Society*. Address: Department of Anthropology, 210 Switzler Hall, University of Missouri, Columbia, Missouri 65201.

Robert F. Heizer is Professor of Anthropology and Coordinator of the Archaeological Research Facility, University of California, Berkeley. He received his Ph.D. at Berkeley in 1941. Professor Heizer has done archaeological fieldwork in California, Nevada, Mexico, Guatemala, Bolivia, and Egypt, and has authored numerous publications dealing with these investigations. In 1955 and at later times, he has carried out investigations at the Olmec site of La Venta and was co-author (with Philip Drucker) of the basic report on that site published in *Bureau of American Ethnology, Bulletin* 170 (1959). Address: Department of Anthropology, University of California at Berkeley, Berkeley, California 94720.

Thomas R. Hester is Associate Professor of Anthropology, and Director, Center for Archaeological Research, The University of Texas at San Antonio. He received his Ph.D. degree from the University of California, Berkeley, in 1972. Hester has carried out archeological work in Texas and northeastern Mexico, the western United States and Egypt. Among his publications are *Field Methods in Archaeology* (with R. F. Heizer and J. A. Graham, Palo Alto 1975) and "The Obsidian Industry of Beleh (Guatemala)" (*Actas, 41st International Congress of Americanists*, 1975). Address: Center for Archaeological Research, The University of Texas at San Antonio, San Antonio, Texas 78285.

William J. Mayer-Oakes received an M.A. in Social Sciences at the University of Chicago in 1949 and his Ph.D. at that institution in 1954. Presently, he is Professor of Anthropology, and Chairman, Department of Anthropology, at Texas Tech University. Dr. Mayer-Oakes has worked as a research specialist, teacher, museum director, and department head, as well as a research administrator, during more than 25 years of professional experience in archeology. He is the author of numerous papers. Address: Department of Anthropology, Texas Tech University, Lubbock, Texas 79409.

Leland W. Patterson is currently Chairman of the Houston Archeological Society. He is an active amateur archeologist with major interests in the upper coast and south-central regions of Texas. His research activities include site survey, lithic technology, cultural change, and cross-cultural comparisons. He has published a number of papers in the *Ohio Archaeologist, La Tierra*, and the *Houston Archeological Society Newsletter*, as well as several articles on lithic technology in other journals. Address: 418 Wycliffe, Houston, Texas 77079.

Harry J. Shafer is Assistant Professor of Anthropology, and Coordinator, Archeological Research Laboratory, at Texas A&M University. He received his Ph.D. in Anthropology at The University of Texas at Austin. Shafer has conducted archeological fieldwork in many areas of Texas and in Israel. His publications include a number of monographs in the Texas Archeological Salvage Project series, and he is also the author of "Clay Figurines from the Lower Pecos Region, Texas" (*American Antiquity* 1975), and "Comments on Woodland Cultures of East Texas" (*Bulletin of the Texas Archeological Society* 1975). Address: Department of Sociology and Anthropology, Texas A&M University, College Station, Texas 77843.

J. B. Sollberger is an amateur archeologist with a major interest in experimentation and interpretation in lithic technology. His publications include "A Technological Study of Beveled Knives" (*Plains Anthropologist* 1971) and "The Basic Tool Kit Required to Make and Notch Arrow Shafts for Stone Points" (*Bulletin of the Texas Archeological Society* 1969). Address: 8515 Forest Hills Blvd., Dallas, Texas 75218.

Al B. Wesolowsky received his B.A. and M.A. degrees in Anthropology from The University of Texas at Austin. He is currently a doctoral student at Christ's College, Cambridge University (England). Wesolowsky has has extensive experience in the archeology and physical anthropology of Texas, Arkansas, Greece, and Yugoslavia. For the past several years, he has participated in the major excavations at Stobi in Yugoslavia. Some of his publication include: "The Skeletons of Lerna Hollow" (*Hesperia* 1973) and "Burial Customs in the West Cemetery" (*Studies in the Antiquities of Stobi*, Vol. I, 1973). Address: 12 Devonshire Road, Cambridge CB1 2 BH, England.

Information for Contributors

The *Bulletin of the Texas Archeological Society* publishes original papers in the field of American archeology. Emphasis is placed on Texas and adjoining areas in the United States and Mexico, but papers on other areas will also be considered. Articles concerning archeological technique, method, or theory are encouraged.

Manuscripts must be typed, double-spaced, on 8½ x 11 white paper. Footnotes should be avoided or kept to a minimum. Reference to published literature, by author, date, and page or figure number should be placed within parentheses in the body of the text, with full bibliographic citations at the end. See this issue of the *Bulletin* for examples. Authors should also consult "Information for Authors", in *Texas Archeology*, Vol. 18, No. 1 (January, 1974) or write to the Editors for a copy.

The proportions of full-page illustrations (picture or drawing plus captions) should be suitable for reduction to the effective page size of the *Bulletin* of 4¼ x 7 inches. Plates may be printed either horizontally or vertically, but allowance for the caption to be printed the same direction must be made. Captions for illustrations should be listed in numerical order and placed behind the list of references cited.

A complete manuscript is one with: a title page, an abstract, main body, references cited, appendices (if necessary), figure captions, and completed photographic and drafted plates. *Only complete manuscripts will be considered.*

Papers published in the *Bulletin* are abstracted and indexed in ABSTRACTS IN ANTHROPOLOGY.

Manuscripts should be addressed to: (1977) Dr. Harry J. Shafer, Anthropology Research Laboratory, Texas A&M University, College Station, TX 77843; (1978) Dr. Thomas R. Hester, Center for Archaeological Research, The University of Texas at San Antonio, San Antonio, TX 78285.