ARCHAEOLOGICAL INVESTIGATIONS OF TWO PREHISTORIC SITES ON THE COLETO CREEK DRAINAGE, GOLIAD COUNTY, TEXAS

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Center for Archaeological Research
The University of Texas at San Antonio
Archaeological Survey Report, No. 69

1979

The following information is provided in accordance with General Rule of Practice and Procedure 355.01.011C, Texas Antiquities Committee:

1. Archaeological investigations of two prehistoric sites on the Coleto Creek drainage;

2. Site 41 GD 21 Mitigation Project;

3. Goliad County, Texas;

4. Thomas R. Hester, Principal Investigator; Daniel E. Fox, Field Director and Author;

5. Guadalupe-Blanco River Authority;

6. Texas Historical Commission Antiquities Permit No. 80;

7. Published by the Center for Archaeological Research, The University of Texas at San Antonio, San Antonio, Texas 78285; October 1979.

INTRODUCTION

The Coleto Creek Project, including the construction of a coal-fired electric generating plant with dam and reservoir, is a joint undertaking of the Central Power and Light Company and the Guadalupe-Blanco River Authority (Fig. 1). An assessment of the archaeological potential of the project area was made in 1975 (Fox and Hester 1976). This was followed in 1977 by an intensive survey and testing of several prehistoric archaeological sites (Fox, Black and James 1978). Two of these sites, 41 GD 21 and 41 GD 30, were nominated to the National Register of Historic Places.

As a result of a meeting in October 1977 between representatives of the Texas Historical Commission, the Guadalupe-Blanco River Authority, URS Forrest and Cotten, Engineers, and the Center for Archaeological Research, The University of Texas at San Antonio, the archaeological mitigation of 41 GD 21 was proposed. (41 GD 21, an extensive occupational area, is hereafter referred to as sites 41 GD 21 and 41 GD 21A.) Mitigation efforts were to be focused on portions of site 41 GD 21A which are to be affected by the construction of a dike and spillway, and on the low-lying portion of site 41 GD 21 which will be inundated.

Under the supervision of Thomas R. Hester, Director of the Center for Archaeological Research, UTSA, the archaeological investigation was conducted during December 1977 and January 1978. Following is a documentation of that work.

ENVIRONMENTAL SETTING

Extensive data on the geology, soils, climate, hydrology, flora, fauna and other elements of the ecology of the Coleto Creek drainage and the Coastal Plain have been compiled for the U.S. Environmental Protection Agency (1977) in compliance with requirements for a detailed study of the environmental impact of the Coleto Creek Project. Additional environmental background information is presented in Fox, Black and James (1978). Following is a brief overview of the environmental context of sites 41 GD 21 and 41 GD 21A.

The Coleto Creek Project area is in a general transition zone in the western part of the coastal prairie of Texas (Fig. 2). Geologically, late Pliocene and early Pleistocene coastward-dipping strata comprised of marine and deltaic deposits underlie the study area. The gently rolling topography ranges in elevation from about 60 feet msl at Coleto Creek to about 240 feet msl in upland areas. Soils consist predominantly of a clay base overlain by sandy loams, derived from underlying geologic strata and stream alluvium.

The Coleto Creek drainage is made up of numerous small streams which flow in a general west-east direction. Most of these tributaries are intermittently dry, except for the lower portion of Perdido Creek. The watershed receives an average annual precipitation of approximately 36 inches.

Having a humid subtropical climate, and located in a transitional zone between biotic provinces, this part of the coastal prairie supports a rich diversity

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ABSTRACT

In December 1977 and January 1978, the Center for Archaeological Research, The University of Texas at San Antonio, carried out archaeological investigations of two prehistoric sites on the Coleto Creek drainage in Goliad County, Texas. A description of backhoe trenching and controlled excavations at sites 41 GD 21 and 41 GD 21A is presented, and the artifacts recovered are illustrated and described. Data from various special analyses is discussed, including information on geomorphology, fauna, malacology, biosilica and soils. Site interpretations and radiocarbon data are also presented.

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ACKNOWLEDGMENTS

A number of individuals and representatives of various institutions cooperated in the archaeological investigation of sites 41 GD 21 and 41 GD 21A. The efficient completion of the project was made possible by cooperation between David Welsch, representing the Guadalupe-Blanco River Authority; Alton K. Briggs, Assistant State Archaeologist; and Dr. Thomas R. Hester, Director of the Center for Archaeological Research, UTSA, and Jack Eaton, Associate Director. Mr. Welsch also helped solve various logistical problems encountered during the field work.

H. G. Uecker, Robert Scott, James Escobedo, Curtis McKinney and Waynne Cox comprised a reliable, hard-working field crew. Vickie Holloway of San Antonio assisted with photographic recording. Archaeologist Anne A. Fox contributed to the field work and made available valuable information from her experience with previous survey and testing of Coleto Creek archaeological sites. E. H. Schmiedlin of Victoria offered complementary ideas based on his personal experience with the archaeology of the Texas Coastal Plain.

The services of Dr. Glen Evans, geomorphologist, UT Austin; Dr. Barbara Butler, faunal consultant, North Texas State University; and Ralph Robinson, phytolith consultant, Center for Archaeological Research, UTSA, are greatly appreciated. Dr. Harold Murray of Trinity University afforded his assistance to H. G. Uecker in the analysis of pelecypods; John W. Clark of the Texas Historical Commission helped Curtis McKinney identify gastropods.

This report was edited by Carol Graves, Thomas R. Hester and Jane Smith.

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of flora and fauna. Climax vegetation is post oak and grassland, although there has been an invasion of mesquite, oak, acacia and prickly pear cactus (Blair 1950). In addition to a variety of mammals, such as opossum, bats, armadillo, cottontail, fox, squirrel, plains pocket gopher, mice, bobcat and whitetailed deer, there are numerous species of reptiles, fish and birds.

It can be supposed that the paleoenvironment was characterized by a similar diversity of plants and animals, as well as mineral resources suitable for exploitation by prehistoric extractive societies.

ARCHAEOLOGICAL BACKGROUND

The Coastal Plain has been characterized as a transitional physiographic and cultural zone between coastal and central Texas (Mallouf, Fox and Briggs 1973:31; Fox *et al.* 1974:19; Fox and Hester 1976:5). Only during the past decade has there been sustained archaeological research on the Coastal Plain (Fig. 2). Contributing to this increase in archaeological attention is recent public awareness of the high rate of destruction of cultural resources due to industrial and population expansion, along with related increases in funding required by antiquities legislation. However, previous to the advent of "contract archaeology," there were developments in the methodological approach to the understanding of space, time and culture in the prehistory of central and coastal Texas.

Culture Areas

During the 1930s and 1940s, central and coastal Texas were conceived of as distinct, although vaguely understood, culture areas. Central Texas archaeology was thought to consist of an Archaic Edwards Plateau Aspect, represented by certain dart point types, and a later Central Texas Aspect, characterized by the occurrence of arrow points and pottery (Story 1960).

In 1935 Sayles defined the preceramic Oso and later ceramic Rockport phases for the central section of the Texas coast. In the 1940s, during excavations of three sites in the Aransas Bay area, Campbell (1947) recognized a preceramic culture which he could not identify with Sayles' (1935) Oso Phase. This Aransas Focus described by Campbell (1947) was characterized by a variety of dart point types, shell and bone tools and ornaments, and basketry containers. Overlying this component was a ceramic component which Campbell (*ibid.*) renamed the Rockport Focus.

During the 1930s the first and only large-scale excavation of a prehistoric site on the Coastal Plain was carried out at the Morhiss site, located on the lower Guadalupe River about six miles south of Victoria. Although these investigations by Jackson, Woolsey, Duffen and the W.P.A. were never published, a summary of the work has been presented by Campbell (1976), and examples of biface forms from the Morhiss site have been presented by Fox *et al.* (1974: Appendices 6-10). In 1955 Kelley suggested a Morhiss Focus, although it has not been clearly defined (Suhm and Jelks 1962:221).

Chronology

In the 1950s the use of the *McKern Classification* (or the *Midwestern Taxonomic Method*) for the definition of culture areas was superseded by an emphasis on chronology and the reconstruction of culture history. Suhm, Krieger and Jelks (1954) forwarded a series of developmental stages for central Texas prehistory. Patterned after Story (1960), a tentative chronological framework for the Coastal Plain has been suggested (Mallouf, Fox and Briggs 1973:32, Fig. 59; Fox *et al.* 1974:19-20; Fox and Hester 1976:5; and others) which can be summarized as follows:

> ...the *Paleo-Indian* (covering roughly the period from 7000 to 5000 B.C.), the *Archaic* (5000 B.C. to A.D. 1000), the *Neo-American* (A.D. 1000 to first European contact) and the *Historic* (A.D. 1600 to the present). These periods are represented by distinctive artifacts which are tentatively dated in the Coleto Creek area through comparisons with assemblages from other Texas sites which have firm dates, established through stratigraphic excavation and radiocarbon dating (Fox and Hester 1976:5).

In the Coleto Creek area, the Paleo-Indian period is characterized by lanceolate and stemmed projectile points which tentatively have been associated with bones of Late Pleistocene mammoth, horse, camel, sloth and bison at the Morhiss site (Fox and Hester 1976:5, Appendix).

The Archaic period is represented by stemmed and unstemmed thin biface forms, thick bifaces such as *Guadalupe* and *Clear Fork* tools, milling stones, and bone and shell artifacts (Calhoun 1965:507). Reflecting earlier consideration of a Morhiss Focus, a Middle and Late Archaic "Morhiss Complex" has been named for an assemblage of chipped stone, shell and bone tools found commonly at sites along the lower Guadalupe and San Antonio Rivers and their major tributaries (Calhoun 1965:4; Fox and Hester 1976:6).

The Neo-American period is represented by arrow points and pottery types common to coastal, southern and central Texas.

Subsistence-Settlement Pattern

In recent years archaeological survey investigations have begun the study of the relationship between culture and environment as expressed in technological and economic adaptation and those forms of cultural remains which can be associated with such pursuits (Mallouf, Fox and Briggs 1973:137-139; Fox *et al.* 1974:61-81, 199-208; Fox, Black and James 1978). In the proposed Cuero I Reservoir area of the Guadalupe River valley in DeWitt and Gonzales Counties, the spatial distribution of sites and of analytic classes of artifacts indicates a more or less flood plain-oriented subsistence-settlement pattern which lasted for possibly more than 8000 years of hunting and gathering exploitation (Fox *et al.* 1974:259). Flood plain environments offered a variety of terrestrial and aquatic plant and animal resources. The surrounding upland areas provided abundant lithic resources as well as plants and animals to satisfy subsistence needs.

A similar concept of a riverine-oriented subsistence-settlement pattern has been forwarded by Fox and Hester (1976:70) for the Coleto Creek Project area. Calhoun (1965:4) suggests that principal occupation sites of the "Morhiss Complex" most often are located on knolls and bluffs overlooking permanent streams, with some sites located on major tributaries within the lower Guadalupe and San Antonio River drainages (Fox and Hester 1976:70).

More intensive investigation of 17 prehistoric sites in the Coleto Creek Project area (Fox, Black and James 1977) found Archaic period sites to be more numerous than Late Paleo-Indian and Neo-American sites, reflecting the greater time span comprising the Archaic, but also suggesting changes in population size and/or subsistence-settlement pattern. The proximity of sites to reliable water sources and the high frequency of occurrence of the remains of a variety of freshwater fauna indicate a subsistence-settlement pattern which focused on the exploitation of riverine environments, particularly during the Late Archaic period.

Recently, the Texas Archeological Survey of The University of Texas at Austin has investigated several prehistoric archaeological sites in the Palmetto Bend Reservoir area of Jackson County. Although McGuff (1978) formulates a number of hypotheses concerning changes in prehistoric subsistence-settlement pattern and socioeconomic organization through time, most of these intuitive concepts have yet to be tested archaeologically. However, of particular interest to this observer is McGuff's perception of differences between archaeological evidence for the "Late Prehistoric" (Neo-American) and "Middle Prehistoric" (Archaic) periods. He proposes that:

> coastal adaptation was, in the beginning (before the Late Prehistoric), oriented to the exploitation of inland resources but that periodic excursions to exploit coastal marine resources were made (McGuff 1978:30).

That:

> during the Transitional to the Late Prehistoric, an explicitly coastal marine adaptation developed out of a society with a coastal inland adaptation (McGuff 1978:31).

And that:

> during the middle and late Middle-Prehistoric and Late Prehistoric periods, but reaching a climax in the Late Middle-Prehistoric, inland hunters and gatherers developed a structure that included social stratification (McGuff 1978:34).

Regardless of whether or not his hypotheses are valid, McGuff (*ibid.*) seems to agree with other archaeologists studying the Coastal Plain that significant variations occur in archaeological data representative of the Middle to Late Archaic and Neo-American periods.

Problems for Further Consideration

Archaeological research thus far indicates that Coleto Creek and the surrounding areas of the Coastal Plain were occupied by prehistoric hunters and gatherers for at least 9000 years. The overall subsistence-settlement pattern emphasized the exploitation of a variety of resources, with preferred occupation areas being located near major streams. Although large amounts of archaeological data have been recovered in recent years, there are still gaps in our knowledge of the region, as noted by Hester (1977:2):

> ...we still lack information on many facets of the prehistoric life-way. For example, we do not have a solid local chronology, we know nothing about the seasonality of site use, there are very few data on subsistence pattern [cf. Fox, Black and James 1978], there have been no excavations that reveal patterns of intra-site activity, etc. In general, the cultural system(s) operating on the Coleto Creek drainage in prehistoric times are virtually unknown there.

METHODOLOGY

From a review of data recovered during previous archaeological survey and testing of sites 41 GD 21 and 41 GD 21A, a research design for current investigation was developed which would further archaeological research on the Coastal Plain. Field work was oriented toward obtaining information applicable to the following archaeological problems: (1) chronology of site occupation; (2) paleoenvironmental reconstruction; (3) subsistence-settlement pattern; (4) intrasite occupational activity; and (5) culture change.

Giving consideration to cost efficiency and the restriction of investigation to areas to be affected by construction, a field strategy was planned to accomplish the above-stated objective. A total of approximately 100 man-days was funded for field work at the two sites.

The area of each site to be affected by construction activities was delimited on maps and on the ground by G-BRA/CP&L Engineers (Fig. 3). Backhoe trenches were dug to facilitate the examination of the geomorphology, depth and condition of soils at sites 41 GD 21 and 41 GD 21A. Inspection and recording of trench profiles aided in the selection of those portions of areas slated for modification which would yield maximum data through hand-controlled excavations.

For horizontal control of excavations, a metric grid system was superimposed over each site. The number, dimensions and placement of hand-controlled vertical and "open-area" excavation units and the thickness of arbitrary levels by which deposits would be removed were determined, giving consideration to time limits and to the condition, depth and character of deposits scheduled to be modified by construction activities. The most common excavation unit employed was a 1-m^2 excavated in 20-cm levels measured from the ground surface at the southwest corner of the unit. When deemed appropriate for maximum data recovery, these 1-m^2 units were grouped in blocks to form "open-area" excavations.

All excavated deposits were screened through 1/4-inch mesh hardware cloth, and

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occasionally samples were screened through 1/8-inch mesh. Additionally, constant volume samples were taken from profiles of selected excavation units. From these, samples suitable for soils analysis and phytolith research were taken. When available, samples of charcoal were collected for radiocarbon analysis. Previous investigation of sites 41 GD 21 and 41 GD 30 found pollen to be absent or poorly preserved. Therefore, palynological studies were not undertaken.

All field work was carefully recorded and documented. Photographic coverage was extensive. Collections of cultural evidence and other materials were processed, inventoried, analyzed and stored at the laboratory facilities of the Center for Archaeological Research, UTSA.

SITE INVESTIGATIONS

Archaeological sites 41 GD 21 and 41 GD 21A are located on the west bank of Sulphur Creek (a shallow intermittent stream) (Fig. 4,a), approximately one km above its confluence with Perdido Creek (a perennial tributary to Coleto Creek) (Fig. 1). Comprising an extensive occupational area covering the lower and upper slopes of the Sulphur Creek valley wall (Figs. 3,5), the sites are separated by a deep gully which recently has been converted into a flume (Fig. 4,b) for discharge of water from the Coleto Creek Power Plant, located some 0.7 km to the south.

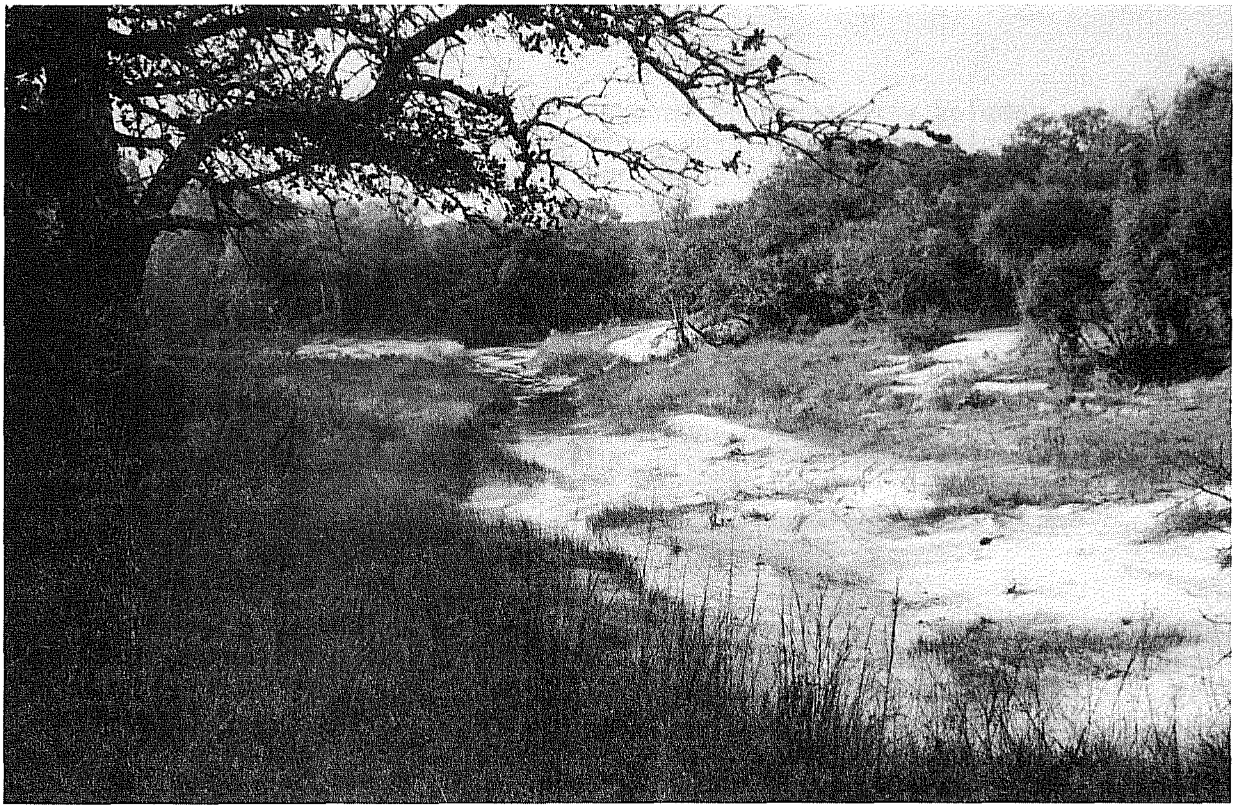
41 GD 21A

Site Description

Spread over approximately 35,000 square meters, site 41 GD 21A was once bounded on the west by a deep gully, recently converted to a concrete-covered flume (Fig. 3). Bluffs overlooking the creek form the northern boundary. The eastern, southeastern and southern margins of the site are difficult to delimit because of the gentle slopes and the overgrowth of vegetation.

The site can be described as two areas (Fig. 3): (1) an eastern part which slopes downward to the north from a grassy upland pasture (35.5 m to 33.5 m msl) to a wooded lower slope (33.5 m to 27.5 m msl), forming a low bluff at the creek channel; and (2) a western part which slopes more gradually downward to the north (36.0 m to 29.5 m msl) from a grassy upland (Fig. 6,a) to the steep, wooded bank of a cut-off channel or slough (Fig. 6,b). Eastern and western areas of site 41 GD 21A are separated by a broad, shallow swale which drains the terrace slope.

In the eastern area, backhoe trenching and controlled excavations of the present investigation were restricted to the central portion, where the construction of a dike is planned (Fig. 3). In the western area, investigations were focused on the northern, tree-covered, terrace margin, near the cut-bank where a spillway will be constructed.



a

b

Figure 4. *General Views of Sites 41 GD 21 and 41 GD 21A.* a, view of Sulphur Creek flood plain below sites, looking east; b, view of upland area looking south, across flume toward power plant construction site.

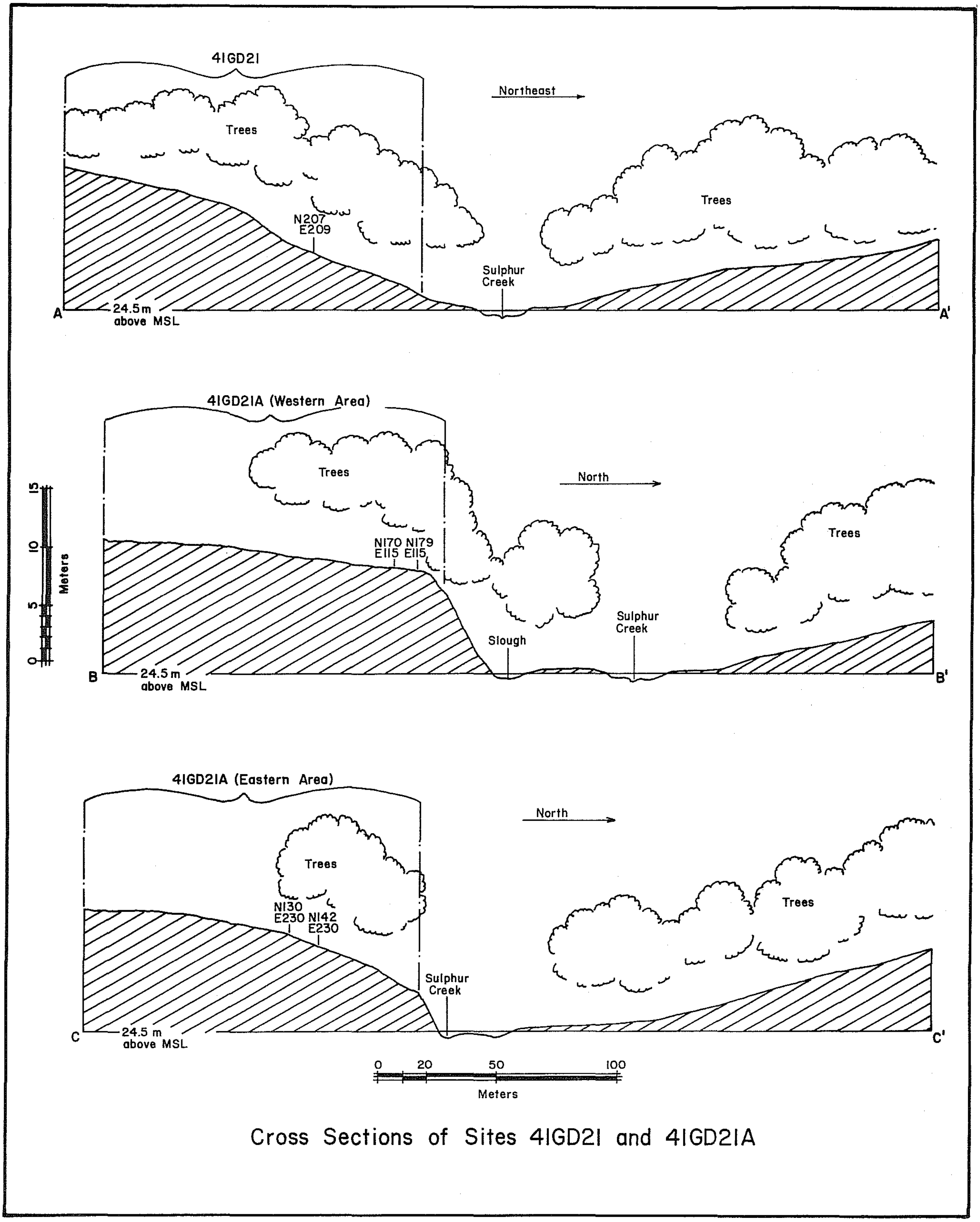


Figure 5. *Cross Sections of Sites 41 GD 21 and 41 GD 21A.*

a

b

Figure 6. *General Views of the Western Area of Site 41 GD 21A.* a, view of upland slope, looking east toward eastern area; b, view of lower slope and flume, looking east toward western area of site.

Previous Investigations

In conjunction with limited testing of nearby site 41 GD 21 in spring 1977, two shovel tests and two 1-m^2 test pits were excavated in the western area of site 41 GD 21A, near the edge of the flume disturbance. A shovel test and a 1-m^2 test pit located midway up the slope of the site (at ca. 34.40 m msl) encountered caliche at 25 cm below the surface. Occupational debris was found in a dark brown sandy clay loam above the caliche.

A shovel test and a 1-m^2 test pit in the lower slope, near the bluff (at ca. 32.25 m msl), encountered dark sandy loam with cultural debris, root and rodent disturbances to depths greater than 100 cm below the surface.

Backhoe Trenches

At the onset of 1977-1978 mitigation efforts at site 41 GD 21A, a series of four backhoe trenches, ranging in length from 9.5 m to 16.5 m, was excavated to depths greater than 1.5 m along the center line of the proposed dike in the eastern area of the site (Figs. 3,7,a). Two similar backhoe trenches were dug in the upper and lower slopes of the western part of the site.

In the eastern area, the slope was found to be comprised of caliche, clays and sands overlain with a dark gray-brown sandy loam (Fig. 8). On the upland slope, a surface zone (20 to 30 cm thick) of sandy loam rests on thick layers of dense compact clay (Fig. 8). Midway down the slope, two soil zones were recognized above sand and caliche: a surface zone of dark sandy loam ranging in depth from 25 to 70 cm, grading into a lighter-colored calcareous sandy clay varying between 15 and 40 cm thick (Fig. 8). On the lower slope, a surface layer, 20 to 40 cm of sandy loam, rests on a thick mantle of red-orange sandy clay (Fig. 8).

In the western area of site 41 GD 21A, the upland slope (Fig. 9) was found to consist of a thin (15 to 20 cm thick) surface zone of dark humic sandy loam, grading into a lighter-colored calcareous sandy clay (10 to 25 cm thick). These soils rest on a massive layer of caliche. On the lower slope (Fig. 9), similar, although thicker (100 to 120 cm deep), topsoil and subsoil zones rest on a layer of caliche.

Controlled Excavations

Artifact-bearing slope deposits at site 41 GD 21A were found to vary in depth and character between eastern and western areas and at different elevations on the slope. In the eastern area, the excavation of a 1 x 2 m test pit adjacent to Backhoe Trench 1 (Fig. 3) revealed that occupational debris was restricted in occurrence to a sandy topsoil zone of humus and slope wash less than 30 cm deep on the lower slope. The excavation of three 1-m^2 units on the upland slope (Fig. 3) revealed similarly disturbed, shallow deposits of occupational evidence (Fig. 7,b).

Deeper deposits were encountered in two 1-m^2 units placed midway down the slope,

a

b

Figure 7. *General Views of the Eastern Area of Site 41 GD 21A.* a, excavation of Backhoe Trench 2, lower slope; b, unit N74.7 E215.0, plow zone removed, upper slope.

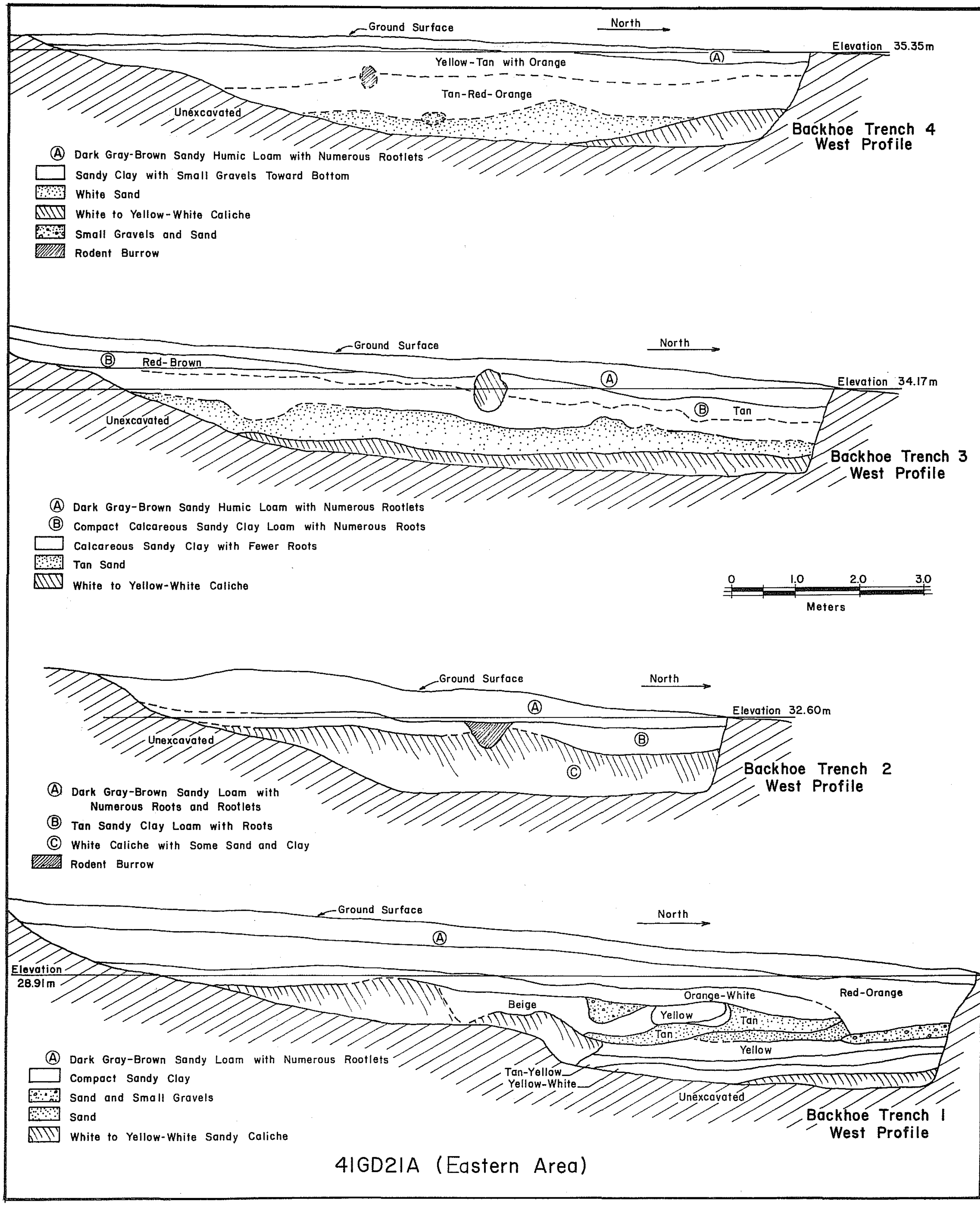


Figure 8. *Site 41 GD 21A (Eastern Area), Profiles of Backhoe Trenches 1-4.*

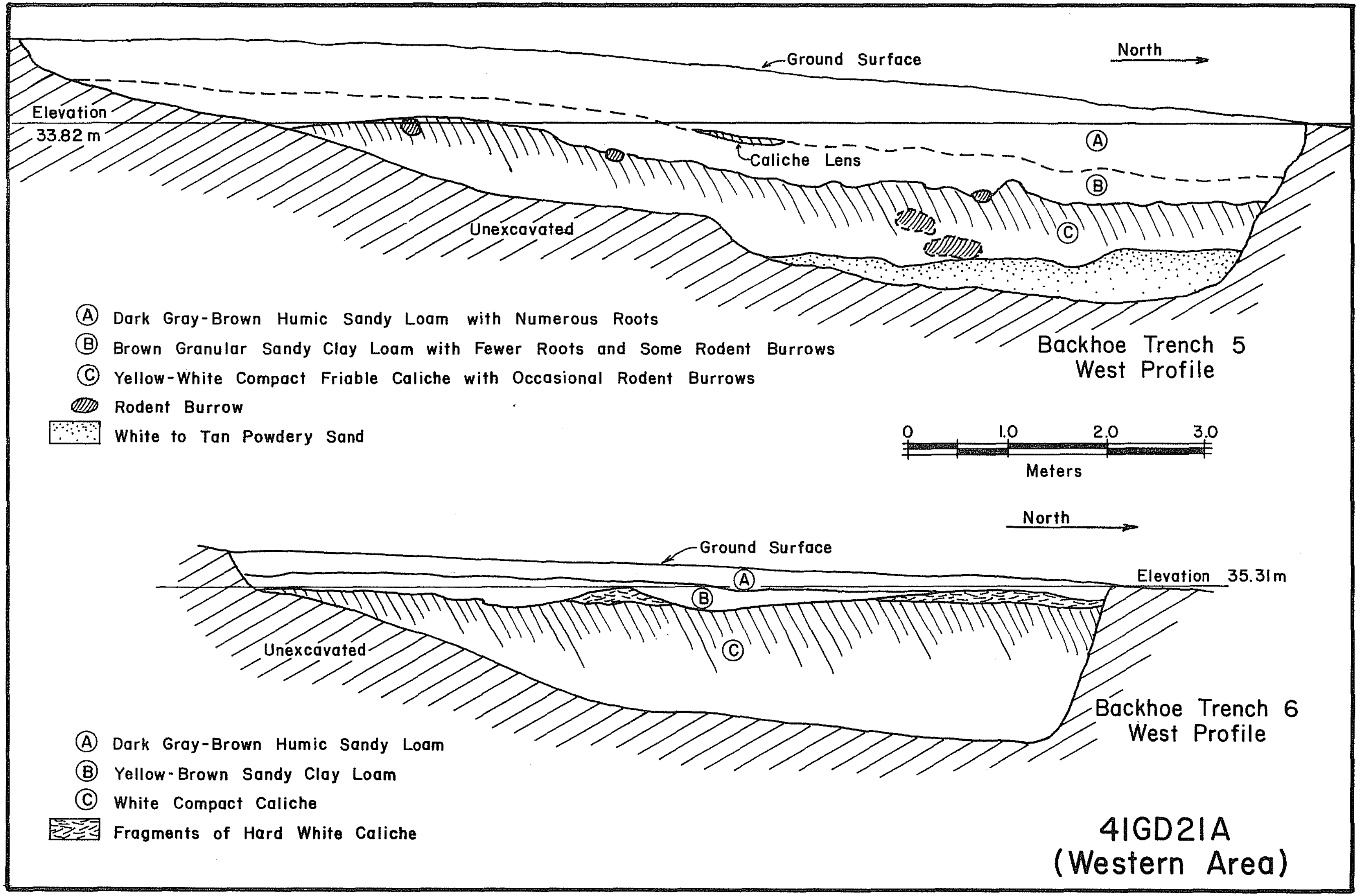


Figure 9. *Site 41 GD 21A (Western Area), Profiles of Backhoe Trenches 5 and 6.*

near Backhoe Trench 2 (Fig. 3). One of these units (N130 E230) penetrated an ant disturbance over 80 cm deep before reaching slope deposits containing cultural material to a depth of about 160 cm below the ground surface (Fig. 10). The excavation of the other unit (N142 E230) encountered two somewhat disturbed zones of sandy loam containing cultural material to a depth of approximately 65 cm below the ground surface (Fig. 10).

In the western part of site 41 GD 21A, the excavation of a 2-m^2 block of one meter units, a 1 x 2 m unit and three scattered 1-m^2 units (Fig. 3) found occupational debris to be contained throughout two soil zones and in the uppermost part of a third zone (Figs. 11,12).

Zone A contains the greatest density of cultural material. Grading from a topsoil of dark gray-brown sandy humic loam with numerous roots into a lighter gray-brown sandy loam, Zone A varies in depth from approximately 70 cm near the bluff at the edge of the lower slope (at unit N195 E83), to about 53 cm upslope about 2 meters in elevation (at units N170 E95 and N170 E115).

Zone B, a tan to gray-tan calcareous sandy clay loam, contains rodent disturbances and less cultural material. A transitional zone between the darker overlying Zone A soils and the lighter, compact caliche of Zone C, Zone B ranges in thickness from about 45 cm on the lower slope (at unit N185 E81) to about 10 cm some 2 meters upslope in elevation (at unit N170 E95).

Cultural material occurs only in the uppermost portion of Zone C.

41 GD 21

Site Description

Similar in soils and vegetation to site 41 GD 21A, site 41 GD 21 once probably covered an area of over 18,000 square meters (Fig. 3). Construction of earthen dams which contain large settling basins has destroyed much of the northern, western and southern portions of the site. Construction of the flume which separates site 41 GD 21 from site 41 GD 21A disturbed the eastern margin. Today, approximately 5000 square meters of the northeastern part is all that remains of site 41 GD 21.

From a mesquite, brush and grass-covered upland area (36.0 m msl), the site slopes to the northeast into a wooded bottomland (Fig. 13, a) fronting on the bank of Sulphur Creek (26.7 m msl). A short backhoe trench (Fig. 13, b) and a 2-m^2 block of one-meter units were placed in the wooded lower slope near the edge of the flume disturbance (Fig. 3).

Previous Investigations

During spring 1977, 13 shovel tests and two 1-m^2 test pits were excavated at site 41 GD 21. Spaced an average of 25 meters apart, a line of shovel tests, running roughly east-west along a contour midway up the slope (at ca. 20.5 m msl), found occupational evidence in dark sandy clay soils above caliche. These deposits range in depth from 30 cm below the surface on the west end to over 80 cm below the surface near the flume. A one-meter test near the edge of the flume

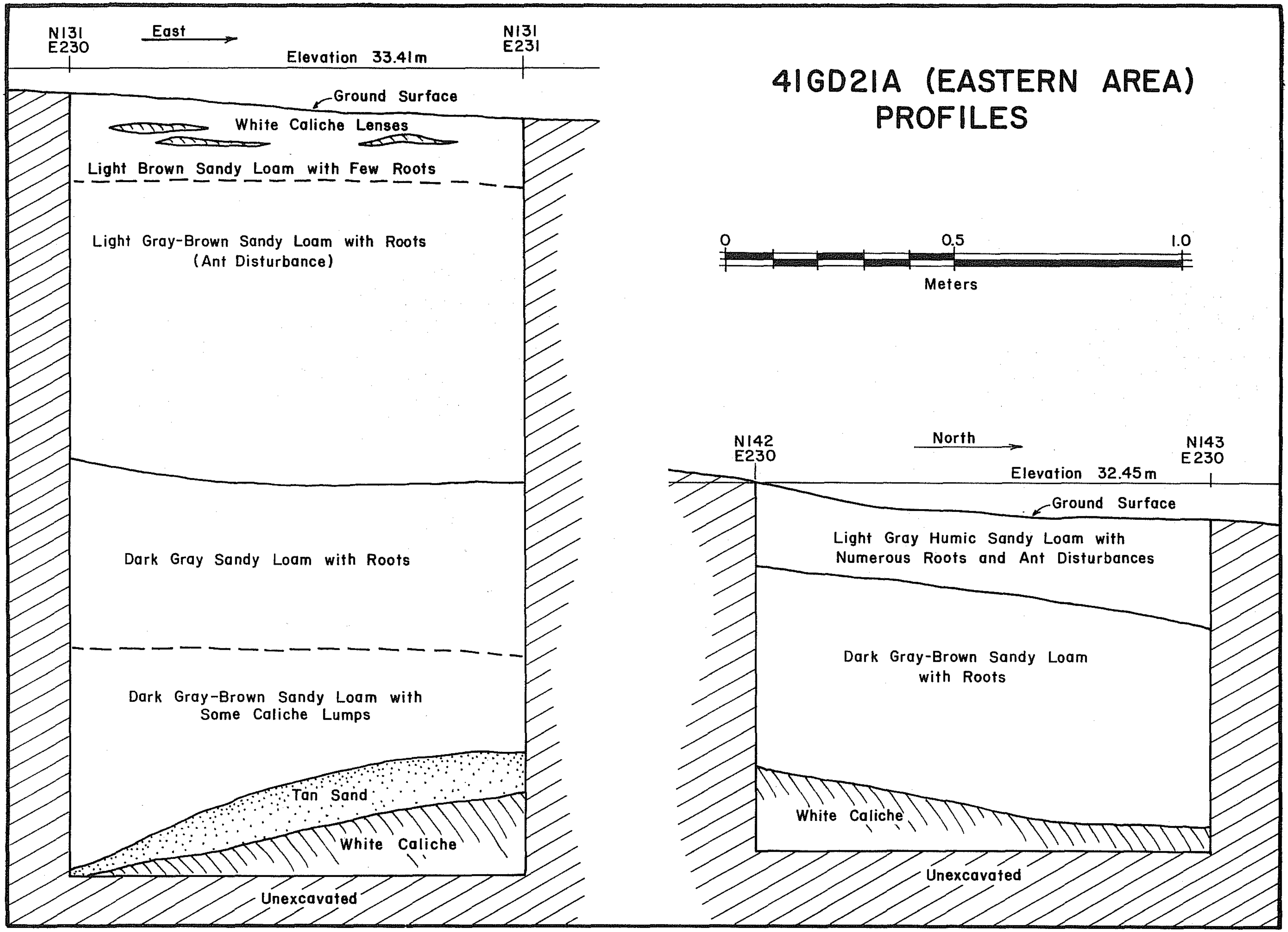


Figure 10. *Site 41 GD 21A (Eastern Area), Profiles of Excavation Units N130 E230 and N142 E230.*

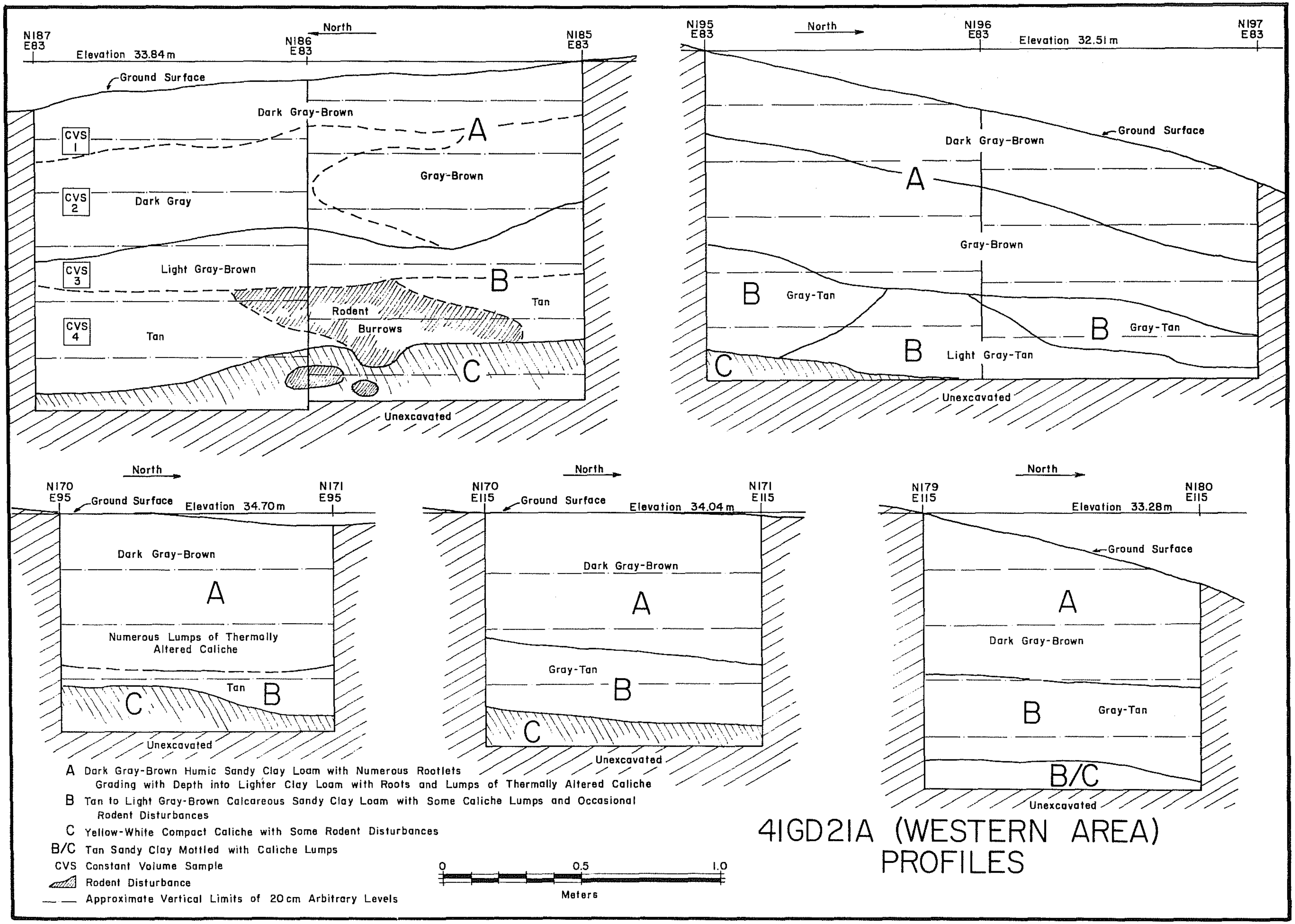
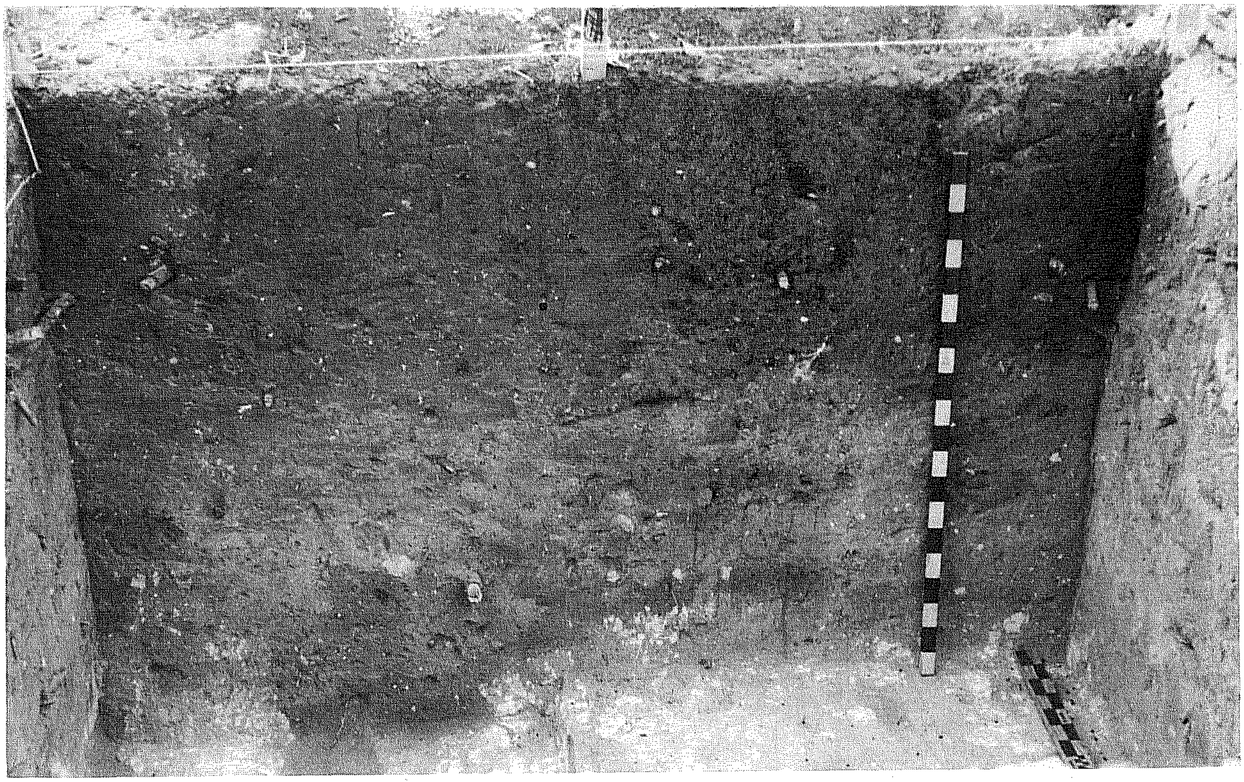


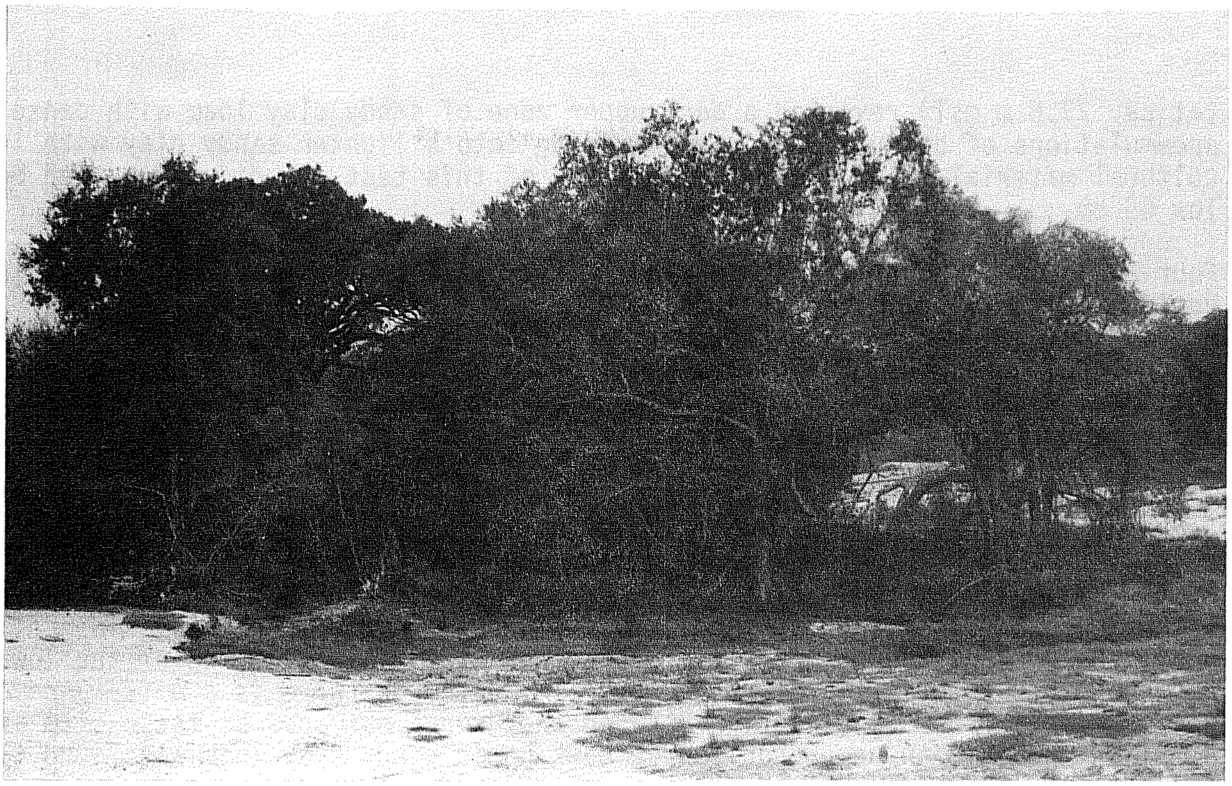
Figure 11. *Site 41 GD 21A (Western Area), Profiles of Excavation Units N185 E82 and N186 E82; N195 E83 and N196 E83; N170 E95; N170 E115; and N179 E115.*



a

b

Figure 12. *Typical Profiles, Western Area of Site 41 GD 21A.* a, south profile of units N185 E81 and N185 E82; b, west profile of unit N197 E115.



a

b

Figure 13. *Views of Site 41 GD 21.* a, view of lower slope area looking west; b, view of Backhoe Trench 1, looking west.

(at ca. 29.6 m msl) revealed a dark upper zone of sandy clay loam with dense accumulations of cultural material, grading into a lighter sandy clay with less cultural material below 50 cm. Excavation of this test pit did not extend below 65 cm.

Four additional shovel tests and a 1-m^2 test pit were placed at different elevations on the slope along the edge of the flume disturbance. On the upper slope, cultural material was found to be contained in sandy clay loam, resting on caliche, ranging in depth from 30 cm to about 75 cm below the surface. On the lower slope, within 35 m of the creek bank, cultural material was found in sandy clay soils to a depth of more than 125 cm below the surface.

Backhoe Trenching

At the beginning of 1977-1978 investigations at site 41 GD 21, one backhoe trench (Fig. 3), 5.8 m long and 2.2 m deep, was placed in the wooded lower slope of the site. Soils encountered (Fig. 14) were somewhat similar to those of the lower slope on the western area of site 41 GD 21A, although there is a difference of approximately 3.5 m in elevation between the ground surfaces at these site areas. At site 41 GD 21, an upper horizon of dark humic sandy clay loam was found to grade into a more calcareous, lighter-colored, fine sandy clay, which rests on a zone of compact caliche.

Controlled Excavations

The slope deposits of site 41 GD 21 were found to contain occupational evidence in three prominent soil zones to a depth greater than 180 cm below the ground surface on the lower slope of the site. Controlled excavation of these deposits was restricted to a 2-m^2 block of one-meter units placed near Backhoe Trench 1 and the edge of the flume disturbance (Fig. 3).

Zone A includes a topsoil layer of dark gray-brown humic silty clay loam with numerous roots which grades into a denser gray-brown silty clay loam with roots and considerable quantities of thermally altered caliche and other occupational debris (Figs. 15,16). At about 43 cm below the ground surface, the dark Zone A soils grade abruptly into the lighter clay loam of Zone B.

Containing fewer roots and less cultural material, Zone B averages about 75 cm in thickness and varies in clay and sand content with depth.

At approximately 118 cm below the ground surface, a transitional zone contains some occupational debris in a mixture of overlying Zone B soils and underlying Zone C caliche soils with small pebbles. This transitional zone is an average of 28 cm thick.

Below the transitional zone, Zone C is a compact, hard, friable caliche containing small pebbles and relatively small amounts of cultural material.

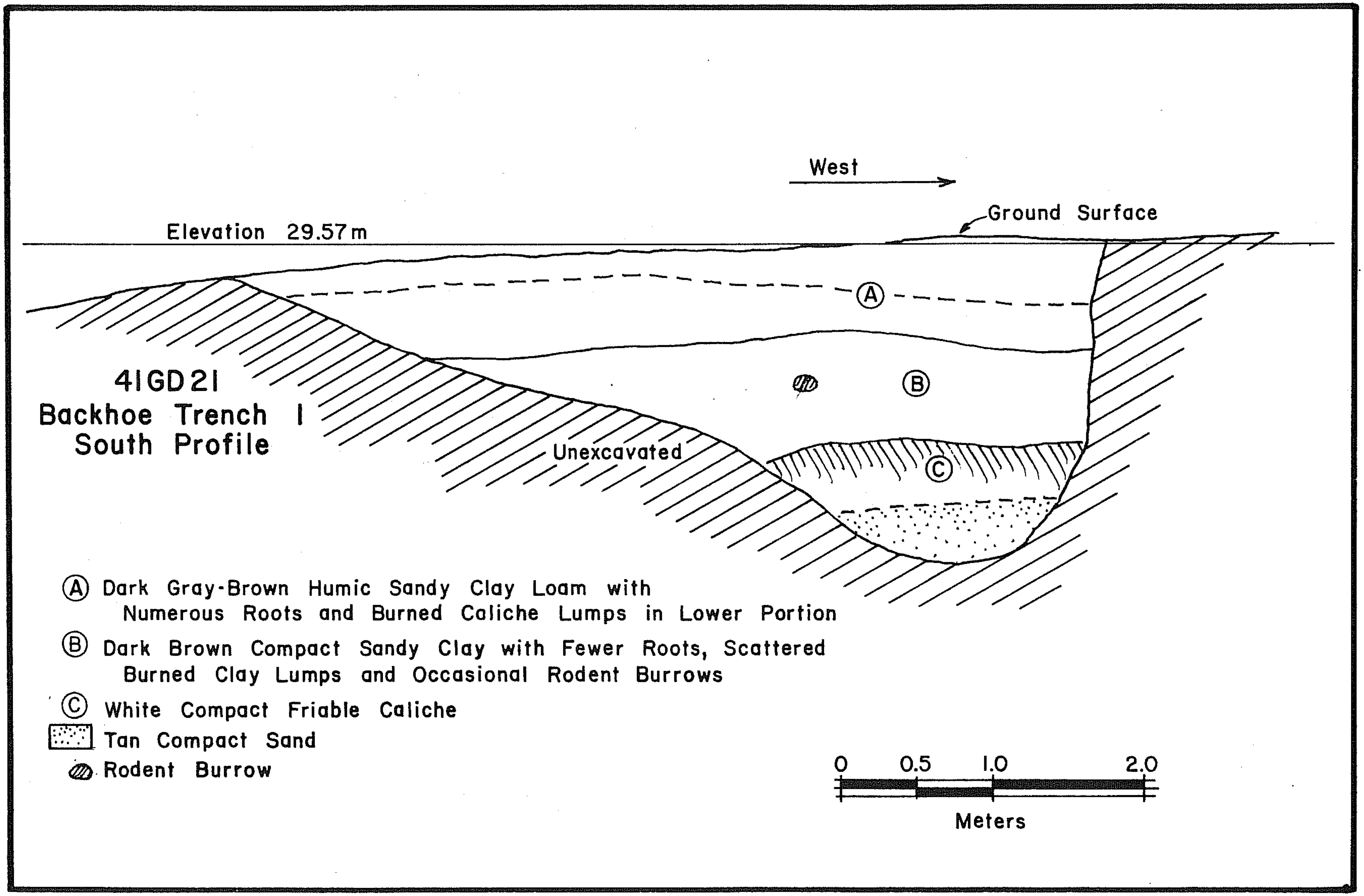


Figure 14. *Site 41 GD 21, South Profile of Backhoe Trench 1.*

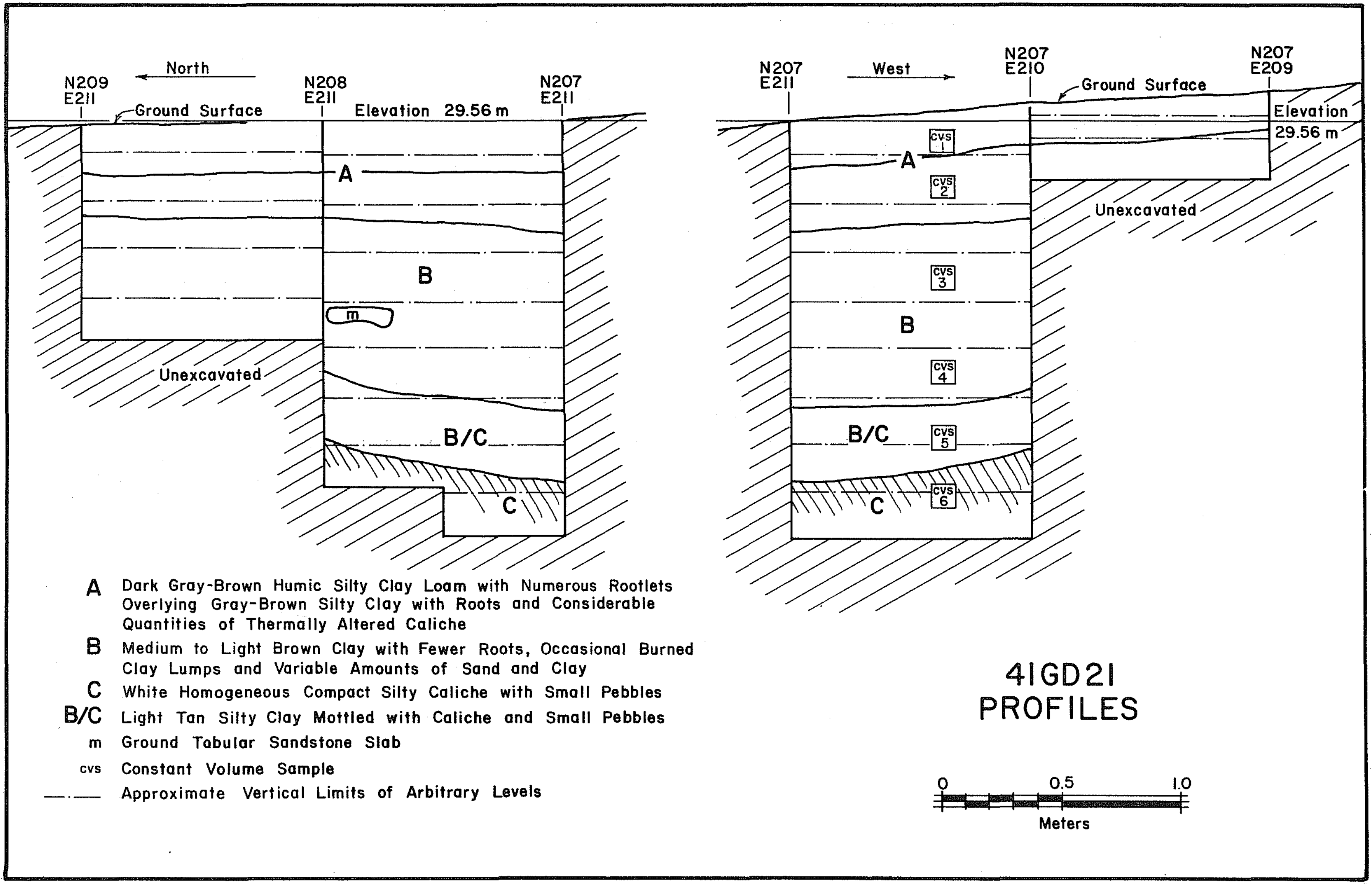


Figure 15. *Site 41 GD 21, Profiles of Excavation Units N208 E210, N207 E210 and N207 E209.*

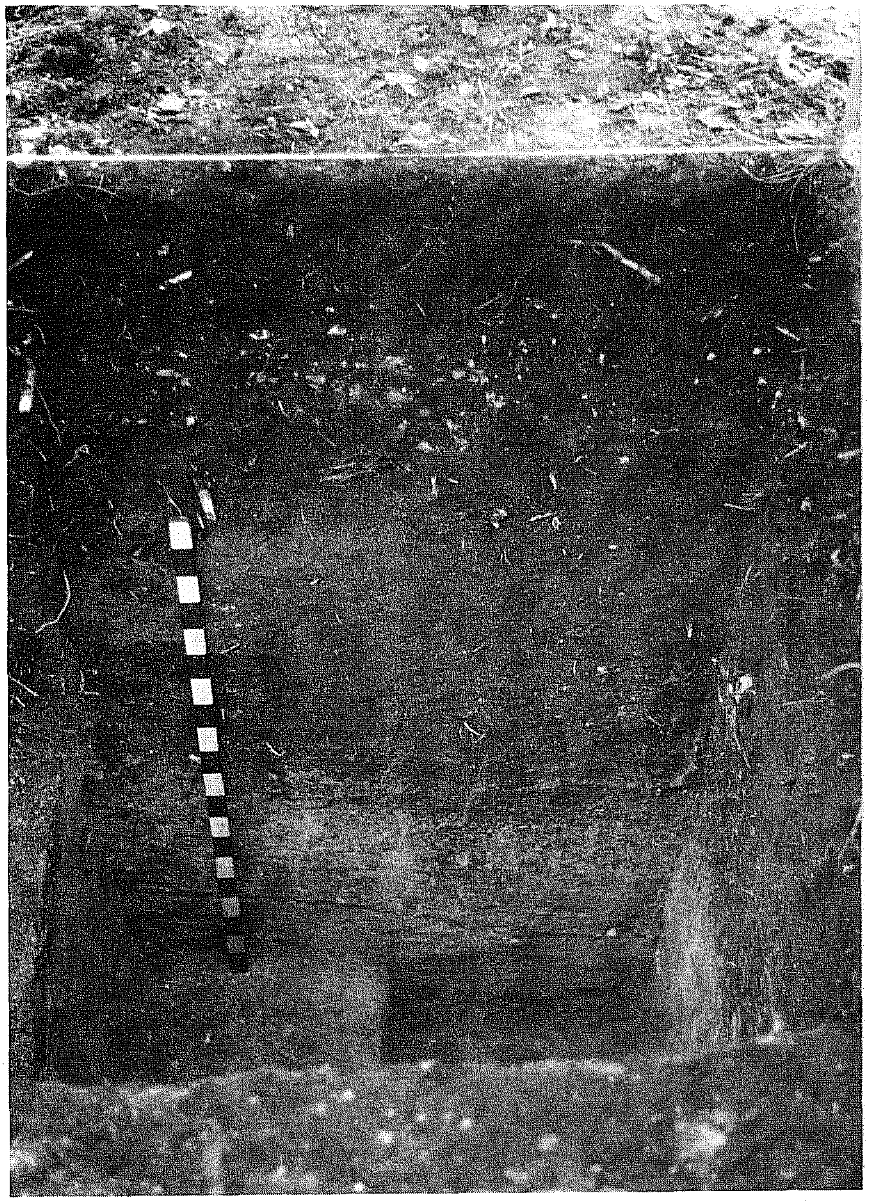


Figure 16. *East Profile of Units N208 E210 and N207 E210, Site 41 GD 21.*

Features

During the course of excavations in the western area of site 41 GD 21A, three features were recognized. All three were concentrations of thermally altered caliche lumps which may represent hearth areas.

Feature 1 was found at about the same elevation in the lower portion of Zone A as a variety of other occupational debris in 2-m^2 unit N185 E81. Flecks of charcoal were found in this burned caliche concentration.

Feature 2 was encountered at the bottom of Zone A in the east side of 1-m^2 unit N170 E115. Feature 3, situated at the top of Zone B, was found in the east side of 1-m^2 unit N179 E115 (Fig. 17). No charcoal or other forms of occupational debris were found in direct association with these concentrations of between 12 and 18 burned caliche lumps.

MATERIAL CULTURE

Prehistoric human occupation of sites 41 GD 21 and 41 GD 21A is represented by a variety of materials recovered during the 1977-1978 investigation. Lithics include chipped, pecked and ground and thermally altered stone. Large quantities of burned caliche, sand and clay were recovered, along with ceramics, worked bone and worked shell. Anglo-American occupation is represented by historic ceramic, metal and glass artifacts. Following is a classification of this prehistoric and historic cultural evidence. The provenience of material culture is presented in Tables 1-7.

LITHICS

A sample of 13,175 chipped stone artifacts, 19 pecked and ground stone implements and 1358 fragments of thermally altered chert and quartzite was recovered.

CHIPPED STONE

These are representative of overlapping stages in the continuum of chipped stone tool production from siliceous gravels. Cores, core-tools, core-bifaces, bifaces, trimmed flakes and chips, and utilized flakes and chips comprise 1.2% of the chipped stone sample. Unmodified flakes and chips of flaking debris make up 98.8%.

Cores (21 specimens)

Nodules or cobbles from which one or more flakes have been removed. Most cores probably represent the initial stages of chipped stone tool production, although it is possible that some were used as tools. Two different kinds of cores are differentiated on the basis of striking platform morphology and extent of reduction.

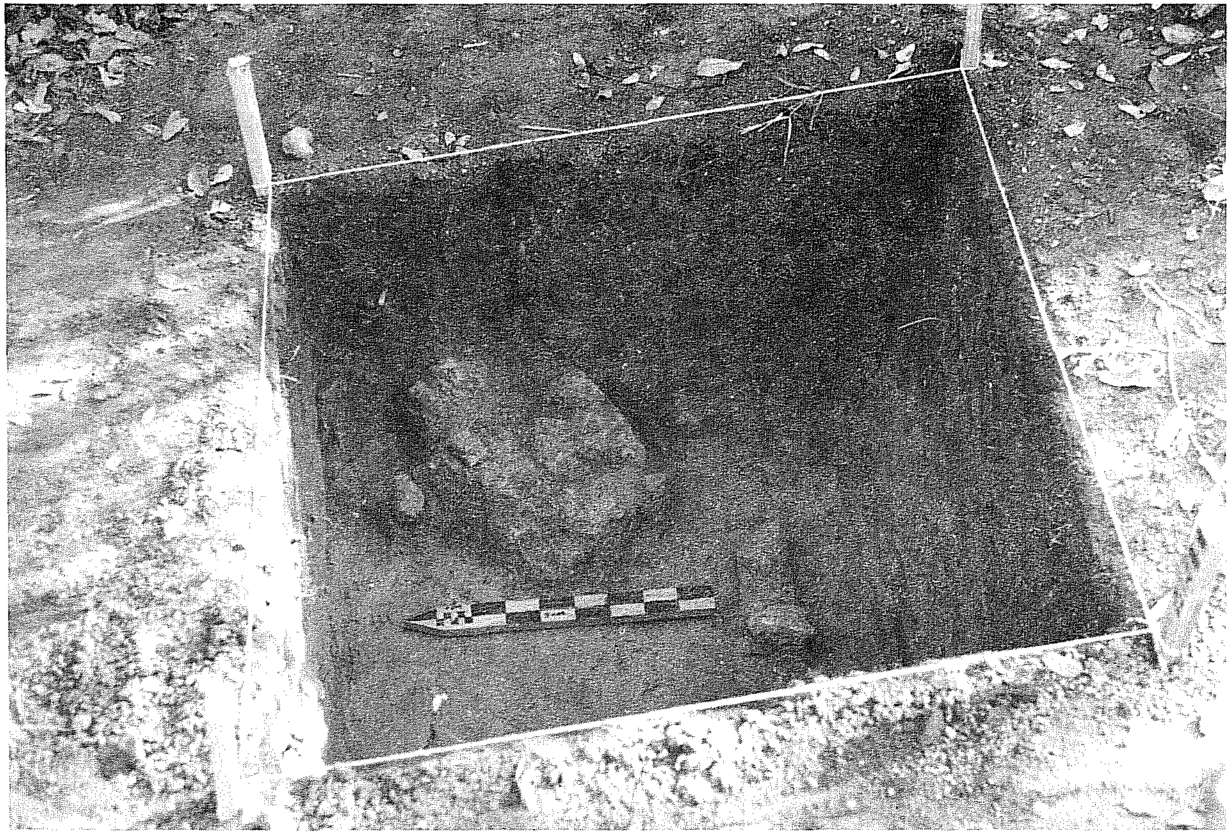


Figure 17. *Feature 3, Unit N179 E115, Looking East.*

TABLE 1
Artifact Proveniences by Unit, 41GD21

Category	Type	N20/N209 0-10 cm	N20/N209 10-20 cm	N20/N209 20-40 cm	N207/E210 0-20 cm	N207/E210 20-40 cm	N207/E210 40-60 cm	N207/E210 60-80 cm	N207/E210 80-100 cm	N207/E210 100-120 cm	N207/E210 120-140 cm	N207/E210 140-160 cm	N207/E210 160-180cm (S. ½)	N208/E209 0-20 cm	N208/E209 20-40 cm	N208/E210 0-20 cm	N208/E210 20-40 cm	N208/E210 40-60 cm	N208/E210 60-80 cm	N208/E210 80-100 cm	S. Wall Bkh. Tr. No. 1 Ca. 53 cm	Surface/Parking Area (W. ½ of Site)	Surface/Flume Disturbance	TOTALS
CORES	Cortex Platform														2				1			1		4
CORES	Decorticate Platform						1				1				1		1							4
CORE-TOOLS					1												1					1	2	5
CORE-BIFACES						1				1					2					1		1		6
BIFACES – THICK BIFACES	Pointed-Ovate/Lenticular															1	1							2
BIFACES – THICK BIFACES	Pointed-Ovate/Plano-Convex																							
BIFACES – THICK BIFACES	Stemmed/Lenticular																							
BIFACES – THIN BIFACES – Unstemmed	Pointed-Ovate Broad					2												1						3
BIFACES – THIN BIFACES – Unstemmed	Pointed-Ovate Narrow (Refugio-like)																	1						1
BIFACES – THIN BIFACES – Unstemmed	Subtriangular			1		1											1							3
BIFACES – THIN BIFACES – Unstemmed	Triangular																							
BIFACES – THIN BIFACES – Stemmed – Straight	Bell																	1						1
BIFACES – THIN BIFACES – Stemmed – Straight	Bulverde-like																							
BIFACES – THIN BIFACES – Stemmed – Straight	Morhiss					1																		1
BIFACES – THIN BIFACES – Stemmed – Straight	Darl-like																							
BIFACES – THIN BIFACES – Stemmed	Contracting Stem (Perdiz)		2														1							3
BIFACES – THIN BIFACES – Stemmed – Expand	Uvalde																							
BIFACES – THIN BIFACES – Stemmed – Expand	Ensor-like																							
BIFACES – THIN BIFACES – Stemmed – Expand	Scallorn				1																			1
BIFACES – THIN BIFACES	FRAGMENTS					2									1	1	3		1		1	1	1	11
TRIMMED FLAKES AND CHIPS	Side									1					1									2
TRIMMED FLAKES AND CHIPS	End and Side(s)																							
TRIMMED FLAKES AND CHIPS	Irregular or Indeterminable						1					1			1									3
UTILIZED FLAKES AND CHIPS	One Edge					1	2								1									4
UTILIZED FLAKES AND CHIPS	Two or More Edges													1			1					1		3
UTILIZED FLAKES AND CHIPS	End		1			1	1							1										4
UNMODIFIED FLAKES	PRIMARY							1								2				1				4
UNMODIFIED FLAKES – SECONDARY	Cortex Platform		1	5	2	13	23	2	1	4	3	4	1	3	25	2	37	19	6	1		2		154
UNMODIFIED FLAKES – SECONDARY	Single-Facet Platform	2	13	22	6	45	46	4	3	10	3	6		16	54	14	114	14	4	2		10		388
UNMODIFIED FLAKES – SECONDARY	Multiple Large-Facet Platform						1								1									2
UNMODIFIED FLAKES – SECONDARY	Multiple Small-Facet Platform			1	2	1	4			1					10		3							22
UNMODIFIED FLAKES – TERTIARY	Single-Facet Platform	2	12	13	7	79	62	3	4	9	5	17	3	5	39	9	168	29	9	6		10		491
UNMODIFIED FLAKES – TERTIARY	Multiple Large-Facet Platform				1	1	1		1	2	1	4	1		4	2	2					2		22
UNMODIFIED FLAKES – TERTIARY	Multiple Small-Facet Platform	5	22	24	7	23	75	4	5	14	7	10	1	17	128	13	107	45	8	6		5		526
CHIPS	Corticate	1	1	3	4	7	6						1		14	4	6	2	1	2		1		53
CHIPS	Partially Decorticate	3	16	23	7	53	49	7	3	10	1	3	3	10	100	11	140	27	7	6		9		488
CHIPS	Decorticate	7	50	94	27	94	312	15	16	35	25	28	9	48	329	36	568	203	23	18		25		1962
THERMALLY ALTERED STONE (qtz.)		2	10	25	7	45	66	12	8	29	4	13	1	12	83	14	120	20	9	6				486
THERMALLY ALTERED STONE (wt. gms.)		2	6	63	7	36	40	10	5	46	4	18	1	10	65	6	77	11	5	3				415
PECKED AND GROUND STONE	Hammerstones (Cobbles)														1								3	4
PECKED AND GROUND STONE	Grinding and Polishing Stones (Cobbles)		1			3	1										3							8
PECKED AND GROUND STONE	Tabular Sandstone	1							1															2
WORKED BONE	Cross-Hatched Bone Fragment																1							1
WORKED BONE	"Awl" Fragment														1									1
WORKED BONE	Asphaltum-Stained Terripan Shell																	1						1
WORKED SHELL	Cut and Smoothed Sunray Clam Shell																							
WORKED SHELL	Cut & Perforated Freshwater Mussel Shell																							
WORKED SHELL	Perforated Freshwater Mussel Shell																1							1

TABLE 2
Artifact Proveniences by Unit, 41GD21A (Western Area)

Category	Type	N185/E81 0-20 cm	N185/E81 20-40 cm	N185/E81 40-60 cm	N185/E81 60-80 cm	N185/E81 80-100 cm	N185/E81 100-120 cm	N185/E82 0-20 cm	N185/E82 20-40 cm	N185/E82 40-60 cm	N185/E82 60-80 cm	N185/E82 80-100 cm	N185/E82 100-120 cm	N185/E82 120-130 cm	N185/E81 & 82 Feature No. 1 (40-60 cm)	N186/E81 0-20 cm	N186/E81 20-40 cm	N186/E81 40-60 cm	N186/E81 60-80 cm	N186/E81 80-100 cm	N186/E81 100-120 cm
CORES	Cortex Platform									1		1					1				
CORES	Decorticate Platform			1			1														
CORE-TOOLS											1										
CORE-BIFACES			1							1								1			
BIFACES – THICK BIFACES	Pointed-Ovate/Lenticular												1								
BIFACES – THICK BIFACES	Pointed-Ovate/Plano-Convex									1								1			
BIFACES – THICK BIFACES	Stemmed/Lenticular				1																
BIFACES – THIN BIFACES – Unstemmed	Pointed-Ovate Broad						1														
BIFACES – THIN BIFACES – Unstemmed	Pointed-Ovate Narrow (Refugio-like)																				
BIFACES – THIN BIFACES – Unstemmed	Subtriangular																				
BIFACES – THIN BIFACES – Unstemmed	Triangular																				
BIFACES – THIN BIFACES – Stemmed – Straight	Bell																				
BIFACES – THIN BIFACES – Stemmed – Straight	Bulverde-like				1																
BIFACES – THIN BIFACES – Stemmed – Straight	Morhiss																				
BIFACES – THIN BIFACES – Stemmed – Straight	Darl-like									1											
BIFACES – THIN BIFACES – Stemmed	Contracting Stem (Perdiz)																				
BIFACES – THIN BIFACES – Stemmed – Expand	Uvalde																		1		
BIFACES – THIN BIFACES – Stemmed – Expand	Ensor-like			1					1												
BIFACES – THIN BIFACES – Stemmed – Expand	Scallorn																				
BIFACES – THIN BIFACES	FRAGMENTS		2						1		2						1	1			
TRIMMED FLAKES AND CHIPS	Side																				
TRIMMED FLAKES AND CHIPS	End and Side(s)		1				1										1				
TRIMMED FLAKES AND CHIPS	Irregular or Indeterminable																				
UTILIZED FLAKES AND CHIPS	One Edge		1						1	1							2				
UTILIZED FLAKES AND CHIPS	Two or More Edges				1												2	2		1	
UTILIZED FLAKES AND CHIPS	End	2																			
UNMODIFIED FLAKES	PRIMARY				1				1												
UNMODIFIED FLAKES – SECONDARY	Cortex Platform	1	23	12	11	5		1	11	23	14	2	2				4	16	6	6	
UNMODIFIED FLAKES – SECONDARY	Single-Facet Platform	1	34	23	23	15	3	7	35	55	25	7	6	3	3	4	29	42	16	7	1
UNMODIFIED FLAKES – SECONDARY	Multiple Large-Facet Platform		1	1						2	1							2			1
UNMODIFIED FLAKES – SECONDARY	Multiple Small-Facet Platform		7	3	3	1	1		4	1	1						3	6	6	2	
UNMODIFIED FLAKES – TERTIARY	Single-Facet Platform	7	55	15	16	16	9	6	30	49	19	12	4			7	24	32	12	8	1
UNMODIFIED FLAKES – TERTIARY	Multiple Large-Facet Platform		5	6	2	3			6	2	5	3					2	3	3	2	
UNMODIFIED FLAKES – TERTIARY	Multiple Small-Facet Platform	17	113	33	48	28	14	15	80	45	41	14	5	1	12	19	72	135	50	37	1
CHIPS	Corticate		4		2	3	1		6	1	4					2	4	8	2	1	1
CHIPS	Partially Decorticate	7	59	27	27	9	10	5	44	39	24	12	2		1	5	46	88	28	7	3
CHIPS	Decorticate	25	384	84	101	86	13	41	179	172	111	49	15	1	8	41	190	305	122	32	5
THERMALLY ALTERED STONE (qtz.)		12	61	22	13	15	5	8	45	32	21	8			5	13	56	69	20	12	
THERMALLY ALTERED STONE (wt. gms.)		10	46	21	18	8	8	5	66	32	34	16			7	18	119	78	15	11	
PECKED AND GROUND STONE	Hammerstones (Cobbles)																	1			
PECKED AND GROUND STONE	Grinding and Polishing Stones (Cobbles)			1																	
PECKED AND GROUND STONE	Tabular Sandstone																		1		
WORKED BONE	Cross-Hatched Bone Fragment																				
WORKED BONE	"Awl" Fragment																				
WORKED BONE	Asphaltum-Stained Terripan Shell																				
WORKED SHELL	Cut and Smoothed Sunray Clam Shell									1											
WORKED SHELL	Cut & Perforated Freshwater Mussel Shell								1												
WORKED SHELL	Perforated Freshwater Mussel Shell																				

N186/E82						N195/E83						N196/E83						N170/E95				N170/E115					N179/E115							
0-20 cm	20-40 cm	40-60 cm	60-80 cm	80-100 cm	100-120 cm	0-20 cm (on slope)	20-40 cm	40-60 cm	60-80 cm	80-100 cm	100-120 cm	0-20 cm (on slope)	20-40 cm (some slope)	40-60 cm	60-80 cm	80-100 cm	100-120 cm	0-20 cm	20-40 cm	40-60 cm	60-80 cm	0-20 cm	20-40 cm	40-60 cm	60-80 cm	Feature No. 2 (40-60 cm)	0-20 cm (some slope)	20-40 cm	40-60 cm	60-80 cm	80-100 cm	Feature No. 3 (60-80 cm)	Surface Flume Edge/Cut Bank	TOTALS
																1		1										1						6
								1						1														1			1			7
																																		1
	1	1																																5
		1																																2
		1																											1					4
																							1											2
																																		1
								1															1											2
																																		1
		1																																1
	1																																	2
																																	1	1
																																		1
																							1											3
1			1																1				2				1	1						14
																																		3
1																												1						2
	1	2	11						1				2	1																				13
	1						1	1	1															1	1			1						13
																																		2
																																		2
3	7	32	20	1	4	1	1	7	6	2			1	6	2	2			9	4		6	9	5	1		1	16	3	1				287
6	26	53	8	6	1		9	30	6	3			11	18	2	4		7	10	11	4	15	34	17	1		7	33	8	2				671
	1			1				3	1					2														2						19
	3	3	3	2	1			1	1	2			3	3		2			4	3	1	3	1					6	2					82
4	26	54	32	7	2		17	29	11	6		1	7	14	1	10		8	10	10	2	14	36	40	4		6	33	11	1				718
2		3		1				2							1			2	2		2	3	1					2		1				64
20	61	85	38	6	10	3	8	65	23	6	1		25	52	7	23		24	49	18	8	30	27	19	8		4	72	16	3	2			1493
	9	6	1	1	1		1	7					2	1	2	2		2	3	1	1	3	4				1	5	1					93
4	37	60	35	9	2		7	51	16	5			7	24	3	6		10	19	11	5	31	27	18	5		3	33	5	2		1		879
36	156	262	130	26	10	1	44	203	41	19	2	2	49	101	7	31		31	81	41	36	73	97	61	11		7	154	37	8	2			3723
	46	55	19	5		3	19	21	18	3	1	2	7	20	1	15		13	14	10	4	35	46	18	4			17	8	4		1		826
	36	85	14	8		13	10	16	15	2	2	2	7	27	3	14		8	17	5	4	112	28	10	14			35	27	13		3		1042
																			1															2
																		1																2
																																		1
	1	1																																3
																																		1

TABLE 3

Artifact Proveniences by Unit, 41 GD 21 A (Eastern Area)

		T.P. No. 1		N130/E230										N747/ E215		N100/ E285.45		N75.95 /E230		N142/E230					
		0-20 cm	20-30 cm	0-20 cm	20-40 cm	40-60 cm	60-80 cm	80-100 cm	100-120 cm	120-140 cm	140-160 cm	160-180 cm	Post Hole/140-180 cm	0-20 cm	20-30 cm	0-20 cm	20-30 cm	0-20 cm	20-30 cm	0-20 cm	20-40 cm	40-60 cm	60-80 cm	Surface/N73 E220	TOTAL
CORES	Cortex Platform																								
CORES	Decorticate Platform																								
CORE-TOOLS																									
CORE-BIFACES																									
BIFACES – THICK BIFACES	Pointed-Ovate/Lenticular																								
BIFACES – THICK BIFACES	Pointed-Ovate/Plano-Convex																								
BIFACES – THICK BIFACES	Stemmed/Lenticular																								
BIFACES – THIN BIFACES – Unstemmed	Pointed-Ovate Broad																								
BIFACES – THIN BIFACES – Unstemmed	Pointed-Ovate Narrow (Refugio-like)																							1	1
BIFACES – THIN BIFACES – Unstemmed	Subtriangular																								
BIFACES – THIN BIFACES – Unstemmed	Triangular																						1		1
BIFACES – THIN BIFACES – Stemmed – Straight	Bell																								
BIFACES – THIN BIFACES – Stemmed – Straight	Bulverde-like																	1					1		2
BIFACES – THIN BIFACES – Stemmed – Straight	Morhiss																								
BIFACES – THIN BIFACES – Stemmed – Straight	Darl-like																								
BIFACES – THIN BIFACES – Stemmed	Contracting Stem (Perdiz)																								
BIFACES – THIN BIFACES – Stemmed – Expand	Uvalde																								
BIFACES – THIN BIFACES – Stemmed – Expand	Ensor-like																								
BIFACES – THIN BIFACES – Stemmed – Expand	Scallorn																								
BIFACES	FRAGMENTS																						1		1
TRIMMED FLAKES AND CHIPS	Side																								
TRIMMED FLAKES AND CHIPS	End and Side(s)																								
TRIMMED FLAKES AND CHIPS	Irregular or Indeterminable																								
UTILIZED FLAKES AND CHIPS	One Edge										1														1
UTILIZED FLAKES AND CHIPS	Two or More Edges																								
UTILIZED FLAKES AND CHIPS	End																								
UNMODIFIED FLAKES	PRIMARY																								
UNMODIFIED FLAKES – SECONDARY	Cortex Platform	1	5						2		4	2	1	11	1		2	7	4			1	1		42
UNMODIFIED FLAKES – SECONDARY	Single-Facet Platform	1	5					1	4	4	5	1	2	29	2	7		4	3		4	1	4		77
UNMODIFIED FLAKES – SECONDARY	Multiple Large-Facet Platform		1																						1
UNMODIFIED FLAKES – SECONDARY	Multiple Small-Facet Platform													2				2							4
UNMODIFIED FLAKES – TERTIARY	Single-Facet Platform	1	5		1	1	2	1		1	3	5	3	19	1	4		9	15		2		3		76
UNMODIFIED FLAKES – TERTIARY	Multiple Large-Facet Platform	1									1			2				6							10
UNMODIFIED FLAKES – TERTIARY	Multiple Small-Facet Platform	7	14			1	1	2	2	1	8	6	2	68	4	11	1	20	3		6	8	5		170
CHIPS	Corticate						1				1			4				2							8
CHIPS	Partially Decorticate	1	3		1	1		2	2	3	3	14		24		9		12	4		1		5		85
CHIPS	Decorticate	9	21		1	4	4	4	6	9	16	30	3	158	6	18	4	63	31		11	3	5		406
THERMALLY ALTERED STONE (qtz.)		4	8									5	1	16		3		5	4						46
THERMALLY ALTERED STONE (wt. gms.)		7	8									3	3	15		2		4	2						44
PECKED AND GROUND STONE	Hammerstones (Cobbles)																								
PECKED AND GROUND STONE	Grinding and Polishing Stones (Cobbles)																								
PECKED AND GROUND STONE	Tabular Sandstone																								
WORKED BONE	Cross-Hatched Bone Fragment																								
WORKED BONE	"Awl" Fragment																								
WORKED BONE	Asphaltum-Stained Terripan Shell																								
WORKED SHELL	Cut and Smoothed Sunray Clam Shell																								
WORKED SHELL	Cut & Perforated Freshwater Mussel Shell																								
WORKED SHELL	Perforated Freshwater Mussel Shell																								

Cortex Platform (10 specimens) (Fig. 18,a,b)

Cobbles or nodules from which a flake or flakes have been struck from corticate (unimproved, cortex-covered) platform surfaces. Two cortex platform cores have been produced by the removal of one or two large flakes, while the remaining eight specimens are smaller and have undergone more extensive reduction.

Decorticate Platform (11 specimens) (Fig. 18,c,d)

Cores created by the removal of several flakes struck from decorticate, as well as corticate, platform surfaces. This sample appears to be representative of the production of both bifaces and flake tools. Seven decorticate platform cores retain small portions of cortex. The four remaining specimens are decorticate. Although eight are small and may be cores which were exhausted during the production of flakes, three are morphologically similar to core-bifaces and may be representative of the reduction of cores into bifaces.

Core-Tools (6 specimens) (Fig. 19,a,a^1)

Cobbles or nodules which have been thinned bifacially, flaked and battered on one end. Three core-tools exhibit signs of battering on corticate as well as decorticate surfaces. Similar chipped stone implements have been reported from other parts of southern Texas (Fox *et al.* 1974:26; Lynn, Fox and O'Malley 1977:49). Perhaps such tools were used to crack open mussel shells.

Core-Bifaces (11 specimens) (Fig. 19,b,c)

Cobbles or nodules which have been thinned bifacially along continuous edges and are roughly lenticular in cross section. Similar in general outline shape to some cortex platform cores, core-bifaces are more reduced, ranging in thickness from 1.4 to 3.2 cm, and probably represent aborted attempts at biface tool production.

Bifaces (65 specimens)

Bifacially thinned chipped stone artifacts which retain little or no cortex and have continuous edges. Bifaces probably are the products and by-products of the reduction of cobbles, cores and flakes into tools. Bifaces are divided into two groups based on thickness.

Thick Bifaces (10 specimens) (Figs. 20,21,a,b)

Greater than 1.3 cm thick. Thick bifaces are subdivided into three groups based on morphology.

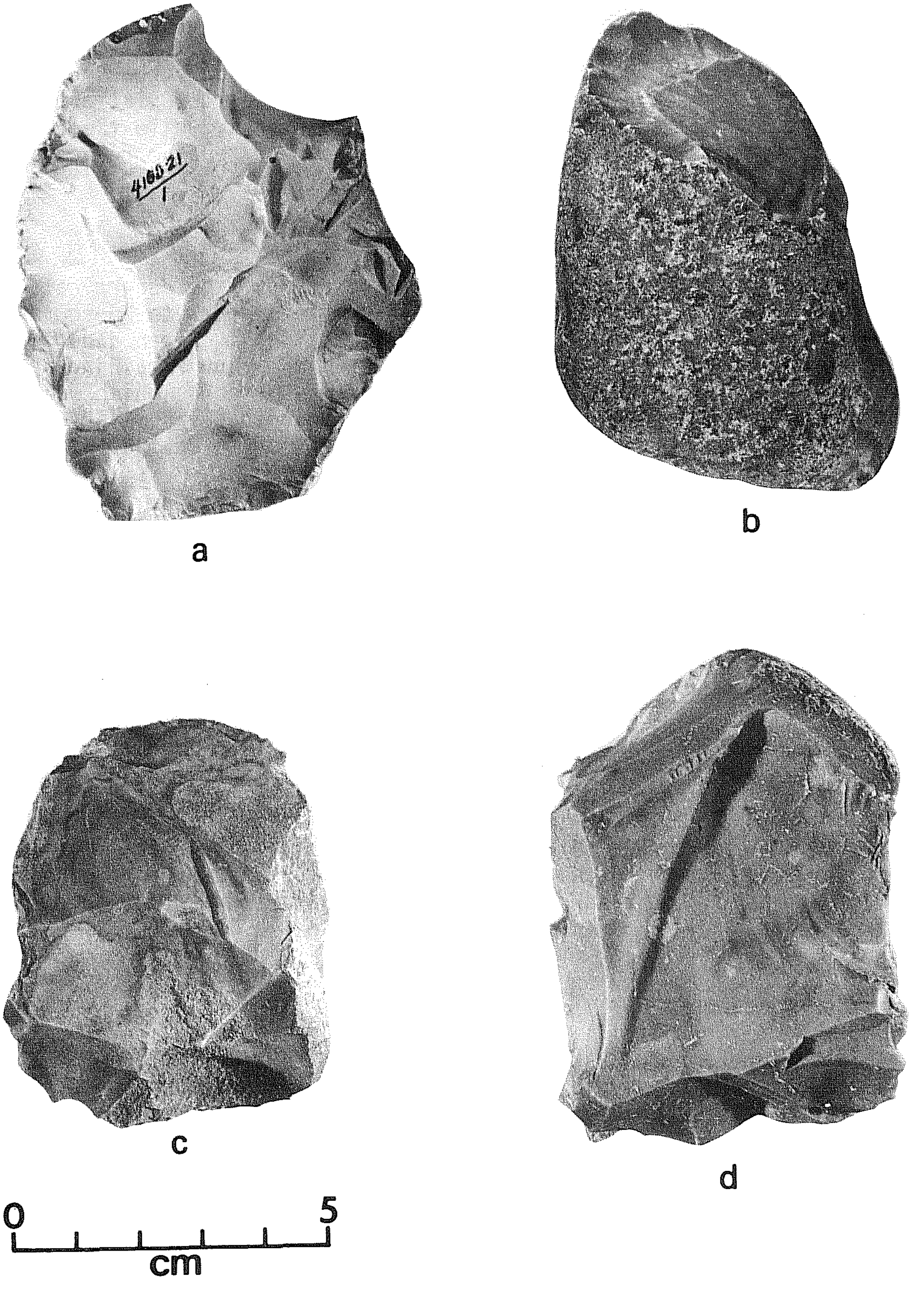


Figure 18. *Cores*. a,b, cortex platform; c,d, decorticate platform.

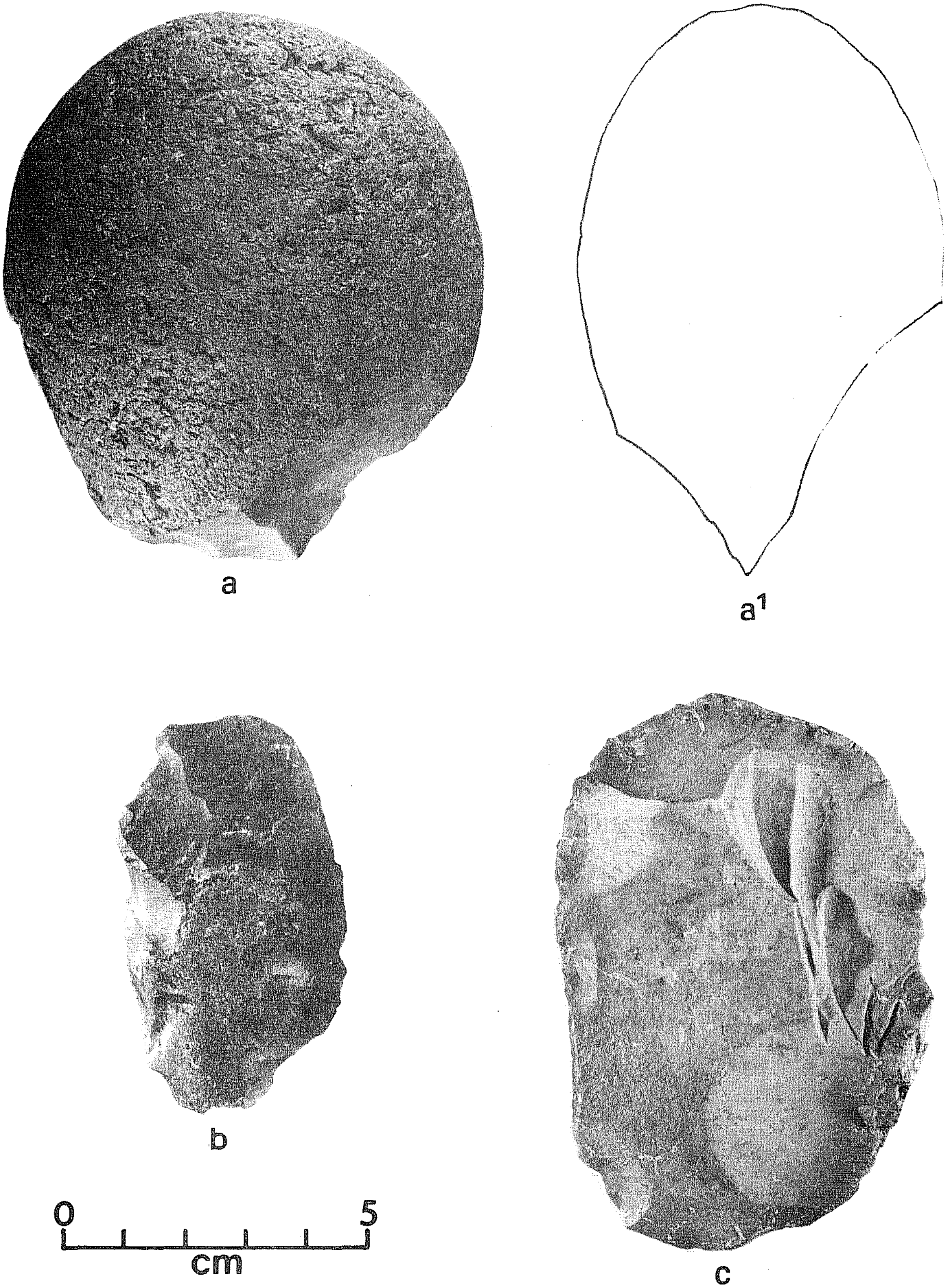


Figure 19. *Core-Tool and Core-Bifaces.* a, core-tool; a^1, cross section; b,c, core-bifaces.

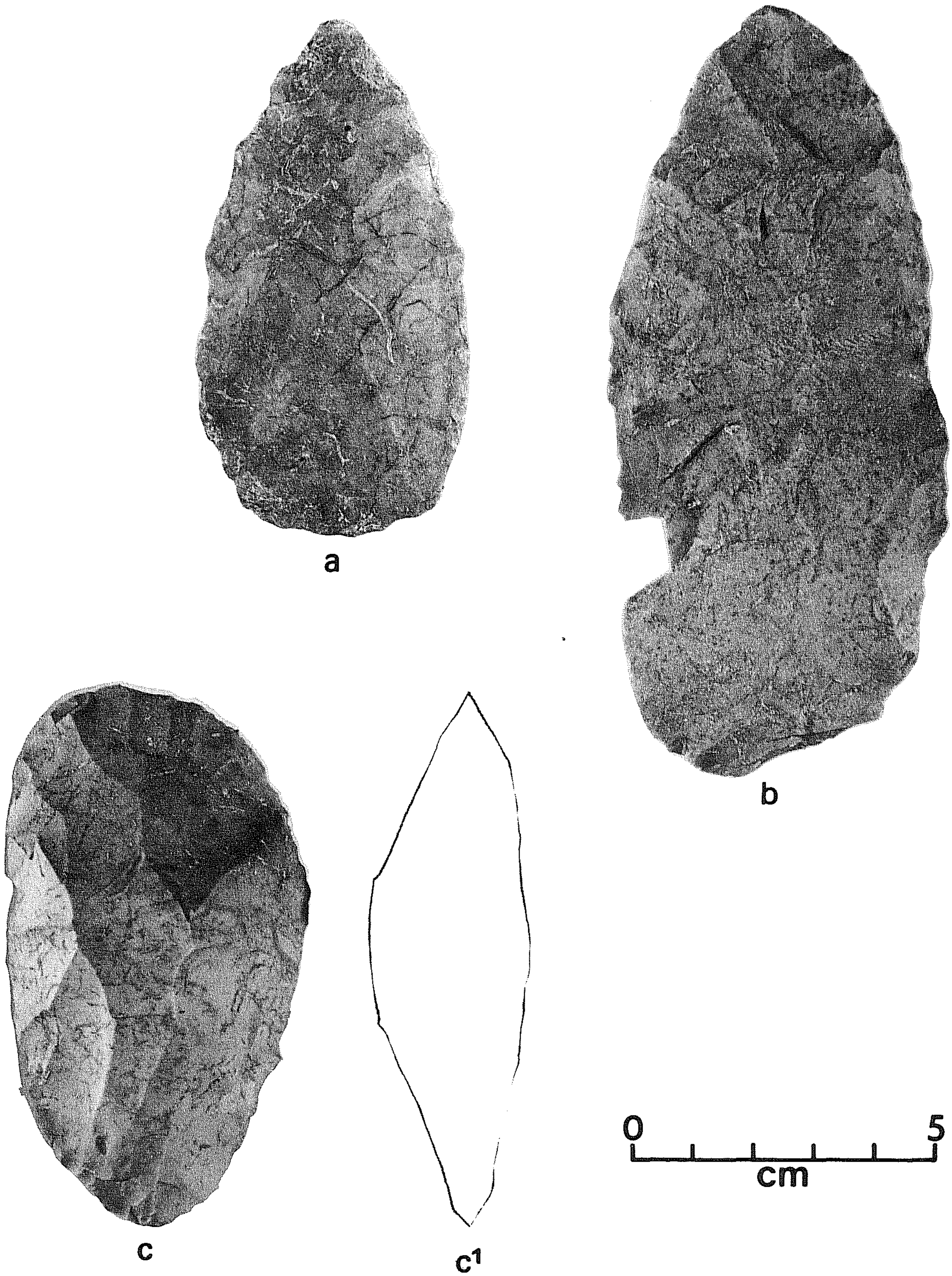


Figure 20. *Thick Bifaces.* a,b, pointed-ovate/lenticular; c, pointed-ovate/plano-convex; c^1, cross section.

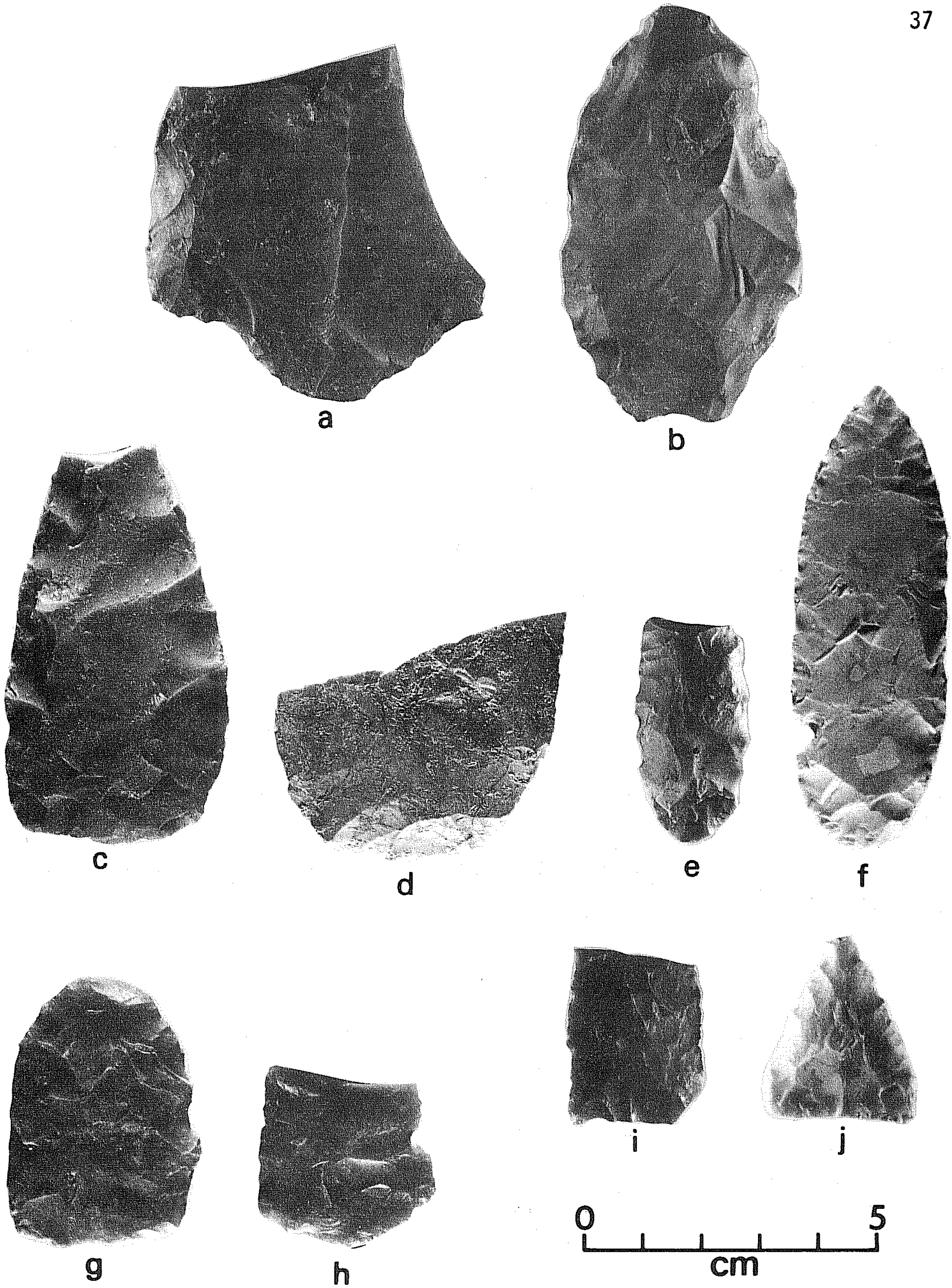


Figure 21. *Thick and Thin Bifaces*. a,b, stemmed lenticular thick bifaces; c,d, unstemmed broad pointed-ovate thin bifaces; e,f, unstemmed narrow pointed-ovate thin bifaces; g,h, unstemmed subtriangular thin bifaces; i,j, unstemmed triangular thin bifaces.

Pointed-Ovate/Lenticular (4 specimens) (Fig. 20,a,b)

Roughly pointed-ovate in outline shape with lenticular cross sections. Three complete specimens range in length from 8.3 to 12.5 cm, in width from 4.3 to 5.8 cm, and in thickness from 1.5 to 2.7 cm. The remaining specimen is 4.6 cm wide and 1.4 cm thick.

Pointed-Ovate/Plano-Convex (4 specimens) (Fig. 20,c,c^1)

Roughly pointed-ovate in outline shape with plano-convex cross sections. One complete specimen measures 9.2 cm long, 4.9 cm wide and 2.7 cm thick, and is morphologically similar to "Group II, Form 3 Thick Bifaces" reported from DeWitt and Gonzales Counties (Fox *et al.* 1974:40).

Stemmed/Lenticular (2 specimens) (Fig. 21,a,b)

Lenticular in cross section with roughly shaped contracting stems and rounded shoulders. One specimen is complete, measuring 6.9 cm long, 3.9 cm wide and 1.4 cm thick. The other is approximately 5.7 cm wide and 1.5 cm thick. Both are similar to stemmed thick bifaces reported from DeWitt and Gonzales Counties (Fox *et al.* 1974:56) and may represent aborted attempts to produce stemmed thin bifaces.

Thin Bifaces (55 specimens)

Less than 1.3 cm thick. Thin bifaces probably are a variety of products and by-products of the final stages of biface tool production. Having uniform thicknesses and edges, they appear to represent predetermined shaping of the original cobbles, cores or flakes from which they were manufactured. Thin bifaces are lenticular in cross section, retain very little or no cortex, and are either unstemmed or stemmed.

Unstemmed (12 specimens) (Fig. 21,c-j)

Thin bifaces which are pointed-ovate, subtriangular or triangular in outline, lacking shoulders, barbs or stems.

Pointed-Ovate (6 specimens) (Fig. 21,c-f)

Pointed distal ends and rounded proximal ends. Edges are slightly convex. Pointed-ovate thin bifaces are subdivided into two forms based on the relationship of length and width.

Broad (4 specimens) (Fig. 21,c,d)

Greater than 3.7 cm wide and probably less than 8.0 cm long. These fragmentary thin bifaces may have been broken during their reduction into stemmed and/or unstemmed thin biface tool forms. Broad pointed-ovate thin bifaces range in thickness from 0.9 cm to 1.2 cm.

Narrow (2 specimens) (Fig. 21,e,f)

Less than 2.6 cm wide. These specimens are more uniform in thickness and edge treatment than broad pointed-ovate thin bifaces. One complete specimen measures 8.0 cm long, 2.6 cm wide and 0.7 cm thick. The other is 1.9 cm wide and 0.8 cm thick and bears asphaltum stains on its proximal end. Both are somewhat similar to "Form 2 Contracting Stem Thin Bifaces" reported from DeWitt and Gonzales Counties (Fox *et al.* 1974:48) and can be compared to *Refugio* artifacts described by Suhm and Jelks (1962:241).

Subtriangular (4 specimens) (Fig. 21,g,h)

Roughly triangular in outline, with rounded corners, straight to slightly convex sides, and slightly convex bases. These thin bifaces are similar in flaking treatment to broad pointed-ovate thin bifaces. One complete specimen measures 4.7 cm long, 3.3 cm wide and 0.9 cm thick. The three remaining subtriangular thin biface fragments range in width from 3.1 to 4.2 cm, and in thickness from 0.5 to 0.9 cm. One specimen is fashioned from purple quartzite.

Triangular (2 specimens) (Fig. 21,i,j)

Triangular in outline, with pointed corners, straight to slightly convex sides, and straight bases. One complete specimen is 3.2 cm long, 2.6 cm wide and 0.6 cm thick. The fragmentary specimen measures 2.3 cm wide and 0.5 cm thick, and probably was greater than 4.0 cm long. Both triangular thin bifaces are comparable to "Late Triangular" forms described by Hester (1971:80) for south-central Texas.

Stemmed (17 specimens) (Fig. 22)

Thin bifaces fashioned with straight, contracting and expanding stems which are thought to be hafting modifications.

Straight Stem (8 specimens) (Fig. 22,a-e)

Shouldered and barbed thin bifaces with relatively straight-sided stems.

Form 1, *Bell* (1 specimen) (Fig. 22,a)

A large stemmed thin biface with barbed shoulders, a broad uniformly shaped flat blade, and a long basally thinned stem with slightly expanding sides, pointed basal corners and a straight base. Stem

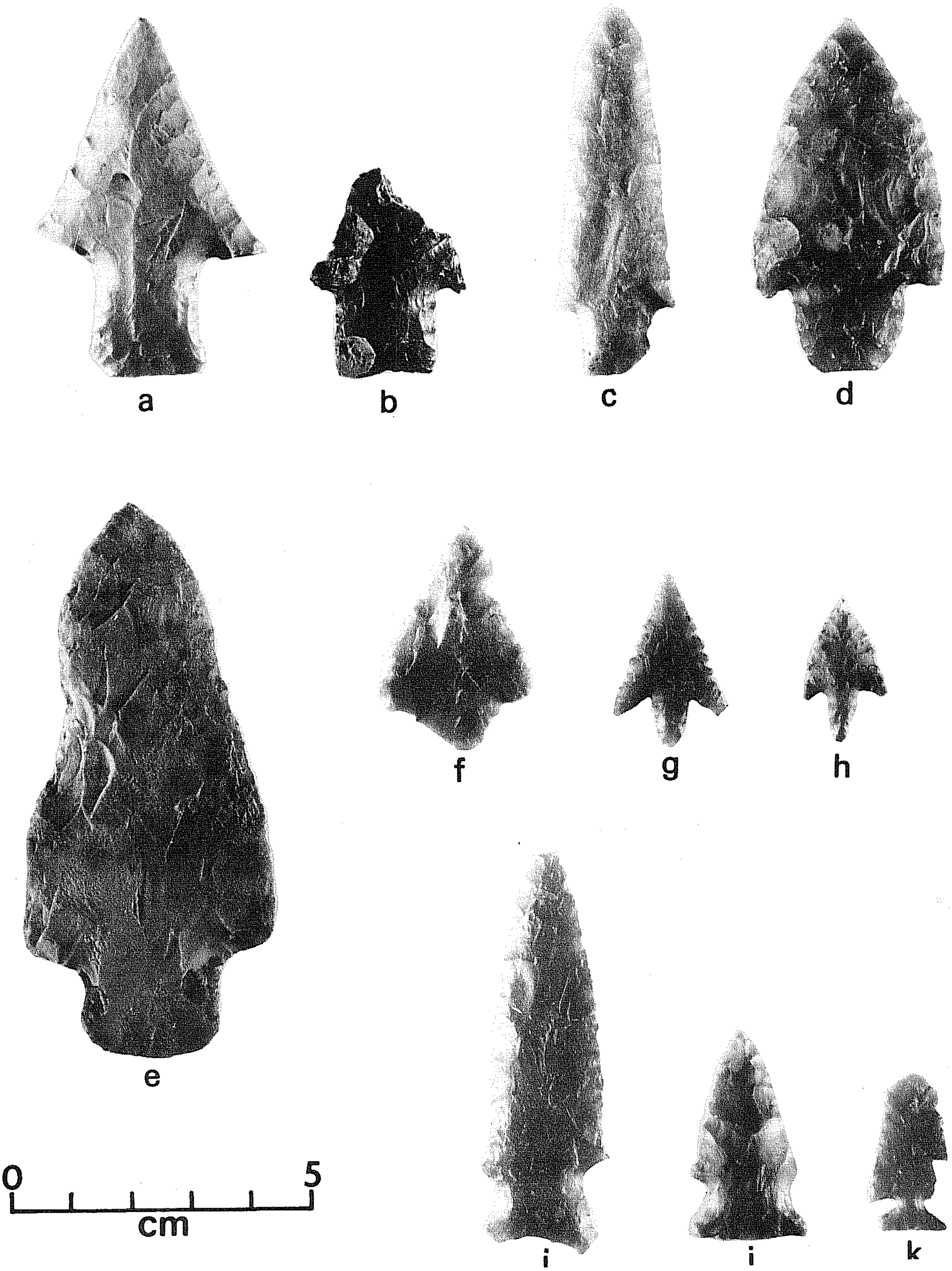


Figure 22. *Stemmed Thin Bifaces*. a, straight stem, form 1, *Bell*; b, straight stem, form 2, *Bulverde*-like; c, straight stem, form 4, *Darl*-like; d,e, straight stem, form 3, *Morhiss*; f-h, contracting stem, *Perdiz*; i, expanding stem, form 1, *Uvalde*; j, expanding stem, form 2, *Ensor*-like; k, expanding stem, form 3, *Scallorn*.

edges appear to have been smoothed. Measuring 5.9 cm long, 3.9 cm wide at the shoulders, 1.9 cm wide at the stem and 0.7 cm thick, this artifact is comparable to *Bell* points defined by Sorrow, Shafer and Ross (1967:Fig. 72) and Sorrow (1969:44) for central Texas. A similar straight-stemmed thin biface is reported from DeWitt County (Fox *et al.* 1974:173), and others are contained in a collection from the Morhiss site (41 VT 1) in Victoria County (*ibid.* 1974:Appendix 7,e,f).

Form 2, *Bulverde*-like (3 specimens) (Fig. 22,b)

Stemmed thin bifaces with prominent unbarbed shoulders, relatively broad, lenticular blades and straight-sided stems, with pointed basal corners and straight bases. One complete specimen measures 4.6 cm long, 2.9 cm wide at the shoulders, 2.2 cm wide at the stem and 0.7 cm thick. Two basal fragments are 1.2 cm and 2.1 cm wide at the stem and 0.6 cm thick. These artifacts are comparable to straight stem thin biface forms reported from DeWitt and Gonzales Counties (Fox *et al.* 1974:48-50) and are somewhat similar to the *Bulverde* type defined by Suhm and Jelks (1962:169).

Form 3, *Morhiss* (2 specimens) (Fig. 22,d,e)

Stemmed thin bifaces with large convex-sided blades, prominent barbed shoulders, and relatively straight stems with rounded basal corners and slightly convex bases. Both specimens are complete. One measures 9.1 cm long, 4.1 cm wide at the shoulders, 2.3 cm wide at the stem and 1.0 cm thick, and bears asphaltum stains on the stem. The other is 5.9 cm long, 3.1 cm wide at the shoulders, 1.7 cm wide at the stem and 1.0 cm thick. These large stemmed thin bifaces can be classified as examples of the *Morhiss* type (Suhm and Jelks 1962:221). Similar artifacts are reported from the Morhiss site in Victoria County (Fox *et al.* 1974:Appendix 8,a-d).

Form 4, *Darl*-like (2 specimens) (Fig. 22,c)

Long, narrow thin bifaces with slightly beveled blade edges (produced by the removal of numerous small flakes), pointed shoulders, and short straight to slightly flaring stems with pointed basal corners. One nearly complete specimen with asphaltum stains on the stem measures 6.2 cm long, 1.9 cm wide at the shoulders, 1.2 cm wide at the stem and 0.6 cm thick. The other is a basal fragment which is 1.4 cm wide at the stem and 0.6 cm thick. These artifacts are somewhat similar to forms classified as *Darl* by Suhm and Jelks (1962:179).

Contracting Stem, *Perdiz* (4 specimens) (Fig. 22,f-h)

Small thin bifaces with triangular blades, prominent barbed shoulders, and narrow contracting stems with rounded bases. Blade edges are evenly thinned and partially serrated. One possibly unfinished specimen is 3.7 cm long, 2.5 cm wide at the shoulders, 1.4 cm wide at the juncture of the stem and the blade, and 0.4 cm thick. The others range in length from

2.4 cm to approximately 3.4 cm, in width at the shoulders from 1.4 to 1.9 cm, in width at the juncture of the stem and the blade from 0.4 to 0.5 cm, and in thickness from 0.15 to 0.30 cm. These contracting stem thin bifaces are comparable to the *Perdiz* type defined by Suhm and Jelks (1962:283) and appear to have been produced from broad, thin, flat flakes.

Expanding Stem (5 specimens) (Fig. 22,i-k)

Thin bifaces with prominent shoulders and expanding stems.

Form 1, *Uvalde* (1 specimen) (Fig. 22,i)

A long, narrow thin biface with sharp, slightly serrated convex blade edges, prominent pointed shoulders, and a side-notched expanding stem with a concave base. This complete artifact measures 6.8 cm long, 2.1 cm wide at the shoulders, 1.9 cm wide at the base and 0.8 cm thick. It is comparable to the *Uvalde* form defined by Suhm and Jelks (1962:255).

Form 2, *Ensor*-like (3 specimens) (Fig. 22,j)

Relatively small, side-notched thin bifaces with triangular blades, unbarbed to slightly barbed shoulders, and wide expanding stems with straight to slightly concave bases. One complete specimen measures 3.5 cm long, 1.8 cm wide at the shoulders, 1.9 cm wide at the base and 0.6 cm thick. All three are comparable to Form 7 Expanding Stem thin bifaces reported from DeWitt and Gonzales Counties (Fox *et al.* 1974:53) and are somewhat similar to the *Ensor* type defined by Suhm and Jelks (1962:189).

Form 3, *Scallorn* (1 specimen) (Fig. 22,k)

A small fragmentary thin biface with a slightly serrated triangular blade, slightly barbed shoulders, and a deeply side-notched expanding stem with a straight base. It measures approximately 1.4 cm wide at the shoulders, 0.25 cm wide at the juncture of the stem and the blade, 1.3 cm wide at the base and 0.25 cm thick. Comparable forms have been classified as the *Scallorn* type by Jelks (1962:27-31).

Thin Biface Fragments (26 specimens) (Fig. 23,a-d)

Biface fragments less than 1.3 cm thick. Both stemmed and unstemmed thin biface forms probably are represented by these distal, medial and proximal fragments which range in thickness from 0.35 to 1.2 cm.

Trimmed Flakes and Chips (10 specimens) (Fig. 23,e-g)

Flakes and chips, an edge or edges of which have been altered by the removal of small flakes to the extent that the original interior and exterior of the

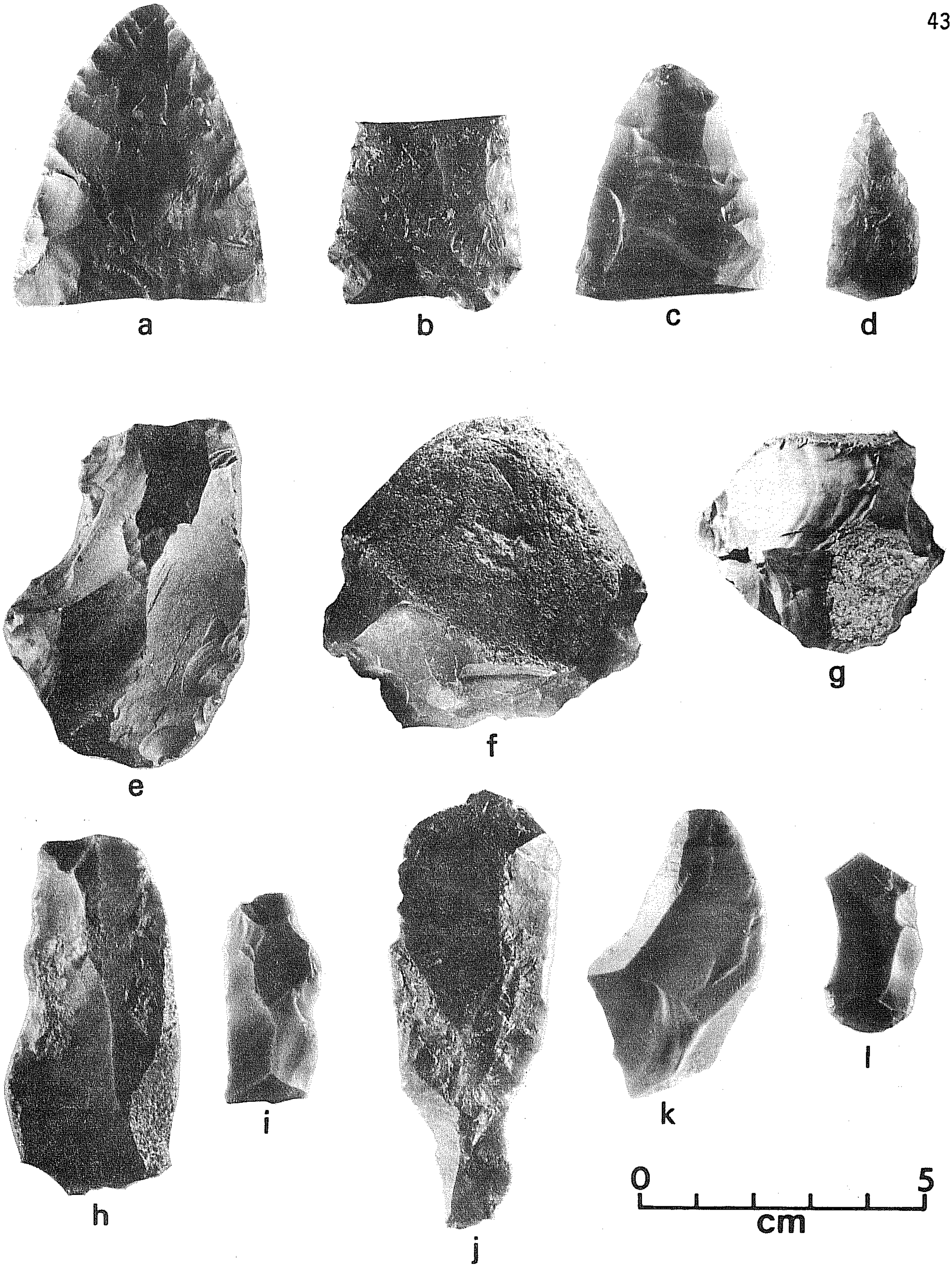


Figure 23. *Thin Biface Fragments, Trimmed and Utilized Flakes and Chips.* a-d, thin biface fragments; e, side-trimmed flake; f, end and side-trimmed flake; g, irregularly trimmed flake; h,i, utilized flake and chip, one edge; j,k, utilized flakes, two edges; l, utilized chip, end.

flake can be recognized. Most trimmed flakes and chips are unifacially trimmed on the exterior surface. Trimmed flakes and chips are divided into three groups based on the relationship of the trimmed edge to the medial axis of the original flake.

Side (2 specimens) (Fig. 23,e)

Trimmed along one edge, more or less parallel to the medial axis of the flake. A single-facet platform tertiary flake, 5.9 cm long, 4.1 cm wide and 1.4 cm thick, and a decorticate chip, 4.3 cm long, 3.3 cm wide and 1.0 cm thick have been intensively trimmed along one side.

End and Side (3 specimens) (Fig. 23,f)

Trimmed along one or both edges, parallel to the medial axis, and on the distal end, perpendicular to the medial axis of the flake. This group is comprised of two cortex platform secondary flakes and one single-facet platform secondary flake. All three are relatively large, ranging in thickness from 1.7 to 2.6 cm.

Irregular or Indeterminable (5 specimens) (Fig. 23,g)

Trimmed in various irregular patterns or too fragmentary to be assigned to a specific group. One single-facet platform tertiary flake, one multiple small-facet platform tertiary flake, one partially decorticate chip and two decorticate chips comprise this group. Thicknesses range from 0.3 to 2.0 cm.

Unmodified Flakes and Chips (13,022 specimens)

Pieces of chipped stone which have been produced during the reduction of siliceous cobbles or nodules into tools. Representative of the various overlapping stages of chipped stone tool production, flakes and chips can be referred to as flaking debris, debitage, or by-products of lithic tool making. All specimens in this sample appear to be unmodified, although it is possible that some were used as tools.

Flakes (5,325 specimens)

Fragments of siliceous stone, primarily chert along with some quartzite, which retain portions of platform areas at which they were struck or pressed from cobbles, cores, core-bifaces and other flakes. Flakes are sorted initially into three categories based on the amount of cortex present. Further subdivision is presented by platform morphology.

Primary Flakes (6 specimens)

Produced as an initial removal from the unaltered exterior surface of a cobble or core. A primary flake retains cortex over its entire exterior surface and has an unprepared cortex platform.

Secondary Flakes (1,749 specimens)

Partially decorticate, having been removed from partially decorticate portions of cores, flakes, core-bifaces and bifaces. Having unprepared or simply prepared platforms, most secondary flakes apparently were removed from cores, core-bifaces and large bifaces.

Cortex Platform (483 specimens)

Partially decorticate flakes with cortex platforms.

Single-Facet Platform (1,136 specimens)

Secondary flakes produced utilizing the single facet formed by the scar of a previous flake removal as a platform.

Multiple Large-Facet Platform (22 specimens)

Secondary flakes with platforms prepared intentionally or unintentionally by the removal of two or more large flakes. Multiple large-facet platforms usually are greater than 1.0 cm wide and exhibit relict removal scars greater than 0.5 cm wide.

Multiple Small-Facet Platform (108 specimens)

Partially decorticate flakes with platforms prepared by the removal of several tiny flakes. Multiple small-facet platforms usually are less than 1.0 cm wide and have numerous small facets.

Tertiary Flakes (3,570 specimens)

Decorticate flakes having been removed from the decorticate portions of cores, flakes and bifaces.

Single-Facet Platform (1,285 specimens)

Of the same platform morphology as single-facet platform secondary flakes, although tending to be smaller in size. Many such platforms on tertiary flakes are characterized by a visible ridge or lip which extends along the interior edge of the striking platform.

Multiple Large-Facet Platform (96 specimens)

Of the same platform morphology as multiple large-facet platform secondary flakes, although many retain broad, thick remnants of the edges of large bifaces and some are lipped.

Multiple Small-Facet Platform (2,189 specimens)

Of the same platform morphology as multiple small-facet platform secondary flakes. These platforms often are lipped and very few appear to have been ground during preparation.

Chips (7,697 specimens)

Flake fragments which do not have platforms. Chips are divided into three categories based on the amount of cortex present on each specimen.

Corticate (154 specimens)

Chips which retain cortex over their entire exterior surfaces and are fragments of primary and secondary flakes.

Partially Decorticate (1,452 specimens)

Fragments of secondary flakes.

Decorticate (6,091 specimens)

Characterized by exterior surfaces which are devoid of cortex. Decorticate chips are fragments of tertiary flakes and the decorticate portions of secondary flakes.

Utilized Flakes and Chips (40 specimens) (Fig. 23,h-l)

Altered by minute chipping, grinding or nibbling along one or more edges. Utilized flakes and chips are divided into three groups based on the number of edges which exhibit signs of wear, and on the relationship of the utilized edge to the medial axis of the original flake.

One Edge (18 specimens) (Fig. 23,h,i)

Exhibiting signs of use along one sharp edge. Although wear along lateral edges is most common, signs of use occur on the sharpest, thinnest edge, no matter what its relationship to the medial axis of the flake. This group includes four single-facet platform secondary flakes, one multiple large-facet platform secondary flake, two single-facet platform tertiary flakes, one multiple small-facet platform tertiary flake, five partially decorticate chips and five decorticate chips.

Two or More Edges (16 specimens) (Fig. 23,j,k)

Exhibiting signs of use along two or more sharp thin edges. There is no consistent pattern of relationship of the altered edge and the medial axis of the flake. Most specimens are large and thin. The group includes three cortex platform secondary flakes, one single-facet platform secondary flake, one multiple large-facet platform secondary flake, three single-facet platform tertiary flakes, three multiple small-facet tertiary flakes and five decorticate chips.

End (6 specimens) (Fig. 23,1)

Exhibiting signs of use along the distal end, more or less perpendicular to the medial axis of the flake. Distal ends appear to have been selected as a working edge on these flakes and chips, which are slightly arched in longitudinal cross section. The group includes one single-facet platform secondary flake, two multiple small-facet platform tertiary flakes and three decorticate chips. The largest specimen is 3.8 cm long, approximately 2.3 cm wide and 0.5 cm thick.

PECKED AND GROUND STONE

Products and by-products of the use of quartzite cobbles and sandstone slabs as tools.

Cobbles (16 specimens) (Fig. 24)

Fine-grained and coarse-grained quartzite cobbles which show wear from pecking, grinding or polishing. Pecked and ground cobbles are divided into two groups based on whether they are pecked, or ground and polished.

Hammerstones (6 specimens) (Fig. 24,a,b)

Quartzite cobbles which have pecked or battered surfaces thought to be the result of the use of these cobbles as hammerstones. Five specimens are roughly oval in shape and have at least one battered end. They range in maximum length from 9.2 to 10.6 cm, in maximum thickness from 4.9 to 7.1 cm, and in weight from 342 to 559 gm. The remaining hammerstone is oval in outline shape, elliptical in cross section, and shows signs of battering around its circumference. It is 7.2 cm long, 6.1 cm wide, 3.0 cm thick and weighs 198 gm.

Grinding and Polishing Stones (10 specimens) (Fig. 24,c,d)

Quartzite cobbles which have smoothed and/or polished surfaces. Two complete specimens are oval in shape, like most hammerstones, and are 8.9 cm and 8.6 cm long, 7.5 cm and 5.4 cm wide, 4.3 cm and 4.1 cm thick, and weigh 410 gm and 293 gm, respectively. Another complete cobble is smaller, oval in outline and elliptical in cross section; it measures 5.3 cm in diameter, 2.5 cm in thickness and weighs 100 gm. The remaining specimens are fragmentary.

Tabular Sandstone (3 specimens) (Fig. 25)

Fragments of sandstone slabs which have been ground and smoothed on at least one surface. One artifact is a large slab of soft, coarse-grained sandstone which has a shallow ground and smoothed basin-like depression in one surface (Fig. 25). This "metate," or "milling slab," measures approximately 36 cm long, 27 cm wide and 8 cm thick. A smaller fragment of soft, coarse-grained sandstone

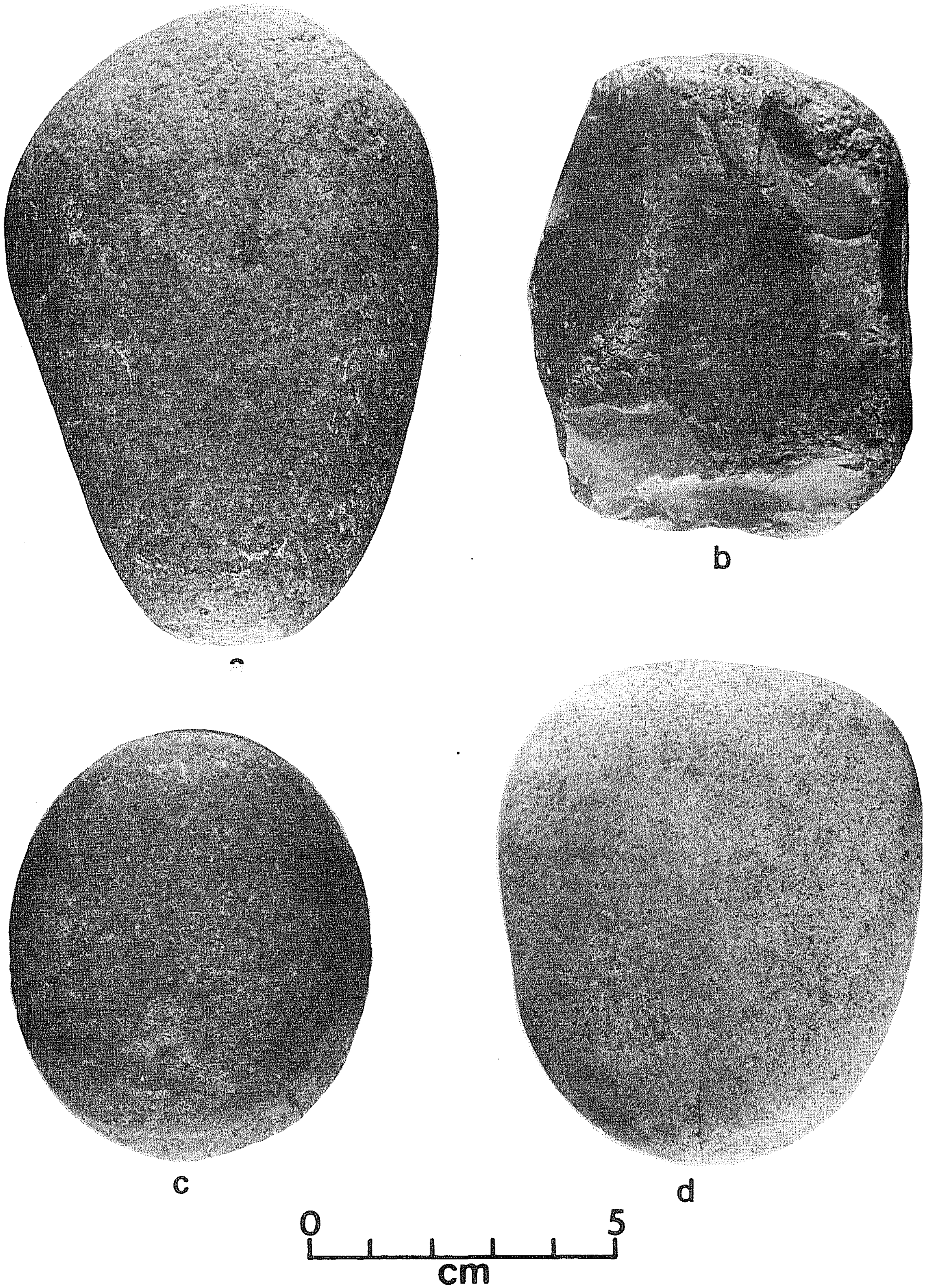


Figure 24. *Pecked and Ground Stone Cobbles.* a,b, hammerstones; c,d, grinding and polishing stones.

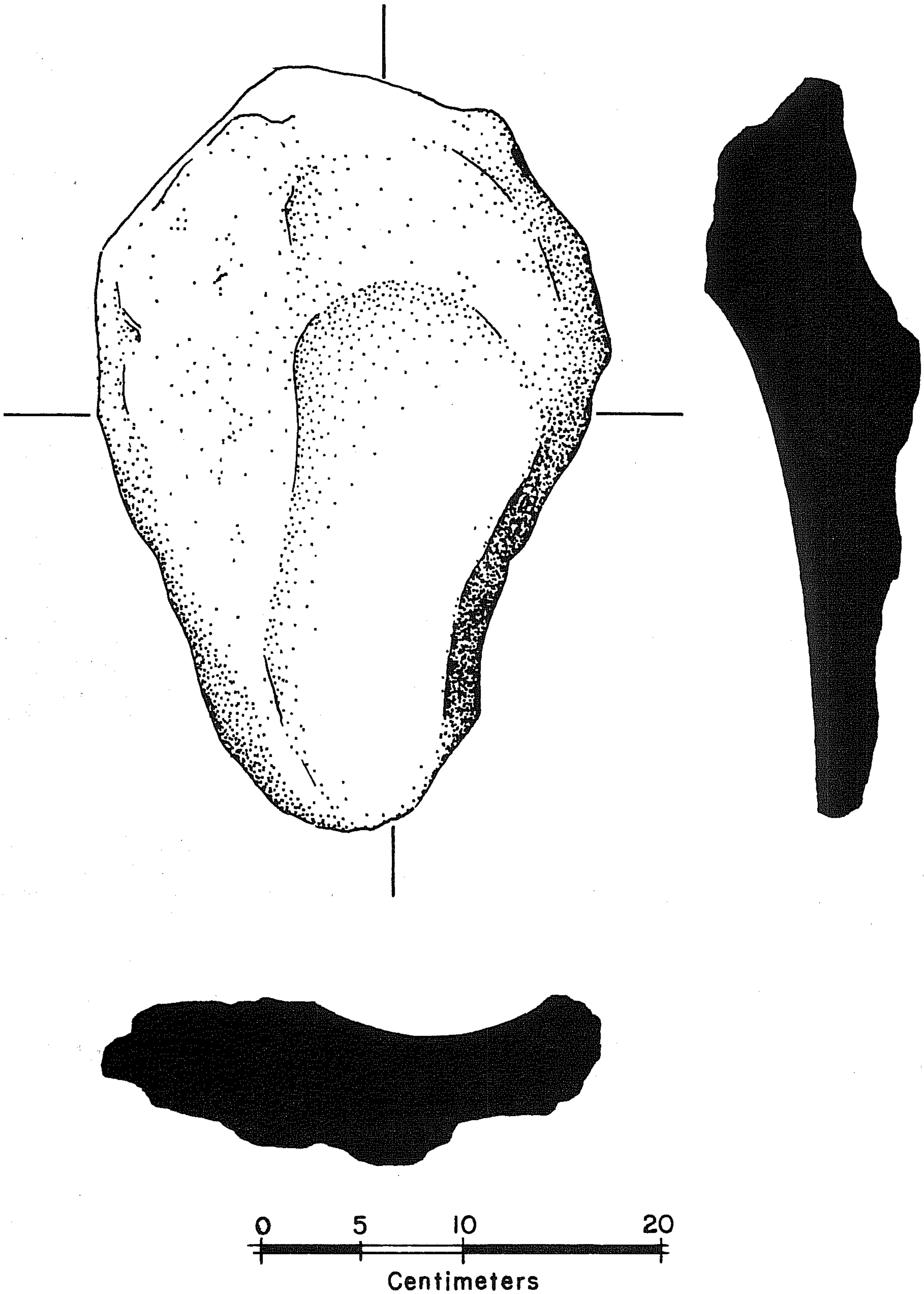


Figure 25. *Pecked and Ground Tabular Sandstone Slab.*

shows signs of grinding and smoothing and may be a fragment of a "metate." The remaining specimen is a small fragment of smoothed, hard, fine-grained sandstone which measures 0.8 cm thick.

THERMALLY ALTERED STONE

Fragments of burned chert and quartzite, most of which are probably thermally altered flakes and chips, and other products and by-products of lithic tool production. Of the total of 1,358 specimens (weighing 1,501 gm), five are fragments of thermally altered quartzite.

Thermally Altered Caliche, Clay and Sand

Amorphous lumps of caliche, sandy clay and sand. Caliche comprises approximately 91% of this sample of fist-size and smaller lumps which weigh a total of 91,992 gm (Tables 4-6).

CERAMICS

Aboriginal pottery sherds similar in paste, temper and color to Neo-American period and Historic ceramic types reported from various parts of central, southern and coastal Texas (Table 7). Of the 547 sherds, 539 probably represent a single *Leon Plain* (Fig. 26,a-e) (Suhm and Jelks 1962:95) or *Goliad Ware* (Campbell 1962:332-334) vessel with a straight-sided rim and loop handles.

WORKED BONE

Three fragments of animal bone which appear to have been shaped into tools and/or ornaments. Butchering marks and additional evidence of the manufacture and use of bone tools were recognized during the analysis of vertebrate faunal remains (Appendix I).

CROSS-HATCHED BONE FRAGMENT

A small fragment (1.8 by 1.0 cm) of a polished piece of long bone bearing a portion of a cross-hatched pattern of cut marks on one flat surface.

"AWL" FRAGMENT

The medial portion of a polished pointed bone tool. This artifact measures 6.5 cm long, 0.8 cm wide and 0.4 cm thick.

ASPHALTUM-STAINED TERRAPIN SHELL

A small fragment of terrapin shell with asphaltum stains on both interior and

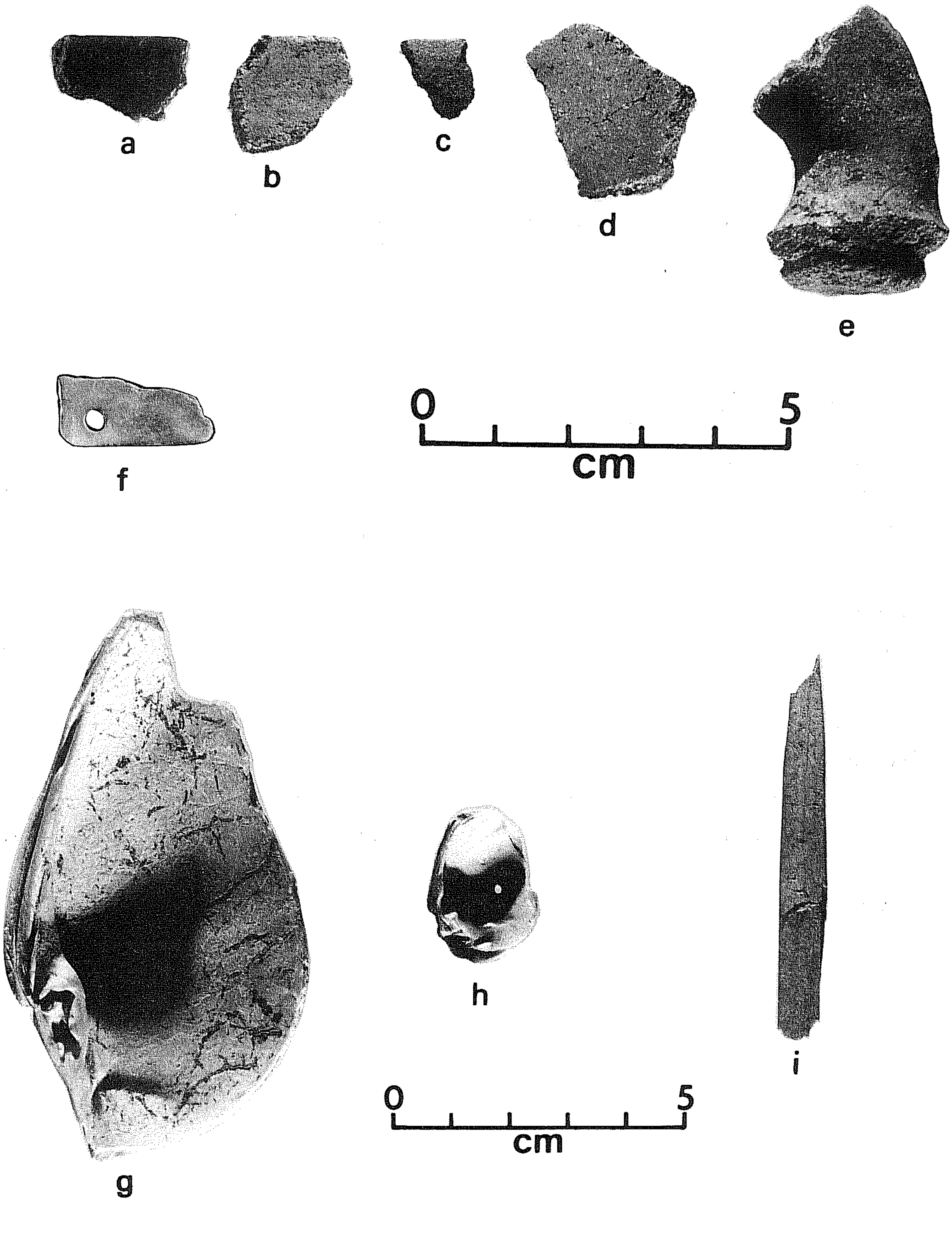


Figure 26. *Ceramics, Worked Shell and Worked Bone.* a-e, bone-tempered undecorated earthenware (a-c, rim sherds; d, body sherd; e, handle fragment); f, cut and perforated freshwater mussel shell; g, cut and smoothed Sunray clam shell; h, perforated freshwater mussel shell; i, bone "awl" fragment.

TABLE 4. PROVENIENCE OF THERMALLY ALTERED CALICHE, SAND AND CLAY, 41 GD 21*

Level (cm)	N207 E209	N208 E209	N207 E210	N208 E210	Total
0-20	343	1062	458	392	2255
20-40	7143	7092	8325	9517	32077
40-60			2290	386	2676
60-80			507	1627	2134
80-100			1930	1948	3878
100-120			1938		1938
120-140			419		419
140-160			701		701
160-180			538		538
Total	7486	8154	17106	13870	46616

*Numbers represent weight in grams.

TABLE 5. PROVENIENCE OF THERMALLY ALTERED CALICHE, SAND AND CLAY, 41 GD 21A (WESTERN AREA)*

Level (cm)	N185 E81	N185 E82	N186 E81	N186 E82	N195 E83	N196 E83	N170 E95	N170 E115	N179 E115	Total
0-20	30	191	38	6	10	0	106	27	10	418
20-40	219	1056	327	436	152	371	495	1332	1133	5521
40-60	1354†	1469†	2518	447	999	232	2611	5493ϕ	1370	16493
60-80	1177	972	1234	1195	959	10	726	523	2632∇	9428
80-100	1224	2335	1259	3485	33	1167			319	9822
100-120	750	1338	868	0	0	0				2956
120-140		0								0
Total	4754	7361	6244	5569	2153	1780	3938	7375	5464	44638

† Feature #1 included
ϕ Feature #2 included
∇ Feature #3 included

* Numbers indicate weight in grams.

TABLE 6. PROVENIENCE OF THERMALLY ALTERED CALICHE, 41 GD 21A (EASTERN AREA)*

Level (cm)	TP#1	N130 E230	N74.7 E215	N100 E285.45	N75.95 E230	N142 E230	Total
0-20	0	0	0	0	0	0	0
20-40	0	0	0	0	0	0	0
40-60		0				0	0
60-80		0				701	701
80-100		0					0
100-120		15					15
120-140		0					0
140-160		22					22
160-180		0					0
Total	0	37	0	0	0	701	738

*Numbers indicate weight in grams.

TABLE 7. CERAMICS

Provenience	No. of Specs.	Thickness	External Color	Internal Color	Paste	Surface Finish	Vessel Form	Comparisons
41 GD 21 N208 E209 0-20 cm	501	3.0 mm (at rim) to 6.5 mm (body)	orange, reddish gray, & dark gray	dark gray	coarse, sandy, with bone temper and dark gray core	hard, smooth exterior and roughly smoothed interior; bone temper evident on surfaces	large olla with straight-sided rim & loop handles	similar to *Goliad Ware* (or *Mission Ware*) (Campbell 1962:332-334)
41 GD 21 N208 E210 0-20 cm	38	4.5 mm to 7.0 mm	same	same	same	same	same vessel	same
41 GD 21 surface, western part of site	2	7 mm	10 YR 7/4	10 YR 7/4	soft, fine-grained, sandy (gritty), with tiny flecks of bone temper & dark gray core	soft, smooth interior and exterior	unknown	
41 GD 21A surface, western margin of site at flume disturbance	4	4.8 mm to 5.9 mm (near rim)	pale yellowish gray	pale yellowish gray	coarse, gritty, heavily bone-tempered (some burned); dark gray core	hard, smooth exterior and interior, with some tool marks and bone temper evident on surfaces	straight-sided rim	similar paste and surface finish to ceramics reported from Gonzales County (Fox *et al.* 1974:62, Table 1); somewhat similar to *Goliad Ware* (or *Mission Ware*) (Campbell 1962: 332-334)
41 GD 21A N170 E95	2	4.8 mm to 6.0 mm	5 YR 5/6	5 YR 5/6	soft, fine-grained, sandy (gritty), with tiny flecks of bone temper & dark orange core	soft, smooth interior and exterior; bone temper evident on exterior surface	unknown	

Manufacture: All apparently coiled

exterior surfaces and along sutures.

WORKED SHELL (Fig. 26,f-h)

Fragments of freshwater and saltwater clam shells which have been perforated and/or cut and smoothed.

CUT AND SMOOTHED SUNRAY CLAM SHELLS (Fig. 26,g)

Three fragmentary shells of *Macrocallista nimbosa*, or Sunray saltwater clams, which have been cut and/or smoothed along posterior and anterior edges. Another example of this coastal shell species was recovered during testing of site 41 GD 30B on Coleto Creek (Fox, Black and James 1978).

CUT AND PERFORATED FRESHWATER MUSSEL SHELL (Fig. 26,f)

A thin fragment of unidentifiable freshwater mussel shell which has been cut into a rectangular shape and perforated. This possible ornament originally was greater than 2.1 cm long and 1.0 cm wide.

PERFORATED FRESHWATER MUSSEL SHELL (Fig. 26,h)

An unidentifiable, immature freshwater mussel shell which has one perforation and a circular engraved spot where another perforation was initiated.

ANGLO-AMERICAN MATERIAL CULTURE

Ceramic, metal and glass artifacts collected from the surface and upper levels of excavation units at site 41 GD 21A. Household items and hardware, including two sherds from white paste earthenware vessels, a cast iron stove part, a metal button fragment, a tin can fragment, a square nail, a glass bead fragment and sherds from aquamarine and olive green glass bottles were found in the western part of 41 GD 21A. A square nail and two pieces of barbed wire were collected from the eastern part. All of this cultural material is probably representative of late 19th century and early 20th century occupation of site 41 GD 21A.

FAUNAL REMAINS*

Vertebrate

Dr. Barbara Butler and her associates at the Institute of Applied Sciences, North Texas State University, have contributed an extensive study of the vertebrate faunal remains recovered during the 1977-1978 investigation of sites 41 GD 21 and 41 GD 21A. This detailed analysis is presented in its entirety as Appendix I of this report.

* Also see Appendix IV for discussion of zooplankton and sponges found among plant microfossils.

Of the total of 1,065 specimens from site 41 GD 21 and 202 specimens from site 41 GD 21A, Butler is able to identify 475 (37.5%). The sample represents a group of fauna typical of Texas. Fish, terrestrial and aquatic turtles, harmless and poisonous snakes, large and small birds, opossums, moles, cottontails and jackrabbits, squirrels, gophers, rats, canids, raccoons, deer, antelope, bison and cow can be identified.

A large proportion (22.0%) of the bone sample exhibits evidence of being burned. A significant amount of butchering marks and use wear was recognized, most often on deer bones.

Noticeable during the analysis (and during field work), bone was better preserved at site 41 GD 21 than at site 41 GD 21A. At both sites the degree of bone deterioration was found to increase with depth.

Invertebrate

Gastropods

Freshwater and land gastropods occurred in most unit levels excavated at sites 41 GD 21 and 41 GD 21A. Samples of different shapes and sizes of snail shells were collected during screening of excavated deposits. During field work, five species were noted. Laboratory analysis revealed, however, that at least seven species had been recovered. Adding to this sampling error was loss through the screen of small species of snails, natural disintegration and breakage during screening. Therefore, quantitative analysis of the gastropod sample was not attempted.

Nevertheless, the distribution of occurrence of gastropod species is noteworthy (Tables 8,9). Six species of land snails were identified which either prefer or tolerate moist, woodland environments. A freshwater snail, *Helisoma* sp., is also represented. Prairie snail, *Rabdotus* sp., which archaeologists have argued could have been used as a food source (Hester and Hill 1975:16), occurred more frequently than other species. The land snail, *Euglandina* sp., is a predator of other land snails (Harold Murray, personal communication).

Pelecypods

Mussel shells were collected from screened deposits excavated from sites 41 GD 21 and 41 GD 21A. One shell of a brackish water clam, three shells of saltwater clams and numerous shells representing 11 species of freshwater clams were recovered from controlled excavations. Because of the fragmentary condition of most specimens in the sample, a quantitative analysis was not attempted. Table 10 presents the distribution of occurrence of the various species of clams within soil zones which comprise the slope deposits at sites 41 GD 21 and 41 GD 21A.

Dr. Harold D. Murray of Trinity University aided in species identification and

TABLE 8. Coleto Creek – 41GD21
Occurrence of Gastropods within Excavation Units, Levels and Soil Zones

NAME OF ORGANISM*	PREFERRED HABITAT OF ORGANISM*	N207 E209 Zone A 0-20 cm	N207 E209 Zone A 20-40 cm	N207 E210 Zone A 0-20 cm	N207 E210 Zone A 20-40 cm	N207 E210 Zone B 40-60 cm	N207 E210 Zone B 60-80 cm	N207 E210 Zone B 80-100 cm	N207 E210 Zone C 100-120 cm	N207 E210 Zone C 120-140 cm	N207 E210 Zone C 140-160 cm	N207 E210 Zone C 160-180 cm	N208 E209 Zone A 0-20 cm	N208 E209 Zone A 20-40 cm	N208 E210 Zone A 0-20 cm	N208 E210 Zone A 20-40 cm	N208 E210 Zone B 40-60 cm	N208 E210 Zone B 60-80 cm	N208 E210 Zone B 80-100 cm
AUGUISPIRA	woodland, also upland		X		X											X	X		
MESODON	heavily wooded areas		X	X		X	X	X	X	X	X	X	X		X	X	X	X	X
POLYGYRA	open fields or woodlands					X	X	X	X	X	X					X	X	X	X
PRACTICOLELLA	open fields or woodlands			X	X			X	X	X	X		X			X		X	
RABDOTUS	semi- and open country	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

*After Allen and Cheatum, 1961.

TABLE 9. Coleto Creek – 41GD21A (Western Area)
Occurrence of Gastropods within Excavation Units, Levels and Soil Zones

NAME OF ORGANISM*	PREFERRED HABITAT OF ORGANISM*	N185 E82 Zone A 0-20 cm	N185 E82 Zone A 20-40 cm	N185 E82 Zone A 40-60 cm	N185 E82 Zone B 60-80 cm	N185 E82 Zone B 80-100 cm	N185 E82 Zone B/C 100-120 cm	N185 E82 Zone B/C 120-130 cm	N186 E82 Zone A 0-20 cm	N186 E82 Zone A 20-40 cm	N186 E82 Zone A 40-60 cm	N186 E82 Zone B 60-80 cm	N186 E82 Zone B 80-100 cm	N186 E82 Zone B/C 100-120 cm	N185 E81 Zone A 0-20 cm	N185 E81 Zone A 20-40 cm	N185 E81 Zone A 40-60 cm	N185 E81 Zone B 60-80 cm	N185 E81 Zone B 80-100 cm	N185 E81 Zone B/C 100-120 cm	N186 E81 Zone A 0-20 cm	N186 E81 Zone A 20-40 cm	N186 E81 Zone A 40-60 cm	N186 E81 Zone B 60-80 cm	N186 E81 Zone B 80-100 cm	N186 E81 Zone B/C 100-120 cm
HELISOMA	water, semi-stagnant to flowing														X											
MESODON	heavily wooded areas	X	X	X	X	X			X	X	X	X	X		X	X	X	X	X		X	X	X	X		
POLYGYRA	open fields or woodlands		X	X		X					X	X					X						X			
PRACTICOLELLA	open fields or woodlands	X	X	X					X	X	X				X	X	X				X		X	X	X	
RABDOTUS	semi-arid open country	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

*After Allen and Cheatum, 1961.

NAME OF ORGANISM*	PREFERRED HABITAT OF ORGANISM*	N195 E83 Zone A 0-20 cm	N195 E83 Zone A 20-40 cm	N195 E83 Zone A 40-60 cm	N195 E83 Zone A 60-80 cm	N195 E83 Zone B/C 80-100 cm	N195 E83 Zone B/C 100-120 cm	N196 E83 Zone A 0-20 cm	N196 E83 Zone A 20-40 cm	N196 E83 Zone A 40-60 cm	N196 E83 Zone B/C 60-80 cm	N196 E83 Zone B/C 80-100 cm	N170 E115 Zone A 0-20 cm	N170 E115 Zone A 20-40 cm	N170 E115 Zone A 40-60 cm	N170 E115 Zone B/C 60-80 cm	N179 E115 Zone A 0-20 cm	N179 E115 Zone A 20-40 cm	N179 E115 Zone A 40-60 cm	N179 E115 Zone B/C 60-80 cm	N179 E115 Zone B/C 80-100 cm	N170 E95 Zone A 0-20 cm	N170 E95 Zone A 20-40 cm	N170 E95 Zone A 40-60 cm	N170 E95 Zone B/C 60-80 cm
EUGLANDINA	well protected areas with abundant moisture			X	X	X						X													
MESODON	heavily wooded areas		X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X		
POLYGYRA	open fields or woodlands		X	X	X	X	X		X	X		X		X		X		X	X		X				
PRACTICOLELLA	open fields or woodlands		X	X	X	X	X		X	X		X	X	X	X		X	X	X	X	X	X			
RABDOTUS	semi-arid open country	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

TABLE 10. Coleto Creek – 41GD21A (Western Area) and 41GD21
Occurrence of Pelecypods within Excavation Units, Levels and Soil Zones

PELECYPODS	41GD21A (WESTERN AREA)																								41GD21								
	N185 E82							N186 E82						N185 E81						N186 E81						N207 E210								
	Zone A			Zone B		Zone B/C		Zone A			Zone B		Zone B/C	Zone A			Zone B		Zone B/C	Zone A			Zone B		Zone B/C	Zone A		Zone B				Zone C		
	DEPTH IN CENTIMETERS BELOW SURFACE																															
	0-20 cm	20-40 cm	40-60 cm	60-80 cm	80-100 cm	100-120 cm	120-130 cm	0-20 cm	20-40 cm	40-60 cm	60-80 cm	80-100 cm	100-120 cm	0-20 cm	20-40 cm	40-60 cm	60-80 cm	80-100 cm	100-120 cm	0-20 cm	20-40 cm	40-60 cm	60-80 cm	80-100 cm	100-120 cm	0-20 cm	20-40 cm	40-60 cm	60-80 cm	80-100 cm	100-120 cm	120-140 cm	140-160 cm	160-180 cm
AMBLEMA PLICATA COSTATA		X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X		X	X	X			X	X	X				X	X	
QUADRULA PETRINA																X																		
QUADRULA PUSTULOSA															X																			
QUADRULA QUADRULA														X																				
QUADRULA SP.			X		X							X				X																		
CARUNCULINA PARVA		X			X			X	X							X						X												
LAMPSILIS ANODONTOIDES									X																									
CYRTONAIAS TAMPECOENSIS		X																																
LEPTODEA FRAGILIS										X																								
STROPHITIS RUGOSUS															X																			
TRITOGONIA VERRUCOSA																					X													
RANGIA CUNEATA*																															X			
MACROCALLISTA NIMBOSA**									X	X																								
UNIDENTIFIABLE FRAGMENTS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

*Estuarian
**Salt Water ("Sunray Clam"), worked

contributed the following analysis of unionids (freshwater mussels):

> The species of unionids obtained from the archaeological sites in Goliad County are typical of south Texas streams and rivers, and all unionid species from this site presently occur in streams and rivers of the area (Strecker 1931). There are some unusual observations relating to this assemblage of unionids. First, there are no specimens over approximately 80 mm shell length in the samples. All specimens of *Amblema plicata costata*, *Cyrtonaias tampicoensis* and *Leptodea fragilis* in the samples are small and thus atypical of area streams and rivers. Three explanations are offered for this condition:
>
> a. The stream or streams for the source of these specimens may have been intermittent; therefore, the replacement populations were small at times of collection and use.
>
> b. The persons collecting the unionids selected (preferred) small specimens instead of larger specimens. Since food was the apparent purpose for these shells, this seems to be an illogical reason.
>
> c. There may have been some condition (pollution?) of the streams which contributed to the small size of the unionids. I judge this as the least tenable explanation since pollution of streams tends to extirpate unionids, not stunt their growth, and small streams do not yield small specimens of these species.
>
> Second, there is an apparent absence of any shell remains of the genus *Anodonta* from the site. If the assumption is correct that these unionids were a source of food, the absence of these thin-shelled species is unusual because they are the easiest of all unionids to open. *Anodonta grandis* and *A. imbecilis* are two species common in the streams and rivers of this area. The following may explain the absence of *Anodonta*:
>
> a. There may be something about the quality of the meat of *Anodonta* that caused those collecting to eliminate this genus from their diet.
>
> b. Because of the extremely fragile nature of *Anodonta* shells, they may have been badly fragmented in the samples and could not be recognized. This seems the most likely explanation.
>
> c. Absence of *Anodonta* could be related to absence of the proper host fish for the glochidia. This seems unlikely because *Lepomis* sp. is recorded as a host fish for *Lampsilis anodontoides* which occurs in this collection, and *A. imbecilis* is recorded from *Lepomis* sp. (Starrett 1971).

d. There may have been some water or substrate condition prohibiting the establishment of *Anodonta* in the immediate area. This, however, seems unlikely based on the overall fauna from the site.

Third, unionid shells of this collection are consistently broken in the same manner. This includes the large, heavy shells of *Amblema* and the small, thin shells of *Carunculina*. The posterior 1/3 to 1/2 of both valves was broken away so that the anterior 2/3 to 1/2 remained intact. Because the posterior 1/2 of the shell is the thinnest part of the shell, it seems natural that specimens were opened in this manner. It is not possible to describe the tool which was used; however, in the laboratory a similar fracture of the shells can be obtained using either a rock or a hammer. This consistent pattern of shell damage was, in my opinion, not due to age, burial or handling during excavation, but resulted from original (aboriginal) handling at the time of collection.

In summary, except for the noted absence of *Anodonta* from the samples, the unionids from this site are typical of the area today. This suggests that the environmental aspects of the water and substrate have not been significantly altered from the time of original (aboriginal) collection of the unionids to present. It is my opinion that the unionids of this site were not collected from the Guadualupe River as evidenced by the small size of the shells but were collected from a smaller stream near the site, possibly Coleto Creek or Perdido Creek.

PLANT REMAINS

Soil samples suitable for pollen and phytolith analyses were taken from selected profiles of controlled excavations at sites 41 GD 21 and 41 GD 21A. Because previous investigation of soils found pollen to be absent or poorly preserved (Fox, Black and James 1978), palynological studies were not undertaken. The results of phytolith studies performed by Ralph Robinson are presented as Appendix IV.

Phytoliths and other biogenic opaline microfossils seem to be more resistant to weathering and cycling than pollen and occurred in great abundance in soil samples from sites 41 GD 21 and 41 GD 21A. Robinson has been able to identify at least 31 diagnostic opaline microfossils and to interpret with some confidence their significance as concerns paleoenvironmental reconstruction. The validity of his analysis and interpretations is supported by the fact that his results correspond to intuition and to conclusions based on other aspects of the archaeological investigations of sites 41 GD 21 and 41 GD 21A, even though he was not fully aware of those findings.

INTERPRETATIONS

The archaeological investigation of sites 41 GD 21 and 41 GD 21A was oriented toward the recovery of information applicable to the solution of problems recognized during previous archaeological research on the Coastal Plain of Texas. Recovery operations were restricted to the intensive testing (or "mitigation") of proposed dike and spillway areas at site 41 GD 21A and the excavation of a block of 1-m^2 units in the portion of site 41 GD 21 which is to be inundated. Following are interpretations of data pertaining to chronology of occupation, paleoenvironment, subsistence-settlement pattern, intrasite occupational activity and culture change.

Chronology of Site Occupation

Table 11 associates specific morphological categories of chipped stone artifacts and aboriginal ceramics with general chronological periods. Most of these categories are associated with the Late Archaic and Neo-American periods, and, although occupations during the Early and Middle parts of the Archaic are represented, no artifacts diagnostic of the Paleo-Indian were recognized in the sample collected from sites 41 GD 21 and 41 GD 21A. A variety of stemmed and unstemmed thin bifaces was observed in private collections from site 41 GD 21 (Fox, in prep.), but none appear to be Paleo-Indian forms.

Although some disturbances by root growth, rodent activity and erosion were noted during excavations, the soil zones which comprise the slope deposits can be treated generally as units (Evans 1978).

Table 12 presents the distribution of chronologically diagnostic artifacts within four soil zones. Seventeen of the total of 21 chronologically diagnostic chipped stone specimens were recovered from Zone A, which can be assigned generally to the Middle to Late Archaic and Neo-American periods. Four specimens diagnostic of the Archaic period (and possibly earlier times) were recovered from the upper portion of Zone B. Although no chronologically diagnostic artifacts were found below this, other cultural materials (particularly flakes and chips and thermally altered caliche, sand and clay) were found in deposits as deep as the upper portion of Zone C.

Three radiocarbon dates were obtained from samples of charcoal recovered from controlled excavations at site 41 GD 21 (Table 13). One sample (TX 2925), taken from the lower portion of Zone A, supports the interpretation that cultural material contained in Zone A soils is representative of the Late Archaic and Neo-American periods. This date (800±370 or 876±373 B.C.) can be associated tentatively with "Morhiss Complex" materials recovered from the lower portion of Zone A.

The two other samples (TX 2924 and TX 2926) were recovered from the lower portion of Zone B and support the Early to Middle Archaic chronological affiliation of cultural material in this soil zone.

TABLE 11. ASSOCIATION OF CHIPPED STONE ARTIFACTS AND CERAMICS WITH CHRONOLOGICAL PERIODS

			Coleto Creek Artifact Category	Comparable Diagnostic	Chronological Affiliation	References
CHIPPED STONE	THICK BIFACES		Pointed-Ovate/ Plano-Convex	Thick Bifaces, Group II, Form 3 ("*Cuero* gouges")	Archaic	Fox *et al.* 1974:40-41,78, Table 11
CHIPPED STONE	THIN BIFACES	Unstemmed	Pointed-Ovate Narrow	*Refugio*	Early Archaic(?)	Johnson, Suhm and Tunnell 1962:45, Table 1
CHIPPED STONE	THIN BIFACES	Unstemmed	Triangular	Late Triangular	Middle to Late Archaic	Hester 1971:80
CHIPPED STONE	THIN BIFACES	Stemmed	Straight Stem			
CHIPPED STONE	THIN BIFACES	Stemmed	*Bell*	*Bell*	Pre-Archaic, Early Archaic	Hester 1971:Table 6;
CHIPPED STONE	THIN BIFACES	Stemmed	*Bulverde*-like	*Bulverde*		Sorrow, Shafer and Ross 1967: Fig. 72; Sorrow 1969:44
CHIPPED STONE	THIN BIFACES	Stemmed	*Morhiss*	*Morhiss*	Middle to Late Archaic	Suhm and Jelks 1962:221
CHIPPED STONE	THIN BIFACES	Stemmed	*Darl*-like	*Darl*	Late Archaic	Suhm and Jelks 1962:179
CHIPPED STONE	THIN BIFACES	Stemmed	Contracting Stem (*Perdiz*)	*Perdiz*	Neo-American	Jelks 1962:86
CHIPPED STONE	THIN BIFACES	Stemmed	Expanding Stem			
CHIPPED STONE	THIN BIFACES	Stemmed	*Ensor*	*Ensor* and other side-notched forms	Late Archaic	Johnson, Suhm and Tunnell 1962:30, Figs. 8,45
CHIPPED STONE	THIN BIFACES	Stemmed	*Uvalde*	*Uvalde*	Archaic	Suhm and Jelks 1962:225
CHIPPED STONE	THIN BIFACES	Stemmed	*Scallorn*	*Scallorn*	Neo-American	Jelks 1962:85
CERAMICS				*Leon Plain* and other wares	Neo-American and Early Historic(?)	Fox *et al.* 1974:Table 7

TABLE 12. DISTRIBUTION OF CHRONOLOGICALLY DIAGNOSTIC ARTIFACTS BY SOIL ZONE

	Neo-American			Late Archaic		Middle to Late Archaic		Archaic		Early Archaic		
	Ceramics	Thin Bifaces, Contracting Stem (*Perdiz*)	Thin Bifaces, Expanding Stem, *Scallorn*	Thin Bifaces, Straight Stem, *Darl*-like	Thin Bifaces, Expanding Stem, *Ensor*	Thin Bifaces, Straight Stem, *Morhiss*	Thin Bifaces, Unstemmed, Triangular	Thick Bifaces, Pointed-Ovate/Plano-Convex	Thin Bifaces, Expanding Stem, *Uvalde*	Thin Bifaces, Pointed-Ovate, Narrow, *Refugio*	Thin Bifaces, Straight Stem, *Bell* and *Bulverde*-like	Totals
Zone A	541	3	1	2	3	2	2	4				558
Zone B									1	1	2	4
Zone B/C												0
Zone C												0
Totals	541	3	1	2	3	2	2	4	1	1	2	562

TABLE 13. RADIOCARBON DATES

Sample No.*	B.P. Date**	B.C. Date	Corrected B.C. Date†	Corrected B.C. Date††	Provenience Horiz.	Provenience Vert.	Soil Zone
TX 2925	2,670±370	720±370	800±370	876±373	41 GD 21 N208 E210	20-40 cm	A
TX 2926	4,550±190	2,600±190	3,180±190	3,281±211	41 GD 21 N207 E210	80-100 cm	B
TX 2924	4,260±250	2,310±250	2,860±250	2,919±276	41 GD 21 N207 E210	100-120 cm	B
TX 2923	"ultra-modern" (sample too small)	———	———	———	41 GD 21 N207 E210	100-120 cm	B

* Radiocarbon Lab, The University of Texas at Austin.

** Calculated on conventional 5568 year half-life.

† From Ralph, Michael and Han 1973.

†† From Damon *et al.* 1974.

Paleoenvironment

Applicable to the reconstruction of the past environments of sites 41 GD 21 and 41 GD 21A are data accumulated from analyses of geomorphology, invertebrate faunal remains and phytoliths. Geomorphologist Glen Evans (1978:1) suspects that most of the mineral constituents of the artifact-bearing slope deposits are wind-borne sands and silts derived from numerous flood-deposited sandbars adjacent to the Sulphur Creek stream channel. The high percentage of organic material which is especially evident in Zone A (Appendix III) is derived from decomposition of both woody and herbaceous plants which still flourish on its surface.

Evans (1978:1,2) offers the following concept of how the artifact-bearing slope deposit originated:

> 1. At a distant time, possibly in the late Pleistocene, stream erosion produced a long meander-cut bluff in the early Pleistocene Lissie formation....
>
> 2. The graded stream channel gradually shifted laterally to the north, widening the valley and concurrently depositing sand bars in the abandoned part of the channel and against the base of the bluff, thus preventing further undercutting, and stabilizing the position of its base.
>
> 3. The upper surface of the bluff continued retreating, due to slumping and crumbling of friable Lissie sediments, and to sheet and rill erosion in times of heavy rains. These processes gradually flattened the slope grade to something approaching its present form, and in doing so leavened the slope debris with bits of the rich prairie soil of the eroded valley rim.
>
> 4. Vegetation gained a foot hold, first in the pockets of dilute soil, then gradually over the entire slope. Stout trees and an understory of shrubs and vines eventually displaced the sub-climax plants, and became an effective wind break. Thus quieted, the winds thereafter shed their air-borne silt and sand over the slope where they commingled with fallen leaves and rotting wood. Meanwhile an interlocking mass of roots was developing in the youthful soil, and anchoring it firmly in place. A suitable habitat for primitive man as well started; and it was, I suspect, still rather early in post-Pleistocene time.

Gastropods sampled from excavation units indicate that sites 41 GD 21 and 41 GD 21A have been wooded, particularly along lower slopes, since the Pleistocene. Table 14 presents the distribution of the seven gastropod species identified (see previous section of report), and they occur in the soil zones of the western part of site 41 GD 21A and the lower slope of site 41 GD 21. In those excavation units situated at lower elevations along the slopes of both sites

TABLE 14. Coleto Creek – 41GD21 and 41GD21A (Western Area)
Occurrence of Gastropods within Excavation Units, Levels and Soil Zones

NAME OF ORGANISM	PREFERRED HABITAT OF ORGANISM	41GD21A (WESTERN AREA)																								
		DEPTH IN METERS (msl)																								
		32.29			32.51			33.28			ca. 33.80												34.04		34.70	
		N196 E83			N195 E83			N179 E115			N186 E82			N185 E81			N186 E81			N185 E81			N170 E115		N170 E95	
		ZONE																								
		A	B	B/C	A	B	B/C	A	B	B/C	A	B	B/C	A	B	B/C	A	B	B/C	A	B	B/C	A	B/C	A	B/C
HELISOMA	fresh water, flowing or semi-stagnant																			X						
EUGLANDINA	well protected areas with abundant moisture			X	X	X																				
MESODON	heavily wooded areas	X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X		X		X	
POLYGYRA	open fields or woodlands	X		X	X	X	X	X		X	X	X		X	X		X			X			X			
PRACTICOLELLA	open fields or woodlands	X		X	X	X	X	X	X	X	X			X			X	X		X	X		X		X	
RABDOTUS	semi-arid open country	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

NAME OF ORGANISM	PREFERRED HABITAT OF ORGANISM	41GD21		
		DEPTH IN METERS (msl)		
		ca. 29.56		
		N207 E210		
		ZONE		
		A	B	C
AUGUISPIRA	woodland, also upland	X		
MESODON	heavily wooded areas	X	X	X
POLYGYRA	open fields or woodlands		X	X
PRACTICOLELLA	open fields or woodlands	X	X	X
RABDOTUS	semi-arid open country	X	X	X

(N196 E83, N195 E83 and N179 E115 at site 41 GD 21A, and N207 E210 at site 41 GD 21), soils were found to contain a variety of snail species in lower as well as upper soil zones, suggesting that these areas may have been covered by woodland vegetation since the Pleistocene.

In excavation units placed in more elevated areas of site 41 GD 21A, back from the lower slope, fewer species of gastropods occurred in lower soil zones. The increase in the number and variety of snails and mussel shells encountered in Zone A soils accompanies an increase in the kinds and amounts of cultural material, especially at the bottom of Zone A. This may reflect a period of increased mesic environmental conditions which has been suggested to have taken place at the beginning of the Late Archaic period in the Guadalupe River valley (Fox *et al.* 1974:214).

The results of Robinson's phytolith research (Appendix IV) indicate that various environmental changes have taken place since the end of the Pleistocene at sites 41 GD 21 and 41 GD 21A. Historically, the earliest known occupations (Zone C) took place during mesic environmental conditions when the site areas were covered by tall and short grasses and an associated bottom land forest. Somewhat later, perhaps during the Early Archaic period (Zone B/C), a change to a more xeric environment occurred along with a corresponding period of rapid deposition or erosion. Xeric conditions apparently continued for a long time, interrupted briefly by a mesic interval (lower Zone B) when rapid deposition or erosion occurred. As the xeric conditions of the Archaic period continued (upper Zone B), vegetation included primarily short grasses and some bottom land forest.

Then, probably by about 1000 B.C. (lower Zone A), increased mesic conditions began. Tall grasses flourished, the bottom land forest expanded, and the people represented by the "Morhiss Complex" of material culture frequented the area. More recently (upper Zone A), plants tolerant of xeric conditions established themselves, and the present day environment developed.

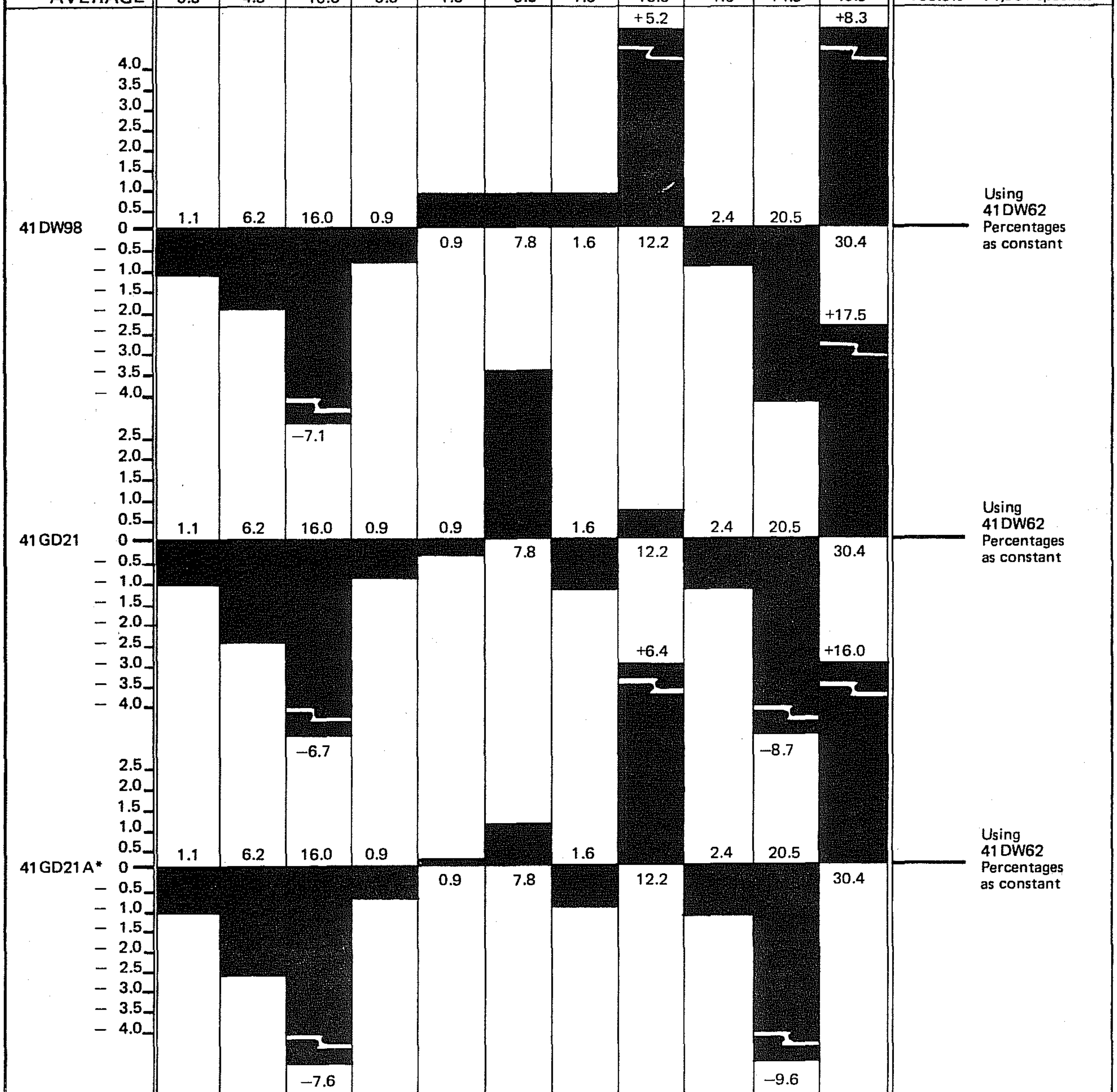
Subsistence-Settlement Pattern

Consideration of the physiographic location of sites 41 GD 21 and 41 GD 21A is important to an understanding of the prehistoric subsistence-settlement pattern of the Coastal Plain, in that these occupation areas are situated near an intermittent tributary, rather than a major stream. The physical extent of the Sulphur Creek sites suggests that the exploitation of tertiary stream environments was a significant part of hunting and gathering technology for thousands of years. It is difficult, however, to determine the frequency and duration of occupations at these sites. Faunal remains indicate that, while Sulphur Creek was intermittently dry throughout the Archaic and Neo-American periods, it did contain enough water to support the growth of freshwater mussels. The stream valley, with its variety of plant and animal life, certainly could have supported short-term seasonal occupations by small extractive groups.

Considerable quantities of chipping debris represent initial and final stages of lithic tool production carried out at sites 41 GD 21 and 41 GD 21A. Figure 27 presents a comparison of the frequencies of occurrence of analytical categories of flakes and chips recovered from two sites in DeWitt County (Fox *et al.* 1974: Tables 31,35) with flakes and chips from sites 41 GD 21 and 41 GD 21A.

Figure 27. Comparison of Frequencies of Occurrence of Flakes and Chips Between Four Sites.

	FLAKES								CHIPS			
	PRIMARY	SECONDARY				TERTIARY			CORTICATE	PARTIAL DECORTICATE	DECORTICATE	TOTALS
		Cortex Platform	Single-Fac. Platform	Mult-Lg-Fac. Platform	Mult-Sm-Fac. Platform	Single-Fac. Platform	Mult-Lg-Fac. Platform	Mult-Sm-Fac. Platform				
41 DW62	1.1	6.2	16.0	0.9	0.9	7.8	1.6	12.2	2.4	20.5	30.4	100.0% = 1,360 specimens
41 DW98	0	4.3	8.9	0.2	1.6	8.5	2.3	17.4	1.6	16.5	38.7	100.0% = 862 specimens
41 GD21	0.1	3.8	9.3	<0.1	0.5	11.9	0.5	12.9	1.3	11.8	47.9	100.0% = 4,048 specimens
41 GD21 A*	<0.1	3.6	8.4	0.2	1.0	8.9	0.8	18.6	1.2	10.9	46.4	100.0% = 8,031 specimens
AVERAGE	0.3	4.5	10.6	0.3	1.0	9.3	1.3	15.3	1.6	14.9	40.9	100.0% = 14,301 specimens



*Western Part

Deposits of stream-worn chert gravels or cobbles were the lithic resources available to the occupants of all four sites. The high frequency of occurrence of primary and secondary (corticate and partially decorticate) flaking debris from site 41 DW 62, located on a gravel-covered section of the valley wall of the Guadalupe River, reflects the immediate availability of the lithic resource. Higher frequencies of occurrence of tertiary (decorticate) flaking debris at sites 41 GD 21 and 41 GD 21A are comparable to those observed at site 41 DW 98, located in the Guadalupe River flood plain, over 0.6 km from the nearest lithic resource area. Apparently the nearest gravel deposit to sites 41 GD 21 and 41 GD 21A is the Perdido Creek channel, approximately 1.0 km to the east. This, considered along with the low frequency of occurrence of primary flaking debris, may reflect a technological adaptation based upon the importation of cobbles, cores and probably core-bifaces and large flakes from quarry areas located some distance from sites 41 GD 21 and 41 GD 21A. Harold Murray suggests (see p.61 of this report) that mussels may have been carried in from Perdido Creek or Coleto Creek.

Other archaeological evidence reflects the exploitation of resources which were more immediately accessible from these sites. Lumps of caliche, gathered for hearthstones (and possibly other uses), may represent principal food preparation activities related to hunting and gathering. The procurement of a variety of vertebrate and invertebrate fauna (see pp.56-61 and Appendix I) probably accompanied the extraction of a wide variety of plants available in the general vicinity of sites 41 GD 21 and 41 GD 21A.

A *Rangia* (brackish water) clam shell, three worked sunray (saltwater) clam shells and asphaltum stains found on three thin bifaces (*Darl*-like, *Morhiss* and *Refugio* forms) from sites 41 GD 21 and 41 GD 21A represent a relationship of trade with and/or travel to and from the Texas coast. Certain thick biface forms (often referred to as "gouges") found in the Coleto Creek area (Fox, Black and James 1978), in DeWitt and Gonzales Counties and at the Morhiss site (Fox *et al.* 1974:211,212), often bear asphaltum stains and are morphologically similar to conch shell gouges reported from the coast (Campbell 1947:69-71). Perhaps sites 41 GD 21 and 41 GD 21A were situated at various times within a subsistence-settlement range which included the coastal lowlands and littoral (see McGuff 1978).

During the analysis of vertebrate faunal remains (Appendix I), Butler speculates about seasonality of site use. If the bison bones identified from Zone A and Zone B soils at site 41 GD 21A represent the northern extent of bison migration, occupation during the summer may be indicated. Because bison remains are absent in samples recovered from excavations at site 41 GD 21, Butler suggests that sites 41 GD 21 and 41 GD 21A may have been occupied during different seasons. Referring to Dillehay's (1974) study of the presence and absence of bison at archaeological sites, Butler further suggests the possibility that site 41 GD 21 was occupied during bison absence periods and site 41 GD 21A during bison presence periods. However, only a relatively small portion of site 41 GD 21 was tested, and it is possible that this disproportionate sampling is responsible for the apparent absence of bison remains at that site.

The high frequency of occurrence of red-ear turtle remains at both sites could indicate springtime exploitation of this food source, since red-ears leave the water during the spring. However, Butler notes that these turtles also are easily visible in their aquatic habitat.

The many bones of whitetail deer represent a wide age range which would suggest occupation of sites 41 GD 21 and 41 GD 21A during the spring, summer or fall.

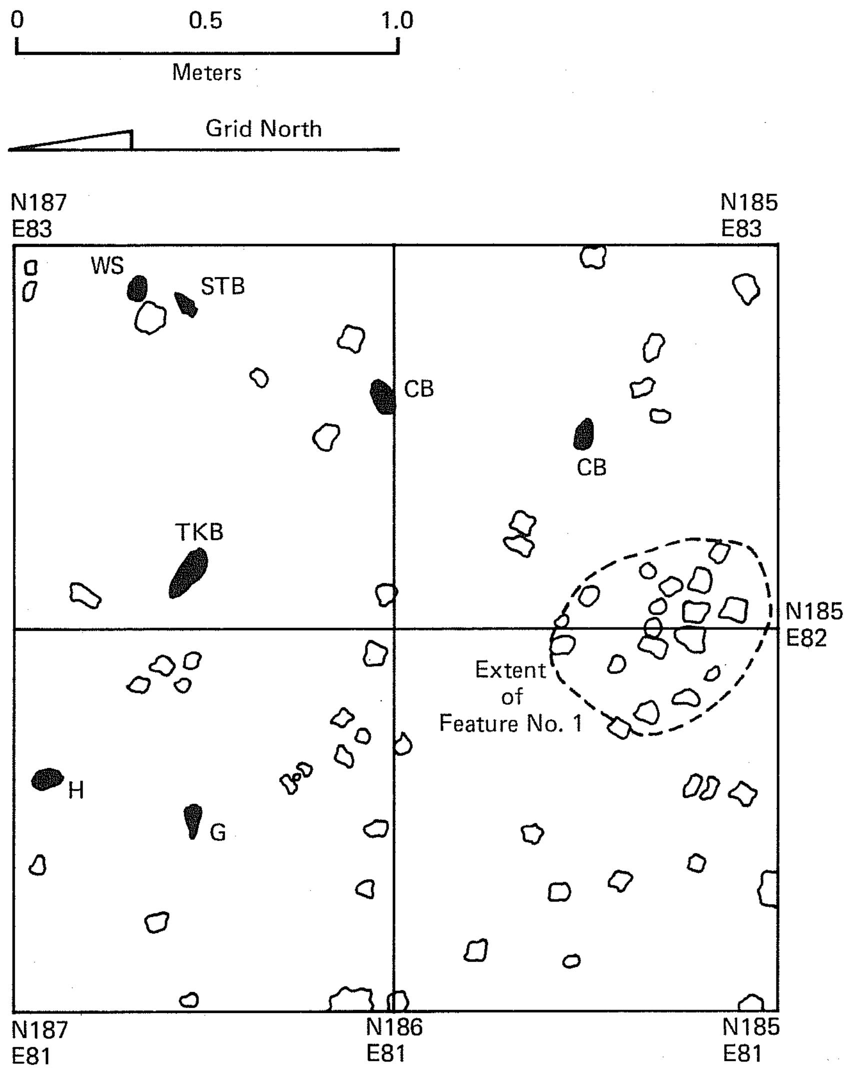
Intrasite Occupational Activity

The horizontal distribution of kinds and amounts of cultural material suggests that several of the same subsistence and maintenance activities were carried out in different areas of sites 41 GD 21 and 41 GD 21A (Table 15). Flaking debris and various other general categories of chipped stone, representative of the initial and final stages of lithic tool production, use and maintenance, and thermally altered caliche, representative of heating and/or food preparation activities, were recovered from virtually every part of both sites. The ratio of chipped stone to thermally altered caliche, sand and clay is higher for more elevated site areas, indicating that fire building and probably other subsistence activities took place more frequently on the lower slopes. Pecked and ground stone and ceramics appear to be more restricted in occurrence to these site areas, which contain the densest accumulations of cultural material. Although vertebrate faunal remains were found in all three areas, such occupational evidence occurs in greatest quantities on the lower slopes of sites 41 GD 21 and 41 GD 21A.

A glimpse of site use affiliated with the Middle and Late Archaic period and the "Morhiss Complex" was recorded as a living floor associated with Feature 1 in the western part of site 41 GD 21A (Fig. 28). A hammerstone, core-bifaces, thick bifaces (including a pointed-ovate/lenticular, gouge-like tool), a *Morhiss* straight-stemmed thin biface, a worked coastal shell, numerous flaking debris, scattered vertebrate and invertebrate faunal remains, and scattered burned caliche lumps were found at the same elevation (approximately 55 cm below the ground surface, in the lower portion of Zone A) as Feature 1, a concentration of lumps of thermally altered caliche containing flecks of charcoal. Maintenance activities, such as tool repair and manufacture, and subsistence activities, such as hunting, gathering and food preparation, are probably represented by this assemblage of cultural material.

Culture Change

Due to the limited understanding of the prehistoric culture(s) of the Coastal Plain of Texas, inferences about culture change are restricted here to general statements concerning changes in subsistence-settlement pattern through time. A continuity in overall lithic technology is reflected in the distribution of analytic categories of flakes and chips representative of the continuum of chipped stone tool production (Fig. 29). Throughout the prehistoric period at sites 41 GD 21 and 41 GD 21A, bifaces and flake tools apparently were produced by the reduction of cobbles, cores and core-bifaces. Pecked and ground stone implements and thermally altered caliche, sand and clay occur in Archaic and Neo-American period soils, suggesting that similar subsistence and maintenance activities were carried out during more than 5,000 years of occupation.



All items at Depth of 50 to 60 cm:

(symbol)	Thermally Altered Caliche
H	Hammerstone
G	Pointed-Ovate/Plano-Convex Thick Biface
CB	Core-Biface
TKB	Pointed-Ovate/Lenticular Thick Biface
STB	Straight-Stemmed Thin Biface ("Morhiss")
WS	Worked Sunray Clam Shell

FIGURE 28.
41GD21A (PLAN OF FEATURE 1 AND ASSOCIATED MATERIAL CULTURE).

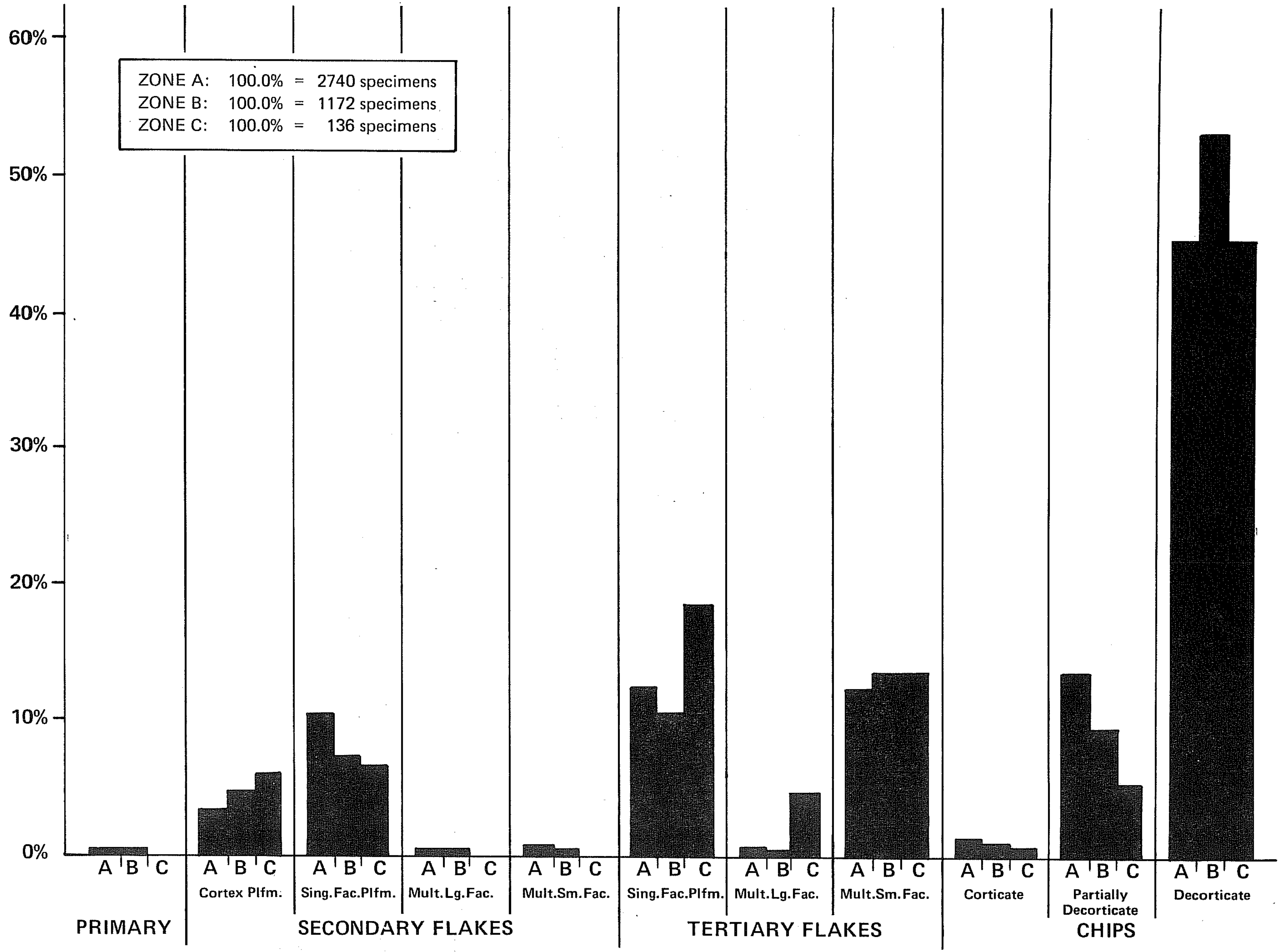


FIGURE 29. DISTRIBUTION OF FLAKES AND CHIPS BY SOIL ZONES AT SITE 41GD21.

TABLE 15. HORIZONTAL DISTRIBUTION OF KINDS AND AMOUNTS OF CULTURAL MATERIAL AT SITES 41 GD 21 AND 41 GD 21A

Category of Material Culture	Site Area: 41 GD 21A Eastern Area	41 GD 21A Western Area	41 GD 21 2 X 2 m test & surface coll.	Totals	Activities Represented
Chipped Stone*					
Flakes and Chips	879	8031	4112	13,022	flint working (all stages)
Cores	0	13	8	21	flint working (initial stages)
Core-Tools	0	1	5	6	chopping/shattering/cutting
Core-Bifaces	0	5	6	11	flint working (initial stages)
Bifaces					
Thick	0	8	2	10	flint working (final stages)
Thin	5	26	24	55	flint working (final stages), hunting
Trimmed Fl. & Ch.	0	5	5	10	scraping/cutting
Utilized Fl. & Ch.	1	28	11	40	scraping/cutting
Pecked & Grd. St.*	0	5	14	19	flint working/food preparation
Ceramics		X	X		food storage/food preparation
Vertebrate Remains	X	X	X		hunting/food preparation and consumption/ornamentation/tool-making
Ther. Alt. Cal., etc.**	738	44,638	46,616	91,991	fire/heat/food preparation

* Specimens
** Grams
X Occurrence

Yellen (1974:192), after a study of the Kung Bushmen in the Dobe region, found that the longer a camp was inhabited, the greater the probability that certain maintenance activities would be carried out. From this principle, Schiffer (1978:333) deduces the corollary: "the diversity of maintenance activities performed at a settlement varies directly with the length of occupation" (see also Schiffer 1975). It is difficult to identify the diversity of maintenance activities represented by the artifact inventory from sites 41 GD 21 and 41 GD 21A. However, considerable variation is observable in the frequency of occurrence of different categories of cultural material (Figs. 30,31). Perhaps there was less change in the duration of occupations than there was in the frequency at which these sites were occupied. In either case, the greatest quantities and diversity of cultural material at sites 41 GD 21 and 41 GD 21A were recovered from the lower portion of Zone A soils, which are thought to be associated with the Middle and Late Archaic periods and possibly can be affiliated with the "Morhiss Complex." An increase in the level of residential stability related to increased subsistence security may have occurred during this time.

SUMMARY AND CONCLUSIONS

Originally recorded as one site during an initial survey in 1976, 41 GD 21 and 41 GD 21A were tested in the spring of 1977. On the basis of information obtained during these studies, both site areas were nominated to the National Register of Historic Places, and it was recommended that further investigations be undertaken previous to construction and clearing in these areas.

In an arrangement with the Guadalupe-Blanco River Authority, a five-man team of investigators affiliated with the Center for Archaeological Research, UTSA, spent approximately 20 days during December 1977 and January 1978 at sites 41 GD 21 and 41 GD 21A. Most (13 days) of this field time was applied to the mitigation of portions of 41 GD 21A where the construction of a dike and spillway was planned. The remaining field time (7 days) was spent testing a portion of 41 GD 21 which is to be inundated.

In the eastern part of 41 GD 21A, four backhoe trenches, a 1 x 2 meter test pit, and five one-meter excavation units were placed in different areas where earth-moving activities are planned. These excavations revealed that this eastern portion of the site is relatively shallow. The upland slope probably has been disturbed by cultivation and erosion, and the lower slope has been disturbed by erosion and other processes.

In the western part of 41 GD 21A, the excavation of two backhoe trenches and nine one-meter units found deposits of cultural material in three soil zones which, when combined, range in depth from 80 to 140 cm below the ground surface. The upper 20 cm of these deposits (the upper portion of Zone A) were found to contain late 19th century Anglo-American glass, metal and ceramics mixed with some evidence of Neo-American occupation. Within Zone A, to a depth of approximately 60 cm below the ground surface, chipped stone, pecked and ground stone, thermally altered caliche and worked shell were found, which may be representative of the "Morhiss Complex" of the Middle to Late Archaic period. Below this, evidence of earlier Archaic occupation was recovered.

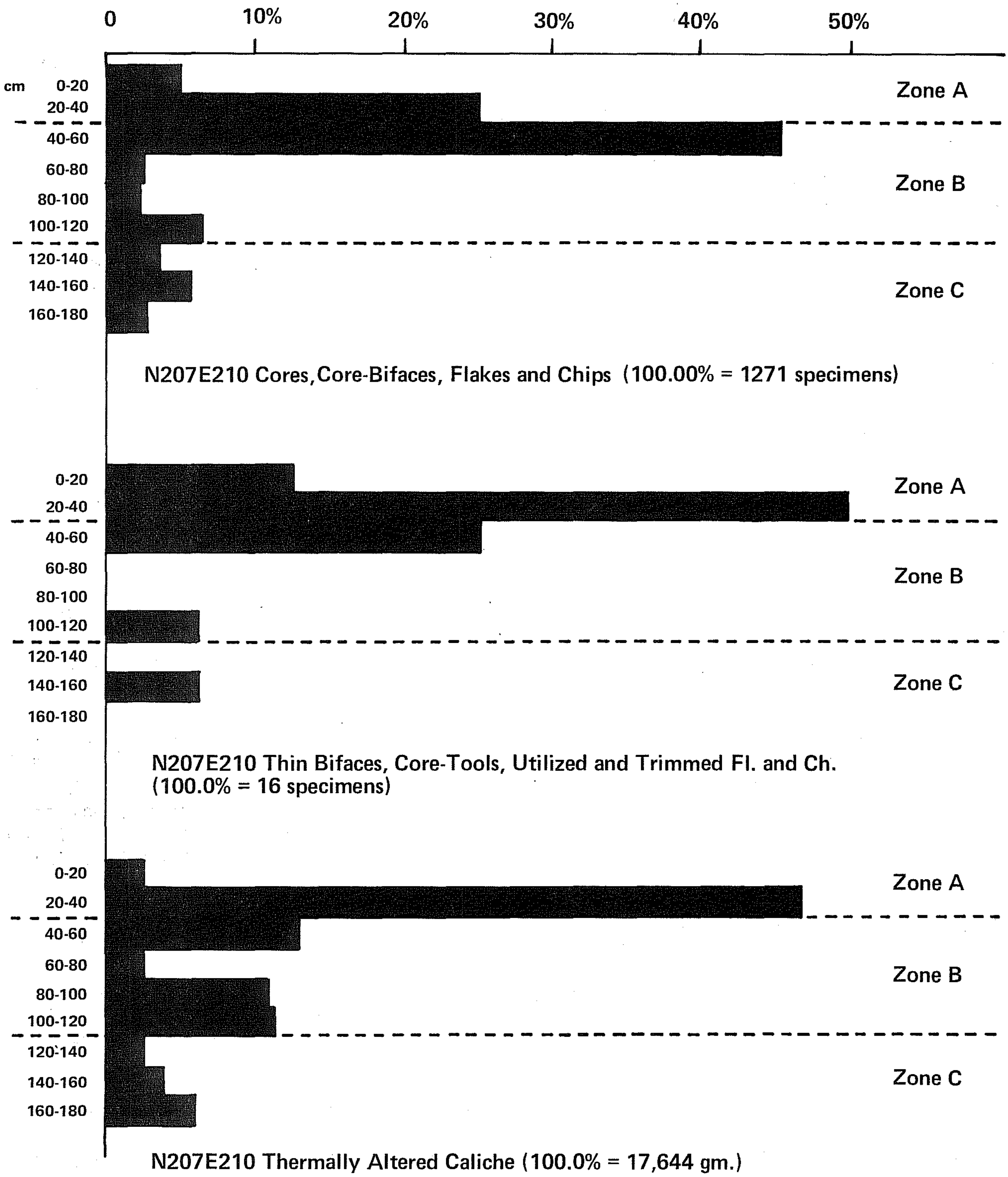


FIGURE 30.
VERTICAL DISTRIBUTION OF KINDS AND AMOUNTS OF CULTURAL MATERIAL
AT SITE 41GD21.

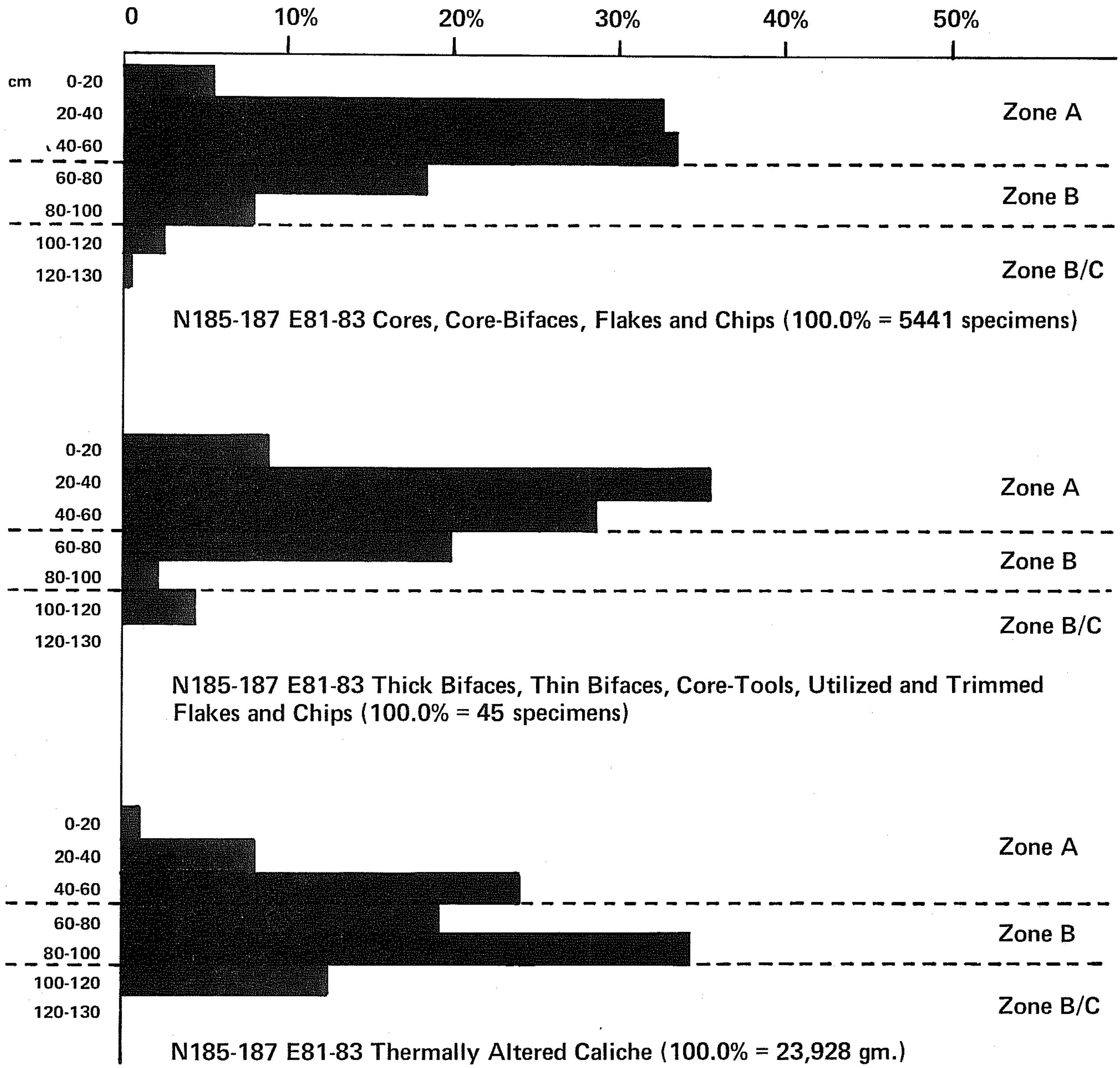


FIGURE 31.
VERTICAL DISTRIBUTION OF KINDS AND AMOUNTS OF CULTURAL MATERIAL AT SITE 41GD21A (WESTERN AREA).

At site 41 GD 21, a backhoe trench and a 2-m^2 controlled excavation were placed in the low-lying woodland area which eventually will be inundated. Backhoe and controlled excavations revealed deposits of cultural material in three prominent soil zones extending to a depth of at least two meters below the ground surface. Comparable to the slope deposits of the western part of site 41 GD 21A, Zone A soils at site 41 GD 21 were found to contain evidence of Neo-American and Late Archaic occupations. A radiocarbon date of 800 ± 370 B.C. was obtained from charcoal recovered from the lower portion of this zone. This date can tentatively be associated with considerable quantities of burned caliche, sand and clay, chipped stone, pecked and ground stone, and worked bone affiliated with the "Morhiss Complex."

Zone B soils were found to contain evidence of earlier Archaic occupation. Radiocarbon dates of 2860 ± 250 B.C. and 3180 ± 190 B.C. were obtained from charcoal recovered from the lower portion of this zone. Although cultural material was recovered from Zone C, no chronologically diagnostic artifacts were found in that soil zone.

The artifact-bearing deposits at sites 41 GD 21 and 41 GD 21A are a soil formation developed by slow accretion on an erosion-modified bedrock slope. Analyses of invertebrate faunal remains and phytoliths indicate that both sites have been wooded, especially along lower slopes, throughout post-Pleistocene times. Although Sulphur Creek was intermittently dry, it apparently carried enough water to support the growth of freshwater mussels and other fauna.

The physical extent of sites 41 GD 21 and 41 GD 21A suggests that the exploitation of tributary environments was a significant part of hunting and gathering technology for thousands of years. Considerable quantities of chipping debris represent the production of stone tools from cobbles, cores, core-bifaces and flakes, imported apparently from quarry areas located some distance from the occupation sites. Lumps of caliche, which outcrop on or near sites 41 GD 21 and 41 GD 21A, probably were gathered for hearthstones. A variety of vertebrate and invertebrate fauna were probably procured, along with plant resources, in the general vicinity of these sites. The occurrence of brackish water and saltwater clam shells and asphaltum staining represent a relationship of trade with and/or travel to and from the Texas coast.

Fire building, and probably other activities, took place more frequently in lower slope areas than on upper slopes. Along the lower slopes, the greatest quantities and diversity of cultural material occur in the lower portion of Zone A soils, which are thought to be affiliated with the "Morhiss Complex." This assemblage of chipped stone, pecked and ground stone, thermally altered caliche and worked shell may represent more frequent occupation of sites 41 GD 21 and 41 GD 21A during a Middle to Late Archaic period of increased subsistence security.

The relatively limited archaeological investigation of sites 41 GD 21 and 41 GD 21A determined the condition and character of these sites and recovered minimal, but valuable, information concerning chronology of occupation, paleoenvironment, subsistence-settlement pattern, intrasite occupational activity and culture change. These and other archaeological problems can be approached successfully through further, more intensive, problem-oriented research and investigation of other archaeological sites in the Coleto Creek drainage and other areas of the Coastal Plain.

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APPENDIX I

FAUNAL REMAINS FROM COLETO CREEK, GOLIAD COUNTY, TEXAS

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INTRODUCTION

Samples from two sites, 41 GD 21 and 41 GD 21A, were analyzed by examining, counting and identifying all the elements recovered from each single substratum excavation unit. This procedure eliminated the necessity of numbering individually the bones, a decision based on the time and resource constraints, and the small sample size. The identifiable elements were compared with a collection of modern, identified skeletal elements in the Osteology Laboratory of the Institute of Applied Sciences at North Texas State University. An inventory of elements recovered from each substratum unit of both sites was made (41 GD 21--Table 17; 41 GD 21A-- Table 19).

One drawback of this procedure is that minimum number of individuals cannot be figured accurately. In a few instances, minimum number is suggested, but these figures really have very little meaning because of the small samples.

Due to the nature of the sample, this report is mainly descriptive. Few interpretations are possible; however, some comparisons can be made between the two sites. These will follow the two descriptive sections.

SITE 41 GD 21

At this site four adjacent 1-m^2 units were excavated to varying depths. The total number of bone fragments recovered is 1,065, and a rather high percentage (41%) of them were identifiable (Table 17). This is due in part to the recovery of mainly larger fragments as a result of the use of a 1/4-inch mesh screen. The greatest number of bones was recovered in the upper 20 cm. The trend toward fewer pieces begins in the 20-40 cm level (the lower portion of Zone A soils).

The bone preservation at this site was better than at 41 GD 21A. The pieces were more complete, and there was less fragmentation than was the case at the other site. The density of bone also seems to be much higher at this site. About 21% of the total sample was burned.

The species identified (Table 16) from this faunal assemblage represent a rather typical group for Texas. Although the relative frequencies represented here may reflect real exploitation practices, this sample is very small; caution in interpretation is recommended.

Fish are probably under represented due to the use of 1/4-inch mesh screen. The one vertebra recovered consists of only a centrum and is not identifiable to species.

Turtle remains represent 34% of the total. This figure, however, may belie their importance, as all of the turtle elements are fragments of the shell. Most of the pieces were relatively small and minimum number of shells present could not be determined. No cranial or post-cranial elements were present.

At least two species of turtle are represented--a box turtle and the red-eared turtle. The fragmentary nature of the shell remains precludes a species determination of the *Terrepene*, but *T. carolina* is generally associated with a woodland habitat and the *T. ornata* is generally found in dry, relatively open areas. Both species are found in Goliad County today. Because most of the turtle shell pieces are very fragmentary, the size of turtles from which they came cannot be estimated. The impression is that many were small individuals; only a very few were from larger individuals.

The red-ear or slider is an aquatic species that is considered quite good to eat. During the spring they are relatively easy to catch, as the females leave the water and go to land to lay eggs. Red-ears also like to sun on rocks, making themselves readily visible.

The two snake vertebrae recovered were from very large individuals. It is surprising that more snake elements were not present either from other individuals or from these two large ones. One is most like a garter snake and the other is most like a rattler. Members of both genera are present in the area today. The vertebra identified as a garter snake was burned to a gray color; the other one was not.

A minimum number of two turkeys was recovered. The elements were all from long bones, and there were a number of fragments in the unidentifiable part of the

TABLE 16. SPECIES IDENTIFIED FROM 41 GD 21

COMMON NAME	SCIENTIFIC NAME	TOTAL NO. ELEMENTS IDENTIFIED	PROVENIENCE** Surface	0-20 (1)	20-40 (2)	40-60 (3)	60-80 (4)	80-100 (5)	100-120 (6)	120-140 (7)	140-160 (8)
Fish	*Percoidei*	1		1							
Box turtle	*Terrepene* sp.	97		15	69	12	1				
Red-eared turtle	*Chrysemys scripta*	21		3	18						
Turtle sp.	*Emydidae*	25		2	18	1			4		
Snake - cf. garter	*Colubridae*	1				1					
Snake - cf. rattlesnake	*Viperidae*	1			1						
Turkey	*Meleagris gallopavo*	10		4	6						
Bird	*Passerines*	8		6	2						
Opossum	*Didelphis virginianus*	7		5	2						
Eastern mole	*Scalopus aquaticus*	6		6							
Cottontail	*Sylvilagus floridanus*	22		13	7	1			1		
Black-tailed jackrabbit	*Lepus californicus*	8		2	3			2			1
Squirrel	*Sciurus* sp.	1		1							
Plains pocket gopher	*Geomys bursarius*	36		30	6						
Hispid cotton rat	*Sigmodon hispidus*	2		2							
Wood rat	*Neotoma* sp.	1			1						
Rodent		2		2							
Canid	*Canidae*	3		2	1						
Raccoon	*Procyon lotor*	1		1							
Whitetail deer	*Odocoileus virginianus*	171	1	110	54	2		3	1		
Pronghorn	*Antilocapra americana*	1			1						
Cow	*Bos* sp.	1	1								
TOTAL		426*	2	205	189	17	1	5	6		1

*Worked pieces not included.
**Depth is in centimeters. The level number is in parentheses.

TABLE 17. INVENTORY OF OSTEOLOGICAL ELEMENTS, 41 GD 21

PROVENIENCE	NUMBER OF FRAGMENTS RECOVERED	NUMBER BURNED	ELEMENTS IDENTIFIED NO.	ELEMENTS IDENTIFIED DESCRIPTION	COMMENTS	LAB LOT NUMBER
Surface of flume	1	-	1	deer humerus, rt. distal section		3
Surface near flume	4	-	4	cow humerus		6
N207 E209 0-10 cm	7	1	4	2 box turtle shell frag. 1 deer cranial frag. 1 rodent sp?, mandible frag.		8
10-20 cm	46	3	16	3 box turtle shell frags. 7 deer long bone frags., max. tooth, etc. 1 *Canis* sp. canine tooth 2 pocket gopher max. and mand. frags. 1 jackrabbit mandible frag. 1 cottontail rabbit mandible frag. 1 cf. turkey ulna frag.	very shiny (jackrabbit mandible frag.)	9
20-40 cm	38	13	22	2 box turtle shell frags. 2 red-eared turtle shell fragments 4 turtle sp?, shell fragments 1 turkey tarsometatarsus - male 1 cottontail rabbit molar 1 opossum cervical vertebra frag. 11 deer long bone fragments	butchering marks on distal metatarsal (deer long bone fragments)	10
N207 E210 0-20 cm	84	1	29	1 red-eared turtle shell frag. 1 box turtle shell frag. 2 bird sp?, fragments 1 mole left humerus		11

TABLE 17. (continued)

PROVENIENCE		NUMBER OF FRAGMENTS RECOVERED	NUMBER BURNED	ELEMENTS IDENTIFIED NO.	DESCRIPTION	COMMENTS	LAB LOT NUMBER
N207 E210	0-20 cm (continued)			7	pocket gopher mandibles and humeri		
				13	deer long bone fragments	"ring and snap" cut mark on mid-shaft humerus(?)	
				4	cottontail rabbit distal frags. and phalange		
	20-40 cm	63	7	26			12
				7	box turtle fragments		
				1	opossum mandible fragment		
				1	pocket gopher, right femur frag. - immature		
				17	deer fragments: atlas, distal radius-unfused, scapula, femur, phalange, etc.	cut marks on one small burned frag.	
	40-60 cm	44	13	9			13
				6	box turtle shell frags.		
				1	garter (?) snake vertebra burned		
				1	cottontail rabbit metatarsal frag.		
				1	deer carpal		
	60-80 cm	7	5	1			14
				1	box turtle shell frag.		
	80-100 cm	5	1	2			15
				2	jackrabbit, molar, metacarpal frag.		
	100-120 cm	31	8	7			17
				4	turtle sp. shell frags.		
				1	cottontail rabbit molar		
				1	deer tibia frag.		
				1	long bone shaft	burned, possibly worked	
	140-160 cm	4	2	1			21
				1	jackrabbit distal tibia		
N208 E209	0-20 cm	203	53	110			25
				9	box turtle shell fragments		
				2	red-eared turtle shell fragments		
				3	turkey, distal humerus, 2 tibio-tarsus	"ring and snap" mark on one tibio-tarsus	

TABLE 17. (continued)

PROVENIENCE		NUMBER OF FRAGMENTS RECOVERED	NUMBER BURNED	ELEMENTS IDENTIFIED NO.	DESCRIPTION	COMMENTS	LAB LOT NUMBER
N208 E209	0-20 cm (continued)				3 bird frags., species?		
					2 mole humeri		
					8 cottontail rabbit fragments 1 immature specimen, others are mature individual		
					5 opossum fragments		
					14 pocket gopher, mostly mandibles and teeth		
					1 squirrel pelvis frag.		
					30 deer rib frags.	frags. probably represent 3-4 ribs	
					29 deer long bone, cranial frags.	1 has cut marks	
					2 small rib frags., species?	cut marks present	
					2 modified pieces, species?		
	40-60 cm	113	15	42	25 box turtle shell fragments		26
					6 red-eared turtle shell frags.		
					1 snake vertebra, large		
					1 turkey tarsometatarsus, distal end		
					2 jackrabbit distal humerus, carpal		
					3 cottontail dental elements		
					1 pronghorn lower third molar frag.		
					3 deer elements and frags.		
N208 E210	0-20 cm	179	35	57	1 fish sp. vertebra		27
					2 box turtle shell frags.		
					7 bird frags., 1 prox. humerus cf. crow		
					3 mole humeri		
					2 jackrabbit humerus and incisor		
					7 pocket gopher frags.		
					1 cotton rat immature femur		

TABLE 17. (continued)

PROVENIENCE		NUMBER OF FRAGMENTS RECOVERED	NUMBER BURNED	ELEMENTS IDENTIFIED NO.	DESCRIPTION	COMMENTS	LAB LOT NUMBER
N208 E210	0-20 cm (continued)				1 rodent phalange		
					2 canid(?) ulna frags.	1 possibly used or worked	
					1 raccoon ulna		
					30 deer various anatomical areas	cut marks on a long bone fragment	
	20-40 cm	203	50	100	38 box turtle shell fragments		28
					10 slider turtle shell fragments		
					11 turtle sp?, shell fragments		
					2 bird cf. chicken coracoid and phalange		
					4 turkey long bone shaft frags.		
					1 jackrabbit ulna frag.		
					3 cottontail maxilla, ulna and radius frags.		
					5 pocket gopher mandibles and femur		
					1 wood rat femur		
					1 canid canine		
					23 deer fragments		
					1 worked piece		
	40-60 cm	24	15	8	3 box turtle shell frags.	fragments from this square very pitted	29
					4 turtle sp?, shell frags.		
					1 deer antler frag.		
	80-100 cm	12	4	3	3 deer ulna, radius, calcaneum		32
TOTAL		1065	226 21.2%	442 41.5%			

sample which looked like small splinters of long bones from a large species of bird. The identifiable pieces consisted mainly of shafts with most if not all of the articular ends broken off. One distal end of a tibio-tarsus has the "ring and snap" marks characteristic of the completed process; the proximal end was burned a reddish color. One of the tarsometatarsal segments was complete, with the spur indicating a male individual.

Eight other bird elements were identifiable to element but not species. They represent a type or types of bird of medium size, much smaller than a turkey.

Of the seven opossum elements, five are fragments of a cranium from level 1 (0-20 cm) of unit N208 E209. One other is a mandibular fragment from level 2 of N207 E210, and the third is a neck vertebra from level 2 (10-20 cm) of N207 E209. Only a minimum of one individual is represented, but because of the scatters, it is not certain whether it is all the same individual.

A minimum of four moles is represented by six pieces. All elements were humeri and four were from the right side. Since moles are burrowing animals, it is most likely that these are intrusive; they are limited to the upper 20 cm of the deposit. The humerus of a mole is a relatively large, almost square bone, which would not pass a 1/4-inch mesh screen, whereas all the other bones probably would. Thus, it may not be unusual that no other mole elements were recovered.

The majority of cottontail rabbit elements were dental fragments and individual molars. Although more were probably present, only a minimum number of two can be counted. Isolated ulnar, radial, metatarsal, calcaneal and phalangeal pieces were recovered throughout the excavated area. Two individuals were recovered from level 1 (0-20 cm) of N208 E209, with fragments representing both a sub-adult and an adult individual.

Jackrabbit elements were recovered from levels 1 (0-20 cm), 2 (20-40 cm), 5 (80-100 cm) and 8 (140-160 cm), and given that only eight identifiable elements were recovered of this species, a more diffuse distribution in the site is observed. Based on the anatomical areas present, however, only one individual can be identified, but based on variations in the size of the bones, at least two individuals are present. One humerus section is somewhat smaller than the comparative specimen, whereas all the others are similar to it.

Since pocket gophers are burrowing animals, it is difficult to say whether they are in context with the archaeological deposits or are intrusive. Thirty of the 36 elements were recovered from the top 20 cm (Zone A soils). A minimum of six individuals was counted, based on the most frequent single element--the right mandible. This species was represented most frequently by the jaws and teeth; relatively few long bones were recovered.

The squirrel species is not identifiable, as the piece is a fragment of a pelvis. The cotton rat is represented by an immature femur and a left mandible which came from two different excavation units, and the wood rat is represented by a femur. Even if all these species are associated with the archaeological deposits, their relative frequency of recovery suggests they were not very important food resources for the site inhabitants.

Two of the three elements identified as *Canidae* are very fragmentary, and as a result they are not identified to species. Both are ulnar fragments. One appears to be worked; the edges are round and it is slightly polished. Both have been burned. The other canid element is a canine tooth, recovered from level 2 (20-40 cm) of N208 E210; the two described above came from level 1 (0-20 cm) of the same unit. The single raccoon element is a proximal end of an ulna. It, too, was recovered from level 1 of N208 E210.

One fragmentary mandibular third molar, probably from a pronghorn, was recovered from level 2 of N208 E209. It is much narrower than the equivalent whitetail deer tooth. The cusps are present and only slightly worn; the roots are partially broken. If this tooth does represent pronghorn, then it is possible that some other post-cranial elements identified as deer might be pronghorn. Because the elements of one species were not placed together for identification, and because the material is so fragmentary, size variations may well have been missed. The traditional distribution of pronghorn was in the central Texas area (Hall and Nelson 1959), so they would have been available locally for exploitation.

The whitetail deer elements are by far the most common; they make up 40% of the identified sample. Although most of the elements were recovered from the top two levels (Zone A soils), a few elements were associated with several lower levels. This distribution is shared with the turtle, cottontail rabbit and jackrabbit elements. As a result of the method used to analyze these fragments, minimum number of deer was not estimated. A range of skeletal elements was recovered; thus, there is no suggestion of selection for parts of the anatomy. Elements from deer representing various ages were recovered: most were adult, but there were a very few sub-adult elements. One pair of third phalanges from an individual only a few weeks old is possibly deer or goat/sheep. If deer, they indicate a wide age range and would suggest the site was occupied at least in the spring. Many of the fragments unidentifiable to anatomical element probably represent deer. Butchering marks were noted on rib sections, on a distal metatarsal section, and on another unidentifiable long bone fragment. Three very distinct grooves for a "ring and snap" break were observed in a mid-shaft area of what is probably a humerus.

Many of the deer elements were burned, as were many pieces of deer-sized unidentifiable fragments. One small piece of antler was recovered from level 3 (40-60 cm); it, too, was burned.

The one large humerus recovered from the surface near the flume is identified as *Bos* because of its context. It is a distal end with a very recent break. In contrast with the other site, no large elements were recovered from deeper levels.

A total of 12 fragments exhibited one of the four types of modifications observed in this sample: butchering marks, deep cuts, shaping for secondary use and polish. Short, delicate, nonparallel cut marks, the sort resulting from the butchering process, were observed on the deer elements previously mentioned. The distal metatarsal fragment has a series of transverse cuts along the posterior surface; one rib fragment about 6.8 mm long has a few transverse cuts, and two other very small rib fragments also exhibit similar transverse cuts.

Another three elements have very deep cuts, the kind resulting from preparation of bone for secondary use. Two, a deer humerus(?) and a turkey tibio-tarsus, have the characteristic marks of the "ring and snap" cut on one end. Very close to this cut on the deer humerus(?) are additional transverse cuts. Another fragment, 18 mm long, unidentifiable to species and anatomical area, has a broad longitudinal groove running its length.

Three pieces appear to have been worked or altered by use, but they are too small and modified to determine species and element. One piece is of flat dense bone 17 mm long with three of the four margins broken; the one intact margin is smooth and rounded. It could have been part of the end of a flat-tipped pointed awl. The other piece, also about 17 mm long and slightly burned, has obvious longitudinal striations and could be the shaft section of a tool. The smooth margins converge slightly and both ends are broken. It has an artificially flattened oval cross section. The third piece is a flat burned fragment 39 mm long. It is broken longitudinally but has obvious vertical striations. One end is broken and the other was worked into a blunt tip.

Two elements appear polished; one mandibular section of a jackrabbit is charred, extremely shiny and smooth. It feels as if it has been rubbed a great deal. The other piece is a burned unidentifiable shaft of a long bone and is also shiny and smooth.

The upper 40 cm (Zone B soils) of the tested area of site 41 GD 21 yielded the majority of osteological elements. Bones from Zone B also had the highest frequency of burned elements present. Unfortunately the sample (from the lower levels) is too small to be able to say anything about relative exploitative practices between the lower (earlier) occupations and the upper (later) occupations. The faunal resources appearing most important for the Late Archaic and Neo-American Zone B soils are turtle, turkey, cottontail rabbit, pocket gopher and deer.

Few cultural interpretations can be made based on this small identifiable sample. Few clues are offered as to the seasonality of the site. Only one antler tip was recovered; it is necessary to see the area of attachment between the antler and cranium before antler observations are meaningful. Except for the box turtle, the other species represented do not have habits which vary markedly with the seasons. The box turtle is known to hibernate in the north any time after it gets cold (ca. November) until it begins to get warmer (March-April). In Texas they hibernate during severe temperatures, but certainly the pattern is not consistent enough to be considered a reliable seasonal indicator.

SITE 41 GD 21A

A limited number of osteological fragments was recovered from this site, even though a relatively large number of units was excavated. The paucity of elements is due to several factors, two of which are the relatively poor preservation of the bone and the use of 1/4-inch mesh screen for recovery. A decision to use the larger mesh was made by the archaeologists after a smaller screen was used for a limited time, and the small difference in the amount of faunal material recovered did not seem to justify the additional time needed.

The sample consists of 202 fragments of which 35 (17%) were identifiable to some degree. The fragments are generally small and exhibit both pre- and post-excavation breaks. The long bones have splintered in the ground; many are partly reconstructable. In the lower levels of this site the bones are extremely pitted and eroded; some are covered with a thin calcium carbonate deposit. Almost 30% of the total sample exhibited evidence of burning.

Faunal elements were recovered from 27 substratum units; the numbers of fragments recovered, burned and identified from each unit are given in Table 19. A very few species were identified from these fragments; they are presented in Table 18.

TABLE 18. SPECIES IDENTIFIED FROM 41 GD 21A

Common Name	Scientific Name	No.
Box turtle	*Terrepene* sp.	10
Red-eared turtle	*Chrysemys scripta*	2
Black-tailed jackrabbit	*Lepus californicus*	1
Deer	*Odocoileus virginianus*	12
Bison	*Bison bison*	5
Cow	*Bos* sp.	1
Other		4
TOTAL		35

These remains are so fragmentary that some of the identifications are presented with a degree of reservation. For example, it would be impossible to distinguish pronghorn antelope elements from whitetail deer. The tentatively identified pronghorn from 41 GD 21 presents the slim suggestion that elements here could also be pronghorn. It is far more likely, however, that they represent deer.

Even with complete elements it is difficult at best to distinguish *Bison* from *Bos*. Some clues to help in the identification are the history of the site, the depth in the deposit and the nature of the bone preservation. Six large mammal fragments were recovered, and two of them appear most likely to be bison. They are pitted and show signs of having been in the ground for a long time; one especially was recovered from the fifth level of excavations. One sesamoid bone is a relatively fresh-looking bone. Cows have been in this area and it is most likely that this is an intrusive element. It does, however, come from between 20 and 40 cm.

The fragmentation of these elements appears more the result of natural splintering than breaking from cultural practices. There are a number of similar-sized longitudinal fragments which have the same coloring and texture and appear to be splinters of a single long bone.

The pitting on the surface of the bone and the calcium carbonate coating on the bones are conditions which made observations for butchering marks fruitless. The degree of burning as evidenced by color of the bones was variable. Some were white/gray and others were black. The sample is too small to see trends.

TABLE 19. INVENTORY OF OSTEOLOGICAL ELEMENTS, 41 GD 21A

PROVENIENCE		NUMBER OF FRAGMENTS RECOVERED	NUMBER BURNED	ELEMENTS IDENTIFIED NO.	DESCRIPTION	COMMENTS
Test Pit #1	20-30 cm	2	-	-		small fragments
N185 E82	20-40	19	11	4	3 pieces - proximal bison(?) tibia; pitted and appears old; old breaks 1 deer maxillary molar; moderate wear	
	80-100	18	4	4	1 jackrabbit distal tibia 1 deer distal metapodial, small fragment 2 red-eared turtle small shell fragments	
N186 E82	0-20	1	-	1	1 deer mandibular 2nd premolar, ½ present.	
	20-40	7	5	-		
	40-60	28	1	2	2 box turtle shell fragments	unidentified pieces possibly splintered fragments of one bone
	60-80	2	1	-		
N185 E81/ N185 E82 Feat. 2	40-60	3	3	-		
N185 E81	0-20	6	1	-		
	20-40	6	-	2	1 deer tarsal fragment 1 prob. box turtle shell fragment - very small	
	40-60	16	5	-		some fragments from deer-sized animals
	80-100	2	-	-		3 pieces of 1 bone have fresh breaks

TABLE 19. (continued)

PROVENIENCE		NUMBER OF FRAGMENTS RECOVERED	NUMBER BURNED	ELEMENTS IDENTIFIED NO.	DESCRIPTION	COMMENTS
N186 E81	0-20 cm	6	2	-		
	20-40	19	11	2	2 box turtle shell fragments	
	40-60	12	8	3	1 deer metatarsal shaft fragment 1 deer tibia fragment (in 2 pieces) 1 turtle shell fragment - species?	
	60-80	5	1	1	1 deer tibia shaft fragment	
	80-100	1	-	1	1 bison(?) fragment - bone unidentifiable; covered with calcium carbonate deposit	many fragments with mostly post-depositional breaks - probably one bone; very large
N195 E83	0-20	2	-	1	1 species? vertebra epiphysis pronghorn/deer-sized animal	
	20-40	7	-	3	1 deer sesamoid bone 1 deer humerus distal/posterior fragment 1 cow/bison sesamoid - looks recent	
	40-60	5	-	2	1 deer antler fragment - pedical present - shed from cranium 1 turtle shell small fragment	
N196 E83	20-40	6	1	2	1 deer mandible in 7 pieces - right 3rd molar present - moderate wear 1 box turtle shell fragment	
	40-60	3	-	1	1 box turtle(?) shell fragment, very small	
	80-100	3	-	3	3 box turtle shells, recent breaks - probably of the same individual	

TABLE 19. (continued)

PROVENIENCE		NUMBER OF FRAGMENTS RECOVERED	NUMBER BURNED	ELEMENTS IDENTIFIED NO.	DESCRIPTION	COMMENTS
N170 E115	0-20 cm	1	-	-		very large mammal bone, pitted with recent breaks
	20-40	1	-	1	1 bison(?) distal metacarpal fragment; both recent and old breaks	
N170 E95	0-20	16	6	2	1 very pitted deer-sized long bone fragment 1 ½ cylinder of turkey-sized bone	
	20-40	5	-	-		
TOTAL		202	60	35		

COMPARISONS

The faunal remains from these two sites are similar in the general species of animals recovered, although the samples are not comparable enough to determine if they are similar in proportion. The samples are different in relative density: 41 GD 21 appears to have a greater density than 41 GD 21A. Different proportions are burned: more elements exhibited burning characteristics from 41 GD 21A than from the other site. The preservation at 41 GD 21 is much better than at 41 GD 21A; there is no evidence of worked bone at 41 GD 21A.

An interesting difference is the presence of *Bison* at 41 GD 21A and its absence at 41 GD 21. From these data one can only speculate; what follows are three reasons which would explain this difference. By attempting to explain the difference, however, the assumption is implied that they are expected to be similar.

1. Historic records indicate that bison were migratory (Hornaday 1889), and they were probably in the northernmost area of their territory during the summer. Based on this slim evidence, one could suggest a different season of occupation for the two sites. Caution must be exercised, however, because the information regarding the movements of bison is conflicting.

2. Dillehay (1974), after examining the data of the presence and absence of *Bison* in association with archaeological sites, suggests that there are temporally related presence and absence periods of *Bison* in the Southern Plains. Possibly these two sites were occupied at different times, 41 GD 21A coinciding with a bison presence period and 41 GD 21 extant during a bison absence period.

3. A third alternative is that the inhabitants of 41 GD 21 did not prefer *Bison*. A minimum of only one individual was recovered from 41 GD 21A, so even though bison is present, it is unlikely that it was the major food source. Deer and box turtle provide the majority of the elements in that sample.

Additional studies of faunal materials recovered from this area and from these time periods will help elucidate the suggested trends observed in these two small samples.

ACKNOWLEDGMENTS

Helping with this project were Bonnie Yates, NTSU Osteology Lab; William L. McClure, Houston; and Billye Dee MacManus, NTSU Historical Collection. Assistance from all these people is gratefully acknowledged.

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APPENDIX II

ASSOCIATION OF ARBITRARY LEVELS WITH SOIL ZONES

Zone A: 41 GD 21A (Western Area)

N185 E81:	0-20 cm 20-40 40-60	N186 E82:	0-20 cm 20-40 40-60	N170 E95:	0-20 cm 20-40 40-60
N185 E82:	0-20 cm 20-40 40-60	N195 E83:	0-20 cm 20-40 40-60 60-80	N170 E115:	0-20 cm 20-40 40-60
N186 E81:	0-20 cm 20-40 40-60	N196 E83:	0-20 cm 20-40 40-60	N179 E115:	0-20 cm 20-40 40-60

41 GD 21

N207 E209:	0-10 cm 10-20 20-40	N208 E209:	0-20 cm 20-40
N207 E210:	0-20 cm 20-40	N208 E210:	0-20 cm 20-40

Zone B: 41 GD 21A (Western Area)

N185 E81:	60-80 cm 80-100	N186 E82:	60-80 cm 80-100	N179 E115:	60-80 cm
N185 E82:	60-80 cm 80-100	N195 E83:	80-100 cm		
N186 E81:	60-80 cm	N196 E83:	60-80 cm		

41 GD 21

N207 E210:	40-60 cm 60-80 80-100 100-120	N208 E210:	40-60 cm 60-80 80-100

Zone B/C: 41 GD 21A (Western Area)

N185 E81:	100-120 cm	N186 E82:	100-120 cm	N170 E95:	60-80 cm
N185 E82:	100-120 cm 120-130	N195 E83:	100-120 cm	N170 E115:	60-80 cm
N186 E81:	100-120 cm	N196 E83:	80-100 cm	N179 E115:	80-100 cm

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Zone C: 41 GD 21

N207 E210:	120-140 cm 140-160 160-180

APPENDIX III

SOIL TEST DATA*

41 GD 21A (Western Area)

Sample No.	Provenience Horiz.	Provenience Vert.	Soil Zone	pH	Ca Level	Mg Level	Nitrogen Level	P_2O_5	K_2O	Salinity	Organic Matter
7214	N186 E82	17-27 cm	A	8.5	Very High	High	Low	Very High	Very High	None	2.6
7215	"	39-49 cm	A	8.7	"	"	"	"	"	"	1.1
7216	"	65-75 cm	B	8.7	"	"	"	"	"	"	0.3
7217	"	85-95 cm	B	8.9	"	"	"	High	"	"	0.2

41 GD 21

Sample No.	Provenience Horiz.	Provenience Vert.	Soil Zone	pH	Ca Level	Mg Level	Nitrogen Level	P_2O_5	K_2O	Salinity	Organic Matter
7208	N207 E210	10-20 cm	A	8.0	Very High	High	Low	Very High	Very High	None	2.5
7209	"	28-38 cm	A	8.5	"	"	"	"	"	"	1.2
7210	"	65-75 cm	B	8.5	"	"	"	"	"	"	0.4
7211	"	104-114 cm	B	8.7	"	"	"	"	"	"	0.4
7212	"	133-143 cm	B/C	8.9	"	"	"	"	"	"	0.2
7213	"	157-167 cm	C	9.0	"	"	"	"	"	"	0.1

*Soil Testing Laboratory, Texas Agricultural Extension Service, for the Texas A&M University System.

APPENDIX IV

BIOSILICA AND CLIMATIC CHANGE AT 41 GD 21 AND 41 GD 21A

Ralph L. Robinson

INTRODUCTION

There are virtually no data on the prehistoric vegetation of south Texas because the subtropical climate quickly destroys even the durable pollen grains which have served to reveal past climate and its changes in many other areas of the world. This study takes an alternative approach. Many plants deposit opaline silica within their cells while they are living, and these microscopic bits of silica, or more specifically, opal phytoliths, are very resistant to chemical destruction. Fortunately, not only plants, but also freshwater sponges and some microscopic, one-celled aquatic plants and animals have skeletons of silica. All of these are preserved to one degree or another, even in the highly alkaline soils of the south Texas Coastal Plain. After two years of research and experimentation, an effective method for recovering the various biosilica (or more specifically, biogenic opaline microfossils) from the soil has been developed, and, through various literary sources and the author's collection of present-day plants, the identification of many specimens to the family, genus or, even in some cases, to species has been possible.

During the course of these studies, biosilica from a dozen archaeological sites in south and central Texas have been collected. However, the two sites analyzed in this paper are the first to be fully and systematically studied. The sites 41 GD 21 and 41 GD 21A are located on Sulphur Creek in Goliad County, Texas. Six soil horizons were sampled. Two soil samples each were taken from the A and B soil zones from both sites. Samples 5 and 6 were taken from the C horizon in 41 GD 21.

All of the samples contained biogenic opaline microfossils, sometimes in great abundance. Careful comparison of the plants and animals represented indicates that climate on the south Texas Coastal Plain has been quite variable over the last 8,000 years. The plant community indicates that sometimes it was dry, while at other times the climate was wet. It is even possible to tell the density of the vegetation and vegetational biomass, a very important factor in understanding erosional conditions and the types of animals that might have lived in the area.

The present paper is a highly condensed version of the extensive biosilica research undertaken at sites 41 GD 21 and 41 GD 21A. The highly detailed data and more extensive discussions resulting from these studies are being published separately (Robinson 1979).

SEPARATION TECHNIQUES

Many methods have been developed by various researchers to separate opaline microfossils from soil. In fact, phytoliths have been known for 175 years and studied by many different individuals in various parts of the world. After experimenting with several of these methods, the author has found that a modified version of Rovner's (1971) technique seems at the same time most practical and least likely to damage the biosilica. All of the methods, including the one used, are extremely time-consuming.

The details of the separation technique are explained in detail in another publication (Robinson 1979). Briefly, the separation technique requires seven steps, each of which involves bathing the sample in acids to remove unwanted materials and immersing it in heavy liquids to float the silica particles. Naturally, each step is performed under the strictest controls in order to avoid contamination. After the biosilica are separated and dried they are mounted on a slide and examined under a microscope, where the various shapes and sizes of particles are identified, measured, counted and recorded.

CLASSIFICATION

As with the separation technique, the process of classification is lengthy and complicated (Robinson 1979). All of the soil samples from both of the Goliad County sites contained thousands of biogenic opaline microfossils, both from plants and animals. These were classified into the categories outlined in Table 20. Basically, they were divided into two groups, plant and animal, and these were subdivided into one-celled varieties such as algae, one-celled plants, and vascular plants, larger multicelled plants such as trees, etc. Each of these categories was then further refined until the final level contained a list of the opaline microfossils with which the author is actually familiar and can confidently identify. In addition to the author's own comparative collection (Table 21), comparisons were made to photomicrographs of over 300 species from 102 separate publications.

Phytoliths were most abundant in all of the samples processed, and, of these, grass phytoliths were the most frequent. Fortunately, grasses are quite sensitive to climatic change. During wetter climates, tall grass (Panicoid type phytoliths) prairies are characteristic of eastern Texas, and they were also closely associated with the climax forest vegetation of east Texas before being destroyed by agricultural activity (Gould 1968). Familiar species such as big bluestem are typical of this group. Short grasses (Chloridoid type phytoliths) are found in western Texas at present and are associated with drier climates. Buffalo grass and grama are familiar varieties. Though occasionally found on the Coastal Plain today, cool humid grasses (Festucoid type phytoliths) were represented in the prehistoric soil samples by only one phytolith. These grasses typically dominate in the northern plains now, so they are representative of cool humid climate. There is no reason to believe, therefore, that cool humid conditions have been important on the coast during the last 8,000 years, as the climate is represented by the samples tested in this project.

TABLE 20. MORPHOLOGICAL CLASSIFICATION OF BIOGENIC OPALINE MICROFOSSILS FROM 41 GD 21 and 41 GD 21A

I. Phytogenic Opaline Microfossils (Plant)
  A. Unicellular (algae)
    1. Bacillariophyta (Diatoms), Frustles
      a. *Epithemia adnata* (Kutz) Breb.
      b. *Coscinodiscus* sp.
    2. Chrysophyceae, Cysts
      a. Type 1
      b. Type 2
  B. Multicellular Vascular Plants
    1. Silicified Cells of Grasses (Opal Phytoliths)
      a. Origin in Epidermal Tissues
        (1) Idoblast (short cell)
          (a) Panicoid Type — tall grass
          (b) Chloridoid Type — short grass
          (c) Festucoid Type
        (2) Long Cell
          (a) Elongate Type 1 — *Bouteloua* sp.
          (b) Unknown
        (3) Trichomes (hairs)
        (4) Stomata
      b. Origin in Inner Tissues
        (1) Bulliform Cells
        (2) Tracheids
        (3) Sclerenchyma Fiber
      c. Tissue Fragments
        (1) Chloridoid
        (2) Unknown
    2. Silicified Cells of Trees and Palm (Opal Phytoliths)
      a. Origin in Epidermal Tissues
        (1) Trichome (hair) bases
          (a) Type 1

TABLE 20. (continued)

(A) Type 1A	*Celtis* sp.
(B) Type 1B n.o.	*Celtis pallida* n.o.
(b) Type 2	*Ehretia anacua*
(c) Type 3 unknowns	
(2) Trichomes (hairs)	
(a) Type 1	
(A) Type 1A	*Celtis* sp.
(B) Type 1B	*Celtis pallida*
(b) Type 2 n.o.	*Ehretia anacua* n.o.
(c) Type 3	
(A) Type 3A	*Ulmus* sp.
(B) Type 3B	*Ulmus crassifolia*
(d) Type 4 unknowns	
(3) Cells	
(a) Type 1	8 species
(b) Type 2	*Quercus* sp. - White
(c) Type 3	*Quercus* sp. - Red
(d) Type 4 unknowns	
(4) Stomata	
b. Origin in Inner Tissues	
(1) Mesophyll	
(a) Cells	
(b) Idoblasts	
(A) Type 1	
(aa) Type 1A	*Sabal minor*
(bb) Type 1B	
(B) Type 2	
(2) Tracheids	
c. Tissue Fragments	
(1) Type 1	*Celtis* sp.
(2) Type 2	*Quercus* sp.
(3) Type 3	
(4) Type 4 unknowns	

n.o. = not observed

TABLE 20. (continued)

II. Zoogenic Opaline Microfossils (Animal)	
A. Unicellular (protozoan)	
1. Silicoflagellidae (Skeleton)	*Dictyocha* sp.
2. Radiolarians	
B. Multicellular, Spongillidae (Freshwater Sponges), spicules	
1. Megascleres (Skeletal Elements)	
a. Spinose Slender Amphioxea (hollow with sharp points)	
b. Smooth	
(1) Robust Amphioxea	
(2) Slender Amphioxea	
2. Microscleres (Dermal Spicules)	
3. Gemmoscleres (Gemmule Spicules)	
a. Birotulate (wheel-like ends) - smooth robust shaft	
(1) Rotules equal	*Trochospongilla leidyi* Bowerbank
(2) Rotules unequal	*T. pennsylvanica* Potts
b. Birotulate - spinose slender shaft	

TABLE 21. PLANTS PROCESSED FOR COMPARATIVE COLLECTION OF OPAL PHYTOLITHS

Scientific Name	Common Name
EQUISTEACEAE	
Equisetum sp. L.	Scouring-rush
PINACEAE	
Pinus taeda L.	Loblolly Pine
CUPRESSACEEAE	
Juniperus ashei Buchh.	Mexican Juniper
Juniperus virginiana L.	Eastern Red Cedar
GRAMINEAE	
Arundinaria gigantea (Walt.) Muhl.	Giant Cane
Phragmites auatrailis (Eav.) Trin. ex Stued.	Common Reed
Stipa leucotricha Trin. and Rupr.	Texas Wintergrass
Elymus canadensis L.	Wild-rye
Panicum virgatum L.	Switchgrass
Schizachyrium scoparium (Michx.) Nash	Little Bluestem
Andropogon gerardii Vitman	Big Bluestem
Andropogon virginicus L.	Broomsedge Bluestem
Sorghastrum nutans L. Nash	Indiangrass
Muhlenbergia sp.	Muhly
Bouteloua rigidiseta (Strud.) Hitche.	Texas Grama
Bouteloua sp.	Grama
CYPERACEAE	
Cladium jamaicense Crantz.	Saw-grass
PALMAE	
Sabal minor (Jacq.) Pers.	Dwarf Palmetto Palm
LILIACEAE	
Yucca treculeana Carr	Spanish Dagger
Yucca rupicola Scheele	Twisted-leaf Yucca
Dasylirion texanun Scheele	Sotol

TABLE 21. (continued)

Scientific Name	Common Name
FAGACEAE	
Fagus grandifolia Ehrh.	Beechnut Tree
Castanea alnifolia Nutt.	Downy Chinquapin
Quercus virginiana Mill.	Live Oak
Quercus Shumardii Buckl.	Southern Red Oak
ULMACEAE	
Celtis pallida Torr.	Desert Hackberry
Celtis reticulata Torr.	Netleaf Hackberry
Ulmus crassifolia Nutt.	Cedar Elm
BERBERIDACEAE	
Berberis trifoliolata Moric.	Agarito
ROSACEAE	
Crataegus viburnifolia Sarg.	Hawthorn
Rubus sp.	Dewberry
LEGUMINOSAE	
Prosopis glandulosa Torr.	Mesquite
ANACARDIACEAE	
Rhus copallina L.	Shining Sumac
ACERACEAE	
Acer saccharum Marsh.	Sugar Maple
TILIACEAE	
Tilia americana L.	American Basswood
CACTACEAE	
Opuntia lindheimeri Engelm.	Texas Prickly Pear
EBENACEAE	
Diospyros texana Scheele	Texas Persimmon
BORAGINACEAE	
Ehretia anacua (Teran and Berl.) I.M. Johnst.	Anacua

Phytoliths from tree and palm cells were also observed in the samples, though in varying numbers and much less frequently than grasses. Opaline silica accumulates in the cells of tree leaves and in and around the bases of hairs on leaves. These were the most frequent and most useful evidence of trees. Various types of elm, oak, hackberry and other trees were identified either to genus or species and frequency in the plant community.

Opaline microfossils from animals as well as plants were observed. Skeletons from one-celled animals and the spicules (or skeletons) of freshwater sponges were identified. Also, marine plankton was found in several samples. These are probably from the Gulf of Mexico. Sponges grow locally in the streams and could have been carried to the site by human activity or, more likely, by flooding. The marine organisms could have been brought to the site by natural agencies, or were brought in by humans either on seaweed or marine shells.

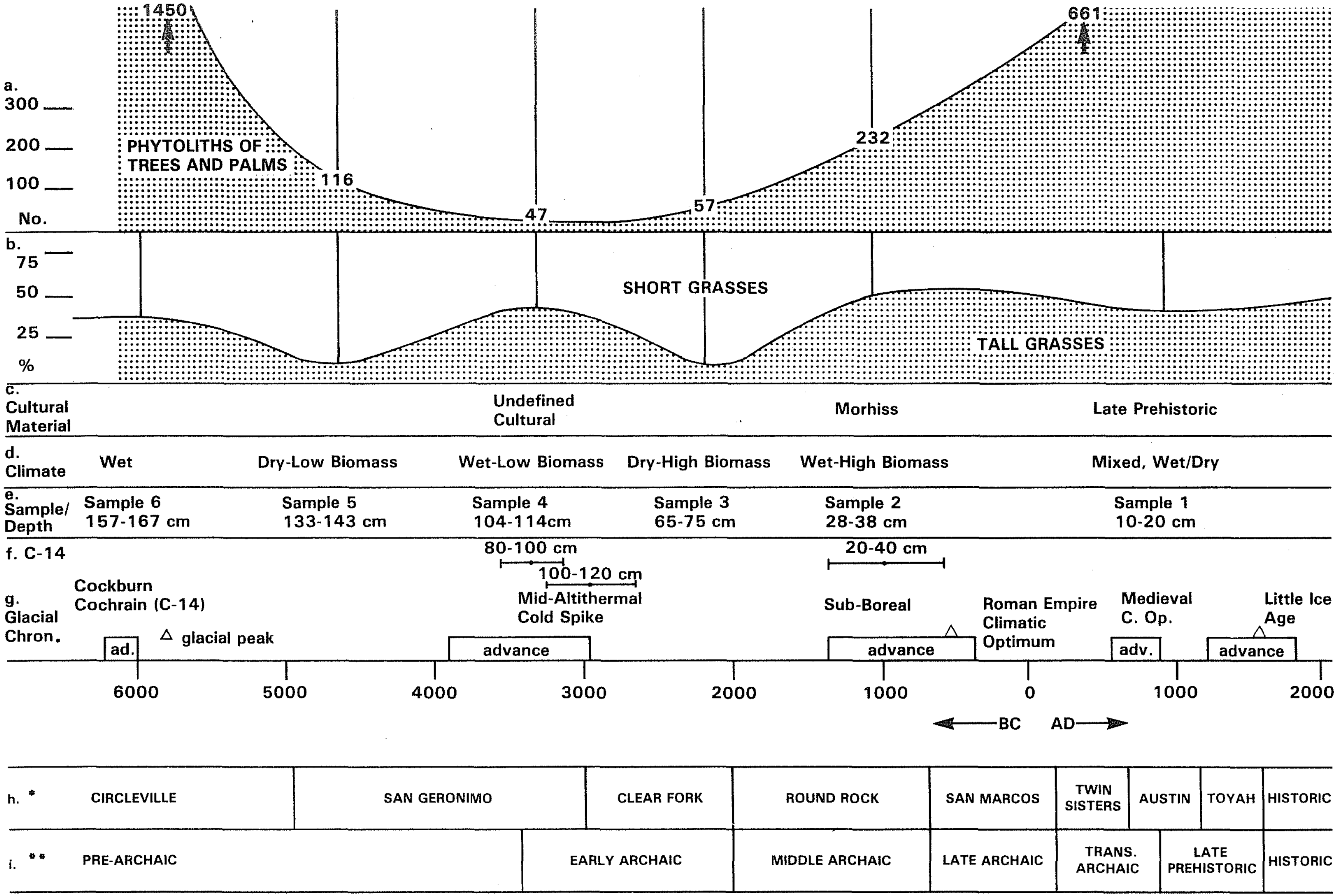
All of these tiny particles of once-living plants and animals have something to say about the environment at the time they were deposited hundreds or thousands of years ago. While it would be dangerous to draw conclusions from any one of them, taken from a larger perspective, they present a fairly reliable and reasonable picture of climatic change on the central Coastal Plain of Texas. Some of the criteria used are as follows. The algae (diatoms and chrysophytes) found in these samples live in ponds and streams and reflect a well-watered environment. When tall grasses predominate in the collection of phytoliths, it is thought that the environment is "wet," since tall grasses have definite limits on the amount of dry weather they can stand. On the other hand, short grasses are very tolerant of arid conditions, so when they are more frequent than tall grasses, the environment is assumed to be "dry." Increased frequencies of tree and palm phytoliths are taken to be an indication of yet damper climate. Sponges live in shallow water and vary in their preference of habitats, as some prefer alkaline waters while others prefer acid waters. Therefore, it is possible to determine the condition of the streams near the site and other aspects of the environment.

INTERPRETATIONS

The following discussion of the course of environmental change in the central Coastal Plain of Texas is based on information summarized in Fig. 32. The sequence is presented from the lowest and oldest sample to the highest and youngest.

Sample 6

While this sample is known from radiocarbon dating (TX 2926; see Table 13) to be older than 2500 B.C., its precise age is not known. It may be either Late Paleo-Indian or Pre-Archaic; an age of around 6000 B.C. is suggested. Grasses were most frequent of any of the samples tested, indicating the greatest density of grasses and permanent stand. The predominance of tall grass types indicates a wet climate. Several types of tree phytoliths were present, but only those of *Quercus* sp. (white oak) could be identified. The extreme age of the sample may have obscured the nature of the tree phytoliths,



* Adapted from Prewitt and Valastro (n.d.).
**Hester (personal communication).
a. Relative numbers of tree and palm phytoliths.
b. Alternating proportions of tall and short grasses.
c. Cultural material associated with various horizons.
d. Description of climate.
e. Sample numbers and depth from surface.
f. Corrected radiocarbon dates (see Table 13).
g. Glacial chronology (adapted from Denton and Karlen 1973).
h. Central Texas cultural sequences.
i. South Texas cultural sequence.

Figure 32. *Biosilica Analysis, 41 GD 21.*

since they are very thin and more subject to destruction than the robust grass phytoliths. The high frequency of tree phytoliths suggests a well-developed, bottom land forest. There were some sponge spicules, but they could not be identified to species. In addition to the above, the small size of the grass phytoliths is also an indicator of a very wet environment.

Sample 5

Like Sample 6, Sample 5 is older than 2500 B.C. At this point the resemblance between the two stops. Diagnostic biosilica are the least frequent of any sample in the series. Of the phytoliths found, short grasses predominate. *Bouteloua* sp. (grama) was abundant in this sample. Also, the one example of grasses adapted to eroded soils was found here, which may indicate a disturbed and poorly covered soil surface. Phytoliths from *Quercus* sp. (red and white oak) were present, but the low frequency suggests a sparse, low density, bottom land forest. The freshwater sponge *Trochospongilla leidyi* Bowerbank, which is tolerant to very alkaline water, was present. Sponge spicules were infrequent and broken into small pieces, again suggesting an extremely dry environment.

Sample 5 shows every indication of being the result of a very dry period with very low vegetational biomass.

Sample 4

A radiocarbon date (TX 2924; see Table 13) from the same level as Sample 4 returned a date of 2860 ± 250 B.C. Overall, the frequency of diagnostic phytoliths is relatively low, and this was the only sample in which *Quercus* sp. (oak) was not observed. These, along with the broken condition of the sponge spicules, indicate a dry period with low plant density. This evidence conflicts with the presence and low mean size of tall grass phytoliths and the presence of the diatom *Epithemia* sp., which are indicators of a wet climate. This strange combination of evidence leads the author to believe that Sample 4 represents a brief mesic episode, perhaps at the end of a dry period. Such an explanation accounts for both the absence of *Quercus* sp. (oak), which requires several years to grow, and the presence of tall grass phytoliths which might respond quickly to a suddenly wetter climate. Other factors which could produce the low number of opaline microfossils would be rapid erosion and deposition of soil in the area of the sample. Such rapid erosion and deposition, however, would only support the proposition of a brief wet period within a dry period, since low vegetation densities encourage erosion.

Sample 3

Sample 3 is older than 750 B.C. and younger than 2550 B.C. All indications are that Sample 3 was deposited in a dry climate. Tall grass phytoliths are the lowest of any sample. Only one fragment of *Quercus* sp. (oak) was found, and algae were completely absent. A few fragments of sponges were found; however, they are able to adapt to very unfavorable conditions, so their low frequency is indicative of dry climate even if their absence is not. Short grasses were the second most frequent of any sample. Taken together, the evidence is for a thick cover of short grasses with occasional trees in the bottom lands.

Samples 2 and 2A

Sample 2 dates from about 800 ± 370 B.C. (TX 2925; see Table 13) and is associated with the Morhiss Complex. The Morhiss Complex is considered by project archaeologists to represent a part of the late Middle Archaic period. Indications are that Sample 2 represents a very wet period, with the second highest percentage of tall grasses and abundant variety of trees in the bottom lands, including *Celtis* sp. (hackberry), *Ulmus* sp. (elm), *Quercus* sp. (oak) and *Ehretia anacua* (Teran and Berl) I. M. Johnst. (anacua). *Sabal minor* (Jacq.) Pers. (dwarf palmetto palm) was also present. Samples 2 and 2A had the highest density of vegetation of any samples. Also, the diatom *Epithemia adnata* (Kutz) Breb. and two species of sponges, *Trochospongilla leidyi* Bowerbank and *T. pennsylvanica* Potts, indicate a well-watered environment.

Samples 1 and 1A

Sample 1 was less than 800 ± 370 B.C. and was associated with Late Prehistoric cultural materials. High frequencies and small sizes of tall grass phytoliths suggest a wet environment. Also, Sample 1 contains the highest frequency of tree phytoliths of any sample, among them *Celtis pallida* (desert hackberry), *Ulmus crassifolia* (cedar elm), *Ehretia anacua* (anacua) and *Quercus* sp. (red and white oak). High frequencies of sponge spicules serve to reinforce the impression of a wet environment. However, the mixture of species of plants from xeric and mesic environments and the presence of some historic bones and artifacts in the horizon caution of bioturbation near the present surface.

CONCLUSIONS

While the absence of pollen in south Texas sites has limited the study of environments in the area up to now, examination of biosilica from six horizons indicates that they are not only present, and present in large numbers, but also vary considerably in types and in relative frequencies from horizon to horizon. While it is apparent that all of the details of climatic change in south Texas cannot be discerned from this small number of samples, the results in general indicate a dry period, probably prior to 1000 B.C., which was bracketed by periods of much wetter conditions. The dry period was punctuated by at least one moderately moist interval. The most recent sample is difficult to interpret, but probably represents rapid change or a series of rapid changes from wet to dry within one sample. As shown in Fig. 32, mesic periods at 41 GD 21 and 41 GD 21A seem to correspond to the Holocene glacial advances, while xeric periods correspond to glacial retreats, as shown by Denton and Karlen (1973).

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