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Cattle Brands of Trinidad de Salcedo, circa 1812

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Contents

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William Marshall Black

1924 – 1993

Marshall Black, native Houstonian and graduate of Rice Institute, passed away on August 11, 1993. Marshall was a mechanical engineer and was employed by Exxon as a Professional Petroleum Engineer. He retired from Exxon after 39 years of service.

During World War II, Marshall trained at the Naval Academy at Annapolis, and then commanded a mine sweeper during the war.

Archeology played an important role in Marshall's life. As a youth he located a number of archeological sites in the Houston area and kept records on these sites. He worked with Joe Ben Wheat in the Addicks Dam area in the late 1940s. Wheat's work on the Addicks sites was one of the first professional investigations of Houston area sites. He acknowledges Marshall's assistance in his Smithsonian Report on the Addicks Dam site by stating "Mr. Black's carefully kept field notes on the Addicks 'Mound' were of considerable use."

Marshall's archeological interest in recent years became focused on the ceramics of the area. He developed a data system based on design patterns on pottery as an important characteristic of the site's population. The Houston Archeological Society will to continue to expand this data base and also has established the Marshall Black Memorial Fund for dating of local sites under investigation.

Marshall also was a fine potter and produced replicas of Gulf Coast pottery that are unmatched in their similarity to the work of the early inhabitants of the area. He was a Director of the Houston Archeological Society at the time of his death.

His contributions to the archeology of the Houston area remain a living tribute. His presence as a friend will be missed.

Alan R. Duke

Bone-Tempered Pottery in Southeast Texas

Leland W. Patterson

Introduction

The study of bone-tempered pottery in Southeast Texas is a rather enigmatic subject, because this pottery type is sparsely distributed in this region both geographically and temporally. Aten (1983:244) has commented that "bone-tempered pottery classification is a problem to be solved elsewhere than on the upper Texas coast." The presence of bone-tempered pottery in Southeast Texas seems to represent sporadic cultural influences from the north at various times during the Early Ceramic (A.D. 100-600) and Late Prehistoric (A.D. 600-1500) time periods.

This paper summarizes data on bone-tempered pottery in the 21-county area of Southeast Texas, based on 1992 updates of computerized data bases for inland (Patterson 1989a) and coastal margin (Patterson 1989b) subregions. Bone-tempered pottery can be regarded as a somewhat intrusive technology in this region. The cultural significance of this pottery type in Southeast Texas is discussed here in terms of intrusions by hunter-gatherer groups from the north, and possible acquisition of women from bands to the north by bands in Southeast Texas. Bone-tempered pottery is not a major technological trait in Southeast Texas, but this pottery type does seem to have time-diagnostic value for the coastal margin subregion (Aten 1983: Figure 14.1).

Geographic distribution of bone-tempered pottery

The occurrence of bone-tempered pottery in Southeast Texas is summarized in Table 1 for the inland subregion and in Table 2 for the coastal margin subregion. This pottery type is found only in low concentrations in this region. Based on 1992 updates of the computerized data bases, bone-tempered pottery comprises only 1.7% of total pottery found in the inland subregion, and only 0.5% of total pottery found in the coastal margin subregion. Distribution of bone-tempered pottery in Southeast Texas is shown as shaded areas of the regional map in Figure 1. The highest concentration of bone-tempered pottery on the coastal margin is centered around Galveston Bay.

There seem to be two types of bone-tempered pottery found in Southeast Texas. In the central and eastern zones of this region, bone-tempered pottery is similar to Goose Creek sandy paste pottery, except for the addition of bone temper. In the western zone of this region, bone-tempered pottery, such as at site 41WH12 (Patterson and Hudgins 1989), is generally well fired and may be related to Leon Plain pottery found in the Colorado River drainage basin (Suhm and Jelks 1962:95). In all cases, origins of bone-tempered pottery in Southeast Texas appear to be from the north.

Chronology of bone-tempered pottery

Bone-tempered pottery is sporadically distributed in time as well as space in Southeast Texas. This pottery type has been found in both the Early Ceramic and Late Prehistoric periods at site 41HR315 in Harris County (Patterson 1980), but most bone-tempered pottery in this region seems to be from the Late Prehistoric period. At site 41WH12 in Wharton County, radiocarbon dates indicate that bone-tempered pottery started before A.D. 900, and continued throughout the later part of the Late Prehistoric period (Patterson and Hudgins 1989,1990).

On the coastal margin of Southeast Texas, bone-tempered pottery occurs mainly after A.D. 1400 (Aten 1983: Figure 14.1), with only traces of this pottery type found earlier in the Late Prehistoric period. In this subregion, bone-tempered pottery seems to be time-diagnostic, as representing the later part of the Late Prehistoric period and some portion of the Historic Indian period.

Origins of bone-tempered pottery in Southeast Texas

The earliest known occurrence of bone-tempered pottery in Texas was in the northeast region at the Resch site (41HS16) in Harrison County (Webb et al. 1969), perhaps between 500 and 100 B.C. Story (1990:246) states that "plain bone-tempered pottery may relate to a very early ceramic technology that is better represented in Southwestern Arkansas." Story (1990:246) also notes that bone-tempered pottery was never abundant in Texas, except among some of the Caddoan groups of East Texas.

While Leon Plain is regarded as a distinctive pottery type, the use of bone-tempered pottery in Central Texas probably is a trait that diffused from East Texas. Suhm and Jelks (1962:95) note that Caddoan pottery of eastern Texas commonly occurs on the same sites as Leon Plain. Two bone-tempered incised sherds were found at site 41WH12 in a stratum radiocarbon dated to A.D. 990 (Patterson and Hudgins 1990). These specimens could be classified as Leon Incised. The design motifs of the incised patterns are similar to those of Caddoan pottery, but not arranged in the same order. It was observed that this may be an example of borrowing of Caddo design elements (Patterson and Hudgins 1989:3).

Two cultural mechanisms may be responsible for the occurrence of bone-tempered pottery in Southeast Texas. One of these possibilities is the result of mobile hunter-gatherer groups from the north occasionally entering Southeast Texas. At site 41WH12 in Wharton County (Patterson and Hudgins 1989), there is evidence of aggregation of groups from adjacent regions, including the Colorado River drainage basin where Leon Plain pottery is commonly found. The other possibility for bone-tempered pottery in Southeast Texas involves acquisition of women from bands to the north by bands in Southeast Texas. This seems especially likely for the occurrence of bone-tempered pottery on the coastal margin subregion in the Late Prehistoric period. Trade is not considered here as a likely explanation for bone-tempered pottery in Southeast Texas. Pottery is heavy and bulky, and is not likely to have been traded much by mobile hunter-gatherers. It may be noted in relation to external cultural influences on Southeast Texas from the north that evidence of significant Caddo influences is found only on the northern fringes of Southeast Texas (Patterson 1992:18).

Summary

Bone-tempered pottery is not abundant in Southeast Texas. The occurrence of bone-tempered pottery in this region is sporadic in time and space. Use of this pottery type in Southeast Texas seems to have been due to cultural influences from the north, but these cultural influences were never very strong. Bone-tempered pottery may be regarded as a minor ceramic type in Southeast Texas that did not have a significant role in the main technological developments of this region.

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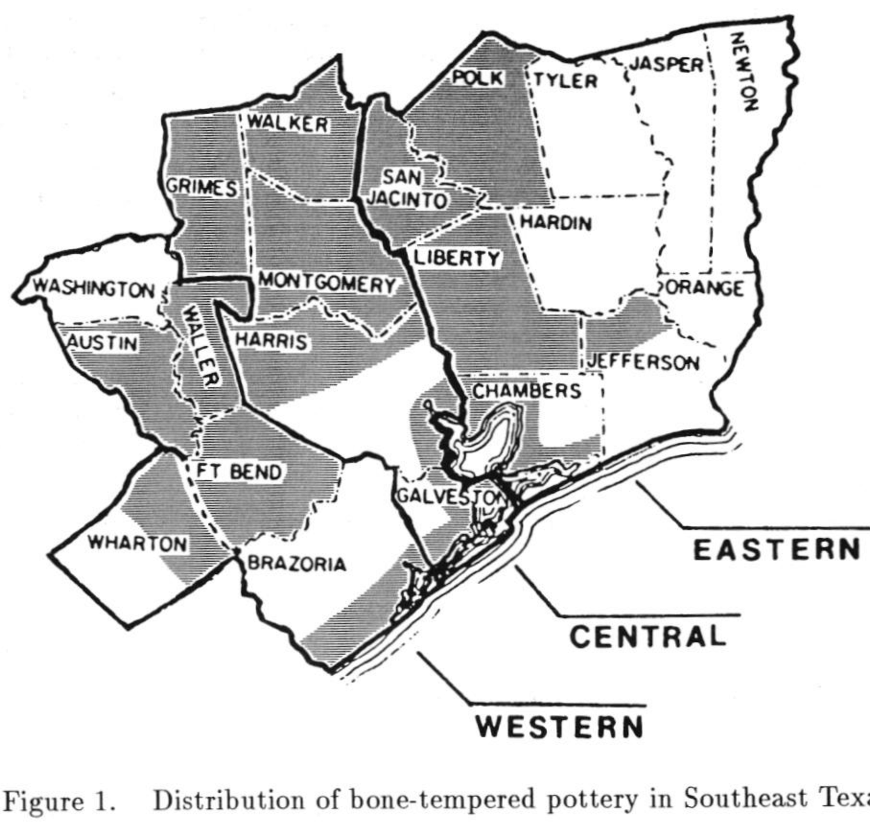

Figure 1. Distribution of bone-tempered pottery in Southeast Texas

Table 1. Bone-Tempered Pottery in Inland Southeast Texas

county	no. of sherds	no. of sites
Western		
Austin	51	3
Brazoria	0	0
Fort Bend	5	2
Waller	3	3
Washington	0	0
Wharton	194	6
	253	14
Central		
Galveston	0	0
Grimes	4	1
Harris	87	11
Montgomery	66	8
Walker	5	1
	162	21
Eastern		
San Jacinto	38	2
Liberty	10	1
Chambers	0	0
Polk	146	4
Hardin	0	0
Jefferson	9	1
Jasper	0	0
Newton	0	0
Orange	0	0
Tyler	0	0
	203	8

Table 2. Bone-Tempered Pottery on the Southeast Texas Coastal Margin

county	no. of sherds	no. of sites
Brazoria	5	2
Chambers	132	21
Galveston	74	3
Harris	24	5
Liberty	8	2
	243	33

Trinidad de Salcedo: A Lost Texas Town

Jean L. Epperson

(continued from 104:13)

John McGee, an Irishman living in Trinidad, wrote on August 30, 1806, to the Governor asking to be granted a town lot and lands on which he had planted corn and built a flour mill, thirteen miles (five leagues) north of Trinidad on the San Francisco River. He acquired the town lot and was granted three leagues of land which included his mill and improvements.[19]

December 1806 was a quiet month at Trinidad. The peace was only disturbed a little when Domingo Delgadillo, the town barber, ran away with a soldier's horse. Neither he nor the horse was ever seen again. The mail passed through, and Lieutenant Colonel Don Simon de Herrera, Commandant of the Texas Frontier, arrived with a twenty-man escort on the 22nd and left on the 24th for Bexar. Herrera was returning from a tour of inspection of the Texas-Louisiana border. Nine Coshatta Indians and their Chief arrived and were given three almudes of corn. They left the same day contented. Commandant Arrambide noted that the post was garrisoned with sixteen men who were employed as guards, keepers of the herds of horses and cattle, and couriers.[20]

Arrambide was appointed lieutenant of the company of La Bahia in early 1807, but he left Trinidad because of illness.[21]

Luciano Garcia remitted the military reports for February through March of 1807 as provisional commandant of Trinidad. On March 23 he acknowledged approval of the Zedo Arman (Harman) and Elisha Nelson families' petitions for settlement and reported the needs of the troops.[22] He reported on May 1 that the soldiers had finished constructing the church and the settlers had planted their late corn patches.[23]

By May, Jose Ignacio Trevino apparently had assumed the duties of provisional commandant of Trinidad because he informed Geronimo Herrera, commandant of Atascosito, that supplies would be sent to him.[24]

Zebulon Pike, United States soldier and explorer, was commissioned to explore and map the Louisiana Purchase. Apprehended on the Red River by the Spanish, Pike was taken to San Antonio for questioning. He was well treated and released. Returning east, Pike arrived at the Trinity River on June 21, 1807. He crossed the river to the post of Trinidad and marked it "Presidio" on his map but did not name it. His diary stated, "Here were stationed two captains, two lieutenants, and three ensigns, with nearly 100 men, all sick, one scarcely able to assist another. Met a number of runaway negroes, some French and some Irishmen." Father Jose Angel Cabaso, who had traveled with the party from San Antonio, left them here, explaining that he was going down river to a place where 300 Spanish troops were stationed. Pike also marked on his map the place on the river where the mythical troops were supposed to have been. Cabaso was probably referring to the Post of Atascosito on the lower Trinity, but there certainly were not 300 troops there. It is understandable that the Anglos were given a little disinformation about Spanish preparedness. Pike left Trinidad the next day for Nacogdoches.[25]

Pedro Lopez Prieto, troop commander of Nuevo Leon, was placed in charge of Trinidad by July 1807. He remained as commandant at that post for three years and two months before he was dismissed for fiscal mismanagement and involvement in contraband trade with Miguel Quinn and others.[26]

In May 1808, twenty-seven slaves who had escaped from Louisiana to Nacogdoches were ordered to be transferred to Trinidad. Nemesio Salcedo explained the order saying that it was necessary to safeguard the slaves from being captured by the Indians until they could be returned to the Americans.[27] The disposition of these slaves is not known, but they did not remain in Trinidad because the 1809 census of the town lists only three mulatto slaves in the household of Enrique Seridan (Henry Sheridan) and one slave in the Zedo Charman (Sharman or Harman) household.

Commandant Prieto's diary for the month of July 1808 gives a good profile of the daily activities of the villa of Trinidad (cf. contemporary map in Figure 1):

1st James Tier, a resident, returned from La Bahia where he had gone to get supplies.

2nd Private Asencio Arriola, interpreter for the Indian tribes of the villa, came from La Bahia del Espiritu Santo with his father-in-law, Jose Maria Rioja, who has permission to settle here.

3rd Miguel Quin, a resident, presented himself with a license from the governor to bring in 254 head of horses to raise in this villa.

4th Alferez Don Jose Cuellar with five privates and two civilians left in search of horses which got mixed up with the wild horses. Two soldiers arrived from Atascosito with parcels of letters of the royal service and some guns to be mended. Father Chaplain of the Alamo Company, Don Angel Cabazos, who is on his way to Bejar, came with the soldiers of Atascosito.

5th Juan Sy, resident, returned from Nacogdoches where he went to get provisions.

6th The regular mail from Nacogdoches bound for Bejar passed through.

7th A mule train arrived bringing provisions for the troops. A sergeant and four privates returned from Bejar where they had gone for treatment.

8th Don Jose Maria Uraga, Don Ygnacio Peres, and Don Manuel Barrera and their servants went on to Bejar. An American deserter was sent along with Don Peres from Nacogdoches to Bejar. The mule train which brought the supplies returned to Bejar.

9th Alferez Don Jose Antonio Cuellar returned from the search for the horses but did not find them.

10th The regular mail arrived from Bejar on its way to Nacogdoches. Father Chaplain, Don Angel Cabazos, left for Bejar.

11th No unusual incident.

12th No unusual incident.

13th Don Bernardo Espalier, resident of this villa, left for Nacogdoches.

14th A soldier left for the Brazos with a package of letters of the royal service.

15th The soldier returned, who had gone as far as the Brazos as guide for a herd.

16th No unusual incident.

17th Cristoval Garcia, a retired corporal of the Laredo Company, died a natural death. He had come with a passport to exhume the body of a son of his who had died in a camp on the Sabine River. Francisco Padilla, a resident of Nacogdoches, arrived in pursuit of a thief who had stolen a horse belonging to a resident of that town.

18th No unusual incident.

19th Three residents of Nacogdoches passed through with a license from their commandant to go on a hunt and to chase wild cattle within the bounds of this jurisdiction.

20th Manuel Casanova, resident of this villa, returned from Nacogdoches. He had escorted there a woman, widow of Hermenegildo de Acosta, a soldier of Bejar.

21st The soldier who went as special messenger returned from the Brazos; with him was Francisco Padilla, the man who was pursuing a thief. The Father Minister of this Villa left for Nacogdoches; a soldier accompanied him.

22nd The regular mail passed through on its way to Bejar.

23rd Don Marcelo Zoto, resident of Ballopier, arrived on his way back from Bejar where he had gone on business concerning the Indians. The assistant justice of this villa left for Bejar with three immigrants he is escorting.

24th Two servants of the general traders with the Indian tribes presented themselves. They were on business for the traders.

25th The regular mail passed through on the way to Nacogdoches.

26th Two soldiers left for Atascosito with letters of the royal service and they also took some guns.

27th A soldier from the station on the Brazos de Dios left. He had come as an escort to the assistant justice of Ballopier. A militia man arrives escorting a mule train that was bringing provisions from Nacogdoches. He was also conducting two deserters from the United States and a fugitive mulatto slave whom the commandant of Nacogdoches was sending.

28th The servants of the traders returned to their community.
29th Don Pedro Zepada passed through on his way back from Nacogdoches.
30th The Father Minister of this villa returned from Nacogdoches.
31st A special messenger from Nacogdoches passed through on his way to Bejar.[28]

During the summer of 1808, nine immigrant families from Louisiana were to be transferred from Atascosito to Trinidad.[29] The only families from the 1807 census of immigrant families at Camp of Orcoquisac (Atascosito) recognizable on the 1809 census of Trinidad are Frederick Stockman and Jose Giru(dt).[30] Stockman had no cows or horses, but Giru had eighty head of cattle and three horses in 1807. Both men had registered cattle brands in Trinidad after 1809. See Figure 2.[31]

James Mirlan, an American, arrived by boat at Atascosito in 1808 with his wife and six children. He was very poor and all the children were small, under eleven years of age. He was allowed to go upstream to Trinidad to settle.[32]

Hugo Coyle, an Irishman, was appointed surveyor at Trinidad on October 11. He was listed on the census a year later as a bachelor, but he had a wife and children in Louisiana where he owned considerable property.[33]

Sergeant Pedro de la Garza Falcon, eight soldiers, and one civilian left Trinidad on October 13, 1808, to check for black fugitives, introduction of foreign goods, and exportation of a herd of horses. Two days later the horse herd and five drovers were sighted. The men fled toward their camp when they saw the soldiers. One man, John McFarland, was captured before the camp was reached. One, Popejoy, was shot and killed after the soldiers returned his fire. The other three, Henry Quirk, Joseph McGee, and Joseph Brenton, arrived at the camp and stood ready to resist the soldiers, declaring they would die before they would surrender. Sergeant Falcon, reasoning with the men, suggested they cool off a little for the purpose of avoiding more bloodshed. After calming themselves somewhat, the men proposed that if the soldiers would let them go on their way to Natchitoches they would give each of them a horse and some merchandise. The Sergeant pretended to agree to the proposal. At a signal from the Sergeant the soldiers fell upon the smugglers and bound them. The prisoners were taken to Nacogdoches along with the 159 animals: horses, mules, and three jackasses.[34]

When examined, the smugglers implicated the Commandant of Trinidad, Don Pedro Lopez Prieto, as having consented to or tolerated the exportation. Michael Quinn, John Magee, and James McNulty, inhabitants of Trinidad, were accused also of complicity in the smuggling operation. It was decided that Prieto be relieved of his command and sent to Bexar to answer the charges. Quinn, Magee, and McNulty were jailed.[35]

Antonio Saenz was made interim Commandant of Trinidad on December 22, 1808, and served until May 8, 1810, when Prieto reassumed his duties.

A census report was made for the villa of Trinidad on January 6, 1809, and signed by Antonio Saenz. Ninety-two individuals were listed, not including the military personnel. An added list of individuals was made on October 6 by Pedro Lopez Prieto. Some of the persons on this list had arrived after January 6, or were deceased, expelled, absent, or in jail.[36]

Friar Francisco Manuel Maynes, a secular priest born in Spain, was transferred from Atascosito to Trinidad sometime in August of 1809.[37]

Increasingly disturbed by the foreign emigrants who had no passports, the officials required them to take an oath of allegiance to the Spanish Crown and to make a statement detailing their birthplace and travels prior to entering Texas. Fourteen persons in Trinidad, and probably others, took the oath and made statements on September 26, 1809. The fourteen were Henry Sheridan, John Magee, Henry Poston, James Mirlan, Peter Patterson, John Lum, William Burgess, Miguel Larrua, Antonio Camano, Joshua Reese, Carlos Dupont, Celestino Lokey, Pierre Lartigue, and Peter Brown.[38]

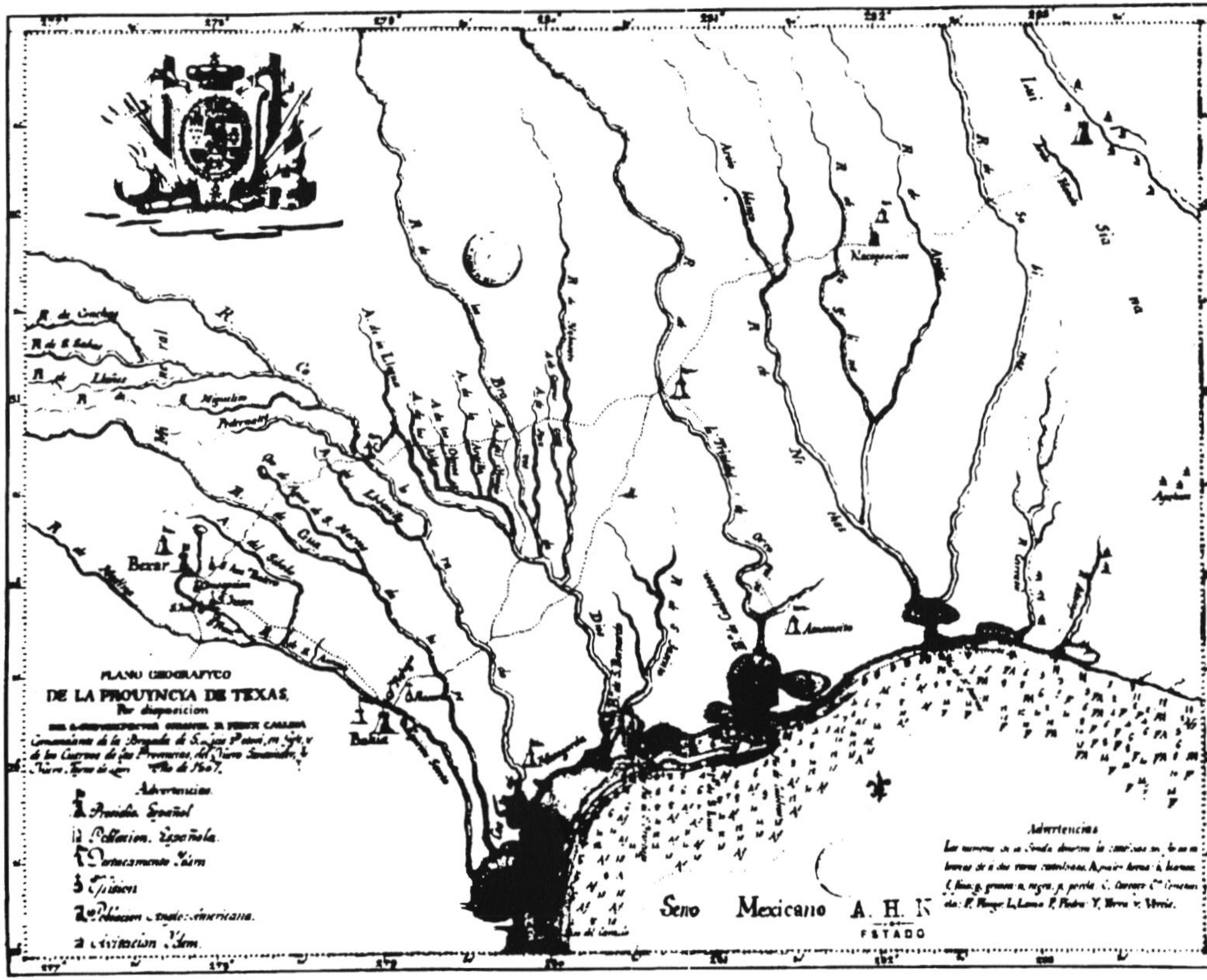

Figure 1. Map of Texas, 1807. Original is in Archivo Historico Nacional, Madrid. The location of Trinidad de Salcedo is indicated by the unlabeled symbol just east of the crossing on the Trinity River, near the center of the map.

Martin Despallier, a resident of Trinidad and nephew of the Commandant of Rapides Post, Valentine Lyssard, petitioned for admission into Spanish service in January 1809. He was accepted, then removed from the army for riotous conduct and illegal trade activities. He escaped from the country in October and by 1812 had joined forces with Bernardo Gutierrez and the invading Republican Army of the North.[39]

Juan Martin Martinez was employed as a school teacher in Trinidad on November 22, 1809.[40]

Whiskey, taffia (rum), and mescal were the major items sold to the settlers in 1809 as listed in the account book of trader John Magee.[41]

(To be continued)

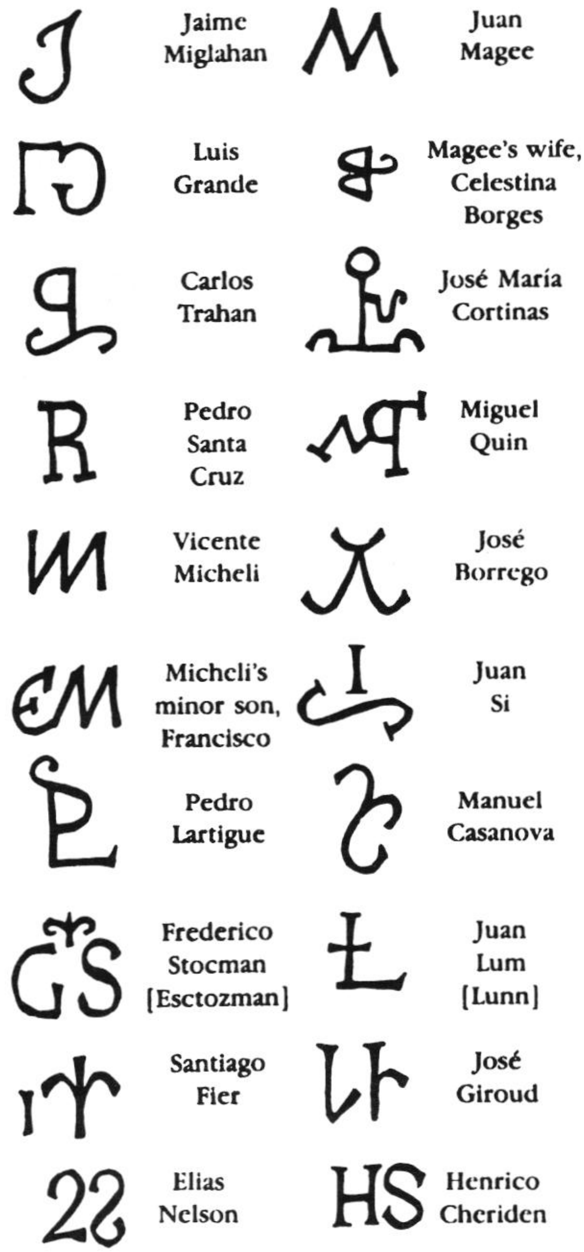

Figure 2. Cattle brands of the settlers of Trinidad de Salcedo

Notes, continued

19. John McGee to Antonio Cordero, August 30, 1806, B.A.

20. Arrambide to Viana, December 9, 1806; Diary of Juan Ignacio de Arrambide, January 1, 1807, B.A.

21. Military transfer of Arrambide, February 2, 1807; Cordero to N. Salcedo, May 7, 1807, B.A.

22. Luciano Garcia to Cordero, March 23, 1807, B.A.

23. Garcia to Cordero, May 8, 1807, B.A.

24. Jose Ignacio Trevino to Geronimo Herrera, May 26, 1807, B.A.

25. Elliott Coues, *The Expeditions of Zebulon Montgomery Pike* (New York: Francis P. Harper, 1895), II, 708.

26. Pedro Lopez Prieto, Bexar, May 29, 1810, B.A.

27. N. Salcedo to Cordero, May 31, 1808, B.A.

28. Diary of Pedro Lopez Prieto, August 1, 1808, B.A.

29. Cordero to N. Salcedo, July 12, 1808; Mariano Varela to Cordero, August 2, 1808, B.A.

30. Hatcher, *The Opening of Texas to Foreign Settlement*, 324-28.

31. Jack Jackson, *Los Mesteños* (College Station: Texas A&M University Press, 1986), 645.

32. Felipe Arceiniega to Cordero, August 1, 1808.

33. Benavides, *The Bexar Archives*, October 11, 1808, 238; Hugo Coyle file in possession of the author.

34. Copy of the Military Opinions of the Judges certified by Jose Agabe de Ayala on June 30, 1810, B.A.

35. Ibid.

36. Antonio Saenz, Census of Trinidad de Salcedo, January 6, 1809; Pedro Lopez Prieto, Others Locating (at Trinidad) Prior to Abandonment of Colonization Plan, October 6, 1809, B.A.

37. Francisco Maynes to Manuel Salcedo, May 30, 1810, B.A.

38. Biographical Sketches, September 26, 1809, B.A.

39. Benavides, *The Bexar Archives*, Bernardo Martin Despallier, 261-262; Julia Kathryn Garrett, *Green Flag Over Texas* (Austin: The Pemberton Press, 1939), 127-128.

40. Benavides, *The Bexar Archives*, November 22, 1809, 636.

41. R. B. Blake Collection, LXX, 186-206, Clayton Genealogical Library, Houston.

The Vertebrates and Soils of 41FB35

W. L. McClure

Introduction

Site 41FB35 is a freshwater shell midden located on the first high terrace on the south bank of the San Bernard River in Fort Bend County, Texas. Six pits were excavated down to culturally sterile soils by the Houston Archeological Society. Prehistoric occupation of the site apparently was discontinuous for some uncertain number of years from the Late Archaic period into the Early Ceramic period. Radiocarbon dating of shells in association with ceramics at the lowest level in one pit created concern about the sequence of occupation (Patterson and Hudgins 1992).

Soils were passed through 1/4-inch mesh screens and the vertebrate materials are reported here along with a suggested sequence of soil deposition and disturbance.

Methods and results

The vertebrate remains were identified by direct comparison with bones of known animals. The data from the excavated units was reviewed in an effort to reveal some information about the sequence of depositions.

Fewer than 500 bones of vertebrates were recovered. Of that number, only 22% could be identified to some species, genus, or family. Of the identified remains, 4% were of fish, 42% of reptiles, 1% of birds, and 53% of mammals.

The following vertebrates were recovered:

Genus unknown	Teleost fish
Lepisosteus sp.	gar
Micropterus salmoides	large-mouth bass
Genera unknown	turtles
Kinosternon sp.	mud turtle
Chrysemys sp.	pond or slider turtle
Terrapene sp.	box turtle
Genera unknown	snakes
Colubridae	nonpoisonous snake
Masticophis sp.	coachwhip snake
Viperidae	poisonous pit viper
Genus unknown	bird
Genera unknown	mammals
Geomys attwateri	Attwater's pocket gopher
Sigmodon hispidus	hispid cotton rat
Baiomys taylori	pigmy mouse
Odocoileus virginianus	white-tailed deer
cf. *Bos taurus*	probable cow

A gar scale and a vomer of a bass are the only remains of those two fish. The unidentified Teleost fish remains are two vertebrae.

The turtle remains include 35 fragments of carapace and plastron. These are 3 of mud turtle, 7 of pond or slider turtles, 2 of box turtles, and 23 of unidentified varieties. Snake bones are all vertebrae and include 1 of coachwhip, 1 of a colubrid, 3 of viperids, and 4 that were too fragmentary to identify.

The only indication of birds in the assemblage is a tibiotarsus that was not complete enough to identify.

Unidentified mammal bones include a rib fragment and 2 pieces of long bones. Pocket gopher bones are a fragment of a cranium and 11 teeth. Cotton rat bones are a mandible and 3 teeth. A skull and some postcranial bones of a recently deceased pigmy mouse were recovered at a depth of 65 cm. One metapodial fragment is of a size that could be only cow or bison. The rest of the identified mammal bones are of deer. Some of these could be of other artiodactyls of the same size but there is no indication that such are included. The deer bones include fragments of 2 crania, 2 mandibles, 4 teeth, 2 antlers, 1 humerus, 3 radii, 1 ulna, 1 femur, 1 patella, 2 metacarpals, 3 metapodials, 1 scaphoid, 1 lunar, 1 naviculo-cuboid, 1 calcaneus, 1 tarsal, 7 phalanges, 1 sesamoid, and a long bone.

Examination of the data from the excavations of the six pits reveals some interesting information. Figure 1 is a layout of excavated pits at the site. Contour lines shown thereon indicate the top of the sterile stratum as indicated by the depth of excavation. This shows that during prehistoric times there was either a slight gully that flowed northwest toward the river or there was a depression that may not have gone all the way to the river. At present there is no indication of that feature at the surface. Figures 2 and 3 are soil sections that are plotted from data from the excavations. These sections show a 'sterile fill' zone at Pit G. This zone had no caliche, shell, lithics, or bones and thus appears to be devoid of cultural impact.

Pocket gophers of the genus *Geomys* are fossorial rodents. They spend most of their lives below ground, seldom venturing out onto the surface. Their tunnels are extensive with chambers as deep as 68 cm. Chambers are provided for nests, storage of food, and disposal of feces. Sandy soils are required. Mounds of soil are pushed to the surface as the tunnels are constructed. As much as 10.21 cubic meters of soil per hectare has been measured for such activity. At that annual rate, all soil in an area could be turned over in 650 years. Food items are primarily plant parts with insects ingested as they are encountered. Storage includes grasses, sedges, bulbs, tubers, berries, and acorns (Davis 1974; Schmidly 1983). Therefore, in sandy soil, any of these plant parts, feces, or nest material encountered as deep as 70 cm could be due to gopher activity.

Gopher bones were recovered in Pit D at 5 to 10 cm and in Pit C at 50 to 65 cm. Pellets of dung that are probably from this species were recovered in Pit F at 50 to 60 cm. These items could be included in the matrix due to activity of gophers and their positions fall within the areas that are postulated to have been disturbed by the gophers. If this hypothetical scenario is correct, the gophers would not disturb cultural materials that are buried by as much as 70 cm.

The sections in Figure 2 and Figure 3 also show what probably was the surface that existed until the time that the uplands nearby were first plowed about a century and a half ago. This would represent the surface as it was after many centuries of occupation, deposition, disturbance, erosion, and deflation, each in an unknown number of repetitions. Erosion after plowing of the uplands then resulted in the lower areas being filled with sandy loam in a relatively brief period. Then the pocket gophers began or continued their disturbance of the soil. This rodent activity apparently did not cause any upward movement of midden material at Pit G, because the new fill is deeper than 70 cm. At the other pits, soil movement brought material from the occupation zone to the surface. Even the tiny pigmy mouse was found at a depth of 65 cm, which shows the extent of rodent intrusion. Probably, the immediate area of the site was never plowed due to the vegetative growth.

This explains why ceramics were found in the bottom of Pit G together with mollusks which have been dated at a time much earlier than would be possible for the ceramics. This sequence of events also would indicate that the caliche formed in the soil before nearby plowing began.

Conclusions

The prehistoric occupants of this site consumed clams, deer, turtles, and other animals. Apparently the use of the site was never intense but occurred over a long time period.

Erosion due to farming of the adjoining land covered the site. Thereafter, disturbance by gophers caused upward movement of some materials from as deep as 70 cm.

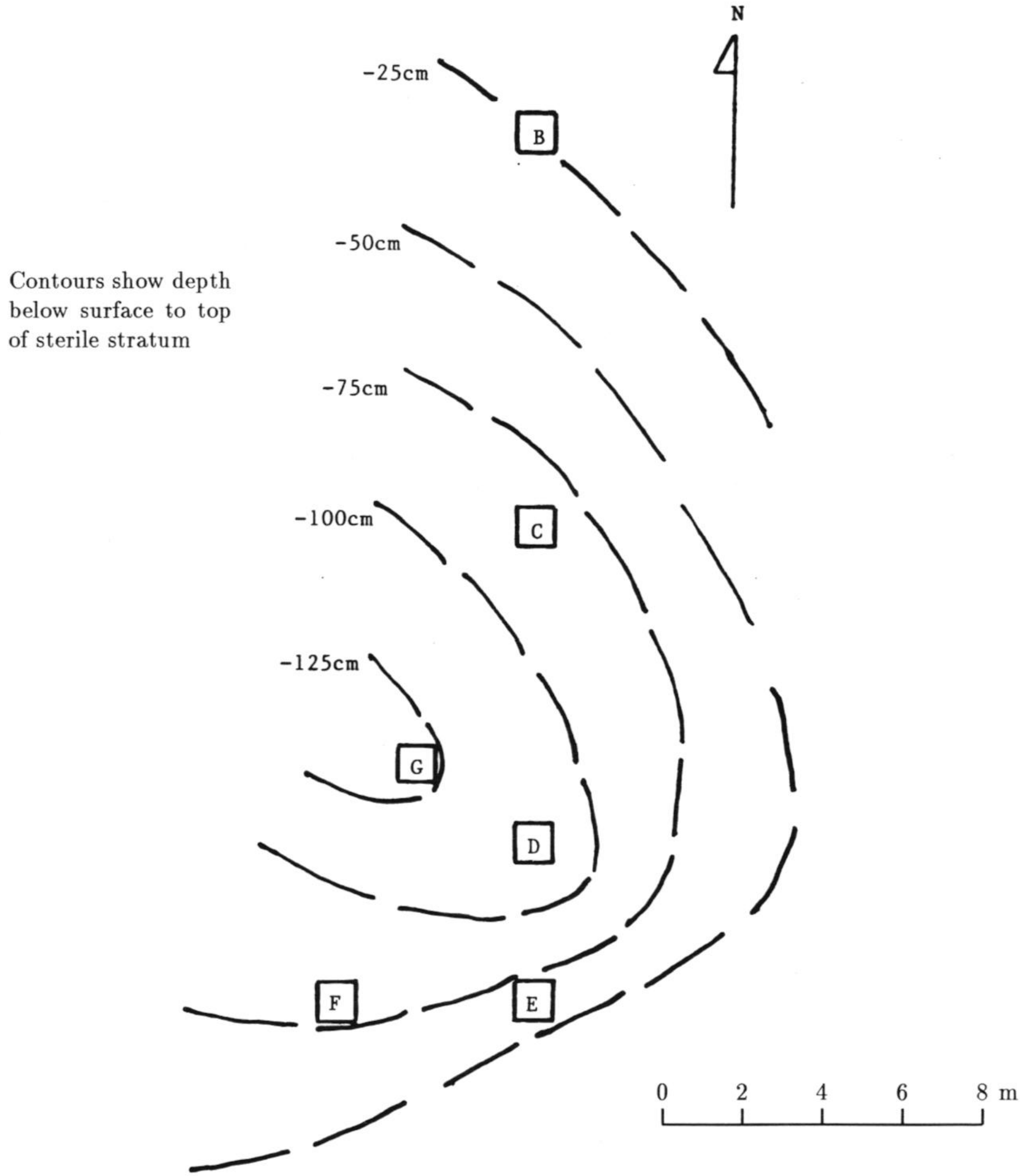

Figure 1. Layout of excavated pits

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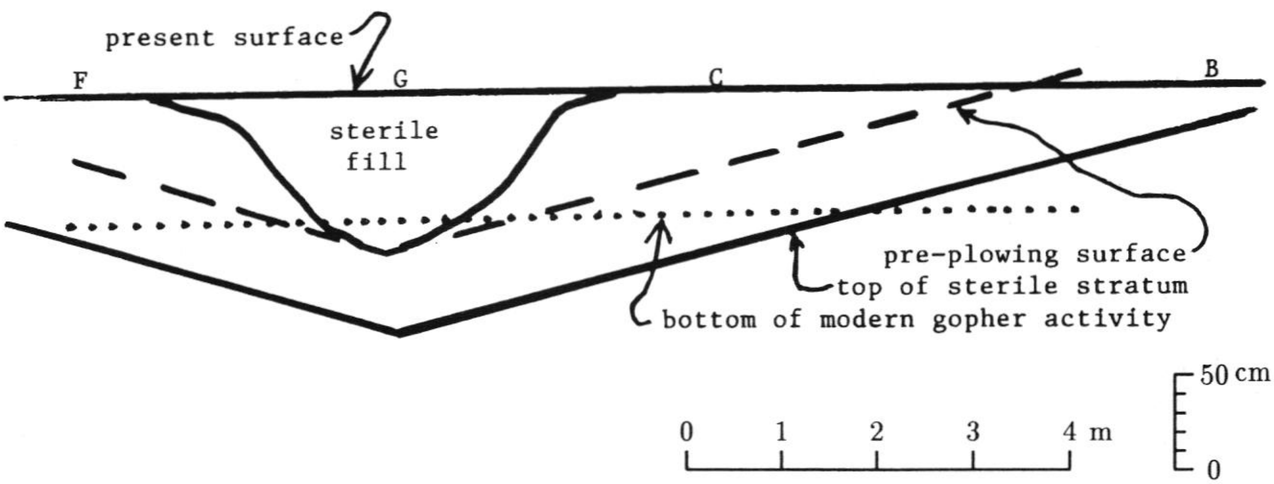

Figure 2. Section from Pit F to Pit B

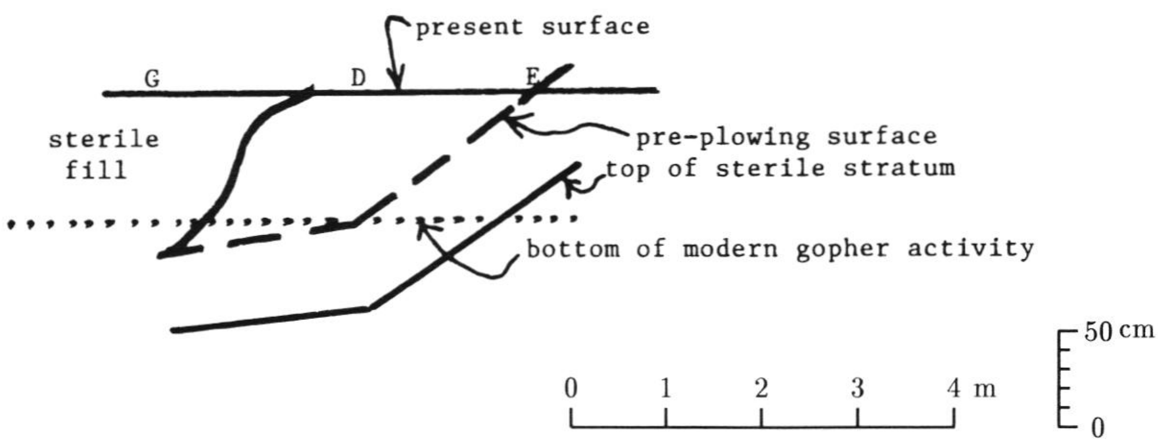

Figure 3. Section from Pit G to Pit E

An Introduction to Lithic Analysis

Leland W. Patterson

Introduction

Lithic analysis is a basic part of archeology because so much of the archeological record has been preserved as stone tools and manufacturing by-product debris (debitage). The fundamental concerns of lithic analysis are (1) how and where lithic raw materials were obtained, (2) how lithic materials were processed to make tools (and ornaments), and (3) how stone tools were used. These basic questions are often followed by more complex studies relating to lifestyles, technological change, and trade. Distinctive stone tool types, such as projectile points, can also have chronological significance.

This article will concentrate on basic lithic analysis for Southeast Texas, as applied to archeological field work and site reports. In this region, lithic analysis is concerned mainly with lithic source locations and campsites. There is little evidence of other specialized intermediate lithic workshop locations. A previously published diagram (Patterson 1984: Figure 1) of the process for manufacturing bifacial projectile points is shown in Figure 1, with possibilities given for doing various manufacturing stages at different locations.

Lithic analysis involves consideration of raw material procurement, manufacturing processes, stone tool function, and stone tool typology. A brief discussion of each of these topics is given here. As indicated by the title, this article is intended to be an introduction to lithic analysis, and not a complete guide to the subject. The reader will see some of the reasons lithic analysis is important, and some of the analytical methods used. Individuals who participate in archeological field work should have at least a general idea of why all lithic materials, including small-size flakes, are so carefully collected. Some knowledge of lithic analysis is helpful for better understanding of archeological site reports.

Raw material procurement

The first step in lithic manufacturing is to obtain suitable raw materials. A checklist of items to consider for the analysis of raw material procurement is given in Table 1. In Texas, most chipped stone tools were made of siliceous minerals such as chert, jasper, and petrified wood. In West Texas, fine-grain igneous rock types, such as rhyolite and basalt, were also used. In Southeast Texas, primary raw materials used were mainly chert cobbles and petrified wood pieces from alluvial deposits in major river drainages. The Colorado River drainage system has large chert cobbles, mainly north of Eagle Lake. The Brazos River drainage system has small chert cobbles and some petrified wood. The Trinity River drainage system has mainly petrified wood. It is difficult to identify exact geographic locations in Southeast Texas that were source locations for most lithic materials found at campsites, because physical properties of lithic materials at different source locations are similar. No work has yet been done in this region to characterize lithic source locations by use of chemical trace element analysis. Because of the geographic distribution of lithic raw material sources in Southeast Texas, chert is the predominant material found at archeological sites west of Houston, and petrified wood is the predominant material found at sites east of Houston.

As shown in Figure 1, various degrees of raw material processing can be done at the lithic source location. In Southeast Texas, it was common to produce flake blanks at the lithic source location, and then transport the blanks to campsites for further processing. The production of flake blanks is classified as primary reduction, generally done with a hammerstone. At most campsites in this region, there is little evidence for much primary reduction having been done. Few whole chert cobbles or cores are found at Indian campsites to indicate primary reduction.

After primary reduction, flake blanks were often heat treated to improve knapping properties. Heat treatment of chert reduces tensile strength by about 40% (Purdy and Brooks 1971; Patterson 1981a). Most chert found in Southeast Texas is very tough, and heat treatment is almost a necessity to obtain easily worked materials. Fracture for controlled flaking is generally instigated as a compressive failure during initial force application. However, the main fracture plane then develops as a tensile fracture. Reduction in tensile strength by heat treatment not only enables the material to be flaked more easily, but also allows longer flakes to be produced. Heat treatment generally does not decrease the strength of the material enough to cause undue breakage and wear during tool use. The basic conchoidal fracture property of chert is not changed by heat treatment. While heat treatment of siliceous raw materials was done extensively in Southeast Texas, it is generally not obvious as to whether heat treatment was done at raw material source locations or at campsites. Heat treatment can be identified by reddish coloration, waxy luster, and potlid surface fracture scars. At site 41FB223, several potlid fracture flakes have been found, which indicates probable heat treatment of chert at this campsite. In this region, use of heat treatment can most commonly be identified on chert specimens. Heat treatment of petrified wood was either done less frequently, or is more difficult to identify.

Lithic manufacturing

The study of lithic manufacturing involves the identification of what types of raw materials were used, what types of product were being made, and what manufacturing processes were being used at a specific location. General product types include bifacial items, flaked on both faces, and unifacial items, flaked on one face. A checklist for analysis of lithic manufacturing is given in Table 2.

In Southeast Texas, billets for soft percussion flaking and pressure flaking tools were made of antler, and specimens are rarely preserved. Both soft and hard hammerstones were used. Hard hammerstones of quartzite are most commonly found. Soft hammerstones of silicified limestone are occasionally found, with the Edwards Plateau being the probable source.

In this region, the manufacture of a bifacial tool, such as a knife or projectile point, generally involved making a bifacial preform from a flake blank by use of percussive flaking. Final finishing was then done by pressure flaking to produce even, sharp edges, and to form tips and stem shapes for projectile points. Small arrow point preforms can be made by pressure flaking. Intermediate stages of biface manufacture can often be identified at a site by unfinished specimens and manufacturing failures.

The analysis of by-product flakes can give information on the details of manufacturing processes. For example, the amounts of remaining cortex on flakes at campsites can indicate how much raw material trimming was done at remote lithic source locations. This has been discussed based on results from experimental flaking of chert cobbles (Patterson 1981b). The attributes of flakes are shown in Figure 2. Force application at the edge of a core results in flake detachment, with a force bulb on the proximal end of the flake below the point of force application. The ventral (inside face) of the flake represents the fracture plane of the flake removal from the core. It is often stated in the literature that hard percussion flakes often have prominent force bulbs and eraillure flake scars, while soft percussion flakes often have diffuse force bulbs and lips. As may be seen in Figure 2, an eraillure flake scar is a small secondary fracture scar on the force bulb. It can be difficult to distinguish between flakes made by hard and soft percussion, however. Individual flakes made using soft and hard percussors often have the same attributes (Patterson 1982; Bradley and Sampson

1986:43). Soft percussion is generally used for bifacial thinning because a soft percussor allows force to be applied closer to the edge of the core without crushing the edge. This permits removal of thinner flakes.

If a sample is available with a sufficient number of flakes, flake size distribution can be used to identify bifacial reduction (Patterson 1990). Flake size distribution from bifacial reduction typically gives an exponential curve shape for a plot with linear axes or a straight line for a semi-log plot, as shown in Figure 3 for data from the Middle Archaic period at site 41WH19 (Patterson et al. 1987).

The number of lithic flakes is an indication of the amount of lithic manufacturing activity at an archeological site. Some experiments have shown that manufacture of a dart point preform from a flake blank can yield 60 to 185 by-product flakes of sizes over 10 mm square (Patterson 1990: Table 2).

At some prehistoric sites in Southeast Texas, such as 41HR182 (Patterson 1985a), there were industries which produced small prismatic blades. Prismatic blades are defined as flakes with parallel lateral edges, and at least one ridge on the dorsal face that is parallel to the lateral edges. Prismatic blades have a length over twice the width. Occasionally, prismatic blades can be produced fortuitously. Therefore, attributes must be identified to indicate a true prismatic blade industry, where blades were made purposefully. A true prismatic blade industry will produce polyhedral cores, with several parallel flake scars, where a series of prismatic blades were removed. A prismatic blade is made by force application over a ridge on a core face (Sollberger and Patterson 1976). The fracture plane follows the ridge and produces a long, narrow flake. Large numbers of prismatic blades are another indication that a true prismatic blade industry is present. In Southeast Texas, small prismatic blades were used to make unifacial and bifacial arrow points, and perforators.

Large Paleo-Indian prismatic blades are occasionally found in Southeast Texas, generally with widths of over 20 mm. Specimens are usually made of exotic Edwards Plateau flint, and can be regarded as items that were imported into Southeast Texas.

The manufacture of a unifacial tool is generally a fairly simple process, compared to the manufacture of a bifacial tool. Unifacial tools are quick and easy to make because only a limited working edge is being shaped, while manufacture of a bifacial tool involves shaping of the entire object.

Tool typology

The typology of stone tools is concerned with form and style. Much effort is devoted to the classification of projectile points, especially because projectile point types can have chronological significance. It should be noted, however, that use of a projectile point type can have a long time range, so that projectile point types are generally useful only for identifying broad time periods. A study by Patterson (1985b) shows that arrow points in Southeast Texas usually have thicknesses under 5 mm, stem widths under 9 mm, and weights under 2.3 grams. Dart points have larger measurements for these metric attributes.

Standard references by Suhm and Jelks (1962) and Turner and Hester (1993) can be used for classification of most projectile points found in Texas. Specific projectile point types are classified by overall shape, stem shape (when present), and other attributes such as ground stem edges. Tabulations of chronologies of dart points (Patterson 1991a) and arrow points (Patterson 1991b) list most projectile point types found in Southeast Texas. Justice (1987) has shown that some projectile point types have very wide geographic distributions. It is common to see the same projectile point type with different names in different regions. Justice (1987) has grouped projectile point types that are morphological correlates.

Aside from projectile points, bifacial tool types found in this region are knives and drills (perforators). Dart point preforms are sometimes confused with bifacial knives. Bifacial knives are often asymmetrical, while dart point preforms generally have bilateral symmetry.

Unifacial tool types found in Southeast Texas include gravers, scrapers, perforators, notched tools, and denticulates. Gravers are flakes with purposefully formed pointed areas. Scrapers generally have fairly steep (over 60 degrees) edge angles formed by a series of parallel flake removals on one face. A notched tool has a purposefully made notch in an edge, generally made by three or more flake removals, as opposed to a fortuitous notch. Unifacial perforators are like bifacial drills, except that shaping retouch is only on one face. Denticulate tools have saw-tooth edges formed by a series of small notches. It is common for unifacial tools to have retouch on the dorsal face, with the flat ventral face having been used as the platform for force application.

In this region, heavy unifacial tools were only made in the Paleo-Indian period (Patterson et al. 1987). Many Paleo-Indian unifacial tools are combination graver-scrapers. Heavy unifacial tools have large dimensions of length, width, and thickness, with thickness often over 10 mm. The Albany side-notched hafted scraper is a Paleo-Indian tool type that is commonly unifacial, but is occasionally of bifacial form (Turner and Hester 1993:277; Patterson 1991c).

A few corner-tang bifaces are found in Southeast Texas (Hall 1981; Patterson et al. 1987), but this is essentially a Central Texas artifact type.

Ground stone items found in Southeast Texas are usually grinding and abrading tools such as manos and metates. Bannerstones (Duke 1989) and boatstones (Hall 1981) are occasionally found. These are imported items made of exotic materials, such as from Arkansas (Hall 1981: Figure 55). Ground stone beads (Site 41FB42 HAS field notes), another type of imported item, are rare in this region.

A checklist for analysis of tool typology and functional use is given in Table 3.

Stone tool functions

Stone tools can be used for many functions performed by modern metal hand tools, such as scraping, planing, cutting, sawing, and drilling. Stone tool function can often be inferred from tool form. A unifacial tool with a steep, uniform edge can be used experimentally for scraping and planing. Cutting tools generally have acute edge angles of less than 30 degrees. A drill or perforator has a long bit that resembles a modern drill bit.

Tool form does not always indicate actual tool functional use. For example, the sharp edge of a dart point could also have been used as a knife for cutting. Ethnographic data can be helpful in showing at least some functions of a stone tool type. A notched tool is sometimes called a spokeshave, and there are ethnographic examples of this functional use (Hayden 1977: Figure 5). One surprising ethnographic example is an illustration of an Australian aborigine using a denticulate to shape a wood shaft by shaving, rather than use of this tool as a saw (Hayden 1977: Figure 6). Of course, a denticulate can also be used as a saw.

In Southeast Texas, few formal unifacial tool types were used after the Paleo-Indian period. The unretouched utilized flake became the dominant tool type, often casually selected from bifacial thinning debitage. A freshly made chert flake has a sharper edge than a steel knife blade, but dulls faster. Unretouched flakes can easily be used for scraping, cutting, and planing. Edge wear patterns are used to identify flakes that have been used as tools. Tringham et al. (1974) have shown typical chert flake edge wear patterns for scraping, planing, and cutting that can be replicated and observed with low-power magnification (10x–80x). It is not always possible to demonstrate that a flake has been used as a tool, however. Cutting of soft materials, such as meat, often results in little edge wear (Patterson 1984b). In a deer butchering experiment (Patterson 1974), a good cutting edge wear pattern could be observed only near the end of the job. If a flake edge is used for more than one type of function, such as cutting and scraping, the edge wear pattern can be confusing.

Edge wear from longitudinal cutting action gives a series of small scallops with polish on the high points (Tringham et al. 1974; Patterson 1974). Edge wear from planing is commonly in the form of a finely nibbled edge (Tringham et al. 1974). Edge wear from scraping is like a miniature pattern of retouch on a purposefully made scraper, with a series of small, parallel flake scars, and a resulting steep edge angle.

Some analysts have used a high-power metallurgical microscope to study edge wear patterns. There are several difficulties in the use of this analytical method. Use of high-power magnification is a very slow procedure, and results are often controversial. Analysts such as Keeley (1980), Vaughn (1985), and Yerkes (1987) claim to be able to identify many specific types of materials that were being worked, by identification of highly magnified edge wear patterns. There can be a bewildering number of wear patterns identified, and experimental wear patterns cannot always be reproduced. For example, Schultz (1992) did not obtain the same wear patterns for bison hide processing that were obtained by some other investigators. One criticism of high magnification wear pattern study is that the analyst can obtain desired wear patterns simply by looking at different areas of a specimen. In any event, the use of low-power magnification to study edge wear patterns is the most practical technique for most archeological field work, especially where individuals do not have special training.

Summary

Fundamental considerations of basic lithic analysis have been reviewed here to give inexperienced individuals an idea of why and how lithic analysis is done. Enough references have been given to allow interested individuals to do more detailed study of this subject. The checklists presented here can be used as a guide for processing artifacts in the laboratory. Lithic analysis is a broad field with many subtopics. It should be noted that lithic analysis is the study of technology, with limitations to inferences that can be made regarding the nontechnical aspects of cultural organization. Many lithic artifact types have geographic distributions that far exceed the limits of specific cultural identity. For example, the Albany scraper has a geographic distribution from East Texas to South Carolina (Patterson 1991d). Used in proper context, lithic analysis is important for the study of prehistoric and protohistoric lifeways, chronology, technological change, and sometimes trade patterns.

Table 1. Checklist for Raw Material Procurement

General Questions

1. Lithic source locations
2. Material types used
3. Form of procurement: quarry procedures, amount of processing at source location

At Lithic Sources

1. Evidence of material testing at site
2. Evidence of primary reduction: hammerstones, cores, debitage characteristics
3. Raw material trimming, preform production
4. Types of cortex
5. Evidence of heat treating
6. Types of raw materials: types and physical properties
7. Quality of raw materials: experimental tests

At Campsites

1. Evidence of primary reduction
2. Presence of flake blanks
3. Presence of cores, chert nodules, large pieces
4. Remaining cortex on flakes and cortex type
5. Size range of flakes: for manufacturing sequence (stage)
6. Raw material classification: type, physical properties, distinctive properties (color, inclusions)
7. Possible sources of raw materials: local, exotic
8. Evidence of heat treating: luster, color, potlid fractures

Table 2. Checklist for Lithic Manufacturing

General Questions

1. Product types
2. Knapping tool types
3. Manufacturing sequences (stages)
4. Process techniques

Manufacturing Details

1. Knapping tools: hammerstones, billets, pressure flakers
2. Intermediate manufacturing stages (mainly bifaces): preforms, fragments, thinning failures, unfinished items
3. General evidence of bifacial reduction: flake size distribution, flake attributes
4. Prismatic blade production: blades, polyhedral cores
5. Starting point of reduction: cores, flake blanks, preforms
6. Type of reduction: soft percussion, hard percussion, pressure
7. Flake attributes: length, width, thickness, force bulbs, lips, eraillure flake scars
8. Types of products: projectile points, unifacial tools, bifacial tools

Table 3. Checklist for Tool Typology and Functional Use

General Questions

1. Tool types
2. Functional uses of tools: cutting, scraping, etc.
3. Relationship of tool use to site activities
4. Nonlocal relationships: mobility and trade

Typology

1. Projectile point types
2. Bifacial tool types
3. Unifacial tool types
4. Utilized flakes
5. Ground stone items
6. Nonutilitarian items

Functional Use

1. Inferences from tool forms
2. Edge wear patterns
3. Experimental and ethnographic data
4. Evidence from site activities (butchered bone, etc.)

Mobility and Trade

1. Exotic materials
2. Nonlocal artifact types
3. Relationships to known trade and mobility patterns

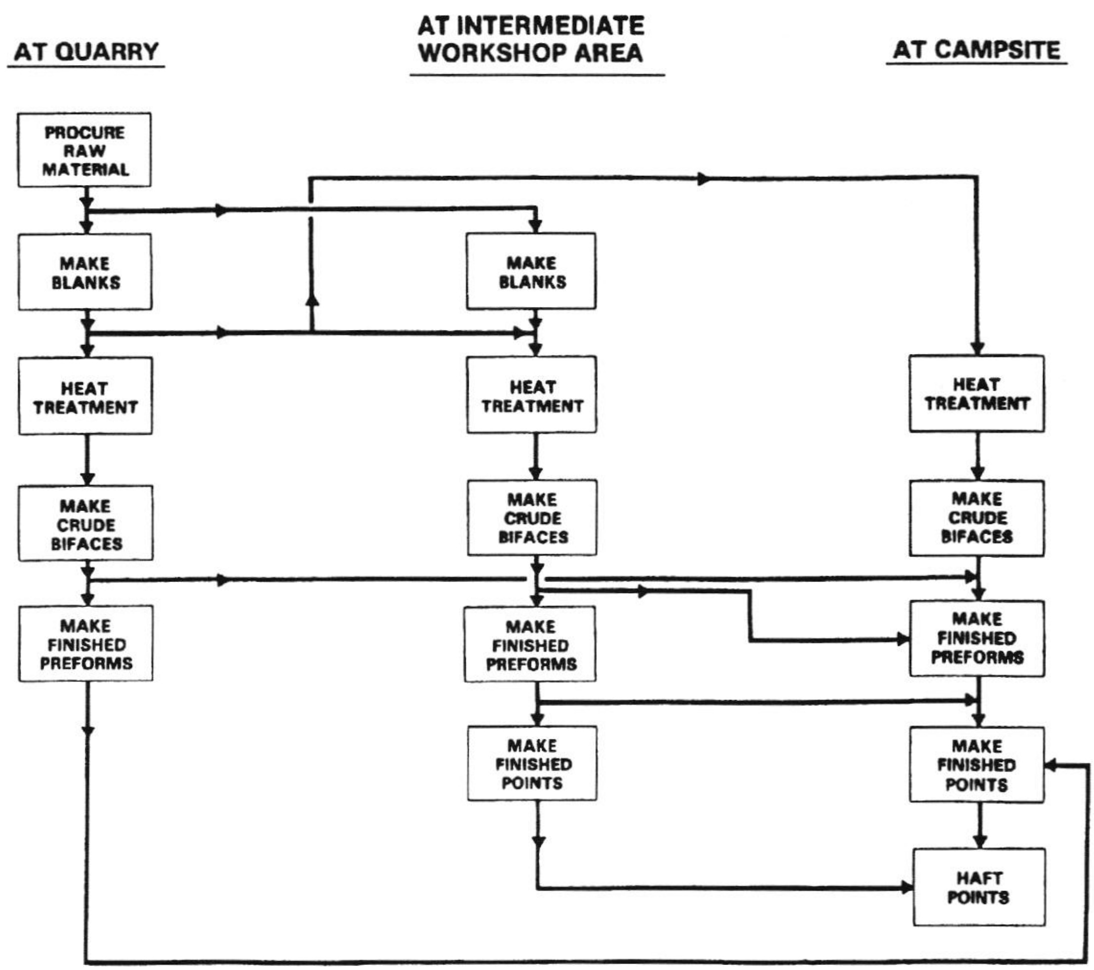

Figure 1. Projectile point manufacturing stages

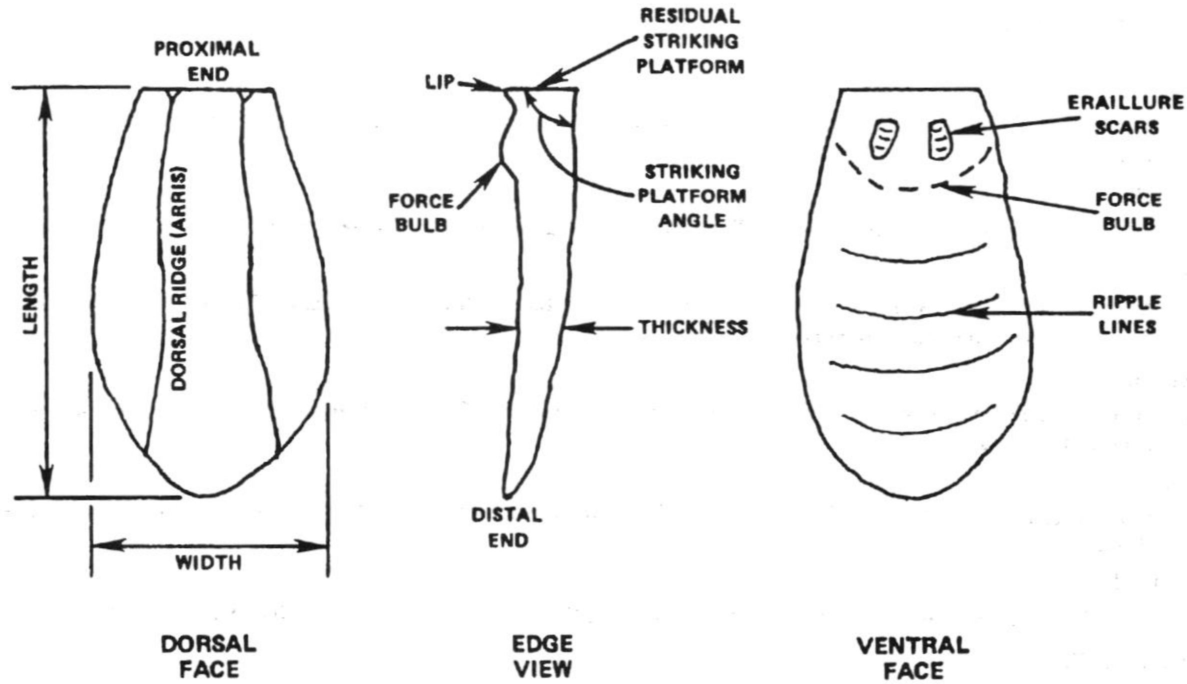

Figure 2. Lithic flake attributes

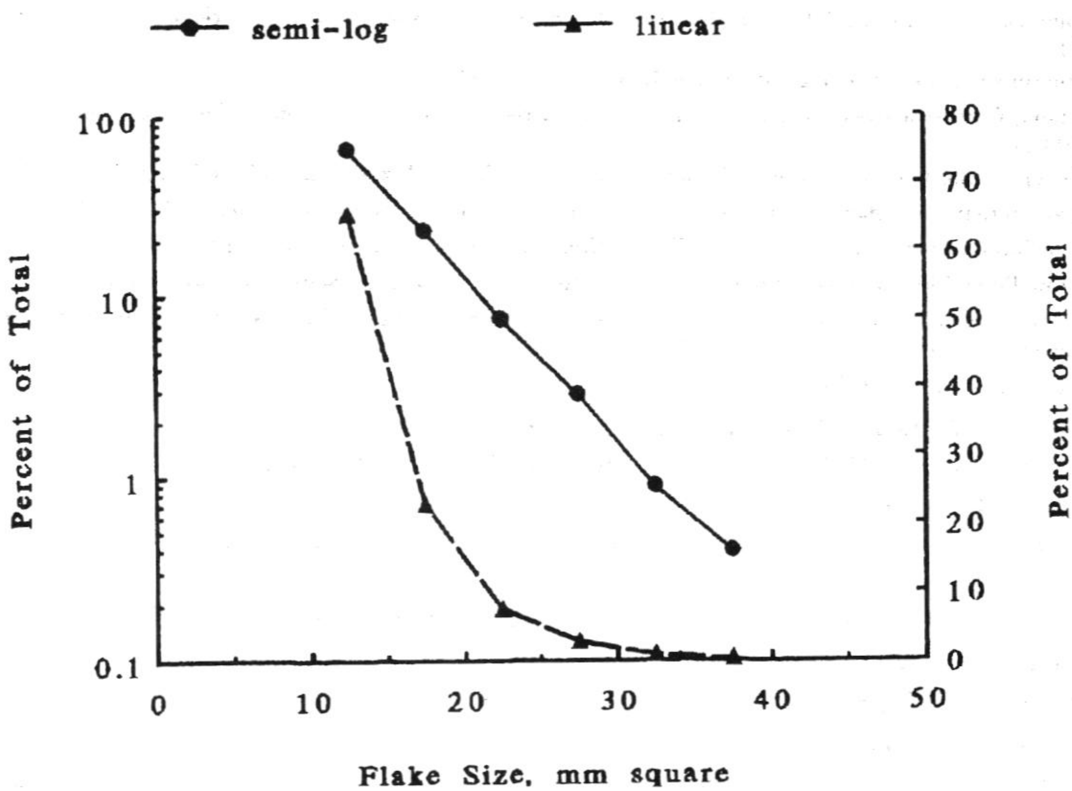

Figure 3. Bifacial reduction flake size distribution

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An Albany Scraper from Site 41WH2

Joe D. Hudgins

Introduction

Site 41WH2 is located on the west side of the West Bernard River, two miles north of the town of Hungerford in Wharton County, Texas. On the north side of the site facing the river, erosion of the sandy soil has exposed a large number of lithic artifacts. Diagnostic artifacts collected from the site suggest occupations from the Late Paleo-Indian to the Late Archaic period (Patterson and Hudgins 1980: Figures 2-6). This site was revisited after recent heavy rains, and an Albany scraper (Figure 1) was exposed along with numerous flint flakes.

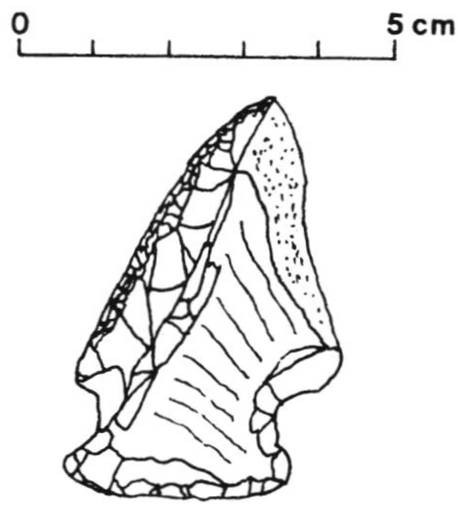

Figure 1. Albany scraper from 41WH2

The artifact

The Albany scraper found on this site was made from dark brown chert and was unifacially chipped. It is side notched with a flat base, with chipping evident along one side of the base. One of the lateral edges is beveled and shows considerable amount of chipping. The other lateral edge is unworked and has some cortex remaining (as indicated by the stippled area in Figure 1). The scraper is 53.0 mm in length, 35.7 mm in width, and 10.5 mm in thickness.

Discussion

Only two Albany scrapers have been previously reported in Wharton County. Both were found on the surface of site 41WH19 (Patterson and Hudgins 1981: Figure 3g,h).

Albany scrapers appear to have been hafted tools used during the Late Paleo-Indian time period and are often associated with San Patrice dart points (Turner and Hester 1993). Patterson (1991) points out that, although Albany scrapers are commonly associated with San Patrice points, they are also found with various types of early side-notched points in sites from Texas to the Atlantic Coast.

Acknowledgements

The writer wishes to thank Lee Patterson for sketching and measuring the artifact.

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Additional Rangia Seasonality Studies

Leland W. Patterson and Karen M. Gardner

The presence of *Rangia cuneata* in archeological sites along the coast of Texas and Louisiana is well documented. Their utilization as a food resource led to interest in their utility as an indicator of the season of occupation at an archeological site. Aten (1981) has developed a method for assessing seasonality based on the growth stage morphology of the brackish water clam, *Rangia cuneata*. Using Aten's dated collection, Carlson (1987) developed a computer program which fits archeological samples with Aten's collection model. Archeologists have made extensive use of Aten's method, facilitated by Carlson's computer program, to study the seasonality of *Rangia cuneata* utilization by Native Americans at coastal midden sites.

Aten's seasonality correlation is based on the measurement of growth rings on *Rangia cuneata* shells. The degree of seasonal development of the last (outside) growth ring is judged in relation to the widths of adjacent growth rings on the shell for previous growth periods (Aten 1981:182-183). Concern has arisen in recent years over the reliability of this technique as a seasonality determiner (Weinstein and Whelan 1986; Howard 1991; Patterson et al. 1991). Problems with adequate sample size, the physical preservation of archeological shell, and the identification of growth patterns are some of the issues causing concern. Another concern is that Rangia growth ring patterns may not be the same in various growth periods because of variation in environmental factors such as water temperature, water salinity, and nutrients.

As a test of Aten's method, C. R. Ebersole, S. M. Kindall, and R. L. Gregg collected live Rangia samples from two locations on the shoreline of Trinity Bay, a few miles northwest of the mouth of the Trinity River. One sample was collected on February 23, 1992, at one location, and two other samples were collected from a different location on May 31 and October 4 of the same year. Details on the study of the first sample have previously been published (Patterson et al. 1991).

The three samples were analyzed by Patterson and Gardner using Aten's method. The right hand valves were analyzed by Patterson (Table 1) while the left hand valves were analyzed by Gardner (Table 2). Patterson additionally reanalyzed the left hand valves from the February sample to test the variability of analysis by different people. Growth ring measurements were used to obtain estimated collection time using Carlson's computer program. Results of the estimation of season are summarized in Table 3.

The results of seasonality calculations for the same samples were not exactly the same for measurements by Patterson and Gardner. Calculation results, however, did not differ more than about 1 1/2 months for the two analysts. Some differences in results may be attributed to the problem of accurately and reliably identifying growth patterns. Patterson obtained a one-month difference using right- and left-hand valves for the February sample, again illustrating the subjectivity involved in choosing a growth pattern.

In general, studies using Aten's correlation have given a Rangia collection time range of late spring to mid-summer, with the most intensive collecting occurring between late April and late May (Story 1990:260). The results of the samples examined here also fall in this range, although only one of them was actually collected in May. The fact that both the February sample and the October sample resulted in estimations of either mid-July by Patterson or mid-May by Gardner leads one to question the reliability of Aten's method.

It is concluded here that Aten's method has some inherent problems that have not been adequately dealt with to make it an effective tool in determining seasonality. If used in conjunction with other indicators of seasonality, such as fish otoliths and faunal remains (Smith 1983; Prewitt 1987; Ricklis 1990; Gardner 1991), it may be useful as a very general indicator. Aten's method does not appear to be suitable, however, for use as the sole method for seasonality estimation.

Table 1. Rangia Measurements by Patterson

	sample date and shell side			
	2-23-92		5-31-92	10-4-92
	right	left	right	left
sample size	60	60	60	60
growth stage				
interrupted	11	2	3	5
early	8	13	0	1
middle	22	35	41	30
late	12	9	16	24
indeterminate	7	1	0	0

Table 2. Rangia Measurements by Gardner

	sample date and shell side		
	2-23-92	5-31-92	10-4-92
	left	left	left
sample size	57	50	50
growth stage			
interrupted	6	7	7
early	15	17	14
middle	28	14	22
late	8	9	6
indeterminate	0	3	1

Table 3. Live Rangia Seasonality Correlation Results

	Patterson		Gardner
sample date	right-hand	left-hand	left-hand
2-23-92	mid-July	mid-June	late May
5-31-92	late June	—	mid-May
10-4-92	mid-July	—	late May

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